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THE UPPERMOST DEVONIAN FORAMINIFERS OF THE ŚWIĘTOKRZYSKIE (HOLY CROSS) MTS., POLAND

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Thirty-one species of silicified foraminifers, representing thirteen genera, are described from the uppermost Devonian deposits of Kowala locality, Świętokrzyskie (Holy Cross) Mts. Two species are new: *Hyperammina eickhoffi* sp. n. and *Tolypammina minuta* sp. n. Most species belong to the agglutinating genera *Hyperammina, Thurammina* and *Tolypammina*. The stratigraphic position of this fauna coresponds to the upper part of the ostracod *hemisphaerica-dichotoma* Zone and conodont *costatus* Zones.

Key words: Foraminiferida, Upper Devonian, Poland.

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INTRODUCTION

The Devonian foraminifers of the area of Poland have so far been rarely studied. Only a few foraminiferal species were described by Duszyńska (1956, 1959) from the Middle Devonian deposits of Wydryszów and Grzegorzowice in the Świętokrzyskie (Holy Cross) Mts. Some species of foraminifers (Neumann *et al.*, 1975) were also identified in thin sections from the Upper Devonian deposits of the Lublin Region, southeastern Poland. The presence of foraminifers in thin sections of the Frasnian deposits of Sobiekurów in eastern Holy Cross Mts. was mentioned in a paper of Olkowicz-Paprocka and Ozonkowa (1970), but these authors did not describe and illustrate the fauna identified.

The present paper gives a description of an assemblage from the condensed Famennian deposits, represented by limestones intercalated with clayey shales, occurring at Kowala in the western part of the Holy Cross Mts. (fig. 1). These deposits represent the upper part of the ostracod *hemisphaerica-dichotoma* Zone and the conodont *costatus* Zones (Olempska 1979, 1981: trench I and II, samples nos. 100—133). These zones correspond approximately to the uppermost part of the Famennian.

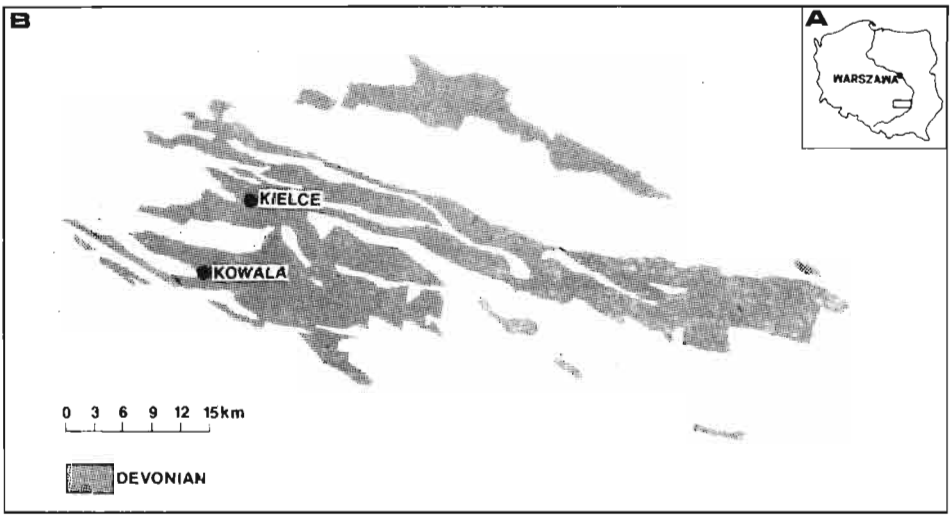

Fig. 1. Distribution of Devonian deposits in the Holy Cross Mts. (after Czarnocki, 1953).

A rich collection of the Devonian silicified foraminifers has been accumulated by the present author while macerating specimens for the description of an ostracod fauna from the Upper Devonian and Carboniferous deposits of Kowala (Olempska 1979, 1981). On the other hand, only rare, indeterminate, fragmentary, tubular foraminifers, probably of the genus *Tolypammina* were found in samples containing conodonts from the Lower Carboniferous *Siphonodella* Zone. The foraminifers were separated by washing soft clayey shales with water and, in part, by dissolving calcareous intercalations in the acetic acid. The same assemblage was found with the application of both methods of maceration. The tests obtained by dissolving samples in the acid, were on the whole less damaged, in particular those with a long, irregularly winding second chamber.

The foraminiferal assemblage described consists of 31 species, including two new ones. The most abundant are the foraminifers of the families Astrorhizidae, Saccamminidae, Moravamminidae and Tournayellidae.

The collection described is housed at the Institute of Paleobiology of the Polish Academy of Sciences in Warsaw (ZPAL).

STRATIGRAPHIC SIGNIFICANCE OF THE FAUNA

The significance of the agglutinating foraminifers to the stratigraphy of the Upper Devonian and Lower Carboniferous has not so far been learned to the full. Considerable ontogenetic variability, resulting from the dependence of the morphology of their tests on the character of

substrate (and the related difficulties in identifying species) as well as considerable dependence of the occurrence of arenaceous foraminifers on the type of facies, recommend a rather cautious approach to this subject.

The data on the significance of the silicified foraminifers to the stratigraphy of the Upper Devonian and Lower Carboniferous of the area of Central Europe were summed up by Eickhoff (1974). According to this author a dozen or so species are of considerable importance to the stratigraphy of these deposits and their occurrence is limited only to the uppermost Devonian (the *costatus* Zones).

At Kowala, 31 species of foraminifers occur in the deposits of the *costatus* Zones, 20 of which are also known from the areas of Thuringia (Thüringen), Rhine Shale Mountains (Rheinisches Schiefergebirge), Harz Mts., Carinthian Alps (Karnische Alpen) and North America. Three species, *Saccammina ingloria*, *Paratikhinella cannula* and *Septatournayella (E.) rauserae potensa* are also known from the Russian Platform (Bykova 1952, Lipina 1965). Of stratigraphically most important species, the Famennian deposits of Kowala contain *Hyperammina aperta* and *Thurammina tubulata fixa* occurrence of which in Karnische Alpen (Langer 1969, Ebner 1973) and in Rheinisches Schiefergebirge (Eickhoff 1970, 1974) is limited to the uppermost Devonian (the *costatus* Zone). ?*Moravammina constricta*, found in the deposists of Kowala, also occurs in Rheinisches Schiefergebirge only in the uppermost Devonian in Dasberg- and Wocklum-Stufe (Eickhoff 1970). The occurrence of the species *S. ingloria* in the area of the Russian Platform is limited to the uppermost Famennian (Bykova 1952). *Septatournayella (E.) rauserae potensa* occurs, in the areas of both Western Europe and the Russian Platform, only in the deposits of Dasberg- to Gattendorfia-Stufe (Eickhoff 1974, Lipina 1965).

The stratigraphic range of the remaining species, on the whole considerably wider, frequently includes the whole Famennian and, in some cases, also part of the Gattendorfia stage. Most species, also known from the area of North America, occur there in the deposits of both the Upper Devonian and the Mississippian stage.

PALEOECOLOGICAL REMARKS

The Recent agglutinating foraminifers occur at all depths of marine basins and are also known as the only foraminifers living in the deepest abyssal parts of such basins (Boersma 1978). Until recently, the Paleozoic agglutinating foraminifers have mostly been described from shallow-water deposits (Ireland 1956, Summerson 1958, Gutschick 1962, Conkin and Conkin 1964, Schneider 1970), frequently as algal-foraminiferal colonies,

as well as from somewhat deeper parts of basins where they occurred in fusulinid limestones (Ireland 1956). Arenaceous foraminifers attached to conodonts, were described from Rheinisches Schiefergebirge and Harz Mts. by Schneider (1970) who found that their settlement took place at the conditions of a very low rate of sedimentation in condensed sections of pelagic geosynclinal limestones deposited under isolated "Schwellen" conditions.

Agglutinating foraminifers were found by Sandberg and Gutschick (1978) in deep-water deposits of the Lower Mississippian of the State of Utah, USA. There, the foraminifers occur, together with sponges, small corals and nectonic radiolarians, goniatites and conodonts, in what is known as "starved-basin facies", determined by Sandberg and Gutschick (1978) as a deep-water dysaerobic facies.

In the Upper Famennian condensed deposits of Kowala, Holy Cross Mts., the agglutinating foraminifers concur with pelagic ostracods of the family Entomozoidae ("Entomozoen Ökotyp", according to Becker, *in*: Bandel and Becker 1975, Becker 1979) and benthic ostracods of the "Thuringer Ökotyp" (Becker 1979). The ostracods of the two types mentioned above probably lived in calm and maybe also deeper and colder waters of the open sea (Becker 1979, Olempska 1979). In addition to the most abundant assemblage of ostracods and foraminifers, the microfauna of these deposits is represented by conodonts and few bryozoans. Their macrofauna includes cephalopods, brachiopods, corals and rather few trilobites. The blind trilobites of the family Phacopidae, also connected with deeper areas of open sea, were found by Osmólska (1962) in the coeval deposits of other pits at Kowala. The occurrence of the fauna mentioned above seems to indicate the presence of deeper areas of open sea in the Upper Famennian of the south-western part of the Holy Cross Mts.

The foraminiferal assemblage described from Kowala include forms with free tests such as *Glomospira*, *Hyperammina*, *Psammosphaera*, *Saccammina*, *Pseudastrorhiza*, *Thurammina*, *Paratikhinella* and *Septatournayella*, as well as forms with attaching tests, *Hemisphaerammina*, *Tholosina*, *Tolypammina* and *Moravammina*.

