Moim Rodzicom — za wszystko

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THE ALBIAN, CENOMANIAN AND TURONIAN FORAMINIFERS OF POLAND AND THEIR STRATIGRAPHIC IMPORTANCE

Contents

Abstract. — Foraminifers from the Upper Albian, Cenomanian and Turonian deposits, found in 16 boreholes of the Szczecin, Mogilno and Łódź Troughs and of the fore Sudetic monocline (North-West and Central Poland) have been studied by the author. Here are described 100 species, including the following seven new ones: *Verneuilinoides gorzowiensis* n.sp., *Quinqueloculina kozlowskii* n.sp., *Globorotalites polonica* n.sp., *Anomalina gorzowiensis* n.sp., *Lingulogavelinella pazdroae* n.sp., *Gavelinella* (*Berthelinia*) *lodziensis* n.sp., and *Gavelinella* (*Gavelinella*) *varsoviensis* n.sp. The subspecies *Lingulogavelinella asterigerinoides arachnoidea* n.subsp. has also been erected. Studies on all representatives of the family Anomalinidae Cushman, 1927 has allowed the writer to extend the knowledge of the microstructure of their wall, of the alternation of generations and of the position of proloculus in the test. The results of these studies contributed to, among other things, an accurate determination of the sides of test. Almost all the species of planktonic foraminifers found have been elaborated by studying the relationships of the area discussed to the Mediterranean belt. They permitted also to establish a fine stratigraphy of the Cenomanian deposits. The agglutinated foraminifers enabled the determination of the age of the beds in which the calcareous foraminifers either do not occur at all, or are very rare. Comparisons have also been conducted between the assemblages of foraminifers of Poland under study and other assemblages cited from France, north-western Germany and the platformic part of the U.S.S.R. Lithological characteristics of this area have been presented, with particular attention paid to the dependence of the occurrence of foraminifers on the type of deposits.

INTRODUCTION

The result of palaeontological and stratigraphic studies on the assemblages of the Upper Albian, Cenomanian and Turonian (mostly Lower) foraminifers in the Szczecin, Mogilno and Łódź Troughs and the fore-Sudetic monocline are shown in the present paper. All the species of the family Anomalinidae found in these areas are here described, along with the representatives of selected genera of other families. A total of 100 species, including seven new ones and a new subspecies, are described. Many of these species, distributed the world over, occur both in the boreal and Mediterranean regions. Most attention has been paid to the representatives of the family Anomalinidae, whose dynamic development starts as late as the Albian, despite its representatives being known since the Triassic. Evolutionary series, started in the Neocomian, terminate on the

boundary between the Lower and Upper Turonian, closing the first phylogenetic cycle of this family's development. The microstructure of wall and the alternation of generations have been studied in the species of this family. The planktonic foraminifers have also been studied almost as a whole in order to find the relationships of the area under study to the Mediterranean region. Due to their stratigraphic importance the agglutinated foraminifers have been elaborated in the deposits in which a decreased amount of calcareous foraminifers is observed. The distribution of foraminifers has been correlated with macrofaunal horizons on the basis of Cieśliński's (1959, 1960, 1965) and Błaszkiewicz's (1970) works.

The results of the writer's stratigraphic studies, here given in an abbreviated form, will be more extensively presented elsewhere.

The author's studies were enabled by abundant materials coming from deep borings made in the Polish Lowland by the Geological Institute and the Oil Enterprise in 1955—1964. Altogether, foraminifers from 430 samples were elaborated, coming from the Upper Albian, Cenomanian and mostly Lower Turonian deposits, found in 16 boreholes (Fig. 1). The assemblages of foraminifers from individual tectonic units are made up in Table 1.

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GENERAL PART

LITHOLOGICAL CHARACTERISTICS OF THE DEPOSITS UNDER STUDY

The foraminifers here elaborated come from the following 16 boreholes: Maszkowo II, Oświno IG-I, Szczecin IG-I, Chociwel IG-I and Choszczno IG-I from the area of the Szczecin Trough; Recz 1, Wągrowiec IG-I, Pa-

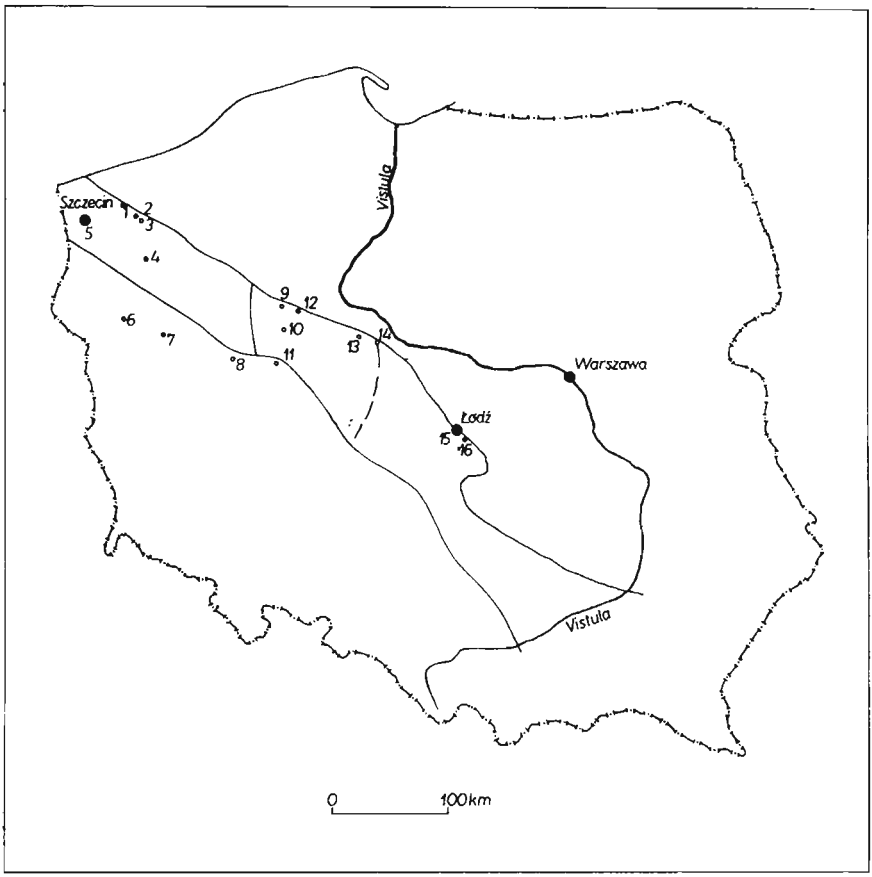


Fig. 1. — A sketch map showing the distribution of borehole from which Foraminifera were examined. Szczecin Trough: (1) Maszkowo II; (2) Oświno IG I; (3) Chocivel IG I; (4) Choszczno IG I; (5) Szczecin IG I. Mogilno Trough: (9) Wągrowiec IG I; (10) Recz 1; (12) Murczyn IG I; (13) Pagórki IG I; (14) Ślazewo 5. Mogilno Trough (15) Łódź 4a; (16) Łódź 5a. Fore-Sudetic monocline: (6) Gorzów Wkp. IG I; (7) Międzychód IG I; (8) Lusowo IG I; (11) Marzenin IG I.

Table 1

ASSEMBLAGE OF THE CRETACEOUS FORAMINIFERA FROM THE NORTH-WESTERN AND CENTRAL POLAND

	SZCZECIN TROUGH					MOGILNO TROUGH					ŁÓDŹ TROUGH				FORE SUDETIC MONOCLINE				
	ALBIAN	CENOMANIAN		TURONIAN		ALBIAN	CENOMANIAN			TURONIAN	ALBIAN	CENOMANIAN			ALBIAN	CENOMANIAN			TURONIAN
	U.	I	II	L.	U.	U	I	II	III	L.	U.	I	II	III	U.	I	II	III	L
Spiroplectinata annectens																			
Arenobulimana sabulosa																			
Quinqueloculina antiqua																			
Quinqueloculina kozlowskii n. sp.																			
Marginulina jonesi																			
Marginulina aequivoca																			
Planularia cenomana																			
Planularia cristellarioides																			
Saracenaria bononiensis																			
Vaginulina aff. paucistriata																			
Vaginulina procera																			
Vaginulina tenuistriata																			
Vaginulina biochei																			
Vaginulina strigillata bettenstaedti																			
Valvulineria gracillima																			
Heterohelix washitensis																			
Globigerinelloides bentonensis																			
Hadbergella hoterivica																			
Pleurostomella reussi																			
Globorotalites polonica n.sp.																			
Bifarina calcarata																			
Lingulogavelinella asterigerinoides arachnoidea n.subsp.																			
Gavelinella (Berthelina) intermedia																			
Gavelinella (Gavelinella) sigmoicosta																			
Gavelinella (Gavelinella) planodorsa																			
Spiroplectammina praelonga																			
Textularia chapmani																			
Textularia foeda																			
Arenobulimina advena																			
Arenobulimina varsoviensis																			
Arenobulimina frankei																			
Arenobulimina conoidea																			
Arenobulimina polonica																			
Planularia bradyana																			
Conorbina brotzeni																			
Dorothia gradata																			
Tritaxia macfadyeni																			
Plectina ruthenica mariae																			
Pseudotextulariella cretosa																			
Guembelitria cenomana																			
Rotalipora appenninica																			
Rotalipora greenhornensis																			
Rotalipora cushmani cushmani																			
Rotalipora cushmani thomei																			
Rotalipora reicheli																			
Rotalipora deeckei																			
Anomalina gorzowiensis n. sp.																			
Lingulogavelinella pazdroae n.sp.																			
Lingulogavelinella ornatissima																			
Gaudryina angustata angustata																			
Gaudryina angustata compressa																			
Vaginulina arguta																			
Praeglobotruncana imbricata																			
Praeglobotruncana helvetica																			
Praeglobotruncana oraviensis																			
Globotruncana renzi																			
Globorotalites hangensis																			
Lingulogavelinella globosa																			
Gavelinella (Berthelina) berthelini																			
Planulina aff. lundegreni																			
Epistomina caracolla																			
Epistomina reticulata																			
Epistomina favosoides																			
Epistomina juliae																			
Epistomina spinulifera polypioides																			
Spiroplectinata complanata																			
Globigerina graysonensis																			
Tritaxia pyramidata																			
Tritaxia plummerae																			
Verneuilinoides gorzowiensis n.sp.																			
Arenobulimina chapmani																			
Eggerellina mariae																			
Saracenaria vestita																			
Vaginulina recta																			
Vaginulina robusta																			
Vaginulina striolata																			
Bolivina textilarioides																			
Schackoina cenomana bicornis																			
Hedbergella infracretacea																			
Hedbergella planispira																			
Lingulogavelinella asterigerinoides asterigerinoides																			
Lingulogaveliinella formosa																			
Gavelinella (Berthelina) lodziensis n.sp.																			
Gavelinella (Gavelinella) schlonbachi																			
Gavelinella (Gavelinella) varsoviensis n.sp.																			
Gavelinella (Gavelinella) cenomanica																			
Gavelinella (Gavelinella) baltica																			
Lingulogavelinella spinosa																			
Planularia complanata																			
Neobulimina minima																			
Praebulimina exexa																			
Schackoina cenomana cenomana																			
Hedbergella brittonensis																			
Clavihedbergella simplicissima																			
Cibicides gorbenkoi																			
Pleurostomella obtusa																			
Gyroidinoides infracretacea																			
Lingulogavelinella orbiculata																			
Gavelinella (Berthelina) belorussica																			
Lingulogavelinella kaptarenkae																			
Valvulineria lenticula																			
Eponides belorussiensis																			
Dorothia truchus																			
Dorothia turris																			
Tappanina eouvigeriniformis																			
Schackoina moliniensis																			
Praeglobotruncana stephani																			

górki IG-I, Ślazewo 5 and Murczyn IG-I from the Mogilno Trough; Łódź 5a and Łódź 4a from the Łódź Trough; Gorzów Wlkp. IG-I, Międzychód IG-I, Lusowo IG-I and Marzenin IG-I from the fore-Sudetic monocline (Fig. 1).

The Upper Albian. — The Middle Albian transgression, including the areas of the Polish Lowland, started a sedimentary cycle which persisted throughout the Upper Cretaceous, the Upper Maastrichtian inclusively. The Upper Albian deposits in the Polish Lowland are mostly developed in carbonate and arenaceous facies.

In the Szczecin, Mogilno and Łódź Troughs, as well as in the studied part of the fore-Sudetic monocline, the Upper Albian on the whole starts with a thin (some scores to 3 m thick) layer of a glauconitic sandstone with phosphatic concretions. In the Łódź Trough, gaizes and spongiolites are deposited besides in the lower part of the Upper Albian. In sandstones, foraminifers are few, probably redeposited and difficult to identify. A fairly abundant assemblage of foraminifers was found in gaizes. In the upper part of the Upper Albian, clayey or calcareous marls were deposited in the area mentioned above. Part of them contain phosphorites with a fairly numerous fauna of pelecypods, abundant *Aucellina gryphaeoides* Sow. and belemnites. The richest assemblage of foraminifers has been found in marly deposits of the north-eastern part of the Mogilno Trough, as well as in the deposits of the Łódź Trough, and fore-Sudetic monocline. The composition of assemblages is slightly varying in particular tectonic units mentioned above. In the entire area, a horizon containing the representatives of the genus *Schackoina* Thalmann is marked on the boundary between the Albian and Cenomanian. In the Mogilno Trough (Pagóki IG-I), the upper boundary of the Albian, determined by microfauna, runs 6 m below the macrofaunal boundary. The Upper Albian deposits do not on the whole reach a great thickness in the tectonic units under study. It fluctuates within limits of a few and a dozen or so meters, except for the south-eastern part of the Łódź Trough, where the Upper Albian deposits reach a thickness of about 50 m (Łódź 5*a*).

The Cenomanian. — A further development of transgression, which covered considerable part of the area so far not flooded by the Upper Albian took place in the Cenomanian. In this stage, carbonate facies predominates in a considerable area of the Polish Lowland. In the Szczecin, Mogilno and Łódź Troughs, light-gray sometimes marly limestones occur, bearing numerous traces of dissolution and having secondary intercalations and laminations of pink limestones and chocolate-colored marls which contain the most richest assemblage of foraminifers. It has been found in this area that numerous planktonic species have continuing ranges which is an evidence of the persistence of conditions optimum for their existence. In the fore-Sudetic monocline, the lower part of the Cenomanian is marly and overlaid with limestones. Among numerous species foraminifers occurring in

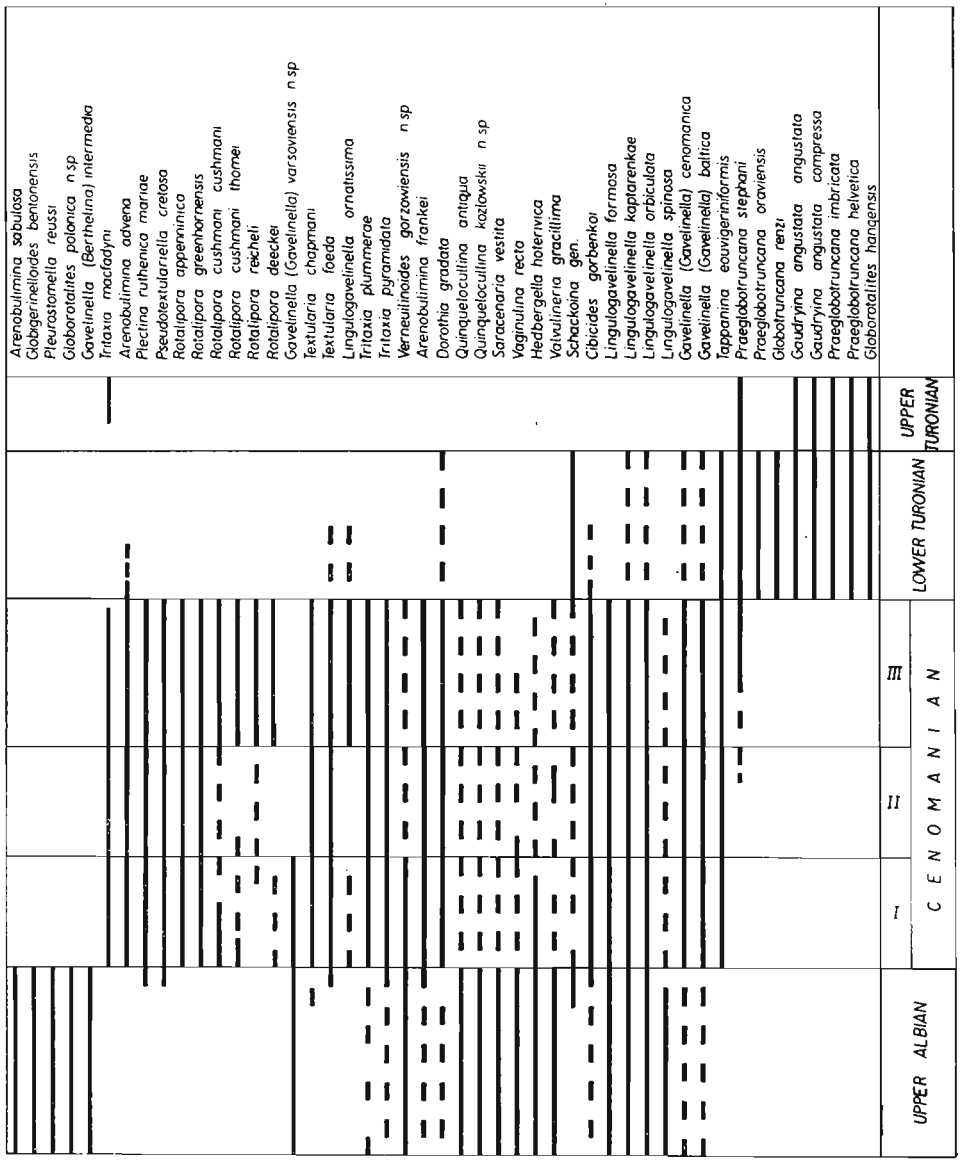
those deposits many are found only in this area. Three foraminiferal horizons, marked as horizons I, II and III, occur in the Cenomanian of the Mogilno and Łódź Troughs and of the fore-Sudetic monocline. Only the first two horizons have been distinguished in the Szczecin Trough. In the entire area under study, except for the fore-Sudetic monocline (Międzychód IG-I), the upper boundary of the Cenomanian, determined by the occurrence of foraminifers, concurs with the macrofaunal boundary. In the fore-Sudetic monocline (Międzychód IG-I), the Cenomanian foraminifers, excepting rotalipores, also occur in the Lower Turonian (*Inoceramus labiatus* Zone and the lower part of *I. lamarcki* Zone). The thickness of the Cenomanian deposits fluctuates within limits of a dozen or so and 100 m.

The Lower Turonian. — A maximum of the Upper Cretaceous transgression took place in the Turonian. It probably extended on the entire extra-Carpathian Poland, together with the central part of the Holy Cross Mountains. The range of the Turonian deposits now observed coincides in principle with the occurrence of the Cenomanian. Locally, however, as in the south-western part of the Miechów Trough and in the Sudeten Mountains, the Turonian deposits transgressively overlie the deposits older than Cenomanian. The lithological differentiation of the Turonian is considerably larger than that of the Cenomanian. As a result of a turbulent sedimentation, the Turonian makes up the most variable part of the profile in the Szczecin Trough, in which the Lower Turonian deposits consist of marly claystones, occurring alternately with opokas (Szczecin IG-I), mudstones (Oświno IG-I and Chociwel IG-I), opokas and clayey opokas (Choszczno IG-I) and marly claystones and sandy marls (Maszkowo II). Numerous pelecypods and foraminifers occur in the sediments of all these types. It is worth mentioning that in the south-western part of this area (Szczecin IG-I and Choszczno IG-I), foraminifers characteristic of the Lower Turonian pass to the lower beds of the Upper Turonian (the lower part of the *Inoceramus inconstans* and *I. costellalus* Zone). In the north-eastern part of this area (Maszkowo II), many epistomines have been found in the Lower Turonian in addition to typical species. Most of these epistomines, recorded in the present paper, have hitherto been known from the Lower Cretaceous deposits. The Lower Turonian beds, in which occurs this characteristic assemblage of foraminifers, have been called "Maszków Beds".

In the Mogilno Trough, the Lower Turonian is on the whole developed in the form of a marly limestone with the intercalations of marls, which locally are clayey, of opokas and clayey opokas, as well as of locally marly limestones (Pagórki IG-I, Ślazewo 5). The deposits contain a rich fauna of inocerams and foraminifers. Certain differences are marked in the assemblages of foraminifers that occur in the north-western and north-eastern parts of the area under study.

Table 2

THE INDEX SPECIES FOR THE UPPER ALBIAN, CENOMANIAN AND THE LOWER PART OF THE TURONIAN IN THE SZCZECIN–MOGILNO–ŁÓDŹ TROUGHS AND IN THE FORE-SUDETIC MONOCLINE



No core is available from the area of the Łódź Trough.

In the fore-Sudetic monocline, the Lower Turonian is developed in the form of organodetrital or marly limestones. A rich assemblage of both macro and microfauna occurs in these deposits. The thickness of the Turonian in the tectonic units studied fluctuates within limits of a few and 100 m.

A COMPARISON WITH FORAMINIFERAL ASSEMBLAGES OF FRANCE, GERMANY AND THE PLATFORM PART OF THE U.S.S.R.

The Upper Albian. — In the main outcrops of the Paris Basin, the Upper Albian and Vraconian deposits were stratigraphically divided by Marie (1938, 1965) on the basis of the genera *Flourensina, Epistomina* and *Citharina*. No representatives of the first two genera have ever been found in Poland, while *Citharina* occurs in this country only sporadically. Of the species of the genus *Lingulogavelinella, Gavelinella* and the subgenus *Berthelina* (Malapris, 1965, 1967), described from the Paris basin only *L. albiensis* Malapris (= *L. asterigerinoides asterigerinoides* (Plummer)), *L. ciryi inflata* Malapris (= *L. kaptarenkae* (Plotnikova)) and *Gavelinella (Berthelina) intermedia* (Berthelin) were found in Poland. A considerable number of the species of the family Anomalinidae, whose ancestors should be sought for among the foraminifers coming from the Lower and Middle Albian of the Paris Basin, occur in the Upper Albian deposits of Poland. Some of these species are related to the phylogenetic series of *Lingulogavelinella albiensis* Malapris and some others come from such series of *Gavelinella (Berthelina) intermedia* (Berthelin). It should be mentioned that the Upper Albian assemblages of foraminifers of Poland have more elements in common with the Upper Albian assemblage from Montcley (Department of Doubs, France; Berthelin, 1880). In Poland the representatives of the family Nodosariidae are considerably fewer.

Due to a sedimentary continuity of the Lower Cretaceous deposits of North-western Germany, the phylogenetic series of foraminifers may be much more accurately traced in that area than in the Paris Basin or in the platform part of the U.S.S.R. Genera, the majority of which reach their optimum development in the Upper Cretaceous, that is, *Globigerina, Gavelinella, Spiroplectinata, Pleurostomella* and *Arenobulimina* (Grabert, 1959; Bartenstein & Bettenstaedt, 1962), start to appear in the fauna of the Lower Cretaceous deposits of North-western Germany beginning with the Barremian. The development of the representatives of the genus *Gavelinella* was traced in the area discussed by Michael (1966). No species, which might be assigned to the genus *Lingulogavelinella*, are cited from that area by German authors. But it seems that species of this genus should occur in the area of Nort-western Germany, since all foraminifers, cited

from the Upper Albian of this area (Bartenstein & Bettenstaedt, 1962), occur in the Upper Albian deposits of Poland. In Germany, the basin was, however, deeper than in Poland as indicated by the presence of abundant radiolarians which sometimes might even displace the foraminiferal fauna. The last-named phenomenon may explain the lack of the representatives of some genera.

The Upper Albian deposits of the Dnieper-Doniets Depression, in which they have best been studied of all the territory of the U.S.S.R. contain a very uniform assemblage of foraminifers coming from a shallow-water basin connected with the West-European Upper Albian marine basin (Kaptarenko-Tschernousova, 1963, 1967). In the fauna of this Depression predominant are the representatives of the family Nodosariidae (76 out of 106 species described), which makes this assemblage similar to the Jurassic ones and differs it from those of the Albian of Poland. In Poland, the representatives of the families Anomalinidae and Rotaliporidae predominate in the Upper Albian.

The Cenomanian. — The Cenomanian assemblages of foraminifers from Poland's area under study are most similar to those from North-western Germany. This similarity, manifested in both Cenomanian and Albian through Cenomanian foraminiferal assemblages results from the continuity of the evolution of foraminifers. This problem is quite different in the Dnieper-Donets Depression, where a marine sedimentary discontinuity occurred on the Albian-Cenomanian boundary interrupting the development of fauna. Consequently, the Upper Albian assemblages of foraminifers radically differ from the Cenomanian ones. An impoverishment of microfauna and predominance of the species *Gavelinella (G.) cenomanica* (Brotzen) and *G. (G.) baltica* Brotzen, are recorded in the Middle Cenomanian deposits of North-western Germany, much the same as in the area of Poland in horizon II.

In the Cenomanian of Poland's area under study much more genera and species of planktonic, warm-water microfauna are observed than in the Paris Basin, North-western Germany or in the platform part of the U.S.S.R. In Germany, rotalipores appear as late as the upper part of the Middle Cenomanian, while in Poland they appear already in its lowermost beds. The distribution of rotalipores in Poland strongly resembles that in the Dijon Cretaceous, the boundary of the Paris Basin and South-eastern France. In the area mentioned above, two horizons are marked in the Cenomanian: horizon I, containing *Rotalipora appenninica* (Renz) in lower beds and horizon II with varieties of *R. cushmani* (Morrow) in upper beds. The French horizon I seems to correspond to horizons I and II from Poland and horizon II — to the Polish horizon III. Horizon III has also been distinguished in France (Malapris & Rat, 1961), but it occurs in that country as late as the Turonian and contains an assemblage of foraminifers which in Poland corresponds to the "alpha"-Turonian assemblage.

In North-western Germany, the accumulation of rotalipores of the "*cushmani*" group is recorded only in the *Inoceramus labiatus* Zone and in the platform part of the U.S.S.R. — in the Upper Cenomanian. The areas compared have many species in common, both planktonic and benthonic foraminifers, but there are also species characteristic of one of them only.

The Turonian. — In the Paris Basin, North-western Germany and the platform part of the U.S.S.R., no accumulation of planktonic species as those included in assemblage "alpha" is recorded in the Turonian. *Lingulogavelinella globosa* (Brotzen), *Praeglobotruncana stephani* (Gandolfi) and *Globotruncana renzi* Gandolfi are common elements for the Lower Turonian (in the Polish sense) beds of the areas compared. Index species common for particular stages of the entire area under study are made up in Table 2.

SYSTEMATIC PART

GENERAL REMARKS

Loeblich & Tappan's (1964) systematics has been adopted in the present paper with only slight modifications. Much the same as Ohm (1967) and Pazdro (1969), the present writer belives that the genus *Hoeglundina* Brotzen, 1948, included in Loeblich & Tappan's (1964) systematics, is a younger synonym of the genus *Epistomina* Terquem, 1883. Most reservations are aroused by an assemblage of genera, assigned by Loeblich & Tappan (1964) to the subfamily Anomalininae. A varying situation of aperture and various degrees of the evoluteness of test in particular genera of this subfamily result in its not being uniform. In the writer's opinion, the genera assigned to this subfamily, should be — on the basis of the lateral situation of aperture — assigned to two subfamilies. Forms with an interiomarginal, equatorial aperture, passing onto the ventral side, with an aperture situated on the ventral side, and with a terminal aperture, which during the ontogeny is, however, connected with the ventral side of test, should be left in the subfamily Anomalininae Cushman. A new subfamily should be erected for forms in which the aperture passes onto the dorsal side and for related forms with a modified aperture. The representatives of the genus *Lingulogavelinella*, erected by Malapris (Malapris, 1965, 1967) and of *Gavinella* Brotzen, 1942 seem to belong to the subfamily Anomalininae sensu Loeblich & Tappan.

The genus *Lingulogavelinella* Malapris, 1965 is related to the genus *Gavelinella* Brotzen, 1942 from which it primarily differs in an almost complete involution of the dorsal, flat or even concave and only rarely convex ventral side of test, in the lack of an umbilical depression on the

ventral side and in the presence of a starlike ornamentation in the middle of ventral surface. No thickenings characteristic of the genus *Gavelinella* occur on the sutures of the representatives of the genus *Lingulogavinella*. In some of the species of the genus *Lingulogavelinella*, coming from the Upper Albian-Lower Turonian of Poland, the sutures between chambers are very deep, particularly so on the dorsal surface of test and the chambers themselves are strongly convex. On the other hand, in forms which are younger geologically, the dorsal side changes from involute to semi-involute, but does not reach a complete evoluteness characteristic of the genus *Gavelinella*. Erected by Butt (1966), the genus *Orostella* is a younger synonym of the genus *Lingulogavelinella*. Butt described this genus on the basis of forms younger geologically than the type species of the genus *Lingulogavelinella* and hence small differences may be observed between these genera. The presence of sutural openings at the base of the elongated part of chamber, which, according to Butt, are distinct "relict" apertures of earlier chambers, is an important character, mentioned by Butt for the genus he erected and not mentioned by Malapris in her description of the genus *Lingulogavelinella*. In the forms, coming from the Upper Albian — Lower Turonian of Szczecin — Łódź Trough, these apertures are closed in most specimens, from one and the same population. A relatively greatest number of open "relict" apertures are observed in the species "*globosa*" (= *O. turonica* Butt, the type species of the genus *Orostella*), but not in all forms and not on all sutures. Thus, the character mentioned above cannot be considered as a generic feature. Butt does not mention whether the "relict" apertures occur on the sutures between all or not all chambers. In the drawing of the holotype, this aperture is not visible between the oldest chambers. This character should be considered as a feature of individual variability.

The two subgenera of the genus *Gavelinella* here described are marked by double septa. The subgenus *Berthelina* differs from the nominal subgenus in the tendency to form a boss on the dorsal side of test, in the ventral side tending to convexity and in the lack of a regular umbilicus, instead of which also a boss can occur.

The microstructure of wall and the situation of the proloculus have been studied in the representatives of the family Anomalinidae on the basis of thin, horizontally and axially oriented, sections. As a result of the studies, the writer succeeded in assigning the representatives of the species "*Cibicides*" *formosa* Brotzen to the genus *Lingulogavelinella*. So far, only Vassilenko (1961) has noticed that the representatives of this species, given by her (1954) a specific name of "*jarzevae*", have lateral apertures extending onto a more involute, that is, ventral side of test. On the basis of this finding, the species referred to above has been considered as a representative of the family Anomalinidae. This view has been confirmed by the

Table 3

Comparative table of the characters of the genera *Cibicides* and *Planulina* (according to Loeblich & Tappan, 1964)

Genera	Structure of wall	Septum	Type of aperture	Type of test	Symmetry of test	Sides		Development of periphery	Perforation of test
						Dorsal	Ventral		
Cibicides de Montfort, 1808	radial	bilamellar	interiomarginal, low, extending onto the dorsal side, reaching spiral suture	trocho-or planispiral	plano-convex	evolute, planoconcave	involute, strongly convex	with a keel not perforate	dorsal side: coarse-perforate, ventral: fine-perforate
Planulina d'Orbigny, 1826	radial	bilamellar	interiomarginal, equatorial, extending onto the ventral side	low-trocho-spiral	disc-like, flattened	evolute	partly evolute	with a thick keel, not perforate	fine-perforate

studies, on the structure of wall and the situation of the proloculus. In the representatives of the species *"Cibicides" formosa* Brotzen the test is calcitic, granular and bilamellar (and strictly speaking, trilamellar) and the proloculus is directed towards the side onto which the aperture does not extend, that is, towards the dorsal side. Without the use of thin sections, the determination of the sides of test in this species and other, similar ones such as, for instance, *Lingulogavelinella pazdroae* n.sp. is very difficult. A considerable convexity of chambers and the presence of a central boss on the side of test opposite to that on which the lateral part of aperture is situated, make it difficult to observe the earlier whorls and, consequently, the degree of the evoluteness of test, which is closely connected with the determination of its sides. The structure of wall has been studied in all the species, described in the present paper, except *G. (Gavelinella) planodorsa* (Saidova) and *G. (G.) sigmoicasta* Ten Dam.

These species have tests composed of a granular calcite. Since in the process of detailed mineralogical studies, it turned out that a dark-brown line, running between the outer, that is, main layer of the test and the inner one, called a lining, is composed of a finely granular calcite, the last should be considered as a trilaminar one. This fact has already attracted Hanzawa's (1962) attention. He recognized the dark line as the third layer of the wall of test and assigned to the trilamellar forms both those with secondarily doubled septa of the type of rotaliids and those with originally bilamellar septa. Other authors are of the opinion that this is an original pseudo-chitinous membrane. According to Reiss (1958, p. 56), the dark lines, occurring between particular layers deposited in succession on older chambers, cannot be recognized as an equivalent of the brown line, running between the outer and inner (lining) layer. Reiss believes that a space between the outer and inner layer, which in thin sections is visible as a brown line, was originally filled in the bilamellids with a protoplasmatic substance. He considers this space as a canal system of the test and the dark streaks at the contact line of successively deposited layers, which cause the thickening of the test, as a contact line of two surfaces.

In the material under study, no extension has been observed of the outer layer of the wall of a younger chamber onto older chambers. In other words, no occurrence has been found of a larger number of layer on the walls of older than of younger chambers. Both the walls of all chambers in whorls and the septa are trilamellar. Also noteworthy is the fact that the grain-size of calcite is variable in particular species' outer and inner (lining) layers and constant in the central layer. After collecting a larger number of observations, one will be capable of answering the question whether the grain-size of calcite in particular layers of the test is a specific or individual character.

The characters of selected genera of the families Cibicididae Cushman,

Table 4

Comparative table of the characters of some genera of the family Anomalinidae Cushman, 1927 (according to Loeblich & Tappan, 1964 and Malapris, 1965)

Genera	Structure of wall	Septum	Type of aperture	Type of test	Symmetry of test	Sides		Development of periphery	Perforation of test
						Dorsal	Ventral		
Anomalina d'Orbigny, 1826	—	—	interiomarginal, equatorial, slightly extending on the ventral side	low trochospiral or nearly planispiral	asymmetric	with an umbilical node	with an umbilical depression	rounded	—
Anomalinoides Brotzen, 1942	granular	—	interiomarginal, equatorial, extending onto the spiral suture on the evolute (dorsal) side slitlike, with a lip	nearly planispiral	asymmetric	partly evolute with an umbilical node	involute with an umbilicus	widely rounded	coarse-perforate
Angulogavelinella Hofker, 1957	—	bilamellar	interiomarginal, situated on the ventral side; a narrow, arcuate deflection occurs on the suture at the base of the last chamber halfway between the periphery of test and the umbilicus	trochospiral	lenticulate unequally biconvex	evolute	with a small, deep umbilicus	with a keel	coarse-perforate on the ventral side

Cibicidoides Thalmann, 1939	probably granular	—	interiomarginal, equatorial, low, arcuate with a small lip	trochospiral	biconvex with two nodes (biumbonate)	evolute, with all whorls visible on it with a node	with an umbilical node	—	coarse-perforate on the dorsal side
Gavelinella Brotzen, 1942	granular	bilamellar	interiomarginal, extending from the periphery to the umbilicus, reaching under lamellar flaps of chambers, low, slitlike, with a narrow lip	trochospiral, nearly planispiral	biconvex with flattened sides	completely evolute with all whorls visible on it	with umbilicus partly covered with by lamellar flaps of chambers or by a node	rounded	perforate
Lingulogavelinella Malapris, 1965	—	bilamellar	interiomarginal, extending onto the ventural side and reaching under lamellar flaps forming a starlike ornamentation	nearly planispiral	planoconvex or concavo-convex	almost completely involute, with a smal depression in the middle	evolute, without umbilicus, in the middle with a starlike ornamentation formed by lamellae	rounded	perforate on the ventral side

1927 and Anomalinidae Cushman, 1927 are compared with each other in Tables 3, 4.

The morphological terminology, used by Loeblich & Tappan (1964), has been applied in the present paper to the descriptions of particular species.

DESCRIPTIONS

Superfamily **Lituolacea** Blainville, 1825
Family **Textulariidae** Ehrenberg, 1838
Subfamily **Spiroplectammininae** Cushman, 1927
Genus *Spiroplectammina* Cushman, 1927

Type species: Textularia agglutinans d'Orbigny var. *biformis* Parker & Jones, 1865.

Both genera, *Spiroplectammina* and *Bolivinopsis*, are marked by a planispiral initial part of test and a biserial remaining part of test, which induces some of the authors to consider the genus *Spiroplectammina* as a younger synonym of the genus *Bolivinopsis*. It is not, however quite certain if *B. capitata* Yakovlev, 1891, a type species of the genus *Bolivinopsis*, has an agglutinated test. Cushman (1940) believes that genus *Bolinopsis* has a calcareous, perforate test and assigns it to the family Heterohelicidae. Loeblich & Tappan (1964) did not form their opinion on this subject since they had not studied the topotypic material. For these reasons, following the example of Russian authors, they distinguished in 1964 both *Spiroplectammina* and *Bolivinopsis*, assigned the two genera to the family Textulariidae. Neumann (1967) considers, on the other hand, the genus *Spiroplectammina* as a younger synonym of the genus *Bolivinopsis*.

Spiroplectammina praelonga (Reuss, 1845)
(Pl. I, Fig. 1)

1845. *Textularia praelonga* Reuss; A. E. Reuss, Die Versteinerungen.., p. 39, Pl. 12, Fig. 14 a,b.
1960. *Spiroplectammina praelonga* (Reuss); A. Tollmann, Die Foraminiferenfauna..., pp. 154, 155, Pl. 9, Figs. 1—3.
1961. *Bolivinopsis praelonga* (Reuss); V. S. Akimez, Stratygrafija i foraminifery..., pp. 79, 80, Pl. 1, Figs. 1 a,b, 2 (*here additional synonymy included*).
1961. *Spiroplectammina praelonga* (Reuss); V. P. Vassilenko, Foraminifery verchnego..., pp. 12—14, Pl. 1, Fig. 4.
1963. *Spiroplectammina praelonga* (Reuss); O. K. Kaptarenko-Tschernousova et al., Atlas charakternych..., p. 68, Pl. 16, Fig. 2.
1966. *Spiroplectammina praelonga* (Reuss); F. Huss, Otwornice aglutynujące..., pp. 38, 39, Pl. 6, Figs. 1—6.

Material. — Ninety, partially damaged specimens.

Dimensions (in mm):

	IG 4201/70/F	IG 4202/70/F	IG 4203/70/F
Length . .	0.774	0.648	0.342
Width . .	0.288	0.270	0.180
Thickness .	0.162	0.180	0.108

Variability. — Individual variability small, concerning the degree of the thickening of sutures between chambers and the suture running along the test.

Remarks. — Specimens found in the Polish Lowland differ from the Czech ones only in the arrangement of three to four pairs of the oldest chambers of the biserial part of test which are subperpendicular to its vertical axis. The material under study contains only specimens of one generation which have a small proloculus and a great number of chambers in both the planispiral and biserial part. Specimens from the Polish Lowland differ from the Carpathian ones in a triangular outline of their planispiral part, lower number of chambers in their biserial part and their tests composed of calcareous grains. The Carpathian specimens have tests composed of fine quartz grains cemented together by a calcareous cement (Huss, 1966), whereas the Byelorussian specimens, the same as Polish ones, are composed of calcareous grains.

Distribution. — Poland: the uppermost Upper Albian and Cenomanian beds of the area under study, the Turonian of Opole (*Inoceramus schloenbachi* Zone), the Węglówka oil-bearing sub-Silesian unit and red, non-calcareous Turonian clays in the Carpathian flysch; Czechoslovakia: Turonian; Germany: Cenomanian, Turonian; U.S.S.R.: Turonian, Coniacian; Austria: Upper Coniacian.

Subfamily **Textulariinae** Ehrenberg, 1838

Genus *Textularia* Defrance, 1824

Textularia chapmani Lalicker, 1935

(Pl. I, Fig. 2 a,b)

1935. *Textularia chapmani* Lalicker; C. G. Lalicker, New Cretaceous..., p. 13, Pl. 2, Figs. 8 a — c, 9.

1961. *Textularia indistincta* Akimez; V. S. Akimez, Stratigrafija i foraminifery..., pp. 77, 78, Pl. 2, Fig. 2 a,b.

1965. *Textularia chapmani* Lalicker; T. Neagu, Albian Foraminifera..., p. 5, Pl. 1, Fig. 2 (*here additional synonymy included*).

Material. — Ninety variously preserved specimens.

Dimensions (in mm):

	IG 4204/70/F	IG 4205/70/F	IG 4206/70/F
Length . .	0.522	0.450	0.360
Width . .	0.368	0.378	0.396
Thickness .	0.270	0.252	0.198

Description. — Polish specimens do not in principle differ from the holotype described by Lalicker (1935). It is worth mentioning that they are composed of calcareous grains and cement.

Variability. — Insignificant individual variability manifested in the dimensions of particular specimens, manner of arranging chambers in relation to the vertical axis of test (at an angle of 90° or approximately 75°), degree of arcuation and depression of sutures and degree of convexity of the youngest two chambers. *Textularia indistincta* Akimez (Akimez, 1961) from the Upper Cenomanian of Byelorussia is a younger synonym of *Textularia chapmani* Lalicker. Specimens from Byelorussia are similar in all characters to Albian specimens from Folkestone, England. Specimens from the Cenomanian of the Polish Lowland are also in complete conformity with the holotype of this species. On the other hand, specimens of *T. chapmani* coming from the Albian deposits of the Rumanian Lowland have a considerably rougher surface, of the test than those described so far. They differ from English specimens in an oval shape of test and smaller two last chambers.

T. chapmani Lalicker differs from *T. conica* d'Orbigny in a sudden extension of test and a different arrangement of sutures. It is also very similar to *T. anglica* Lalicker from which it differs, however, in a narrower and thinner initial part of test, triangular outline, more convex two youngest chambers and narrower aperture.

Distribution. — Poland: Upper Albian, Cenomanian; England: Upper Albian; Holland: Upper Albian; U.S.S.R. (Byelorussia): Cenomanian.

Textularia foeda Reuss, 1845

(Pl. I, Fig. 3 *a*, *b*)

1845. *Textularia foeda* Reuss; A. E. Reuss, Die Versteinerungen..., pp. 109, 110, Pl. 43, Figs. 12 a,b, 13.
1862. *Textularia pygmaea* Reuss; A. E. Reuss, Die Foraminiferen des nord-deutschen..., p. 80, Pl. 9, Fig. 11 a,b.
1962. *Textularia foeda* Reuss; H. E. Bartenstein & F. Bettenstaedt, Leitfossilien..., p. 270, Pl. 37, Fig. 10; Pl. 39, Fig. 19, Tab. 18.
1963. *Textularia foeda* Reuss; V. Scheibnerova, Some new Foraminifera..., pp. 225, 226, Text-fig. 5 a,b (*here additional synonymy included*).

Material. — A hundred and eighty well preserved or partly damaged specimens.

Dimensions (in mm):

	IG 4207/70/F	IG 4208/70/F	IG 4209/70/F
Length . .	0.612	0.503	0.450
Width . .	0.252	0.342	0.198
Thickness .	0.180	0.234	0.144

Description. — The characters of Polish specimens are on the whole in conformity with Bartenstein & Bettenstaedt's (1962) description of this species except for their being composed of fine calcareous grains and cement.

Variability. — Insignificant individual variability, mostly expressed in different dimensions of particular specimens.

Remarks. — Specimens from Poland differ from the holotype in a smooth surface of the test and its smaller flattening. Those from the Western Carpathians (Czechoslovakia) are coarsely granular (Scheibnerova, 1963). A smaller number of chambers in a series and smaller dimensions of Polish specimens as compared with Reuss' (1845) specimens are only apparent, since large specimens from Poland were broken to pieces. Broken tests are very frequently met with in the material studied and these are mostly the largest specimens having more than ten chambers in each of the two rows. A strong flattening of tests in Reuss' specimens seems to be a secondary phenomenon. The material from Poland includes many variously deformed specimens, among them, strongly flattened ones.

T. pygmaea Reuss, 1862, having only a smaller number of chambers in each of the two rows, is probably a younger synonym of *T. foeda* Reuss, 1845. Specimens with a triserial initial part of the test, coming from the Middle Turonian — Santonian deposits of California, are assigned, by Trujillo (1960) to *T. foeda*. The triseriality of the initial part of test in the American specimens is a fundamental character in which they differ from the Czech and Polish ones.

Distribution. — Poland: Cenomanian; Germany: Valanginian to Upper Senonian; Czechoslovakia: Middle and Upper Cretaceous.

Family **Ataxophragmiidae** Schwager, 1877
Subfamily **Verneuilininae** Cushman, 1911
Genus *Gaudryina* d'Orbigny (in de la Sagra, 1839)
Gaudryina angustata angustata Akimez, 1961
(Pl. I, Figs. 4, 5)

1961. *Gaudryina angustata angustata* Akimez; V. S. Akimez, Stratigrafija i foraminifery..., p. 87, Pl. 4, Figs. 1 a,b, 2, 3 a,b, 4.

Material. — Sixty-three well-preserved specimens.

Dimensions (in mm):

	IG 4210/70/F	IG 4211/70/F	IG 4212/70/F
Length . .	0.738	0.684	0.394
Width . .	0.288	0.270	0.216

Description. — Test finely granular, slightly lustrous, elongate, in the older part tri- and in the younger biserial, straight or slightly arcuate and somewhat twisted in relation to vertical axis in the biserial part. The tri-

serial part wedge-shaped occupying two-thirds or a half of the length of test, composed of five to seven slightly convex chambers in each row. Transverse section triangular, margins rounded, walls slightly concave. Inter-chamber sutures slightly depressed, straight, perpendicular to the vertical axis of test. The surface of chambers slightly convex. The biserial part straight, widely — oval in transverse section, with margins parallel to each other and strongly lobulate, mostly composed of two or three pairs of chambers. Chambers quadrilateral, markedly convex, arranged at an angle of approximately 45° in relation to the vertical axis of test. Sutures depressed. Aperture semicircular, large, basal.

Variability. — Individual variability expressed in a varying number of chambers in the triserial (five to seven, mostly six in each rows) and biserial (two to three in each row) part of test, in the degree of depressing inter-chamber sutures in both parts of test, this depression being stronger in the biserial part and in the convexity of chambers, which in the triserial part are flat or very slightly convex and in the biserial flat or strongly convex.

Remarks. — Specimens from Poland are in almost all their characters similar to those from the lowermost Turonian beds of Byelorussia, from which they differ only in a somewhat greater number of chambers in each of the rows of the triserial (five to seven and not three to five) and a smaller number of chamber in the biserial (two to three pairs in Polish and one to four in Byelorussian specimens) part. This variety differs from *G. arenosa* Akimez in a smaller triserial part of test, lower degree of the roughness of its surface and strongly expressed chambers and sutures. In the shape of its test *G. angustata angustata* Akimez resembles *G. dividens* Grabert from the Aptian and Albian of Germany. It differs from the last-named species primarily in the lack of uniserial part, never observed in it and, in addition, it is marked by less concave sides in the triserial part, less convex chambers and their number which is smaller particularly in the biserial part of test.

Distribution. — Poland: Turonian; U.S.S.R. (Byelorussia): the lowermost beds of the Turonian.

Gaudryina angustata compressa Akimez, 1961
(Pl. I, Figs. 6, 7)

1961. *Gaudryina angustata var. compressa* Akimez; V. S. Akimez, Stratigrafija i foraminifery..., pp. 87, 88, Pl. 4, Fig. 5 a,b.

Material. — Fifty four well-preserved specimens.

Dimensions (in mm):

	IG 4213/70/F	IG 4214/70/F	IG 4215/70/F
Length . .	0.512	0.468	0.450
Width . .	0.238	0.180	0.206

Description. — Test very similar to that of the subspecies described above, but differing from it in smaller dimensions, considerably smaller triserial than biserial part, lower number of chambers in the triserial and greater in the biserial part and, finally, in a smaller convexity of chambers in the biserial part of test.

Variability. — Individual variability expressed in the degree of convexity in both parts of the test, the depression of interchamber sutures, the number of chambers in the triserial and the number of the pairs of chambers in the biserial part, the shape of the biserial part and the degree of the lobation of test.

Remarks. — A small tri- and a large biserial part of test make up a characteristic feature of the specimens of this subspecies from Poland. It make them similar to *G. serrata* Franke, from which they differ, however, in a smaller convexity of chambers, their number which is lower in the biserial part, less depressed sutures, smaller degree of the roughness of test and smaller dimensions.

Specimens from Poland differ from the Byelorussian ones only in a lower number of chambers in the triserial part (two to four in each of the rows of this part as opposed to three to six in the Byelorussian specimens). Some of the specimens also differ in a somewhat larger convexity of chambers in the biserial part.

Distribution. — Poland: Lower and, sporadically, Upper Turonian; U.S.S.R. (Byelorussia): Lower Turonian.

Genus *Spiroplectinata* Cushman, 1927

Spiroplectinata annectens (Parker & Jones, 1863)

(Pl. I, Fig. 8)

1863. *Textularia annectens* Parker & Jones; On the nomenclature..., p. 92, Pl. 1, Fig. 1 (fide B. F. Ellis & A. R. Messina, Cat. of Foram).

1959. *Spiroplectinata annectens* (Parker & Jones); B. Grabert, Phylogenische Untersuchung..., pp. 12, 13, Pl. 1, Figs. 10—12; Pl. 2, Figs. 36—38; Pl. 3, Figs. 77, 78 (*here additional synonymy included*).

1965. *Spiroplectinata annectens* (Parker & Jones); T. Neagu, Albian Foraminifera..., p. 6, Pl. 2, Fig. 19.

1966. *Spiroplectinata annectens* (Parker & Jones); J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., p. 127, Text — fig. 1 (*here additional synonymy included*).

Material. — Seventy partly damaged (mostly the uniserial part lacking) specimens.

Dimensions (in mm):

	IG 4216/70/F	IG 4217/70/F	IG 4218/70/F
Length . .	0.864	0.486	0.450
Width . .	0.252	0.185	0.180

Description. — Polish specimens are in a complete conformity with Grabert's (1959) description.

Variability. — A considerable individual variability concerns almost all characters, except sutures. Specimens of *S. annectens* have margins mostly parallel to each other in the biserial part of test but there are also individuals with this part of test strongly extended. In the biserial part, chambers may be flat or strongly convex. The chambers are most strongly variable in shape in the uniserial part. Mostly, they are spherical, but sometimes strongly flattened. Variable is also the manner in which the chambers accrue in this part of test. They accrue along the vertical axis or at a certain angle to it in the continuation of one of the chambers of the biserial part.

Remarks. — Due to the sporadical occurrence of this species in the Upper Albian beds of Poland's area under study, it was impossible to collect appropriate material for statistical studies which would enable drawing a curve of variability determining the stage of its phylogenetic development. *S. annectens* (Parker & Jones) differs from all other species of this genus not only in a smaller, narrower and more delicate test, but also in having a lower number of chambres in the biserial part and a lower general number of chambers, as well as in a strongly developed uniserial stage.

Distribution. — Poland: Upper Albian through Lower Turonian; Germany: Middle Albian through Lower Cenomanian; England: Upper Albian; Holland: Upper Albian; Rumania: Upper Albian; Czechoslovakia (western Carpathians): Upper Aptian, Albian.

Spiroplectinata complanata (Reuss, 1860)

(Pl. I, Fig. 9)

1860. *Proroporus complanatus* Reuss; A. E. Reuss, Die Foraminiferen..., p. 231, Pl. 12, Fig. 5 a,b.

1959. *Spiroplectinata complanata* (Reuss); B. Grabert, Phylogenische Untersuchung..., pp. 14, 15, Pl. 1, Fig. 13; Pl. 2, Figs. 39—41; Pl. 3, Figs. 87, 88 (*here additional synonymy included*).

1966. *Spiroplectinata complanata* (Reuss); J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., p. 128, Text — fig. 2 (*here additional synonymy included*).

Material. — Eighty well preserved specimens.

Dimensions (in mm):

	IG 4219/70/F	IG 4220/70/F	IG 4221/70/F
Length	1.080	0.774	0.324
Width	0.432	0.396	0.180

Description. — Polish specimens are in principle in conformity with Grabert's (1959) description.

Variability. — A small individual variability is mostly expressed in a variable appearance of inter-chamber sutures, which may be either flat, or slightly raised. The uniserial part is lacking in many specimens.

Remarks. — Like in *S. annectens* (Parker & Jones), the number of chambers in the biserial part of the test of *S. complanata* (Reuss) increases in specimens younger geologically. According to Grabert (1959), in the lower part of the Middle Albian a peak value of the variability curve occurs with 18 chambers, while in the upper part of the Middle Albian it occurs already with 20 chambers. In the specimens from the Gorzów Wkp. IG-I borehole, coming from the Upper Albian beds, most specimens have 12 chambers in the biserial part of test. Grabert (1959) believes that the species discussed is most closely related to *S. lata* Grabert. *S. complanata* (Reuss) is somewhat similar, particularly in the number of chambers in the biserial part of test, to *S. bettenstaedti* Grabert, from which it differs, however, in a more extended lanceolate shape of test and a greater number of wider chambers. Grabert (1959), the same as Bartenstein & Bettenstaedt (1962), believe that the specimens of the species discussed, coming from the Mediterranean area make up a variety whose wall is composed of coarser grains and whose biserial part is thicker than that of the boreal specimens and more robust.

Distribution. — Poland: Upper Albian through Lower Senonian; England: Albian; Holland: Albian; Rumania: Albian; Czechoslovakia (Western Carpathians): Upper Aptian and Albian; North-western Germany: abundant in the Middle, less so in the Upper Albian and rare in the Cenomanian; Austria: Albian; probably, it also occurs in France, Yugoslavia and western Australia.

Genus *Tritaxia* Reuss, 1860
Tritaxia macfadyeni Cushman, 1936
(Pl. II, Fig. 2 *a,b*)

1936. *Tritaxia macfadyeni* Cushman; J. A. Cushman, New genera and species..., p. 3, Pl. 1, Fig. 6 a,b.
1953. *Tritaxia macfadyeni* Cushman; T. Barnard & F. T. Banner, Arenaceous Foraminifera..., p. 195, Pl. 7, Fig. 2 a,b (*here additional synonymy included*).
1957. *Tritaxia macfadyeni* Cushman; J. Vapcarova, Fosilni predstavitieli..., pp. 45, 46, Figs. 6, 6 a.

Material. — Twenty-five well-preserved specimens.

Dimensions (in mm):

	IG 4222/70/F	IG 4223/70/F	IG 4224/70/F
Length . .	1.800	1.188	0.810
Width . .	0.630	0.450	0.378

Description. — Polish specimens are in conformity with Cushman's (1937) description.

Variability. — A small variability is displayed in a varying shape of aperture (oval or round) and degree of concavity of the lateral walls of test.

Remarks. — Specimens from Poland differ from the holotype in chambers and sutures, both invisible. The remaining characters are identical. The species under study differs from *T. pyramidata* Reuss in a fusiform shape of test rounded margins, strongly elongate last chamber and slightly concave sides.

Distribution. — Poland: Cenomanian; England: Cenomanian; *Schloenbachia varians* Zone and the lower part of *Holaster subglobosus* Zone; Bulgaria: Hauterivian.

Tritaxia plummerae Cushman, 1936

(Pl. II, Figs. 1 *a,b*, 3 *a,b*)

1931. *Tritaxia pyramidata* Reuss; H. Plummer, Some Cretaceous..., pp. 133, 134, Pl. 10, Figs. 18, 19, 21 (non Fig. 20).
1936. *Tritaxia plummerae* Cushman; J. A. Cushman, New genera and species..., pp. 3, 4, Pl. 1, Fig. 7 a,b.
1961. *Tritaxia tricarinata* (Reuss) var. *plummerae* Cushman; R. P. S. Jefferies, The paleoecology of the Actinocamax..., p. 4, Pl. 78, Fig. 2.
1965. *Tritaxia plummerae* Cushman; T. Neagu, Albian Foraminifera of the Rumanian..., p. 5, Pl. 1, Fig. 19 (*here additional synonymy included*).

Material. — A hundred and forty well-preserved specimens.

Dimensions (in mm):

	IG 4225/70/F	IG 4226/70/F	IG 4227/70/F
Length . .	1.440	1.008	0.648
Width . .	0.396	0.360	0.324

Description. — Polish specimens are in conformity with Cushman's (1936) description.

Variability. — A considerable individual variability is manifested in the arrangement and shape of the youngest two chambers which may occur in the form of one or two series. Their transverse section in the specimens examined is mostly elliptical, rarely round. Variable is also the degree of concavity of the sides of test, shape of aperture (oval to round) and roughness of test.

Remarks. — Specimens from Poland differ from the holotype only in more spherical chambers of the uniserial part of test. Some of the Polish specimens of this species resemble in the arrangement of the youngest chambers *Gaudryina alexandri* Cushman, from which they differ in a smaller biserial part of test, which is made up of only one pair of chambers, in less concave sides and considerably blunter margins. Specimens, in which the youngest two chambers are not arranged rectilinearly one in the con-

tinuation of the other, but side by side forming in a way a biserial part of test consisting of one pair of chambers, are most similar to a specimen illustrated by Neagu (1965, Pl. I, Fig. 19). The species under study differs from *T. pyramidata* Reuss in an almost uniform width of test over its entire length, in a greater number of chambers and their stage in the uniserial part, in strongly oblique sutures and more rounded margins of test. In its tendency to uniseriality, *T. plummerae* Cushman most strongly resembles *T. macfadyeni* Cushman, from which it differs, however, in the shape of test, greater number of chambers in the uniserial part, considerably less rounded margins and more distinct sutures.

Distribution. — Poland: Upper Albian, Cenomanian; Holland: Albian; Rumania: Albian; Anglo-Parisian Basin: the lowermost Turonian beds; U.S.A. (Northern Texas): the lowermost Albian beds.

Tritaxia pyramidata Reuss, 1862
(Pl. I, Fig. 10 *a,b*)

1862. *Tritaxia pyramidata* Reuss; A. E. Reuss, Die Foraminiferen des norddeutschen..., pp. 32, 33, Pl. 1, Fig. 9 a — c.
1925. *Tritaxia pyramidata* Reuss; A. Franke, Die Foraminiferen der pommerschen..., p. 18, Pl. 2, Fig. 1 a — c.
1953. *Tritaxia pyramidata* Reuss; T. Barnard & F. T. Banner, Arenaceous Foraminifera..., p. 195, Pl. 7, Fig. 1 A,B,Text — fig. 5 J — N, p. 197.
1957. *Tritaxia pyramidata* Reuss; J. Vapcarova, Fosilni predstavitieli..., p. 45, Pl. 2, Fig. 3.
1959. *Tritaxia pyramidata* Reuss; N. J. Maslakova, Atlas verchnemelovoj fauny..., p. 92, Pl. 1, Fig. 7.
1961. *Tritaxia pyramidata* Reuss; V. S. Akimez, Stratigrafija i foraminifery..., pp. 83, 84, Pl. 3, Figs. 1a, b, 2.
1961. *Tritaxia tricarinata* Reuss var. *pyramidata* Reuss; R. P. S. Jefferies, The paleoecology of the Actinocamax..., p. 4, Pl. 78, Fig. 3.
1966. *Tritaxia pyramidata* Reuss; I. Dieni & F. Massari, Foraminiferi del Valanginiano..., p. 103, Pl. 2, Fig. 10 a,b (*here additional synonymy included*).

