Acta Musei Nationalis Pragae, Series B, Natural History, 58 (3–4): 83–140 issued December 2002
Sborník Národního muzea, Serie B, Přírodní vědy, 58 (3–4): 83–140

SILURIAN AND DEVONIAN FORAMINIFERS AND OTHER ACID-RESISTANT MICROFOSSILS FROM THE BARRANDIAN AREA

KATARÍNA HOLCOVÁ
Institute of Geology and Palaeontology, Charles University, Albertov 6, CZ-128 43 Prague 2, Czech Republic

Holcová, K. (2002): Silurian and Devonian foraminifers and other acid-resistant microfossils from the Barrandian area. – Acta Mus. Nat. Pragae, Ser. B, Hist. Nat., 58 (3–4): 83–140. Praha ISSN 0036-5343

Abstract. The first systematic study of the Silurian and Devonian foraminifers from acid-insoluble residues from the Barrandian area was based on 14 Silurian and 24 Devonian sections including stratotypes and auxiliary stratotypes. Eighty morphotypes of agglutinated foraminifers from families Psammosphaeridae, Hemisphaeramminidae, Saccamminidae, Hippocrepinidae, Ammodiscidae and Lituolidae and 6 morphotypes of calcareous foraminifers were distinguished. Foraminifers are rare in the Silurian (with the exception of the Ludfordian). In the Devonian, foraminifers are common to abundant. They are the most abundant in the Dalejan Třebotov and Pragian Dvorce-Prokop Limestones.
The stratigraphical ranges of the Barrandian Silurian and Devonian foraminifers were summarized and the species of biostratigraphical value were selected. As the occurrence of foraminifers was influenced by palaeoecological conditions, the stratigraphical ranges represent only ecostratigraphical data for the Barrandian area.
The highest abundance and diversity of foraminifers in the Třebotov and Dvorce-Prokop Limestones reflect the fact that nodular limestones were deposited under the environmental conditions favoured by the Devonian foraminifers: low-energy, deeper-water environment (below the wave base). The clastic components necessary for building agglutinated tests were present.
Foraminifers are a good palaeogeographical indicator. They mainly indicate broad migration of foraminiferal fauna between the Barrandian Dalejan and the Saxothuringian Upper Devonian. Close affinities of foraminiferal assemblages between the Dalejan of the Barrandian, Upper Devonian of the Saxothuringicum and Upper Devonian of the Rhenohercynicum and the Holy Cross Mountains confirm the hypothesis of the closure of the Rheic Ocean in the Late Devonian. Foraminifers migrated to the Rhenohercynicum from the Saxothuringicum in the Late Devonian. In the time interval from the Upper Devonian to the Lower Mississippian, the assemblages penetrated to the North American basins through an unknown passageway.

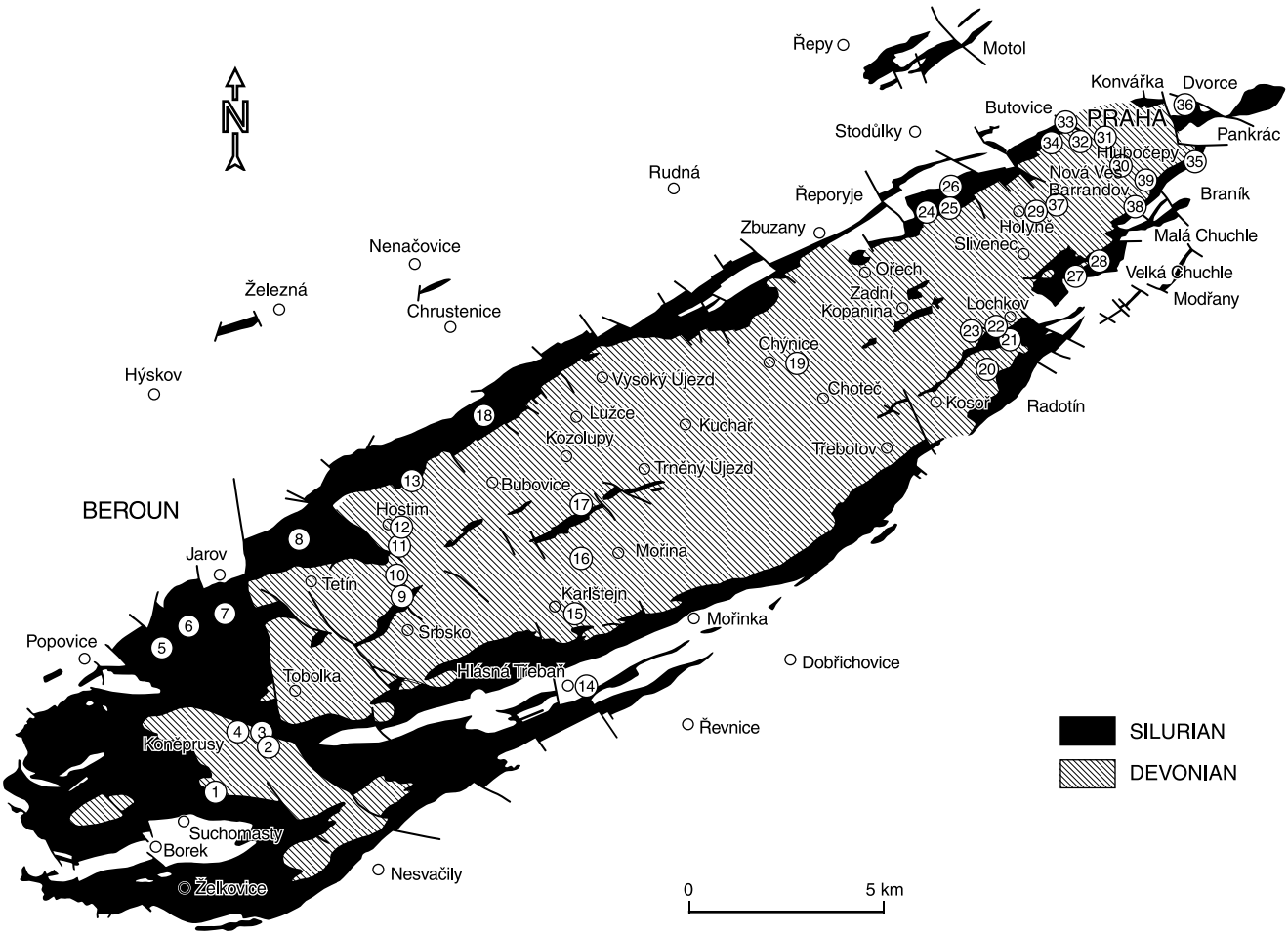
■ Foraminifera, Silurian, Devonian, Barrandian, biostratigraphy, palaeoecology, palaeogeography

Received January 29, 2001

Introduction

Foraminifers from the Barrandian were first mentioned at the beginning of the 20th century (Schubert and Liebus, 1902; Liebus and Wahner, 1904). These authors described foraminifers from the Eifelian of Hlubočepy near Prague. These studies were revised by Pokorný (1959) who found foraminifers of the genera *Psammosphaera, Thurammina* and sessile hemispherical saccamminids in the Eifelian from Hlubočepy. A new species *Psammosiphon remesi* was described by Prantl (1947). Nowadays, this genus is classified among Polychaeta (Loeblich and Tappan, 1987). Agglutinated foraminifers from a slide from the Eifelian of Hlupočepy were mentioned by Petránek (1950). Recently, a find of foraminifers in the Ordovician was reported by Bubík (1995, 1996). Foraminifers from the micropalaeontological collection of the Department of Paleontology, Charles University, Prague were revised by Holcová (1999). A systematic study of the Barrandian foraminifers has not been done yet.

A limited number of studies focused on Silurian and Devonian foraminifers appeared also in the world literature. Numerous papers with the highest number of newly described taxa deal with the North American Palaeozoic: from Silurian (Moreman, 1930; Grubbs, 1939; Stewart and Priddy, 1941; Dunn, 1942; Browne and Schott, 1963; Miller, 1956; Mound, 1961; Ireland, 1966; Mound, 1968; Watkins et al., 1999), Silurian and Devonian (Moreman, 1933; Ireland, 1939; McClellan, 1966) and Devonian (Cushman and Stainbrook, 1943; Stewart and Lampe, 1947; Summerson, 1958; Conkin and Conkin, 1964; Gutschick and Wuellner, 1983). A synthesis of stratigraphical ranges of North American Palaeozoic foraminifers was given by Conkin and Conkin (1982). In Europe, Silurian and Devonian foraminifers were studied in the following regions: Thuringian Slate Mountains (Blumenstegel, 1961, 1963), Eifel synclinorium (Bartenstein, 1937; Pichler, 1971; Langer, 1991), Rheinisches Schiefergebirge (Beckmann, 1952; Eickhoff, 1970, 1971), Sauerland (Flugel and Hotzl, 1971), Holy Cross Mountains (Duszynska, 1956, 1959; Olempska, 1983; Malec, 1992), Carnic Alps (Kristan-Tollmann, 1971), Baltic region (Eisenack, 1932, 1937, 1954, 1959, 1967, 1969, 1971; Bykova, 1956), Moravia (Pokorný, 1951) and Bulgaria (Trifonova, 1964). Foraminifers from the Russian Platform and Volga-Ural Area (Bykova, 1952, 1953; Bykova and Polenova, 1955; Reytlinger, 1957), Ural region (Tschernych, 1965, 1969; Pronina, 1963, 1968a, b) and Siberia (Lipina, 1959) were described from Russia. Russian authors predominantly described foraminifers from slides, which complicates their comparison with isolated specimens. Silurian and Devonian foraminifers were mentioned also from Australia (Crespin, 1961; Simpson et al., 1993; Winchester-Seeto and Bell,



Text-fig. 1. Location of the Devonian and Silurian sections containing the foraminifers studied. 1 – Klonk section, 2 – "Červený lom" Quarry, 3 – "Jiráskův lom" Quarry, 4 – "Houbův lom" Quarry + "Hergetův lom" Quarry + "Zlatý kůň" Hill, 5 – Litohlavy section, 6 – Kosov Quarry, 7 – Koledník Quarry, 8 – "U Drdů" section, 9 – "Na bříči" section, 10 – Srbsko-Kačák Creek section, 11 – Kačák Creek Valley, 12 – Hostim section (Roblín Mb.), 13 – Stydlé vody Quarry, 14 – Hlásná Třebáň Section, 15 – Budňany Rock, 16 – "Údolí Hluboké" Valley near Karlštejn, 17 – Smoking Quarry near Kozolupy, 18 – Bubovice – Loděnice section, 19 – Chýnice – old quarry, 20 – "Černá rokle" section, 21 – Cephalopod Quarry, 22 – Marble Quarry, 23 – Cikánka – old quarry, 24 – Požáry Quarry, 25 – "V tůních" Quarry, 26 – Mušlovka – Arethusina Gorge section, 27 – Homolka near Velká Chuchle, 28 – "Žákův lom" Quarry, 29 – Prastav Quarry, Praha-Holyně, 30 – Hlubočepy – railway section, 31 – "Nad tratí" Quarry, 32 – "U jezírka" Quarry, 33 – Kační Quarry + Na břekvici section, 34 – Kovárovic mez, 35 – Braník section + Braník Quarry, 36 – Dvorce section, 37 – "Opatřilka (Červený lom)" Quarry, 38 – Vyskočilka, 39 – section below Barrandov.

1994; Bell, 1996; Bell, 1999). For the determination of foraminiferal taxa, an analysis of Upper Palaeozoic foraminifers is important (e.g., Ireland, 1956; Gutschick and Treckman, 1959; Gutschick et al., 1961; Conkin, 1961; Gutschick, 1962; Conkin et al., 1965, 1968).

The aim of this paper is to present the results of the first systematic study of the Silurian and Devonian foraminifers from the thoroughly documented Barrandian sections.

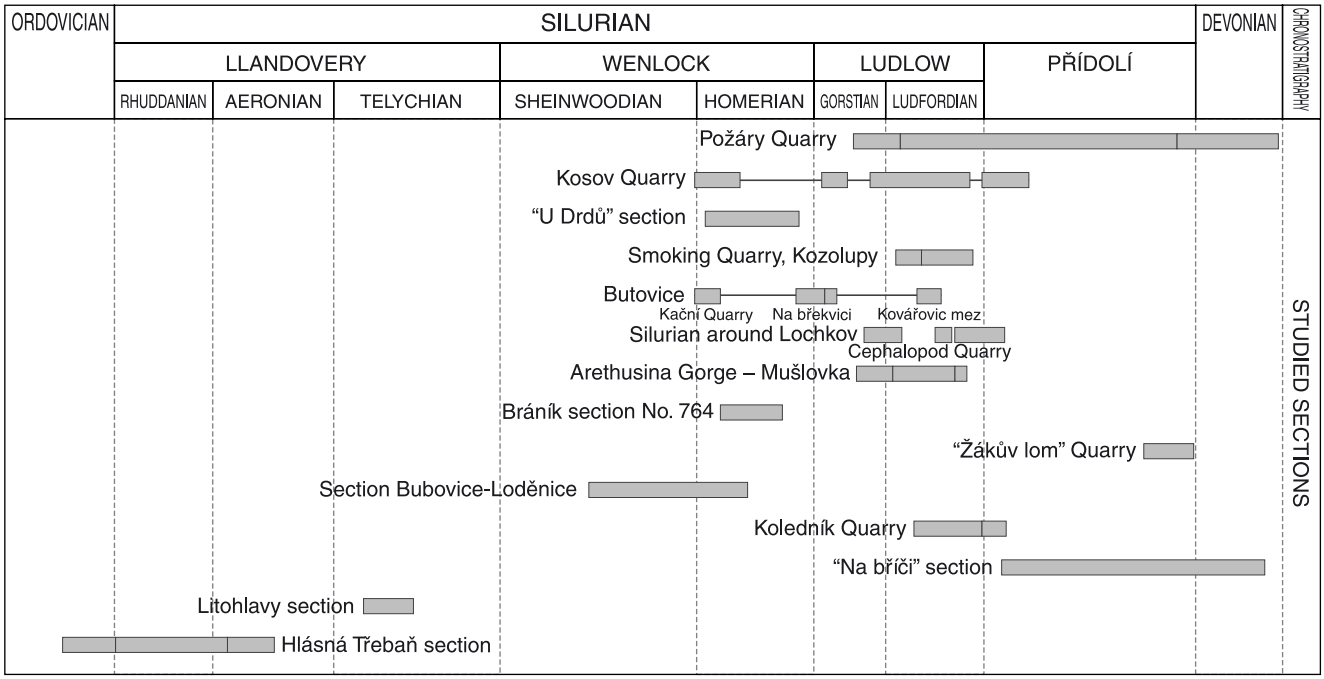
Material and methods

The Barrandian is a classical Lower Palaeozoic area with numerous thoroughly documented sections. These sections were chosen for a pioneer study of the Barrandian foraminifers because the existing biostratigraphical and palaeoecological data can be used for the assessment of biostratigraphical and palaeoecological value of foraminiferal assemblages.

Locations of the studied sections are shown in Text-fig. 1, their stratigraphical ranges are given in Text-figs 2, 3. Detailed descriptions of the sections are provided in Text-figs 5, 7–9,12, 13, 16–19, 23–28, 31–41, 44, 46, 48, 50, 51.

The present study was based on the analysis of isolated foraminiferal tests. At the beginning of the study, no dissolution of rock samples in an acid was intended. The use of this method allows preservation of calcareous tests.

But practically no foraminifers were found in undis-



Text-fig. 2. Stratigraphical ranges of the Silurian sections studied.

solved washing residue. In the next step, dissolution of rock samples in acetic acid was tested using acids of different concentrations for the same sample. The sample was broken into small pieces (about 1 cm^3) and dissolved in the 5 %, 10% and 30% acetic acid for 3–4 weeks. The acid was completely changed every week. Foraminiferal tests were the most abundant when 10% acetic acid was used for test dissolution (Text-fig. 4). Therefore, 10 % acetic acid was chosen for the dissolution of the analysed samples.

Foraminifers and other microfossils were separated using a stereomicroscope. SEM was used for a detailed study of test morphology, internal tests structures were studied in transmitted light. Test parameters were measured using a video system.

Abundances of foraminiferal tests were roughly evaluated using a semiquantitative scale (abundant-common-rare-very rare) because the dissolution of samples did not allow an accurate recalculation of the foraminiferal abundances in washing residua into the abundances in rock samples. The relative abundances of taxa in samples were established where absolute abundances ranged between common and abundant. Relative and absolute abundances of foraminifers in samples are given in Text-figs 5, 7–9,12, 13, 16–19, 23–28, 31–41, 44, 46, 48, 50, 51.

Taxonomical study of the Barrandian foraminifers was based on the determination of morphotypes (Text-figs 6, 11, 14, 15, 20–22). The weak points of this classification were the low numbers of foraminiferal tests in many samples. Therefore, the variability of test morphology could be studied on rare occasions only.

These morphotypes can be: (1) well-correlated with the described taxa; (2) correlable with the described taxa but showing some differences between the holotype of the described species and the Barrandian specimens; (3) fragments of tests which are indeterminable; (4) new taxa. The taxa could not be described because sufficient material for the study of variability and a well-preserved specimen for the designation of a holotype were missing. Collection of plentiful material from the samples with probably new taxa is proposed as the next step in the study of the Barrandian foraminifers.

Systematic part

The suprageneric classification follows Loeblich and Tappan (1987).

Order **Foraminiferida** EICHWALD, 1830

Suborder **Textulariina** DELAGE et HÉRUARD, 1896

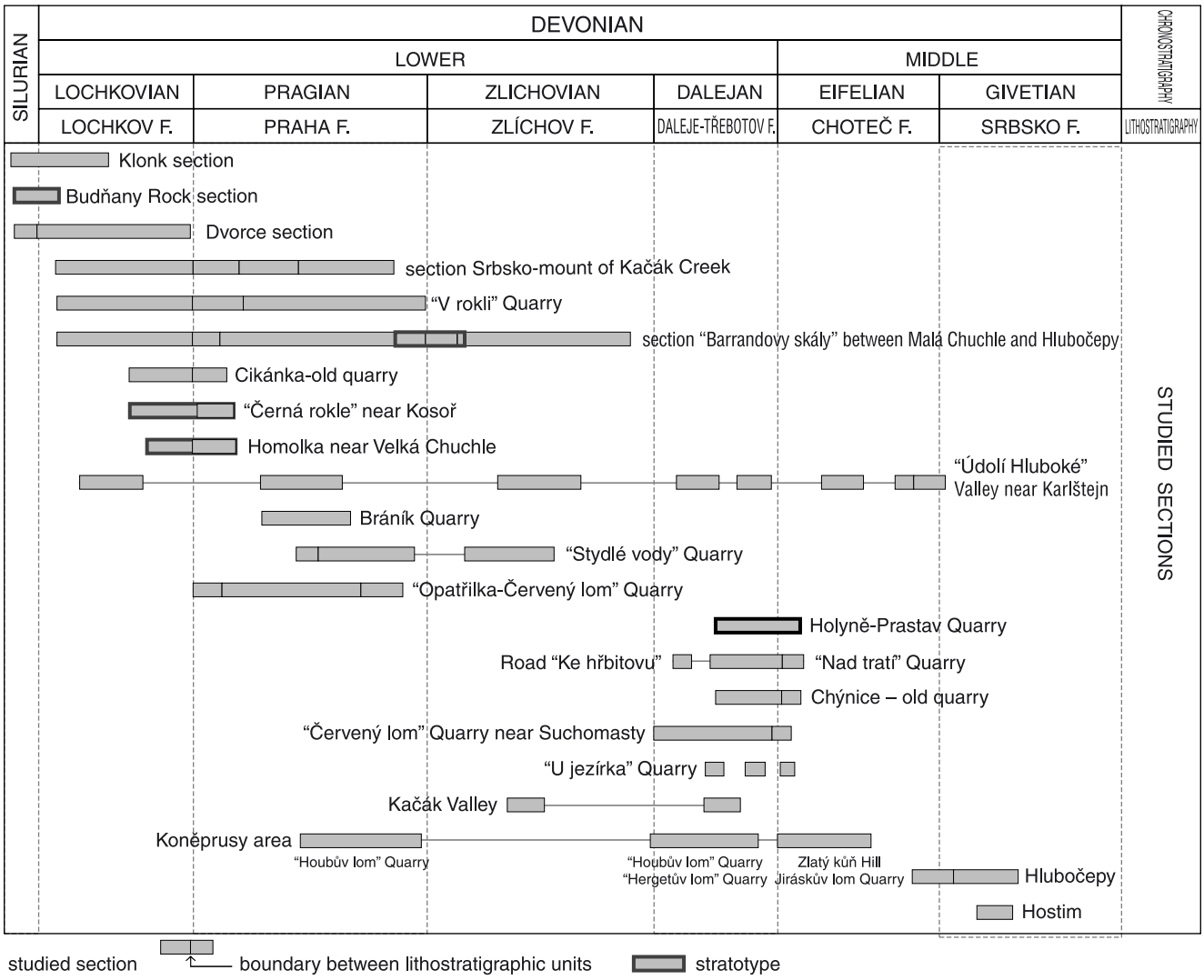
Family **Bathysiphonidae** AVNIMELECH, 1952

Genus ***Bathysiphon*** SARS, 1872

Bathysiphon sp.

Pl. 8, fig. 1; Pl. 14, fig. 12

Description: Test free, represented by a straight undivided and unbranched tube, postmortem-flattened, open at both ends. Wall agglutinated, composed of fine material. Only three broken specimens were found, which cannot be determined in more detail.



Text-fig. 3. Stratigraphical ranges of the Devonian sections studied.

Material: 3 specimens

Distribution in the Barrandian area: Pragian (Stydlé vody), Zlichovian (section below Barrandov)

Family **Astrorhizidae** BRADY, 1881

Genus ***Psammosiphon*** VINE, 1882

Psammosiphon remesi PRANTL, 1947

Pl. 22, fig. 11

1947 *Psammosiphon remesi* PRANTL, Prantl, Výskyt rodu *Psammosiphon*..., pp. 227–228, Pl. I, figs 1–4

Description: Test attached, approximately hemitubular and irregularly branched. Numerous apertures at ends of conical projections irregularly arranged in convex part of test. Wall agglutinated, composed of fine-grained material, thick.

Remarks: Genus *Psammosiphon* VINE, 1882 described from the Wenlock of England was classified within Annelida. Prantl (1947) reclassified the genus within Foraminifera. Leoblich and Tappan (1987) treated *Psammosiphon* as Polychaeta. Based on the character of numerous irregularly arranged apertures at the end of projections, I agree with the opinion of Prantl (1947) and attribute the genus *Psammosiphon* to Foraminifera.

Material: 2 specimens

Distribution in the Barrandian area: Rhuddanian (Hlásná Třebaň section), Prantl (1947): Pragian (Dvorce-Prokop Lst., U kapličky Quarry), Dalejan (Třebotov Lst., Prastav Quarry)

Family **Rhabdamminidae** BRADY, 1884

Genus **Rhabdammina** SARS, 1869

Rhabdammina (?) sp. – fragments

Description: Test free, tubular, branching dichotomously. Wall agglutinated, composed of medium- to fine-grained material, surface rough.

Remarks: Distinguishing of morphotypes among di-

Concentration of acetic acid	0 %*	5 %	10 %	30 %
Locality	Number of species/number of specimens			
Opatřilka - Červený lom Quarry, Dvorce-Prokop Lst. Sample 1	0	2/6	4/10	1/1
Opatřilka - Červený lom Quarry, Dvorce-Prokop Lst. Sample 2	2/2	5/12	8/21	3/7
"Údolí Hluboké" Valley near Karlštejn, Dalej Shales	0	2/13	2/38	1/3
Road "Ke hřbitovu" Dalej Shales	0	1/1	2/4	0
Original stratotype of Pragian/Zlichovian boundary, Praha-Barrandov	0	4/9	4/18	2/8

* only freezing of rock sample

Text-fig. 4. Results of the testing of the best concentration of acetic acid for the dissolution of rock samples.

chotomously branching fragments was impossible, but it is probable that these fragments represent two or more taxa.

