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FORAMINIFERA FROM THE PALEOCENE OF POLAND, THEIR ECOLOGICAL AND BIOSTRATIGRAPHICAL MEANING

(OTWORNICE Z PALEOCENU POLSKI, ICH EKOLOGICZNE I BIOSTRATYGRAFICZNE ZNACZENIE)

BY
KRYSTYNA POŻARYSKA & JANINA SZCZECHURA

(WITH 22 TEXT-FIGURES, 3 TABLES AND 18 PLATES)

WARSZAWA 1968

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PREFACE

The present paper is a supplement to existing publications on lowermost Tertiary in Poland (POŻARYSKI & POŻARYSKA, 1960; BROTZEN & POŻARYSKA, 1957, 1961) and in particular to POŻARYSKA's monograph (1965) on Dano-Montian Foraminifera of Central and Northern Poland. It is based on investigations of the Pamiętowo boring (North Poland), where the present authors observed a merging of the influence of boreal and meridional (non Mediterranean) Paleocene. The superposition of boreal and meridional Paleocene formations in Poland and the analysis of Paleocene formations outside Poland allowed the authors to correlate the lowermost Tertiary beds in Europe and to a certain extent those beyond it. The authors came to, among others, the conclusion that the Montian s.s. is partly of the same age as the Selandian s.s. However, at the marginal area of Boreal and Meridional Provinces, i.e. mainly in Poland, the Paleocene subtropical sediments cover those exclusively containing a boreal microfauna. The Paleocene is here considered as the oldest stage of Tertiary embracing Danian, Montian and Thanetian. Montian s.s. and Selandian s.s. are considered as partly stratigraphical-facies units. The term Selandian was in 1924 introduced by ROSENKRANTZ to include the Paleocene series of strata which in Denmark and Scania is resting on the Danian and is overlaid by the Lower Eocene ash layer series. This division of the lowermost Tertiary is accepted in the present paper.

In the present paper, 97 species (belonging to 50 genera and 21 families) are described, out of which 7 species and 2 subspecies are new ones. Their systematics is taken from the Treatise on Invertebrate Paleontology (by LOEBLICH & TAPPAN), C, 2, 1964, and is not revised here. The main attention is concentrated on the description, distribution and variation of the determined species, the variation, however, being treated in a rather wide sense. The cited number of specimens for each given species includes specimens not only from the Pamiętowo boring, but also those from the Paleocene of Central Poland, i.e. those examined earlier by POŻARYSKA (1965).

The collection of specimens figured in this paper is housed in the Palaeozoological Institute of the Polish Academy of Sciences, for which the abbreviation *Z. Pal.* is used.

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GENERAL PART

THE LOWERMOST TERTIARY IN THE PAMIĘTOWO BORING, NORTH POLAND

(Text-figs. 1, 2; Table 1)

The starting point of the present paper is the Pamiętowo boring near Chojnice in Pomerania, North Poland. This boring was drilled in 1959 by the Geological Institute of Poland. The boring passed through a rather thin series of Quaternary and Tertiary sediments, whose age could not be precisely determined because of a complete lack of fauna, and then penetrated a glauconitic-marly series yielding a considerable amounts of coarse calcareous sand at the base of the Tertiary beds. On examination this calcareous sand was found to be the same type of sediment as the so-called „tuffeau", representing calcareous detritic sediment formed by crushed, worn out, friable, calcareous, mainly organic sediment, containing a great admixture of glauconite. This was the first time, the so-called „tuffeau" type of sediment had been found in Poland. Previously, it was known in series of that age in Belgium, Holland and France on one side, and in the Crimea on the other. In this detritic series, which is about 70 m in thickness in the Pamiętowo boring, there occur several thin layers of hard limestone, interbedded with the „tuffeau". Throughout the whole of this series there are rather small, gray concretions of silica (cherts), although these are not very numerous. At the base of the series, small phosphatic nodules occur as well as abundant remains of bryozoan colonies. In the Pamiętowo boring all this „tuffeau" series lies directly on a hard ground layer, ending the Lower Maastrichtian sedimentation. This latter layer is composed of white-gray limestone, containing a typical foraminiferal assemblage with *Rugoglobigerina rugosa* (PLUM.), *Stensiöina pommerana* BROTZ., *Bolivina incrassata* (REUSS) and others. Upper Maastrichtian and Danian beds are absent.

Macrofaunal remains in the above mentioned series of „tuffeau" are scarce, badly preserved, almost unidentifiable. They mainly consist of small pelecypod valves, worm tubes, single loose plates of echinids, spicules of silica sponges and others. In contrast to the scarce, badly preserved macrofauna in the „tuffeau" series, there is a very rich, well preserved assemblage of microfauna, this latter, comprising Foraminifera, being subject of the present study.

The age of the „tuffeau" series in Pamiętowo was determined, in a preliminary note of BROTZEN and POŻARYSKA (1961). It was there assigned to the Paleocene with the uppermost 15—16 metres, erroneously considered as belonging to the lowermost Eocene. Determination of the age, especially the lower part of the examined profile, was based, at that time, on an assemblage of Foraminifera analogous to that known and described from Sweden (BROTZEN,

1948) and Central Poland (BROTZEN & POŻARYSKA, 1957). The „tuffeau" series of Pamiętowo yields typical Selandian Foraminifera, i.e. Scandinavian Lower Paleocene (ROSENKRANTZ, 1924). In addition to the Selandian assemblage, there are in the Pamiętowo boring, especially in its upper part, several species previously unknown in the Lower Paleocene (Selan-

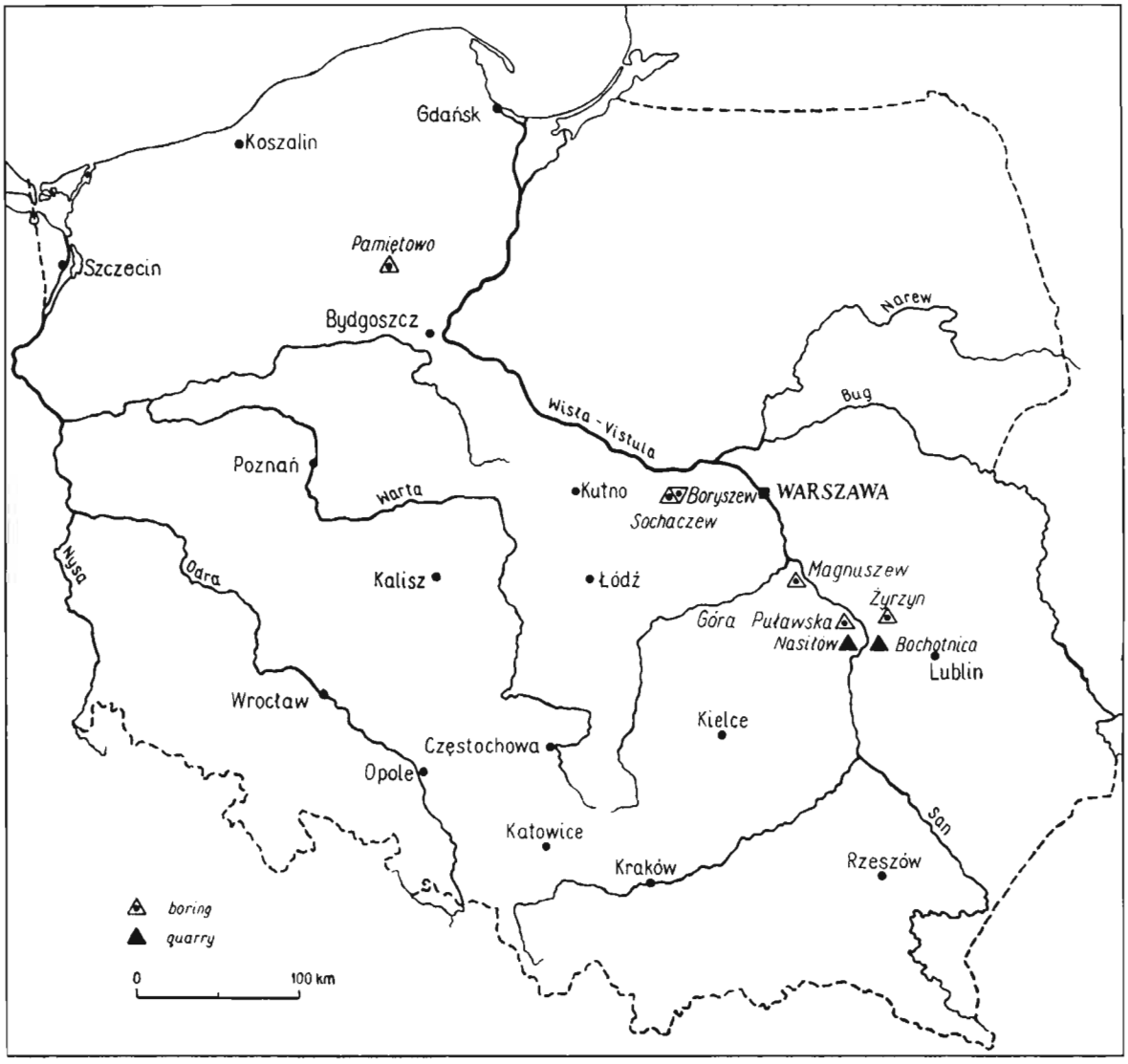


Fig. 1
Boring and quarry sites in Central and North Poland.

dian). These latter were provisionally considered, at that time (1961), as representing new species. Some of them were identified, however, as being very similar to those occurring in the Bunde Beds in Holland, described by VAN BELLEN (1946) and referred by him to Eocene.

For further investigation of the Pamiętowo boring it was necessary to obtain comparative material. Several samples have been kindly sent by Prof. R. MARLIÈRE from Belgium, from the famous boring in Mons (Puits Artésien at Polytechnic Faculty), drilled a hundred

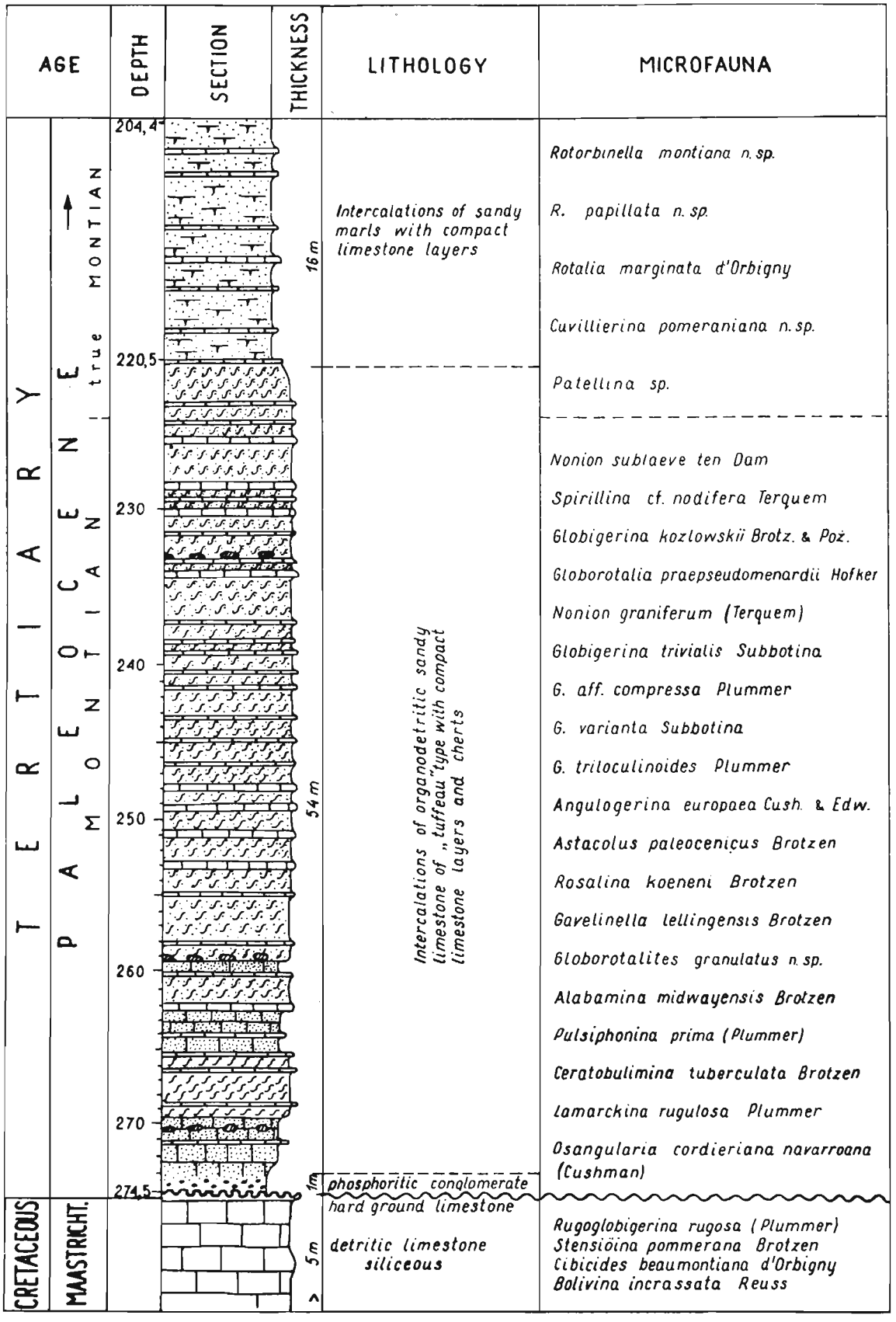


Fig. 2. Pamietowo boring, North Poland.

TABLE I

DISTRIBUTION OF FORAMINIFERA IN THE MONTIAN OF THE PAMIĘTOWO BORING

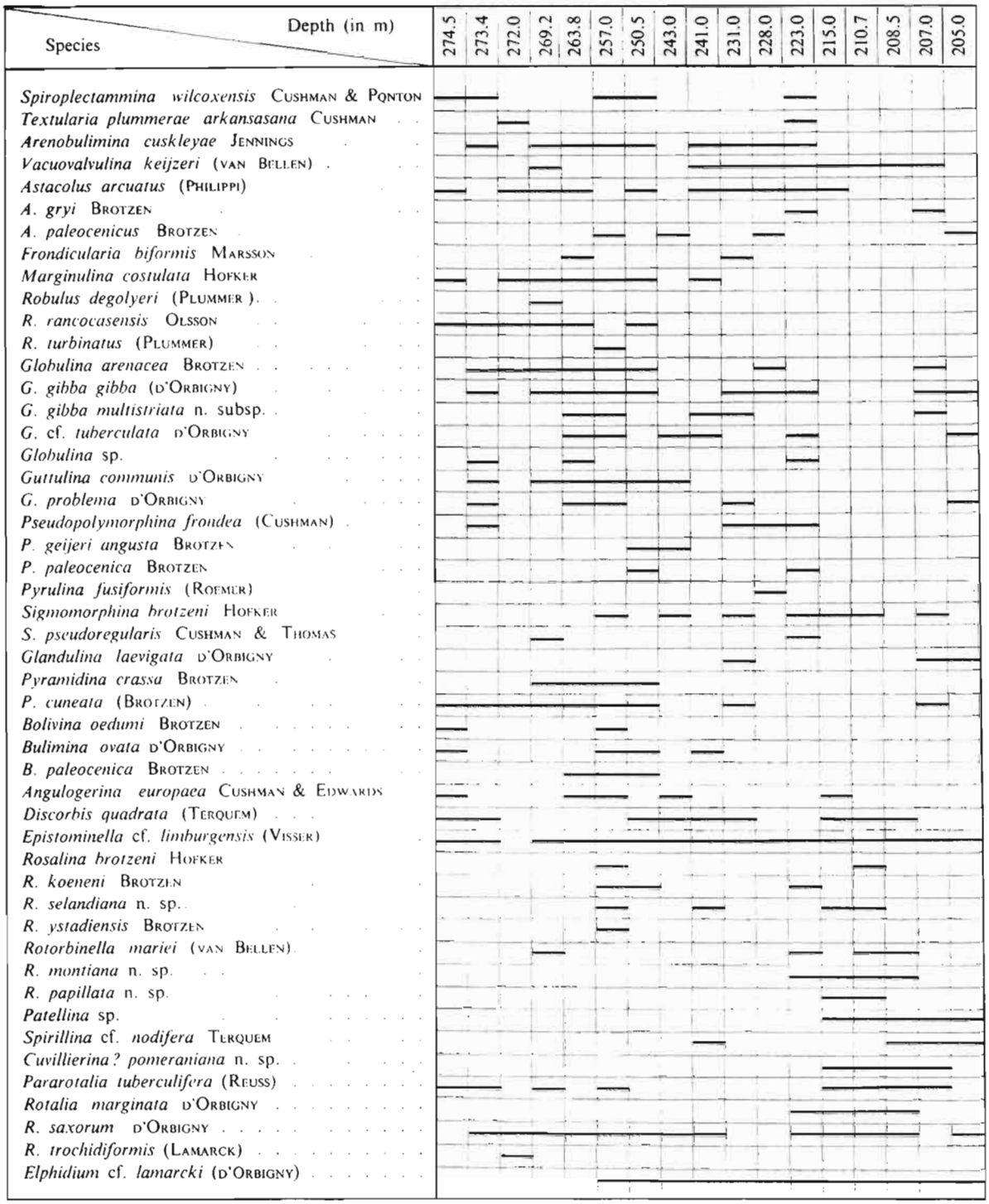
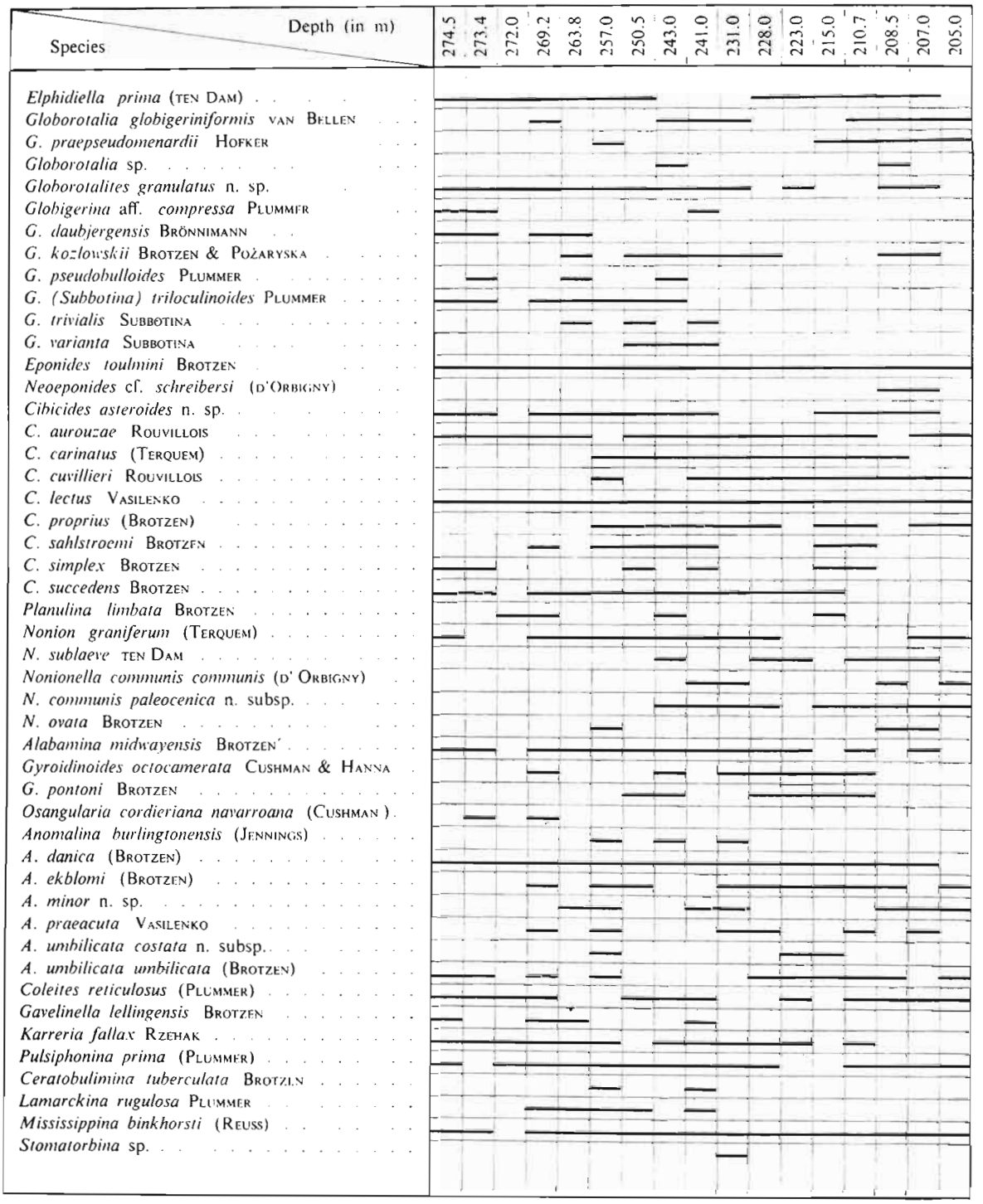


TABLE I

(continued)



years ago, where the true Montian, according to MARLIÈRE, was pierced and the Montian as a lower substage of Paleocene established. The present authors also had at their disposal single samples from the Bunde Beds (Limburg Province, Holland), as well as some samples from the English Thanet Beds. Thanks to these samples, it was possible to compare their foraminiferal contents with that from the Pamiętowo boring, and so define more correctly the age of the „tuffeau" series in the Pamiętowo section. It was also possible to establish the relation between the boreal Scandinavian Lower Paleocene (Selandian) sediments and the meridional[1] (non Mediterranean) west European Lower Paleocene (Montian) sediments from their stratotypes.

THE BOREAL PROVINCE IN EUROPE AND THE REGIONS WITH SIMILAR BIOFACIES CONDITIONS

(Text-figs. 3, 4; Tables 1, 2)

Foraminifera occurring in the sediments of the Pamiętowo boring are of Paleocene (Montian) age. From the point of view of ecology, the Foraminifera from the Pamiętowo boring show that, in Northern Poland, the two different environments: boreal and meridional, merge. The boreal influence was somewhat stronger at the base of the Paleocene series (as can be seen in the basal sediments of this boring) with the meridional (non Mediterranean) influence increasing later (top sediments of the Pamiętowo boring). On the whole, however, the meridional influence is much weaker than the boreal. This conclusion can be drawn from the proportion of a little warmer to somewhat colder species, as well as from the state of their test development. In the Pamiętowo boring boreal species predominate, subtropical species forming only 15% of the whole. Moreover the tests of the last species, in comparison with analogous species in optimal conditions, are much smaller, less variable, with weaker ornamentation, if at all, and thinner.

In the Tertiary sediments in the lower part of the Pamiętowo section, there occurs an assemblage of Foraminifera similar to the well known assemblage, described from the Lower Tertiary more sandy sediments of Central Poland (BROTZEN & POŻARYSKA, 1957; POŻARYSKA, 1965). In this assemblage benthonic foraminifers predominate, especially representatives of the families: Cibicididae, Nonionidae, Polymorphinidae, Discorbidae and Anomalinidae. They, together with the sediments in which they appear, prove that the depth of this early Tertiary basin was not considerable. The planktonic forms indicate clearly that this shallow sea was connected with the open sea. However, there are some clear differences between the foraminiferal assemblage in the Lower Tertiary sediments of Pamiętowo and this described from Central Poland, the main difference being the lack in Pamiętowo of some rather large Foraminifera of the genera: *Palmula* and *Planularia*. The genus *Robulus* is very scarce in Pamiętowo, just as are the index forms for Selandian such as *Lamarckina rugulosa* PLUM. and *Ceratobulimina tuberculata* BROTZ. A similar difference can be seen between the foraminiferal boreal assemblage of Pamiętowo and that characteristic for the Paleocene sediments of Denmark and Sweden (Scania). On the whole, however, the majority of species present in the Pamiętowo boring, as well as in Central Poland, also occur not only in the Paleocene of Denmark and Sweden, but also in the Paleocene in Austria, England, European and Asiatic regions of U.S.S.R., North and Central America (U.S.A.) and Australia. Those

[1] The here used expression „meridional" has the same meaning as in DEROO's paper (1966).

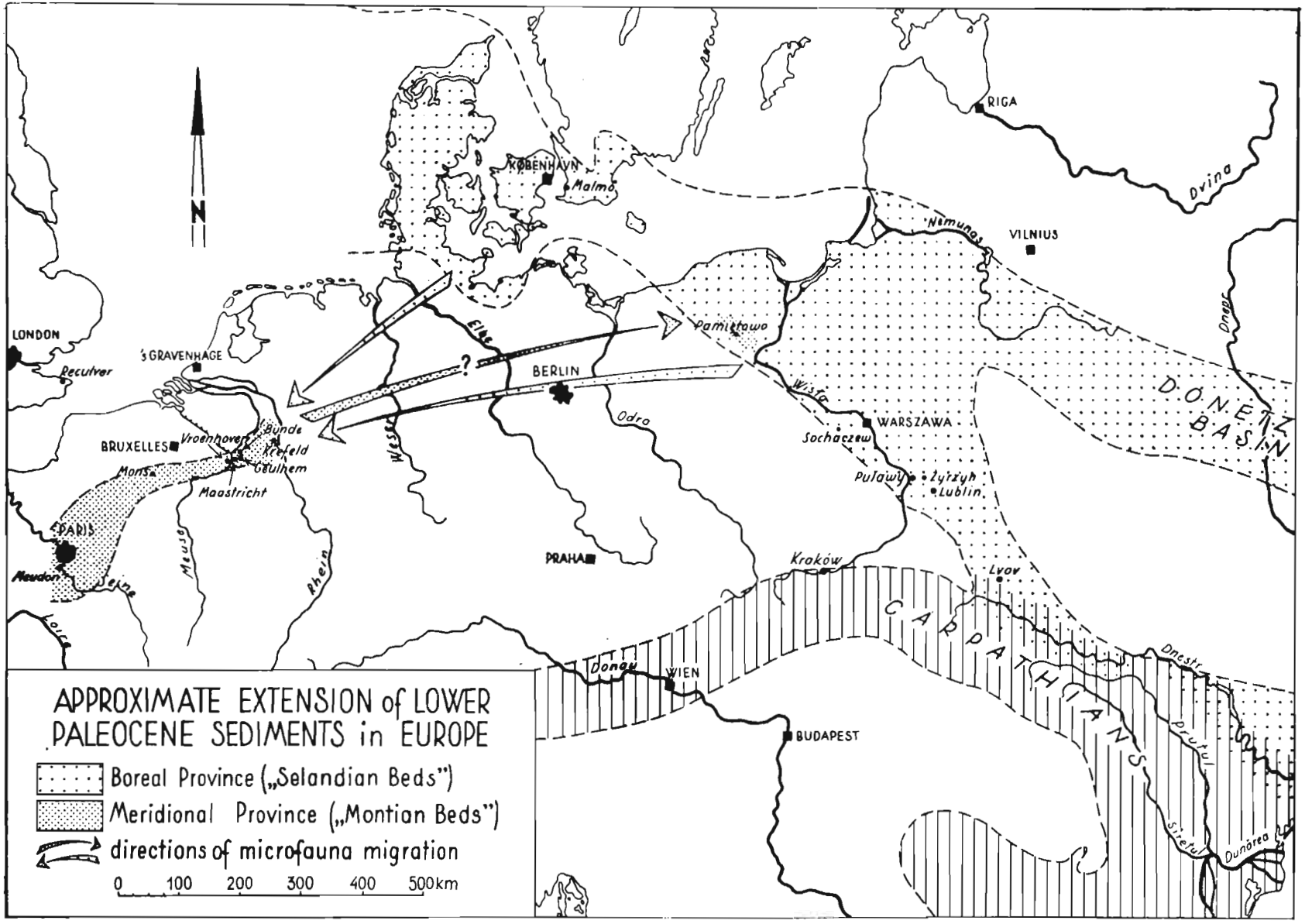

APPROXIMATE EXTENSION of LOWER PALEOCENE SEDIMENTS in EUROPE
Boreal Province („Selandian Beds")
Meridional Province („Montian Beds")
directions of microfauna migration
0 100 200 300 400 500km
N
LONDON
Recutver
's GRAVENHAGE
BRUXELLES
Vroenhoven
Aachen
Krefeld
Gaulhem
Mons
Maastricht
PARIS
Meudon
Seine
Loire
Meuse
Rhein
Elbe
Weser
KØBENHAVN
Malmö
BERLIN
Odra
PRAHA
Pamiętowo
Wisła
WARSZAWA
Sochaczew
Puławy
Żyrzyn
Lublin
Kraków
Lvov
RIGA
Dvina
Niemunas
VILNIUS
Dnepr
DONETZ BASIN
Donau
WIEN
BUDAPEST
CARPATHIANS
Dnestr
Prutul
Siretul
Dunărea

Fig. 3

common foraminiferal elements are less numerous in the Paleocene of Germany, S Holland and NE Belgium (Limburg Province), and still less numerous in SW Belgium (Mons Basin) and France (Paris Basin). These latter areas should be considered as a different province — a tropical or subtropical one, i.e. meridional (non Mediterranean) one. The extent of this latter area can be seen by the geographical distribution of the warm-water assemblage of Foraminifera.

DENMARK AND SWEDEN

The Upper Maastrichtian (Stevnsian) sediments in Denmark and Sweden are covered by Danian sediments, developed as limestone, similarly as the below lying Cretaceous layers. Although the Danian sediments were referred by BROTZEN (1959) to Upper Cretaceous, in the present paper they are treated as the lowermost Tertiary sediments. In Denmark and Sweden, the beds younger than Danian and older than the lowermost Eocene, were designated by ROSENKRANTZ (1924) as Selandian. These are detritic, sandy-glauconitic sediments, lying on the grey Upper Danian limestone. They begin as a basal conglomerate, which lies unconformly on the corroded hard ground surface of Danian beds, or on flint layers, penetrating into the latter's upper surface, being cut by numerous canals and burrows. This basal conglomerate is calcareous, containing numerous, small sized phosphatic nodules and small pebbles of Danian limestone. The basal conglomerate of Sweden (Scania), the so-called Klagshamn conglomerate, is considerably more calcareous than that of Denmark, i.e. the Copenhagen conglomerate. The latter contains a rich foraminiferal fauna, partly derived from the Danian, as well as numerous badly crushed macrofaunal remains, the majority of which are probably reworked. In Sweden (Scania), there is a thin series of green, calcareous, quartz-glauconitic sand with numerous Foraminifera described by BROTZEN (1948), lying on an equally thin layer of conglomerate (Klagshamn quarry near Malmö).

In Denmark, Lower Paleocene (Selandian) sediments occur, in the first place, in Zealand (Lellinge, Copenhagen), as well as in several localities in Jutland (among others Hvalløse and Egsmark). The microfauna of those sediments was described by FRANKE (1927) and later mentioned by BROTZEN (1948) when describing Foraminifera from Sweden (Scania). More recently Selandian Foraminifera from Denmark were quoted by BANG (*fide* L. B. RASMUSSEN, 1960), and later supplemented by POŻARYSKA (1965) and HOFKER (1966). The below cited species being the most important, are common to the Selandian and, in most cases, to the Danian beds sediments of Denmark, Sweden and Poland. Species not recognized in the Pamiętowo boring, but occurring in Central Poland, are marked by an asterisk. The list of species given below seems to represent the most characteristic assemblage of foraminifers of boreal Paleocene in Europe. It should be mentioned that over 40% of those species listed occur also in Denmark in the marl known as „Kerteminde marls", described from Copenhagen, the upper part of which was assigned to the lower part of Upper Paleocene.

Spiroplectammina wilcoxensis CUSH. & PON.
Arenobulimina cuskleyae JENN.
Robulus klagshamnensis BROTZ.*
Planularia pulavensis pulavensis POŻ.*
P. discus (BROTZ.)*
Astacolus gryi BROTZ.
A. paleocenicus BROTZ.
Palmula robusta BROTZ.*
Globulina arenacea BROTZ.
Pyrulina fusiformis (ROEM).
Pseudopolymorphina frondea (CUSH.)
P. geijeri angusta BROTZ.
P. paleocenica BROTZ.
Sigmomorphina brotzeni HOF.
S. soluta BROTZ.
S. pseudoregularis CUSH. & THOM.

* Not known in the Pamiętowo boring.

Nonionella ovata BROTZ.
Elphidiella prima (TEN DAM)
Bolivina oedumi BROTZ.
Bulimina ovata D'ORB.
B. paleocenica BROTZ.
Loxostomum applinae (PLUM.)*
Pyramidina cuneata (BROTZ.)
P. europaea (CUSH. & EDW.)
P. crassa BROTZ.
Rosalina koeneni BROTZ.
R. ystadiensis BROTZ.
Lamarckina naheolensis CUSH. & TODD
Gavelinella lellingensis BROTZ.
Gyroidinoides pontoni BROTZ.
G. octocamerata CUSH. & HANNA
Eponides toulmini BROTZ.
Osangularia cordieriana navarroana (CUSH.)
Coleites reticulosus (PLUM.)
Hoeglundina scalaris (FRANKE)*
Pulsiphonina prima (PLUM.)
Ceratobulimina tuberculata BROTZ.
Alabamina midwayensis BROTZ.
Globigerina triloculinoides PLUM.
Anomalina praeacuta VAS.
A. ekblomi BROTZ.
A. danica BROTZ.
Cibicides proprius BROTZ.
C. sahlstroemi BROTZ.
C. simplex BROTZ.
C. succedens BROTZ.
Karreria fallax RZEH.
Tappanina selmensis (CUSH.)*

AUSTRIA

Austria, belonging to the Alpine geosyncline, is considered here because in the Paleocene biofacies conditions were similar as in other countries of Boreal Province. The Foraminifera, planktonic and benthonic, from the Paleocene deposits of Austria have been elaborated in detail by HILLEBRANDT (1962) and also by SCHMID (1962). Mention of some Austrian Paleocene Foraminifera was made by HOFKER (1966) and POŻARYSKA (1965). In a sample of Paleocene sediments from Austria, from Kreisbach, north of Salzburg, kindly sent by Prof. A. ROSENKRANTZ, the present writers identified the following species: *Robulus pseudo-mamilligerus* (PLUM.), *R. klagshamnensis* BROTZ., *Angulogerina europaea* CUSH. & EDW., *A. cuneata* BROTZ., *Pulsiphonina prima* (PLUM.), *Eponides toulmini* BROTZ., *Bulimina midwayensis* CUSH. & PARK., *B. arkadelphiana* CUSH. & PARK., *B. paleocenica* BROTZ., *Vaginulina* sp., *Allomorphina halli* JENN., *Hoeglundina scalaris* (FRANKE), *Globigerina pseudobulloides* PLUM., *G. triloculinoides* PLUM., *Ceratobulimina tuberculata* BROTZ., *Anomalina praeacuta* VAS., *Osangularia navarroana cordieriana* (CUSH.), *Cibicides succedens* BROTZ., *C. proprius* BROTZ. and *Globorotalia angulata* (WHITE). Among the above mentioned species, only *Globorotalia angulata* (WHITE) was never found either in the Polish or Dano-Swedish Paleocene.

The lowermost Tertiary sediments in Eastern Austria are developed in the form of sand and sandstone as well as lithothamnic limestone. The Foraminifera assemblage described by SCHMID (1962) from the „Bruderndorfer Feinsand", referred by him to Danian, in reality seems to represent Paleocene (Montian), older however, in all probability, than the Paleocene from Kreisbach, examined by the present authors. SCHMID did not find the Paleocene (Montian) index forms, especially *Ceratobulimina tuberculata* BROTZ., however, according to the present writers, species such as *Robulus pseudo-mamilligerus* (PLUM.), *R.* cf. *klagshamnensis* BROTZ. and *Loxostomum applinae* (PLUM.) confirm the Montian age of the „Bruderndorfer Feinsand".

ENGLAND

The oldest Tertiary sediments in England are of Thanetian age. Thanet Beds occurring in SE England, in Kent, are about 30 m thick and consist of marl, clay, silt, glauconitic-sandy silt and silty-sand, which in HAYNES' opinion correspond in age to the Lower Landenian of

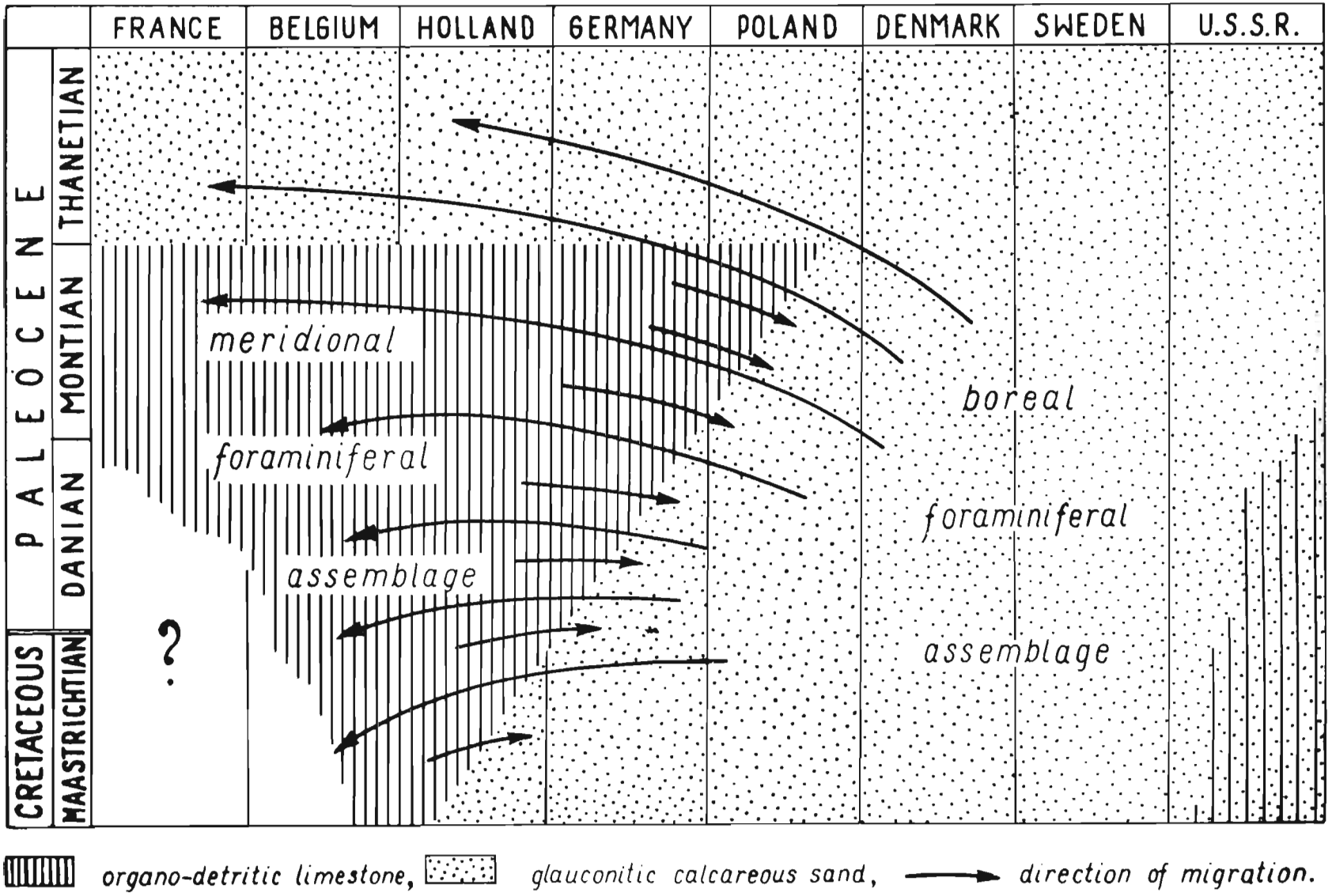


Fig. 4. Repartition of Foraminifera in the Paleocene of Europe.

North Europe. Foraminiferal microfauna described by HAYNES (1954—1958) from the Thanet Beds, just as that examined by the present authors from these same layers (samples from Pegwell, horizons 47 and 54), shows considerable similarity to that of the Danish-Swedish and Polish Selandian. This similarity confirms that there existed a connection and communication between the Swedish-Danish and English Paleocene basins (as well as between Belgian and French Thanetian, as suggested by BROTZEN, 1948). The below mentioned species from Pegwell, common to the English, Polish and Danish-Swedish Paleocene, predominate in the assemblage: *Cibicides sahlstroemi* BROTZ., *C. proprius* (BROTZ.), *C. succedens* BROTZ., *C. carinatus* (TERQ.), *Anomalina praeacuta* VAS., *A. ekblomi* (BROTZ.), *A. burlingtonensis* (JENN.), *A. umbilicata umbilicata* BROTZ., *A. danica* (BROTZ.), *Anomalinoides nobilis* BROTZ., *Pyramidina crassa* BROTZ., *Angulogerina europaea* CUSH. & EDW., *Osangularia cordieriana navarroana* (CUSH.), *Globigerina triloculinoides* PLUM., *Eponides toulmini* BROTZ., *Alabamina midwayensis* BROTZ., *Rosalina selandiana* n. sp., *R. ystadiensis* BROTZ., *R. koeneni* BROTZ., *Bolivina oedumi* BROTZ., *Tappanina selmensis* (CUSH.), *Bulimina ovata* D'ORB., *B. paleocenica* BROTZ., *Nonion graniferum* (TERQ.), *Ceratobulimina tuberculata* BROTZ., *Pulsiphonina prima* (PLUM.), *Epistominella* cf. *limburgensis* (VISS.), and others.

U.S.S.R. (EUROPEAN AND ASIATIC PART)

In the European part of U.S.S.R. (Crimea excluded) the oldest Tertiary sediments are of Paleocene age. Paleocene sediments occur in the depressions of the Russian Platform in many regions, the most important of which are: Lithuania as well as Dnieper-Donetz Basin and other places of Ukraine. On the Russian Platform the Paleocene sediments are developed in the so-called platformic facies, corresponding in character to the epicontinental facies occurring in Northern Europe.

The Danian sediments occur in the south-east part of the Russian Platform in the region Obshchyj Syrt, as well as eastern of the Ural River region. They represent a rather thin series of limestones, 5—8 m of thickness.

Marly silts interbedded by marls and sandstones, 15—20 m of thickness, forming so-called „Tziganovskij horizon", are lying on the Danian sediments in the Obshchyj Syrt region. This „Tziganovskij horizon" is of Lower Paleocene age (LEONOV, 1961), i.e. Montian age, or still of Danian age (BEZRUKOV, 1933). Similar series are known also in the Baskunchak-lake region and in the boring at Novouzensko city.

In the southern part of the Russian Platform, the silty sandstones with glauconite, forming „Belogrodny horizon" of the Middle Volga Region, and glauconitic sandstone of „Berezovskij horizon" of the Lower Volga Region, are of Lower Paleocene age (LEONOV, 1961), i.e. Lower Montian.

„Kanevskij horizon", developed as sandstones and silts, is of Upper Montian or Lower Thanetian age (V. P. VASILENKO, 1950) and was found in borings at the Dnieper Basin, between cities Romny and Zmijevym.

Of the Upper Paleocene age are: „Syzranskij horizon", developed as „opoka"-rock, and sandstone of Middle and Lower Volga Region, „Upper Tacinskij horizon" (LEONOV, 1961) — silty „opoka"-rock and silts of Don River Basin, and „Reshetnikovskij horizon" (V. K. VASILENKO, 1946) — „opoka"-rock of the Middle Desna region and of Upper North Donetz region.

The Paleocene sediments (Danian and Montian) are developed in a similar platformic

facies in the Crimean Peninsula, Central Georgia and the Tadzhik depression (where Danian is lacking).

Lithuania. — The most northern region, in which the Paleocene sediments of the Russian Platform occur, is SW Lithuania. The Paleocene sediments of Lithuania are developed as calcareous sand and sandstone with glauconite, lying directly on Maastrichtian or Campanian sediments, with a maximum thickness of over 60 m. GRIGELIS (1960), describing the foraminiferal assemblage in the Paleocene sediments of Lithuania, compared it with the known assemblage of the same age from the Ukraine, as well as with that from Poland and Sweden, stating a very considerable faunistic analogy and defining the age ot these sediments as Lower Paleocene (Selandian). The following species present in the Polish and Swedish Paleocene were also cited by GRIGELIS (1960) from SW Lithuania: *Bulimina (?) paleocenica* BROTZ., *Cibicides (?) lunatus* (BROTZ.), *Ceratobulimina tuberculata* BROTZ., *Alabamina wilcoxensis* Toulm., *Anomalina danica* (BROTZ.), *A. praeacuta* VAS., *Cibicides lectus* VAS., *C. proprius* (BROTZ.), *C. succedens* BROTZ., *Karreria fallax* RZEH.

Dnieper-Donetz Basin. — The Paleocene sediments of the Dnieper-Donetz Basin are similarly developed as those in Lithuania and the below mentioned W Ukraine. Its foraminiferal fauna was described in detail by V. P. VASILENKO (1950), who correlated the two lower horizons of the local Kaniew substage of the Dnieper-Donetz Basin with the Lower Paleocene of Sweden and Denmark. According to VASILENKO, these horizons ought to be referred to the Montian. The list of Foraminifera given by VASILENKO contains many species (cited below) common to the Paleocene of the Dnieper-Donetz Basin, Sweden, Denmark, and Poland: *Globulina gibba* D'ORB., *G. amygdaloides* REUSS, *Reussella paleocenica* (BROTZ), *Alabamina wilcoxensis* TOULM., *Gyroidina* ex gr. *soldanii* D'ORB., *Anomalina midwayensis* (PLUM.), *A. danica* (BROTZ.), *A. praeacuta* VAS., *Cibicides(?) lunatus* (BROTZ.), *Cibicides lectus* VAS.

Ukraine. — In the southern region of the Russian Platform, i.e. in W Ukraine, the Paleocene sediments do not exceed 70 m in thickness. KAPTARENKO-ČERNOUSOVA *et al.* (1963) described from there an assemblage of Foraminifera, among which are the following species, known also from Poland and Sweden: *Spiroplectammina variata* VAS. cf. *laevis* (ROEM.), *Gaudryina rugosa* D'ORB., *Lenticulina (Astacolus) gryi* BROTZ., *Robulus discus* BROTZ., *Reussella paleocenica* (BROTZ.), *Siphonina prima* (PLUM.), *Diofrondicularia geijeri* (BROTZ.), *Anomalina (Anomalina) danica* BROTZ., *A. (Pseudovalvulineria) praeacuta* VAS., *Cibicides (Cibicidoides) lectus* VAS., *C. (Gemellides) lunatus* (BROTZ.).

Crimea. — The lowermost Tertiary sediments lying on the Cretaceous in southern Crimea (Bakchisaray near Simferopol) are well developed and particularly well exposed, as an almost 60 m thick deposit of the so-called Dano-Montian series. Most Soviet geologists and palaeontologists included it into Tertiary, only a few considering its lower part (Danian) as the Cretaceous. It is a series of calcareous detritic limestone, sandy-marly at the base, passing upwards into organo-detritic limestone, similar to the detritic sediments of the same age in Limburg Province, the so-called „tuffeau". The top of the series is developed as hard limestone with flints and siliceous marls, corresponding to calcareous gaizes. Mainly on the base of echinids and foraminifers, this series was divided in the Crimea into Danian and Montian. The microfauna, characteristic of Dano-Montian sediments in the Crimea, was described by MOROZOVA (1959—1961), ŠUCKAJA (1958), MASLAKOVA (1959) and others. It is characterized by a foraminiferal assemblage very close to that known from lowermost Tertiary, i.e. Danian

and Montian of the Polish Lowlands. The lower part of the discussed series represents the Danian, well characterized by index macrofauna, as well as by an assemblage of smooth, planktonic Foraminifera, while the upper represents Montian, its foraminiferal assemblage corresponding to the known assemblage of Lower Paleocene (Selandian) of Denmark, Sweden and Poland (MOROZOVA, 1960; POŻARYSKA, 1965). MOROZOVA listed from the Montian of Crimea several species of Foraminifera, evidence of the similarity between the Selandian of above mentioned countries. These are following the most important species: *Ceratobulina tuberculata* BROTZ., *Loxostomum applinae* (PLUM.), *Planularia discus* (BROTZ.), *Globigerina varianta* SUBB., *Cibicides lectus* VAS.

In samples from the Montian of Kurskoe (Crimea), the present authors stated, in addition, the presence of the following foraminiferal species: *Alabamina midwayensis* BROTZ., *Eponides frankei* BROTZ., *Anomalina danica* BROTZ., *A. praeacuta* VAS., *Osangularia cordieriana navarroana* CUSH., *Bulimina ovata* D'ORB., *Cibicides succedens* BROTZ. and *Epistominella* cf. *limburgensis* (VISS.).

In the Montian assemblage of Foraminifera from Crimea, MOROZOVA (1960) also stated the presence of the first representatives of *Acarinina angulata* (WHITE), not known from the Selandian beds of North and Central Europe.