Material. — A hundred and ninety-five well preserved specimens.

Dimensions (in mm):

	IG 4228/70/F	IG 4229/70/F	IG 4230/70/F
Length . .	1.764	1.656	0.810
Width . .	0.648	0.720	0.666

Description. — The Polish specimens are in conformity with Barnard & Banner's (1953) description.

Variability. — Variability is expressed in a varying degree of the extension of test within the growth, in a varying degree of the inclination of chambers to the vertical axis of test (an angle of 90° or, on the average, 75°) and in some concavity of the sides of test.

Remarks. — Polish specimens of this species are similar to the holotype in nearly all characters. This species is most similar to *T. tricarinata* Reuss, from which it differs in a sharpened, narrow initial part of test, in a gradual extention of test accompanying the growth, somewhat concave sides and very slightly inclined sutures.

Distribution. — Poland: Upper Albian and Cenomanian of the area studied, Turonian of the Island Wolin; Europe: Upper Valanginian through Turonian; Trinidad (West Indies): Lower Cretaceous.

Genus *Verneuilinoides* Loeblich & Tappan, 1949

Verneuilinoides gorzowiensis n.sp.

(Pl. II, Figs. 8 *a,b*, 9 *a,b*, 10 *a,b*)

1880. *Bulimina polystropha* Reuss; M. Berthelin, Mémoire sur les Foraminifères..., p. 30, Pl. 2, Fig. 3 a,b.

Holotype: specimen shown in Pl. II, Fig. 8 *a,b*.
Type horizon: Upper Albian beds.
Type locality: Gorzów Wkp. IG-I borehole.
Derivation of the name: after the locality in which the species was found.

Material. — Eighty-four well preserved specimens.

Dimensions (in mm):

	Holotype	Paratypes	
	IG 4067/70/F	**IG 4060/70/F**	**IG 4068/70/F**
Length . .	0.468	0.234	0.342
Width . .	0.236	0.162	0.216

Diagnosis. — Test agglutinated, siliceous, finely granular, lustrous, trochospiral, triserial, conical, composed of three to six distinct whorls.

Description. — Test lustrous, similar to hyaline, very slightly roughened, rounded at the bottom, with a projecting proloculus and slightly extending upwards. It consists of three to six whorls having three chambers each. In all the whorls, chambers are strongly convex, almost spherical, clearly visible and arranged in three rows one on top of another. Least visible are the chambers of the oldest whorl. With their growth, chambers increase very regularly but to a relatively small extent. Inter-chamber sutures clearly visible, depressed, spiral, almost perpendicular to the vertical axis of test. Aperture intermarginal, loop-shaped, surrounded by a fairly prominent lip, running perpendicularly to the line of contact between the internal margin of the last chamber and the surface of two preceding chambers.

Variability. — Variability concerns the number of whorls and arrangement of their chambers mostly in three rectilinear rows, so that each of the three chambers of a subsequent whorl is situated over a corresponding chamber of a preceding whorl. Sometimes, these series are, however, helically twisted in relation to the vertical axis of test.

Remarks. — The newly described species is quite similar to a specimen presented by Berthelin (1880) under the name *Bulimina polystropha* Reuss. Conducting a revision of the foraminifers described by Berthelin from the Albian deposits of Montcley, Bartenstein (1957) has arrived at the conclusion that the alleged *Bulimina polystropha* was an agglutinated specimen and, preserving its specific name, assigned it to the genus *Verneuilina*. Berthelin's specimens and Polish ones here assigned to *V. gorzowiensis* n.sp., differ from Reuss' (1845) specimens in a lower number of whorls (at most six as opposed to unic to ten of the Czech specimen), smaller dimensions, different shape of aperture (loop-shaped, surrounded by a lip not semicircular). Specimens very similar to the Polish ones were described by Bukalova (1960) as *Bulimina rara* from the Albian deposits of the Northern Ciscaucasia. If they also turn out to have an agglutinated test, *V. gorzowiensis* n.sp. will be included to the synonymy of *B. rara*.

Distribution. — Poland: Upper Albian, Cenomanian; France: Albian.

Subfamily **Globotextulariinae** Cushman, 1927
Genus *Dorothia* Plummer, 1931

Type species: Gaudryina bulletta Carsey, 1927.

Trujillo (1960) maintains that the genus *Marssonella* is a younger synonym of the genus *Dorothia*. This author calls attention to the description of *Dorothia*, according to which the initial whorls consist of three or more chambers and, therefore, there is the possibility that four of five chambers occur in initial stages, which would relate this genus to *Marssonella*. In the representatives of the two genera, the apertural surface is flat or concave. Trujillo's view is shared by Loeblich & Tappan (1964), but denied by Neumann (1967). In the present paper, *Marssonella* is considered as a younger synonym of *Dorothia*.

Dorothia gradata (Berthelin, 1880)
(Pl. II, Fig. 7 *a,b*)

1880. *Gaudryina gradata* Berthelin; M. Berthelin, Mémoire sur les Foraminifères..., p. 24, Pl. 1, Fig. 6 a — c.
1891/98. *Gaudryina dispansa* Chapman; F. Chapman, The Foraminifera of the Gault..., p. 753, Pl. 11, Fig. 10 a,b.
1928. *Gaudryina gradata* Berthelin; A. Franke, Die Foraminiferen der Oberen..., p. 142, Pl. 13, Fig. 4.
1928. *Gaudryina spissa* Berthelin; A. Franke, *Ibid.*, p. 143, Pl. 13, Fig. 5 a — c.
1931. *Gaudryina gradata* Berthelin; H. Plummer, Some Cretaceous Foraminifera..., pp. 136, 137, Pl. 8, Fig. 12 a,b.
1942. *Gaudryina spissa* Berthelin; R. Gandolfi, Ricerche micropaleontologische..., p. 41, Text — fig. 4 a,b, p. 41.
1948. *Gaudryina aff. spissa* Berthelin; V. G. Morozova, Foraminifery nižnemelovych..., p. 35, Pl. 1, Fig. 9.

1950. *Dorothia gradata* (Berthelin); A. Ten Dam, Les Foraminifères de l'Albien..., pp. 16, 17 (*here additional synonymy included*).
1951. *Gaudryina spissa* Berthelin; R. Noth, Foraminiferen aus Unter..., p. 36, Pl. 3, Fig. 17 a,b.
1959. *Gaudryina spissa* Berthelin; N. I. Maslakova, Atlas verchnemelovej fauny..., p. 92, Pl. 1, Fig. 8.
1961. *Dorothia gradata* (Berthelin); R. P. S. Jefferies, The paleoecology of the Actinocamax..., p. 4, Pl. 78, Fig. 11.
1962. *Dorothia gradata* (Berthelin); H. Bartenstein & F. Bettenstaedt, Leitfossilien..., p. 296, Pl. 39, Fig. 11, Tab. 18.
1962. *Dorothia gradata* (Berthelin); H. Hiltermann & W. Koch, *Ibid.*, p. 306, Tab. 19.
1965. *Dorothia gradata* (Berthelin); T. Neagu, Albian Foraminifera of the Rumanian..., p. 8, 10, Pl. 2, Fig. 23.

Material. — Two hundred and ten variously preserved specimens.

Dimensions (in mm):

	IG 4231/70/F	IG 4232/70/F	IG 4233/70/F
Length . .	1.080	0.756	0.504
Width . .	0.468	0.378	0.306

Description. — Polish specimens are in conformity with Cushman's (1937) description.

Variability. — A small individual variability mostly concerning the degree of convexity and number of chambers in the biserial part and the dimensions and shape of test.

Remarks. — In their fundamental characters the specimens from Poland are similar to the holotype. They differ from Berthelin's (1880) specimens in a more strongly developed triserial part of test and in a smooth surface. Specimens described by various authors under the name *Gaudryina spissa* Berthelin, which are probably juvenile individuals of *Dorothia gradata* (Berthelin), have also been assigned here to the species under study. Numerous specimens of this species in various stages of their ontogenetic development have been met with in the Polish material studied.

Here described species is most similar to *D. filiformis* (Berthelin), from which it differs in a smaller biserial part of test, wider and shorter test and strongly convex chambers.

Distribution. — Poland: sporadically in the Upper Albian and Lower Turonian, optimum development in the Cenomanian; other European countries: Albian, Cenomanian and Lower Turonian of the Mediterranean and Boreal area; U.S.A. (Texas): upper beds of the Albian.

Dorothia trochus (d'Orbigny, 1840)

(Pl. II, Fig. 4 *a* — *c*)

1840. *Textularia trochus* d'Orbigny; A. d'Orbigny, Mémoire sur les Foraminifères..., pp. 45, 46, Pl. 4, Figs. 25, 26.
1937. *Marssonella oxycona* (Reuss); J. A. Cushman, A monograph of the foramini-

feral family Valvulinidae, pp. 56—59, Pl. 5, Fig. 29; Pl. 6, Figs. 6, 7 (non Pl. 5, Figs. 27, 28; Pl. 6, Figs. 1—5, 8—15).

1948. *Textularia trochus* d'Orbigny; V. G. Morozova, Foraminifery nižnemelovych..., pp. 34, 35, Pl. 1, Figs. 7, 8.

1957. *Marssonnella trochus* (d'Orbigny); J. Hofker, Foraminiferen der Oberkreide..., pp. 81—83, Text — figs. 82, 82 a, 83 a — f (non Text — fig. 83 g — i).

1962. *Marssonella cf. trochus* (d'Orbigny); H. Bartenstein & F. Bettenstaedt, Leitfossilien..., pp. 283, 284, Pl. 36, Fig. 12 a,b, Tab. 18.

1965. *Marssonella trochus* (d'Orbigny); T. Neagu, Albian Foraminifera of the Rumanian..., p. 8, Pl. 1, Figs. 14, 15 (*here additional synonymy included*).

1966. *Marssonella trochus* (d'Orbigny); A. A. Butt, Foraminifera of the type..., p. 172, Pl. 1, Figs. 3 a,b, 4 a,b.

Material. — Forty-five well preserved or partly damaged specimens.

Dimensions (in mm):

	IG 4234/70/F	IG 4235/70/F	IG 4236/70/F
Length . .	0.702	0.630	0.396
Width . .	0.638	0.686	0.306

Description. — Test fine granular, conical in outline, sharpened at the bottom, very strongly extending upwards, with a smooth, lustrous surface. Transverse section round over the entire length. Spiral part very short, narrow, consisting in succession of five, four and three chambers. The biserial part three times as long as the young one, very strongly extending and, in the youngest part, upturned in the form of a collar. In the spiral part, chambers are poorly visible, slightly convex and separated from each other by flat sutures. In the biserial part, they are very low, wide, arcuate, horizontally arranged and separated from each other by narrow, raised sutures. Apertural surface of the youngest two chambers flat or strongly concave, bordered with a wide, flat rim.

Variability. — Variability is manifested by a manner of growing of the biserial part of test (it grows rectilinearly or is slightly arcuate), varying degree of the depression of the apertural surface of the youngest two chambers and a varying degree of the convexity of inter-chamber sutures.

Remarks. — Specimens from the Cenomanian of Poland are similar to the holotype in nearly all characters. They differ from French specimens only in a fine granular wall of test. Barnard (1953, 1963) considers *Gaudryina oxycona* Reuss, 1860 as a younger synonym of *T. trochus* d'Orbigny. It should be, however, made clear that the English specimens, described by this author, have a fairly wide, rounded initial part of test and a gradually extending biserial part, in which they differ from *G. trochus*, but are similar to *G. oxycona*.

Distribution. — Poland: Cenomanian, Lower Turonian; France: Turonian through Campanian of the Paris Basin; Rumania: Albian; U.S.S.R. (North-western Caucasia): Albian; in the territory of Tethys, it appears as early as beginning with the Middle Barremian.

Dorothia turris (d'Orbigny, 1840)
(Pl. II, Figs. 5, 6)

1840. *Textularia turris* d'Orbigny; A. d'Orbigny, Mémoire sur les Foraminifères..., p. 46, Pl. 4, Figs. 27, 28.
1891/98. *Textularia turris* d'Orbigny; F. Chapman, The Foraminifera of the Gault..., pp. 328, 329, Pl. 6, Fig. 19.
1891/98. *Textularia trochus* d'Orbigny; F. Chapman, *Ibid.*, p. 328, Pl. 6, Fig. 18.
1946. *Marssonella oxycona* (Reuss); A. Ten Dam, Arenaceous Foraminifera and Lagenidae..., p. 572, Pl. 87, Fig. 9 a,b.
1957. *Marssonella oxycona* (Reuss); P. Michajlova-Jovczeva, Vyrchu prisystvito na predstaviteli..., pp. 107, 108, Pl. 2, Figs. 8, 14, 11(?) (non Figs. 9, 10, 12, 13).
1957. *Marssonella oxycona* (Reuss); J. Sztejn, Stratygrafia mikropaleontologiczna..., pp. 32, 33, Pl. 3, Fig. 14 a,b.
1963. *Marssonella turris* (d'Orbigny); T. Barnard, The morphology and development..., pp. 42, 43, Text — fig. 2 a — h, p. 43 (*here additional synonymy included*).

Material. — Three hundred and ten well-preserved specimens.

Dimensions (in mm):

	IG 4237/70/F	IG 4238/70/F	IG 4239/70/F
Length . .	0.864	0.540	0.324
Width . .	0.378	0.288	0.234

Description. — Test finely granular, composed of fine grains of quartz cemented by a considerable amount of a calcereous cement, strongly elongate, conical, narrow, sharpened at the bottom and only slightly extending upwards. Transverse section round. Older whorls, composed of five and four and younger — of three chambers are situated in the trochospiral part over a spherical proloculus. The biserial part composed of seven to eight pairs of chambers. In the trochospiral part, chambers poorly visible, slightly convex, semicircular, in the biserial part chambers, wide, with parallel sides and flat or slightly convex surface, arranged parallel to and over each other. In the trochospiral part, sutures flat or somewhat depressed, in the biserial part rectilinear, fairly wide, listlike or depressed. Apertural surface of the youngest two chambers flat or somewhat convex, slightly inclined to the vertical axis of test. Aperture slitlike, long, situated at the base of apertural surface, in some specimens having a lip.

Variability. — A considerable variability is manifested in a varying degree of the extension of the biserial part of test, a rectilinear or arcuate outline of test, a degree of flattening the sides of test, of the convexity of chambers, and of the convexity of sutures, as well as in the appearance of the apertural surface of the youngest two chambers.

Remarks. — Specimens from Poland differ from the type specimen coming from the Cretaceous of the Paris Basin only in a smaller degree of the roughness of its test. Many specimens of this species were probably included by various authors in *D. oxycona* (Reuss), as the two species are similar to each other in many respects. The difference between them con-

sists in the fact that in *D. turris* the test is narrower in the trochospiral part and less extending upwards in the biserial part than in *D. oxycona*. Specimens of the last-named species from the Valanginian of Central Poland differ from the Cenomanian ones only in flat or slightly depressed sutures. In 1953, Barnard recognized *Marssonella turris* as a younger synonym of *Marssonella oxycona*, but in his work of 1963 he distinguished it as an valid species.

Distribution. — Poland: Valanginian, Albian, Cenomanian, Turonian; France: Cretaceous of the Paris Basin; England: Albian, Cenomanian and Lower Senonian; North-western Germany: Turonian through Campanian; Holland, Hauterivian, Turonian through Campanian; probably also Cretaceous of Bulgaria.

Genus *Eggerellina* Marie, 1941
Eggerellina mariae Ten Dam, 1950
(Pl. III, Figs. 1 *a,b*, 2 *a,b*)

1950. *Eggerellina mariae* Ten Dam; A. Ten Dam, Les Foraminifères de l'Albien..., pp. 15, 16, Pl. 1, Fig. 17 a — e.

Material. — Sixty well-preserved specimens.

Dimensions (in mm):

	IG 4240/70/F	IG 4241/70/F	IG 4242/70/F
Length . .	0.486	0.414	0.360
Width . .	0.378	0.360	0.288

Distribution. — Poland: Valanginian Albian, Cenomanian, Turonian; tion of the holotype, but they have a siliceous test and a tooth in the aperture, which is not mentioned by Ten Dam (1950).

Variability. — The individual variability is manifested in a varying height of the last whorl, varying width of the initial part of test, and the number of chambers of the last whorl. It is also expressed in the degree of depression of inter-chamber sutures, size and shape of specimens.

Remarks. — The specimens from Poland are in almost all their characters in conformity with those described by Ten Dam (1950) from the Albian of Holland from which they differ in the presence of a tooth in the aperture and in a siliceous test. The Dutch specimens seem, however, also to have a tooth, which may be observed in Pl. I, Fig. 17*c* (Ten Dam, *l.c.*).

The presence of the tooth in the specimens of the species under study confirms Marie's (1941) supposition that *Eggerellina mariae* descends from the genus *Valvulina* d'Orbigny. The tooth is a relict character inherited by the genus *Eggerellina* from their ancestors. It disappears in the process of further evolution and does not occur any more in species of the genus *Eggerellina* coming from higher beds than the Cenomanian.

Distribution. — Poland: Upper Albian, Cenomanian, few: Holland; Upper Albian, fairly common.

Subfamily **Valvulininae** Berthelin, 1880
Genus *Plectina* Marsson, 1878
Plectina ruthenica mariae (Franke, 1928)
(Pl. III, Fig. 3 *a,b*)

1928. *Gaudryina ruthenica* Reuss f. *mariae* Franke; A. Franke, Die Foraminiferen der Oberen..., p. 146, Pl. 13, Fig. 15 a,b.
1937. *Plectina ruthenica* (Reuss) var. *mariae* (Franke); J. A. Cushman, A monograph of the foraminiferal family Valvulinidae, p. 106, Pl. 11, Fig. 15 a,b.
1963. *Plectina ruthenica* (Reuss) var. *mariae* (Franke); O. K. Kaptarenko-Tshernousova et al., Atlas charakternych foraminifer..., p. 72, Pl. 14, Fig. 3 a,b.

Material. — A hundred and forty well-preserved specimens.

Dimensions (in mm):

	IG 4243/70/F	IG 4244/70/F	IG 4245/70/F
Length . .	0.900	0.648	0.486
Width . .	0.468	0.360	0.252

Description. — The specimens examined correspond in principle to Franke's (1928) description.

Variability. — A small individual variability is mostly expressed in a varying degree of the extension of test in the process of growth and in a varying size of specimens.

Remarks. — The specimens under study differ from Franke's (1928) one in a smaller width of test and a lower number of chambers in the biserial part. This variety differs from the typical *P. ruthenica* (Reuss), occurring in the Senonian deposits, in smaller dimensions, lower degree of the roughness of test, more convex chambers and more strongly depressed sutures.

Distribution. — Poland: in the area under study, in the boundary beds between the Albian and the Cenomanian, as well as in the Cenomanian of the Cretaceous of Lwówek (Franke, 1928); France: Cenomanian; U.S.S.R.: Cenomanian of Dnieper-Donets Depression.

Family **Pavonitinidae** Loeblich & Tappan, 1961
Subfamily **Pfenderininae** Smout & Sugden, 1962
Genus *Pseudotextulariella* Barnard, in Barnard & Banner, 1953
Pseudotextulariella cretosa (Cushman, 1932)
(Pl. III, Fig. 4 *a,b*)

1932. *Textulariella cretosa* Cushman; J. A. Cushman, The relationships of Textulariella..., pp. 97, 98, Pl. 11, Figs. 17—19.
1963. *Pseudotextulariella cretosa* (Cushman); T. Barnard, The morphology and development..., pp. 48—51, Pl. 7, Figs. 1—6, 8, Text — fig. 6 a — d; p. 49, Fig. 7 a — f; p. 50, Figs. 8 a — c; p. 51 (*here additional synonymy included*).

Material. — A hundred and twenty-five well-preserved specimens.

Dimensions (in mm):

	IG 4246/70/F	IG 4247/70/F	IG 4248/70/F
Length . .	0.882	0.720	0.576
Width . .	0.828	0.738	0.594

Description. — Polish specimens correspond to Barnard's description (1963).

Variability. — The individual variability is expressed in the shape of test, which may resemble a cone variable in width and in a certain deformation of the apertural surface.

Remarks. — No specimens, changing the direction of their growth, as is the case of the specimens from the Cenomanian of England, are met with in the material from the discussed area of Poland.

Distribution. — Poland: boundary layers between the Albian and Cenomanian and the Cenomanian itself; England: Cenomanian.

Superfamily **Miliolacea** Ehrenberg, 1839
Family **Miliolidae** Ehrenberg, 1839
Subfamily **Quinqueloculininae** Cushman, 1917
Genus *Quinqueloculina* d'Orbigny, 1826
Quinqueloculina antiqua Franke, 1928
(Pl. III, Fig. 6 *a*—*c*)

1928. *Miliolina (Quinqueloculina) antiqua* Franke; A. Franke, Die Foraminiferen der Oberen..., pp. 126, 127, Pl. 11, Figs. 25, 26 a,b.
1957. *Quinqueloculina kochi* (Reuss); J. Hofker, Foraminiferen der Oberkreide..., p. 436, Text-fig. 494.
1961. *Quinqueloculina antiqua* (Franke); V. P. Vassilenko, Foraminifery verchnego mela, pp. 33, 34 Pl. 6, Figs. 8 a,b,w, 9 a,b,w.
1965. *Pseudosigmoilina antiqua* (Franke); H. Bartenstein, Taxonomische Revision..., pp. 351, 352 (*here additional synonymy included*).

Material. — A hundred and twenty well-preserved specimens.

Dimensions (in mm):

	IG 4249/70/F	IG 4250/70/F	IG 4251/70/F
Length . .	0.413	0.360	0.306
Width . .	0.288	0.252	0.216
Thickness . .	0.216	0.216	0.144

Description. — Test oval in outline, coiled in a bundle-like manner quinqueloculine in plan. Transverse section irregularly triangular, with rounded corners. The last chamber longer than the preceding ones and projecting in the lower part of test. Chambers tubular, uniform in width over the entire length, slightly curved. Chamber peripheries strongly raised, rounded. Four chambers are visible on the convex and three on the

flat side of test. Aperture terminal, triangular, with a small rectangular tooth on the inner wall of neck.

Variability. — A considerable individual variability is manifested in the size of test, outline of transverse section, degree of curvature of the last chamber and height of neck on which the aperture occurs provided always with a tooth.

Remarks. — Specimens from Poland are in complete conformity with Franke's holotype, found in the Turonian deposits of Chrząszczewo (former Gristow) on the Island of Wolin. The form *"angusta"*, distinguished by Franke (1928), is included in the range of variability of *Q.antiqua*. A specimen, desribed by Hofker (1957, p. 435, Fig. 492) under the name of *Sigmoilina antiqua* Franke probably is not a representative of the species discussed, since it differs from it in many characters. On the other hand, the species. *"antiqua"* does include a specimen described by Hofker (1957, p. 436, Fig. 492) as *Q. kochi*. Franke's specimen, described by him (1925, p. 8, Pl. 1 Fig. 8) under the name of *Miliolina kochi* (Reuss), is included by Hofker in the synonymy of two species: *Sigmoilina antiqua* (Franke) and *Q. kochi* (Reuss), which probably took place by mistake. It should be mentioned that the specimen included in 1925 by Franke in *Miliolina kochi* (Reuss) was included by him subsequently (1928) in the synonymy of a new species *Miliolina (Quinqueloculina) antiqua* he erected. Revising Hecht's (1938) work, Bartenstein erected a new genus, *Pseudosigmoilina*, for specimens pertaining to the family Miliolidae. This genus has, however, never been accurately characterized. In its diagnosis Bartenstein mentions a quinqueloculine plan of chambers, a toothless aperture and a triangular or oval transverse section of test, but he does not illustrate this section. He maintains that his new genus is related neither to the genus *Quinqueloculina* nor *Sigmoilina*, but he fails to elucidate its genetic relationships. He also expresses the opinion that the newly erected genus includes, among other species, also *Q. antiqua*. However, as follows from the diagnosis of the new genus, its representatives should have a toothless aperture. Since Franke's species has a tooth in the aperture and a quinqueloculine plan of chambers, it is a representative of the genus *Quinqueloculina*.

Distribution. — Poland: Turonian of Chrząszczewo, Senonian of Niemica (Franke, 1925, 1928) and the Upper Albian and Cenomanian of the area studied; Germany: Middle Albian through Emscherian; England: Albian; Holland: Albian; U.S.S.R. (Mangishlak Peninsule): Cenomanian.

Quinqueloculina kozlowskii n.sp.

(Pl. III, Fig. 5 *a*, *b*; Text-fig. 2)

Holotype: specimen in Pl. III, Fig. 5 *a,b*.
Type horizon: Cenomanian beds.
Type locality: Gorzów Wkp. IG-I.

Derivation of the name: after the eminent Polish palaeontologist Prof. Dr. Roman Kozłowski.

Material. — A hundred and sixty well-preserved specimens.

Dimensions of the holotype (in mm);

	IG 4079/70/F
Length . .	0.810
Width . .	0.324
Thickness . .	0.162

Dimensions of the paratypes (in mm):

	IG 4252/70/F	IG 4253/70/F	IG 4254/70/F
Length . .	0.974	0.522	0.396
Width . .	0.396	0.216	0.180
Thickness . .	0.198	0.108	0.072

Diagnosis. — Test slightly flattened, thin, strongly elongate. Aperture on neck with lip, but without tooth.

Description. — Test strongly elongate, with a triangular transverse section nearly twice as long as wide, with nearly parallel margin, slightly convex on the side with a larger number of chambers and concave on the opposite side. The entire test narrowly elliptical in outline. Periphery narrow, almost sharp and forming a keel. On one of the sides four and on

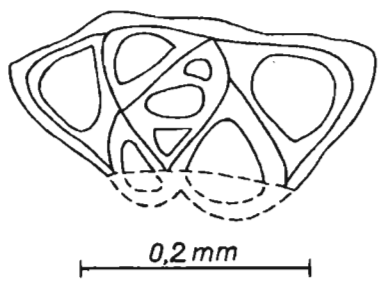


Fig. 2. — Vertical section of *Quinqueloculina kozlowskii* n.sp. showing the arrangement of chambers in the test, Gorzów Wkp. IG I boring, depth, 715.0 m.

the other three chambers are visible. They are elongate, somewhat arcuate and slightly narrowing towards aperture. The surface of chambers, viewed laterally, is concave in the middle and slightly raised on the peripheries, where it, forms almost sharp ribs running along sutures. Chambers are arranged in pairs, one in each whorl. The upper part of the last chamber extends to form a fairly long, narrow neck, terminating at the apex in an upturned, fairly thick lip. Aperture round, toothless.

Variability. — A small individual variability manifests itself, mostly in a varying degree of curvature of the ventral part of the last but one chamber. The periphery of the last but one chamber may also be, in the

dorsal part of test, very slightly or very strongly arcuate. The degree of the elevetion of ribs along sutures, the size of test and outline of transverse section may also be variable.

Remarks. — The species discussed differs from *Q. antiqua* (Franke) in a more elongate, narrower and thinner test, in the presence of a narrow neck and a lip on it, in a round aperture and the lack of tooth in aperture. The newly described species is very similar to *Triloculina kochi* Reuss (1855) in sharp margins of test, in the margins of chambers raised along sutures and in a long neck. It differs from this species in a more elongate, narrow outline of test, which has subparallel margins, in the presence of lip on the apex of neck, in the lack of tooth in aperture and in the outline of the transverse section of test. In the outline of its test, *Q. kozlowskii* n.sp. is also similar to *Q. stollei* Brotzen, 1936, from which it differs, however, in the lack of rounded margins of test and tubular, convex chambers, as well as in a narrower transverse section of test. In its general appearance, the new species strongly resembles *Q. czestochowiensis* (Pazdro) from the Bathonian deposits of the Częstochowa Region. It differs from the Jurassic species in a considerably longer and wider, but thinner test, more flattened surface of chambers, subparallel margins of test and a small individual variability.

Distribution. — Poland: Upper Albian and lower beds of Cenomanian.

Superfamily **Nodosariacea** Ehrenberg, 1838
Family **Nodosariidae** Ehrenberg, 1838
Subfamily **Nodosariinae,** Ehrenberg, 1838
Genus *Marginulina* d'Orbigny, 1826
Marginulina aequivoca Reuss, 1862
(Pl. III, Fig. 7)

1862. *Marginulina aequivoca* Reuss; A. E. Reuss, Die Foraminiferen des norddeutschen Hils..., pp. 60, 61, Pl. 5, Fig. 17.
1891/98. *Marginulina aequivoca* Reuss; F. Chapman, The Foraminifera of the Gault..., p. 162, Pl. 4, Fig. 20.
1957. *Marginulina aequivoca* Reuss; K. Pożaryska, Lagenidae du Crétacé..., pp. 104, 105, Pl. 12, Fig. 5 (*here additional synonymy included*).
1965. *Marginulina aequivoca* Reuss; T. Neagu, Albian Foraminifera of the Rumanian..., p. 17, Pl. 4, Figs. 36, 37.

Material. — Fifteen well-preserved specimens.

Dimensions (in mm):

	IG 4255/70/F	IG 4256/70/F	IG 4257/70/F
Length . .	0.648	0.522	0.432
Width . .	0.198	0.162	0.144

Remarks. — The specimens studied by the present writer do not differ from Pożaryska's (1957) ones and correspond to the holotype. Specimen

from the Albian of Rumania differ from typical representatives of *M. aequivoca* only in more oblique sutures.

Distribution. — Poland: Upper Albian and Cenomanian; Germany, France, Holland, England and Rumania: Albian.

Marginulina jonesi Reuss, 1862
(Pl. III, Fig. 8)

1862. *Marginulina jonesi* Reuss; A. E. Reuss, Die Foraminiferen des norddeutschen Hils..., p. 61, Pl. 5, Fig. 19 a,b.
1934. *Marginulina jonesi* Reuss; W. Eichenberg. Die Erforschung der Mikroorganismen..., p. 160, Pl. 17, Fig. 5.
1950. *Marginulina jonesi* Reuss; A. Ten Dam, Les Foraminifères de l'Albien..., pp. 22, 23, Pl. 2, Fig. 4 (*here additional synonymy included*).
1957. *Astacolus jonesi* (Reuss); J. Sztejn, Stratygrafia mikropaleontologiczna..., pp. 46, 47, Pl. 5, Fig. 38.
1957. *Marginulina jonesi* Reuss; K. Pożaryska, Lagenidae du Crétacé..., pp. 108, 109, Pl. 12, Fig. 4 (*here additional synonymy included*).
1963. *Marginulina jonesi* Reuss; O. K. Kaptarenko-Tshernousova et al., Atlas charakternych foraminifer..., pp. 79, 80, Pl. 14, Fig. 4.
1965. *Marginulina jonesi* Reuss; T. Neagu, Albian Foraminifera of the Rumanian..., p. 17, Pl. 5, Figs. 11, 12.

Material. — Forty well-preserved specimens.

Dimensions (in mm):

	IG 4258/70/F	IG 4259/70/F	IG 4260/70/F
Length . .	0.540	0.504	0.396
Width . .	0.252	0.198	0.234

Description. The specimens examined corresponds to Sztejn's (1957) description.

Variability. — Variability manifests itself in varying dimensions of test, varying number of chambers forming tests (four to six), degree of the depression of inter-chamber sutures, degree of the curvature of test and the ornamention of the test chamber. In some of the specimens, the surface of this chamber is quite smooth, in some others its inferior part is covered with ribs and in still others the entire surface is ornamented by ribs which are considerably thinner than those on preceding chambers.

Remarks. — The specimens under study differ from the holotype in smaller dimensions and from those, described by Pożaryska (1957) in a slimmer test, less convex chambers and a higher number of ribs (12 to 14, as opposed to 10 in Pożaryska's specimens).

Distribution. — Poland: Upper Valanginian, Albian, Cenomanian; Germany, France, England, Holland: Lower Cretaceous; Rumania: Albian; U.S.S.R.: Albian and Cenomanian.

Genus *Planularia* Defrance in de Blainville, 1826
Planularia bradyana (Chapman, 1894)
(Pl. III, Fig. 11)

1891/98. *Cristellaria bradyana* Chapman; F. Chapman, The Foraminifera of the Gault..., p. 654, Pl. 10, Fig. 13 a,b.

1950. *Planularia bradyana* (Chapman); A. Ten Dam, Les Foraminifères de l'Albien..., p. 24, Pl. 2, Fig. 8.

1951. *Lenticulina (Planularia) complanata* Reuss; R. Noth, Foraminiferen aus Unter..., p. 45, Pl. 3, Fig. 4, Pl. 4, Fig. 19 (non Fig. 20).

Material. — Fifteen well-preserved specimens.

Dimensions (in mm):

	IG 4261/70/F	IG 4262/70/F	IG 4263/70/F
Length . .	0.876	0.414	0.226
Width . .	0.270	0.216	0.180

Description. — Test flat, suboval, in the initial part planispiral, subsequently uncoiled. Dorsal periphery arcuate, in the spiral part having a narrow, sharp keel with a shallow groove occurring above this part. Ventral periphery depressed above the spiral part. Test mostly composed of 10 to 12 low, slightly arcuate chambers in the uncoiled part strongly inclined and extended towards the proloculus. The surface of test flat, smooth; sutures slightly arcuate, narrow, with superstructures in the form of very thin, sharp sutural lists which are smooth near the ventral and gradually extend and increase their height towards the dorsal margin where they become more arcuate, wide and their surface covers with irregular tubercles and denticles. The proloculus, projecting on both sides of test, is situated near the ventral margin. Apertural surface of the last chamber is bordered by a sharp, delicate edge. Radiate aperture terminal, situated in the extension of the dorsal side.

Variability. — A small individual variability concerns the number of chambers forming test (unic to twelve), size of test, thickness of its walls and thickness of ornamentation on sutures. In specimens of thin wall of test, the lists and the tubercles which project in the extension of the latter near the dorsal periphery are considerably higher than those in specimens of thick wall test. The degree of the prominence of ornamentation is also variable.

Remarks. — Polish specimens correspond in all their characters to the holotype. This species is similar to *P. gemmata* Brady, from which it differs in the lack of beadlike thickenings over the entire length of sutures and in the presence of a sharp keel bordering the coiled part of test. It is also similar to *P. complanata* (Reuss), from which it differs, however, in thinner and sharper lists on sutures having a characteristic ornamentation near the dorsal periphery.

Distribution. — Poland: Cenomanian and the lowermost Turonian beds; England, Holland and Austria: Albian.

Planularia cenomana (Schacko, 1897)
(Pl. IV, Fig. 1)

1897. *Cristellaria cenomana* Schacko; G. Schacko, Ver. Freunde Naturg. Mecklenburg, Archiv, Jahrg. 50, p. 162 (fide B. F. Ellis & A. Messina, Cat. of Foram.).
1928. *Cristellaria cenomana* Schacko; A. Franke, Die Foraminiferen der Oberen..., p. 105, Pl. 18, Figs. 14 a,b, 15 a,b.

Material. — Ten specimens, part of them well-preserved, part damaged.

Dimensions (in mm):

	IG 4264/70/F	IG 4265/70/F	IG 4266/70/F
Length . .	0.792	0.594	0.432
Width . .	0.360	0.328	0.180
Thickness . .	0.090	0.071	0.072

Description. — Test lancetolate, flat; in the initial part arcuate, evolute, with an open spiral, higher up rectilinear. Its initial part is composed of eight, rather strongly arcuate, low chambers; the higher part comprise fine, wide and fairly high chambers strongly extended towards the arcuate part of test. The proloculus is invisible, being covered with a large boss projecting on both sides of test. The dorsal part of test slightly arcuate and the ventral sigmoidal in outline. The dorsal margin rounded, ventral flattened. All inter-chamber sutures slightly arcuate, in the initial, arcuate part of test and between four chambers of the rectilinear part covered with very numerous, short ribs arranged parallel to each other and slightly obliquely to sutures. Suture between the youngest two chambers narrow, listlike. In the arcuate part, the surface of chambers smooth, in the streightened one covered with long, thin ribs arranged subparallel to the dorsal side of test, except for the youngest two chambers in which it is also smooth.

Remarks. — The specimens described correspond to Schacko's one determined by him as *Cristellaria cenomana* n.sp. Var., but differ from it in the initial part of test, which does not form a closed spiral but is strongly arcuate and in the lack of gaps in sutures in the places of former apertures. The accurate counting of chambers is difficult on account of a rich ornamentation of sutures and the surface of test. Specimens, not described in the present paper and which correspond to the typical *Cristellaria cenomana* Schacko, also occur in the material from Poland. Since a small number of specimens available prevents one from preparing thin sections and the boss, concealing the initial chamber, from it accurate measuring, it is difficult to judge whether these two types of tests belong to different generations of one and the same species, as supposed by Schacko (1897), or

they are individuals of two different subspecies. Specimens, corresponding to the typical *C. cenomana* are similar in the shape of test, ornamentation of sutures and the manner of coiling the initial part of test to *Planularia mariae* Ten Dam. It may well be that the last-named species is a younger synonym of *P. cenomana* (Schacko).

Distribution. — Poland: Upper Albian, Cenomanian, Lower Turonian; Germany: very few in Cenomanian.

Planularia complanata (Reuss, 1845)
(Pl. III, Fig. 10)

1845. *Cristellaria complanata* Reuss; A. E. Reuss, Die Versteinerungen der böhmischen..., p. 33, Pl. 13, Fig. 54.
1862. *Cristellaria complanata* Reuss; A. E. Reuss, Die Foraminiferen des norddeutchen Hils..., p. 92, Pl. 12, Fig. 13 a,b.
1891/98. *Cristellaria complanata* Reuss; F. Chapman, The Foraminifera of the Gault..., pp. 653, 654, Pl. 10, Fig. 12 a,b.
1928. *Cristellaria complanata* Reuss; A. Franke, Die Foraminiferen der Oberen..., p. 101. Pl. 9, Figs. 18, 19.
1951. *Lenticulina complanata* (non Reuss) Franke; R. Noth, Foraminiferen aus Unter..., p. 45, Pl. 4, Fig. 20.
1954. *Lenticulina complanata* (Reuss 1846)); H. Bartenstein, Revision von Berthelin's Memoire..., p. 46.
1960. *Planularia, complanata* (Reuss); A. Tollmann, Die Foraminiferen Fauna..., p. 168, Pl. 13, Figs. 3—5.

Material. — Seventy well-preserved specimens.

Dimensions (in mm):

	IG 4083/70/F	IG 4267/70/F	IG 4268/70/F
Length . .	0.612	0.576	0.468
Width . .	0.270	0.252	0.198

Description. — Specimens from Poland are most similar to those described by Tollmann (1960) from Austria. Polish specimens have not, however, lateral walls bordered with edges, their tubercles in the extension of sutural lists are oval and occur not in all specimens and, finally, the spiral part of their tests is bordered with a keel.

Variability. — A considerable individual variability concerns the outline of tests, degree of extension of chambers in the developing part, width of chambers, width and height of sutural lists and the presence of an oval thickening of list near the dorsal periphery of test. Despite certain morphological differences, these are individuals of one and the same generation of the species discussed, which was found after making thin sections. The size of the proloculus in the specimens examined amounts to 27 μ. Specimens with a wide outline of test are in complete conformity with Reuss' one, figured on Pl. 12, Fig. 13 *a,b* (Reuss, 1862), while the elongate ones correspond to the holotype (Reuss, 1845, p. 33, Pl. 13, Fig. 54).

Remarks. — Specimens of the species under study, having oval tests, are most similar to *P. bradyana* (Chapman), from which they differ in smooth lists on sutures and more extended and less arcuate chambers and sutures near the dorsal side of test. Brotzen (1936) tends to consider his species, *P. liebusi* (p. 60, Pl. IV, Fig. 5, Text-fig. 18), as the youngest phylogenetic stage of *P. complanata* (Reuss).

Distribution. — Poland: Turonian and Lower Senonian of Pomerania (Niemica, Lubin, Chrząszczewo; Franke, 1928) and in the area under study, Upper Albian, Cenomanian and the lowermost Turonian beds; Germany: Albian and Emscherian; England: Albian; France: (?) Albian; Czechoslovakia: Albian; Austria (Alps): Albian and Coniacian.

Planularia cristellarioides (Reuss, 1862)
(Pl. III, Fig. 9)

1862. *Vaginulina cristellarioides* Reuss; A. E. Reuss, Die Foraminiferen des norddeutschen Hils..., p. 48, Pl. 3, Fig. 17 a,b.
1891/98. *Vaginulina priceana* Chapman; F. Chapman. The Foraminifera of the Gault..., p. 427, Pl. 8, Fig. 5 a,b.

Material. — Twelve well-preserved specimens.

Dimensions (in mm):

	IG 4084/70/F	IG 4269/70/F	IG 4270/70/F
Length . .	0.774	0.450	0.414
Width . .	0.324	0.234	0.234

Description. — Test flat, suboval, in the initial part planispiral, in the final part uncoiled. Dorsal side subrectilinear; dorsal wall flat, surrounded on both sides by single, thin lists and with a rib running through its center and reaching halfway the height of test.

Ventral side strongly arcuate, with a trough-like wall, bordered by two keels. An oval boss, covered with ribs and hiding the proloculus, projects on both sides of test in its coiled part. The proloculus is situated near the ventral periphery of test. In the coiled part, chambers are poorly visible, narrow, somewhat arcuate and perhaps numbering six. The uncoiled part, composed of three, low chambers oblique to the dorsal and arcuate near the ventral margin. The youngest two chambers may extend towards the proloculus. Inter-chamber sutures flat, slightly arcuate. A characteristic ornamentation of test consists of ribs oblique to the periphery of test and parallel to each other. The proximal part of each chamber and the inter-chamber sutures are covered with ribs, which are absent from the distal part. In the spiral part, ribs are considerably thinner than in the uncoiled part, except for those, on the boss which covers the proloculus.

Remarks. — Polish specimens differ from the holotype in the lack of a sharp list running through the center of the dorsal side of test and in

the coiled part of test which is less projecting anteriorly and not standing out against the background of the straight part. The specimens under study are also in an almost complete conformity with the Albian ones from Folkestone described by Chapman (1894) as *Vaginulina priceana*. They differ from the English specimens in smaller dimensions and less developed ribs in the spiral part of test. The species under study is most similar to *P. cenomana* (Schacko), from which it differs in a more oval outline of test, chambers considerably more extended towards the proloculus, lack of raised, sharp lists between the youngest chambers and short ribs covering the surface of chambers.

Distribution. — Poland: Upper Albian; North-western Germany: Albian; England: Albian, very few.

Genus *Saracenaria* Defrance in de Blainville, 1824
Saracenaria bononiensis (Berthelin, 1880)
(Pl. IV, Figs. 2, 3)

1880. *Cristellaria bononiensis* Berthelin; M. Berthelin, Mémoire sur les Foraminifères..., p. 55, Pl. 3, Fig. 23 a—c.
1891/98. *Cristellaria bononiensis* Berthelin; F. Chapman, The Foraminifera of the Gault..., pp. 652, 653, Pl. 10, Fig. 9 a,b.
1940. *Saracenaria bononiensis* (Berthelin); H. Tappan, Foraminifera from the Grayson..., pp. 105, 106, Pl. 16, Fig. 16 a,b.
1962. *Lenticulina (Saracenaria) bononiensis* (Berthelin); H. Bartenstein & F. Bettenstaedt, Leitfossilien..., pp. 287, 288, Pl. 41, Fig. 7; Pl. 36, Fig. 18, Tab. 18.
1963. *Saracenaria bononiensis* (Berthelin); O. K. Kaptarenko-Tshernousova et al., Atlas charakternych foraminifer..., p. 83, Pl. 13, Fig. 5.
1965. *Lenticulina (Saracenaria) bononiensis* (Berthelin); T. Neagu, Albian Foraminifera of the Rumanian..., p. 16, Pl. 4, Figs. 26, 27 (*here additional synonymy included*).

Material. — Sixty-five well-preserved specimens.

Dimensions (in mm):

	IG 4271/70/F	IG 4087/70/F	IG 4086/70/F
Length . .	1.026	0.522	0.396
Width . .	0.234	0.126	0.144
Thickness . .	0.234	0.126	0.144

Description. — The specimens under study correspond to Pożaryska's (1957) description.

Variability. — A considerable individual variability of these specimens concerns the size and the degree of curvature of test, number and convexity of chambers, development of sutures (depressed or flat and lucent) and ornamentation. In some of the specimens lists occur in all the three angles of the triangle and run from the proloculus up to the aperture, in some other, they terminate at the base of the last chamber. A similar variability is displayed by a rib which runs through the center of the ventral

surface. Sometimes, two accessory ribs occur on both sides of this rib. Ribs, numbering one or two each, may also occur on the sides of test. Also not infrequent are specimens having three ribs each on lateral walls and two ribs on the ventral side.

Remarks. — Here studied specimens are similar to both those described by Pożaryska (1957) and those known from Nort-western Germany in having accessory ribs on lateral sides of test. This feature was considered by Bartenstein & Bettenstaedt (1962) as an accessory specific character. According to these authors, here probably belong also the species described by Tappan (1943) under the name of *S. collitoecha* Tappan.

Distribution. — Poland: Upper Albian, Cenomanian; France, England, Holland, U.S.S.R.: Upper Albian; North-western Germany: higher beds of the Upper Aptian through Upper Albian; U.S.A. (Texas): the Washita group deposits.

Saracenaria vestita (Berthelin, 1880)
(Pl. IV, Figs. 7—10)

1880. *Cristellaria vestita* Berthelin; M. Berthelin, Mémoire sur les Foraminifères..., pp. 55, 56, Pl. 3, Fig. 22 a,b.
1954. *Lenticulina (Vaginulinopsis) vestita* (Berthelin), H. Bartenstein, Revision von Berthelin's Mémoire..., p. 46.
1957. *Saracenaria vestita* (Berthelin); J. Sztejn, Stratygrafia mikropaleontologiczna..., pp. 59, 60, Pl. 6, Fig. 57 a,b (*here additional synonymy included*),

Material. — Thirty well-preserved specimens.

Dimensions (in mm):

	IG 4092/70/F	IG 4273/70/F	IG 4274/70/F
Length . .	0.540	0.504	0.396
Width . .	0.234	0.216	0.180
Thickness . .	0.090	0.108	0.090

Description. — The specimens under study correspond to Sztejn's (1957) description.

Variability. — The following characters are subject to variability: the shape of test, degree of curvature of the uncoiled part of test, width of test, number of chambers in the uncoiled part and ornamentation. The coiled part may be devoid of ornamentation or covered with tubercles or with tubercles and ribs. In the uncoiled part, the ribs, running obliquely from the place of former aperture towards keel, may extend to only one of the chamber or run through the surface of several chambers.

Remarks. — Polish specimens are on the whole in conformity with the holotype. The tubercles and ribs covering the coiled part of test are in Polish specimens an accessory character, not mentioned by Berthelin (1880).

Distribution. — Poland: Valanginian, Upper Albian, the lowermost Cenomanian beds; England, France, Holland: Albian.

Genus *Vaginulina* d'Orbigny, 1826
Vaginulina arguta Reuss, 1860
(Pl. IV, Fig. 14)

1860. *Vaginulina arguta* Reuss; Reuss, A. E. Die Foraminiferen der westphälischen..., p. 202, Pl. 8, Fig. 4.
1952. *Vaginulina truncata* Reuss; H. Bartenstein, Taxonomische Revision..., p. 175.
1952. *Vaginulina truncata* Reuss, H. Bartenstein, *Ibid.*, p. 303.
1952. *Vaginulina arguta* Reuss; J. Albers, Taxonomie und Entwicklung..., pp. 85—89, Pl. 5, Figs. 1,4,6, Text-figs. 12—15 (*here additional synonymy included*).
1954. *Vaginulina truncata* Reuss; H. Bartenstein, Revision von Berthelin's Mémoire..., p. 43.
1954. *Vaginulina arguta* Reuss; H. Bartenstein, *Ibid.*, p. 43.
1957. *Vaginulina arguta* Reuss; H. Bartenstein & F. Bettenstaedt & H. Bolli, Die Foraminifera der Unterkreide..., p. 38, Pl. 5, Fig. 104, Pl. 6, Fig. 136.
1963. *Vaginulina truncata* Reuss; L. V. Alekseeva, in L. V. Alekseeva & M. K. Rodionova, Foraminifery niżnego mela..., pp. 32, 33, Pl. 5, Fig. 7 a,b.
1965. *Vaginulina arguta* Reuss; T. Neagu, Albian Foraminifera of the Rumanian..., p. 24, Pl. 5, Fig. 37.
1966. *Vaginulina arguta* Reuss; L. Dieni & F. Massari, Foraminiferi del Valanginiano..., pp. 149, 150, Pl. 6, Figs. 15—17 (*here additional synonymy included*)

Material. — Fifteen well-preserved specimens.

Dimensions (in mm):

	IG 4275/70/F	IG 4276/70/F	IG 4277/70/F
Length . .	1.530	0.918	0.504
Width . .	0.630	0.342	0.450
Thickness . .	0.216	0.108	0.234

Description. — The specimens under study correspond to Albers' (1952) description.

Variability. — It is manifested in a varying degree of the extension of test, of the curvature of the dorsal side of test and in the ornamentation of the dorsal side, which, in some of the specimens, is smooth and, in some others, thin, narrow ribs parallel to keels, are visible halfway the height.

Remarks. — Polish specimens differ from the holotype in the lack of a furrow running along the dorsal side of test and in the presence of short, elongate ribs. In the process of his detailed studies on species of *Vaginulina* d'Orbigny, Albers (1952) arrived at the conclusion that the specimens, described by Reuss (1860, 1862) under the names of *V. arguta* Reuss and *V. truncata* Reuss, are individuals different generations of one and the same species. This author also recognized *V. transversalis* Reuss as a synonym to *V. arguta*. In literature, specimens of *V. arguta* are mostly described under the name of *V. truncata* Reuss. Albers' view was shared by Barten-

stein & Bettenstaedt (1957). *V. arguta* Reuss differs from *V. striolata* Reuss in, among other things, an elongate outline of test, less extreme extension of test, taking place with the growth and the presence of single lists on inter-chamber sutures.

Distribution. — Poland: Upper Albian, Lower Turonian; North-western Germany: Barremian through Albian; England, France, Rumania: Albian; Austria (Northern Alps): Hauterivian; Holland ? Hauterivian and Albian; Italy: Upper Valanginian; U.S.S.R.: Hauterivian and Albian; U.S.A.: Middle and Upper Albian; Trinidad (West Indies): Lower Cretaceous.

Vaginulina biochei Berthelin, 1880
(Pl. IV, Fig. 16)

1880. *Vaginulina biochei* Berthelin; Mémoire sur les Foraminifères..., p. 42, Pl. 2, Fig. 9 a,b.
1950. *Vaginulina biochei* Berthelin; A. Ten Dam, Les Foraminifères de l'Albien..., p. 36, Pl. 2, Fig. 28.
1951. *L. (Vaginulina) biochei* Berthelin; R. Noth, Foraminiferen aus Unter..., p. 48, Pl. 1, Fig. 12 a,b (*here additional synonymy included*).
1954. *Vaginulina biochei* Berthelin; H. Bartenstein, Revision von Berthelin's Mèmoire..., p. 43.
1963. *Vaginulina biochei* Berthelin; L. V. Alekseeva, in L. V. Alekseeva & M. K. Rodionova, Foraminifery niżnego mela..., pp. 33, 34, Pl. 5, Fig. 6.

Material. — Twenty well-preserved specimens.

Dimensions (in mm):

	IG 4278/70/F	IG 4094/70/F	IG 4279/70/F
Length . .	0.576	0.540	0.414
Width . .	0.180	0.252	0.144
Thickness . .	0.090	0.090	0.054

Description. — Polish specimens are to the greatest extent in conformity with Ten Dam's (1950) description, although display certain characters not mentioned by Ten Dam. They have a narrow dorsal periphery, which at the level of the youngest two chambers is flat and separated from lateral sides by sharp lists. A fairly wide, sharp list borders the ventral side of test up to the level of the apertural surface of the last chamber. Apertural surface narrow, flat, bordered on both sides by sharp, low lists.

Variability. — It concerns the curvature of the ventral side, outline of test, convexity of chambers and depression of sutures.

Remarks. — Polish specimens of this species display a complete conformity with the holotype, described from the Albian of France. This species is very similar to *V. duestensis* Bartenstein, from which it differs in the lack of elongate ribs on the surface of chambers. Examining the specimens from Berthelins (1880) collection, Bartenstein (1954) also noticed incipient elongate ribs on the surface of test in specimens of *V. biochei*,

which was not observed by Berthelin. Such ribs do not, however, occur in Polish specimens.

Distribution. — Poland: Upper Albian; France, England, Holland: Albian; Austria (Northern Alps): Hauterivian and Albian; U.S.S.R.: Hauterivian and Upper Barremian.

Vaginulina aff. paucistriata Reuss, 1862
(Pl. IV, Fig. 15)

1862. *Vaginulina paucistriata* Reuss; A. E. Reuss, Die Foraminiferen des norddeutschen..., p. 48, Pl. 3, Fig. 16 a,b.

Material. — Twelve well-preserved specimens.

Dimensions (in mm):

	IG 4280/70/F	IG 4281/70/F	IG 4295/70/F
Length . .	1.332	0.882	0.684
Width . .	0.288	0.252	0.198
Thickness . .	0.126	0.090	0.090

Description. — Test small, thin, elongate, composed mostly of six chambers rectangular in transverse section. Each edge of test is provided with a very narrow, thin list. Dorsal side straight, flat, smooth, without ornamentation. Neither chambers, nor sutures are visible on it. On the ventral side, sutures slightly depressed, poorly visible, the surface of chambers flat. On lateral sides, chambers obliquely arranged, trapezoidal in outline; sutures at an angle of 35° to the dorsal side of test, with a superstructure formed by narrow, low sutural lists slightly projecting above the surface of test. The surface of chambers covered with delicate, barely visible ribs, two to three of them on each chamber. The ribs may run uninterruptedly over the surface of two chambers adjoining each other. Proloculus spherical, smooth, slightly projecting over the lateral surfaces of test.

Variability. — A considerable individual variability, concerning the outline of test, ornamentation of sutures, which may be either covered with, or devoid of lists and the number, height and length of ribs, which may run even through all chambers of test.

Remarks. — The specimens under study considerably differ from the holotype in the lack of ribs on both the dorsal and ventral side of test, lower number of chambers forming the test and in the fact that the ribs on the lateral sides may be uninterrupted on sutures. The specimens described above are most similar to *V. recta* Reuss, from which they differ in the presence of ornamentation on the surface of chambers. In the continuity of ribs on sutures they slightly resemble *V. stringillata bettenstaedti* Albers.

Distribution. — Poland: Upper Albian and middle part of Cenomanian.

Vaginulina procera Albers, 1952
(Pl. IV, Fig. 6)

1952. *Vaginulina procera* Albers; J. Albers, Taxonomie und Entwicklung..., pp. 80—82, Pl. 4, Figs. 1—4, Text-figs. 4—9, p. 81.
1957. *Vaginulina procera* Albers; H. Bartenstein & F. Bettenstaedt & H. Bolli, Die Foraminiferen der Unterkreide..., p. 39, Pl. 5, Fig. 102; Pl. 6, Fig. 133.
1962. *Vaginulina procera* Albers; H. Bartenstein & F. Bettenstaedt, Leitfossilien..., pp. 273, 274, Pl. 39, Fig. 2, Tab. 18.

Material. — Seventeen partly damaged specimens.

Dimensions (in mm):

	IG 4096/70/F	IG 4282/70/F	IG 4283/70/F
Length . .	2.520	1.728	0.900
Width . .	0.594	0.360	0.360
Thickness . .	0.360	0.162	0.198

Description. — Polish specimens are to the greatest extent in conformity with Albers' (1952) description.

Variability. — It concerns the thickness of ribs and sutural lists, number of ribs on the proloculus, thickness of lists bordering the edges of test, number of chambers of which the test is composed and the ornamentation of the surface of chambers on lateral sides. In some of the specimens, delicate ribs running parallel to the vertical axis of test and obliquely to sutures are observed on the surface of chambers.

Remarks. — Polish specimens differ from those coming from the Barremian of North-western Germany only in the presence of double lists on each edge of test and in a lower number of chambers forming the test.

Distribution. — Poland: Upper Albian, lower beds of Cenomanian; Germany: Barremian and Lower Aptian; Trinidad (West Indies): Barremian.

Vaginulina recta Reuss, 1862
(Pl. IV, Fig. 11)

1862. *Vaginulina recta* Reuss; A. E. Reuss, Die Foraminiferen des norddeutschen Hils..., p. 48, Pl. 3, Figs. 14, 15.
1957. *Vaginulina recta* Reuss; K. Pożaryska, Lagenidae du Crétacé..., p. 112, Pl. 14, Fig. 10.
1963. *Vaginulina recta* Reuss; L. V. Alekseeva, in L. V. Alekseeva & M. K. Rodionova, Foraminifery niżnego mela..., p. 32, Pl. 5, Fig. 8 a,b.
1966. *Vaginulina recta* Reuss; H. Bartenstein & F. Bettenstaedt & H. Bolli, Die Foraminiferen der Unterkreide..., p. 155, Pl. 3, Figs. 250—253.
1966. *Vaginulina recta* Reuss; L. Dieni & F. Massari., Foraminiferi del Valanginiano..., p. 151, Pl. 6, Figs. 10—12 (*here additional synonymy included*).

Material. — Sixty well-preserved specimens.

Dimensions (in mm):

	IG 4284/70/F	IG 4285/70/F	IG 4286/70/F
Length . .	1.170	0.666	0.594
Width . .	0.198	0.144	0.198
Thickness . .	0.090	0.072	0.090

Description. — The specimens under study correspond to Pożaryska's (1957) description.

Variability. — A considerable variability is manifested in the number of chambers forming the test, outline of test, height of sutural lists on lateral sides and height of lists bordering the edges of test.

Remarks. — Specimens of *V. recta* Reuss, occurring in the deposits under study, are in conformity with the holotype. Some of them differ from it only in a greater number of chambers, which makes them similar to specimens described by Albers (1952) from North-western Germany. The greater number of chambers is a character in which they also differ from Sztejn's (1957) and Pożaryska's (1957) specimens, from which they differ, in addition, in the occurrence of lists on inter-chamber sutures and in a slightly extending test.

Distribution. — Poland: Upper Valanginian, Upper Albian, Cenomanian; North-western Germany: Lower Cretaceous deposits; England, France, Holland, Rumania, U.S.S.R.: Albian; Italy: Upper Valanginian; Trinidad (West Indies): Lower Cretaceous deposits; U.S.A.: ? Albian.

Vaginulina robusta Chapman, 1894

(Pl. IV, Fig. 5)

1880. *Vaginulina truncata* Reuss; M. Berthelin, Mémoire sur les Foraminifères..., pp. 39—41, Pl. 2, Fig. 4 a,b.

1891/98. *Vaginulina truncata* Reuss var. *robusta* Berthelin & Chapman; F. Chapman, The Foraminifera of the Gault..., pp. 424, 425, Pl. 8, Fig. 7 a,b.

1952. *Vaginulina robusta* (Chapman); J. Albers, Taxonomie und Entwicklung..., pp. 92, 93, Pl. 5, Figs. 3, 5; Text-figs. 20, 21, p. 92. (*here additional synonymy included*).