Foraminifers, which in their lifetime settled on the shells of other animals, occur, in our material, on the whole separated from their substrate, but most of them have, on their lower surface, a replica of the sculpture of a surface to which they were attached in their lifetime, generally, in the form of fine ribs. The settled foraminifers are also observed on bryozoans, corals, brachiopod shells, fragments of trilobites and crinoids columnals. These deposits contain columnals densely covered on both sides by foraminifers which may be indicative of the existence of a weak current transporting fossil fragments lying on the bottom.

Specimens of *Tolypammina minuta* settle as a rule in the inner part

of tests of other, much larger hemitubular foraminifers, mostly of the *Tolypammina* (pl. 19: 1—5). The material under study also includes many foraminifers, mostly of the genus *Tolypammina*, which intermingle with each other overgrowing each other. Tubes are on the whole open on the side of the substrate on which they grew. These specimens are considerably similar to what is known as microreefs described by Schneider (1970) from the Upper Devonian of Rheinisches Schiefergebirge and Harz Mts., as well as to microreefs described by Wendt (1969) from the Alpine Triassic. According to these authors, it is possible that the formation of microreefs is related with a considerably low rate of sedimentation. The low rate of sedimentation also occurred in the Famennian profile of Kowala which confirms the observations of the authors mentioned above.

Order **Foraminiferida** Eichwald, 1830
Suborder **Textulariina** Delage et Hérouard, 1896
Superfamily **Ammodiscacea** Reuss, 1862
Family **Ammodiscidae** Reuss, 1862
Genus *Glomospira* Rzehak, 1885
Glomospira sp.
(pl. 13: 7)

Material. — Seven specimens.

Dimensions (in mm):

	Ø of test	Ø of the 2nd chamber
ZPAL F.XXVI/1	0.75	0.15

Description. — Test tubular, coiled irregularly into tight knot. Proloculus and initial part of the second chamber invisible. Traces of attachment lacking. Distal part of the second chamber erect in some specimens. Test composed of fairly coarse, angular quartz grains with a small amount of cement.

Remarks. — Only one form, assigned to *Glomospira* sp. from the Upper Devonian (do I and do VI) of Karnische Alpen (Bandel 1972), neither described nor illustrated, has so far been identified in Central Europe.

Occurrence. — Holy Cross Mts: Kowala (*S. costatus* Zones).

Family **Astrorhizidae** Brady, 1881
Subfamily **Hippocrepininae** Rhumbler, 1895
Genus *Hyperammina* Brady, 1878
Hyperammina aperta Eickhoff, 1970
(pl. 13: 6)

1970. *Hyperammina aperta* Eickhoff: 237, pl. 30: 14—17, text-fig. 2.
1973. *Hyperammina aperta* Eickhoff; Ebner: 400, pl. 3: 3—4 (here earlier synonymy).
1974. *Hyperammina aperta* Eickhoff; Eickhoff: text-fig. 2: 17.

Material. — Thirty-three variously preserved specimens.

Dimensions (in mm):

	Length	⌀ of the 2nd chamber		⌀ of aperture	angle
		min.	max.		
ZPAL F.XXVI/2	0.18	0.05	0.18	0.16	42°

Remarks. — Maximum angle maesured by Eickhoff (1970) in *H. aperta* amounts to 46°. Test composed of very fine grains. The structure of wall was assigned by Ebner (1973) to type C — "thin-layered" without quartz.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Karnische Alpen (Cephalopodenkalk, do VI); Rheinisches Schiefergebirge (Dasberg- and Wocklum-Stufe, do V, VI); N. America (Mississippian).

Hyperammina carinthiaca Ebner, 1973

(pl. 13: 3—4)

1973. *Hyperammina carnica* Ebner: 404, pl. 5: 1—6 (here earlier synonymy).
1974. *Hyperammina "carnica"* Ebner; Eickhoff: text-fig. 2: 7.
1974. *Hyperammina carinthiaca*, nom. nov., Ebner: 309.

Material. — Twenty-three specimens with preserved proloculi and fragments of the second chamber, as well as several dozen specimens of proloculi and fragments of the second chamber probably belonging to this species.

Dimensions (in mm):

	Length	⌀ of the 2nd chamber		proloculus ⌀ of
		min.	max.	
ZPAL F.XXVI/3	1.22	0.11	0.16	0.19
ZPAL F.XXVI/4	0.67	0.10	0.11	0.13

Remarks. — Specimens from the Holy Cross Mts. have their proloculi composed of a much finer material than the second chamber which is made up of coarse quartz grains 0.06 mm in maximum diameter and a small amount of cement. This difference in structure is considerably less visible in speciments illustrated by Ebner (1973) and Eickhoff (1973*a*). The specimens from the Holy Cross Mts. have their proloculus also considerably more distinctly separated from the second chamber than those illustrated by Eickhoff (1970, 1973*a*, 1974). In the shape of its proloculus, *H. carinthiaca* is similar to *H. mendena* Eickhoff (1973b) from which it differs, however, in a somewhat larger diameter of proloculus and irregularly winding of the second chamber.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Harz (dm, do I — do VI); Karnische Alpen (Slumphorizont, do Iθ — do IIβ; Cephalopodenkalk, do VI); Rheinisches Schiefergebirge (Adorf-, Hemberg-, Dasberg- and Wocklum-Stufe, do I — do VI).

Hyperammina rockfordensis Gutschick et Treckman, 1959

(pl. 13: 1—2)

1959. *Hyperammina rockfordensis* Gutschick et Treckman: 238, pl. 34: 1—4, text-fig. 1 *A*—*C*.

1973. *Hyperammina rockfordensis* Gutschick et Treckman; Ebner: 401, pl. 1: 3, pl. 4: 1—4 (here earlier synonymy).

Material. — Seventeen well preserved specimens.

Dimensions (in mm):

	Length	ϕ of the 2nd chamber		ϕ of proloculus
		min.	max.	
ZPAL F.XXVI/5	2.40	0.08	0.16	0.08
ZPAL F.XXVI/6	1.07	0.06	0.10	0.08

Remarks. — *H. rockfordensis* differs from *H. kahlleitensis* Blumenstengel in a more elongate outline of proloculus, gradual passage of proloculus into the second chamber and a small increase in diameter of the second chamber as a result of growth.

Occurrence. — Holy Cross Mts: Kowala (*S. costatus* Zones); Karnische Alpen (Bunte Flaserkalke, do IIβ; Cephalopodenkalk, do VI); Rheinisches Schiefergebirge (Adorf-to Gattendorfia-Stufe, do I — cu I); Thüringen (do II); N. America (Upper Devonian, Mississippian).

Hyperammina stabilis Blumenstengel, 1961

(pl. 13: 5)

1961. *Hyperammina stabilis* Blumenstengel: 323, pl. 2: 21—23.
1970. *Hyperammina stabilis* Blumenstengel; Eickhoff: 233, pl. 30: 5—7 (here earlier synonymy).
1973. *Hyperammina stabilis* Blumenstengel; Ebner: 403, pl. 4: 5—6 (here the remaining synonymy).
1974. *Hyperammina stabilis* Blumenstengel; Eickhoff: text-fig. 2: 15.

Material. — Thirty specimens without proloculus.

Dimensions (in mm):

	Length	ϕ of the 2nd chamber		angle
		min.	max.	
ZPAL F.XXVI/7	0.72	0.08	0.18	15°

Remarks. — The revision of *H. stabilis* was conducted by Eickhoff (1970) who included in the synonymy of this species several North American forms.

Occurrence. — Holy Cross Mts: Kowala (*S. costatus* Zones); Rheinisches Schiefergebirge (Dasberg- to Gattendorfia-Stufe, do V — cu I); Thüringen (do II); N. America (Upper Devonian, Mississippian).

Hyperammina eickhoffi sp. n.

(pl. 14: 1—2)

Holotype: ZPAL F.XXVI/8; pl. 14: 1.
Type horizon: Upper Devonian, *S. costatus* Zones.
Type locality: Kowala, Holy Cross Mts., Poland.

Derivation of the name: In honor of Dr. Günther Eickhoff, researcher of Devonian Foraminiferida.

Diagnosis. — A specimen of *Hyperammina* with a short, extending, calyxlike second chamber.

Material. — A hundred and thirty variously preserved specimens.

Dimensions (in mm):

	Length	Ø of the 2nd chamber		Ø of proloculus	Ø of aperture	angle
		min.	max.			
ZPAL F.XXVI/8	0.32	0.04	0.35	0.035	0.29	85°
ZPAL F.XXVI/9	0.16	0.08	0.19	0.064	0.13	60°

Description. — Proloculus oval, 0.05—0.07 mm in diameter in megalospheric and 0.02—0.03 mm in microspheric forms, gradually and smoothly passing into the second chamber which extend upward in calyx-like form. Aperture round, 0.4 mm in maximum diameter. Proloculus and initial part of the second chamber composed of fine-grained material, upward the second chamber consists of fairly coarse, angular quartz grains 0.06 mm in maximum diameter, with an admixture of a small amount of cement. Inside surface of the wall of the second chamber is smooth.