Georgia. — On the European-Asiatic transitional territories of U.S.S.R., mainly in Western Georgia there occur Upper Cretaceous and Lower Tertiary sediments, developed in platformic facies. These are found on the tectonic block, situated between the Great and Small Caucasus. The sediments deposited during the Upper Cretaceous and Lower Tertiary lie here almost horizontally, not disturbed and never reaching a great thickness. The Danian sediments lying conformably on the Maastrichtian, continue the same type of facies, whereas the Paleocene sediments lying nonconformably with the Danian sediments, are eroded entirely in several places. Often it lacks completely the Lower Paleocene sediments there.

The Upper Cretaceous and Lower Tertiary sediments were examined there in the first place by TZAGARELI (1954) and KAČARAVA & KAČARAVA (1960). The Danian sediments assigned by Georgian authors to the Cretaceous, consist of white limestone, continuing the Cretaceous calcareous sedimentation. The higher lying deposits of green, glauconitic marl and sandy silt contain a foraminiferal assemblage close to that in the Paleocene sediments of Central Europe. However, they have numerous elements typical of geosyncline, for instance nummulites, which hinder both the making of a close correlation between these distant sea basins and establishing its exact age, which probably should be placed not so low in stratigraphical schedule (POŻARYSKA, 1965) as was stated by Georgian geologists and palaeontologists. The white limestone, assigned by them to Upper Danian, should be assigned to the Montian on the base of the following foraminiferal species: *Lamarckina rugulosa* PLUM., *Robulus degolyeri* (PLUM.), *R. pseudo-mamilligerus* (PLUM.), *Hoeglundina scalaris* (FRANKE) and *Pyrulina fusiformis* (ROEM.).

The above cited species are never met with in European epicontinental Danian sediments. In addition, according to some Georgian authors, in the layer considered by them as Danian, there occur also some *Globorotalia* species, such as *G. angulata* (WHITE) and *G. conicotruncata* (SUBB.), ~~which~~ in other regions date ~~the Upper~~ Paleocene beds (BOLLI, 1966). Because of the occurrence in these layers of the above mentioned foraminiferal species, not known in deposits older than Montian, and of others known only from Upper Paleocene in epicontinental as well as in geosynclinal facies, it seems that these layers should be assigned to the Montian and not to Danian, which in addition is considered in Georgia as belonging to the Cretaceous. The foraminiferal assemblage reveals a great microfaunal similarity between the Paleocene of

Georgia, Sweden, Denmark and Poland, showing an open connection between the epicontinental sea basins and those forming connecting basins to the open oceans and great geosynclinal seas.

Tadzhik depression. — The Paleocene sediments of the Russian Platform are prolonged into the Tadzhik depression, north of Amu-Daria, beyond the Caspian Sea. There the Paleocene occurs in the form of marl and dolomite with gypsum. It was described by BYKOVA (1953) and later by MOROZOVA, KREJDENKOV and DAVIDZON (1965) and at the same time characterized by Foraminifera. The Paleocene sediments in this region were divided by the latter authors into three local horizons. The middle horizon, so-called „Aruktauskij Horizon" corresponds, in the opinion of these authors, to the European Selandian, however it was placed by them into the Thanetian. The following species of Foraminifera, occurring there, are also common to the Paleocene (Montian) of Poland: *Lenticulina degolyeri* (PLUM.), *Gyroidina octocamerata* (CUSH. & HANNA), *Allomorphina* aff. *halli* JENN., *Alabamina midwayensis* BROTZ., *Globigerina triloculinoides* PLUM., *G. pseudobulloides* PLUM., *G. trivialis* SUBB., *Anomalina umbilicata* (BROTZ.), *A. ekblomi* BROTZ., *A. danica* BROTZ., *Cibicides* aff. *succedens* BROTZ., *C. burlingtonensis* JENN., *C. simplex* BROTZ., *C. proprius* BROTZ., *Bulimina ovata* D'ORB., *B. paleocenica* BROTZ. and *Eponides* aff. *lunatus* BROTZ.

Together with this assemblage, are found representatives of the *Globorotalia angulata* (WHITE) and *G. pseudomenardii* BOLLI, which are species, according to BOLLI (1966), characterizing the Upper Paleocene.

NORTH AMERICA

In addition to the European continent, the boreal type of Paleocene sediments are known from North and Central America and Australia. The foraminiferal microfauna occurring there proves the existence of some connections in the Lower Tertiary between Europe, Gulf Coastal Region of U.S.A. and Australia. In North America, the sediments assigned to the so-called Midway Group correspond to the European Paleocene. These sediments were first characterized in detail by H. J. PLUMMER (1926) and later by CUSHMAN (1944—1951). The Midway Formation, especially well developed in the Gulf Coastal Region, where the sediments reach a thickness of almost 200 m, consists of clay, glauconitic sand, silt and limestone, all with concretions. At first, all the Midway Formation was compared with the Eocene (PLUMMER, 1926), later with the Danish-Swedish Paleocene (F. B. PLUMMER, 1932) and lastly with European Danian (SCOTT, 1934, *fide* BROTZEN, 1948, p. 32). In 1948, BROTZEN, on the base of Foraminifera, referred the Lower Midway to Danian, and Upper Midway to the Danish-Swedish Lower Paleocene (Selandian).

The present authors have examined a sample from the Upper Midway, Wills Point, Mexia Clay member, from Texas. The below mentioned foraminiferal species present there, are also known from the European Paleocene, this indicating the considerable similarity between the Upper Midway and Danish-Swedish and Polish Paleocene (Selandian): *Robulus degolyeri* (PLUM.), *R. pseudo-mamilligerus* (PLUM.), *Pulsiphonina prima* (PLUM.), *Citharina plumoides* (PLUM.), *Hoeglundina scalaris* BROTZ., *Loxostomum applinae* (PLUM.), *Alabamina midwayensis* BROTZ., *Anomalina midwayensis* (PLUM.), *A. ekblomi* (BROTZ.), *Lamarckina rugulosa* PLUM., *L. naheolensis* CUSH. & TODD, *Osangularia cordieriana navarroana* (CUSH.), *Globigerina triloculinoides* PLUM., *G. daubjergensis* BRÖN. and *G. pseudobulloides* PLUM.

This list may be enlarged by species common to European Paleocene which have also been described by CUSHMAN (1951) from American Paleocene. They are not cited here, because of their less stratigraphical value.

AUSTRALIA

Foraminiferal species common to both the North American and European Paleocene were also identified by MCGOWRAN (1965, 1966) in Australian (Western Victoria) Paleocene. Australian Paleocene, developed mainly in the form of clay and sand, is represented by Pebble Point and Rivernook Member Formations, belonging to the Wangerip Group. On the base of the benthonic Foraminifera, MCGOWRAN correlated the Victoria Paleocene with the Lower Paleocene of North Europe and North America, however, on the base of the planktonic Foraminifera known from the Tethys, he considered the Pebble Point Formation as Middle Paleocene, and the Rivernook Member as Upper Paleocene. In the Australian Paleocene, among the species of Foraminifera described by MCGOWRAN, the following are common to the Australian, American and European Paleocene: *Citharina plumoides* (PLUM.), *Siphonina (Pulsiphonina) prima* (PLUM.), *Robulus discus* BROTZ., *R. pseudo-mamilligerus* (PLUM.), *Cibicidina mariae* (RUPERT JONES), *Karreria fallax* RZEH., *Lamarckina rugulosa* PLUM., *Hoeglundina scalaris* BROTZ., *Angulogerina europaea* CUSH. & EDW., *Bolivinoides oedumi* (BROTZ.), *Tappanina selmensis* (CUSH.).

* *
*

Some species characteristic for the Paleocene of Boreal Province occur also in the Paleocene of the Meridional (non Mediterranean) Province in Western Europe, i.e. in Limburg Province, Mons and Paris Basin. The number of boreal species in the Meridional Province decreases westwards, while at the same time undergoing a gradual reduction in the higher part of the tropical or subtropical Paleocene. In the Meridional Province the tests of boreal foraminifers are smaller and less numerous than in the boreal. On the base of an analysis of samples from the lowermost Tertiary of Limburg Province (Geulhem; Vroenhoven), the present authors considered the below mentioned species (only the most important stratigraphically) as the most cosmopolitan, common to the lowermost Tertiary (Danian and Montian) of the Boreal Province and the eastern boundary of the Meridional Province.

Coleites reticulosus (PLUM.)
Eponides toulmini BROTZ.
Planulina limbata BROTZ.
Frondicularia biformis MARSS.
Elphidiella prima (TEN DAM)
Textularia plummerae arkansasana CUSH.
Alabamina midwayensis BROTZ.
Robulus turbinatus (PLUM.)
Epistominella cf. *limburgensis* (VISS.)
Cibicides carinatus (TERQ.)
C. sahlstroemi BROTZ.
C. simplex BROTZ.
Karreria fallax RZEH.
Anomalina praeacuta VAS.
A. ekblomi BROTZ.
Pulsiphonina prima (PLUM.)

According to the writers' own observations of samples from the older Paleocene (Montian) of Limburg Province, Mons Basin and in Paris Basin (the foraminiferal assemblage of latter basin mentioned by BROTZEN, 1948), the number of boreal foraminiferal species is even

less numerous, while there is a rise in the number of meridional species which are moreover better developed.

In Western Europe, only in the Thanet Beds the boreal foraminiferal fauna appears as an almost exclusive assemblage.

THE MERIDIONAL (NON MEDITERRANEAN) PROVINCE

(Text-figs. 3, 4; Table 2)

As was mentioned previously, in the lower part of the Pamiętowo boring an assemblage of boreal Foraminifera predominates, however, single foraminifers characteristic of subtropical Paleocene of West Europe also occur. In the upper part of the boring the number of warm-water species increases, however, they do not exceed 15% of the total. The assemblage of warm-water foraminifers is mainly represented by the family Rotaliidae, being poor in other groups of meridional foraminifers, especially representatives of Miliolidae. The composition of the subtropical foraminiferal assemblage from the Pamiętowo boring, the test development of its individual species, as well as the relation in number between the warm-water and boreal species, all indicate that the ecological conditions in the Polish Paleocene were not sufficiently favourable for the development of warm-water foraminiferal microfauna. However, even this small percentage of meridional foraminiferal fauna in the Montian of North Poland proves that in this period the climate had become somewhat warmer in this part of Europe. On the other hand, it shows that at that time there existed a connection between the meridional sea of Western and the boreal sea of Eastern Europe.

The assemblage of subtropical species occurring in the Pamiętowo boring is known from the Lower Tertiary (Paleocene) of France (Paris Basin), SW Belgium (Mons Basin), the Belgian-Holland frontier (Limburg Province) and the western part of Germany (Krefeld region). This region, in the uppermost Cretaceous and lowermost Tertiary was occupied by warm sea, in which the organo-detritic sediments of „tuffeau" type predominated.

FRANCE (PARIS BASIN)

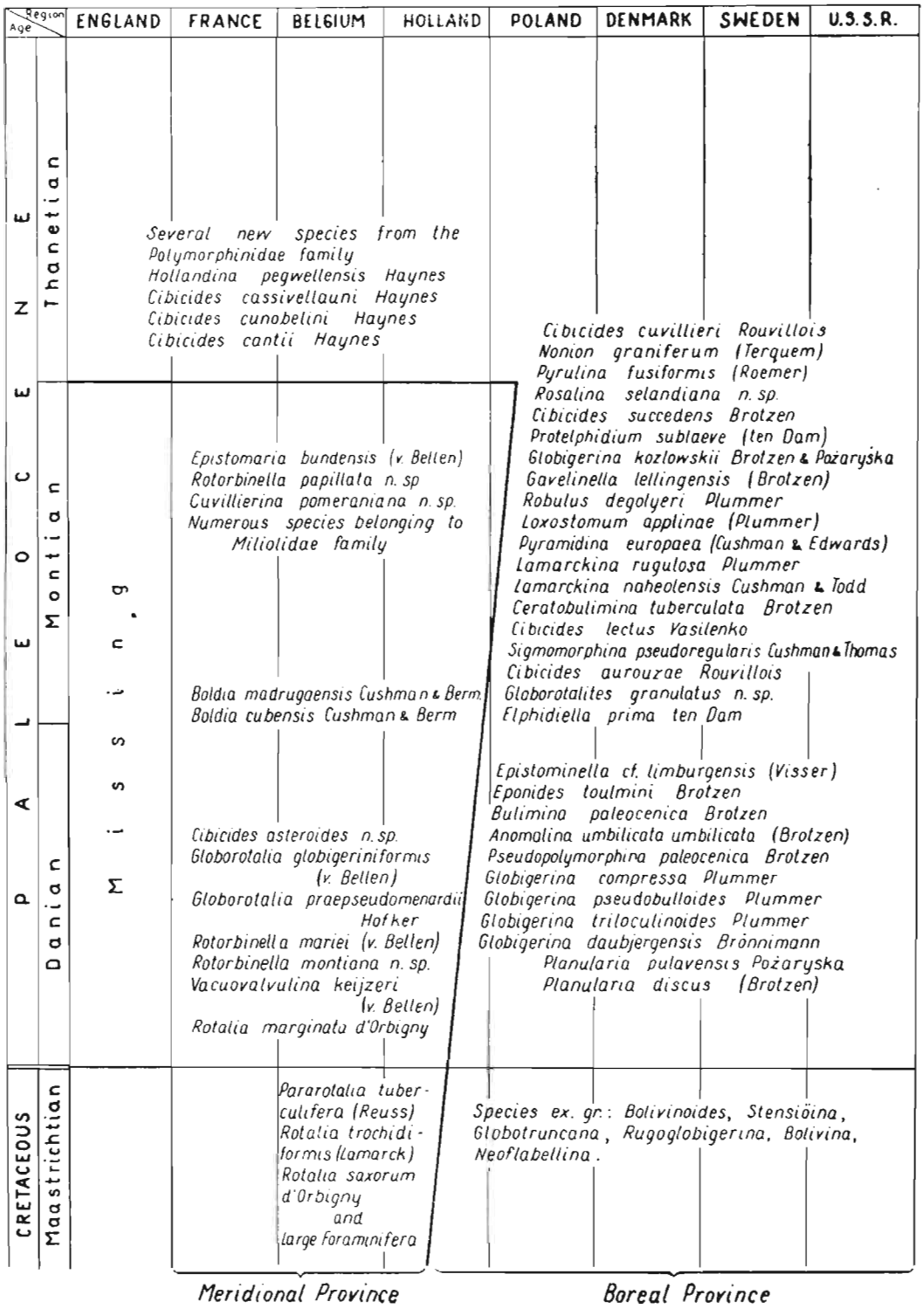
The most classical area of the Meridional (non Mediterranean) Province is the Paris Basin. The Paleocene (Montian) sediments are developed there in the form of limestone, the so-called „Calcaire pisolithique", which probably represents the oldest Tertiary sediments in this region. The age of „Calcaire pisolithique" was recognized by MEUNIER (1912) as Danian, by LEMOINE (1937) and ABRARD (1937) as Dano-Montian, by MARIE (1937) and DAMOTTE (1964) as Montian and by van BELLEN (1946) as Danian or Montian.

From the description of the foraminiferal assemblage occurring in „Calcaire pisolithique", given by MARIE (1937—1964 and MS), it appears that the most predominating representatives pertain to the following families: Textulariidae, Valvulinidae, Ataxophragmiidae, Miliolidae, Soritidae, Anomalinidae, Rotaliidae, Discorbidae. Some of the subtropical species mentioned by MARIE occur also in the Polish Montian, the majority however are common to Montian of Mons Basin and Limburg Province.

The present authors had at their disposal a single sample from „Calcaire pisolithique" of Vigny, from which unfortunately only two meridional species, known also from Polish Montian, could be identified. These are *Rotalia trochidiformis* (LAM.) and *R. marginata* D'ORB.

TABLE 2

SOME GUIDE FORAMINIFERAL ASSEMBLAGES IN THE LOWER PALEOCENE (DANIAN AND MONTIAN) OF EUROPE (THE ALPINE GEOSYNCLINAL EXCLUDED)



SW BELGIUM (MONS BASIN)

Corresponding to the „Calcaire pisolithique" of France there is in the Mons Basin the so-called „Calcaire grossier de Mons" („Calcaire de Mons"), limestone lying on a similar series of „Tuffeau de Ciply". While „Calcaire de Mons" is known only from wells, the „Tuffeau de Ciply" occurs also in outcrops. The age of the latter two series has been under discussion for many years. Some authors, e.g. CORNET (1922), VINCENT (1930), WIENBERG RASMUSSEN (1962) and DEROO (1966) assigned „Tuffeau de Ciply" to the Danian, while the above lying „Calcaire de Mons" was referred to Montian. Others, e.g. LERICHE (1937), DE HEINZELIN and GLIBERT (1957, in the Stratigraphical Lexicon) and MARLIÈRE (1958) considered both the „Tuffeau de Ciply" and „Calcaire de Mons" as Montian. ROSENKRANTZ (1964) put the „Tuffeau de Ciply" in the Middle Danian, according to WIENBERG RASMUSSEN, and the „Calcaire Grossier de Mons", which rests conformably on the tuffeau, in the Upper Danian.

Foraminiferal fauna of these sediments was described by HOFKER (1960—1966) and listed by POŻARYSKA (1966). HOFKER, on the base of Foraminifera, assigned „Tuffeau de Ciply" and „Calcaire de Mons" to Paleocene, comparing them to „Q" and „R" Zone of Limburg Province. On the other hand, POŻARYSKA who had at her disposal samples from the boring in Mons, stated that the foraminiferal fauna occurring there does not permit one to define the stratigraphical boundary between the „Tuffeau de Ciply" and „Calcaire de Mons". Furthermore POŻARYSKA (see also BROTZEN & POŻARYSKA, 1961) stated that the foraminiferal fauna from the Bunde Beds in Limburg Province, described by VAN BELLEN (1946), was very similar to that occurring in the Montian of Poland. The below mentioned species (from boring in Mons) are common to the lowermost Tertiary beds of Mons Basin and the Montian of North Poland. The determination of some of the below listed species given by POŻARYSKA (1966) has been here revised.

Rotalia trochidiformis (LAM.)
R. saxorum D'ORB.
R. marginata D'ORB.
Pararotalia tuberculifera (REUSS)
Rotorbinella mariei (VAN BEL.)
R. montiana n. sp.
Rotorbinella papillata n. sp.
Vacuovalvulina keijzeri (VAN BEL.)
Globorotalia globigeriniformis VAN BEL.,
G. praepseudomenardii HOF.
Anomalina minor n. sp.
Cuvillierina? pomeraniana n. sp.

The above given list contains the meridional species only, the boreal, cosmopolitan species are excluded.

NE BELGIUM AND S HOLLAND (LIMBURG PROVINCE)

The lowermost Tertiary of the Limburg Province is developed as a glauconitic tuff chalk the so-called „Tuffeau glauconieux" passing higher into tuff chalk. On the base of the Ostracoda, DEROO (1966) correlated „Tuffeau glauconieux" with „Tuffeau de Ciply" whereas the tuff chalk, resting on „Tuffeau glauconieux" was referred to „Série intermédiaire" and „Calcaire de Mons" of the Mons Basin. According to DEROO, „Tuffeau glauconieux" belongs to Danian, and the overlying tuff chalk beds — to Montian. HOFKER (1966) divided the uppermost Cretaceous and the lowermost Tertiary layers into zones. To the uppermost Cretaceous, i.e. Dano-Maastrichtian, he included among others „N" („Me") Zone, i.e. „Tuffeau glauconieux", while the above lying tuff chalk was assigned to Paleocene. Within the Paleocene of Limburg, HOFKER determined „P" Zone, correlating it with the Swedish Lower Paleocene (Selandian), „Q" Zone, with „Tuffeau de Ciply" and „R" Zone, with „Calcaire de Mons". In this way he stated the analogy between the Lower Tertiary of Mons Basin and Limburg Province.

The above given division of HOFKER of uppermost Cretaceous and lowermost Tertiary in Limburg Province is based on foraminiferal fauna, which is described in detail by this author. VAN BELLEN (1946), however, was the first to describe the tropical Foraminifera from the upper part of tuff chalk from so-called Bunde Beds. He referred the Bunde Beds (HOFKER'S „R" Zone) to Middle Eocene. In 1947, however, TEN DAM stated, as earlier suggested by MARIE (1945), that there is a similarity between the foraminiferal fauna of the French, Belgian and Dutch Montian.

The present authors, who had at their disposal numerous samples from the uppermost Cretaceous and lowermost Tertiary of Limburg Province (Vroenhoven, Geulhem, Bunde), found there numerous boreal and subtropical foraminiferal species; among them all the subtropical species present in the Montian of the Pamiętowo boring and in the samples from the Mons Basin (see list on p. 26). An analysis of the vertical distribution of foraminifers in the lowermost Tertiary of Limburg, undertaken by the present authors, showed that the number of subtropical species and representatives increase towards the top of the sections. A similar situation is found in North Poland (Pamiętowo boring), however in Limburg the warm sea transgressed already in Upper Maastrichtian which accounts for the single specimens of warm-water Foraminifera found there, e.g. *Rotalia trochidiformis* LAM., *R. saxorum* D'ORB. and *Pararotalia tuberculifera* (REUSS). The influence of meridional sea was not felt in North Poland before the Montian, therefore the warm-water foraminiferal species are lacking in older layers.

GERMANY

The lowermost Tertiary of Germany is, so far, little known. The Paleocene of NW Germany was described in very general terms by STAESCHE and HILTERMANN (1940) and divided by them into Lower and Upper Paleocene. The determination of the not numerous Foraminifera, listed and partly figured by these authors, is rather provisional. Judging from the not very clear illustrations, there are, besides the boreal type Foraminifera assemblage, a few warm-water foraminiferal species. A more uniform foraminiferal Paleocene assemblage from NW Germany (Krefeld region) has been described by INDANS (1965). Among the species given by INDANS, the following are in common with the Paleocene of NW Germany, lowermost Tertiary of the Meridional Province and North Poland: *Textularia plummerae* (LALICKER), *Anomalina grosserugosa* (GÜMBEL) (recte *A. danica* BROTZ.), *Eponides gratus* (REUSS) (recte *E. toulmini* BROTZ.), *Discorbis corrugata* (CUSH. & BERM.) (recte *Rotorbinella montiana* n. sp.), *Rotalia saxorum* D'ORB., *Coleites reticulosus* (PLUM.), *Rotalia trochidiformis* (LAM.), *Marssonella keijzeri* VAN BEL. [(recte *Vacuovalvulina keijzeri* (VAN BEL.)], *Elphidiella prima* (TEN DAM).

In almost all the Meridional Province, the Montian beds are covered by lagoonar sediments, containing a boreal type of Foraminifera and are usually correlated to English Thanetian. The foraminifers of these sediments, similar to that of Danish-Swedish Paleocene (Selandian), have been presented in a previous part of this paper.

THE STRATIGRAPHY OF THE LOWERMOST TERTIARY IN EUROPE

(Table 3)

In the previous part of this paper, when the lowermost Tertiary in Europe was being analysed, attention was concentrated mainly on the differences in the ecological conditions in Europe in Lower Tertiary and, connected with this, the differentiation of foraminiferal micro-

fauna, while the stratigraphy of this period in Europe was treated only in general terms. This was because the problem of the stratigraphy of lowermost Tertiary, just as that of the Cretaceous-Tertiary boundary, has not, up to now, been definitely resolved. Therefore particular, local horizons were assigned to different stratigraphical units. Especially controversial is the stratigraphical position of the Danian and the correlation of local Tertiary horizons in the area in question.

The Danian stage was established by DESOR (1846) who considered the limestone from Fakse in Zealand as typical of the Danian, comparing it to the limestone from Laversine in France, i.e. the „Calcaire pisolithique" of the Paris Basin. However, the results of further investigations on the „Calcaire pisolithique" of France showed it to be of the same age as „Calcaire de Mons" from Belgium, i.e. the stratotype of Montian (CORNET & BRIART, 1865). As a result, the typical section of Danian was regionally restricted to the territory of Denmark, being localised there in Fakse in an old quarry on land, where, as it later appeared, only Middle Danian limestone occurred. Borings in Faxe show the Lower Danian on top of the Maastrichtian as well. The typical section was completed by shore exposures at Stevns Klint representing Lower Danian, and further extended by outcropping in the neighbouring region of Sweden (Scania), where, in addition to Lower and Middle Danian, the Upper Danian is also represented. Upper Danian is present also in East Zealand, Copenhagen, Funen and Yutland. TROELSEN (1956) and BROTZEN (1956) (*fide* BROTZEN, 1959) designated the above mentioned exposures of East Zealand, together with those in Scania, as a type-region, representing a complete Danian profile from the lowermost to uppermost inclusive.

In contrast to the original stratigraphical position of the Danian, defined as uppermost Cretaceous by DESOR (1846), DE GROSSOUVRE (1897) assigned it to the Tertiary as its lowermost horizon. However, it appeared that much earlier than either DE GROSSOUVRE or DESOR, the *Cerithium* limestone of Stevns Klint and Bryozoan limestone with Coral limestone from Fakse were described by FORCHHAMMER (1825), on the base of the molluscs fauna compared with „Calcaire pisolithique" from the Paris Basin, and assigned by him to the Tertiary. Next to accept Tertiary age for the Danian was BRÜNNICH NIELSEN (1920), who moreover included Danian into the Paleocene, ROSENKRANTZ (1920) and HARDER (1922); this view being held up to the well known paper by RAVN (1925), the latter placing it back again into the Cretaceous.

Up to now, the stratigraphical position of the Danian is controversial. In spite of many works on this subject, the Danian is still considered by some authors as belonging to the Cretaceous, while others assign it to the Tertiary. At present, in Denmark the prevailing opinion inclines towards the Tertiary. On the other hand, in the neighbouring territory of Sweden, the traditional view is still held, i.e. the Danian is assigned to Cretaceous (BROTZEN, 1959; see also Lex. Stratigr. Intern., I, Europe, 2, p. 87, Mexico). BROTZEN mentioned certain differences between the Upper Danian microfaunal assemblage and that from the Middle Danian. He noted that the newly appearing microfauna of Upper Danian had already the character of Tertiary. An analogous view was lately given by BANG (pers. comm.) about the appearance of Paleocene foraminiferal assemblages (Selandian) in the uppermost Danian sediments in Denmark. The problem of whether the Danian should be assigned to the Cretaceous or Tertiary, was also recently discussed by BERGGREN (1964).

Up to now, there is no monographical elaboration of the Foraminifera either from the stratotype of the Danian in Denmark or from the Danian in Sweden (Scania), i.e. from the type-region, with the exception of BROTZEN'S remarks (1948, 1959), TROELSEN'S (1957) and BANG'S remarks (1960, *fide* RASMUSSEN, and 1962). A more complete list of Foraminifera from the Danian of Denmark, with illustrations and remarks, was given by HOFKER (1966). The

TABLE 3

DIAGRAMMATIC CORRELATION OF THE MOST IMPORTANT SECTIONS OF THE LOWERMOST TERTIARY IN MIDDLE EUROPE

AGE		ENGLAND (Kent) (HAYNES, 1954)	FRANCE (Paris Basin) (MARIE, 1937-64, ROUVILLOIS, 1960, DAMOTTE, 1964)	BELGIUM (Mons Basin) (MARLIÈRE, 1957-62, HOFKER, 1966, POŻARYSKA, 1966)	BELGIUM-HOLLAND (Limburg) (VAN BELLEN, 1946, MEIJER 1959, DEROO, 1966, HOFKER, 1966)	POLAND (Carpathians excluded) (BROTZEN & POŻARYSKA, 1961, POŻARYSKA, 1965, POŻARYSKA & SZCZECHURA, present paper)	DENMARK (Zealand) (ROSENKRANTZ, 1924-60, BROTZEN, 1948, BANG, 1960)	SWEDEN (Scania) (BROTZEN, 1948, 1959)	U. S. S. R. (Russian Platform) (GRIGELIS, 1960, KAPTARENKO-ČERNOUSOVA, 1963, VASILENKO, 1950, MOROZOVA, 1965-66, LEONOV, 1961)
PALEOCENE	THANETIAN	Woolwich and Reading Beds Thanet Beds (Thanet s.s.) *)	Thanet Beds sand limestone	Freshwater sand with lignite, Heersian limestone and sand	HOFKER's S Zone	Missing	„Kerteminde marl"	In erratic blocks known as „Maglehem boulders"	Upper Tacinskij horizon; siliceous marl, silt, and Syzranskij horizon; opoka and sandstone
	MONTIAN		„Calcaire pisolithique"	Lacustrine and lagoonar Montian = HOFKER's S Zone Mons limestone „Calcaire de Mons" (Montian s.s.) Compact limestone	Bunde Beds HOFKER's R Zone Tuff chalk	Pamiętowo Beds detritic sandy limestone „tuffeau" type	Selandian s.s. = Lellinge greensand (Paleocene of Copenhagen)	Selandian s.s. = Klagshamn sand and clay	Kanevskij horizon; sandy glauconitic silt Belogrodny and Berezovskij horizons; marly sandstone, Obshchij syrt; Tziganovskij horizon; silt, marl, sandstone
		Missing	„de Vigny" reef limestone	?	HOFKER's P-Q Zones	Pulawy Beds so-called „siwak"	Phosphoritic conglomerate	Phosphoritic conglomerate	Limestone (thin series)
	DANIAN		Missing	Ciply limestone „Tuffeau de Ciply"		Sochaczew Beds marly glauconitic sand	Coccolithic limestone Danian s.s. = Coral and bryozoan limestone Bryozoan limestone Cerithium limestone Fish clay	Coral limestone Bryozoan limestone	
CRETACEOUS	UPPER MAASTRICHTIAN	Chalk	Missing	Conglomerate „Poudingue de la Malogne" „Tuffeau St. Symphorien"	Tuffeau glauconitic = HOFKER's N („Me") Zone Tuffeau not glauconitic „Md" = HOFKER's L-M Zones	Żyrzyn Beds Siliceous marl so-called „opoka"	White chalk (Stevnsian)	White chalk (Stevnsian)	Chalk

*) · · · · = unconformity or hiatus.

latter author referred the Danish Danian to Cretaceous, including it to the Dano-Maastrichtian. Earlier HOFKER (1960, p. 53) based the correlation of the Danian of Denmark with the uppermost Cretaceous of Limburg Province on the evolution of pores in tests of several species from the Maastrichtian and Danian. This theory, however, was not supported by any micropalaeontologist working on this problem.

In the present writers' opinion, the appearance in the Danian of Denmark and Sweden of foraminiferal assemblages characteristic for the early Tertiary (foraminiferal species cited by BROTZEN (1959, p. 23) and HOFKER (1966, pp. 294—304)), proves that the Scandinavian Danian already belongs to the Tertiary. The not numerous Cretaceous species present in the Danian sediments of Scandinavia could be considered, as in Poland, as being reworked, or as disappearing Cretaceous relicts in the lowermost Tertiary. This last phenomenon may result from the fact that in the type-region, the Danian deposits are developed in facies somewhat similar to the underlying Cretaceous. Possibly the conditions in the Danian sea were identical or very close to those existing during the late Cretaceous, thanks to which the Cretaceous fauna had a better chance of continuing into the Danian in this region, than in other, more eastern regions. At the end of Maastrichtian, true belemnites (*Belemnella casimirovensis*, in the area under discussion), ammonites (*Hoploscaphites constrictus vulgaris*, ibidem) and inoceramids (*Inoceramus tegulatus*, ibidem) became extinct, in spite of the fact that the ecological conditions probably remained stable. The lack of micro-index forms in the Danian makes it difficult to correlate on a large area. The stratigraphy of the Danian beds of Denmark and Sweden (Scania), based on *Tylocidaris* remains, could not be applied in other regions, because of the nearly total lack of these forms of echinids and the type of facies with which this particular fauna is connected.

Danian beds in Denmark and Sweden are covered by so-called Selandian beds. The Selandian stratotype is described by ROSENKRANTZ (1924) from Lellinge in Zealand, south of Copenhagen. It represents strongly glauconitic, weakly cemented calcareous sand, lying directly on white Danian limestone. ROSENKRANTZ (1924—1960) assigned it, together with Danian, to the Paleocene, i.e. within the frame of Tertiary. In the light of recent investigations, this has been fully confirmed. BROTZEN (1948), describing foraminiferal microfauna from the Selandian of Sweden (Scania), referred it also to the Lower Paleocene.

The most recent studies in Poland (POŻARYSKI & POŻARYSKA, 1960; POŻARYSKA, 1965), show that the Polish Danian in the Lowlands is confined to a very restricted area and occurs mainly as remnants. All those places where the Polish Danian and Montian do not vary facially, are grouped along a line running from NW to SE Poland. This line is an axis of the marginal synclinorium. These sediments are preserved mainly in the Middle Vistula Valley, in the vicinity of Puławy (Bochotnica and Nasiłów).

Danian sediments in Poland are very strongly differentiated facially. In Poland, as on the whole eastern European Platform, terrigenic type of sediments predominate, such as: sand, sandstone, marl, calcareous gaize with glauconite and so on. The Danian sediments in the Polish Lowlands are usually not of great thickness, from a few to about twenty metres. In many places they are completely eroded, occurring only as remnants. Greater thickness is found only in eastern Pomerania, i.e. the north province of Poland.

The foraminiferal assemblage in the Danian sediments of Poland differs from that occurring in the underlying beds of Maastrichtian age (POŻARYSKA, 1952, 1965). In addition to the not numerous Cretaceous foraminiferal species occurring in the Danian, where they are rather reworked, the majority of species appearing in the Danian are continued into the above lying layers of Montian age. This is why the Danian in Poland is considered as definitely of Tertiary

age (POŻARYSKA, 1965) and placed into Paleocene (POŻARYSKA, 1966). Because of the absence of index forms characteristic exclusively for Danian, assignment of the Danian to Paleocene is based on a negative premise, i.e. on the lack of certain elements characteristic for the higher lying deposits of Montian age. The ostracods examined by SZCZECHURA (1965) did not permit differentiating the Danian from the Montian so as to establish the Danian as a separate stratigraphical unit. They support, however, the position of the Cretaceous-Tertiary boundary, as lying between Maastrichtian and Danian, which was previously stated on the base of many animal groups, and finally on the base of Foraminifera.

Several Maastrichtian macrofaunal elements stated in Poland at the base of the Danian sediments or occasionally in Montian in places where the Danian is completely eroded, are undoubtedly reworked. This supports the supposition that Cretaceous microfauna in lowermost Tertiary deposits can also be reworked.

In Poland, all the foraminiferal assemblage passes from the Danian into the Montian sediments, which as suggested by the present authors, correspond in age to those of the Selandian in Denmark and Sweden. The development of Montian sediments in Poland is analogous to that of the Selandian sediments from Denmark and Scania, all containing analogous assemblages of foraminiferal microfauna.

A correlation of lowermost Tertiary sediments of Denmark and Sweden, i.e. Danian and Selandian sediments, with those of Poland does not present any special difficulties. In the U.S.S.R., where the Danian is included by several authors to Tertiary (among others KELLER, 1956; BYKOVA, 1956; NAJDIN, 1960; POSLAVSKAJA & MOSKVIN, 1960; CHALILOV, 1948; MOROZOVA, 1960), the Danian sediments, especially those in the European part of U.S.S.R., differ from the Cretaceous ones as well as from the higher lying Paleocene sediments known as Selandian or sometimes as Thanetian. The lowermost Tertiary sections of the European part of U.S.S.R. are easy, however, to compare with analogous series from Poland and Scandinavia.

Whereas, there is no great difficulty in correlating lowermost Tertiary beds of Poland with those of North and Eastern Europe, some difficulties arise when comparing the uppermost Cretaceous and lowermost Tertiary beds of Poland with those of Western Europe. This results mainly from the fact that the facies of sediments of this age in Western Europe are very varying. Both in the Limburg Province and the Mons Basin, the Lower Tertiary sediments (Danian and Montian) are developed in the form of pure zoogenic limestone of the organo-detritic series called „tuffeau". Foraminiferal microfauna found in these calcareous sediments is decidedly meridional, in contrast to that contained in sediments of the same age in Denmark, Sweden and U.S.S.R., where it is definitely boreal.

The presence of the Danian in the Mons region and in Limburg is difficult to prove on the base of Foraminifera. Many authors, especially in Belgium and Holland, have concerned themselves with this problem. Recently the problem was investigated in more detail by MARLIÈRE (1957, 1958, 1962), WIENBERG RASMUSSEN (1962), HOFKER (1937—1966), MARIE (1964), DEROO (1966) and others.

The Danian in the Mons Basin, i.e. the „Tuffeau de Ciply" series, was assigned to Danian by VINCENT (1930) and later by WIENBERG RASMUSSEN (1962) and DEROO (1966). On the base of MARLIÈRE's supposition in an unpublished supplementing plate to his communication (1962), the „Tuffeau de Ciply" series was referred by him to Danian. However, in the text itself he rather implies that the age of the „Tuffeau de Ciply" is the same as the above lying „Calcaire de Mons", the latter being the stratotype of Montian. ROSENKRANTZ (1964) considered the „Calcaire Grossier de Mons" as Upper Danian. MARIE (1964) and HOFKER (1966) assigned

the „Tuffeau de Ciply" series to Montian, and not to Danian. All the above mentioned authors except WIENBERG RASMUSSEN, are inclined to consider the „Tuffeau de Ciply" as representing Tertiary, as was suggested much earlier by RUTOT (1885) and VAN BROECK (1885).

The post-Maastrichtian sediments of Limburg Province are covered by a thin series, the so-called „Tuffeau glauconieux" („Me" local horizon), occurring on a hard ground layer of Upper Maastrichtian age („Md" local horizon); they are present in Belgium in the Albert Canal (Vroenhoven) as well as in neighbouring Holland (Geulhem). According to MEIJER (1959), WIENBERG RASMUSSEN (1962) and DEROO (1966), „Tuffeau glauconieux" is of Danian age and, in the opinion of the last two authors, corresponds to the „Tuffeau de Ciply" series from the Mons Basin, as well as to the Danian from Denmark. Recently HOFKER (1966), who also compared this series to the Danish Danian, assigned this local „Me" horizon to the so-called Dano-Maastrichtian series, within Cretaceous. According to this author, only „P" zone should be considered as the beginning of the Tertiary period.

In the present writers' opinion, the Cretaceous-Tertiary boundary in the South Limburg area should be placed between HOFKER's local „M" (upper part of „Md" horizon) and „N" („Me" horizon) zones, on the base of the distribution of foraminiferal species presented by HOFKER (1966, table 1). Other authors, e.g. MEIJER (1959), WIENBERG RASMUSSEN (1962) and DEROO (1966), are of the same opinion as the present authors.

By comparing the microfauna of Denmark and Sweden (Scania) with that of Western Europe on the one hand, and Eastern Europe on the other, the present writers are unable to distinguish the Danian in Western Europe. The foraminiferal microfauna characteristic for the Montian sediments („Calcaire de Mons") occurs also in the below lying „Tuffeau de Ciply" series, as is shown by some authors (among them POŻARYSKA, 1966). A few Montian species appear as early as in the Upper Maastrichtian („Ma" horizon) in Limburg Province. In spite of this the „Tuffeau de Ciply" series in the Mons Basin and the corresponding „Me" horizon in Limburg Province are only tentatively assigned to the Danian by the present writers, supporting the view of WIENBERG RASMUSSEN and DEROO.

It is proposed in this paper, that the position of the Danian in the general stratigraphical schedule should, together with the Montian, be considered as Paleocene within the frame of lowermost Tertiary. In the included stratigraphical table, the Danian is shown under the Montian, to which are referred deposits more or less of the same age as Selandian. Because the Danian differs greatly in its foraminiferal assemblage from the Maastrichtian, while varying only slightly from the upper lying Montian, and because in Western Europe (the Carpathians and Alps excluded) the Danian presence may be problematic, it is a question if the Danian does merit to be ranged as a separate stage.

CONCLUSIONS

(Text-figs. 3, 4; Tables 2, 3)

From the investigations of the lowermost Tertiary Foraminifera, which have been carried out up to now in Poland (the Carpathians excluded), and their comparison with assemblages of Foraminifera of the same age from other countries, the following palaeogeographic picture appears.

In the Lower Paleocene of Europe, including Denmark, Sweden (Scania), Poland and the European part of U.S.S.R., there was an extensive boreal sea basin strongly under the

influence of the North Atlantic Basin. This boreal basin did not represent a very extensive sea, but was composed of several elongated, narrow, intercontinental basins, having the character of narrow straits between the surrounding continents, which supplied the sea with rich terrigenic material. This elongated boreal basin consisted of several individual sea basins, the main being the Donetz Basin, Danish-Swedish Basin, Polish Basin, Crimean Basin and Lower Volgian depression. The character of its sedimentation varied according to the changes in the line of the sea shore. The Laramic synorogeny from the Cretaceous-Tertiary boundary strongly influenced the character of this boreal, northern province as applied to its size and to the character of its sediments.

In this Boreal Province the strongest influence of the Laramic synorogeny was felt in the area of Poland, where it gave rise to the upheaving of the Pomeranian-Kuiavian anticlinorium in the lowermost Tertiary, i.e. in the Danian, which resulted in an inevitable regression of a shrinking Upper Cretaceous sea from the territory of Poland. On the other hand, on the Danish-Swedish territory, compensatory movements caused, in Danian, a subsidence of the bottom of this sea basin, a consequence of this being an increase of the sedimentation, as well as a continuence of the zoogenic Cretaceous sedimentation, which existed up to then.

An analogical situation existed in the southern area of the Russian Platform, especially in the part adjoining the Crimean peninsula, where in the lowermost Tertiary, i.e. „Dano-Montian", a calcaro-zoogenic sedimentation, very similar in character to Cretaceous, was continued just as in Denmark and Sweden during Danian.

The foraminiferal microfauna, characteristic for Lower Tertiary sediments of the Boreal Province, is of benthonic character, with very meagre participation of planktonic forms (grobigerines only) and without meridional elements. Only on the periphery of the Boreal Province, especially the transition zone in the southern basins with geosyncline, among others, in the Crimea, meridional elements appear (ŠUCKAJA, 1958), penetrating from the neighbouring geosynclinal sea. On the other hand, a meridional province existed in the area of Western Europe in lowermost Tertiary. It was probably connected at that time with the Atlantic Ocean and across France with the Tethys Ocean. This province, which can be called the Meridional (non Mediterranean) Province, occupied a comparatively small area of Europe, much smaller than the Boreal Province. It extended over the eastern part of the Paris Basin and Mons Basin, which at that time was a small bay of the former, further east being narrowly joined to the Limburg Basin of Belgium-Holland and continuing somewhat eastwards to the territory of the Lower Rhine in Western Germany.

The predominating type of sediments in the Meridional (non Mediterranean) Province was calcaro-detritic of the type „tuffeau" zoogenic sediments, similar to the reef sediments of a shallow, warmer sea. This type of zoogenic-detritic limestone was being constantly deposited in this basin right from the beginning of Upper Maastrichtian up to Montian. The Laramic synorogenic movements in this area were much weaker, having only an insignificant influence on the type of sedimentation in comparison with its influence in Central and Eastern Europe.

Foraminiferal fauna occurring in the lowermost Tertiary of the Meridional (non Mediterranean) Province, consists mostly of benthonic forms, being poor in planktonic forms, just as in the Boreal Province, however, here meridional elements predominate (see Table 2). The presence of boreal forms in the Dano-Montian foraminiferal assemblage of the Meridional (non Mediterranean) Province, as well as the presence of subtropical foraminifers in the marginal western region of the Boreal Province in somewhat younger Montian is evidence of the existence, in those times, of some sea connection between these provinces, which made

the exchange of microfauna possible. As Lower Tertiary sediments have so far not been found between the above mentioned provinces, it is difficult to define exactly the route of the connection, however, an analysis of the regional and stratigraphical distribution of Foraminifera gives some idea as to the general route and sequence of faunistic migration.

Microfaunistic interchange, which took place in the lowermost Tertiary between East and West, of Europe, proves that the ecological conditions of the Boreal Province were unfavourable then for meridional fauna. Only in the younger Montian was the climate more favourable, the result of the warming of the climate of the western periphery of the boreal basin. This permitted a two-directional interchange of fauna, i.e. from West to East, as well as from East to West. POŻARYSKI and POŻARYSKA as early as in 1959 indicated that warm-water Tertiary foraminiferal microfauna appeared earlier in Western Europe than in Eastern Europe, due to the more favourable ecological conditions. This applied, however, to somewhat older microfauna, i.e. Tertiary forms appearing in the Belgian-Dutch Limburg already in the Upper Maastrichtian. Present investigations show that the earlier appearance of warm-water microfauna in Western Europe was not confined to Upper Cretaceous, but continued also in the lowermost Tertiary.

Analysing the Pamiętowo section and correlating it with other sections from Central Poland, it is necessary to state that the main migration of subtropical foraminifers in North Poland took place in the younger Montian, when older Montian sediments of the Selandian type, especially in Central Poland, were already deposited. On the base of present data it seems that the migration from the West to East took place through Germany, from where subtropical Montian foraminifers were mentioned (INDANS, 1965) and that Poland represents the most eastern area under meridional (although very weak) influence.

In the opinion of the present authors, the Dano-Montian sediments of the Meridional (non Mediterranean) Province should be laterally correlated to the Dano-Selandian sediments of Boreal Province, where the Montian s.s. is definitely the age equivalent of the Selandian s.s. with its upper extension above the Selandian. This superposition can be observed especially in North Poland and to a lesser extend in Limburg Province, where the influence of the Paleocene tropical sea was decidedly younger than of boreal. A similar opinion of the Montian-Selandian relation is held by NAKKADY (1957). The present investigations, showing the predominance of Selandian microfauna below that of subtropical Montian microfauna, supports NAKKADY'S supposition that „the Swedish-Danish Lower Paleocene is very similar to that of the type Upper Danian, would mean an earlier Tertiary transgression depositing the Scandinavian Lower Paleocene (Selandian), before the type Montian, with a slight vertical extension to the base of the Thanetian" (1957, p. 433).

HOFKER (1956—1966) also is in agreement with the above view of the superposition of the discussed stratigraphic units of the lowermost Tertiary. According to the latter author, the Scandinavian Paleocene, as identified by BROTZEN (1948) in South Limburg, lies on the uppermost Maastrichtian (local horizon „Md") sediments, which are covered by „Tuffeau de Ciply" and „Calcaire de Mons", i.e. typical Montian layers, thus considering Selandian s.s. as older than Montian s.s. On the other hand, an opposing view is held by ROSENKRANTZ (1963, MS) and BERGGREN (1962—1965).

The Paleocene sedimentation in the mainland of Europe, the geosynclinal region excluding, finished just above the uppermost Montian in several countries. Then fresh-water, lagoonar Paleocene (Thanetian) sediments appear. These are developed in France (ROUVILLOIS, 1960), Belgium and Holland (HOFKER in 1966 described from there the so-called „S" Zone, referred by him to Thanetian). It is probable that the Kerteminde marl of Denmark was also deposited

at that time. This was suggested by BROTZEN (1959) who stated that sediments, rich in Foraminifera similar to that occurring in Middle and Upper Paleocene sediments of England and Western Europe, occur in the Selandian sediments of Denmark.

The Tertiary sedimentation in England began with the transgression of the boreal Thanetian sea. Its sedimentation, as well as the foraminiferal fauna it contains, can be compared to that of Scandinavian Selandian. In the opinion of the present authors, the foraminiferal assemblage characteristic of English Thanetian, and its equivalent on the mainland of Europe, are a continuation of the Scandinavian Selandian foraminiferal microfauna. HOFKER (1966, p. 327) considered that the „resemblance between Thanetian and Selandian is very meagre". HAYNES (1958), BERGGREN (1964) and ROSENKRANTZ (1924), however, suggested that Thanetian corresponds in age to Selandian.

Due to the absence of Paleocene layers younger than Montian in the Polish Lowlands, the present authors were unable to consider the upper boundary of Paleocene. This is also why the present authors were not concerned with the Upper Paleocene and did not analyse substages younger than Thanetian. The Thanetian, although unknown in Poland, is discussed in the present paper on account of its similarity to Selandian.

The present authors assigned the Danian and Montian to Paleocene, considering the Montian s. l. as at least partly an equivalent of Montian s.s. and Selandian s.s., this former, however, with its upper extension above the Selandian. As already mentioned, HOFKER (1966) as well as other authors, e.g. BROTZEN (1959), V. P. VASILENKO (1961), JANŠIN (1960) and others consider the Paleocene as a synonym from which the Tertiary is dated, while assigning Danian to the Cretaceous.

SYSTEMATIC PART

Family TEXTULARIIDAE EHRENBERG, 1838

Genus **SPIROPLECTAMMINA** CUSHMAN, 1927

Spiroplectammina wilcoxensis CUSHMAN & PONTON, 1932

1932. *Spiroplectammina wilcoxensis* CUSHMAN & PONTON; J.A. CUSHMAN & G.M. PONTON, An Eocene foraminiferal fauna..., p. 51, Pl. 7, fig. 1.

1965. *Spiroplectammina wilcoxensis* CUSHMAN & PONTON; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 50, Pl. 3, fig. 1 *(here additional synonymy included)*.

Material. — About 20 specimens, most of them damaged on the apertural end.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965, p. 50).

Occurrence. — Not common in the Paleocene (Montian only) of Polish Lowlands and the Pamiętowo boring. Present in the Paleocene (Selandian) of Sweden, Denmark and in the Eocene of America (U.S.A.).

