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PROBLEMATIC MICROFOSSILS FROM THE UPPER EOCENE OF POLAND

The present paper contains a description of the problematic calcareous marine microfossils of the Upper Eocene of S. E. Poland. The five following species are described: *Voorthuyseniella lageniformae* n. gen., n. sp. (the form previously known as "*Lagena*"-x Voorthuysen, 1949), *Pseudoarcella feugueuri* Le Calvez, 1959, *P. glabra* n. sp., *Spinophenia multituba* n. gen., n. sp. and *Urnulella costata* n. gen., n. sp.; the two last representing organisms so far unknown in literature.

En el presente trabajo se describen unos microfósiles problemáticos calizos marinos del Eoceno superior del S. E. de Polonia: *Voorthuyseniella lageniformae* n. gen., n. sp. (forma previamente conocida como "*Lagena*"-x Voorthuysen, 1949), *Pseudoarcella feugueri* Le Calvez, 1959, *P. glabra* n. sp., *Spinophenia multituba* n. gen., n. sp. y *Urnulella costata* n. gen., n. sp. Las dos últimas especies representan organismos desconocidos, hasta ahora, en la literatura.

INTRODUCTION

The problematic calcareous microfossils described in the present paper come from the Upper Eocene sediment of the Lublin region, S E Poland. The sediment, some meters thick, consisting mainly of glauconitic sand and marl, outcrops in the locality of Siemien near Parzew its underlying beds belong to the Cretaceous, while those above are of Quaternary age.

A more detailed description of the outcrop as well as its location, lithology and age analy-

sis, based on pelecypods, can be found in Wozny's paper (1966). The latter author presents the history of the investigations of the here mentioned outcrop as well as that of the Polish Eocene sediments in general, at the same time attempting to determine the range of the Upper Eocene sea in Poland and beyond its boundary.

The present author has at her disposal small samples, the property of the Geological Institute, Warsaw, obtained by courtesy of Prof. K. Pozaryska and Prof. W. Pozaryski. The microfossils represented in the residuum of these

samples are: foraminiferal microfauna, actually studied by K. Pozaryska and W. Pozaryski /MS/, bryozoan remnants, corals, teeth of fishes, unrecognized organic elements and ostracods which will be described in the nearest future by the author of the present article. The mentioned biotope, as well as the lithology of the studied samples, suggest that they were deposited in a warm, rather shallow sea which was connected with the open sea.

Of the four types of problematic microfossils, described in the present paper, two are hitherto known in literature, while two are entirely new. To those already known belong: "*Lagena*"-*x*, described by Voorthuysen (1949), renamed here as *Voorthuyseniella lageniformae* n. gen., n. sp., found in sediments of different age from the Eocene up to Recent, in Europe and Asia, and two species, one of which is new, representing the genus *Pseudoarcella*, erected by Spandel (1909), emended by Le Calvez (1959), and later by Lindenberg (1965); these latter species are described as *Pseudoarcella feugueuri* Le Calvez, 1959, and *P. glabra* n. sp. The species representing *Pseudoarcella* occur in the Tertiary deposits of Europe and America. The two forms described for the first time in the present paper are *Spinophemia multituba* n. gen., n. sp. and *Urnulella costata* n. gen., n. sp.

The present writer was unable to establish the systematic position of the studied forms, suggesting, however, that they approach to Protozoa. A more detailed discussion of this problem is given later in the text.

The material at the present author's disposal in all about 300 specimens, is very well preserved. The prevailing number of specimens belong to the *Urnulella costata* species. In the comparative material from the Upper Eocene of Belgium the author has found many representatives of *Pseudoarcella glabra* n. sp. and *Voorthuyseniella lageniformae* n. gen., n. sp.

During the preparation of the present paper, very helpful and valuable were the remarks of Prof. R. Kozłowski and Prof. K. Pozaryska (Palaeozoological Institute of the Polish Academy of Sciences, Warsaw), Prof. E. Voigt and

Prof. W. Häntzschel (Geologisches Staatsinstitut, Hamburg) and Dr. F. Plumhoff (Deutsche Erdöl-Aktiengesellschaft, Hamburg). To all these persons the present author wishes to express her gratitude and thanks. Many thanks are also due to Dr. A. Nowakowski (Geological Institute of the Polish Academy of Sciences, Warsaw) for the petrographical interpretation of the test sections, to Miss L. Luszczewska and Mr. J. Kazmierczak for taking photographs, and to Mrs. K. Budzynska and Mrs. D. Slawik for inking drawings on the basis of the author's pencil sketches.

The material described is housed at the Palaeozoological Institute of the Polish Academy of Sciences in Warsaw, abbreviated as Z. Pal.

SYSTEMATIC DESCRIPTIONS

Genus *Voorthuyseniella* n. gen.

SYNONYM: "*Lagena*"-*x* Voorthuysen; J. H. van Voorthuysen, 1949, *Lagena-x.*, p. 31, 4 text-figs.

TYPE SPECIES: *Voorthuyseniella lageniformae* n. sp.

DERIVATIO NOMINIS: *Voorthuyseniella*, named in honour of Professor J. H. van Voorthuysen (Geol. Stichting, Haarlem).

DIAGNOSIS: The test calcareous, hyaline, imperforate, consisting of a main part, named here frontal, which can be more globular or less, and a gutter-like part situated as its base. In the globular part of the test there is one distinct aperture, whereas in the gutter-like part, named here the basic one, there are two terminal openings and one opening in the bottom, at midlength; this latter may pass into a short tube reaching into the inner main cavity. On the inside of the test, near the terminal openings, singular, septa-like reinforcements may occur. Surface of the test smooth, glossy. Uni-

que species *Voorthuyseniella lageniformae* n. sp.