1957. *Vaginulina robusta* (Chapman); K. Pożaryska, Lagenidae du Crétacé..., pp. 112, 113, Pl. 14, Fig. 5.

1965. *Vaginulina robusta* Chapman; T. Neagu, Albian Foraminifera of the Rumanian..., p. 24, Pl. 5, Fig. 35.

1965. *Vaginulina robusta* (Chapman); I. Bach, Bemerkungen zur Faziesabhängigkeit..., pp. 181, 182, Pl. 13, Figs. 1, 2; Pl. 14, Fig. 4.

Material. — Twenty well-preserved specimens.

Dimensions (in mm):

	IG 4098/70/F	IG 4287/70/F	IG 4288/70/F
Length . .	1.548	1.026	0.864
Width . .	0.540	0.396	0.324
Thickness . .	0.196	0.180	0.180

Description. — The specimens described are most similar to those described by Pożaryska (1957).

Variability. — A considerable individual variability is expressed in the degree of bulging the ventral side of test, ornamentation of the proloculus, which may be spherical and smooth or ornamented with one to fuor ribs. It is also manifested in the number of chambers forming the test (5—10), degree of curvature and height of sutural lists.

Remarks. — The specimens examined are representatives of a macrospherical generation. Polish specimens differ from *V. truncata* Reuss var. *robusta* Chapman from the Albian of Folkestone in their lists which do not reach the dorsal keel, much the same in fact as in the specimens assigned by Ten Dam (1950), Albers (1952), Pożaryska (1957) and Bach (1965) to *V. robusta* Chapman. Our specimens differ from those described by Pożaryska (1957) in a sudden extension of test in the process of growth and in a more convex ventral side. The species under study is very closely related to *V. arguta* Reuss sensu Albers (1952), differing from it in a wider and thicker test, faster increase in its width and higher sutural lists. From *V. tenuistriata* Chapman it differs in the lack of thin ribs on lateral surfaces and in its more rapid extension.

Distribution. — Poland: Upper Albian, Cenomanian; North-western Germany: Middle Barremian and Albian, France, England, Holland, Rumania: Albian.

Vaginulina striolata Reuss, 1862
(Pl. IV, Fig. 13)

1862. *Vaginulina striolata* Reuss; A. E. Reuss, Die Foraminiferen des norddeutschen Hils..., p. 46, Pl. 3, Fig. 7.
1950. *Vaginulina kochi* Roemer 1840 var. *striolata* (Reuss); A. Ten Dam, Les Foraminifères de l'Albien..., p. 35.
1966. *Vaginulina striolata* Reuss; L. Dieni & F. Massari, Foraminiferi del Valanginiano..., pp. 152, 153, Pl. 6, Fig. 19 (*here additional synonymy included*).
1967. *Vaginulina costulata* Roemer; P. Marks, Foraminifera from the Craie..., pp. 434—436, Text-fig. 8 a—c (non 8d); Pl. 2, Fig. 6.

Material. — Fifteen well-preserved specimens.

Dimensions (in mm):

	IG 4289/70/F	IG 4290/70/F	IG 4291/70/F
Length . .	0.954	0.918	0.630
Width . .	0.414	0.378	0.288
Thickness . .	0.126	0.180	0.126

Description. — Test elongate, mostly composed of eight chambers, arcuate and extended ventrally. On the dorsal side slightly arcuate, on the

ventral slightly concave or rectilinear in outline; transverse section rectangular. The wall of the dorsal side flat or somewhat convex, of the ventral side slightly convex, corrugated with distinct, slightly convex chambers and slightly depressed, rectilinear sutures. Lateral sides flat, bordered by sharp and fairly high lists. On lateral sides chambers flat, narrow, in the initial part of test fairly strongly arcuate, in the higher part arranged at an angle of about 50° to the dorsal side of test. The surface of chambers smooth, sutures strongly arcuate in the initial part of test and slightly bent towards the aperture of test in the higher part. Sutures ornamented by many thin, fairly long ribs formed by the splitting of a sutural list, arranged parallel to sutures. In the ventral part of test, sutures may be covered with uniform, unsplit liste. Aperture radiate, terminal, situated in the extention of the dorsal periphery.

Variability. — A considerable individual variability is expressed in the outlines of dorsal and ventral sides, in a ventral elongation of the initial part of test, in the degree of the extension of test and in the manner of ornamenting sutures. In some of the specimens, the sutural ornamentation consists of many, single, short, thin ribs parallel to the suture and to each other and oblique to the dorsal side. In some others, the lists near the ventral side of test are uniform and near the dorsal dichotomously divided and extended onto the surface of adjoining chambers.

Remarks. — Specimens from Poland differ from the holotype in an almost parallel situation of the sutural ribs to the sutures. They differ from those described by Albers (1952) and Tappan (1940, 1943) primarily in the lack of distinct ribs on the surface of the chambers occurring on the lateral sides of test, in a parallel position of ribs to sutures and in a different outline of test. The species is most similar to *V. gaultina* Berthelin. Prior to the publication of Bartenstein's (1954) work, in which he presented the results of his studies on the foraminifers from Berthelin's collection from the Albian of Montcley, many authors (Cushman & Alexander, 1930; Tappan, 1940; Albers, 1952, *etc.*) considered the specimens, described by Berthelin (1880) under the name of *V. gaultina*, as the representatives of *V. striolata*. Bartenstein found that the specimens from Berthelin's collection have no transverse lists on sutures and the surface of their chambers is quite smooth, which contradicts Berthelin's description and illustrations (*l.c.*, Pl. I, Figs. 22—24). Bartenstein recognized the specimens of *V. comitina* Berthelin as a transitional form between *V. gaultina* Bethelin and *V. striolata* Reuss but still belonging to *V. gaultinia* Berthelin. He also considered *V. vandenbroecki* Berthelin, in which the sutural lists were — in his opinion — erroneously presented, as a synonym of *V. gaultina*.

Distribution. — Poland: Upper Albian, Cenomanian; Germany: Upper Valenginian through Turonian; England, Holland, Rumania: Albian.

Vaginulina tenuistriata Chapman, 1894
(Pl. IV, Fig. 12)

1891/98. *Vaginulina recta* Reuss *var. tenuistriata* Chapman; F. Chapman, The Foraminifera of the Gault..., pp. 422, 423, Pl. 8, Fig. 2.
1950. *Vaginulina recta* Reuss *var. tenuistriata* Chapman; A. Ten Dam, Les Foraminifères de l'Albien..., p. 34, Pl. 3, Fig. 1.
?1966. *Vaginulina cf. recta tenuistriata* Chapman; H. Bartenstein, F. Bettenstaedt & H. Bolli, Die Foraminiferen der Unterkreide..., p. 156, Pl. 3, Figs. 260—264.

Material. — Fifteen well-preserved specimens.

Dimensions (in mm):

	IG 4101/70/F	IG 4292/70/F	IG 4293/70/F
Length . .	2.322	1.638	1.404
Width . .	0.540	0.396	0.360
Thickness . .	0.180	0.144	0.144

Description. — Polish specimens almost completely correspond to Chapman's (1894) description. Ribs (mostly five) covering the proloculus are an additional character of the specimens from Poland.

Variability. — A considerable individual variability is manifested in a varying size of tests, number of chambers and height and thickness of sutural lists and ribs covering the surface of chambers. In some of the specimens, sutural ribs are interrupted in places of former apertures, in some others they are uniform and connected with the dorsal keel.

Remarks. — The specimens under study differ from the holotype in their sutural lists on the lateral sides of test not reaching, in some of them, the dorsal keel, in a lower number of chambers and, finally, in the presence of ribs on the proloculus. Specimens which come both from Poland and England are similar to *V. arguta* Reuss sensu Albers (1952), from which they differ only in the presence of ribs on the surface of chambers occurring on lateral sides of test. Specimens very similar to our ones are described by Perner (1892) under the name of *V. cenomana*. This description does not allow one for more accurate comparisons, but *V. tenuistriata* Chapman may well be a younger synonym of *V. cenomana* Perner.

Specimens similar in shape to *V. recta* Reuss, in which Bartenstein & Bettenstaedt & Bolli (1966) observed twelve ribs obliquely running over the surface of each chamber were found by these author in the Lower Cretaceous deposits of Trinidad. Polish specimens differ from them in higher sutural ribs, more regular outline of test and a lower number (at most six) of ribs on the surface of chambers.

Distribution. — Poland: Upper Albian, Cenomanian; England and Holland: Albian; Trinidad (West Indies): ?Lower Cretaceous deposits.

Superfamily **Buliminacea** Jones, 1875
Family **Turrilinidae** Cushman, 1927
Genus *Neobulimina* Cushman & Wickenden, 1928
Neobulimina minima Tappan, 1940
(Pl. V, Fig. 2)

1940. *Neobulimina minima* Tappan; H. Tappan, Foraminifera from the Grayson..., p. 117, Pl. 19, Figs. 5 a—c, 6.
1951. *Neobulimina minima* Tappan; H. Bartenstein & E. Brand, Mikropalaeontologische Untersuchungen..., p. 324, Pl. 13, Figs. 366, 367.
1954. *Neobulimina minima* Tappan; D. L. Frizzell, Handbook of Cretaceous..., p. 116, Pl. 17, Fig. 13 a,b (*here additional synonymy included*).

Material. — Five hundred and sixty well-preserved specimens.

Dimensions (in mm):

	IG 4294/70/F	4295/70/F	IG 4296/70/F
Length . .	0.275	0.216	0.180
Width . .	0.126	0.126	0.108

Description. — Test very small, smooth, lustrous, wedge-shaped, in the initial part triserial, with the last whorl consisting of two to two and a half chambers. Transverse section round, outline fairly lobulate. The last whorl occupies one-third to a half of the length of test. In the initial whorls chambers small, with a convex surface, in the last whorl high, fairly convex. The septal sutures and the spiral suture depressed, most strongly between the chambers of the last whorl. Aperture semilunar situated at the base of the apertural surface of the last chamber.

Variability. — The individual variability concerns the shape of test (wedgelike or roller-like), its extension with the growth number of chamber in the last whorl (two or two and a half), convexity of the surface of chambers, depression of septal sutures and spiral suture and degree of uncoiling and height of the last whorl.

Remarks. — Polish specimens differ from the holotype in a slightly more extended test and a smaller pitch of spiral in the initial part of test which causes that all the three chambers of particular whorls in this part of test are situated at approximately the same level. They are almost identical with the paratype illustrated by Tappan (1940). It has been observed in the Polish material that the specimens of this species increase their dimensions in the process of the phylogenetic development. An increase in the degree of the convexity of chambers has also been recorded in specimens younger geologically.

Distribution. — Poland: Upper Albian, Cenomanian, Lower Turonian: North-western Germany: Upper Valanginian; U.S.A.: Aptian and Albian.

Genus *Praebulimina* Hofker, 1953
Praebulimina evexa (Loeblich & Tappan, 1949)
(Pl. V, Fig. 1)

1949. *Bulimina evexa* Loeblich & Tappan; A. R. Loeblich & H. Tappan, Foraminifera from the Walnut..., p. 263, Pl. 51, Fig. 5 a,b.
1967. *Praebulimina reussi* (Morrow); P. Marks, Foraminifera from the Craie..., p. 439, Pl. 3, Fig. 1 a,b.

Material. — Four hundreds and fifty well-preserved specimens.

Dimensions (in mm):

	IG 4297/70/F	IG 4298/70/F	IG 4299/70/F
Height . .	0.198	0.140	0.110
Width . .	0.180	0.110	0.090

Discription. — Polish specimens correspond to Loeblich & Tappan's (1949) description.

Variability. — A small individual variability mostly concerns the number of chambers (three or three and a half) in the last whorl and the presence of a lip near the aperture.

Remarks. — The specimens described are in almost all characters in conformity with the holotype. They differ from it only in a wider last whorl. Likewise, they are very similar to specimens described by Reuss (1845) under the name of *Bulimina ovulum* (*l.c.* p. 37, Pl. 8, Fig. 57; Pl. 13, Fig. 73) and which were called by Morrow (1934) *B. reussi*. Specimens from Poland differ from the Czech ones in the proportions of test and its somewhat different shape. They are nearly as wide as high and more rounded in the initial part of test. According to Reuss, the width of test in Czech specimens is a half of its height. Specimens from Poland are identical with those described by Marks (1967) from France.

Distribution. — Poland: Upper Albian, Cenomanian and the lowermost Turonian beds; France: Cenomanian; U.S.A.: Albian.

Family **Bolivinitidae** Cushman, 1927
Genus *Bolivina* d'Orbigny, 1839
Bolivina textilarioides Reuss, 1862
(Pl. V, Fig. 6 *a,b*)

1862. *Bolivina textilarioides* Reuss; A. E. Reuss, Die Foraminiferen des norddeutschen Hils..., p. 81, Pl. 10, Fig. 1 a,b.
1880. *Bolivina textilarioides* Reuss; M. Berthelin, Mémoire sur les Foraminifères..., p. 28, Pl. 1, Fig. 5 a—c.
1891/98. *Bolivina textularioides* Reuss; F. Chapman, The Foraminifera of the Gault..., p. 757, Pl. 12, Fig. 12 a,b.

1940. *Bolivina cf. textilarioides* Reuss; H. Tappan, Foraminifera from the Grayson..., p. 118, Pl. 18, Fig. 8 a—c (*here additional synonymy included*).
1961. *Bolivina textilarioides* Reuss; C. A. Tairov, Foraminifery aptskyego..., Pl. 24, Fig. 3 a,b.

Material. — Sixty well-preserved specimens.

Dimensions (in mm):

	IG 4104/70/F	IG 4300/70/F	IG 4301/70/F
Height . .	0.468	0.340	0.250
Thickness . .	0.090	0.090	0.070
Width . .	0.126	0.126	0.070

Description. — Polish specimens correspond to Cushman's (1937) description.

Variability. — A small individual variability concerns the convexity of chambers, depression of sutures and degree of the lobularity of the margins of test.

Remarks. — Specimens from Poland differ from Reuss' specimens in a lower number of chambers and by half smaller dimensions. In Polish material includes two types, of tests, large and small, which are composed of an equal number of chambers. Large tests differ from small ones in a strong roughness of their walls resulting from coarse pores closely spaced on the surface of chambers. Small tests are smooth, lustrous and very finely perforated. In the present writer's opinion, specimens similar to the representatives of *B. textilarioides* Reuss, having a triserial initial part of test and occurring from the Middle Malm up to the Upper Valanginian should not be connected with the species under study. Specimens described by Bielecka & Pożaryski (1954, p. 65, Pl. X, Fig. 50) from the Kimmeridgian of Poland under the name of *Neobulimina varsoviensis* and which are considered by Dieni & Massari (1966, pp. 101, 102) as a synonym of *B. textilarioides*, have nothing in common with Reuss specimens. They differ from *B. textilarioides* in a triserial initial part of test, its different outline and more convex chambers.

Distribution. — Poland: Upper Albian, Cenomanian; North-western Germany, France, U.S.S.R., U.S.A.: Albian.

Genus *Tappanina* Montanaro-Gallitelli, 1955
Tappanina eouvigeriniformis (Keller, 1935)
(Pl. V, Fig. 5 *a,b*)

1935. *Bolivinita eouvigeriniformis* Keller; B. M. Keller, Mikrofauna verchnego mela..., pp. 548, 549, Pl. 3, Figs. 20, 21.
1959. *Bolivinita eouvigeriniformis* Keller; N. I. Maslakova, Atlas verchnemelovoj fauny..., p. 116, Pl. 15, Fig. 1 a,b.
1962. *Bolivinita eouvigeriniformis* Keller; H. Hiltermann & W. Koch, Leitfossilien..., p. 313, Pl. 49, Fig. 1, Tab. 19.

1963. *Bolivinita eouvigeriniformis* Keller; O. K. Kaptarenko-Tschernousova et all., Atlas charakternych foraminifer..., pp. 112, 113, Pl. 17, Fig. 6 a,b.

1965. *Tappanina eouvigeriniformis* (Keller); J. P. Beckmann & W. Koch, Vergleiche von Bolivinoides..., pp. 53, 54, Pl. 7, Figs. 1—5 (*here additional synonymy included*).

Material. — Sixty-five well-preserved specimens.

Dimensions (in mm):

	IG 4302/70/F	IG 4105/70/F	IG 4303/70/F
Height . .	0.252	0.216	0.198
Width . .	0.144	0.144	0.162
Thickness . .	0.090	0.072	0.090

Description. — Test small, biserial, bilaterally flattened, wedgelike — rhomboid in outline, with a rectangular transverse section and incrised peripheries. Test mostly composed of five pairs of clearly visible chambers trapezoidal in outline and with a flat or concave surface. It is almost equally thick over the entire length, regularly and considerably extending in the process of growth and the widest at the base of the last two chambers. A spherical proloculus, projecting above lateral surfaces of test, is visible in the initial part of test. In this part, sutures are oblique, in the final a little arcuate and with a superstructure of high ribs. Imbricated chambers of one of the series are visible on the narrower sides of test. Inter-chamber sutures rectilinear, parallel to each other and strongly depressed. A thin, narrow, sharp list, running parallel to the suture occurs on the most convex part of each of the above mentioned sides of test. The surface of the last chamber convex, smooth. A comma-shaped aperture runs from the apex of test perpendicularly to the inner margin of the final chamber.

Variability. — The individual variability is manifested only in a varying development of the wider sides of test (flat, concave or slightly convex) as well as in the height and thickness of sutural lists.

Remarks. — Polish specimens may be assigned to the second group of forms distinguished by Beckmann & Koch (1965), in which wider walls of test resemble, in the pattern of ornamentation, a honeycomb. Specimens completely corresponding to Keller's holotype occur in the material studied. On the other hand, no specimens have been found which are assigned by Beckmann & Koch to the third group. Specimens assigned by Akimez (1961, p. 191, Pl. XIX, Fig. 8 *a,b*) to *Bolivinita eouvigeriniformis* Keller are similar to those described by Cushman (1937) as *B. costifera* (p. 105, Pl. 4, Fig. 15). Specimens, described by Scheibnerova (1969) under the name of *T. eouvigeriniformis*, are probably representatives of another species.

Distribution. — Poland: Cenomanian, Lower Turonian; North-western Germany: Upper Albian, Lower Coniacian; U.S.S.R.: Cenomanian, Turonian; Trinidad (West Indies): Turonian, Coniacian.

Superfamily **Discorbacea** Ehrenberg, 1838
Family **Discorbidae** Ehrenberg, 1838
Subfamily **Discorbinae** Ehrenberg, 1838
Genus *Conorbina* Brotzen, 1936
Conorbina brotzeni Gandolfi, 1942
(Pl. VI, Fig. 4 *a—c*)

1942. *Conorbina brotzeni* Gandolfi; R. Gandolfi, Ricerche micropaleontologische..., pp. 91, 92, Text-fig. 27 a—c, p. 91, Text-fig. 28—1 a,b, 2 a,b, p. 92.

Material. — Eight well-preserved specimens.

Dimensions (in mm):

	IG 4307/70/F	IG 4106/70/F	IG 4305/70/F
Greater diameter . . .	0.468	0.396	0.324
Smaller diameter . . .	0.414	0.342	0.306
Height	0.234	0.198	0.198

Description. — Test round or slightly oval, lobulate in outline, periphery sharp, spiral side domelike, evolute, with 2 or 2.5 whorl visible on it. In the first whorl, chambers poorly visible, with a slightly concave surface, in the next whorl, at first arcuate, with a flat or concave surface and trapesoidal, become slightly convex in the process of growth. The last whorl is composed of four to six chambers of which the youngest two or three are the largest and most convex. In older whorls, sutures arcuate, convex, connected with a thickened and also convex spiral suture. Inter-chamber sutures of the last whorl strongly arcuate, in the initial part of whorl thickened between two to three chambers and depressed between the remaining ones. The umbillical side involute, concave, with four to five triangular chambers, having visible convex surfaces. The last chamber occupies one-third of the surface of whorl. Sutures poorly visible, in the initial part of whorl flat and transparent, in the terminal part depressed. Aperture creviced, interiomarginal, extraumbilical-umbilical. Umbilicus invisible being filled with rock.

Variability. — A considerable individual variability concerns the size and outline of tests, convexity of the spiral side, convexity of the youngest chambers in the last whorl on both sides of test, number of chambers in the last whorl and convexity of inter-chamber sutures and spiral suture on the spiral side.

Remarks. — Specimens from Poland differ from the holotype in a slightly convex surface of the last three chambers in the youngest whorl. They resemble the specimens assigned by Gorbenko to *Discorbis concavata* (Gorbenko, 1960, p. 72, Figs. 1 and 4 *a,b*) and differ from them in a lower number of whorls, considerably lower number of chambers in the last whorl and their strongly elongate shape on the spiral side as well as in the lack of accessory apertures.

Distribution. — Poland: Upper Albian; Italy: Scaglia Variegata (Aptian ?Albian?) series of the Ticina Canton.

Subfamily **Bagginae** Cushman, 1927
Genus *Valvulineria* Cushman, 1926
Valvulineria gracillima Dam, 1947
(Pl. VI, Fig. 5 *a*—*c*)

1947. *Valvulineria gracillima* Ten Dam; A. Ten Dam, Geol. en Mijnb., s-Gravenhage, n.s., 1947, Jaand. 9, No 2, p. 26, Fig. 4 a—c (fide B. F. Ellis & A. Messina cat. of Foram.
1950. *Valvulineria gracillima* Ten Dam; A. Ten Dam, Les Foraminifères de l'Albien..., pp. 47, 48 (*here additional synonymy included*).
1962. *Valvulineria gracillima* Dam; H. Bartenstein & F. Bettenstaedt, Leitfossillen..., p. 287, Pl. 36, Fig. 17 a—c, Tab. 18.
1965. *Valvulineria gracillima* Ten Dam; T. Neagu, Albian Foraminifera of the Rumanian..., p. 30, Pl. 7, Figs. 33—35.

Material. — Two hundred and fifteen well-preserved specimens.

Dimensions (in mm):

	IG 4306/70/F	IG 4307/70/F	IG 4308/70/F
Greater diameter . . .	0.360	0.340	0.270
Smaller diameter . . .	0.290	0.250	0.216
Thickness	0.200	0.160	0.162

Description. — Polish specimens correspond to the greatest extent to Bartenstein & Bettenstaedt's (1962) description. They have, however, seven to nine chambers in the last whorl and the German ones — six to seven.

Variability. — A considerable individual variability concerns the number of the chambers of the last whorl, convexity of the spiral side and depression of inter-chamber sutures.

Remarks. — Our specimens differ from the holotype only in a greater number of chambers in the last whorl, slightly more lobulate periphery of test and more strongly depressed sutures on the umbilical side.

Distribution. — Poland: Upper Albian, Cenomanian; North-western Germany: Upper Aptian, Albian, Cenomanian; France, England, Holland and Rumania: Albian.

Valvulineria lenticula (Reuss, 1845)
(Pl. VI, Fig. 6 *a*—*c*)

1845. *Rotalina lenticula* Reuss; A. E. Reuss, Die Versteinerungen boehmischen..., p. 35, Pl. 12, Fig. 17 a—c.
1862. *Rotalia lenticula* Reuss; A. E. Reuss, Die Foraminiferen des norddeutschen Hils..., pp. 82, 83, Pl. 10, Fig. a—c.

1925. *Anomalina lenticula* (Reuss); A. Franke, Die Foraminiferen der pommerschen..., p. 87, Pl. 7, Fig. 15 a—c.
1928. *Anomalina lenticula* (Reuss); A. Franke, Die Foraminiferen der Oberen..., p. 183, Pl. 16, Fig. 11 a—c.
1961. *Valvulineria lenticula* (Reuss); V. S. Akimez, Stratigrafia i foraminifery..., pp. 111, 112, Pl. 11, Fig. 5 a,b,w.
1966. *Valvulineria lenticula* (Reuss); J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., pp. 142, 143, Pl. 3, Fig. 1 a—c (*here additional synonymy included*).

Material. — A hundred and ninety well-preserved specimens.

Dimensions (in mm):

	IG 4309/70/F	IG 4310/70/F	IG 4107/70/F
Greater diameter . . .	0.270	0.252	0.234
Smaller diameter . . .	0.216	0.108	0.180
Thickness	0.126	0.126	0.198

Description. — Polish specimens correspond to Akimez's (1961) description of this species from U.S.S.R.

Variability. — In *V. lenticula*, there are the following variable characters: the convexity of the spiral side of test, the convexity of chambers on the umbilical side, the depression of sutures on the umbilical side, the size of a flap covering the umbilical depression and the number of chambers in the last whorl.

Remarks. — The species under study differs from *V. gracillima* Ten Dam in a more oval outline of test, lenticular — convex test, its narrower periphery, smaller convexity of the surface of chambers, smaller flap covering the umbilicus and more strongly elongate last chamber.

Distribution. — Poland: Upper Albian, Cenomanian; Turonian; Northwestern Germany: Turonian and Coniacian; U.S.S.R.: Cenomanian through Maestrichtian.

Superfamily **Globigerinacea** Carpenter & Parker & Jones, 1862
Family **Heterohelicidae** Cushman, 1927
Genus *Guembelitria* Cushman, 1933
Guembelitria cenomana (Keller, 1935)

(Pl. V, Fig. 4)

1935. *Guembelitria cenomana* Keller; B. M. Keller, Mikrofauna verhnego mela..., p. 547, Pl. 2, Figs. 13, 14.
1959. *Guembelitria cenomana* (Keller); N. I. Maslakova, Atlas verchnemelovoj fauny..., p. 118, Pl. 15, Fig. 6.
1961. *Guembelitria cenomana* (Keller); O. S. Lipnik, Foraminifery i stratigrafia..., p. 42, Pl. 2, Fig. 2 a,b.
1961. *Guembelitria cenomana* (Keller); V. S. Akimez, Stratigrafia i foraminifery..., pp. 199, 200, Pl. 19, Fig. 17.
1963. *Guembelitria cenomana* (Keller); O. K. Kaptarenko-Tshernousova *et al.*, Atlas charakternych foraminifer..., p. 114, Pl. 15, Fig. 6 a,b.

Material. — Eighty well-preserved specimens.

Dimensions (in mm):

	IG 4311/70/F	IG 4109/70/F	IG 4312/70/F
Length . .	0.198	0.144	0.126
Width . .	0.126	0.108	0.108

Description. — Polish specimens correspond to the greatest extent to the description of the holotype.

Variability. — It is manifested in a varying degree of the increase in their chambers in the process of the growth of test and in the changes in the size of the last chambers.

Remarks. — Polish specimens are, in all their characters, in conformity with the holotype. *G. cenomana* (Keller) must probably include *G. brevis* Tairov (Tairov, 1961, Pl. XXIV, Fig. 2 *a,b,w*), illustrated by its author but not described which makes its identification difficult. *G. cenomana* (Keller) is most similar to *G. harrisi* Tappan from the middle horizon of the Grayson Formation of Northern Texas, which differs from Keller's species in a sudden increase in the size of chambers in the process of growth of test and in a different size of test.

Distribution. — Poland and U.S.S.R.: Upper Albian, Cenomanian.

Subfamily **Heterohelicinae** Cushman, 1927

Genus *Heterohelix* Ehrenberg, 1843

Type species: *Spiroplecta americana* Ehrenberg, 1843

The genus *Guembelina* Egger, 1889 is considered by Montanaro-Gallitelli (1957) as a synonym of *Heterohelix* Ehrenberg. In a sense, so far generally accepted, *Heterohelix* may include either completely biserial specimens or those with a coiled initial part of test. *H. washitensis* (Tappan), accepted as an starting form, is the oldest species of the genus under study.

Heterohelix washitensis (Tappan, 1940)

(Pl. V, Fig. 3 *a,b*)

1940. *Guembelitria washitensis* Tappan; H. Tappan, Foraminifera from the Grayson.... p. 115, Pl. 19, Fig. 1 a,b.

Material. — Seventy well-preserved specimens.

Dimensions (in mm):

	IG 4313/70/F	IG 4110/70/F	IG 4314/70/F
Length . .	0.198	0.180	0.144
Width . .	0.095	0.095	0.072
Thickness . .	0.054	0.072	0.072

Description. — Test very small, biserial, gradually and only slightly extending upwards, composed of six to seven pairs of swollen chambers, almost quadrangular in outline and closely adhering to each other. Inter-chamber sutures distinct, depressed, subhorizontal, in some of the specimens of the older part of test somewhat oblique. Test strongly lobulate in outline, periphery widely rounded, surface smooth, lustrous, covered with very fine pores. Aperture semilunar, situated at the base of apertural surface.

Variability. — A small individual variability is manifested only in a varying number of chamber.

Remarks. — Polish specimens are, in all their characters, in conformity with the holotype. This species is most similar to *Guembelina globulosa* (Ehrenberg) and *G. moremani* Cushman. It differs from the former in smaller dimensions, smaller thickness of test, gradual and slight extension of test in the process of growth and, from the latter, in the chambers closely adhering to each other subhorizontal sutures, lower number of chambers and less lobulate peripheries of test. The presence of the planispiral part has not so far been confirmed in this species. The Polish populations studied contain biserial specimens only.

Distribution. — Poland: Upper Albian and sporadically, Cenomanian; U.S.A. (Texas): Albian.

Genus *Bifarina* Parker & Jones, 1872
Bifarina calcarata (Berthelin, 1880)
(Pl. V, Fig. 7)

1880. *Bigenerina calcarata* Berthelin; M. Berthelin, Mémoire sur les Foraminifères..., p. 27, Pl. 1, Fig. 14 (non 15 a,b, 16); Pl. 2, Fig. 2.
1891/98. *Sagrina calcarata* Berthelin; F. Chapman, The Foraminifera of the Gault..., p. 15, Pl. 2, Fig. 14 a,b.
1965. *Bifarina calcarata* (Berthelin); T. Neagu, Albian Foraminifera of the Rumanian..., p. 29, Pl. 7, Figs. 11, 12 (*here additional synonymy included*).

Material. — Twenty-five well-preserved specimens.

Dimensions (in mm):

	IG 4315/70/F	IG 4111/70/F	IG 4316/70/F
Length . .	0.468	0.396	0.360
Width . .	0.108	0.108	0.108

Description. — Test elongate, gradually and only slightly extending upwards, in the initial part bi-, in the final uniserial. The biserial part short (one-fifth or one-sixth of the length of test), mostly composed of two pairs of chambers, triangular or trapezoidal in outline, slightly bilaterally flattened and arranged at an angle of about 30° to the vertical axis of test. Outer margin of test slightly deflected and, in many specimens terminating in a thin, elongate spine. Inter-chamber sutures are, in this

part of test, strongly depressed and oblique. The initial chamber round or elongate terminating in a sharp spine. The uniserial part composed of four to five hemispherical chambers superposed on each other along the vertical axis of test like caps. The lower part of each chamber protrudes from the preceding one and is ornamented by very fine spines or narrow, hardly visible lists, or tubercles. Aperture round, surrounded by an upturned lip, situated on top a domelike, arched apertural surface.

Variability. — A small individual variability is expressed by a varying number of chambers in both the bi- and uniserial part and in an arcuate bend of some of the tests.

Remarks. — Polish specimens differ from those from the Albian of Montcley in the presence of a round aperture and lack of sutural ornamentation in the biserial portion of test.

Distribution. — Poland: Upper Albian and lower beds of Cenomanian; France, England and Rumania: Albian.

Family **Planomalinidae** Bolli & Loeblich & Tappan, 1957
Genus *Globigerinelloides* Cushman & Ten Dam, 1948
Globigerinelloides bentonensis (Morrow, 1934)
(Pl. VI, Fig. 7 *a—c*)

1934. *Anomalina bentonensis* Morrow; A. L. Morrow; Journ. Paleont., vol. 8, No. 2, p. 201, Pl. 30, Fig. 4 a,b (fide B. F. Ellis & A. Messina, Cat. of Foram.).
1964. *Globigerinelloides bentonensis* (Morrow); R. Todd & D. Low, Cenomanian (Cretaceous)..., pp. 400, 401, Pl. 1, Figs. 3 a—c, 4 a—c.
1965. *Globigerinelloides bentonensis* (Morrow); L. D. Eicher, Foraminifera and biostratigraphy..., p. 904, Pl. 106, Fig. 10 (*here additional synonymy included*).

Material. — Eighty well-preserved specimens.

Dimensions (in mm):

	IG 4112/70/F	IG 4317/70/F	IG 4318/70/F
Length . .	0.342	0.270	0.250
Thickness . .	0.180	0.120	0.120

Description. — Polish specimens correspond to the greatest extent to Loeblich & Tappan's (1961) description, except for their not having spines on the surface of chambers.

Variability. — A small individual variability concerns the size and shape of tests, number of chambers in the last whorl (seven to eight), shape of sutures and number of visible relict apertures.

Remarks. — *G. bentonensis* (Morrow) is most similar to *G. carsey* (Bolli, Loeblich & Tappan). The latter differs from the species under study in a greater evoluteness, more uncovered umbilicus on both sides of test and an average number of nine to ten (and not seven) chambers in the last whorl. According to Bandy (1967), *G. bentonensis* (Morrow) was evolved

from *G. escheri* (Kaufmann) by developing a more involute test, increasing the diameter of test and developing chambers which closely adhere to each other.

Distribution. — Poland: Upper Albian; North America and North Africa: Cenomanian.

Family **Schackoinidae** Pokorny, 1958
Genus *Schackoina* Thalmann, 1932
Schackoina cenomana cenomana (Schacko, 1897)
(Pl. VI, Fig. 1)

1897. *Siderolina cenomana* Schacko; G. Schacko, Ver. Freunde Naturg. Mecklenburg, Archiv. Jahr. 50, p. 116, Figs. 3—5 (fide Ellis & Messina Cat. of Foram).
1930. *Hantkenina cenomana* (Schacko); J. A. Cushman & R. T. Wickenden, The development of Hantkenina..., p. 40, Pl. 6, Figs. 1—3.
1954. *Schackoina sp.* grupe *cenomana* (Schacko); G. Auroze & J. Klasz, Sur la présence de Schackoines..., Pl. 6 a.
1959. *Schackoina cenomana* (Schacko); N. I. Maslakova, in M. M. Moskvin, Atlas verchnemelovoj fauny..., pp. 107, 108, Pl. 10, Fig. 2.
1966. *Schackoina cenomana* (Schacko); A. W. Marianos & R. P. Zingula, Cretaceous planktonic foraminifers..., p. 334, Pl. 37, Fig. 2 a,c.
1966. *Schackoina cenomana cenomana* (Schacko); T. Neagu, Schackoina from the Cenomanian..., pp. 365, 366, Pl. 1, Figs. 1—2, 9—17 (*here additional synonymy included*).
1967. *Schackoina cenomana cenomana* (Schacko); O. L. Bandy, Cretaceous planktonic foraminiferal..., p. 15, Text-fig. 6.
1969. *Schackoina cenomana* (Schacko); R. G. Douglas, Upper Cretaceous planktonic..., pp. 162, 163, Pl. 6, Fig. 5.
1969. *Schackoina cenomana* (Schacko, 1896); V. Scheibnerova, Middle and Upper Cretaceous..., p. 57, Pl. 7, Figs. 5—7 a—b.

Material. — Forty-five well preserved specimens.

Dimensions (in mm):

	IG 4319/70/F	IG 4320/70/F	IG 4321/70/F
Greater diameter	0.234	0.216	0.144
Smaller diameter (without tubospines)	0.162	0.180	0.144

Description. — Test subplanispiral, composed of two whorls, covered with fine pores giving it a rough look. Chambers of the first whorl invisible. The outer whorl composed of four (most frequently) to five, radially arranged chambers. The older three chambers of the outer whorl are bulbous, the last one bottle-shaped. A trace of a broken-off tubospine is visible on each chamber. Sutures rectilinear, radial, depressed. Aperture interomarginal, extraumbilical, with a narrow lip.

Variability. — The individual variability is mostly expressed by the shape of the youngest chamber, which may be either strongly elongated and very narrow, or elongated but fairly thick.

Remarks. — Specimens from Poland differ from the holotype in a sudden increase in the size of chambers of the last whorl and in an elongate last chamber terminating in a tubospine. In Schacko's (1897) specimens, the last chamber is shaped like an irregular bulb and devoid of a tubospine. Bolli Loeblich & Tappan (1957) and Loeblich & Tappan (1961) maintain that the tubospine does occur on the last chamber of most German specimens. Loeblich & Tappan (1961) consider *S. gandolfi* Reichel and *Hastigerinoides rohri* Bronnimann as younger synonyms of *S. cenomana*. Not all of the later authors, however, share this view.

Distribution. — Poland: boundary beds between Upper Albian and Cenomanian, Cenomanian. Lower Turonian; Germany: Cenomanian; France: ? Cenomanian; Austria (the Alps): Cenomanian; Czechoslovakia (the Carpathians): Cenomanian, Lower beds of Turonian; Rumania (the Carpathians): Cenomanian; U.S.S.R. (Caucasus, Crimea): Cenomanian: U.S.A. (Texas, Kansas, California): Cenomanian through Campanian.

Schackoina cenomana bicornis Reichel, 1947
(Pl. VI, Fig. 2)

1947. *Schackoina cenomana bicornis* Reichel; M. Reichel, Les Hantkéninidés de la Scaglia..., pp. 401, 402, Text-fig. 4 a—g; p. 396, Text-fig. 6 (4); p. 396, Text-fig. 7 (4); p. 398, Text-fig. 8 (b); p. 399, Text-fig. 9; p. 401, Text-fig. 10 (6, 8); p. 403.

1962. *Schackoina cenomana bicornis* Reichel; O. Samuel, Mikrobiostratigrafické pomery kriedovych..., pp. 181, 183, Pl. 8, Figs. 5, 6.

1966. *Schackoina multispinata bicornis* Reichel; T. Neagu, Schackoina from the Cenomanian..., pp. 366, 368, Pl. 1, Figs. 5—8; Pl. 2, Figs. 3—22 (*here additional synonymy included*).

Material. — Forty-two well-preserved specimens.

Dimensions (in mm):

	IG 4114/70/F	IG 4322/70/F	IG 4323/70/F
Greater diameter	0.216	0.180	0.162
Smaller diameter (without tubospines)	0.180	0.144	0.144

Variability. — It is manifested only in a more or less distinct division of the last chamber into two bulbous lobes.

Remarks. — *S. cenomana bicornis* Reichel differs from the nominal species only in the shape of the final chamber, consisting as if of two lobes forming two bulbs and provided with tubospines. Reichel's subspecies is included by Loeblich & Tappan (1961) in synonymy of the species *S. multispinata* (Cushman & Wickenden) since it has more than one spine on the chamber. As Reichel's subspecies radically differs from *S. multispinata* in the presence, in adult individuals, of four instead of three chambers in the last whorl and in having only two tubespines on the last cham-

ber instead of two to three or sometimes even on the last but one chamber, Loeblich and Tappans's view is untenable. Reichel supposes that specimens of the "*bicornis*" type might be present in the material from Moltzow, Germany and that they might escape Schacko's attention. Loeblich & Tappan (1961), who studied the material from Germany, do not mention any specimens of the "*bicornis*" type and they assign to the typical *S. cenomana* (Schacko) only the specimens which have merely one tubospine on each of the four chambers of the last whorl.

Distribution. — Poland: boundary beds between Upper Albian and Cenomanian, Cenomanian, Lower Turonian; Switzerland and Italy: Cenomanian; France: Cenomanian, Turonian; Rumania (The Carpathians) and Czechoslovakia (the Carpathians): Cenomanian.

Schackoina moliniensis Reichel, 1947

(Pl. VI, Fig. 3)

1947. *Schackoina moliniensis* Reichel; M. Reichel, Les Hantkéninidés de la Scaglia..., pp. 402, 404, Text-fig. 5; p. 396, Text-fig. 6/5; p. 398, Text-fig. 7/5; p. 398, Text-fig. 8 c; p. 399, Text-fig. 10/13; p. 403, Pl. 8, Fig. 2.

1959. *Schackoina bicornis* Reichel; D. M. Rauser-Tschernousova et al.; Osnovy paleontologii, Text-fig. 675 a,b, 300.

1962. *Schackoina moliniensis* Reichel; O. Samuel, Mikrobiostriatigrafiské pomery kriedovych..., p. 183, Pl. 8, Figs. 7, 8.

Material. — Fifty well-preserved specimens.

Dimensions (in mm):

	IG 4115/70/F	IG 4324/70/F	IG 4325/70/F
Greater diameter	0.252	0.234	0.180
Smaller diameter (without tubospines)	0.216	0.198	0.126

Description. — Polish specimens correspond to the greatest extent to the description of the holotype (Reichel, 1947).

Variability. — It is manifested mostly in a varying degree of the convexity of lobes on the last two chambers.

Remarks. — The species here discussed is most similar to *S. cenomana bicornis* Reichel, from which it differs in a division of two chambers and not one — of the last whorl into two bulbous lobes. Polish specimens are, in all their characters, in conformity with the holotype. They differ from *S. multispinata* (Cushman & Wickenden) in a greater number of chambers in the last whorl (four and not three) and a lower number of tubospines on the last chambers (in all cases two and not three to five).

Distribution. — Poland: boundary layers between Upper Albian and Cenomanian, Cenomanian, Lower Turonian; Switzerland, Czechoslovakia (the Carpathians) and U.S.S.R. (Caucasus): Cenomanian.

Family **Rotaliporidae** Sigal, 1958
Subfamily **Hedbergellinae** Loeblich & Tappan, 1961
Genus *Hedbergella* Brönnimann & Brown, 1958
Hedbergella brittonensis Loeblich & Tappan, 1961
(Pl. VII, Figs. 1 *a—c*, 2 *a—c*)

1961. *Hedbergella brittonensis* Loeblich & Tappan; A. R. Loeblich & H. Tappan, Cretaceous planktonic..., pp. 274, 275, Pl. 4, Figs. 1—8 (*here additional synonymy included*).

Material. — More than 300 well-preserved specimens.

Dimensions (in mm):

	IG 4326/70/F	IG 4327/70/F	IG 4328/70/F
Diameter . .	0.486	0.430	0.360
Thickness . .	0.378	0.250	0.288

Description. — Test hemispherical, with an elevated spiral and flat umbilical side, composed of two and a half to three clearly visible whorls, round and strongly lobulate in outline. Its surface covered with many, closely spaced, thick spines. Sutures on both sides depressed, radial. Spiral side hemispherical, with all whorls visible. Whorls give the impression as if they were detaching from each other, which is caused by their situation high up one over another and their being separated by a strongly depressed spiral suture. In all whorls chambers are spherical, in the oldest two of them considerably increasing their dimensions and in the last one being of equal size. Each whorl is composed of five chambers. Ventral side flat, with a deep umbilicus, occupying aproximately a quarter of its area and surrounded by spherical or triangular, convex chambers of the last whorl. Aperture low, arcuate, interiomarginal, extraumbilical and having a thin lip.

Variability. — The following characters are subject to variability: the convexity of the spiral part, the degree of mutual adherence of the chambers of the last whorl, the outline of chambers on the ventral side, the dimensions of test, the number of chambers in the last whorl and the ornamentation of the surface of test (the surface of the youngest two chambers in the last whorl may be smooth).

Remarks. — In their general appearance of the test, this species resembles *Globigerina paradubia* Sigal (Sigal, 1952, p. 28, Fig. 28). It may be a younger synonym of *G. paradubia*, which seems to be indicated by an almost identical stratigraphic position of the two species. The identification is, however, difficult since no detailed description of his species has been given by Sigal. In the outline of its test, number of whorls and chambers in whorls it also resembles *G. kelleri*, described by Subbotina (1953, p. 54, Pl. 1, Fig. 16 *a,b,w*). Specimens described as *G. portsdownensis* Williams & Mitchell from the Cenomanian of Northern Caucasia and Crimea (Maslako-

va, 1959, pp. 105, 106, Pl. X, Fig. 6 *a,b,w*) and from the Cenomanian of Germany (Loeblich & Tappan, 1961) are also similar to *H. brittonensis*. The German specimens differ, however, in a less convex spiral side and somewhat less spherical chambers of the last whorl. Bandy (1967), considers *H. brittonensis* as a younger synonym of *G. portsdownensis* William & Mitchell, 1948. In the present writer's opinion, the representatives of the two species, differring in the number of whorls and chambers and position of the last chamber, cannot be considered as conspecific as long as the range of the individual variability in the population of *G. portsdownensis* from the type locality is not sufficiently studied. In some of its characters *H. brittonensis* resembles *H. trochoidea* (Gandolfi), from which it differs in a lower number of chambers in the last whorl and in a more convex spiral side of test. According to Pazdro (Birkenmajer & Pazdro, 1963) individuals, ranging from almost planispirally coiled to trochospirally coiled ones are within limits of variability of *H. trochoidea* (Gandolfi). Pazdro cites various authors' views on the range of *H. trochoidea* which was not precisely determined by Gandolfi.

Distribution. — Poland: Upper Albian, Cenomanian, Turonian; Germany: ?Cenomanian; U.S.A. (Texas, Kansas, Georgia): Cenomanian, Lower Turonian.

Hedbergella hoterivica (Subbotina, 1953)

(Pl. V, Figs. 9 *a—c*, 10 *a—c*, 11 *a—c*)

1953. *Globigerina hoterivica* Subbotina; N. N. Subbotina, Globigerinidy, Hantkeninidy..., pp. 50, 51, Pl. 1, Figs. 1 a,b,w, 2 a,b,w, 3 a,b,w, 4 a,b,w.

1966. *Hedbergella hoterivica* (Subbotina); J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., pp. 168, 169, Pl. 8, Fig. 8, Fig. 7 a—c.

Material. — Sixty well-preserved specimens.

Dimensions (in mm):

	IG 4329/70/F	IG 4119/70/F	IG 4330/70/F
Diameter . .	0.252	0.180	0.162
Thickness . .	0.192	0.126	0.126

Description. — Test with a high axis of coiling, strongly convex spiral side and composed of $2^1/_2$ to 3 whorl. The wall of test covered with thin, short spines. Test irregularly oval or round and lobulate in outline. In the oldest whorl, chambers disproportionally small as composed with those of younger whorls. In the second whorl, chambers convex and projecting over those of the preceding whorl. Their size suddenly increases in the process of growth. The last whorl is composed of four to six strongly convex chambers trapezoidal in outline, deflecting and separated from each other by depressed, radial sutures. The youngest chamber of the last whorl is strongly inclined on the ventral side of test. A very narrow umbilical de-

pression, surrounded by the chambers of the last whorl, which are triangular in outline and have strongly convex surfaces, is visible on the ventral side. The last chamber is the most convex, very frequently rectangular in outline and with its inner margin almost completely covering the umbilical depression. Aperture low, interiomarginal, extraumbilical, umbilical and with a narrow lip.

Variability. — It is manifested in a varying degree of the convexity of the spiral part, shape of inter-chamber sutures in older whorls, outline of test and shape of the last chamber on the ventral side.

Remarks. — Polish specimens differ from the holotype in, among other things, a more orderly arrangement of chambers on the spiral side low aperture and less close mutual adherence of the chambers of the last whorl. Mutations having six chambers in the last whorl (Pl. V, Fig. 10 *a*—*c*) are very rare. The specimens described are also in a nearly complete conformity with those of *H. hoterivica* (Subbotina) which occur in the Hauterivan and Aptian beds of Western Carpathians.

Distribution. — Poland: Upper Albian, lower beds of Cenomanian; Czechoslovakia (the Carpathians): Upper Hauterivian through Upper Aptian; U.S.S.R. (Caucasus): Hauterivian.

Hedbergella infracretacea (Glaessner, 1937)
(Pl. VI, Fig. 8 *a*—*c*)

1937. *Globigerina infracretacea* Glaessner; M. F. Glaessner, Plankton Foraminiferen..., p. 28, Text-fig. 1 (*here additional synonymy included*).
1948. *Globigerina infracretacea* Glaessner; A. Ten Dam, Foraminifera from the Middle Neocomian..., pp. 188, 189.
1951. *Globigerina infracretacea* Glaessner; R. Noth, Foraminiferen aus Unter..., pp. 73, 74, Pl. 7, Fig. 5 a,b.
1959. *Globigerina infracretacea* Glaessner; N. I. Maslakova, in M. M. Moskvin, Atlas verchnemelovoj fauny..., p. 105, Pl. 10, Fig. 3 a,b,w.
1960. *Globigerina infracretacea* Glaessner; M. Moullade, Sur quelques Foraminifères du Crétacé..., p. 136, Pl. 2, Figs. 18—20.
1960. *Globigerina infracretacea trochoidea* Moullade; M. Moullade, *Ibid.*, p. 136, Pl. 2, Figs. 21, 23—25.
1961. *Globigerina infracretacea* Glaessner; V. Scheibnerova, Mikrofauna srednej a vrchnej kriedy..., pp. 52, 53, Pl. 7, Fig. 2 a—c.
1962. *Globigerina infracretacea* Glaessner H. Bartenstein & F. Bettenstaedt, Leitfossilien..., pp. 280, 281, Pl. 39, Fig. 15 a,b.
1962. *Hedbergella infracretacea* (Glaessner); H. Bartenstein, Taxionomische Revision und Nomenklator..., pp. 129, 130; pro Globigerina D 11 (*here additional synonymy included*).
1963. *Globigerina infracretacea* Glaessner; O. K. Kaptarenko-Tshernousova et al., Atlas charakternych foraminifer..., p. 103, Pl. 13, Fig. 7 a,b.
1963. *Globigerina infracretacea* Glaessner; L. V. Alekseeva, in. L. V. Alekseeva & M. K. Rodionova, Foraminifery nižnego mela..., p. 44, Pl. 8, Fig. 7 a,b,w. (*here additional synonymy included*).

1965. *Globigerina infracretacea* Glaessner; T. Neagu, Albian Foraminifera of the Rumanian..., p. 36, Pl. 10, Figs. 10—12 (*here additional synonymy included*).
1966. *Hedbergella delrioensis* (Carsey); A. F. Butt, Foraminifera of the type..., pp. 173, 174, Pl. 2, Figs. 1—8.
1966. *Hedbergella infracretacea* (Glaessner); J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., pp. 169, 170, Pl. 8, Fig. 8 a—c.

Material. — About one thousand well-preserved specimens.

Dimensions (in mm):

	IG 4121/70/F	IG 4331/70/F	IG 4332/70/F
Diameter . .	0.414	0.378	0.252
Thickness . .	0.180	0.144	0.162

Description. — Polish specimens correspond to the greatest extent to Subbotina's (1953) description. The surface of their test is however, covered with thin, closely spaced spines, except for the surfaces of the youngest chambers of the last whorl.

Variability. — It is expressed in the manner of arranging whorls degree of the inclination of the last chamber on the ventral side, shape of the last chamber, outline of test and of the ornamentation of test by fine spines which may cover either the entire test, or only the surface of older whorls, or also the surface of the last whorl except for the youngest two chambers. Specimens devoid of ornamentation may be also met with.

Remarks. — Specimens from Poland are in an almost complete conformity with the holotype. Bartenstein (1955, p. 346) believes that *H. infracretacea* (Glaessner) and *H. delrioensis* (Carsey) are synonyms. As emphasized by Loeblich & Tappan (1961, p. 275), detailed studies of the type material should, however, be conducted prior to uniting the two species.

Distribution. — Poland: Upper Albian, Cenomanian, Lower Turonian; North-western Germany: Middle Barremian through Cenomanian; France: Hauterivian through Turonian; England, the Netherlands, Austria, Rumania: Albian; Czechoslovakia (the Carpathians): Upper Barremian through Lower Albian; U.S.S.R.: Barremian through Cenomanian.

Hedbergella planispira (Tappan, 1940)

(Pl. V, Fig. 8 *a—c*)

1940. *Globigerina planispira* Tappan; H. Tappan, Foraminifera from the Grayson..., p. 122, Pl. 19, Fig. 12 a—c.
1959. *Globigerina globigerinelloides* Subbotina; N. I. Maslakova, in M. M. Moskvin, Atlas verchnemelovoj fauny..., p. 105, Pl. 10, Fig. 1 a,b,w.
1961. *Hedbergella planispira* (Tappan); A. R. Loeblich & H. Tappan, Cretaceous planktonic..., pp. 276, 277, Pl. 5, Figs. 4—11 (*here additional synonymy included*).
1963. *Globigerina globigerinelloides* Subbotina; O. K. Kaptarenko-Tschernousova et al., Atlas charakternych foraminifer..., pp. 103, 104, Pl. 13, Fig. 8 a,b.

1963. *Globigerina globigerinelloides* Subbotina; L. V. Alekseeva, in L. V. Alekseeva & M. K. Rodionova, Foraminifery niznego mela..., pp. 44, 45, Pl. 8, Fig. 8 a,b,w. (*here additional synonymy included*).
1964. *Hedbergella planispira* (Tappan); R. Todd & D. Low, Cenomanian (Cretaceous)..., p. 402.
1965. *Hedbergella planispira* (Tappan); D. E. Eicher, Foraminifera and biostratigraphy..., p. 905, Pl. 106, Fig. 1 a—c.
1965. *Hedbergella planispira* (Tappan); T. Neagu, Albian Foraminifera of the Rumanian..., p. 36, Pl. 10, Figs. 1—4.
1965. *Hedbergella planispira* (Tappan); H. Bartenstein, Taxionomische Revision und Nomenklator... p. 346.
1966. *Hedbergella planispira* (Tappan); A. W. Marianos & R. P. Zingula, Cretaceous planktonic foraminifers..., p. 335, Pl. 37, Fig. 6 a—c.
1966. *Hedbergella planispira* (Tappan); J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., pp. 169, 170, Pl. 8, Fig. 10 a—c.
1969. *Hedbergella planispira* (Tappan); R. Douglas, Upper Cretaceous planktonic foraminifera..., p. 168, Pl. 5, Fig. 1.

Material. — More than two thousand well-preserved specimens.

Dimensions (in mm):

	IG 4333/70/F	IG 4122/70/F	IG 4334/70/F
Diameter . .	0.210	0.198	0.180
Thickness . .	0.070	0.070	0.070

Description. — Polish specimens are to the greatest extent in conformity with Loeblich & Tappan's (1961) description.

Variability. — A small individual variability concerns the convexity of the spiral side, number of chambers in the last whorl and presence of spines on the surface of test.

Remarks. — Specimens from Poland are in conformity with the holotype. Specimens of this species from the U.S.S.R. are described under the name of *Globigerina globigerinellinoides* Subbotina. On the basis of the structure of aperture Bolli, Loeblich & Tappan (1957) assigned *H. planispira* to the genus *Praeglobotruncana*. Later, Loeblich & Tappan (1961) acknowledged, however, that this species, having no trace of a keel on its chambers, a feature characteristic of the genus *Praeglobotruncana*, belonged to the genus *Hedbergella*. Bartenstein (1965) considers *Globigerina portsdownensis* Williams & Mitchell (1948) as a younger synonym of *H. planispira*, but it differs from *H. planispira* in a higher axis of test, lower number of chambers in the last whorl, less close adherence of the chambers of the last whorl and in larger dimensions.

Distribution. — Poland: Upper Albian, Cenomanian; North-western Germany: Middle Albian through Cenomanian; Rumania and Czechoslovakia (the Carpathians): Albian, Cenomanian; U.S.S.R.: Upper Albian, Cenomanian; U.S.A.: Upper Albian through the lowermost beds of Campanian.

Genus *Clavihedbergella* Banner & Blow, 1959
Clavihedbergella simplicissima (Magné & Sigal, 1953)
(Pl. VII, Fig. 3 *a*—*c*)

1953. *Hastigerinella simplicissima* Magne & Sigal; G. Cheylan, J. Magné, J. Sigal & N. Grekoff, Résultats géologiques et micropaléontologiques..., pp. 487, 488, Pl. 14, Fig. 11 a—c.
1964. *Clavihedbergella simplex* (Morrow); R. Todd & D. Low, Cenomanian (Cretaceous..., pp. 403, 404, Pl. 1, Fig. 1 a—c.
1966. *Clavihedbergella amabilis* (Loeblich & Tappan); J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., p. 173, Pl. 10, Fig. 3 a—c.
1966. *Clavihedbergella simplicissima* (Magne & Sigal); M. Caron, Globotruncanidae du Crétacé..., p. 71, Pl. 6, Fig. 5 a—c. (*here additional synonymy included*).

Material. — Fifty well-preserved specimens.

Dimensions (in mm):

	IG 4123/70/F	IG 4335/70/F	IG 4336/70/F
Diameter . .	0.486	0.378	0.306
Thickness . .	0.162	0.090	0.090

Description. — Polish specimens are in an almost complete conformity with Magné & Sigal's (1953) description.

Variability. — It concerns the size of test, number of chambers in the last whorl and their degree of deflecting from each other. Also variable is the degree of a radial stretching of the chambers of the last whorl.

Remarks. — Specimens from Poland differ from the holotype only in the occurrence of six chambers in the last whorl. Caron (1966) believes that some of the specimens, assigned by Loeblich & Tappan (1961, Pl. 3, Figs. 2, 3, 5 *a*—*c*) to *Hedbergella amabilis*, belong to *H. infracretacea* (Glaessner). In the present writer's opinion, the, last-named species is similar to *C. simplicissima*, from which it differs in a stronger mutual deflection of the chambers of the last whorl and in their more elongate outline. Loeblich & Tappan's, specimens referred to above fit within the range of the variability of the species *C. simplicissima* (Magné & Sigal), which may be placed on the boundary of the two genera, that is, *Hedbergella* and *Clavihedbergella*. Undoubtedly, *C. simplicissima* is, however, most closely related to, on the one hand, *H. infracretacea* (Glaessner), from which it probably descends and, on the other, *C. simplex* (Morrow). Douglas (1969) distinguishes *H. amabilis* Loeblich & Tappan and *C. simplex* (Morrow), considering *Hastingerinella simplicissima* as a younger synonym of the latter. The specimens he describes under the name of *H. amabilis* differ from those described under this name by Loeblich & Tappan (1961) in spherical chambers which are not stretched radially. The specimens described by Douglas are indubitable representatives of the genus *Hedbergella*, while those described by Loeblich and Tappan are marked by the characters of the genus *Clavihedbergella*. In regard to *C. simplex* (Morrow), this is a species which can-

not be considered as a synonym of *C. simplicissima*, since it differs from the latter in a radial stretching of all chambers of the last, whorl, larger mutual deflection of the chambers and their as if digitate shape.

Distribution. — Poland: Upper Albian through Lower Turonian; Switzerland and Czechoslovakia (the Carpathians): Cenomanian; U.S.A.: Cenomanian through Santonian; Tunisia: lower beds of Cenomanian.