Material: about 10 specimens

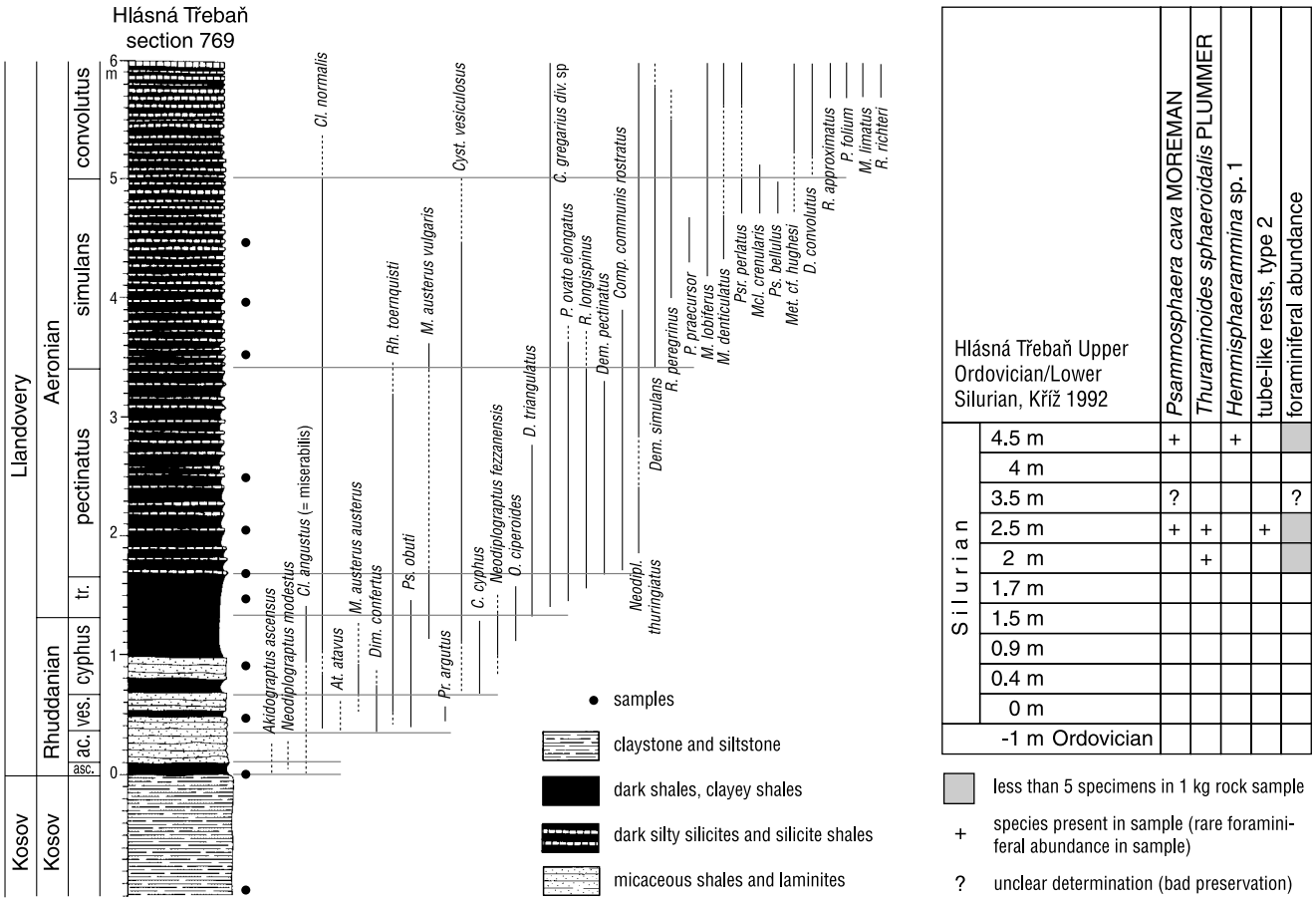
Distribution in the Barrandian area: Gorstian (surroundings of Lochkov), Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry), Dalejan (Třebotov Lst.: Prastav Quarry)

Family **Psammosphaeridae** HAECKEL, 1894

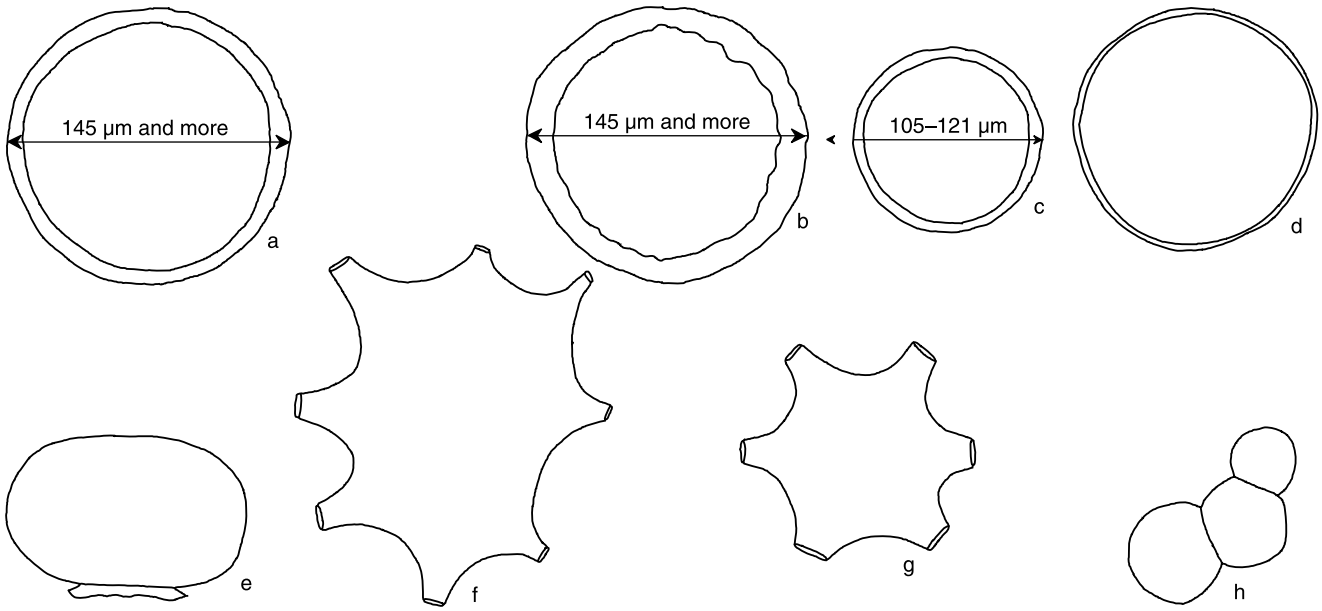
Genus ***Psammosphaera***

Moreman (1930), Eisenack (1932), Ireland (1939), Dunn (1942), Parr (1942), Stewart and Lampe (1947) and Summerson (1958) described 17 species of psammosphaeras from the Palaeozoic rocks. The following criteria were used for the description of new species: shape of test, size of test, thickness of test wall, size of grain material. Mound (1961), Browne and Schott (1963) and Mac Clellan (1966) discussed intraspecific variability of psammosphaeras and proposed that these criteria were not adequate for the speciation. Based on this concept, Kristan-Tollmann (1971) revised the Early Palaeozoic *Psammosphaera* and 14 species were put in synonymy with *P. cava.* To accept this intraspecific variability, all specimens occurring in the Barrandian material can be determined as *P. cava*.

To document the variability of psammosphaeras in the Barrandian material, four morphotypes were distinguished. These morphotypes are clearly defined and no transitions between them were observed. The morphotypes are well



Text-fig. 5. Hlásná Třebaň section, lithology and ranges of selected fossils from Kříž 1992.



Text-fig. 6. A sketch of morphotypes from family Psammosphaeridae Haeckel, 1894. a – *Psammosphaera cava* MOREMAN; b – *Psammosphaera devonica* STEWART et LAMPE; c – *Psammosphaera minuta* DUNN; d – *Psammosphaera gracilis* IRELAND; e – *Psammosphaera* sp; f – *Pseudastrorhiza* aff. *irregularis* DUNN; g – *Pseudastrorhiza* sp., h – *Sorophaera tricella* MOREMAN.

comparable with species synonymized with *Psammosphaera cava* and names of these species were used for their designation. Although the morphotypes could represent ecophenotypes, their occurrence in the same samples testifies against this hypothesis.

Among the morphotypes, the group of *P. cava – P. devonica – P. minuta* can be distinguished. Test size (text-fig. 10) and wall thickness allow to distinguish the morphotypes within this group, while the size of grain material changes gradually. *P.gracilis* is clearly different.

Psammosphaera cava MOREMAN, 1930

Text-fig. 6a, Pl. 10, figs 6, 8; Pl. 11, fig. 13; Pl. 13, fig. 4; Pl. 15, figs 1, 4, 12

1930 *Psammosphaera cava* MOREMAN; Moreman, Arenaceous Foraminifera from Ordovician, p. 48, Pl. 6, fig.12

Description: Test free, spherical, compressed or not. Wall thin, composed of fine to medium material, gradual changes in the size of grains were observed. Aperture indefinite. Diameters of tests larger than 145 µm (Text-fig. 10).

Material: about 200 specimens

Distribution in the Barrandian area: Aeronian (Hlásná Třebáň section), Sheinwoodian (section Bubovice-Loděnice), Homerian (Kační Quarry), Ludfordian (Požáry section, Smoking Quarry, Koledník Quarry), Lochkovian (Homolka near Velká Chuchle), Pragian (Dvorce-Prokop Lst.: Homolka near Velká Chuchle, Opatřilka Quarry, Braník Quarry, Karlík Valley, Stydlé vody Quarry; Slivenec Lst.: Cikánka Quarry), Zlichovian (section below Praha-Barrandov), Dalejan (Daleje Sh.: Ke hřbitovu section; Třebotov Lst.: Chýnice – old quarry, Údolí Hluboké Valley, Prastav Quarry, Nad tratí Quarry; Suchomasty Lst.: Červený lom Quarry)

Other distribution: Common at numerous localities of Ordovician sediments (Conkin and Conkin,1982)

Psammosphaera devonica STEWART et LAMPE, 1947

Text-fig. 6b, Pl. 2, fig. 7; Pl. 6, figs 7–9 ; Pl. 10, figs 1, 9, 10; Pl. 13, figs 1, 2; Pl. 15, figs 2, 3, 9–11

1947 *Psammosphaera devonica* STEWART et LAMPE, Stewart and Lampe, Foraminifera from the Middle Devonian Bone beds of Ohio, p. 533, Pl. 78, fig. 2

Description: Test free, spherical. Wall thick, composed of fine to coarse grains, grain size gradually changing with a discrete difference between the thin wall of *'P. cava'* morphotype and the thick wall of *'P. devonica'* morphotype. This variability was studied at the localities of Karlík Valley and Prastav Quarry where plentiful material (about 50 specimens) was collected (see also Holcová, 1999). Aperture not apparent. Diameters of tests larger than 145 µm (Text-fig. 10).

Material: about 25 specimens

Distribution in the Barrandian area: Silurian/Devonian boundary (Klonk), Pragian (Dvorce-Prokop Lst: Karlík Valley), Dalejan (Třebotov Lst.: Chýnice – old quarry, Údolí Hluboké Valley, Prastav Quarry, U jezírka Quarry)

Other distribution: Middle Devonian of Ohio (Stewart and Lampe, 1947; Summerson, 1958)

Psammosphaera minuta DUNN, 1942

Text-fig. 6c, Pl. 13, fig. 3; Pl. 15, figs 5 – 8

1942 *Psammosphaera minuta* DUNN, Dunn, Silurian Foraminifera of the Mississippi Basin, p. 323, Pl. 42, figs 10–12

Description: Test free, spherical, small-sized. Wall agglutinated with fine to medium-grained material. No aperture observable. Test diameters ranging between 105 to

121 µm (Text-fig. 10), differing from those of *'P. cava'* in their smaller size in agreement with the diagnosis of *'P. minuta'*. In the studied material, this morphotype occurs either with larger psammosphaeras (Dalejan, Údolí Hluboké Valley, Prastav) or separately (Zlichovian, section below Barrandov).

Material: about 40 specimens

Distribution in the Barrandian area: Ludfordian (Smoking Quarry, Cephalopod Quarry), Pragian (Dvorce-Prokop Lst.: Údolí Hluboké Valley, Opatřilka Quarry, Stydlé vody Quarry), Zlichovian (section below Praha-Barrandov, Stydlé vody Quarry), Dalejan (Daleje Sh.: Ke hřbitovu section; Třebotov Lst.: Údolí Hluboké Valley, Prastav Quarry)

Other distribution: Silurian of the Mississippi Basin (Dunn, 1942)

Psammosphaera gracilis IRELAND, 1939

Text-fig. 6d, Pl. 2, fig. 12; Pl. 12, fig. 2; Pl. 14, fig. 2

1939 *Psammosphaera gracilis* IRELAND, Ireland, Devonian and Silurian Foraminifera from Oklahoma, p. 194, figs A-10, 11

Description: Test free, spherical. Wall agglutinated, very thin, composed of very fine material. Aperture not apparent.

Remarks: This morphotype is clearly different from the morphotypes of *'P.cava-P. devonica- P. minuta'* –group and may represent a separate species.

Material: about 35 specimens

Distribution in the Barrandian area: Telychian (Litohlavy section), Dalejan (Nad tratí Quarry, Chýnice – old quarry, Prastav Quarry), Eifelian (Kačák Creek Valley)

Other distribution: Silurian of Oklahoma (Ireland, 1939), Kansas (Ireland, 1966), Thuringian Slate Mts. (Blumenstengel, 1963); Middle Devonian of Ohio (Summerson, 1958)

Psammosphaera sp.

Text-fig. 6e, Pl. 1, fig. 9; Pl. 2, fig. 15; Pl. 7, fig. 13

Description: Test attached, subglobular, with rests of objects of attachment often preserved on the test. Aperture not visible. Wall agglutinated of fine particles.

Material: about 15 specimens

Distribution in the Barrandian area: Aeronian (Hlásná Třebaň section), Ludfordian (Smoking Quarry), Pragian (Stydlé vody Quarry)

Genus ***Pseudastrorhiza*** EISENACK, 1932

Pseudastrorhiza aff. ***irregularis*** DUNN, 1942

Text-fig. 6f, Pl. 7, figs 11, 12

1942 *Pseudastrorhiza irregularis* DUNN, Dunn, Silurian Foraminifera of the Mississippi Basin, p. 321, Pl. 42, fig. 2

Description: Test free, with an irregular central chamber. 6–8 arms of various size irregularly arranged around the periphery of the central chamber. Apertures not apparent. Wall agglutinated, thin, composed of medium-sized grains.

Remarks: In comparison with the holotype, arms are spaced only around the periphery of the central chamber.

Material: about 40 specimens

Distribution in the Barrandian area: Ludfordian (Požáry section, Smoking Quarry), Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry, Údolí Hluboké Valley, Homolka near Velká Chuchle, Braník Quarry), Dalejan (Třebotov Lst.: Prastav Quarry, Údolí Hluboké Valley, Chýnice – old quarry), Eifelian (Kačák Creek Valley)

Other distribution: Silurian of the Mississippi Basin (Dunn, 1942)

Pseudastrorhiza sp.

Text-fig. 6g, Pl. 2, fig. 4, Pl. 7, fig. 7

Description: Test free, central chamber spherical, small-sized (80–120 (m), with 6 arms arranged nearly regularly around the periphery of the central chamber. Arms broken in all specimens. Aperture not apperent. Wall agglutinated, composed of medium to coarse grains loosely cemented.

Material: 3 specimens

Distribution in the Barrandian area: Ludlow (Kosov Quarry), Pragian (Stydlé vody Quarry)

Genus ***Sorosphaera*** BRADY, 1879

Sorosphaera tricella MOREMAN, 1930

Text-fig. 6h, Pl. 9, fig. 6

1930 *Sorosphaera tricella* MOREMAN, Moreman, Arenaceous Foraminifera from the Ordovician..., p. 49, Pl. 5, figs 12, 14

Description: Test free, consisting of three spherical chambers arranged in V-turn. Aperture not apparent. Wall agglutinated, composed of fine-grained material.

Material: 2 specimens

Distribution in the Barrandian area: Pragian (Opatřilka Quarry)

Other distribution: Common from the Ordovician (Conkin and Conkin,1982)

Genus ***Thuraminoides*** PLUMMER, 1945

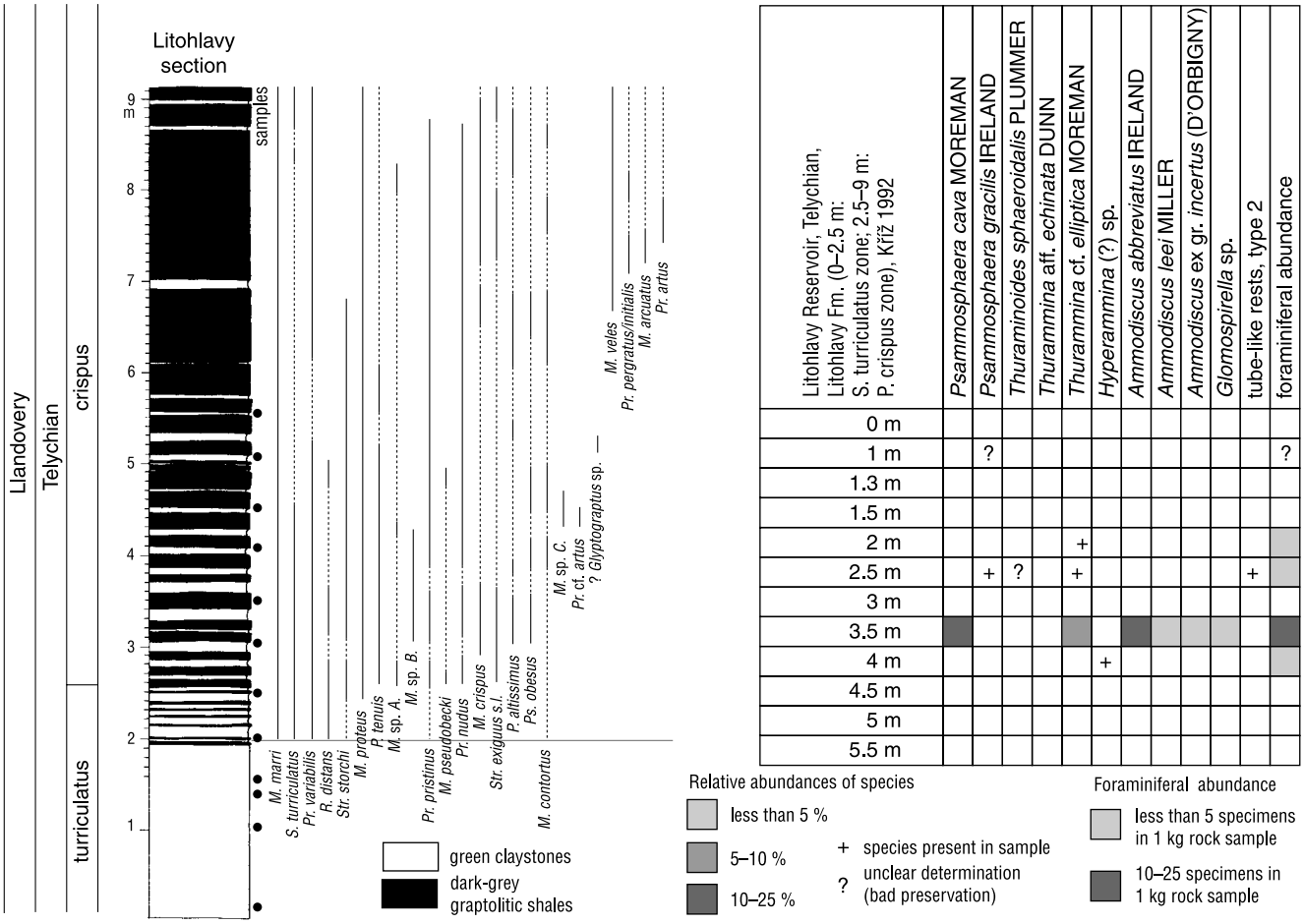
Thuraminoides sphaeroidalis PLUMMER, 1945

Pl. 1, figs 1, 2, 4, 6; Pl. 2, figs 6, 8, 14; Pl. 3, fig. 14; Pl. 7, fig. 1; Pl. 8, figs 12–15; Pl. 9, figs 1, 15–16; ? Pl. 10, fig. 7; Pl. 12, fig. 3; Pl. 13, fig. 5; Pl. 14, figs 8–11

1945 *Thuramminoides sphaeroidalis* PLUMMER; Plummer, Smaller foraminifera in the Marble Falls ..., p. 218, Pl. 15, figs 4–10

1961 *Thuramminoides sphaeroidalis* PLUMMER, Conkin, Mississippian smaller foraminifera from Kentucky..., p. 243

Description: Test free, compressed, discoidal with broadly rounded periphery. Aperture not visible. Wall agglutinated, thick, composed of fine material.

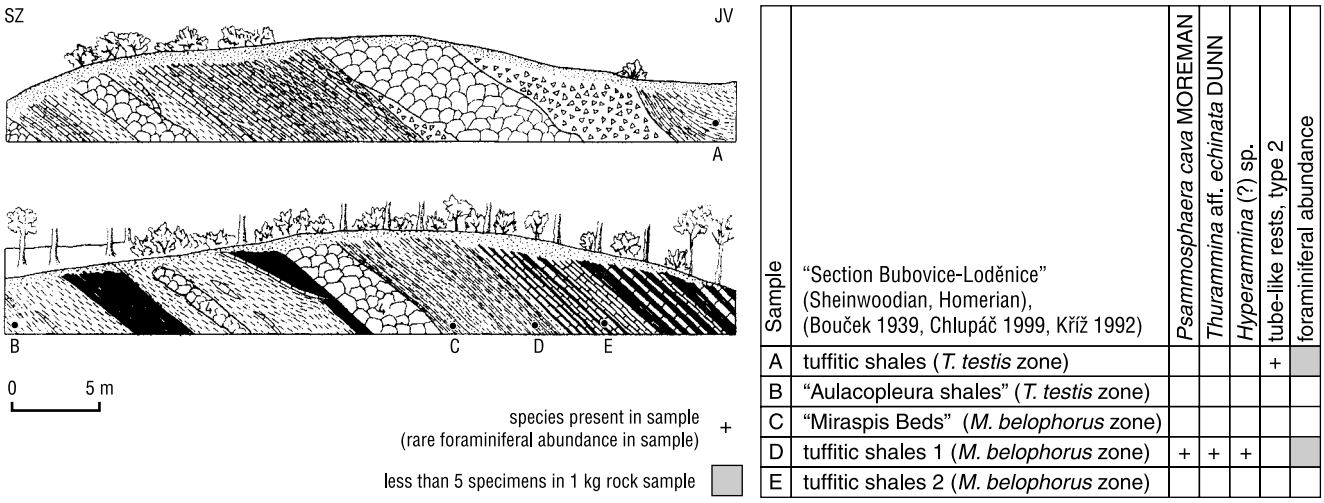


Text-fig. 7. Litohlavy section, lithology and ranges of selected fossils from Kříž 1992.

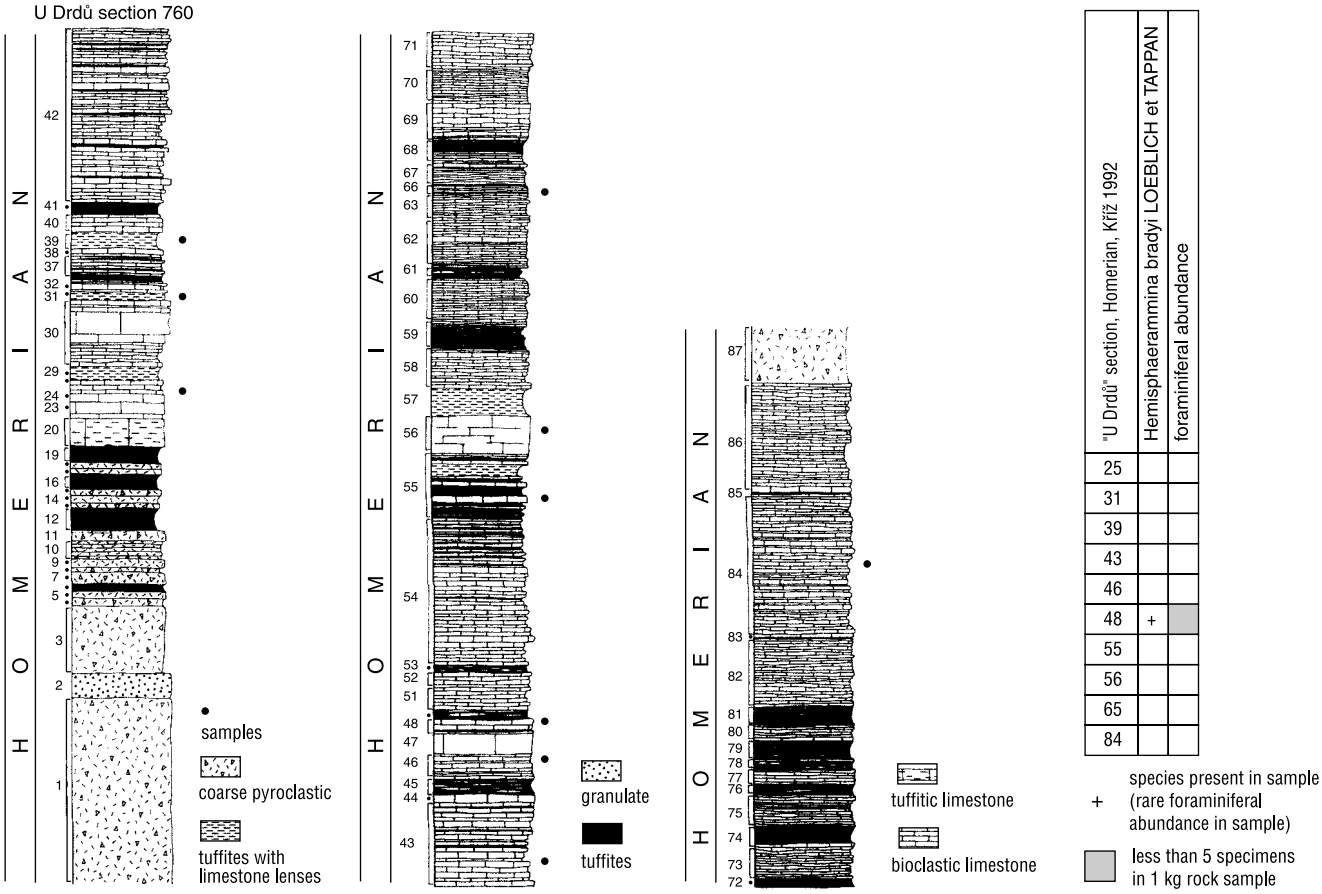
Remarks: Loeblich and Tappan's (1987) revision of the holotype of *Thuramminoides sphaeroidalis* was accepted. The genus *Thuramminoides* differs from the psammospheras in the thick wall agglutinated by fine grains.

Material: about 100 specimens

Distribution in the Barrandian area: Rhuddanian (Hlásná Třebaň section), Telychian (Litohlavy resorvoir), Homerian (Kační Quarry), Ludfordian (Smoking Quarry, Koledník Quarry, Cephalopod Quarry), Přídolí (Na bříči section), Silurian/Devonian boundary (Klonk), Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry, Opatřilka Quarry, Údolí Hluboké Valley, U kapličky Quarry, Pod terasami



Text-fig. 8. Section Bubovice-Loděnice section from Bouček 1939.



Text-fig. 9. "U Drdů" section, lithology from Kříž 1992.

Quarry, Old Quarry; Řeporyje Lst.: Srbsko section), Zlichovian (Chapel Coral Horizon, section below Barrandov, Stydlé vody), Dalejan (Daleje Sh.: Ke hřbitovu section; Třebotov Lst.: Prastav Quarry, Chýnice Quarry; Suchomasty Lst.: Hergetův lom Quarry), Eifelian (Kačák Creek Valley)

Other distribution: Common at numerous localities, from the Cambrian (Alexandrowicz, 1969) to Permian (Plummer, 1945)

Family **Hemisphaeramminidae** LOEBLICH et TAPPAN, 1961

In this family, many genera were erected for Palaeozoic foraminifers: *Hemisphaerammina* LOEBLICH et TAPPAN, *Fairliella* SUMMERSON, *Metamorphina* BROWNE, *Sorosphaerella* CONKIN, CONKIN et THURMAN , *Webinella* RHUMBLER, *Webinelloidea* STEWART et LAMPE, and *Sorosphaeroidea* STEWART et LAMPE. The concept of these genera differs among different authors (e.g., Loeblich and Tappan, 1957; Browne and Schott, 1963; McClellan, 1966). The herein used concept follows Loeblich and Tappan, 1987.

Some authors (Adegoke et al., 1969; Bell and Burn, 1979) noted that egg-capsules of different species of gastropods may be of similar shape, size and morphology as those of the forms placed into *Hemisphaerammina*.