Remarks. — In the calyx-like shape of its second chamber, *H. eickhoffi* is similar to *H. aperta* from which it differs, however, in a considerably larger angle of the second chamber (the largest angle measured here by Eickhoff (1970) amounts to 46°) and considerably higher degree of coarseness of the material of which the second chamber is composed.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones).

Family **Saccamminidae** Brady, 1884
Subfamily **Hemisphaeramminae** Loeblich et Tappan, 1961
Genus *Hemisphaerammina* Loeblich et Tappan, 1957
Hemisphaerammina aff. *bradyi* Loeblich et Tappan, 1957

(pl. 14: 5—6)

Material. — Twelve well preserved specimens.

Dimensions (in mm):

	Ø of specimen	height	Ø of base
ZPAL F.XXVI/10	0.40	0.24	0.32
ZPAL F.XXVI/11	0.35	0.16	0.29

Description. — Test subhemispherical in lateral outline and irregularly rounded in dorsal view. Base flat oval to subcircular in outline. Angle between test wall and base nearly right. Maximum diameter of test occurring halfway the height between base and upper surface. Test composed of very coarse quartz grains 0.03—0.05 mm in diameter.

Remarks. — In its hemispherical outline and flat base, the form described is most similar to *H. bradyi* (Loeblich and Tappan, 1957: pl. 72: 1) from which it differs, however, in a somewhat more irregular dorsal outline and considerably coarser material of which its test is composed.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones).

Genus ? *Tholosina* Rhumbler, 1895
? *Tholosina multifistulata* Langer, 1969
(pl. 14: 3, 4; pl. 15: 1)

1969. *Tholosina multifistulata* Langer: 48, pl. 2: 1—3.

Material. — Fifty well preserved specimens.

Dimensions (in mm):

	⌀ of test	height	⌀ of base	number of protuberances
ZPAL F.XXVI/12	0.36	0.24	0.32	11
ZPAL F.XXVI/13	0.48	0.26	0.43	11
ZPAL F.XXVI/14	0.47	0.23	—	—

Remarks. — Specimens from the Holy Cross Mts. differ from the holotype of *Th. multifistulata* in somewhat smaller dimensions of protuberances which are on the whole 0.016—0.020 mm long, except for very large specimens in which some protuberances reach 0.03 mm in length. In most specimens of the Holy Cross Mts. no apertures occur on the ends of protuberances, except for some few protuberances terminating in apertures, but it is very difficult to ascertain whether these are natural apertures or damaged specimens. Most protuberances are composed of single, large quartz grains. A certain doubt occurs here, namely the question whether the specimens from the Holy Cross Mts. belong to the genus *Tholosina*, which has apertures at its base or, maybe, to the *Hemisphaerammina* in which no apertures occur. The scpecimens described are identical, in shape dimensions of test, with those of *T. multifistulata* from Karnische Alpen. The original description of those specimens does not include remarks on the situation of apertures.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatuts* Zones); ? Rheinisches Schiefergebirge — Kellerwald (do II); ? Karnische Alpen (do V — do VI).

Subfamily **Psammosphaerinae** Haeckel, 1894
Genus *Psammosphaera* Schulze, 1875
Psammosphaera cava Moreman, 1930
(pl. 15: 3, 5, 6)

1930. *Psammosphaera cava* Moreman: 48, Pl. 6: 12.

1971. *Psammosphaera cava* Moreman; Kristan-Tollmann: 255, text-fig. 2—3 (here earlier synonymy).

1973. *Psammosphaera cava* Moreman; Ebner: 408, pl. 7: 1—5 (here ealier synonymy).

Material. — Eight well preserved specimens.

Dimensions (in mm):

	⌀ of test
ZPAL F.XXVI/15	0.32
ZPAL F.XXVI/16	0.41
ZPAL F.XXVI/17	0.38

Remarks. — Specimens composed of small, angular quartz grains about 0.03 mm in diameter (pl. 15: 5 and 6) and of distinctly coarser ones about 0.06 mm in diameter (pl. 15: 3) occur among those of the Holy Cross Mts. On the other hand, no specimens of type C (thin-layered, without quartz), found by Ebner (1973) in Karnische Alpen, were among them.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Karnische Alpen (Lower Silurian, Upper Devonian — Bunte Flaserkalke, do II β, Cephalopodenkalk, do VI — cu I); Rheinische Schiefergebirge (Adorf — Wocklumer-Stufe); Thüringen (Silurian); Gotland (Ordovician, Silurian); N. America (Ordovician, Silurian, Devonian, Mississippian); Australia (Permian).

Subfamily **Saccamininae** Brady, 1884
Genus *Saccammina* Sars, 1869
Saccammina ingloria Bykova, 1952
(pl. 15: 2)

1952. *Saccammina ingloria* Bykova: 18, pl. 1: 6—8; pl. 2: 1—2.

Material. — Ten well preserved specimens.

Dimensions (in mm):

	⌀ of test	height (including neck)	⌀ of aperture
ZPAL F.XXVI/18	0.40	0.48	0.11

Remarks. — Specimens described by Bykova (1952) are marked by a very high degree of the variability of aperture. All specimens of the Holy Cross Mts. have their aperture mounted on a short neck and are most similar to those illustrated by Bykova (*l.c.*) on pl. 1: 6.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); USSR: Russian Platform (Upper Famennian, Turgeniev Beds).

Saccammina sp.
(pl. 15: 4)

Material. — Three specimens.

Dimensions (in mm):

	⌀ of specimen	height	⌀ of aperture
ZPAL F.XXVI/19	0.27	0.29	0.08

Description — Test subspherical in outline, composed of angular quartz grains 0.016—0.035 mm in size. Attachment traces lacking. Fairly large, round aperture.

Remarks. — The form described differ from *S. ingloria* in the lack of neck on the apex of test.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones).

Genus *Pseudastrorhiza* Eisenack, 1932

Pseudastrorhiza conica Gutschick, Weiner et Young, 1961

(pl. 16: 1)

1961. *Pseudastrorhiza conica* Gutschick, Weiner et Young: 1202, pl. 148: 7, 14, 15, 18; text-fig. 3—17, 24.

1969. *Thurammina* cf. *conica* (Gutschick, Weiner et Young): Langer: 46, pl. 1: 15—17.

Material. — Four specimens.

Dimensions (in mm):

	Φ of central chamber	number of projections	length of projections	Φ of projections	
				min. (at the end)	max. (at the base)
ZPAL F.XXVI/20	0.40	8	0.16—0.24	0.032	0.112

Remarks. — In certain specimens of the Holy Cross Mts., some projections are devoid of apertures on their ends, while in some other projections (of the same specimens) projections do occur, but these projections are, on the whole, shorter, irregularly terminating and giving impression as if being formed as a result of damage. The lack of apertures would indicate that this species belongs to the genus *Pseudastrorhiza* and not, as suggested by Langer (1969), to *Thurammina*.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Karnische Alpen (Cephalopodenkalk, do VI): N. America (Mississippian).

Genus *Thurammina* Brady, 1879

Thurammina congesta Gutschick, Weiner et Young, 1961

(pl. 16: 3)

1961. *Thurammina congesta* Gutschick, Weiner et Young: 1208, pl. 148: 1—3, 8—10 (non 4, 5); text-fig. 4: 3—6, 16.

1973. *Thurammina congesta* Gutschick, Weiner et Young; Ebner: 409, pl. 7: 8—9 (here earlier synonymy).

Material. — Five well preserved specimens.

Dimensions (in mm):

	Φ of central chamber	number of projections	length of projections	Φ of projections	
				min. (at the aperture)	max. (at the base)
ZPAL F.XXVI/21	0.21	4	0.025—0.03	0.024	0.032

Remarks. — Specimens of the Holy Cross Mts. vary considerably in the number and distribution of neck-like projections. As compared with specimens illustrated by Gutschick *et al.* (1961, pl. 148: 4 and 5), they decidedly differ in the subspherical shape of their central chamber. Most specimens, illustrated by Gutschick *et al.* (1961) as *T. congesta*, were included later by Mound (1968) in other species what, at least in some cases, seems to be groundless. In the outline of their central chamber and shape of projections, the specimens of the Holy Cross Mts. are most similar to those illustrated by Ebner (1973) from the Upper Devonian of Karnische Alpen and by Conkin *et al.* (1968) from the Mississippian of North America.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Karnische Alpen (Cephalopodenkalk, do VI); Thüringen (do II); N. America (Mississippian).

Thurammina tubulata Moreman, 1930

(pl. 17: 2—3)

1930. *Thurammina tubulata* Moreman: 52, pl. 5: 8.
1968. *Thurammina tubulata* Moreman; Mound: 110, pl. 7: 3—4 (here earlier synonymy).

Material. — Twenty-eight variously preserved specimens.

Dimensions (in mm):

	⌀ of central chamber	⌀ max. (projection included)	mean length of projections	⌀ of projections at aperture	number of projections
ZPAL F.XXVI/22	0.48	0.64	0.11	0.048	10
ZPAL F.XXVI/23	0.37	0.48	0.064	0.048	8

Remarks. — In the outline of central chamber and development of neck-like projections, the specimens of the Holy Cross Mts. are identical with those illustrated by Gutschick *et al.* (1961) from the Carboniferous of North America, and differ from them only in somewhat smaller tests (0.30—0.50 mm). From the Silurian specimens, illustrated by Mound (1968), they differ in somewhat larger projections.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Karnische Alpen (Cephalopodenkalk, do VI); N. America (Silurian, Mississippian).

