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BATHONIAN GLOBIGERINA OF POLAND

(Pl. II—IV, 16 Figs.)

Globigeryny batonu Polski

(Tabl. II—IV, 16 fig.)

Abstract: Differences in opinions on the diagnostic characters and stratigraphic range of the genus *Globigerina* are discussed. A new species: *Globigerina bathoniana* is established on the basis of very well preserved specimens found in the Bathonian of the Częstochowa Region (Middle Poland).

INTRODUCTION

The genus *Globigerina* was established by d'Orbigny in 1826, but till now it has no diagnosis accepted generally, and generic diagnoses published by various authors are differing widely. The problem of the lower boundary of its stratigraphic range remains unsolved, and the question of evolution of this genus remains controversial.

Numerous very well preserved specimens found in the Bathonian of the Częstochowa region, may be assigned undoubtedly to the genus *Globigerina*. A detailed study of these specimens brought the solution of some controversial problems. No specimens of *Globigerina* have been found in Poland in rocks older than the Bathonian.

REMARKS ON CLASSIFICATION

Only the following characters are generally accepted in all descriptions of *Globigerina*: chambers more or less spherical, trochospirally coiled, test walls calcareous, perforated, with radial structure. Opinions differ in the questions of shape, size and location of the aperture, occurrence of additional apertures and chambers, the height of the spire, detailed structure of the walls and ornamentation of the surface of chambers. V. Pokorný (1958) states in the definition of the genus *Globigerina*: aperture large, low-shaped, usually with a lip, open, umbilical; instead, D. M. Rauzer-Chernousova and A. V. Fursenko (1959) state: aperture marginal, in some forms umbilical, open towards the gaping umbilicus; while A. R. Loeblich and H. Tappan (1964) note: aper-

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ture interiomarginal, umbilical, with a tendency towards extraumbilical in some forms. Intraumbilical aperture during the entire ontogenetic evolution was considered as the main diagnostic character by F. T. Banner and W. H. Blow (1959). V. G. Morozova (1959) admits the existence of additional apertures in the genus *Globigerina,* distinguishing two sub-genera, depending on the size of the aperture in forms with a single umbilical aperture: *Globigerina* with a large aperture, and *Eoglobigerina* with a small aperture. J. Hofker (1963) did not regard the aperture as an important diagnostic feature of the genus *Globigerina,* which was considered in the wide sense, embracing also *Praeglobotruncana* and *Rubroglobigerina* as younger synonyms. Instead, O. L. Bandy (1967) regarded the character of the aperture as the main diagnostic character, stating that the genus *Globigerina* has an umbilical aperture, while similar forms belonging to the genus *Hedbergella* have an extraumbilical aperture. Many authors (see A. R. Loeblich and H. Tappan, 1964) distinguish the genus *Globigerinoides* Cushman differing from *Globigerina* only by the occurrence of small additional apertures on the sutures. F. Brotzen and K. Pożaryska (1961) described within the variability of one species cases of apertures: umbilical and extraumbilical, large without lip and small with a lip, single or with additional apertures on the sutures (as in the genus *Globigerinoides*), open or covered by additional chambers (as in the genera *Catapsydrax* or *Globigerinoita*).

However, the majority of authors agree, that typical *Globigerina* are characterized by a semicircular rather large umbilical aperture, most frequently with a lip, that is conformable with the definition of V. Pokorný. Such an aperture is present in the specimens from the Bathonian of Poland.

V. G. Morozova and T. A. Moskalenko (1961) assumed that the height of the spire is an important diagnostic character on the sub-generic level. *Globigerina* (*Conoglobigerina*) established on this basis by the above mentioned authors, was considered by A. Loeblich and H. Tappan (1964) as a separate genus, and a younger synonym of the genus *Gubkinella* Sulejmanov assigned to the family Heterohelicidae. Instead, D. M. Rauzer-Chernousova and A. V. Fursenko (1959) assigned the genus *Gubkinella* to the family Discorbidae. A. Loeblich and H. Tappan (1964) distinguished the genus *Globoconusa* Khalilov, which is very similar to *Globigerina,* but has a high spire, and one or two additional apertures on the sutures on the spiral side. Other authors (e.g. O. L. Bandy, 1967) still ascribe the typical species of the above genus to *Globigerina* (*G. daubjergensis* Brönnimann). Many authors accept a large variability of the spire height within a genus and even within a species (see *Globigerina kozlovskii* Brotzen and Pożaryska 1961). Such a variability can be observed in the new species from the Bathonian of Poland.

The structure of the test wall in *Globigerina* is also a controversial problem. Some authors described a distinctly bilamellar structure of walls (Z. Reiss, 1963; A. Loeblich and H. Tappan, 1964; I. Premoli Silva, 1966) while others noted a monolamellar structure (F. Brotzen and K. Pożaryska, 1961). According to the latter authors the walls are monolamellar in the last chamber and in the septa, while polylamellar and thicker in the older chambers. A new

genus *Subbotina* has been established by these authors on the basis of the microstructure of the walls and the surface ornamentation of the test, covering forms regarded hitherto as *Globigerina*. A. Loeblich and H. Tappan (1964) also distinguish the genus *Subbotina*, but I. Premoli Silva (1966) noted that the microstructure of the wall regarded as diagnostic for this genus is present also in other genera belonging to the family Globigerinidae and therefore the generic name *Subbotina* should be considered invalid. J. Hofker (1967) did not regard the microstructure of the wall as a diagnostic generic character.

The surface ornamentation of the test in the specimens found in the Bathonian of Poland is very similar to that of *Globigerina bulloides* d'Orbigny and *G. oxfordiana* Grigelis. The sections of the walls confirm the presence of bilamellar structure.

The greatest divergence of opinion is noted with regard to the time of appearance of the genus *Globigerina*. V. Pokorný (1958) questioned the occurrence of Globigerina in the Jurassic. D. M. Rauzer-Chernousova and V. Fursenko (1959), and V. G. Morozova (1958) note the occurrence of *Globigerina* since the Jurassic, while R. Oberhauser (1960) and E. Kristan-Tollmann (1964) since the Trias. The Jurassic forms assigned to *Globigerina* were considered by F. Brotzen (1963) as related rather with the genus *Ammoglobigerina* (synonym: *Trochammina*) on account of the arenaceous structure of the walls. Also Z. Reiss (1963) regarded the systematic position of Jurassic Globigerina as uncertain noting that these forms have non-lamellar walls, seemingly not perforated, calcitic. However, I. Premoli Silva (1966) proved the presence of bilammelar, radial, perforated structure of walls in undoubtedly Jurassic „Globigerina". According to F. Brotzen (1963) and J. Hofker (1963) the first *Globigerina* appeared during the Cretaceous, while F. T. Banner and W. H. Blow (1959), Z. Reiss (1963) and A. Loeblich and H. Tappan (1964) note the occurrence of *Globigerina* only since the Palaeocene. O. L. Bandy (1967) admitted the possibility that *Globigerina* appeared already in the Trias, expressing at the same time the opinion that the systematic position of the triassic and liassic forms should be confirmed by investigations of the structure of walls and of the character of aperture on a better preserved material. Since the Middle, and especially the Upper Jurassic Globigerina are more certain to occur, being noted more frequently and better known. O. L. Bandy notes that it can be reasonably admitted that the genus *Globigerina* appears at least since the Upper Jurassic. The investigations of the present writer demonstrated that Globigerina are present undoubtedly in the Middle Jurassic.