Genus ***Hemisphaerammina*** LOEBLICH et TAPPAN, 1957

Hemisphaerammina bradyi LOEBLICH et TAPPAN, 1957

Text-fig. 11a, Pl. 1, figs 11, 13, 15; Pl. 3, figs. 1, 2, 7; Pl. 6, fig. 1; Pl. 13, fig. 14; Pl. 18, fig. 3

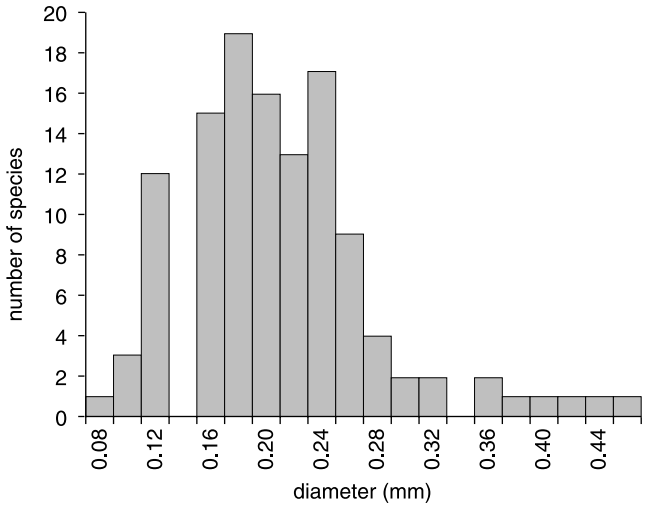
1957 *Hemisphaerammina bradyi* LOEBLICH et TAPPAN, Loeblich and Tappan, Eleven new genera of foraminifera, p. 224, Pl. 72, fig. 3

1966 *Hemisphaerammina bradyi* LOEBLICH et TAPPAN, McClellan, Arenaceous foraminifera from the Waldron Shales..., p. 485, Pl. 37, figs 20a, b – 22; Pl. 41, figs 20a, b – 22

Description: Test attached, hemispherical, highly convex with sharp margin between attached area and convex part of test. Diameter of attached area smaller than maximum test diameter (Text-fig. 11). Tests compressed or not (Pl. 1, figs. 13, 15). Wall agglutinated, composed of fine to medium-grained material. Aperture not apparent.

Material: about 20 specimens

Distribution in the Barrandian area: Gorstian (Na břekvici section), Homerian (Kační Quarry, U Drdů section), Ludfordian (Smoking Quarry, Koledník Quarry, Kosov Quarry, Mušlovka Quarry), Přídolí (Požáry



Text-fig. 10. Size distribution of *P. cava – P. devonica – P. minuta* group.

section), Pragian (Údolí Hluboké Valley, Opatřilka Quarry), Dalejan (Údolí Hluboké Valley, Prastav Quarry), Eifelian (Kačák Creek Valley)

Other distribution: Silurian of Indiana (MacClellan, 1966), Austria (Kristan-Tollmann, 1971), holotype from the Recent

Hemisphaerammina carmani (SUMMERSON, 1958)

Text-fig. 11b, Pl. 1, fig. 5; Pl. 3, fig. 9, 11, 12; Pl. 4, figs 4–5, 7; Pl. 5, figs 1, 12; Pl. 6, figs 10, 11; Pl. 10, figs 2, 3; Pl. 12, fig. 1; Pl. 15, figs 15, 16

1958 *Fairliella carmani* SUMMERSON, Summerson, Arenaceous Foraminifera from the Middle Devonian...., p. 556, Pl. 82, figs 15, 16; text-figs 4a,b

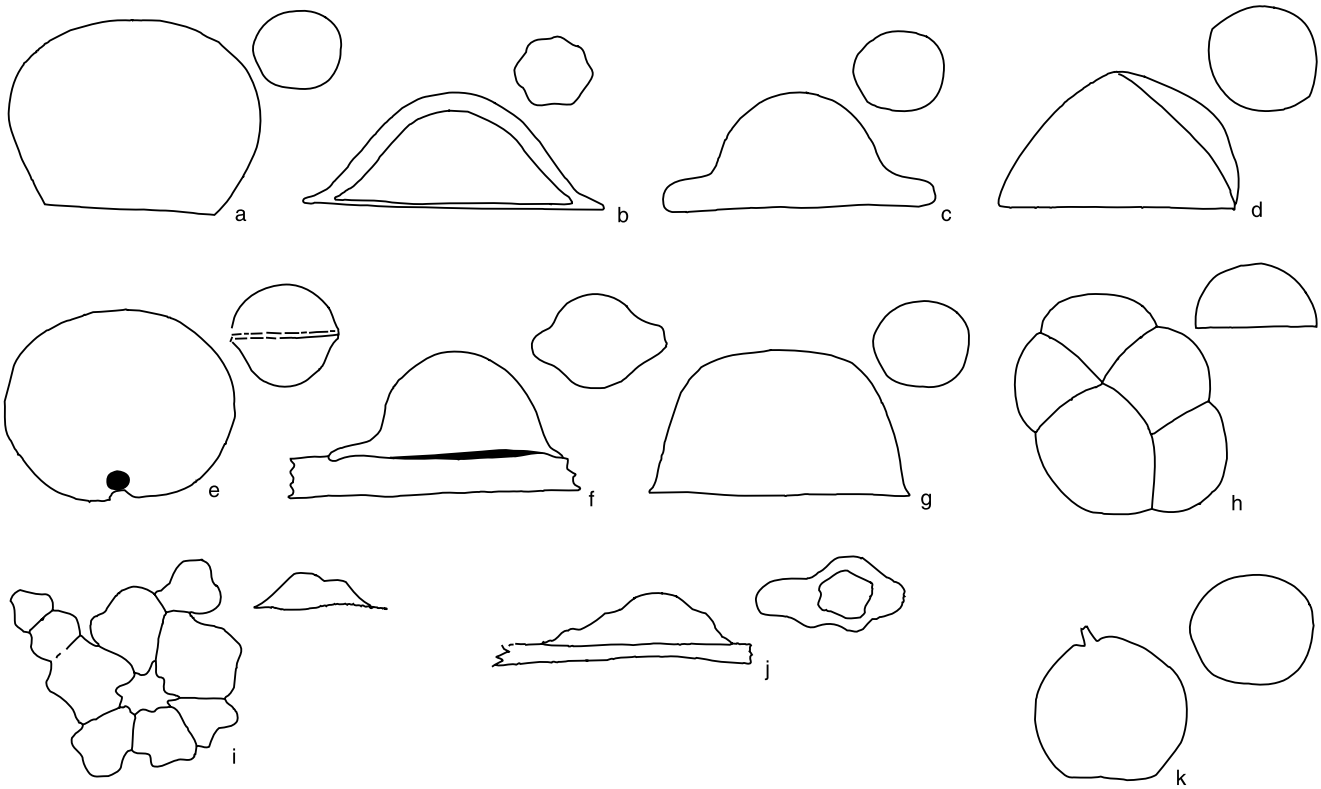
1996 *Hemisphaerammina* sp. BELL, Early Devonian (Emsian) agglutinated foraminiferans, p. 97, fig. 8N

Description: Test attached, composed of a single hemispherical chamber with a flange at the base. Diameter of attached area larger than that of hemispherical part of test (fig.6). Wall thin, agglutinated, composed of medium- to fine-grained particles. Attached area having thinner wall, in some specimens often missing (e.g., Pl. 1, fig. 5). No apparent aperture. Interstitial pores visible in some specimens (Pl. 4, fig. 5).

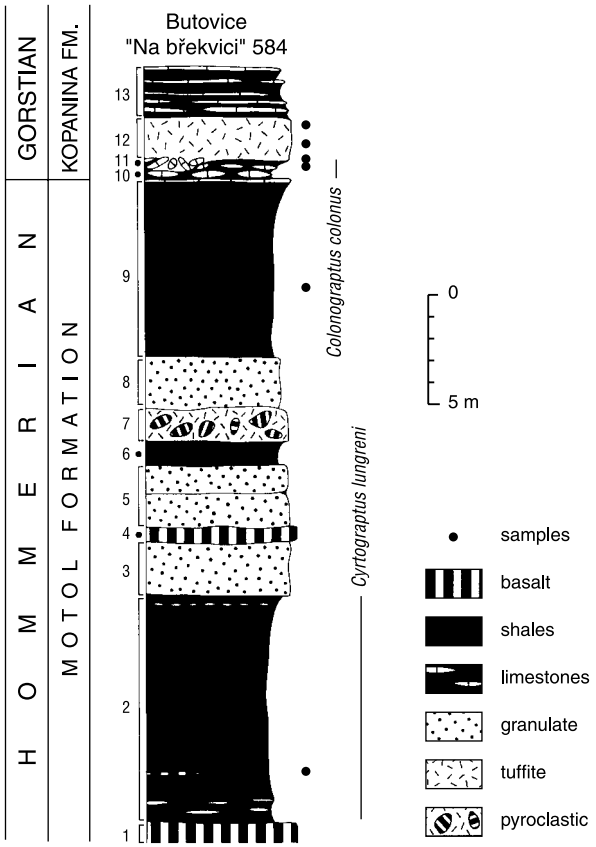
Remarks: Genus *Fairliella* is put into synonymy with *Hemisphaerammina* by Loeblich and Tappan, 1987. Some authors (e.g., Bell and Burn, 1979) consider this species to represent egg-capsules of gastropods.

Material: about 15 specimens

Distribution in the Barrandian area: Ludfordian (Smoking Quarry, Koledník Quarry), Pragian (Homolka near Velká Chuchle, Old Quarry, Pod terasami Quarry, Braník Quarry), Zlichovian (section below Bar-



Text-fig. 11. A sketch of morphotypes from family Hemisphaeramminidae LOEBLICH et TAPPAN, 1961. a – *Hemisphaerammina bradyi* LOEBLICH et TAPPAN; b – *Hemisphaerammina carmani* (SUMMERSON); c – *Hemisphaerammina* aff. *casteri* McCLELLAN; d – *Hemisphaerammina* sp.; e – *Tholosina* sp. 1; f – *Tholosina* (?) sp. 2; g – *Webbinelloidea hattini* McCLELLAN; h – *Webbinelloidea tholus* (MOREMAN); i – *Webbinelloidea* sp.; j – *Sorosphaerella* sp.; k – *Colonammina* sp.



Butovice, Kační Quarry (uppermost Wenlock), Na břekvici [Hommerian (shales)/Gorstain (tuffite + concretions)], Kovářovic mez (uppermost part of Kopaniny Mb., *Ananaspis fecunda* z.), (Kříž 1961, 1992, 1999)	*Psammosphaera cava* MOREMAN	*Thuraminoides sphaeroidalis* PLUMMER	*Hemisphaerammina bradyi* LOEBLICH et TAPPAN	*Thurammina aff. echinata* DUNN	*Hyperammina* (?) sp. 2	foraminiferal abundance
Kovářovic mez (Ludfordian)						
Kační quarry 1 (Hommerian)		+			+	
Kační quarry 2 (Hommerian)	+					
Na břekvici -shales 1						
Na břekvici - shales 2						
Na břekvici - concretions 1						
Na břekvici - concretions 2		?				?
Na břekvici - tuffite 1						
Na břekvici - tuffite 2			+	+		

less than 5 specimens in 1 kg rock sample + species present in sample

Text-fig. 12. Butovice, lithology and ranges of selected fossils from Kříž 1992.

randov), Dalejan (Chýnice – old quarry, Prastav Quarry), Eifelian (Chýnice – old quarry, Prastav Quarry)

Other distribution: Middle Devonian of Ohio (Summerson, 1958)

Hemmisphaerammina aff. ***casteri*** McCLELLAN, 1966

Text-fig. 11c, Pl. 1, fig. 8; ? Pl. 7, fig. 15

1966 *Hemmisphaerammina casteri* McCLELLAN, McClellan, Arenaceous foraminifera from the Waldron Shales..., p. 486, Pl. 38, figs 1a, b; Pl. 42, figs 1a, b

Description: Test attached, hemispherical. Characteristic wide marginal flange distinguishing this species from other hemisphaeramminas. Test rounded in outline. Wall agglutinated, composed of well cemented fine material. Aperture not apparent.

Remarks: Barrandian specimens are differentiated from the holotype on the basis of a fine-grained wall (medium-grained wall in the holotype) and rounded test outline (irregular in the holotype).

Material: 10 specimens

Distribution in the Barrandian area: Ludfordian (Smoking Quarry), Pragian (Stydlé vody Quarry)

Other distribution: Silurian of Indiana (McClellan, 1966)

Hemmisphaerammina sp.

Text-fig. 11d, Pl. 15, fig. 14

Description: Tests attached, pyramidal, highly convex. Side wall forming an acute angle at junction with basal wall. Aperture not visible. Wall agglutinated, composed of medium-sized grains.

Material: 8 specimens

Distribution in the Barrandian area: Dalejan (Při trati Quarry), Eifelian (Prastav Quarry)

Genus ***Tholosina*** RHUMBLER, 1895

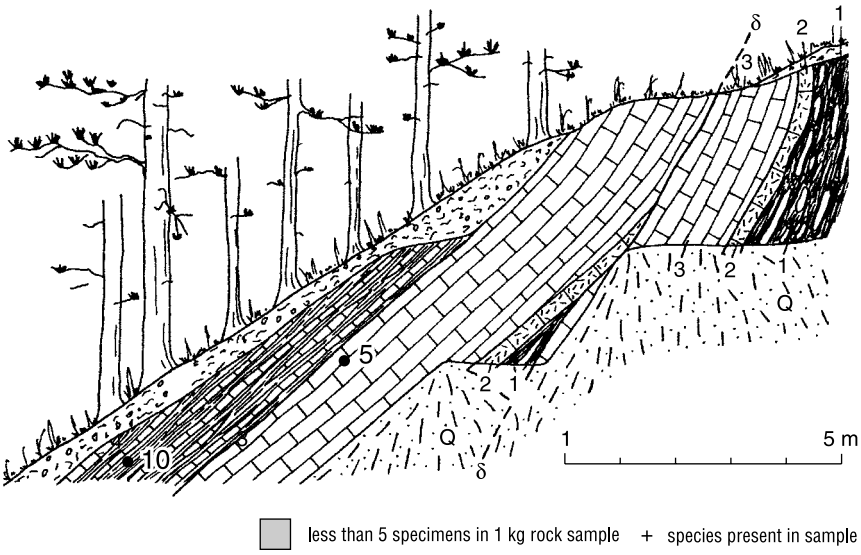
Tholosina sp. 1

Text-fig. 11e, Pl. 14, figs 15–16

Description: Test attached, globular, with rounded periphery, furrow crossing the area of attachment (?line of attachment to (?) an alga). Two apertures situated at ends of short tubes arranged on test periphery. Wall agglutinated, thin, composed of fine material.

Material: about 20 specimens

Distribution in the Barrandian area: Dalejan (Prastav Quarry)



Silurian around Lochkov: (1) Cephalopod Quarry 1–5 Ludfordian, 7–12 Přídolí; (2) Marble Quarry 1–11 Ludfordian, 12–24 Přídolí; (3) roadcut between Lochkov and Radotin Kopanina Mb. (shales), (Chlupáč, 1999, Chlupáč et al. 1998, bed numbers according Kříž 1992)	*Rhabdammina* (?) sp. - fragments	*Psammosphaera minuta* DUNN	*Thuraminoides sphaeroidalis* PLUMMER	*Hyperammina* sp. 1	foraminiferal abundance
roadcut 1	+		+	+	
roadcut 2					
Cephalopod Quarry 5		+	+		
Cephalopod Quarry 10					
Marble Quarry 14					

Text-fig. 13. Silurian around Lochkov, lithology of Cephalopod Quarry from Chlupáč 1999.

Tholosina (?) sp. 2

Text-fig. 11f, Pl. 3, fig. 10; Pl. 11, fig. 4; Pl. 13, figs 15, 16; Pl. 18, figs 1, 2

Description: Test attached to another one (Pl. 3, fig. 10) or to sponge spicules (Pl. 11, fig. 4), hemispherical, irregular in outline, small-sized. Aperture representing a narrow opening on the base of convex part of test. Wall agglutinated, composed of fine to medium-sized grains.

Remarks: Determination of these specimens as *Tholosina* is questionable. *Tholosina* is characterized by two or more apertures, while these specimens possess one aperture only.

Material: about 25 specimens

Distribution in the Barrandian area: Ludfordian (Koledník Quarry), Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry; Loděnice Lst.: V rokli Quarry), Dalejan (Třebotov Lst.: Chýnice – old quarry, Údolí Hluboké Valley, Prastav Quarry)

Genus *Webbinelloidea* STEWART et LAMPE, 1947

Webbinelloidea hattini McCLELLAN, 1966

Text-fig. 11g, Pl. 1, fig. 3; Pl. 3, fig. 5; Pl. 7, figs 14, 16; Pl. 10, figs 4, 5

1966 *Webbinelloidea hattini* McCLELLAN, McClellan, Arenaceous foraminifera from the Waldron Shale, p. 495, Pl. 38, figs 10, 11; Pl. 42, figs 10, 11

Description: Test attached, hemispherical, highly convex, with an acute angle of junction between base and side wall. Diameter of attached area equal to maximum diameter of hemispherical part of test. Aperture not apparent. Wall agglutinated, thick, composed of coarse-grained, poorly cemented particles.

Remarks: Barrandian specimens are only single-chambered. They are placed among *Webbinelloidea* species on the basis of species diagnosis, *W. hattini* may be either single-chambered or double-chambered.

Material: 7 specimens

Distribution in the Barrandian area: Ludlow (Požáry section), Ludfordian (Smoking Quarry), Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry), Dalejan (Třebotov Lst.: Chýnice – old quarry), Eifelian (Chýnice – old quarry)

Other distribution: Silurian of Indiana (McClellan 1966), Nevada (McClellan 1973)

Webbinelloidea tholus (MOREMAN, 1933)

Text-fig. 11h, Pl. 12, fig. 11

1933 *Webbinella tholus* MOREMAN, Moreman, Arenaceous foraminifera from the Lower Palaeozoic rocks, p. 395, Pl. 47, figs 8, 10

Description: Test attached, composed of 3–5 hemispherical chambers in approximately circular arrangement. Chambers highly convex, with sharp basal edge. Sutures between chambers prominent, linear or slightly curved. Aperture not visible. Wall agglutinated, composed of medium-sized grains.

Remarks: The species is classified among *Webbinelloidea* due to the presence of more than one chamber.

Material: 2 specimens

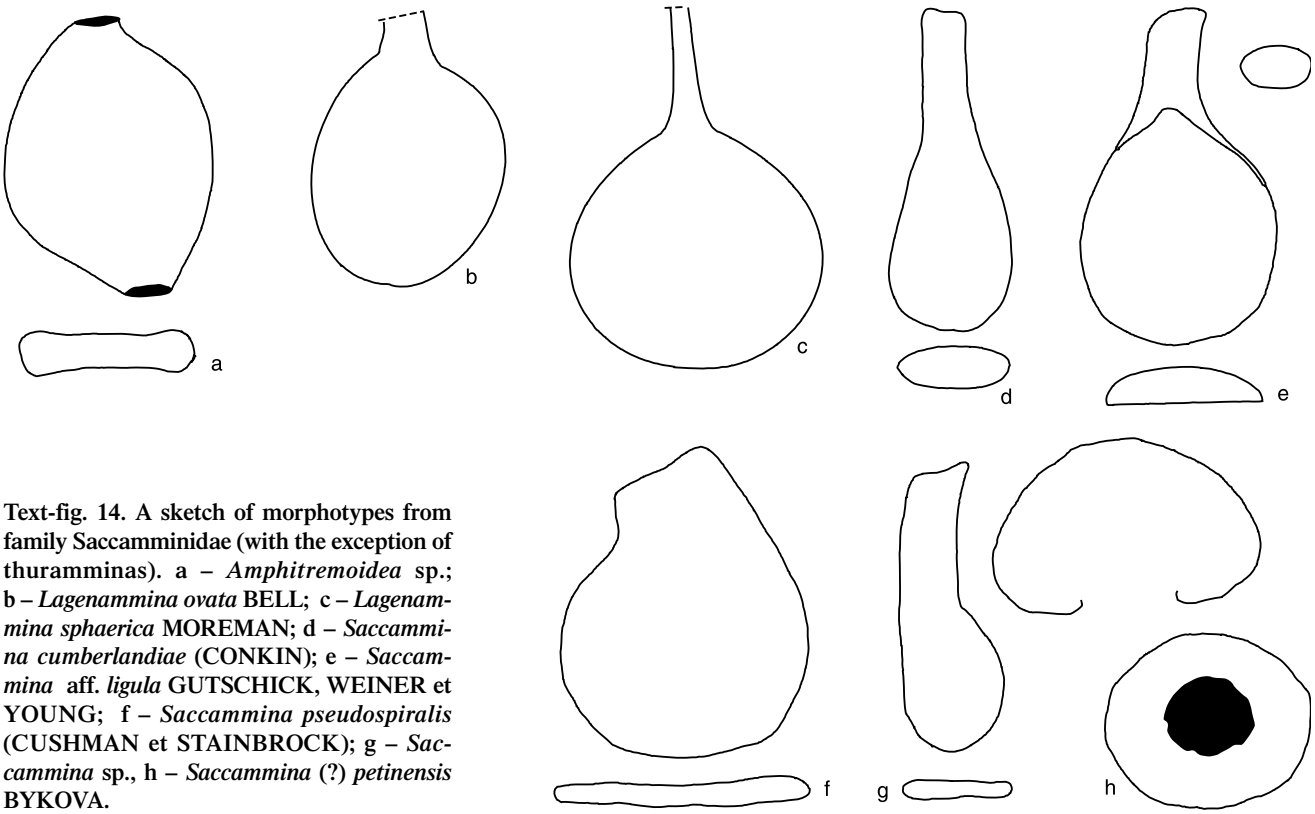
Distribution in the Barrandian area: Dalejan (Třebotov Lst: Údolí Hluboké Valley, Prastav Quarry)

Other distribution: Ordovician of Oklahoma (Moreman, 1933), Lower Silurian of Indiana (Browne and Schott, 1963; McClellan, 1966), Mississippian of Montana (Gutschick et al., 1961)

Webbinelloidea sp.

Text-fig. 11i, Pl. 2, figs 9–11

Description: Test attached, numerous irregular, approximately hemispherical chambers arranged into ring structures (Pl. 2, fig. 11) sometimes having irregular



Text-fig. 14. A sketch of morphotypes from family Saccamminidae (with the exception of thuramminas). a – *Amphitremoidea* sp.; b – *Lagenammina ovata* BELL; c – *Lagenammina sphaerica* MOREMAN; d – *Saccammina cumberlandiae* (CONKIN); e – *Saccammina* aff. *ligula* GUTSCHICK, WEINER et YOUNG; f – *Saccammina pseudospiralis* (CUSHMAN et STAINBROCK); g – *Saccammina* sp., h – *Saccammina* (?) *petinensis* BYKOVA.

branches (Pl.2, fig. 10). Aperture not observed. Wall agglutinated, composed of medium-sized grains.

Material: 4 specimens

Distribution in the Barrandian area: Přídolí (Na bříči section)

Genus *Sorosphaerella* CONKIN, CONKIN et THURMAN, 1979

Sorosphaerella sp.

Text-fig. 11j, Pl. 3, fig. 6; Pl. 5, fig. 4

Description: Test attached to various objects: sponge spicules or echinoid spines (Pl.3, fig.6). Tests approximately hemispherical and irregular in outline. All specimens small (about 100 µm in size). Aperture not visible. Wall agglutinated, composed of poorly sorted and poorly cemented grains.

Material: 3 specimens

Distribution in the Barrandian area: Ludlow (Požáry section), Pragian (Dvorce-Prokop Lst.: Old Quarry)

Genus *Colonammina* MOREMAN, 1930

Colonammina sp.

Text-fig. 11k, Pl. 3, fig. 3

Description: Test small in size, attached, globular, periphery of attachment area rounded. Aperture rounded, on small elevation situated in the centre of ventral part of test. Wall agglutinated, composed of very fine material, well cemented.

Material: 2 specimens

Distribution in the Barrandian area: Ludfordian (Požáry section)

Family **Saccamminidae** BRADY, 1884

Genus *Amphitremoida* EISENACK, 1938

Amphitremoida sp.

Text-fig. 14a, Pl. 3, figs 8, 13

Description: Test free, elongate, flattened, two apertures situated at opposite ends of test. Wall agglutinated, with fine particles.

Remarks: Only broken specimens were studied; it cannot be determined more precisely.

Material: 4 specimens

Distribution in the Barrandian area: Ludfordian (Koledník Quarry)

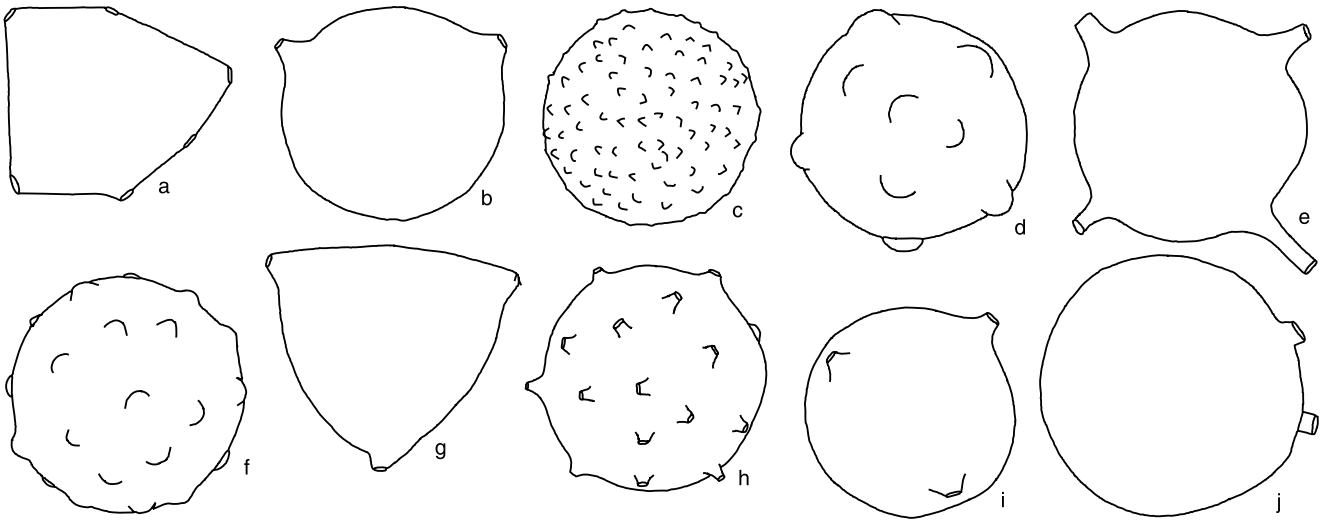
Genus *Thurammina* BRADY, 1879

Thurammina arcuata MOREMAN, 1930

Text-fig. 15a, Pl. 16, fig. 6

1930 *Thurammina arcuata* MOREMAN, Moreman, Arenaceous Foraminifera from the Ordovician and Silurian, p. 54, Pl. 6, figs 2, 3

Description: Test free, irregularly polygonal in outline, with broad and low projections situated at corners



Text-fig. 15. A sketch of morphotypes from family Saccamminidae (genus *Thurammina*). a – *Thurammina arcuata* MOREMAN; b – *Thurammina* aff. *diforamens* IRELAND; c – *Thurammina* aff. *echinata* DUNN; d – *Thurammina papillata* BRADY; e – *Thurammina* aff. *quadritubulata* DUNN; f – *Thurammina sphaerica* IRELAND; g – *Thurammina triradiata* GUTSCHICK et TRECKMAN; h – *Thurammina* aff. *tubulata* MOREMAN; i – *Thurammina* sp. 1; j – *Thurammina* sp. 2.

along polygonal outline of test. Circular apertures situated at ends of the projections. Wall agglutinated, composed of medium to coarse grains.