REMARKS: Genus *Voorthuyseniella* n. gen. is erected for the forms known, up to now, under the name "*Lagena*"-*x*, first described by Voorthuysen (1949) from the Lower Pliocene of Holland and later by the other authors from various parts of the world from beds of different age from Eocene up to Recent.

The texture of the test wall of the representatives of *Voorthuyseniella* genus does not exclude their assignment to Foraminifera, however, taking into consideration their morphology, especially their internal morphology, the present author excludes the assignment of the representatives of the *Voorthuyseniella* genus to Foraminifera, and especially to *Lagena*. To the genus *Lagena*, erected by Walker and Boys (1789) are referred tests unilocular, rarely with two or more chambers, having one aperture on the neck (see Loeblich and Tappan, 1964, C518). Doubts as to the assignment of "*Lagena*"-*x* (recte *Voorthuyseniella lageniformae* n. gen., n. sp.) to *Lagena*, as well as to Foraminifera in general, were expressed by the author of "*Lagena*"-*x*, and by later investigators.

At present it is difficult to establish the true systematic position of the discussed form, however its morphology as well as associated fauna and the facies conditions in which *Voorthuyseniella* occurs, show it to be a marine, shallow water form. In the present author's opinion, *Voorthuyseniella* represents a colonial or — at least — sedentary organism.

Similarity in general morphology, especially external, suggests that *Voorthuyseniella* and another problematic microfossil, described as *Bicornifera* by Liendenberg (1965) from the Oligocene of Austria, present also in the Oligocene of Yugoslavia and Turkey, represent the same type of organism. The similarity of both compared forms was noted earlier by Liendenberg (1965) who, moreover, pointed out the similarity between the *Bicornifera* and *Fissuricella* Voigt, 1959, this latter belonging to Bryozoa.

Voorthuyseniella lageniformae n. gen., n. sp.

(Plate 1, figs. 1, 2; plate 2, figs. 1, 2; plate 3, fig. 4)

- 1949 *Lagena*-*x* Voorthuysen; J. H. van Voorthuysen, *Lagena*-*x*..., p. 31, 4 tex-fig.
- 1956 *Lagena*-*x* Voorthuysen; J. H. van Voorthuysen, *Lagena*-*x* again..., p. 91, text-fig. 1-4.
- 1962 *Lagena*-*x* van Voorthuysen; G. Bignot, *Etude micropaleontologique*..., p. 174, pl. 4, fig. 11.
- 1962 "*Lagena*"-*x* Voorthuysen; T u y n o w Huang, "*Lagena*"-*x* from Taiwan..., p. 111, tex-figs. 1-5.
- 1964 "*Lagena*"-*x* Voorthuysen; A. J. Keij, Recent "*Lagena*"-*x*..., p. 65, pl. 1, fig. 2-11.
- 1967 "*Lagena*"-*x* Voorthuysen; E. Kümmerle and A. Gunawardena, Some new occurrence..., p. 115, text-figs. 1-3.

HOLOTYPE: Pl. 1, fig. 1, No. V. II/15.

STRATUM TYPICUM: Upper Eocene.

LOCUS TYPICUS: Siemien near Parczew (Lublin region).

DERIVATIO NOMINIS: *lageniformae* — named after the general shape of the test, similar to that characteristic for the representatives of the *Lagena* genus.

DIAGNOSIS: The test imperforate, consisting of a globular or compressed frontal part, with round or slit-like aperture, and a gutter-like basal part possessing two terminal openings and one opening at the bottom; this latter may pass into a tubular, short canal reaching the inner cavity. More or less distinct septa-like reinforcements sometimes occur near the terminal openings of the basal part of the test.

MATERIAL: Sixteen specimens, in most cases well-preserved.

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DIMENSIONS OF SIX SPECIMENS (in mm) :

Form x:

	No. V. II/20	V. II/21	V. II/22
Height	0.27	0.29	0.27
Width	0.34	0.27	0.29
Thickness	0.24	0.27	0.22
Diameter of the aperture	0.074	0.098	0.12

Form y:

	No. V. II/23	V. II/24	V. II/25
Height	0.245	0.245	0.245
Width	0.37	0.32	0.34
Thickness	0.12	0.12	0.12
Length of the aperture	0.15	0.19	0.22

DESCRIPTION: The test unilocular, thin-walled, hyaline, imperforated, rather solid. It consists of two parts, i.e. globular or distinctly compressed frontal part and an elongated horizontally gutter-like part at its base. In the top of the frontal part there is a distinct aperture, the shape of which depends on the shape of this part of the test, i.e. it is round or slit-like, elongated in accordance with the test compression and

length of the basal part of the test. The basal part has two terminal openings and one opening in the bottom at mid-length. One of the two mentioned terminal openings, more regularly developed, generally terminates the more extended end of the basal part of the test. The second terminal opening, smaller than the above mentioned, is situated in the middle of the partition, partly covering the other, shorter end of the basal part (Plate 1, fig. 1c), sometimes the shorter end seems to be entirely closed.

As may be seen in the damaged specimens and on the test sections, the interior of the test sometimes contains a short tube, a prolongation of the opening present in the bottom of the basal part of the test. There may occur also septa-like reinforcements near the terminal openings (Plate 3, fig. 4).