Jurassic *Globigerina* were first noted and described by O. Terquem and G. Berthelin (1875) — (*G. liassica*) from the Lower Jurassic, O. Terquem (1883, 1886) — (*G. oolitica* Terquem, *G. bulloides* d'Orb., *G. lobata* Terquem) from the Middle Jurassic, and by R. Haeusler (1881) — (*G. helvetojurassica*) from the Upper Jurassic. Further reports came half a century later, when H. Bartenstein and E. Brand (1937) noted *G. bulloides* d'Orb. in the Middle Jurassic of north-west Germany. The specimens described in the papers quoted above were poorly preserved, usually as internal moulds, and inadequately illustrated or described without illustrations. The descriptions are not adequate for the determination of the systematic position of these forms.

W. T. Balakhmatova (1953) reported the occurrence of *Globigerina* in the Middle Jurassic and described them in some detail; however the material did not permit to study the character of the aperture. Since that data reports on the occurrence of Globigerina more or less well preserved in jurassic rocks are more frequent. Various authors established the following new species: *Globigerina oxfordiana* Grigelis (1958) from the Lower Malm of Lithuania, *G. jurassica* Hofman (1958) from the Bathonian and Lower Callovian of Crimea, *G. gaurdakensis* Balakhmatova & Morozova, *G. dagestanica* Morozova, *G. avarica* Morozova, *G. balakhmatovae* Morozova from the Upper Bajocian and the Bathonian of Turkmenia and Dagestan (V. G. Morozova and T. Moskalenko 1961). Among these species the most frequently encountered and relatively well studied are *G. oxfordiana* Grigelis and *G. helvetojurassica* Haeusler. E. Seibold and I. Seibold (1960) described and illustrated *G.*? cf. *helvetojurassica* Haeusler from the Lower Oxfordian of South Germany and Switzerland, but these forms were found in such a bad state of preservation, that the authors themselves expressed reservations with regard to the generic and specific determination.

Students of microfacies often use the name *Protoglobigerina* to denote forms encountered in thin sections of rocks ranging in age from Liassic to Tithonian (G. Colom and Y. Rangheard, 1966), but this name is invalid, as pointed out by G. Bignot and J. Guyader (1966) since the original publication is anonymous, no description has been given, and no typical species has been established.

JURASSIC *GLOBIGERINA* FROM POLAND

The first report on the occurrence of *Globigerina* in Poland was made by M. O. Terquem (1886) who denoted *G. bulloides* d'Orbigny and *G. oolithica* Terquem. The forms described by Terquem were preserved as pyritized internal moulds, and consequently it was possible to study only a few morphological details. The findings were made in the ore-bearing clays of the Częstochowa region, where fairly numerous and well preserved globigerins have been found recently. Studies carried out hitherto indicate that in the Middle Jurassic of Poland *Globigerina* are present rarely and only in the Bathonian and in the Callovian. In this latter stage they are more abundant but till now no well preserved specimens have been found and internal moulds found were determined therefore as *G.* cf. *helveto-jurassica* Haeusler (W. Bielecka and O. Styk, 1967). Relatively the most abundant and best preserved specimens found in the clay facies of the Bathonian in the area of Ogrodzieniec, were determined as *G. dagestanica* Morozova (O. Pazdrowa, 1967). Further more detailed studies led the present author to the conclusion that the establishment of a new species is justified. Also to this new form belong the specimens found previously in rare cases in the Bathonian of the other regions of Poland determined as *Globigerina* sp. (O. Pazdrowa, 1960).

Small dimensions, delicate calcareous tests, and similarity to recent *Globigerina* suggest their planctonic character. G. Colom and Y. Rangheard (1966) noted that „*Protoglobigerina*" found in thin sections of jurassic rocks appear within the facies of littoral limestones

with pelagic influences. Also G. Bignot and J. Guyader (1966), note that *Globigerina* occur also in jurassic clays and mudstones deposited in shallow littoral waters communicating with the open sea.

Globigerina bathoniana n. sp.
Pl. II—IV, Text figs. 1—16.

Holotypus: text fig. 1 a—c.

Locus typicus: Ogrodzieniec, Polish Jura [1].

Stratum typicum: Middle Bathonian, ore-bearing clays, *Morrisiceras morrisi* zone.

Material: c. 150 well preserved specimens

Dimensions, mm:

	Holotypus	Smallest specimen	Largest specimen
maximum diameter, *D*	0.150	0.120	0.185
Height, *H*	0.150	0.09	0.190
number of chambers in the spire	9	8	12
number of chambers in the last whorl	4	4	3
H/D ratio	1	0.75	1.02
number of whorls	2	2	3

Diagnosis: Globigerina trochospiral, height nearly equal to diameter, proloculus surrounded by four chambers, 3—4 chambers in the last whorl, aperture large, semicircular, with a narrow lip, interiomarginal, umbilical.

Description: Tests white, calcareous, trochospiral, usually with diameter nearly equal to height, consisting of 7—13, most often 9 chambers, spherical, rapidly increasing in size, coiled helicoidally in 2—3 whorls. The first whorl around the proloculus consists of 4 chambers, arranged often planispirally, the next whorls are more trochospiral. The last whorl consists of 3—4 chambers. The last chambers increase their dimension less rapidly. Chambers in the first whorl are less distinctly separated by shallow sutures. During the formation of a younger chamber the wall is formed not only on it, but also on the whole older part of the test. Consequently the external walls of older chambers are thicker and consisting of several layers. Only the last chamber has a single-layer wall (Pl. II, Fig. 9a). This does not contradict the bilamellar character of the structure of the walls. i.e. the primary layer consists of two lamellae, best visible in septa or in the wall of the last chamber (Pl. II, Fig. 9).

Pores are small and densely distributed, perpendicular to the surface of the wall (Pl. II, Fig. 9). Aperture relatively large semicircular, umbilical, enclosed on the peripheral side by a narrow lip nearly perpendicular to the test wall. There is no lip on the umbilical margin. The

[1] The term Polish Jura has been recently introduced by Z. S. Różycki to denote a range of Jurassic rocks in the eastern part of the Cracow — Silesia Upland.

apertures of the older chambers maintain their shape, lip and position forming the foramen (Pl. II, Fig. 7, text-fig. 9). The last chamber is often broken, the traces of the break being so small that they are visible only when appropriately illuminated (Pl. II, Fig. 7). The ratio of sinistrally coiled to dextrally coiled tests is approximately 1 : 1. The surface of the test is rough, covered by a dense irregular network of tubercles and ridges between which the pores are situated (Pl. II, Fig. 8). The picture of this surface is very similar to that of recent *Globigerina* (vide F. Brotzen and K. Pożaryska, 1961, Pl. 4, Figs. 1, 2) and of Oxfordian ones (vide G. Bignot and J. Guyader, 1966, Pl. I, Figs. 1, 10). A black cross appearing during observation with crossed