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Prastav Quarry)

Other distribution: Silurian of Oklahoma (Moreman, 1930)

Thurammina aff. *diforamens* IRELAND, 1956

Text-fig. 15b, Pl. 5, fig. 14

1956 *Thurammina diforamens* IRELAND, Ireland, Upper Pennsylvanian Arenaceous Foraminifera..., p. 841, figs 3–7

Description: Test free, spherical, with two neck-like tapering projections at opposite sides, meeting at an angle of 120°. Apertures situated in these projections. Wall agglutinated, composed of fine, well cemented material.

Remarks: Specimens from the Barrandian area have shorter projections than the other described specimens.

Material: 2 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: V rokli Quarry)

Other distribution: Upper Devonian of the East Thuringian Slate Mountains (Blumenstengel, 1961); Mississippian of Indiana (Gutschick and Treckman, 1959); Pennsylvanian of Kansas (Ireland, 1956)

Thurammina aff. *echinata* DUNN, 1942

Text-fig. 15c, Pl. 1, fig. 12; Pl. 6, fig. 12; Pl. 7, fig. 9; Pl. 9, figs ?2, 3; Pl. 16, fig. 7

1942 *Thurammina echinata* DUNN, Dunn, Silurian Foraminifera of the Mississippi Basin, p. 331, Pl. 43, figs 20, 21, 23

Description: Test free, spherical, small, with very numerous small-sized protuberances covering whole test and apertures at summits of protuberances. Wall agglutinated, composed of very fine material, well cemented.

Remarks: Barrandian thuramminas differ from the holotype in their fine material and the absence of larger tests.

Material: about 40 specimens

Distribution in the Barrandian area: Telychian (Litohlavy resorvoir), Sheinwoodian (Bubovice-Loděnice section), Gorstain (Na břekvici Quarry, Ludfordian (Smoking Quarry, Kosov Quarry), Pragian (Dvorce-Prokop Lst.: Braník Quarry, Stydlé vody Quarry, Opatřilka Quarry, Old Quarry), Zlichovian (Stydlé vody Quarry), Dalejan (Třebotov Lst.: Prastav)

Other distribution: Upper Silurian of the Mississippi Basin (Dunn, 1942); Llanvirnian of NW Germany (Riegraph and Niemeyer, 1996)

Thurammina papillata BRADY, 1879

Text-fig. 15d, Pl. 16, fig. 11

1879 *Thurammina papillata* BRADY; Brady, Notes on some reticularian Rhizipoda, etc., p. 45, Pl. 6: 4–8

1930 *Thurammina papillata* BRADY; Moreman, Arenaceous Foraminifera from Ordovician, etc., p. 51 , Pl. 5: 13

1942 *Thurammina papillata* BRADY; Dunn, Silurian Foraminifera of the Mississippi Basin, p. 334, Pl. 43: 30

Description: Test free, spherical, large, with many large protuberances irregularly arranged around the test. Apertures situated at summits of each protuberance. Wall agglutinated, composed of fine quartz grains.

Material: about 25 specimens

Distribution in the Barrandian area: Ludfordian (Smoking Quarry), Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry), Dalejan (Daleje Sh.: Ke hřbitovu section; Třebotov Lst.: Prastav Quarry, Údolí Hluboké Valley, U jezírka Quarry, Při trati Quarry)

Other distribution: Silurian of Oklahoma (Moreman, 1933)

Thurammina aff. *quadritubulata* DUNN, 1942

Text-fig. 15e, Pl. 7, fig. 10; Pl. 10, fig. 13; Pl. 16, fig. 8

1942 *Thurammina quadritubulata* DUNN; Dunn, Silurian Foraminifera of Mississippi Basin, p. 334, Pl. 43: 22

Description: Test free, spherical. Four long, slightly tapering tube-like projections situated in the "corners" of test. Apertures situated at ends of the projections. Wall thin, often broken, agglutinated, with medium- to coarse-grained material.

Remarks: Barrandian specimens differ from the holotype in more massive projections.

Material: about 35 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry), Dalejan (Třebotov Lst.: Chýnice – old quarry, Prastav Quarry)

Other distribution: Silurian of the Mississippi Basin (Dunn, 1942); Upper Devonian of the East Thuringian Slate Mountains (Blumenstengel, 1961)

Thurammina sphaerica IRELAND, 1939

Text-fig. 15f, Pl. 16, fig. 5

1939 *Thurammina sphaerica* IRELAND, Ireland, Foraminifera from Oklahoma, p. 197, figs A-33, 34

Description: Test free, spherical. Numerous large protuberances arranged irregularly around the tests similarly to *T. papillata.* Apertures situated at ends of protuberances. Wall agglutinated, composed of medium-sized grains.

Remarks: This species differs from *T. papillata* in its wall being composed of coarser grains, in agreement with the original diagnosis.

Material: 3 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Old Quarry), Dalejan (Třebotov Lst.: Prastav Quarry, Chýnice – old quarry)

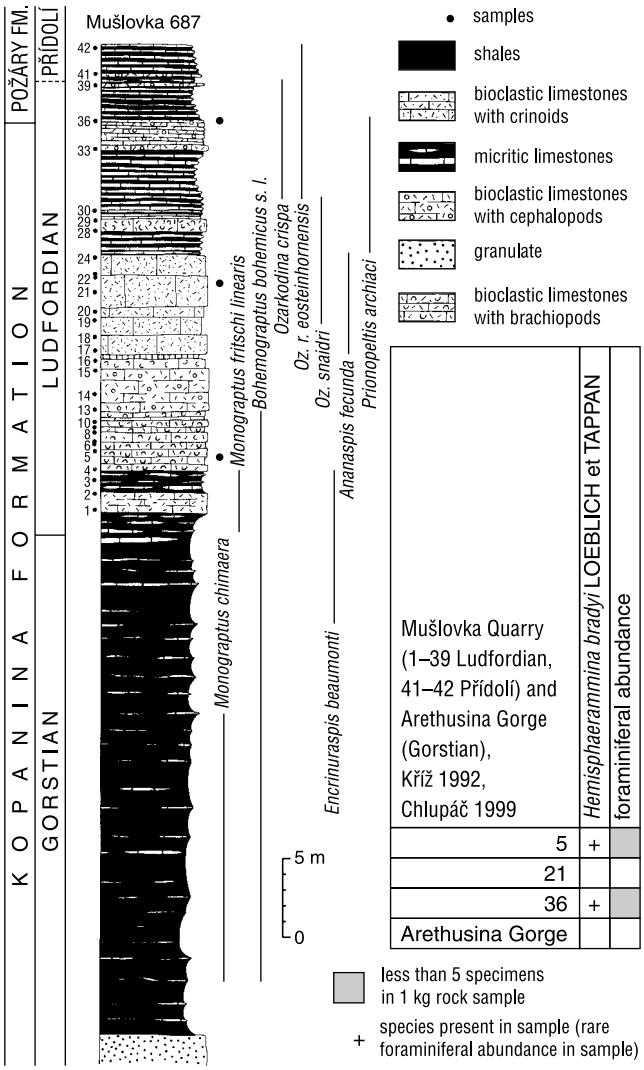
Other distribution: Silurian of Oklahoma (Ireland, 1939); Upper Devonian of the East Thuringian Slate Mountains (Blumenstengel, 1961)

Thurammina triradiata GUTSCHICK et TRECKMAN, 1959

Text-fig. 15g, Pl. 4, fig. 3; Pl. 16, fig. 4

1959 *Thurammina triradiata* GUTSCHICK et TRECKMAN, Gutschick and Treckman, Arenaceous Foraminifera from the Rockford..., p. 233, Pl. 33, figs 16, 17

Description: Test free, triangular in outline, with three long and relatively broad tapering neck-like projections situated in the corners of the triangle. Apertures circular at ends of projections. Wall agglutinated, composed with medium-grained grains.



Text-fig. 16. Mušlovka Quarry, lithology and ranges of selected fossils from Kříž 1992.

Material: 10 specimens

Distribution in the Barrandian area: (?) Ludfordian (Smoking Quarry, Koledník Quarry) Lochkovian + Pragian (Homolka Quarry), Dalejan (Třebotov Lst.: Prastav Quarry, Chýnice – old quarry)

Other distribution: Upper Devonian of the East Thuringian Slate Mountains (Blumenstengel, 1961); Mississippian of Indiana (Gutschick and Treckman, 1959)

Thurammina aff. *tubulata* MOREMAN, 1933

Text-fig. 15h, Pl. 2, figs 2, 3; Pl. 16, fig. 10

1933 *Thurammina tubulata* MOREMAN, Moreman, Arenaceous Foraminifera from Ordovician, etc., p.52 , Pl. 5 : 8

Description: Test free, spherical. Numerous circular apertures situated at the end of tube-like projections irregularly arranged around the test. Wall agglutinated, composed of fine to medium-grained material.

Remarks: In comparison with Oklahoma specimens, foraminifers from the Barrandian area have more massive tube-like projections.

Material: 6 specimens

Distribution in the Barrandian area: Ludfordian (Kosov Quarry), Dalejan (Třebotov Lst.: Prastav Quarry)

Other distribution: Silurian of Oklahoma (Moreman, 1933; Ireland, 1939)

Thurammina sp. 1

Text-fig. 15i, Pl. 10, fig. 11, 12; Pl. 13, fig. 7

Description: Test free, spherical, with 3 to 5 tapering, short neck-like projections irregularly arranged around the test. Rounded apertures situated at ends of projections. Test agglutinated, with medium grains.

Material: about 15 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry), Dalejan (Třebotov Lst.: Chýnice – old quarry, Údolí Hluboké Valley, Prastav Quarry), Eifelian (Kačák Creek Valley)

Thurammina sp. 2

Text-fig. 15j, Pl. 16, fig. 9

Description: Test free, spherical, with two short tubular neck-like projections lying close to each other. Apertures situated at ends of these projections. Wall agglutinated, composed of well cemented, very fine material.

Material: 2 specimens

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Prastav Quarry)

Genus *Lagenammina* RHUMBLER , 1911

Lagenammina ovata BELL, 1996

Text-fig. 14b, Pl. 1, fig. 7

1996 *Lagenammina ovata* BELL, Bell, Early Devonian (Emsian) agglutinated foraminiferans, p. 92, fig. 7 O P

Description: Test free, monothalmous, ovate, aperture terminal, present on a short neck, in thinner part of test. Wall is agglutinated, composed of medium-grained material.

Material: 3 specimens

Distribution in the Barrandian area: Ludfordian (Smoking Quarry)

Other distribution: Early Devonian of Australia (Bell, 1996)

Lagenammina sphaerica MOREMAN, 1930

Text-fig. 14c, Pl. 4, fig. 2; Pl. 6, fig. 2; Pl. 7, figs 2, 3, 4, 6; Pl. 11, figs 1–3, 12; Pl. 13, fig. 6; Pl. 14, fig. 1; Pl. 16, figs 1–3

1930 *Lagenammina sphaerica* MOREMAN, Moreman, Arenaceous foraminifera from the Ordovician..., p. 51, Pl. 5, fig. 15

Description: Test free, spherical to oval. Aperture rounded, situated on an elongate neck in thicker part of test. Neck usually broken, representing about 1/3 – 1/2 of test diameter if well preserved. Wall agglutinated, thin (often with small breaks; Pl. 7, fig. 2) with unsorted grain material dominated by fine grains.

Material: 70 specimens

Distribution in the Barrandian area: Ludfordian (Kosov Quarry), Pragian (Dvorce-Prokop Lst.: Homolka Quarry, Údolí Hluboké Valley, Stydlé vody Quarry, Old Quarry, Opatřilka Quarry), Dalejan (Třebotov Lst.: Chýnice – old quarry , Nad tratí Quarry, Údolí Hluboké Valley, U jezírka Quarry, Prastav Quarry); Suchomasty Lst.: Červený lom Quarry), Eifelian (Kačák Quarry)

Other distribution: common from the Lower Silurian

Genus *Saccammina* CARPENTER, 1869

Species *S.pseudospiralis* and *S. cumberlandie* were originally designated to *Proteonina* WILLIAMSON. This genus was revised by Loeblich and Tappan (1955). Based on this revision, *Proteonina* is treated as a junior synonym of *Reophax* MONFORT. McClellan (1966) recommended Palaeozoic "proteoninas" to be ranked within *Sacammina* (absence of neck) or *Lagenammina* (pyriform outline, presence of neck). In this paper, only very thin-walled (often broken) specimens were placed among *Lagenammina,* and the other to *Saccammina.*

Generic classification of *Saccammina petinensis* is questionable.

Saccammina cumberlandiae (CONKIN, 1961)

Text-fig. 14d, Pl. 6, fig. 6

1961 *Proteonina cumberlandiae* CONKIN, Conkin, Mississippian smaller foraminifera of Kentucky ...., p. 248, figs 2, 3; Pl. 19, figs 1–3; Pl. 26, figs 4, 5

Description: Test free, compressed, originally probably with ovoid part gradually continuing to long, rounded neck. Aperture rounded at end of the neck. Wall agglutinated, composed of very fine particles.

Material: 1 specimen

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Údolí Hluboké Valley)

Other distribution: Llandovery of Indiana (Browne and Schott, 1963); Wenlock of Indiana (McClellan, 1966); Mississippian of Kentucky (Conkin, 1961)

Saccammina aff. *ligula* GUTSCHICK, WEINER et YOUNG, 1961

Text-fig. 14e, Pl. 6, figs 14, 15

1961 *Saccammina ligula* GUTSCHICK, WEINER et YOUNG, Gutschick, Weiner and Young, Lower Mississippian arenaceous Foraminifera..., p.1207, Pl. 150, figs 3, 6, 8, 11; text-figs 3–14, 18–22

Description: Test attached, hemispherical. Surface of attachment reflects the substrate morphology. Aperture

Relative abundances of species

less than 5 %

25–50 %

Foraminiferal abundance

5–10 specimens in 1 kg rock sample

Kosov Quarry Kříž, 1992	*Pseudastrorhiza* sp.	*Hemisphaerammina bradyi* LOEB. et TAP.	*Nephrosphaera* sp.	*Thurammina* aff. *echinata* DUNN	*Thurammina* aff. *tubulata* MOREMAN	*Lagenammina sphaerica* MOREMAN	*Hyperammina* sp. 1	*Serpenulina uralica* TSCHERNICH	foraminiferal abundance
PřídolíL									
Ludfordian (z. with *A. fecunda*) 1									
Ludfordian (z. with *A. fecunda*) 2									
Ludfordian (z. with *E. beaumonti*) 1									
Ludfordian (z. with *E. beaumonti*) 2									
Ludfordian (z. with *E. beaumonti*) section 780/platy limestones									
Homerian (z. *T. testis*)									
Gorstian (shales)									
Homerian (shales)									

Text-fig. 17. Kosov Quarry.

hemitubular, situated at long apertural neck shifted at one side of test. Wall agglutinated, composed of medium-grained material. Surface rough.

Remarks: Barrandian specimens differ from the holotype in their asymmetrical position of apertural neck. Therefore, they are closer to S. *pseudospiralis* than the type material and differ from S. *pseudospiralis* in the attachment of the test.

Material: 2 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst: Opatřilka Quarry; Řeporyje Lst.: Srbsko section)

Other distribution: Mississippian of Oklahoma and Indiana (Gutschick et al., 1961)

Saccammina pseudospiralis (CUSHMAN et STAINBROOK, 1943)

Text-fig. 14f, Pl. 4, fig. 6; Pl. 5, fig. 17; Pl. 9, fig. 11; Pl. 11, fig. 14; Pl. 12, figs 5, 6; Pl. 18, figs 4–6

1943 *Proteonina pseudospiralis* CUSHMAN et STAINBROOK, Cushman and Stainbrook, Some foraminifera from the Devonian of Iowa, p. 76, Pl. 13, figs 8–13

Description: Test free, monothalmous, rounded, aperture situated on relatively short (1/2 of test diameter) and thick neck situated at one side of rounded test. Position of the neck gives a spiral appearance of test. Test including neck compressed. Wall agglutinated, composed of medium- to fine-grained material.

Material: about 40 specimens

Distribution in the Barrandian area: Ludfordian (Smoking Quarry, Koledník Quarry), Lochkovian (Údolí Hluboké Valley), Pragian (Dvorce-Prokop Lst.: Homolka near Velká Chuchle, Stydlé vody Quarry, section below Barrandov; Řeporyje Lst.: Srbsko section), Dalejan (Třebotov Lst: U jezírka Quarry, Prastav Quarry, Chýnice – old quarry, Suchomasty Lst.: Červený lom Quarry, Hergotův lom Quarry; Acanthopyge Lst.: Zlatý kůň Hill), Eifelian (Kačák Creek Valley)

Other distribution: Upper Devonian of Iowa (Cushman and Stainbrook, 1943)

Saccammina sp. 1

Text-fig. 14g, Pl. 4, fig. 8; Pl. 5, fig. 3

Decsription: Test flattened, originally probably globular. Aperture situated on long (about 2 test diameters) and thick neck. Wall agglutinated, composed of medium to fine-grained material. Interstitial pores present in globular part of test.

Material: 1 specimen

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Homolka near velká Chuchle; Řeporyje Lst: Srbsko section)

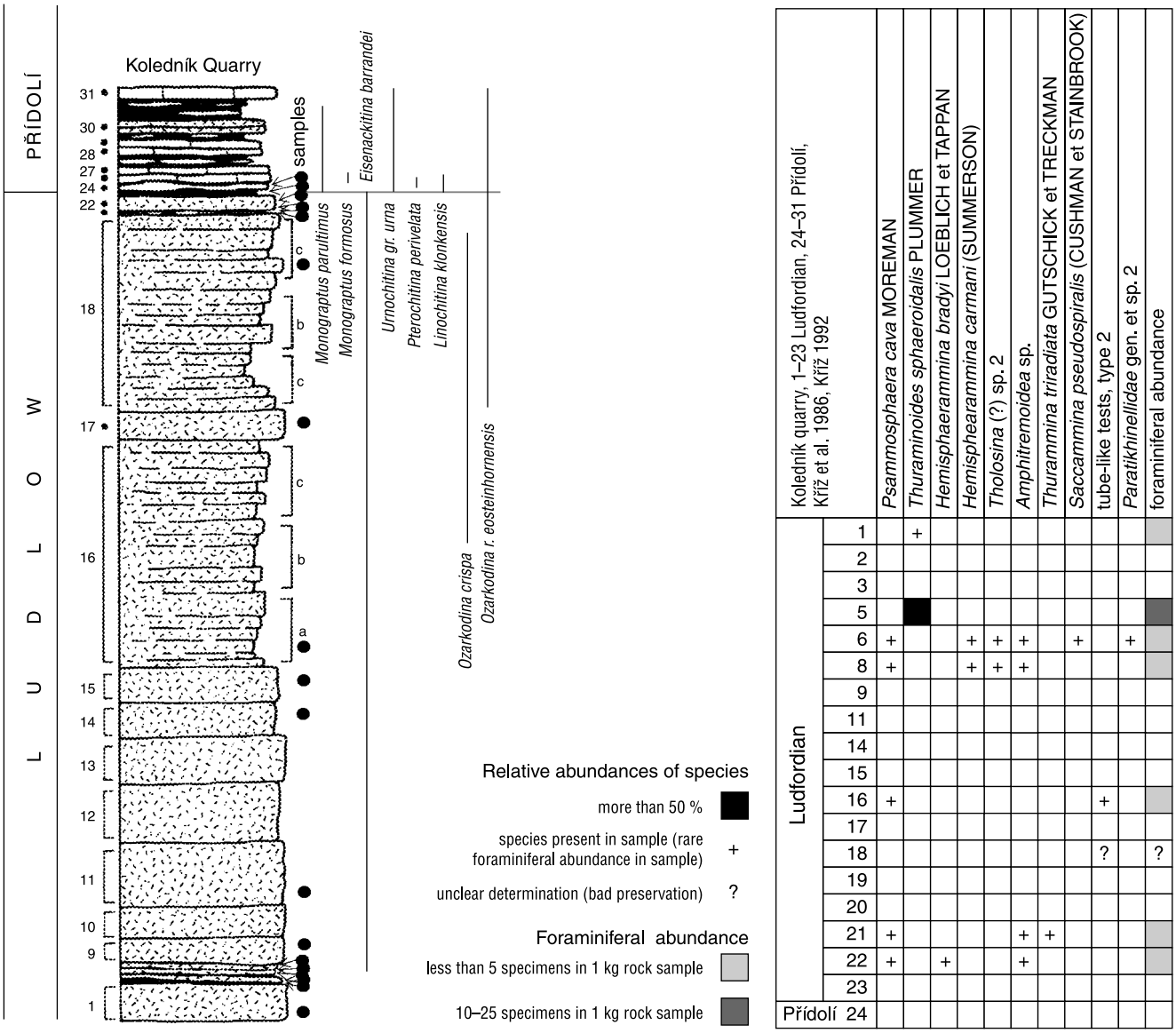
Saccammina (?) *petinensis* BYKOVA, 1955

Text-fig. 14h, Pl. 14, fig. 3; (?)Pl. 16, fig. 12

1955 *Saccammina petinensis* BYKOVA, Bykova and Polenova, Foraminifery, radiolarii i ostrakody..., p. 14, Pl. I, fig. 1; Pl. IV, figs 1, 2

Description: Test free, hemispherical with a rounded border. Aperture large, rounded, situated in the middle of flat area. Wall agglutinated, rough, composed of medium-sized grains.

Material: 4 specimens



Text-fig. 18. Koledník Quarry, lithology and ranges of selected fossils from Kříž 1992.

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Nad tratí Quarry, (?)Prastav Quarry)

Other distribution: Frasnian of the Voronez region (Bykova and Polenova, 1955)

Family **Hippocrepinidae** RHUMBLER, 1895

Genus ***Hyperammina*** BRADY, 1878

Hyperammina gracilenta GUTSCHICK et TRECKMAN, 1959

Text-fig. 20a, (?) Pl. 2, fig. 5; Pl. 13, fig. 12; Pl. 17, figs 1, 5, 6

1959 *Hyperammina gracilenta* GUTSCHICK et TRECKMAN, Gutschick and Treckman, Arenaceous Foraminifera from the Rockford limestone..., pp. 237–238, Pl. 34, figs 10, 11, text-fig. 1-G-I

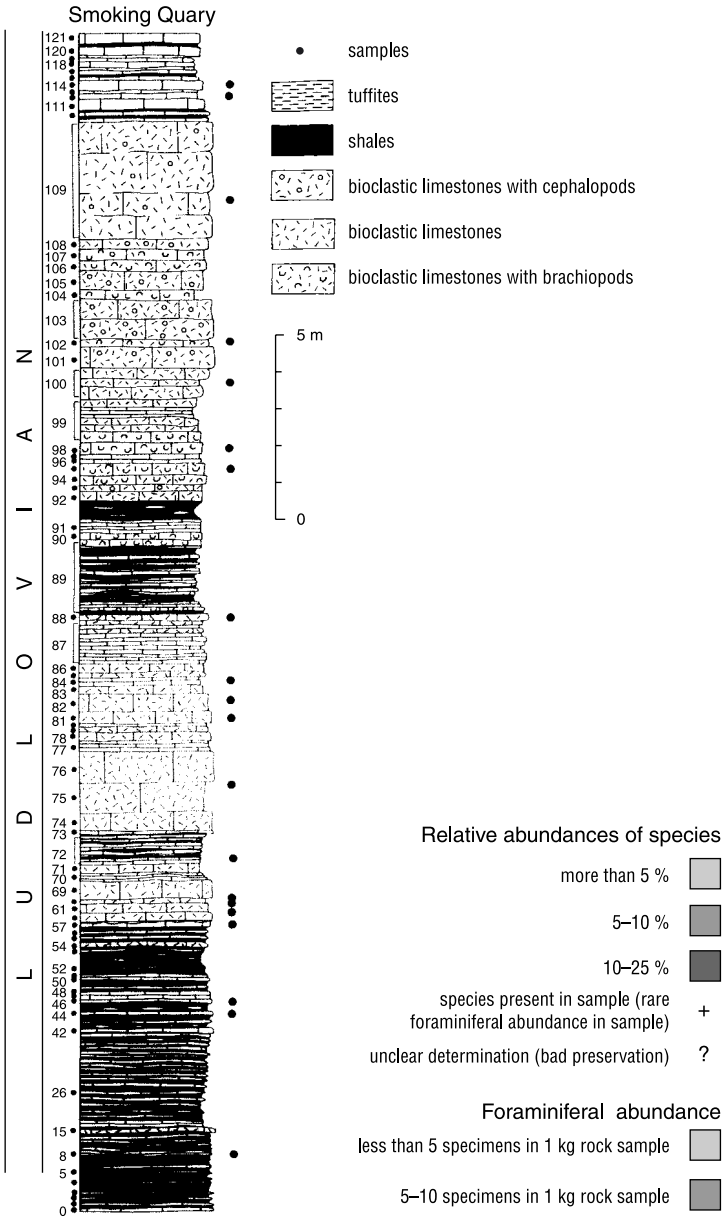
Description: Test free, small, with elongate or bulbous proloculus followed by a slender tubular second chamber. Diameter of proloculus markedly broader than second chamber. Second chamber straight or slightly curved. Wall agglutinated, thin, composed of medium-grained material.

Remarks: Accurate determination of Silurian specimens is impossible as only two fragments of proloculus were found.