Genus **TEXTULARIA** DEFRANCE, *in* DE BLAINVILLE, 1824

Textularia plummerae arkansasana CUSHMAN, 1951

1951. *Textularia plummerae* LALICKER var. *arkansasana* CUSHMAN; J. A. CUSHMAN, Paleocene Foraminifera..., p. 7, Pl. 2, figs. 4-5.

1965. *Textularia plummerae* (LALICKER); J. INDANS, Mikrofaunistische Normalprofil..., Pl. 1, fig. 4.

1965. *Textularia plummerae arkansasana* CUSHMAN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 51, Pl.1, fig. 6*a-b (here additional synonymy included)*.

Material. — Few specimens, damaged on both ends.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland rare in the Paleocene, i.e. Danian and Montian (Selandian only) of Polish Lowlands and the Pamiętowo boring. Present in the lowermost Tertiary of Denmark, Holland, Belgium, Germany (Krefeld region) and in America (U.S.A.), where it occurs in the Paleocene (Midway), as well as in somewhat younger strata.

Family ATAXOPHRAGMIIDAE SCHWAGER, 1877

Genus **ARENOBULIMINA** CUSHMAN, 1927

Arenobulimina cuskleyae JENNINGS, 1936

(Text-fig. 5)

1936. *Arenobulimina cuskleyae* JENNINGS; P. H. JENNINGS, A microfauna..., p. 13, Pl. 1, fig. 8.
1965. *Arenobulimina cuskleyae* JENNINGS; K. POŻARYSKA, Foraminifera and biostratigraphy.... p. 56, Pl. 4, fig. 8 *(here additional synonymy included)*.

Material. — About 30 specimens, usually well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

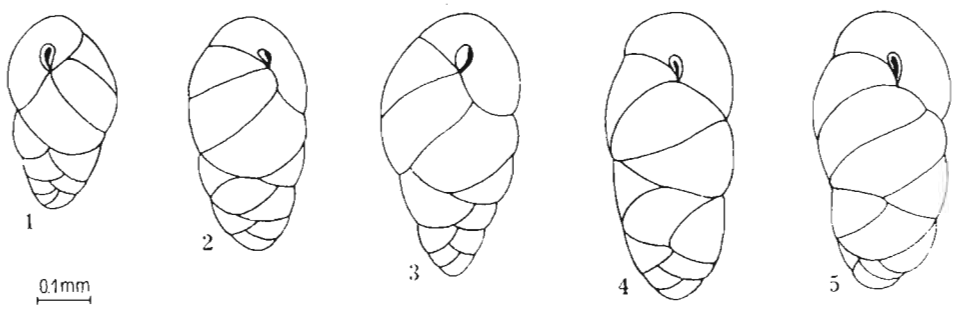


Fig. 5
Individual variation of *Arenobulimina cuskleyae* JENNINGS; Pamiętowo boring, 243 m, Montian.

Variation concerns mainly the size and shape of tests. As is shown above (Text-fig. 5), there are probably megalospheric and microspheric forms.

Occurrence. — In Poland not very common in the Paleocene, i.e. Danian and Montian in the Pamiętowo, Sochaczew and Boryszew borings. Common in the Swedish and Danish Paleocene (Selandian) and in the Paleocene (Midway) of America (U.S.A.).

Genus **VACUOVALVULINA** HOFKER, 1966

Vacuovalvulina keijzeri (VAN BELLEN, 1946)

(Pl. III, figs. 9-12)

1946. *Marssonella keijzeri* VAN BELLEN; R. C. VAN BELLEN, Foraminifera from the Middle Eocene..., p. 30, Pl. 2, figs. 3-5.
1964. *Conicovalvulina keijzeri* (VAN BELLEN); P. MARIE, Les faciès du Montien..., p. 1, fig. 3*a-b*.
1966. *Vacuovalvulina keyzeri* (VAN BELLEN); J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 250, Pl. 49, figs. 1-7.

Material. — About 20 specimens, rather well preserved.
Dimensions of two specimens (in mm):

	F. IX/15	F. IX/12
Diameter	0·32	0·28
Height	0·18	0·18

Description. — Test conical, slightly concave on ventral side, more elevated or less on dorsal side, rounded in outline. Chambers about 3 in number in the only visible whorl on the ventral side, rapidly increasing in size as added, low and crescent on dorsal side. A distinct umbilical hollow on the ventral side, covered partially by a large valvular, slightly serrate tooth. Sutures flush with surface or slightly depressed, nearly invisible on ventral side, dorsally raised, thickened, strongly curved. Surface except the ventral side fairly porous, somewhat rough. Aperture large, irregular, under the valvular tooth-lip-like, at the base of the last formed chamber.

Variation insignificant; it concerns mainly the size and shape of test. Specimens are elevated dorsally in different degree, with more developed or less developed valvular tooth (see Pl. III, figs. 9—12).

Remarks. — Specimen described from Poland as *Vacuovalvulina keijzeri* represent undoubtedly the species described by VAN BELLEN (1946) as *Marssonella keijzeri* from the Eocene (recte Montian) of Holland and cited and illustrated later by MARIE (1964) as *Conicovalvulina keijzeri* from Calcaire Pisolithique (Montian) of France, and by HOFKER (1966) as *Vacuovalvulina keijzeri* from the Paleocene of Holland and Belgium. Our specimens, however, are generally less conical dorsally and definitely smaller.

Occurrence. — In Poland, not common in the Paleocene (Montian; in true Montian it is most common) in Pamiętowo boring only. Known to be common in the Paleocene (Montian) of France (Calcaire Pisolithique of Paris Basin), Belgium (Tuffeau de Ciply and Calcaire de Mons, „Puits Artésien" in Mons) and Holland (Bunde).

Family LAGENIDAE CARPENTER, 1862

Genus **ASTACOLUS** DE MONTFORT, 1808

Astacolus arcuatus (PHILIPPI, 1843)

1843. *Marginulina arcuata* PHILIPPI; R. A. PHILIPPI, Beiträge zur Kenntnis..., p. 5, Pl. 1, fig. 28.
1965. *Astacolus arcuatus* (PHILIPPI); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 77, Pl. 10, fig. 6 a-b *(here additional synonymy included)*.

Material. — Some dozen specimens, in most cases well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation insignificant; it applies mainly to the size and shape of test; specimens almost round or elongated in the outline occur. They have moreover sutural ornamentation, sometimes more distinctly developed, sometimes less.

Occurrence. — In Poland, common in the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known to be common in the Paleocene of Denmark (Selandian).

Astacolus gryi BROTZEN, 1948

1948. *Astacolus gryi* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 44, Pl. 7, fig. 6 a-c.
1964. *Astacolus gryi* BROTZEN; K. POŻARYSKA, On some Foraminifera..., p. 542, Pl. 1, figs. 20, 21; Pl. 3, figs. 1-25.
1965. *Astacolus gryi* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 77, Pl. 10, fig. 1 a-b.

Material. — More than 30 specimens well preserved.

Dimensions, description, a detailed illustrated variation and remarks are given in POŻARYSKA'S papers (1964, 1965).

Occurrence. — In Poland not very common in the Paleocene, i.e. Danian and Montian of Polish Lowlands and the Pamiętowo boring. Present in the Paleocene (Selandian) of Denmark, Sweden and of U.S.S.R. (Russian Platform).

Astacolus paleocenicus BROTZEN, 1948

(Text-fig. 6)

1948. *Astacolus paleocenicus* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 43, Pl. 7, fig. 7 a-b; Text-fig. 8.
1965. *Astacolus paleocenicus* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 78, Pl. 10, fig. 9.

Material. — A dozen or so specimens, sometimes damaged.

Dimensions, description and remarks are given in POŻARYSKA'S paper (1965).

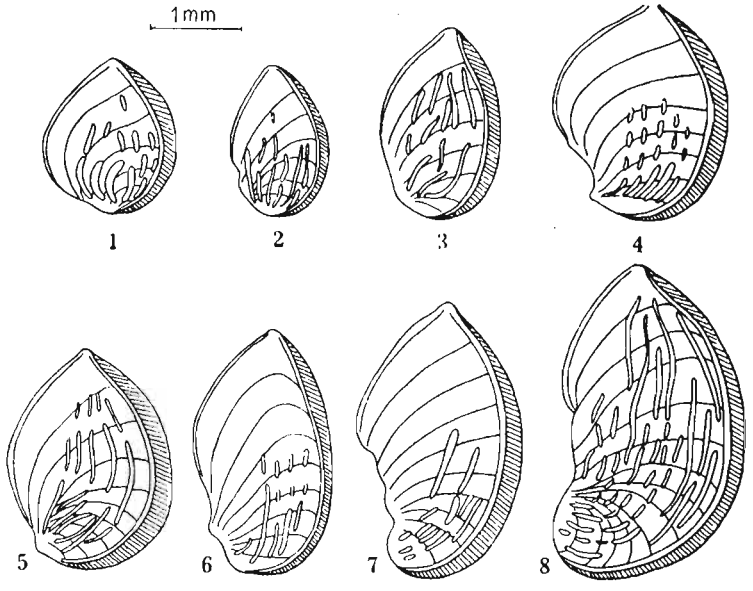


Fig. 6
Ontogeny and individual variation of *Astacolus paleocenicus* BROTZEN; Pamiętowo boring, 207 m, Montian.

Variation rather significant. There are differences in size, shape and ornamentation of tests. The tests can be slim, either elongated or short and broad. The ornamentation can occur all over the surface of the test, or can be find to its initial part, therefore the pattern differs. Both the size and ornamentation are independent of the ontogenetic development of test, as is shown on the figures above (see Text-fig. 6).

Occurrence. — In Poland common in the Paleocene (Montian) of Polish Lowlands and Pamiętowo boring, where is less common. Known to be common in the Paleocene (Selandian) of Sweden and Denmark. It appears as rare in the uppermost Danian.

Genus **FRONDICULARIA** DEFRANCE, *in* D'ORBIGNY, 1826

Frondicularia biformis MARSSON, 1878

1878. *Frondicularia biformis* MARSSON; T. MARSSON, Foraminifera der weissen Schreibkreide..., p. 137, Pl. 2, fig. 17*c-d*.
1965. *Frondicularia biformis* MARSSON; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 82, Pl. 11, fig. 1 *(here additional synonymy included)*.

Material. — Some dozen specimens well preserved.
Dimensions, description and variation are given in POŻARYSKA's papers (1957, 1965).

Remarks. — Within specimens from the Polish Montian there occur forms having a different stage of development as shown on illustrations in POŻARYSKA's paper (1957, p. 139, fig. 33*a-g*).

Occurrence. — In Poland common in the uppermost Cretaceous, rarely met in the Paleocene, i.e. Danian and Montian. Known as common from the Upper Cretaceous of Europe and America.

Genus **MARGINULINA** D'ORBIGNY, 1826

Marginulina costulata HOFKER, 1958

1951. *Marginulina* sp. *B*; J. A. CUSHMAN, Paleocene Foraminifera..., p. 18, Pl. 5, figs. 32-33.
1957. *Marginulina* cf. *armata* REUSS; K. POŻARYSKA, Lagenidae du Crétacé..., p. 105, Pl. 11, fig. 13.
1958. *Marginulina costulata* HOFKER; J. HOFKER, Foraminifera from the Cretaceous..., XXXIV, p. 66, Text-fig. 10*a-b*.
1965. *Marginulina costulata* HOFKER; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 68, Pl. 9, figs. 1, 2.

Material. — Some dozen specimens well preserved.
Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland, common in the Paleocene (Montian) of Polish Lowlands and Pamiętowo boring. Present in the Paleocene (Selandian) of Sweden and Denmark.

Genus **ROBULUS** DE MONTFORT, 1808

Robulus degolyeri (PLUMMER, 1926)

1926. *Cristellaria degolyeri* PLUMMER; H. J. PLUMMER, Foraminifera of the Midway..., p. 97, Pl. 7, fig. 7.
1964. *Robulus degolyeri* (PLUMMER); K. POŻARYSKA, On some Foraminifera..., p. 540, Pl. 1, fig. 22.
1965. *Robulus degolyeri* (PLUMMER); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 62, Pl. 7, fig. 4 *(here additional synonymy included)*.

Material. — About 30 specimens rather well preserved.
Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland not common in the Paleocene (Montian only) of Polish Lowlands and the Pamiętowo boring. Known to be common in the Paleocene (Midway) of America (U.S.A.).

Robulus rancocasensis OLSSON, 1960

(Text-fig. 7)

1960. *Robulus rancocasensis* OLSSON; K. R. OLSSON, Foraminifera of the latest..., p. 10, Pl. 2, figs. 5, 6.
1965. *Robulus rancocasensis* OLSSON; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 64, Pl. 7, figs. 3*a-b*, 5*a-c*.

Material. — Several hundred specimens well preserved.
Dimensions, description and remarks are given in POŻARYSKA'S paper (1965).

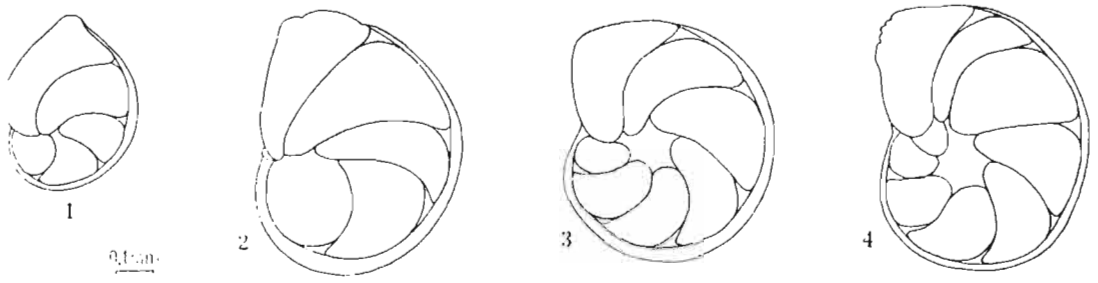


Fig. 7
Robulus rancocasensis OLSSON: *1*, *2* megalospheric forms, *3*, *4* microspheric forms; Pamiętowo boring, 228 m, Montian.

Variation insignificant; it concerns mainly the size and shape of the tests. Tests can be regularly rounded in outline or elongated at the apertural end. Microspheric and megalospheric forms occur (see Text-fig. 7).

Occurrence. — In Poland, very common in the Paleocene, i.e. in Danian and Montian. Common in the Paleocene, i.e. Danian and Selandian of Denmark and Sweden, and Paleocene (Midway) of America (U.S.A.).

Robulus turbinatus (PLUMMER, 1926)

1926. *Cristellaria turbinata* PLUMMER; H. J. PLUMMER, Foraminifera of the Midway..., p. 93, Pl. 7, fig. 4*a-b*.
1965. *Robulus turbinatus* (PLUMMER); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 64, Pl. 8, fig. 1*a-b (here additional synonymy included)*.

Material. — About 40 specimens, in most cases well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).
Variation completely insignificant.

Occurrence. — In Poland rather common in the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known as common in Paleocene, i.e. Danian of Denmark and Midway of America (U.S.A.).

Family POLYMORPHINIDAE D'ORBIGNY, 1839

Genus GLOBULINA D'ORBIGNY, *in* DE LA SAGRA, 1839

Globulina arenacea BROTZEN, 1948

1948. *Globulina arenacea* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 48, Text-pl. 10, fig. 3*a-d*.
1965. *Globulina arenacea* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 85, Pl. 22, fig. 5.

Material. — About 30 specimens well preserved.

Dimensions and description are included in POŻARYSKA's paper (1965).

Variation is mainly observed in the size and degree of tests ornamentation.

Occurrence. — In Poland, not common in Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known as not common in Paleocene (Selandian) of Sweden.

Globulina gibba gibba (D'ORBIGNY, 1826)

1826. *Globulina gibba* D'ORBIGNY; A. D'ORBIGNY, Ann. Sci. Nat., p. 266, modèles 63 (*fide* Cat. of Foram., ELLIS & MESSINA).
1960. *Globulina gibba* D'ORBIGNY; A. ROUVILLOIS, Le Thanétien..., p. 59, Pl. 1, fig. 8.
1965. *Globulina gibba* D'ORBIGNY; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 86, Pl. 13, fig. 3 *(here additional synonymy included)*.

Material. — Over one hundred specimens well preserved.

Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation concerns the size and shape of the test. Specimens can be more ovate or less, or rounded in outline.

Occurrence. — In Poland, common in Paleocene, i.e. Danian and Montian in all studied localities. Known as common in the Lower Tertiary strata of Europe and America.

Globulina gibba multistriata n. subsp.

(Pl. III, fig. 8)

unpubl. *Globulina gibba* v. *multistriata* MARIE; P. MARIE, Foraminifères du Calcaire Pisolithique..., (MS), Pl. 11, fig. 6.

Holotypus: Specimen presented on Pl. III, fig. 8 (F. IX/1).

Stratum typicum: Montian.

Locus typicus: Pamiętowo boring, depth 208·5 m (North Poland).

Derivatio nominis: Lat. *multistriata* = with many ribs, the name being suggested by P. MARIE (MS).

Material. — Several specimens well preserved.

Dimensions of an average specimen (in mm):

	F. IX/1
Width	0.33
Height	0·37

Description. — Test almost sphaerical, somewhat pointed on both ends, chambers few, 3—4 in number, sutures flush with surface, quite invisible, surface ornamented with numerous regular longitudinal ribs. Aperture terminal, radiate.

Variation indistinct, concerns mainly the shape of tests and number of surface ribs.

Remarks. — Our specimens in comparison with figured specimen of *Globulina gibba multistriata* described by MARIE (MS) from the Montian of Belgium, are generally less compressed at both ends, having less sharp ribs. Because of the variability of our specimens it seems possible that there may be more than one species.

Occurrence. — In Poland rare in Paleocene (Montian) of Pamiętowo boring only. Present in Montian (Calcaire de Mons) of Belgium, Holland and in France.

Globulina cf. **tuberculata** D'ORBIGNY, 1846

(Pl. III, fig. 6)

1846. *Globulina tuberculata* D'ORBIGNY; A. D'ORBIGNY, Foraminifères fossiles..., p. 230, Pl. 13, figs. 21-22.
1964. *Globulina tuberculata* D'ORBIGNY; J. HOFKER, Foraminifera from the Cretaceous..., LXXX, p. 117, fig. 13.

Material. — Several specimens well preserved.
Dimensions of an average specimen (in mm):

	F. IX/3
Width	0·40
Height	0·43

Description. — Test somewhat ovate in outline, more pointed at the apertural end, round at the base, chambers few, 3—4 in number, sutures and aperture not visible, surface covered by numerous, irregularly scattered, blunt and short knobs.

Variation not known because of the scarcity of material.

Remarks. — Our specimens seem to be very similar to those described by D'ORBIGNY from the Miocene of Vienna Basin, but D'ORBIGNY's figures are inadequate and too schematic to be taken into consideration. Specimens assigned to this species, described by HOFKER (1964) from the Paleocene of Holland (Curfs quarry), differ somewhat in comparison with those from Poland in ornamentation, being scarcely and more regularly tuberculated.

Occurrence. — In Poland rare in the Paleocene (Montian) in the Pamiętowo boring only. Present in the Miocene of Vienna Basin.

Globulina sp.

(Pl. III, fig. 7)

Material. — A few specimens well preserved.
Dimensions of an average specimen (in mm):

	F. IX/2
Width	0·33
Height	0·33

Description. — Test about spherical, compressed at both ends, chambers few, 3—4 in number, sutures nearly invisible, flush with surface. Surface covered by well developed interrupted ribs, thick and blunt, which here and there pass into single tubercles.

Variation not known because of the scarcity of material.

Remarks. — Our specimens are slightly similar to *Globulina gibba* var. *striata* EGGER, 1857, from the Miocene of Germany, differing however in having thicker and more regularly dispersed ribs on the surface of test.

Occurrence. — In Poland rare in the Paleocene (Montian) in the Pamiętowo boring only.

Genus **GUTTULINA** D'ORBIGNY, *in* DE LA SAGRA, 1839

Guttulina communis D'ORBIGNY, 1826

(Text-fig. 8)

1826. *Guttulina communis* D'ORBIGNY; A. D'ORBIGNY, Ann. Sci. Nat., no. 15, p. 266, Pl. 12, figs. 1-4 (*fide* Cat. of Foram., ELLIS & MESSINA).

1960. *Guttulina communis* D'ORBIGNY; A. ROUVILLOIS, Le Thanétien..., p. 58, Pl. 1, fig. 5*a-b*.
1965. *Guttulina communis* D'ORBIGNY; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 83, Pl. 12, fig. 1*a-b (here additional synonymy included)*.

Material. — Several hundred specimens well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation is mainly restricted to the size and shape of tests. Some examples are given below (see Text-fig. 8).

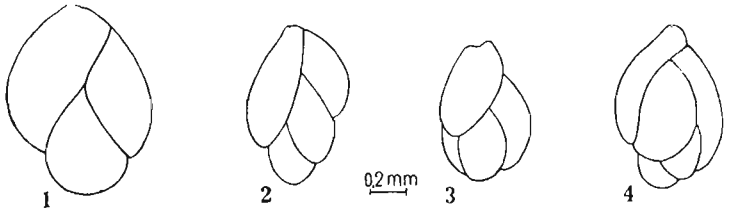


Fig. 8
Individual variation of *Guttulina communis* D'ORBIGNY; Pamiętowo boring, 241 m, Montian.

Occurrence. — In Poland very common in the uppermost Maastrichtian, and Paleocene, i.e. Danian and Montian in all studied localities of Polish Lowlands and in the Pamiętowo boring. Known as common in Lower Tertiary sediments in Europe.

Guttulina problema D'ORBIGNY, 1826

(Text-fig. 9)

1826. *Guttulina problema* D'ORBIGNY; A. D'ORBIGNY, Ann. Sci. Nat., no. 14, p. 26 (*fide* Cat. of Foram., ELLIS & MESSINA).
1960. *Guttulina problema* D'ORBIGNY; A. ROUVILLOIS, Le Thanétien..., p. 58, Pl. 1, fig. 6*a-b*.
1965. *Guttulina problema* D'ORBIGNY; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 84, Pl. 12, fig. 2*a-b (here additional synonymy included)*.

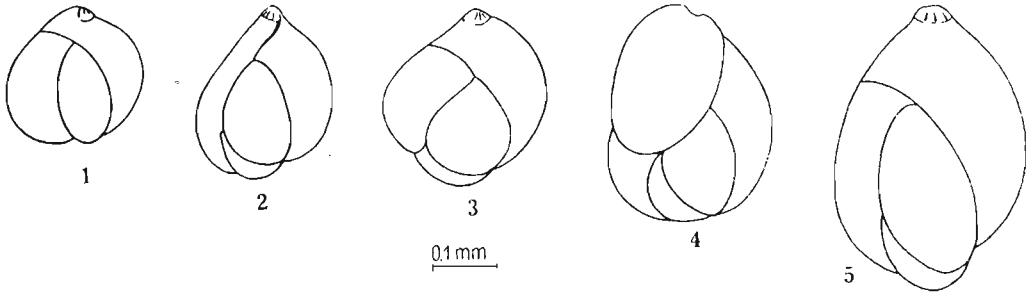


Fig. 9
Individual variation of *Guttulina problema* D'ORBIGNY; Pamiętowo boring, 231 m, Montian.

Material. — Over two hundred specimens well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation significant; it concerns the size and the shape of the test. Some specimens vary in the arrangement of chambers, which are inflated to different degrees (see Text-fig. 9).

Occurrence. — In Poland very common in the Paleocene, i.e. Danian and Montian in all studied samples from Polish Lowlands and the Pamiętowo boring. Known to be common from the Tertiary of Europe and America (U.S.A.).

Genus **PSEUDOPOLYMORPHINA** CUSHMAN & OZAWA, 1928

Pseudopolymorphina frondea (CUSHMAN, 1922)

1922. *Bolivina frondea* CUSHMAN; J. A. CUSHMAN, The Foraminifera of the Mint Spring..., p. 126, Pl. 29, fig. 3.
1951. *Polymorphina frondea* (CUSHMAN); J. A. CUSHMAN, Paleocene Foraminifera of the Gulf..., p. 35, Pl. 10, fig. 13.
1965. *Pseudopolymorphina frondea* (CUSHMAN); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 87, Pl. 12, figs. 5-6 *(here additional synonymy included)*.

Material. — Over 30 specimens well preserved.
Dimensions and description are given in POŻARYSKA's paper (1965).

Variation insignificant; this is an extremely uniform species.

Occurrence. — In Poland, rare in the Paleocene, i.e. Danian and Montian of Polish Lowlands and the Pamiętowo boring. Known in America (U.S.A.) from the Paleocene up to the Oligocene.

Pseudopolymorphina geijeri angusta BROTZEN, 1948

1948. *Pseudopolymorphina geijeri angusta* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 52, Text-pl. 10, fig. 15; Text-fig. 12.
1965. *Pseudopolymorphina geijeri angusta* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 88, Pl. 12, fig. 8*a-b*.

Material. — About 20 specimens well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).
Variation not known because of the scarcity of material.

Occurrence. — In Poland, not very common in the Paleocene, i.e. Danian and Montian of Polish Lowlands and the Pamiętowo boring. Known from the Paleocene, i.e. Selandian of Sweden and U.S.S.R. (Donetz Basin) and Montian of Holland (Bunde).

Pseudopolymorphina paleocenica BROTZEN, 1948

1948. *Pseudopolymorphina paleocenica* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 50, Text-fig. 10 (fig. 13); Text-fig. 11 (figs. 1-22).
1958. *Pseudopolymorphina paleocenica* BROTZEN; J. HAYNES, Certain smaller..., p. 11, Pl. 4, figs. 7, 7*b*.
1965. *Pseudopolymorphina paleocenica* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 88, Pl. 13, fig. 6 *(here additional synonymy included)*.

Material. — Over 50 specimens well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation insignificant; the infraspecific variation observed within this species in Poland corresponds to the range variation studied in detail and illustrated by BROTZEN (1948).

Occurrence. — In Poland, not very common in the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known to be common in the Paleocene (Selandian) of Sweden and Denmark and in the Paleocene of Holland, England and U.S.S.R. (Crimea).

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

Pyrulina fusiformis (Roemer, 1838)

1838. *Polymorphina fusiformis* Roemer; F. A. Roemer, Die Cephalopoden des Nord-Deutschen..., p. 386, Pl. 3, fig. 37*a-b*,
1930. *Pyrulina fusiformis* (Roemer); J. A. Cushman & Y. Ozawa, Monograph of the foraminiferal family..., p. 55. Pl. 13, figs. 3-8.
1965. *Pyrulina fusiformis* (Roemer); K. Pożaryska, Foraminifera and biostratigraphy..., p. 86, Pl. 13, fig. 4*a-b (here additional synonymy included)*.

Material. — A dozen or so specimens well preserved.
Dimensions and description are given in Pożaryska's paper (1965).

Variation insignificant; this is a highly distinctive species.

Remarks. — The identification of our specimens is based on Brotzen's (1948) and Haynes's (1958) papers, because of the inaccuracy of Roemer's figures. The specimens described there and included into *Pyrulina fusiformis* do not differ from those from Poland referred to that species. Recent species described by Cushman and Ozawa as *P. fusiformis* do not seem to belong to this species judging from their shape.

Occurrence. — In Poland, rare in the Paleocene (Montian only) of Polish Lowlands and Pamiętowo boring. Present in lowermost Tertiary sediments in Europe and America (U.S.A.).

Genus **SIGMOMORPHINA** Cushman & Ozawa, 1928

Sigmomorphina brotzeni Hofker, 1957

1957. *Sigmomorphina brotzeni* Hofker; J. Hofker, Foraminifera from the Cretaceous..., XXIII, p. 18, Text-figs. 18-25.
1965. *Sigmomorphina brotzeni* Hofker; K. Pożaryska, Foraminifera and biostratigraphy..., p. 89, Pl. 12, fig. 3*a-b (here additional synonymy included)*.

Material. — About 70 specimens, some damaged.
Dimensions, description and remarks are given in Pożaryska's paper (1965).

Variation significant according to the size and general shape of test. Studied in detail by Hofker (1957, p. 18, Text-figs. 18—25).

Occurrence. — In Poland, not common in the Paleocene, i.e. rare in Danian, more common in Montian of Polish Lowlands and Pamiętowo boring. Known to be common in the Paleocene, i.e. Selandian of Sweden and Denmark and Montian of Holland, where it starts from uppermost Maastrichtian.

Sigmomorphina pseudoregularis Cushman & Thomas, 1930

1930. *Sigmomorphina pseudoregularis* Cushman & Thomas; J. A. Cushman & Y. Ozawa, A monograph..., p. 125, Pl. 32, fig. 8.
1948. *Sigmomorphina pseudoregularis* Cushman & Thomas; F. Brotzen, The Swedish Paleocene..., p. 54, Text-pl. 10, fig. 17.
1965. *Sigmomorphina pseudoregularis* Cushman & Thomas; K. Pożaryska, Foraminifera and biostratigraphy..., p. 89, Pl. 12, fig. 9 *(here additional synonymy included)*.

Material. — A dozen or so specimens well preserved.

Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland, rare in the Paleocene (Montian only) of Polish Lowlands and Pamiętowo boring. Common in Paleocene (Selandian) of Sweden and Denmark and in the Eocene of North America.

Family GLANDULINIDAE REUSS, 1860

Genus **GLANDULINA** D'ORBIGNY, *in* DE LA SAGRA, 1839

Glandulina laevigata D'ORBIGNY, 1826

1826. *Nodosaria (Glandulina) laevigata* D'ORBIGNY; A. D'ORBIGNY, Tableau méthodique..., p. 252, Pl. 10, figs. 1-3 (*fide* Cat. of Foram., ELLIS & MESSINA).
1846. *Glandulina laevigata* D'ORBIGNY; A. D'ORBIGNY, Foraminifères fossiles..., p. 29, Pl. 1, figs. 4-5.
1965. *Glandulina laevigata* D'ORBIGNY; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 91, Pl. 22, fig. 7 *(here additional synonymy included)*.

Material. — A dozen or so specimens, often damaged.

Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation extremely insignificant; this is a remarkably individual species.

Occurrence. — In Poland, rare in the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known to be common in the Upper Tertiary sediments in Europe.

Family TURRILINIDAE CUSHMAN, 1927

Genus **PYRAMIDINA** BROTZEN, 1940, nom. nud., emend. BROTZEN, 1948

Pyramidina crassa BROTZEN, 1948

1948. *Pyramidina crassa* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 63, Pl. 6, fig. 8.
1965. *Pyramidina crassa* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 99, Pl. 15, fig. 5*a-c*.

Material. — About 30 specimens well preserved.

Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation insignificant; it is rather a distinctive species. Some specimens are twisted in different degrees.

Occurrence. — In Poland, not common in the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Common in the Paleocene (Selandian) of Sweden and Denmark and in U.S.S.R. (Russian Platform).

Pyramidina cuneata (BROTZEN, 1948)

1948. *Angulogerina cuneata* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 64, Pl. 6, fig. 10.
1965. *Angulogerina cuneata* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 99, Pl. 15, fig. 7*a-c*.

Material. — Over two hundred specimens well preserved.

Dimensions and description are given in POŻARYSKA's paper (1965).

Variation insignificant; it applies generally to the size and development of marginal keels; they can be more distinct or less. Moreover, part of the specimens is somewhat twisted.

Remarks. — According to BROTZEN (1948), the forms belonging to *Angulogerina* genus always have an aperture on the neck. Illustrated holotype of *Angulogerina cuneata*, species described by BROTZEN (1948) from the Paleocene of Sweden, is without a neck as all specimens occurring in the Polish specimens of Montian age. For that reason the mentioned species is referred here to *Pyramidina* genus.

Occurrence. — In Poland, very common in the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known to be common in the Paleocene (Selandian) of Sweden and Denmark.

Family BOLIVINITIDAE CUSHMAN, 1927

Genus **BOLIVINA** D'ORBIGNY, 1839

Bolivina oedumi BROTZEN, 1948

1948. *Bolivina ödumi* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 65, Pl. 9, figs. 3-4.
1965. *Bolivinita oedumi* (BROTZEN); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 101, Pl. 15, fig. 13.
1965. *Bolivinoides oedumi* (BROTZEN); B. MCGOWRAN, Two Paleocene..., p. 41, Pl. 1, fig. 6.

Material. — Several specimens well preserved.
Dimensions and description are given in POŻARYSKA's paper (1965).
Variation not known due to the scarcity of material.

Occurrence. — In Poland, extremely rare in the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known to be rare in the Maastrichtian of Germany and Holland, in the Paleocene of Sweden (Selandian), and in Paleocene of Australia (Western Victoria). Probably present in the Paleocene, i.e. Thanetian of England.

Family BULIMINIDAE JONES, 1875

Genus **BULIMINA** D'ORBIGNY, 1846

Bulimina ovata D'ORBIGNY, 1846

(Text-fig. 10)

1846. *Bulimina ovata* D'ORBIGNY; A. D'ORBIGNY, Foraminifères fossiles..., p. 185, Pl. 11, figs. 13-14.
1954. *Praeglobulimina ovata* (D'ORBIGNY); J. HAYNES, Taxonomic position..., p. 190, Text-figs. 9-12, 17-19.
1965. *Bulimina ovata* D'ORBIGNY; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 98, Pl. 15, fig. 10 *(here additional synonymy included)*.

Material. — About two hundred specimens well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation insignificant; it is mainly found in the size, width/length ratio of tests and arrangement of chambers. There are both microspheric and megalospheric forms (see Text-fig. 10).

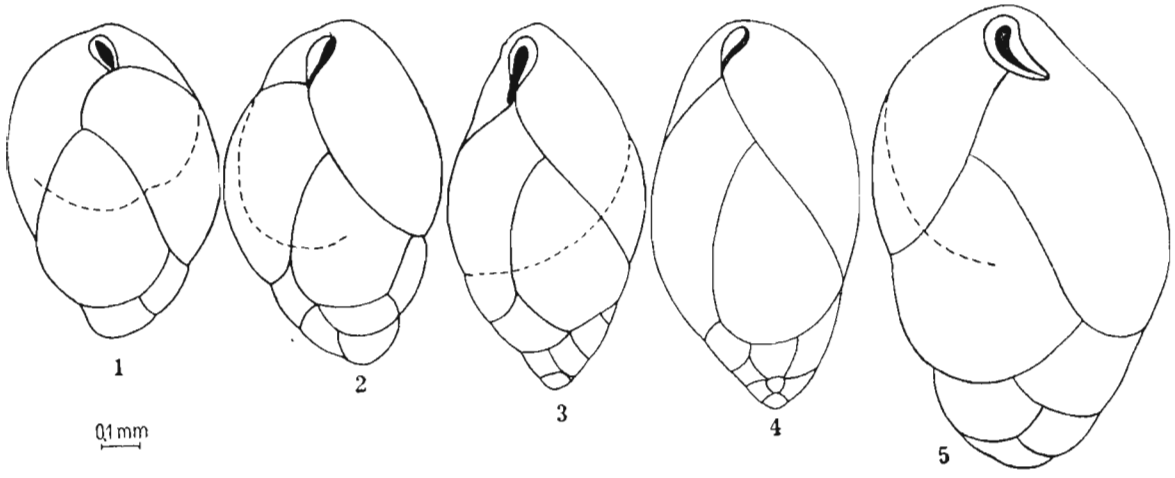


Fig. 10
Bulimina ovata D'ORBIGNY: *1, 2, 5* megalospheric forms, *3, 4* microspheric forms; Pamiętowo boring, 257 m, Montian.

Occurrence. — In Poland common in the Paleocene, i.e. Danian and Montian everywhere in Polish Lowlands and the Pamiętowo boring. Known from the uppermost Maastrichtian up to the Upper Eocene in Europe and America (U.S.A.).

Bulimina paleocenica BROTZEN, 1948

1948. *Bulimina (Reussella) paleocenica* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 61, Pl. 6, figs. 5-6.
1958. *Bulimina paleocenica* BROTZEN; J. HAYNES, Certain smaller..., p. 74, Pl. 16, fig. 17.
1965. *Bulimina paleocenica* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 98, Pl. 15, fig. 4 *(here additional synonymy included)*.

Material. — About one hundred specimens well preserved.
Dimensions, description and remarks are given in POŻARYSKA'S paper (1965).

Variation rather insignificant; it concerns mainly the length/width ratio of test and to margins rounded or angled. Some specimens are slightly twisted. Studied in detail by BROTZEN (1948, pp. 61—62).

Occurrence. — In Poland, common in the Paleocene, i.e. Danian and Montian sediments. Present in the Paleocene, i.e. Danian and Selandian of Denmark, Sweden, Paleocene of Holland, England (Thanetian) and south regions of U.S.S.R. (Russian Platform).

Family UVIGERINIDAE HAECKEL, 1894

Genus **ANGULOGERINA** CUSHMAN, 1927

Angulogerina europaea CUSHMAN & EDWARDS, 1937

(Pl. I, figs. 1-7)

1937. *Angulogerina europaea* CUSHMAN & EDWARDS; J. A. CUSHMAN & P. G. EDWARDS, Note on the early..., p. 61, Pl. 8, figs. 17*a-b*, 18.
1948. *Angulogerina europaea* CUSHMAN & EDWARDS; F. BROTZEN, The Swedish Paleocene..., p. 64, Pl. 6, fig. 9.

1966. *Reussella europaea* (CUSHMAN & EDWARDS); J. HOFKER, Maastrichtian, Danian and Paleocene..., p. 242, Pl. 49, fig. 58.
1962. *Angulogerina europaea* CUSHMAN & EDWARDS; M. E. SCHMID, Die Foraminiferenfauna des Bruderndorfer..., p. 334, Pl. 4, fig. 7.

Material. — A dozen or so specimens, in most cases well preserved.
Dimensions of 3 specimens (in mm):

	F. IX/6	F. IX/7	F. IX/9
Height of test	0·36	0·40	0·30
Maximum width	0·16	0·20	0·15

Description. — Test triserial, tapering, almost triangular in a horizontal section. Chambers growing rapidly in size as added, inflated or flattened, overhanging each other, projecting more or less on the margins, with excavations developed to different degrees at their base, where they are bordered sometimes by a slight ridge. Sutures depressed, curved or sickled, sometimes strongly sigmoid. Surface generally rough, porous. Aperture terminal, basal, loop-shaped.

Variation significant; it concerns the size and shape of the tests, which are more twisted or less, having angles more rounded or less rounded. Moreover the chambers are overhanging each other to different degrees, having excavations at their base differently developed. The particular chambers are not always bordered on their lower part by distinct ridges.

Remarks. — Our specimens are very similar to the holotype of this species described by CUSHMAN and EDWARDS from the Montian of Paris Basin. The Swedish specimens referred by BROTZEN to this species slightly differ from the holotype, as well as from Polish specimens, in having well developed three longitudinal ridges along the most external parts of the test. It is probably related with *Angulogerina muralis* (TERQUEM, 1882), known from the Eocene of Franco-Belgian Basin.

Occurrence. — In Poland, not common in the Paleocene (Montian) in Pamiętowo boring only. Known to be very rare in Paleocene, i.e. Danian and Selandian of Sweden, Montian and Thanetian of Paris Basin, Montian of Holland (Bunde boring), Thanetian of England.

Family DISCORBIDAE EHRENBERG, 1838

Genus **DISCORBIS** LAMARCK, 1804

Discorbis quadrata (TERQUEM, 1882)

(Pl. II, fig. 3)

1882. *Rosalina quadrata* TERQUEM; O. TERQUEM, Les Foraminifères de l'Eocène..., p. 98, Pl. 10, fig. 12.
1949. *Discorbis quadrata* (TERQUEM); Y. LE CALVEZ, Révision..., p. 25, Pl. 2, figs. 21-23.
1961. *Discorbis quadrata* (TERQUEM); J. P. H. KAASSCHIETER, Foraminifera of the Eocene..., p. 208, Pl. 10, fig. 17*a-c*.

Material. — A dozen or so specimens well preserved.
Dimensions of an average specimens (in mm):

	F. IX/11
Longest diameter	0·35
Shortest diameter	0·30
Height of test	0·15

Description. — Test plano-convex, outline rounded or slightly lobulate, peripheral margin acute, bluntly keeled, ventral side slightly concave, with a small umbilical depression, spiral side convex. Chambers flattened, low, 4—6 in number in the only visible last whorl on ventral side. Sutures sickled, transparent, flush with surface or sometimes a little raised on dorsal side depressed on ventral one. Surface smooth, indistinctly finely perforated on both sides. Aperture, a low slit-like interiomarginal arch or a large, regular sutural opening at the base of the last chamber, near the umbilicus.

Variation insignificant, mainly concerning the general shape and character of sutures. Spiral side can be more convex or less.

Remarks. — Our specimens are, on one hand, nearly the same as those described by LE CALVEZ (1949) who revised the TERQUEM'S species from the Lutetian of Paris Basin and, on the other hand, as those described by KAASSCHIETER (1961) from the Eocene of Belgium. Specimens from the Montian of Poland generally have more elongated chambers and more sickled sutures, moreover they have a more finely porous surface in comparison with specimens from Belgium. In the present authors' opinion this species is very close to *Discorbis ubiqua* LE CALVEZ (1949, p. 23, Pl. 2, figs. 27—29), as was stated by KAASSCHIETER (1961, p. 209). At first sight *Discorbis quadrata* (TERQUEM) is very similar to *Trochammina* sp. (HOFKER, 1962, p. 10), its walls, however, are arenaceous, without pores.

Occurrence. — In Poland, not common in the Paleocene (Montian) of the Pamiętowo boring. Present in the Paleocene (Montian) of Belgium („Puits Artésien" in Mons). Known to be very rare in the Eocene of France and Belgium.

Genus **EPISTOMINELLA** HUSEZIMA & MARUHASI, 1944

Epistominella cf. **limburgensis** (VISSER, 1951)

(Text-fig. 11)

1946. *Eponides minimus* CUSHMAN; R. C. VAN BELLEN, Foraminifera..., p. 58, Pl. 7, figs. 10-12 (non *Eponides minima* CUSHMAN 1933, in CCL 9, p. 17, Pl. 2, fig. 8).
?1951. *Pseudoparrella limburgensis* VISSER; A. M. VISSER, Monograph on the Foraminifera..., p. 278, Pl. 7, fig. 10.
1960. *Eponides acutus* ROUVILLOIS; A. ROUVILLOIS, Le Thanétien..., p. 68, Pl. 2, fig. 33*a-c*.
1961. *Pseudoparrella limburgensis* VISSER; J. HOFKER, Foraminifera from the Cretaceous..., LIII, p. 67, figs. 9-10.
1965. *Pseudoparrella limburgensis* VISSER; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 113, Pl. 16, fig. 5*a-c*.

Material. — One hundred specimens well preserved.

Dimensions and description are given in POŻARYSKA'S paper (1965).

Variation insignificant; it applies mainly to the general shape of tests and to the position of aperture, as is seen on figures below (Text-fig. 11).

Remarks. — Polish specimens are very similar to those distinguished by HOFKER (1961) as megalospheric forms of *Pseudoparrella limburgensis* VISSER (1951). In HOFKER'S opinion, *P. limburgensis* (recte *Epistominella limburgensis*) is represented by two forms, *A* and *B*, out of which only megalospheric form probably occurs in the Montian of Poland. Both forms differ greatly and deviate, however, from the holotype of *P. limburgensis* illustrated by VISSER (holotype of the discussed species was designated by HOFKER in 1961 as a microspheric form); so it is quite possible that they represent a different species, not conspecific with *Pseudoparrella limburgensis* s.s. For that reason, the presence of representatives of *Epistominella limburgensis* in the Montian of Poland is confirmed only tentatively.

Polish specimens are the same as those described and illustrated by ROUVILLOIS (1960) as *Eponides acutus*, and by VAN BELLEN (1946) as *E. minimus* CUSHMAN, but differ considerably from those described by CUSHMAN (1933) as *E. minima*. That is why specimens described by VAN BELLEN and ROUVILLOIS are put by the present writers into the synonymy of *Epistominella* cf. *limburgensis* VISSER. The generic name of this species has been adapted after Treatise of Invertebrate Paleontology (C, 2, 1964), where LOEBLICH and TAPPAN revised generic name of *Pseudoparrella* CUSHMAN & TEN DAM, 1948, changing it into *Epistominella* HUSEZIMA & MARUHASI, 1944.

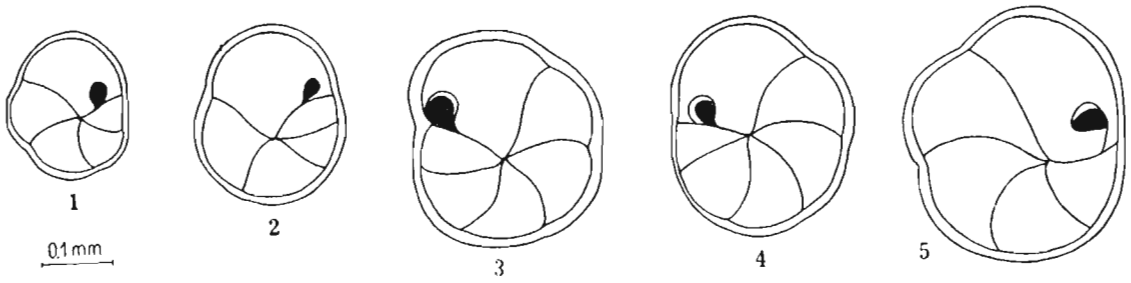


Fig. 11
Individual variation of *Epistominella* cf. *limburgensis* (VISSEI); Pamiętowo boring, 257 m, Montian.

Occurrence. — In Poland, not very common in the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known to be common in the Paleocene, i.e. Danian and Selandian of Denmark, Montian of Belgium („Puits Artésien" in Mons) and Holland (Geulhem, Bunde). Present in the Paleocene of U.S.S.R. (Russian Platform) and in the Paleocene (Thanetian) of France (Paris Basin) and England.

Genus **ROSALINA** D'ORBIGNY, 1826

Rosalina brotzeni HOFKER, 1961

(Pl. II, fig. 1)

1961. *Rosalina brotzeni* HOFKER; J. HOFKER, Foraminifera from the Cretaceous..., LIII, p. 63, fig. 3*a-c*.
1962. *Rosalina brotzeni* HOFKER; J. HOFKER, Correlation of tuff chalk..., p. 1081, Text-fig. 25*c*.
1965. *Conorbina brotzeni* (HOFKER); B. MCGOWRAN, Two Paleocene..., p. 45, Pl. 2, fig. 4.
1966. *Rosalina brotzeni* HOFKER; J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 225, Pl. 46, fig. 138.

Material. — A few specimens, rather well preserved.
Dimensions of an average specimen (in mm):

	F. IX/16
Longest diameter	0·20
Shortest diameter	0·16
Height of test	0·11

Description. — Test small, trochospiral, more convex on dorsal side than on ventral one, nearly rounded, somewhat lobulate in outline, periphery slightly acute with roll-like thickenings along the edge. Chambers crescent on dorsal side, inflated, indistinctly arranged in 2—3 whorls, the last containing about 5 chambers visible on the ventral side. Sutures radial, flush with surface and curved on the dorsal side, somewhat depressed, enlarging at the open,

cross-like umbilicus on ventral side. Surface rather smooth, glassy, finely porous. Aperture slit-like, obscured at the base of the last chamber, between the periphery and the umbilicus.

Variation insignificant, concerning mainly the general appearance of tests.

Remarks. — Specimens referred to *Rosalina brotzeni* HOFKER from Poland are very similar to those described under the same specific name by HOFKER (1961) from the holes in the hard ground of Curfs quarry (Holland). Specimens from Poland are smaller, somewhat more convex on the ventral side and less rounded, with a roll-like keel on their periphery.

Occurrence. — In Poland, rare in the Paleocene (Montian) in Pamiętowo boring only. Known from Paleocene of Holland (Montian) and of Australia.

Rosalina koeneni BROTZEN, 1948

(Pl. II, fig. 2)

1948. *Rosalina koeneni* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 73, Pl. 9, fig. 11.
1956. *Rosalina koeneni* BROTZEN; J. HAYNES, Certain smaller British..., p. 91, Pl. 16, fig. 12*a-d.*
1961. *Rosalina koeneni* BROTZEN; J. HOFKER, Foraminifera from the Cretaceous..., LIII, p. 63, Fig. 2.
1962. *Rosalina koeneni* BROTZEN; J. HOFKER, Correlation..., Text-fig. 25*B.*
1966. *Rosalina koeneni* BROTZEN; J. HOFKER, Maestrichtian, Danian and Paleocene Foraminifera..., p. 225, Pl. 54, fig. 82*a-c.*

Material. — Several specimens well preserved.
Dimensions of an average specimen (in mm):

	F. IX/17
Longest diameter	0·46
Shortest diameter	0·40
Height of test	0·15

Description. — Test small, trochospiral, elevated on dorsal side, concave on ventral one, rounded or somewhat ovate, not lobulate in outline, periphery sharply acute with well developed sharp keel. Chambers slightly inflated, arranged into three whorls; the last, consisting of 6—7 chambers, is seen on the ventral side. Sutures strongly curved and flush with surface on dorsal side, slightly depressed and nearly radial on ventral side, passing into a star-shaped large umbilicus; an umbilical hollow filled up by a small but distinct, elevated plug. Surface smooth, finely porous. Aperture slit-like near the umbilicus, under a lip at the base of the last formed chamber.