Thurammina tubulata fixa Langer, 1969

(pl. 16: 4)

1969. *Thurammina tubulata fixa* Langer: 48, pl. 3: 2—7.

Material. — Two specimens.

Dimensions (in mm):

	⌀ of central chamber	length of projections	⌀ of projections		number of projections
			min. (at aperture)	max. (at base)	
ZPAL F.XXVI/24	0.43	0.06—0.07	0.03	0.05	10

Remarks. — Specimens of the Holy Cross Mts. differ from the holotype only in having a flat basal surface which, in the holotype, is slightly concave.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Karnische Alpen (Cephalopodenkalk, do VI).

Thurammina aff. *diforamens* Ireland, 1956

(pl. 17: 1)

Material. — Five specimens.

Dimensions (in mm):

	⌀ of central chamber	⌀ of projections at aperture
ZPAL XXVI/25	0.32	0.040

Description. — Test with an elongate outline of central chamber and with two neck-like projections situated on opposite sides. Passage of central chamber into projections is fluent and gradual and, consequently, it is difficult to trace a boundary between them. Central chamber 0.30—0.50 mm and projections, near aperture, 0.04—0.05 mm in diameter.

Remarks. — The presence of two projections makes the form described most similar to *T. diforamens* Ireland from which it differs, however, in an elongated outline of central chamber, whereas in *T. diforamens*, described by Ireland (1956) and specimens of this species of Thüringen and Rheinisches Schiefergebirge (Blumenstengel 1961, Eickhoff 1970, 1973*a*, *b*), this chamber is distinctly spherical and projections are long and thin over their whole length.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones).

Thurammina aff. *quadritubulata* Dunn, 1942

(pl. 16: 5)

1970. *Thurammina* aff. *quadritubulata* Dunn; Eickhoff: 244, pl. 31: 7—8.

Material. — Thirteen specimens.

Dimensions (in mm):

	⌀ of central chamber	length of projections	number of projections
ZPAL F.XXVI/26	0.19	0.03	4

Remarks. — Specimens identical with those described by Eickhoff (1970).

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Rheinisches Schiefergebirge (Wocklum-Stufe, do VI).

Thurammina sp. A Blumenstengel, 1961

(pl. 16: 2)

1961. *Thurammina* sp. A Blumenstengel: 319, pl. 17: 12—13.
1970. *Thurammina* sp. A Blumenstengel; Eickhoff: 244, pl. 31: 9—10.
1973*a*. *Thurammina* sp. A Blumenstengel; Eickhoff: text-fig. 3: 26.
1973*b*. *Thurammina* sp. A Blumenstengel; Eickhoff: pl. 2: 14—15.

Material. — Twenty-five specimens.

Dimensions (in mm):

	Φ of central chamber	length of projections	Φ of projections		number of projections
			min	max.	
ZPAL F.XXVI/27	0.43	0.13	0.048	0.064	11

Remarks. — Specimens of the Holy Cross Mts. are on the whole larger than those described by Blumenstengel (1961) and have a larger number of projections, but are very similar to specimens of *Thuramмina* sp. A illustrated by Eickhoff (1973*b*) from the Upper Devonian of Rheinisches Schiefergebirge.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Thüringen (do I, do II, do V); Rheinisches Schiefergebirge (Wocklum-Stufe, do VI).

? *Thurammina* sp. 1

(pl. 17: 5)

Material. — One specimen.

Dimensions (in mm):

	length	thickness	number of tubercles
ZPAL F.XXVI/28	0.65	0.16	11

Description. — Test cuboidal in outline, with eleven small tubercles, terminating in apertures, irregularly distributed on its walls. Wall composed of fairly coarse quartz grains, with a small amount of cement.

Remarks. — In its elongated outline, the test described resembles that of *T. rectangularis* Ireland (1956; text-figs. 3—8), but differs from it in larger size and smaller number of tubercles.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones).

Subfamily **Tolypammininae** Cushman, 1928

Genus *Tolypammina* Rhumbler, 1895

Tolypammina bulbosa (Gutschick et Treckman, 1959)

(pl. 17: 6, pl. 20: 4)

1959. *Ammovertella bulbosa* Gutschick et Treckman: 247, pl. 37: 4—5, 8—9.
1973. *Tolypammina bulbosa* (Gutschick et Treckman); Ebner: 412, pl. 8: 1 (here earlier synonymy).

Material. — Ten specimens.

Dimensions (in mm):

	length	Φ of the second chamber near proloculus	Φ of proloculus
ZPAL F.XXVI/29	0.32	0.08	0.14
ZPAL F.XXVI/30	0.59	0.14	0.24

Remarks. — Cf. Ebner (1973).

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Karnische Alpen (Cephalapodenkalk, do VI); N. America (Upper Devonian, Mississippian).

Tolypammina gersterensis Conkin et Conkin, 1964
(pl. 18: 1—2)

1964. *Tolypammina gersterensis* Conkin et Conkin: 37, pl. 2: 42—44.
1968. *Tolypammina gersterensis* Conkin et Conkin; Conkin *et al.*: 164, pl. 3: 19—27.

Material. — Fifty specimens.

Dimensions (in mm):

	⌀ of coiled part	number of whorls	erect part	
			length	⌀
ZPAL F.XXVI/31	0.40	1½	0.88	0.11
ZPAL F.XXVI/32	0.38	1½	0.80	0.19

Remarks. — In a general manner of coiling, the test of *T. gersterensis* is most similar to that of *T. irregularis* Blumenstengel which, however, has 2—3 whorls. Specimens of *T. gersterensis*, the same in fact as other species of the genus *Tolypammina*, display such a high degree of ontogenetic variability that there are practically no two specimens identical with one another. They are related by the presence of a hemicircular proloculus and a planispirally coiled test in the initial part of one to 1½ whorls.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); N. America (Upper Devonian, Mississippian).

Tolypammina irregularis Blumenstengel, 1961
(pl. 17: 4, pl. 18: 4, 6)

1961. *Tolypammina irregularis* Blumenstengel: 324, pl. 2: 25—28, 31.
1973. *Tolypammina irregularis* Blumenstengel; Ebner: 413, pl. 1: 1, 4; pl. 8: 2—3 (here earlier synonymy).

Material. — A hundred and sixty variously preserved specimens.

Dimensions (in mm):

	⌀ of coiled part	number of whorls
ZPAL F.XXVI/33	0.26	2½
ZPAL F.XXVI/34	0.48	—
ZPAL F.XXVI/35	0.64	2½

Remarks. — Cf. Ebner (1973).

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Thüringen (do II-cu I); Karnische Alpen (Slumphorizont, do I δ — do II β, Bunte Flaserkalke, do II β, Cephalopodenkalk, do VI); Rheinisches Schiefergebirge (Hemberg-, Dasberg-, Wocklum-Stufe, do II — do VI).

Tolypammina minuta sp. n.
(pl. 19: 1—5)

Holotype: ZPAL F.XXVI/42; pl. 19: 5.
Type horizon: Upper Devonian, *S. costatus* Zones.
Type locality: Kowala, Holy Cross Mts., Poland.
Derivation of the name: Lat. *minuta* = minute, tiny.
Diagnosis. — An irregularly winding *Tolypammina*, with a very small diameter of its second chamber (0.02—0.05 mm) and a small, attached, proloculus.

Material. — Fifteen specimens, mostly attached inside the tubes of other species of foraminifers.

Dimensions (in mm):

	size of specimen	⌀ of the 2nd chamber		⌀ of proloculus
		min.	max.	
ZPAL F.XXVI/38	0.80	—	0.030	—
ZPAL F.XXVI/39	—	—	0.040	—
ZPAL F.XXVI/40	0.70	—	0.40	—
ZPAL F.XXVI/41	0.29	0.025	0.035	—
ZPAL F.XXVI/42	0.36	0.020	0.050	0.025

Description. — Proloculus hemicircular, attaching, 0.025 mm in diameter. The second chamber tubular or hemitubular, irregularly winding, very small in diameter (0.02—0.05 mm). Walls very thin, smooth.
Remarks. — This form occurs most frequently in much larger hemitubular fragments of tests of other species of the *Tolypammina*. The walls of *T. minuta* frequently fuse with each other, forming larger assemblages. Other specimens of *T. minuta*, intermingling with considerably larger species of the *Tolypammina* and forming the so-called "microreefs" were also found. The species described differs from other known *Tolypammina* in very small dimensions and, consequently, very fine-grained material of which its test is composed.
Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones).

Tolypammina sp. 1
(pl. 18: 3)

Material. — Twenty specimens.

Dimensions (in mm):

	⌀ of coiled part	erect tube	
		length	⌀
ZPAL F.XXVI/37	0.29	0.56	0.11

Description. — The irregularly coiled in its initial part, composed of $1^1/_2$ to 3 whorls; in further parts, irregularly winding and, in some sectors, tubular or, partly, hemitubular.
Remarks. — The form described is related, in a general appearance of its test,

to *T. irregularis* Blumenstengel from which it differs in an irregular manner of coiling of the initial part of test.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones).

Tolypammina sp. 2
(pl. 18: 5)

1970. *Tolypammina* sp. Schneider: 92, pl. 1: 2—17.
1973b. *Tolypammina* sp. *sensu* Schneider; Eickhoff: 426, pl. 2: 21, 22; pl. 4: 14, 15.