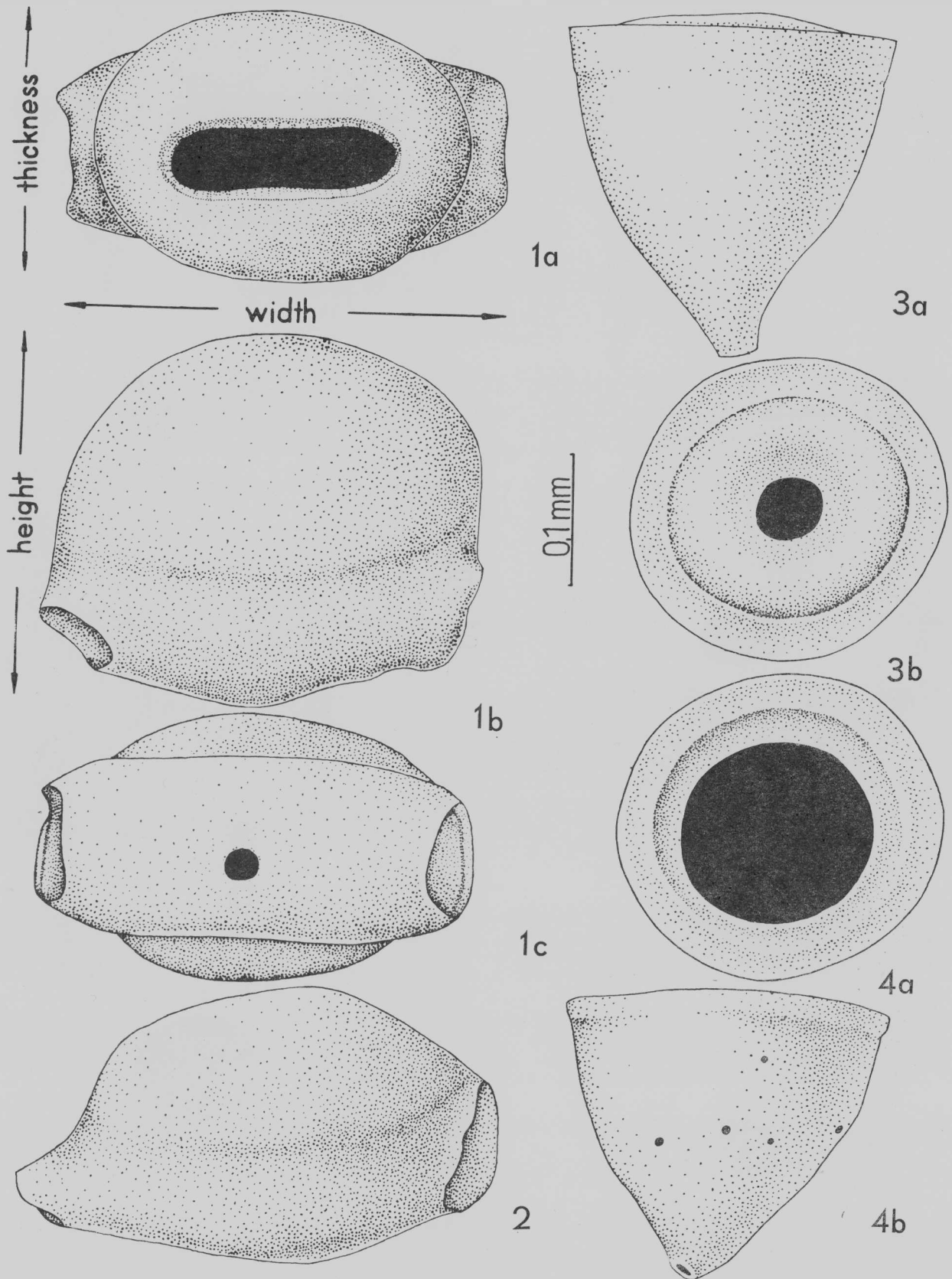
Surface of the test smooth, glossy, with a striae around the aperture.

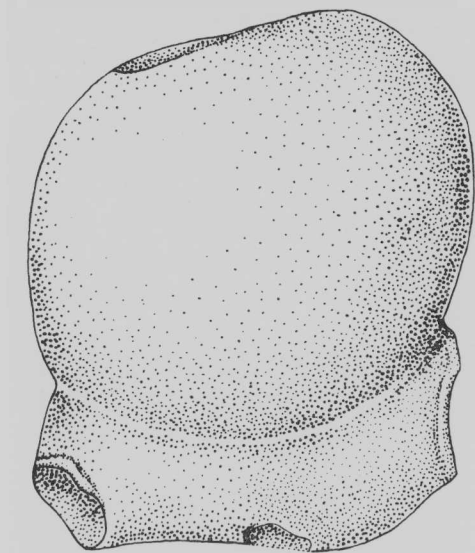
VARIABILITY: Variability in the size of the test is small, but significant when applied to the general shape of the test and shape of the aperture. With these latter under consideration, the present author distinguished two forms: form x —having a globular frontal part of the

PLATE 1

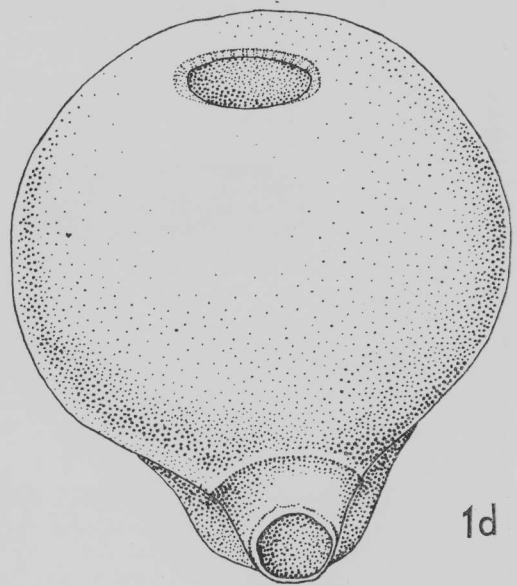
- 1, 2 *Voorthuyseniella lageniformae* n. gen.,
n. sp., type x.
1 a-e, holotype, specimen No. V. II/15,
seen from the different sides.