Material: about 45 specimens

Distribution in the Barrandian area: (?) Gorstian (Cephalopod Quarry), (?) Ludfordian (Kosov Quarry), Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry), Dalejan (Třebotov Lst.: Údolí Hluboké Valley, Prastav Quarry, Chýnice – old quarry)

Other distribution: Mississipian of Missouri, Illinois and Indiana (Gutschick and Treckman, 1959; Conkin et al., 1968)



Smoking Quarry, Kozolupy, Ludfordian, Kříž 1992	*Psammosphaera cava* MOREMAN	*Psammosphaera minuta* DUNN	*Pseudastrorhiza* aff. *irregularis* DUNN	*Thuraminoides sphaeroidalis* PLUMMER	*Hemisphearammina carmani* (SUMMERSON)	*Hemmisphaerammina* aff. *casteri* McCLELLAN	*Hemmisphaerammina* sp. 1	*Webbinelloidea hattini* McCLELLAN	*Thurammina* aff. *echinata* DUNN	*Thurammina papillata* BRADY	*Thurammina triradiata* GUTSCHICK et TRECKMAN	*Lagenammina ovata* BELL	*Saccammina pseudospiralis* (CUSHMAN et STAINBROOK)	*Hyperammina* sp.	*Glomospira* (?) sp.	Tube-like rests, type 2	foraminiferal abundance
8																	
44								+									
46	+															+	
57									+		+			+			
60	+				+										+		
63						+											
65				+		+											
72			+	+												+	
75																	
81				+	+												
82																	
84																	
88																	
95																	
98																	
100				+													
102																	
109																	
112																	
114																	

Text-fig. 19. Smoking Quarry, lithology from Kříž 1992.

Hyperammina kahlleinwensis BLUMENSTENGEL, 1961

Text-fig. 20b, Pl. 13, fig. 13

1961 *Hyperammina kahlleinwensis* BLUMENSTENGEL, Blumenstengel, Foraminiferen aus dem Thuringer Oberdevon, p. 322, Pl. II, figs 1–6, 11, 13; Pl. III, fig. 4

Description: Test free, small spherical proloculus followed by tubular second broader chamber, in the final part maybe slightly tapered. Diameter of tubular chamber higher than that of proloculus, max. 2 times higher. It is the largest *Hyperammina* in the Barrandian material. Rounded aperture at end of second chamber. Wall agglutinated, thick, composed of fine material.

Material: 4 specimens

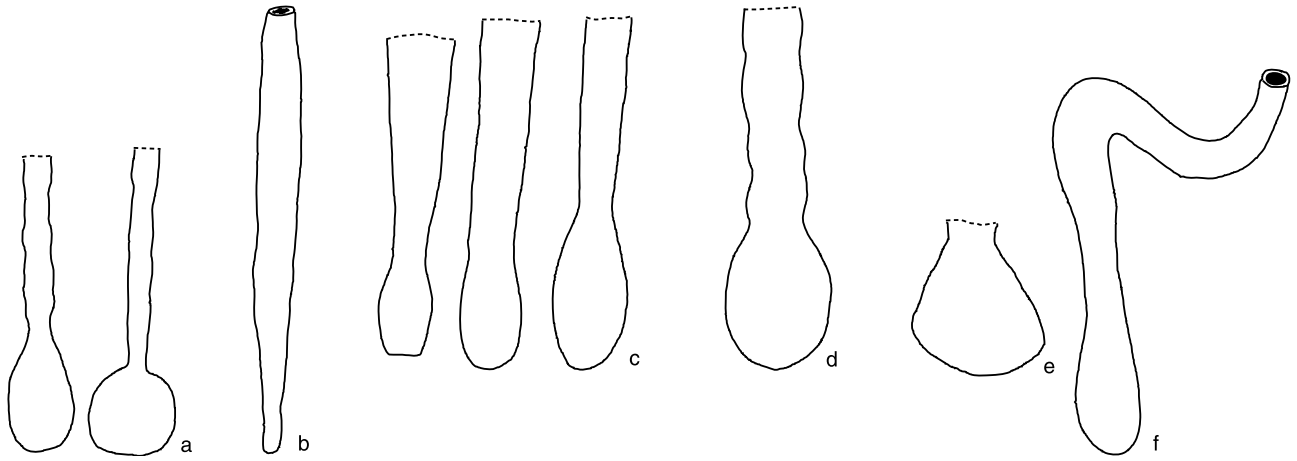
Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Údolí Hluboké Valley, Při trati Quarry, U jezírka Quarry)

Other distribution: Upper Devonian of the East Thuringian Slate Mountains (Blumenstengel, 1961); Mississipian of Missouri, Illinois, Montana (Gutschick, 1962; Conkin et al., 1968)

Hyperammina rockfordensis GUTSCHICK et TRECKMAN, 1959

Text-fig. 20c, Pl. 6, fig. 3; Pl. 8, figs 2 – 5; Pl. 9, fig. 4, 8; Pl. 11, fig. 7, 8

1959 *Hyperammina rockfordensis* GUTSCHICK et TRECKMAN, Gutschick and Treckman, Arenaceous Foraminifera from the Rockford Limestone..., pp. 238, pl. 34, figs 1–5, text-fig. 1-a-c



Text-fig. 20. A sketch of morphotypes from family Hippocrepinidae Rhumbler 1895. a – *Hyperammina gracilenta* GUTSCHICK et TRECKMAN; b – *Hyperammina kahlleinwensis* BLUMENSTENGEL; c – *Hyperammina rockfordensis* GUTSCHICK et TRECKMAN; d – *Hyperammina* sp. 1; e – *Hyperammina* (?) sp. 2; f – *Saccorhiza* aff. *proboscis* (BELL).

Description: Test free, robust. Ellipsoidal proloculus followed by tubular straight second chamber. Only gently tapering between proloculus and second chamber. In some specimens, second chamber having poorly visible constrictions (Pl. 8, figs. 2–5) or slightly enlarged (Pl. 11, fig. 7, 8). Diameter of proloculus similar to that of the second chamber. Aperture not preserved in any broken test (only broken specimens studied). Wall agglutinated, composed of fine material.

Material: about 150 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Údolí Hluboké Valley, Stydlé vody Quarry, Opatřilka Quarry, Homolka near Velká Chuchle, section below Barrandov); Dalejan (Třebotov Lst.: Chýnice – old quarry, Údolí Hluboké Valley, Prastav Quarry, U jezírka Quarry), Eifelian (Kačák Creek Valley)

Other distribution: Upper Devonian of the East Thuringian Slate Mountains (Blumenstengel, 1961) and Kentucky (Conkin, 1961); uppermost Devonian of the Holy Cross Mts. (Olempska 1983); Mississippian of Indiana (Gutschich and Treckman, 1959), Missouri (Conkin et al. 1968).

Hyperammina sp. 1

Text-fig. 20d, Pl. 11, fig. 6; ? Pl. 14, fig. 5

Description: Test free, with elongate proloculus followed by slender tubular straight second chamber. Proloculus broader than the second chamber, being separated by constriction. Wall agglutinated, composed of fine-grained material.

Remarks: Test shape is very similar to that of *H. gracilenta*, which is smaller and has a thinner test wall.

Material: about 60 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Old Quarry), Dalejan (Chýnice, Nad tratí) Třebotov Lst. (nodular)

Hyperammina (?) sp. 2

Text-fig. 20e, Pl. 1, fig. 14

Description: Test free, proloculus triangular in outline, separated from second tubular chamber by a tapering. Wall agglutinated, composed of fine-grained material. With only a small part of the second chamber being known, the specimens cannot be safely attributed to genus *Hyperammina*.

Material: 1 specimen

Distribution in the Barrandian area: Homerian (Kační Quarry)

Genus ***Saccorhiza*** EIMER et FICKERT, 1899

Saccorhiza aff. ***proboscis*** (BELL, 1996)

Text-fig. 20f, Pl. 17, fig. 2

1996 *Hyperammina proboscis* BELL, Bell, Early Devonian (Emsian) agglutinated foraminiferans..., p. 86, 88, figs 7A, B

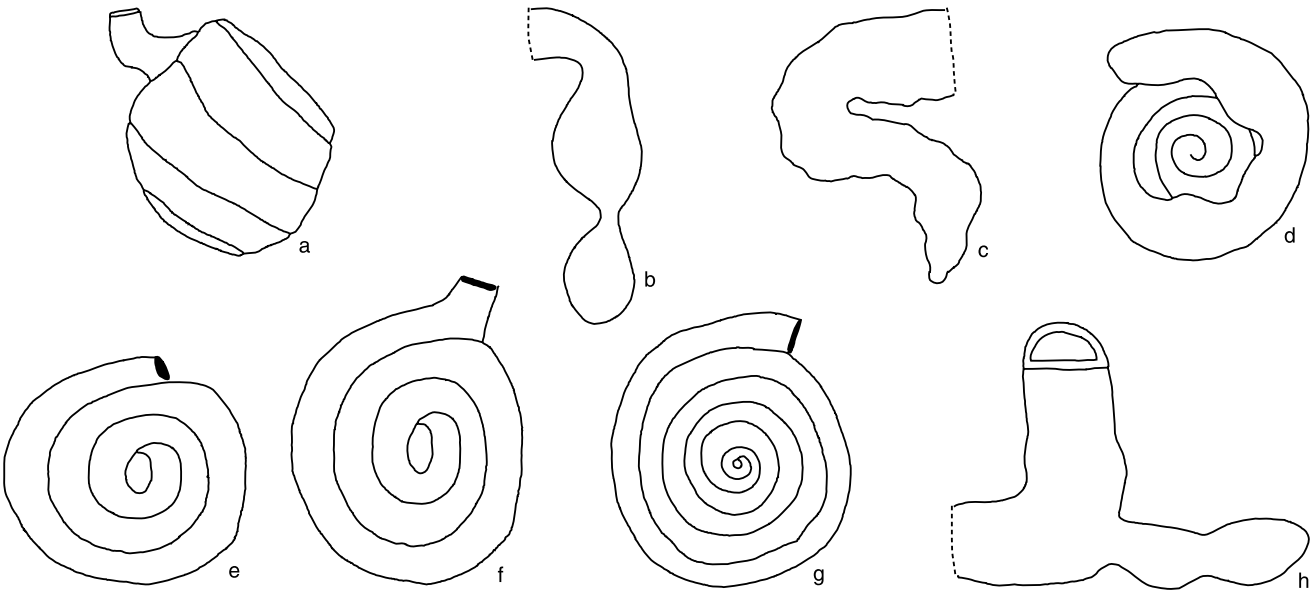
Description: Test free. Ellipsoidal proloculus gradually followed by tubular second chamber without any constriction. Second chamber slightly tapered and then slightly enlarged, sinusoidally curved after the first straight interval. Aperture rounded at the end of second chamber. Wall agglutinated, composed of very fine, well cemented material.

Remarks: Specimens from the Barrandian area differ from the original material in their fine and well cemented material of tests in comparison with poorly cemented angular grains. They have two turns while the Australian specimens possess one turn only.

Material: 3 specimens

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Prastav Quarry)

Other distribution: Emsian of Victoria, Australia (Bell, 1996)



Text-fig. 21. A sketch of morphotypes from family Ammodiscidae REUSS, 1862 (with the exception of tolypamminas). a – *Glomospira* (?) sp.; b – *Ammovolummina* sp.; c – *Serpenulina uralica* TSCHERNICH; d – *Ammodiscella* sp.; e – *Ammodiscus* sp.; f – *Ammodiscus exsertus* CUSHMAN; g – *Ammodiscus* ex gr. *incertus* (D'ORBIGNY); h – Ammodiscidae gen. et sp. indet.

Family ***Ammodiscidae*** REUSS, 1862

Genus ***Glomospira*** RZEHAK, 1885

Glomospira (?) sp.

Text-fig. 21a, Pl. 1, fig. 10

Description: Test free, secondarily compressed. Proloculus followed by undivided tubular second chamber trochospirally coiled about its axis, with a sharp change in direction of coiling observed in the final stages. Wall agglutinated, composed of fine material. Aperture circular, situated at open end of the second chamber.

Material: 1 specimen

Distribution in the Barrandian area: Ludfordian (Smoking Quarry)

Genus ***Ammovolummina*** CHERNYKH, 1967

Ammovolummina sp.

Text-fig. 21b, Pl. 5, fig. 8

Description: Test free, with large ovoid proloculus followed by tubular second chamber, and separated from the second chamber by hourglass tapering. Second chamber curved, rapidly enlarged in initial stage, later with constant diameter. Wall agglutinated, thick, composed of medium-grained material.

Remarks: In contrast to the described Siberian specimens, the second chamber does not enlarge continuously from the proloculus to the apertural end. Only the figured, partly broken specimen was found, which is not sufficient for the establishment of a new species.

Distribution in the Barrandian area: Pragian (Old Quarry)

Other distribution: Middle Silurian of Siberia (Tschernich, 1967)

Genus ***Serpenulina*** TSCHERNICH, 1967

Serpenulina uralica TSCHERNICH, 1967

Text-fig. 21c, Pl. 2, fig. 1

1967 *Serpenulina uralica* TSCHERNICH, Tschernich, Novyje pozdnesilurskije foraminifery Urala, p. 43, Pl. 3, figs 8–11

Description: Test attached, oval proloculus poorly recognizable, followed by hemitubular enlarged second chamber. Second chamber making a weak U-turn. Aperture situated at open end of the second chamber. Wall agglutinated, composed of fine to medium-sized, well cemented grains.

Distribution in the Barrandian area: Ludfordian (Kosov Quarry)

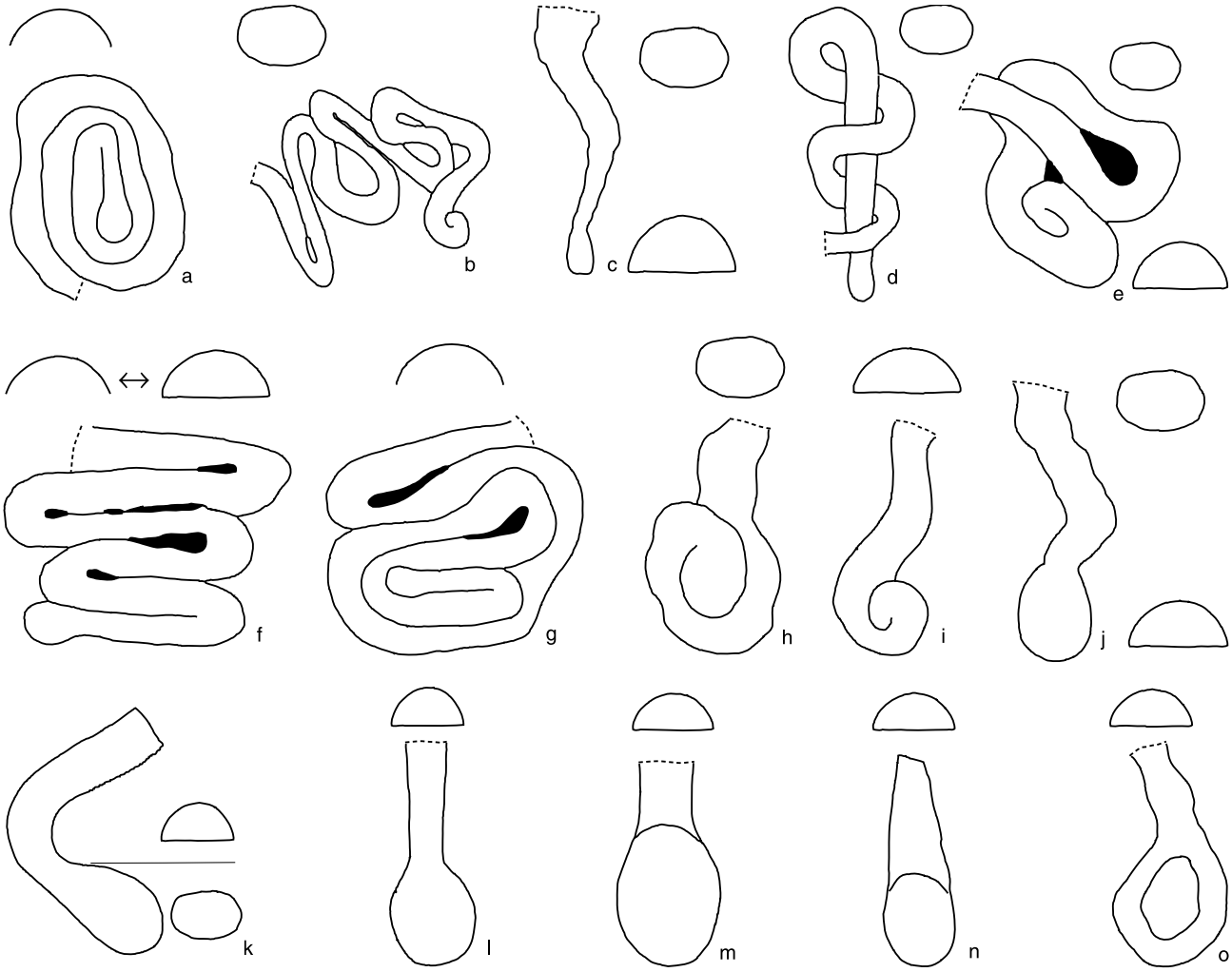
Other distribution: Ludlow of Siberia (Tschernich, 1965); Lochkovian of Australia (Bell, 1999)

Genus ***Ammodiscella*** IRELAND, 1956

Ammodiscella sp.

Text-fig. 21d, Pl. 9, fig. 12

Description: Test attached, small proloculus followed by tubular, planispirally coiled second chamber. 3–4 whorls regular, the last one becoming irregular, overlapping the previous whorls. Aperture rounded, situated at open end of tube. Wall agglutinated, with small-sized grains.



Text-fig. 22. A sketch of morphotypes from family Ammodiscidae (genus *Tolypammina* RHUMBLER, 1895). a – *Tolypammina irregularis* BLUMENSTENGEL; b – *Tolypammina polyverta* IRELAND; c – *Tolypammina sperma* GUTSCHICK, WIENER et YOUNG; d – *Tolypammina* aff. *tornella* (IRELAND); e – *Tolypammina tortuosa* DUNN; f – *Tolypammina* sp. 1; g – *Tolypammina* sp. 2; h – *Tolypammina* sp. (? *T. nodosa* IRELAND); i – *Tolypammina* sp. 3; j – *Tolypammina* sp. 4; k – *Tolypammina bulbosa* (GUTSCHICK et TRECKMAN); l – *Tolypammina* sp. 5; m – *Tolypammina* sp. 6; n – *Tolypammina* sp. 7; o – *Tolypammina* sp. 8.

Remarks: Rare occurrence (2 specimens) does not permit to study variability of ammodiscellas. Therefore, a more detailed classification was not proposed.

Distribution in the Barrandian area: Dalejan (Suchomasty Lst.: Hergetův lom Quarry)

Other distribution: Pennsylvanian of Kansas (Ireland, 1956)

Genus ***Tolypammina*** RHUMBLER, 1895 versus ***Ammovertella*** CUSHMAN, 1928

Separation of genera *Tolypammina* and *Ammovertella* resulted in an equivocal interpretation of their concept in the literature (Ireland, 1956; Barnard, 1958; Gutschick and Treckman, 1959; Conkin, 1961; Conkin and Conkin, 1964; Loeblich and Tappan, 1987; Bell, 1996). Ireland (1956) proposed the following criteria for distinguishing the genera: cross-sections of second chamber (circular in *Tolypammina*, hemicircular in *Ammovertella*), coiling of the initial part of second chamber (possibly coiled in *Tolypammina*, sinuous in *Ammovertella*), and the presence/absence of agglutinated floor of attached part of second chamber (agglutinated floor present in *Tolypammina* but not found in *Ammovertella*). Gutschick and Treckmann (1959) followed these criteria but described forms which combined features of both genera. This observation was also confirmed by the study of Barrandian foraminifers (forms with hemicircular second tube with coiled initial part). Also Conkin (1961) used the same criteria for distinguishing different genera. Barnard (1958) proposed a simple separation of these genera: *Tolypammina* has no initial coiling of second chamber, *Ammovertella* has this initial coiling. This concept was also applied by Bell (1996). As it has been shown by the observations of Ireland (1956), the presence/absence of initial coiling may represent intraspecific variability (*T. polyverta* IRELAND, *A. inclusa* CUSHMAN et WATERS, *A.primaparva* IRELAND),

which contradicts the concept of Barnard (1958). Loeblich and Tappan (1987) characterized genus *Ammovertella* by the second chamber grown in zigzag fashion only. *Tolypammina* has an irregular second chamber. Forms with coiled second chamber can be attributed to *Ammodiscella* IRELAND or *Hemidiscella* BOCK. This concept contradicts the original diagnosis of *Ammodiscella*, where at least four coils of planispiral part of the second chamber are described. Maximum 2–3 coils were described in *Ammovertella* and *Tolypammina* species.

As no criterion was found to provide an explicit separation of genera *Ammovertella* and *Tolypammina*, genus *Ammovertella* is synonymized with genus *Tolypammina* in this paper.

Tolypamminas are common foraminifers in the Devonian samples but majority of the specimens are broken. As fragments are impossible to determine, the *Tolypammina* morphotypes to be classified are diveded into three groups: (1) complete specimens or almost complete specimens, which can be determined; (2) fragments of proloculus and a small part of the second chamber (*Tolypammina* sp. 3–8); (3) fragments of the second chamber. These can be classified as *Tolypammina* only if they are hemicircular in cross-section (sp. 6). Tube-like fragments with circular outline may also belong to hyperamminas. Classification of these fragments is summarized at the end of Suborder Textulariina.

(1) Complete and almost complete specimens

Tolypammina irregularis BLUMENSTENGEL, 1961

Text-fig. 22a, Pl. 9, fig. 9; Pl. 17, fig. 16

1961 *Tolypammina irregularis* BLUMENSTENGEL, Blumenstengel, Foraminiferen aus den Thuringer Oberdevon, p. 324, pl. II, figs. 25–28, 31

Description: Test attached, with hemispherical proloculus followed by hemitubular second chamber. After straight stage, chamber is planispirally coiled. Its diameter may change irregularly. Wall agglutinated, composed of fine material. Bottom wall of attachment absent.

Material: about 15 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Opatřilka Quarry), Dalejan (Třebotov Lst.: Prastav Quarry)

Other distribution: Upper Devonian of the East Thuringian Slate Mountains (Blumenstengel, 1961) and Holy Cross Mountains (Olempska, 1983)

Tolypammina polyverta IRELAND, 1956

Text-fig. 22b, Pl. 8, figs. 9, 10, 11

1956 *Tolypammina polyverta* IRELAND, Ireland, Upper Pennsylvanian arenaceous Foraminifera from Kansas, p. 850, textfigs 4-30-35

Description: Proloculus small, followed by tubular, slightly enlarged second chamber. Initial stage of tube coiled (about 1 whorl), with growth becoming irregular later: prevalently sinuous growth, with U-turns (Pl. 8, figs 10, 11). Irregular structures arranged in space. Wall agglutinated, with very fine material, surface smooth.

Material: 3 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry)

Other distribution: Pennsylvanian of Kansas (Ireland, 1956)

Tolypammina sperma GUTSCHICK, WIENER et YOUNG, 1961

Text-fig. 22c, Pl. 6, fig. 4; Pl. 13, figs 10, ?11

1961 *Tolypammina sperma* GUTSCHICK, WIENER et YOUNG, Gutschick, Wiener and Young, Lower Mississippian arenaceous Foraminifera, p. 1217, Pl. 150, fig. 12

Distribution: Tests attached, with large hemispherical proloculus followed by hemitubular, later tubular enlarged second chamber. The second chamber is sinuous. Constriction present between proloculus and second chamber. Wall agglutinated, composed of medium-grained material.

Material: 5 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Údolí Hluboké Valley), Dalejan (Třebotov Lst.: Údolí Hluboké Valley)

Other distribution: Mississippian of Oklahoma, Texas and Montana (Gutschick et al., 1961)

Tolypammina aff. ***tornella*** (IRELAND, 1956)

Text-fig. 22d, Pl. 4, fig. 11

1956 *Ammovertella tornella* IRELAND, Ireland, Upper Pennsylvanian arenaceous Foraminifera from Kansas, p. 855, textfigs 5-16-19

Description: Proloculus small, followed by tubular second chamber. Tube gradually enlarged and irregularly coiled around a spine-like object. Initial stage of tube straight and parallel to this object, with the straight part partly covered by coils. Wall agglutinated, composed of medium- to fine-grained material, surface rough.

Remarks: Barrandian specimens differ from Ireland's specimens in their rough surface and gaps between coils.

Material: 2 specimens

Distribution in the Barrandian area: Pragian (Homolka Quarry)

Other distribution: Pennsylvanian of Kansas (Ireland, 1956)

Tolypammina tortuosa DUNN, 1942

Text-fig. 22e, Pl. 8, figs 7, 8

1942 *Tolypammina tortuosa* DUNN, Dunn, Silurian Foraminifera of the Mississippi Basin, p. 44, figs 19–21, 32

Description: Test attached, proloculus followed in initial stage by planispiral coiled and hemitubular second chamber (one and a half whorl). The second chamber later becomes

irregular in growth and ellipsoidal in cross-section. Wall agglutinated, composed of medium-sized grain material.

Material: 10 specimens

Distribution in the Barrandian area: Lochkovian (Homolka near Velká Chuchle), Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry, Homolka Quarry), Zlichovian (Stydlé vody Quarry)

Other distribution: Silurian of the Mississippi Basin (Dunn, 1942)

Tolypammina sp. 1

Text-fig. 22f, Pl. 4, figs 9, 10

Description: Test attached, proloculus small and hemioval, followed by hemitubular second chamber of constant diameter. Initial part of second chamber narrow, with tubes making U-turns later. Distances between bends approximately equal. Test generally rectangular in shape. Walls between bends partly doubled, partly single. Final part of tube probably irregular. Wall agglutinated, composed of fine material, with smooth surface on convex side and rough surface on attached side. Floor of attached side missing in some specimens.

Remarks: Zigzag growth characterizes initial stage of species *A. inclusa* CUSHMAN et WATERS, *A. primaparva* IRELAND, *A. prodigalis* IRELAND. None of these species can be compared with specimens from the Barrandian area. Well preserved specimens with preserved irregular final stage of second chamber for the establishment of a new species are missing.

Material: 3 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Homolka Quarry, Pod terasami Quarry)

Tolypammina sp. 2

Text-fig. 22g, Pl. 17, fig. 13

Description: Test attached. Proloculus small, followed by hemicircular second chamber. Chamber making a U-turn after 1 1/2 coil and then a U-turn after another 1 1/2 of coil. Wall agglutinated, composed of fine material. Attached wall absent.