Material. — Forty specimens.

Dimensions (in mm):

	length	Φ of proloculus	Φ of the 2nd chamber	
			min.	max.
ZPAL F.XXVI/36	0.88	0.06	0.08	0.11

Remarks. — The specimens found are identical with those described by Schneider (1970). Cf. Eickhoff (1973b).

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Harz (Nehden-Hemberg-Stufe, do II — do IV); Rheinisches Schiefergebirge (Hemberg- to Gattendorfia-Stufe, do III — cu I).

Suborder **Fusulinina** Wedekind, 1937
Superfamily **Parathuramminacea** Bykova, 1955
Family **Moravamminidae** Pokorný, 1951
Subfamily **Earlandiinae** Cummings, 1955
Genus *Paratikhinella* Reitlinger, 1954
Paratikhinella cannula (Bykova, 1952)
(pl. 20: 1—2)

1952. *Tikhinella cannula* Bykova: 32, pl. 8: 10, 11.
1970. *Paratikhinella cannula* (Bykova); Eickhoff: 250, pl. 32: 6—11 (here earlier synonymy).

Material. — Sixty specimens, including micro- and megalospheric forms.

Dimensions (in mm):

	Φ of proloculus	Φ of the 1st chamber		Φ of pseudochambers		length of specimen
		min.	max.	length	number	
ZPAL F.XXVI/43	0.020	0.032	0.038	0.038—0.16	9	0.91
ZPAL F.XXVI/44.	0.048	0.037	0.040	0.048—0.144	7	0.75

Remarks. — Cf. Eickhoff (1970).

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Rheinisches Schiefergebirge (Dasberg-Wocklum-Stufe, do V — do VI); Russian Platform (Frasnian); Moravia (Lower Tournaisian).

Subfamily **Moravammininae** Pokorný, 1951
Genus ? *Moravammina* Pokorný, 1951
? *Moravammina constricta* Eickhoff, 1970
(pl. 20: 5)

1970. *Moravammina ? constricta* Eickhoff: 255, pl. 32: 1—5, text-fig. 7.
1973b. *Moravammina ? constricta* Eickhoff; Eickhoff: 428, pl. 3: 11—12.

Material. — Two specimens in the form of broken-off erect parts of the second chamber.

Dimensions (in mm):

	⌀ of coiled part	⌀ of proloculus	⌀ of the 2nd chamber	
			min.	max.
ZPAL F.XXVI/45	0.22	0.03	0.024	0.033

Remarks. — Specimens of ? *M. constricta* of the Holy Cross Mts. consist of $1^1/_5$ whorls. The whole initial part, including proloculus, is attached as far as the end of the first whorl. They differ from specimens of Rheinisches Schiefergebirge only in the lack of the erect part of the second chamber which was probably destroyed.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Rheinisches Schiefergebirge (Dasberg- and Wocklum-Stufe, do V — do VI).

? *Moravammina* sp. 1
(pl. 20: 6)

Material. — Six specimens, without proloculi.

Dimensions (in mm):

	⌀ of coiled part	⌀ of the 2nd chamber, in distal part
ZPAL F.XXVI/46	0.22	0.048

Description. — In the initial part, test coiled, composed of $1^1/_4$ to $1^1/_2$ whorls. Distal part of the second chamber straight, tubular. The coiled part of the second chamber was attached. The second chamber 0.03 mm in minimum diameter and to 0.05 mm near aperture.

Remarks. — Specimens of the Holy Cross Mts. are almost identical with those described by Ebner (1973: pl. 9: 1—2) as Foraminifere sp. A from the Lower Carboniferous of Karnische Alpen, but in some of them the distal part of the second chamber is erect. In all likelihood, these specimens belong to the species ? *M. constricta* and their initial part was destroyed.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones).

? *Moravammina* sp. 2
(pl. 20: 3)

Material. — One specimen.

Dimensions (in mm):

	length of specimen	Ø of the 2nd chamber	
		min.	max.
ZPAL F.XXVI/47	0.63	0.06	0.08

Description. — In the initial part, test coiled, having one whorl only. The distal part of the second chamber erect. The coiled part with traces of attachment. Proloculus not preserved.

Remarks. — The form described differs from the specimens of ? M. sp. 1 in having one whorl only and in a larger diameter of the second chamber.

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones).

Family **Tournayellidae** Dain, 1963
Genus *Septatournayella* Lipina, 1965
Subgenus *Septatournayella* (*Eoseptatournayella*) Lipina, 1965
Septatournayella (Eoseptatournayella) rauserae potensa Durkina, 1959
(pl. 20: 8)

1955. *Septatournayella rauserae* Lipina: 40, pl. 4: 2, 6, 7 (*non* pl. 3, 14, pl. 4: 1, 3—5).
1959. *Septatournayella potensa* Durkina: 142, pl. 1: 13—16.
1973. *Septatournayella* (*Eoseptatournayella*) *rauserae potensa* Durkina; Ebner: 417, pl. 2: 4, pl. 9: 6—7 (there earlier synonymy).

Material. — A hundred and ten well preserved specimens.

Dimensions (in mm):

	Ø of test
ZPAL F.XXVI/48	0.256

Remarks. — Cf. Eickhoff (1970).

Occurrence. — Holy Cross Mts.: Kowala (*S. costatus* Zones); Karnische Alpen (Cephalopodenkalk, do VI); Rheinisches Schiefergebirge (Dasberg-, Wocklum-, and Gattendorfia-Stufe, do V — cu I); Russian Platform (Upper Devonian, Tournaisian).

Subgenus *Septatournayella (Rectoseptatournayella)* Brazhnikova et Rostovceva, 1963

Septatournayella (Rectoseptatournayella) chappelensis Gutschick, Weiner et Young, 1961

(pl. 20: 7)

1961. *Ammobaculites chappelensis* Gutschick, Weiner et Young: 1218, pl. 149: 19—22; text-fig. 3: 25, text-fig. 4: 27.

1973. *Septatournayella (Rectoseptatournayella) chappelensis* (Gutschick, Weiner et Young); Ebner: 417, pl. 9: 8—9 (here earlier synonymy).

Material. — Thirty well preserved specimens.

Dimensions (in mm):

	Φ of coiled part	length of erect part	Φ of erect part
ZPAL F.XXVI/49	0.288	0.096	0.064

Remarks. — In specimens of the Holy Cross Mts., either the whole last pseudochamber, or part of last but one and last chamber are erect. In the last-named cases, the length of the erect part reaches about 0.2 mm.

Occurrence. — Holy Cross Mts: Kowala (*S. costatus* Zones); Karnische Alpen (Cephalopodenkalk, do VI); Rheinisches Schiefergebirge (Hemberg-, Dasberg-, Wocklum- und Gattendorfia-Stufe, do III — cu I); N. America (Mississippian).

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EWA OLEMPSKA

GÓRNO-FAMEŃSKIE OTWORNICE Z GÓR ŚWIĘTOKRZYSKICH, POLSKA

Streszczenie

Praca zawiera opisy 31 gatunków skrzemionkowanych otwornic. Pochodzą one ze skondensowanych utworów najwyższego famenu, reprezentowanych przez wapienie przeławicające się z łupkami ilastymi. Osady te należą do górnej części małżoraczkowego poziomu *hemisphaerica-dichotoma* oraz konodontowych poziomów *costatus*. Wyróżniono dwa nowe gatunki otwornic — *Hyperammina eickhoffi* sp. n. i *Tolypammina minuta* sp. n. Większość badanych otwornic należy do aglutynujących rodzajów *Hyperammina*, *Thurammina* i *Tolypammina*. Przedyskutowano znaczenie stratygraficzne opisanego zespołu otwornic.

Otwornice występują w badanych osadach wspólnie z pelagicznymi małżoraczkami z rodziny Entomozoidae ("Entomozoen Ökotyp" wg Beckera *in*: Bandel and Becker 1975, Becker 1979) oraz bentonicznymi małżoraczkami ("Thuringer Ökotyp": Becker 1979). Małżoraczki obydwu wymienionych typów zamieszkiwały prawdopodobnie spokojne, a przypuszczalnie głębsze i zimniejsze, wody otwartego morza (Becker 1979). Stwierdzono również występowanie skupień otwornic tworzących tzw. „mikro-rafy", których powstawanie było zapewne, możliwe dzięki bardzo zwolnionemu tempu sedymentacji (Schneider 1970, Wendt 1969).

EXPLANATION OF THE PLATES 13—20

All specimens from Kowala, Holy Cross Mts., Famennian, Wocklumeria Stage, do VI. Magnification approximate.

Plate 13

1—2. *Hyperammina rockfordensis* Gutschick et Treckman: 1*a* ZPAL F.XXVI/5, × 45; 1*b* fragment of the same specimen, × 300; 2 ZPAL F.XXVI/6, × 105.
3—4. *Hyperammina carinthiaca* Ebner: 3*a* ZPAL F.XXVI/3, × 70; 3*b* fragment of the same specimen, × 300; 4 ZPAL F.XXVI/4, × 120.
5. *Hyperammina stabilis* Blumenstengel: ZPAL F.XXVI/7, × 120.
6. *Hyperammina aperta* Eickhoff: ZPAL F.XXVI/2, × 300.
7. *Glomospira* sp.: ZPAL F.XXVI/1, × 100.