- 2, specimen No. II/16, seen from one
side.

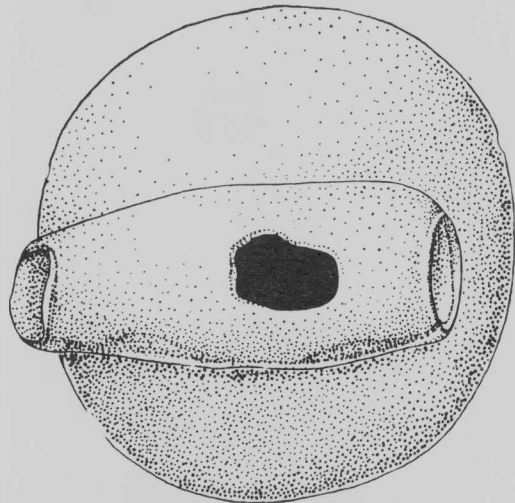




1a

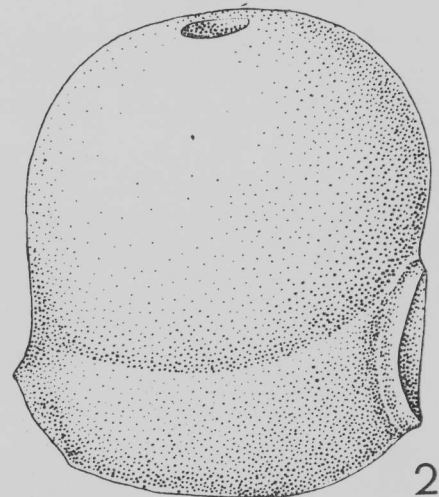


1d

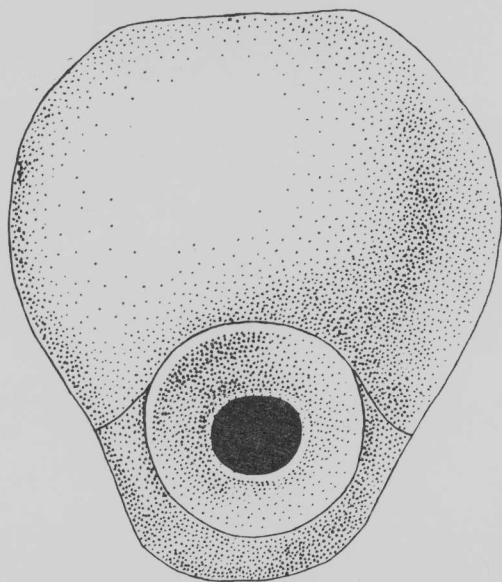


1b

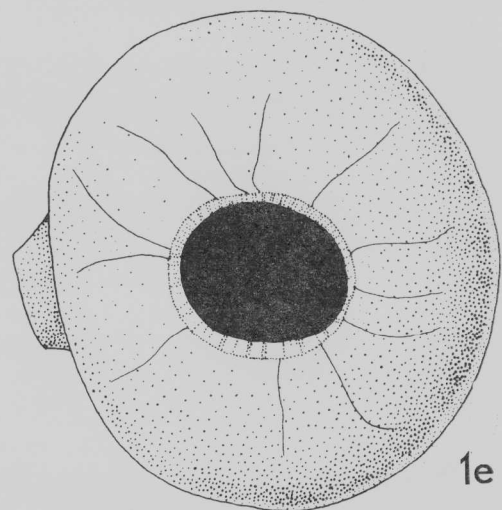
0.1mm



2



1c



1e

test, and form y— with a compressed frontal part. In forms assigned to the latter type, the external morphology of the test is generally less distinctly differentiated, i.e. there is only an indistinctly marked boundary between the frontal and basal parts of the test.

In the studied specimens, as has been mentioned above, the internal tube and reinforcements at the terminal openings are not always present. It could depend, probably, on the state of preservation of the test, or it may be a natural variable feature within the discussed forms.

REMARKS: Specimens from the Upper Eocene of Poland, included to *Voorthuyseniella lageniformae*, differ only in details from the specimens described by different authors (see synonymy) as "*Lagena*"-x (recte *Voorthuyseniella lageniformae*). On the basis of the observations made on specimens from Poland, these insignificant differences in the size, shape, external and internal morphological features of the test, are within the frame of variability attributed to the discussed species.

OCCURRENCE: Lower Eocene of France, Upper Eocene of Poland (Lublin region) and Belgium (sands from Wemmel), Oligocene of Germany and Holland, Miocene of Portugal and Formosa, Pliocene of Holland, Recent sediments of China Sea.

Genus *Pseudoarcella* Spandel, 1909,
emend. Le Calvez, 1959,
emend. Lindenberg, 1965
Pseudoarcella glabra n. sp.

? 1962 *Pseudoarcella campanula* Le Calvez; G. Bignot, Etude de la formation..., p. 174, Pl. 4, fig. 10 a-b (non *Pseudoarcella campanula* Le Calvez, 1959, p. 91, Pl. 1, figs. 3,4).

HOLOTYPE: Pl. 2, fig. 3, No. V. II/5.

STRATUM TYPICUM: Upper Eocene.

LOCUS TYPICUS: Siemien near Parczew (Lublin region).

DERIVATIO NOMINIS: Lat. *glabra* = smooth; named after the smooth test surface.

DIAGNOSIS: The test conical in shape, with aperture on flattened side, a more distinctly or less distinctly pronounced an opening ending distal part of the inflated side, smooth test surface.

MATERIAL: About twenty specimens well-preserved.