Genus *Praeglobotruncana* Bermudez, 1952

Praeglobotruncana helvetica (Bolli, 1944)

Pl. VIII, Fig. 4 *a*—*c*)

1944. *Globotruncana helvetica* Bolli; H. Bolli, Zur Stratigraphie der Oberen Kreide..., pp. 226, 227, Text-fig. 1 (9—12), p. 234, Pl. 9, Figs. 6—8.
1954. *Globotruncana helvetica* Bolli; H. Hagn & W. Zeil, Globotruncanen aus dem Ober-Cenoman..., pp. 30, 31, Pl. 3, Fig. 1 a—c; Pl. 5, Figs. 5, 6.
1955. *Globotruncana helvetica* Bolli; E. Schijfsma, La position stratigraphique..., p. 324, Text-fig. 2.
1956. *Globotruncana helvetica* Bolli; M. Książkiewicz, Jura i kreda..., pp. 270, 271, Pl. 30, Fig. 17, Text-fig. 38, p. 270.
1956. *Globotruncana helvetica* Bolli; St. Alexandrowicz, Globotrunkany w turonie..., pp. 53, 54, Text-fig. 5, p. 54 (*here additional synonymy included*).
1957. *Helvetoglobotruncana helvetica* Bolli; Z. Reiss, The Bilamellidae, nov. superfam. and remarks..., pp. 137, 138.
1960. *Globotruncana helvetica* Bolli; E. F. Trujillo, Upper Cretaceous Foraminifera..., pp. 341, 342, Pl. 50, Fig. 2 a—c.
1962. *Globotruncana helvetica* Bolli; J. Sigal & M. Dardenne, Correlations dans la craie..., p. 221, Pl. 13, Fig. 5.
1965. *Globotruncana helvetica* Bolli; R. Lehmann, Résultats d'une étude des Globotruncanidés p. 623, 624, Pl. 2, Fig. 9 a—c.
1964. *Globotruncana helvetica* Bolli; I. Küpper, Mikropaläontologische Gliederung..., ..., p. 115, Text-fig. 1 (g,h).
1966. *Praeglobotruncana stephani* (Gandolfi); R. Douglas & W. V. Sliter, Regional distribution of some Cretaceous..., p. 107, Pl. 4, Fig. 1 a—c.
1966. *Praeglobotruncana? helvetica* (Bolli) M. Caron, Globotruncanidae du Crétacé..., p. 74, Pl. 3, Fig. 2 a—c.
1969. *Praeglobotruncana helvetica* (Bolli); R. Douglas, Upper Cretaceous planktonic..., pp. 169, 170, Pl. 4, Figs. 4—5.
1969. *Praeglobotruncana helvetica* (Bolli); V. Scheibnerová, Midle and Upper Cretaceous..., pp. 58, 59, Pl. 8, Fig. 2 a—c (*here additional synonymy included*).

Material. — More than two hundred well-preserved specimens.

Dimensions (in mm):

	IG 4337/70/F	IG 4338/70/F	IG 4339/70/F
Diameter . .	0.594	0.468	0.360
Thickness . .	0.144	0.252	0.180

Description. — Polish specimens correspond to the greatest extent to Bolli's (1957) description.

Variability. — A considerable individual variability concerns the convexity of chambers, shape of sutures in the last whorl on the spiral side and the development of keel.

Remarks. — The conformity of the specimens from Poland with Bolli's (1944) holotype, coming from the boundary of the Cenomanian and Turonian deposits of Eastern Switzerland seems to be beyond any doubt. *P. helvetica* (Bolli) probably also includes specimens, described by Trujillo (1960, p. 340, Pl. 49, Fig. 6 *a*—c) under the name of *Rugoglobigerina praehelvetica*, which seem to correspond completely to the specimens of *P. helvetica* with an only slightly outlined keel and not ornamented, radial sutures on the spiral side of test. Specimens with such characters are considered by Bolli (1957) as transitional to the rugoglobigerins. Reiss (1957) erected a new genus *Helvetoglobotruncana* with the type *Globotruncana helvetica* Bolli. Loeblich & Tappan (1964) acknowledged the genus *Helvetoglobotruncana* as a younger synonym of the genus *Globotruncana* Cushman. It is very difficult to decide to which of the known genera *P. helvetica* should be assigned as it has the characters of the genera *Praeglobotruncana, Globotruncana* and *Rugoglobigerina*. Douglas (1969) believes that, since the species *P. helvetica* has not accessory apertures and tegillae, it should be assigned to the genus *Praeglobotruncana*. Bandy (1967) maintains that it originates from the stock of *P. delrioensis* (Plummer) and that it was formed by the development of a flattened surface on the spiral side of test and a delicate keel surrounding the periphery of test on the spiral side.

Distribution. — Poland: Upper Cenomanian through the lowermost beds of the Upper Turonian; Switzerland: Turonian; Italy: Cenomanian, Turonian; France: Turonian; Austria: lower beds of Turonian; Czechoslovakia: the lowermost Cenomanian and Turonian; Algeria: Lower Turonian; Morocco and Trinidad (West Indies): Turonian; U.S.A.: Cenomanian.

Praeglobotruncana imbricata (Mornod, 1949)

(Pl. VIII, Figs. 2 *a*—*c*, 3 *a*—*c*)

1949. *Globotruncana imbricata* Mornod; L. Mornod, Les Globorotalidés du Crétacé..., pp. 589, 590, Text-fig. 5 (II a—c, III a—d); p. 581, Pl. 15, Figs. 21—34.

1954. *Globotruncana imbricata* Mornod; H. Hagn & W. Zeil, Globotruncanen aus dem Ober..., pp. 34, 35, Pl. 2, Fig. 6 a—c, Pl. 5, Figs. 9, 10.

1958. *Globotruncana imbricata* Mornod; M. Książkiewicz, On the Turonian..., Text-fig. 1 (16 a—c), p. 539.

1959. *Rotundina imbricata* (Mornod); N. I. Maslakova in M. M. Moskvin, Atlas verchnemelovoj fauny..., p. 112, Pl. 11, Fig. 2 a,b,w.

?1959. *Praeglobotruncana renzi* (Thalmann); J. Klaus, Le "Complexe schisteux intermédiaire"..., pp. 795, 796, Pl. 6, Fig. 4 a—c.

1969. *Globotruncana imbricata* Mornod; R. Douglas, Upper Cretaceous planktonic..., pp. 180, 181, Pl. 2, Figs. 4—7.

1969. *Praeglobotruncana imbricata* (Mornod. 1949); V. Scheibnerova, Middle and Upper Cretaceous..., pp. 59, 60, Pl. 8, Fig. 4 a—c, Pl. 9, Figs. 1—7 a—c (*here additional synonymy included*).

Material. — More than three hundred thirty well preserved specimens.

Dimensions (in mm):

	IG 4126/70/F	IG 4125/70/F	IG 4340/70/F
Diameter . .	0.594	0.468	0.360
Thickness . .	0.342	0.270	0.234

Description. — Polish specimens correspond well to Mornod's (1949) description of the holotype.

Variability. — A considerable individual variability is expressed in a varying degree of the convexity of the spiral side (from a strongly conical to nearly flat), a varying development of keels, which may be composed of beaded thickenings or listlike, a varying degree of the convexity of chambers on the umbilical side (subspherical to flattened), a varying number of chambers in the last whorl and in a varying degree of the ornamentation of test.

Remarks. — *P. imbricata* (Mornod) descends from *P. stephani* (Gandolfi), as has already been pointed out by Mornod (1949). Transitional forms, connecting the two species were also found in the Polish material under study. In the evolution of *P. imbricata* (Mornod) can be observed a trend to lower the axis of the coiling of test. As follows from the discussion, description and illustrations cited by Reichel (1949), specimens, described by him under the provisional name of *Globotruncana (Globotruncana)* sp. aff. *renzi* Thalmann & Gandolfi from the marls of the Lower Turonian of Algeria, are representatives of *P. imbricata* (Mornod). Likewise, this species must probably include the specimen described by Klaus (1959) as *P. renzi* (Thalmann).

Distribution. — Poland: Lower Turonian, lower beds of Upper Turonian; Austria: Lower Turonian; Switzerland. Cenomanian, Turonian, perhaps also Coniacian and Santonian; Czechoslovakia (the Carpathians): Upper Cenomanian, Lower Turonian; U.S.S.R. (Crimea): Turonian, Coniacian; U.S.A.: Turonian, Coniacian of California.

Praeglobotruncana oraviensis Scheibnerová, 1960

(Pl. VIII, Fig. 5 *a—c*)

1960. *Praeglobotruncana oraviensis* Scheibnerová; V. Scheibnerová, Poznáky k rodu Praeglobotruncana..., pp. 85, 86, Text-fig. 4 a—c, p. 87.

1961. *Praeglobotruncana oraviensis* Scheibnerová; V. Scheibnerová, Mikrofauna strednej a vrchnej kriedy..., pp. 61, 62, Pl. 10, Fig. 1 a,c.

1969. *Praeglobotruncana oraviensis* Scheibnerová, 1960; V. Scheibnerová, Middle and Upper Cretaceous..., p. 62, Pl. 8, Figs. 5—6 a—c. (*here additional synonymy included*).

Material. — Seventy well-preserved specimens.

Dimensions (in mm):

	IG 4341/70/F	IG 4127/70/F	IG 4342/70/F
Diameter . .	0.774	0.648	0.540
Thickness . .	0.450	0.342	0.270

Description. — Polish specimens correspond to the greatest extent to Scheibnerova's (1969) description, except for one of the chambers in the last whorl which in the specimens from Poland may be smaller than the remaining ones, which influences the outline of test.

Variability. — A very large individual variability concerns the convexity of the spiral and depression of the umbilical side, as well as the outline of test, which depends on the manner of growing and arrangement of the chambers of the last whorl.

Remarks. — In their principal characters Polish specimens are in conformity with the holotype. As a matter of fact, Scheibnerowá (1960) mentions a sudden increase in the size of chambers in the last whorl, which has not been observed in Polish specimens, but she fails to show this fact in her illustrations. Due to its convex spiral side, shape of chambers and presence, particularly on the umbilical side, of a delicate keel consisting of beaded swellings, this species is related to *P. stephani* (Gandolfi), from which it differs in the outline of test, greater number of chambers in the last whorl, more incized periphery of test, imbricate arrangement of the chambers of the last whorl and a strongly, radially stretched last chamber.

Distribution. — Poland: Lower Turonian; Czechoslovakia: Upper Cenomanian, Lower and Middle Turonian.

Praeglobotruncana stephani (Gandolfi, 1942)

(Pl. VIII, Fig. 1 *a*—*c*)

1942. *Globotruncana stephani* Gandolfi; R. Gandolfi, Ricerche micropaleontologische..., pp. 130—133, Pl. 3, Figs. 4, 5; Pl. 4, Figs. 36, 37, 41—45; Pl. 6, Figs. 4, 6; Pl. 9, Figs. 5, 8; Pl. 14, Fig. 2.

1948. *Globotruncana stephani* Gandolfi; M. B. Cita, Ricerche stratigrafische..., pp. 17, 18, Pl. 4, Fig. 6.

1956. *Marginotruncana turbinata* (Reichel); J. Hofker, Die Globotruncanen von N. W-Deutschland..., pp. 324, 325, Text-fig. 9 a—c, p. 324, 10, p. 325.

1958. *Globotruncana stephani var. stephani* Gandolfi; E. Witwicka, Stratygrafia mikropaleontologiczna..., pp. 209, 210, Pl. 14, Fig. 26 a—c.

1958. *Globotruncana stephani* Gandolfi; M. Książkiewicz, On the Turonian..., Text-fig. 1 (15 a,b), p. 539.

1960. *Praeglobotruncana stephani* (Gandolfi); J. Klaus, Le répartition stratigraphique..., pp. 302, 304, Text-fig. 1 e, p. 291.

1961. *Praeglobotruncana delriocensis turbinata* (Reichel); V. Scheibnerová, Mikrofauna strednej a vrchnej kriedy..., p. 60, Pl. 9, Fig. 3 a—c.

1961. *Praeglobotruncana stephani* (Gandolfi); A. R. Loeblich & H. Tappan, Cretace-

ous planktonic..., pp. 284, 286, 288, 290, Pl. 6, Figs. 1—8 (*here additional synonymy included*).

1961. *Praeglobotruncana stephani* (Gandolfi); M. Malapris & P. Rat, Données sur les Rosalines..., pp. 88—90, Text-fig. 4 a,b, Pl. 2, Figs. 1—3.

1962. *Globotruncana stephani* Gandolfi; H. Hiltermann & W. Koch, Leitfossilien..., p. 330, Pl. 47, Fig. 3 a—c, Tab. 19.

1963. *Praeglobotruncana stephani* (Gandolfi); N. V. Dabagjan, Nekotorye cenomanskije..., pp. 115—119, Pl. 1, Fig. 5 a,b,w. (*here additional synonymy included*).

1963. *Rotundina stephani* (Gandolfi); J. Salaj & O. Samuel, Mikrobiostratygrafia strednej a vrchnej kriedy..., pp. 103, 104, Pl. 6, Figs. 2 a—c, 3 a—c.

1964. *Globotruncana stephani stephani* Gandolfi; I. Küpper, Mikropaleontologische Gliederung, pp. 631, 632, Pl. 2, Fig. 5 a—c

1964. *Globotruncana stephani turbinata* Reichel; I. Küpper, *Ibid.*, pp. 632, 633, Pl. 2, Fig. 7 a—c.

1966. *Praeglobotruncana stephani* (Gandolfi); L. Eicher, Foraminifera from the Cretaceous..., p. 28, Pl. 6, Fig. 4 a—c.

1966. *Praeglobotruncana helvetica* (Bolli); R. Douglas & W. V. Sliter, Regional distribution of some Cretaceous..., pp. 105, 106, Pl. 5, Fig. 1 a—c.

1966. *Praeglobotruncana stephani* (Gandolfi); A. W. Marianos & R. P. Zingula, Cretaceous planktonic Foraminifers..., p. 337, Pl. 37, Fig. 10 a—c.

1966. *Praeglobotruncana stephani* (Gandolfi); A. A. Butt, Foraminifera of the type..., p. 176, Pl. 3, Fig. 5 a—c.

1966. *Praeglobotruncana marginaculeata* (Loeblich & Tappan); M. Caron, Globotruncanidae du Crétacé..., p. 73, Pl. 2, Fig. 2 a—c.

1966. *Praeglobotruncana stephani stephani* (Gandolfi); M. Caron, *Ibid.*, p. 73, Pl. 2, Fig. 3 a—c.

1967. *Praeglobotruncana stephani* (Gandolfi); P. Marks, Rotalipora et Globotruncana..., pp. 273, 274, Pl. 2, Figs. 4—12; Pl. 3, Figs. 1—6 (*here additional synonymy included*).

1969. *Praeglobotruncana stephani* (Gandolfi); R. Douglas, Upper Cretaceous planktonic..., p. 173, Pl. 2, Fig. 1 a—c.

Material. — Two hundred and fifty-eight well-preserved specimens.

Dimensions (in mm):

	IG 4343/70/F	IG 4344/70/F	IG 4345/70/F
Diameter . .	0.540	0.522	0.360
Thickness . .	0.360	0.234	0.252

Description. — Polish specimens correspond to the greatest extent to Loeblich & Tappan's (1961) description.

Variability. — A very large individual variability concerns the convexity of the spiral side of test, thickness of keel, number of chambers and their shape and manner of arranging in the last whorl. Specimens with a low axis of coiling and a strongly marked keel on the chambers of the last two whorls, as well as high and conical specimens, with a slightly marked keel, which occurs in the first two whorls only, are met with in the Polish material under study. Common are slightly convex specimens with an indistinctly outlined keel and strongly convex ones with a very well-developed keel even on the chambers of the last two whorls. In the last-named group, the keel on the chambers of the last whorl gives the

impression of a double one and extends to the inter-chamber sutures in the form of fairly thick rollers. The chambers of the last whorl may closely adhere to or overlap each other in an imbricate manner. Such specimens are very similar to *P. imbricata* (Mornod). The considerable variability of this widely distributed species causes many classification discrepancies which has already been noticed by Loeblich & Tappan (1961).

Distribution. — Poland: Cenomanian, Lower Turonian, lower beds of Upper Turonian; North-western Germany: Cenomanian, Lower Turonian; France: Cenomanian, Turonian; Switzerland: Cenomanian; Italy: Cenomanian, lower beds of Turonian; Austria: Upper Cenomanian, Lower Turonian; Rumania: Upper Albian, lower beds of Cenomanian; Czechoslovakia: Cenomanian, Turonian; U.S.S.R.: Upper Albian, Cenomanian; U.S.A.: Cenomanian, Turonian; Morocco: Cenomanian.

Subfamily **Rotaliporinae** Sigal, 1958

Genus *Rotalipora* Brotzen, 1942

Rotalipora appenninica (Renz, 1936)

(Pl. IX, Figs. 1 *a*—*c*, 2 *a*—*c*, 3 *a*—*c*)

1936. *Globotruncana appenninica* Renz; O. Renz, Stratigraphische und micropalaeontologische..., pp. 20, 135, Text-fig. 2, p. 14, Text-fig. 7 a; p. 71, Pl. 6, Figs. 2—8; Pl. 7, Fig. 1; Pl. 8, fig. 4.

1958. *Rotalipora appenninica* (Renz); M. Książkiewicz, On the Turonian..., Text-fig. 1 a—c, p. 539.

1959. *Rotalipora (Thalmanninella) appenninica appenninica* (Renz); J. Klaus, Le "Complexe schisteux intermédiaire"..., pp. 808—810, Pl. 3, Fig. 3 a—c.

1961. *Rotalipora appenninica* (Renz); A. R. Loeblich & H. Tappan, Cretaceous planktonic..., pp. 296, 297, Pl. 7, Figs. 11 a—c, 12 a—c (*here additional synonymy included*).

1961. *Rotalipora appennina var. appenninca* (Renz); V. Vassilenko, Foraminifery verchnego mela..., p. 149, Pl. 32, Fig. 8 a,b,w.

1963. *Rotalipora appenninica* (Renz); N. V. Dabagjan, Nekotoryje cenomanskie..., pp. 104—107, Pl. 1, Fig. 1 a,b,w (*here additional synonymy included*).

1966. *Rotalipora appenninica* (Renz); A. W. Marianos & R. P. Zingula, Cretaceous planktonic foraminifers..., p. 338, Pl. 38, Fig. 1 a—c.

1966. *Thalmanninella appenninica* (Renz); J. Salaj & O. Samuel. Foraminifera der Westkarpaten..., p. 177, Pl. 11, Fig. 8 a—c.

1966. *Rotalipora (Thalmanninella) appenninica gandolfi* Luterbacher & Premoli-Silva & Caron; M. Caron, Globotruncanidae du Crètacé..., p. 72, Pl. 1, Fig. 5 a—c.

1969. *Rotalipora appenninica* (Renz); V. Scheibnerová, Middle and Upper Cretaceous..., pp. 64—65, Pl. 10, Fig. 4 a—c.

Material. — Sixty well-preserved specimens.

Dimensions (in mm):

	IG 4131/70/F	IG 4346/70/F	IG 4347/70/F
Diameter . .	0.540	0.504	0.468
Thickness . .	0.252	0.234	0.198

Description. — Polish specimens correspond to the greatest extent to Loeblich & Tappan's (1961) description except for the fact that in the specimens under study two accessory apertures may occur on each chamber, one of them being situated near umbilicus and the other high up on the suture.

Variability. — A considerable individual variability concerns the shape and convexity of chambers in older whorls, thickness of keel and sutural lists, convexity of test (uniformly convex or more strongly convex on the umbilical side) and shape of sutures on the umbilical side.

Remarks. — This species was first described, on the basis of thin sections, by Renz (1936). Observing an isolated material, Gandolfi (1942) distinguished many varieties of this species. Now, four of them are considered as separate species. After obtaining isolated specimens from sediment, later authors such as, for instance, Klaus (1959), Luterbacher & Premoli-Silva (1962) and Caron (1966), distinguished various subspecies. The present writer, not being sure about the possibility of an accurate comparison of isolated specimens with those from thin sections, presents the species according to the synonymy given above.

Distribution. — Poland: Cenomanian; Italy: Cenomanian; Switzerland: Cenomanian, Lower Turonian; Austria: Cenomanian, Lower Turonian; Rumania: boundary between Albian and Cenomanian; Czechoslovakia: Cenomanian; U.S.S.R.: Upper Albian, Cenomanian; U.S.A.: Cenomanian; Algeria: Upper Cenomanian.

Rotalipora cushmani cushmani (Morrow, 1934)
(Pl. X, Figs. 1 *a*—*c*, 2 *a*—*c*)

1934. *Globorotalia cushmani* Morrow; A. L. Morrow, Journ. Paleont., p. 199, Pl. 31, Figs. 2, 4. (fide B. F. Ellis & A. M. Messina, Cat. of Foram.).
1958. *Rotalipora cushmani* (Morrow); M. Książkiewicz, On the Turonian..., Text-fig. 1 (6 a—c, 7 a—c), p. 593.
1958. *Rotalipora turonica* Brotzen; M. Książkiewicz, *Ibid.* Text-fig. 1 (9 a—c), p. 539.
1958. *Rotalipora turonica expansa* Carbonnier; M. Książkiewicz, *Ibid.*, Text-fig. 1 (10 a—c), p. 539.
1958. *Rotalipora montsalvensis* Mornod; M. Książkiewicz, *Ibid.*, Text-fig. 1 (11 a—c), p. 539.
1959. *Rotalipora montsalvensis* Mornod; T. Neagu, Studiul micropaleontologic..., p. 167, Pl. 2, Figs. 10—12.
1959. *Rotalipora montsalvensis* Mornod *var. minor* Mornod; T. Neagu, *Ibid.*, p. 167, Pl. 2, Figs. 7—9.
1959. *Rotalipora (Rotalipora) turonica* Brotzen; J. Klaus, Le "Complexe schisteux intermédiaire"..., pp. 815, 816, Pl. 5, Fig. 3 a—c.
1959. *Rotalipora (Rotalipora) turonica var. expansa* Carbonnier; J. Klaus, *Ibid.*, pp. 816, 817, Pl. 5, Fig. 4 a—c.
1959. *Rotalipora (Rotalipora) montsalvensis* Mornod; J. Klaus, *Ibid.*, pp. 813, 814, Pl. 5, Fig. 1 a—c.

1959. *Rotalipora turonica* Brotzen; M. Haque, Some Later Cretaceous smaller..., pp. 21, 22, Pl. 2, Fig. 8.
1961. *Rotalipora cushmani* (Morrow); A. R. Loeblich & H. Tappan, Cretaceous planktonic..., pp. 297, 298, Pl. 8, Figs. 1—10 (*here additional synonymy included*).
1961. *Rotalipora cushmani* (Morrow); *turonica* Brotzen; M. Malapris & P. Rat, Données sur les Rosalines..., pp. 87, 88, Pl. 1, Figs. 1 a—c, 3 a—c (non 2 a—c).
1962. *Rotalipora turonica* Brotzen; H. Hiltermann & W. Koch, Leitfossilien..., p. 329, Pl. 49, Figs. 2, 3, Tab. 19.
1963. *Rotalipora cushmani* (Morrow); N. V. Dabagjan, Nekotorye cenomanskie..., pp. 110—113, Pl. 1, Fig. 3 a,b,w. (*here additional synonymy included*).
1963. *Rotalipora montsalvensis* Mornod; N. V. Dabagjan, *Ibid.*, pp. 108, 109, Pl. 1, Fig. 2 a,b,w.
1963. *Rotalipora appenninica* (Renz); O. K. Kaptarenko-Tshernousova et al., Atlas charakternych foraminifer..., p. 104, Pl. 15, Fig. 4 a,b,w.
1964. *Rotalipora turonica turonica* Brotzen; I. Küpper, Mikropalaeontologische Gliederung..., pp. 613, 614, Pl. 2, Fig. 2 a—c.
1964. *Rotalipora turonica expansa* Carbonnier; I. Küpper, *Ibid.*, p. 614, Pl. 2, Fig. 3 a—c.
1964. *Rotalipora montsalvensis* Mornod, I. Küpper, *Ibid.*, p. 613, Pl. 2, Fig. 1 a—c.
1967. *Rotalipora cushmani* (Morrow); P. Marks, Rotalipora et Globotruncana..., pp. 272, 273, Pl. 1, Figs. 1—12; Pl. 2, Figs. 1—3.
1969. *Rotalipora cushmani* (Morrow); R. G. Douglas, Upper Cretaceous planktonic..., pp. 173, 174, Pl. 1, Figs. 1, 2 (*here additional synonymy included*).
1969. *Rotalipora cushmani* (Morrow, 1934); V. Scheibnerova, Middle and Upper Cretaceous..., p. 66, Pl. 11, Figs. 2 a—c, 5 a—c (*here additional synonymy included*).

Material. — 240 well-preserved specimens.

Dimensions (in mm):

	IG 4348/70/F	IG 4349/70/F	IG 4350/70/F
Diameter . .	0.756	0.684	0.432
Thickness . .	0.342	0.370	0.234

Description. — Polish specimens correspond to the greatest extent to Loeblich & Tappan's (1961) description.

Variability. — A very large individual variability concerns the convexity and symmetry of test, ornamentation of chambers and sutures, shape of test on the spiral side and the degree of the incision of the outline of test.

Remarks. — Polish specimens have their range of variability similar to that of the topotypes from Kansas (Loeblich & Tappan, 1961). The populations from Poland include specimens identical with those described by Brotzen (1942) and considered by Sigal (1948, p. 90) as more primitive than those, assigned by Morrow (1934) to *G. cushmani*, and which are not yet completely stabilized and still subject to many changes. Specimens with strongly radially stretched chambers, slightly expressed or even lacking sutural lists, called by Mornod (1949) *Globotruncana (Rotalipora) montsalvensis* and immature specimens with a not yet fully developed last whorl,

called by Carbonnier (1958) *G. (R.) turonica var. expansa*, are younger synonyms of *R. cushmani* (Morrow).

Distribution. — Poland: Upper Cenomanian of the localities Zastań (former name Zunz), Świniec (Schwenz), Lower Turonian of Chrząszczewo (Gristow), Niemica (Nemitz) and Jaromin (Jordansee) (Brotzen, 1942), Cenomanian of the Pieniny Klippen belt and Cenomanian of the area under study; North-western Germany: Cenomanian, Lower Turonian; Italy: Cenomanian; Switzerland, Austria and France: Cenomanian, Lower Turonian; Rumania: boundary between Albian and Cenomanian; Czechoslovakia: Cenomanian, lower beds of Turonian; U.S.S.R.: Cenomanian; U.S.A. and North Africa: Cenomanian, Lower Turonian; Asia (Pakistan): Cenomanian, Turonian.

Rotalipora cushmani thomei Hagn & Zeil, 1954
(Pl. X, Figs. 3 *a—c*, 4 *a—c*)

1954. *Rotalipora turonica* Brotzen *thomei* Hagn & Zeil; H. Hagn & W. Zeil, Globotruncanen aus dem Ober..., p. 28, Pl. 1, Fig. 6; Pl. 4, Figs. 5, 6.
1959. *Rotalipora turonica var. thomei* Hagn & Zeil; J. Klaus, Le "Complexe schisteux intermédiaire"..., p. 817, Pl. 5, Fig. 5 a—c.
1961. *Rotalipora cushmani* (Morrow 1934) et *Rotalipora turonica* Brotzen 1942; M. Malapris & P. Rat, Données sur les Rosalines..., pp. 87, 88, Pl. 1, Fig. 2 a—c (non Pl. 1, Figs. 1 a—c, 3 a—c).
1966. *Rotalipora cushmani thomei* Hagn & Zeil; J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., p. 185, Pl. 12, Fig. 6 a—c.

Material. — Sixty-five well-preserved specimens.

Dimensions (in mm):

	IG 4351/70/F	IG 4352/70/F	IG 4134/70/F
Diameter . .	0.612	0.540	0.468
Thickness . .	0.360	0.324	0.270

Description. — The subspecies under study differs from the nominal one in a conical, domelike, vaulted spiral side, strongly depressed umbilical side, chambers of the last whorl almost perpendicularly dropping towards the periphery of test, considerably less incised outline of test, considerably less convex chambers' on the umbilical side and a lower number of chambers in the last whorl.

Variability. — A small individual variability concerns the dimensions, outline and ornamentation of test, degree of incision of the periphery of test, convexity of chambers on the umbilical side and number of chambers in the last whorl.

Remarks. — The specimens discussed are mostly in conformity with the type specimen. Some Polish specimens, the same as those from the Alps (cf. Hagn & Zeil, 1954) give the impression of being deformed.

Distribution. — Poland: Cenomanian; France: Upper Cenomanian; Swi-

tzerland: Upper Cenomanian, Lower Turonian; Austria (Bavarian Alps): Upper Cenomanian; Czechoslovakia (Western Carpathians): Upper Cenomanian, lower beds of Turonian.

Rotalipora deeckei (Franke, 1925)

(Pl. XI, Figs. 2 *a*—*c*, 3 *a*—*c*)

1925. *Rotalia deeckei* Franke; A. Franke, Die Foraminiferen der pommerschen..., pp. 90, 91, Pl. 8, Fig. 7 a—c.
1959. *Rotalipora (Thalmanninella) deeckei* (Franke); J. Klaus, Le "Complexe schisteux intermédiaire"..., p. 806, Text-fig. 7 (2 a—c), p. 807 (*here additional synonymy included*).
1961. *Rotalipora deeckei* (Franke); V. Scheibnerová, Mikrofauna srednej a vrchnej kriedy..., pp. 56, 57, Pl. 8, Fig. 4 a—c.
1961. *Thalmanninella deeckei* (Franke); N. I. Maslakova, K sistematike i filogenii..., p. 51, Pl. 3, Fig. 3 a—c; Pl. 4, Figs. 4, 5.
1963. *Thalmanninella deeckei* (Franke); N. V. Dabagjan, Nekotorye cenomanskie planktonnye..., pp. 113—115, Pl. 1, Fig. 4 a,b,w.
1966. *Thalmanninella deeckei* (Franke); J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., p. 179, Pl. 12, Fig. 4 a—c.
1969. *Rotalipora deeckei* (Franke); V. Scheibnerová, Middle and Upper Cretaceous..., p. 65, Pl. 12, Figs. 1—3 a—c.

Material. — Seventy-five well-preserved specimens.

Dimensions (in mm):

	IG 4353/70/F	IG 4137/70/F	IG 4354/70/F
Diameter . .	0.612	0.576	0.486
Thickness . .	0.306	0.360	0.198

Description. — Polish specimens correspond to the greatest extent to Dabagjan's (1963) description, except for the fact that they have seven to eight chambers in the last whorl and that their chambers are, on the umbilical side, narrow, strongly convex and wedgelike. Their last chamber considerably larger than the remaining ones, projects in the form of an isolated wedge.

Variability. — The individual variability manifests itself in the outline of test, convexity of the central part of the spiral side, width of whorls on the spiral side, height of chambers on the umbilical side and width of the umbilical depression.

Remarks. — This species has for the first time been described by Franke (1925) under the name of *Rotalia deeckei* Franke from the Turonian(?) deposits of the locality Jaromin (Jordansee) on the Island Wolin in Polish Pomerania. Brotzen was the first to acknowledge this species as a representative of the genus *Rotalipora* and subgenus *Thalmanninella* (cf. Dalbiez, 1957). Specimens, in which the accessory aperture occurs high up on the sutures and not within the range of umbilicus, are found in the Polish material under study. The situation of accessory apertures is not, there-

fore, a fixed character and, thus, the separation of the subgenus or genus *Thalmanninella* is unnecessary. This genus has not been separated in Loeblich & Tappan's (1964) systematics.

A specimen, very similar to Franke's one, illustrated by Dalbiez (1957), was described by Mornod (1949) under the name of *Globotruncana (Rotalipora) reicheli* Mornod. *R. reicheli* is considered by Scheibnerova (1961) and Maslakova (1961) as a younger synonym of *R. deeckei*. Since *R. deeckei* differs from *R. reicheli* in a greater number of chambers in the last whorl, semilunar outline of chambers on the spiral side, narrower chambers on the umbilical side and conically raised older whorls on the spiral side of test. The present writer does not share Scheibnerova's and Maslakova's view. *R. deeckei* is very closely related to *R. greenhornensis* (Morrow), from which it descends. The material from Poland includes specimens which relate the two species.

Distribution. — Poland: Albian through Turonian; Switzerland: Upper Cenomanian; Czechoslovakia (Western Carpathians): Cenomanian; U.S.S.R. (Crimea, Eastern Carpathians): Cenomanian.

Rotalipora greenhornensis (Morrow, 1934)
(Pl. IX, Figs. 4 *a*—*c*, 5 *a*—*c*)

1934. *Globorotalia greenhornensis* Morrow; A. L. Morrow, Journ. Paleont, vol. 8, p. 199, Fig. 1 a—c (fide B. F. Ellis & A. M. Messina Cat. of Foram).
1958. *Rotalipora globotruncanoides* Sigal; M. Książkiewicz, On the Turonian..., Text-fig. 1 (5 a—c), p. 539.
1958. *Rotalipora appenninica-reicheli* intermediate form; M. Książkiewicz, *Ibid.*, Text-fig. 1 (4 a—c), p. 539.
1959. *Rotalipora (Thalmanninella) greenhornensis* (Morrow); J. Klaus, Le "Complexe schisteux intermédiaire..., p. 805, Pl. 2, Fig. 3 a—c.
1959. *Rotalipora (Thalmanninella) brotzeni* Sigal; J. Klaus, *Ibid.*, p. 805, Pl. 3, Fig. 1 a—c.
1961. *Rotalipora greenhornensis* (Morrow); A. R. Loeblich & H. Tappan, Cretaceous planktonic..., pp. 299—301, Pl. 7, Figs. 5—10 (*here additional synonymy included*).
1961. *Rotalipora appenninica typica* (Gandolfi); M. Malapris & P. Rat, Données sur les Rosalines..., p. 87, Pl. 3, Fig. 4 a—c.
1961. *Thalmanninella brotzeni* Sigal; N. I. Maslakova, K sistematike i filogenii..., p. 51, Pl. 3, Fig. 1 a—c.
1961. *Rotalipora greenhornensis* (Morrow); R. Douglas, Upper Cretaceous planktonic..., p. 174, Pl. 1, Fig. 3 (*here additional synonymy included*).
1966. *Thalmanninella greenhornensis* (Morrow 1934); J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., pp. 180, 181, Text-fig. 15, p. 181.

Material. — Seventy well-preserved specimens.

Dimensions (in mm):

	IG 4355/70/F	IG 4356/70/F	IG 4139/70/F
Diameter . .	0.486	0.450	0.378
Thickness . .	0.252	0.252	0.198

Description. — Specimens from Poland correspond to the greatest extent to Loeblich & Tappan's (1961) description. It should be mentioned that the specimens under study are uniformly biconvex, that the chambers on the umbilical side slightly overlap each other and that the sutures are in all specimens thickened.

Variability. — A considerable individual variability concerns the symmetry of tests; size of the chambers of the last whorl, convexity of the chambers on the umbilical side, shape and ornamentation of sutures on the umbilical side and structure of keel and sutural lists. The last-named may occur either in the form of uniform rollers or mammilate thickenings situated next to each other.

Remarks. — *R. greenhornensis* (Morrow) is fairly similar to *R. appenninica* (Renz), from which it differs, however, in the disposition of accessory apertures within the range of umbilicus, very slightly incised outline of test, greater number of chambers in the last whorl, rhomboidal outline of chambers on the umbilical side and arcuate sutures, covered with roller-like thickenings on the umbilical side of test. A specimen presented by Książkiewicz (1958, p. 539, Fig. 1, drawing 5) as *R. globotruncanoides* Sigal, as well as those, considered by Książkiewicz (1958) as transitional between *R. appenninica* and *R. reicheli*, probably belong to *R. greenhornensis*. Marianos & Zingula (1966) erected a new species called *R. tehamaensis*, to which they assigned some of the specimens recognized by Loeblich & Tappan (1961, Pl. 7, Figs. 5, 6) as *R. greenhornensis*. *R. tehamaensis*, fitting within the variability range of the last-named species, is, however, included in its synonymy, as shown by Douglas' (1969) studies conducted on the holotype of *R. tehamaensis* and topotypes of *R. greenhornensis*.

Distribution. — Poland: Cenomanian; Germany: Cenomanian, Lower Turonian; France: Cenomanian; Switzerland: Cenomanian, Lower Turonian; Czechoslovakia (Western Carpathians): Cenomanian; U.S.S.R. (Crimea): Lower Cenomanian; U.S.A.: Albian, Cenomanian, Lower Turonian; Algeria: Cenomanian: Morocco: Cenomanian.

Rotalipora reicheli Mornod, 1949
(Pl. XI, Fig. 1 *a—c*)

1942. *Globotruncana appenninica* Renz var. *gamma* Gandolfi; R. Gandolfi, Ricerche micropaleontologische... p. 119, Text-fig. 41 (1 a,b); p. 118, Text-fig. 42 (1 non 2,3); p. 119, Text-fig. 44 (394), p. 122, Pl. 6, Fig. 6 (Part); Pl. 14, Fig. 6.

1949. *Globotruncana (Rotalipora) reicheli* Mornod; L. Mornod, Les Globorotalidés du Crétacé..., pp. 583, 584, Text-fig. 5 (IV a—c); p. 581, Text-fig. 6 (1—6); p. 583, Pl. 15, Figs. 2 a—p, 3—8.

1953. *Rotalipora reicheli* Mornod; N. N. Subbotina, Globigerinidy, Hantkeninidy..., pp. 162—164, Pl. 2, Fig. 4 a,b,w (non 3 a,b,w).

1958. *Rotalipora reicheli* Mornod; M. Książkiewicz, On the Turonian..., Text-fig. 1 (2, 3 a—c), p. 539.

1959. *Rotalipora reicheli* Mornod; N. I. Maslakova, in... M. M. Moskvin, Atlas verchnemelovoj fauny..., p. 108, Pl. 11, Fig. 4 a,b,w.
1959. *Rotalipora reicheli* Mornod; T. Neagu, Studiul micropaleontogic..., p. 169, Pl. 3, Figs. 1—9.
1959. *Rotalipora (Thalmanninella) reicheli* (Mornod); J. Klaus, Le "Complexe schisteux intermédiaire"..., pp. 806—808, Pl. 4, Figs. 2 a—c, 3 a—c, 7.
1961. *Rotalipora reicheli* (Mornod); A. R. Loeblich & H. Tappan, Cretaceous planktonic..., p. 301, Pl. 8, Fig. 12 (*here additional synonymy included*).
1961. *Rotalipora aff. reicheli* Mornod 1959; M. Malapris & P. Rat, Données sur les Rosalines..., p. 87, Pl. 1, Fig. 4.
1963. *Rotalipora reicheli* Mornod; O. K. Kaptarenko-Tshernousova et al., Atlas charakternych foraminifer..., pp. 104, 105, Pl. 15, Fig. 3 a,b,w.
1966. *Thalmanninella reicheli* (Mornod); J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., pp. 181, 182, Pl. 11, Fig. 7 a—c.

Material. — Forty well-preserved specimens.

Dimensions (in mm):

	IG 4140/70/F	IG 4357/70/F	IG 4358/70/F
Diameter . .	0.576	0.522	0.468
Thickness . .	0.192	0.288	0.234

Description. — Polish specimens correspond to the greatest extent to Mornod's (1949) description of the holotype.

Variability. — The individual variability manifests itself in the degree of the depression of the spiral side of test, ornamentation of sutures, number of chambers in the last whorl, ornamentation of chambers, particularly on the umbilical side and in the width and depth of umbilicus.

Remarks. — Specimens from Poland are in an almost complete conformity with the holotype. They differ from Swiss specimens in a lower number of whorls (two to two and a half as opposed to three), lower number of chambers in the last whorl (six to seven as opposed to eight) and situation of accessory apertures (in the initial part of whorl-near the umbilicus, in the final part — higher up on sutures). The species discussed is most similar to *R. deeckei* (Franke), from which it differs in a lower number of chambers in the last whorls, incised outline of chambers on the spiral side and wider chambers on the umbilical side. *Globotruncana appenninica* Renz var. *gamma* Gandolfi was included by Mornod (1949) to *Globotruncana (Rotalipora) reicheli*. Not all of the specimens, described by Gandolfi (1942, Pl. XIV, Fig. 6) seem to belong to the species *R. reicheli*.

Distribution. — Poland, France, Germany and the U.S.S.R.: Cenomanian; Switzerland and Austria: Cenomanian, Lower Turonian; Rumania: Albian, Cenomanian; Czechoslovakia (Western Carpathian) and Morocco: Upper Cenomanian.

Family **Globotruncanidae** Brotzen, 1942
Genus *Globotruncana* Cushman, 1927
Globotruncana renzi Gandolfi, 1942
(Pl. XI, Fig. 4 *a—c*)

1942. *Globotruncana renzi* Gandolfi; R. Gandolfi, Ricerche micropaleontologische..., pp. 124—125, Text-fig. 45 a—c, p. 124, Pl. 3. Fig. 1 a—c; Pl. 4, Figs. 15, 16, 28, 29 (non Pl. 10, Fig. 2).
1954. *Globotruncana renzi* Thalmann & Gandolfi; H. Hagn & W. Zeil, Globotruncanen aus dem Ober..., pp. 37—39, Pl. 3, Fig. 2 a—c; Pl. 6, Figs. 3, 4.
1957. *Globotruncana renzi* Gandolfi; H. Bolli, The genera Praeglobotruncana..., p. 58, Pl. 14, Fig. 3 a—c.
1960. *Globotruncana renzi* Gandolfi; E. F. Trujillo, Upper Cretaceous Foraminifera..., p. 343, Pl. 50, Figs. 3 a—c, 4 a—c.
1961. *Praeglobotruncana renzi* (Gandolfi); V. Scheibnerova, Mikrofauna srednej a vrchnej kriedy..., pp. 60, 61, Pl. 9, Fig. 4 a—c.
1964. *Globotruncana renzi* Gandolfi; I. Küpper, Mikropalaeontologische Gliederung..., pp. 628—630, Pl. 2, Fig. 1 a—c.
1966. *Globotruncana renzi* Gandolfi; M. Caron, Globotruncanidae du Crétacé..., pp. 77—79, Pl. 4, Figs. 4 a—c, Text-figs. 4 a—c, 5 a—c. (*here additional synonymy included*).
1966. *Globotruncana renzi* Gandolfi; J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., p. 211, Pl. 18, Fig. 1 a—c.
1966. *Globotruncana coldreriensis* Gandolfi; J. Salaj & O. Samuel, *Ibid.*, pp. 201, 202, Pl. 18, Fig. 2 a—c.
1969. *Praeglobotruncana renzi* (Gandolfi); R. Douglas, Upper Cretaceous planktonic..., pp. 172, 173, Pl. 2, Fig. 8.
1969. *Globotruncana renzi* Gandolfi, 1942; V. Scheibnerova, Middle and Upper Cretaceous..., pp. 66—68, Pl. 13, Figs. 1—4 a—c.

Material. — A hundred and twenty well-preserved specimens.

Dimensions (in mm):

	IG 4141/70/F	IG 4359/70/F	IG 4360/70/F
Diameter . .	0.558	0.540	0.414
Thickness . .	0.252	0.234	0.198

Description. — Test with a low coiling axis, plano-convex. Spiral side flat or slightly convex, composed of two to two and a half whorls, umbilical side strongly convex. Test oval or square in outline, strongly incised particularly so at the end of whorls. All whorls visible on the spiral side. Each whorl composed of five chambers. The oldest two whorls very narrow as compared with the last one. Chambers of the first whorl invisible, those of the remaining two trapezoidal, with a flat or slightly concave surface. In the process of growth, chambers considerably but proportionally increase their dimensions, except for the youngest chamber of the last whorl which frequently is smaller than the preceding ones. Sutures slightly arcuate, covered with lists, except for those of the first whorl which are radial, depressed and devoid of ornamentation. The umbilical side fairly strongly convex with a narrow and shallow umbilicus. Five trapezoidally

or triangularly outlined chambers of the last whorl with a strongly convex, somewhat overhanging surface, are visible on this side. Sutures on the umbilical side slightly arcuate, subradial, in some of the specimens sigmoidally curved, covered with listlike thickenings. In some of the specimens, also thickened is the periumbilical part of chambers. The periphery, of test is, except for the final chamber, surrounded by two keels, situated very close to each other. In the proximal part of the chambers of the last whorl, keel is single, in the distal part it splits in two and its dorsal part is connected with the sutural roller and umbilical runs for a certain distance parallel to the spiral keel and, afterwards, is either disconnected on interchamber sutures, or extends on the suture on the umbilical side of test. The final chamber has a single keel. Aperture interiomarginal — umbilical, surrounded by a thin lip.

Variability. — A considerable variability expressed in many characters such as, the shape and outline of test, degree of the convexity of chambers and curvature of sutures on both sides of test.

Remarks. — The specimens described above are most similar to Gandolfi's (1942) one, shown on p. 124, Fig. 45. They differ from it in a slightly different outline of chambers on the umbilical side and from other ones, presented by this author, in less arcuate and wider chambers on the spiral side. The specimen figured by Gandolfi (1942) in Pl. 3, Fig. 1 *a*—*c* has been choised by Caron (1966) as a holotype of *G. renzi* and illustrated once again. *Praeglobotruncana renzi* Thalmann described by Eichner (1966, p. 28, Pl. 6, Fig. 9) and Sliter (1966, p. 106, Pl. 4, Fig. 3), belongs to *P. stephani* (Gandolfi). Ellis & Messina (1958) explained that *G. renzi* Thalmann, 1945 was a homonym of *G. renzi* Gandolfi. Other specimens are holotypes of these species.

Distribution. — Poland: Lower Turonian; Austria, Czechoslovakia (Western Carpathians) and Switzerland: Turonian, Coniacian; U.S.A.: Lower and Middle Turonian; Trinidad (West Indies): Coniacian, lower beds of Santonian.

Family **Globigerinidae** Carpenter & Parker & Jones, 1862
Subfamily **Globigerinidae** Carpenter & Parker & Jones, 1862
Genus *Globigerina* d'Orbigny, 1826
Globigerina graysonensis Tappan, 1940
(Pl. V, Fig. 12 *a*—*c*)

1940. *Globigerina graysonensis* Tappan; H. Tappan, Foraminifera from the Grayson..., p. 122, Pl. 19, Figs. 15 a—c, 16, 17.
1950. *Globigerina graysonensis* Tappan; A. R. Loeblich & H. Tappan, Foraminifera of the type Kiowa..., p. 14, Pl. 2, Fig. 21 a—c (*here additional synonymy included*).

?1961. *Rotaliatina asiatica* Bykova; V. P. Vassilenko, Foraminifery verchnego mela..., pp. 69, 70, Pl. 9, Figs. 1 a,b,w; 2 a,b,w; 4 a,b,w; 11 (*here additional synonymy included*).

Material. — A hundred and thirty well-preserved specimens.

Dimensions (in mm):

	IG 4361/70/F	IG 4142/70/F	IG 4362/70/F
Greater diameter . . .	0.162	0.126	0.126
Smaller diameter . . .	0.126	0.126	0.108
Thickness	0.108	0.090	0.108

Description. — Test very small, with a strongly convex spiral and flat or slightly convex umbilical side, sometimes conical, composed of two to three whorls, round or slightly oval, strongy incised in outline. The periphery of test widely rounded. The surface of test smooth and very finely and densely perforate. Spiral side slightly or strongly convex, conical, with all whorls visible on it. The last whorl consists of five to six chambers. In older whorls, chambers are poorly visible, quadrangular in outline, slightly convex, in the last whorl subspherical. The chambers of particular whorls strongly increase their dimensions as compared with a preceding whorl but gradually within the same whorl. Inter-chamber sutures and the spiral suture clearly visible, depressed, the former slightly arcuate between chambers. Umbilical side flat or somewhat convex, with only the chambers of the last whorl, which are uniform in size, visible on it. These chambers are triangular in outline and with a strongly convex surface. Sutures rectilinear radial, depressed. Umbilical depression very narrow, almost non-existant. Aperture slitlike, surrounded by a narrow lip, extraumbilical.

Variability. — Mostly the height of the spiral side and the outline and depression of inter-chamber sutures are subject to variability.

Remarks. — The Polish specimens described above are in almost all of their characters in conformity with the holotype. They differ from the American specimens in an almost uniform size of chambers in particular whorls on the spiral side. The specimens under study are also very similar to *Rotaliatina asiatica* Bykova.

Since in the shape of its test, manner of coiling and shape of chambers, the species discussed resembles the genus *Globigerina*, it is very difficult to assign it to any of the known genera, which has already been pointed out by Tappan (1940). It differs, however, from *Globigerina* in a slitlike, low, extraumbilical aperture. Loeblich & Tappan (1964) suppose that *G. graysonensis* Tappan may belong to the genus *Gubkinella* Suleymanov, 1955 as indicated by the high-coiled test, low aperture and the number of chambers in a whorl. Studying the phylogenetic development of planktonic forms, Bandy (1967) concludes that this species cannot be assigned to the genus *Gubkinella* because of the lower whorl on the spiral side than that

of this genus and because of the aperture similar to those in many globigerins, coming from the Cenozoic as, for instance, *G. pachyderma* (Ehrenberg).

Distribution. — Poland: Albian, Cenomanian; U.S.A.: Albian.

Superfamily **Orbitoidacea** Schwager, 1876
Family **Eponididae** Hofker, 1951
Genus *Eponides* de Montfort, 1808
Eponides belorussiensis Akimez, 1961
(Pl. XII, Fig. 1 *a*—*c*)

1961. *Eponides belorussiensis* Akimez; V. S. Akimez, Stratigrafija i foraminifery..., pp. 125, 126, Pl. 11, Fig. 8 a,b,w.

Material. — Seventy well preserved specimens.

Dimensions (in mm):

	IG 4363/70/F	IG 4364/70/F	IG 4143/70/F
Diameter . .	0.180	0.162	0.126
Thickness . .	0.090	0.090	0.072

Description. — Test very small, round, biconvex, with a more strongly convex spiral side, smooth, lustrous, composed of three whorls. The periphery of test widely rounded, incised in outline. Spiral side evolute, slightly convex, with a distinctly visible last whorl. Outer whorls covered with a crusted substance forming a sort of a large disc, projecting over the last whorl and separated by a depressed spiral suture from the outer whorl. The last whorl very narrow, composed of six to eight trapezoidal, slightly convex, chambers separated from each other by depressed, somewhat arcuate sutures. Umbilical side completely involute, slightly convex or slightly concave in the region of a very narrow, round umbilicus. Only the last whorl, with triangular, convex chambers, is visible on it. Sutures clearly visible, rectilinear, radial, depressed. Aperture narrow, slitlike, covered by a very narrow lip, interiomarginal, umbilical.

Variability. — A small individual variability mostly concerns the number of chambers in the last whorl and the convexity of the central part of the spiral side and the umbilical part of the ventral side.

Remarks. — Polish specimens are in almost all their characters in conformity with the holotype. They differ from the Byelorussian ones in a greater number of chambers in the last whorl and in a lower number of whorls.

Distribution. — Poland: Upper Albian, Cenomanian and, sporadically, Lower Turonian; U.S.S.R.: Turonian, Coniacian.

Family **Cibicididae** Cushman, 1927
Subfamily **Planulininae** Bermudez, 1952
Genus *Planulina* d'Orbigny, 1826
Planulina aff. *lundegreni* Brotzen, 1936
(Pl. XII, Figs. 2 *a*—*c*, 3 *a*—*c*, 4 *a*—*c*; Text-fig. 3)

1936. *Planulina lundgreni* Brotzen; F. Brotzen, Foraminiferen aus dem schwedischen..., pp. 181—184, Pl. 14, Fig. 1 a—c, Text-fig. 65 (1,2,3, a—c).

Material. — Twenty-five well-preserved specimens.

Dimensions (in mm):

	IG 4365/70/F	IG 4145/70/F	IG 4366/70/F
Diameter	0.342	0.288	0.270
Thickness	0.090	0.090	0.090

Description. — Test flat, smooth, round in outline, composed of two to three whorls the last of them occupying three-quarters of the surface of test. Inner whorls very small, mostly partly covered by the last whorl.

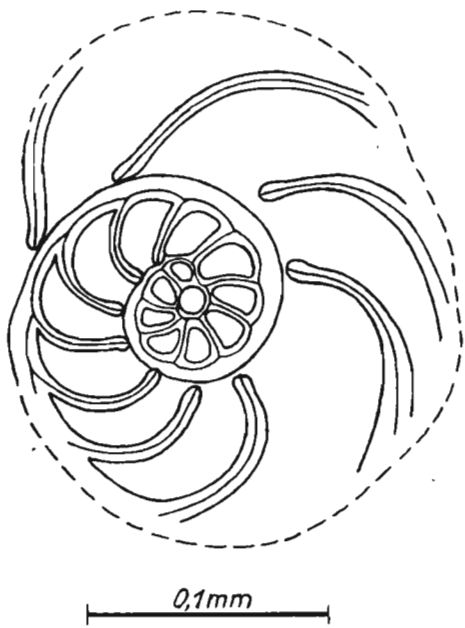


Fig. 3. — Horizontal section of *Planulina aff. lundegreni* Brotzen; diameter of the test, 0.270 mm, its thickness, 0.090 mm, diameter of the proloculus 17.0 μ. Szamotuły Geo 10 boring, depth, 500.5 m.

Periphery narrow, rounded. Dorsal side flat or slightly convex, with a flat node. The last whorl composed of nine to twelve, strongly arcuate chambers which have flat surfaces, are separated from each other by high, wide and arcuate sutures, projecting above the surface of chambers and having superstructures. In some of the specimens, the width of sutural lists is iden-

tical with that of the surface of chamber. Ventral side flat or slightly concave, involute, with a clearly visible last whorl. Chambers are, like on the dorsal side, narrow, strongly arcuate, with a flat surface and a greater number of pores than on the dorsal side. Sutures slightly lower and wider than on the dorsal side. A narrow umbilical depression, situated in the middle of the ventral side, is open or, in some of the specimens, covered by a small, flat thickening of test, taking the form of a node. Apertural surface triangular, flat, or slightly concave. Aperture slightly arcuate, slit-like, situated on the periphery of test and extended onto the ventral side under the inner margin of the last chambers in the whorl. These chambers may sometime terminate in triangular flaps. Specimens, of which thin sections have been prepared, are composed of two whorls with a total number of 19—20 chambers. The last whorl consists of nine to ten chambers. The proloculus measures 17.5 microns (Text-fig. 3).

Variability. — A fairly large variability concerns the convexity of the dorsal side, depression of the ventral side, height and width of sutural lists on both sides of test (in all the specimens on the dorsal side they are higher and somewhat narrower than on the ventral side), ornamentation of the inner whorl on the dorsal side (bordered by a raised spiral suture or covered by a nodulose thickening of test), development of umbilicus on the ventral side (depressed, open or covered with a flat thickening consisting of a test substance) and width of the margin of test.

Remarks. — Specimens from Poland have many characters in common with the holotype, from which they differ in the presence of a node or a raised list on the spiral suture of the dorsal side and in the lack of a list-like thickening bordering the apertural surface of the last chamber. Three generations of individuals: A_1, A_2 and B were distinguished by Brotzen (1936). The sectioned Polish specimens correspond in the size of their proloculus and morphological characters, to the individuals of generation B, but they have less whorls (two to two and a half, as opposed to three) and less chambers in the last whorl (ten to nine and not eleven to twelve). A small number of available specimens of this species, has not allowed the present writer to make a sufficient number of thin sections for finding individuals of the remaining two generations.

Distribution. — Poland: Lower Turonian; Sweden: Upper Cretaceous deposits.

Subfamily **Cibicidinae** Cushman, 1927

Genus *Cibicides* de Montfort, 1808

Cibicides gorbenkoi Akimez, 1961

(Pl. XII, Figs. 5 *a*—*c*, 6 *a*—*c*; Text-fig. 4)

1960. *Cibicides vassilenkoae* Gorbenko; V. F. Gorbenko, Novie vidy foraminifer..., pp. 75, 76, Text-fig. 5 (7 a,b,w), p. 73.

1961. *Cibicides (Cibicidoides) gorbenkoi* Akimez; V. S. Akimez, Stratigrafija i foraminifery..., p. 166, Pl. 16. Figs. 6 a,b,w, 7 a,b,w.
1961. *Cibicides (Cibicidoides)* rarus Lipnik; O. S. Lipnik, Foraminifery i stratigrafija..., p. 61, Pl. 7, Fig. 2 a—c.
1963. *Cibicides (Cibicidoides) gorbenkoi* Akimez; O. K. Kaptarenko-Tshernousova et al., Atlas charakternych foraminifer..., pp. 100, 101, Pl. 15, Fig. 2 a,b.

Material. — More than 350 well-preserved or partly damaged specimens.

Dimensions (in mm):

	IG 4367/70/F	IG 4368/70/F	IG 4369/70/F
Diameter	0.630	0.468	0.342
Thickness	0.252	0.216	0.180
Thickness of the last chamber	0.180	0.162	0.180

Description. — Test oval, less frequently round semievolute, planoconvex, conical, composed of two and a half to three and a half whorls, with a periphery provided with a narrow keel. Dorsal side flat, evolute, with

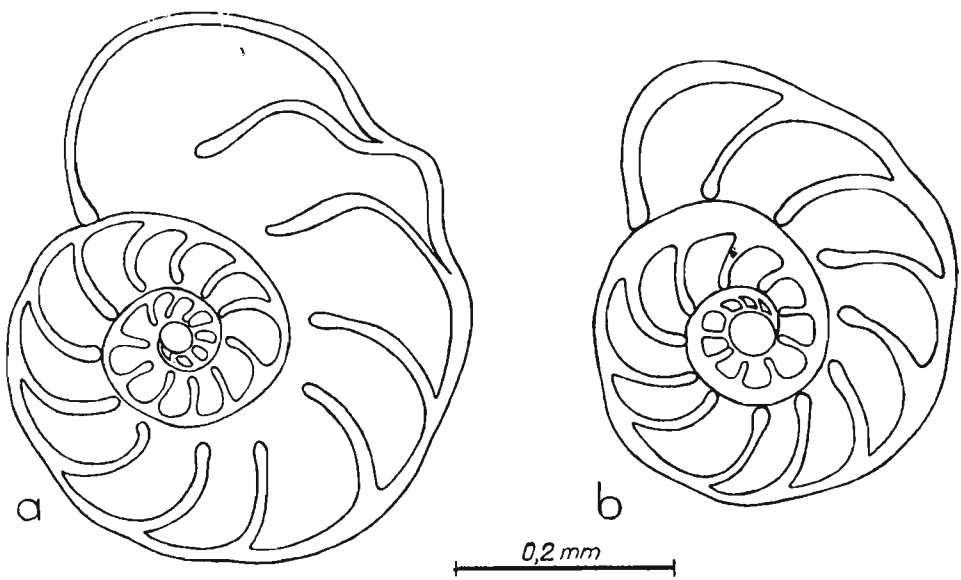


Fig. 4. — *Cibicides gorbenkoi* Akimez; *a* horizontal section of generation B, diameter of the test, 0.540 mm, its thickness, 0.216 mm, diameter of the proloculus, 12.5 μ *b* horizontal section of generation A, diameter of the test, 0.468 mm, its thickness, 0.252 mm, diameter of the proloculus, 37.5 μ. Gorzów Wkp. IG I boring, depth, 711.6 m.

all whorls clearly visible on it, the last one being composed of eight to eleven rhomboidal, fairly narrow chambers with flat surfaces. Sutures wide, transparent and forming a whole with the surface of test. The middle of test covered with a transparent thickening of test concealing the inner

whorls. Ventral side conical, with only the last whorl, composed of triangular chambers increasing their size in the process of the growth of test, visible on it. The surface of chambers flat; sutures in the initial part of whorl flat, subradial, in the final part slightly deflected posteriorly and depressed. A large node formed of a test substance and making up an apex of the cone occurs in the middle of the ventral side. Apertural surface triangular, narrow, flat. Aperture semilunar, surrounded by a thin lip, situated on the periphery of test and extended onto the dorsal side reaching under the periumbilical peripheries of the final three or four chambers. In the populations studied, individuals of two generations have been distinguished which differ from each other in morphological characters and in the number of whorls and chambers. Individuals of microspherical generation B are marked by an oval outline of test, slightly convex ventral side and are composed of three and a half whorls, having a total of 30 chambers. The last whorls contains ten to eleven chambers. The proloculus is 12.5 μ in size (Text-fig. 4). Individuals of macrospherical generation A are characterized by a subround outline of test and a high cone on the ventral side. They consist of two and a half whorls with a total of 21 chambers. The last whorl has ten chambers. The proloculus measures 37.5 μ.