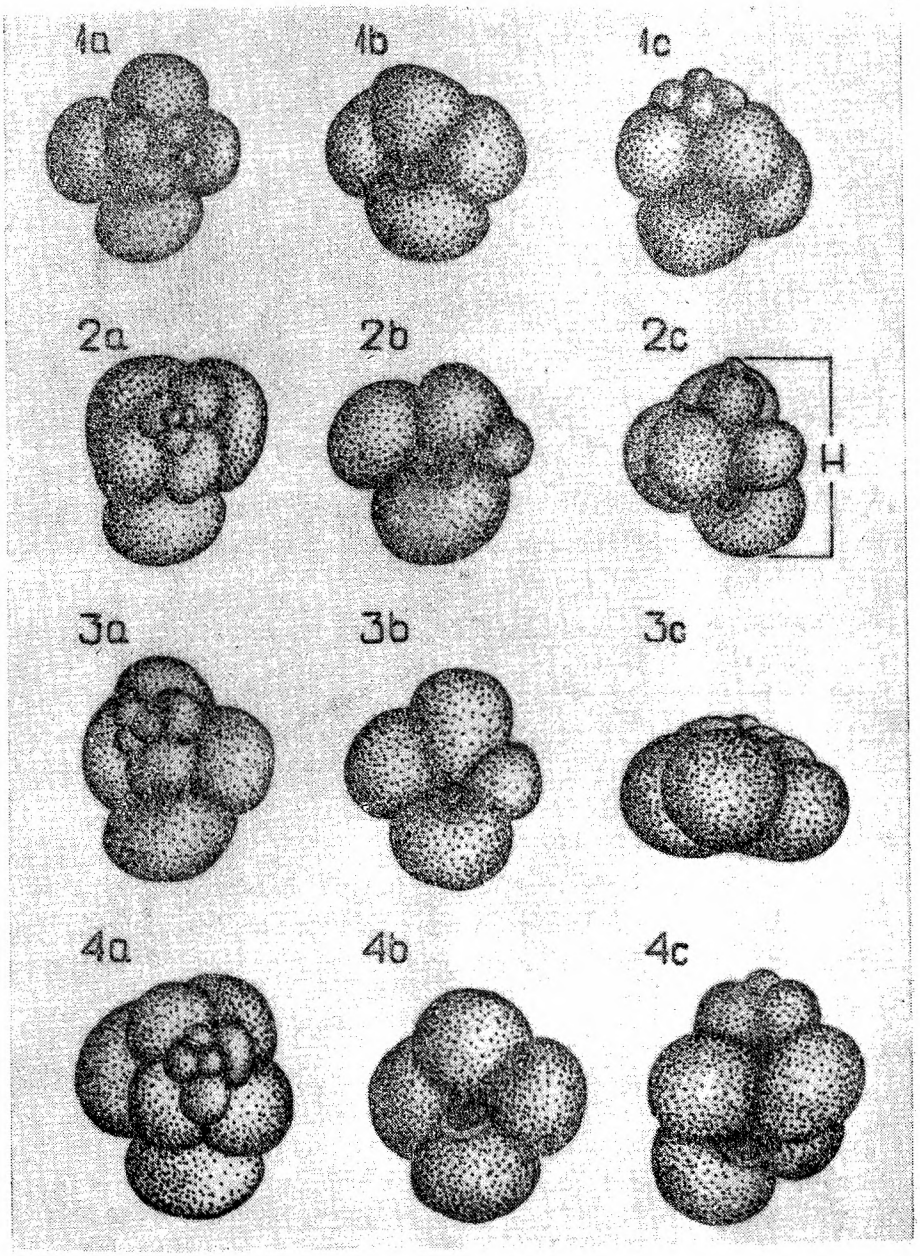

Fig 1—4. Globigeri*na bathoniana* n.sp. Middle Bathonian, Ogrodzieniec
Fig 1. Specimen DG-1, maximum diameter 0.150 mm, sinistrally coiled. Holotypus
Fig. 2. Specimen DG-2, maximum diameter 0.140 mm, dextrally coiled
Fig. 3. Specimen DG-3, maximum diameter 0.150 mm, dextrally coiled, low spire
Fig. 4. Specimen DG-4, maximum diameter 0.170 mm, sinistrally coiled, high spire
H — height; a — the spiral side; b — the umbilical side; c — axial view

nicols indicates a fibrous radial structure of the wall. Details of the ornamentation and structure of the surface are shown on electron micrographs (Pl. III and IV).

Attempts to distinguish between megalospheric and microspheric forms were not successful. The diameter of the proloculus (Figs. 10, 11) is 0.01—0.02 mm, the exceptional limiting values being 0.02 and 0.005 mm. Generally specimens with a large number of chambers have a smaller proloculus, but occasionally a large proloculus is present in

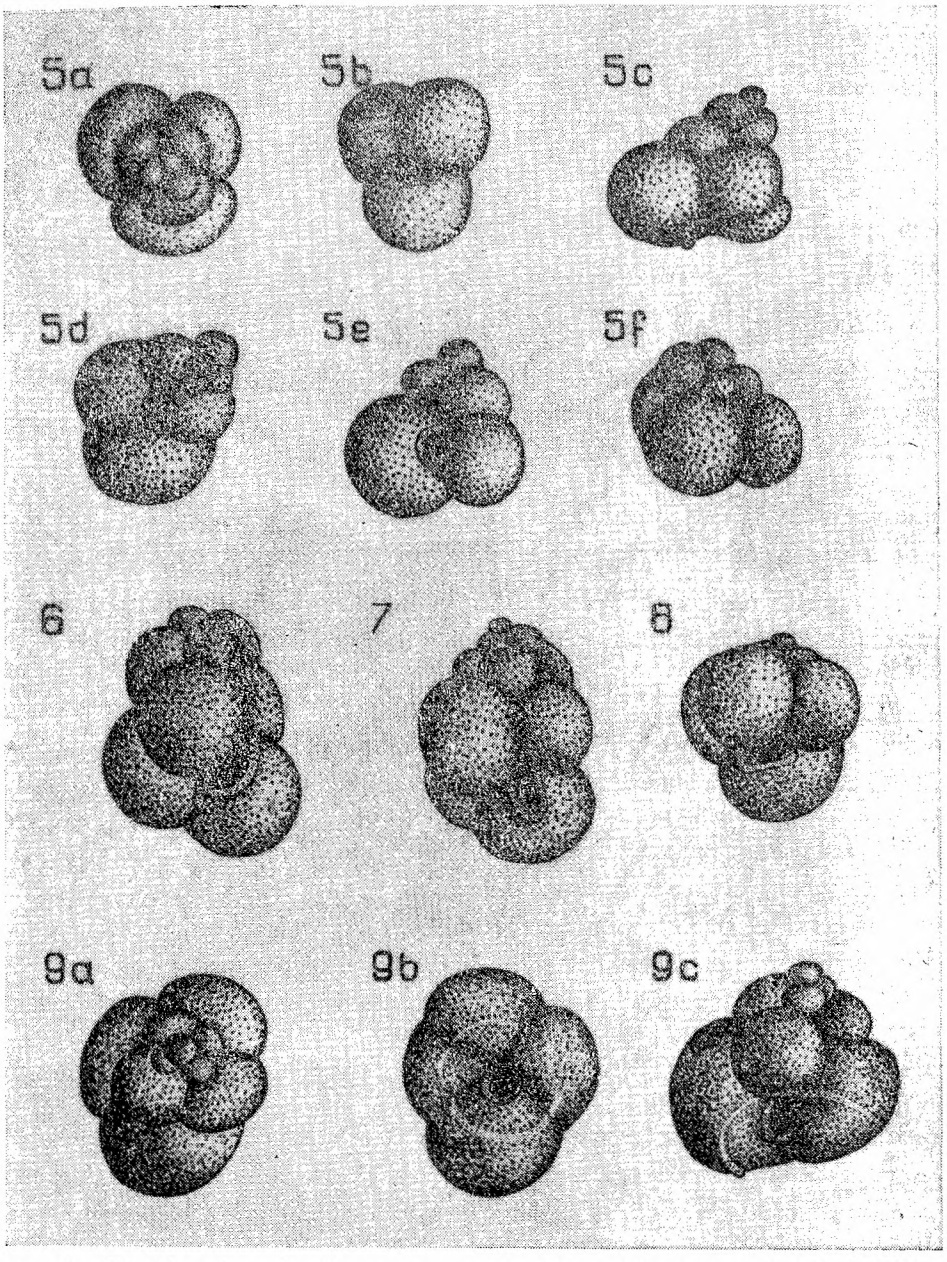

Fig. 5—9. *Globigerina bathoniana* n.sp., Ogrodzieniec, Middle Bathonian

Fig. 5 a-f. Specimen DG-5, maximum diameter 0.130 mm, in various positions, sinistrally coiled. a — spiral side; b — umbilical side; c — axial view; d— spiral side, view in the plane parallel to the last three chambers; e — oblique axial view; f — oblique view on the penultimate chamber

Fig. 6. Specimen DG-6, height 0.180 mm, axial view, large semicircular aperture dextrally coiled

Fig. 7. Specimen DG-11, height 0.180 mm, aperture elongated, dextrally coiled

Fig. 8. Specimen DG-8 diameter 0.130 mm, aperture low, sinistrally coiled

Fig. 9. Specimen DG-9, diameter 0.155 mm, sinistrally coiled, specimen with last chamber broken off

specimens consisting even of 12 chambers. The lack of morphological features permitting to distinguish between forms with large and small proloculuses and numerous intermediate forms hamper the separation of the population into two generations.