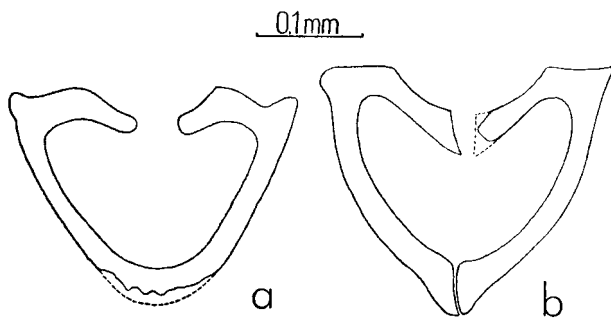
DIMENSIONS OF THREE SPECIMENS (in mm):

	No. V. II/26	V. II/4	V. II/5
Height of the test	0.245	0.245	0.245
Diameter of the apertural side	0.32	0.245	0.245
Diameter of the aperture	0.05	0.15	0.03

PLATE 2

- 1, 2 *Voorthuyseniella lageniformae* n. gen., n. sp., type y.
1 a-c, specimen No. V. II/17, seen from the different sides.
2, specimen No. V. II/18, seen from one side.

- 3, 4 *Pseudoarcella glabra* n. sp.
3, holotype, specimen No. V. II/5; a - side view, b - apertural view.
4, specimen No. V. II/4; a - apertural view, b - side view.



TEXT-FIGURE 1

Pseudoarcella glabra n. sp., axial thin-section;
a - specimen No. V. II/1, b - specimen No.
V. II/2.

DESCRIPTION: The test hyaline, unilocular, conical in shape, thin-walled, irregularly but distinctly perforated, observed perforation does not seem, however, to be homologous to that known, for instance, in Foraminifera. The flattened side of the test, named here the oral one, may be partly covered, in which case the aperture occurs in its concave middle part, or it may be entirely opened. Inflated part of the test, named here aboral one, is distinctly thickened and pierced by a thin canal in its distal part (see Text-fig. 1b, cf. Bignot, 1962, p. 174, fig. 4). Contact margin of the flattened and inflated parts of the test is also thickened, sometimes fairly keeled. Test surface smooth, glossy. Studies of the longitudinal thin-sections of the test of *Pseudoarcella glabra* n. sp. by polarizing microscope show that the test structure is that of a single crystal.

VARIABILITY: Variability in the size and general shape of the test is insignificant; some specimens have a sharply conical shape, others a more globular inflated side. More significant is the variation in the development of the apertural side; as has been pointed out above, specimens are entirely opened on the oral side or partly covered.

REMARKS: The specimens attributed to *Pseudoarcella glabra* n. sp. from the Upper Eocene of Poland do not seem to differ from the figu-

red specimen, assigned by Bignot (1962) to *P. campanula* Le Calvez, this latter however seems to differ in ornamentation from the holotype of *P. campanula*, described by Le Calvez (1959); in contrast to the ornamented specimens of *P. campanula*, described by Le Calvez (1959), the specimens from Poland, and probably that described by Bignot from the Lower Eocene of France, have a smooth test surface. This is why Bignot's specimen is here tentatively included into the synonymy of *Pseudoarcella glabra* n. sp.

In the specimens found in the Polish Eocene, the situation of the opening on the aboral side is always connected with its most distal part, whereas in specimens described by Lindenberg (1965), attributed to *Pseudoarcella*, more exactly —to *P. rhumbleri* Spandel, type species for *Pseudoarcella* genus, this opening is situated laterally; in the present author's opinion, such a difference is not sufficient to decide the systematic position of the discussed forms on the generic level, as was suggested by Lindenberg (1965).

According to the present writer, the described specimens represent a fixed organisms, not belonging to Foraminifera.

OCCURRENCE: Upper Eocene of Poland (Lublin region), Upper Eocene of Belgium (sands from Wemmel), Lower Eocene of France (?).

Pseudoarcella feugueuri Le Calvez, 1959

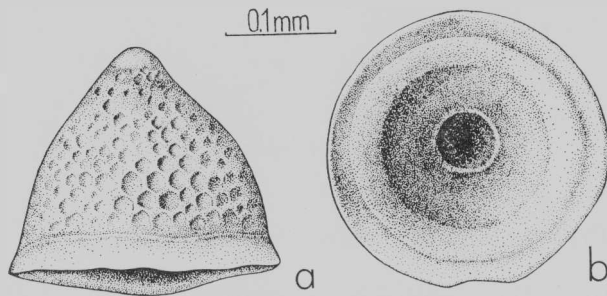
(Text-fig. 2)

1959 *Pseudoarcella feugueuri* Le Calvez; Le Calvez, Etude de quelques Foraminifères..., p. 90, pl. 1, figs. 1,2.

MATERIAL: Two specimens well-preserved.

DIMENSIONS OF ONE SPECIMEN (in mm) :

	No. V. II/3
Height of the test	0.29
Diameter of the aperture side	0.27
Diameter of the aperture	0.05



TEXT-FIGURE 2

Pseudoarcella feugueuri Le Calvez, specimen No. V. II/3; a - side view, b - apertural view.

DESCRIPTION: In comparison with the above described specimens of *Pseudoarcella glabra* n. sp., specimens assigned to *P. feugueuri*, described by Le Calvez (1959) from the Lower Eocene of Belgium, differ only in test ornamentation. The ornamentation present in specimens of *P. feugueuri* is of a hexagonal pattern, covers only the aboral side and does not reach the contact margin between the inflated and flattened side. The others morphological features are the same for both species.

OCCURRENCE: Lower Eocene of Belgium, Upper Eocene of Poland (Lublin region), Upper Eocene of Belgium (sands from Wemmel).

Genus *Spinophenia* n. gen.

TYPE SPECIES: *Spinophenia multituba* n. sp.

DERIVATIO NOMINUS: *Spinophemia*, Lat. *spina* = spine; named after the morphology of the test.