Variability. — The following characters are subject to a fairly large individual variability: the shape of test, thickness of wall and sutures on the dorsal side, size of node on the ventral side, curvature of sutures on both sides of test convexity of the last chambers in the whorl on the ventral side and outline of chambers on both sides of test (rhomboidal or triangular).

Remarks. — Specimens of the species under study were first described by Gorbenko (1960) under the name of *Cibicides vassilenkoae*.

Finding this name to be already employed (*C. vassilenkoae* Lipman, 1955), Akimez (1961) changes it and finding the specimen, illustrated by Gorbenko, not to be accurately localized, chooses a new holotype. Specimens, described by Lipnik (1961) under the name of *Cibicides (Cibicidoines) rarus*, probably belong to the species discussed.

Distribution. — Poland: the highermost beds of Upper Albian, Cenomanian and, now and then, Lower Turonian; U.S.S.R.: Cenomanian.

Superfamily **Cassidulinacea** d'Orbigny, 1839
Family **Pleurostomellidae** Reuss, 1860
Subfamily **Pleurostomellinae**, 1860
Genus *Pleurostomella* Reuss, 1860
Pleurostomella obtusa Berthelin, 1880
(Pl. XIII, Figs. 1 *a,b*, 2 *a,b*, 4 *a,b*)

1880. *Pleurostomella obtusa* Berthelin; M. Berthelin, Mémoire sur les Foraminifères..., p. 29, Pl. 1, Fig. 9 a,b.

1880. *Pleurostomella barroisi* Berthelin; M. Berthelin, Ibid., p. 30, Pl. 1, Fig. 13 a,b.
1891/98. *Pleurostomella obtusa* Berthelin; F. Chapman, The Foraminifera of the Gault..., p. 757, Pl. 12, Fig. 13 a,b.
1938. *Pleurostomella* D_5; F. E. Hecht, Standart-Gliederung..., Pl. 2b, Figs. 23—26.
1951. *Pleurostomella obtusa* Berthelin; R. Noth, Foraminiferen aus Unter..., p. 66, Pl. 4, Figs. 2—4.
1955. *Pleurostomella obtusa* Berthelin 1880 et aff. sp. sp.; F. Bettenstaedt & C. A. Wicher, Stratigraphic correlation..., p. 503, Pl. 4, Fig. 33.
1960. *Pleurostomella obtusa* Berthelin; G. V. Bukalova, Rotaliidy i Epistominidy..., pp. 227, 228, Pl. 1, Figs. 4 a,b, 5 a,b.
1963. *Pleurostomella obtusa* Berthelin; L. V. Alekseeva, in L. V. Alekseeva & M. K. Rodionova, Foraminifery niżnego mela..., pp. 46—57, Pl. 9, Figs. 5 a,b, 6 a,b (*here additional synonymy included*).
1965. *Pleurostomella obtusa* Berthelin; T. Neagu, Albian Foraminifera of the Rumanian..., p. 29, Pl. 7, Figs. 29—32 (*here additional synonymy included*).

Material. — A hundred and five well-preserved specimens.

Dimensions (in mm):

	IG 4149/70/F	IG 4370/70/F	IG 4371/70/F
Length . .	0.720	0.666	0.522
Width . .	0.216	0.198	0.198

Description. — Test straight, elongate, incised in outline, with a smooth, lustrous surface, almost equally wide over the entire length or somewhat widening in the process of growth mostly composed of six to seven chambers, round in transverse section. Proloculus spherical and, consequently, the lower part of test rounded. Subsequent chambers trapezoidal in outline, convex, arranged alternately into a single row. Sutures slightly oblique, depressed. The last chamber oval, slightly streched towards the apex of test, more swollen than the remaining ones. The biserial part is in this species very small or does not occur at all. Aperture terminal, with a projecting tip at the top and a bifid tooth at the bottom.

Variability. — Mostly the number and convexity of chambers and curvature of sutures are characters subject to the individual variability.

Remarks. — Bartenstein (1954) and Bartenstein & Bettenstaedt (1962) believe that the specimens described by Berthelin (1880) as *P. barroisi* and *P. reussi* are synonyms of *P. obtusa*. According to these authors, *P. obtusa* and *P. barroisi* are representatives of the macrospherical, and *P. reussi* of the microspherical generation. A certain similarity to *P. obtusa* is displayed by *P. fusiformis* Reuss and *P. subnodosa* Reuss. The first of these species comes from the Upper Cretaceous, the second from the Albian. The specimens of *P. subnodosa* and *P. fusiformis* are included by Bartenstein (1954) in a younger specific name, that is, *P. obtusa*. The present writer does not agree with this standpoint. As follows from the observations on the material from Poland, specimens of the two generations are both among those with characters of *P. obtusa*, bluntly terminating and without the biserial stage and among those with characters of *P. reussi*, with a well-

developed, large biserial part. For this reason they must not be included in one and the same species.

Distribution. — Poland: Upper Albian through Lower Turonian; Austria, England, France, Germany, Rumania, U.S.S.R.: Albian.

Pleurostomella reussi Berthelin, 1880

(Pl. XII, Figs. 3 *a,b*, 5 *a,b*)

1880. *Pleurostomella reussi* Berthelin; M. Berthelin, Mémoire sur les Foraminifères..., pp. 28, 29, Pl. 1, Figs. 10—12.
1891/98. *Pleurostomella alternans* Schwager; F. Chapman, The Foraminifera of the Gault...., p. 758, Pl. 12, Fig. 14 a,b.
1927. *Pleurostomella reussi* Berthelin; J. A. Cushman & R. W. Harris, Notes on the genus..., p. 132, Pl. 25 a—c.
1933. *Pleurostomella alternans* Schwager; W. Eichenberg, Foraminiferen aus dem Albian..., p. 18, Pl. 5, Fig. 4.
1938. *Pleurostomella* D_4; F. E. Hecht, Standart-Gliederung..., Pl. 2 a, Fig. 15; Pl. 2 b, Figs. 19, 20.
1951. *Pleurostomella fusiformis* Reuss; R. Noth, Foraminiferen aus Unter..., pp. 66, 67, Pl. 4, Fig. 5 a,b.
1960. *Pleurostomella reussi* Berthelin; G. V. Bukalova, Rotaliidy i Epistominidy..., pp. 228, 229 (*here additional synonymy included*).
1962. *Pleurostomella obtusa* Berthelin; H. Bartenstein & F. Bettenstaedt, Leitfossilien..., p. 290, Pl. 36, Fig. 19, Tab. 18.
1963. *Pleurostomella reussi* Berthelin; L. V. Alekseeva, in L. V. Alekseeva & M. K. Rodionova, Foraminifery niżnego mela..., pp. 47, 48, Pl. 9, Figs. 2 a,b, 3 a,b.
1965. *Pleurostomella reussi* Berthelin; T. Neagu, Albian Foraminifera of the Rumanian..., p. 30, Pl. 7, Figs. 27, 28 (*here additional synonymy included*).

Material. — Fifty-five well-preserved specimens.

Dimensions (in mm):

	IG 4372/70/F	IG 4373/70/F	IG 4374/70/F
Length . .	0.900	0.520	0.400
Width . .	0.180	0.126	0.116

Description. — Test elongate, straight or slightly bent, in the older part bi-, in the younger uniserial. Test strongly incised in outline, surface smooth, lustrous, transverse section oval. The initial part of test very narrow, composed of four pairs of chambers arranged in two rows. These chambers are trapezoidal in outline, their surface is smooth, slightly convex. The oldest chambers poorly visible, sutures in the biserial part arcuate or subperpendicular to the vertical axis of test, narrow, slightly depressed. A slightly depressed suture runs through the middle of the biserial part. The uniserial part is mostly composed of four trapezoidal and sometimes triangular, strongly convex, alternately arranged chambers. Sutures are in this part oblique, strongly depressed. The last chamber oval, slightly stretched at the top. Aperture terminal, at the top with a slightly extended tip, at the bottom with a bifid tooth.

Variability. — The individual variability is manifested in the size of test, outline and convexity of chambers, depression of sutures and sharpenning of the initial part of test.

Remarks. — Specimens from Poland are most similar to that presented by Berthelin (1880, Pl. 1, Fig. 12). Less frequent are strongly elongate specimens, with a very narrow initial part of test and indistinct biserial part shown by Berthelin in Pl. I, Fig. 10 *a,b* and still rarer are those similar to the specimen figured in his Pl. I, Fig. 11.

Distribution. — Poland: Upper Albian; Austria, England, France, Germany, Holland, U.S.S.R.: Albian.

Family **Osangulariidae** Loeblich & Tappan, 1964
Genus *Globorotalites* Brotzen, 1942
Globorotalites hangensis Vassilenko, 1961
(Pl. XIII, Fig. 7 *a—c*)

1961. *Globorotalites hangensis* Vassilenko; V. P. Vassilenko, Foraminifery verchnego mela..., pp. 56, 57, Pl. 9, Figs. 3 a,b,w, 5 a,b,w, 6 a,b,w.
1966. *Globorotalites hangensis* Vassilenko; J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., p. 152, Text-fig. 10, p. 152.

Material. — Fifty-five well-preserved specimens.

Dimensions (in mm):

	IG 4375/70/F	IG 4376/70/F	IG 4377/70/F
Greater diameter . . .	0.300	0.275	0.237
Smaller diameter . . .	0.251	0.252	0.216
Height	0.144	0.144	0.144

Description. — Test plano-convex or concavo-convex, with a conically convex ventral and flat or slightly concave dorsal side. Cone low, truncated. Outline of test oval, incised, surface smooth, lustrous, margin narrow but not sharp. Dorsal side evolute, flat or slightly concave. Test composed of two whorls or one and a half. Older whorl poorly visible, in some of the specimens covered by a lustrous thickening of test forming a sort of a flat disc. It covers approximately one-third of the surface of dorsal side and is situated at the level of the last whorl or somewhat below it. The last whorl composed of seven to eight narrow, semilunar chambers, strongly deflected posteriorly and with a slightly convex surface. Ventral side semi-involute, convex, shaped like a flatty truncated cone. The chambers of the last whorl are visible on it. On the ventral side, chambers are high, trapezoidal in outline, with a convex surface. Their size considerably increases in the process of growth. Septal sutures sigmoidal, depressed, the most strongly so between the youngest three chambers. A deep, wide, round umbilicus, surrounded in some of the specimens by thin lamellae growing from the periumbilical part of the walls of chamber, is situated in the mid-

dle of the ventral side. A flat node occurs in some of the specimens at the bottom of umbilicus. Apertural surface slightly convex, aperture slitlike, sometimes arcuate, in a position typical of the genus.

Variability. — A fairly large individual variability concerns the depression of the central part of the dorsal side of test, depression of sutures, convexity of the youngest chambers on the dorsal side, increase in the height of chambers on the ventral side, development of umbilicus and shape of aperture.

Remarks. — Polish specimens are in conformity with Vassilenko's (1961) one presented by her in Pl. IX, Figs. 6 *a,b,w*, 5 *a,b,w*. They slightly differ from the holotype (Pl. IX, Fig. 3 *a,b,w*) in a greater number of chambers in the last whorl, sigmoidal sutures on the umbilical side and wide umbilicus. The species under study differs from *G. ouachensis* Sigal and *G. djaffaensis* Sigal in a lower number of whorls, wider last whorl on the dorsal side, greater number of chambers in the last whorl and non-thickened sutures on the dorsal side of test. It differs from *G. polonica* n.sp. in a twice as large test, greater number of chambers in the last whorl, depressed sutures on the dorsal side and a varying outline of chambers on both sides of test.

Distribution. — Poland: Lower Turonian and the lowermost Upper Turonian; Czechoslovakia (Western Carpathians): Middle Turonian; U.S.S.R.: Lower Turonian.

Globorotalites polonica n.sp.
(Pl. XIII, Fig. 6 *a—c*)

Holotype: specimen in Pl. XIII, Fig. 6 *a—c*
Type horizon: Cenomanian.
Type locality: Łódź 4a borehole.
Derivation of the name: after the country's name.

Diagnosis. — Test very small, plano-convex, ventral side conical, round and strongly incised in outline. Margin provided with a keel, surface smooth, lustrous. The last whorl composed of five to six chambers.

Material. — Seventy well-preserved specimens.

Dimensions (in mm):

	IG 4378/70/F	IG 4155/70/F	IG 4379/70/F
Greater diameter . . .	0.198	0.180	0.144
Smaller diameter . . .	0.144	0.162	0.126
Height	0.126	0.095	0.108

Description. — Test very small, conical. Dorsal side completely evolute, flat or, more frequently, fairly strongly concave, with inner whorls invisible, obscured by a glassy thickening of test. Outer whorl narrow, com-

posed of five to six chambers. Chambers lobular in outline, their surfaces flat or concave. Sutures slightly arcuate, thickened, connected with keel. Ventral side almost completely involute, conical, with only the last whorl visible. Chambers high, strongly convex, triangular in outline. Apexes of chambers rounded at the umbilicus. Sutures strongly depressed, radial. Umbilicus very distinct, narrow, round, deep, open. Apertural surface convex, aperture narrow, slitlike, covered with a thin, very narrow lip.

Variability. — Mostly the depression of the central part of the dorsal side of test and the width of umbilicus are the characters subject to a rather small individual variability.

Remarks. — The newly described species differs from the hitherto known representatives of the genus *Globorotalites* in its very characteristic appearance. It differs from *Conorotalites intercedens* (Bettenstaedt) and *C. aptiensis* (Bettenstaedt) from the Barremian and Aptian deposits in finer pores on the surface of test, invisible inner whorls which are obscured by test substance, triangular outline of chambers on the ventral side, radial sutures on the ventral side and more strongly developed umbilicus. In the position of the walls of the chambers on the ventral side subperpendicular to the periphery of test, *G. polonica* n.sp. is related to *C. bartensteini* (Bettenstaedt) the oldest phylogenetically and to *C. intercedens* (Bettenstaedt), which is the next in this series. It differs from *C. bartensteini* in a different outline of test, invisible inner whorls on the dorsal side, radial sutures on the ventral side and different outline of chambers on the ventral side. The species from Poland differs from *G. brotzeni* Hofker, 1957 from the Upper Albian of the Netherlands in its by half smaller dimensions, lower number of chambers in the last whorl, triangular outline of chambers and radial sutures on the ventral side, invisible inner whorls on the dorsal side and thickened sutures of the last whorl on the dorsal side. From *G. brotzeni rumanus* Neagu, 1965 from the Albian of Rumania, it differs in its dimensions more than two times smaller triagular outline of chambers with rounded apexes on the ventral side, considerably stronger convexity of the surface of chambers, uniform increase in the height of chambers and a slightly convex apertural surface.

Distribution. — Poland: Upper Albian.

Genus *Gyroidinoides* Brotzen, 1942

Gyroidinoides infracretacea (Morozova, 1948)

(Pl. XIII, Fig. 8 *a*—*c*)

1948. *Gyroidina nitida* (Reuss) var. *infracretacea* Morozova; V. G. Morozova, Foraminifery niżnemelovych..., p. 40, Pl. 2, Figs. 12—14.

1963. *Gyroidina* cf. *infracretacea* (Morozova); O. Pazdro, in K. Birkenmajer & O. Pazdro, Wiek i pozycja geologiczna..., p. 446, Pl. 20, Figs. 6—9.

1966. *Gyroidina infracretacea* Morozova; J. Salaj & O. Samuel, Foraminiferen der Westkarpaten..., pp. 143, 144, Text-fig. 7, p. 143 (*here additional synonymy included*).

Material. — More than 300 well-preserved specimens.

Dimensions (in mm):

	IG 4156/70/F	IG 4380/70/F	IG 4381/70/F
Diameter . .	0.234	0.180	0.160
Height . .	0.144	0.160	0.110

Description. — Polish specimens corresponding to the greatest extent to Mjatliuk's (1953) description, have, however, only seven and not six chambers in the last whorl.

Variability. — The convexity of the dorsal side of test and dimensions of individuals are subject to variability.

Remarks. — Our spicimens differ from the holotype in smaller dimensions, lesser convexity of the ventral side of test and its more spherical shape. In these same characters they differ from the specimens from Western Slovak Carpathians. In their dimensions and outline of test they resemble *Gyroidina nitida* Reuss, 1845, from which they differ in a less convex ventral side and more convex dorsal side, convex chamber on the ventral and strongly depressed sutures. They differ from the specimens desmribed from the Pieniny Mts (Pazdro, 1963) in smaller dimensions and more regular outline of test.

Distribution. — Poland: the Pieniny Klippen Belt: Lower Barremian through Albian, Polish Lowland: Albian through Lower Turonian; Czechoslovakia (Western Carpathians): Middle Barremian, Albian; U.S.S.R.: Albian.

Family **Anomalinidae** Cushman, 1927
Subfamily **Anomalininae** Cushman, 1927
Genus *Anomalina* d'Orbigny, 1826
Anomalina gorzowiensis n.sp.
(Pl. XIV, Figs. 2—4; Text-fig. 5)

Holotype: specimen in Pl. XIV, Fig. 3 *a*—*c*.
Paratypes: specimens in Pl. IV, Figs. 2 *a*—*c* and 4 *a*—*c*.
Type horizon: Cenomanian.
Type locality: Gorzów Wkp. borehole, a depth of 709 m.
Derivation of the name: after the name of locality in which this species was first found.

Diagnosis. — Test involute, nearly plani-spiral, biconvex or plano-convex, oval and strongly lobulate in outline, composed of one and a half to two whorls. Apertural surface irregularly quadrangular.

Material. — Sixty well preserved specimens.

Dimensions (in mm):

	IG 4157/70/F	IG 4158/70/F	IG 4159/70/F
Diameter	0.288	0.324	0.270
Thickness	0.144	0.108	0.072
Thickness of the last chamber	0.180	0.162	0.126

Description. — Test biconvex, with a narrow, rounded margin. Only the last whorl, composed of seven to ten, triangular chambers, is visible on both its sides. In the initial part of whorl, the surface of chambers is flat

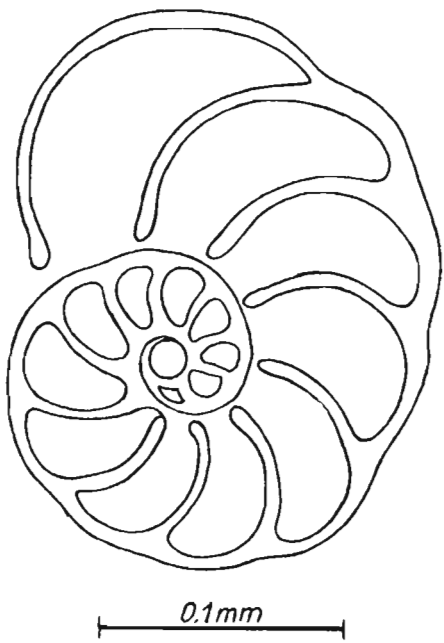


Fig. 5. — Horizontal section of *Anomalina gorzowiensis* n.sp.; diameter of the test, 0.270 mm, its thickness, 0.090 mm, diameter of the proloculus, 25.0 μ. Maszkowo II boring depth, 214.0 m.

on both sides and at the end of whorl strongly convex, more so on the dorsal side, which gives the impression of the test being plano-convex. On the dorsal side, the convexity of chambers suddenly increases in the terminal part of whorl. The last most convex chamber inclines towards the ventral side. Part of the inner whorl, situated in a narrow, shallow depression and taking the form of a small disc, is visible in the middle of the dorsal side. Septal sutures on both sides arcuate, in the initial part of whorl covered with listlike thickening or flat, transparent. In some of the specimens, they may be depressed. In the final part of whorl, sutures are depressed, particularly so on the dorsal side. Ventral side completely in-

volute, with a narrow, trough-like depression in the middle. In some of the specimens, the periumbilical part of chambers terminates in very small flaps. Apertural surface of the last chamber irregularly quadrangular or triangular, flattened or slightly convex. An arcuate, low aperture, surrounded by a thin lip, extending on the ventral side and reaching under the periumbilical part of the youngest two chambers occurs at its base. The four sectioned specimens, coming from Maszkowo II borehole (from a depth of 214.0 m), probably belong to macrospherical generation A. They are composed of one and a half to two whorls. The number of chambers in a test composed of one whorl and a half amounts to 17 and in the last whorl to nine. The writer has not succeeded in counting the number of chambers in individuals composed of two whorls. The size of the proloculus in all the specimens sectioned amounts to 25 μ.

Variability. — Almost all of the characters, that is, the outline, thickness and symmetry of test and ornamentation of sutures, particularly in the initial part of whorl, are subject to a very large individual variability. It is also manifested by either the presence or absence of flaps in the periumbilical part of chambers on the ventral side, degree of the inclination of the last chamber onto the ventral side and differentiation in the size and convexity of the apertural surface.

Remarks. — The newly described species resembles, in the shape and arragement of chambers, *Cibicides* (*Cibicides*) *polyrraphes* (Reuss) var. *juncta* Vassilenko (Vassilenko, 1961, p. 128, Pl. 25, Figs. 4, 5). The last-named species resembles the specimens, described by Tappan, 1943 (non 1940) under the name of *Anomalina plummerae* Tappan, but differs from them, in, among other characters, a more sudden increase in the convexity of chambers.

Distribution. — Poland: Upper Albian through Lower Turonian.

Genus *Lingulogavelinella* Malapris, 1965

Type species: *Lingulogavelinella albiensis* Malapris, 1965

The type species seems to be, in all its characters, in conformity with the American species *Valvulineria asterigerinoides* Plummer and should be acknowledged as its younger synonym.

Lingulogavelinella asterigerinoides asterigerinoides (Plummer, 1931)

(Pl. XIV, Fig. 5 *a—c*; Text-fig. 6)

1931. *Valvulineria asterigerinoides* Plummer; H. Plummer, Some Cretaceous Foraminifera..., p. 190, Pl. 14, Fig. 6 a—c.

1940. *Valvulineria asterigerinoides* Plummer; H. Tappan, Foraminifera from the Grayson..., p. 120, Pl. 19, Fig. 9 a—c.

1943. *Valvulineria asterigerinoides* Plummer; H. Tappan, Foraminifera from the Duck..., p. 511, Pl. 82, Figs. 10 a—c, 11.

1961. *Anomalina (Pseudovalvulineria) frankei* (Bykova); V. P. Vassilenko, Foraminifery verchnego mela..., pp. 115, 116, Pl. 21, Figs. 1 a,b,w, 2 a,b,w (non Pl. 20, Fig. 6 a,b,w).

1965. *Lingulogavelinella albiensis* Malapris; M. Malapris, Les Gavelinellidae et Formes..., p. 140, Pl. 4, Figs. 5—8.

1967. *Lingulogavelinella albiensis albiensis* Malapris-Bizouard; M. Malapris-Bizouard, Les Lingulogavelinelles de l'Albien..., pp. 132, 133, Pl. 1, Figs. 4—9; Pl. 2, Figs. 6—10.

Material. — More than 200 well-preserved specimens.

Dimensions (in mm):

	IG 4160/70/F	IG 4382/70/F	IG 4383/70/F
Diameter . .	0.360	0.288	0.234
Thickness . .	0.144	0.126	0.108

Description. — Test involute, with a very low axis of coiling, smooth, oval, slightly biconvex, either equally convex on both sides, or more so

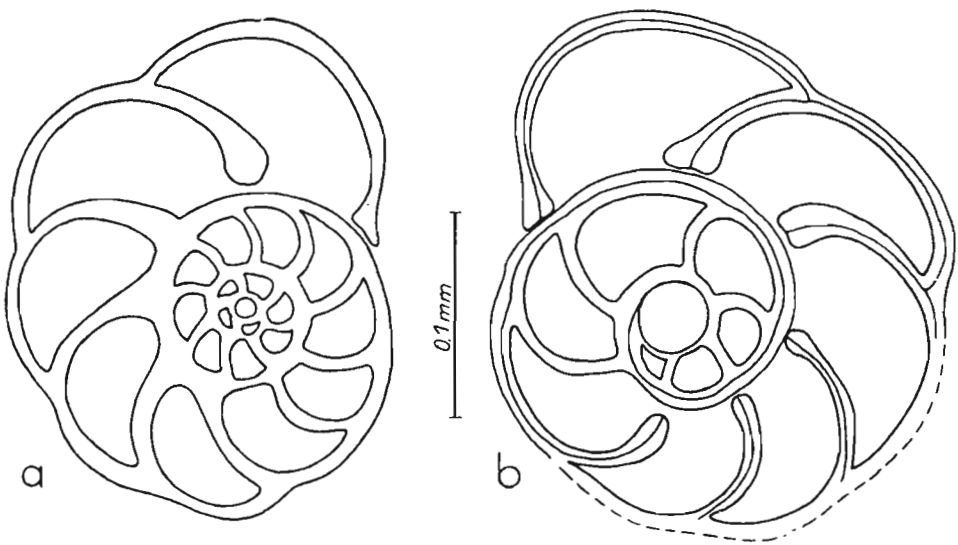


Fig. 6. — *Lingulogavelinella asterigerinoides asterigerinoides* (Plummer); *a* horizontal section of generation B, diameter of the test, 0.288 mm, its thickness, 0.126 mm, diameter of the proloculus 12.0 μ; *b* horizontal section of generation A, diameter of the test, 0.324 mm, its thickness, 0.162 mm, diameter of the proloculus 40.8 μ. Łódź 5a boring, depth 626.0 m.

on the dorsal side, composed of one and a half to three whorls, slightly incised in outline. Periphery narrow but not sharp, in the younger part of test rounded. Only the last whorl, composed of six to eight chambers, is visible on both sides of test. The dorsal side less involute than the

ventral and, in most of the specimens, more convex. A narrow, shallow, round depression, with a small disc, formed of test substance, visible on its bottom, occurs in its middle. The outline of chambers triangular, in the final part of whorl rhomboidal. The surface of chambers slightly convex. The most strongly convex are the youngest two chambers which are also the largest and form nearly a half of the last whorl. Sutures slightly deflected posteriorly, in the initial part flat, transparent, in the final depressed between two or three chambers. The ventral side completely involute, slightly convex, flat, or — in some of the specimens slightly concave. Chambers triangular, with flat surfaces, except for the final one, which is rhomboidal in outline and slightly convex. Lamellate flaps, extended more or less to halfway the length of sutures, grow from the periumbilical parts of chambers. In the younger chamber, this flap overlaps that of the older chamber on the sutural periphery. Thus, a characteristic starlike ornamentation is formed in the middle of test. A small thickening occurs in the middle of this "star" in some of the specimens. Sutures situated near the lamellate flaps in the initial part of whorl are flat and deflected posteriorly and in the terminal part of whorl depressed, sigmoidal. Apertural surface of the final chamber slightly convex, with an arcuate aperture surrounded by a thin and fairly wide lip, situated at its base. Aperture extends onto the ventral side and reaches under a subrectangular, large lamella of the final chamber. Specimens belonging to two generations have been found in populations studied. They do not differ from each other in their morphological characters. The longer diameter of five sectioned specimens of both generations amounts from 0.306 to 0.824 mm and the shorter from 0.252 to 0.288 mm. Specimens of macrospherical generation A (three to five of them on the specimen sectioned) are composed of one and a half to two whorls with a total of 13 chambers, the last whorl containing six to seven chambers. The size of the proloculus amounts in these specimens from 35.0 to 40.8 μ. In individuals of microspherical generation B, the size of the proloculus varies within limits of 12.5 and 15.0 μ. Test composed of three whorls with a total of 21 to 22 chambers, the last whorl consisting of 8 chambers. Since in preparing thin sections attention has only been paid to cutting through the middle of the proloculus, no lamellae are visible in Fig. 6.

Variability. — A considerable individual variability concerns the following characters: the symmetry of test, involuteness of the dorsal side, curvature and depression of sutures, convexity of chambers, width of lamellate flaps on the ventral side and shape of aperture (arcuate, fairly high or only slightly arcuate, slitlike).

Remarks. — Specimens from Poland differ from the American ones (Plummer, 1931) only in a somewhat larger involuteness of the dorsal side and more arcuate sutures.

Distribution. — Poland: Upper Albian through lowermost Turonian; France: Lower Albian; U.S.S.R.: probably the Cenomanian of the Mangishlak Peninsula; U.S.A. (Texas): Albian.

Lingulogavelinella asterigerinoides (Plummer) *arachnoidea* n.subsp.
(Pl. XV, Figs. 1 *a—c*; 2 *a—c*)

Holotype: specimen shown in Pl. XV, Fig. 1 *a—c*.
Type horizon: Upper Albian deposits.
Type locality: Łódź 5a borehole.
Derivation of the name: after the ornamentation of the ventral side of test.

Diagnosis. — Test involute, biconvex, composed of two whorls, the last of them consisting of seven to nine chambers. A node, formed by a thickening of test, occurs in the middle on its both sides.

Material. — A hundred and fifty well-preserved specimens.

Dimensions (in mm):

	Holotype IG 4161/70/F	IG 4385/70/F	IG 4386/70/F
Diameter	0.378	0.342	0.252
Thickness	0.180	0.144	0.126
Thickness of the last chamber	0.162	0.180	0.126

Description. — Test involute, biconvex, equally convex on both sides or somewhat more so on the ventral side, lustrous and mostly composed of two whorls and one or two chambers in an incipient third whorl. Outside of test, only the last whorl, consisting of seven to nine chambers is visible on both sides. Test suboral almost round, non-incised in outline, except in some of the specimens which are slightly incised at the end of whorl. The margin of test rounded, relatively narrow in the initial part of whorl and wider in its terminal part. Dorsal side less involute than ventral. A node, formed of a glassy test substance, occurs in the middle of the dorsal side. Chambers triangular in outline. The surface of chambers in the initial part of whorl flat, in the final convex. Septal sutures either slightly translucid, flat, or somewhat depressed. In some of the specimens they are visible only near the central part of test and disappear towards its periphery. In the terminal part of whorl sutures are in all specimens depressed over the entire length. Ventral side completely involute, chambers triangular with a flat surface, except for the youngest three in which it is slightly convex. Septal sutures sigmoidal, depressed, in the initial part of whorl invisible in some of the specimens. A node, projecting above the surface of chambers and surrounded by a pattern resembling in shape the arrangement of a spider limbs, occurs in the middle of the ventral side. This pattern is formed by inter-chamber sutures. Apertural surface

convex, aperture arcuate, high, surrounded by a fairly wide lip, situated equatorially at the base of the apertural surface of the last chamber, extending itself onto the ventral side and reaching under the flap of the last chamber. Specimens belonging only to macrospherical generation A have been found in the population studied from Łódź 5a borehole (from a depth of 608.5 mm). They are mostly composed of two whorls, an incipient third whorl being observed in one case out of four. A total number of chambers in two-whorl specimens amounts to 15 to 19, the last whorl containing eight to nine of them. The proloculus is 30.0 to 40.8 μ in size.

Variability. — A considerable individual variability concerns the depression of sutures on the dorsal side, size of node on both sides of test (in some of the specimens, a narrow depression devoid of node occurs on the dorsal side) and width of lamellae growing from the periumbilical part of chambers. In some of the specimens, the lamellae do not occur, in particular near the chambers in the initial part of whorl. In such cases, sutures are depressed near the umbilicus and flat at the periphery of test.

Remarks. — The newly erected subspecies differs from the nominal one in a greater number of chambers forming the test, greater number of chambers in the last whorl, thicker test, its symmetry, shape of ornamentation on its ventral side and presence of nodes on its both sides. There are also transitional specimens which relate these two subspecies.

Distribution. — Poland: Upper Albian, Cenomanian.

Lingulogavelinella formosa (Brotzen, 1945)
(Pl. XIV, Fig. 1 *a*—*c*; Text-fig. 7)

1945. *Cibicides formosa* Brotzen; F. Brotzen, De geologiska resultaten..., p. 55, Pl. 2, Fig. 3.
1961. *Anomalina (Pseudovalvulineria) jarzevae* (Vassilenko); V. P. Vassilenko, Foraminifery verchnego mela..., pp. 114, 115, Pl. 20, Figs. 3 a,b, 4 (*here additional synonymy included*).
1961. *Cibicides (Cibicidoides) jarzevae* Vassilenko; O. S. Lipnik, Foraminifery i stratigrafija..., p. 57, Pl. 7, Fig. 1 a—c.
1962. *Cibicides formosa* Brotzen; H. Hiltermann & W. Koch, Leitfossilien..., p. 319, Pl. 46, Fig. 1 a—c, Tab. 19.

Material. — Eighty well-preserved specimens.

Dimensions (in mm):

	IG 4387/70/F	IG 4388/70/F	IG 4389/70/F
Diameter	0.360	0.320	0.270
Thickness	0.144	0.126	0.126
Thickness of the last chamber	0.180	0.162	0.180

Description. — The specimens under study completely correspond to Pożaryska's (1954) description. Individuals belonging to two generations

have been found among specimens not differing from each other in their morphological characters. Individuals of microspherical generation B are composed of two and a half whorls with a total of 19 chambers, six and a half to seven of them in the last whorl. The size of the proloculus in

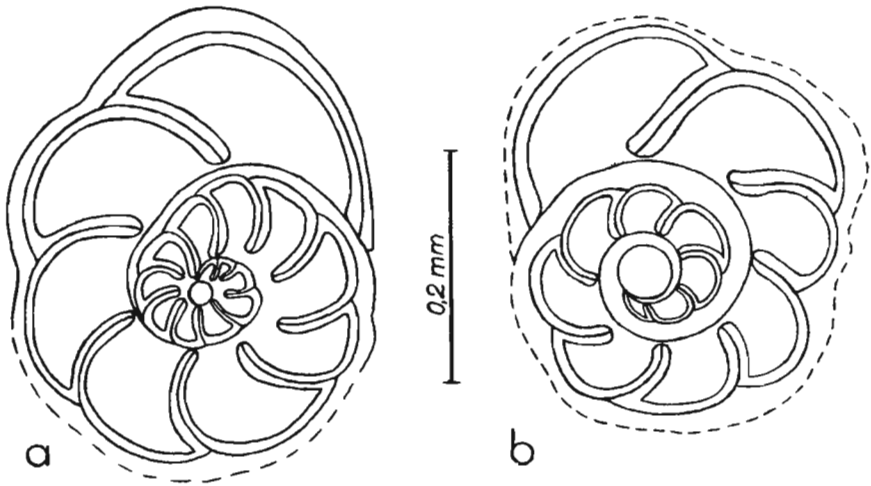


Fig. 7. — *Lingulogavelinella formosa* (Brotzen); *a* horizontal section of generation B, diameter of the test, 0.360 mm, its thickness, 0.144 mm, diameter of the proloculus, 10.0 μ; *b* horizontal section of generation A, diameter of test, 0.320 mm, its thickness 0.126 mm, diameter of the proloculus 43.2 μ; Łódź 5a boring, depth 595.0 m.

these specimens amounts to 10.0 μ. Individuals of macrospherical generation A consist of one whorl and a half with a total of 13 chambers, six to seven of them in the last whorl. The size of the proloculus amounts to 43.2 μ.

Variability. — It manifests itself in the convexity of chambers on the dorsal side which form a sort of a crown, degree of the curvature of sutures on both sides of the test, presence or absence of a node on the dorsal side and size of lingulate flaps on the ventral side.

Remarks. — Specimens from Poland are, in all their characters, in conformity with the holotype. Brotzen's specimen, described as *Cibicides formosa* Brotzen, was given a new specific name of *Cibicides* (*Cibicides*) *jarzevae* by Vassilenko (1954) who found that the specific name *C. formosa* had been employed by Sequenz in 1880 to call one of the species of the genus *Cibicides* coming from the Pliocene deposits of Italy. Later, Vassilenko (1961) assigned *C. jarzevae* to the genus *Anomalina*. *C. formosa* Brotzen seems, however, to belong to the genus *Lingulogavelinella* Malapris, since it has an involute test and an umbilicus covered on the ventral side with lingulate flaps of the periumbilical parts of chambers forming a star-shaped ornamentation. For this reason, the specific name "*formosa*" should be restored to these forms. According to Hiltermann & Koch (1962),

Cibicides formosa Brotzen begins to change itself in the Upper Cenomanian deposits: the chambers forming "crowns" on its dorsal side become lower and the middle of test-higher. These authors believe that the changes that took place in the Middle Turonian were so far-reaching that the forms of this age cannot be assigned any more to *L. formosa*. Thus, the German authors found some species similar to *L. formosa* and *L. pazdroae* n.sp.

Distribution. — Poland: Upper Albian, Cenomanian; Germany: Cenomanian, Lower Turonian; Sweden: Albian, Cenomanian; U.S.S.R.: Cenomanian.

Lingulogavelinella globosa (Brotzen, 1945)

(Pl. XV, Figs. 4 *a—c*, 5 *a—c*)

1954. *Anomalinoides globosa* Brotzen; F. Brotzen, De geologiska resultaten..., pp. 55, 56, Pl. 2, Fig. 6 a—c.
1954. *Anomalinoides globosa* Brotzen; K. Pożaryska, O przewodnich otwornicach..., p. 268, Fig. 28 a,—c.
1958. *Anomalinoides globosa* Brotzen; E. Witwicka, Stratygrafia mikropaleontologiczna..., p. 228, Pl. 19, Fig. 38 a—c.
1961. *Anomalina (Pseudovalvulineria) globosa* (Brotzen); V. P. Vassilenko, Foraminifery verchnego mela..., pp. 113, 114, Pl. 20, Figs. 2 a,b,w, 5 a,b,w. (*here additional synonymy included*).
1961. *Cibicides (Anomalinoides) globosa* Brotzen; O. S. Lipnik, Foraminifery i stratigrafia..., pp. 57, 58, Pl. 6, Fig. 1 a—c.
1961. *Anomalina (Pseudovalvulineria) globosa* Brotzen; V. S. Akimez, Stratigrafia i foraminifery..., p. 156, Pl. 15, Figs. 7 a,b,w, 8 a,b,w.
1963. *Cibicides (Anomalinoides) globosus* (Brotzen); O. K. Kaptarenko-Tshernousova et al., Atlas charakternych foraminifer..., p. 202, Pl. 14, Fig. 6 a,b,w.
1966. *Orostella turonica* Butt; A. A. Butt, Foraminifera of the type..., p. 180, Pl. 3, Fig. 6 a,b,c; Pl. 4, Fig. a—c.

Material. — More than 200 well-preserved specimens.

Dimensions (in mm):

	IG 4390/70/F	IG 4391/70/F	IG 4392/70/F
Diameter	0.522	0.342	0.252
Thickness	0.216	0.162	0.108
Thickness of the last chamber	0.270	0.216	0.126

Description. — Our specimens correspond to the greatest extent to Pożaryska's (1954) description. Having varying diameters of their tests (between 0.522 and 0.360 mm), they belong to one generation. The size of the proloculus amounts in them from 41.0 to 37.5 μ. They are composed of one and a half to two whorls with a total of nine to thirteen chambers, five to seven of them being in the last whorl.

Variability. — A fairly large individual variability concerns the size of specimens, evoluteness of the dorsal side, number of whorls and chamb-

ers in the last whorl, shape of tests, curvature of sutures on the dorsal side, shape and size of aperture.

Remarks. — Much the same as the specimens coming from Paris Basin and described by Butt (1966) as *Orostella turonica*, those from Poland differ from the holotype in a lower number of chambers in the last whorl (five to seven and not eight to nine). In the populations studies no specimens have been found with a completely evolute dorsal side or deformed ones with the inner whorl projecting above the outer, similar to those described by Vassilenko (1961). Specimens, described by Akimez (1961) from the Cenomanian of Byelorussia, differ from the Polish ones in a greater number of whorls and chambers in the last whorl, in which they are similar to the holotype. The species discussed probably includes *Anomalina aumalensis* Sigal (1952) from the Cenomanian of Algeria. In the appearance of its ventral side, *L. globosa* resembles *L. orbiculata* (Kuznezova) (differences cf. the description of *L. orbiculata*). Probably *L. globosa* related to *L. asterigerinoides asterigerinoides*. Specimens, described by Franke (1928) as *Anomalina lorneiana* d'Orbigny and those described by Mjatliuk (1953) as *Valvulineria frankei* Bykova might be transitional forms between the two species. They are related more to the species *globosa* than *orbiculata*. Akimez (1961) considers them as representatives of *L. globosa*.

Distribution. — Poland: Upper Albian through Lower Turonian; Sweden: Cenomanian; U.S.S.R.: Cenomanian, Lower Turonian.

Lingulogavelinella kaptarenkae (Plotnikova, 1962)
(Pl. XVII, Fig. 3 *a—c*)

1962. *Anomalina* (*Pseudovalvulineria*) *kaptarenkae* Plotnikova; L. F. Plotnikova, Novije vidy vierchniokrejdovych..., p. 53, Pl. 2, Fig. 3 a,b,w.
1967. *Lingulogavelinella ciryi inflata* Malapris-Bizouard; M. Malapris-Bizouard, Les Lingulogavelinelles de l'Albien..., pp. 139—141, Pl. 1, Fig. 20, Pl. 2, Figs. 21, 22.

Material. — About 500 well-preserved specimens.

Dimensions (in mm):

	IG 4393/70/F	IG 4394/70/F	IG 4395/70/F
Diameter	0.234	0.216	0.198
Thickness	0.090	0.090	0.072
Thickness of the last chamber	0.126	0.108	0.090

Description. — Test very small, semi-involute, with a very short axis of coiling, plano-convex, with one whorl and a half visible on the dorsal side. Test round even or slightly incised in outline margin widely rounded. Dorsal side slightly convex, almost completely evolute, with one whorl

and a half visible on it. Inner whorl situated in a depression. Its division into chambers poorly visible. A depressed spiral suture separates it from the outer whorl. Outer whorl composed of eight to ten rhomboidal, wide chambers with a convex surface and very regularly increasing their height in the process of growth. Sutures between all chambers depressed, narrow, very slightly deflected posteriorly. Ventral side flat, completely involute, with a very small umbilicus. Only the last whorl, consisting of triangular chambers, having flat surfaces and covered with many fairly coarse pores is visible on that side. Short, triangular, lingulate flaps, covering a very small umbilicus, grow from the walls of chambers adjoining the umbilicus. Septal sutures arcuate, flat, translucent or slightly thickened. Apertural surface a little convex, aperture slightly arcuate, narrow, surrounded by a thin lip, situated on the margin of test, extending onto the ventral side and reaching under the flaps of chambers. Individual of two generations have been distinguished among identically looking specimens. In the individuals of microspherical generation B, the test consists of two and a half whorls with a total of 21—24 chambers, the last one containing nine to ten of them. The diameter of the proloculus amounts to 12.5 μ. The individuals of macrospherical generation A are composed of two whorls with a total of 18—20 chambers, eight to ten of them in the last whorl. The diameter of the proloculus amounts from 22.5 to 25.0 μ.

Variability. — A small individual variability mostly concerns the development of sutures on the ventral side of test. They may be either translucent, or lightly thickened and projecting over the surface of chambers. The variability is also expressed in the development of lingulate flaps on the ventral side. In some of the specimens, these flaps fuse with each other in the initial part of whorl forming an arcuate thickening connected with thickened sutures.

Remarks. — Specimens from Poland are, in almost all their characters, in conformity with the holotype. *L. ciryi inflata* Malapris-Bizouard, 1967 is a synonym of this species. The French specimens differ from the Russian ones only in smaller dimensions of the test and a greater number of chambers in the last whorl (nine to eleven in the former and nine to ten in the latter). The species under study differs from *L. ciryi*, to which it is most closely related, in a thicker and more symmetrical profile of test, flat and not concave ventral side and more convex outer whorl projecting above inner whorl on the dorsal side. Specimens, described by Eichenberg (1932—1933, p. 23, Pl. 2, Fig. 17 *a*—*c*) as *Anomalina complanata* Eichenberg (non Reuss) probably also belong to the species discussed.

Distribution. — Poland: Upper Albian through Lowermost Turonian; North-west Germany: Albian; France: Vraconian; U.S.S.R.: Upper Cenomanian, Lower Turonian.

Lingulogavelinella? ornatissima (Lipnik, 1961)
(Pl. XV, fig. 6 *a*—*c*; Text-fig. 8)

1961. *Cibicides (Anomalinoides) ornatissimus* Lipnik; O. S. Lipnik, Foraminifery i stratygrafia verchnokrejdowych..., pp. 59, 60, Pl. 6, Fig. 4 a—c.

Material. — Eighty well preserved specimens.

Dimensions (in mm):

	IG 4167/70/F	IG 4397/70/F	IG 4398/70/F
Diameter	0.414	0.360	0.270
Thickness	0.180	0.162	0.108
Thickness of the last chamber	0.216	0.180	0.126

Description. — Test planispiral, completely involute, thick equally convex on both sides devoid of umbilicus, round or slightly oval and even in outline, composed of two to two and a half whorls. Margin widely

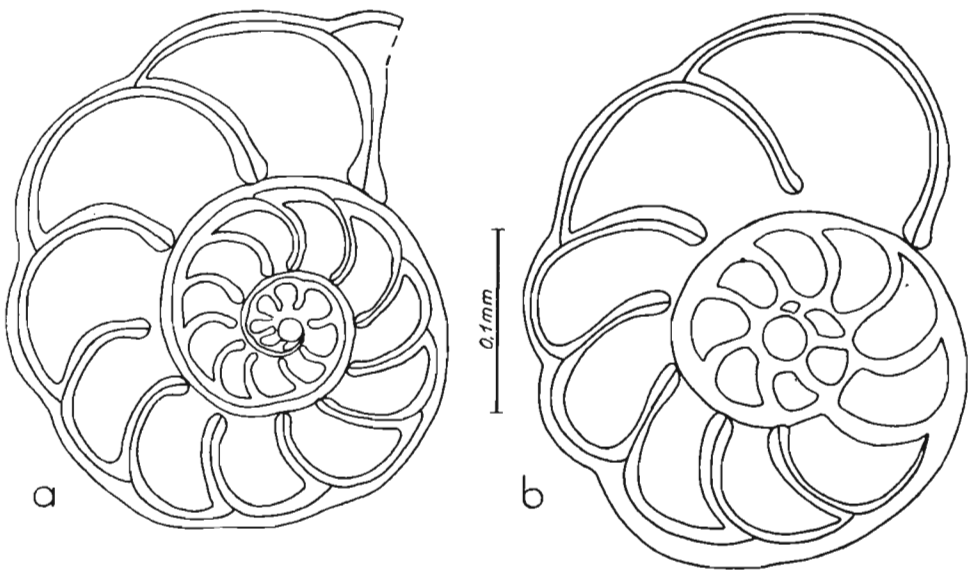


Fig. 8. — *Lingulogavelinella ornatissima* (Lipnik); *a* horizontal section of generation B, diameter of the test, 0.360 mm, its thickness, 0.144 mm, diameter of the proloculus 17.5 μ; *b* horizontal section of generation A, diameter of the test, 0.360 mm, its thickness, 0.162 mm, diameter of the poloculus 35.0 μ; Łódź 4a boring, depth 692.0 m.

rounded. Only the last whorl, composed of nine to ten chambers, is visible on both sides. The surface of chambers on both sides flat, covered with fairly coarse pores whose number decreases at the periphery of test. The surface of the last chamber slightly convex. All chambers terminate, in the middle of test on its both sides, in lamellate, triangular flaps. On one of the sides, those processes fuse with each other in the initial part

of whorl. On the opposite side of test, a tubercle surrounded by the processes of all chambers occurs in its middle. In most specimens, septal sutures are invisible, in some of them they are slightly marked at the end of whorl. Apertural surface slightly convex. Aperture semilunar, interiomarginal, situated equatorially, passing onto both sides of test and reaching under the flaps of chambers. In the population under study, individuals of two generations have been distinguished. They do not differ from each other in their exterior morphological characters. The sectioned individuals of both generations are of the same size (diameter, 0.378 mm). The individuals of microspherical generation B are composed of two and a half whorls with a total of 27 chambers, ten of them forming the last whorl The diameter of the proloculus amounts to 17.5 μ. The individuals of macrospherical generation A are composed of two whorls with a total of 19 chambers. The diameter of the proloculus amount to 35.0 μ.

Variability. — A small individual variability concerns the outline of test, distinctness of sutures and length of flaps in the periumbilical part of chambers.

Remarks. — It is very difficult to assign the species described to any of the genera known so far. It is most closely related to the representatives of the genus *Anomalina* d'Orbigny in its planospiral coiling of test, rounded margin and interiomarginal aperture. It seems, however, to resemble to the greatest extent the representatives of the genus *Lingulogavelinella* Malapris. Of the characters common to them, noteworthy are a complete involuteness of test, lack of umbilicus, type of ornamentation and aperture. On the other hand, the presence of lamellar flaps on both sides of test and extension of aperture are distinctive characters. Specimens from Poland differ from Russian ones only in the presence of a tubercle, surrounded by the flaps of chambers, on one of the sides.

Distribution. — Poland: Cenomanian through Lower Turonian; U.S.S.R.: Upper Cenomanian.

Lingulogavelinella orbiculata (Kusnezova, 1953)
(Pl. XV, Fig. 3 *a*—*c*)

1953. *Valvulineria orbiculata* Kusnezova; E. V. Mjatliuk, Spirillinidy, Rotaliidy..., p. 81, Pl. 9, Fig. 5 a,b,w.
1961. *Anomalina (Pseudovalvulineria) orbiculata* (Kusnezova); V. P. Vassilenko, Foraminifery verchnego mela..., pp. 116, 117, Pl. 21, Figs. 3 a,b,w, 4 a,b,w, 5 a,b,w.
1961. *Cibicides (Anomalinoides) globosa* (Brotzen) var. *pentacameratus* Lipnik; O. S. Lipnik, Foraminifery i stratygrafija..., pp. 58, 59, Pl. 6, Fig. 3 a—c.

Material. — A hundred and fifty well-preserved specimens.

Dimensions (in mm):

	IG 4399/70/F	IG 4400/70/F	IG 4401/70/F
Diameter	0.288	0.234	0.180
Thickness	0.144	0.108	0.090
Thickness of the last chamber	0.162	0.108	0.126

Description. — Test round, involute, biconvex, strongly incised in outline, composed of one to one and a half whorls. The last whorl composed of five, convex, triangular chambers. The last chamber, the largest of them, occupies one-third of the test is slightly inclined on the dorsal side and covers with its margin the area of umbilicus. The margin of test wide, rounded. Sutures on the dorsal side radial and depressed, on the ventral side sigmoidal and covered with lamellar flaps of the periumbilical parts of chambers. Lamellae reach halfway the length of suture, completely covering the area of umbilicus. Aperture slitlike, narrow, surrounded by a thin lip, situated at the base of apertural surface, extending onto the ventral side and reaching under the lamellae of the last chamber. Tests are composed of either one whorl or one and a half. A total number of chambers in the specimens, composed of one and a half whorls, amounts to seven, with five of them in the last whorl. The size of the proloculus amounts to 20 μ. In the individuals formed by a single whorl, the last is composed of six chambers and the size of the proloculus amounts to 15 μ. They seem to be individual of one generation.

Variability. — The number of whorls, shape of aperture and inclination of the last chamber towards the dorsal side are elements of a small individual variability.

Remarks. — Polish specimens are, in almost all their characters, in conformity with the holotype and with Vassilenko's (1961) specimens. Specimens described by Lipnik (1961) as *Cibicides (Anomalinoides) globosus pentacameratus* are in all details in conformity with *L. orbiculata.*

Distribution. — Poland: Upper Albian through Lowermost Turonian; U.S.S.R.: Cenomanian.

Lingulogavelinella pazdroae n.sp.
(Pl. XIV, Fig. 6 *a*—*c*; Text-fig. 9)

Holotype: specimen shown in Pl. XIV, Fig. 6 *a*—*c*.
Type horizon: Cenomanian.
Type locality: Maszkowo II borehole (at a depth of 214.0 m)
Derivation of the name: dedicated to Professor Olga Pazdro, a Polish micropalaeontologist.

Diagnosis. — Test involute, with a short axis of coiling, biconvex with more convex dorsal side, composed of two and a half whorls. Only the last

whorl is visible on both its sides. At the end of the whorl on the dorsal side chambers take a cuneate shape. A large boss occurs in the middle of the dorsal side.

Material. — Seventy well-preserved specimens.

Dimensions (in mm):

	Holotype	Paratypes		
	IG 4169/70/F	**IG 4402/70/F**	**IG 4403/70/F**	**IG 4404/70/F**
Diameter	0.540	0.540	0.414	0.270
Thickness	0.234	0.252	0.198	0.144
Thickness of the last chamber	0.288	0.270	0.216	0.126

Description. — Test involute, sub-planispiral, biconvex, round, even and, at the end of whorl in some of the specimens slightly incised in outline. The margin of test narrow, provided with a rounded keel. Only the last whorl,

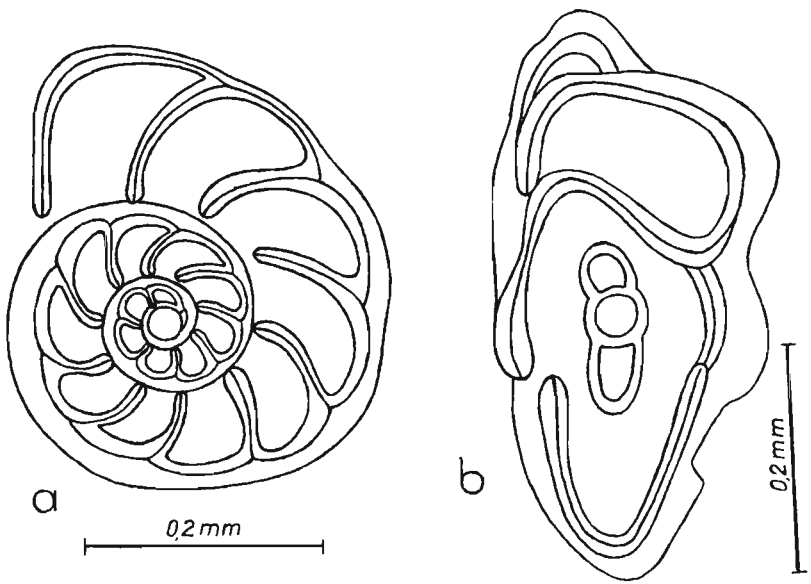


Fig. 9. — *Lingulogavelinella pazdroae* n.sp., *a* horizontal section of generation A, diameter of the test, 0.450 mm, its thickness, 0.216 mm, diameter of the proloculus 30.0 μ; Maszkowo II boring, depth, 214.0 m, *b* vertical section of the test showing the arrangement of chambers, Marzenin IG I boring depth, 196.0 m.

composed of nine to ten chambers, is visible on both sides of test. The surface of test smooth, lustrous. Dorsal side fairly strongly convex, with the chambers of the last whorl, in the initial part low, flat or slightly convex and at the end (three to four chambers) high, conical, convex, visible on this side. The apexes of chambers strongly swollen. Sutures slightly arcuate, subradial, narrow, most strongly depressed between three to four last chambers. In some of the specimens, sutures in the initial part of whorl

are flat, almost invisible. A large, lustrous boss, occupying about one-third of the surface of test occurs in the middle of the dorsal side. In the initial part of whorl, it is connected with the surface of chambers but projects above them, in the final part of whorl, it is separated from the chambers by a depression and surrounded by the apexes of the youngest three chambers. Ventral side feebly convex, with a narrow, hooklike thickening occurring in its middle. In some of the specimens, this thickenning takes the form of a small, flat node. In the last, visible whorl, chambers are narrow, trapezoidal and deflected towards the posterior part of test with a completely flat surface. The periumbilical peripheries of chambers, terminating in large, lamellar flaps, may be arranged in a starlike pattern. Apertural surface flat or slightly convex. Aperture arcuate, high, surrounded by a narrow lip, interiomarginal, equatorially situated, extended onto the ventral side and reaching under lamellar flaps. The two specimens sectioned display tests composed of two and a half whorls with a total of 20 chambers, nine of them in the last whorl. The diameter of the proloculus amounts to 30.0 μ.

Variability. — The individual variability is manifested in a varying convexity of chambers on the dorsal side and a varying degree of the depression of sutures.

Remarks. — In its shape and in the shape of chambers on the dorsal side, the newly described species slightly resembles *L. formosa* (Brotzen), from which it differs, however, in twice as large dimensions, greater number of chambers in the last whorl presence of a large boss on the dorsal side and convex ventral side. In the shape of its test and presence of a boss on the dorsal side, it resembles specimens described by Bukalova (1958) as *Cibicides jarzevae* Vassilenko var. *caucasica*. From this subspecies the individuals of *L. pazdroae* n.sp. differ in twice as large dimensions, lower number of whorls, biconvex test, presence of a large boss projecting above the surface of the oldest chambers in the whorl on the dorsal side and in the presence of a hooklike thickening or node on the ventral side.

Distribution. — Poland: Upper Albian through Lower Turonian.

Lingulogavelinella spinosa (Plotnikova, 1962)
(Pl. XVIII, Fig. 1 *a—c*)

1962. *Cibicides (Cibicides) spinosus* Plotnikova; L. E. Plotnikova, Novije vidy verhnokrejdovych..., p. 54, Pl. 2, Fig. 4 a,b,w.

Material. — More than 200 well-preserved specimens.

Dimensions (in mm):

	IG 4448/70/F	IG 4449/70/F	IG 4450/70/F
Diameter	0.252	0.216	0.180
Thickness	0.072	0.090	0.072
Thickness of the last chamber	0.120	0.108	0.090

Description. — Test very small, semi-involute, planoconvex, round or suboval in outline, composed of two whorls. Only the last whorl is visible on both sides of the test. The periphery of test narrow, rounded. Dorsal side convex, conical, semi-involute, with a distinctly visible last whorl composed of nine, narrow chambers, gradually increasing in the process of growth. The surface of chambers flat, covered with very fine, closely spaced tubercles. The surface of the youngest two chambers slightly convex, devoid of ornamentation. Sutures wide, raised, projecting above the surface of chambers, frayed, covered with a beaded ornamentation, in the initial part of whorl subradial, in the final part strongly deflected posteriorly. A deep depression, occupying approximately one-third of the surface of test, occurs in the middle of the dorsal side. The preceding whorl is situated on the bottom of this depression. Ventral side completely involute, flat, with a very small umbilical depression, surrounded by short, lamellar flaps of chambers, forming in some of the specimens a starlike ornament. The surface of chambers flat, covered with many coarse, closely spaced pores. Sutures wide, flat or slightly projecting over the surface of test, strongly arcuate. Apertural surface slightly convex or flat. A low, arcuate aperture, surrounded by a very narrow lip, is situated at its base on the margin of test. It extends onto the ventral side and extends under lamellar flaps of chambers. The five sectioned specimens of this species are representatives of one generation. The diameter of the proloculus amounts to 25.0 μ. They are composed of two whorls each with a total of 17 chambers, nine of them in the last whorl.

Variability. — The shape of test, convexity of the last two chambers, convexity of sutures on the ventral side and number of lamellar flaps on the ventral side are subject to a rather small individual variability.