Variation not known, due to the scarcity of material.

Remarks. — Our specimens do not differ either from those described from Sweden by BROTZEN (1948) or from those described by HOFKER (1961, 1962, 1966) from Holland.

Occurrence. — In Poland rare, in the Paleocene (Montian) of Pamiętowo boring only. Known to be scarce in the Paleocene, i.e. Selandian of Sweden and Denmark, Montian of Holland, Thanetian of England.

Rosalina selandiana n. sp.

(Pl. II, fig. 4; Text-fig. 12)

1966. *Neoconorbina (Rosalina) parisiensis* (D'ORBIRNY); J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 226, Pl. 42, fig. 67) (non *Rosalina parisiensis* D'ORBIGNY, 1826, p. 105, No. 5 — *fide* Cat. of Foram., ELLIS & MESSINA).

Holotypus: Specimen presented on Pl. II, fig. 4 (F. IX/18).
Stratum typicum: Montian.
Locus typicus: Nasiłów outcrop, 3 m above the Upper Maastrichtian hard ground.
Derivatio nominis: Lat. *selandiana* — from Selandian, Scandinavian Lower Paleocene.

Material. — A dozen or so specimen well preserved.
Dimensions of an average specimen (holotype) in mm:

	F. IX/18
Longest diameter	0·23
Shortest diameter	0·20
Height of test	0·10

Description. — Test small, trochospiral, convex on dorsal side, flat or even slightly concave on ventral side, outline rounded and insignificantly lobulate, periphery acute with a weakly developed keel. Chambers crescent on the dorsal side, coiled into over two whorls indistinctly seen on the dorsal side, 5—6 in number in the last whorl; sutures strongly curved, limbate, flush with surface on dorsal side, not visible on ventral side. Large umbilical depression covered by irregular ripples radially scattered. Surface smooth, finely pitted, aperture obscured cannot be observed.

Variation insignificant, concerning mainly the development of ripples in the middle of ventral side, as is shown below (see Text-fig. 12).

Remarks. — Our specimens of *Rosalina selandiana* n. sp. differ from specimens of so far described species of *Rosalina* mainly in their ornamentation. Our specimens do not seem to differ from specimens described by HOFKER (1966) as *Neoconorbina (Rosalina) parisiensis* (D'ORBIGNY) from Holland. Those last ones, however, differ considerably from the figured specimen of *Rosalina parisiensis* D'ORB. (1826) described from Paris Basin, so in the present paper they are included into the here erected new species *R. selandiana.*

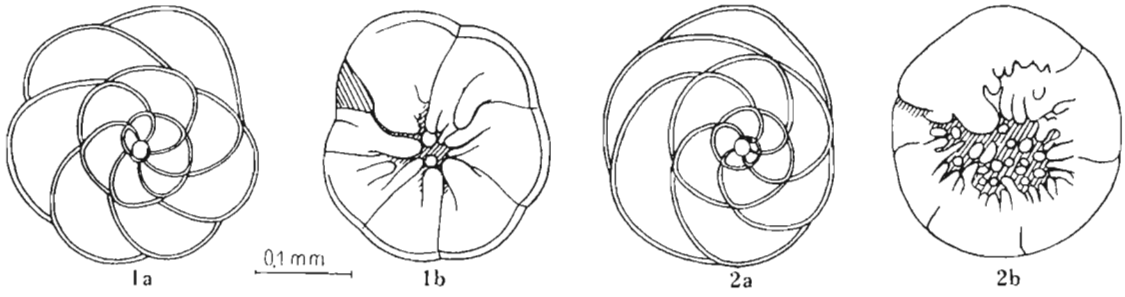


Fig. 12
Individual variation of *Rosalina selandiana* n. sp.; Pamiętowo boring, 210·7 m, Montian.

Occurrence. — In Poland, not common in the Paleocene (Montian) of Polish Lowlands and Pamiętowo boring, also in Paleocene of Holland. Probably present in the Paleocene, i.e. Thanetian of France (Paris Basin) and of England.

Rosalina ystadiensis BROTZEN, 1948

(Pl. XVI, fig. 7)

1948. *Rosalina ystadiensis* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 72, Pl. 9, fig. 9.
1956. *Rosalina* cf. *ystadiensis* BROTZEN; J. HAYNES, Certain smaller British..., p. 92, Pl. 16, fig. 17.
1961. *Rosalina ystadiensis* BROTZEN; J. HOFKER, Foraminifera from the Cretaceous..., LIII, p. 63, Text-fig. 1*a-c.*

1962. *Rosalina ystadiensis* BROTZEN; J. HOFKER; Correlation of the tuff chalk..., Text-fig. 25*A*.
1966. *Rosalina ystadiensis* BROTZEN; J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 225, Pl. 45, fig. 137.

Material. — A single specimen well preserved.
Dimensions of one specimen (in mm):

	F. IX/19
Longest diameter	0·25
Shortest diameter	0·20
Height of test	0·20

Description. — Test very small, somewhat conical, spiral side elevated, umbilical side concave, involute. Outline rounded, indistinctly lobulate, peripheral margin abruptly keeled and transparent, with radial marks. Chambers crescent on dorsal side, arranged in at least 3 whorls, the outer one containing 5 chambers; on the ventral side chambers of last whorl visible, being separated by radial, depressed sutures. On the dorsal side sutures transparent, flush with surface. Umbilical depression shallow but distinct, connected with slit-like aperture below the last chamber and penetrating into sutures within the umbilicus. Wall surface slightly perforated, more on ventral side.

Variation not known due to the scarcity of material.

Remarks. — Our specimen differs from the illustrated holotype of *Rosalina ystadiensis* BROTZEN, 1948 from Sweden in not having any tubercles inside the umbilical depression.

Occurrence. — In Poland, a single specimen in the Paleocene (Montian) of Pamiętowo boring. Very rarely found in the Paleocene of Sweden (Selandian) and Holland (Montian). Probably also present in England (Thanetian).

Genus **ROTORBINELLA** BANDY, 1944

Rotorbinella mariei (VAN BELLEN, 1946) [2]

(Pl. IV, figs. 1-3; Pl. XVII, figs. 1-4)

1946. *Parrella mariei* VAN BELLEN; R. C. VAN BELLEN, Foraminifera from the Middle Eocene..., p. 70, Pl. 10, figs. 1-6.
?1957. *Rotorbinella mariei* (VAN BELLEN); J. HOFKER, Foraminifera from the Cretaceous..., XXX, p. 123, fig. 2, non fig. 1.
?1959. *Rotorbinella mariei* (VAN BELLEN); J. HOFKER, Les Foraminifères des craies tuffoïdes, p. 293, figs. 110-112.
1964. *Pożaryskaia mariei* (VAN BELLEN); P. MARIE, Les faciès du Montien..., p. 1098, Pl. 2, fig. 5*a-c*.
1966. *Rotorbinella mariei* (VAN BELLEN); J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 257, Pl. 54, figs. 91-93.
?1966. *Rotorbinella bundensis* (VAN BELLEN); J. HOFKER, *Ibid.*, p. 258, Pl. 54, figs. 88-90 (non *Rotalia bundensis* VAN BELLEN; R. C. VAN BELLEN, 1946, Foraminifera..., p. 61, Pl. 8, figs. 1—4).

Material. — Two dozen specimens, in most cases well preserved.
Dimensions of an average specimen (in mm):

	F. IX/47
Longest diameter	0·17
Shortest diameter	0·15
Height of test	0·09

[2] The genus *Pożaryskaia* instead of *Rotorbinella* was proposed by MARIE (1964) as *nomina nuda*. That is why we use here the earlier generic name for the discussed species.

Description. — Test plano-convex, dorsal side convex, ventral side flat or even slightly concave, outline rounded, fairly lobulate, periphery broadly rounded, generally with a keel-like list formed by a marginal prolongation of sutural thickening on the dorsal side. Chambers slightly inflated on both sides, arranged into at least two poorly visible whorls, about seven in number in the last whorl, very slowly increasing in size as added. Sutures indistinct, gently depressed on ventral side in contrast with raised, limbate, radial sutures on dorsal side. Umbilicus a deep, rather large hollow, filled up with numerous, regular, small bosses. Surface rough to spiny on dorsal side, smooth only at the periphery of ventral side. Aperture a large short opening at the base of the last chamber, between the umbilicus and periphery on the ventral side.

Variation significant; it applies mainly to the ornamentation of tests on the dorsal side, where spines are not always well developed and sutures not raised, in which case the peripheral keel is also lacking. Small bosses on the ventral side vary in number and arrangement.

Remarks. — Our specimens differ only in size from the illustrated specimens described by VAN BELLEN (1946) as *Parrella mariei* and from MARIE's (1964) ones assigned by him to *Pożaryskaia mariei*, both from the Montian of Holland. It seems that specimens, described by HOFKER (1957, 1959 not 1966) from the Maastrichtian („Md" horizon) of Limburg, assigned to *Rotorbinella mariei*, belong to another species, on the base to their general habitus and ornamentation. According to the present authors' opinion, *Rotorbinella mariei* (VAN BELLEN) is probably related to *Discorbis bundensis* (recte *Rotorbinella bundensis*) (VAN BELLEN, 1946, p. 47, Pl. 4, figs. 19—24) (see also *Rotorbinella bundensis* [VAN BELLEN] HOFKER, 1966), from which it differs in being coarsely pitted on the dorsal side between sutures; sometimes even it has weakly developed protuberances, as is seen in comparative material from Holland (Bunde) (see Pl. XVII, figs. 1—4).

Occurrence. — In Poland not common in the Paleocene (Montian) of Pamiętowo boring only. Common in the Paleocene (Montian) of Holland (Bunde), Belgium („Puits Artésien" in Mons) and France.

Rotorbinella montiana n. sp.

(Pl. VI, figs. 5-6)

1946. *Discorbis corrugata* (CUSHMAN & BERMUDEZ); R. C. VAN BELLEN, Foraminifera from the Middle Eocene..., p. 49, Pl. 5, figs. 7-13 (non *Anomalina corrugata* CUSHMAN & BERMUDEZ; J. A. CUSHMAN & P. J. BERMUDEZ (1937), p. 27, Pl. 2, figs. 57-59).

1965. *Discorbis corrugata* (CUSHMAN & BERMUDEZ); J. INDANS, Mikrofaunistisches Normalprofil..., p. 13.

1966. *Rotorbinella corrugata* (CUSHMAN & BERMUDEZ); J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 258, Pl. 54, figs. 85-87.

Holotypus: Specimen presentes on Pl. VI, fig. 5 (F. IX/50).
Paratypus: Specimen presented on Pl. VI, fig. 6 (F. IX/51).
Stratum typicum: Montian.
Locus typicus: Pamiętowo boring, depth 210·7 m (North Poland).
Derivatio nominis: Lat. *montiana* — from Montian.

Material. — About 30 specimens damaged.
Dimensions of an average specimen (holotype) in mm:

	F. IX/50
Longest diameter	0·25
Shortest diameter	0·23
Height of test	0·12

Description. — Test plano-convex, dorsal side slightly convex, ventral side flat or even gently concave. Outline nearly round, not lobulate except between the last chambers, periphery bluntly acute, roll-like. Chambers globularly inflated on dorsal side, rapidly increasing in size as added, arranged in two whorls, the last consisting of about 7 chambers visible. Chambers fused on the ventral side. Sutures indistinct, rather depressed on dorsal side, flush with surface, obscured on ventral side. Umbilicus large, with several knobs, rather shallow, irregularly developed, filled with one or several plugs, which are pronounced sometimes more, sometimes less. Numerous protuberances and several pits are developed around the umbilicus. A smooth, rather wide border occurs along the periphery on the ventral side. Aperture a slit-like between the periphery and the umbilicus.

Variation rather significant; it applies mainly to the ornamentation of ventral side. Tubercles are not always numerous and are developed to different degrees.

Remarks. — Our specimens in comparison with illustrated French specimens (in MARIE'S manuscript as *Rotorbinoides montis* n. sp.) seem to represent the same species, althought the Polish specimens have less whorls and are not ornamented at the periphery on the ventral side; moreover their peripheral border is much wider. Our specimens are of the same appearance as those described by VAN BELLEN (1946) as *Discorbis corrugata*, found by the present authors in samples from the Montian of Holland (Bunde), where they have, however, a greater variation. Polish specimens are much smaller in comparison with Dutch ones. It is fairly sure that specimens described by VAN BELLEN as *D. corrugata* do not differ from those of *Rotorbinella montiana* n. sp. Specimens described by CUSHMAN and BERMUDEZ (1937) as *Anomalina corrugata* from the Eocene of Cuba are of quite different shape and ornamentation.

Occurrence. — In Poland not common in the Paleocene (Montian) of Pamiętowo boring only. Common in Paleocene (Montian) of Holland (Bunde and Beatrix borings), Belgium („Puits Artésien" in Mons), France (Calcaire Pisolithique of Paris Basin) and Germany (Krefeld region). *Rotorbinella montiana* n. sp. seems to be a good index fossil for true Montian.

Rotorbinella papillata n.sp.

(Pl. VI, fig. 11)

Holotypus: Specimen presented on Pl. VI, fig. 11 (F. IX/52).
Stratum typicum: Montian.
Locus typicus: Pamiętowo boring, depth 210·7 m (North Poland).
Derivatio nominis: Lat. *papillata* — with a rough, coarsely pitted surface.

Material. — Three specimens well preserved.
Dimensions of one specimen, holotype (in mm):

	F. IX/52
Longest diameter	0·13
Shortest diameter	0·10
Height of test	0·05

Description. — Test small, planispiral, ventral side nearly flat or even slightly concave, dorsal side somewhat convex, round in outline, lobulate, periphery truncated, forming a roll-like keel. Chambers strongly inflated, globular, rapidly increasing in size, 6—7 in number in the last whorl on dorsal side; chambers of inner whorls more flattened, poorly visible, fused on ventral

side. Sutures radial, strongly depressed on dorsal side, flush with surface, indistinct on ventral side. Surface rough, coarsely pitted and somewhat tubercular, especially so on the ventral side, except for the admarginal part of it, which is almost smooth. Aperture, a slit at the base of the last chamber, near the margin of ventral side.

Variation insignificant; it applies only to the size and development of ornamentation; it is not well known because of the scarcity of material.

Remarks. — Our specimens are very similar in general appearance to those from Bunde boring (Holland) illustrated by MARIE (MS); they have similarly developed dorsal sides, while their ventral sides are difficult to compare because of the too schematic drawing done by MARIE. *Rotorbinella papillata* n. sp. is somewhat similar to *R. montiana* n. sp., from which it differs mainly in lacking of an umbilicus and in being more perforated especially on ventral side.

Occurrence. — In Poland very rare, in the Paleocene (Montian) of Pamiętowo boring only. In Belgium it was found by the present writers in the Paleocene (Montian) in Mons („Puits Artésien"). Present also in the Paleocene (Montian) of Holland (Bunde).

Family SPIRILLINIDAE REUSS, 1862

Genus **PATELLINA** WILLIAMSON, 1858

Patellina sp.

(Pl. III, figs. 4, 5)

Material. — About 20 specimens badly preserved.
Dimensions of two specimens (in mm):

	F. IX/20	F. IX/21
Longest diameter	0·30	0·35
Shortest diameter	0·30	0·30
Height of test	—	0·21

Description. — Test conical, involute, dorsal side elevated, umbilical side flat or even concave, outline rounded. The bad state of preservation does not allow all the details to be distinguished or the inner structure of test to be analysed, but it seems that the test consists of proloculum followed by an elongated tube, coiled into 7 whorls. The outer margins of the whorls are serrate-like, giving an impression of numerous small chamberlets, which in reality do not exist. On the umbilical side, cross-like indistinct groove occurs. Aperture obscured cannot be observed.

Variation not known due to the poverty of material.

Remarks. — Our specimens seem to be similar, on one hand, to those of *Patellina dentata* TERQUEM (1882, p. 123, Pl. 12, figs. 36, 37) by their similar shape and ornamentation and, on the other hand, to those of recent species *P. corrugata* WILLIAMSON (1858, p. 47, Pl. 3, figs. 86—89). They both are too schematically illustrated to be compared with Polish specimens, but it seems that the main difference lies in the ornamentation on the ventral side.

Occurrence. — In Poland known from the Paleocene (Montian) of the Pamiętowo boring only. Probably present in the lowermost Tertiary of Holland.

Genus **SPIRILLINA** EHRENBERG, 1843

Spirillina cf. **nodifera** TERQUEM, 1882

(Pl. III, figs. 1-3)

1882. *Spirillina nodifera* TERQUEM; O. TERQUEM, Les Foraminifères de l'Eocène..., p. 34, Pl. 1, fig. 32*a-b*.
1948. *Spirillina nodifera* TERQUEM; F. BROTZEN, The Swedish Paleocene..., p. 67, Pl. 10, fig. 12 *(here earlier synonymy included)*.

Material. — About 20 specimens, rather badly preserved.
Dimensions of two specimens (in mm):

	F. IX/22	F. IX/23
Longest diameter	0·30	0·22
Shortest diameter	0·27	0·20
Height of test	—	0·07

Description. — Test planispiral, evolute, coiled in one plan, somewhat concave on both sides, composed of a very small proloculum and a long, undivided, tubular second chamber, forming 3—6 whorls moderately increasing in size as added. From aside rectangular, rather thick. Numerous small tubercles, more regular or less, are seen on one side, and irregular, indistinct protuberances on the opposite side. They all give a false impression of the presence of several, small chamberlets. Surface generally rough, porous. Aperture formed by the open end of the tube, in most cases obscured.

Variation concerns mainly the size and ornamentation development, but study could not be made as nearly all specimens are too badly preserved.

Remarks. — Our specimens, whose surface ornamentation is usually indistinct, seem to be most related to specimens referred by TERQUEM (1882) to *Spirillina nodifera*. That is why the specimens from Poland are described here as conforming to *S. nodifera* TERQUEM.

Occurrence. — In Poland not common in the Paleocene (Montian) of the Polish Lowlands and Pamiętowo boring. Known to be common in the Paleocene (Selandian) of Sweden, rare in the Eocene of France and America.

Family ROTALIIDAE EHRENBERG, 1839

Genus **CUVILLIERINA** DEBOURLE, 1955

Cuvillierina? pomeraniana n. sp.

(Pl. IV, figs. 4-5)

1961. *Thalmannita madrugaensis* (CUSHMAN & BERMUDEZ); J. HOFKER Foraminifera from the Cretaceous..., LVI, p. 124, Text-fig. 4*a-c* (non *Rotalia madrugaensis* CUSHMAN & BERMUDEZ, 1947, p. 24, Pl. 5, fig. 4*a-c*).
1966. *Thalmannita madrugaensis* (CUSHMAN & BERMUDEZ); J. HOFKER, Maestrichtian..., p. 234, Pl. 53, figs. 55-60.

Holotypus: Specimen presented on Pl. IV, fig. 5 (F. IX/26).
Paratypi: Specimens presented on Pl. IV, figs. 4, 6 (F. IX/25, 27).
Stratum typicum: Montian.
Locus typicus: Pamiętowo boring, depth 210·7 m (North Poland).
Derivatio nominis: Lat *pomeraniana* — from Pomerania, name of north region of Poland.

Material. — A dozen or so specimens, most of them damaged.
Dimensions of two specimens (in mm):

	F. IX/25	F. IX/26
Longest diameter	0·20	0·30
Shortest diameter	0·15	0·20
Height of test	0·15	0·15

Description. — Test very thick, somewhat plano-convex, dorsal side slightly convex, ventral side flat or even concave, outline oval, slightly lobulate, peripheral margin broadly rounded. Chambers globular, inflated, arranged in two or more whorls, the inner ones indistinct, 6—7 in number in the last whorl, moderately increasing in size as added. Sutures radial, deeply depressed on both sides, surface extremely rough, completely covered by numerous protuberances and knobs, forming a meander-like pattern, especially well developed and visible along sutures. On both sides of test, several small knobs occur in the central part. A chevron pattern over sutures, typical for *Cuvillierina* genus, can be observed but rarely. Aperture, a distinct slit on the peripheral margin under a narrow lip.

Variation insignificant; it applies mainly to the size and surface ornamentation, which can be more regular or less, forming meandering ribs perpendicular to the suture line, or irregularly arranged protuberances.

Remarks. — Our specimens do not differ from those described as *Thalmannita madrugaensis* (CUSHMAN & BERMUDEZ) by HOFKER (1961) from the basal sediments of the Paleocene in Belgium, neither do they differ from comparative specimens from true Montian of Belgium („Puits Artésien" in Mons), and of Holland (Bunde boring), nor from those of Paleocene age of Germany (Krefeld region). However, all these differ from specimens described by CUSHMAN and BERMUDEZ (1947) as *Rotalia madrugaensis* from Paleocene of Cuba and Madagascar. In the light of the above, HOFKER's specimens ought certainly to be included into our newly erected species *Cuvillierina? pomeraniana*. Our specimens are also similar to those described as *Laffiteina vallensis* by GAONA (1948) from the Eocene of Spain and France. They differ, however, in having somewhat different ornamentation. The last chamber of our specimens is more rounded in outline and not elongated, moreover the peripheral margin of Polish specimens is broadly rounded in contrast with the acute periphery of *Laffiteina vallensis* Gaona.

Specimens of *Cuvillierina? pomeraniana* from Poland are only tentatively assigned to *Cuvillierina* genus; their somewhat asymmetrical coiling rather refers them to *Cuvillierina*, but on the other hand, their ornamentation is more characteristic for representatives of *Thalmannita* genus.

Occurrence. — In Poland not very common in the Paleocene (Montian) in Pamiętowo boring only. Known to be common in Paleocene (Montian) of Belgium („Puits Artésien" in Mons), of Holland (Bunde), Germany (Krefeld region) and probably of France (Paris Basin). This species seems to be a good facies and stratigraphical index fossil for subtropical Montian.

Genus **PARAROTALIA** LE CALVEZ, 1949

Pararotalia tuberculifera (REUSS, 1862)

(Pl. VII, Figs. 1-10; Text-fig. 13)

1862. *Rotalia tuberculifera* REUSS; A. E. REUSS, Die Foraminiferen des Kreides..., p. 313, Pl. 2, fig. 2.
1957. *Pararotalia tuberculifera* (REUSS); J. HOFKER, Foraminifera from the Cretaceous..., XXIV, p. 32, Text-figs. 1-18.
1965. *Pararotalia tuberculifera* (REUSS); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 118, Pl. 20, fig. 3*a-c*.

Material. — Some hundred specimens well preserved.

Dimensions and description are given in POŻARYSKA's paper (1965).

Variation considerable; it applies to the general shape, size and ornamentation. Outline is regularly lobulate up to strongly serrate, especially when chambers are marginally bordered by distinct, sharp spine. Umbilicus sometimes larger, sometimes less large, generally with a central plug single or divided into several small, knob-like plugs; protuberances around central plug, if present, formed by older raised parts of chambers (tena). On the dorsal side, tests are either smooth or ornamented by subradial, irregular thickenings (see Text-fig. 13).

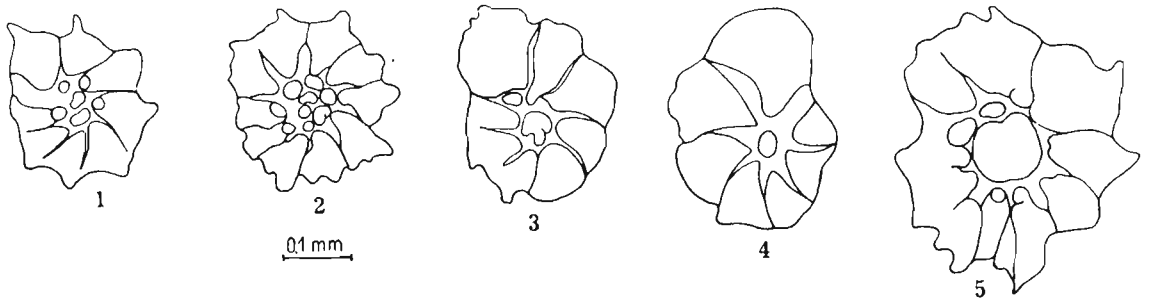


Fig. 13
Individual variation of *Pararotalia tuberculifera* (REUSS); Pamiętowo boring, 215 m, Montian.

Remarks. — This species was studied in details by HOFKER (1957—1963), who presented its numerous variations. Our specimens belong certainly to the same species.

Occurrence. — In Poland, not common in the Paleocene, i.e. Danian and Montian, especially of Pamiętowo boring, where it is most common. Known to be common in the Paleocene (Montian) of Belgium („Puits Artésien" in Mons) and in Maastrichtian-Paleocene of Holland (Bunde).

Genus **ROTALIA** LAMARCK, 1804

Rotalia marginata D'ORBIGNY, 1826

(Pl. V, figs. 2, 5-9; Pl. XVIII, figs. 1-4)

1826. *Rotalia marginata* D'ORBIGNY; A. D'ORBIGNY, Ann. Sci. Nat., p. 106 (272) no. 9 — nom. nud. (*fide* Cat. of Foram., ELLIS & MESSINA).
1850. *Rotalia marginata* D'ORBIGNY; A. D'ORBIGNY, Prodrome de Paléontologie..., vol. 2, p. 407, Figs. 1, 1*a-b*.
1946. *Rotalia marginata* D'ORBIGNY; R. C. VAN BELLEN, Foraminifera from the Middle Eocene..., p. 63, Pl. 8, figs. 11-13.
?1946. *Discorbis pseudodiscoides* VAN BELLEN; R. C. VAN BELLEN, *Ibid.*, p. 53, Pl. 6, figs. 10-15.
1961. *Gavelinopsis pseudodiscoides* (VAN BELLEN); J. HOFKER, Foraminifera..., p. 124, figs. 5*a-c*.
1966. *Discorbis pseudodiscoides* VAN BELLEN; J. HOFKER, Maestrichtian, Danian..., p. 244, Pl. 47, fig. 17*a-c*.

Material. — Thirty five specimens in different state of preservation.

Dimensions of two specimens (in mm):

	F. IX/33	F. IX/29
Longest diameter	0·50	0·25
Shortest diameter	0·47	0·20
Height of test	0·30	—

Description. — Test biconvex, more convex or almost conical on dorsal side, less convex on ventral side, rounded in outline, not lobulate, periphery sharply acute. Two and a half

indistinct whorls on the dorsal side, the last one visible on the ventral side. Chambers strongly compressed, 7—9 in number in the last whorl. Sutures to be seen only on the ventral side, depressed and enlarged at the fairly prominent median knob. The development of median knob varies in different specimens; it may be connected with the walls of the chambers or in different degrees detached from them, moreover, it may have a small hollow on the top, in the middle. Surface smooth and glossy on the dorsal side, distinctly pitted, except the admarginal area on the ventral side. Aperture, slit-like at the base of the last chamber on the ventral side.

Variation rather significant; it concerns above all the size of test and development of central part of the ventral side. The median knob may be developed in many ways; it may be high or low and only rarely is directly connected with the wall chambers, like on Pl. V, fig. 6 and Pl. XVIII, figs. 1—4.

Remarks. — The illustration done by D'ORBIGNY is very schematic and inaccurate, that is why our designation is based on VAN BELLEN's paper (1946). Our specimens represent the same species as described by VAN BELLEN as *Rotalia marginata*, although our specimens are much smaller than those belonging to that species from Holland. *Discorbis pseudodiscoides* VAN BELLEN seems to contain specimens of *R. marginata*, in which the median knob is connected with walls of chambers, as is mentioned in the description and variation of *R. marginata*. This suggestion is confirmed when analysing variation of *R. marginata* specimens from the comparative material from Montian of Holland (Bunde), (see Pl. XVIII, figs. 1—4). Therefore, specimens referred by VAN BELLEN to *Discorbis pseudodiscoides* are here tentatively included into synonymy of *Rotalia marginata*.

Occurrence. — In Poland, common in the Paleocene (Montian) of Pamiętowo boring only. Known to be common in the Paleocene (Montian) of Holland (Bunde) and Belgium („Puits Artésien" in Mons), as well as in the Lower Eocene of France.

Rotalia saxorum D'ORBIGNY, 1850

(Pl. V, figs. 1, 3, 4; Pl. XVIII, figs. 5-9)

1826. *Rotalia saxorum* D'ORBIGNY; A. D'ORBIGNY, Ann. Sci. Nat., p. 106(272), nom. nud. (*fide* Cat. of Foram., ELLIS & MESSINA).
1850. *Rotalia saxorum* D'ORBIGNY; A. D'ORBIGNY, Prodrome de Paléontologie..., p. 407, fig. 5.
1882. *Rotalina perovalis* TERQUEM; O. TERQUEM, Les Foraminifères de l'Eocène..., p. 70, Pl. 6, fig. 5.
1946. *Rotalia saxorum* D'ORBIGNY; R. C. VAN BELLEN, Foraminifera from the Middle Eocene..., p. 64, Pl. 8, figs. 17-19.
1952. *Rotalia perovalis* (TERQUEM); Y. LE CALVEZ, Révision des Foraminifères..., p. 49, Pl. 4, figs. 47-48.
1959. *Rotalia saxorum* D'ORBIGNY; J. HOFKER, Les Foraminifères des craies..., p. 286, figs. 79-84.
1966. *Rotalia saxorum* D'ORBIGNY; J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 263, Pl. 55, fig. 94; p. 246, Pl. 47, fig. 20*a-c*.
1966. *Rotalia perovalis* (TERQUEM); J. HOFKER, *Ibid.*, p. 263, Pl. 55, fig. 97.

Material. — About 20 specimens in a rather poor state of preservation.
Dimensions of two specimens (in mm):

	F. IX/34	F. IX/35
Longest diameter	0·50	0·25
Shortest diameter	0·46	0·20
Height of test	0·28	—

Description. — Test plano-convex, flat on the ventral side, conical on the dorsal side, quite round in outline, not lobulate, periphery acute. Test is composed of probably more than

two whorls, the last one containing 6—7 chambers visible on the ventral side. The arrangement of chambers on the dorsal side is quite obscured, sutures flush with surface not visible. On the ventral side, sutures distinct, do not reach the margin of test, but become deeper and enlarged near the well pronounced umbilical plug. Surface coarsely pitted on the ventral side around the umbilicus, smooth and glossy on the dorsal side, as well as along the periphery of ventral side. Aperture, slit-like at the base of the last formed chamber, on ventral side.

Variation insignificant; it applies mainly to the general size of test and the development of older raised parts of chambers (tena), which are developed in different degree. In small specimens, probably young ones, tena are not yet distinctly developed (see Pl. V, figs. 3—4 and Pl. XVIII, figs. 5—9).

Remarks. — Our specimens seem to differ only in size from those described by D'ORBIGNY (1825, emend. FORNASINI, 1906), VAN BELLEN (1946) and HOFKER (1959, 1966). Specimen illustrated and described by TERQUEM (1882), revised by LE CALVEZ (1952), as *Rotalia perovalis* from the Lutetian of Paris Basin, is in our opinion conspecific with *R. saxorum* D'ORBIGNY, falling well within the variability of this last one, as it was observed in the comparative material from Montian of Holland (Bunde) and as is shown on Pl. XVIII, figs. 5—9. It seems that very often specimens, referred to *R. perovalis* (TERQUEM), in reality represent the early stages of ontogenetic development of *R. saxorum* D'ORB. That is why HOFKER's illustrated specimen of *R. perovalis* (TERQ.) is included here into synonymy of *R. saxorum* D'ORB.

Occurrence. — In Poland, rare in the Paleocene (Montian) of Pamiętowo boring only. Known to be common from the Maastrichtian up to Paleocene (Montian) of Holland (Bunde), Belgium („Puits Artésien" in Mons) and Germany (Krefeld region). Probably present in the Eocene (Lutetian) of France (Paris Basin).

Rotalia trochidiformis (LAMARCK, 1804)

(Pl. V, fig. 10; Pl. XVII, figs. 5-8)

1804. *Rotalites trochidiformis* LAMARCK; J. B. LAMARCK, Ann. Mus., vol. 5, p. 184.
1806. *Rotalites trochidiformis* LAMARCK; J. B. LAMARCK, *Ibid.*, vol. 8, Pl. 14, fig. 8*a-b*.
?1850. *Rotalia thouini* D'ORBIGNY; A. D'ORBIGNY, Prodrome de Paléontologie..., p. 107, (nom. nud.), see FORNASINI 1906, Mém. R. Acad. Sci. Bologna, ser. 6, t. 3, Pl. 2, fig. 7 (*fide* Cat. of Foram., ELLIS & MESSINA).
1882. *Rotalina saxorum* (D'ORBIGNY); O. TERQUEM, Les Foraminifères de l'Eocène..., p. 69, Pl. 6, fig. 4.
1946. *Rotalia trochidiformis* (LAMARCK); R. C. VAN BELLEN, Foraminifera from the Middle Eocene..., p. 66, Pl. 9, figs. 7-9.
1946. *Rotalia trochidiformis* (LAMARCK) var. VAN BELLEN; R. C. VAN BELLEN, *Ibid.*, p. 66, Pl. 9, figs. 4-6.
1946. *Rotalia thouini* D'ORB.; R. C. VAN BELLEN, *Ibid.*, p. 65, Pl. 9, figs. 1-3.
1954. *Rotalia trochidiformis* (LAMARCK); A. H. SMOUT, Lower Tertiary Foraminifera..., p. 43, Pl. 1, figs. 1-6 (*fide* Cat. of Foram., ELLIS & MESSINA).
1955. *Rotalia trochidiformis* (LAMARCK); J. HOFKER, Foraminifera from the Cretaceous..., XI, p. 119, Text-figs. *a-c* on p. 121.
1959. *Rotalia trochidiformis* (LAMARCK); J. HOFKER, Les Foraminifères des craies..., p. 287, figs. 85-94.
1959/60. *Rotalia trochidiformis* (LAMARCK); J. HOFKER, Les Foraminifères du Crétacé..., p. 376, fig. 38*a-c*.
unpubl. *Rotalia trochidiformis montensis* MARIE; P. MARIE, Les Foraminifères du Calcaire Pisolithique..., (MS), Pl. 20, figs. 1-5.
1966. *Rotalia trochidiformis* (LAMARCK); J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 247, Pl. 47, fig. 19*a-c*.

Material. — A single specimen somewhat damaged.
Dimensions of one specimen (in mm):

	F. IX/258
Longest diameter	0·35
Shortest diameter	0·35

Description. — Test trochoidal, biconvex, almost round in outline, periphery distinctly acute, not lobulate, ventral side more convex than the dorsal one. Chambers 7 in number seen on both sides, arranged in two or two and a half whorls, sutures radial, deeply depressed and slightly ramified on the ventral side, somewhat curved and flush with surface on the dorsal side. Surface smooth; coarse pits occur on the dorsal side, mainly between septal sutures, disappearing in the central part of test. Aperture not visible.

Remarks. — According to the revision of *Rotalia trochidiformis* (LAMARCK, 1804) by SMOUT (1954), our single specimen is very similar to specimens referred to this species. In comparison with illustrated specimens, described as *R. trochidiformis* by VAN BELLEN (1946), SMOUT (1954) and HOFKER (1955, 1959, 1966), our specimen is smaller, more convex on the ventral side than on the dorsal, and with not such intensively ramified sutures on the ventral side. The periphery of the Polish specimen is more acute, with umbilicus lacking. Specimens illustrated by MARIE (MS) from „Calcaire Pisolithique" of France, assigned by him to a new subspecies, seem not to differ from the specimens known as *R. trochidiformis* (LAMARCK). *Rotalia trochidiformis* described by LAMARCK (1804) and *R. thouini* described by D'ORBIGNY (1826), both from the Eocene (Lutetian) of France, are known as differing each other in the presence of a pronounced umbonal plug in specimens of *R. thouini* and lack of it in specimens of *R. trochidiformis*. As may be observed, however, on tests undoubtedly belonging to *R. trochidiformis* from the Paleocene, i.e. Montian of Holland (Bunde), the development of their central part of ventral side seem to be changeable to a different degrees within one species (see Pl. XVII, figs. 5—8).

Occurrence. — In Poland a single specimen found in the Paleocene, i.e. Montian of the Pamiętowo boring only. Known to be common in the Paleocene (Montian) of Belgium („Puits Artésien" in Mons), Holland (Bunde), France (Paris Basin), Germany (Krefeld region), the Paleocene of India and Eocene of Syria and Iraq.

Family ELPHIDIIDAE GALLOWAY, 1933

Genus **ELPHIDIUM** DE MONTFORT, 1808

Elphidium cf. **lamarcki** (D'ORBIGNY, 1826)

(Pl. IX, figs. 1-5)

1826. *Nonionina lamarckii* D'ORBIGNY; A. D'ORBIGNY, Ann. Sci. Nat., p. 128 (294) nom. nud. (*fide* Cat. of Foram., ELLIS & MESSINA).
1904. *Nonionina lamarckii* D'ORBIGNY; C. R. FORNASINI, Mem. R. Acad. Sci. Bologna, Pl. 3, fig. 1.

Material. — About 40 specimens, in most cases well preserved.
Dimensions of specimens (in mm):

	F. IX/53	F. IX/55
Longest diameter	0·22	0·27
Shortest diameter	0·20	0·22
Height of test	—	0·12

Description. — Test planispiral, involute, biconvex, nearly round in outline, periphery abruptly acute, slightly keeled. Chambers 12—14 in number in the last whorl, separated by strongly curved, slightly limbate, depressed sutures, on which there are more distinct or less

distinct, small openings. Umbilical region depressed, covered by numerous, regular, small papillae, extending on the periphery at the base of the last formed chamber. Aperture developed as a row of pores along the base of the last chamber.

Variation insignificant; it applies mainly to the size, number of chambers and development of sutural pores, as well as to the papillae within the umbilical region.

Remarks. — Our specimens are similar to figured specimen described by d'ORBIGNY (1826) as *Nonionina lamarckii*, however, this last one is illustrated very schematically. Ours are more compressed laterally having less chambers, and for that reason they are referred as conformed to *Elphidium lamarcki*. Our specimens resemble somewhat, in their general appearance, specimens described by VAN BELLEN (1946, p. 42, Pl. 3, figs. 22—25) as *Nonion geleenense*. They differ, however, in having distinctly depressed, fairly tuberculated umbilical region.

Occurrence. — In Poland, common in the Paleocene (Montian) of Polish Lowlands and Pamiętowo boring. Present in the Paleocene (Montian) of Belgium („Puits Artésien" in Mons) and Holland (Bunde) and in the Lower Tertiary sediments of France.

Genus **ELPHIDIELLA** CUSHMAN, 1936

Elphidiella prima (TEN DAM, 1944)

(Pl. IX, figs. 16-19)

1944. *Elphidium primum* TEN DAM; A. TEN DAM, Die stratigraphische..., p. 109, Pl. 3, fig. 15.
1946. *Nonion multisuturatum* VAN BELLEN; R. C. VAN BELLEN, Foraminifera from the Middle Eocene..., p. 44, Pl. 4, figs. 4-6.
1948. *Elphidiella prima* (TEN DAM); F. BROTZEN, The Swedish Paleocene..., p. 70, Pl. 8, fig. 2.
1965. *Elphidiella prima* (TEN DAM); J. INDANS, Mikrofaunistisches Normalprofil..., p. 12, Pl. 1, fig. 6.

Material. — About 50 specimens well preserved.
Dimensions of two specimens (in mm):

	F. IX/61	F. IX/63
Longest diameter	0·30	0·60
Shortest diameter	0·25	0·55
Height of test	—	0·36

Description. — Test planispiral, involute, convex on both sides, round and indistinctly lobulate in outline, periphery rounded or slightly angled. Chambers 12 in number in the last whorl, moderately increasing in size as added. A distinct elevated umbo is developed in the umbilical region. Sutures slightly depressed between the last chambers and flush with surface between the chambers in the early portion of test, with two rows of pores. Aperture invisible, surface smooth, glossy.

Variation insignificant; in small specimens tiny papillae like tubercles occur at the inner margin of the last chamber, while sutural openings and umbo are indistinct.

Remarks. — Specimens described as *Elphidiella prima* from Poland differ from those described as *Elphidium primum* by TEN DAM (1944), or as *Elphidiella prima* by VAN BELLEN (1946) and BROTZEN (1948) but only in having generally somewhat less chambers in last whorl.

Occurrence. — In Poland, common in the Paleocene (Montian) of Polish Lowlands and Pamiętowo boring. Known to be common in the Paleocene, i.e. Danian and Selandian of Sweden, Montian of Holland (Bunde), France and Germany (Krefeld region).

Family GLOBOROTALIIDAE CUSHMAN, 1927

Genus **GLOBOROTALIA** CUSHMAN, 1927

Globorotalia globigeriniformis VAN BELLEN, 1946

(Pl. VII, figs. 11-19)

1946. *Globorotalia globigeriniformis* VAN BELLEN; R. C. VAN BELLEN, Foraminifera from the Middle Eocene..., p. 71, Pl. 10, figs. 10-12.

?1961. *Pararotalia globigeriniformis* (VAN BELLEN); J. HOFKER, Foraminifera from the Cretaceous..., LIV, p. 86, fig. 2*a-c*.

?1962. *Pararotalia globigeriniformis* (VAN BELLEN); J. HOFKER, Correlation..., p. 1082, Text-fig. 26*B*.

1966. *Pararotalia globigeriniformis* (VAN BELLEN); J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 233, Pl. 44, fig. 123*a-c*.

Material. — About 120 specimens well preserved.
Dimensions of two specimens (in mm):

	F. IX/71	F. IX/66
Longest diameter	0·35	0·20
Shortest diameter	0·30	0·17
Height of test	0·16	—

Description. — Test plano-convex, thick, rounded in outline, strongly lobulate in adult or angled in juvenile forms, periphery broadly rounded. The ventral side moderately convex, dorsal side nearly flat. Chambers globular, 6—7 in number in the last whorl, arranged in one or two whorls; only the outer whorl to be seen on the ventral side. Sutures depressed on both sides, more on the ventral one, especially near the umbilicus, radial or slightly oblique between the last chambers. On the dorsal side there occur a rib-like projections in juvenile forms, or knob-like projections in the adult forms. Umbilicus generally filled by a single or several knobs, bordered by the older raised parts of chambers (tena). Surface rough, especially in the central part of the ventral side, distinctly porous. Aperture as a slit at the base of the last formed chamber, on the ventral side.

Variation considerable; it applies to the size, general shape and ornamentation. The outline varies from the sharply angled up to the regularly, gently lobulate. Chambers not globular, compressed in the juvenile forms up to prominently globular in the adult, ornamentation more intensively developed in the adult forms, whose surface is also more rough (see Pl. VII, figs. 11—18).

Remarks. — General appearance of specimens, described as *Globorotalia globigeriniformis* from the Montian of Poland, seems to be very similar to the illustrated forms described by VAN BELLEN (1946) as a *G. globigeriniformis* from the Eocene (recte Montian) of Holland. Our specimens do not differ from those described by HOFKER in 1966, who revised VAN BELLEN'S original collection. However, Polish specimens are markedly smaller and they have less chambers in the last whorl. Moreover, generally they have a plug in the central part of the ventral side. Specimens, described by HOFKER (1961, 1962) as *Pararotalia globigeriniformis*, from the layers lying just above the „Md" horizon in Holland, are here only tentatively included into synonymy of *Globorotalia globigeriniformis*. In comparison with specimens described by VAN BELLEN and with those occurring in Poland, they are too sharply angled in the outline and they differ in the development of umbilicus.

Occurrence. — In Poland, very common in the Paleocene (Montian) of Polish Lowlands (Sochaczew boring) and Pamiętowo boring. Known as common in the Paleocene (Montian) of Belgium („Puits Artésien" in Mons), Holland (Bunde), and Germany (Krefeld region).

Globorotalia praepseudomenardii HOFKER, 1961

(Pl. VI, figs. 7-10)

1961. *Globorotalia praepseudomenardii* HOFKER; J. HOFKER, Foraminifera from the Cretaceous..., XIV, p. 85, fig. 1*a-d*.
1961. *Globorotalia praepseudomenardii* HOFKER; J. HOFKER, Les Foraminifères planctoniques..., p. 56.
1966. *Globorotalia praepseudomenardii* HOFKER; J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 233, Pl. 43, fig. 105; Pl. 46, fig. 140.

Material. — About 50 specimens, generally somewhat damaged.
Dimensions of two specimens (in mm):

	F. IX/83	F. IX/81
Longest diameter	0·30	0·23
Shortest diameter	0·23	0·18
Height of test	0·10	—

Description. — Test compressed, flatly biconvex, trochoidal, slightly ovate in outline, periphery lobulate, bluntly acute, keeled. Dorsal side, with all chambers visible in last whorl, more convex than ventral side. Chambers gently inflated, especially on the ventral side in the outer whorl, arranged in two whorls, 8 in number in the last whorl, rapidly increasing in size as added. Sutures radial on the ventral side, curved or even sickled on dorsal, more depressed on ventral side. Umbilicus distinctly developed, generally filled up with a single or several knobs, formed by older raised parts of chambers (tena). Surface slightly rough, wall porous. Aperture a slit-like on the ventral side, at the base of the last formed chamber.

Variation insignificant; it applies to the size, general shape and ornamentation. The smaller tests are less lobulate in outline, with less pronounced particular chambers, moreover they have a singular umbilical plug. Dorsal side is more porous or less, or even covered by papillae-like ornamentation.

Remarks. — In comparison with the illustrated holotype of *Globorotalia praepseudomenardii* HOFKER (1961), our specimens differ only in having the umbilical plug and in being not so high. Some specimens represented by KAASSCHIETER as *Rotalia audouini* D'ORB. (1961, p. 241, Pl. 16, figs. 8—10), seem to be very similar to specimens assigned by the present writers to *G. praepseudomenardii* HOFKER. However, our specimens are never spinulose, i.e. never ornamented with spines along the periphery and they have a very distinct furrow around the umbilical plug.

Globorotalia praepseudomenardii seems to be not related with *G. pseudomenardii* as may be suggested by its name; this last one described by BOLLI (1957), has different general appearance, and particularly differently arranged chambers.

Occurrence. — In Poland, common in the Paleocene (Montian) of the Pamiętowo boring only. Known to be common in the Montian of Belgium („Puits Artésien" in Mons), Holland (Bunde), France, and of Germany (Krefeld region). This species seems to be a good index fossil for beds of Montian age.

Globorotalia sp.

(Pl. VI, figs. 1-4)

1946. *Rotalia? marginata* D'ORBIGNY; R. C. VAN BELLEN, Foraminifera from the Middle Eocene..., p. 63, Pl. 8, figs. 8-10 (non *Rotalia marginata* D'ORBIGNY, 1850, p. 407, type figure, see FORNASINI, 1906, Pl. 2, fig. 1).

Material. — Nine specimens well preserved.
Dimensions of two specimens (in mm):

	F. IX/85	F. IX/88
Longest diameter	0·25	0·40
Shortest diameter	0·20	0·32
Height of test	0·10	—

Description. — Test plano-convex, slightly convex on the dorsal side, flat or even concave on ventral side, nearly round and gently lobulate in outline. Periphery bluntly acute, somewhat keeled. Nearly two whorls visible on the dorsal side, out of which only last one is seen on the ventral side. Chambers distinct, slightly inflated on both sides, especially the last ones, 6 in number in the last whorl. Sutures somewhat curved, depressed on ventral side, nearly flush with surface on dorsal side. A shallow small umbilicus, usually filled by a low plug, occurs on ventral side. Surface smooth, on ventral side, except the admarginal periphery, distinctly pitted. Aperture, a slit-like between the periphery and the umbilicus, generally poorly visible.

Variation not known due to the scarcity of material. The studied specimens differ only in size and development of the umbilical area.

Remarks. — Our specimens are the most similar to those illustrated and described by VAN BELLEN (1946) as *Rotalia? marginata* D'ORB. from the Eocene (recte Montian) of Holland. Polish specimens differ from them only in being less conical on the dorsal side. They differ, however, conspicuously from specimens referred to *R. marginata* — species erected by D'ORBIGNY.

Occurrence. — In Poland, rare in the Paleocene (Montian) of the Pamiętowo boring only. Found by the present authors in the Paleocene (Montian) of Holland (Bunde) and Belgium („Puits Artésien" in Mons). Present in Calcaire pisolithique (Montian) of France.

Genus **GLOBOROTALITES** BROTZEN, 1942

Globorotalites granulatus n. sp.

(Pl. VIII, figs. 1-7)

1962. *Globorotalites?* n. sp.; M. E. SCHMID, Die Foraminiferenfauna..., p. 350, Pl. 6, fig. 8*a-c*.

Holotypus: Specimen presented on Pl. VIII, fig. 7 (F. IX/80).
Paratypi: Specimens presented on Pl. VIII, figs. 1, 6 (F. IX/74, 79); Pamiętowo boring, 274·5 m.
Stratum typicum: Montian.
Locus typicus: Sochaczew boring, depth 194 m (Central Poland).
Derivatio nominis: Lat. *granulatus* — from the granulation, characteristic for the umbilical part of test.