DIAGNOSIS: Unilocular, calcareous, hyaline test, globular in shape, covered by empty, open, thorn-like tubes, with a more or less distinct aperture bordered by a collar. Apertural end may be modified in different ways. Wall of the test finely perforated. Unique species - *Spinophenia multituba* n. sp.

REMARKS: Specimens representing the newly erected genus *Spinophenia* somewhat resemble in shape some Flagellata, especially the cysts referred to Chrysomonadina, they differ from them, however, by being much larger. The nature of the test material in both forms is also different; in contrast to the calcareous tests in representatives of *Spinophenia*, the test in Chrysomonadina are siliceous. Taking under consideration the building material and structure of the test wall of *Spinophenia* representatives, it can not be excluded but that they represent Protozoa, affined or even related to Rhizopoda; calcareous, hyaline, perforated test are known in many representatives of Foraminifera.

Variability concerning the development of the apertural end, i.e. the presence of a well developed aperture (bordered by a distinct collar, or its various, below described modifications, suggest that the opened aperture was not a particularly important element in the existence of the organisms, assigned to *Spinophenia* genus. The modified apertural ends one could suppose were used for attachment, their shape depending on that of the objects which they were attached. It is probable the opened, thorn-like tubes, covering the test surface, made contact possible between the soft part of the organism and the external environment.

Spinophenia multituba n. gen., n. sp.

(Plate 3, figs. 1-3; plate 4, figs. 4, 5, 6)

HOLOTYPE: Pl. 4, fig. 5, No. V. II/8.

STRATUM TYPICUM: Upper Eocene.

LOCUS TYPICUS: Siemien near Parczew (Lublin region).

DERIVATIO NOMINUS: *Spinophemia*, Lat. *spina* = many, *tuba* = tube; named after the morphology of the test.

DIAGNOSIS: Test globular in shape, ornamented with empty, opened thorn-like tubes, irregularly scattered. Apertural end regularly developed or modified in different ways.

MATERIAL: About thirty specimens well-preserved.

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DIMENSIONS OF THREE SPECIMENS (in mm) :

	No. V. II/12	No. V. II/13	No. V. II/14
Height	0.34	0.245	0.32
Width	0.29	0.29	0.29

DESCRIPTION: The test unilocular, hyaline, with a thin, very finely perforated wall, microgranular in structure, globular in general appearance. Apertural end, generally with a somewhat thickened, neck-like extension, is bordered by a collar and bears more regular or less regular in shape aperture. The aperture, as well as the collar bordering it may be modified in various ways. The test surface is covered by irregularly scattered thorn-like tubes, which may be enlarged and sometimes slightly ragged at their distal, open ends.

In the present author's opinion, the above discussed forms represent fixed organisms.

VARIABILITY: Variation concerning the general appearance and size of the test is insignificant. Greater variation applies to the development of the apertural end and collar bordering it. The shape as well as the size of the aperture varies by being open, more regularly or less regularly round, or by being overgrown to different degrees; sometimes the aperture is reduced into one or two small, laterally situated openings within the coalesced edges of the collar. The collar may regularly border the aperture or take the shape of a vertical tube, a horizontally elongated furrow, or be entirely flattened.

OCCURRENCE: Upper Eocene of Poland (Lublin region).

Genus *Urnulella* n. gen.

TYPE SPECIES: *Urnulella costata* n. sp.

DERIVATIO NOMINIS: *urnulella*, Lat. *urnu'la* = small pot; named after the test shape.

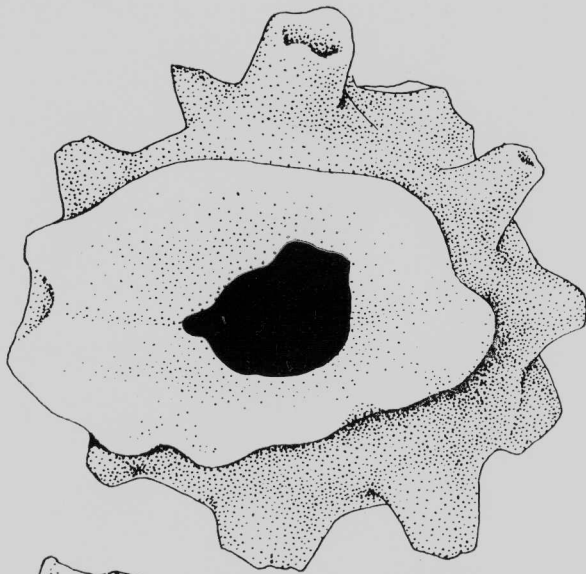
DIAGNOSIS: Test calcareous, unilocular, scoop-shaped, with a more or less distinct lateral ridge and triangle, bordered by a collar aperture. Surface ornamented or smooth. Unique species *Urnulella costata* n. sp.

REMARKS: The general appearance of the assigned to the newly erected genus *Urnulella*, does not resemble any of the so far known organisms, although their ornamentation is somewhat similar to that present in some Characea representatives. The fibrous structure of the calcareous test, such as in the representatives of the *Urnulella* genus, is known in many genera belonging to the Foraminifera, however the remaining features of both compared types of organisms seem to exclude their close relation. In the present author's opinion, *Urnulella* represents a fixed form, approaching to Rhizopoda. This suggestion, concerning the behaviour of the representatives of the *Urnulella* genus, results mainly from the arrangement of their ornamentation, especially that part along the lateral ridge; it seems to be formed as an attachment point.