Remarks. — Specimens from Poland are in conformity with the holotype. This species does not belong to the genus *Cibicides*, within which it was placed by Plotnikova (1962) because of the initial part of its whorl is situated on a more evolute, conical side of test, which should be considered as the dorsal side. *L. spinosa* is most similar to *Gavelinella thalmanni* (Brotzen) in the pattern of the ornamentation of its dorsal and development of its ventral side. It differs from this species in considerably smaller dimensions, smaller evoluteness of the dorsal side and its conical convexity.

Distribution. — Poland: Upper Albian, Cenomanian; U.S.S.R.: Upper Cenomanian.

Genus *Gavelinella* Brotzen, 1942
Subgenus *Berthelina* Malapris, 1965
Gavelinella (Berthelina) belorussica (Akimez, 1961)

(Pl. XVI, Figs. 5 *a—c*, 6 *a—c*; Text-fig. 10)

1880. *Anomalina complanata* Reuss; M. Berthelin, Mémoire sur les Foraminifères..., pp. 66, 67, Pl. 4, Figs. 12 a—c, 13.
1950. *Anomalina berthelini* Ten Dam; A. Ten Dam, Les Foraminifères de l'Albien..., pp. 56, 57, Pl. 4, Fig. 9 a—c.
1954. *Anomalina (Pseudovalvulineria) berthelini* Keller; V. P. Vassilenko, Anomalinidy, Pl. 14, Fig. 4 a,b,w. (non Pl. 14, Fig. 3 a,b,w).
1954. *Gavelinella berthelini* (Dam 1950); H. Bartenstein, Revision von Berthelin's Mémoire..., p. 49.
1961. *Anomalina (Brotzenella) belorussica* Akimez; V. S. Akimez, Stratygrafia i foraminifery..., pp. 160, 161, Pl. 16, Fig. 1 a,b,w.
1965. *Anomalina complanata* Berthelin; M. Malapris, Les Gavelinellidae et Formes..., Pl. 1, Fig. 1 a,b,c.
1965. *Gavelinella (Berthelina) intermedia* (Berthelin); M. Malapris, Ibid., Pl. 2, Figs. 6 a,b,c, 7 a,b,c.
1965. *Gavelinopsis infracretacea simionensis* Neagu; T. Neagu, Albian Foraminifera of the Rumanian..., p. 32, Pl. 8, Figs. 4—7; Pl. 9, Figs. 1,2.
1966. *Gavelinopsis berthelini* (Keller 1935); E. Michael, Die Evolution der Gavelinelliden..., pp. 437, 438, Pl. 50, Figs. 18, 19.

Material. — More than 500 well-preserved specimens.

Dimensions (in mm):

	IG 4407/70/F	IG 4408/70/F	IG 4409/70/F
Diameter	0.684	0.486	0.306
Thickness	0.198	0.198	0.144
Thickness of the last chamber	0.180	0.144	0.090

Description. — Test smooth, finely and densely perforate, oval, biconvex or planoconvex, slightly incised or even in outline, with a narrow, rounded margin. Dorsal side more convex than the ventral. A thicknening, occurring in the central part on both sides of test, on the dorsal side takes the shape of a boss and on the ventral side of a hook or, sometimes, a small node. Only the last whorl, composed of nine to eleven trapezoidal chambers gradually increasing in the process of growth, is visible on both sides of the test. The surface of chambers on the dorsal side is, in the initial part of whorl, flat and in the final slightly convex in the youngest two or three chambers. On the dorsal side, sutures are slightly arcuate, in the initial part of whorl subradial, flat or slightly thickened, fairly wide and slightly projecting over the surface of chambers, between the youngest two or three chambers slightly concave. A boss situated in the middle of the dorsal side is strongly convex and occupies a quarter to one-third of its surface. Ventral side less convex than dorsal, in some of the specimens flat. The surface of chambers flat, except for the last chamber in which

it is slightly convex. Narrow and short lamellar flaps, situated on the margin of the umbilical depression, grow out of the periumbilical margin of the youngest three or four chambers. On the ventral side, sutures are slightly deflected posteriorly, wide, strongly projecting over the surface of

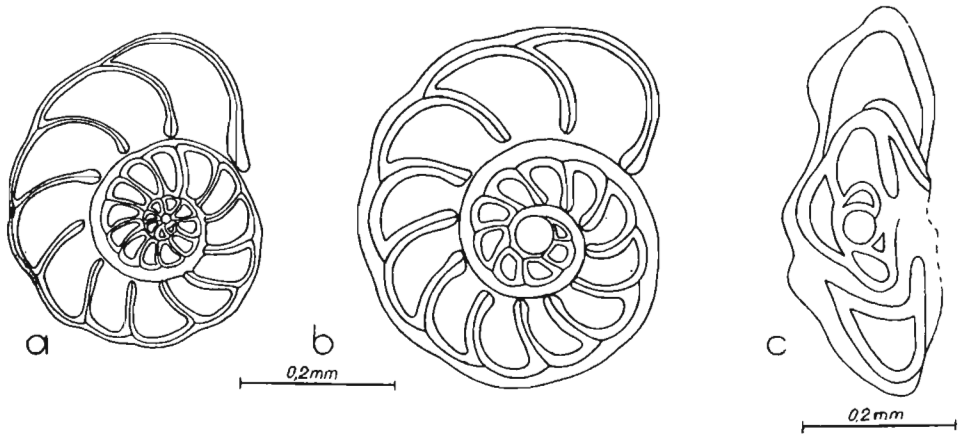


Fig. 10. — *Gavelinella* (*Berthelina*) *belorussica* (Akimez), *a* horizontal section of generation B, diameter of the test, 0.432 mm, its thickness, 0.198 mm, diameter of the proloculus 20.0 μ; Łódź 4a boring, depth, 817.0 m; *b* horizontal section of generation A, diameter of the test, 0.540 mm, its thickness, 0.234 mm diameter of the proloculus, 60.0 μ; Maszkowo II boring, depth, 237.0 μ; *c* vertical section showing the arrangement of chambers, diameter of the test, 0.501 mm and its thickness, 0.216 mm diameter of the proloculus, 40.0 μ; Łódź 5a boring, depth 595.0 m.

chambers. In the initial part of whorl, they take the form of rollers and between the youngest two or three chambers they are flat or slightly concave. A hooklike thickening, projecting above the surface of test to the some extent as the sutures, occurs in the area of umbilicus. In some of the specimens a small node occurs in the middle of the ventral side. Apertural surface triangular, slightly convex or flat. Aperture low, semilunar, situated on the periphery of test, passing onto the ventral side and reaching under the lamellar flaps of the youngest three or four chambers. The diameter of test in the individuals, belonging to the macrospherical generation, is somewhat longer than in those of the microspherical generation. In the former, it amounts to about 0.524 mm and in the latter to about 0.432 mm. The microspherical specimens are composed of three whorls, which are invisible from the outside of test. Total numbers of chambers in these specimens amount to 29, with ten chambers in the last whorl. The diameter of the proloculus amounts to 25.0 μ. Macrospherical specimens are composed of two to two and a half whorls with a total of 20—23 chambers, eleven of them in the last whorl. The diameter of the proloculus varies from 48 to 60 μ.

Variability. — The following characters are subject to the individual variability: the convexity of a boss on the dorsal side, convexity of both sides of test, ornamentation of the ventral side, height and width of sutures, in particular on the ventral side and number of chambers in the last whorl (nine to twelve).

Remarks. — The holotype is contained within the limits of the variability of Polish specimens. Similar specimens were described by Bukalova (1958) as *Anomalina spinosa*, which differ from the specimens of *G. (B.) belorussica* from Byelorussia and Poland only in a greater extent of the evoluteness of both sides of test. For this reason, it is not unlikely that *G. (B.) belorussica* is a younger synonymy of *A. spinosa*. Bukalova (1958) includes *Anomalina complanata* Berthelin, 1880 (non Reuss) in the synonymy of her species. *A. complanata* Berthelin, 1880 (non Reuss) was included by Akimez (1961) also in the synonymy of *A. (Berthelina) belorussica*. It should be emphasized that *A. complanata* Berthelin, (non Reuss) was included by various authors in the synonymy of different species.

Distribution. — Poland: abundant in the deposits of the Upper Albian, less so in the Cenomanian and Lower Turonian; Germany: Albian, Cenomanian; France, Holland, Rumania: Albian; U.S.S.R.: Albian, Cenomanian.

Gavelinella (Berthelina) berthelini (Keller, 1935)

(Pl. XVI, Fig. 1 *a—c*; Text-fig. 11)

1935. *Anomalina berthelini* Keller; B. M. Keller, Mikrofauna verchnego mela..., pp. 552, 553, Pl. 2, Figs. 25—26.
1959. *Anomalina berthelini* Keller; N. I. Maslakowa in M. M. Moskvin, Atlas verchnemelovoj fauny..., pp. 102, 103, Pl. 6, Fig. 3 a,b,w.
1961. *Anomalina (Pseudovalvulineria) berthelini* Keller; O, S. Lipnik, Foraminifery i stratygrafia..., p. 54, Pl. 4, Figs. 5 a—c, 6 a,b.
1961. *Anomalina (Brotzenella) berthelini* Keller; V. S. Akimez, Stratygrafia i foraminifery..., pp. 158, 159, Pl. 16, Fig. 2 a,b,w.
1963. *Anomalina (Pseudovalvulineria) berthelini* Keller; O. K. Kaptarenko-Tshernousova *et al.*, Atlas charakternych foraminifer..., p. 94, Pl. 16, Fig. 5 a,b,w. (*here additional synonymy included*).

Material. — Fifty well-preserved specimens.

Dimensions (in mm):

	IG 4410/70/F	IG 4411/70/F	IG 4412/70/F
Diameter	0.558	0.414	0.360
Thickness	0.252	0.186	0.186
Thickness of the last chamber	0.108	0.162	0.180

Description. — Test round, semievolute, biconvex, even or slightly incised in outline; margin rounded, in the initial part of whorl narrower than in the terminal part. On both sides of the test, the last whorl is mostly

composed of eight chambers with slightly convex surfaces, uniformly growing, trapezoidal in shape. On both sides of the test, in the initial part of whorl sutures are radial or slightly arcuate, flat, transparent, in the terminal part of whorl arcuate and depressed. The dorsal side is mostly some-

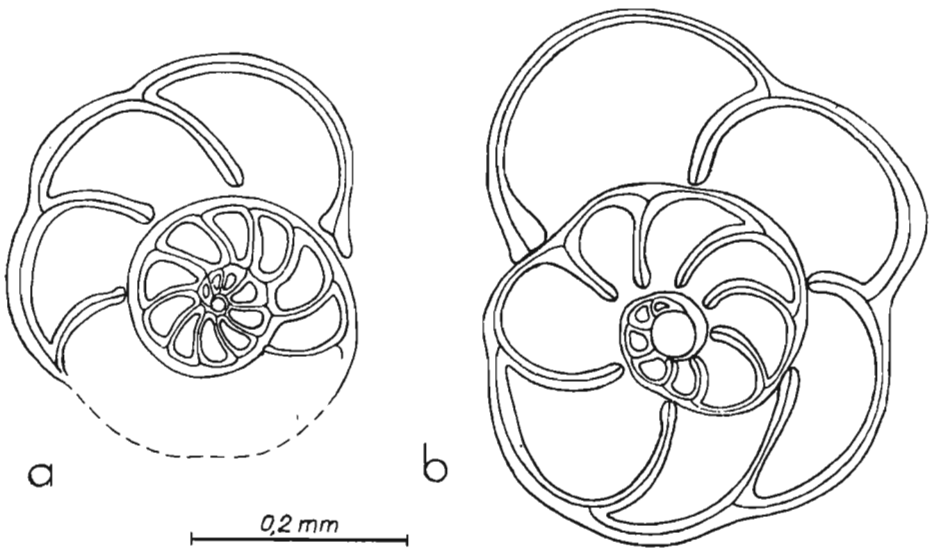


Fig. 11. — *Gavelinella (Berthelina) berthelini* (Keller), *a* horizontal section of generation B, diameter of the test, 0.414 mm, diameter of the proloculus, 10.0 μ; *b* horizontal section of generation A, diameter of the test, 0.540 mm, diameter of the proloculus, 30.0 μ; Bartoszyce IG I boring, depth, 400 m.

what more convex than the ventral and a flat node, formed by a thickening of test and not projecting over the surface chambers is situated in its middle. It is connected with the margin of chambers. The central part of test is flat on the ventral side. Umbilicus very narrow, covered with a transparent, flat, not very thick swelling. The youngest chambers, terminate in lamellar processes. Apertural surface convex, aperture slitlike, covered with a narrow lip, interiomarginal-equatorial, extended onto the ventral side. In the specimens examined, which could be considered as microspheric forms, the diameter of the proloculus amounts to 10—17.5 μ. The test is composed of two and a half to three whorls with a total of 18—24, chambers, eight to nine of them in the last whorl. In the macrospheric individuals, the test consists of two to three whorls with a total of 15—20 chambers, six to seven of them in the last whorl. The diameter of the proloculus amounts to 30—32.5 μ.

Variability. — The degree of convexity of both sides of test, number of chambers in the last whorl, as well as the depression and curvature of sutures are subject to variability.

Remarks. — Specimens from Poland have most of their characters in conformity with those of the holotype and other specimens described from the U.S.S.R.

Distribution. — Poland: Turonian; U.S.S.R.: Cenomanian, Turonian, Lowermost Coniacian.

Gavelinella (Berthelina) intermedia (Berthelin, 1880)

(Pl. XV, Figs. 7 *a*—*c*, 8 *a*—*c*, 9 *a*—*c*; Text-fig. 12)

1880. *Anomalina intermedia* Berthelin; M. Berthelin, Mémoire sur les Foraminifères..., pp. 67, 68, Pl. 4, Fig. 14 a—c.
1949. *Anomalina suturalis* var. *involuta* Mjatliuk; E. V. Mjatliuk, Materialy k monografičeskomu..., pp. 218, 219, Pl. 5, Figs. 3 a—c, 4 a—c.
1954. *Anomalina (Anomalina) biinvoluta* Mjatliuk; V. P. Vassilenko, Anomalinidy, pp. 51, 52, Pl. 1, Fig. 2 a,b,w.
1958. *Anomalina biinvoluta* Mjatliuk; V. G. Bukalova, Anomalinidy albskich..., pp. 188—190, Pl. 4, Fig. 3 a,b,w.
1960. *Gavelinella intermedia* Berthelin; M. Moullade, Sur quelques Foraminifères..., pp. 138—140, Pl. 2, Figs. 15—17, 22, 29.
1965. *Gavelinella intermedia* (Berthelin); H. Bartenstein, Taxionomische Revision und Nomenklatur..., p. 355.
1965. *Gavelinella intermedia* (Berthelin); T. Neagu, Albian Foraminifera of the Rumanian..., p. 32, Pl. 8, Figs. 1, 2 (*here additional synonymy included*).
1965. *Gavelinella (Berthelina) intermedia* (Berthelin); M. Malapris, Les Gavelinellidae et Formes..., pp. 138, 139, Pl. 1, Figs. 2, 3, 4, 6 (non Figs. 1, 5, 7); Pl. 2, Figs. 2, 3, 4, 6 (non Figs. 1, 5, 7).

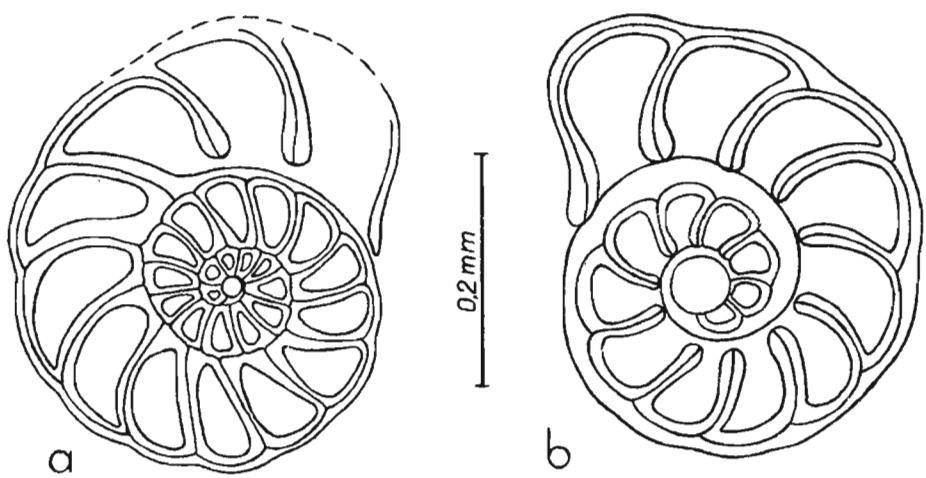


Fig. 12. — *Gavelinella (Berthelina) intermedia* (Berthelin), *a* horizontal section of generation B, diameter of the test 0.468 mm, its thickness, 0.198 mm, diameter of the proloculus, 25.0 μ; b horizontal section of generation A, diameter of the test, 0.324 mm, its thickness, 0.162 mm. diameter of the proloculus, 50,4 μ. Łódź 4a boring, depth, 626.0 m.

1966. *Gavelinella intermedia* (Berthelin); H. Bartenstein, F. Bettenstaedt & H. Bolli, Die Foraminiferen der Unterkreide..., pp. 161, 162, Pl. 4, Figs. 340—353.
1966. *Gavelinella intermedia* (Berthelin, 1880); E. Michael, Die Evolution der Gavelinelliden..., pp. 432—434, Pl. 50, Figs. 4—13.
1966. *Anomalina (Gavelinella) intermedia* Berthelin; J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., pp. 153, 154, Pl. 4, Fig. 3 a—c (*here additional synonymy included*).

Material. — Two hundred and fifty well-preserved specimens.

Dimensions (in mm):

	IG 4413/70/F	IG 4414/70/F	IG 4415/70/F
Diameter	0.576	0.378	0.270
Thickness	0.288	0.180	0.144
Thickness of the last chamber	0.234	0.162	0.126

Description. — Test biconvex, lustrous, round, slightly incised or even in outline; margin narrow, rounded. Dorsal side more convex than ventral, semi-involute, with one whorl and a half visible on it. The outer whorl is composed of ten to twelve rhomboidal chambers. A part of the older whorl, visible on this side, is situated in a depression. The inner whorl is covered with a thickening which forms, in some of the specimens, a round nodulose elevation. A depressed, troughlike spiral suture is marked only along, the youngest four chambers of the last whorl. The surface of chambers on both sides of test is either convex or flat. On the dorsal side, septal sutures are slightly arcuate, somewhat depressed, the deepest between the youngest three chambers and, in many specimens, thickened in the initial part of whorl. Ventral side somewhat more (or equally) convex than dorsal, involute. In the initial part of whorl, septal sutures prominent, thickened, lustrous, gradually extending towards the middle of test where they fuse with a thickening formed by the fussion of lamellar flaps of the periumbilical parts of chambers. In the specimens, in which the lamellar flaps still occur, septal sutures are depressed and less thickened. Apertural surface flat, aperture interiomarginal-equatorial, semilunar, surrounded by a fairly wide lip, extending onto the ventral side and reaching under the flaps of the last chambers. Specimens of the two generations of this species differ from each other only in the number of chambers in the last whorl. In the microspheric generation, the number of chambers in the last whorl amounts to 12. The individuals of this generation are composed of two whorls and a half with a total of 30 chambers, the diameter of the proloculus amounting to 25.0 μ. In the macrosperic generation, the test is composed of a whorl and a half with a total of 16 chambers, ten of them in the last whorl, the diameter of the proloculus amounting to 50.4 μ.

Variability. — A very large individual variability concerns almost all characters, such as, the size and convexity of test, convexity of chambers, in particular on the ventral side, thickening of sutures on this side, etc.

In some of the specimens, all lamellar flaps fuse with each other and form a small node, situated at the beginning of a hooklike thickening on the ventral side.

Remarks. — The populations under study, coming from the Upper Albian of Poland, include specimens which are in complete conformity with Berthelin's (1880) holotype, illustrated by Bartenstein (1954). At the opportunity of her studies on the family Gavelinidae and related forms from the Albian of Courcelles (Aube), France, Malapris (1965) erected a new subspecies *Berthelina* with the type species *Anomalina intermedia* Berthelin, to which she assigned *A. complanata* Berthelin, 1880 (non Reuss, 1850, 1862). The present writer is not inclined, however, to share this view, since these forms distinctly differ from each other. Likewise, they cannot be considered as particular generations of one and the same species, as believed by Bertenstein (1954), which might otherwise explain their morphological differences. It has been stated by Malapris (1965) herself that both the holotype of *A. intermedia* Berthelin and of *A. complanata* Berthelin (non Reuss) have a large proloculus and, therefore, they are representatives of one and the same generation.

Distribution. — Poland: Upper Albian, the lowermost beds of Cenomanian; North-western Germany: Aptian, Albian; France, Holland, Rumania, U.S.S.R.: Albian; Czechoslovakia (Western Carpatians): Lower Albian; Trinidad (W. I.): Lower Cretaceous.

Gavelinella (Berthelina) lodziensis n.sp.
(Pl. XVI, Figs. 3 *a—c*, 4 *a—c*; Text-fig. 13)

Holotype: specimen shown in Pl. XVI, Fig. 4 *a—c*.
Type horizon: Upper Albian beds.
Type locality: Łódź 5a borehole, at a depth of 602.5 m.
Derivation of the name: after the name of the city of Łódź, a locality in which the specimens of this species were first found.

Diagnosis. — Test semi-involute, biconvex, more strongly convex on the dorsal side, with only the last whorl visible on both sides. A node, formed by many tubercles which are also scattered over the periumbilical surface of chambers, occurs in the middle of the dorsal side.

Material. — More than 400 well-preserved specimens.

Dimensions (in mm):

	Holotype	Paratypes		
	IG 4177/70/F	**IG 4416/70/F**	**IG 4417/70/F**	**IG 4418/70/F**
Diameter	0.576	0.630	0.468	0.306
Thickness	0.144	0.198	0.180	0.162
Thickness of the last chamber	0.126	0.198	0.162	0.144

Description. — Test oval, even, rounded in outline, with only the last whorl, composed of ten to twelve chambers, visible on its both sides. The ventral side convex, in some of the specimens conical. Chambers narrow, trapezoidal, gradually increasing with the growth. The surface of chambers

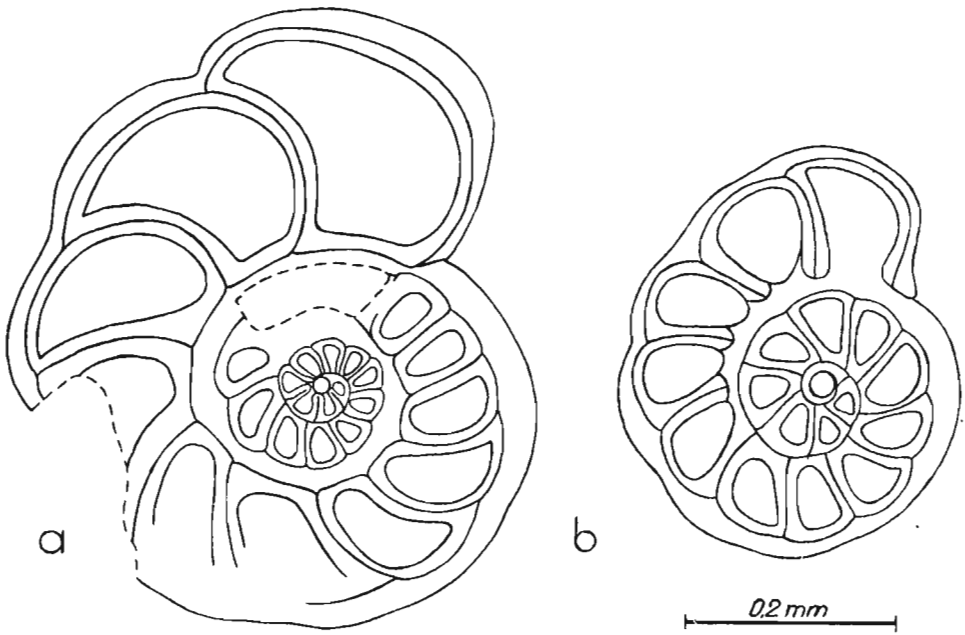


Fig. 13. — *Gavelinella* (*Berthelina*) *lodziensis* n.sp. *a* horizontal section of generation B, diameter of the test, 0.504 mm, its thickness, 0.270 mm. diameter of the proloculus 15.0 u; horizontal section of generation A, diameter of the test, 0.396 mm, its thickness 0.234 mm diameter of the proloculus, 37.5 μ; Murczyn IG I boring, depth, 162.0 m.

flat in the initial part of whorl and slightly convex in the terminal part. In the initial part of whorl, sutures flat, subradial, in the terminal slightly arcuate, projecting over the surface of test in the form of rollerlike thickenings. A large node covering about one-third of the surface of test and formed of tubercles also scattered over the surface of chambers near umbilicus in the initial part of whorl is situated in the middle of the dorsal side. The ventral side flat or slightly convex. Chambers trapozoidal in outline, with a flat surface which is very densely, finely and uniformly perforate, this perforation being much coarse on the dorsal side. Sutures slightly deflected posteriorly, in some of the specimens wide, raised, projecting above the surface of chambers, sometimes flat. A very narrow umbilical depression, very frequently covered with lamellar, triangular flaps of the last three to five chambers, occurs in the middle of the ventral side. The flaps of older chambers fuse together, forming a hooklike thickenings. Apertural surface triangular, flat. Aperture interiomarginal-equatorial, arcuate, low, bordered by a thin lip, extended onto the ventral side and

reaching under the flaps of the last chambers. In the Cenomanian population under study consisting of specimens with a strongly ornamented node individuals of two generations have been found. The microspheric individuals are composed of three whorls with a total of 27 chambers, ten to eleven of them in the last whorl. The diameter of the proloculus amounts, to 15 μ. The macrospheric individuals consist of one whorl and a half to two whorls containing together 17 chambers, 10 of them in the last whorl. The diameter of the proloculus amounts from 37.5 to 45 μ.

Variability. — This species is marked by a considerable individual variability. The populations under study include individuals with uniformly biconvex tests, with a slightly convex ventral and more convex dorsal side as well as planoconvex ones having flat ventral and conical dorsal side. Also variable are the number of chambers in the last whorl, height and width of thickenings on sutures, in particular on the ventral side, ornamentation of node and adjoining chambers on the dorsal side and finally, dimensions.

Remarks. — The species described is very closely related to *Gavelinella (Gavelinella) varsoviensis* n.sp. from which it descends. Two specimens have been found, which are transitional forms linking the two species *G. (B.) lodziensis* n.sp. differs from *G. (G.) varsoviensis* n.sp. in a higher degree of involuteness of its dorsal side, presence of a node, consisting of tubercles, on the dorsal side, more convex dorsal side and flat sutures between the last chambers of the dorsal side. The evolution of *G. (B.) lodziensis* n.sp. consists in the concentration, in the middle of the dorsal side of test, of a greater and greater number of tubercles and in the decrease in their number on the surface of chambers near the middle of test on the dorsal side. The initially detached tubercles, which in *G. (G.) varsoviensis* n.sp. become arranged along the spiral suture, in *G. (B.) lodziensis* n.sp. form a round node which, in the specimens of this species coming from the Middle Cenomanian beds, has part of its surface and in those from the Upper Cenomanian, due to the fusion of the tubercles, the entire surface smooth. Externally, these specimens are very similar to the representatives of *G. (B.) belorussica* (Akimez). Thus here we have to do with a typical example of homeomorphism. As revealed by thin sections, forms with a high, smooth node, coming from the lowermost Turonian (Murczyn IG-I borehole, a depth of 162.0 m), belong to *G. (B.) lodziensis* n.sp. although they differ from the Lower Cenomanian forms. This is primarily indicated by the diameter of the proloculus in the individuals of generation B, which, the same as in the Cenomanian specimens, amounts to 15 μ. The number of whorls in the test is also identical and variable are only the general number of chambers (from 25 to 27) and the number of chambers in the last whorl (from 12 to 11). In the Turonian representatives of generation A, the diameter of the proloculus amounts to 37.5 μ and the test consists of two

whorls with a total of 17 chambers, ten of them in the last whorl. The number of chambers in the last whorl remains, therefore, identical with that in the Cenomanian specimens. The size of the proloculus, number of whorls, total number of chambers and that of chambers in the last whorl differ the specimens discussed above from the representatives of *G. (B.) belorussica* (Akimez), most closely resembling them.

Distribution. — Poland: Upper Albian through Lower Turonian.

Gavelinella (Gavelinella) baltica Brotzen, 1942
(Pl. XVII, Fig. 5 *a*—*c*)

1925. *Anomalina ammonoides* Reuss; A. Franke, Die Foraminiferen der pommerschen..., p. 86, Pl. 7, Fig. 13 a—c.
1942. *Gavelinella baltica* Brotzen; F. Brotzen, Die Foraminiferengattung Gavelinella..., pp. 50, 51, Pl. 1, Fig. 7.
1959. *Anomalina baltica* (Brotzen); N. I. Maslakova in M. M. Moskvin, Atlas verchnemelovej fauny..., p. 99, Pl. 5, Fig. 1 a,b,w.
1961. *Anomalina (Gavelinella) baltica* (Brotzen); V. S. Akimez, Stratygrafia i foraminifery..., pp. 137, 138, Pl. 13, Fig. 4 a,b,w, (*here additional synonymy included*).
1961. *Anomalina (Gavelinella) cuvillieri* Carbonnier subsp. *savelievi* Vassilenko; V. P. Vassilenko, Foraminifery verchnego mela..., p. 110, Pl. 20, Fig. 1 a,b,w.
1962. *Gavelinella baltica* Brotzen; H. Hiltermann & W. Koch, Leitfossilien..., p. 319, Pl. 47, Fig. 1, Tab. 19 (*here additional synonymy included*).

Material. — Two hundred and fifty well-preserved specimens.

Dimensions (in mm):

	IG 4419/70/F	IG 4420/70/F	IG 4421/70/F
Diameter	0.648	0.540	0.288
Thickness	0.216	0.234	0.126
Thickness of the final chamber	0.270	0.288	0.162

Description. — Test round or slightly oval, equally biconvex, in the initial part of whorl even and in the terminal slightly incized in outline, composed of one and a half to three whorls. The last whorl contains nine to eleven chambers. The margin of test wide, rounded. The wall smooth, lustrous, densely and, on both sides, uniformly perforate. Only the chambers of the last whorl are visible on both sides of test. Older whorls, situated in a depression, making up one-fifth to one-third of the surface of test and frequently covered with a slight thickening forming a sort of a disc. Umbilicus deep, variable in width, with preceding whorls visible on its bottom in some of the specimens. On both sides of test, the chambers of the last whorl trapezoidal and slightly convex, the most convex being the last chambers. Triangular lamellae, partly covering the umbilical depression, grow from the parts of walls adjoining the umbilicus in the final

three to five chambers in the last whorl. On both sides of test, sutures subradial listlike, wide and high, in some specimens considerably higher in the initial part of whorl. Apertural surface oval, slightly convex or flat. Aperture arcuate, fairly high, rimmed by a thin lip, situated on the periphery of test, extending onto the ventral side towards the umbilicus and reaching under lingulate flaps of the last chambers. Two generations, not differing from each other in their morphological characters, have been found. In the microspheric individuals, the diameter of the proloculus amounts to 22.5 μ and the test is composed of three whorls with a total of 27 chambers, eleven of them in the last whorl. The macrospheric individuals of generation A are composed of one and a half to two whorls with a total of 15 to 17 chambers, nine to ten of them in the last whorl. The diameter of the proloculus amounts to 60.0 to 69.6 μ.

Variability. — A considerable individual variability concerns the size of tests, evoluteness of the dorsal side, width of umbilicus and the convexity of chambers and sutures.

Remarks. — The specimens under study display an almost complete conformity with those described by Brotzen (1942) from Zastań (former Zünz) in Pomerania. This species was recognized by Vassilenko (1961) as a subspecies *G. cuvillieri* Carbonnier and the name *baltica* as a homonym of the Recent species "*Nautilus*" *balticus* Schroeter. Consequently, she gave Brotzen's specimens a new name. Apart from the unnecessary change in name, the standpoint of this author on the taxonomic position of this species seems groundless, since *G. (G.) baltica* Brotzen differs from *G. cuvillieri* Carbonnier in a biconvex test, lower number of chambers in the last whorl, smaller convexity of the surface of chambers, convex sutures and less evolute dorsal side.

Distribution. — Poland: Upper Albian through Turonian; North-western Germany: Cenomanian, Turonian; U.S.S.R.: Cenomanian.

Gavelinella (Gavelinella) cenomanica (Brotzen, 1945)
(Pl. XVII, Fig. 4 *a*—*c*)

1945. *Cibicidoides cenomanica* Brotzen; F. Brotzen, De geologiska resultaten fran..., p. 54, Pl. 2, Fig. 2 a—c.
1959. *Anomalina cenomanica* (Brotzen); I. N. Maslakova in M. M. Moskvin, Atlas verchnemelovoj fauny..., p. 100, Pl. 5, Fig. 5 a,b,w.
1961. *Anomalina (Pseudovalvulineria) cenomanica* (Brotzen); V. P. Vassilenko, Foraminifery verchnego mela..., pp. 118, 119, Pl. 21, Fig. 6 a,b,w.
1961. *Anomalina (Pseudovalvulineria) cenomanica cenomanica* (Brotzen); V. S. Akimez, Stratygrafia i foraminifery..., p. 145, Pl. 14, Fig. 4 a,b,w.
1961. *Anomalina (Pseudovalvulineria) cenomanica* (Brotzen); O. S. Lipnik, Foraminifery i stratygrafia..., p. 46, Pl. 7, Fig. 4 a,b,w.
1962. *Gavelinella à crete periombilicale*; J. Sigal & M. Dardenne, Correlations dans la craie..., Pl. 8, Fig. 7.

1963. *Anomalina (Pseudovalvulineria) cenomanica* (Brotzen); O. K. Kaptarenko-Tshernousova et al. Atlas charakternych foraminifer..., p. 97, Pl. 14, Fig. 7 a,b,w.
1966. *Gavelinopsis cenomanica* (Brotzen); E. Michael, Die Evolution der Gavelinelliden..., pp. 436, 437, Pl. 50, Figs. 16, 17 (*here additional synonymy included*).

Material. — About 500 well-preserved specimens.

Dimensions (in mm):

	IG 4422/70/F	IG 4423/70/F	IG 4424/70/F
Diameter	0.729	0.576	0.306
Thickness	0.306	0.270	0.108
Thickness of the final chamber	0.306	0.288	0.126

Description. — Test biconvex, oval, even in outline, with its surface lustrous and perforate, much more strongly on the ventral side. The margin of test narrow, slightly rounded. Dorsal side semi-evolute, with two and a half to three whorls visible on it. The division into chambers is visible only in the last whorl, composed of nine to twelve chambers. Chambers trapezoidal, with a flat surface. Septal sutures slightly deflected posteriorly, subradial, near the spiral suture wide, convex and thick, near the outer margin flat. The presence of a fairly thick, high and apically frayed ridge, running along the spiral suture is a characteristic feature of the dorsal side. On the ventral side, chambers are, in the initial part of whorl, triangular and flat and in the terminal part trapezoidal, with a slightly convex or flat surface. Septal sutures fairly strongly deflected posteriorly, wide and, over the entire lenght, thickened. Umbilical depression narrow and shallow, surrounded by lamellar flaps of the parts of last chambers which adhere to the umbilicus. Apertural surface triangular, flat, sometimes trapezoidal, slightly convex. Aperture semilunar, fairly high, surrounded by a fairly thick lip. In the populations examined, the diameter of the proloculus in microspheric individuals amounts to 25.0 to 27.0 μ and the test is composed of three whorls with a total of 24—26 chambers, of which 11 to 12 from the last whorl. In the macrospheric individuals, the diameter of the proloculus amounts to 45.6 to 48 μ, the test consists of two whorls with a total of 16 to 18 chambers, nine to eleven of them in the last whorl.

Variability. — The following characters are subject to considerable individual variability: the symmetry of test, width and thickness of sutures on both sides of test, degree of the evoluteness of the dorsal side, size of lamellar flaps on the ventral side, shape of the apertural surface, as well as height, thickness and degree of fraying of the ridge on the spiral suture.

Remarks. — The differences occurring between *G. (G.) varsoviensis* n.sp. and *G. (G.) cenomanica* (Brotzen) are given below (p. 133). Vassilenko (1954) included *Anomalina falcata* Plummer in the synonymy of *Anomalina (Pseudovalvulineria) cenomanica* (Brotzen). As follows from Plummer's description and illustrations (1931, p. 202, Pl. XIV, Figs. 7 *a*—*c*, 8 *a*—*c*), this

form may belong rather to *Gavelinella (Berthelina) belorussica* (Akimez) or perhaps to *G. (B.) lodzensis* n.sp.

Distribution. — Poland: The uppermost beds of the Upper Albian, Cenomanian; North-western Germany: Albian, Cenomanian, Lower Turonian; France: Cenomanian, Turonian; Holland: Cenomanian; Sweden: Upper Albian, Cenomanian; U.S.S.R.: Cenomanian.

Gavelinella (Gavelinella) planodorsa (Saidova) in Bukalova, 1958
(Pl. XVII, Fig. 2 *a*—*c*)

1958. *Anomalina planodorsa* (Saidova); G. V. Bukalova, Anomalinidy albskich..., pp. 191, 192, Pl. 4, Fig. 4 a,b,w.

Material. — Fifteen well-preserved specimens.

Dimensions (in mm):

	IG 4425/70/F	IG 4426/70/F	IG 4427/70/F
Diameter	0.486	0.360	0.270
Thickness	0.216	0.144	0.108
Thickness of the last chamber	0.270	0.216	0.144

Description. — Test biconvex, with a slightly more convex ventral side, composed of two whorls, oval and strongly incised in outline with a widely rounded margin. Dorsal side slightly flattened, with part of the older and the entire last whorl visible on it. The inner whorl covered with a thickening separated from the outer whorl by a depressed spiral suture. In the outer whorl, five to seven rhomboidal, strongly convex, subspherical chambers strongly increasing in the process of growth are visible on both sides of test. The surface of chambers more convex on the ventral side. Sutures depressed, on the dorsal side slightly deflected posteriorly, on the ventral side radial. The last chamber, the largest, spherical, in some of the specimens strongly inclined ventrally. Apertural surface convex, with a low, slightly arcuate aperture, surrounded by a thin narrow lip, situated at its base. Aperture extended onto the ventral side and reaching under the inner margin of the last chamber. The five specimens sectioned are composed each of two whorls with a total of 13 chambers, six of them in the last whorl. The diameter of the proloculus amounts to 30.0 μ.

Variability. — A small individual variability concerns the dimensions of test number of chambers in the last whorl, inclination of the last chamber onto the ventral side and degree of the involuteness of test.

Remarks. — Polish specimens are, in almost all their characters, in conformity with those, described by Bukalova (1958), from which they differ only in a lower number of chambers in the last whorl (five to seven and not seven to nine) and more rounded margin of test. Since it is marked by a semi-involute test with the inner whorl visible on its dorsal and a fairly

wide umbilical depression on its ventral side. This species has been included by the present writer in the genus *Gavelinella* Brotzen. A more accurate study of the terminations of chambers near the umbilicus has, however, been precluded by the rock filling the umbilicus. The arcuate, low aperture passes onto the ventral side and reaches under the periphery of the last chamber, the same as in typical representatives of the genus *Gavelinella*. In the shape of test, manner of its coiling and form of chambers, it is most similar to *G. moniliformis* (Reuss), from which it differs in more convex chambers on both sides of test and stronger increase in the size of chambers of the last whorl.

Distribution. — Poland: Upper Albian, Cenomanian; England: probably in the Hauterivian and Upper Albian deposits; U.S.S.R.: Upper Albian.

Gavelinella (Gavelinella) schloenbachi (Reuss, 1862)
(Pl. XVI, Fig. 2 *a*—*c*)

1862. *Rotalia schloenbachi* Reuss; A. E. Reuss, Die Foraminiferen des norddeutschen..., p. 84, Pl. 10, Fig. 5 a—c.
1941. *Discorbis minima* Vieaux; D. G. Vieaux, New Foraminifera from the Denton..., p. 627, Pl. 85, Fig. 10 a—c.
1961. *Discorbis sanjarensis* Lipnik; V. S. Akimez, Stratygrafia i foraminifery..., pp. 110, 111, Pl. 10, Fig. 1 a,b,w. (*here additional synonymy included*).
1965. *Planulina schloenbachi* (Reuss); T. Neagu, Albian Foraminifera of the Rumanian..., p. 32, Pl. 8, Fig. 3 a—c (*here additional synonymy included*).
1967. *Gavelinella minima* (Vieaux); P. Marks, Foraminifera from the Craie..., p. 440, Pl. 3, Fig. 4 a—c.

Material. — Seventy well-preserved specimens.

Dimensions (in mm):

	IG 4428/70/F	IG 4429/70/F	IG 4430/70/F
Diameter	0.468	0.396	0.288
Thickness	0.180	0.162	0.090
Thickness of the last chamber	0.180	0.162	0.090

Description. — Test on the whole flat, thin, with a slightly convex dorsal and flat or slightly concave ventral side, composed of two to three whorls, oval, even, or lobulate in outline, with a narrow margin, provided with a distinct, rounded keel; surface smooth lustrous, finely perforate. The dorsal side slightly convex, completely evolute, with all whorls visible on it. The inner whorls very narrow, in some of the specimens with a distinct division into chambers. The last whorl composed of nine to ten chambers. In the initial part of whorl on the dorsal side, chambers triangular, strongly arcuate, with a flat surface, at the end of whorl trapezoidal, wide with a convex surface and separated from each other by narrow, arcuate, listlike sutures. In some of the specimens, sutures may be somewhat thick-

ened. The ventral side slightly concave, with only the last whorl visible on. In the initial part of whorl, chambers triangular, with a flat surface, but considerably wider than those on the dorsal side, separated from each other by flat, fairly wide, translucent sutures slightly deflected posteriorly. At the end of whorl, they are trapezoidal, with a strongly convex surface, separated from each other by deep subradial sutures. Near the umbilicus, chamber terminate in triangular lamellar flaps, partly covering the umbilical depression. Umbilicus fairly wide and open, in some of the specimens with a flat node, formed of test substance. Aperture slightly arcuate, rimmed by a narrow lip, situated on the margin of test, extended onto the ventral side and reaching under the flaps of last chambers. In the populations studied, individual of two generations have been distinguished, differing from each other in their morphological characters. The microspheric individuals are very flat, round or very strongly oval, with all whorls distinctly visible on the dorsal side and revealing the division into particular chambers. The proloculus usually invisible. On the ventral side, a flat node occurs, in these individuals, in the umbilicus. These individuals are composed of three whorls with a total of 23 chambers, eight to eleven of them in the last whorl. The diameter of the proloculus amounts to 12.0—17.0 μ. The macrospheric individuals are subround, with a convex dorsal and depressed ventral side. On the dorsal side they display a spherical, lustrous proloculus, projecting over the surface of test. The inner whorl without any noticeable division into chambers, covered by test substance and with an open umbilicus. In these specimens composed of two whorls with a total of sixteen chambers, the last whorl contains nine of them. The diameter of the proloculus amounts to 40.0 μ.

Variability. — It manifests itself in the degree of the curvature of sutures, differentiation in the width of umbilicus, shape of aperture, outline of test and degree of convexity of the last chambers in a whorl.

Remarks. — Specimens coming from the Upper Albian of Poland are in conformity with Reuss' (1862) description of *Rotalia schloenbachi* Reuss. Reuss' much too schematic illustration of this species, as well as varying aspects of its both generations have caused that its representatives were described under different names. Specimens described by Vieaux (1941) as *Discorbis minima* and by Marks (1967) as *Gavelinella minima* (Vieaux) seem to be representatives of macrospheric generation A. They completely correspond to the individuals of this generation coming from Poland. Specimens described by Lipnik (1961), as *Discorbis sanjarensis* seem to belong to the microspheric generation of *Rotalia schloenbachi* Reuss, which is indicated by the dimensions of test and number of chambers. Specimens of both generations, which completely correspond to the representatives of these generations from Poland, were distinguished by Akimez (1961) from those assigned to *D. sanjarensis*. *Discorbis minima* Vieaux is iden-

tified by Malapris (1965) with *Gavelinella tormarpensis* Brotzen, 1942, whose syntypes she received from Brotzen. Thus, it should be supposed that Brotzen's species is a younger synonym of *G. schloenbachi* (Reuss). The lastnamed two species have, therefore, an identical range of distribution.

Distribution. — Poland: Upper Albian through the lowermost Turonian beds; North-western Germany: Upper Albian, lower beds of Cenomanian; Holland Upper Albian; France: Cenomanian; Rumania: Upper Albian; U.S.S.R.: Cenomanian; U.S.A. (Texas): Albian.

Gavelinella (Gavelinella) sigmoicosta Ten Dam, 1948
(Pl. XVII, Fig. 1 *a*—*c*)

1948. *Anomalina sigmoicosta* Ten Dam; A. Ten Dam, Foraminifera from the Middle Neocomian..., p. 189, Pl. 32, Figs. 23, 24.
1961. *Conorotalites sigmoicosta* (Dam 1948); B. Zedler, Stratigraphische Verbreitung..., p. 51, Pl. 8, Fig. 13 a—c.
1962. *Gavelinella? sigmoicosta* (Dam 1948); H. Bartenstein & F. Bettensteaedt, Leitfossilien..., p. 271, Pl. 38, Fig. 12 a,b; Pl. 37, Fig. 6 a—c, Tab. 18.

Material. — Fifty well-preserved specimens.

Dimensions (in mm):

	IG 4431/70/F	IG 4432/70/F	IG 4183/70/F
Diameter	0.342	0.270	0.234
Thickness	0.108	0.108	0.108
Thickness of the final chamber	0.162	0.144	0.144

Description. — Test oval, planoconvex, even in outline, semi-involute, with widely rounded margin. The dorsal side flat, with the last whorl visible on it and displaying the division into chambers. The inner whorl invisible, covered by a thickening of test substance. The chambers of the last whorl very narrow, strongly arcuate, with a flat or slightly concave surface. Sutures arcuate, deflected posteriorly, projecting over the surface of chambers, thickened. On the ventral side, only the last whorl is visible, mostly consisting of seven to eight gradually increasing chambers. The last chamber the highest has a strongly convex surface. Sutures arcuate, wide, thick, projecting over the surface of chambers more thickened than those on the dorsal side. The last chambers terminate, near the umbilicus, in lamellar flaps. Umbilicus occupies about one-third of the surface of test. Apertural surface oval, flat. A slitlike aperture, extending towards the umbilicus and covered by a narrow lip, occurs at its base.

Variability. — The individual variability manifests itself in a varying thickness of sutures, in particular on the dorsal side, varying height of chambers on the ventral side and their size.

Remarks. — Specimens coming from the Upper Albian of Poland differ from those described by Ten Dam (1948) in a smaller number of chambers

in the last whorl (seven to eight as opposed to nine to ten), smaller dimensions and less thickened sutures on the dorsal side.

Distribution. — Poland: few in Upper Albian; North-western Germany: Upper Hauterivian, Lower Barremian; Holland: Middle Neocomian.

Gavelinella (Gavelinella) varsoviensis n.sp.
(Pl. XVII, Fig. 6 *a*—*c*; Text-fig. 14)

Holotype: specimen shown in Pl. XVII, Fig. 6 *a*—*c*.
Type horizon: Upper Albian.
Type locality: Łódź 5a borehole, at a depth of 602.5 m.
Derivation of the name: after Poland's capital.

Diagnosis. — Test semi-involute, biconvex, composed of one and a half to two and a half whorls. Tubercles, also situated on the surface of the

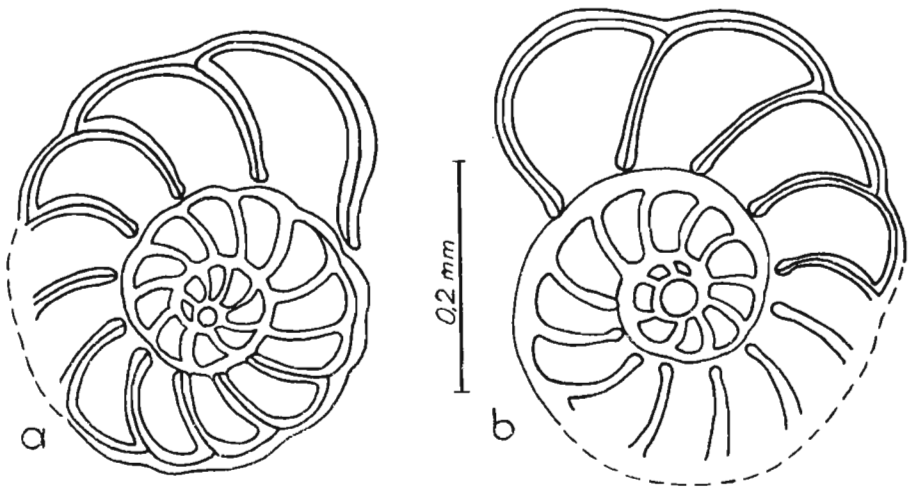


Fig. 14. — *Gavelinella* (*Gavelinella*) *varsoviensis* n.sp. *a* horizontal section of generation B, diameter of the test, 0.414 mm, its thickness, 0.126 mm, diameter of the proloculus, 27.0 μ: *b* horizontal section of generation A, diameter of the test, 0.432 mm its thickness, 0.162 mm, diameter of the proloculus, 43.2 μ; Ślazewo 5 boring, depth, 228.0 m.

chambers of the last whorl near spiral suture, occur on the dorsal side along the spiral suture.

Material. — More than 500 well-preserved specimens.

Dimensions (in mm):

	Holotype			
	IG 4184/70/F	**IG 4433/70/F**	**IG 4434/70/F**	**IG 4435/70/F**
Diameter	0.360	0.450	0.360	0.270
Thickness	0.162	0.144	0.144	0.108
Thickness of the final chamber	0.126	0.162	0.162	0.108

Description. — Test semi-involute, slightly biconvex, with a somewhat more convex dorsal side, composed of one and a half to two and a half whorls, subround, even or slightly incised in outline. Margin narrow, rounded. The last whorl composed of ten to twelve chambers. The dorsal side almost evolute, but the septal sutures of the inner whorl and the spiral suture are obscured by many tubercles, which also partly cover the surface of the chambers of the last whorl. These chambers are trapezoidal in outline with slightly convex surface. Septal sutures slightly arcuate, somewhat depressed, narrow, in some of the specimens convex, listlike near the inner periphery of whorl and flat near the outer periphery. The ventral side semi-involute, with only the last whorl visible on it. Umbilicus occupies one-fifth to one third of the surface of test. Chambers very narrow in the initial part of whorl and considerably wider and triangular in the terminal part. In the initial part of whorl, they are flat or slightly concave. The final two to four of them are slightly convex, the last one being the most convex. Perforation uniform, considerably coarser than on the dorsal side. The last three to five chambers in the whorl terminate in the umbilicus in triangular flaps. Sutures between the youngest two chambers depressed, not thickened, white, the remaining ones convex, thick, arcuate. Apertural surface oval, slightly convex, extended onto the ventral side and reaching under the flaps of last chambers. Individuals of two generations not differing from each other in their morphological characters have been found in the populations under study. The microspheric individuals consist of two whorls and a half with a total of 25 chambers, eleven of them in the last whorl. The diameter of the proloculus amounts to 27.0 μ. The macrospheric ones are composed of one and a half to two whorls with a total of 17—23 chambers, ten to eleven of them in th last whorl. The diameter of the proloculus amounts to 43.2 to 48.0 μ.

Variability. — The individual variability small, manifested mostly in a varying number of chambers in the last whorl, development of sutures on the dorsal side of test and varying degree of ornamentation of the middle part of test on the dorsal side.

Remarks. — *G. (G.) varsoviensis* n.sp. is related to *G. barremiana* Bettenstaedt, from which it differs primarily in a greater evolutenes and ornamentation of the dorsal side and dimensions and symmetry of test. Our species is an ancestor of *G. (Berthelina) lodziensis* n.sp. and *G. (G.) cenomanica* (Brotzen). It is related to the two species through the transitional forms from the highermost beds of the Upper Albian. The evolution takes place in two directions. In the forms which initiate the evolutionary series of *G. (Berthelina) lodziensis* n.sp., the degree of evoluteness decreases and the convexity of the dorsal side of test increases. Tubercles accumulate in the middle of test, forming a rough node. In the evolutionary series of *G. (G.) cenomanica* (Brotzen), the degree of evoluteness of the dorsal side and

the diameter of test increase, the tuberculate ornamentation disappears from the surface of chambers and the tubercles, occurring on the spiral suture, join each other to form a high frayed, ridge.

Distribution. — Poland: Upper Albian through Lower Cenomanian.

Superfamily **Robertinacea** Reuss, 1850
Family **Ceratobuliminidae** Cushman, 1927
Subfamily **Epistomininae** Wedekind, 1937
Genus *Epistomina* Terquem, 1883
Epistomina caracolla (Roemer, 1841)
(Pl. XIX, Figs. 1 *a*—*c*, 2, 3, 4, 5 *a*,*b*,*c*, 6)

1949. *Epistomina caracolla* (Roemer); E. V. Mjatliuk, Materialy k monografičesko-mu..., pp. 203, 204, Pl. 2, Fig. 3 a,b,w.
1952. *Epistomina djaffaensis* Sigal; J. Sigal, Aperçu stratigraphique..., p. 14, Text-fig 7, p. 15.
1953. *Epistomina caracolla* (Roemer); E. V. Mjatliuk, Spirillinidy, Rotaliidy..., pp. 224, 225, Pl. 5, Figs. 2 a,b,w, 4 a,b,w.
1957. *Epistomina caracolla* (Roem.); J. Sztejn, Stratygrafia mikropaleontologiczna... pp. 80, 81, Pl. 10, Fig. 93 a,b (*here additional synonymy included*).
1967. *Epistomina caracolla* (Roemer); U. Ohm, Zur Kenntnis der Gattungen..., pp. 136, 137, Pl. 18, Fig. 3 a,b (*here additional synonymy included*).

Material. — Sixty well-preserved and ten damaged specimens.

Dimensions (in mm):

	IG 4436/70/F	IG 4437/70/F	IG 4438/70/F
Diameter . .	1.170	0.954	0.450
Thickness . .	0.720	0.594	0.234

Description. — The specimens under study are in conformity with Sztejn's (1957) description. It can be stated on the material examined that the lateromarginal apertures stretch, along the largest width of each chamber, in the form of narrow slits parallel to keel. These apertures are secondarily closed, white the lateromarginal aperture on the last chamber is open in all specimens. Tooth plate smooth, well developed only in the last chamber, but in some cases also visible in older ones (Pl. XIX, Fig. 2). Septal aperture oval, situated areally.

Variability. — A considerable individual variability, concerning the size of specimens, degree of the convexity of the ventral side, number of chambers in the last whorl varying between eight and eleven, thickness of sutures, size of disc on the ventral side and degree of the visibility of whorls on the dorsal side.

Remarks. — The populations from the Lower Turonian of Poland include both very large specimens, 1.17 mm in diameter, composed of three whorls, containing eleven chambers in the last whorl, with a considerably more convex ventral side and small, lenticulate ones, about 0.45 mm in

diameter, composed of two and a half to three whorls, with eight chambers in the last whorl, sutures less convex than in large specimens and corresponding in their characters to the specimens called by Ten Dam (1948) *E. chapmani*. The concurrence of the specimens, differing from each other only in the size and number of chambers in the last whorl, as well as in a more or less strongly expressed ornamentation lead one to suppose that these are different generations of one and the same species. The similarity of *E. caracolla* to *E. chapmani* has already been indicated by Ten Dam (1948) and other authors, who, however, did not combined into one, which would require studies on a topotypical material. According to Hofker (1954) and Ohm (1967), both species are similar to each other and display a pronounced dimorphism.

The specimens of *E. caracolla* (Roemer) from the Upper Valanginian and Hauterivian of Central Poland (Sztejn, 1957) do not differ at all from those occurring in the Lower Turonian deposits of the area studied.

Distribution. — Poland: Infravalanginian, Valanginian, Hauterivian and Lower Turonian, a cosmopolitan species; Germany: Upper Valanginian through Lower Barremian; Holland; Neocomian; England, Madagascar, Portugal, Switzerland, Yugoslavia and Trinidad (W. I.): Lower Cretaceous.

Epistomina favosoides (Egger, 1899)

(Pl. XIX, Figs. 7 *a*—*c*, 8, 9, 10 a—c)

1899. *Truncatulina favosoides* Egger; J. G. Egger, Foraminiferen und Ostracoden..., p. 150, Pl. XX, Figs. 22, 23, 24, 25.
1960. *Hoeglundina favosoides* (Egger); A. Tolmann; Die Foraminiferenfauna..., pp. 188, 189, Pl. 19, Figs. 6, 7.
1966. *Epistomina (Hoeglundina) favosoides* (Egger); J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., p. 158, Pl. 4, Fig. 4 a—c.
1967. *Epistomina favosoides* (Egger 1899); U. Ohm, Zur Kenntnis der Gattungen..., pp. 153—155, Pl. 20, Figs. 5, 6; Pl. 21, Fig. 2 a,b (*here additional synonymy included*).

Material. — Twenty specimens, all of them with last chambers broken-off.

Dimensions (in mm):

	IG 4439/70/F	IG 4440/70/F	IG 4191/70/F
Diameter . .	0.468	0.378	0.360
Thickness . .	0.252	0.198	0.180

Description. — Test lenticulate, biconvex, round and even in outline, bordered by a narrow keel, composed of two whorls and a half, with eight chambers in the last whorl. The dorsal side somewhat less convex. Only the last whorl is fairly clearly visible. Older whorls invisible, forming a uniformly convex disc in the middle of test. In the last whorl, the surface of chambers flat, quadrangular in outline. Sutures somewhat convex

or flat, slightly arcuate. On the ventral side, chambers triangular in outline, with a flat surface. Septal sutures rectilinear, radial, connected in the middle of test with a small umbilical disc. The surface of test covered on both sides with regularly scattered, small, oval depressions, which are the largest in the middle of test on both sides and smaller towards margin. Most specimens are devoid of ornamentation on the surface of the last whorl on the dorsal side. Apertures lateromarginal, secondarily closed, stretching along the largest width of chambers on the ventral sides and shaped like narrow slits adjoining the keel. An elongate-oval septal aperture, interiomarginally (Brotzen, 1942) or basally (Ohm, 1967, p. 16) arranged along the suture is visible on broken specimens. In the specimens examined, the tooth plate is reduced in older chambers and very thin narrow and slightly arcuate ventrally in the last chamber.

Variability. — It is displayed in the degree of ornamentation and the degree of visibility of sutures of both sides of test.

Remarks. — Specimens from Poland differ from those described by Egger (1899) from the Maestrichtian only in smaller dimensions.

Distribution. — Poland: Lower Turonian; Holland: Campanian, Maestrichtian; Austria: Coniacian, Campanian, Maestrichtian; Czechoslovakia (Western Carpathians): Santonian.

Epistomina juliae Mjatliuk, 1949
(Pl. XVIII, Fig. 3 *a*—*c*)

1949. *Epistomina juliae* Mjatliuk; E. V. Mjatliuk: Materialy k monograficeskomu..., pp. 205, 206, Pl. 2, Figs. 4 a—c, 5 a,b.
1963. *Brotzenia juliae* (Mjatliuk); L. V. Alekseeva in L. V. Alekseeva & M. K. Rodionova, Foraminifery niżnego mela..., pp. 37, 38, Pl. 7, Fig. 1 a,b,w (*here additional synonymy included*).