Material: 1 specimen

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Prastav Quarry)

(2) Fragments of proloculus and coiled second chamber

Tolypammina sp. (? *T. nodosa* IRELAND, 1956)

Text-fig. 22h, Pl. 17, fig. 15

1956 *Tolypammina nodosa* IRELAND, Ireland, Upper Pennsylvanian arenaceous Foraminifera..., p. 850, Text-fig. 4-25-29

Description: Test apparently free, with inflated spots probably representing areas of attachment. Proloculus large, spherical, separated from tubular second chamber by constrictions. Initial stage of second chamber planispirally coiled (1 whorl), later stage uncoiled. Second chamber possessing characteristic constrictions and only slightly enlarged. Wall thin, composed of fine material.

Remarks: Fragments of proloculus and initial stage in the Barrandian material agree with the diagnosis of *T. nodosa*. No complete specimens have been found; as a result, these fragments cannot be safely determined.

Material: about 100 specimens

Distribution in the Barrandian area: (?) Ludlow (Požáry section), Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry, Homolka Quarry, Opatřilka Quarry, V rokli Quarry), Dalejan (Daleje Sh.: Ke hřbitovu section; Třebotov Lst.: Prastav Quarry, Chýnice – old quarry, U jezírka Quarry, Údolí Hluboké Valley)

Other distribution: Pennsylvanian of Kansas (Ireland, 1956)

Tolypammina sp. 3

Text-fig. 22i, Pl. 5, fig. 5

Description: Test attached, secondarily compressed. Proloculus large, originally globular to hemiglobular, followed by slightly enlarging second chamber: its initial stage planispirally coiled, than uncoiled. Diameter of second chamber very probably hemitubular. Wall agglutinated, composed of fine to medium-grained material.

Remarks: These fragments may represents initial stage of *T. botonuncus* GUTSCHICK et TRECKMAN or *T. cyclops* GUTSCHICK et TRECKMAN described from the Carboniferous of several regions of the U.S.A.

Material: 3 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop. Lst.: Old Quarry)

(3) Fragments of proloculus and uncoiled second chamber

Tolypammina sp. 4

Text-fig. 22j, Pl. 11, figs 10, 11; Pl. 14, fig. 4 ; Pl. 17, figs 7, 8, 10

Description: Test attached. Proloculus large, hemiovoid followed by sinuous, hemitubular, later tubular second chamber. Second chamber possessing characteristic constrictions, with irregularly changing diameter. Wall agglutinated, composed of medium-grained material.

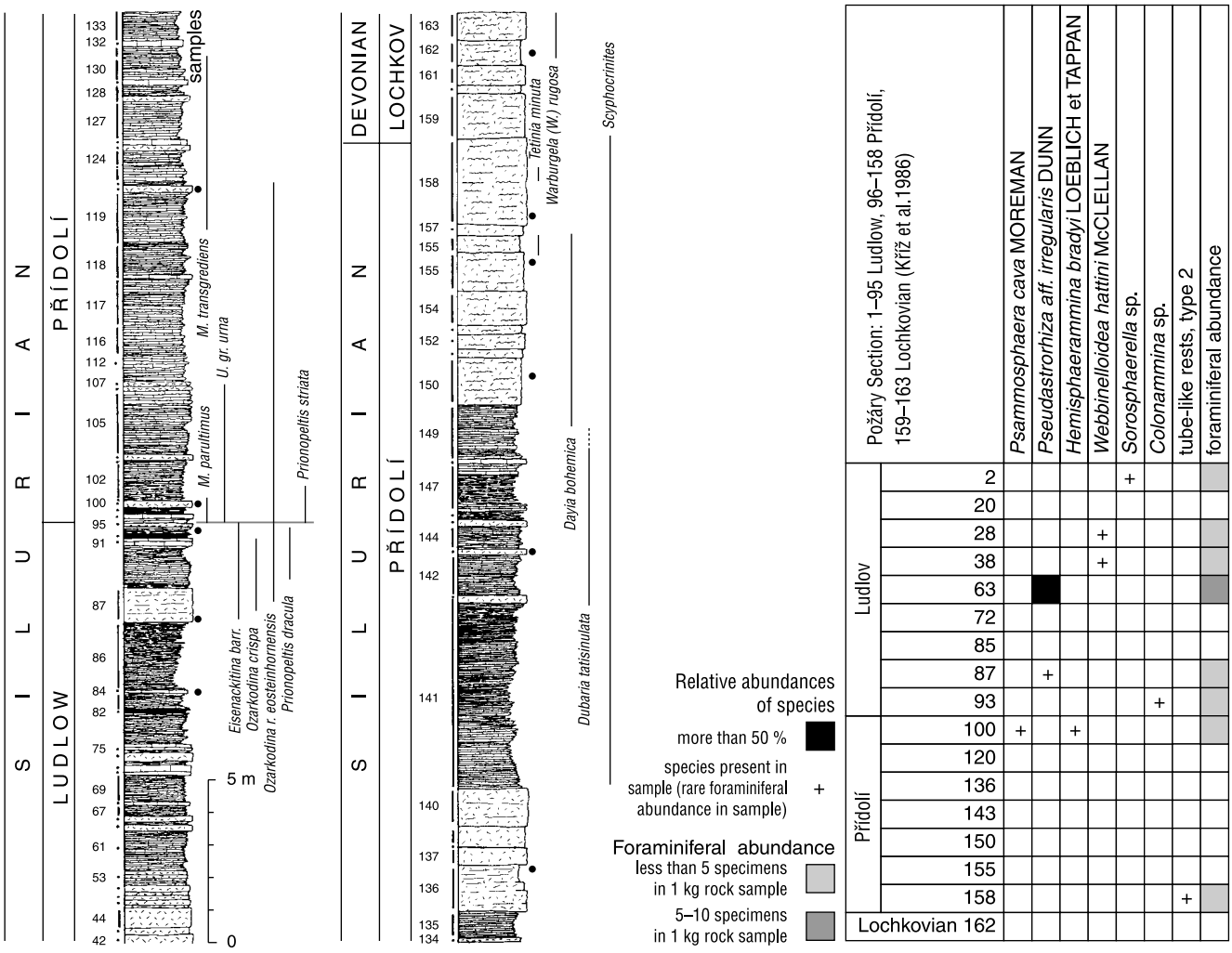
Material: about 10 specimens

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Chýnice – old Quarry, Údolí Hluboké Valley, Nad tratí Quarry, Prastav Quarry)

Tolypammina bulbosa (GUTSCHICK et TRECKMAN, 1959)

Text-fig. 22k, Pl. 17, figs 11, 12

1959 *Ammovertella bulbosa* GUTSCHICK et TRECKMAN, Gutschick and Treckman, Arenaceous Foraminifera from the Rockford limestone ... , p. 247, Pl. 37, figs 4–5, 8–9



Text-fig. 23. Požáry section, lithology and ranges of selected fossils from Kříž 1992.

1964 *Tolypammina bulbosa* (GUTSCHICK et TRECKMAN), Conkin and Conkin, Devonian Foraminifera..., pp. 92–95, Pl. 13, figs 12–17

Description: Test attached. Proloculus large, ovoid, followed by hemitubular second chamber. Initial stage of tubular chamber turning, then straight. Further continuation of the chamber not observed. Wall agglutinated, composed of fine- to medium-grained material.

Material: about 100 specimens

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Prastav Quarry, Údolí Hluboké Valley, Chýnice – old quarry), Eifelian (Choteč Lst.: Kačák Creek Valley)

Other distribution: Devonian of Missouri and Illinois (Conkin and Conkin, 1964); Mississippian of Indiana (Gutschick and Treckman, 1959)

Tolypammina sp. 5

Text-fig. 22l, Pl. 9, fig. 7; Pl. 12, fig. 7

Description: Test attached. Hemispherical proloculus is followed by hemitubular straight second chamber. Its diameter is constant. Wall is agglutinated, composed of fine to medium material.

Material: 4 specimens

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Opatřilka Quarry), Eifelian (Choteč Lst.: Kačák Creek Valley)

Tolypammina sp. 6

Text-fig. 22m, Pl. 4, fig. 1

Description: Test attached. Proloculus large, hemispherical, followed by probably straight hemitubular narrow second chamber. Constriction present between proloculus and second chamber in convex part of test. Shape of second chamber questionable due to preservation of only very small part. Test agglutinated, composed of medium-grained material.

Material: 4 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Homolka Quarry, Stydlé vody Quarry, Braník Quarry); Zlichovian (Stydlé vody Quarry)

	Na bříči section, Požáry Fm. (Přídolí), Lochkovian, Kříž, 1992, Chlupáč et al., 1972	*Thuraminoides sphaeroidalis* PLUMMER	*Webbinelloidea* sp.	tube-like rests, type 2	foraminiferal abundance
Ludlov	1				
	2	+	+	+	
	3				
Přídolí	0 m				
	0.5 m				
	1.0 m				
	2.0 m				

less than 5 specimens in 1 kg rock sample

\+ species present in sample (rare foraminiferal abundance in sample)

Text-fig. 24. "Na bříči" section.

Tolypammina sp. 7

Text-fig. 22n, Pl. 5, fig. 13

Description: Test attached, proloculus hemispherical, followed by gradually narrowing hemitubular straight second chamber. Diameter of initial part of second chamber nearly equal to proloculus diameter. Second chamber possessing constrictions. Wall agglutinated, composed of medium-sized material.

Material: 1 specimen

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Pod terasami Quarry)

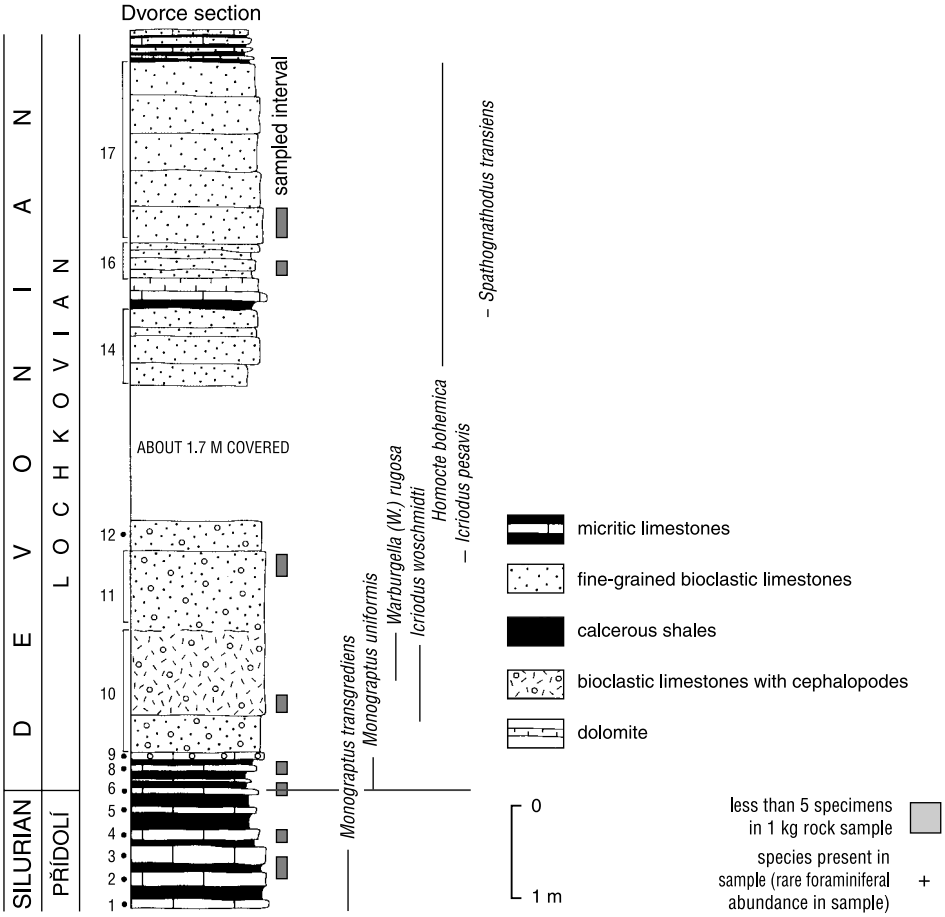
Tolypammina sp. 8

Text-fig. 22o, Pl. 5, fig. 7

Description: Test attached, proloculus large, hemispherical, followed by a narrow hemitubular second chamber. Floor of attached side absent in some specimens, especially in the proloculus. Second chamber inclined towards proloculus. Wall agglutinated, composed of fine-grained material.

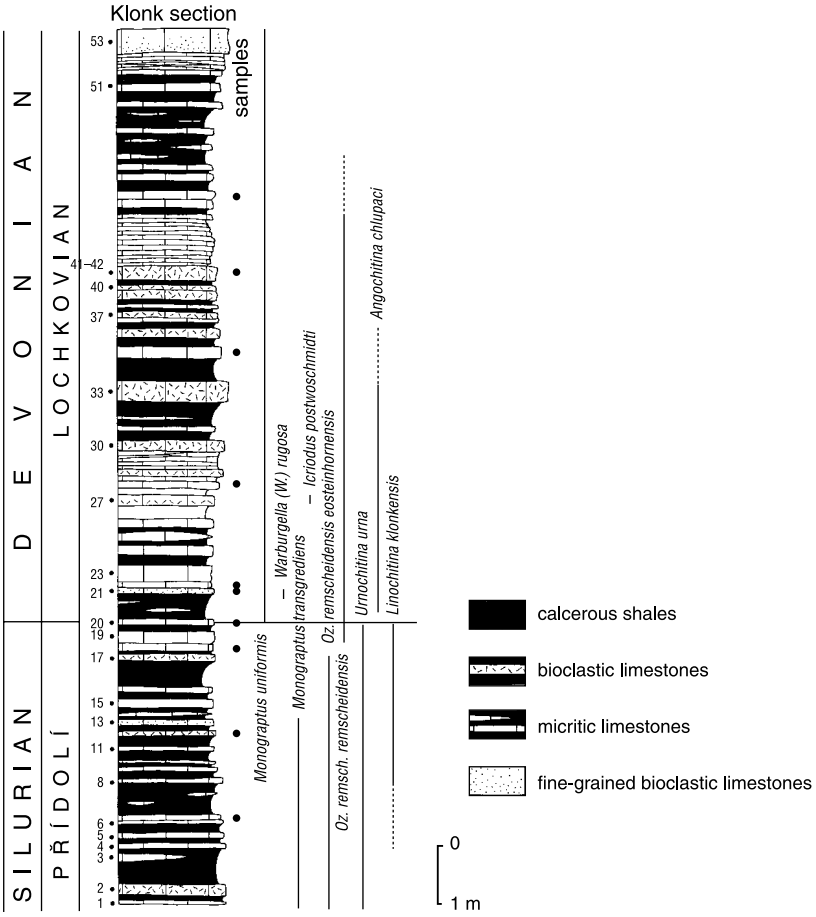
Material: 1 specimen

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Old Quarry)



Dvorce section, northern section, 1–6 Silurian (Požáry Mb., Pridolian), 7 Devonian (Lochkov Mb., Lochkovian) Chlupáč et al. 1972, Kříž 1992, 1999	*Rhabdammina* (?) sp. – fragments	*Psammosphaera cava* MOREMAN	*Thuraminoides sphaeroidalis* PLUMMER	foraminiferal abundance
2–3		+		
4				
6–7				
8				
10	+		+	
11				
16		+		
17				

Text-fig. 25. Dvorce section, lithology and ranges of selected fossils from Kříž 1992.



Klonk – stratotype of Silurian/Devonian boundary, 1-lower part of 20 – Silurian (Přídolí), upper part of 20 – Devonian (Lochkovian), Chlupáč et al. 1972, Chlupáč et al. 1998	*Psammosphaera devonica* STEWART et LAMPE	*Thuraminoides sphaeroidalis* PLUMMER	foraminiferal abundance
7			
12			
18			
19			
20	+	+	
21			
22			
26			
34			
42			
46			

less than 5 specimens in 1 kg rock sample
species present in sample
\+ (rare foraminiferal abundance in sample)

Text-fig. 26. Klonk section, lithology and ranges of selected fossils from Chlupáč et al. 1972.

Tolypammina sp. – fragment of tubular second chamber
Pl. 5, figs 9, 16; Pl. 9, fig. 5; Pl. 12, fig. 8

Description: Among numerous tubular rests, only hemitubular ones were classified as *Tolypammina* sp. The others cannot be classified into genera and are described below. Hemitubular fragments slightly curved, composed of medium-grained material.

Material: about 80 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Údolí Hluboké Valley), Zlichovian (Kačák Creek Valley), Dalejan (Suchomasty Lst: Červený lom Quarry)

Genus ***Ammodiscus*** REUSS, 1862

Ammodiscus ex gr. ***incertus*** (D'ORBIGNY, 1838)
Text-fig. 21g, Pl. 11, fig. 5; Pl. 12, fig. 4; Pl. 18, figs 7–9

1838 *Operculina incerta* D'ORBIGNY; d Orbigny, Foraminiferes, p. 49, Pl. 6: 16,17

1941 *Ammodiscus incertus* (D'ORBIGNY); Stewart and Priddy, Arenaceous Foraminifera from the Niagarian rock, etc., p. 374, Pl. 54: 19

Description: Test free, planispirally coiled, with tubular second chamber having 4–6 coils. Last whorls (the 5th and 6th) partly enclosed by the successive whorl. Aperture situated at open end of tube. Wall agglutinated, composed of fine to medium-sized grains.

Material: about 300 specimens

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Chýnice – old quarry, Údolí Hluboké Valley, Prastav Quarry, Při trati Quarry), Eifelian (Choteč Lst.: Kačák Creek Valley)

Other distribution: common from the Lower Silurian (Conkin and Conkin, 1982)

Ammodiscus exsertus CUSHMAN, 1910
Text-fig. 21f, Pl. 12, fig. 9, (?) 10

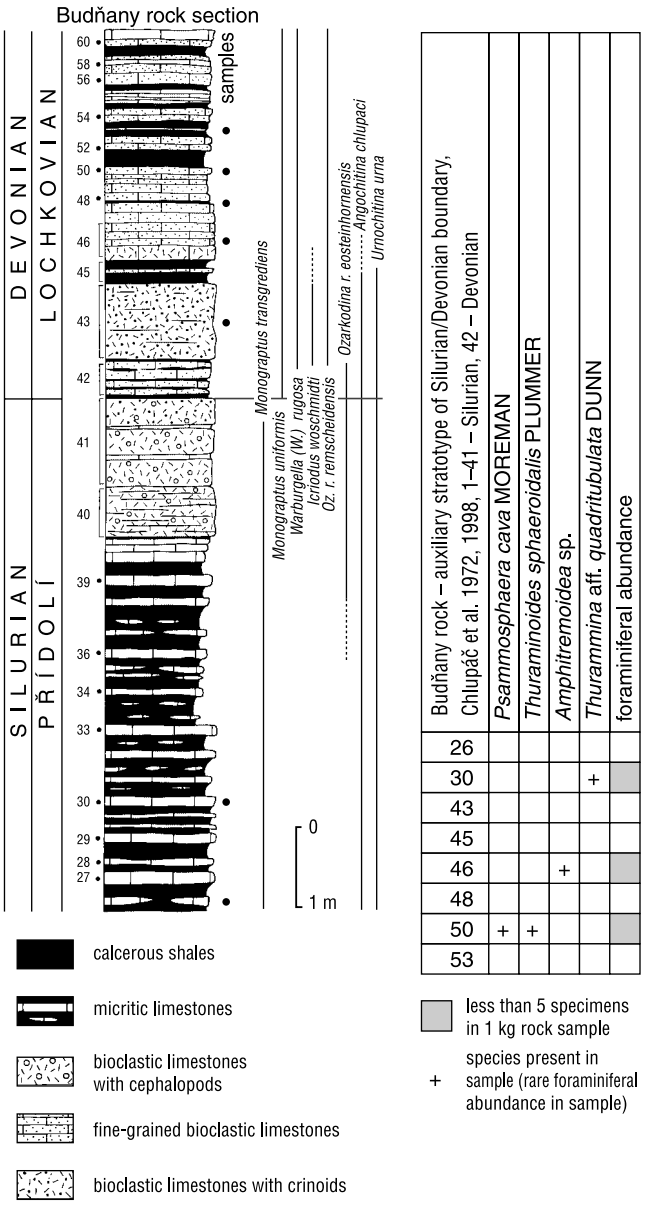
1910 *Ammodiscus exsertus* CUSHMAN, Cushman, A monograph of the foraminifera... , p. 75, figs 97a, b

Description: Test free, proloculus followed by tubular second chamber planispirally coiled with 3–4 coils. Final part of second chamber uncoiled, extending perpendicular from the plane of coiling. Aperture situated at end of second chamber. Wall agglutinated, composed of medium to coarse grains.

Material: 2 specimens

Distribution in the Barrandian area: Dalejan (Údolí Hluboké Valley)

Other distribution: common from the Lower Silurian (Conkin and Conkin, 1982)



Budňany rock – auxiliary stratotype of Silurian/Devonian boundary, Chlupáč et al. 1972, 1998, 1–41 – Silurian, 42 – Devonian	*Psammosphaera cava* MOREMAN	*Thuraminoides sphaeroidalis* PLUMMER	*Amphitremoidea* sp.	*Thurammina* aff. *quadritubulata* DUNN	foraminiferal abundance
26					
30				+	
43					
45					
46			+		
48					
50	+	+			
53					

Text-fig. 27. Budňany Rock section, lithology and ranges of selected fossils from Chlupáč et al. 1972.

Ammodiscus sp.

Text-fig. 21e, Pl. 8, fig. 6

Description: Proloculus small, followed by planispirally coiled second chamber. Central part of test with proloculus often missing. 3–4 whorls observable. Aperture representing open end of the second chamber. Wall agglutinated, composed of medium-sized grains, poorly cemented.

Remarks: *Ammodiscus* sp. described from the Pragian differs from *A.incertus* from the Dalejan in its poorly cemented wall, abundant damages of test and smaller size of test with lower number of coils.

Material: 5 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry, Old Quarry, V rokli Quarry, section below Barrandov)

Ammodiscidae gen. et sp. indet.

Text-fig. 21h, Pl. 13, figs 8, 9; Pl. 17, fig. 14

Distribution: Test attached, proloculus ovoid to hemiovoid, followed by undivided hemitubular second chamber that may be dichotomously branched. Attached wall markedly plane. Diameter of second chamber irregularly changing, with characteristic constrictions. Aperture not observed. Wall agglutinated with very fine-grained material.

Remarks: Dichotomous branching has not been described among attached Ammodiscidae. Barrandian morphotype probably represents a new genus. No complete specimen acceptable as a holotype was found in the studied material. Therefore, the new taxa have not been described yet.

Material: about 20 specimens

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Údolí Hluboké Valley, Prastav Quarry)

Tube-like rests

Tube-like rests are common in many samples. They lack characteristics diagnostic for the classification into specific genera. Therefore, the different types of the tube-like rests are described separately.

Tube-like rests, type 1

Pl. 17, fig. 3, 4

Description: Irregularly curved tubular fragments, agglutinated with fine-grained material, probably represent rests of *Saccorhiza proboscis* which occur in the same sample.

Material: 4 specimens

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Prastav Quarry)

Tube-like rests, type 2

Pl. 3, fig. 4

Description: Fragments with a circular cross-section. Straight or slightly arcuate segments are interrupted by acute turns which may represent fractures of test. Tubes are agglutinated, composed of fine-grained material. No complete specimens with tubular chambers were found in samples with these fragments.

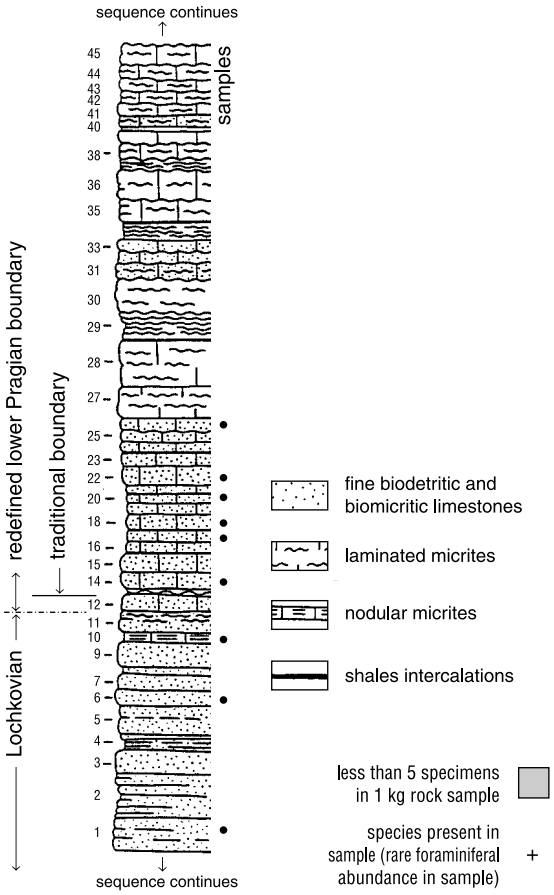
Material: about 10 specimens

Distribution in the Barrandian area: Aeronian (Hlásná Třebáň), Telychian (Litohlavy section), Homerian (Bubovice-Loděnice section), Ludfordian (Smoking Quarry, Koledník Quarry), Přídolí (Požáry section, Na bříči section)

Tube-like rests, type 3

Pl. 5, fig. 10

Description: Tubular fragments are slightly arcuate. They are agglutinated with fine grains. They occur together with hyparamminas as well as tolypamminas.



Homolka - stratotype of Lochkovian/Pragian boundary, Chlupáč et al. 1985, 1998, Chlupáč and Oliver, 1989, 1–11 – Lochkovian, 12 – Pragian		*Psammosphaera cava* MOREMAN	*Pseudastrorhiza* aff. *irregularis* DUNN	*Hemispheratammina carmani* (SUMMERSON)	*Thurammina triradiata* GUTSCHICK et TRECKMAN	*Lagenammina sphaerica* MOREMAN	*Saccammina pseudospiralis* (CUSHMAN et STAINBROOK)	*Saccammina* sp. 1	*Hyperammina rockfordensis* GUTSCHICK et TRECKMAN	*Tolypammina* aff. *tornella* (IRELAND)	*Tolypammina tortuosa* DUNN	*Tolypammina* sp. 1	*Tolypammina* sp. (? *T. nodosa* IRELAND)	*Tolypammina* sp.6	*Paratikhinellidae* gen. et sp.1	foraminiferal abundance
Pragian	26	+									+					
	22					+			+							
	20			+	+	+	+				+	+				
	18							+	+			+	+	+	+	
	17	+	+			+							+			
	14															
Lochkovian	10				+											
	6	+		+												
	1									+	+					

Text-fig. 28. Homolka-Velká Chuchle section, lithology from Chlupáč et al. 1985.