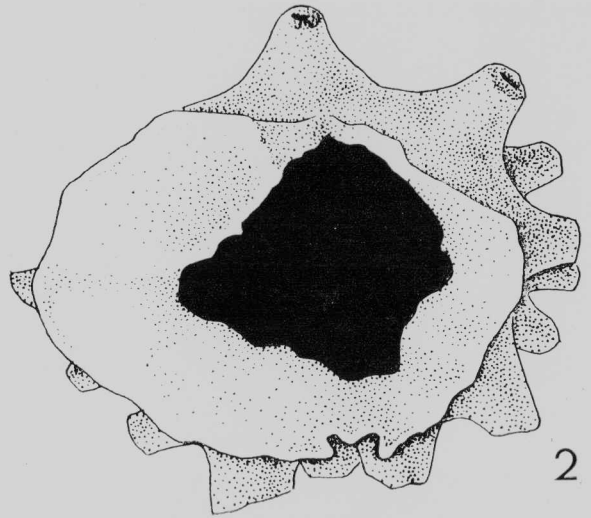
PLATE 3

- 1-3 *Spinophenia multituba* n. gen., n. sp.
 1, specimen No. V. II/12; a - side view,
 b - apertural view.
 2, specimen No. V. II/13; side view.

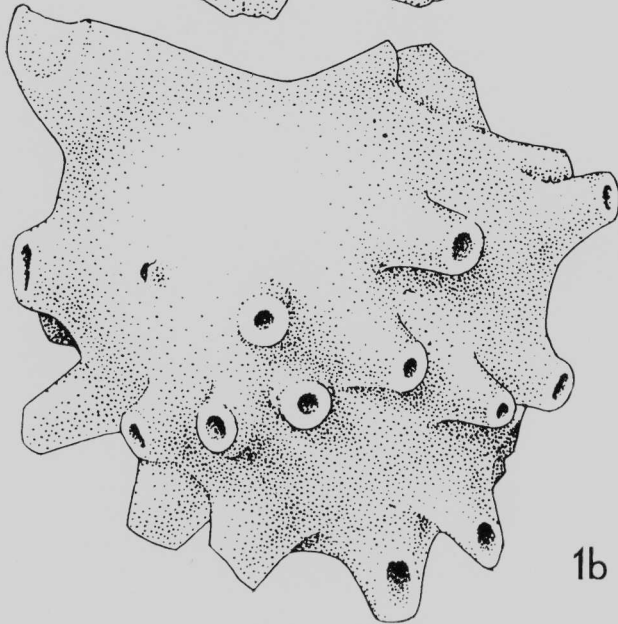
- 3, specimen No. V. II/14; a - apertural view, b - side view.
 4 *Voorthuyseniella lageniformae* n. gen., n. sp.; inner view of the damaged specimen No. V. II/19.