Plate 14

1—2. *Hyperammina eickhoffi* sp.n.: 1 holotype, ZPAL F.XXVI/8, × 200; 2 ZPAL F.XXVI/9, × 300.
3—4. ? *Tholosina multifistulata* Langer: 3 ZPAL F.XXVI/12, × 200, oblique basal view; 4 ZPAL F.XXVI/13, × 200, side view.
5—6. *Hemisphaerammina* aff. *bradyi* Loeblich et Tappan: 5 ZPAL F.XXVI/10, × 200, top view: 6 ZPAL F.XXVI/11, × 200, side view.

Plate 15

1. ? *Tholosina multifistulata* Langer: ZPAL F.XXVI/14, × 150, broken test showing slightly rough exterior wall and smooth interior.
2. *Saccammina ingloria* Bykova: ZPAL F.XXVI/18, × 150.
3, 5, 6. *Psammosphaera cava* Moreman: 3 ZPAL F.XXVI/15 × 200; 5 ZPAL F.XXVI/16, × 150; 6 ZPAL F.XXVI/17, × 150.
4. *Saccammina* sp.: ZPAL F.XXVI/19, × 300.

Plate 16

1. *Pseudastrorhiza conica* Gutschick, Weiner et Young: ZPAL F.XXVI/20, × 120.
2. *Thurammina* sp. A Blumenstengel: ZPAL F.XXVI/27, × 130.
3. *Thurammina congesta* Gutschick, Weiner et Young: 3*a* ZPAL F.XXVI/21, × 300; 3*b* fragment of the same specimen, × 1000.
4. *Thurammina tubulata fixa* Langer: ZPAL F.XXVI/24, × 150, basal view.
5. *Thurammina* aff. *quadritubulata* Dunn: ZPAL F.XXVI/26, × 300.

Plate 17

1. *Thurammina* aff. *diforamens* Ireland: ZPAL F.XXVI/25, × 200.
2—3. *Thurammina tubulata* Moreman: 2 ZPAL F.XXVI/22, × 140; 3 ZPAL F.XXVI/23, × 200.
4. *Tolypammina irregularis* Blumenstengel: ZPAL F.XXV/33, × 300, basal view.
5. ? *Thurammina* sp. 1: ZPAL F.XXVI/28, × 200.
6. *Tolypammina bulbosa* (Gutschick et Treckman): ZPAL F.XXVI/29, × 250.

Plate 18

1—2. *Tolypammina gersterensis* Conkin et Conkin: 1 ZPAL F.XXVI/31, × 90; 2 ZPAL F.XXVI/32, × 105, tops views.
3. *Tolypammina* sp. 1: ZPAL F.XXVI/37, × 150, basal view.
4, 6. *Tolypammina irregularis* Blumenstengel: 4 ZPAL F.XXVI/34, × 120, top view; 6 ZPAL F.XXVI/35, × 150, basal view.
5. *Tolypammina* sp. 2: ZPAL F.XXVI/36, × 80, top view.

Plate 19

1—5. *Tolypammina minuta* sp.n.: 1*a* holotype ZPAL F.XXVI/38, × 100; 1*b* enlarged fragment of the same specimen, × 450; 2 ZPAL F.XXVI/39, × 1000; 3 ZPAL F.XXVI/40, × 125; 4 ZPAL F.XXVI/41, × 200; 5 ZPAL F.XXVI/42, × 200 (1, 3, 5, specimens of the *T. minuta* settle in the inner parts of test of other, much larger hemitubular foraminifers).

Plate 20

1—2. *Paratikhinella cannula* (Bykova): 1a ZPAL F.XXVI/43, × 112; 1*b* enlarged fragment of the same specimen, × 1000; 2 ZPAL F.XXVI/44, × 200.
3. ? *Moravammina* sp. 2: ZPAL F.XXVI/47, × 120.
4. *Tolypammina bulbosa* (Gutschick et Treckman): ZPAL F.XXVI/30, × 120.
5. ? *Moravammina constricta* Eickhoff: ZPAL F.XXVI/45, × 300.
6. ? *Moravammina* sp. 1: ZPAL F.XXVI/46, × 250.
7. *Septatournayella (Rectoseptatournayella) chappelensis* (Guitschick, Weiner et Young): ZPAL F.XXVI/49, × 200.
8. *Septatournayella (Eoseptatournayella) rauserae potensa* Durkina: ZPAL F.XXVI/48, × 300.