Material. — Ten well-preserved specimens.

Dimensions (in mm):

	IG 4441/70/F	IG 4195/70/F	IG 4442/70/F
Diameter . .	0.648	0.522	0.360
Thickness . .	0.414	0.288	0.180

Description. — Test biconvex, lenticulate, round or suboval in outline, composed of two whorls to two and a half with a total of nine to twelve chambers, mostly six of them in the last whorl. In all specimens, the last chamber is broken-off. The margin of test provided with a narrow, wavy keel. All whorls are visible on the dorsal side. The chambers of the inner whorl oval or round, of the last whorl trapezoidal and strongly falciform. The surface of chambers concave. On the dorsal side, the septal sutures strongly arcuate, deflected posteriorly. The septal sutures and the spiral suture with super structures of high ribs and ornamented by numerous small, oval or triangular depressions. The ribs of the last whorl fuse with

keel. Only the last whorl, composed of trapezoidal chambers, is visible on the ventral side. Much the same as on the dorsal side, the surface of chambers is convex, sutures arcuate and having a superstructure of listlike ribs with a smaller number of depressions than on the dorsal side. An ornament, consisting of trapezoidal or oval depressions on sutural lists, occurs in the middle of the ventral side. Apertures lateromarginal, adjoining keel, stretching along chambers and secondarly closed. Outer apertural lips, more or less of the same size as sutural lists are situated over apertures. Lips run subparallel to keel and are fused with sutural lists. In some of the specimens they give an impression of forming another keel.

Variability. — A fairly large individual variability, manifested in the degree of the convexity of both sides of test, outline of test height and thickness of sutural lists and degree of the ornamentation of sutural lists and umbilicus.

Remarks. — The specimens described differ from the holotype in more convex sides of test. The ornamentation on the sutures of Polish specimens has the same range of variability as that in Russian specimens. In the height and width of sutural ribs *E. juliae* Mjatliuk resembles *E. spinulifera* Reuss, from which it differs in a more rounded ventral side, different outline of chambers on both sides of test and presence of depressions on sutural ribs. In the convexity of test and presence of depressions on the spiral suture, the species discussed is related to *E. alveolata* Mjatliuk from the Kimmeridgian of the Volga Region, from which it differs in higher sutural lists, greater degree of the curvature of sutures on the dorsal side, different outline of chambers on both sides and lack of a reticular ornamentation on the umbilicus. The specimen, described by Bukalova (1960) as *E. juliae* Mjatliuk, probably belongs to *E. cretacea* Ten Dam, 1947.

Distribution. — Poland: Lower Turonian (Maszkowo II); U.S.S.R.: Upper Barremian, Aptian.

Epistomina reticulata (Reuss, 1862)
(Pl. XVIII, Fig. 2 *a—c*)

1862. *Rotalia reticulata* Reuss; A. E. Reuss, Die Foraminiferen des norddeutschen..., pp. 83, 84, Pl. 10, Fig. 4 a—c.
1950. *Epistomina reticulata* (Reuss); A. Ten Dam, Les Foraminifères de l'Albien..., pp. 52, 53, Text-fig. 8, p. 53.
1967. *Epistomina reticulata* (Reuss); U. Ohm, Zur Kenntnis de Gattungen..., pp. 146, 147, Pl. 19, Figs. 6 a,b, 7 a,b, (*here additional synonymy included*).

Material. — Ten, variously preserved specimens.

Dimensions (in mm):

	IG 4443/70/F	IG 4444/70/F	IG 4445/70/F
Diameter . .	0.396	0.378	0.324
Thickness . .	0.198	0.162	0.198

Description. — Test oval or round in outline, lenticulate, biconvex, with the ventral side more convex, composed of two whorls, bordered by a narrow, sharp keel. The dorsal side slightly convex, covered with a thickening which makes the whorls invisible or at least very poorly visible. The last whorl composed of seven to eight rhomboidal chambers with a flat surface. Septal sutures slightly deflected posteriorly, flat, not projecting over the surface of chambers. The ventral side slightly conically convex. The last whorl composed of triangular chambers, with a flat surface, separated from each other by radial, flat sutures, which are connected with the umbilical disc, situated on the apex of the ventral side, is visible on this side. The disc is covered with many, small, oval depressions. Lateromarginal aperture, in the form of narrow, secondarily closed slits, stretch along the greatest width of chambers and running parallel to the keel. A small number of the specimens available, prevented the observation of the tooth plate and of the situation of septal aperture.

Variability. — The individual variability concerns the convexity of test (biconvex, or with a conically convex ventral side), convexity of sutures (flat, almost invisible, or very slightly convex) and the occurence, in some of the specimens, of thin lips over lateromarginal apertures.

Remarks. — Polish specimens differ from Reuss'one in smaller dimensions, smaller number of whorls and presence of a sharp keel. From other specimens described, they differ only in a flat surface of chambers on both sides of test and flat sutures on the dorsal side. In the type of its ornamentation, the species discussed resembles *E. favosoides* (Egger), from which it differs in the lack of ornamentation on the dorsal side and on the chambers of the ventral side.

Distribution. — Poland: higher part of the Lower Turonian; North-western Germany, England, Holland and France: Albian; U.S.S.R.: Aptian, Albian.

Epistomina spinulifera polypioides (Eichenberg, 1933)

(Pl. XVIII, Figs. 4 *a*—*c*, 5, 6 *a*,*b*, 7 *a*—*c*)

1933. *Rotalia(?) (Epistomina) polypioides* Eichenberg; W. Eichenberg, Foraminiferen aus dem Albien..., p. 21, Pl. 3, Fig. 1 a—c.
1963. *Brotzenia spinulifera* (Reuss); L. V. Alekseeva in L. V. Alekseeva & M. K. Rodionova, Foraminifery niżnego mela..., p. 37, Pl. 6, Fig. 6 a,b,w.
1966. *Epistomina (Brotzenia) spinulifera polypioides* (Eichenberg); J. Salaj & O. Samuel, Foraminifera der Westkarpaten..., pp. 157, 158, Pl. 5, Fig. 2 a—c.
1967. *Epistomina spinulifera polypioides* (Eichenberg, 1933); U. Ohm, Zur Kenntnis der Gattungen..., p. 141, Pl. 18, Figs. 7 a,b, 8 a—c, 9 a,b, 11; Pl. 19, Figs. 1 a,b, 9 (*here additional synonymy included*).
1968. *Epistomina* ex. gr. *spinulifera* (Reuss, 1863); O. Jendrejakowa, Benthonische Foraminiferen..., pp. 324—326, Pl. 5, Fig. 1 a—c.

1968. *Epistomina* aff. *reticulata* (Reuss, 1862); O. Jendrejakova, *Ibid.* p. 326, Pl. 5, Fig. 2 a—c.

1968. *Epistomina* sp. Jendrejakova; O. Jendrejakova, *Ibid.*, pp. 326—328, Pl. 4, Fig. 5 a,b.

Material. — Twenty-five partly damaged specimens.

Dimensions (in mm):

	IG 4200/70/F	IG 4446/70/F	IG 4447/70/F
Diameter . .	0.936	0.864	0.468
Thickness . .	0.576	0.504	0.324

Description. — Test planoconvex or with a slightly convex dorsal side and strongly convex ventral side, composed of two whorls, with a total of 12—13 chambers, seven to eight of them in the second whorl. The outline of test oval, periphery with a wide, sharp, frayed keel. All sutural ribs high and sharp. The dorsal side slightly convex with all whorls and chambers visible on. The outline of chambers in the first whorl rounded, in the second whorl quadrangular, surface flat, sutures strongly arcuate, sutural ribs the narrowest and sharpest between the chamber of the second whorl. The ventral side strongly conically convex, chambers triangular in outline, with a flat surface. Sutural ribs rectilinear, deflected posteriorly halfway the length or somewhat nearer the keel, connected, at the apex of the ventral side, with a small disc. The disc either completely smooth or covered with depressions. Lateromarginal apertures, situated near the keel surrounded with the remnant of the apertural lip in the form of a small roof. Apertures are closed, except in the last and, sometimes, last but one chamber. A thin, fairly wide tooth flate, running nearly perpendicularly to the vertical axis of test, is visible in each chamber of, the damaged specimens. In the last chamber, this plate is somewhat thicker and wider than in the preceding chambers.

Variability. — It is manifested in the degree of convexity of both side of test, (but in each case the dorsal side is less convex), degree of the curvature of the septal sutures on the ventral side, height and width of sutural ribs on both sides of test, width of keel and ornamentation of the umbilical disc.

Remarks. — Specimens of *E. spinulifera* which, judging from the ornamentation of their sutures, represent the lowermost level of the phylogenetic development of this stock, have been found by Bartenstein & Bettenstaedt (1962) in the Middle and Upper Barremian deposits of Germany. Some of them instead of sutural lists have closely spaced, single nodes or series of them. The representatives of *E. spinulifera polypioides* frequently occur in the U.S.S.R. Specimens very similar to the variety "*polypioides*" are known from the Mediterranean zone under the name of *E. Colomi* Sigal (in Dubourdier & Sigal, 1949).

Distribution. — Poland: Lower Turonian; North-western Germany: Upper Aptian through the lowermost beds of the Upper Albian; the Mediterranean zone (Austria, Balearic Islands, North Africa, Turkmenistan, Western Carpathians, Yugoslavia): Upper Aptian through Upper Albian and, maybe also, Cenomanian.

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EUGENIA GAWOR-BIEDOWA

OTWORNICE ALBU, CENOMANU I TURONU POLSKI I ICH ZNACZENIE STRATYGRAFICZNE

Streszczenie

W pracy przedstawiono wyniki badań otwornic pochodzących z 16 wierceń z niecek: szczecińskiej, mogileńskiej, łódzkiej i z monokliny przedsudeckiej. Z osadów górnego albu, cenomanu i przeważnie dolnego turonu opracowano 100 gatunków otwornic należących do 20 rodzin i 42 rodzajów. Wprowadzono 7 nowych gatunków i 1 nowy podgatunek (Tab. 1). Zbadano wszystkie gatunki należące do rodziny Anomalinidae Cushman, 1927 gdyż właśnie w albie rozpoczyna się pierwsza faza dynamicznego rozwoju tej rodziny. Kończy się ona na pograniczu dolnego i górnego turonu wymieraniem gatunków, których szeregi ewolucyjne zostały zapoczątkowane już w neokomie. W górnym turonie pojawia się już inny, nowy zespół gatunków tej rodziny. U przedstawicieli rodziny Anomalinidae zbadano mikrostrukturę ścianki, położenie w skorupce komory początkowej oraz przemianę pokoleń. Badania te umożliwiły zaszeregowanie opracowywanych gatunków do odpowiedniej rodziny, rodzajów oraz ustalenie podobieństw i różnic morfologicznych między osobnikami różnych generacji. Mikrostrukturę ścianki zbadano niemal u wszystkich gatunków omawianej rodziny z wyjątkiem *Gavelinella (Gavelinella) planodorsa* (Saidova) i *G. (G.) sigmoicosta* Ten Dam. U badanych gatunków skorupka zbudowana jest z ziarnistego kalcytu, bilamellarna, a właściwie trilamellarna. Przy szczegółowych obserwacjach okazało się bowiem, że ciemnobrązowa linia leżąca między zewnętrzną, główną warstwą skorupki, a wewnętrzną — wyściółką jest mikroziarnistym kalcytem. Hanzawa (1962) pierwszy tę ciemną linię uznał za trzecią warstwę budującą ściankę skorupki. Do trójblaszkowych form autor ten odnosi zarówno te o septach wtórnie podwójnych — typu rotaliidów, jak i pierwotnie podwójnych typu bilamellidów. Reiss (1958) uważał, że przestrzeń między warstewką zewnętrzną a wewnętrzną była pierwotnie u bilamellidów wypełniona przez substancję protoplazmatyczną. Przestrzeń tę uważa Reiss za system kanałowy skorupki. Ciemne smugi na kontakcie kolejno nakładających się warstewek, powodujących zgrubienie skorupki uważa on za kontakt dwóch powierzchni. W badanym materiale nie stwierdzono ani w jednym przypadku, aby warstewka zewnętrzna ścianki komory młodszej przedłużała się na komorę starszą. Inaczej mówiąc nie za-

uważono więcej warstewek na ściankach komór starszych niż młodszych. Zarówno ścianki wszystkich komór jak i septa są trilamellarne. Wielkość ziarn kalcytu w warstewce zewnętrznej-głównej i wewnętrznej-wyściółce jest różna, a stała w środkowej. Dalsze badania wykażą czy wielkość ziarn kalcytu jest cechą gatunkową czy też osobniczą.

Bardzo duże znaczenie w klasyfikacji anomalinidów ma prawidłowe rozpoznanie stron skorupki. U większości badanych gatunków nie można tego dokonać bez wykonania cienkich płytek. Wypukłość komór po stronie przeciwnej niż ta, na którą przedłuża się boczna część ujścia, jak i obecność w centrum tej strony guzka, uniemożliwiają obserwację położenia komory początkowej i ewolutności skorupki, co ściśle wiąże się z wyznaczeniem jej stron. Dzięki przeprowadzonym badaniom udało się w pierwszym rzędzie rozstrzygnąć kwestie sporne, jak np. problem zaszeregowania *Cibicides formosa* Brotzen do odpowiedniego rodzaju. Dotychczas jedynie Vassilenko (1961) uznała ten gatunek za przedstawiciela rodziny Anomalinidae. U większości badanych gatunków tej rodziny stwierdzono obecność przedstawicieli generacji mikro i makrosferycznej. Osobniki te nie różnią się między sobą cechami morfologicznymi, różnice zaznaczają się dopiero w budowie wewnętrznej skorupki. Poszczególne generacje różnią się nie tylko wielkością komory początkowej lecz również liczbą skrętów i komór. Jedyną cechą, przy pomocy której możnaby rozpoznać osobniki poszczególnych generacji niektórych gatunków bez wykonania cienkich płytek, jest różnica w liczbie komór w ostatnim skręcie. U osobników generacji mikrosferycznej ostatni skręt zbudowany jest z jednej komory więcej niż u osobników generacji makrosferycznej. Jednak ten sposób rozróżniania generacji napotyka na trudności, gdyż w populacjach występują osobniki w różnych stadiach rozwoju ontogenetycznego.

Opracowane otwornice planktoniczne pozwoliły zbadać powiązania obszaru Polski ze strefą śródziemnomorską, a zlepieńcowate do ustalenia stratygrafii warstw, w których otwornice wapienne bądź nie występują, bądź występują sporadycznie. Wszystkie przedstawione w pracy gatunki posłużyły do dokładnego rozpoziomowania osadów, do ustalenia różnic między zespołami otwornic z poszczególnych jednostek tektonicznych i do porównania tych zespołów z zespołami innych krajów. Należy dodać, że zasięgi występowania otwornic skorelowano z zasięgami przewodniej makrofauny.

W wyniku analizy mikropaleontologicznej w osadach cenomanu badanego obszaru, z wyjątkiem niecki szczecińskiej, wyróżniono trzy poziomy otwornicowe. W niecce szczecińskiej tylko dwa (Tab. 2). Stwierdzono że gatunki otwornic uznane dotychczas za przewodnie dla dolnego turonu mogą również występować w dolnych warstwach turonu górnego (niecka szczecińska). Zespół tych otwornic nazwano zespołem „alfa" turonu, obniżając jego wartość stratygraficzną. Dotychczas bowiem jego występowanie łączono jedynie z osadami dolnego turonu tj. z poziomem z *Inoceramus labiatus* i dolną częścią poziomu z *I. lamarcki*, nazywając te warstwy poziomem „alfa" turonu. Zespołowi „alfa" turonu w niecce szczecińskiej towarzyszą gatunki rodzaju *Epistomina* Terquem, 1883, cytowane w literaturze przeważnie z dolnej kredy. Dla osadów zawierających ten unikalny dotychczas zespół otwornic proponuje się nazwę warstwy „maszkowskie". Wiekowo odpowiadają one dolnemu turonowi. Porównując zespoły

otwornic Polski i Francji stwierdzono, że wielu przodków gatunków rodziny Anomalinidae występujących w osadach albu, cenomanu i dolnego turonu badanego obszaru, należy szukać wśród otwornic dolnego i środkowego albu Basenu Paryskiego. W cenomanie badanego obszaru obserwuje się znacznie więcej rodzajów i gatunków planktonicznej, ciepłolubnej mikrofauny niż w Basenie Paryskim, Niemczech północno-zachodnich czy na platformowej części ZSRR.

Rozprzestrzenienie rotalipor w Polsce jest bardzo podobne do ich rozprzestrzenienia w kredzie Dijon na pograniczu Basenu Paryskiego i południowo-wschodniej Francji. Na wspomnianym obszarze Francji wyróżniono w cenomanie dwa poziomy, poziom I w dolnych warstwach, odpowiadający poziomom I i II cenomanu z obszaru Polski, i poziom II odpowiadający polskiemu, cenomańskiemu poziomowi III. Francuski poziom III obejmuje już warstwy turonu dolnego. Występuje w nim zespół gatunków nazwany w tej pracy zespołem „alfa" turonu. Zespoły cenomańskie z badanego obszaru są najbardziej podobne do zespołów z północno-zachodnich Niemiec, z tą jednak różnicą, że w Niemczech nagromadzenie rotalipor notuje się dopiero w poziomie *Inoceramus labiatus*. Należy również podkreślić, że na żadnym z porównywanych obszarów nie stwierdzono w osadach dolnego turonu tak bogatego zespołu otwornic planktonicznych jak na obszarze Polski.

ЭУГЕНИЯ ГАВОР-БЕДОВА

ФОРАМИНИФЕРЫ АЛЬБА, СЕНОМАНА И ТУРОНА ПОЛЬШИ И ИХ СТРАТИГРАФИЧЕСКОЕ ЗНАЧЕНИЕ

Резюме

В работе представлены результаты исследования фораминифер из пород верхнего альба, сеномана и, главным образом, нижнего турона, пройденных 16 буровыми скважинами на площади Щецинской, Могильновской и Лодзинской мульд и на Предсудетской моноклинали. Было изучено 100 видов фораминифер, принадлежащих к 20 семействам и 42 родам. Установлены 7 новых видов и 1 новый подвид (табл. 1). Исследованы все виды, относящиеся к семейству Anomalinidae Cushman, 1927, так как именно в альбе начинается первая фаза бурного развития этого семейства. Она завершается на рубеже между нижним и верхним туроном вымиранием тех видов, эволюционные ряды которых появились еще в неокоме. В верхнем туроне появляется уже другое, новое сообщество видов этого семейства. У представителей семейства Anomalinidae исследовалась микроструктура стенки, расположение начальной камеры в раковине и смена поколений. Полученные данные составили основу для зачисления изученных видов в соответствующие семейства и роды, а также для выявления морфологических сходств и различий у особей разных генераций. Микроструктура стенки исследовалась почти у всех видов рассматриваемого семейства, за исключением *Gaveli-*

nella (Gavelinella) planodorsa (Saidova) и *G. (G.) sigmoicosta* Ten Dam. Изученнные виды обладают двухслойной, а вернее трехслойной раковиной, состоящей из зернистого кальцита. Детальные наблюдения показали, что темнокоричневая полоска, виднеющаяся между внешним, главным слоем раковины и внутренним, выстилающим слоем, состоит из мелкозернистого кальцита. Ганзава (Hanzawa, 1962) впервые принял эту темную полоску в качестве третьего слоя в строении стенки раковины. К трехпластинчатым формам этот автор относит как формы с вторично двойными септами типа роталиид, так и формы с первично двойными септами типа биламеллид. Рейсс (Reiss, 1958) высказал предположение, что пространство между внешним и внутренним слоями у биламеллид было первоначально заполнено протоплазматическим веществом и представляло систему каналиков раковины. Темные полоски на сочленении последовательных слоев, утолщающих раковину, этот автор рассматривает как контакт двух поверхностей. В исследованном материале ни в одном случае не отмечено, чтобы внешний слой стенки младшей камеры захватывал старшую камеру. Иначе говоря, на стенках более древних камер не отмечается больше слоев по сравнению с младшими камерами. Стенки всех камер и септа трехслойные. Наружный, главный и внутренний, выстилающий слои состоят из зерен кальцита разной величины, а средний слой сложен равнозернистым кальцитом. Дальнейшие исследования покажут, является ли величина зерен кальцита видовой или же индивидуальной особенностью.

Весьма важное значение в классификации аномалинид имеет правильное определение сторон раковины. У большинства исследованных видов это невозможно без производства шлифов. Выпуклость камер на стороне противоположной по отношению к стороне, на которой продолжена боковая часть устья, а также наличие в середине этой стороны бугорка, препятствуют определению положения начальной камеры и эволютности раковины и, таким образом, определению ее сторон. В итоге проведенных исследований удалось в первую очередь решить ряд спорных проблем, как, например, зачисление *Cibicides formosa* Brotzen к соответствующему роду. До сих пор единственно Василенко (1961) считала этот вид представителем семейства Anomalinidae. У большинства исследованных видов этого семейства были обнаружены представители микросферической и макросферической генераций. Эти особи не отличаются друг от друга морфологическими признаками и различия проявляются лишь во внутреннем строении раковины. Отдельные генерации отличаются не только величиной начальной камеры, но также количеством оборотов и камер. Единственным признаком, с помощью которого можно различить представителей разных генераций некоторых видов без необходимости производства шлифов является разное количество камер в последнем обороте. Представители микросферической генерации имеют в последнем обороте на одну камеру больше, чем особи макросферической генерации. Однако дополнительное затруднение состоит в том, что в популяциях представлены особи разных стадий онтогенетического развития.

Изученные планктонные фораминиферы предоставили возможность просле-

дить связи территории Польши со Средиземноморской зоной, а агглютинированные фораминиферы помогли в установлении стратиграфии слоев, в которых известковые фораминиферы не встречаются или же представлены спорадически. Все описанные в работе виды были использованы для детального расчленения отложений, выявления особенностей фораминиферовых сообществ разных тектонических элементов и сопоставления их с сообществами других стран. Следует отметить, что была проведена корреляция границ распространения фораминифер с распространением руководящей макрофауны.

На основании микропалеонтологического анализа сеноман исследованной площади, за исключением Щецинской мульды, был расчленен на три фораминиферовых горизонта. В Щецинской мульде отмечены лишь два горизонта (табл. 2). Констатировано, что виды фораминифер, считающиеся до сих пор руководящими для нижнего турона, могут встречаться и в низах верхнего турона (Щецинская мульда). Сообщество этих фораминифер названо сообществом „альфа" турона с уменьшением его стратиграфического значения. До сих пор считалось, что распространение этого сообщества ограничивается к нижнему турону, т.е. горизонту *Inoceramus labiatus* и нижней части горизонта *I. lamarcki*. Эти слои именовались горизонтом „альфа" турона. Сообщество „альфа" турона в Щецинской мульде сопровождается видами рода *Epistomina* Terquem, 1883, известными по литературным данным преимущественно из нижнего мела. Предлагается наименовать отложения, содержащие это уникальное сообщество фораминифер, машковскими слоями. По возрасту они эквивалентны с нижним туроном.

Сопоставление фораминиферовых сообществ из территории Польши и Франции показало, что многие предки видов семейства Anomalinidae, распространенных в альбе, сеномане и нижнем туроне исследованной площади, представлены среди фораминифер нижнего и среднего альба в Парижском бассейне. В сеномане рассматриваемой площади наблюдается намного больше родов и видов планктонной теплолюбивой микрофауны, чем в Парижском бассейне, Севере-Западной Германии и в платформенной части СССР.

Распространение роталипор в Польше характеризуется большим сходством с их распространением в меловых породах Дижон на границе Парижского бассейна и Юго-Восточной Франции. В этой части Франции в сеномане различаются два горизонта: горизонт I, охватывающий нижние слои и эквивалентный сеноманским горизонтам I и II на территории Польши, и горизонт II, соответствующий горизонту II в сеномане Польши. Французский горизонт III охватывает уже слои нижнего турона. Он включает виды, названные в настоящей работе сообществом „альфа" турона. Сеноманские сообщества исследованной территории проявляют наибольшее сходство с сообществами Северо-Западной Германии, однако различие состоит в том, что в Германии скопление роталипор появляется только лишь с горизонта *Inoceramus labiatus*. Необходимо также отметить, что ни в одном из сопоставляемых регионов не наблюдается настолько богатого как в Польше сообщества фораминифер, распространенных в нижнем туроне.

EXPLANATIONS OF PLATES

Plate I

Spiroplectammina praelonga (Reuss)

Fig. 1. side view (IG 4034/70/F); boring Łódź 4a, depth 776.6 m, Cenomanian

Textularia chapmani Lalicker

Fig. 2. *a* side view, *b* apertural view, (IG 4055/70/F); boring Łódź 4a, depth 790 m. Cenomanian.

Textularia foeda Reuss

Fig. 3. *a* side view, *b* apertural view (IG 4056/70/F); boring Łódź 4a, depth 780.6 m Cenomanian.

Gaudryina angustata angustata Akimez

Figs. 4, 5. a side view, b apertural view (IG 4057/70/F, 4058/70/F); boring Szczecin IG I, depth 1461 m, Lower Turonian.

Gaudryina angustata compressa Akimez

Figs. 6, 7. a side view, b apertural view (IG 4059/70/F, 4060/70/F); boring Szczecin IG I, depth 1461 m, Lower Turonian.

Spiroplectinata annectens (Parker & Jones)

Fig. 8. Side view (IG 4061/70/F); boring Gorzów Wkp. IG I, depth 709.6 m, Cenomanian.

Spiroplectinata complanata (Reuss)

Fig. 9. Side view (IG 4062/70/F); boring Łódź 5a, depth 602.5 m Cenomanian.

Tritaxia pyramidata (Reuss)

Fig. 10. *a* side view, *b* apertural view (IG 4063/70/F); boring Gorzów Wkp. IG I, depth 706 m, Cenomanian.

Plate II

Tritaxia plummerae Cushman

Figs. 1, 3. *a* side view, *b* apertural view (IG 4065/70/F 4066/70/F); Fig. 1 boring Lusowo IG I, depth 360.9 m; Fig. 3 boring Ślazewo 5, depth 128 m, Cenomanian.

Tritaxia macfadyeni Cushman

Fig. 2. *a* side view, *b* apertural view (IG 4064/70/F); boring Murczyn IG I, depth 244.5 m, Cenomanian.

Dorothia trochus (d'Orbigny)

Fig. 4. *a* dorsal view, *b* side view, *c* apertural view (IG 4073/70/F); boring Gorzów Wkp. IG I, depth 711.6 m, Cenomanian.

Dorothia turris (d'Orbigny)

Figs. 5, 6. Fig. 5 side view, Fig. 6 horizontal section of an initial part of a test (IG 4071/70/F 4072/70/F); boring Maszkowo II, depth 189.5 m, Cenomanian.

Dorothia gradada (Berthelin)

Fig. 7. *a* side view, *b* apertural view (IG 4070/70/F); boring Gorzów Wkp. IG I, depth 669 m, Cenomanian.

Verneuilinoides gorzowiensis n.sp.

Figs. 8—10. *a* side view, *b* apertural view (IG 4067/70/F—4069/70/F); boring Gorzów Wkp. IG I, depth 709 m, Cenomanian.

Plate III

Eggerellina mariae Ten Dam

Figs. 1, 2. *a* apertural view, *b* side view (IG 4074/70/F 4075/70/F); boring Łódź 4a, depth 817.5 m, Upper Albian.

Plectina ruthenica mariae (Franke)

Fig. 3. *a* side view, *b* apertural view (IG 4076/70/F); boring Gorzów Wkp. IG I, depth 685 m, Cenomanian.

Pseudotextulariella cretosa Cushman

Fig. 4. *a* apertural view (inner structure), *b* side view (IG 4077/70/F); boring Gorzów Wkp. IG I depth 685 m, Cenomanian.

Quinqueloculina kozlowskii n.sp.

Fig. 5. *a*, *b*, side views, *c* apertural view, (IG 4079/70/F); boring Gorzów Wkp. IG I, depth 709 m, Cenomanian.

Quinqueloculina antiqua Franke

Fig. 6. *a*, *b* side views, *c* apertural view (IG 4078/70/F); boring Łódź 5a, depth 595 m, Cenomanian.

Marginulina aequivoca Reuss

Fig. 7. (IG 4080/70/F); boring Łódź 4a, depth 815 m, Upper Albian.

Marginulina jonesi Reuss

Fig. 8. (IG 4081/70/F); boring Łódź 4a, depth 792.5 m, Upper Albian.

Planularia cristellarioides Reuss

Fig. 9. (IG 4084/70/F); boring Ślazewo 5, depth 210 m, Cenomanian.

Planularia complanata (Reuss)

Fig. 10. (IG 4083/70/F) boring Łódź 5a, depth 580 m, Cenomanian.

Planularia bradyana (Chapman)

Fig. 11. (IG 4082/70/F); boring Murczyn IG I, depth 244.5 m, Cenomanian.

Plate IV

Planularia cenomana (Schacko)

Fig. 1. (IG 4085/70/F); boring Ślazewo 5, depth 90 m, Cenomanian.

Saracenaria bononiensis (Berthelin)

Figs. 2—4. (IG 4086—4088/70/F); boring Łódź 4a, depth 817.5 m, Upper Albian.

Vaginulina robusta Chapman

Fig. 5. (IG 4098/70/F); boring Łódź 5a, depth 605 m, Cenomanian.

Vaginulina procera Albers

Fig. 6. (IG 4096/70/F); boring Murczyn IG I, depth 237 m, Cenomanian.

Saracenaria vestita (Berthelin)

Figs. 7—10. (IG 4089—4091/70/F); boring Pagórski IG I, depth 925.2 m, Upper Albian.

Vaginulina recta Reuss

Fig. 11. (IG 4097/70/F); boring Murczyn IG I, depth 244.5 m, Cenomanian.

Vaginulina tenuistriata Chapman

Fig. 12. (IG 4101/70/F); boring Łódź 5a, depth 605 m, Cenomanian.

Vaginulina striolata Reuss

Fig. 13. (IG 4100/70/F); boring Łódź 5a, depth 605 m, Cenomanian.

Vaginulina arguta Reuss

Fig. 14. (IG 4093/70/F); boring Ślazewo 5, depth 228 m, Upper Albian.

Vaginulina aff. *paucistriata* Reuss

Fig. 15. (IG 4095/70/F); boring Łódź 4a, depth 808.8 m, Cenomanian.

Vaginulina biochei Berthelin

Fig. 16. (IG 4094/70/F); boring Pagórki IG I, depth 919.1 m, Cenomanian.

Vaginulina strigillata bettenstaedti Albers

Fig. 17. (IG 4099/70/F); non described, boring Łódź 5a, depth 602.5 m, Upper Albian.

Plate V

Praebulimina evexa (Loeblich & Tappan)

Fig. 1. (IG 4103/70/F); boring Łódź 4a, depth 811.2 m, Upper Albian.

Neobulimina minima Tappan

Fig. 2. *a* side view, *b* apertural view (IG 4102/70/F); boring Łódź 4a, depth 811.2 m, Upper Albian.

Heterohelix washitensis Tappan

Fig. 3. a side view, b apertural view, (IG 4110/70/F); boring Łódź 4a, depth 794.30 m, Cenomanian.

Guembelitria cenomana (Keller)

Fig. 4. (IG 4109/70/F); boring Łódź 5a, depth 618 m, Upper Albian.

Tappanina eouvigeriniformis (Keller)

Fig. 5. *a* side view, *b* apertural view (IG 4105/70/F); boring Łódź 4a, depth 787.2 m, Cenomanian.

Bolivina textilarioides Reuss

Fig. 6. *a* side view, *b* apertural view (IG 4104/70/F); boring Łódź 5a, depth 598 m, Cenomanian.

Bifarina calcarata (Berthelin)

Fig. 7. (IG 4111/70/F); boring Łódź 4a, depth 787.2 m, Cenomanian.

Hedbergella planispira (Tappan)

Fig. 8. *a* spiral side, *b* umbilical side, *c* edge view (IG 4112/70/F); boring Maszkowo II, depth 237 m, Upper Albian.

Hedbergella hoterivica (Subbotina)

Fig. 9—11. *a* spiral side, *b* umbilical side, *c* edge view, (IG 4118—4120/70/F); boring Gorzów Wkp. IG I, depth 711.6 m, Cenomanian.

Globigerina graysonensis Tappan

Fig. 12. *a* spiral side, *b* umbilical side, *c* edge view (IG 4142/70/F) boring Łódź 4a, depth 787.2 m, Cenomanian.

Plate VI

Schackoina cenomana cenomana (Schacko)

Fig. 1. (IG 4113/70/F); boring Gorzów Wkp. IG I, 709.6 m, Cenomanian.

Schackoina cenomana bicornis Reichel

Fig. 2. (IG 4114/70/F); boring Gorzów Wkp. IG I depth 709.6 m, Cenomanian.

Schackoina moliniensis Reichel

Fig. 3. (IG 4115/70/F); boring Gorzów Wkp. IG I, depth 709.6 m, Cenomanian.

Conorbina brotzeni Gandolfi

Fig. 4. *a* spiral side, *b* umbilical side, *c* edge view (IG 4106/70/F) boring Łódź 4a, depth 822.5 m, Upper Albian.

Valvulineria gracillima Dam

Fig. 5. *a* spiral side, *b* umbilical side, *c* edge view (IG 4108/70/F), boring Łódź 4a, depth 808.8 m, Cenomanian.

Valvulineria lenticula (Reuss)

Fig. 6. *a* spiral side, *b* umbilical side, *c* edge view (IG 4107/70/F) boring Łódź 4a, depth 817.5 m, Cenomanian.

Globigerinelloides bentonensis (Morrow)

Fig. 7. *a, b* side views, *c* edge view (IG 4112/70/F); boring Maszkowo II, depth 237 m, Upper Albian.

Hedbergella infracretacea (Glaessner)

Fig. 8. *a* spiral side, *b* umbilical side, *c* edge view (IG 4121/70/F), boring Gorzów Wkp. IG I, depth 711.6 m, Cenomanian.

Plate VII

Hedbergella brittonensis Loeblich & Tappan

Figs. 1, 2. *a* spiral side, *b* umbilical side, *c* edge view (IG 4116/70/F 4117/70/F); boring Maszkowo II, depth 178 m, Cenomanian.

Clavihedbergella simplicissima (Magne & Sigal)

Fig. 3. *a* spiral side, *b* umbilical side, *c* edge view (IG 4123/70/F), boring Maszkowo II, depth 112 m, Lower Turonian.

Plate VIII

Praeglobotruncana stephani (Gandolfi)

Fig. 1. *a* spiral side, *b* umbilical side, *c* edge view (IG 4128/70/F) boring Maszkowo II, depth 151 m, Lower Turonian.

Praeglobotruncana imbricata (Mornod)

Figs. 2, 3. *a* spiral side, *b* umbilical side, *c* edge view (IG 4125/70/F 4126/70/F); Fig. 2 boring Maszkowo II, depth 112 m, Fig. 3 boring Pagórki IG I, depth 826.67 m, Lower Turonian.

Praeglobotruncana helvetica (Bolli)

Fig. 4. *a* spiral side, *b* umbilical side, *c* edge view (IG 4124/70/F); boring Maszkowo II, depth 74 m, Lower Turonian.

Praeglobotruncana oraviensis Scheibnerová

Fig. 5. *a* spiral side, *b* umbilical side, *c* edge view (IG 4127/70/F); boring Maszkowo II, depth 151 m, Lower Turonian.

Plate IX

Rotalipora appenninica (Renz)

Figs. 1—3. *a* spiral side, *b* umbilical side, *c* edge view (IG 4129—4131/70/F); Fig. 1 boring Maszkowo II, depth 220 m, Figs. 2, 3 boring Łódź 4a, depth 787.2 m, Cenomanian.

Rotalipora greenhornensis (Morrow)

Figs. 4, 5. *a* spiral side, *b* umbilical side, *c* edge view (IG 4138/70/F 4139/70/F); boring Maszkowo II, depth 178 m, Cenomanian.

Plate X

Rotalipora cushmani cushmani (Morrow)

Figs. 1, 2. *a* spiral side, *b* umbilical side, *c* edge view (IG 4132/70/F 4133/70/F); Fig. 1 boring Ślazewo 5, depth 120 m, Fig. 2 boring Murczyn IG I, depth 232 m, Cenomanian.

Rotalipora cushmani thomei Hagn & Zeil

Figs. 3, 4. *a* spiral side, *b* umbilical side, *c* edge view (IG 4134/70/F 4135/70/F); boring Ślazewo 5, depth 120 m, Cenomanian.

Plate XI

Rotalipora reicheli Mornod

Fig. 1. *a* spiral side, *b* umbilical side, *c* edge view (IG 4140/70/F); boring Maszkowo II, depth 189.5 m, Cenomanian.

Rotalipora deeckei (Franke)

Figs. 2, 3. *a* spiral side, *b* umbilical side, *c* edge view (IG 4136/70/F 4137/70/F); boring Murczyn IG I, depth 242 m, Cenomanian.

Globotruncana renzi Gandolfi

Fig. 4. *a* spiral side, *b* umbilical side, *c* edge view (IG 4141/70/F), boring Pagórki IG I, depth 806 m, Lower Turonian.

Plate XII

Eponides belorussiensis Akimez

Fig. 1. *a* spiral side, *b* umbilical side, *c* edge view (IG 4143/70/F); boring Łódź 4a, depth 790.5 m, Upper Albian.

Planulina aff. *lundegreni* Brotzen

Figs. 2—4. *a* dorsal side, *b* ventral side, *c* edge view (IG 4144—4146/70/F); boring Szamotuły Geo 10, depth 500.5 m, Turonian.

Cibicides gorbenkoi Akimez

Figs. 5, 6. *a* dorsal side, *b* ventral side, *c* edge view (IG 4147/70/F 4148/70/F); boring Gorzów Wkp. IG I, depth 711.6 m, Cenomanian.

Plate XIII

Pleurostomella obtusa Berthelin

Figs. 1, 2, 4. *a* apertural view, *b* side view (IG 4149—4151/70/F); boring Pagórki IG I, depth 921.70 m, Upper Albian.

Pleurostomella reussi Berthelin

Figs. 3, 5. *a* apertural view, *b* side view (IG 4152/70/F 4153/70/F) boring Łódź 4a, depth 820.6 m, Upper Albian.

Globorotalites polonica n.sp.

Fig. 6. *a* dorsal side, *b* ventral side, *c* edge view (IG 4155/70/F); boring Łódź 4a, depth 797.3 m, Cenomanian.

Globorotalites hangensis Vassilenko

Fig. 7. *a* dorsal side, *b* ventral side, *c* edge view (IG 4154/70/F); boring Szamotuły Geo 10, depth 500.5 m, Turonian.

Gyroidinoides infracretacea Morozova

Fig. 8. *a* dorsal side, *b* ventral side, *c* edge view (IG 4156/70/F); boring Łódź 4a, depth 808.8 m, Cenomanian.

Plate XIV

Lingulogavelinella formosa (Brotzen)

Fig. 1. *a* dorsal side, *b* ventral side, *c* edge view (IG 4163/70/F), boring Maszkowo II, depth 189.5 m, Cenomanian.

Anomalina gorzowiensis n.sp.

Fig. 2—4. *a* dorsal side, *b* ventral side, *c* edge view (IG 4157—4159/70/F); Fig. 3 holotype Figs. 2, 4 paratypes, boring Gorzów Wkp. IG I, depth 709.6 m, Cenomanian.

Lingulogavelinella asterigerinoides asterigerinoides (Plummer)

Fig. 5. *a* dorsal side, *b* ventral side, *c* edge view (IG 4160/70/F) boring Łódź 5a, depth 626 m, Upper Albian.

Lingulogavelinella pazdroae n.sp.

Fig. 6. *a* dorsal side, *b* ventral side, *c* edge view (IG 4169/70/F); boring Maszkowo II, depth 214 m, Cenomanian.

Plate XV

Lingulogavelinella asterigerinoides arachnoidea n.subsp.

Figs. 1, 2. *a* dorsal side, *b* ventral side, *c* edge view (IG 4161/70/F 4162/70/F); Fig. 1 — holotype, Fig. 2 paratype, boring Łódź 5a depth 608.5 m, Upper Albian.

Lingulogavelinella orbiculata (Kusnezova)

Fig. 3. *a* dorsal side, *b* ventral side, *c* edge view (IG 4168/70/F); boring Łódź 5a, depth 602.5 m, Upper Albian.

Lingulogavelinella globosa (Brotzen)

Figs. 4, 5. *a* dorsal side, *b* ventral side, *c* edge view (IG 4164/70/F 4165/70/F); boring Maszkowo II, depth 112 m, Lower Turonian.

Lingulogavelinella ornatissima (Lipnik)

Fig. 6. *a*, *b* sides view, *c* edge view (IG 4167/70/F); boring Łódź 4a, depth 692 m, Cenomanian.

Gavelinella (*Berthelina*) *intermedia* (Berthelin)

Figs. 7—9. *a* dorsal side, *b* ventral side, *c* edge view (IG 4174—4176/70/F); Fig. 7 boring Łódź 5a, depth 626 m Upper Albian; Figs. 8, 9 boring Gorzów Wkp. IG I, depth 711.6 m, Cenomanian.

Plate XVI

Gavelinella (*Berthelina*) *berthelini* (Keller)

Fig. 1. *a* dorsal side, *b* ventral side, *c* edge view (IG 4173/70/F); boring Bartoszyce IG I, depth 400 m, Turonian.

Gavelinella (*Gavelinella*) *schloenbachi* (Reuss)

Fig. 2. *a* dorsal side, *b* ventral side, *c* edge view (IG 4182/70/F); boring Łódź 4a, depth 820.6 m, Upper Albian.

Gavelinella (*Berthelina*) *lodziensis* n.sp.

Figs. 3, 4. *a* dorsal side, *b* ventral side, *c* edge view (IG 4177/70/F 4178/70/F); Fig. 4 holotype, Fig. 3 paratype, boring Łódź 5a, depth 602.5 m, Upper Albian.

Gavelinella (*Berthelina*) *belorussica* Akimez

Figs. 5, 6. *a* dorsal side, *b* ventral side, *c* edge view (IG 4171/70/F 4172/70/F); boring Łódź 4a, depth 817.5 m, Upper Albian.

Plate XVII

Gavelinella (Gavelinella) sigmoicosta Ten Dam

Fig. 1. *a* dorsal side, *b* ventral side, *c* edge view, (IG 4183/70/F); boring Łódź 5a, depth 398 m, Cenomanian.

Gavelinella (Gavelinella) planodorsa (Saidova)

Fig. 2. *a* dorsal side, *b* ventral side, *c* edge view (IG 4181/70/F); boring Łódź 5a, depth 587 m, Cenomanian.

Lingulogavelinella kaptarenkae (Plotnikova)

Fig. 3. *a* dorsal side, *b* ventral side, *c* edge view (IG 4166/70/F); boring Łódź 5a, dept 624.3 m, Upper Albian.

Gavelinella (Gavelinella) cenomanica (Brotzen)

Fig. 4. *a* dorsal side, *b* ventral side, *c* edge view (IG 4180/70/F); boring Łódź 5a, depth 605 m, Cenomanian.

Gavelinella (Gavelinella) baltica Brotzen

Fig. 5. *a* dorsal side, *b* ventral side, *c* edge view (IG 4179/70/F); boring Łódź 4a, depth 820.6 m, Upper Albian.

Gavelinella (Gavelinella) varsoviensis n.sp.

Fig. 6. *a* dorsal side, *b* ventral side, *c* edge view (IG 4184/70/F); boring Łódź 5a, depth 602.5 m, Upper Albian.

Plate XVIII

Lingulogavelinella spinosa (Plotnikova)

Fig. 1. *a* dorsal side, *b* ventral side, *c* edge view (IG 4170/70/F); boring Łódź 5a, depth 620 m, Upper Albian.

Epistomina reticulata (Reuss)

Fig. 2. *a* dorsal side, *b* ventral side, *c* edge view (IG 4196/70/F); boring Maszkowo II, depth 78.6 m, Lower Turonian.

Epistomina juliae Mjatliuk

Fig. 3. *a* dorsal side, *b* ventral side, *c* edge view (IG 4195/70/F); boring Maszkowo II, depth 78.6 m, Lower Turonian.

Epistomina spinulifera polypioides (Eichenberg)

Figs. 4—7. *a* dorsal side, *b* ventral side, 7*c* edge view, 4*c*, 5 test destroyed showing septa, foramina and remains of internal partition (IG 4197—4200/70/F); boring Maszkowo II, Figs. 4, 5 depth 95 m, Figs. 6, 7 depth 117.7 m, Lower Turonian.

Plate XIX

Epistomina caracolla (Roemer)

Figs. 1—6. *a* dorsal side, *b* ventral side, *c* edge view, 2 showing septum, septal foramen and remains of internal partition, *3*, *4* natural horizontal sections, *6* dorsal view (IG 4185—4190/70/F); boring Maszkowo II, Figs. 1—3 depth 90 m, Figs. 4—6 depth 117.70 m, Lower Turonian.

Epistomina favosoides (Egger)

Figs. 7—10. *a* dorsal side, *b* ventral side, *c* edge view, *8* showing septum, septal foramen and remains of internal partition, *9* natural horizontal section (IG 4191—4194/70/F); boring Maszkowo II, depth 78.60 m, Lower Turonian.

Plate XX

Quinqueloculina kozlowskii n.sp.

Fig. 1. Vertical section showing a manner of arrangement of chambers in the test. Tops of two chambers on the convex side are destroyed (IG 4448/70/F);

Fig. 2. Horizontal section showing a manner of arrangement of chambers (IG 4449/70/F); boring Gorzów Wkp. IG I, depth 713.0 m, Upper Albian

Gavelinella (Berthelina) belorussica (Akimez)

Fig. 3. Vertical section showing embrional chamber laying nearer dorsal side than the chambers of the first whorl which are somewhat nearer of the ventral side: *a* dorsal side, *b* ventral side (IG 4450/70/F); boring Łódź 5a, depth 595 m, Upper Albian.

Lingulogavelinella formosa (Brotzen)

Fig. 4. Horizontal section of a form B showing a very fine embrional chamber and trilamellar structure of septa (IG 4451/70/F);

Fig. 5. Horizontal section of a form A showing a big embrional chamber and trilamellar structure of septa (IG 4452/70/F); boring Łódź 5a, depth 595 m, Upper Albian

Lingulogavelinella pazdroae n.sp.

Fig. 6. Vertical section showing a position of the embrional chamber in the test: *a* dorsal side, *b* ventral side (IG 4453/70/F); boring Murczyn IG I, depth 237 m, Cenomanian.

Lingulogavelinella ornatissima (Lipnik)

Fig. 7. Vertical section showing embrional chamber's position, chambers of the first whorl and trilamellar structure of the test, top of the figure (IG 4454/70/F); boring Ślazewo 5, depth 128 m, Upper Cenomanian.

Gavelinella (Gavelinella) varsoviensis n.sp.

Fig. 8. Horizontal section of a form A showing trilamellar structure of septa (IG 4455/70/F); boring Slazewo 5, depth 209 m, Lower Cenomanian.

Anomalina gorzowiensis n.sp.

Fig. 9. Horizontal section of a form A showing trilamellar structure of septa (IG 4456/70/F); boring Maszkowo II, depth 214 m, Cenomanian.

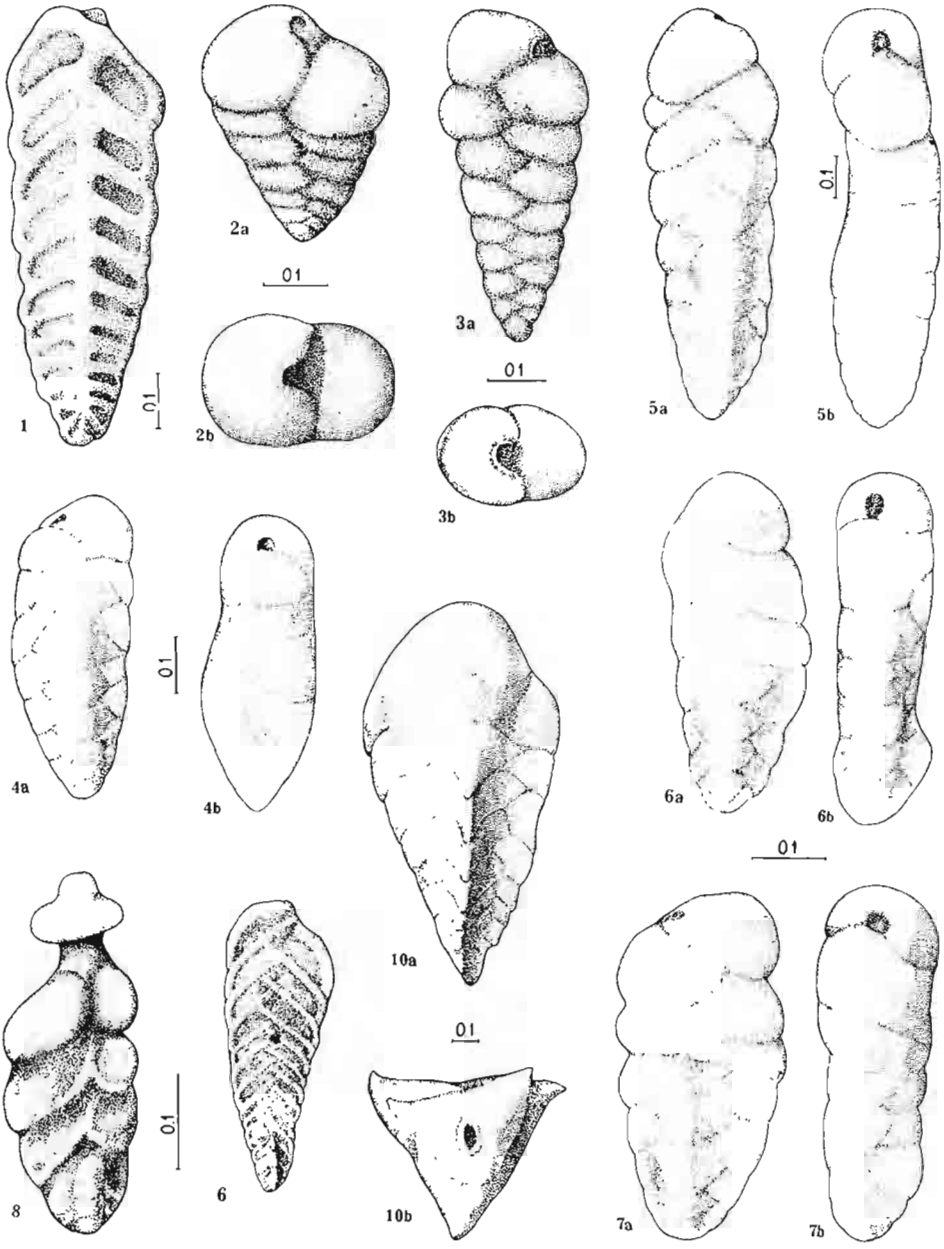
Gavelinella (Berthelina) berthelini (Keller)

Fig. 10. Horizontal section of a form B showing trilamellar structure of septa (IG 4456/70/F); boring Maszkowo II, depth 214 m, Cenomanian.

Gavelinella (Berthelina) lodziensis n.sp.

Fig. 11. Vertical section showing embrional chamber's position, chambers of the first whorl and trilamellar structure (top of the figure) *a* dorsal side, *b* ventral side (IG 4458/70/F); boring Ślazewo 5, depth 120 m, Cenomanian.