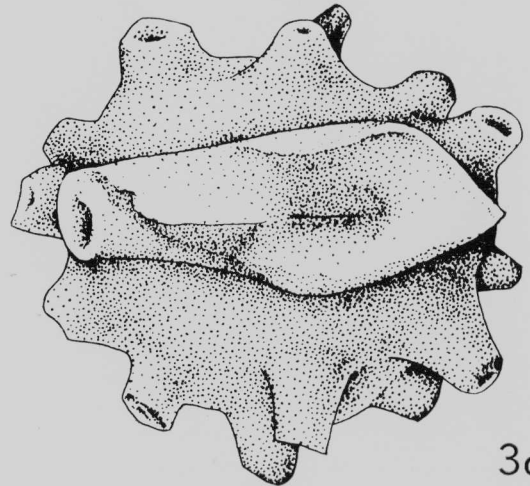
1a



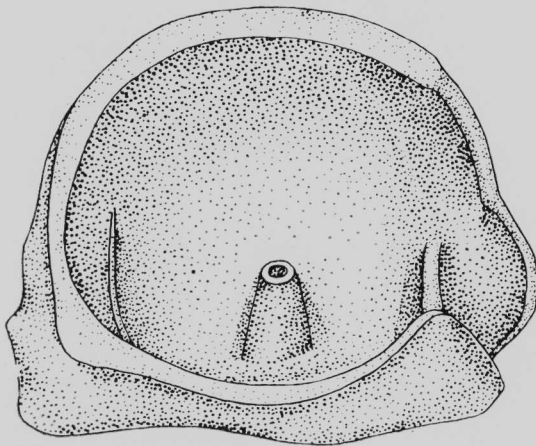
2



1b

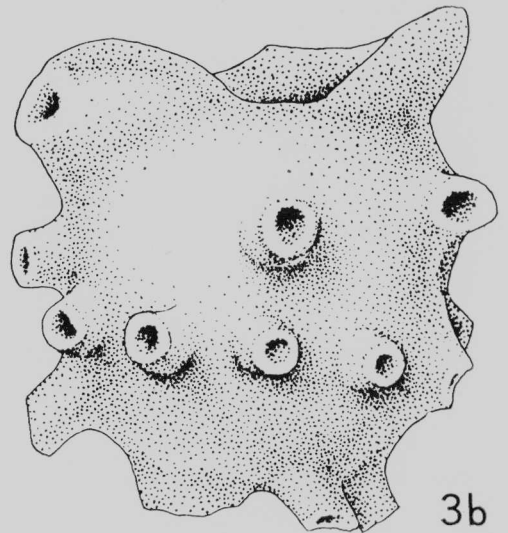


3a

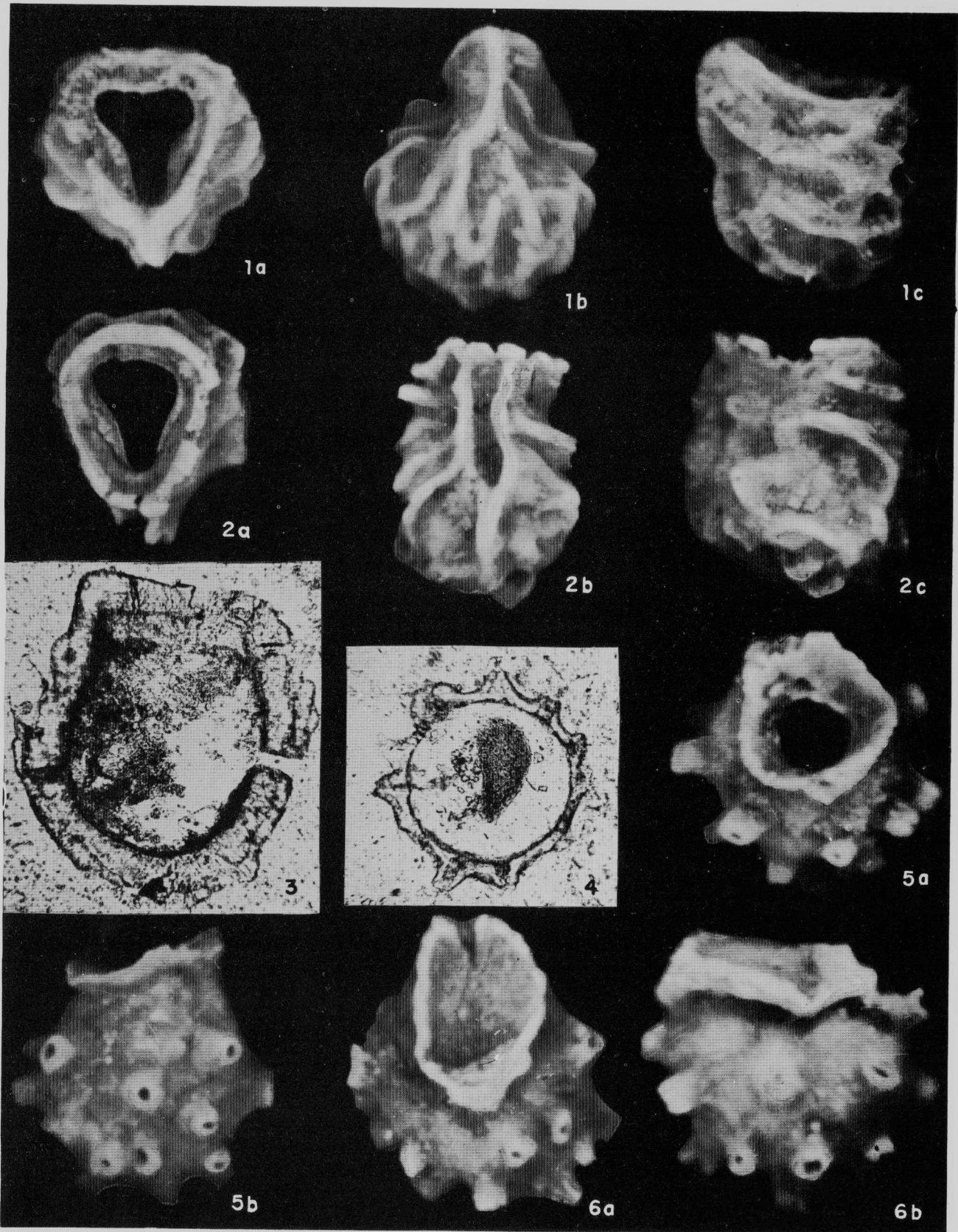


4

0.1mm



3b



Urnulella costata n. gen., n. sp.

(Plate 4, figs. 1, 2, 3)

HOLOTYPUS: Pl. 4, fig. 1, No. V. II/6.

STRATUM TYPICUM: Upper Eocene.

LOCUS TYPICUS: Siemien near Parczew (Lublin region).

DERIVATIO NOMINIS: *costata*, Lat. *costa* = rib; named after the test ornamentation, i.e. ribbed test surface.

DIAGNOSIS: Test scoop-shaped, ornamented with list-like ribs. Ribs arranged more horizontally or less, except the ridged part of the test where they are arranged rather vertically.

MATERIAL: About three hundred specimens mostly well-preserved.

DIMENSIONS OF THREE SPECIMENS (in mm) :

	No. V. II/27	V. II/28	V. II/29
Height	0.44	0.39	0.39
Width	0.34	0.34	0.34
Maximum diameter of the aperture	0.147	0.147	0.17

DESCRIPTION: The test unilocular, thin-walled, solid, weakly transparent, imperforated, having a scoop-like shape. It has a distinct lateral ridge along the longer axis of the test, in accordance with which it is nearly always more or less elongated towards the top. Open end, named here the apertural, contains a triangle aperture, rimmed by a more distinct or less distinct collar. The test surface is covered by list-like ribs which are orientated nearly spirally or almost horizontally and are more or less parallel to each other, except the lateral ridge where they lie vertically, in accordance with the elongation of the test; at the lateral ridge the ornamentation reaches the collar.

VARIABILITY: Considerable variability applies mainly to the shape and ornamentation of the test. In addition to the scoop-like forms, there are almost smooth, without a distinctly pronounced lateral ridge. Unornamented tests generally have a thinner and irregularly developed aperture and seem to be not completely calcified.

OCCURRENCE: Upper Eocene of Poland (Lublin region).

PLATE 4

1,2,3 *Urnulella costata* n. gen., n. sp.

1, holotype, specimen No. V. II/6, x 130; a - apertural view; b, c - side views.

2, specimen No. V. II/7, x 130; a - apertural view; b, c - side views.

3, Axial thin-section, specimen No. V. II/11, x 90.

4, 5, 6 *Spinophenia multituba* n. gen., n. sp.

4, equatorial thin-section, specimen No. V. II/10, x 70.

5, holotype, specimen No. V. II/8, x 160; a - apertural view, b - side view.

6, specimen No. V. II/9, x 160; a - apertural view, b - side view.

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