Material. — About 80 specimens, some of them damaged.
Dimensions of 3 specimens (in mm):

	F. IX/80	F. IX/74	F. IX/19
Longest diameter	0·30	0·22	0·35
Shortest diameter	0·28	0·17	0·25
Height of test	0·18	—	0·22

Description. — Test trochospiral, usually high, outline nearly rounded, gently lobulate, periphery acute, slightly keeled. Dorsal side flat or even convex, ventral side distinctly convex. Chambers angular, inflated on the ventral side, arranged in 2—3 whorls; five chambers

of the last whorl increase rapidly in size as added. Sutures slightly depressed ventrally, flush with surface dorsally, generally curved, even sickled on the ventral side. Umbilicus more deep or less, filled by small papillae, or opened and then bordered by well developed inner raised parts of chambers (tena). Surface smooth, glistening. Aperture, an enlarged slit on the ventral side, at the base of last chamber near the umbilicus, partly obscured by umbilical papillae.

Variation rather significant, concerning both the size, coiling and general appearance of test. Within the studied specimens there are forms with quite flat or somewhat convex dorsal side, with more elevated or less elevated chambers on ventral side and with large, deep, well developed umbilicus or with an indistinct umbilicus, and then without distinguished tena. This last one depends probably on the stage development of test. Umbilical papillae are also differently scattered inside the umbilicus.

Remarks. — Our specimens are comparable to *Globorotalia angulata* (WHITE), on one hand, and with *G. acuta* TOULMIN, on the other. From the first they differ in having a more acute keeled periphery, less depressed and not radial sutures and in having fairly smooth surface. In contrast to specimens referred to *G. acuta*, our specimens have not so thickened keel and sutures on the dorsal side and have chamber tops (tena) glistening, without any ornamentation. Contrarily to two above mentioned species, our specimens have rather characteristic papillae inside the umbilical depression, which are lacking in other species of *Globorotalites* genus. Specimens of *G. granulatus*, especially those young ones, resemble figured specimen of *Globorotalites?* n. sp., described by SCHMID (1962) from the Danian[3] of Austria. Both forms, from Poland and Austria, are very similar in general appearance, but as results of description and illustration of *Globorotalites?* n. sp. specimens, they lack papillae or a sort of tubercles inside their umbilicus; there is, however, no difference between these probably conspecific forms when take under consideration SCHMID's original collection. Close to *Globorotalia kochi* PIJPER from Upper Eocene.

Occurrence. — In Poland, common in the Paleocene (Montian) of Pamiętowo and Polish Lowlands. Present in Danian[3] of Austria. This species seems to be a good index fossil for Montian Beds.

Family GLOBIGERINIDAE CARPENTER, PARKER & JONES, 1862

Genus **GLOBIGERINA** D'ORBIGNY, 1826

Globigerina aff. **compressa** PLUMMER, 1926

(Text-fig. 14)

1926. *Globigerina compressa* PLUMMER; H. J. PLUMMER, Foraminifera of the Midway..., p. 135, Pl. 8, fig. 11.
1953. *Globigerina compressa* PLUMMER var. *compressa* PLUMMER; N. N. SUBBOTINA, Globigerinidy..., p. 56, Pl. 2, figs. 2-6.
1955. *Globorotalia compressa* PLUMMER; J. CUVILLIER, F. DALBIEZ & C. GLINTZBOECKEL, Etudes micropaléontologiques..., Pl. 1, fig. 3*a-c*.
1957. *Globorotalia compressa* PLUMMER; H. M. BOLLI, The genera *Globigerina*..., p. 77, Pl. 20, figs. 21-23.
1957. *Globigerina compressa* PLUMMER; J. C. TROELSEN, Some planctonic Foraminifera..., p. 129, Pl. 30, fig. 5*a-c*.
1960. *Globorotalia compressa* (PLUMMER); R. K. OLSSON, Foraminifera of latest Cretaceous..., p. 45, Pl. 8, figs. 20-22.
1961. *Globorotalia compressa* (PLUMMER); P. J. BERMUDEZ, Contribucio al estudio..., p. 1285, Pl. 14, fig. 8*a-b*.

[3] The Danian age of „Bruderndorfer Feinsandes" from Austria is called in question here by the present writers.

1962. *Globorotalia (Turborotalia) compressa* (PLUMMER); W. A. BERGGREN, Some planctonic..., p. 94, Pl. 14, fig. 5*a-c*; Text-fig. 13 (1-6).
1962. *Globigerina compressa* PLUMMER; M. E. SCHMID, Die Foraminiferenfauna des Bruderndorfer..., p. 347, Pl. 6, fig. 6*a-c*.
1965. *Globigerina* sp.; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 126, Pl. 22, fig. 1*a-c*.
1966. *Globorotalia compressa* (PLUMMER); Z. R. EL-NAGGAR, Stratigraphy..., p. 203, Pl. 17, figs. 1-3.
non 1966. *Globigerina compressa* PLUMMER; J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 231, Pl. 43, fig. 94.

Material. — A dozen or so specimens, often damaged.
Dimensions of an average specimen (in mm):

	F. VI/127
Longest diameter	0·22
Shortest diameter	0·19
Height of test	0·12

Description. — Test small, very low, trochospiral, plano-convex, somewhat compressed, outline lobulate, periphery broadly rounded or acute. Dorsal side flat, ventral convex. Chambers

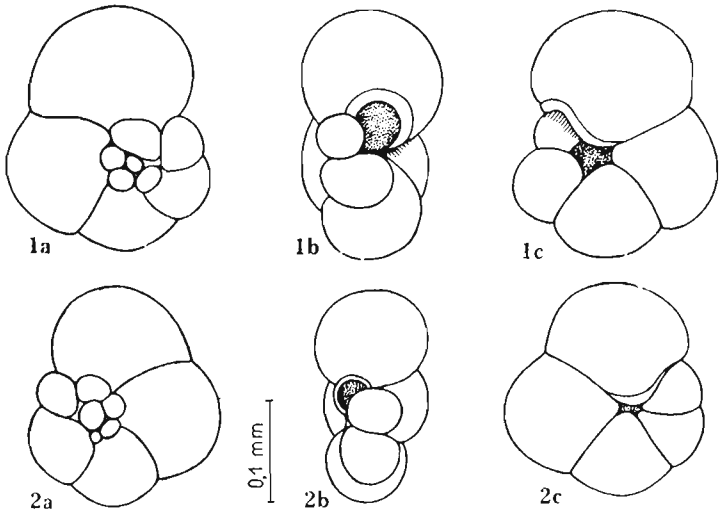


Fig. 14
Individual variation of *Globigerina* aff. *compressa* PLUMMER; Pamiętowo boring, 241 m, Montian.

inflated, sometimes globular, generally 5 in number in the last whorl, rapidly increasing in size as added. Sutures distinctly depressed. Umbilical depression narrow and deep. Aperture, a low arched opening, extending from the umbilicus towards the periphery, bordered by a distinct lip. Wall smooth, very finely perforated.

Globigerina daubjergensis BRÖNNIMANN, 1953

1953. *Globigerina daubjergensis* BRÖNNIMANN; P. BRÖNNIMANN, Note on planctonic..., p. 340, Text-fig. 1.
1962. *Globigerina daubjergensis* BRÖNNIMANN; M. E. SCHMID, Die Foraminiferenfauna..., p. 346, Pl. 6, fig. 4*a-c*.
1965. *Globigerina daubjergensis* BRÖNNIMANN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 121, Pl. 23, fig. 4*a-c* *(here additional synonymy included)*.
1966. *Globigerina daubjergensis* BRÖNNIMANN; Z. R. EL-NAGGAR, Stratigraphy..., p. 161, Pl. 15, fig. 3*a-c*.

Material. — A few specimens well preserved.

Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland, in the Paleocene, i.e. Danian and Montian, where it is less common, of Pamiętowo boring and Polish Lowlands. This species is an index fossil for the Danian beds all over the world.

Globigerina kozlowskii BROTZEN & POŻARYSKA, 1961

(Text-fig. 15)

1916. *Globigerina kozlowskii* BROTZEN & POŻARYSKA; F. BROTZEN & K. POŻARYSKA, Foraminifères du Paléocène..., p. 162, Pl. 1, figs. 1-14; Pl. 2, figs. 1-17.
1962. *Globigerina kozlowskii* BROTZEN & POŻARYSKA; J. HOFKER, Foraminifera from the Cretaceous..., LXI, p. 129, Text-fig. on p. 130.
1965. *Globigerina kozlowskii* BROTZEN & POŻARYSKA; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 122, Pl. 23, fig. 1*a-c*.
1966. *Globigerina kozlowskii* BROTZEN & POŻARYSKA; Z. R. EL-NAGGAR, Stratigraphy..., p. 168, Pl. 15, figs. 1*a-c*, 2.
1966. *Globigerina kozlowskii* BROTZEN & POŻARYSKA; J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 231, Pl. 46, fig. 139.

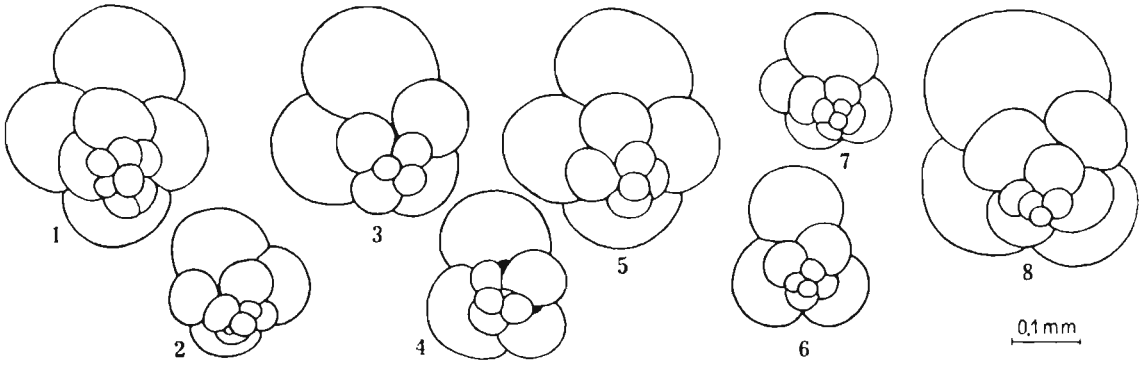


Fig. 15
Individual variation of *Globigerina kozlowskii* BROTZEN & POŻARYSKA; Pamiętowo boring, 243 m, Montian.

Material. — One hundred or so specimens well preserved.

Dimensions, description, a detailed variation and remarks are given in the paper by BROTZEN & POŻARYSKA (1961) and POŻARYSKA (1965); additional examples of infraspecific variation are given above (Text-fig. 15).

Occurrence. — In Poland common in the Paleocene, i.e. Montian of Pamiętowo boring and Polish Lowlands. Present in the Paleocene of Holland (Limburg region and Bunde boring). Noted in Egypt by EL-NAGGAR (1966) as early as in the uppermost Danian up to the Lower Paleocene.

Globigerina pseudobulloides PLUMMER, 1926

1926. *Globigerina pseudobulloides* PLUMMER; H. J. PLUMMER, Foraminifera of the Midway..., p. 133, Pl. 8, fig. 9.
1962. *Globigerina pseudobulloides* PLUMMER; M. E. SCHMID, Die Foraminiferenfauna..., p. 348, Pl. 6, figs. 1*a-c*, 2.
1965. *Globigerina pseudobulloides* PLUMMER; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 123, Pl. 23, figs. 2-3.
1966. *Globorotalia pseudobulloides* (PLUMMER); Z. R. EL-NAGGAR, Stratigraphy..., p. 224, Pl. 18, fig. 3*a-c*.

Material. — About 50 specimens, rather well preserved.

Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland common in the Paleocene, i.e. in Danian and Montian of Polish Lowlands and Pamiętowo boring. Common from uppermost Cretaceous up to the Lower Tertiary all over the world.

Globigerina (Subbotina) triloculinoides PLUMMER, 1926

1926. *Globigerina triloculinoides* PLUMMER; H. J. PLUMMER, Foraminifera of the Midway..., p. 134, Pl. 8, fig. 10.
1965. *Globigerina (Subbotina) triloculinoides* PLUMMER; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 124, Pl. 22, fig. 2*a-c (here additional synonymy included)*.
1966. *Globigerina triloculinoides* PLUMMER; Z. R. EL-NAGGAR, Stratigraphy..., p. 178, Pl. 15, fig. 7*a-c*.

Material. — About 30 specimens well preserved.

Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965) and a detailed discussion in EL-NAGGAR'S paper (1966).

Occurrence. — In Poland not so common in the Paleocene, i.e. Danian and Montian, where it is more common than in Danian, of Polish Lowlands and Pamiętowo boring. Known to be common from the Danian up to the Eocene from some countries in Europe and America. Restricted to the Paleocene in Egypt (Esna-Idfu region), where is considered as one of the best index fossils for the Paleocene.

Globigerina trivialis SUBBOTINA, 1953

1953. *Globigerina trivialis* SUBBOTINA; N. N. SUBBOTINA, Globigerinidy..., p. 64, Pl. 4, figs. 4-6, non figs. 7-8.
1965. *Globigerina trivialis* SUBBOTINA; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 125, Pl. 22, fig. 3*a-c (here additional synonymy included)*.

Material. — Several specimens well preserved.

Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland rare in the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known from the uppermost Maastrichtian up to the Danian in U.S.S.R. (Russian Platform).

Globigerina varianta SUBBOTINA, 1953

1953. *Globigerina varianta* SUBBOTINA; N. N. SUBBOTINA, Globigerinidy..., p. 63, Pl. 3, figs. 5, 10-12; Pl. 4, figs. 1-3; Pl. 15, figs. 1-3.
1965. *Globigerina varianta* SUBBOTINA; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 125, Pl. 23, fig. 5*a-c (here additional synonymy included)*.

Material. — Several specimens well preserved.

Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland rare in the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known to be common in Europe in the Lower Tertiary sediments up to the Eocene.

Family EPONIDIDAE HOFKER, 1957

Genus **EPONIDES** DE MONTFORT, 1808

Eponides toulmini BROTZEN, 1948

(Pl. XV, figs. 1-4)

1946. *Eponides gratus* (REUSS); R. C. VAN BELLEN, Foraminifera from the Middle Eocene..., p. 57, Pl. 7, figs. 4-9 (non *Rotalia grata* REUSS, 1865, p. 47, Pl. 4, fig. 17).
1948. *Eponides toulmini* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 178, Pl. 10, fig. 16.
1959. *Alabamina bigibbera* LE CALVEZ; Y. LE CALVEZ, Etude de quelques Foraminifères..., p. 94, Pl. 1, figs. 5–7.
1960. *Eponides veslensis* ROUVILLOIS; A. ROUVILLOIS, Le Thanétien..., p. 68, Pl. 2, fig. 29*a-b*.
1961. *Eponides toulmini* BROTZEN; J. P. H. KAASSCHIETER, Foraminifera of the Eocene..., p. 211, Pl. 12, fig. 2*a-c*.
1965. *Eponides toulmini* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 110, Pl. 17, fig. 4*a-c*.
1965. *Eponides gratus* (REUSS); J. INDANS, Mikrofaunistisches Normalprofil..., p. 13, Pl. 1, fig. 2.
1966. *Eponides toulmini* BROTZEN; J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 261, Pl. 54, figs. 83-84.

Material. — Some hundred specimens well preserved.
Dimensions, description and remarks are given in POŻARYSKA'S paper (1965).

Variation rather significant; there are forms coiled left as well as right, with periphery acute to different degrees and round or distinctly lobulate outline. Tests differ in height and number of chambers. Juvenile specimens have less coils than adult ones and they are not so high (see Pl. XV, figs. 1—4).

Remarks. — According to remarks in POŻARYSKA'S paper (1965), it must be added here that the specimens, described by ROUVILLOIS (1960) as *Eponides veslensis*, and specimen figured by LE CALVEZ (1959), described as *Alabamina bigibbera* n. sp., represent undoubtedly *Eponides toulmini* BROTZEN.

Occurrence. — In Poland, very common in the uppermost Cretaceous and the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known as common from the Upper Maastrichtian up to the Paleocene (Montian) of Holland, Belgium, France, Germany and U.S.S.R., from the Paleocene, i.e. Thanetian of France (Paris Basin) and England.

Genus **NEOEPONIDES** REISS, 1960

Neoeponides cf. **schreibersi** (D'ORBIGNY, 1846)

(Pl. XV, fig. 5)

1846. *Rotalina schreibersii* D'ORBIGNY; A. D'ORBIGNY, Foraminifères fossiles..., p. 154, Pl. 8, figs. 4-6.
1960. *Neoeponides schreibersi* (D'ORBIGNY); Z. REISS, Structure of the so-called *Eponides*..., p. 17.
1961. *Eponides schreibersi* (D'ORBIGNY); J. P. H. KAASSCHIETER, Foraminifera from the Eocene..., p. 210, Pl. 11, figs. 14, 15*a-c*.

Material. — Two specimens well preserved.
Dimensions of one specimen (in mm):

	F. IX/93
Longest diameter	0·23
Shortest diameter	0·20
Height of test	0·11

Description. — Test small, trochospiral, plano-convex, high on dorsal side, nearly flat on ventral side, outline lobulate, rounded, periphery angled and carinate, about 3 whorls poorly visible on dorsal side; ventral side involute, with triangular chambers slightly inflated, 9—10 in number in the last whorl. Sutures indistinct in the early portion of whorl, slightly depressed between last chambers; spiral suture fairly thickened, septal sutures oblique, flush with surface on dorsal side, radial on ventral side. A small, distinct umbilical depression, surrounded by weakly developed secondary thickenings of older raised parts of chambers (tena) near umbilical margin, forming there a star-like pattern. Surface smooth, glassy, finely porous. Aperture poorly visible as an interiomarginal slit-like arch, extending from the periphery to umbilicus.

Variation not known due to the scarcity of material.

Remarks. — Our specimens seem to be the most similar to the figured specimen of *Rotalina schreibersi* (recte *Neoeponides schreibersi*), species described by D'ORBIGNY (1846) from Miocene of Vienna Basin. Polish specimens in comparison with that from Austria differ, however, in being smaller, less biconvex, and in having thickened spiral suture. Tena are not so distinctly developed. In the Paleocene, i.e. Montian of Holland (Bunde and Beatrix borings) and in the Eocene of Belgium (see KAASSCHIETER, 1961) there are specimens more similar to that from the Miocene of Vienna Basin, so it is quite possible that in Polish Montian there occur the most primitive forms, representing a starting line of the above mentioned species. A detailed revision of this species is given by REISS (1960), after whom systematic position of the above discussed species is maintained here.

Occurrence. — In Poland, two specimens in the Paleocene, i.e. Montian of the Pamiętowo boring only. Present in the Paleocene (Montian) of Holland (Bunde and Beatrix borings) according to present writers' own observation. Known in the Eocene of Belgium and Miocene of Austria (Vienna Basin), Israel and Morocco.

Family CIBICIDIDAE CUSHMAN, 1927

Genus **CIBICIDES** DE MONTFORT, 1808

Cibicides asteroides n. sp.

(Pl. XI, figs. 3-7)

?1961. *Cibicides* sp. cf. *mauricensis* HOWE & ROBERTS; J. P. H. KAASSCHIETER, Foraminifera of the Eocene..., p. 223, Pl. 14, fig. 8.

1965. *Cibicides* sp.; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 138, Pl. 28, fig. 3*a-c*.

Holotypus: Specimen presented on Pl. XI, fig. 7 (F. IX/98).

Paratypi: Specimens presented on Pl. XI, figs. 5, 6 (F. IX/96, 97).

Stratum typicum: Montian.

Locus typicus: Pamiętowo boring, depth 215 m (North Poland).

Derivatio nominis: Lat. *asteroides* = star-like; after a star-like pattern, developed in the central part of the ventral side.

Material. — About 50 specimens, in most cases well preserved.

Dimensions of 3 specimens (in mm):

	F. IX/96	F. IX/97	F. IX/98
Longest diameter	0·25	0·42	0·35
Shortest diameter	0·22	0·35	0·25
Height of test	—	—	0·15

Description. — Test plano-convex, almost round and gently lobulate in outline, peripheral margin angular. Dorsal side, nearly flat, bears a small plug, surrounded by a more distinct or less distinct furrow, penetrating somewhat into the inner margin of chambers and forming there a star-like pattern. The ventral side strongly convex, with a slightly depressed plug. Chambers 10—12 in number in the last whorl, the only one seen on dorsal side, increasing gradually in size as added. Sutures distinct, rather depressed and radial, only very slightly curved on the ventral side, elevated, strongly limbate and curved on dorsal side. Surface perforated, more coarsely on the dorsal side, finely on ventral one. Aperture slit-like, marginal, extending however onto the ventral side, as well as on the dorsal one, sometimes bordered by a narrow lip.

Variation insignificant. It applies only to the size and the development of the umbonal region. Adult forms are sometimes somewhat uncoiled.

Remarks. — Specimens referred to *Cibicides asteroides* n. sp. from the Montian of Poland seem to be similar in general appearance to specimens, described by KAASSCHIETER (1961) from the Eocene of Belgium, included by him tentatively to *Cibicides mauricensis* HOWE & ROBERTS. Belgian specimens seem to differ only in having not thickened, depressed sutures on the dorsal side.

Occurrence. — In Poland common in the Paleocene, i.e. Montian of Polish Lowlands and Pamiętowo boring. It has been observed in samples from the Lower Eocene of France, and probably in the Eocene of Belgium.

Cibicides aurouzae ROUVILLOIS, 1960

(Pl. X, figs. 8-12)

1946. *Cibicides choctavensis* CUSHMAN & MCGLAMARY var. *ornata* VAN BELLEN; R. C. VAN BELLEN, Foraminifera from the Middle Eocene..., p. 79, Pl. 12, figs. 7-9.
1960. *Cibicides (Cibicidina) aurouzae* ROUVILLOIS; A. ROUVILLOIS, Le Thanétien..., p. 76, Pl. 4, fig. 60 *a-c*.
1965. *Cibicides ornatus* (VAN BELLEN) emend. POŻARYSKA; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 133, Pl. 25, fig. 1 *a-c*.

Material. — Some hundred specimens well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation considerable; it applies to the size and general appearance, as well as to the structural details of test. The most variable is the development of umbilical region, where there is a star-like regular hollow in small, probably young specimens, and a large, irregular opening, often bordered by thickenings of older raised parts of chambers (tena) in large specimens. The umbilical depression is very often filled up by numerous tubercles.

Remarks. — According to remarks given in POŻARYSKA's paper (1965), it ought to be mentioned here that specimens, described by ROUVILLOIS (1960) as *Cibicides aurouzae* from the Thanetian of France, in reality do not differ either from those described by VAN BELLEN as *C. choctavensis ornata* and later by POŻARYSKA as *C. ornatus*, or from those referred to *C. aurouzae* by the present writers.

Occurrence. — In Poland very common in the Paleocene, i.e. Montian of the Polish Lowlands and Pamiętowo boring. Common in the Paleocene, i.e. Montian of Holland (Bunde) and Belgium („Puits Artésien" in Mons), in the Paleocene, i.e. Thanetian of France (Paris Basin), as well as in Lower Eocene of Paris Basin (writers' own observation).

Cibicides carinatus (TERQUEM, 1882)

(Pl. XI, fig. 1; Text-fig. 16)

1882. *Truncatulina carinata* TERQUEM; O. TERQUEM, Les Foraminifères de l'Eocène..., p. 94, Pl. 10, figs. 1-2.
1944. *Cibicides orbicularis* (TERQUEM); A. TEN DAM, Die stratigraphische..., p. 134, Pl. 5, fig. 10*a-c*.
1949. *Cibicides carinatus* (TERQUEM); Y. LE CALVEZ, Révision des Foraminifères..., p. 45, Pl. 4, figs. 72-74.
1961. *Cibicides carinatus* (TERQUEM); J. P. H. KAASSCHIETER, Foraminifera of the Eocene..., p. 221, Pl. 14, fig. 6*a-c*.

Material. — About 30 specimens, in most cases badly preserved.
Dimensions of an average specimen (in mm):

	F. IX/104
Longest diameter	0·35
Shortest diameter	0·32
Height of test	0·12

Description. — Test plano-convex, completely flat on the dorsal side, slightly convex ventrally, generally somewhat lobulate and irregularly ovate in the outline, periphery strongly acute, with a wide, angled, serrate keel. Chambers gently inflated on the ventral side, on the dorsal side arranged into at least two whorls, the last one containing about 6 chambers, considerably increasing in size as added. Sometimes both sides are evolutely coiled. Sutures limbate, flush with surface or indistinct, rather depressed on dorsal side, distinctly depressed on ventral side. Surface smooth on ventral side, slightly rough and coarsely perforated on dorsal side. Aperture, slit-like on the ventral side at the base of the last formed chamber.

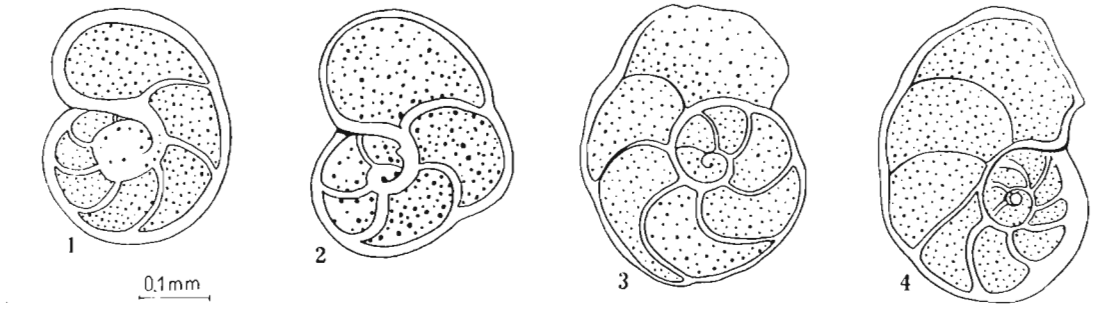


Fig. 16
Individual variation of *Cibicides carinatus* (TERQUEM); Pamiętowo boring, 257 m, Montian.

Variation significant; it applies both to the size and to general shape of test. Specimens can be twisted to a different degree, with a more distinct or less distinct arrangement of chambers and with differently developed peripheral margin, which is more keeled or less, serrate or smooth (see Text-fig. 16).

Remarks. — Specimens described as *Cibicides carinatus* from Poland do not seem to differ from those described by TERQUEM (1882,) revised by LE CALVEZ (1949), and from those by KAASSCHIETER (1961) or TEN DAM (1944), all from the Eocene of Europe. In comparison with the specimens from France and Belgium, ours are never so pitted on the ventral side and they are generally less lobulate in outline.

Occurrence. — In Poland common from the uppermost Maastrichtian up to the Paleocene, i.e. Montian. Present in the Paleocene, i.e. Thanetian of France (Paris Basin) and of England. Known to be common in the Eocene of France, Belgium and Holland.

Cibicides cuvillieri ROUVILLOIS, 1960

(Pl. XII, figs. 1-7)

1960. *Cibicides cuvillieri* ROUVILLOIS; A. ROUVILLOIS, Le Thanétien..., p. 74, Pl. 3, fig. 51*a-c* (non Pl. 3, fig. 52; Pl. 4, fig. 54*a-c*).

1960. *Cibicides subinvolutus* ROUVILLOIS; A. ROUVILLOIS, *Ibid.*, p. 73, Pl. 4, fig. 53*a-c*.

1965. *Cibicides* cf. *cryptomphalus hercegovinensis* DE WITT PUYT; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 130, Pl. 26, fig. 1*a-c*.

?1965. *Cibicides* sp. *2*; B. MCGOWRAN, Two Paleocene foraminiferal faunas..., p. 55, Pl. 4, fig. 2.

Material. — Over two hundred specimens, mostly well preserved. Dimensions of 3 specimens (in mm):

	F. IX/224	F. IX/227	F. IX/230
Longest diameter	0·20	0·37	0·40
Shortest diameter	0·15	0·27	0·27
Height of test	—	0·15	—

Description. — Test plano-convex, generally concave on the dorsal side, convex on the ventral. Outline rounded or gently oval, sometimes lobulate, peripheral margin acute, bluntly keeled; sometimes the keel is visible only on the dorsal side, not seen on the ventral one. Dorsal side somewhat evolute, early whorls forming a small central plug finely dropped, because the final whorl strongly embraces the preceding ones. Chambers distinct, 8—11 in number in the last whorl, flat on the dorsal side, distinctly inflated on the ventral one. Sutures moderately curved on the dorsal side, limbate, visible between all the chambers, sometimes in the early portion of test only, and then becoming obscured in the last portion; sutures on the ventral side more radial, commonly thickened in early portion of test, but depressed between two or three last chambers. Surface smooth, perforated on both sides, except for the raised sutures. Aperture, slit-like at the base of the last formed chamber, extending on the dorsal side at the inner margin along the last few chambers.

Variation considerable; it applies mainly to the size, shape and ornamentation. There are specimens with the outline lobulate, others not lobulate but then keeled. Chambers inflated to different degrees, sutures more depressed or less, even distinctly limbate, especially on the dorsal side where they form roll-like thickenings around the inner whorl. There are, however, intermediate specimens, the systematic position of which cannot be determined as certain.

Remarks. — Specimens from Poland included into *Cibicides cuvillieri* ROUVILLOIS (1960), because of their great variability, probably represent a group of species closely related to each other. Some of them do not differ from specimens described by ROUVILLOIS as *C. cuvillieri*, or from those assigned by the same author in 1960 to *C. subinvolutus*, both described from the Thanet beds of the Paris Basin. Specimens assigned by ROUVILLOIS as *C. subinvolutus* seem, however, to represent less developed, probably younger specimens of *C. cuvillieri* species. Some of the Polish specimens are, on the other hand, similar to certain specimens of *C. lobatulus* WALKER & JACOB (1798) emend. D'ORBIGNY (1846). The variability of *C. lobatulus* was given earlier in BATJES paper (1958, p. 153). The Polish specimens, in comparison with those referred to *C. lobatulus*, are usually more closely and regularly coiled. It is possible that *Cibicides* sp. *2*, described by MCGOWRAN from Australian Paleocene, represents also the above discussed species, differing only slightly on the dorsal side. General appearance of specimens referred to *C. cuvillieri* is also similar to that of specimens described as *C. cantii* by HAYNES (1957, p. 50, Pl. 5, figs. 13, 13*b*; Pl. 6, fig. 2), from the Thanetian of England. The specimens,

assigned by POŻARYSKA (1965) as *Cibicides* cf. *hercegovinensis cryptomphalus* DE WITT PUYT, are reclassificated in the present paper as *C. cuvillieri* ROUVILLOIS.

Occurrence. — In Poland, very common in the Paleocene, i.e. Danian and Montian everywhere in the Polish Lowlands and Pamiętowo boring. Known from the Paleocene, i.e. Montian of Holland (Bunde) and Belgium („Puits Artésien" in Mons) and from the Thanetian of France (Paris Basin); probably present also in the Paleocene of Australia.

Cibicides lectus VASILENKO, 1950

(Pl. X, figs. 3-7)

1950. *Cibicides (Cibicidoides) lectus* VASILENKO; V. P. VASILENKO, Foraminifery paleocena..., p. 218, Pl. 6, figs. 2-3.
1965. *Cibicides lectus* VASILENKO; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 132, Pl. 25, fig. 2*a-c (here additional synonymy included)*.

Material. — Some hundred specimens well preserved.

Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation considerable; it applies mainly to the size and to the development of central part of dorsal side. The outline is rounded or lobulate, peripheral margin transparent or not. In small, probably young specimens, the thickenings and additional apertures on the dorsal side are not yet as well developed as in large, probably adult forms (see Pl. X, figs. 3—7).

Occurrence. — In Poland very common in the Paleocene, i.e. Montian of the Polish Lowlands and Pamiętowo boring. Known to be common in the Paleocene, i.e. Selandian of Denmark, Sweden (writers' own observation), U.S.S.R. (Russian Platform) and probably in France.

Cibicides proprius (BROTZEN, 1948)

(Pl. XVI, figs. 1-4)

1948. *Cibicides proprius* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 78, Pl. 12, figs. 3-4.
1960. *Cibicides (Cibicidoides) proprius* (BROTZEN); A. ROUVILLOIS, Le Thanétien..., p. 74, Pl. 4, fig. 55*a-c*.
?1960. *Cibicides breslesensis* ROUVILLOIS; A. ROUVILLOIS, *Ibid.*, p. 75, Pl. 4, fig. 56*a-c*.
1961. *Cibicides proprius* (BROTZEN); J. P. H. KAASSCHIETER, Foraminifera of the Eocene..., p. 229, Pl. 13, fig. 9*a-c*.
1965. *Cibicides proprius* (BROTZEN); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 134, Pl. 27, figs. 1*a-c*, 5*a-c (here additional synonymy included)*.

Material. — Over one hundred specimens well preserved.

Description, variation and remarks are given in POŻARYSKA's paper (1965). It must be added, however, that *Cibicides breslesensis* ROUVILLOIS is tentatively referred here to *C. proprius*. In the true Montian of Poland there are specimens of the same size and general appearance as *C. breslesensis*, having however not so thickened sutures on the ventral side. A comparison of *C. proprius* (BROTZEN) and *C. breslesensis* ROUVILLOIS is based on comparative material from the Thanetian of France, offered kindly by Miss A. ROUVILLOIS, and those from Selandian of Sweden sent kindly by Dr. F. BROTZEN. The specimens from France and these from Poland are both markedly smaller than specimens of typical *C. proprius* BROTZEN from Sweden (type locality), but as may be observed in the Pamiętowo boring, the specimens of *C. proprius* have changed their size in geological time, being large in Selandian, but small in true Montian. Similarly small specimens of *C. proprius* occur in the Montian of Belgium („Puits Artésien"

in Mons) and Holland (Bunde's boring) according to the writers' own observations. The difference between *C. breslesensis* ROUVILLOIS and *C. proprius* BROTZEN given by ROUVILLOIS (1961) fall within the variation range of *C. proprius* (see Pl. XVI, figs. 1—4).

Occurrence. — In Poland, common in the Paleocene, i.e. Danian and Montian of the Polish Lowlands and Pamiętowo boring. Present in the Paleocene, i.e. Danian and Selandian of Sweden, Denmark, north and south regions of U.S.S.R. (Russian Platform). Known also from the Paleocene, i.e. Montian of Holland, Montian and Thanetian of France (Paris Basin) and Thanetian of England.

Cibicides sahlstroemi BROTZEN, 1948

(Text-fig. 17)

1948. *Cibicides sahlströmi* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 85, Pl. 17, fig. 1.
1961. *Gavelinella sahlströmi* (BROTZEN); J. HOFKER, Foraminifera from the Cretaceous..., LIII, p. 66, fig. 5*a-c*.
1965. *Cibicides sahlstroemi* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 134, Pl. 27, fig. 2*a-c*.
1966. *Cibicides sahlstroemi* BROTZEN; K. POŻARYSKA, The Cretaceous-Tertiary boundary..., p. 63.

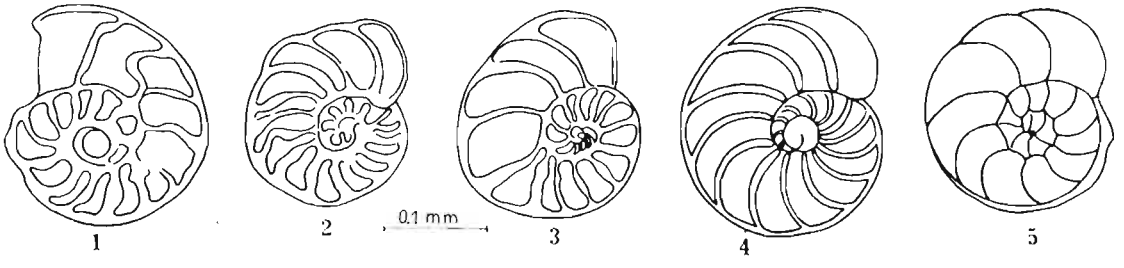


Fig. 17
Individual variation of *Cibicides sahlstroemi* BROTZEN; Pamiętowo boring, 257 m, Montian.

Material. — One hundred specimens, mostly well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation insignificant; it applies mostly to the dorsal side ornamentation, which can be more regular or less obscuring the chamber arrangement (see Text-fig. 17). A very distinctive species.

Occurrence. — In Poland very common from the Upper Maastrichtian up to the Paleocene (Montian) of Polish Lowlands and Pamiętowo boring. Common in the Paleocene, i.e. Danian and Selandian of Sweden and Denmark, Montian of Belgium („Puits Artésien" in Mons) and Holland (Bunde), and in the Paleocene, i.e. Thanetian of England.

Cibicides simplex BROTZEN, 1948

1948. *Cibicides simplex* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 83, Pl. 13, fig. 4.
1961. *Gavelinella simplex* (BROTZEN); J. HOFKER, Foraminifera from the Cretaceous..., LIII, p. 66, fig. 4*a-c*.
1965. *Cibicides simplex* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 135, Pl. 26, fig. 2*a-c (here additional synonymy included)*.
1966. *Cibicides simplex* BROTZEN; K. POŻARYSKA, The Cretaceous-Tertiary boundary..., p. 63.

Material. — Some hundred specimens well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation extremely insignificant. This is one of the most uniform species.

Occurrence. — In Poland common in the uppermost Cretaceous and Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Common in the Paleocene, i.e. Danian and Selandian of Denmark and Sweden, in the Paleocene (Montian) of Holland, and in the Paleocene, i.e. Thanetian of France (Paris Basin).

Cibicides succedens BROTZEN, 1948

(Text-fig. 18)

1944. *Cibicides cryptomphalus* (REUSS) var. *hercegovinensis* DE WITT PUYT; A. TEN DAM, Die stratigraphische..., p. 132, Pl. 5, fig. 9 (non *Cibicides cryptomphalus* (REUSS) var. *hercegovinensis* DE WITT PUYT, 1941).

1948. *Cibicides succedens* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 80, Pl. 12, fig. 2.

1965. *Cibicides succedens* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 136, Pl. 28, figs. 1, 5 *(here additional synonymy included)*.

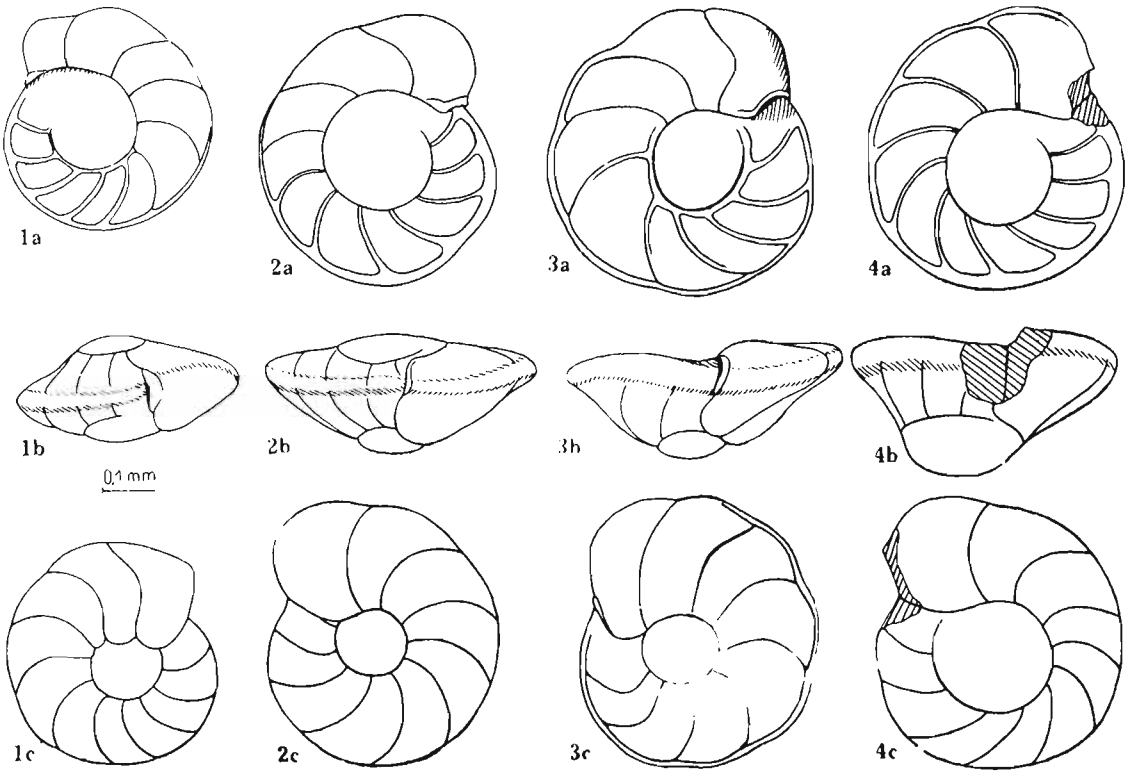


Fig. 18
Individual variation of *Cibicides succedens* BROTZEN; Pamiętowo boring, 231 m, Montian.

Material. — Some hundred specimens well preserved.

Dimensions and description are given in POŻARYSKA's paper (1965).

Variation concerns the general shape of the test and development of central plug on ventral side, which is figured above (see Text-fig. 18).

Remarks and comparison with other species are given in detail by BROTZEN (1948).

Occurrence. — In Poland common in the Paleocene (Montian) of Polish Lowlands and Pamiętowo boring. Known as common in all the Paleocene of Europe.

Genus **PLANULINA** D'ORBIGNY, 1826

Planulina limbata BROTZEN, 1948

(Pl. XI, fig. 2)

1948. *Planulina limbata* BROTZEN; F. BROTZEN, Twe Swedish Paleocene..., p. 85, Pl. 13, fig. 7*a-c*.

1962. *Discopulvinulina trinitatensis* CUSHMAN & RENZ; J. HOFKER, Foraminifera from the Cretaceous..., LVII, p. 8, fig. 1*a-c* (non *Discorbis midwayensis* CUSHMAN var. *trinitatensis* CUSHMAN & RENZ; J. A. CUSHMAN (1951), Paleocene Foraminifera..., p. 48, Pl. 13, fig. 22*a-c*).

non 1963. *Gavelinella limbata* (BROTZEN); J. HOFKER, Foraminifera from the Cretaceous..., LXIII, p. 6, fig. 2*a-c*.

Material. — A few specimens, generally damaged.

Dimensions of one average specimen (in mm):

	F. IX/119
Longest diameter	0·30
Shortest diameter	0·25
Height of test	0·12

Description. — Test small, trochospiral, strongly compressed, only slightly convex on the dorsal side, concave on ventral side, ovate and gently lobulate in outline. Periphery rather acute, with a limbate border as a continuation of the raised spiral and septal sutures of the dorsal side. Chambers coiled in 2—3 whorls visible on dorsal side, only the last one visible ventrally. In the last whorl, there are about 6 chambers moderately increasing in size as added. Umbilicus shallow, filled by a plug or open. Sutures limbate and curved on the dorsal side, somewhat depressed on the ventral. Surface finely porous. Aperture slit-like on the ventral side, running from umbilicus to margin under a small lip, extending as far as 3 last chambers.

Variation not studied due to the scarcity of material.

Remarks. — Our specimens referred to *Planulina limbata* differ from specimens described under this name by BROTZEN (1948) only in having less inflated chambers. They do not differ, however, from the specimens described by HOFKER (1962) from the lowermost Tertiary of Holland, determined as *Discopulvinulina trinitatensis* (CUSHMAN & RENZ). Specimens from the fillings of the holes in the hard ground in Curfs quarry (Holland) and the Paleocene (Selandian) of Denmark, included into *Gavelinella limbata* by HOFKER (1963), differ greatly from those described by BROTZEN from the Paleocene of Sweden, and probably represent other species. In contrast with holotype, HOFKER's specimens have a broadly rounded peripheral margin and their chambers are much more inflated. Our specimens are similar in general appearance to those described by VAN BELLEN (1946) as *Discorbis plana* from the Eocene (recte Montian) of Holland. VAN BELLEN's illustrations are not sufficiently clear, but it seems that the figured specimens have less limbate and less curved sutures not raised at all, than those of BROTZEN's species from Sweden and Poland.

Occurrence. — In Poland very rare in the Paleocene (Montian) of Pamiętowo boring only. More common in the Paleocene, i.e. Selandian of Sweden, Denmark and in Montian of Belgium („Puits Artésien" in Mons) and Holland (Bunde).

Family NONIONIDAE SCHULTZE, 1854

Genus **NONION** DE MONTFORT, 1808

Nonion graniferum (TERQUEM, 1882)

(Pl. IX, figs. 10-12; Text-fig. 19)

1882. *Nonionina granifera* TERQUEM; O. TERQUEM, Les Foraminifères de l'Eocène..., p. 42, figs. 8*a-b*, 9*a-b*.
1965. *Nonion graniferum* TERQUEM; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 93, Pl. 21, fig. 5*a-b (here additional synonymy included)*.

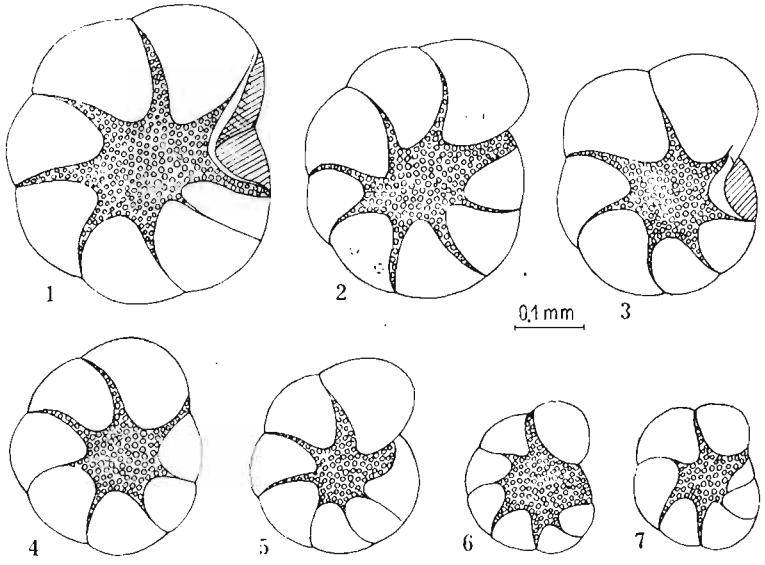


Fig. 19
Individual variation of *Nonion graniferum* (TERQUEM); Pamiętowo boring, 257 m, Montian.

Material. — About one hundred specimens well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation not significant; there are specimens of different size and number of chambers. Their umbilical region as well as sutures and ornamentation are inequally developed, as is seen on figures above (see Text-fig. 19).

Occurrence. — In Poland common in the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known from the Paleocene (Selandian) of Sweden and Denmark, Paleocene of Asia and America, Paleocene (Thanetian) and Eocene of France (Paris Basin).

Nonion sublaeve TEN DAM, 1944

(Pl. IX, figs. 13-15)

1944. *Nonion sublaeve* TEN DAM; A. TEN DAM, Die stratigraphische..., p. 109, Pl. 3, fig. 8*a-b*.
1956. *Protelphidium sublaeve* (TEN DAM); J. HAYNES, Certain smaller British..., p. 87, Pl. 16, figs. 2, 2*c*.
1960. *Protelphidium sublaeve* (TEN DAM); A. ROUVILLOIS, Le Thanétien..., p. 65, Pl. 2, fig. 23.

Material. — About 30 specimens well preserved.
Dimensions of 2 specimens (in mm):

	(F. IX/58)	(F. IX/59)
Longest diameter	0·32	0·33
Shortest diameter	0·28	0·28
Height of test	—	0·09

Description. — Test planispiral and involute, equally compressed on both sides, slightly lobulate in outline, periphery broadly rounded. Chambers 9 in number, increasing gradually in size as added. Sutures depressed, slightly curved, enlarging at the umbonal region; umbonal region rather large, covered by a distinct, transparent, more regular or less regular knob and by a more numerous or less numerous fine protuberances. Surface smooth, glossy. Aperture generally obscured, but sometimes a row of small apertural pores is seen at the base of the last formed chamber.

Variation insignificant, concerning mainly the size and the general appearance of test, especially in the outline. Sometimes, a central knob in the umbonal area is not developed or reduced.

Remarks. — Specimens referred to *Nonion sublaeve* from Poland do not differ from those, described as *N. sublaeve* by TEN DAM (1944) from the Paleocene of Holland.

Occurrence. — In Poland, not common in the Paleocene, i.e. Montian of Pamiętowo boring only. Known from the Paleocene of Holland, and from the Paleocene, i.e. Thanetian of France and England.

Genus **NONIONELLA** CUSHMAN, 1926

Nonionella communis communis (D'ORBIGNY, 1846)

(Pl. IX, fig. 6)

1846. *Nonion communis* D'ORBIGNY; A. D'ORBIGNY, Foraminifères fossiles..., p. 106, Pl. 5, fig. 7; *fide* Cat. of Foram., ELLIS & MESSINA.
1882. *Nonion commune* (D'ORBIGNY); O. TERQUEM, Les Foraminifères de l'Eocène..., p. 42, Pl. 2, fig. 6.
1939. *Nonion commune* (D'ORBIGNY); J. A. CUSHMAN, A Monograph of the foraminiferal family..., p. 10, Pl. 3, fig. 2.
1944. *Nonion acutidorsatum* TEN DAM; A. TEN DAM, Die stratigraphische..., p. 108, Pl. 3, fig. 19*a-b*.
1950. *Nonion commune* (D'ORBIGNY); Y. LE CALVEZ, Révision des Foraminifères..., p. 52.