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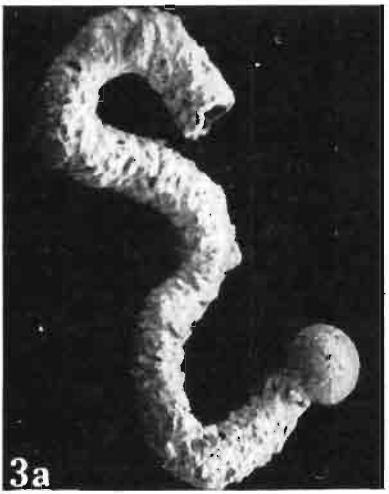
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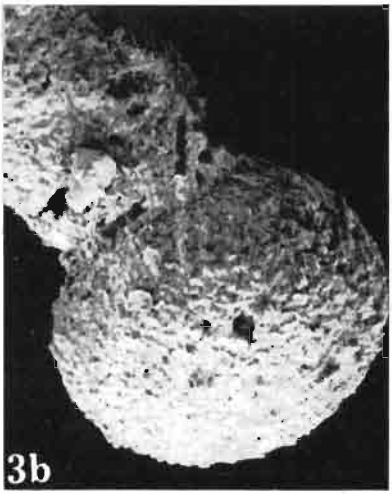
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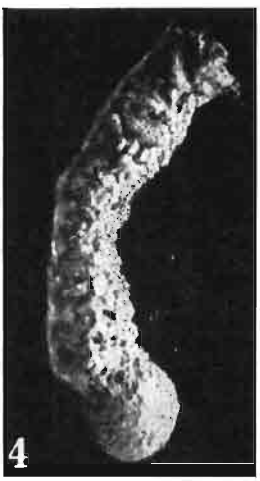
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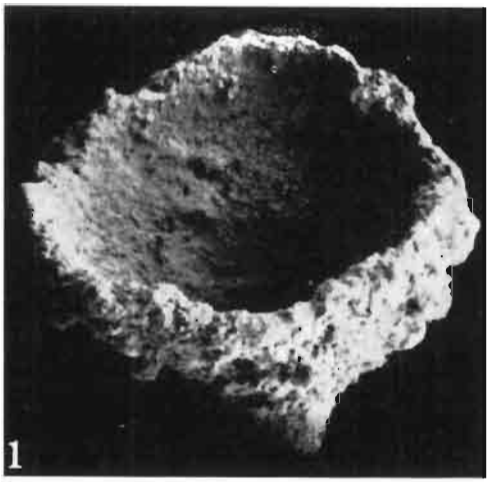
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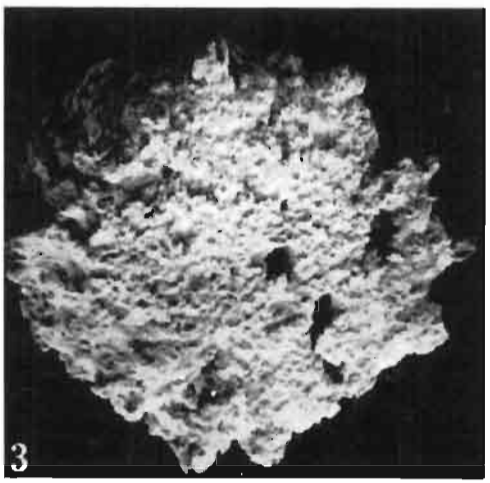
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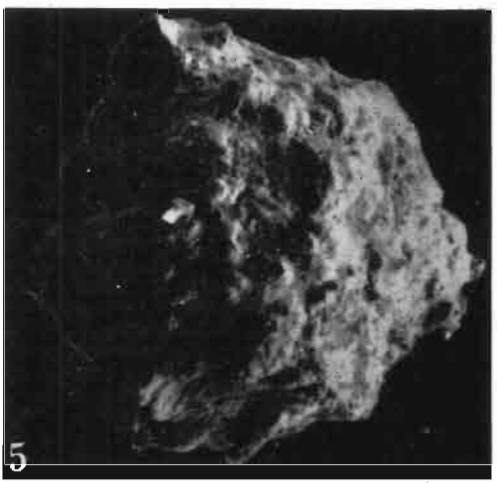
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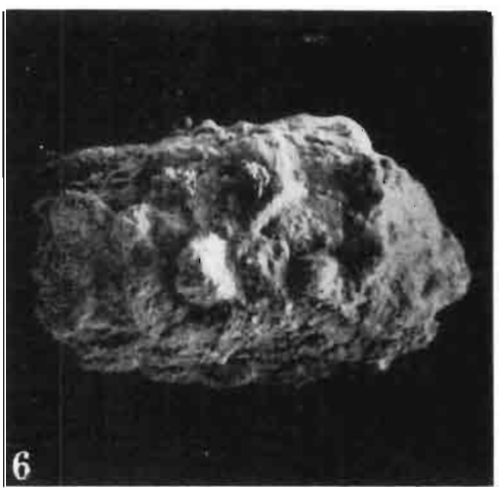
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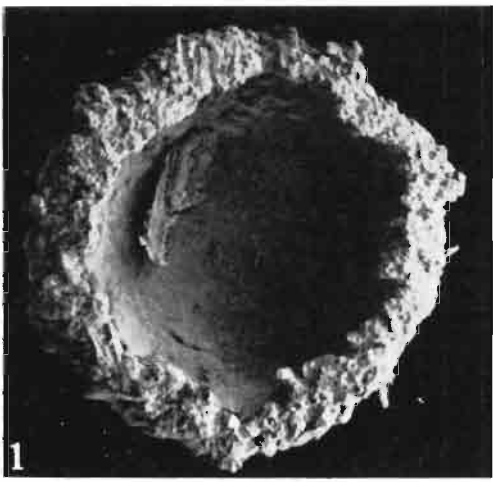
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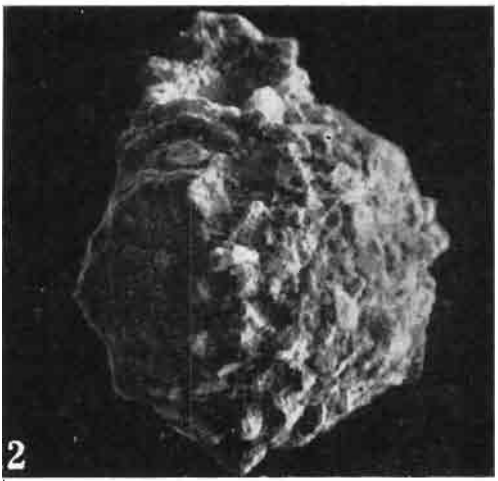
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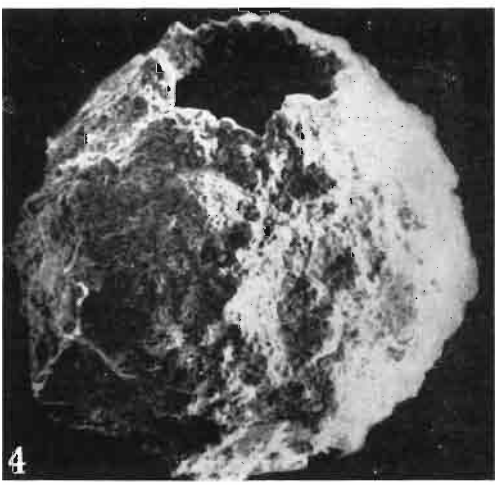
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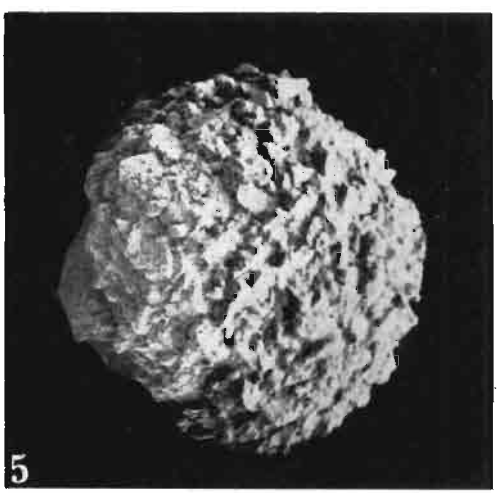
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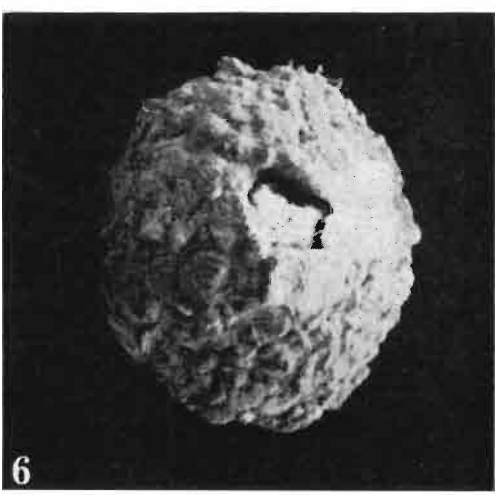
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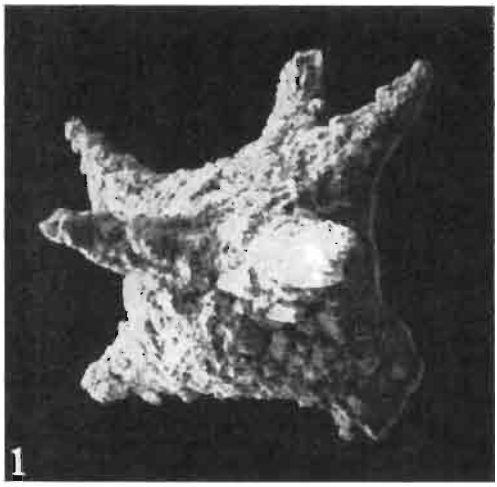
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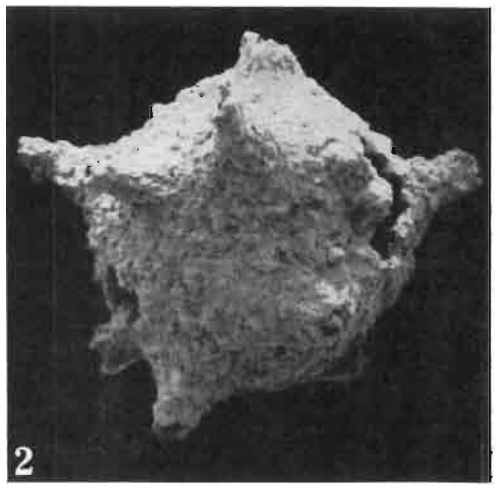
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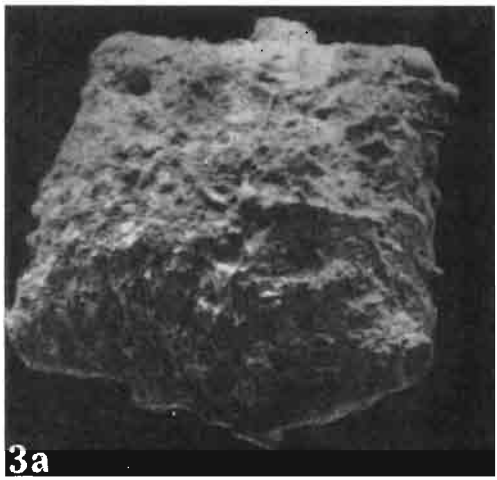
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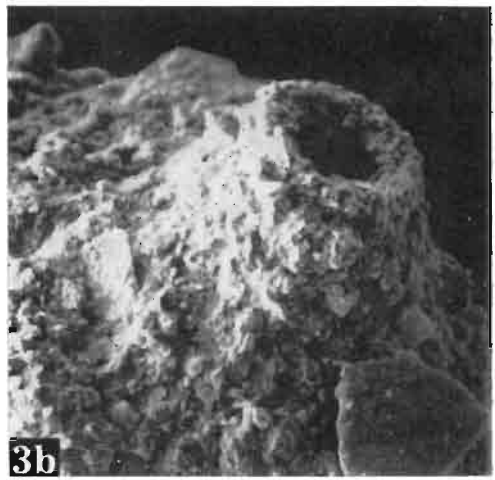