Fig. 12. Horizontal section of a form B showing embrional chamber, first whorls and trilamellar structure of septa (IG 4459/70/F); boring Murczyn IG I, depth 162 m, Lower Turonian.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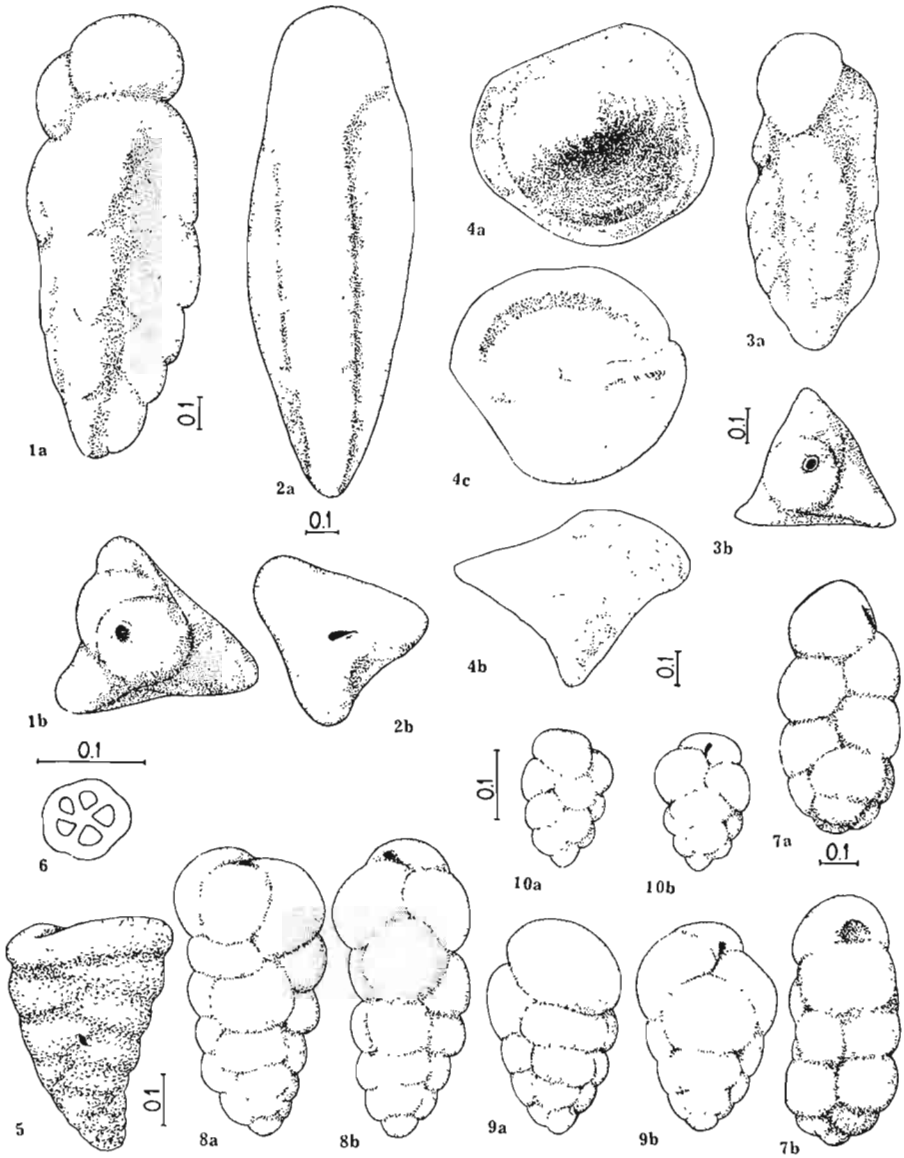
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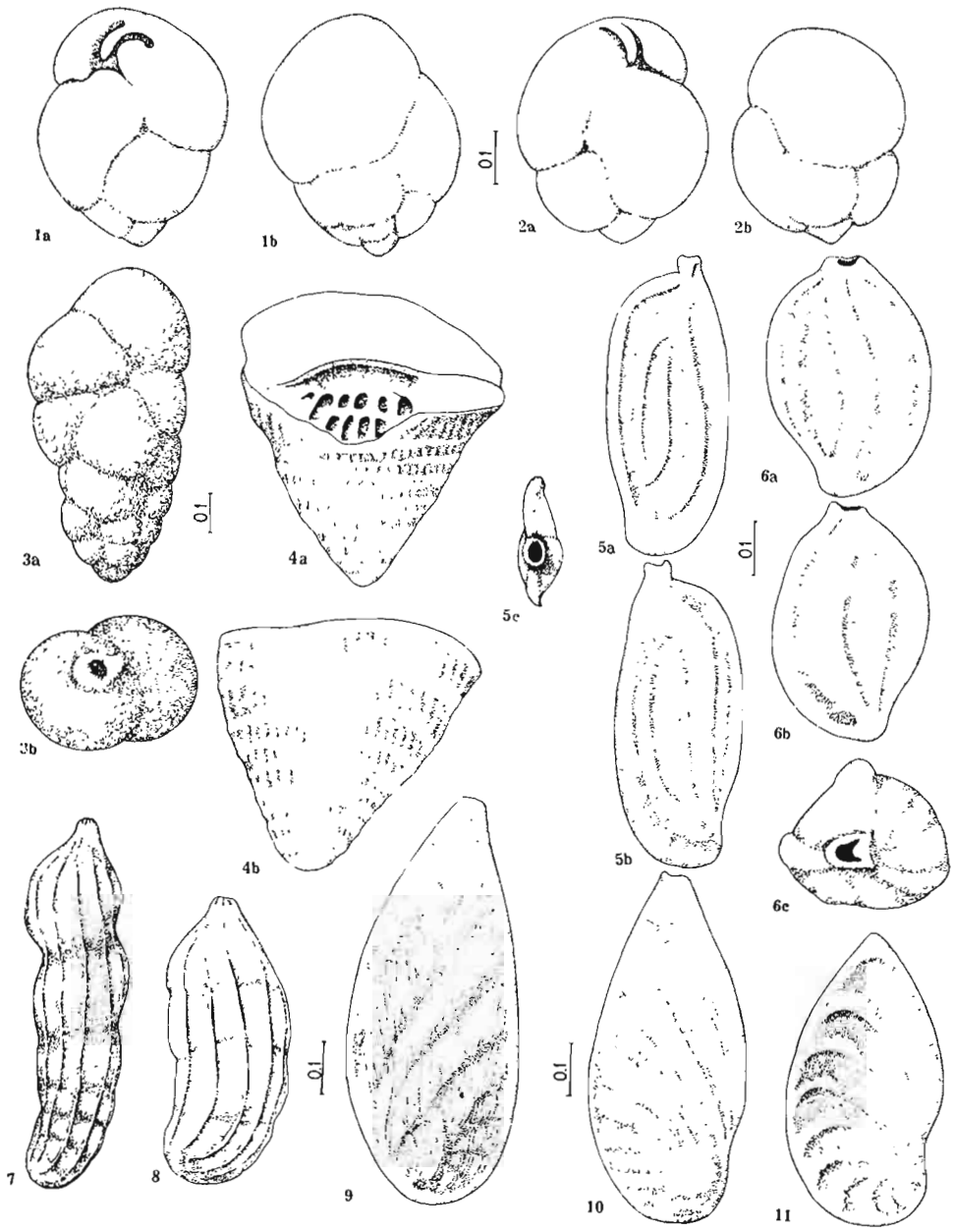
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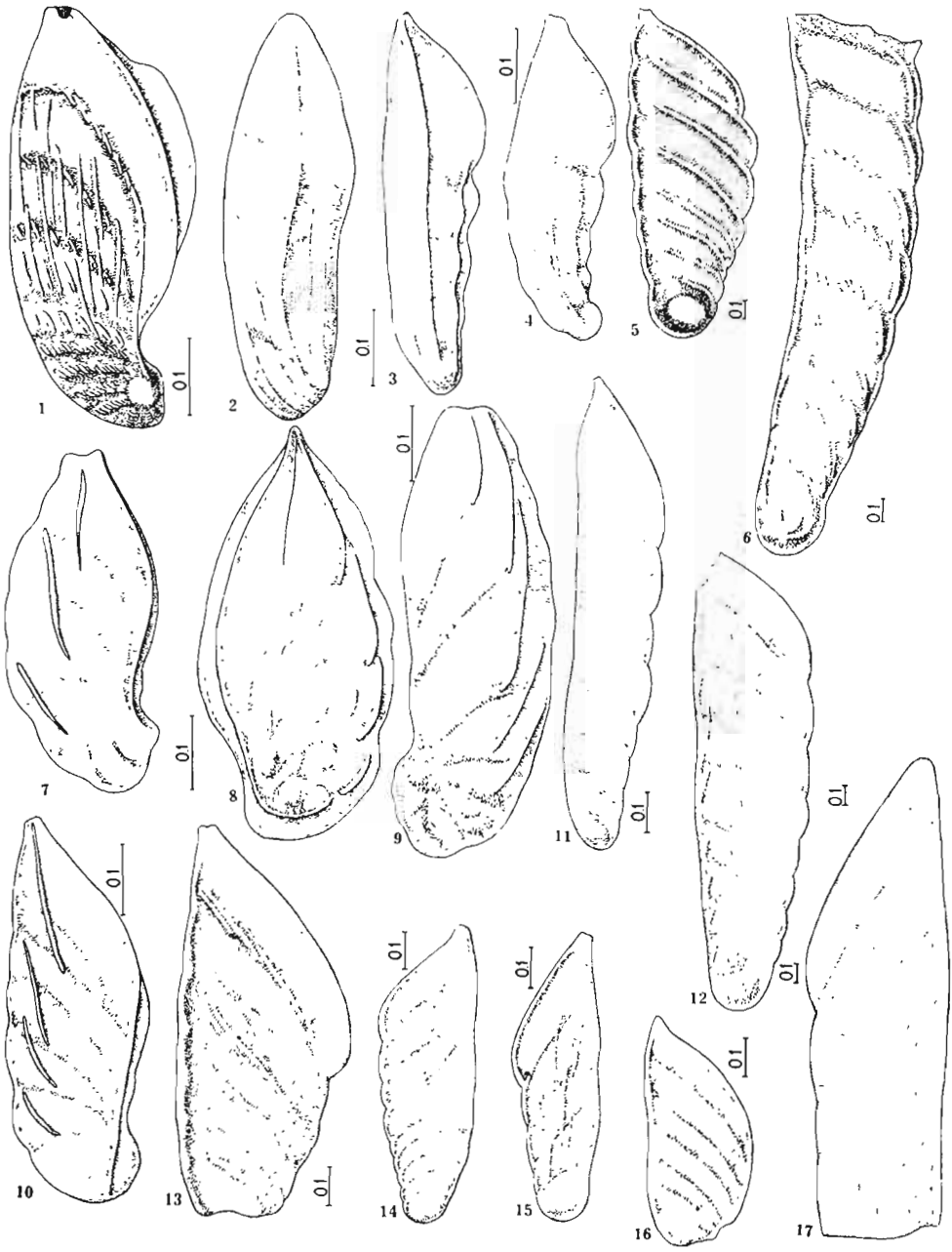
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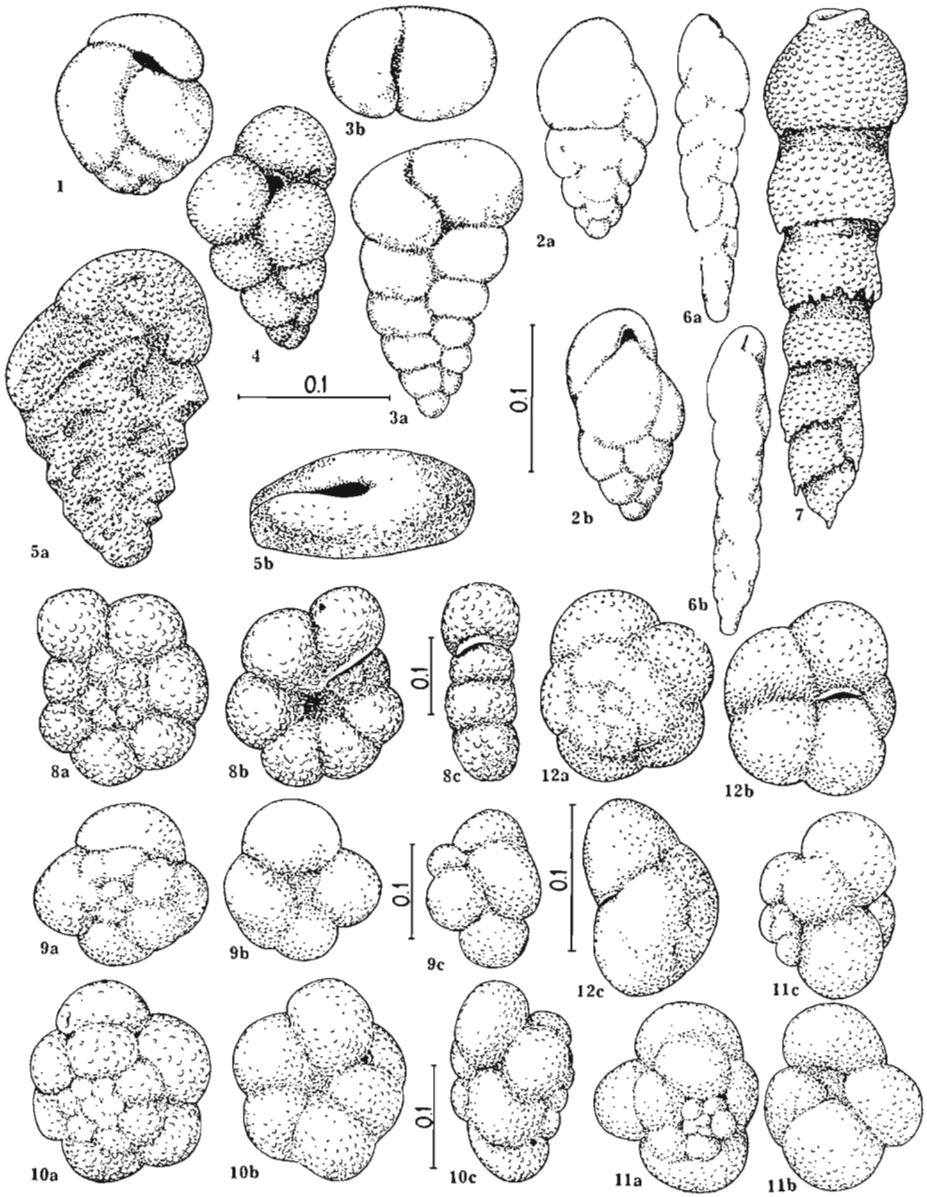
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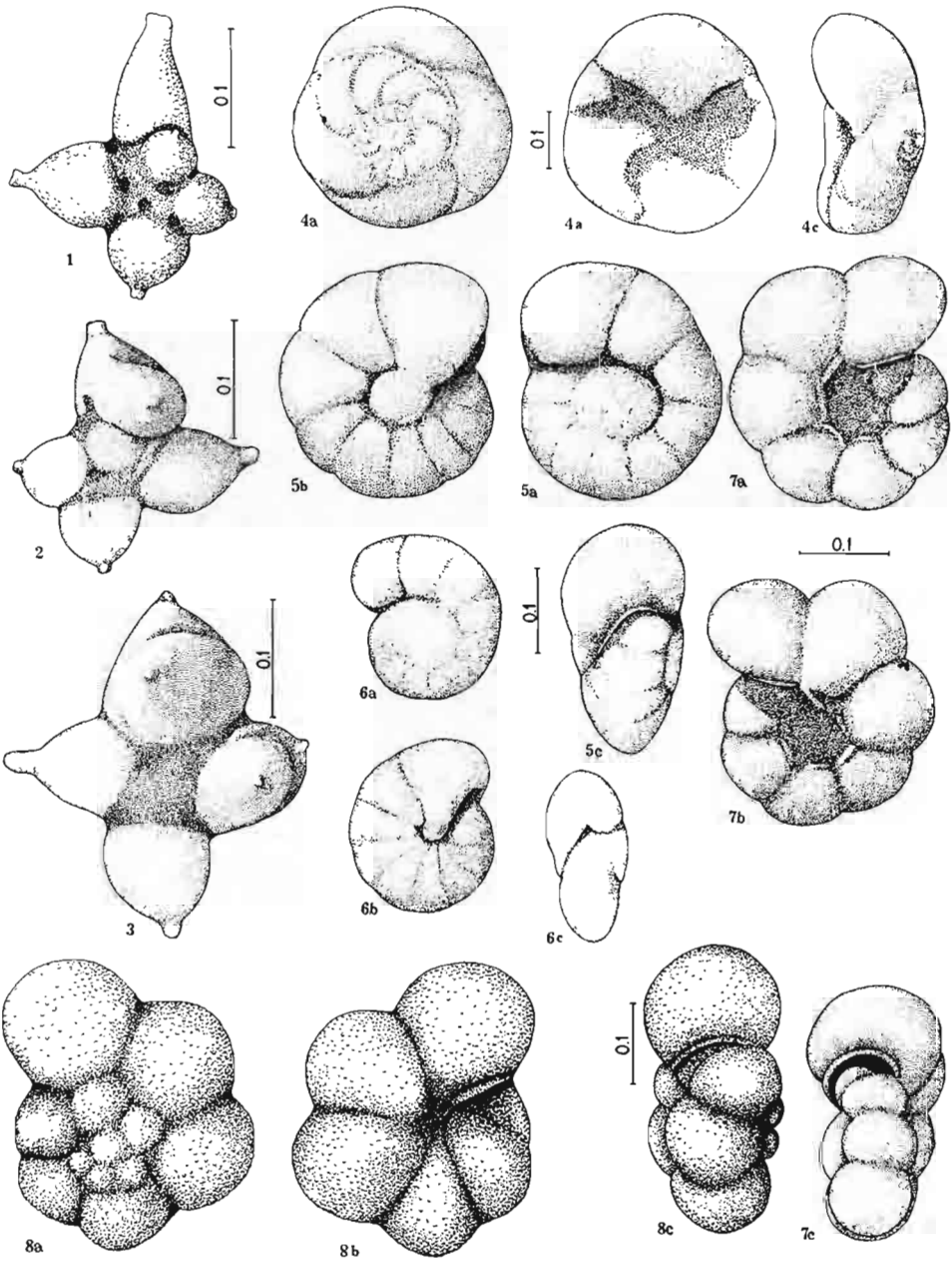
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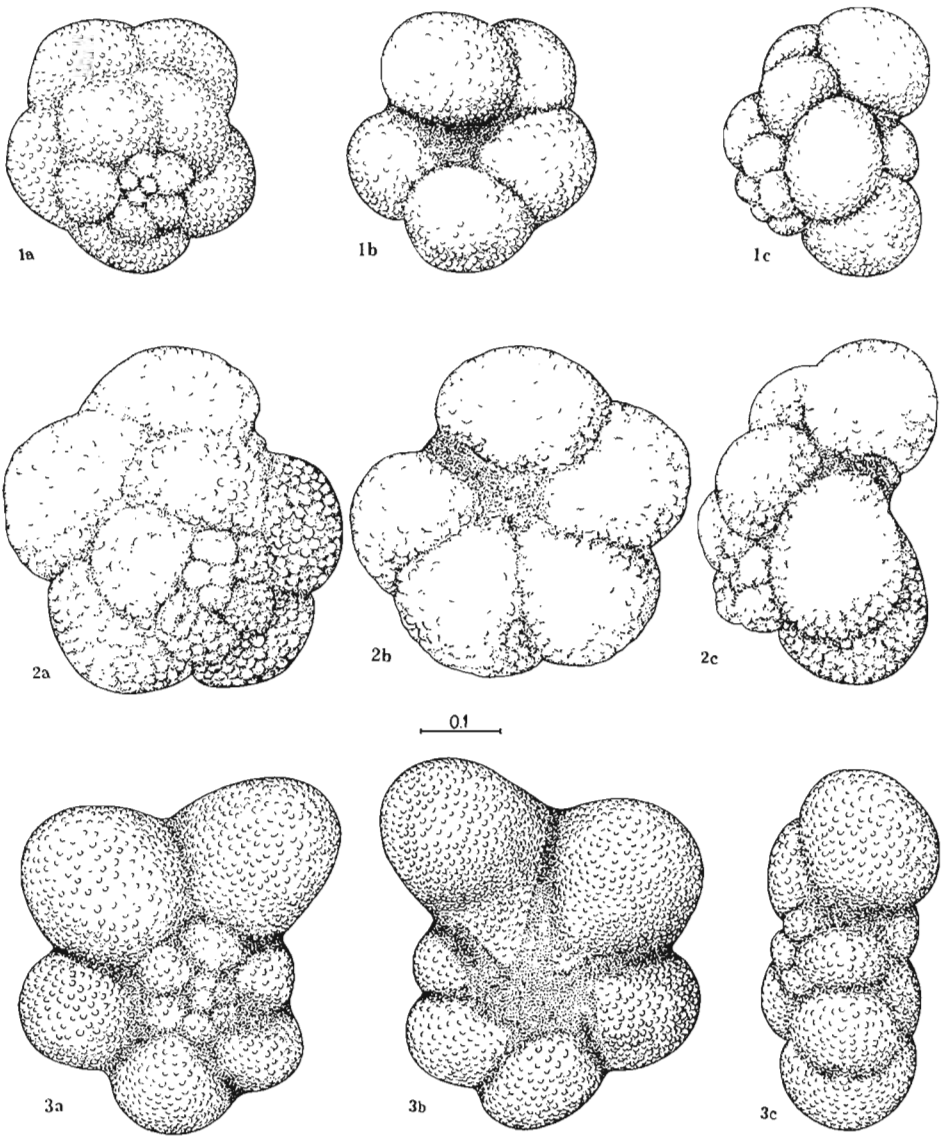
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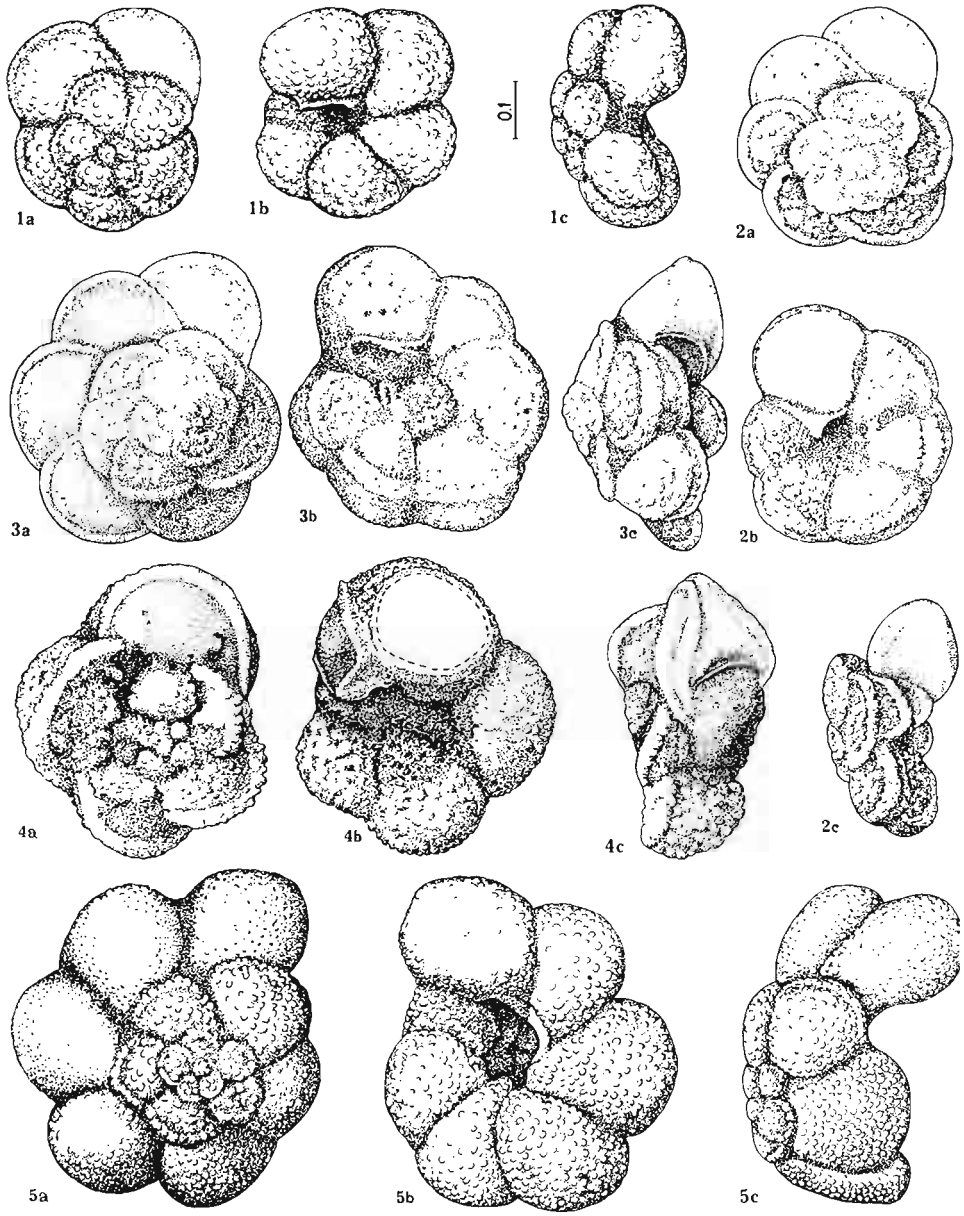
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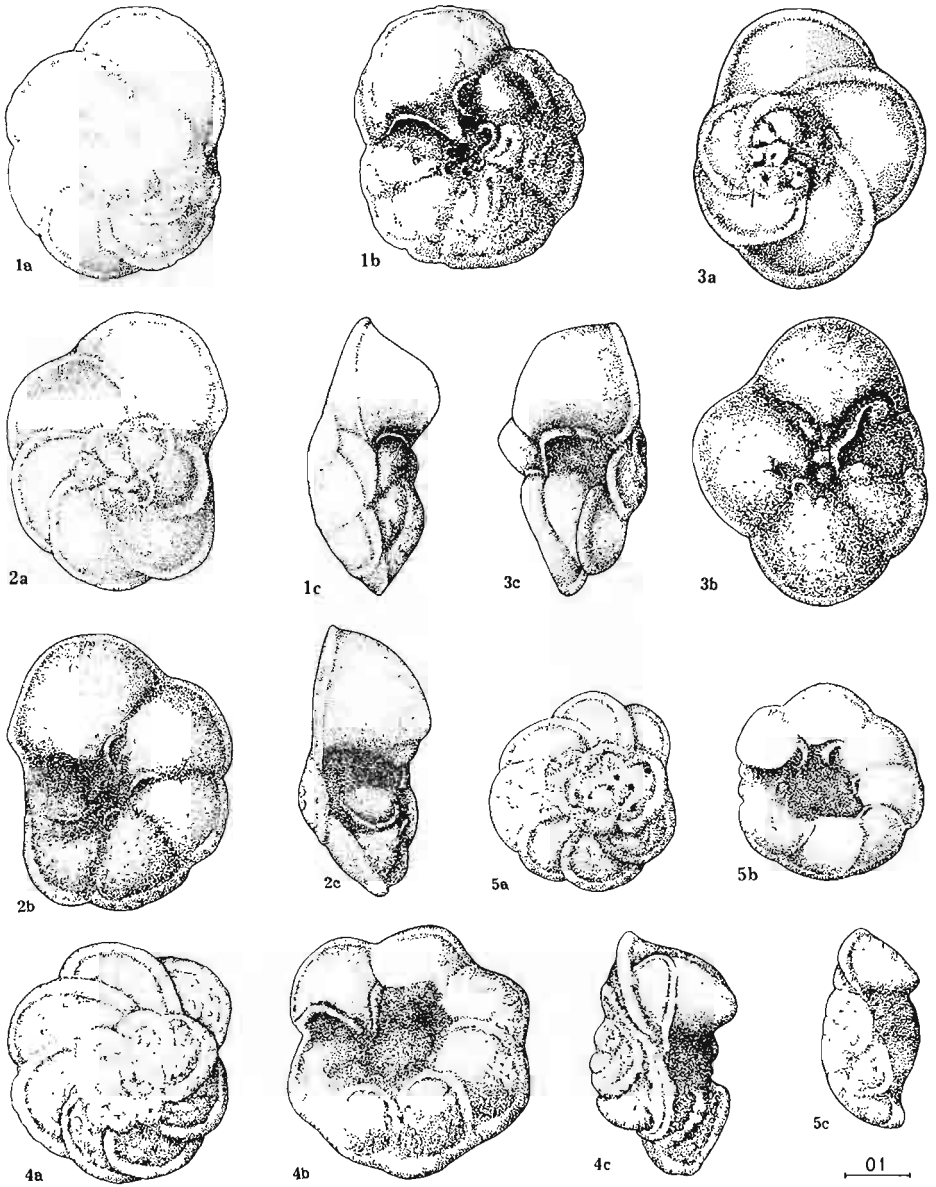
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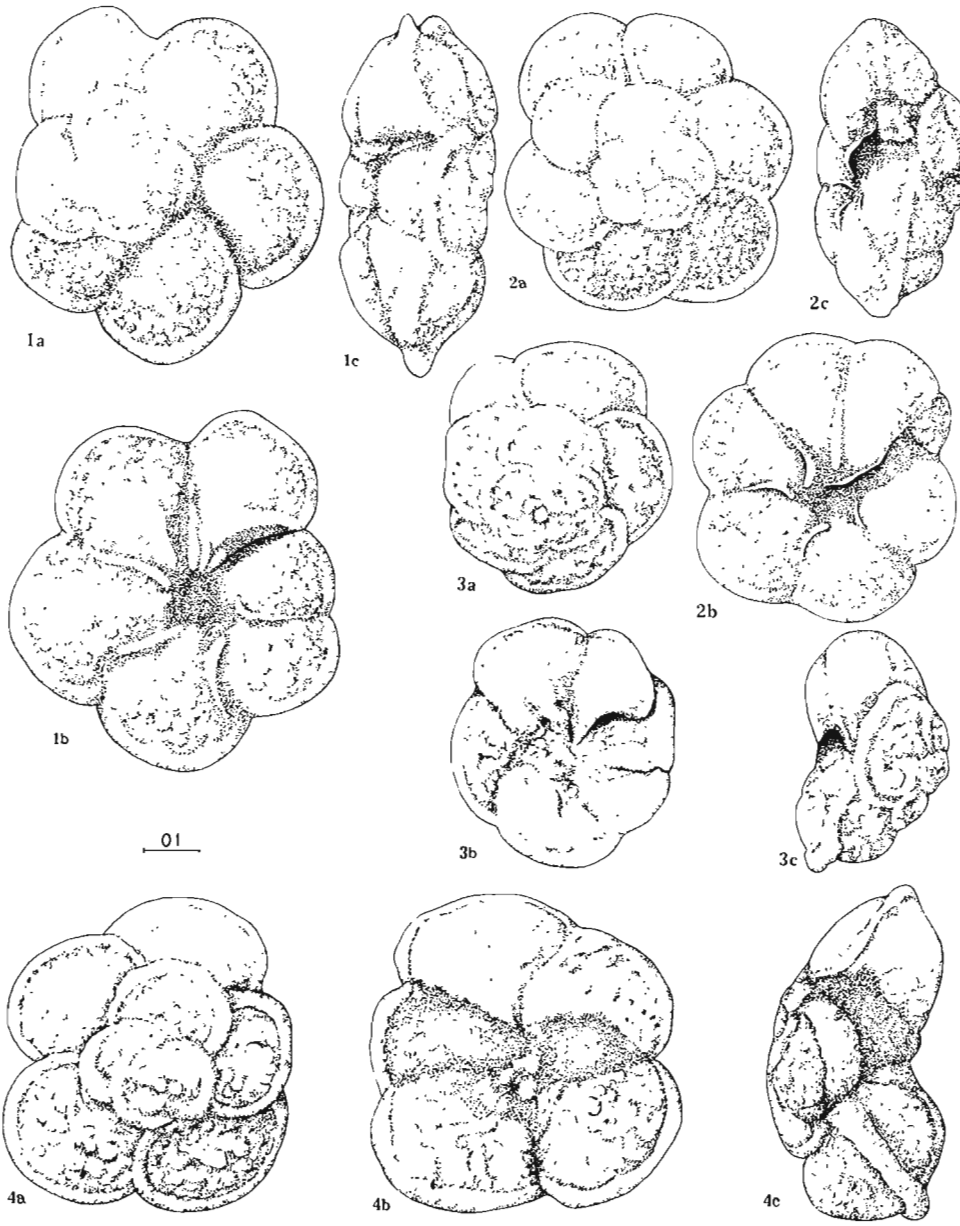
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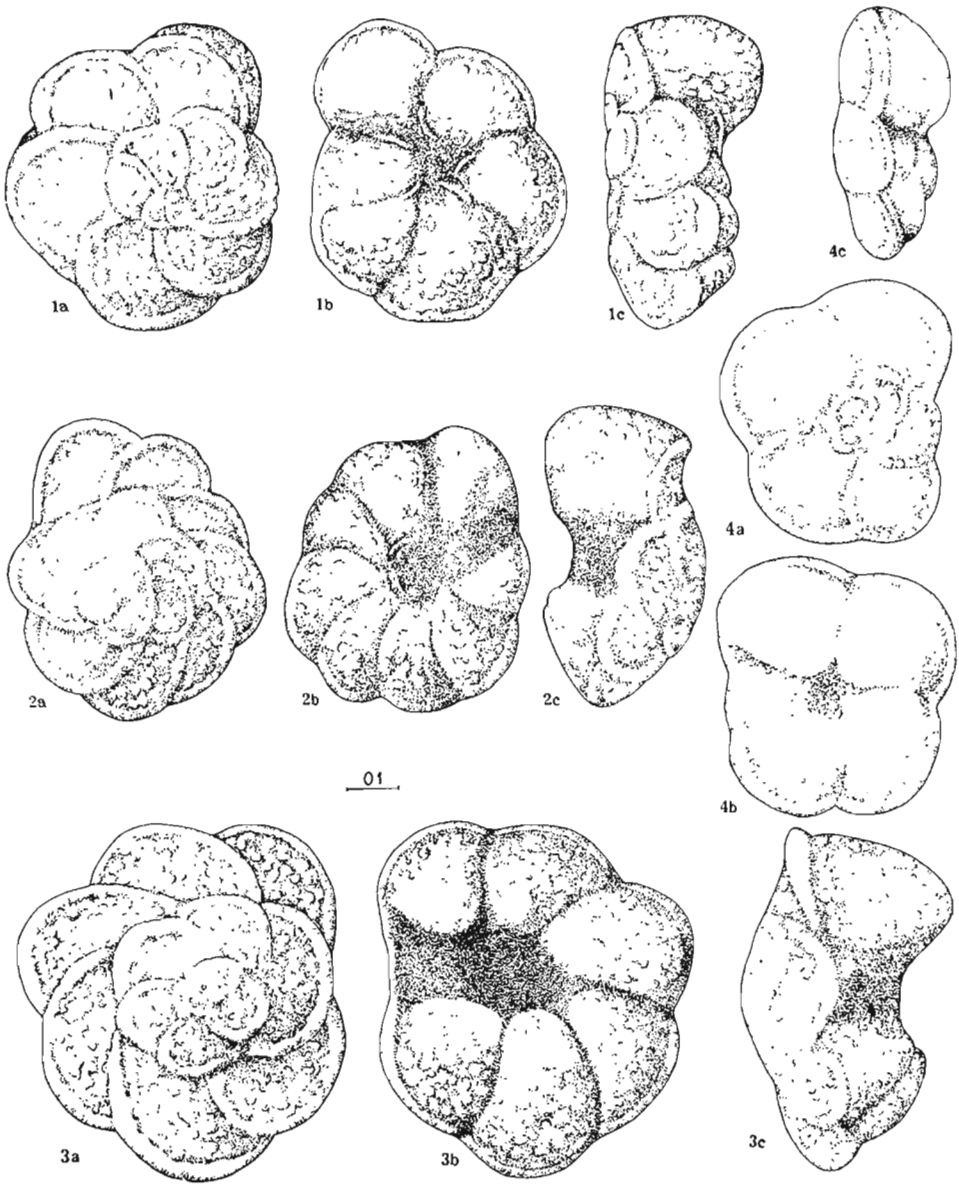
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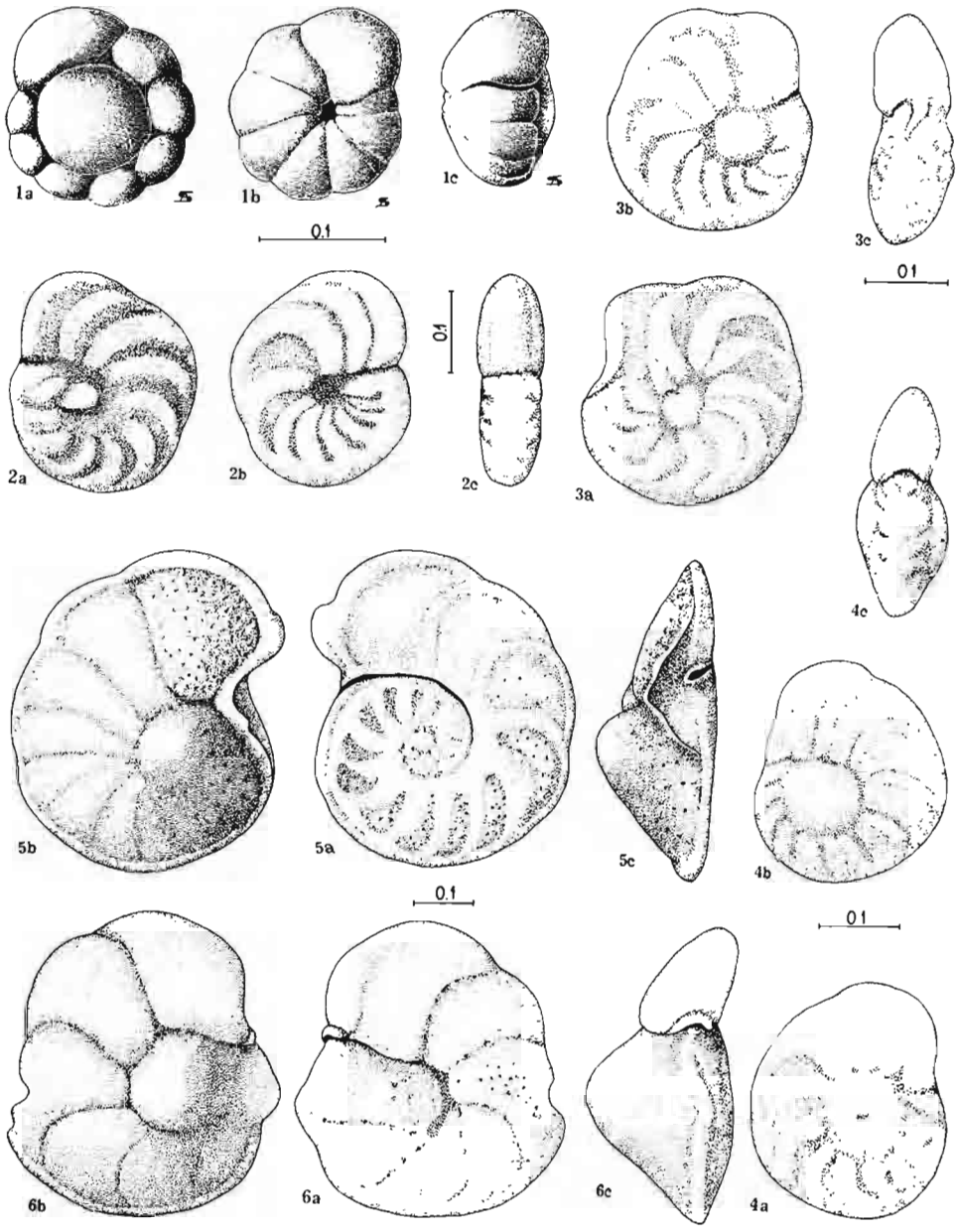
3a
3b
3c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3b
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3a
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0.1
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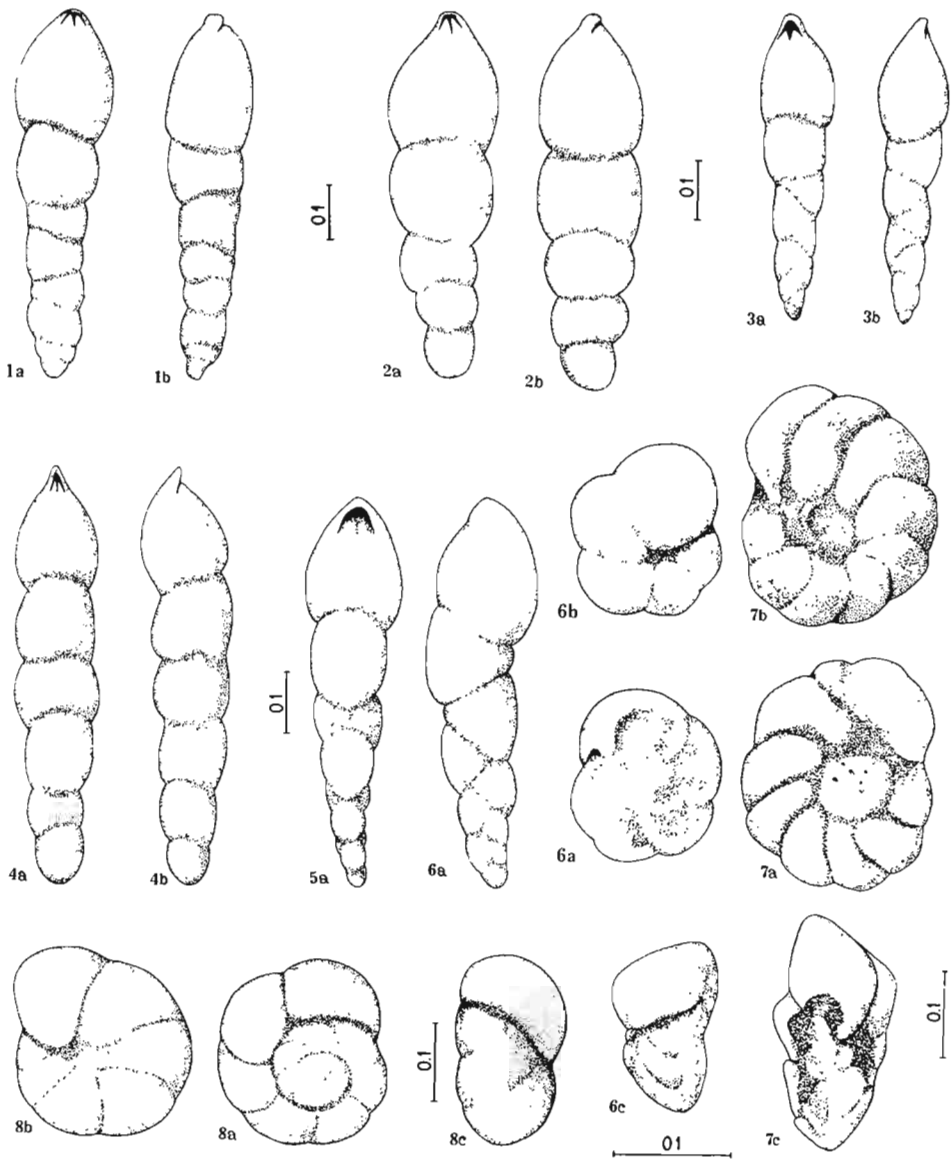
6a
6c
4a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4b
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0·1
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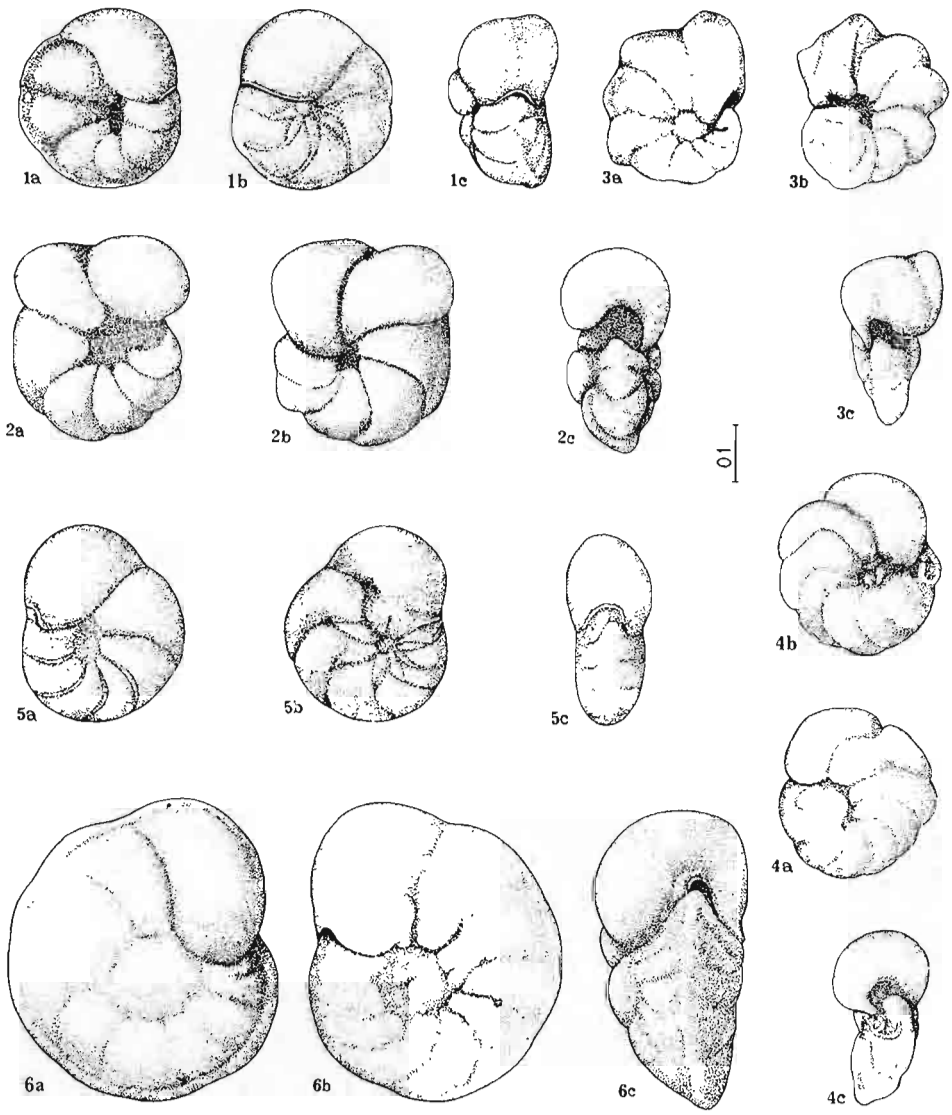
0·1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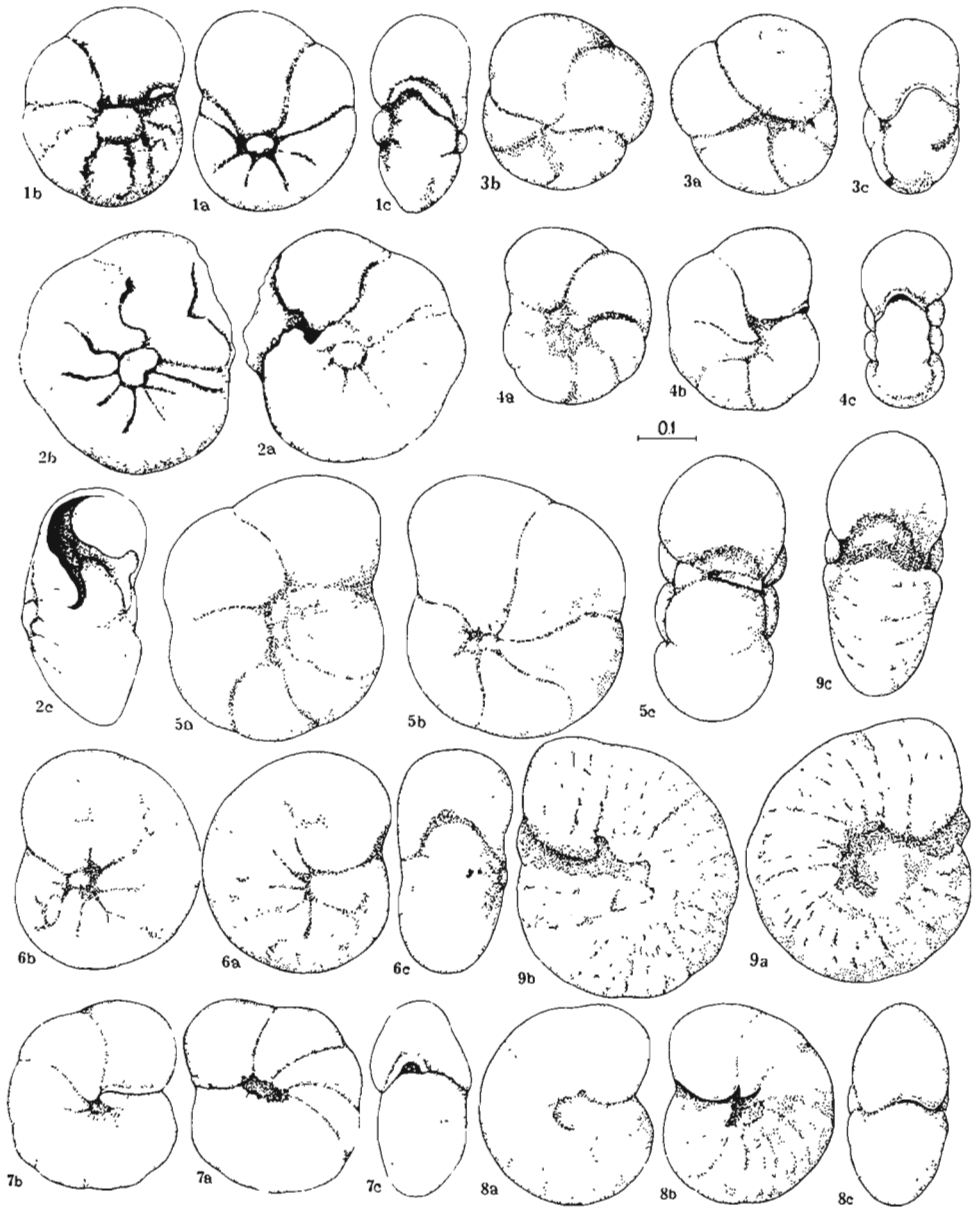
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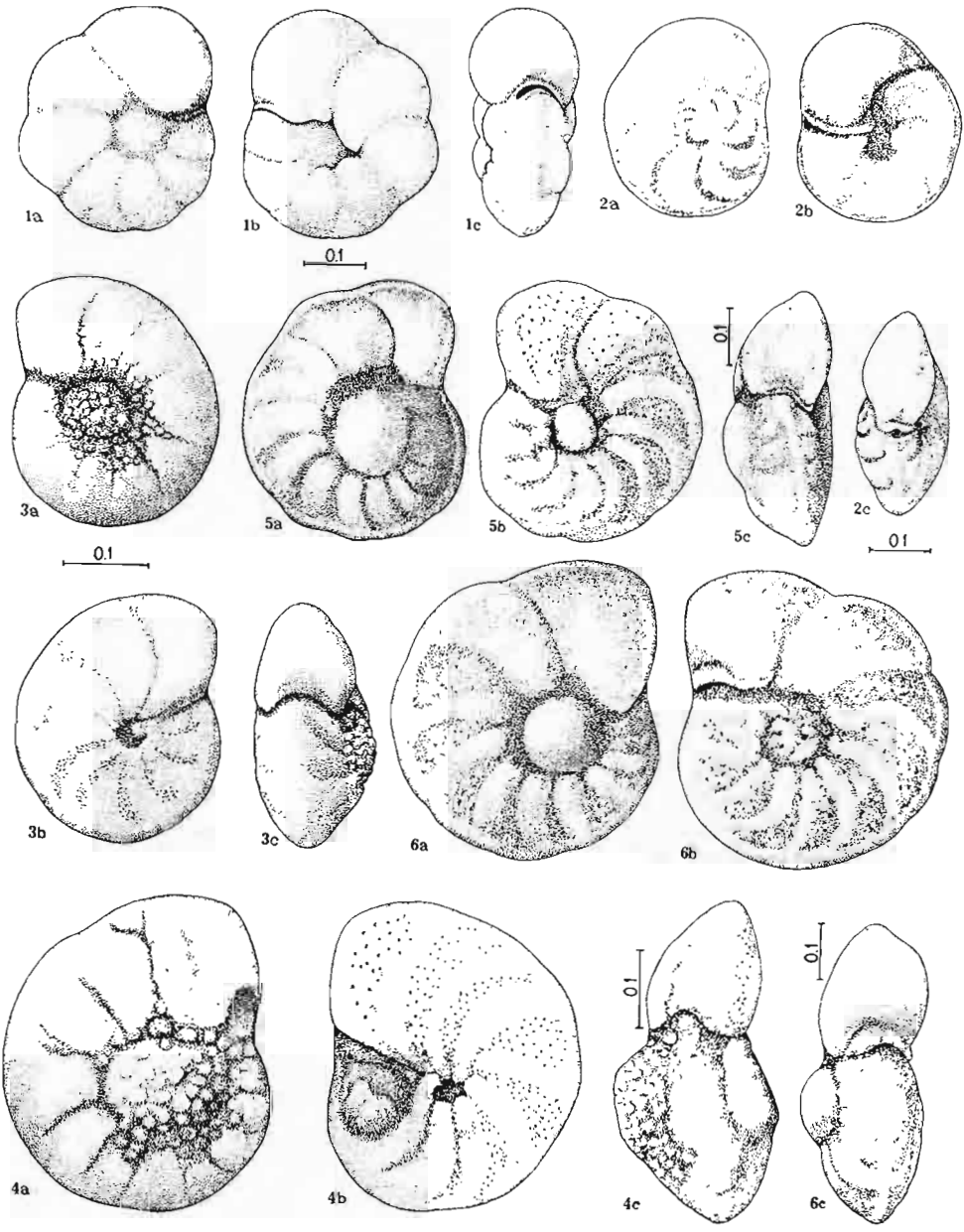
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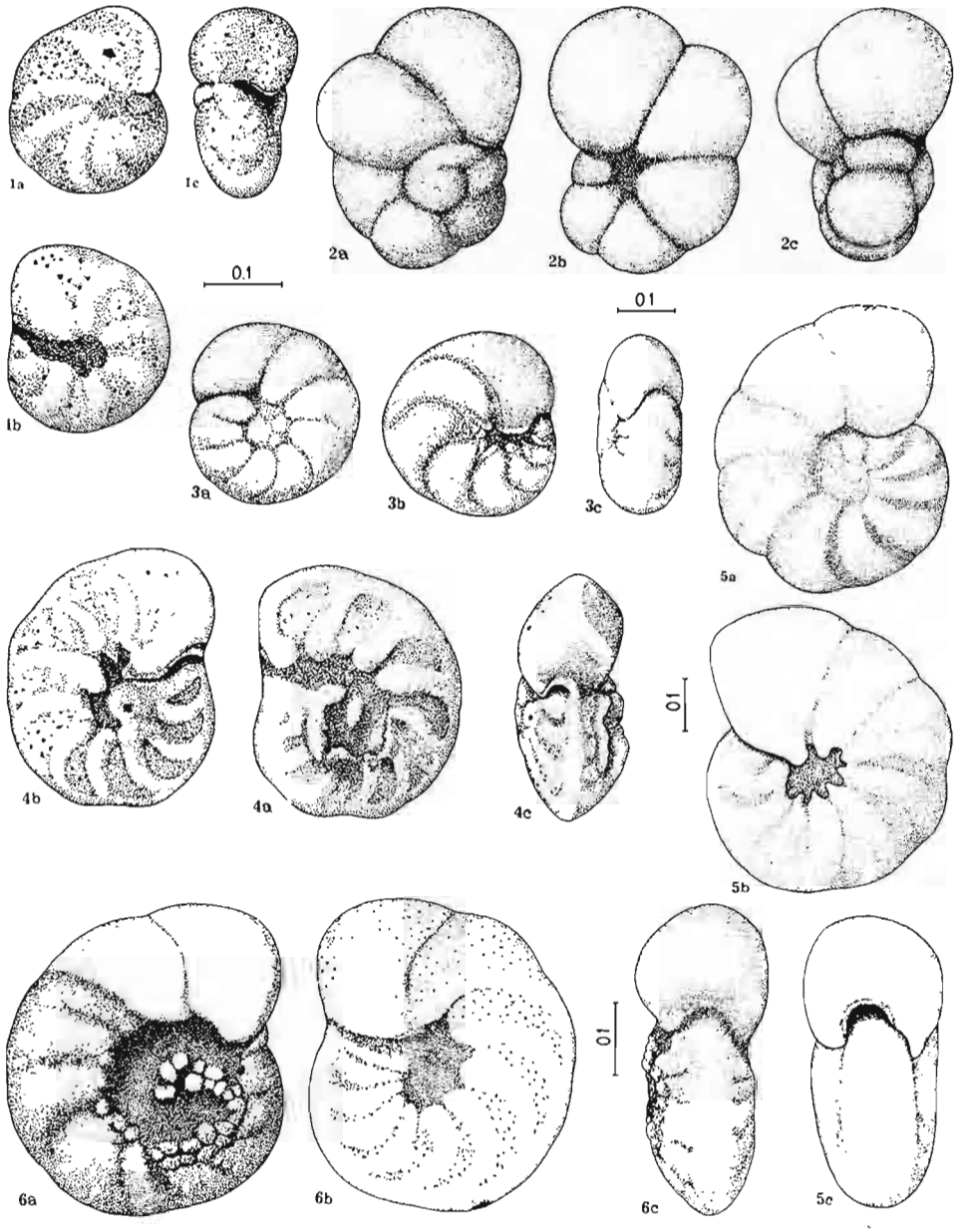
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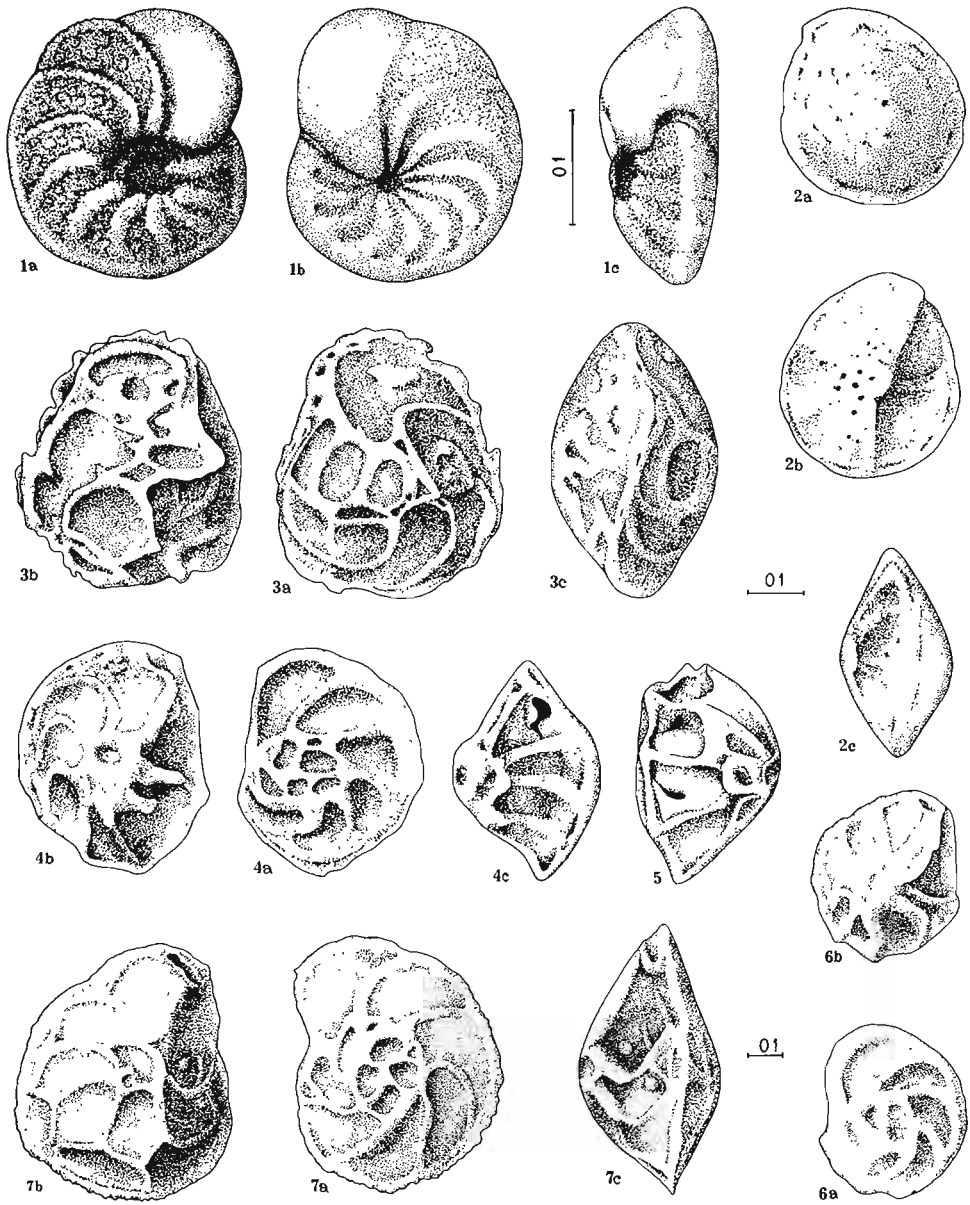
6c
5c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7c
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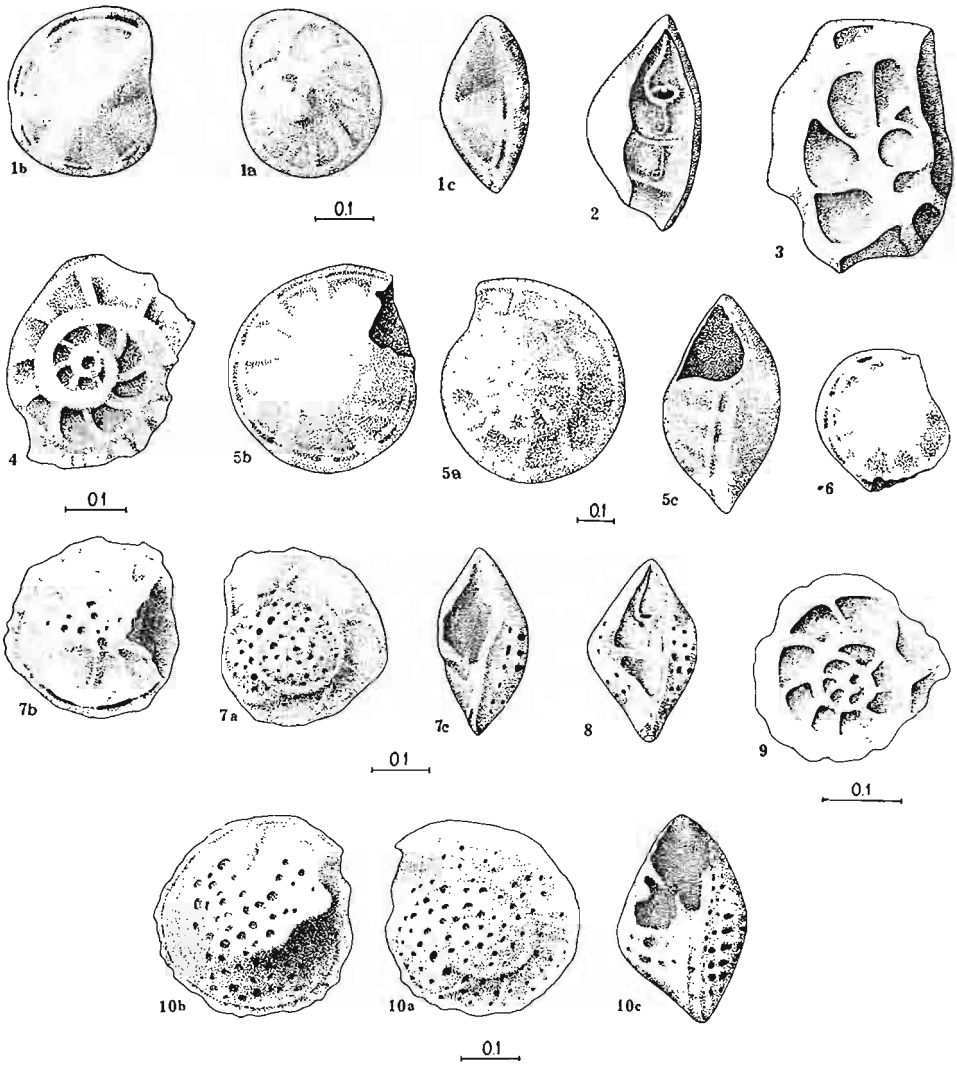
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6
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7c
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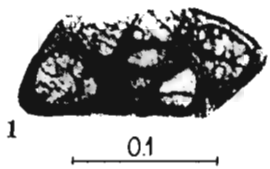
10c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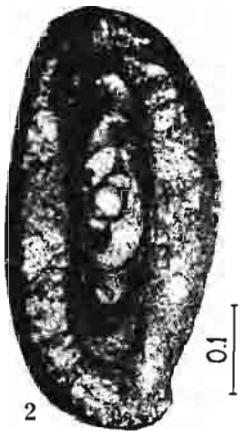
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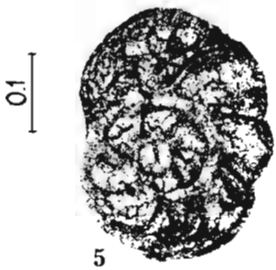
a
b
3


4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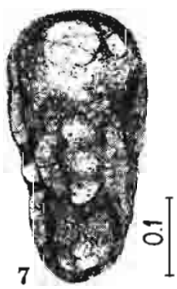
a
b
6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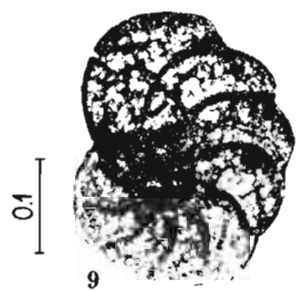
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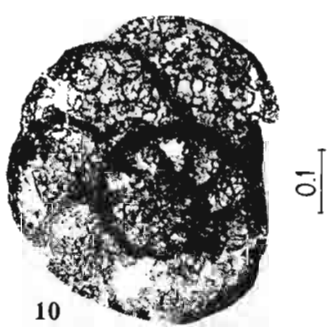
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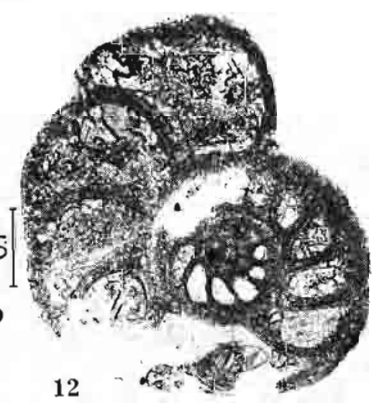
10


0.1
a
b
11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