Variability: The height of spire, dimensions and number of chambers show a rather large variability (Fig. 12—16). The highest spire

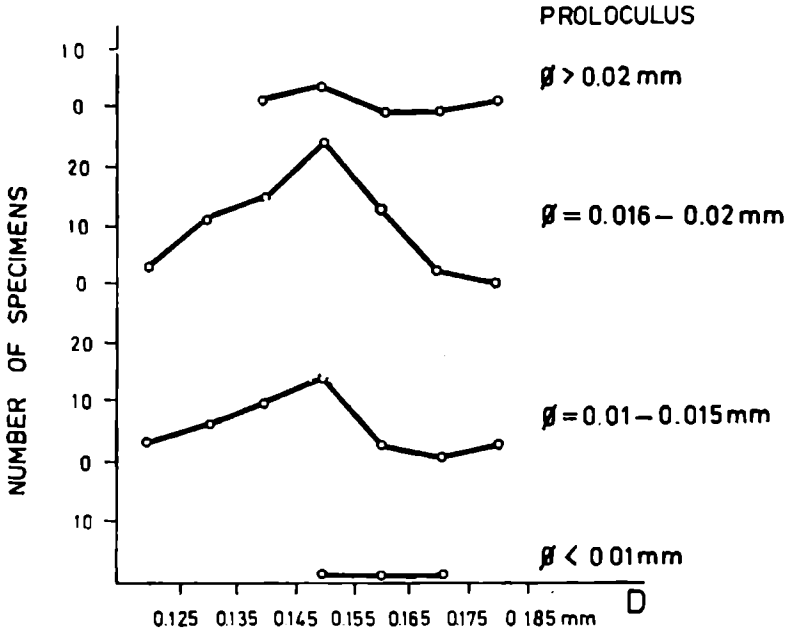

Fig. 10. Relation between the diameter of the proloculus and the max. diameter (D) of the tests of 120 specimens of *Globigerina bathoniana* n.sp. measured in class intervals 0.116—0.125, 0.126—0.135, 0.136—0.140... mm

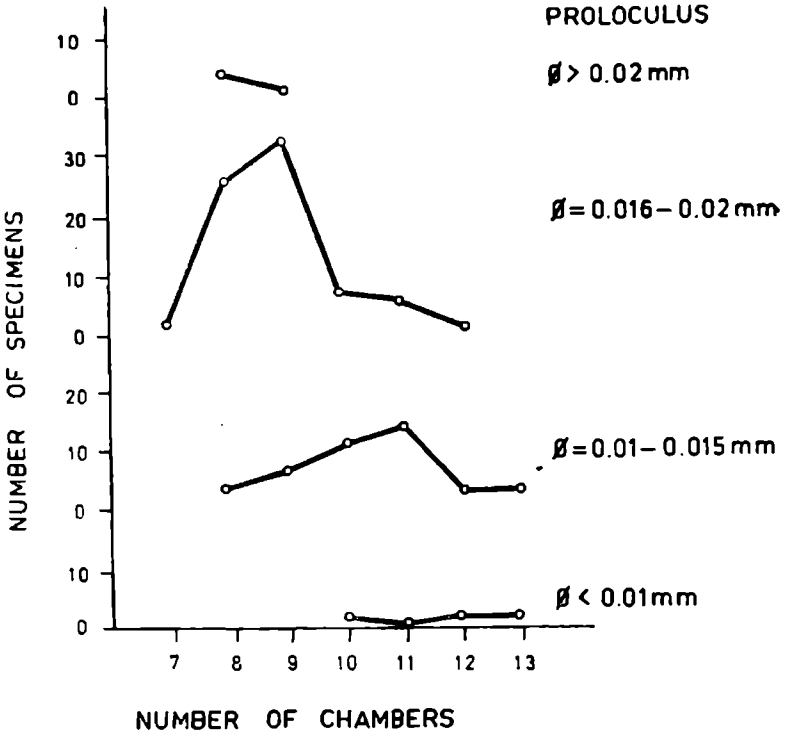

Fig. 11. Relation between the diameter of the proloculus and the number of chambers in *Globigerina bathoniana* n.sp. (120 specimens)

consisting of 3 whorls was found in a specimen consisting of 11 chambers with dimensions: $D = 0.140$ mm and $H = 0.180$ mm and ratio $H/D = 1.28$. The lowest — $H/D = 0.100/0.150$ mm $= 0.66$ with 8 chambers and 2 whorls. Specimens with $H = 0.140$—0.150 mm and D: 0.150 mm and 9 chambers are most common. The type of spire changes somewhat:

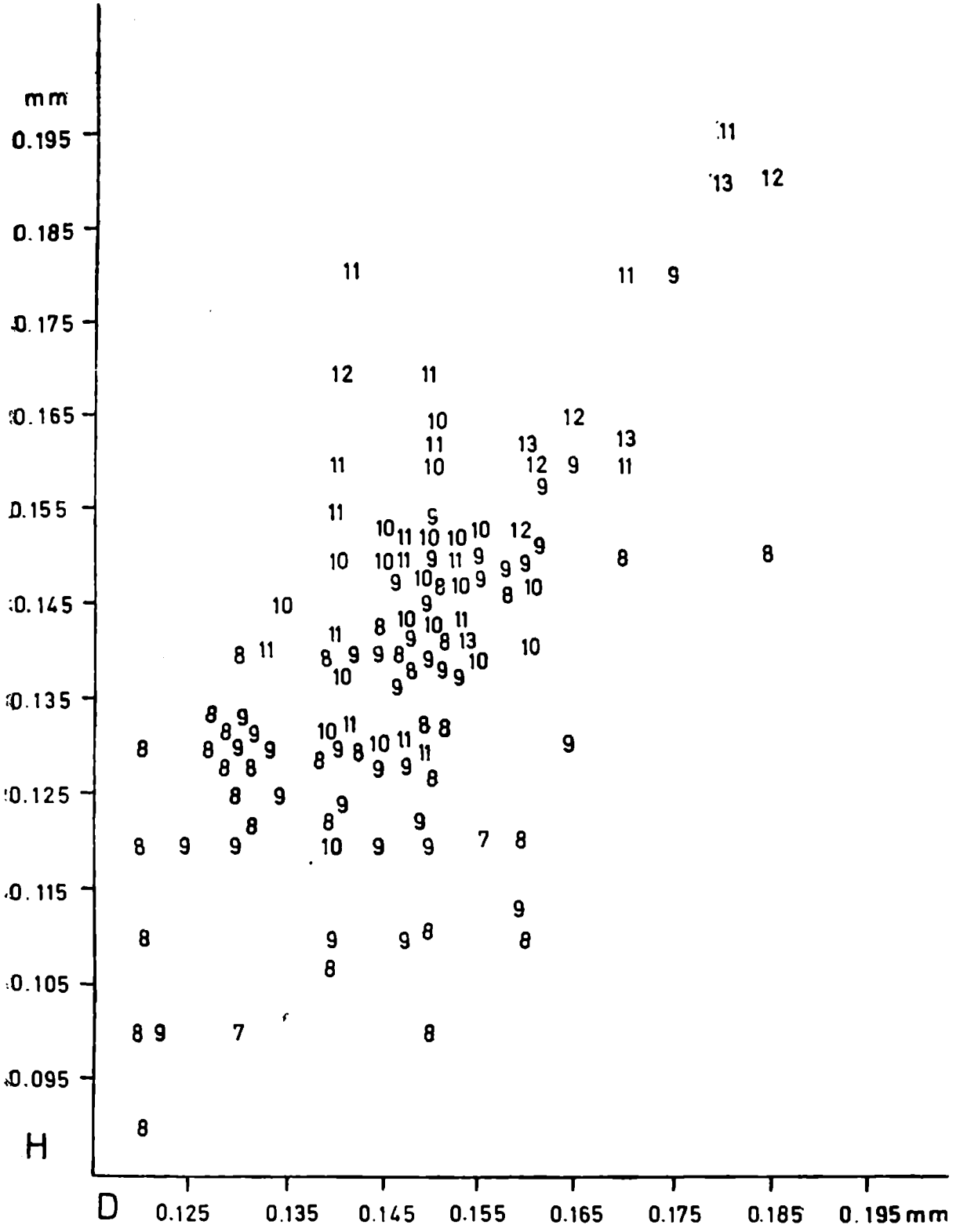

Fig. 12. Scatter diagram of 120 specimens of *Globigerina bathoniana* n.sp.; D — max. diameter; H — height; 7—13 — number of chambers of specimens

the first whorl is more or less distinctly separated from the next one, protruding and more or less planispiral, the second whorl is more or less helicoidally coiled, i.e. chambers are arranged more steeply along the axis of the whorl. The height of the spire depends largely on the way of the coiling. The present writer wishes to stress, that it is difficult to estimate the height of the spire in Globigerina on the basis of data given in the literature if the method of measurement in not described. The spire appears higher or lower, depending on the position of the specimen (Fig. 5). In the present study the height has been measured along the axis of the coil, i.e. along the line connecting the centre of initial chamber with the centre of the umbilicus, from the top of the proloculus to the edge of the last chamber (Fig. 2 c). The umbilicus is

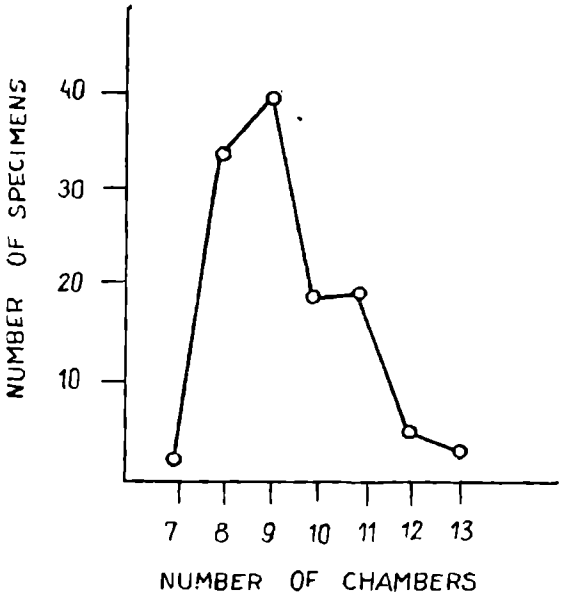

Fig. 13. Frequency curve of number of chambers by *Globigerina bathoniana* n.sp. (120 specimens)

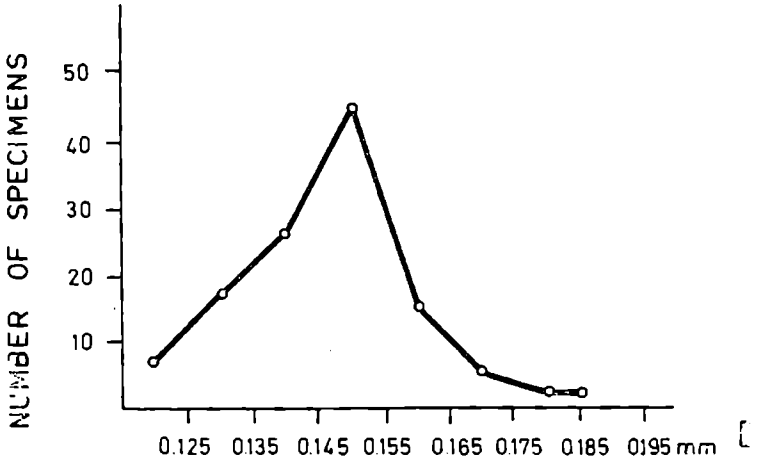

Fig. 14. Size frequency curve of 120 specimens of *Globigerina bathoniana* n.sp. measured as in Fig. 10. D — max. diameter of the test

more or less depressed, but there is no umbilicus in the sense adopted by Z. Reiss (1963).

The variation in shape of the aperture is smaller or greater but generally speaking is small. Besides specimens with a normal aperture, rare ones display either a high and narrow aperture perpendicular to the umbilical margin of the chamber (Fig. 7), or a low and broad aperture (Fig. 8). The presence of passage forms does not permit the establishment of separate systematic units.

Remarks and comparisons: Among the Jurassic species, the most similar is *Globigerina dagestanica* Morozova, 1961 but it differs from *G. bathoniana* n. sp. by a much less distinct aperture, which is much smaller and has no lip. The first whorl is composed often of 5 chambers, while in *G. bathoniana* n. sp. there is always only 4 chambers in the first whorl. *G. dagestanica* has also a much smaller proloculus (according to the description in the microspheric form 1—2 microns in diameter, in the megalospheric form 2—3 microns in diameter — if there is no printing error in these data — a possibility which is suggested by the illustrations). The smallest diameter of the proloculus in *G. bathoniana* n. sp. was 5 microns, and diameter circa 20 microns were the most frequent.

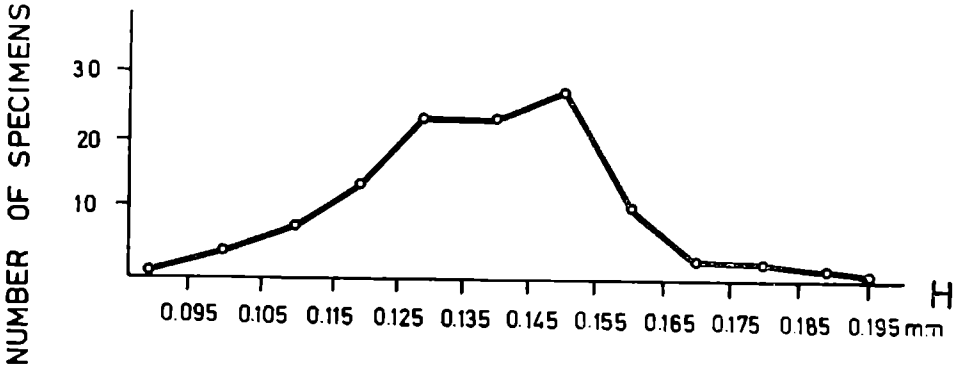

Fig. 15. Size-frequency curve of 120 specimens of *Globigerina bathoniana* n.sp. measured in class intervals 0.096—0.105, 0.106—0.115, 0.116—0.125... mm. H — height