Material: 3 specimens

Distribution in the Barrandian area: Pragian (Old Quarry, Údolí Hluboké Valley)

Tube-like rests, type 4

Pl. 5, fig. 11

Description: Tubular fragments possess U-shape turns. They represent probable fragments of tolypamminas. The tubes are agglutinated with fine grains.

Material: 1 specimen

Distribution in the Barrandian area: Pragian (Old Quarry)

Family **Hormosinidae** HAECKEL, 1894

Hormosinidae gen. et sp. indet.

Pl. 14, fig. 14

Description: Test multilocular, with irregular chambers arranged in a rectilinear series. Test postmortem-flattened. Aperture not preserved. Wall agglutinated, composed of medium-sized material.

Material: 1 specimen

Distribution in the Barrandian area: Chapel Coral Horizon (section below Barrandov)

Family **Lituolidae** DE BLAINVILLE, 1827

Genus ***Ammobaculites*** CUSHMAN, 1910

Ammobaculites aff. ***leptos*** GUTSCHICK et TRECKMAN, 1959

Text-fig. 29a, Pl. 17, fig. 17

1959 *Ammobaculites leptos* GUTSCHICK et TRECKMAN, Gutschick and Treckman, Arenaceous foraminifera from the Rockford limestone ..., pp. 247–248, Pl. 37, figs 12, 13

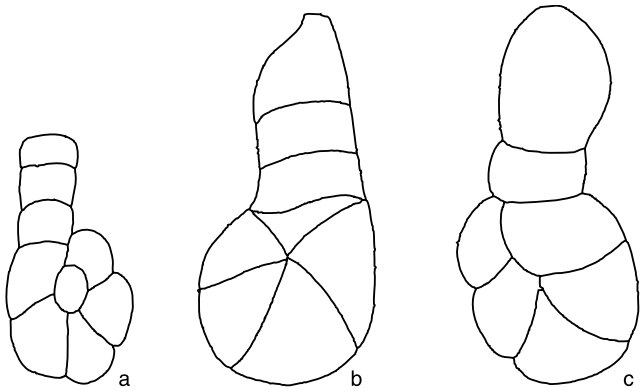
Description: Test free, small-sized, multilocular, with its early portion coiled with 5 spherical chambers in outer whorl. Later portion monoserial. Monoserial part with max. 5 chambers observed, however, with no complete specimens studied. Aperture not preserved. Wall agglutinated, with fine-grained material, surface rough.

Remarks: Barrandian specimens differ from the original material in their small size.

Material: 3 specimens

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Prastav Quarry)

Other distribution: Mississipian of Oklahoma, Texas and Montana (Gutschick and Treckman, 1959; Gutschick et al., 1961)



Text-fig. 29. A sketch of morphotypes from family Lituolidae DE BLAINVILLE, 1827. a – *Ammobaculithes* aff. *leptos* GUTSCHICK et TRECKMAN; b – *Ammobaculithes minutus* WATERS; c – *Ammobaculithes* sp. 1.

Ammobaculites minutus WATERS, 1927

Text-fig. 29b, Pl. 11, fig. 9

1927 *Ammobaculites minutus* WATERS, Waters, A group of Foraminifera from the Dornick Hills ... p. 133, Pl. 22, figs 3a, b

Description: Test free, multilocular, planispiral in early stage, later monoserial. Planispiral stage formed by 1 whorl consisting of 5–6 chambers. Sutures very slightly inflated. Periphery of planispiral stage rounded. Monoserial stage consisting of 3–4 chambers with more inflated sutures. Aperture rounded, terminal, situated at end of small neck. Wall agglutinated, composed of fine-grained material.

Material: 1 specimen

Distribution in the Barrandian area: Dalejan (Třebotov Lst.: Chýnice – old quarry)

Other distribution: Pennsylvanian of Texas (Waters, 1927) and Kansas (Ireland, 1956)

Ammobaculites sp. 1

Text-fig. 29c, Pl. 6, fig. 5

Description: Test free, multilocular, early stage planispiral, later monoserial. Planispiral stage composed of 5–6 chambers of irregular shape arranged in 1 whorl. Sutures slightly depressed, irregular in outline. Monoserial stage consisting of 3 chambers. Aperture terminal, rounded, shifted eccentrically. Wall agglutinated, composed of fine-grained material.

Material: 1 specimen

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Údolí Hluboké Valley)

Ammobaculites (?) sp.

Pl. 9, fig. 17

Description: A poorly preserved specimen, maybe partly dissolved in an acid. Test free, multilocular, consisting of coiled early portion and monoserial portion. Planispiral stage possessing a higher number of whorls. Shape of chambers difficult to distinguish, aperture not preserved. Definite classification of these specimens is hindered by their poor preservation. They may be correlated with *A. chappelensis* GUTSCHICK, WEINER et YOUNG.

Material: 1 specimen

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Údolí Hluboké Valley)

Fragments of monoserially arranged tests

Pl. 6, fig. 13

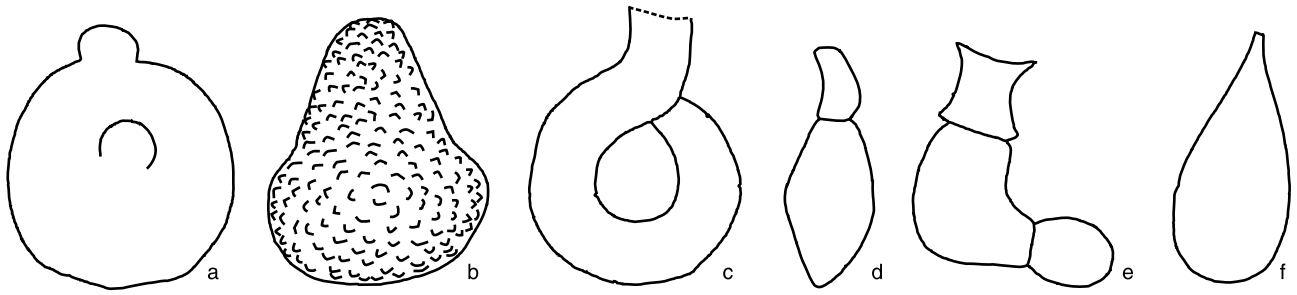
Fragments of multilocular tests are composed of elongate, monoserially arranged chambers. Fragments with 2–3 chambers were found. Wall is agglutinated, composed of fine-grained material. They may represent fragments of *Ammobaculites* or *Reophax*.

Material: 1 specimen

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Braník Quarry)

Suborder **Fusulinina** WEDEKIND, 1896

Calcareous tests were preserved only very rarely in dissolution residua. Specimens are fragmentary, partly dissolved, and morphotypes are often represented only by a single specimen. Therefore, their determination is only approximate.



Text-fig. 30. A sketch of morphotypes from suborder Fusulinina WEDEKIND. a – Archaesphaeridae gen. et sp. indet.; a – *Bisphaera* (?) sp.; a – Moravamminidae gen. et sp. indet.; a – Paratikhinellidae gen. et sp. 1; a – Paratikhinellidae (?) gen. et sp. 2; a – Nodosinellidae (?) gen. et sp. indet.

Family **Archaesphaeridae** MALAKHOVA, 1956

Archaesphaeridae gen. et sp. indet.

Text-fig. 30a, Pl. 9, figs 13, 14

Description: Test free, central sphere with two or three hemispherical protrusions. No aperture observed. Wall calcareous, very thin.

Material: 2 specimens

Distribution in the Barrandian area: Dalejan (Daleje Sh.: "Ke hřbitovu" section)

Family **Usloniidae** MIKLUKHO-MAKLAY, 1963

Genus ***Bisphaera*** BIRINA, 1948

Bisphaera (?) sp.

Text-fig. 30b, Pl. 14, fig. 17

Description: Test free. Large globular chamber connected with a smaller elongate chamber via constriction, with no septum developed between them. Aperture not visible. Wall calcareous, perforate.

Material: 1 specimen

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Pod terasami Quarry)

Other distribution: Middle and Upper Devonian, Lower Carboniferous of Russia (Bykova, 1955; Birina, 1948)

Family **Moravamminidae** POKORNÝ, 1951

Moravamminidae gen. et sp. indet.

Text-fig. 30c, Pl. 5, fig. 2

Description: Test attached. Tubular nonseptate chamber coiled, forming ring structure, probably around slender tubular object of attachment. Continuation of test probably uncoiled. Wall calcareous.

Material: 1 specimen

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Old Quarry)

Family **Paratikhinellidae** LOEBLICH et TAPPAN, 1984

Paratikhinellidae gen. et sp. 1

Text-fig. 30d, Pl. 5, fig. 15, (?) 18; Pl. 14, fig. 13

Description: Test free. Proloculus drop-like, connected via constriction with slightly curved tube partly subdivided to cylindrical chambers. Aperture not preserved. Wall calcareous.

Material: 4 specimens

Distribution in the Barrandian area: Pragian (Dvorce-Prokop Lst.: Pod terasami Quarry, Homolka Quarry)

Paratikhinellidae (?) gen. et sp. 2

Text-fig. 30e, Pl. 2, fig. 13

Description: Test free. Proloculus large, elongate, followed by second elongate curved chamber. Following chambers cylindrical, flattened in their middle parts, with restrictions between chambers. Apertural end of test not preserved. Wall calcareous.

Material: 1 specimen

Distribution in the Barrandian area: Ludfordian (Koledník Quarry)

	Černá Rokle near Kosoř – auxiliar stratotype of the Lochkovian/Pragian boundary, Chlupáč et al. 1985, 1998	*Psammosphaera gracilis* IRELAND	foramineral abundance
less than 5 specimens in 1 kg rock sample	20–25	+	
species present in sample (rare foraminiferal abundance in sample) +	80–85		

Text-fig. 31. Černá rokle near Kosoř.

Family **Nodosinellidae** RHUMBLER, 1895

Nodosinellidae (?) gen. et sp. indet.

Text-fig. 30f, Pl. 3, fig. 15; Pl. 5, fig. 19

Description: Chambers of sack type, narrower towards open end (? aperture), with calcareous wall. They may represent fragments of tests of family Nodosinellidae.

Material: 3 specimens

Distribution in the Barrandian area: Wenlock (Vyskočilka section), Pragian (V rokli Quarry)

Microfossils of other groups

These organic rests were not studied and classified in much detail. The following data are intended as information about the occurrence of other organic groups.

Radiolaria

Pl. 20, figs 1–6

Only spumellarids were found in the analysed samples. With the exception of the Choteč Lst., poorly preserved specimens were found. Abraded specimens may be mistaken for psammosphaeras. Study of walls in transmitted light enables a clear discrimination between radiolarians and psammosphaeras (psammosphaeras have thicker wall composed of grains).

Distribution: Homerian (Kační Quarry), Sheinwoodian (Loděnice-Bubovice section), Ludfordian (Smoking Quarry, Kosov Quarry), Lochkovian (Srbsko section), Pragian (Dvorce-Prokop Lst.: Opatřilka Quarry, V rokli Quarry, section below Barrandov), Zlichovian (Kačák Creek Valley, section below Barrandov), Dalejan (Třebotov Lst.: Nad tratí Quarry, U jezírka Quarry, Prastav Quarry), Eifelian (Choteč Lst.: U jezírka Quarry, Prastav Quarry)

Relative abundances of species

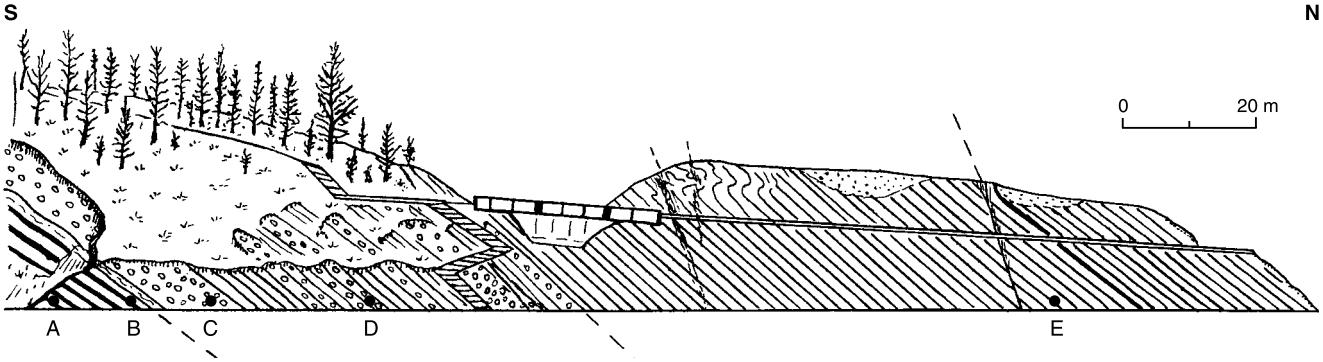
- less than 5 %
- 5–10 %
- 10–25 %
- 25–50 %
- \+ species present in sample

Foraminiferal abundance

- less than 5 specimens in 1 kg rock sample
- 5–10 specimens in 1 kg rock sample

Barrandovské skály section between Malá Chuchle and Hlubočepy and original stratotype of Pragian/Zlichovian boundary (Pragian 1–11, Zlichovian 12–15, 15 – Chapel Corral Horizon) Chlupáč et Lukeš, 1999; Kříž, 1999

		Bathysiphon sp.	*Psammosphaera cava* MOREMAN	*Thuraminoides sphaeroidalis* PLUMMER	*Hemisphearammina carmani* (SUMMERSON)	*Sorosphaerella* sp.	*Thurammina* aff. *echinata* DUNN	*Lagenammina sphaerica* MOREMAN	*Saccammina pseudospiralis* (CUSHMAN et STAINBROOK)	*Hyperammina rockfordensis* GUTSCHICK et TRECKMAN	*Ammovolummina* sp.	*Tolypammina* sp. 1	*Tolypammina* sp.3	*Tolypammina* sp.7	*Tolypammina* sp.8	*Ammodiscus* sp.	Tube-like rests, type 3	*Hormosinidae* gen. et sp. 1	*Bisphaera* (?) sp.	*Paratikhinellidae* gen. et sp.1	*Nodosinellidae* (?) gen. et sp. 1	indeterminable foraminifers	foraminiferal abundance
	Vyskočilka, wenlock																				+	+	
	Barrandova skala, Lochkov Mb., Lochkovian 1																						
	Barrandova skala, Lochkov Mb., Lochkovian 2																						
	"Old Quarry", Dvorce-Prokop Lms., Pragian																						
	"Old Quarry", Dvorec-Prokop Lms., Pragian 2																						
	"Old Quarry", Dvorce-Prokop Lms., Pragian 3				+			+			+												
	"Old Quarry", Dvorce-Prokop Lms., Pragian 4						+								+								
	"Pod terasami" Quarry, Dvorce-Prokop Lms., Pragian			+	+					+		+		+					+	+			
	"U kapličky" Quarry, Dvorce-Prokop Lms., Pragian																						
A	original stratotype 2																						
B	original stratotype 5	+			+			+		+													
C	original stratotype 14																						
D	original stratotype 15																						
E	section under the Barrandov bridge, Zlichovian	+		+																			



Text-fig. 32. "Barrandovské skály", section from Chlupáč 1999.

Sponge spicules

Pl. 20, figs16–20, 22; Pl. 21, figs 11–13, Pl. 22, fig. 10

The most common types are small-sized smooth sphaeras, often broken with clearly visible internal structure (Pl. 20, figs16–18, 20; Pl. 21, figs 11–13). Another common type is desma. Tetrapods (Pl. 20, fig. 19) and oxyasters (Pl. 20, fig. 22) occur rarely.

Distribution: Sheinwoodian (Loděnice-Bubovice section), Gorstian (Arethusina Gorge, Na břekvici section), Ludfordian (Mušlovka Quarry, Cephalopod Quarry, Koledník Quarry, Smoking Quarry, Kosov Quarry, Požáry section), Přídolí (Koledník Quarry, Kosov Quarry, Požáry section, Podolí section), Lochkovian (Barrandova skála section, Srbsko section, Homolka Quarry), Pragian (Dvorce-Prokop Lst.: Homolka Quarry, V rokli Quarry, Stydlé vody Quarry, Braník Quarry; Slivenec Lst.: Srbsko section), Zlichovian (Kačák Creek Valley, Údolí Hluboké Valley, Stydlé vody Quarry, section below Barrandov), Dalejan (Daleje Sh.: Údolí Hluboké Valley; Třebotov Lst.: Nad tratí Quarry, Chýnice – old quarry, Údolí Hluboké Val-

	"Údolí Hluboké" Valley near Karlštejn, a - Kotýs Lst. (Lochkovian), b - house No. 27 – Dvorce-Prokop Lst. (Pragian), c – Zlichov Lst. (Zlichovian), d – house No. 130 – Dalej Shales (Dalejan), Chlupáč 1999	*Psammosphaera minuta* DUNN	*Pseudastrorhiza* aff. *irregularis* DUNN	*Thuraminoides sphaeroidalis* PLUMMER	*Hemisphaerammina bradyi* LOEBLICH et TAPPAN	*Lagenammina sphaerica* MOREMAN	*Saccammina cumberlandiae* (CONKIN)	*Saccammina pseudospiralis* (CUSHMAN et STAINBROOK)	*Hyperammina rockfordensis* GUTSCHICK et TRECKMAN	*Tolypammina sperma* GUTSCHICK, WIENER et YOUNG	*Tolypammina* sp. – fragment of tubular second chamber	Tube-like rests, type 3	*Ammobaculites* aff. *leptos* GUTSCHICK et TRECKMAN	foraminiferal abundance
Kotýs Lms.	a1			+	+			+						
	a2													
	a4													
*	b1													
Zlíchov Lms.	c1													
	c2		+									+		
	c3											+		
	c4													
Daleje Sh.	d0			+										
	d1													
	d2			+										
	d3			+										
	d4													
	d5													
	d6													
	d7			+										
	d8													
	d9													

	"Údolí Hluboké" Valley near Karlštejn: e – Třebotov Lst. (Dalejan), f – quarry in Choteč Lst. (Eifelian), Chlupáč 1999	*Rhabdammina* (?) sp. - fragments	*Psammosphaera cava* MOREMAN	*Psammosphaera devonica* STEWART et LAMPE	*Psammosphaera minuta* DUNN	*Pseudastrorhiza* aff. *irregularis* DUNN	*Thuraminoides sphaeroidalis* PLUMMER	*Hemisphaerammina bradyi* LOEBLICH et TAPPAN	*Tholosina* (?) sp. 2	*Webbinelloidea tholus* (MOREMAN)	*Thurammina papillata* BRADY	*Thurammina* sp. 1	*Lagenammina sphaerica* MOREMAN	*Hyperammina gracilenta* GUTSCHICK et TRECKMAN	*Hyperammina kahlleinwensis* BLUMENSTENGEL	*Hyperammina rockfordensis* GUTSCHICK et TRECKMAN	*Hyperammina* sp. 1	*Tolypammina sperma* GUTSCHICK, WIENER et YOUNG	*Tolypammina* sp. (? T. nodosa IRELAND)	*Tolypammina* sp. 4	*Tolypammina bulbosa* (GUTSCHICK et TRECKMAN)	*Ammodiscus* ex gr. *incertus* (D'ORBIGNY)	*Ammodiscus exsertus* CUSHMAN	*Ammodiscidae* gen. et sp. indet.	foraminiferal abundance
e1			+					+											+			+		+	
e2																									
e3																									
e4																									
e5																									
e6																									
e7																									
f1								+																	
f2								+																	
f3																									
f7																									

* Dvorce-Prokop Lst.

Relative abundances of species
- less than 5 %
- 5–10 %
- 10–25 %
- 25–50 %
- \+ species present in sample

Foraminiferal abundance
- less than 5 specimens in 1 kg rock sample
- 5–10 specimens in 1 kg rock sample
- 25–50 specimens in 1 kg rock sample

Text-fig. 33. "Údolí Hluboké" Valley near Karlštejn.

ley; Suchomasty Lst.: Červený Lom Quarry), Eifelian (Choteč Lst.: Chýnice – old quarry, Kačák Creek Valley)

(?) ***Proastrum*** div. sp.

Pl. 21, figs 5–10

Star-shaped micorfossils are composed of a central body and very regularly arranged six arms in a single plane. The arms are approximately twice as long as the diameter of central body and may be predominantly slender (Pl. 21, figs 5, 7–10), rarely thick (Pl. 21, fig. 6). Two morphotypes can be distinguished on the basis of these differences in thickness of arms. They may be correlated with sponge spicules.

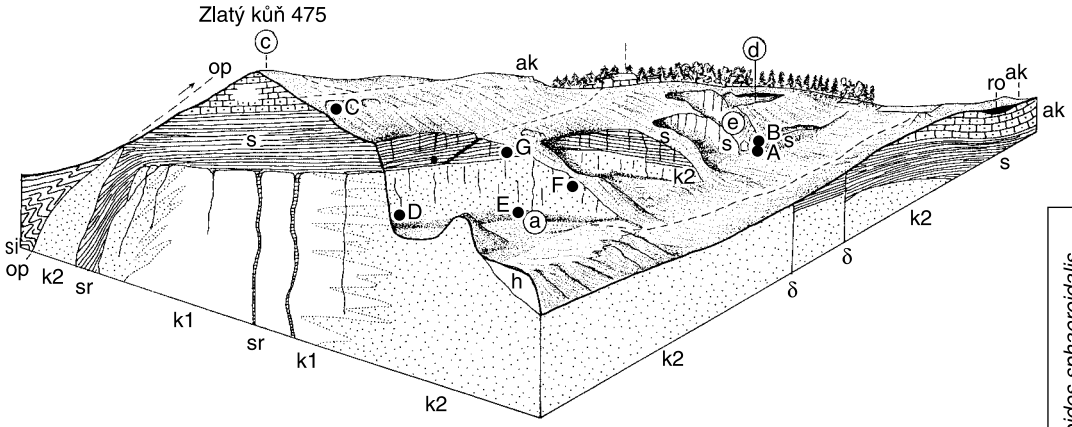
Similar forms were described by Grubbs (1939) from the Niagarian of the Chicago area. Grubbs's forms are pentagonally symmetrical (with 5 arms) but all other characteristics are fully identical. Grubbs (1939) discussed the correlation of these fragments with pelmatozoans (pentagonal symmetry) or bryozoans similar to the genus *Evactinopora*.

Distribution: Ludfordian (Koledník Quarry, Kosov Quarry, Smoking Quarry), Lochkovian (Kotýs Lst.: Údolí Hluboké Valley), Pragian (Dvorce-Prokop Lst.: Údolí Hluboké Valley, Homolka, Opatřilka Quarry, Stydlé vody Quarry, Old Quarry; Řeporyje Lst.: Srbsko section, V rokli Quarry; Koněprusy Lst.: Houbův lom Quarry), Zlichovian (Stydlé vody Quarry), Dalejan (Třebotov Lst.: Nad tratí Quarry, Chýnice – old quarry, Údolí Hluboké Valley; Suchomasty Lst. Červený Lom Quarry), Eifelian (Choteč Lst.: Kačák Creek Valley)

Polychaeta

Pl. 20, figs 7, 8, 15

The test represents a turned tube with two openings on the opposite sides of tubes. Such open tubes are described as tests of polychaetas from different stratigraphical levels. Diameter of tube is invariable. The tubes are interweaved. Wall is agglutinated, composed of fine-grained material.



Sample	Koněprusy area: Houbův lom Quarry – upper part of Koněprusy Lst. (Pragian) + Suchomasty Lst. (Dalejan), upper part of Zlatý kůň Hill Acanthopyge Lst. (Eifelian), Hergetův lom Quarry – lower part – Suchomasty Lst., Jiráskův lom Quarry-Acanthopyge Lst., Kobyla Quarry – Slivenec Lst. (Chlupáč et al., 1986; Chlupáč, 1999)	*Thuraminoides sphaeroidalis* PLUMMER	*Saccammina pseudospiralis* (CUSHMAN et STAINBROOK)	*Ammodiscella* sp.	foraminiferal abundance
A	Hergetův lom Quarry 1, Suchomasty Lst.		+		
B	Hergetův lom Quarry 2, Suchomasty Lst.	+		+	
C	Zlatý kůn Hill, Acantopyge Lst.		+		
D	Houbův lom Quarry, Koněprusy Lst., lower part				
E	Houbův lom Quarry, Koněprusy Lst., middle part				
F	Houbův lom Quarry, Koněprusy Lst., upper part				
G	Houbův lom Quarry, Suchomasty Lst.				
	Kobyla Quarry, lower part of Slivenec Lst.				
	Kobyla Quarry, upper part of Slivenec Lst.				
	Jiráskův lom Quarry, Acantopyge Lst.				

+ species present in sample (rare foraminiferal abundance in sample) less than 5 specimens in 1 kg rock sample

Text-fig. 34. Koněprusy area, section from Chlupáč 1999.

Distribution: Pragian (Dvorce-Prokop Lst.: Stydlé vody Quarry)

Ostracods

Pl. 22, figs 1–4

In the studied acid-resistant residua, only recrystallized small-sized podocopids were found with no preserved taxonomically significant characteristics.

Distribution: Aeronian (Hlásná Třebáň section), Sheinwoodian (Loděnice-Bubovice section), Homerian (U Drdů section), Gorstian (Na břekvici section), Ludfordian (Koledník Quarry, Smoking Quarry), Lochkovian (Homolka Quarry), Pragian (Dvorce-Prokop Lst.: Údolí Hluboké Valley, Opatřilka Quarry, Homolka Quarry, Stydlé vody Quarry, Starý lom Quarry; Řeporyje Lst.: Srbsko section), Zlichovian (Stydlé vody Quarry), Dalejan (Daleje Sh.: Údolí Hluboké Valley; Suchomasty Lst.: Koněprusy area), Eifelian (Choteč Lst.: Chýnice – old quarry, Prastav Quarry)

Sclerites of **Holothuroidea**

Pl. 21, fig. 8

Mostly fragments of sclerites with pentalateral symmetry were found.