Material. — A dozen or so specimens well preserved.
Dimensions of one specimen (in mm):

	F. IX/223
Longest diameter	0·46
Shortest diameter	0·32
Height of test	0·25

Description. — Test indistinctly trochospiral, nearly planispiral, strongly compressed, coiled asymmetrically and having the last chamber slightly overhanging the former ones. Outline ovate, indistinctly lobulate, peripheral margin rather angled. Chambers low, triangular, 9 in number in the last whorl, rapidly increasing in size as added, sutures gently curved, very slightly depressed, nearly flush with surface. Surface smooth, glossy. Aperture interiomarginal near the periphery, extending on the ventral side.

Variation insignificant; it concerns mainly the size and the degree of compression of test.

Remarks. — Our specimens are very similar to the figured holotype of *Nonion communis* (recte *Nonionella communis communis*) D'ORBIGNY, differing only in having the peripheral margin not so angular. The differences with a new erected subspecies *Nonionella communis paleocenica* are given below.

Occurrence. — In Poland, not common in the Paleocene (Montian) of Pamiętowo boring. Known from the Paleocene (Montian) of Holland and Eocene of France (Paris Basin).

Nonionella communis paleocenica n. subsp.

(Pl. IX, figs. 7-9)

Holotypus: Specimen presented on Pl. IX, fig. 9 (F. IX/226).
Stratum typicum: Montian.
Locus typicus: Pamiętowo boring, depth 208·5 m (North Poland).
Derivatio nominis: Lat. *paleocenica* = common in the Paleocene beds.

Material. — About 40 specimens well preserved.
Dimensions of two specimens (in mm):

	F. IX/226	F. IX/224
Longest diameter	0·44	0·40
Shortest diameter	0·27	0·25
Height of test	0·20	—

Description. — Test subtrochoidal, compressed, ovate in outline. Dorsal side partially evolute with an umbonal boss, ventral side completely involute. Peripheral margin slightly rounded. Chambers strongly increasing in size as added, inequilateral, especially the last one, about 9 in number in the last whorl. Sutures radial or slightly curved, depressed between the last chambers, flush with surface in the earlier portion of test. Surface smooth, except for the umbilical depression and umbonal boss, which are covered by small tubercles, sometimes wedging in between the inner parts of chambers. Aperture interiomarginal, slit-like near the periphery, extending slightly onto the ventral side.

Variation not significant, concerns the size of test, as well as the coiling of whorls. There are specimens with more distinct or less distinct umbonal boss, which is not always covered by ornamental tubercles.

Remarks. — Our specimens are the most similar to those referred to *Nonionella communis communis* (D'ORBIGNY, 1846), they differ, however, in being more trochospiral, not so closely involute and in having a distinct umbilical depression, generally filled up with more numerous or less numerous small tubercles.

Occurrence. — In Poland, common in the Paleocene (Montian) of the Pamiętowo boring only.

Nonionella ovata BROTZEN, 1948

pars 1926. *Nonionina turgida* PLUMMER (not WILLIAMSON); H. J. PLUMMER, Foraminifera of the Midway..., p. 159, Pl. 12, fig. 7.
1948. *Nonionella ovata* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 68, Pl. 10, figs. 13-14.
1951. *Nonionella* sp.; J. A. CUSHMAN, Paleocene Foraminifera..., p. 37, Pl. 11, figs. 5-6.
1965. *Nonionella ovata* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 94, Pl. 21, fig. 1*a-c*.

Material. — Over one hundred specimens, mostly well preserved.

Dimensions, description, variation and remarks are given in BROTZEN's (1948) and in POŻARYSKA's (1965) papers.

Occurrence. — In Poland, common in the Paleocene (Montian) of Pamiętowo boring and the Polish Lowlands. Known to be seldom in Paleocene (Selandian) of Sweden and Denmark.

Family ALABAMINIDAE HOFKER, 1951

Genus **ALABAMINA** TOULMIN, 1941

Alabamina midwayensis BROTZEN, 1948

(Text-fig. 20)

1948. *Alabamina midwayensis* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 99, Pl. 16, figs. 1-2.

1965. *Alabamina midwayensis* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 114, Pl. 21, fig. 3*a-c* *(here additional synonymy included)*.

Material. — Some hundred specimens well preserved.

Dimensions and description are given in POŻARYSKA's paper (1965). Variation discussed by BROTZEN (1948) and HOFKER (1960).

Remarks. — Within specimens found in the Montian of Pamiętowo boring, there are some with a more convex dorsal side, than the true *Alabamina midwayensis*, and they seem to represent rather *A. wilcoxensis* described by TOULMIN (1941) from the Wilcox formation of Alabama, U.S.A. (see Text-fig. 20).

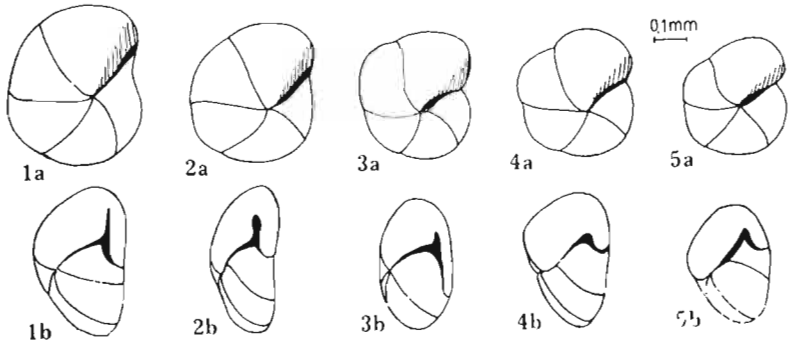


Fig. 20
Individual variation of *Alabamina midwayensis* BROTZEN; Pamiętowo boring, 231 m, Montian.

Occurrence. — In Poland, very common in the uppermost Maastrichtian and Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known to be common in the Paleocene, i.e. Danian and Selandian of Sweden, Denmark, Montian of Holland and Paleocene of Egypt. Present in the Paleocene, i.e. Thanetian of France (Paris Basin) and England. Present also in U.S.S.R. (Russian Platform and Asiatic part).

Family OSANGULARIIDAE LOEBLICH & TAPPAN, 1964

Genus **GYROIDINOIDES** BROTZEN, 1942

Gyroidinoides octocamerata (CUSHMAN & HANNA, 1927)

1927. *Gyroidina soldanii* D'ORBIGNY subspecies *octocamerata* CUSHMAN & HANNA; J. A. CUSHMAN & C. D. HANNA, Foraminifera from the Eocene..., p. 223, Pl. 14, figs. 16-18.
1965. *Gyroidinoides octocamerata* CUSHMAN & HANNA; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 107, Pl. 18, figs. 3*a-c*, 5*a-c* *(here additional synonymy included)*.
1965. *Gyroidinoides octocamerata* CUSHMAN & HANNA; B. MCGOWRAN, Two Paleocene..., p. 47, Pl. 2, fig. 5.

Material. — Over two hundred specimens well preserved.
Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland very common from the uppermost Maastrichtian up to the Montian of Polish Lowlands and Pamiętowo boring. Known as common in the Upper Maastrichtian and Paleocene, i.e. Danian and Montian of Europe and Australia, and the Eocene of America.

Gyroidinoides pontoni BROTZEN, 1948

1948. *Gyroidinoides pontoni* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 76, Pl. 11, figs. 4, 5.
1965. *Gyroidinoides pontoni* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 108, Pl. 18, fig. 4*a-c* *(here additional synonymy included)*.

Material. — Over two hundred specimens well preserved.
Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland very common in the Paleocene, i.e. Danian and Montian (Selandian and true Montian) of Polish Lowlands and Pamiętowo boring. Known as common in the Paleocene of Sweden, Denmark and Belgium.

Genus **OSANGULARIA** BROTZEN, 1940

Osangularia cordieriana navarroana (CUSHMAN, 1938)

1938. *Pulvinulinella navarroana* CUSHMAN; J. A. CUSHMAN, Some new species..., p. 66, Pl. 11, fig. 5.
1962. *Osangularia cordieriana navarroana* (CUSHMAN, 1938); E. v. HERMANNI, Zur Artfassung von Osangularian..., p. 280, Pl. 19, figs. 2-4.
1965. *Osangularia cordieriana navarroana* (CUSHMAN); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 112, Pl. 19, figs. 1*a-c*, 5*a-b* *(here additional synonymy included)*.

Material. — Some hundred specimens well preserved.
Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland very common in the Paleocene, i.e. Danian and Montian of Polish Lowlands; in the Pamiętowo boring only a few specimens just above the Maastrichtian. Common in the Paleocene of Sweden, Denmark, U.S.S.R. (Russian Platform) and Holland, where it starts from the uppermost Maastrichtian. It is not observed in the true Montian strata. Probably present in the Paleocene, i.e. Thanetian of France (Paris Basin) and England.

Family ANOMALINIDAE CUSHMAN, 1927

Genus **ANOMALINA** D'ORBIGNY, 1826

Anomalina burlingtonensis (JENNINGS, 1936)

(Pl. XVI, figs. 5-6)

1936. *Cibicides burlingtonensis* JENNINGS; P. H. JENNINGS, A microfauna..., p. 39, Pl. 5, fig. 5*a-c*.
1965. *Anomalina burlingtonensis* (JENNINGS), K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 127, Pl. 26, figs. 3-4 *(here additional synonymy included)*.
1966. *Cibicides burlingtonensis* JENNINGS; J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 239, Pl. 47, fig. 21; Pl. 48, fig. 54.

Material. — About one hundred specimens, in most cases well preserved.

Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965); here ought to be added, however, that specimens from Poland, referred to this species, seem to be very similar to compressed specimens of *Anomalina danica* (BROTZEN); more than once it is difficult to distinguish with certainty small, compressed representatives of *A. danica* and these referred to *A. burlingtonensis*.

Occurrence. — In Poland common in the Paleocene, i.e. Danian and Montian, in the Polish Lowlands, as well as in Pamiętowo boring. Known from the uppermost Cretaceous up to Paleocene in Limburg, Paleocene, i.e. Danian and Selandian of Sweden and Denmark, Paleocene of U.S.S.R. (Asiatic part) and Eocene of North America.

Anomalina danica (BROTZEN, 1940)

(Pl. XIV, figs. 6-11)

1940. *Cibicides danica* BROTZEN; F. BROTZEN, Flinträннans..., p. 31, Pl. 7, fig. 2.
1948. *Anomalinoides danica* (BROTZEN); F. BROTZEN, The Swedish Paleocene..., p. 87, Pl. 14, fig. 1; Text-fig. 22.
1965. *Anomalina danica* (BROTZEN); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 128, figs. 1-3 *(here additional synonymy included)*.
1966. *Gavelinella danica* (BROTZEN); J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 227, Pl. 43, fig. 86*a-c*.

Material. — Some hundred specimens very well preserved.

Dimensions of 3 specimens (in mm):

	F. IX/227	F. IX/230	F. IX/231
Longest diameter	0·30	0·52	0·90
Shortest diameter	0·25	0·45	0·65
Height of test	—	—	0·19

Description and variation are given in BROTZEN's (1940, 1948), HOFKER's (1955, 1966) and POŻARYSKA's (1965) papers.

Remarks. — Our specimens are described as *Anomalina danica* BROTZEN, because in most cases they do not differ from specimens of this species described from Sweden. They also seem to be very similar to forms occurring in higher strata in Europe, assigned either to *A. granosa* (VAN BELLEN, not HANTKEN) or to *A. grosserugosa* GÜMBEL. Undoubtedly, they all are related to each other, being changed in geological time only very slightly, especially in ornamentation. The variation within our rich collection confirms this opinion. Variation is significant, applying to several features such as size, general shape and ornamentation.

Specimens are peripherally lobulate to different degrees, having chambers more inflated or less, with sutures distinctly depressed, flush with surface or strongly thickened. The umbilical depression is filled or open, forming a distinct hollow extending along the last formed chambers. Surface of test is nearly smooth, generally fairly pitted or sharply rough, even granulated. There are specimens distinctly compressed, finely perforated, resembling specimens referred to *A. burlingtonensis* JENNINGS; both these species coexist in many samples of Polish Montian.

Occurrence. — In Poland very common in the uppermost Maastrichtian up to the Paleocene, as in the Lower Tertiary sediments all over the world.

Anomalina ekblomi (BROTZEN, 1948)

(Pl. XIII, figs. 1-4)

1948. *Cibicides ekblomi* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 82, Pl. 13, fig. 2*a-c*.
?1965. *Cibicidina mariae* (RUPERT JONES); B. MCGOWRAN, Two Paleocene..., p. 51, Pl. 4, fig. 1.
1965. *Anomalina ekblomi* (BROTZEN); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 127, Pl. 27, fig. 6 *(here additional synonymy included)*.
1966. *Gavelinella ekblomi* (BROTZEN); J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 197, Pl. 36, fig. 26; p. 208, Pl. 39, fig. 44; p. 259, Pl. 56, fig. 108.

Material. — Over three hundred specimens well preserved.
Dimensions, description and variation are given in POŻARYSKA's paper (1965).

Remarks. — In the MCGOWRAN's opinion (1965), *Cibicidina mariae* (RUPERT JONES) is conspecific with *Anomalina ekblomi* (BROTZEN). Taking under consideration both illustrations of specimen of *C. mariae* from Paleocene of Australia given by MCGOWRAN, and specimens kindly sent us by HAYNES from Thanetian of England (from where is described *C. mariae*), it results that *C. mariae* have less chambers and generally is more inflated than *A. ekblomi* specimens.

Occurrence. — In Poland very common from uppermost Maastrichtian up to Montian of Polish Lowlands and in Pamiętowo boring. Known to be common in the Paleocene (Selandian) of Denmark, Sweden, Austria, Germany, U.S.S.R. (Russian Platform) and Australia. Present in the Paleocene, i.e. Thanetian of England and France (Paris Basin).

Anomalina minor n. sp.

(Pl. XIV, figs. 1-5; Text-fig. 21)

Holotypus: Specimen presented on Pl. XIV, fig. 3 (F. IX/235).
Paratypi: Specimens presented on Pl. XIV, figs. 1, 2, 4 (F. IX/233, 234, 236).
Stratum typicum: Montian.
Locus typicus: Pamiętowo boring, depth 205 m (North Poland).
Derivatio nominis: Lat. *minor* = smaller; because of its small size in comparison with other *Anomalina* species.

Material. — About 30 specimens well preserved.
Dimensions of 4 specimens (in mm):

	F. IX/233	F. IX/234	F. IX/235	F. IX/236
Longest diameter	0·20	0·25	0·30	0·16
Shortest diameter	0·15	0·22	0·22	0·12
Height of test	—	—	0·16	—

Description. — Test small, almost planispiral, rather compressed, gently lobulate and ovate in outline, periphery broadly rounded. Chambers slightly inflated, arranged in at least two whorls, the outer one containing up to 5—6 chambers, moderately increasing in size as added. Sutures curved, somewhat depressed on both sides, those between the earlier portion of the test are completely obscured on the ventral side. The inner coil on ventral side is partly bordered by a deep furrow, extending on the apertural area along the base of the last chamber. Aperture slit-like, marginal, extending somewhat onto the ventral side. Surface strongly pitted, but only on 2—3 last chambers on ventral side, slightly porous on dorsal side; surface of older chambers, especially on ventral side conspicuously smooth, glistening.

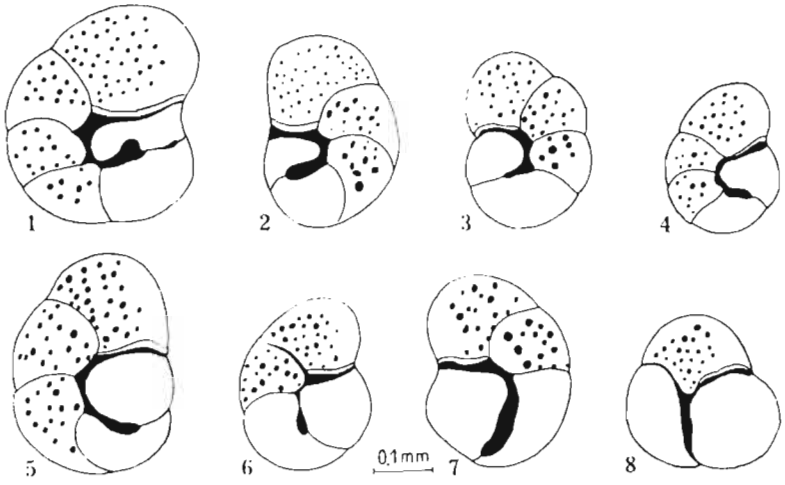


Fig. 21
Anomalina minor n. sp.; *1—4* microspheric forms, *5—8* megalospheric forms; Pamiętowo boring, 257 m, Montian.

Variation insignificant; it applies in the first place to the size and number of chambers in the last whorl and to the degree of development of surface perforation. Pits on ventral side are strongly variable in their size and distribution. There occur micro- and megalospheric forms (see Text-fig. 21).

Remarks. — *Anomalina minor* n. sp. is a well distinguished species from the other described species of the *Anomalina* genus. Some specimens of *A. minor* resemble most young specimens of *A. danica* BROTZEN, from which they differ in being distinctly smaller, differently pitted and in having a characteristic furrow near the center of ventral side.

Occurrence. — In Poland not common, in the Paleocene (Montian) of Polish Lowlands and Pamiętowo boring. According to the present writers' observations, present in the Paleocene (Montian) of Belgium („Puits Artésien" in Mons).

Anomalina praeacuta VASILENKO, 1950

pars 1937. *Anomalina acuta* PLUMMER; M. F. GLAESSNER, Studien über Foraminiferen..., p. 386, Pl. 5, fig. 39.
1950. *Anomalina praeacuta* VASILENKO; V. P. VASILENKO, Foraminifery paleocena..., p. 208, Pl. 5, figs. 2-3.
1965. *Anomalina praeacuta* VASILENKO; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 129, Pl. 28, fig. 2*a-c* *(here additional synonymy included).*

Material. — Some hundred specimens well preserved.

Dimensions, description, variation and remarks are given in VASILENKO'S (1950) and POŻARYSKA'S (1965) papers.

Occurrence. — In Poland very common from uppermost Maastrichtian up to the Montian in Polish Lowlands and in Pamiętowo boring. Common in the Paleocene, i.e. Danian and Montian (Selandian) of Sweden, Denmark and U.S.S.R. (Russian Platform).

Anomalina umbilicata costata n. subsp.

(Pl. XIII, figs. 8-10)

Holotypus: Specimen presented on Pl. XIII, fig. 10 (F. IX/243).
Paratypi: Specimens presented on Pl. XIII, figs. 8-9 (F. IX/241, 242).
Stratum typicum: Montian.
Locus typicus: Pamiętowo boring, depth 208 m (North Poland).
Derivatio nominis: Lat. *costata* = with ribs; having rib-like chambers inflation.

Material. — A dozen or so specimens, well preserved.

Dimensions of 3 specimens (in mm):

	F. IX/241	F. IX/242	F. IX/243
Longest diameter	0·17	0·22	0·35
Shortest diameter	0·15	0·17	0·25
Height of test	—	—	0·15

Description of this subspecies does not differ much from that given for *Anomalina umbilicata umbilicata* (BROTZEN). The differences concern exclusively the development of chamber walls, which are distinctly inflated along all sutures on both sides of test. Moreover, the peripheral margin is more acute in *A. umbilicata costata* n. subsp. than in *A. umbilicata umbilicata*.

Variation not significant. Our specimens differ mainly in size and in the degree of coiling. Some of them are closely involute, especially the small ones, others not so closely, showing slightly the inner margins of the earlier whorls.

Remarks. — The specimens referred to *Anomalina umbilicata costata* n. subsp. occur mainly in the higher strata of Montian in the Pamiętowo boring. Its appearance seems to be a result of an evolutionary trend of *A. umbilicata umbilicata* (BROTZEN).

Occurrence. — In Poland not so common, in the Paleocene (Montian) of Pamiętowo boring only.

Anomalina umbilicata umbilicata (BROTZEN, 1948)

(Pl. XIII, figs. 5-7)

?1926. *Truncatulina midwayensis* PLUMMER; H. J. PLUMMER, Foraminifera of the Midway..., p. 141, Pl. 9, fig. 7.
?1948. *Anomalina midwayensis* (PLUMMER); F. BROTZEN, The Swedish Paleocene..., p. 88, Pl. 14, fig. 3.
1948. *Cibicides umbilicata* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 84, Pl. 13, fig. 6.
1960. *Anomalina simplex* (BROTZEN); E. K. ŠUCKAJA, Foraminifery verchnego paleocena..., p. 250, Pl. 3, figs. 1-2.
1961. *Gavelinella umbilicata* (BROTZEN); J. HOFKER, Foraminifera from the Cretaceous..., LIII, p. 66, Text-fig. 6.
1966. *Gavelinella umbilicata* (BROTZEN); J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 227, Pl. 42, figs. 83-84.

Material. — About 120 specimens, in most cases well preserved.

Dimensions of two specimens (in mm):

	F. IX/238	F. IX/239
Longest diameter	0·40	0·35
Shortest diameter	0·30	0·25
Height of test	0·20	—

Description. — Test trochospiral, low, nearly planispiral, somewhat compressed, almost round and lobulate in outline, periphery broadly rounded. Chambers distinct, inflated, especially the last one, moderately increasing in size as added, arranged in at least two whorls, the last containing 10 chambers clearly visible on the ventral side. Sutures curved, usually depressed, more on the ventral side, where chamber margins overlap each other forming a false thickening, with the exception of margin of last chambers. Umbilical depression small but distinct. Surface, when well preserved, porcellanous, smooth, finely porous. Aperture, peripheral at the base of the last chamber, extending onto the umbilical hollow on the ventral side, with a narrow lip above. Aperture continuous beneath the inner, lip-like part of earlier chambers.

Variation not significant, concerning mainly the size and general appearance of specimens, which may be more lobulate or less in outline and may have a more developed or less apertural region. There are forms closely coiled or somewhat uncoiled.

Remarks. — Our specimens do not differ from the illustrated holotype of that species from Sweden. Specimens described from Limburg by HOFKER (1961) are more perforated and more compressed. Specimens, described by ŠUCKAJA (1960) as *Anomalina simplex* BROTZEN from the Paleocene of Crimea, are quite the same as Polish ones referred to *A. umbilicata umbilicata* (BROTZEN). Specimens referred to *A. umbilicata umbilicata* (BROTZEN) from Poland are certainly very near to the specimens, figured and described by PLUMMER (1926) as *Truncatulina midwayensis* (recte *Anomalina midwayensis*) from the Midway of America, and by BROTZEN (1948) from the Swedish Paleocene as *Anomalina midwayensis*. In contrast with the *A. umbilicata umbilicata*, they have more pronounced, distinctly limbate sutures. Taking under consideration the topotypes of *A. midwayensis* from America and specimens referred here to *A. umbilicata umbilicata* from Poland, it seems the above mentioned differences could be understand as connected with intraspecific variation within firstly described *A. midwayensis* (PLUMMER) species. That is why *A. midwayensis* (PLUMMER) is here tentatively included into the synonymy of *A. umbilicata umbilicata*.

Occurrence. — In Poland very common in the Paleocene (Montian) in Pamiętowo, Sochaczew and Boryszew borings. Present in the Paleocene, i.e. Selandian of Denmark and Sweden, Montian of Belgium („Puits Artésien" in Mons), Paleocene, i.e. Thanetian of England and Paleocene of U.S.S.R. (Asiatic part).

Genus **COLEITES** PLUMMER, 1934

Coleites reticulosus (PLUMMER, 1926)

1926. *Pulvinulina reticulosa* PLUMMER; H. J. PLUMMER, Foraminifera of the Midway..., p. 152, Pl. 12, fig. 5.
1965. *Coleites reticulosus* (PLUMMER); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 117, Pl. 20, figs. 1*a-c*, 2*a-b* *(here additional synonymy included)*.

Material. — Twenty specimens usually damaged.

Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — Not common in the Paleocene (Montian) of Polish Lowlands and Pamiętowo boring. A very similar species occurs in the Paleocene (Montian) of France (MARIE, MS) and Belgium („Puits Artésien" in Mons) and in the Paleocene of Sweden. Known as common in the Paleocene, i.e. Danian and Montian and Eocene of America and Africa.

Genus **GAVELINELLA** BROTZEN, 1942

Gavelinella lellingensis BROTZEN, 1948

(Pl. XII, fig. 8)

1948. *Gavelinella lellingensis* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 75, Pl. 2, figs. 1, 2; Text-fig. 20.
1966. *Gavelinella lellingensis* BROTZEN; J. HOFKER, Maestrichtian, Danian and Paleocene..., p. 227, Pl. 43, fig. 85*a-c*.

Material. — About 30 specimens, in most cases well preserved.
Dimensions of an average specimen (in mm):

	F. IX/244
Longest diameter	0·50
Shortest diameter	0·46
Height of test	0·26

Description. — Test trochospiral, flattened slightly on dorsal side, convex on ventral side, lobulate, nearly round in outline, peripheral margin broadly rounded. All whorls visible on dorsal side, the inners ones indistinctly, only chambers of final whorl are seen around the umbilicus. Chambers gently inflated, increasing in size and height as added, especially so the three last ones on ventral side. Sutures curved more dorsally, depressed between the early chambers, generally thickened and transparent. Aperture a low marginal slit extending from the periphery to the open umbillicus, bordered above by a narrow lip. Surface coarsely pitted.

Variation insignificant; it concerns mainly the size of test and the development of umbilicus.

Occurrence. — In Poland, not very common in the Paleocene (Montian) of Polish Lowlands and Pamiętowo boring. Known to be common in the Paleocene (Selandian) of Sweden and Denmark; probably present also in the Montian of Paris Basin.

Genus **KARRERIA** RZEHAK, 1891

Karreria fallax RZEHAK, 1891

(Text-fig. 22)

1891. *Karreria fallax* RZEHAK; A. RZEHAK, Die Foraminiferenfauna..., p. 4, Pl. 7, figs. 7*a-c*, 8*a-b*.
1965. *Karreria fallax* RZEHAK; B. MCGOWRAN, Two Paleocene..., p. 56.
1965. *Karreria fallax* RZEHAK; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 138, Pl. 19, figs. 3-4 *(here additional synonymy included)*.

Material. — Some hundred specimens well preserved.
Dimensions, description and remarks are given in POŻARYSKA's paper (1965).

Variation significant, presented in detail by BROTZEN (1948). It applies mainly to general shape of test, which can be closely coiled or uncoiled to a different degree, up to rectilinear. The spiral side varies being flat or even concave irregularly, according to the base on which the test was fixed. Moreover, the aperture may occur at the base of the last formed chamber or at its top, being under the shape of a slit or a round hollow, sometimes represented by a double aperture. Examples of morphological variation are given below (see Text-fig. 22).

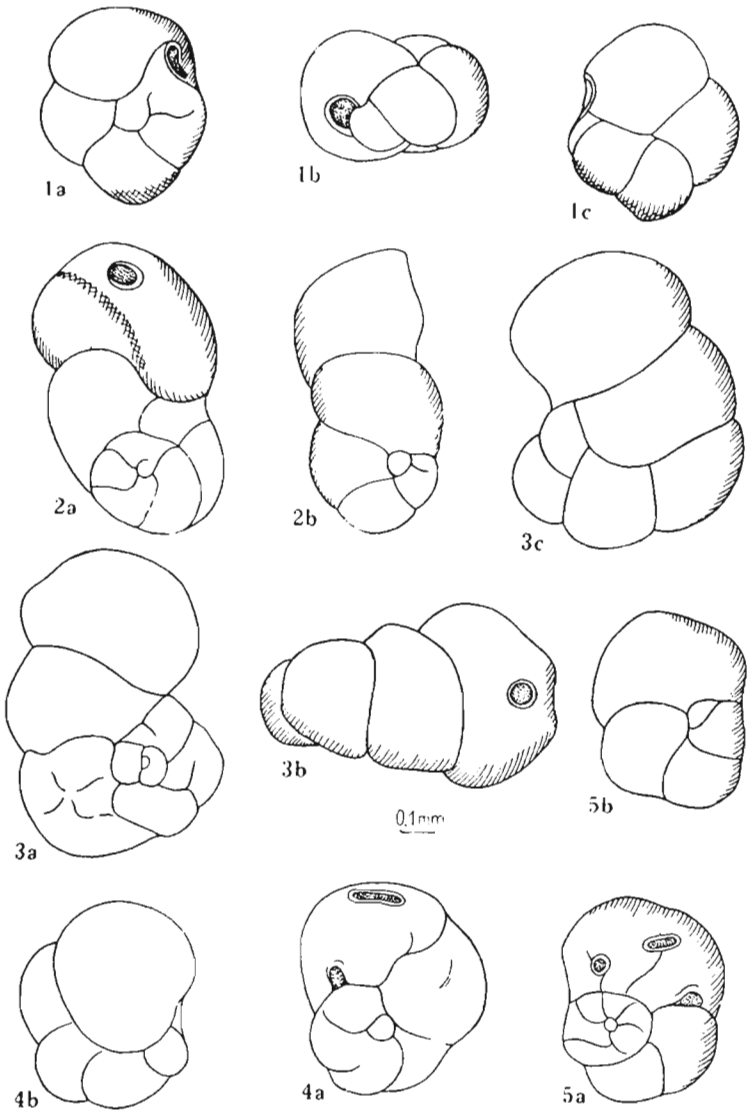


Fig. 22
Individual variation of *Karreria fallax* RZEHAK; Boryszew boring, 202 m, Montian.

Occurrence. — In Poland very common in the Paleocene, i.e. Danian and Montian of Polish Lowlands and Pamiętowo boring. Known as common from the uppermost Cretaceous up to the lowermost Tertiary in Europe and Australia.

Genus **PULSIPHONINA** BROTZEN, 1948

Pulsiphonina prima (PLUMMER, 1926)

1926. *Siphonina prima* PLUMMER; H. J. PLUMMER, Foraminifera of the Midway..., p. 148, Pl. 12, fig. 4.
1960. *Siphonina (Pulsiphonina)* cf. *prima* (PLUMMER); A. ROUVILLOIS, Le Thanétien..., p. 70, Pl. 2, fig. 36*a-b*.
1961. *Siphonina prima* PLUMMER; J. P. H. KAASSCHIETER, Foraminifera of the Eocene..., p. 230, Pl. 15, figs. 2, 15.

1962. *Siphonina (Pulsiphonina) prima* (PLUMMER); M. E. SCHMID, Die Foraminiferenfauna..., p. 344, Pl. 4, fig. 11*a-b*.
1965. *Siphonina (Pulsiphonina) prima* (PLUMMER); B. MCGOWRAN, Two Paleocene..., p. 47.
1965. *Pulsiphonina prima* (PLUMMER); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 111, Pl. 16, figs. 3*a-c*, 6*a-c (here additional synonymy included)*.

Material. — Over one hundred specimens, rather well preserved.
Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland common from the uppermost Cretaceous up to the Montian of Polish Lowlands and Pamiętowo boring. Common in the Paleocene (Danian and Montian) of Belgium and Holland, Danian (?) of Austria, Paleocene of Sweden, Denmark and U.S.S.R. (Russian Platform), Paleocene (Thanetian) of England, and Paleocene of America (U.S.A.) and Australia.

Family CERATOBULIMINIDAE CUSHMAN, 1927

Genus **CERATOBULIMINA** TOULA s.s., emend. FINLAY, 1939 and TROELSEN, 1954

Ceratobulimina tuberculata BROTZEN, 1948

1948. *Ceratobulimina tuberculata* BROTZEN; F. BROTZEN, The Swedish Paleocene..., p. 124, Pl. 19, figs. 2-3.
1965. *Ceratobulimina tuberculata* BROTZEN; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 117, Pl. 20, fig. 6*a-c (here additional synonymy included)*.

Material. — Over two hundred specimens, partly damaged.
Dimensions, description and variation are given in BROTZEN's (1948) and in POŻARYSKA's (1965) papers.

Occurrence. — In Poland, common in the Paleocene, i.e. Montian, mainly in Polish Lowlands, to be rare in the Pamiętowo boring. Common in the Paleocene, i.e. Selandian of Denmark, Sweden, U.S.S.R. (Russian Platform), and in the Paleocene, i.e. Thanetian of England. It occurs in the Paleocene, i.e. Montian, Selandian type beds.

Genus **LAMARCKINA** BERTHELIN, 1881

Lamarckina rugulosa PLUMMER, 1926

1926. *Lamarckina rugulosa* PLUMMER, MS; J. A. CUSHMAN, The genus *Lamarckina...*, p. 8, Pl. 3, fig. 6*a-c*.
1926. *Lamarckina rugulosa* PLUMMER; H. J. PLUMMER, Foraminifera of the Midway..., p. 140, Pl. 9, fig. 3*a-c*.
1965. *Lamarckina rugulosa* PLUMMER; B. MCGOWRAN, Two Paleocene..., p. 57, Pl. 5, fig. 6.
1965. *Lamarckina rugulosa* PLUMMER; K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 116, Pl. 24, fig. 4*a-c (here additional synonymy included)*.

Material. — About 40 specimens, usually well preserved.
Dimensions, description, variation and remarks are given in POŻARYSKA's paper (1965).

Occurrence. — In Poland, not so common in the Paleocene (Montian only) of Polish Lowlands and Pamiętowo boring, where it is extremely rare. Known from the Paleocene of America (U.S.A.), Australia and U.S.S.R. (Georgia). *Lamarckina rugulosa* PLUMMER was found by the present writers also in the Paleocene sediments of Austria. This species is a good index species for the Paleocene, Selandian type beds.

Genus **MISSISSIPPINA** HOWE, 1930

Mississippina binkhorsti (REUSS, 1862)

(Pl. XV, figs. 6-10)

1862. *Rosalina Binkhorsti*; A. E. REUSS, Paläontologische Beiträge..., p. 317, Pl. 2, fig. 3.
?1958. *Mississippina binkhorsti* (REUSS); J. HOFKER, Foraminifera from the Cretaceous..., XXXVI, p. 101, Text-figs. 1-6.
?1959. *Mississippina binkhorsti* (REUSS); J. HOFKER, Les Foraminifères du Crétacé..., p. 376, Text-fig. 39.
?1960. *Mississippina binkhorsti* (REUSS); J. HOFKER, Les Foraminifères du Crétacé..., p. 170, Text-fig. 22.
1961. *Discorbis binkhorsti* (REUSS); V. P. VASILENKO, Foraminifery verchnego mela..., p. 37, Pl. 7, fig. 5.
1962. *Discopulvinulina binkhorsti* (REUSS, 1862); H. HILTERMANN & W. KOCH, Oberkreide..., (*in* Leitfossilien), p. 335, Pl. 50, fig. 17.
?1965. *Mississippina binckhorsti* (REUSS, 1862); K. POŻARYSKA, Foraminifera and biostratigraphy..., p. 119, Pl. 16, fig. 1 *a-b*.
1965. *Mississippina midwayensis trinitatensis* CUSHMAN & RENZ; K. POŻARYSKA, *Ibid.*, p. 119, Pl. 17, fig. 2.

Material. — About one hundred specimens well preserved.

Dimensions, description and variation are given in POŻARYSKA'S paper (1965).

Variation significant; it concerns the size, shape and ornamention. Specimens from the base of Montian (Selandian) are generally much bigger and lower, being less distinctly perforated on dorsal side than those from the true Montian, which are smaller, higher and generally with a more distinct umbilicus, whose inlets penetrate the sutures; their umbilicus is sometimes filled with a small, regular plug (cf. Pl. XV, figs. 6—10). It is not excluded that there are two different, probably related species, or one species morphologically differentiated during the evolution process.

Remarks. — Specimens from Poland included into *Mississippina binkhorsti* (REUSS), especially these from the Selandian beds, do not differ from specimen figured and described by REUSS (1862) as *Rosalina binkhorsti* from the Maastrichtian of Holland. They also do not differ from specimen described by VASILENKO (1961) as *Discorbis binkhorsti* from the Danian of U.S.S.R., as well as from those illustrated and described as *Discopulvinulina binkhorsti* by HILTERMANN and KOCH (1962) from the Maastrichtian and Danian of Germany, and by POŻARYSKA (1965) who described it as *Mississippina midwayensis trinitatensis* CUSHMAN & RENZ from the Maastrichtian and Paleocene of Poland. Specimens referred to this species by HOFKER (1958, 1959, 1960) from the Maastrichtian of Holland, and by POŻARYSKA (1965) from the Upper Cretaceous and Paleocene of Poland, differ however in shape and ornamentation from true *Mississippina binkhorsti* (REUSS), being much lower and having an ornamented umbilical side; specimens of *M. binkhorsti* (REUSS) are never covered by tubercles on the umbilical side, where they have not any bands of clear shell material parallel to peripheral margin. For this reason, it seems possible that they deviate, representing another species.

Occurrence. — In Poland no common in uppermost Maastrichtian up to the Montian of Polish Lowlands and Pamiętowo boring. Known to be common in the Paleocene of Denmark, Sweden, Germany, Belgium, Holland and U.S.S.R., where it occurs also beginning the Upper Maastrichtian.

Genus **STOMATORBINA** DORREEN, 1948

Stomatorbina sp.

(Pl. X, figs. 1-2)

?1958. *Epistomina inkermanica* ŠUCKAJA; E. K. ŠUCKAJA, Foraminifery verchnich sloev..., p. 205, Pl. 3, fig. 2.
?1963. *Stomatorbina torrei* (CUSHMAN & BERMUDEZ); J. E. VAN HINTE, Zur Stratigraphie..., p. 116, Pl. 18, fig. 1 a-c (non *Lamarckina torrei* CUSH. & BERM.; J. A. CUSHMAN & P. J. BERMUDEZ, 1937, Further..., p. 21, Pl. 2, figs. 24—26).

Material. — Three specimens damaged.
Dimensions of two specimens (in mm):

	F. IX/254	F. IX/255
Longest diameter	0·16	0·17
Shortest diameter	0·15	0·15
Height of test	0·08	—

Description. — Test trochospiral, biconvex, more convex on the ventral side, less on dorsal side, almost round, slightly lobulate in outline, periphery broadly rounded, thickened. Chambers triangular, gently inflated, 6 in number in the last whorl, increasing moderately in size as added, coiled in at least two whorls; sutures of dorsal side somewhat curved, raised, limbate, partly obscured, joining the peripheral thickenings; on the ventral side sutures are depressed, narrow and radial enlarging near the weakly marked central depression. Near the peripheral margin, there are on both sides regular, ovate depressions, parallel to the margin. Surface smooth. Aperture slit-like at the base of the last formed chamber on ventral side, extending onto the periphery up to the umbilical depressions, which are somewhat asymmetrical.

Variation not known due to the scarcity of material.

Remarks. — Specimens, assigned to *Stomatorbina* sp. from Poland, are the most similar to those included by Šuckaja (1958) into *Epistomina inkermanica* from the Dano-Montian of the Crimea (U.S.S.R.), differing from them, however, by being flatter, not concave ventrally and having less chambers. In comparison with specimens figured by VAN HINTE (1963), described as *Stomatorbina torrei* (CUSHMAN & BERMUDEZ), specimens from the Polish Montian are somewhat higher; in the latters, the inner whorls are not visible.

Occurrence. — In Poland, a few specimens in the Paleocene (Montian) of Pamiętowo boring only.

BIBLIOGRAPHY

ABRARD, M. R. 1937. Observations sur l'article de R. Soyer. — *Bull. Soc. Géol. France*, **5**, 7, 281, Paris.

BANG, I. 1962. Preliminary note on the occurrence of Globorotalia cf. reissi Loeblich & Tappan in the Danian deposits of Denmark. — *Dansk. Geol. Foren.*, **15**, 1, 104-106, København.

BATJES, D. A. J. 1968. Foraminifera of the Oligocene of Belgium. — *Mém. Inst. Roy. Sci. Nat. Belgique*, **143**, 1-188, Bruxelles.

BELLEN, R. C. VAN. 1946. Foraminifera from the Middle Eocene in the southern part of the Netherlands, Province of Limburg. — *Med. Geol. Sticht.*, 1-145, Maastricht.

BERGGREN, W. A. 1960*a*. Paleogene biostratigraphy and planctonic Foraminifera of the SW Soviet Union. An analysis of recent Soviet investigation. — *Acta Univ. Stockh., Contr. Geol.*, **6**, 5, 1-125. Stockholm.

— 1960*b*. Paleogene biostratigraphy and planctonic Foraminifera of Nigeria (West Africa). — *Int. Geol. Congr.*, 21 *Sess., Norden*, 41-55, Copenhagen.

— 1960*c*. Biostratigraphy, planctonic Foraminifera and the Cretaceous-Tertiary boundary in Denmark and Southern Sweden. — *Ibidem*, 181-192.

— 1962*a*. Stratigraphic and taxonomic-phylogenetic studies of Upper Cretaceous and Paleogene Foraminifera. — *Acta Univ. Stockholm.*, **9**, 2, 107-129, Stockholm.

— 1962*b*. Some planctonic Foraminifera from the Maestrichtian and type Danian stages of southern Scandinavia. — *Ibidem*, **9**, 1, 1-106.

— 1964. The Maestrichtian, Danian and Montian stages and the Cretaceous-Tertiary boundary. — *Ibidem*, **11**, 5, 104-176.

BERMUDEZ, P. J. 1949. Tertiary smaller Foraminifera of the Dominican Republic. — *Contr. Cush. Lab. Foram. Res., Spec. Publ.*, **25**, 1-286, Sharon, Mass.

BOLLI, H. M. 1966. Zonation of Cretaceous to Pliocene marine sediments based on planctonic Foraminifera. — *Bol. Inf. Asoc. Venez. Geol. min. petr.*, **9**, 1, 3-32, Enero.

BROTZEN, F. 1940. Flinträннans och Trindelrännans geologi (Öresund). — *Sveriges geol. unders.*, **435**, Stockholm.

— 1942. Die Foraminiferengattung Gavelinella nov. gen. und die Systematik der Rotaliiformes. — *Ibidem*, C, **451**, 1-60.

— 1945. De geologiska resultaten från borrningarna vid Höllviken. — *Ibidem*, C, **465**, 38, 7, 1-64.

— 1948. The Swedish Paleocene and its foraminiferal fauna. — *Ibidem*, **493**, 42, 2, 1-140.

— 1959. On Tylocidaris species (Echinoidea) and the stratigraphy of the Danian of Sweden. — *Ibidem*, **54**, 2, 1-81.

BROTZEN, F. & POŻARYSKA, K. 1957. The Paleocene in central Poland (O paleocenie w Polsce środkowej). — *Acta Geol. Pol.*, **7**, 2, 273-280, Warszawa.

— & — 1961. Foraminifères du Paléocène et de l'Eocène inférieur en Pologne septentrionale. Remarques paléogéographiques. — *Rev. Micropaléont.*, **4**, 3, 155-166, Paris.

BRÖNNIMANN, P. 1952. Note on planctonic Foraminifera from Danian localities of Jutland, Denmark. — *Ecl. geol. Helv.*, **45**, 2, 339-341, Zürich.

BYKOVA, N. K. 1953. Foraminifery suzakskogo jarusa Tadžikskoj depressii. — *Mikrofauna SSSR*, **6**, 1-103, Moskva-Leningrad.

— 1960. K voprosu o datskich i paleocenovych otloženijach severnogo Mangyšlaka i južno-Embenskogo raiona. — *Mežd. Geol. Kongr., 21 Sess., Dokl. sov. geol.*, 148-161, Kopenhaga.

CALVEZ, Y. LE. 1947-1952. Révision des Foraminifères Lutétiens du Bassin de Paris, I-IX. — *Mém. expl. carte géol. France*, 1-45 (1947), 1-54 (1949), 1-64 (1950), 1-64 (1952), Paris.

— 1959. Étude de quelques Foraminifères nouveaux du Cuisien franco-belge. — *Rev. Micropaléont.*, **2**, 2, 88—94, Paris.

CUSHMAN, J. A. 1938. Some new species of Rotaliform Foraminifera from the American Cretaceous. — *Contr. Cush. Lab. Foram. Res.*, **14**, 3, 66-71, Sharon, Mass.

— 1939. A Monograph of the foraminiferal family Nonionidae. — *U. S. Dept. Int. Geol. Surv., Prof. Pap.*, **191**, 1-100, Washington.

— 1944. A paleocene foraminiferal fauna from the Coal Bluff marl member of the Naheola formation of Alabama. — *Contr. Cush. Lab. Foram. Res.*, **20**, 2, 29-50, Sharon, Mass.

— 1947. Some new Foraminifera from the Paleocene of the Southern United States. — *Ibidem*, **23**.

— 1951. Paleocene Foraminifera of the Gulf Coastal Region of the United States and adjacent areas. — *U. S. Geol. Surv., Prof. Pap.*, **232**, 1-75, Washington.

— 1955. Foraminifera, their classification and economic use. 1-478, Cambridge, Mass.

— & BERMUDEZ, P. J. 1937. Further new species of Foraminifera from the Eocene of Cuba. — *Contr. Cush. Lab. Foram. Res.*, **13**, 1, Sharon, Mass.

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

— & PARKER, L. F. 1947. Bulimina and related foraminiferal genera. — *U. S. Dep. Int. Geol. Surv., Prof. Pap.*, **210**, D, 1-176, Washington.

— & PONTON, G. M. 1932 (repr. 1947). An Eocene foraminiferal fauna of Wilcox age from Alabama. — *Contr. Cush. Lab. Foram. Res.*, **8**, 3/4, 51-72, Sharon, Mass.

— & TODD, R. 1942. The Foraminifera of the type locality of the Naheola formation. — *Ibidem*, **18**, 1-39.

— & — 1946. A foraminiferal fauna from the Paleocene of Arkansas. — *Ibidem*, **22**, 2, 45-65.

CUVILLIER, J., DALBIEZ, F., GLINTZBOECKEL, C. *et al.* 1955. Etudes micropaléontologiques de la limite Crétacé-Tertiaire dans les mers mésogéennes. — *Proc. 4th World Petr. Congr.*, Sect. 1/D, 517-544, Rome.

DAM, A. TEN. 1944. Die stratigraphische Gliederung der niederländischen Paläozäns und Eozäns nach Foraminiferen. — *Med. Geol. Sticht.*, C, **5**, 3, 1-142, Maastricht.

— 1947. (Rec.) R. C. VAN BELLEN: „Foraminifera from the Middle Eocene in the southern part of the Netherlands Province of Limburg". — *J. Paleont.*, **21**, 2, p. 187*a*, Menasha.

DAMOTTE, R. 1964. Contribution à l'étude des „Calcaires Montiens" du Bassin de Paris: La faune d'Ostracodes. — *Bull. Soc. Geol. France*, **7**, 6, 349-356, Paris.

DEROO, G. 1959. Répartition stratigraphique de quelques Ostracodes des „craies-tuffeaux" des tranchées du canal Albert (Belgique). — *Ann. Soc. Geol. Belg.*, **82**, 281—292, Liège.

— 1966. Cytheracea (Ostracodes) du Maastrichtien de Maastricht (Pays-Bas) et des régions voisines; résultats stratigraphiques et paléontologiques de leur étude. — *Med. Geol. Sticht.*, C, **2**, 2, 1-197, Maastricht.

DESOR, E. 1846. Sur le terrain danien, nouvel étage de la Craie. — *Bull. Soc. Géol. France*, Sér. 8, **4**, 179-182, Paris.

ELLIS, F. B. & MESSINA, R. A. 1940-1962. Catalogue of Foraminifera. — *Amer. Mus. Nat. Hist.*, New York.

FOX, S. K. Jr. & ROSS, J. R. Jr. 1942. Foraminiferal evidence for the Midway (Paleocene) age of the Cannonball Formation in North Dakota. — *J. Paleont.*, **16**, 5, 660-673, Menasha.

FRANKE, A. 1927. Die Foraminiferen und Ostracoden des Paläozäns von Rugaard in Jütland und Sundkrogen bei Kopenhagen. — *Danm. Geol. Unders.*, **2**, 46, 1-49, Kopenhague.

GLAESSNER, M. F. 1937. Studien über Foraminiferen aus der Kreide und dem Tertiär des Kaukasus. I. Die Foraminiferen der ältesten Tertiärschichten des Nordwest-Kaukasus. — *Probl. Paleont.*, **2/3**, 349-423, Moskau.

GRIGELIS, A. A. 1960. O vozraste i mikrofaune pograničnych meždu melom i paleogenom sloev v južnoj Pribaltike. — *Mežd. Geol. Kongr., 21 Sess., Dokl. sov. geol.*, 101-104, Moskva.

HAYNES, J. 1954. Taxonomic position of some British Palaeocene Buliminidae. — *Contr. Cush. Found. Foram. Res.*, **5**, 4, 185-191, Washington.

— 1956, 1958. Certain smaller British Paleocene Foraminifera. — *Ibidem*, **7**, 3 (1956); **9**, 1 & 3 (1958).