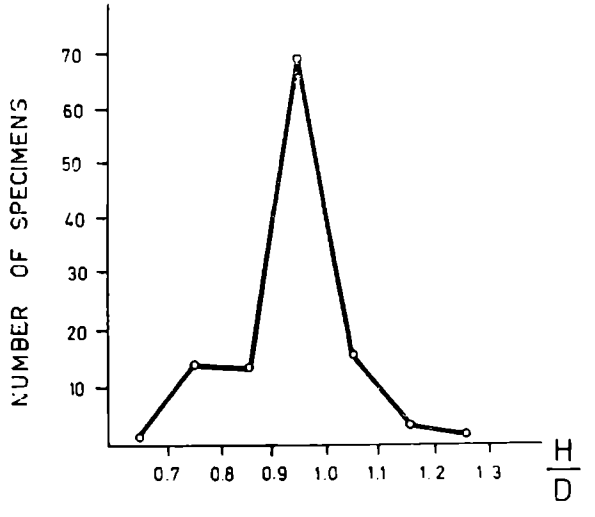

Fig. 16. Relation between the height (H) and max. diameter (D) of *Globigerina bathoniana* n.sp., 120 specimens measured in class intervals 0.61—0.70, 0.71—0.80, 0.81—0.90... mm

G. jurassica Hofman (1958) is a related species, but it has chambers irregularly arranged, and the aperture is much less distinct, smaller and lower. Rare specimens with irregular arrangement of chambers rarely noticed in the material described in the present paper belong rather to aberrant, pathological forms.

G. oxfordiana Grigelis, 1958, is very similar in the shape and position of the aperture and lip, and arrangement of chambers, but it has a distinctly lower spire. Also the species *G. balakhmatovae* Morozova, *G. bulloides* d'Orbigny and *G. helvetojurassica* Haeusler differ from *G. bathoniana* n. sp., having a much lower spire.

The new species differs from *G. gaurdakensis* Balakhmatova and Morozova by a larger and more distinct aperture, a somewhat higher spire and a smaller number of chambers in the first whorl. *G. avarica* Morozova has a much higher spire, and a less distinct aperture (see V. G. Morozova and T. A. Moskalenko, 1961).

It is difficult to compare the new species with *G. liassina* Terquem and Bertelin (1875) and with *G. oolithica* Terquem (1883) as these are not adequately described and illustrated. They are preserved only as internal moulds, but they seem to be much lower. The Middle Jurassic forms assigned by Terquem (1883) to *G. lobata* are difficult to compare with the new species for the same reasons. Only Terquem's Fig. 9, Pl. XXXI suggests that the discussed author assigned forms similar to *G. bathoniana* n. sp. to *G. lobata*. These forms have, a high spire and a large umbilical semicircular aperture.

G. cf. helvetojurassica Haeusler, described by E. Seibold and I. Seibold (1960) is larger, has more chambers in the first whorl a lower spire and an indistinct aperture.

Globigerina conica and *G. terquemi* Jov. et Trif. were created on the basis of glauconitic moulds in the Tithonian of Bulgaria (P. Iovčeva and E. Trifonova, 1961). The first of them is much higher and its initial whorl more conical than the species described here. *G. terquemi* is low trochoid, almost flat.

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STRESZCZENIE

W osadach batonu Polski znajdowano nieliczne globigeryny, które oznaczano jako *Globigerina* sp. (O. Pazdrowa, 1960) lub *G. dagestanica* Morozova (O. Pazdrowa, 1967). Bliższe badania dosyć bogatego materiału znalezionego w iłach rudonośnych rejonu częstochowskiego pozwoliły na ustanowienie nowego gatunku.

Poglądy na cechy diagnostyczne rodzaju *Globigerina* d'Orbigny 1826, i na czas jego pojawienia się różnią się dosyć znacznie między sobą. Rozbieżności zdań tyczą szczególnie wielkości, kształtu i położenia ujścia, ujść dodatkowych, komór dodatkowych, wysokości spirali, struktury i rzeźby ścian skorupki i dolnego zasięgu stratygraficznego. Typowe globigeryny według większości autorów charakteryzuje ujście pojedyncze, pępkowe, dosyć duże, półkoliste, najczęściej z wąską wargą, zgodnie z definicją V. Pokornego (1958). Takie właśnie ujścia mają okazy z batonu Polski. Ujść ani komór dodatkowych u nich nie stwierdzono, nie ma ich też u typowych globigeryn. Wysokość spirali jest raczej cechą diagnostyczną na szczeblu gatunku, nie rodzaju. Strukturę i rzeźbę ścian badane okazy mają bardzo podobną do globigeryn współczesnych i górnojurajskich (vide F. Brotzen & K. Pożaryska, 1961; G. Bignot & J. Guyader, 1966; I. Premoli Silva, 1966). Poglądy, że globigeryny pojawiły się dopiero w paleocenie (np. F. Banner & W. Blow, 1959; Z. Reiss, 1963; A. Loeblich & H. Tappan, 1964) nie wydają się słuszne.

Globigerina bathoniana n.sp

Holotypus: okaz ilustrowany na Fig. 1. str. 46.

Wymiary podano na str. 45.

Diagnoza: Globigeryny trochospiralne o wysokości prawie równej średnicy, 4 komory otaczają prolokulus, 3 do 4 komory w ostatnim skręcie, 2 rzadziej 3 skręty. Ujście duże, półkoliste, z wąską wargą, umbilikalne.

Uwagi i porównania: Zmienność w obrębie gatunku przedstawiają podane ilustracje i wykresy.

Dotychczas notowane w jurze gatunki globigeryn różnią się od nowego gatunku głównie następującymi cechami: najbardziej zbliżony *Globigerina (Conoglobigerina) dagestanica* Morozova, 1961, ma znacznie mniej wyraźne ujście, mniejsze i bez wargi. Ma często 5 komór w pierwszym skręcie. Ma niezwykle mały prolokulus według opisu 1 do 3 mikrony w obydwu generacjach (o ile nie jest to błąd drukarski). Występuje w batonie Dagestanu. *G. (Eoglobigerina) balakhmatovae* Morozova (1961), ma również ujście dużo mniejsze, 5 i więcej komór w pierwszym skręcie i dużo niższą spiralę. Występuje w batonie Dagestanu i górnym bajosie Turkmenii. *G. (Conoglobigerina) gaurdakensis* Balakhmatova & Morozova (1961) ma również ujście mniej wyraźne i mniejsze, nieco niższą spiralę i więcej komór w pierwszym skręcie (5). Występuje w górnym bajosie Turkmenii. *G. (C.) avarica* Morozova (1961), ma znacznie wyższą spiralę, mniej wyraźne i szczelinowate ujście. Występuje w batonie Dagestanu. *G. (C.) jurassica* Hofmann (1958) ma kłębkowate nieregularne ułożenie komór, a ujście niewyraźne, niskie, wydłużone. Występuje w batonie i keloweju Krymu. *G. (Eoglobigerina) oxfordiana* Grigelis (1958) ma zupełnie podobne ujście, wargę, ułożenie, kształt i ilość komór, ale ma niższą spiralę i nieco większe wymiary. Występuje w dolnym oksfordzie Litwy i Basenu Paryskiego. *G. helvetojurassica* Haeusler (1881), i *G.?* cf. *helvetojurassica* Haeusler opisany przez E. i I. Seiboldów (1960) ma ujście niewyraźne, jest większy, spiralę ma niższą i 5 komór w pierwszym skręcie. Występuje na granicy doggeru i malmu Niemiec i Szwajcarii. Okazy z osadów jurajskich oznaczane jako *G. bulloides* d'Orbigny (gatunek współczesny), *G. liassina* Terquem & Berthelin, *G. oolithica* Terquem, *G. lobata* Terquem są tak słabo opisane i ilustrowane, że trudno jest o porównanie.