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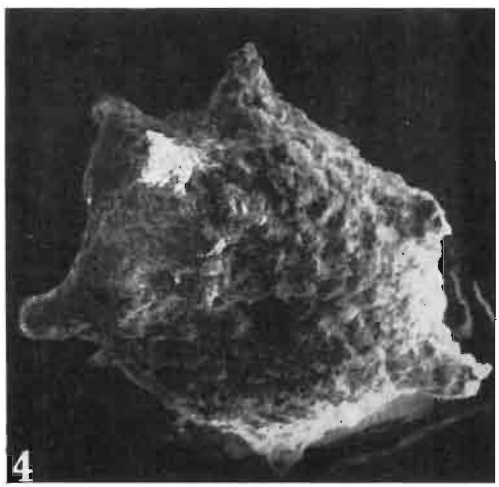
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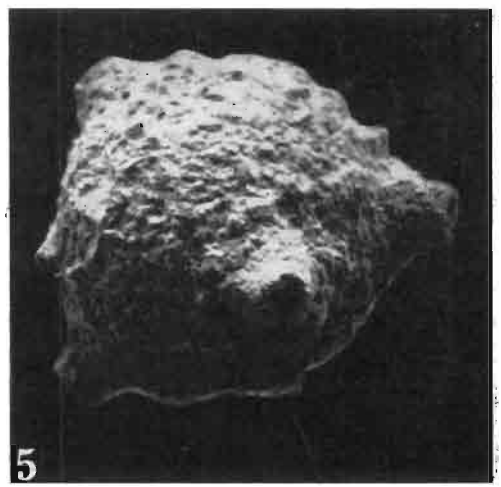
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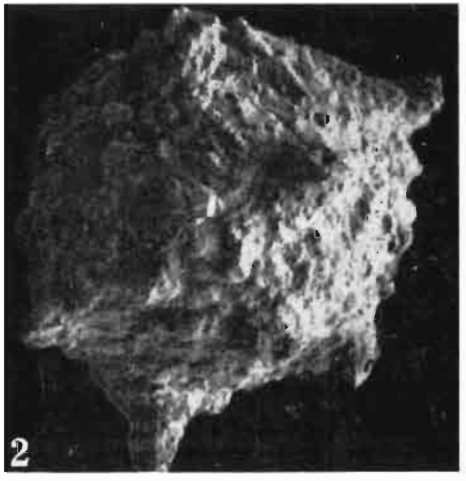
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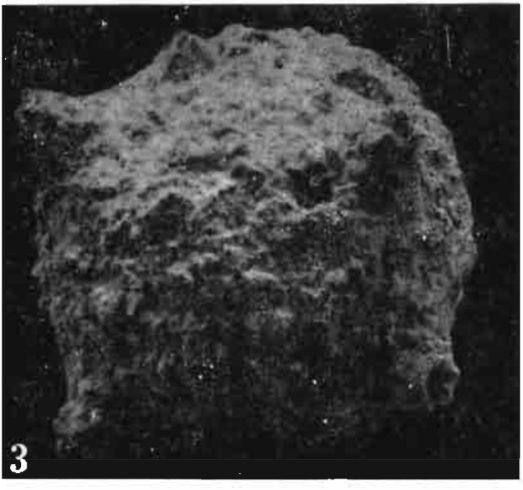
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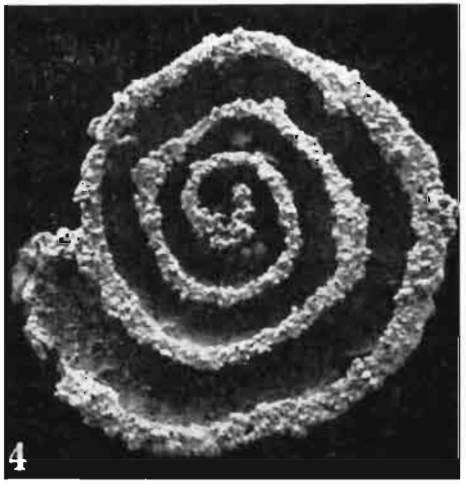
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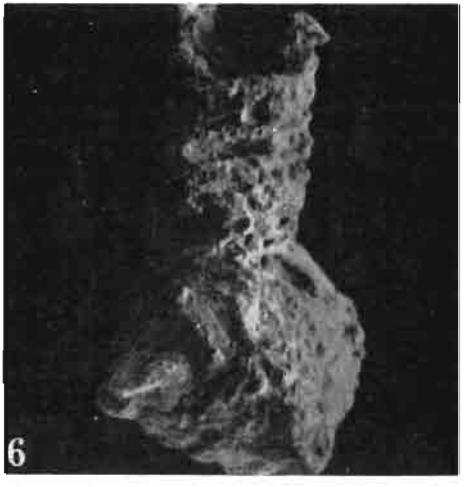
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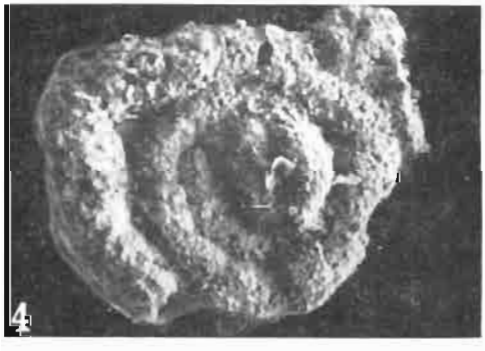
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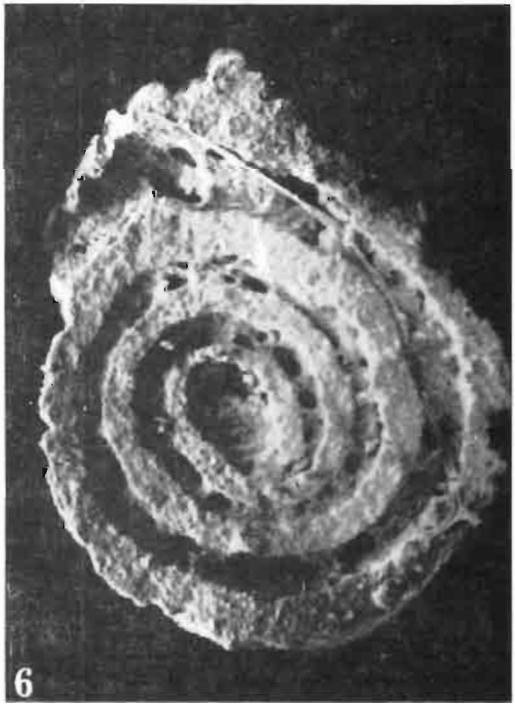
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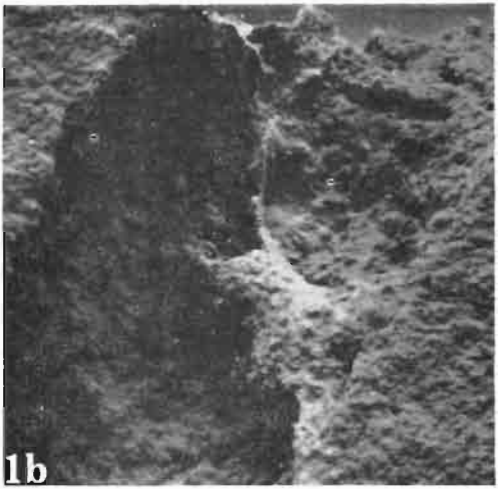
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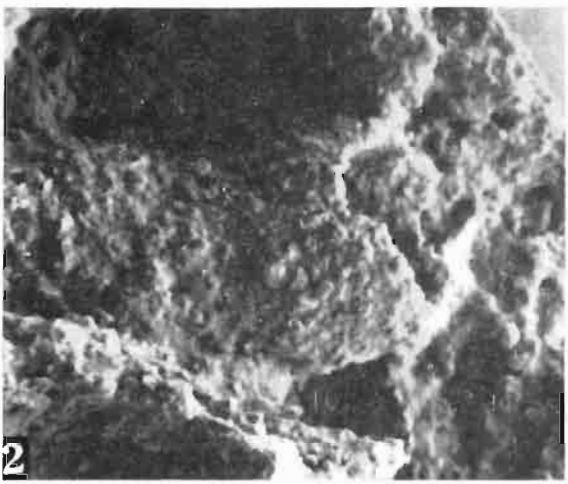
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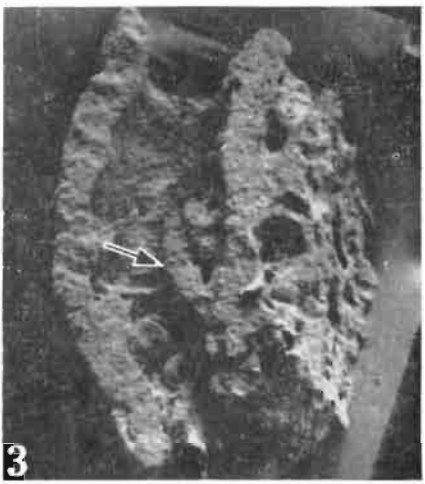
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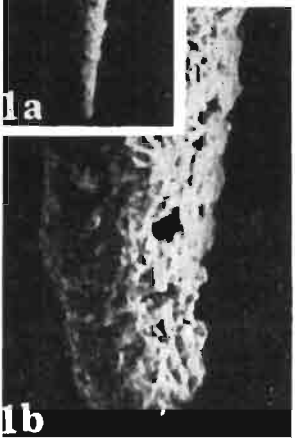
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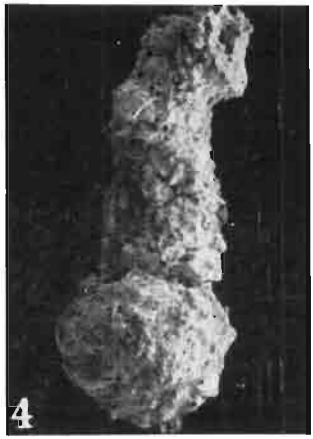
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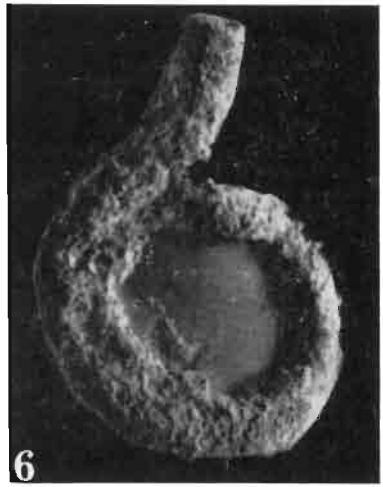
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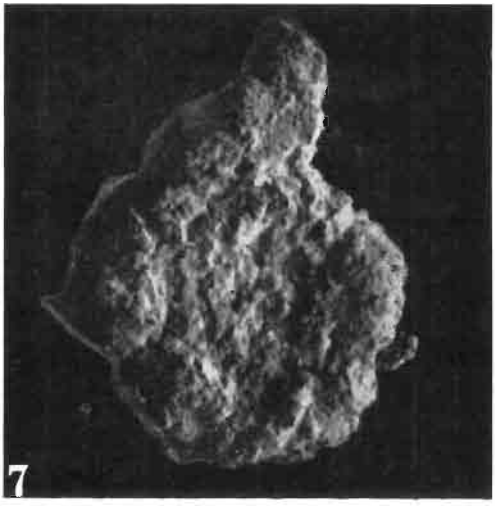
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