HERMANNI, E. v. 1962. Zur Artfassung von Osangularien aus der Oberkreide (Foraminiferen). — *N. Jb. Geol. Paläont. Abh.*, **115**, 3, 263-288, Stuttgart.

HILLEBRANDT, A. VON. 1962. Das Paläozän und seine Foraminiferenfauna im Becken von Reichenhall und Salzburg. — *Bayer. Akad. Wiss. Abh.*, N. F. **108**, 1—182, München.

HILTERMANN, H. 1947. Fortschritte der stratigraphischen Mikropaläontologie in Deutschland. — *Festschr. 150 J.-Feier Gründ. Ges.*, 7-33, Hannover.

— & KOCH, W. 1960. Oberkreide-Biostratigraphie mittels Foraminiferen. — *Int. Geol. Kongr., 21 Sess., Norden*, 69-76, Copenhagen.

— & — 1962. Oberkreide des nördlichen Mitteleuropa. — *In:* Leitfossilien der Mikropaläontologie, 299-338, Berlin.

HINTE, J. E. VAN. 1963. Zur Stratigraphie und Mikropaläontologie der Oberkreide und des Eozäns des Krappelfeldes (Kärnten). — *Jb. Geol. Bundesanst.*, Sonderb. **8**, 1—147, Wien.

HOFKER, J. 1949. On Foraminifera from the Upper Senonian of south Limburg (Maestrichtian). — *Mém. Inst. Roy. Sci. Nat. Belg.*, **112**, 1-69, Bruxelles.

— 1957. Foraminiferen der Oberkreide von Nordwestdeutschland und Holland. — *Beih. Geol. Jb.*, **27**, 1-464, Hannover.

— 1959. Les Foraminifères du Crétacé supérieur du Cotentin. — *84e Congr. Soc. Sav.*, 369-397, Dijon.

1960*a*. Le problème du Dano-Paléocène et le passage Crétacé-Tertiaire. — *Rev. Micropaléont.*, **2**, 119-130, Paris,

— 1960*b*. The Foraminifera of the Lower Boundary of the Danish Danian. — *Med. Dansk Geol. For.*, **14**, 3, 212-242. København.

— 1960*c*. The type localities of the Maestrichtian (Maestrichtian chalk tuff) and of the Montian (Tuffeau de Ciply, Calcaire de Mons, lagunar and lacustre Montian). — *J. Paleont.*, **34**, 3, 584-588, Menasha.

— 1961. Les Foraminifères planctoniques du Montien de la localité type. — *Rev. Micropaléont.*, **1**, 53-57, Paris.

— 1962. Correlation of the Tuff Chalk Maastricht (type Maestrichtian) with the Danske Kalk of Denmark (type Danian), the stratigraphic position of the type Montian, and the planktonic foraminiferal faunal break. — *J. Paleont.*, **36**, 5, 1051-1089, Menasha.

— 1946-1965. Foraminifera from the Cretaceous of southern Limburg, Netherlands. I-LXVII. — *Natuurh. Maand.*, Maastricht.

— 1966. Maestrichtian, Danian and Paleocene Foraminifera. — *Paleontographica*, Suppl., **10**, 1-376, Stuttgart.

INDANS, J. 1965. Mikrofaunistisches Normalprofil durch das marine Tertiär der Niederrheinischen Bucht. — *Forsch. Land. Nordrhein-Westfalen*, **1484**, 1-85, Köln.

JANŠIN, A. L. 1953. Geologija severnogo Priaralja. — *Mosk. Obšč. Isp. Prir.*, 182-200, Moskva.

— 1960. Stratigraphic position of the Danian Stage and the problem of the Cretaceous-Paleocene boundary. — *Int. Geol. Congr., 21 Sess., Norden*, **5**, 210-215, Copenhagen.

JENNINGS, P. H. 1936. A microfauna from the Monmouth and Basal Rancocas groups of New Jersey. — *Bull. Amer. Paleont.*, **23**, 78, 1-62, Ithaca, N. Y.

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

KAČARAVA, I. & KAČARAVA, M. 1960. Datskij jarus Gruzii i ego sopostavlenie s analogičnymi otloženijami sredizemnomorskoj provincii. — *Mežd. Geol. Kongr., 21 Sess., Dokl. sov. geol.*, 127-138, Moskva.

KAPTARENKO-ČERNOUSOVA, O. K., GOLIAK, L. M. *et al.* 1963. Atlas charakternych foraminifer jury, mela i paleogena platformennoj časti Ukrainy. — *Inst. Geol. Nauk A. N. USSR, Ser. Strat. i Pal.*, **45**, 1-200, Kiev.

KONGIEL, R. 1935. W sprawie wieku „siwaka" w okolicach Puław (Contribution à l'étude du „siwak" dans les environs de Puławy). — *Prace Tow. Przyj. Nauk*, **9**, 19, 1-59, Wilno.

— 1958. O kolcach jeżowców z warstw z Crania tuberculata Nilss. w Boryszewie k. Sochaczewa (Sur les radioles des Échinides des couches à Crania tuberculata Nilss. de Boryszew près de Sochaczew). — *Prace Muz. Ziemi*, **2**, 1-27, Warszawa.

LEMOINE, P. 1937. L'âge et les conditions de dépôt du „Calcaire pisolithique". — *Bull. Soc. Géol. France*, **5**, 7, 283-286, Paris.

LOEBLICH, A. R. & TAPPAN, H. 1957*a*. Morphology and taxonomy of the foraminiferal genus Pararotalia Le Calvez, 1949. — *Smiths. Misc. Coll.*, **135**, 2, 1-24, Washington.

— & — 1957*b*. Correlation of the Gulf and Atlantic coastal plain Paleocene and Lower Eocene formations by means of planktonic Foraminifera. — *J. Paleont.*, **31**, 6, 1109-1137, Menasha.

— & — 1964. *In:* R. C. MOORE, (ed.), Treatise on Invertebrate Paleontology. C: Protista, **2**, 1-900, Univ. Kansas Press.

—, —, BECKMANN, J. P. *et al.* 1957. Studies in Foraminifera. — *U. S. Nat. Mus. Bull.*, **215**, 1-323, Washington.

MANGIN, J. P. 1957*a*. Remarques sur le terme Paléocène et sur la limite Crétacé-Tertiaire. — *C. R. Soc. Géol. France*, **14**, 319-322, Paris.

— 1957*b*. La limite Crétacé-Tertiaire sur le versant sud des Pyrénées occidentales. — *C. R. Acad. Sci.*, **244**, 1227-1229, Paris.

MARIE, P. 1937. Sur la faune de Foraminifères du Calcaire Pisolithique du Bassin de Paris. — *Bull. Soc. Géol. France*, **5**, 7, 289-294, Paris.

— 1950. Sur l'évolution de la faune de Foraminifères des couches de passage du Crétacé au Tertiaire. — *Proc. Inst. Geol. Congr.*, **15**, p. 50*a*, London.

— 1964. Les faciès du Montien (France, Belgique, Hollande). — *Mém. Bur. Rech. Géol. Min.*, **28**, 2, 1077-1096 (Colloque Paléogène), Paris.

— (unpubl.). Foraminifères du Calcaire Pisolithique (Bassin Parisien, Belgique, Hollande). 26 planches.

MARLIÈRE, R. 1939. Contribution à l'étude des formations crétacées et tertiaires du Bassin de Mons. — *Ann. Soc. Géol. Belg.*, **63**, 52-78, Liège.

— 1954. Le Crétacé (chap. XII). Le Paléocène (chap. XIII). — *Extr. Prodrome Descr. Géol. Belg.*, 417-449, Liège.

— 1955. Définition actuelle et gisement du Montien dans le Bassin de Mons. — *Ann. Soc. Géol. Belg.*, **78**, 297-316, Liège.

— 1957. Sur le „Montien" de Mons et de Ciply. — *Bull. Soc. Belge Géol.*, **66**, 1, 153-166, Bruxelles.

— 1958. Ostracodes du Montien de Mons et résultats de leur étude. — *Mém. Soc. Belge Géol.*, **5**, 1-53, Bruxelles.

— 1961. Le Paléocène et le Crétacé supérieur de la région de Mons. — *7e Coll. Europ. Micropaléont., Guide d'excurs.*, 1-9.

— 1962. Le Montien de Mons: état de la question. — *Coll. Paléogène*, 1-12, Bordeaux.

MASLAKOVA, N. I. 1959. Stratigrafičeskaja schema verchnemelovych otloženij Kryma. — *Vestn. Mosk. Univ.*, **1**, 109-112, Moskva.

MATWIEJEWÓWNA, L. 1934. Analiza fauny małżów i ślimaków siwaka z oklic Puław. Stratigraphische Betrachtung der Pelecypoden- und Gastropodenfauna des „Siwak" in der Umgegend von Puławy bei Lublin. — *Prace Tow. Przyj. Nauk*, **9**, 91-117, Wilno, 1935.

MCGOWRAN, B. 1965. Two Paleocene foraminiferal faunas from the Wangerrip Group, Pebble Point Coastal section, Western Victoria. — *Proc. Roy. Soc. Victoria*, **79**, 1, 1-74.

— 1966. Australian Paleocene Lamarckina and Ceratobulimina, with a discussion of Cerobertina, Pseudobulimina, and the family Robertinidae. — *Contr. Cush. Found. Foram. Res.*, **17**, 3, 77-103, Bridgewater.

MEIJER, M. 1959. Sur la limite supérieure de l'étage Maastrichtien dans la région-type. — *Acad. Roy. Belg.*, Sér. 5, **45**, 3, 316-338, Bruxelles.

MEUNIER, S. 1912. Géologie des environs de Paris. 1-540, Paris.

MJATLUK, E. V. 1953. Spirillinidy, Rotalinidy, Epistominidy i Asterigerinidy. — *Iskop. Foram. SSSR*, **71**, 1-261, Leningrad-Moskva.

MOROZOVA, V. G. 1939. K stratigrafii verchnego mela i paleogena Embenskoj oblasti po faune foraminifer. — *Bjul. Mosk. Obšč. Isp. Prir.*, Otd. geol., **17**, 4/5, 59-86, Moskva.

— 1946. The boundary between Cretaceous and Tertiary deposits in the light of the study of foraminifers. — *C. R. (Dokl.) Acad. Sci. URSS.*, **54**, 2, 153-155, Moskva.

— 1958. K sistematike i morfologii paleogenovych predstavitelej nadsemejstva Globigerinidea. — *Vopr. Mikropaleont.*, **2**, 22-52, Moskva.

— 1959. Stratigrafija datsko-montskich otloženij Kryma po foraminiferam. — *Dokl. Akad. Nauk SSSR.*, **124**, 5, 1113-1116, Moskva.

— 1961. Datsko-montskie planktonnye foraminifery juga SSSR. — *Paleont. Žurn. Akad. Nauk SSSR.*, **2**, 8-19, Moskva.

—, KREIDENKOV, G. P. & DAVIDZON, R. M. 1965. Biostratigrafia paleocenovych otloženij Tadžikskoj depresii. — *Biul. Mosk. Obšč. Isp. Prir., Otd. geol.*, **3**, 34-55, Moskva.

MOSKVIN, M. M. 1959. Atlas verchnemelovoj fauny severnogo Kavkaza i Kryma. — *Tr. VNIIGAZ*, 1-304, Moskva.

— & NAJDIN, D. P. 1959. Stratigraphie du Crétacé supérieur de la Plate-forme Russe de la Crimée et du Caucase du Nord. — *84e Congr. Soc. Sav.*, 497-522, Dijon.

— & — 1960. Datskie i pogranične s nimi otloženija Kryma, Kavkaza, Zakaspijskoj oblasti i jugovostočnoj časti Russkoj platformy. — *Mežd. Geol. Kongr., 21 Sess., Dokl. sov. geol.*, 15-40, Kopenhaga.

NAGGAR, Z. R. EL-. 1966. Stratigraphy and planctonic Foraminifera of the Upper Cretaceous — Lower Tertiary succession in the Esna-Idfu Region, Nile Valley, Egypt, U.A.R. — *Bull. Brit. Mus. (Nat. Hist.), Geology*, Suppl. **2**, 1-291, London.

NAKKADY, S. E. 1957. Biostratigraphy and inter-regional correlation of the Upper Senonian and Lower Paleocene of Egypt. — *J. Paleont.*, **31**, 2, 428-447, Menasha.

— 1958. Stratigraphic and Petroleum Geology of Egypt (U.A.R.). — *Univ. Assiut, Monogr. ser.*, **1**, 1-215, Assiut.

— 1959. Biostratigraphy of the Um Elghanayem section, Egypt. — *Micropaleontology*, **5**, 4, 453-465, New York.

OLSSON, R. K. 1960. Foraminifera of latest Cretaceous and earliest Tertiary age in the New Jersey Coastal Plain. — *J. Paleont.*, **34**, 1, 1-59, Menasha.

ORBIGNY, A. D'. 1846. Foraminifères fossiles du bassin tertiaire de Vienne. 1-152, Paris.

PLUMMER, F. B. 1932. Cenozoic systems in Texas. The geology of Texas. — *Bull. Texas Univ.*, 3232, Austin.

PLUMMER, H. J. 1926. Foraminifera of the Midway Formation in Texas. — *Ibidem*, **2644**, 1-204.

— 1934. Epistominoides and Coleites, new genera of Foraminifera. — *Amer. Midl. Natur.*, **15**, 5, 601-608, Lancaster.

— 1936. Structure of Ceratobulimina. — *Ibidem*, **17**, 2, 460-463.

POŻARYSKA, K. 1952. Zagadnienia sedymentologiczne górnego mastrychtu i danu okolic Puław (The sedimentological problems of Upper Maestrichtian and Danian of the Puławy environment, Middle Vistula). — *Biul. P. Inst. Geol.*, **81**, 1-104, Warszawa.

— 1957. Lagenidae du Crétacé supérieur de Pologne (Lagenidae z kredy górnej Polski). — *Palaeont. Pol.*, **8**, 1-190, Warszawa.

— 1964. On some Foraminifera from Boryszew boring, central Poland (O pewnych otwornicach z wiercenia w Boryszewie). — *Acta Palaeont. Pol.*, **9**, 4, 539-548, Warszawa.

— 1965. Foraminifera and biostratigraphy of the Danian and Montian in Poland (Otwornice i biostratygrafia danu i montu Polski). — *Palaeont. Pol.*, **14**, 1-154, Warszawa.

— 1966. The Cretaceous-Tertiary boundary in Poland and adjacent areas (in the light of Foraminifera). — *Ann. Soc. Géol. Belg.*, **89**, Bull. 3, 47-64, Liège.

POŻARYSKI, W. 1938. Stratygrafia senonu w przełomie Wisły między Rachowem i Puławami (Senonstratigraphie im Durchbruch der Weichsel zwischen Rachów und Puławy in Mittelpolen). — *Biul. P. Inst. Geol.*, **6**, 1-94, Warszawa.

— 1957. Południowo-zachodnia krawędź Fennosarmacji. The south-western margin of Fenno-Sarmatia. — *Kwart. Geol.*, **1**, 3/4, 383-424, Warszawa.

— & POŻARYSKA, K. 1959. Comparaison entre le Crétacé de la Belgique et de la Pologne. — *Ann. Soc. Géol. Belg.*, **82**, 1-14, Liège.

— & — 1960. On the Danian and Lower Paleocene sediments in Poland. — *Int. Geol. Congr., 21 Sess., Norden*, **5**, 170-180, Copenhagen.

RASMUSSEN, L. B. 1960. Geology of north-eastern Jylland, Denmark. — *Ibidem*, **2**, Guide excurs. A42, C37, 1-38.

RAUZER-ČERNOUSOVA, D. M.& FURSENKO, A. V. 1959. Prostejšie. *In:* J. A. ORLOV (red.), Osnovy Paleontologii. 1-482, Moskva.

RAVN, J. P. J. 1925. Sur le placement géologique du Danien. — *Publ. Serv. Géol. Danemark*, Sér. 2, **43**, 5, 1-48, Kjøbenhavn.

REICHEL, M. 1952. Remarques sur les Globigérines du Danien de Faxe (Danemark) et sur celles des couches de passage du Crétacé au Tertiaire dans la Scaglia de l'Apennin. — *Ecl. geol. Helv.*, **45**, 2, 341-349, Zürich 1953.

REISS, Z. 1960. Structure of so-called Eponides and some other Rotaliiform Foraminifera. — *Geol. Surv. Israel, Paleont. Div., Bull.* **29**, 1-24, Jerusalem.

REUSS, A. E. 1861. Paläontologische Beiträge. 1-3. — *Sitzber. k. Akad. Wiss.*, **44**, 304-342, Wien.

ROSENKRANTZ, A. 1920. Craniakalk fra Københavns Sydhavn. — *Danm. Geol. Unders.*, **2**, 36, København.

— 1924. Nye lagttagelser over Cerithiumkalken i Stevns Klint med Bemaerkninger om Graensen mellem Kridt og Tertiaer. — *Medd. Dansk. Geol. For.*, **6**, 28-31, København.

— 1937. Bemaerkninger om det østsjaellandske daniens stratigrapfi og tektonik. — *Ibidem*, **9**, 2, 199-212.

— 1939. Faunaen i cerithiumkalken og det haerdnede skrivekridt i Stevns Klint. — *Ibidem*, **9**, 4, 509-514.

— 1960. Danian Mollusca from Denmark. — *Int. Geol. Congr., 21 Sess., Norden*, **5**, 193-198, Copenhagen.

— 1964. Note on some Cranias from central Poland (O pewnych kraniach z Polski środkowej). — *Acta Palaeont. Pol.*, **9**, 4, 513-531, Warszawa.

ROUVILLOIS, A. 1960. Le Thanétien du Bassin de Paris (Étude hydrogéologique et micropaléontologique). — *Mém. Mus. Nat. Hist.*, N. S., **8**, 1-151, Paris.

SCHMID, E. M. 1962. Die Foraminiferenfauna des Bruderndorfer Feinsandes (Danien) von Haidhof bei Ernstbrunn, NÖ. — *Sitzber. Österr. Akad. Wiss., Math.-Nat. Kl.*, Abt. I, **171**, 8/10, 315-361, Wien.

SIGAL, J. 1958. Réflexions à propos des termes Paléocène et Danien. — *C. R. Soc. Géol. France*, **5**, 94-97, Paris.

STAESCHE, K. & HILTERMANN, H. 1940. Mikrofaunen aus dem Tertiär Nordwestdeutschlands. — *Abh. Reichsst. Bodenf.*, N. F., **201**, 1-26, Berlin.

SUBBOTINA, N. N. 1947. Foraminifery datskich i paleogenovych otloženij severnogo Kavkaza. — *Mikrofauna SSSR, Tr. VNIGRI*, 39-160, Leningrad-Moskva.

— 1950. Mikrofauna i stratigrafija Elburganskogo gorizonta i gorizonta Gorjačego kluča. — *Ibidem*, **4**, 51, 1-109.

— 1953*a*. Verchne-eocenovye lagenidy i buliminidy juga SSSR. — *Ibidem*, **6**, 115-255.

— 1953*b*. Globigerinidy, Hantkeninidy i Globorotality. — *Iskop. Foram. SSSR, Tr. VNIGRI*, N. S., **76**, 1-239, Leningrad-Moskva.

ŠUCKAJA, E. K. 1956. Stratigrafija nižnich gorizontov paleogena centralnogo Predkavkaz'ja po foraminiferam. — *Tr. GIN AN SSSR*, **164**, Moskva.

— 1958. Foraminifery verchnich sloev „datsko-monskich" izvestnjakov jugo-zapadnogo Kryma. — *Tr. VNIGNI*, **9**, 197-210, Moskva.

— 1960. Foraminifery verchnego paleocena jugo-zapadnogo Kryma (Bachčisarajskij raion). — *Ibidem*, **16**, 235-259.

SZCZECHURA, J. 1965. Cytheracea (Ostracoda) of the uppermost Cretaceous and lowermost Tertiary from Central and North Poland (Cytheracea (Ostracoda) najwyższej kredy i najniższego trzeciorzędu Polski środkowej i północnej).— *Acta Palaeont. Pol.*, **10**, 4, 451-564, Warszawa.

TERQUEM, O. 1882. Les Foraminifères de l'Éocène des environs de Paris. — *Mém. Soc. Géol. France*, Sér. 3, **2**, 1-193, Paris.

TOULMIN, D. L. 1941. Eocene smaller Foraminifera from the Salt Mountain limestone of Alabama. — *J. Paleont.*, **15**, 6, 567-611, Menasha.

TZAGARELI, A. L. 1954. Verchnij mel Gruzii. — *Akad. Nauk Gruz. SSR, Monogr.*, **5**, 1-462, Tbilisi.

TROELSEN, J. C. 1957. Some planctonic Foraminifera of the type Danian and their stratigraphic importance. *In:* LOEBLICH, A. R., TAPPAN, H., BECKMANN, J. P. *et al.*, Studies in Foraminifera. — *U.S. Nat. Mus. Bull.*, **215**, 125-132, Washington.

VASILENKO, V. P. 1950. Foraminifery paleocena centralnoj časti dneprovsko-doneckoj vpadiny. — *Mikrofauna SSSR, Tr. VNIGRI*, **4**, 177-224, Leningrad.

— 1954. Anomalinidy. — *Iskop. Foram. SSSR*, **80**, 1-203, Moskva-Leningrad.

— 1961. Foraminifery verchnego mela poluostrova Mangyšlaka. — *Trudy VNIGRI*, **171**, 1-487, Leningrad.

VINCENT, E. 1930. Études sur les Mollusques montiens du poudingue et du tuffeau de Ciply. — *Mém. Mus. Roy. Hist. Nat. Belg.*, **46**, Bruxelles.

VISSER, A. M. 1951. Monograph of the Foraminifera of the type locality of the Maestrichtian (South-Limburg, Netherland). — *Leidse Geol. Med.*, **16**, 197-359, Leiden.

VOIGT, E. 1960. Zur Frage der stratigraphischen Selbständigkeit der Danienstufe. — *Int. Geol. Congr.*, **21** *Sess., Norden*, **5**, 199-209, Copenhagen.

— 1964. A Bryozoan fauna of Dano-Montian age from the boring Boryszew near Sochaczew in Central Poland. — *Acta Palaeont. Pol.*, **9**, 4, 419-498, Warszawa.

VOLOŠINOVA, N. A. & DAIN, L. G. 1952. Nonionidy, Kassidulinidy i Chilostomellidy. — *Iskop. Foram. SSSR*, N. S. **63**, 1-151, Leningrad-Moskva.

WIENBERG RASMUSSEN, H. 1962. The Danian affinities of the Tuffeau de Ciply in Belgium and the post-Maastrichtian „Me" in the Netherlands. — *Coll. Paléogène*, 1-8, Bordeaux.

WILLIAMSON, W. C. 1858. On the recent Foraminifera of Great Britain. Roy. Soc. of London, 1-99, London.

WOOD, A. & HAYNES, J. 1957. Certain smaller British Paleocene Foraminifera. — *Contr. Cush. Found. Foram. Res.*, **8**, 2, 45-53, Washington.

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PLATE I

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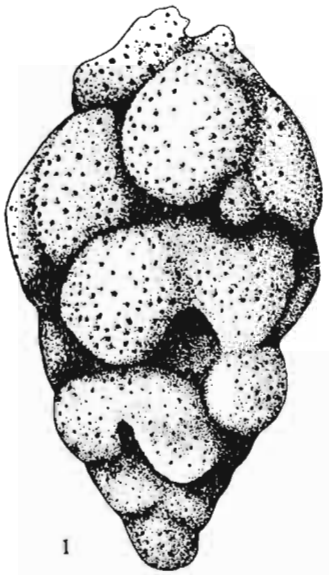
Angulogerina europaea CUSHMAN & EDWARDS 48

Fig. 1. (F. IX/4), 215 m.
Fig. 2. (F. IX/5), 257 m.
Fig. 3. (F. IX/6), 274·5 m.
Fig. 4. (F. IX/7), 257 m.
Fig. 5. (F. IX/8), 263·8 m.
Fig. 6. (F. IX/9), 274·5 m.
Fig. 7. (F. IX/10), 257 m.

All specimens from Pamiętowo boring, 205—274·5 m, Montian



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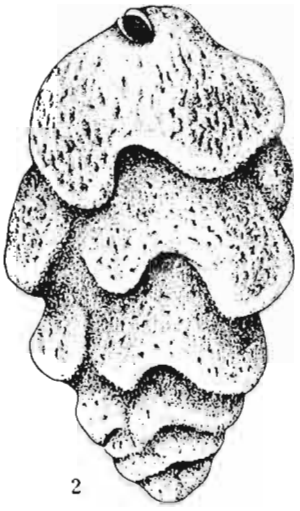

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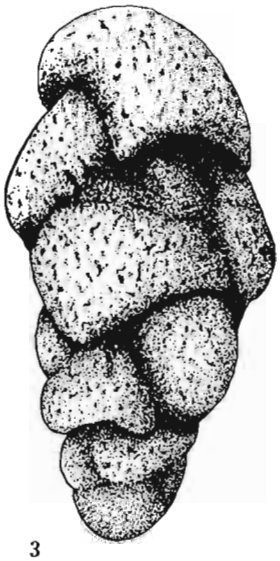

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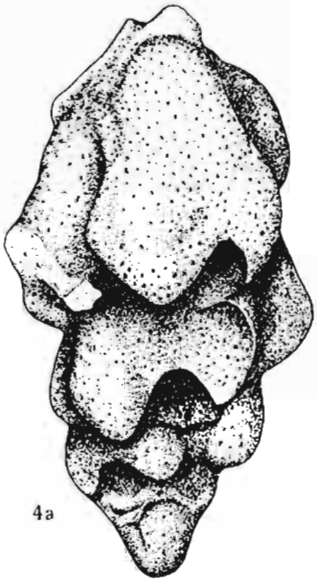

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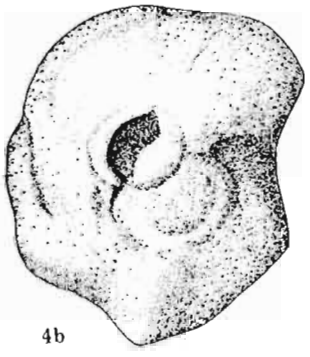

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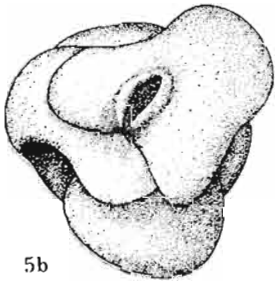

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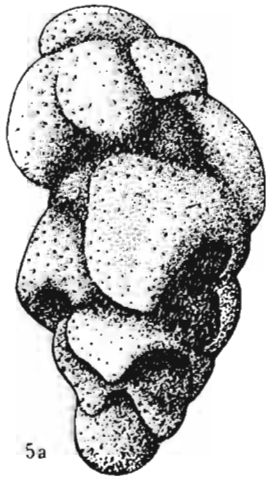

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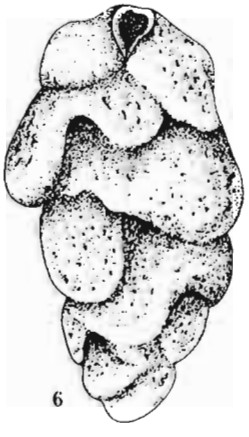

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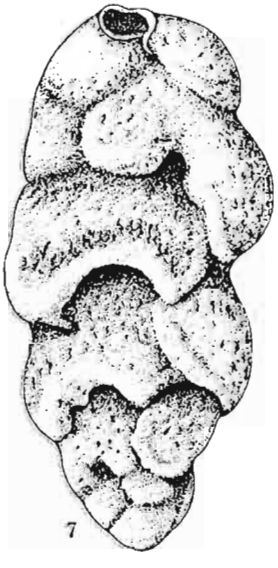

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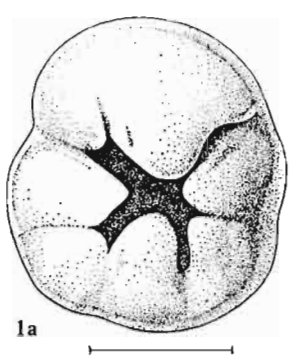
All specimens, except F. IX/18, from Pamiętowo boring, 205—274·5 m, Montian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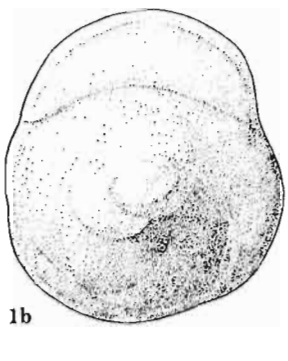
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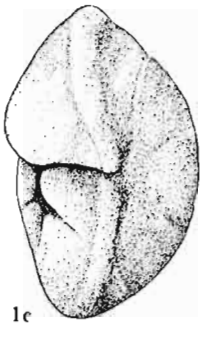
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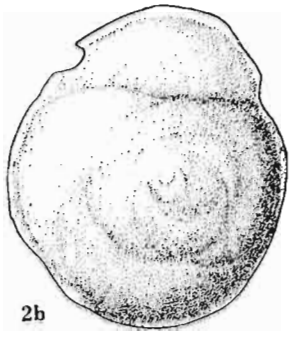
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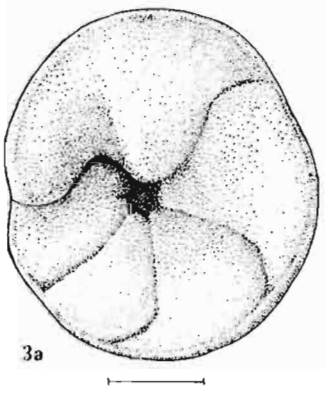
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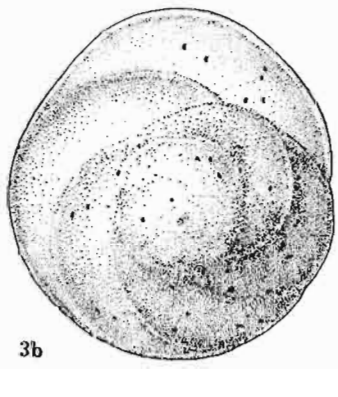
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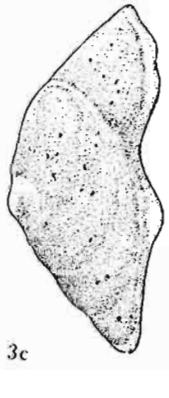
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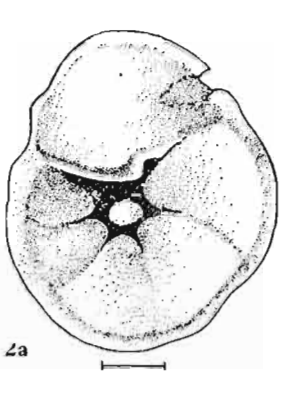
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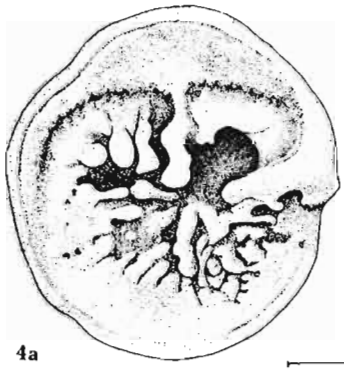
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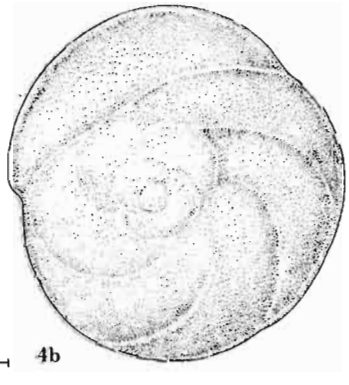
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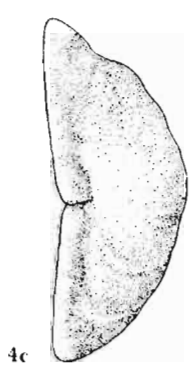
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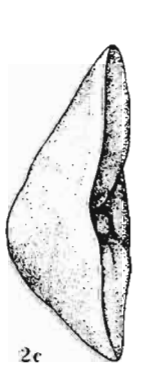
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PLATE III

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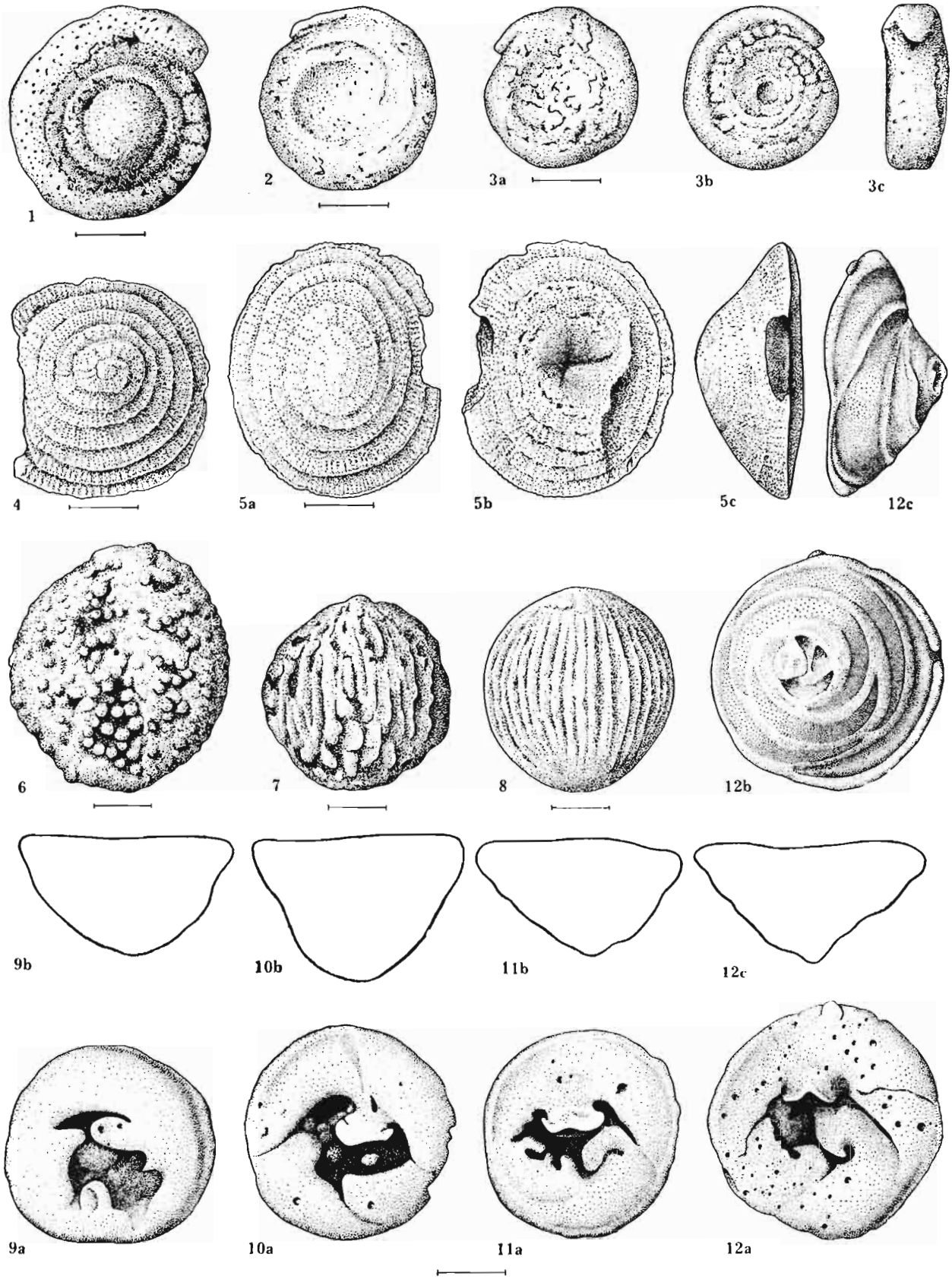
All specimens from Pamiętowo boring, 205-274·5 m, Montian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12c
9a
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PLATE IV

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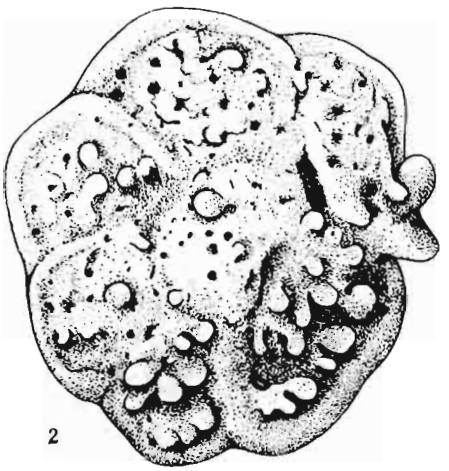
All specimens from Pamiętowo boring, 205-274·5 m, Montian



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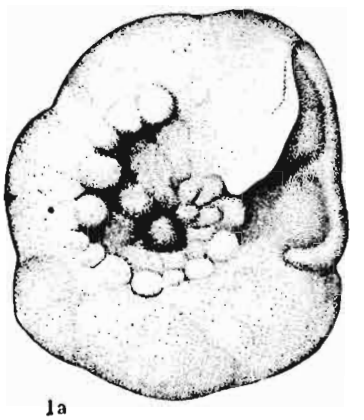

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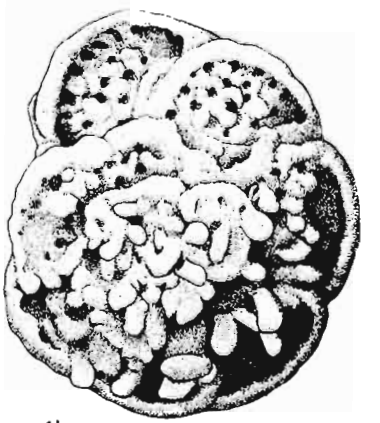

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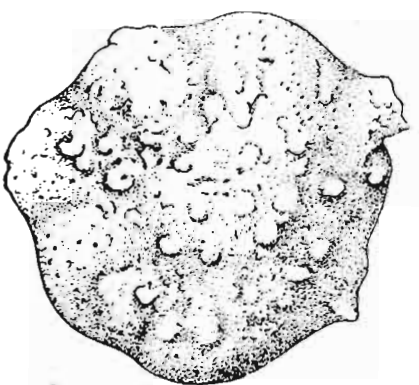

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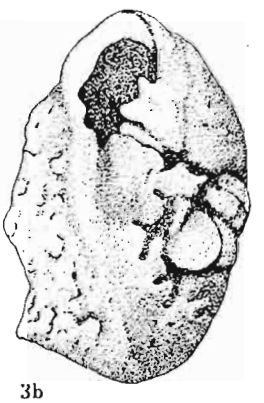

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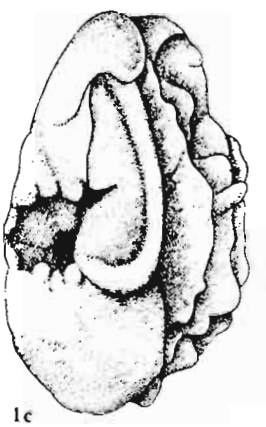

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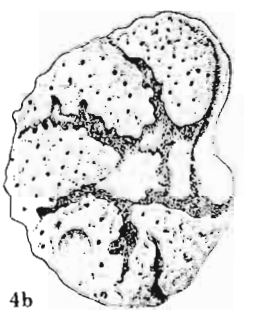

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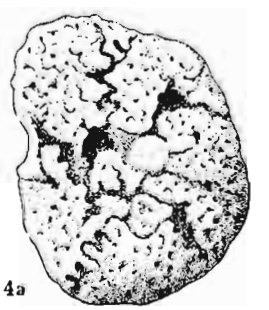

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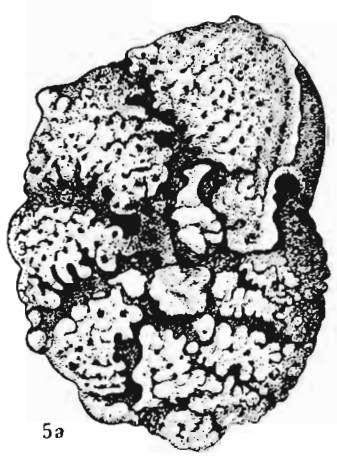

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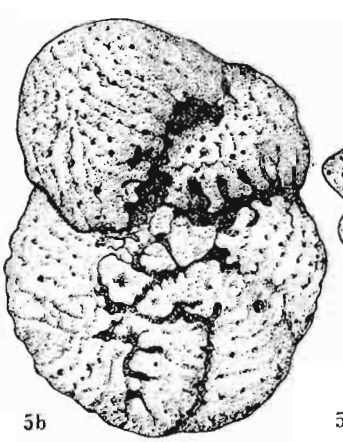

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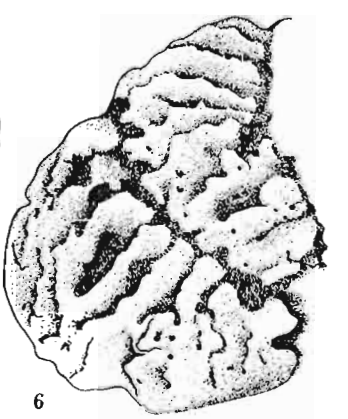

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PLATE V

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Figs. 1, 3, 4. *Rotalia saxorum* D'ORBIGNY (F. IX/34), 273·4 m; (F. IX/35, 36), 208·5 m 61

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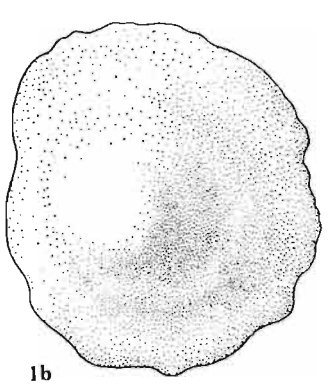
Fig. 10. *Rotalia trochidiformis* (LAMARCK) (F. IX/258), 272 m 62

All specimens from Pamiętowo boring, 205-274·5, Montian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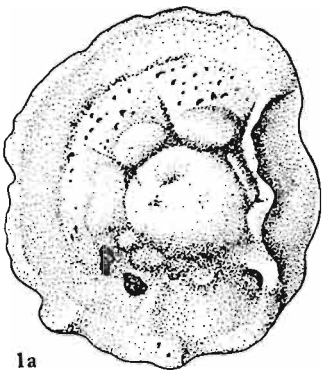
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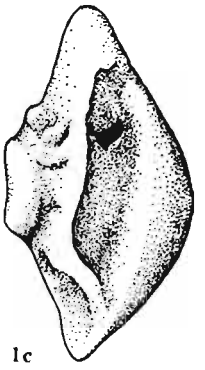
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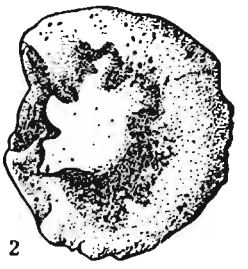
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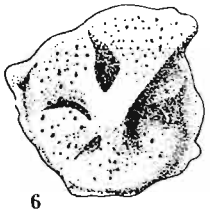
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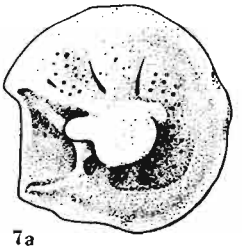
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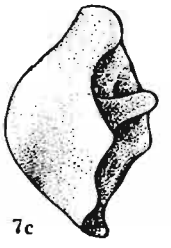
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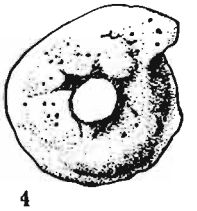
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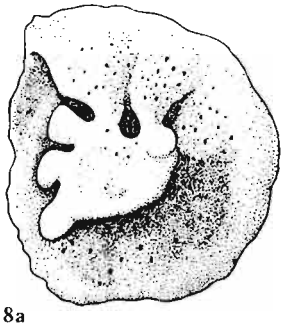
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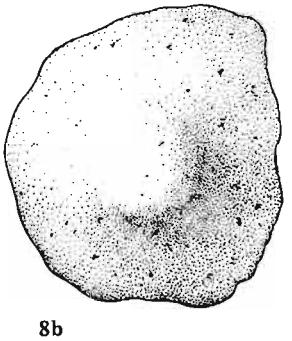
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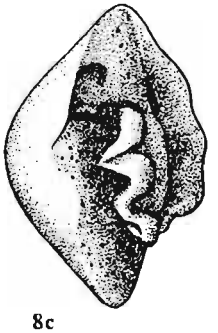
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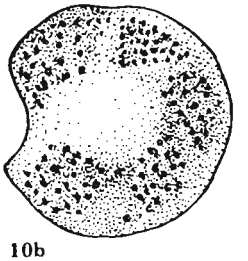
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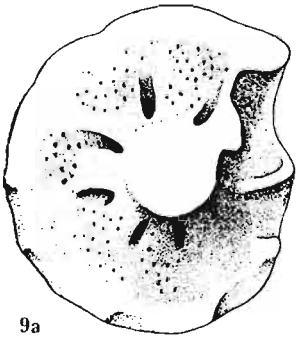
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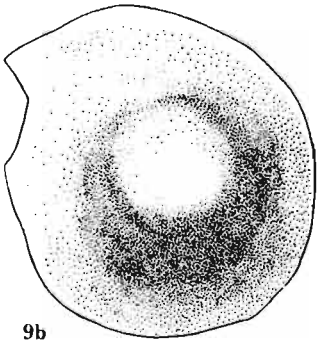
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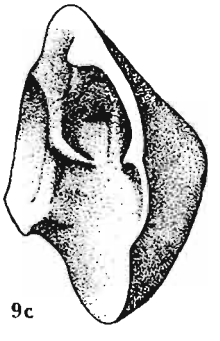
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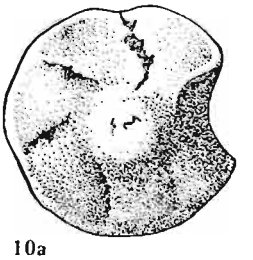
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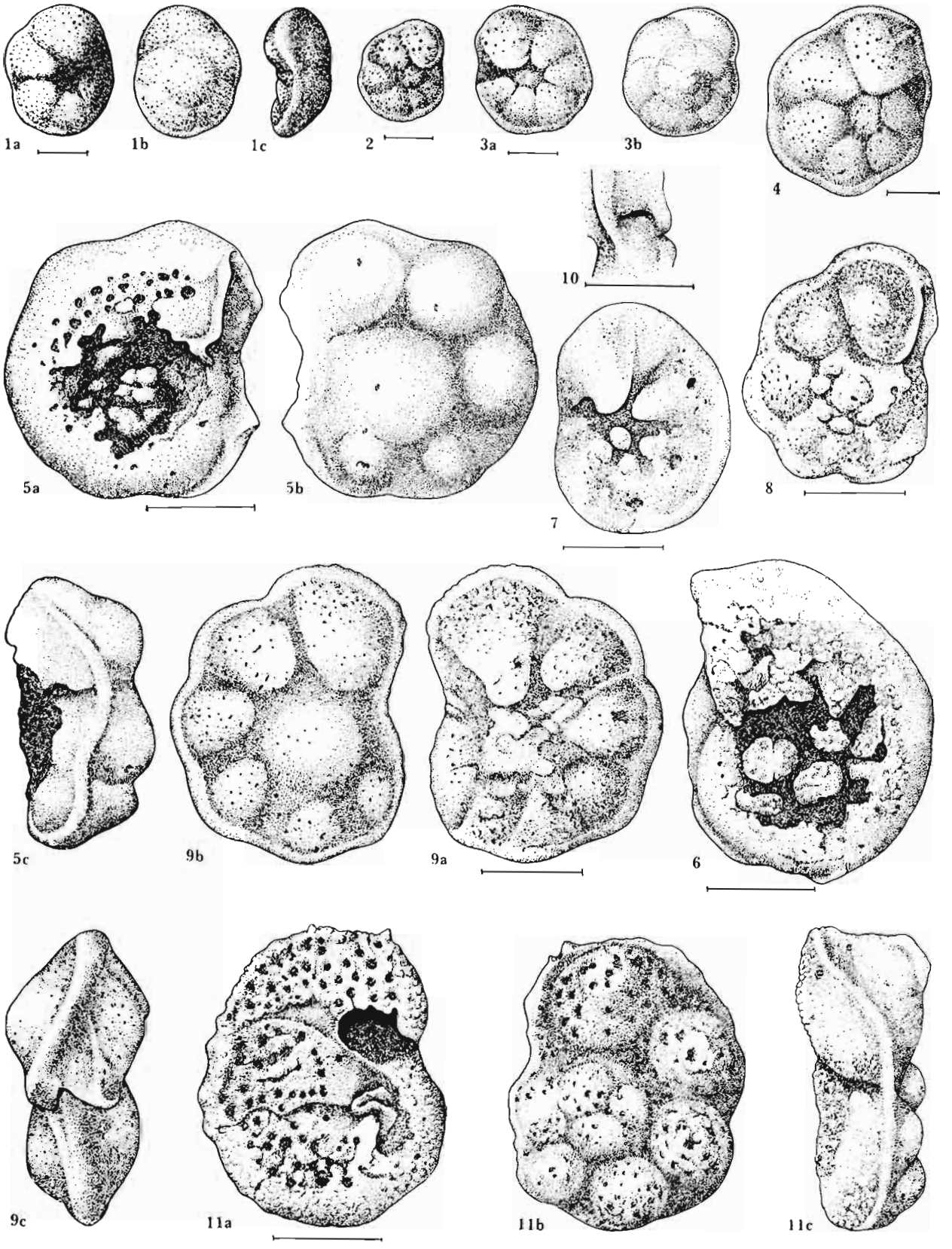
All specimens from Pamiętowo boring, 205-274·5 m, Montian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All specimens from Pamiętowo boring, 205-274·5 m, Montian