Globigerina conica i *G. terquemi* Iov. et Trif. były opisane na podstawie ośródek glaukonitowych (P. Iovčeva i E. Trifonova, 1961). Pierwszy gatunek jest większy i stosunkowo wyższy, jego pierwszy zwój jest bardziej stożkowaty niż opisany tutaj. *G. terquemi* jest prawie płaski. Pochodzą z tytonu Bułgarii.

EXPLANATION OF PLATES

Plate II

Globigerina bathoniana n.sp.

Fig. 1. Specimen DG-13, dextral, Middle Bathonian, Ogrodzieniec. Magnification ca. 200×. a — spiral view; b — axial view, heavily coated with magnesia

Fig. 2. Specimen DG-15, dextral, Middle Bathonian Ogrodzieniec, nearly axial view. Magnification ca. 200×

Fig. 3. Specimen DG-11, dextral, Middle Bathonian, Ogrodzieniec, heavily coated, axial view. Magnification ca. 200×

Fig. 4. Specimen DG-16, Middle Bathonian, Ogrodzieniec, magnification ca. 200×

Fig. 5. Specimen DG-12, sinistral, Middle Bathonian, Ogrodzieniec. Magnification ca. 200×

Fig. 6. Specimen DG-14 with low spire, Middle Bathonian Ogrodzieniec, magnification ca. 200×. a — spiral view; b — nearly axial view

Fig. 7. Specimen DG-17, sinistral, last chamber broken, nearly axial view. Upper Bathonian, Iwanowice Wielkie, borehole depth 35.30 m. Magnification ca. 200×

Fig. 8. Specimen DG-19, Middle Bathonian, Ogrodzieniec, fragment of wall, magnification ca. 840×. a — transmitted light not polarized; b — polarized light, crossed nicols

Fig. 9. Specimen DG-18, Middle Bathonian, Ogrodzieniec. Note the radial structure of walls, thin dense pores, multilamellar structure of walls in older chambers, single-layer bilamellar wall in the last chamber, primarily bilamellar internal layer in older chambers. a — axial section, transmitted light, magnification ca. 300×; b — fragment of wall of the central chamber on the left side of the same specimen, magnification ca. 840×, transmitted light, not polarized; c — the same, polarized light, crossed nicols

Photomicrographs by L. Łuszczewska

Plate III

Globigerina bathoniana n.sp., Middle Bathonian, Ogrodzieniec

Fig. 1. Surface of the last three chambers, obliquely to the axis, ventral side on the right. Magnification 500×

Fig. 2. The same specimen as in Fig. 1 in a slightly different position. Orientation made possible by the attached particle. Magnification 500×

Fig. 3. A fragment of the surface of wall of the same specimen, with the attached particle at the top. Magnification 1000×. Note the relief of the surface, papillae and pores

Plate IV

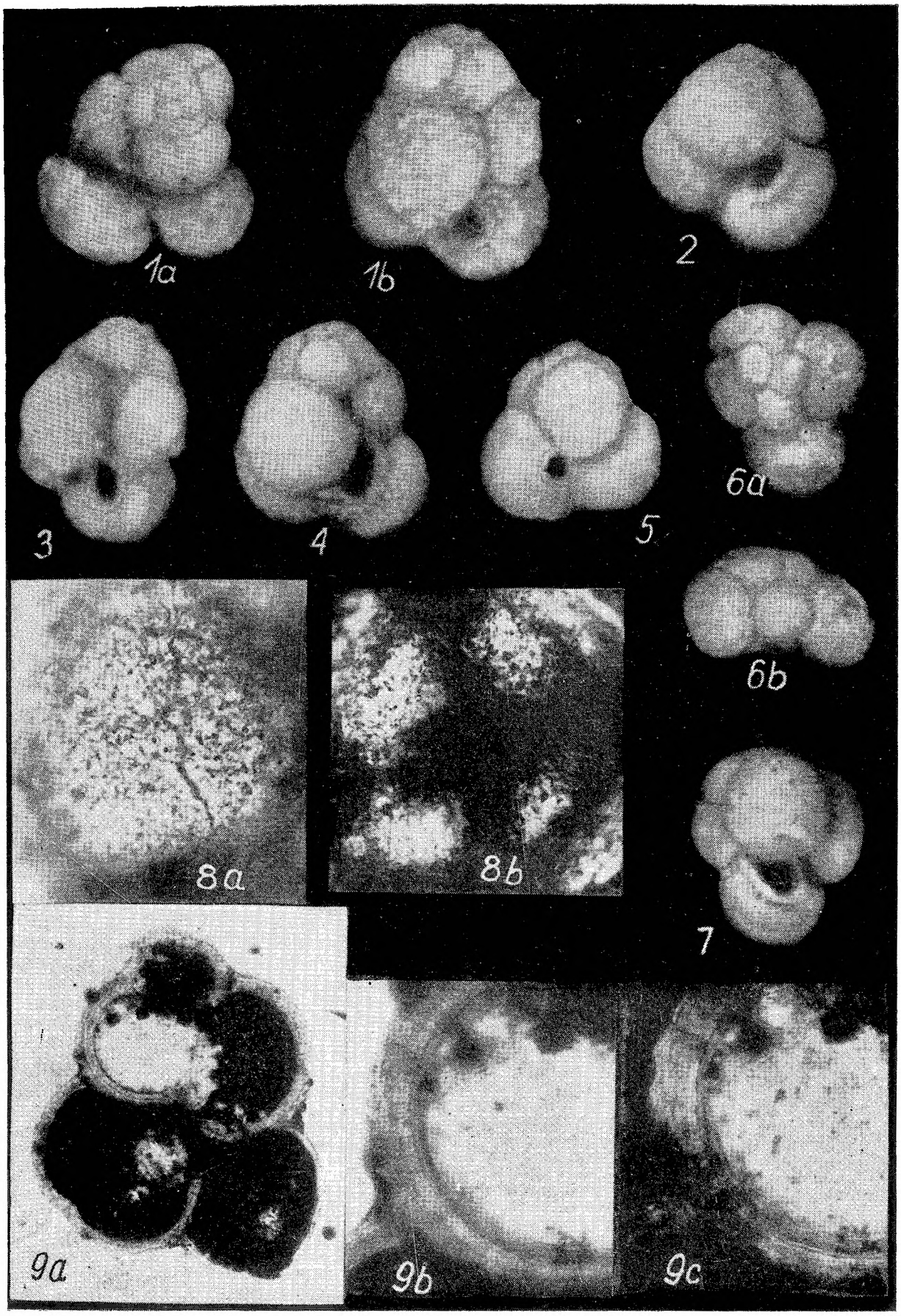
The same specimen as in Plate III

Fig. 1. Fragment of the surface of test, attached particle at the top. Magnification 2000×

Fig. 2. A fragment of the surface of test, magnification 5000×

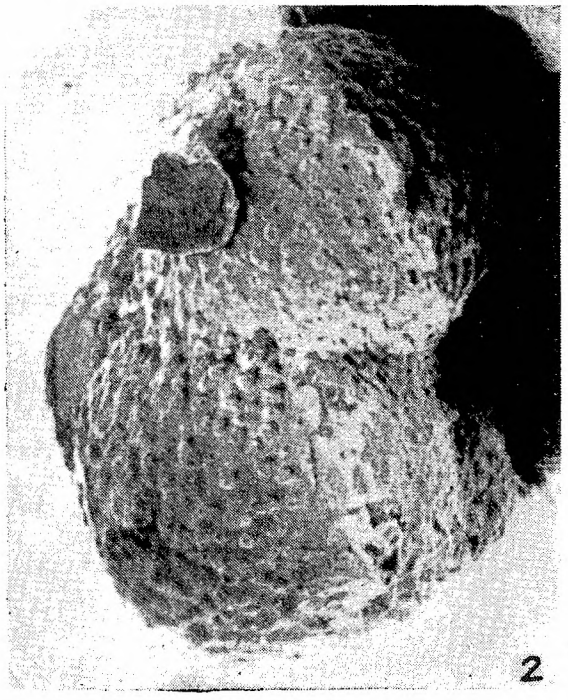
Fig. 3. Another fragment of the surface of test of the same specimen. Magnification 5000×.
The irregular distribution of pores and papillae is visible. Abraded papillae show a central plate and a circular or polygonal ring

Plate III and IV. Elektron micrographs made with Stereoscan II electron microscope in the Institute of Electronic Technology of the Polish Academy of Science. The autor expresses her gratitude to dr J e l o n e k and co-workers



O. Pazdrowa


1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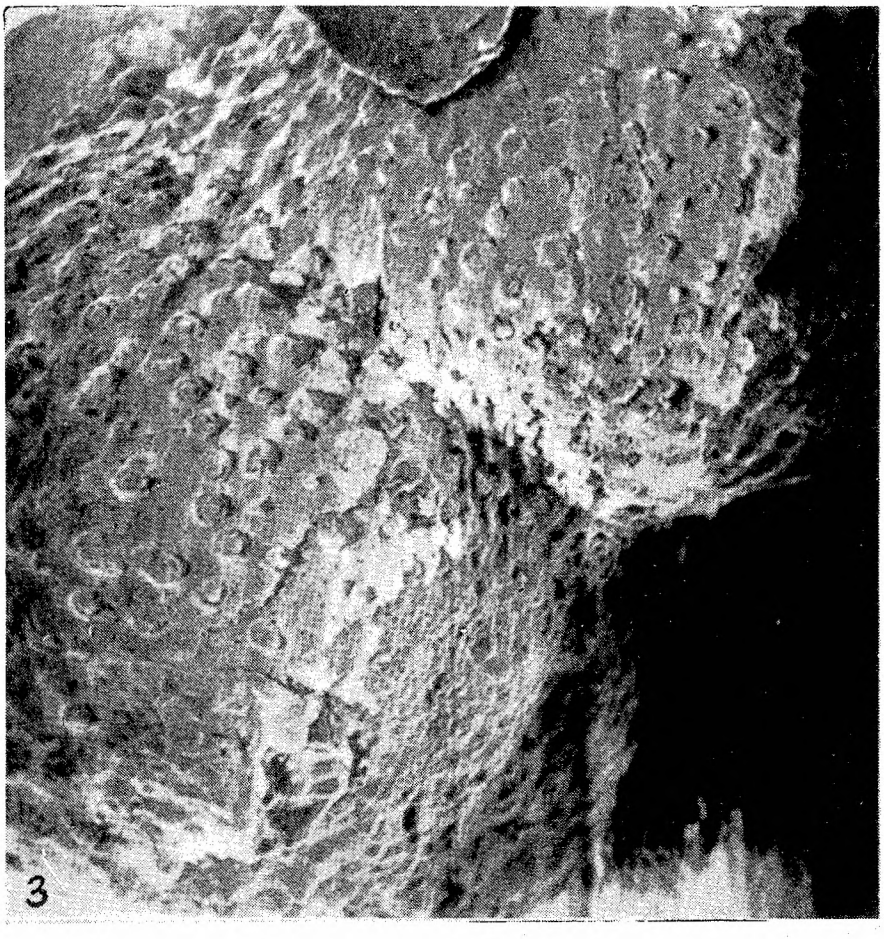
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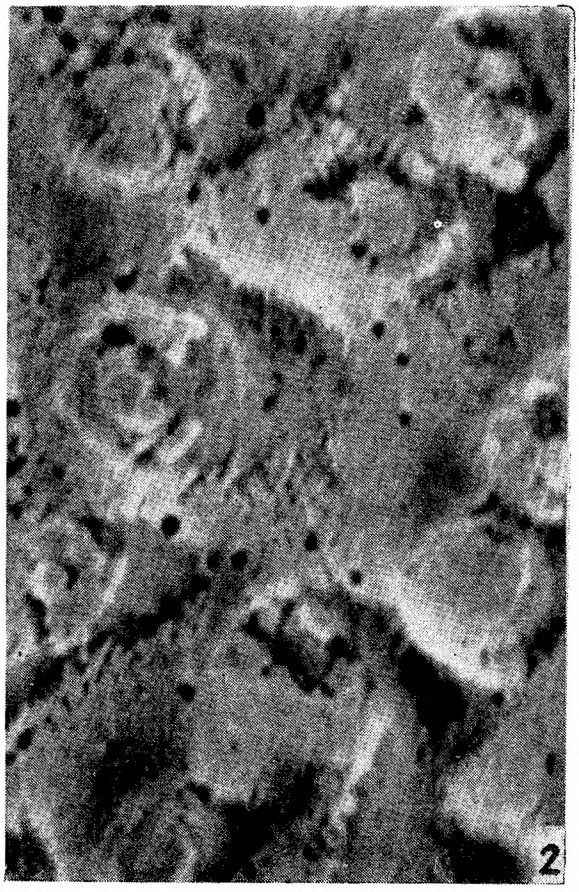
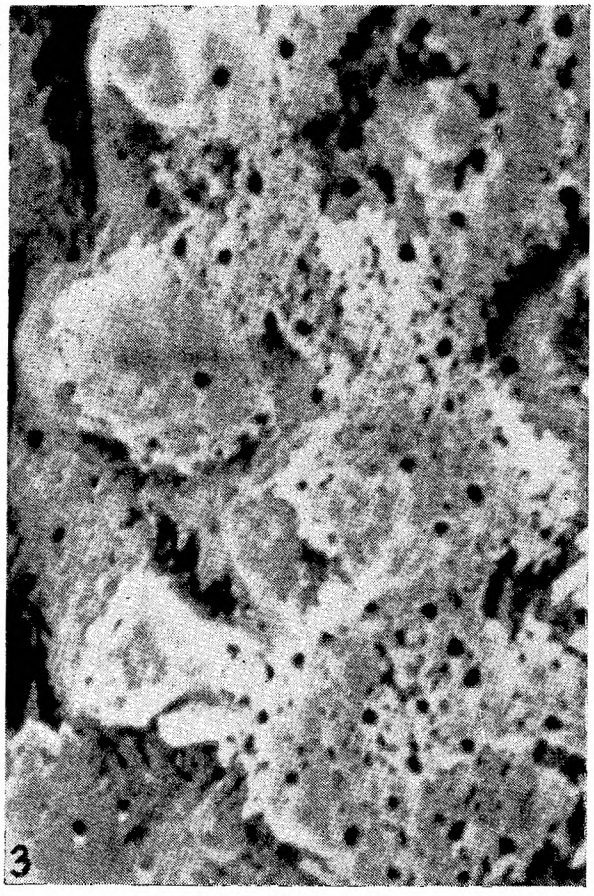
O. Pazdrowa





O. Pazdrowa