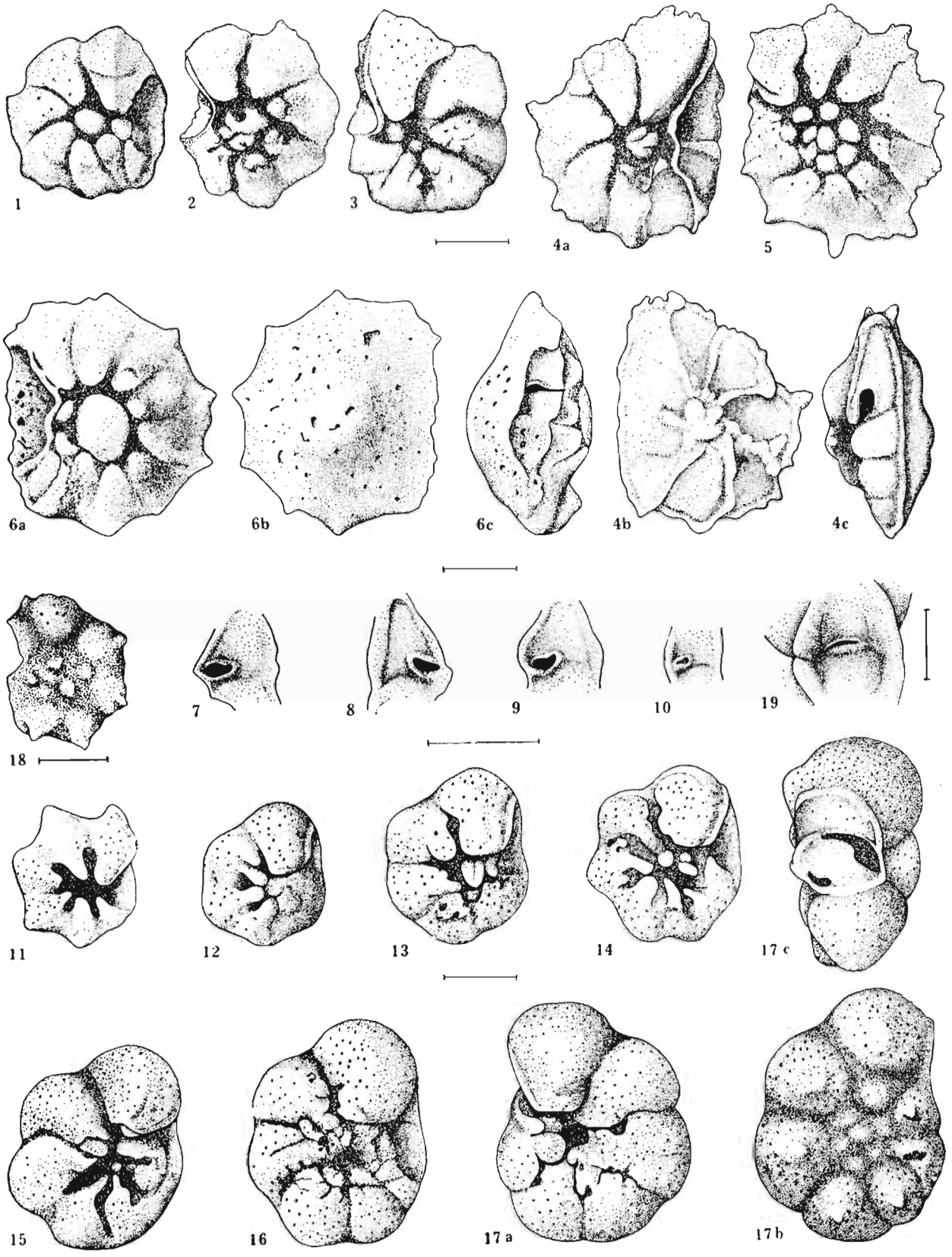
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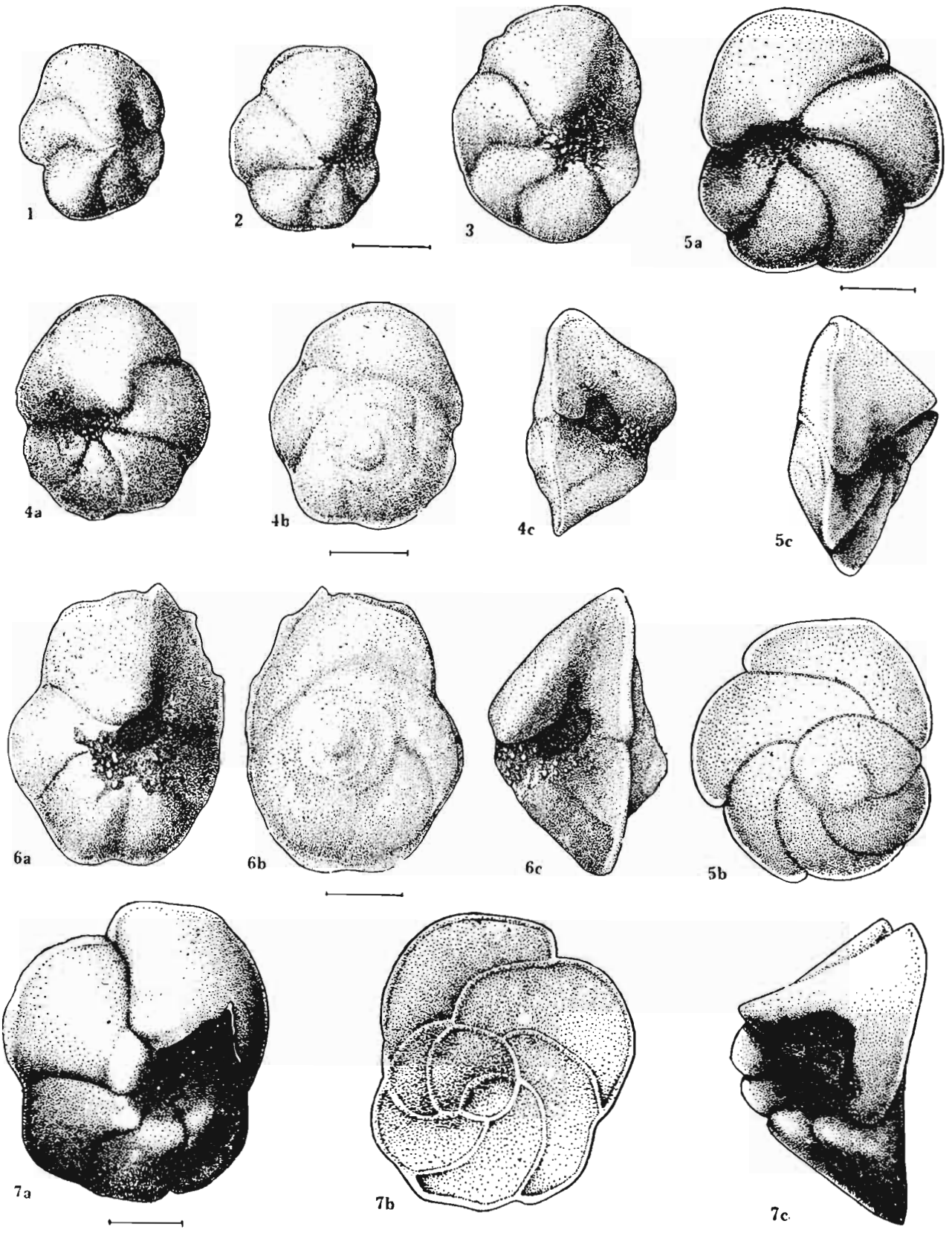
Fig. 6. Paratype (F. IX/79), 274·5 m

Fig. 7. Holotype (F. IX/80), Sochaczew boring, 194 m

All specimens, except F. IX/80, from Pamiętowo boring, 205-274·5 m, Montian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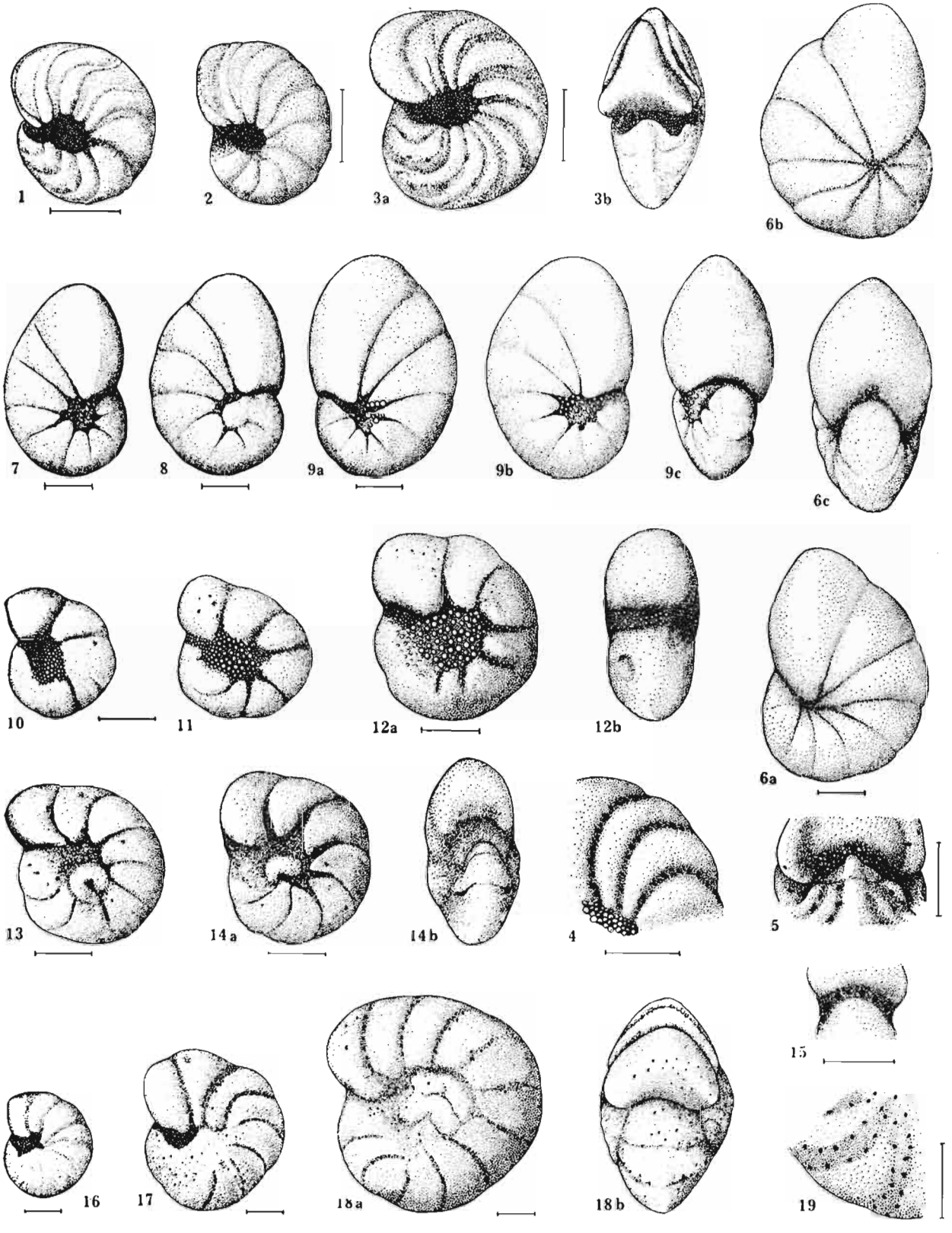
All specimens from Pamiętowo boring, 205-274·5 m, Montian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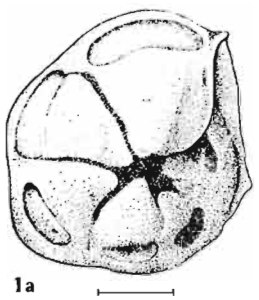
Figs. 3-7. *Cibicides lectus* VASILENKO (F. IX/105, 109), 231 m 77
Figs. 8-12. *Cibicides aurouzae* ROUVILLOIS (F. IX/99-103), 231 m 74

All specimens from Pamiętowo boring, 205-274·5 m, Montian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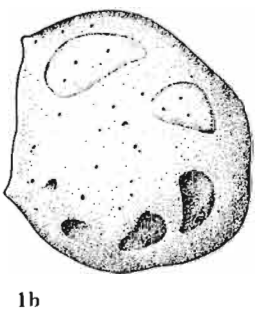
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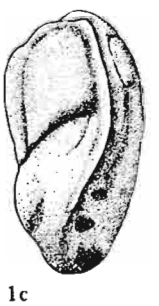
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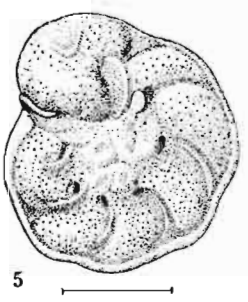
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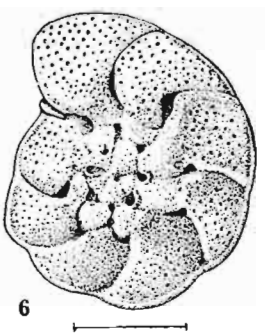
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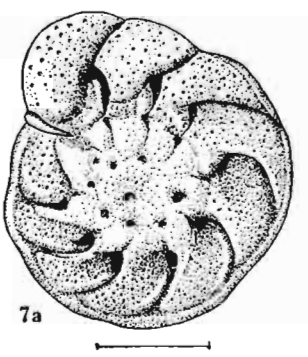
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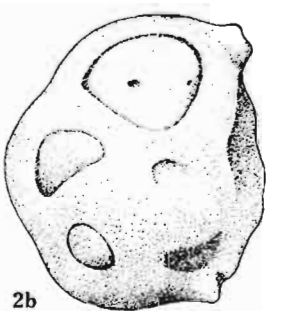
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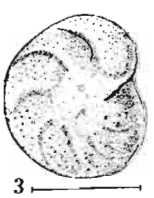
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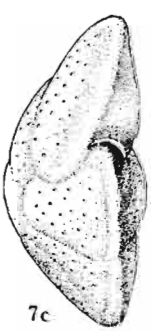
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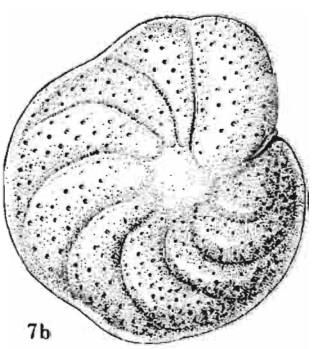
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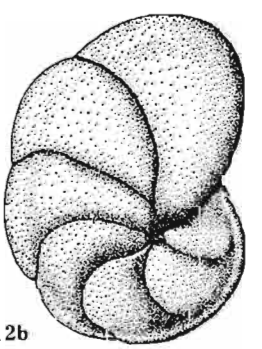
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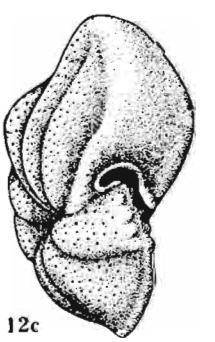
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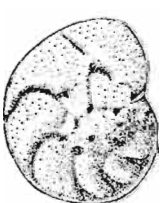
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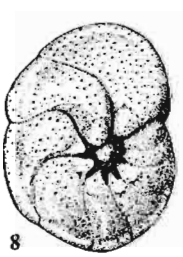
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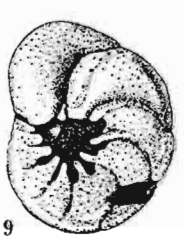
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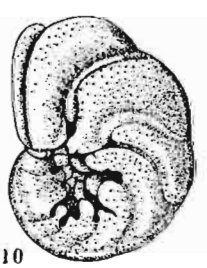
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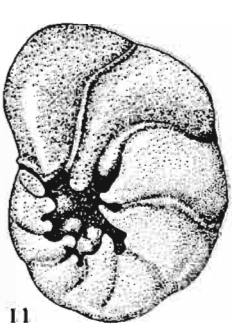
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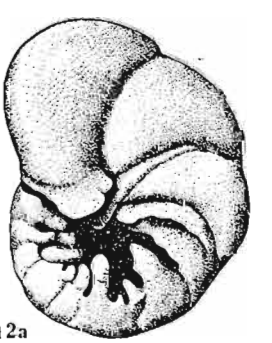
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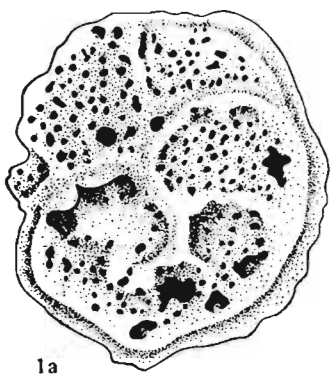
Fig. 1. *Cibicides carinatus* (TERQUEM) (F. IX/104), 257 m 75

Fig. 2. *Planulina limbata* BROTZEN (F. IX/119), 215 m 80

Figs. 3-7. *Cibicides asteroides* n. sp., holotype (F. IX/98), paratypes (F. IX/96, 97); (F. IX/94-95); 215 m . . 73

All specimens from Pamiętowo boring, 205-274·5 m, Montian



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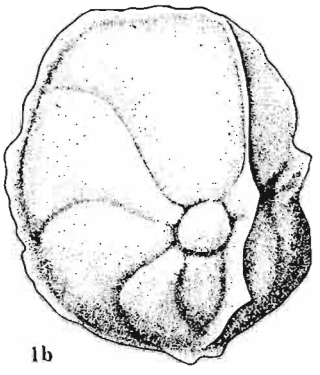

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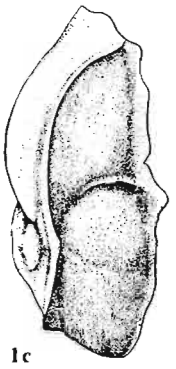

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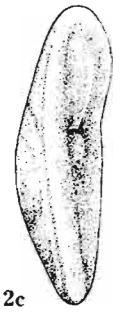

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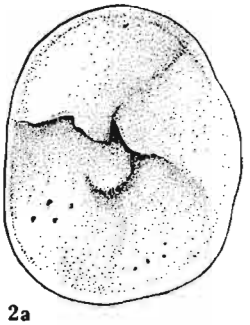

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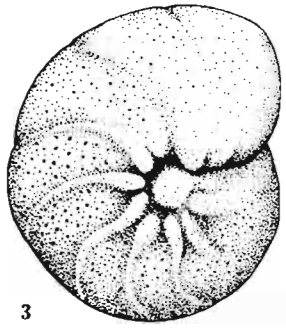

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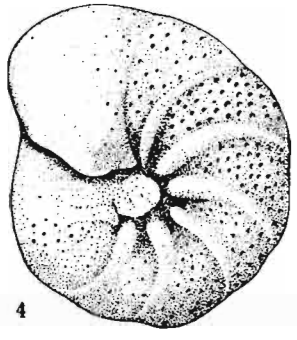

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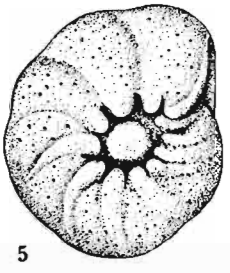

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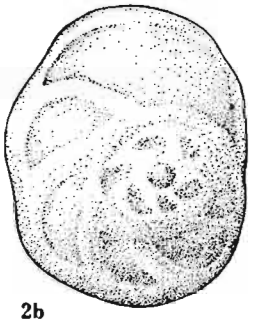

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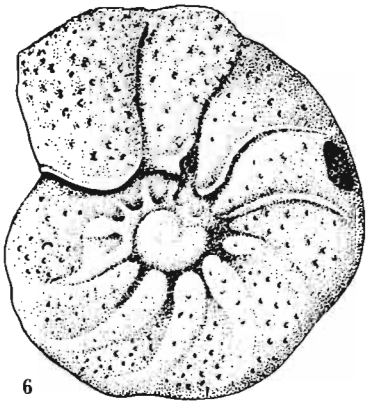

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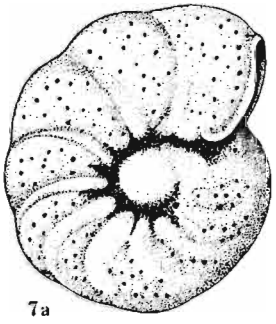

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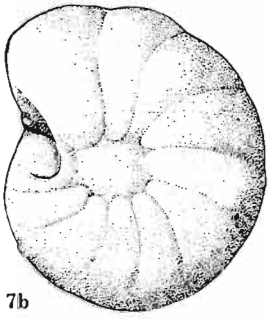

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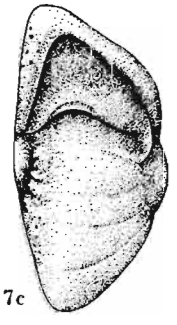

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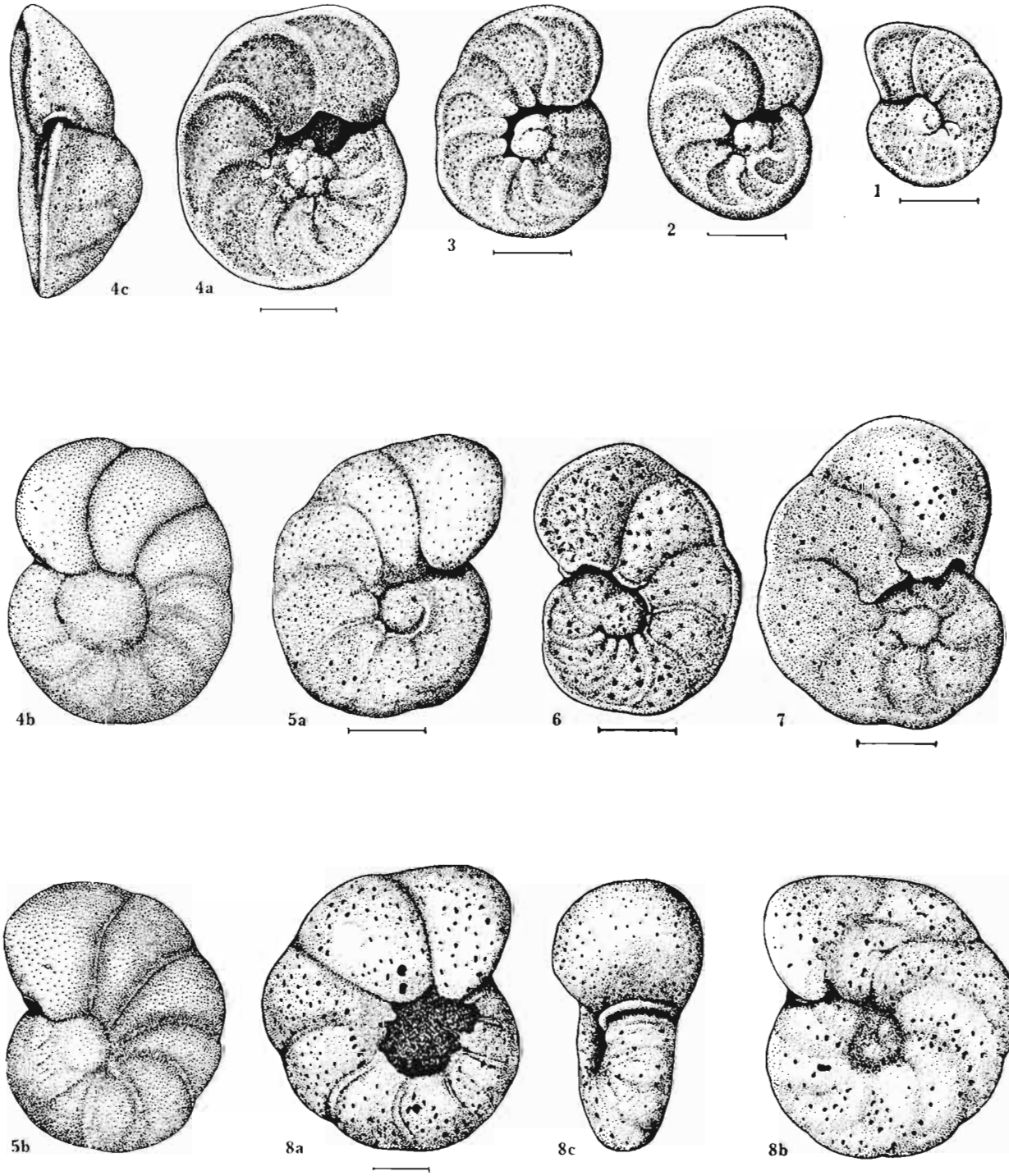
Figs. 1-7. *Cibicides cuvillieri* ROUVILLOIS (F. IX/112-118), 210·7 m. 76

Fig. 8. *Gavelinella lellingensis* BROTZEN (F. IX/244), 241 m 91

All specimens from Pamiętowo boring, 205-274·5 m, Montian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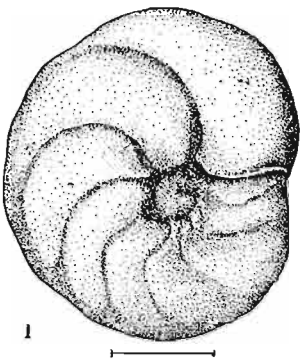
Figs. 1-4. *Anomalina ekblomi* (BROTZEN) (F. IX/245-248), 208·5 m 87

Figs. 5-7. *Anomalina umbilicata umbilicata* (BROTZEN) (F. IX/238-240), 210·7 m. 89

Figs. 8-10. *Anomalina umbilicata costata* n. subsp., paratypes (F. IX/241, 242), holotype (F. IX/243), 208·5 m 89

All specimens from Pamiętowo boring, 205-274·5 m, Montian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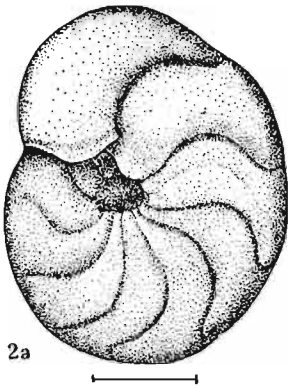
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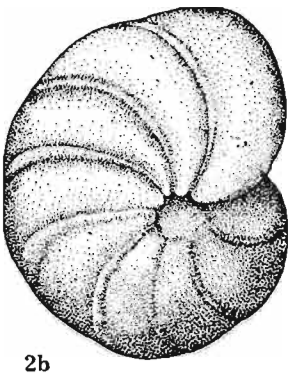
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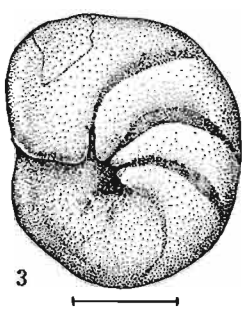
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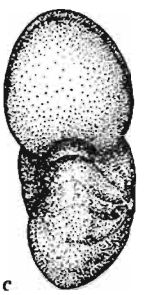
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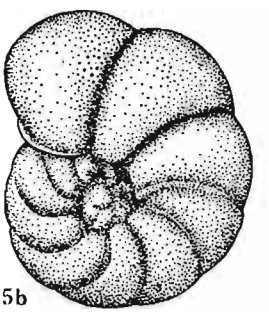
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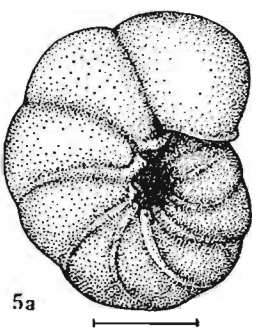
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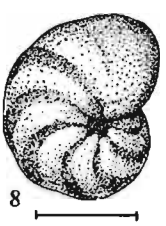
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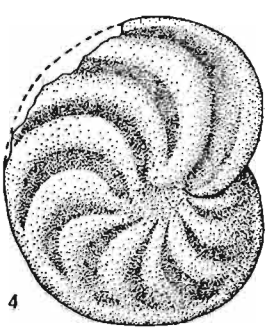
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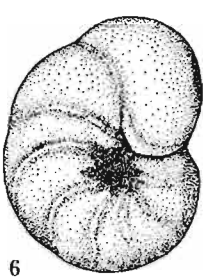
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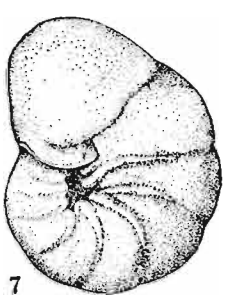
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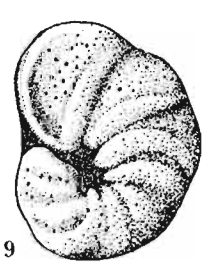
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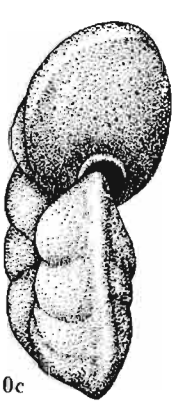
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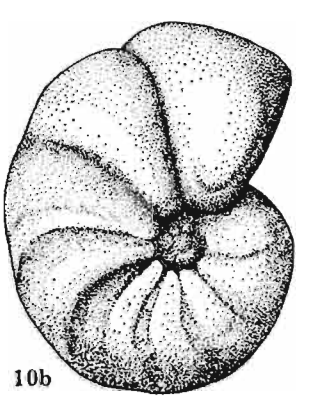
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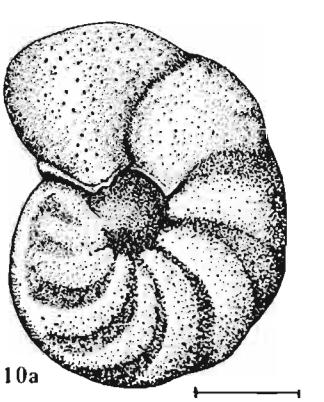
10a

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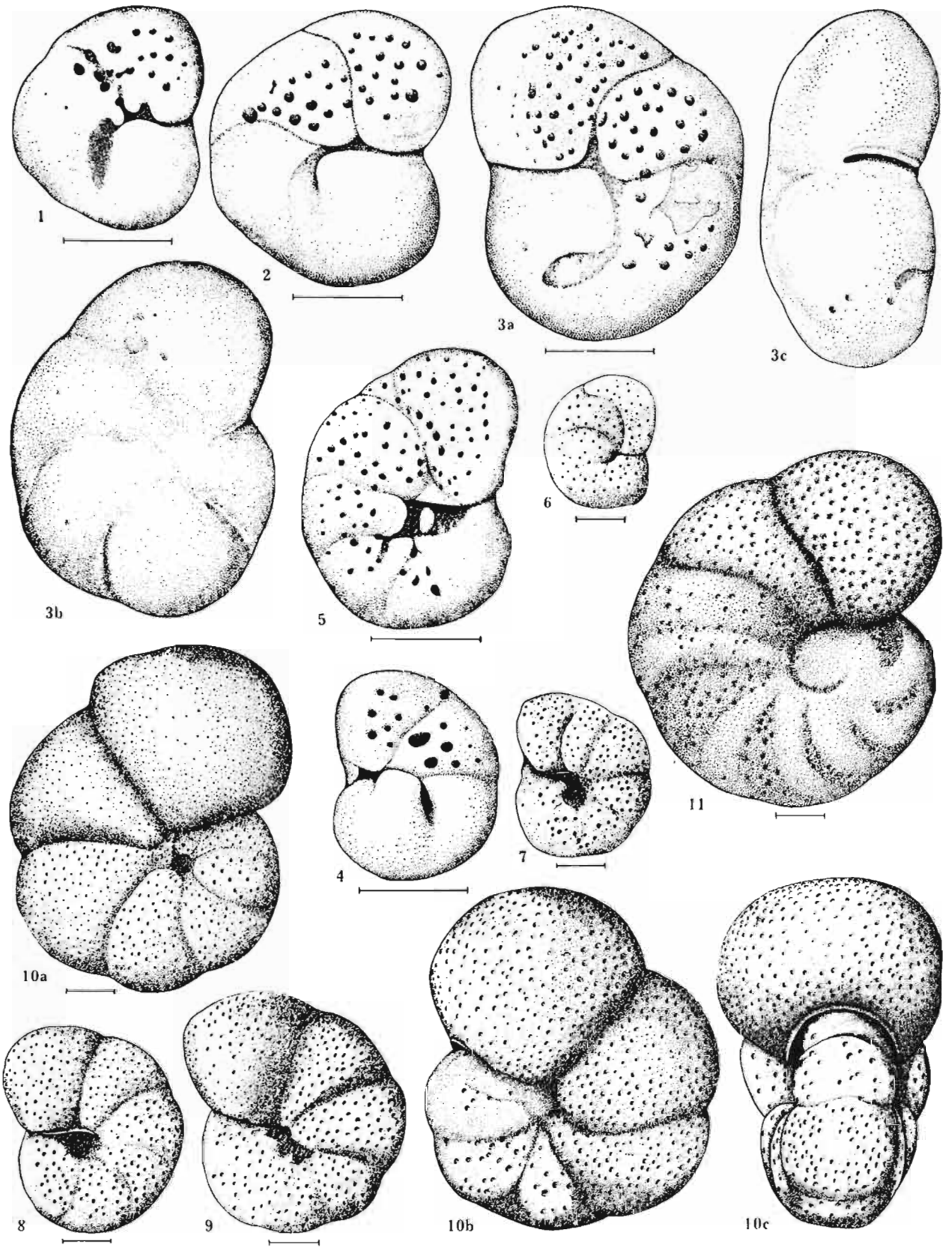
All specimens from Pamiętowo boring, 205-274·5 m, Montian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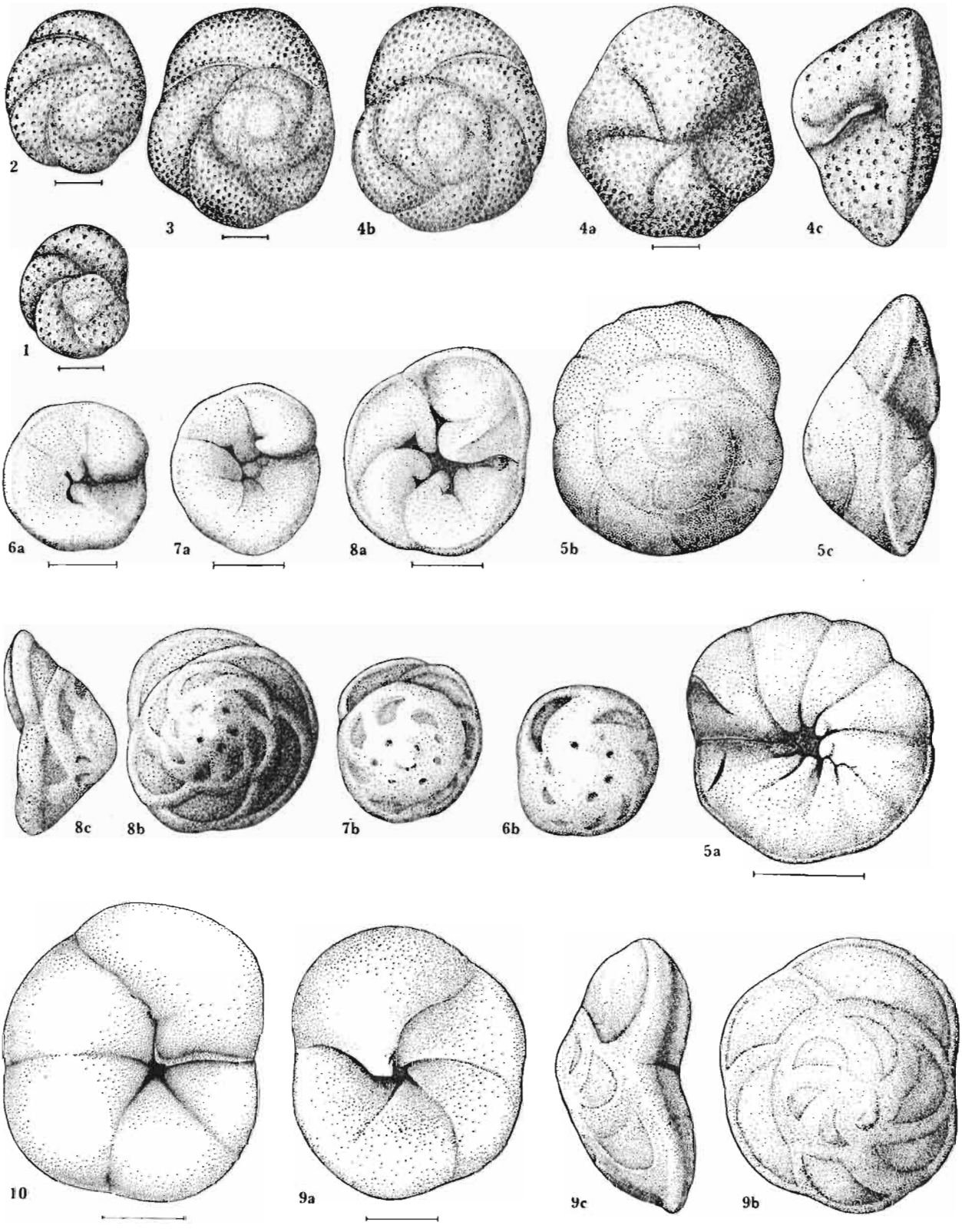
All specimens from Pamiętowo boring, 205-274·5 m, Montian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6b
5a
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9a
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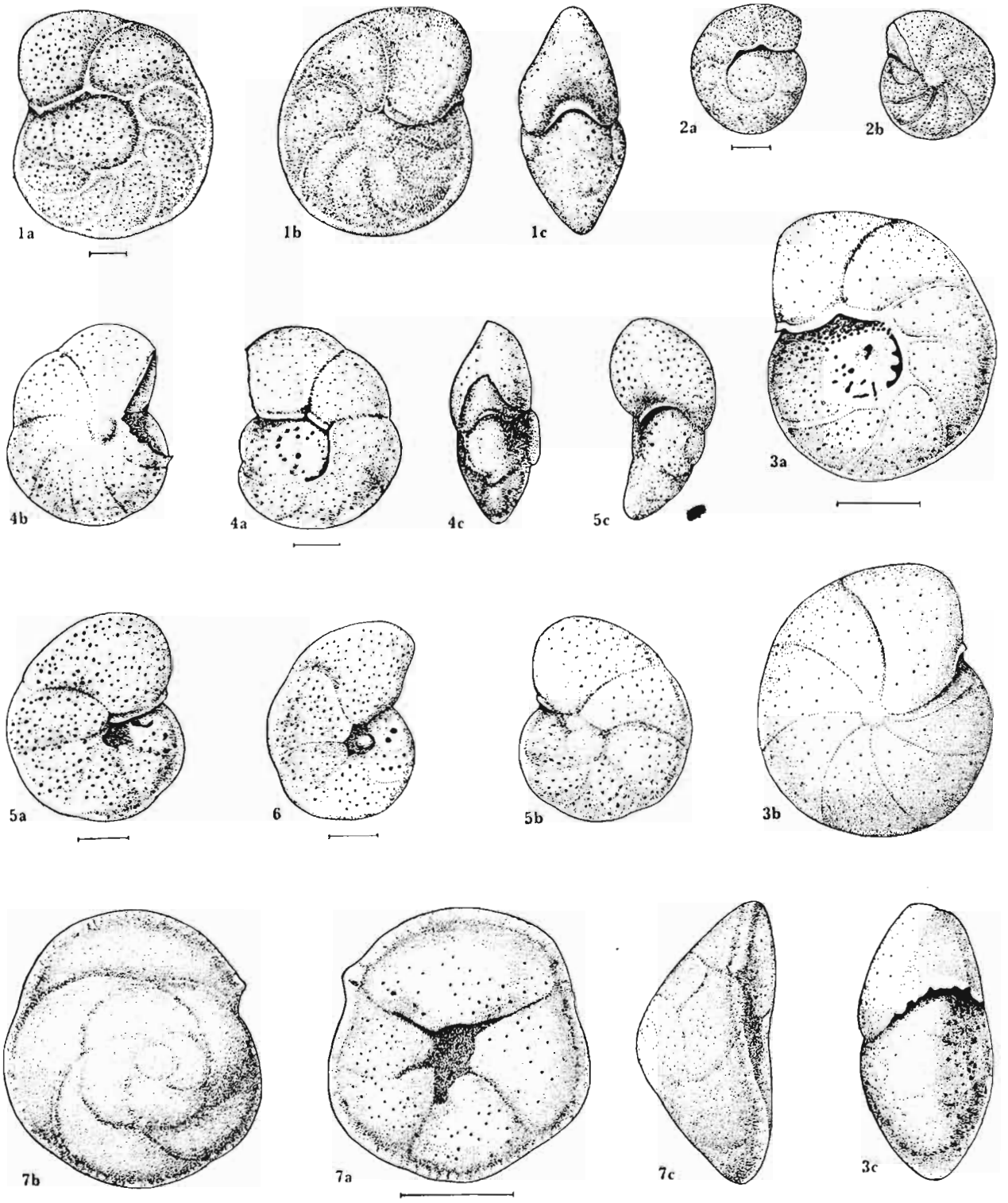
All specimens, except F. IX/147, from Pamiętowo boring, 205-274·5 m, Montian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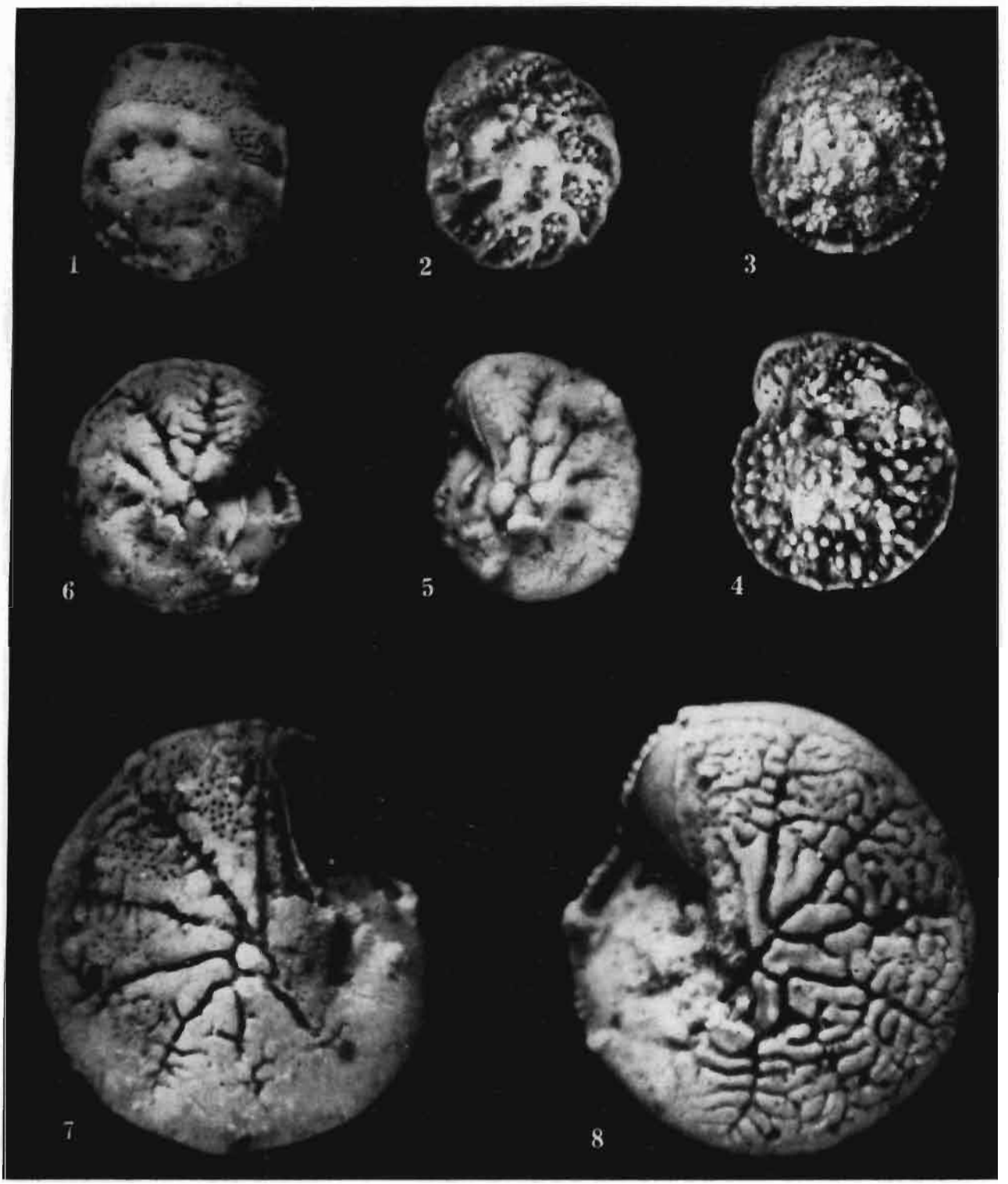
All specimens from Limburg (Bunde boring), Montian, x60



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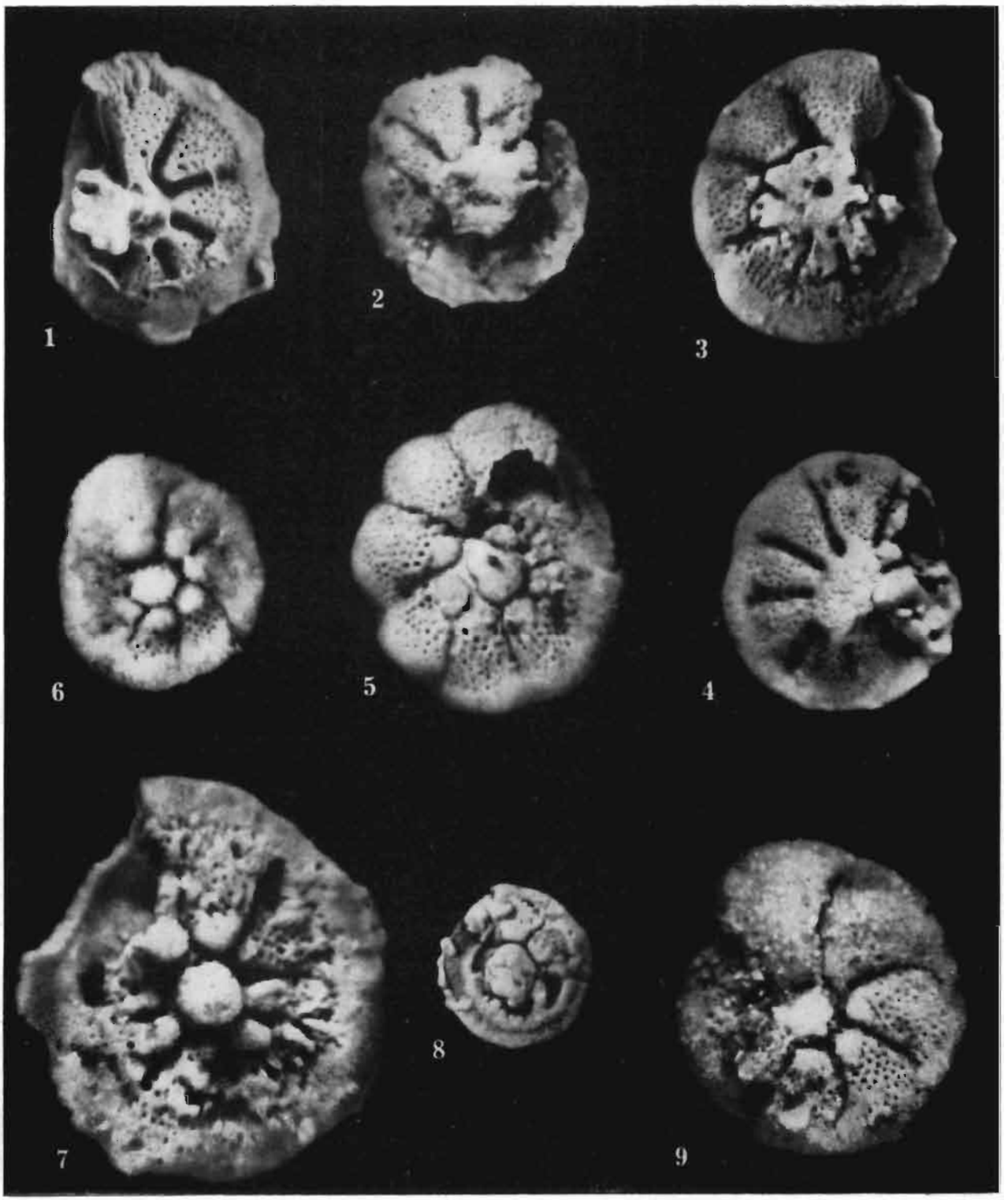
All specimens from Limburg (Bunde boring), Montian, × 60



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