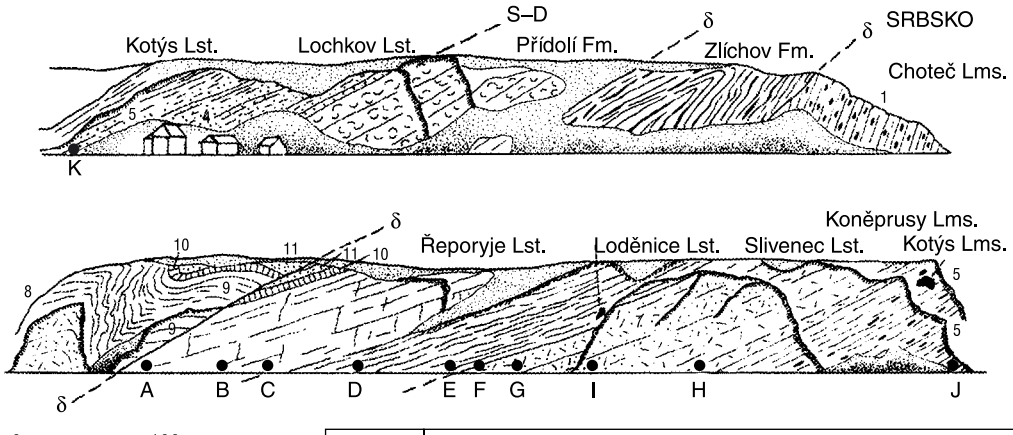
Distribution: Sheinwoodian (Loděnice-Bubovice section), Pragian (Dvorce-Prokop Lst.: Homolka Quarry, Stydlé vody Quarry; Řeporyje Lst.: Srbsko section), Dalejan (Třebotov Lst.: Chýnice – old quarry, Prastav Quarry; Suchomasty Lst.: Červený lom Quarry), Eifelian (Choteč Lst.: Prastav Quarry, Kačák Creek Valley)

Braník Quarry, Dvorce-Prokop Lms. (Pragian), Kříž 1999	*Psammosphaera cava* MOREMAN	*Pseudastrorhiza* aff. *irregularis* DUNN	*Hemisphearammina carmani* (SUMMERSON)	*Thurammina* aff. *echinata* DUNN	*Tolypammina* sp.6	foraminiferal abundance
Braník Quarry, S part			+			
Braník Quarry, middle part		+				
Braník Quarry, N part 1					+	
Braník Quarry, N part 2	+	+				

+ species present in sample (rare foraminiferal abundance in sample)

less than 5 specimens in 1 kg rock sample

Text-fig. 35. Braník Quarry.

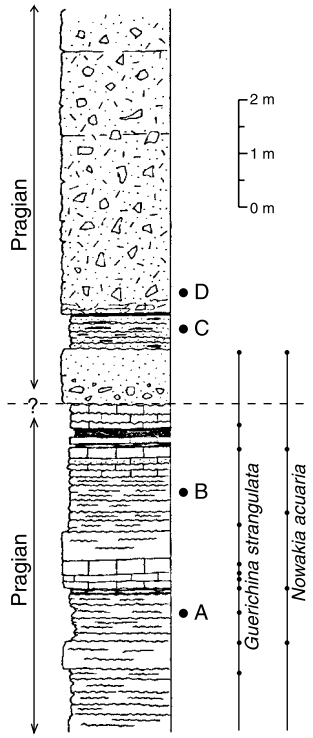


species present in sample (rare foraminiferal abundance in sample) +

less than 5 specimens in 1 kg rock sample

Sample	Section Srbsko – Lochkovian (Kotýs Lms.), Pragian (Koněprusy Lms., Slivenec Lms., Loděnice Lms., Řeporyje Lms.), Chlupáč 1999	*Thuraminoides sphaeroidalis* PLUMMER	*Saccammina pseudospiralis* (CUSHMAN et STAINBROOK)	foraminiferal abundance
A	Řeporyje Lms.	+	+	
B	Řeporyje Lms.			
C	Řeporyje Lms.			
D	Loděnice Lms.			
E	Loděnice Lms.			
F	Slivenec Lms.			
G	Slivenec Lms.			
H	Koněprusy Lms.			
I	Koněprusy Lms.			
J	Kotýs Lms.			
K	Kotýs Lms.			

Text-fig. 36. Section Srbsko, from Chlupáč 1999.



Relative abundances of species

less than 5 %

5–10 %

10–25 %

25–50 %

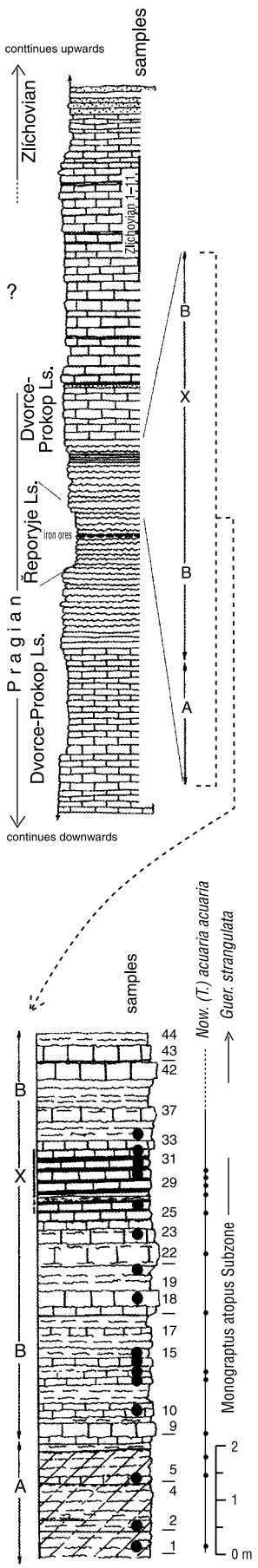
Foraminiferal abundance

less than 5 specimens in 1 kg rock sample

5–10 specimens in 1 kg rock sample

"Opatřilka-Červený lom" Quarry – Pragian Chlupáč et al. 1977, 1986, Kříž 1999	*Psammosphaera cava* MOREMAN	*Psammosphaera minuta* DUNN	*Sorosphaera tricella* MOREMAN	*Thuraminoides sphaeroidalis* PLUMMER	*Hemisphaerammina bradyi* LOEBLICH et TAPPAN	*Thurammina* aff. *echinata* DUNN	*Lagenammina sphaerica* MOREMAN	*Saccammina* aff. *ligula* GUTSCHICK, WEINER et YOUNG	*Hyperammina rockfordensis* GUTSCHICK et TRECKMAN	*Tolypammina irregularis* BLUMENSTENGEL	*Tolypammina* sp. (? *T. nodosa* IRELAND)	*Tolypammina* sp. – fragment of tubular second chamber	abundance of foraminifers
Zlichov Lst. 2 (D)													
Zlichov Lst. 1 (C)													
Dvorce-Prokop Lst. 2 (B)													
Dvorce-Prokop Lst. 1 (A)													
Řeporyje Lst.													

Text-fig. 37. "Opatřilka – Červený lom" Quarry, lithology and ranges of selected fossils from Chlupáč et al. 1986.



	"Stydlé vody" Quarry A – Pragian 1–8 Řepořyje Lst., B – 9–44 Dvorce-Prokop Lst., C – Zlichovian, D – "normal" Zlichov Lst., Chlupáč and Lukeš, 1999	*Bathysiphon* sp.	*Rhabdammina* (?) sp. – fragments	*Psammosphaera cava* MOREMAN	*Psammosphaera minuta* DUNN	*Pseudastrorhiza* aff. *irregularis* DUNN	*Pseudastrorhiza* sp.	*Thuraminoides sphaeroidalis* PLUMMER	*Hemmisphaerammina* cf. *casteri* McCLELLAN	*Hemmisphaerammina* sp. 1	*Tholosina* (?) sp. 2	*Webbinelloidea hattini* McCLELLAN	*Thurammina* aff. *echinata* DUNN	*Thurammina papillata* BRADY	*Thurammina quadritubulata* DUNN	*Lagenammina sphaerica* MOREMAN	*Saccammina pseudospiralis* (CUSH. et STAINB.)	*Hyperammina gracilenta* GUTSCH. et TRECK.	*Hyperammina rockfordensis* GUTSCH. et TRECK.	*Tolypammina polyverta* IRELAND	*Tolypammina tortuosa* DUNN	*Tolypammina* sp. (? *T. nodosa* IRELAND)	*Tolypammina* sp. 6	*Tolypammina* sp. – fragm. of tubular sec. chamber	*Ammodiscus* sp.	foraminiferal abundance
main section	34																									
	33			+									+											+		
	32								+															+		
	31																							+		
	30																									
	26			+																						
	23									+				+										+		
	21																									
	18					+		+							+	+								+		
	15																									
	14																									
	13		+					+		+														+		
	12																									
	10			+														+	+					+		
	5																									
	2					+					+				+									+		
	1																									
above the iron ore horizon		+	+																	+	+	+		+		
iron ore horizon																										
below the iron ore horizon																										
Section W from the main section	8 = 33																					+				
	7 = 32/33																									
	6 = 32																					+				
	5 = 30				+																	+				
	4 = 28								+						+							+				
	3 = 26																									
	2 = 25																									
	1 = 24														+							+				
Zlichovian, E part of quarry, interval D	1																				+		+			
	2						+																			
	3																									
	4																									
	5																				+					
	6						+																			
	7																									
	8																									
	9												+								+					
	10						+																+			
	11																									

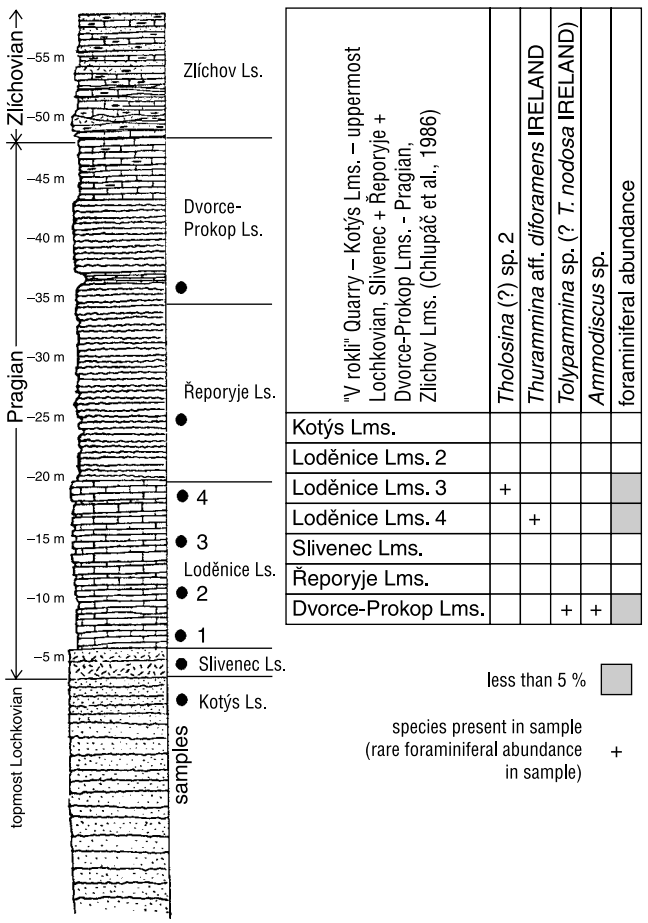
Relative abundances of species

less than 5 %
5–10 %
10–25 %
25–50 %
more than 50 %
\+ species present in sample (rare foraminiferal abundance in sample)

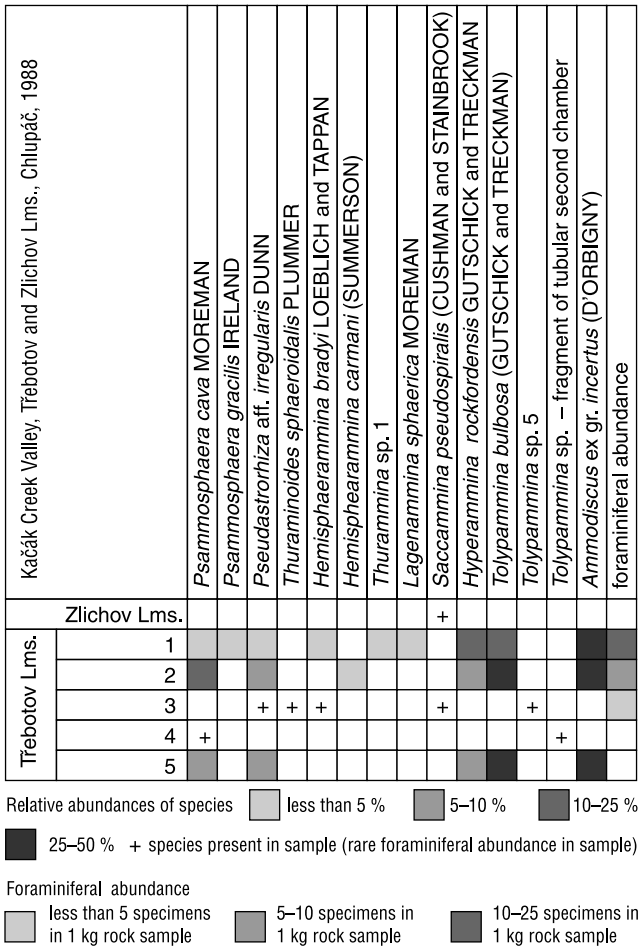
Foraminiferal abundance

less than 5 specimens in 1 kg rock sample
5–10 specimens in 1 kg rock sample
10–25 specimens in 1 kg rock sample

Text-fig. 38. "Stydlé vody" Quarry, lithology and ranges of selected fossils from Chlupáč and Lukeš 1999.



Text-fig. 39. "V rokli" Quarry, lithology from Chlupáč et al. 1986.



Text-fig. 40. Kačák Creek Valley.

Incertae sedis

Sphaeras

Pl. 21, figs 1–4

Regularly globular or elongate sphaeras were found rarely. The walls of sphaeras are very thin, siliceous, with distinct perforation. Sphaeras may evoke radiolarians with plate walls but they are known only from the Neogene.

Distribution: Pragian (Dvorce-Prokop Lst.: Opatřilka Quarry), Dalejan (Třebotov Lst.: Prastav Quarry)

Sack-like tests

Pl. 19, figs 1–21

Small, sack-like tests with large, rounded openings are very common in the studied samples. Shape of tests is variable: spherical (e.g. fig. 2), ovoid (e.g. fig. 16), cup-like (e.g. fig. 1). Ornamentation appears in younger forms (from the Dalejan) and is represented by rings (e.g. fig.16). The rings vary from 5 to 10 in number and have different densities and intensities. Borders of openings may bear denticulation (e.g. fig. 15). The openings may be situated on necks: neck diameter may be close to test diameter (figs 9, 19) or narrow and long (fig. 13). Walls of shells are acid-resistant, thick.

This morphogroup may include different organisms. It can be supposed that microfossils with acid resistant tests are morphologically closest to tintinnids. Their occurrences in the Palaeozoic sediments are very rare.

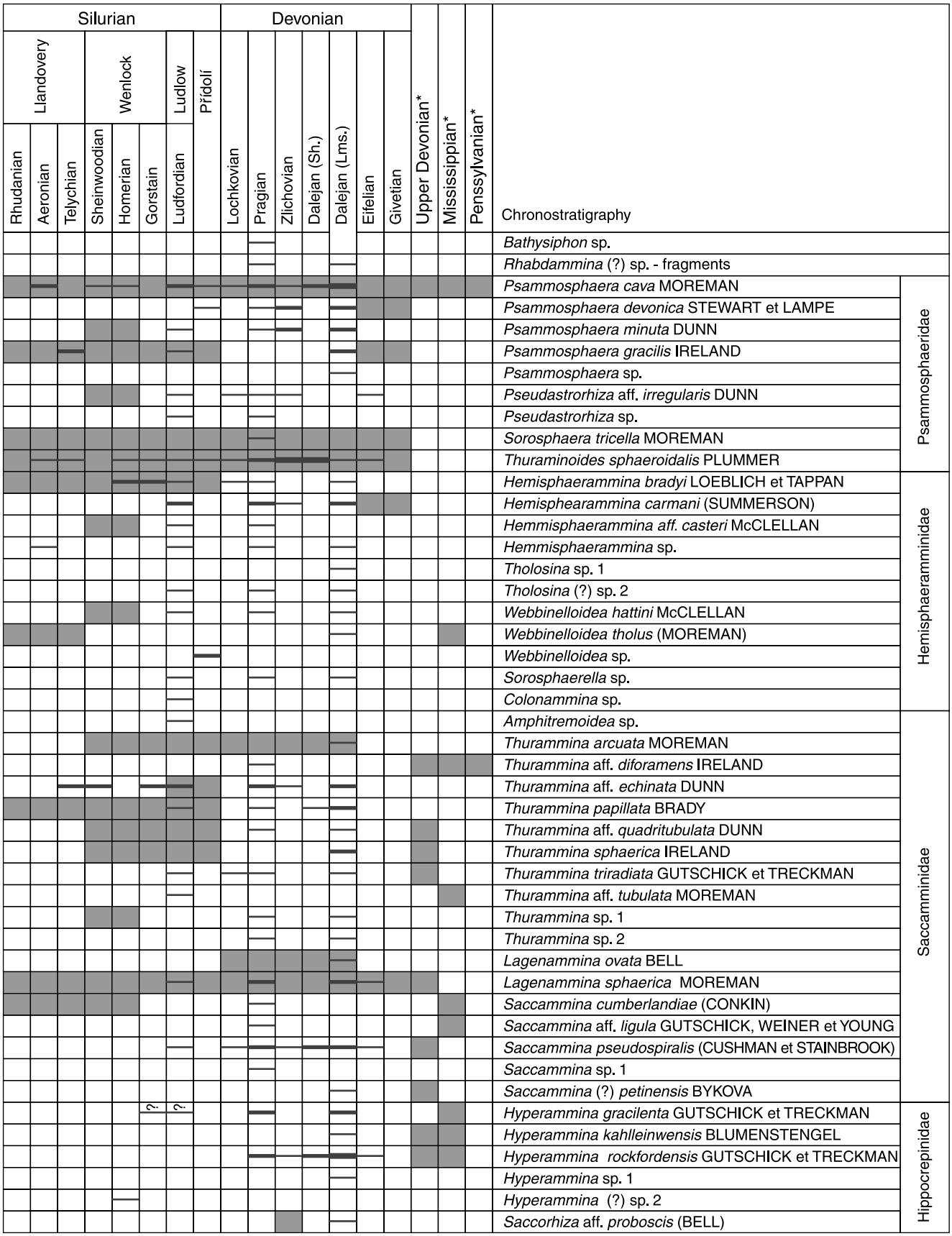
A detailed systematic study of the group may provide very useful data as its representants are common also at the levels with no microfossils. They can be used as index fossils because they have a sufficient morphological variability.

Distribution: Ludfordian (Koledník Quarry, Kosov Quarry, Požáry Quarry), Lochkovian (Srbsko section), Zlichovian (Údolí Hluboké Valley, Stydlé vody, section below Barrandov), Pragian (Dvorce-Prokop Lst.: Opatřilka Quarry, Homolka Quarry, Stydlé vody Quarry, section below Barrandov), Dalejan (Třebotov Lst.: Prastav Quarry, Nad tratí Quarry, Údolí Hluboké Valley; Suchomasty Lst.: Červený lom, Koněprusy area), Eifelian (Choteč Lst.: Kačák Creek Valley, U jezírka Quarry, Prastav Quarry)

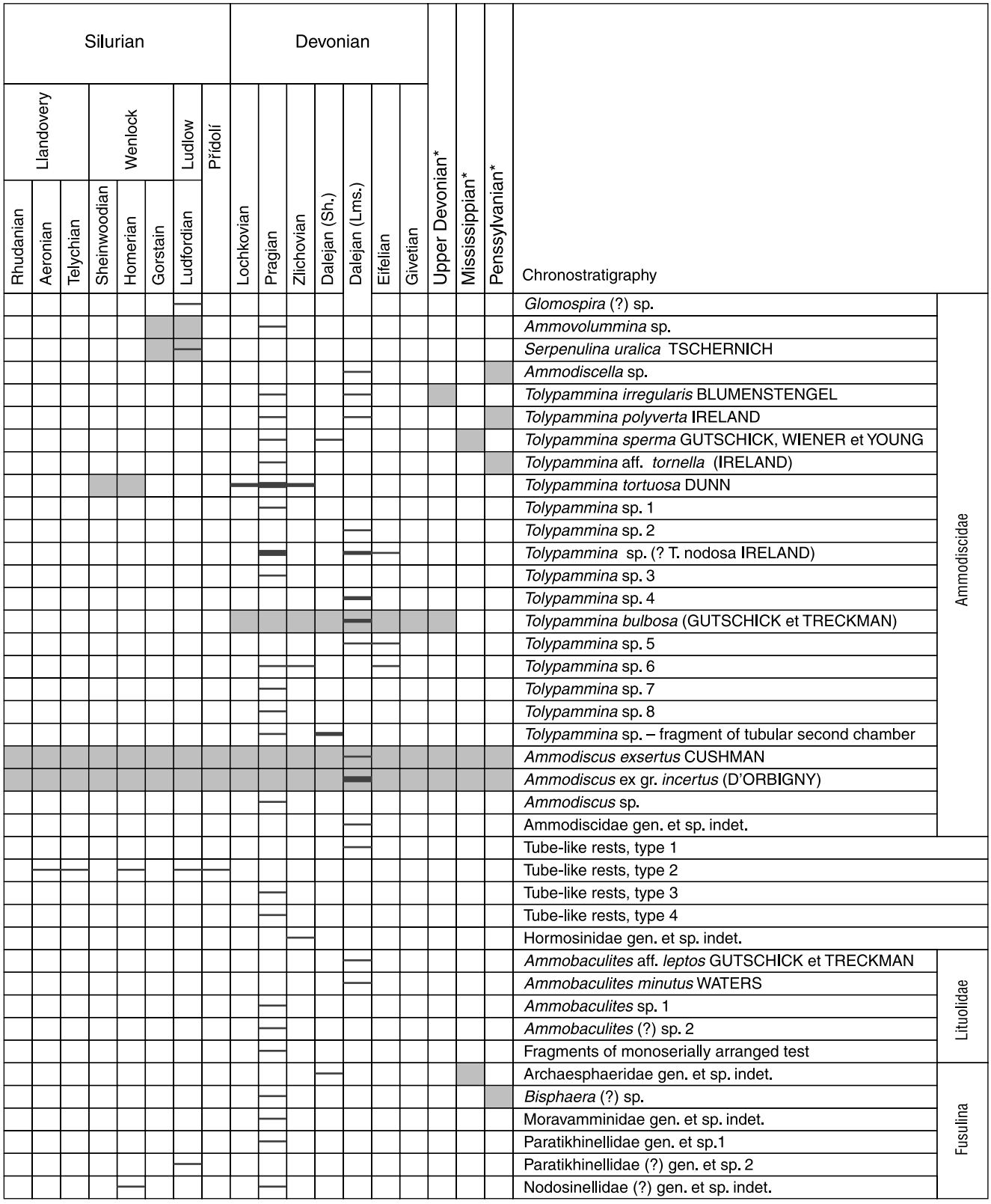
Incertae sedis 1

Pl. 20, figs 9–14

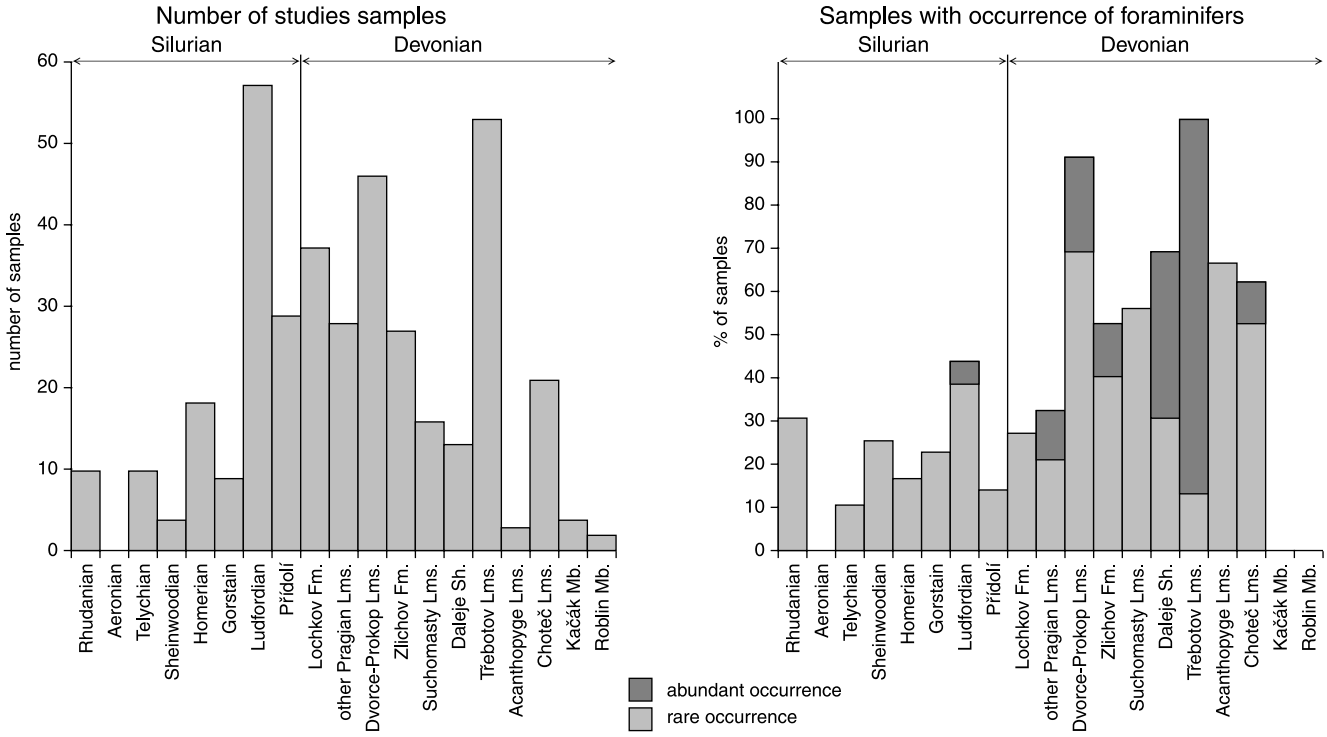
Test attached, composed of an ovoid central chamber with two narrow long tubes on the opposite side of test. One tube represents a narrowed central chamber, second



Text-fig. 41. Stratigraphical ranges of Silurian and Devonian foraminifers from the Barrandian. Continued on p. 121.



Text-fig. 41. Continued from p. 120.



Text-fig. 42. Occurrence of foraminifers in the Silurian and Devonian Stages in the Barrandian area.

tube comes from the basal part of test and meets the central part of test at various angles. The basal part is represented by a base representing the area of attachment. Wall very thin, siliceous.

Fragments, which may represent central chambers of the described tests were figured by Pichler (1971) and described as internal moulds of foraminifers.

Taxonomical position of this test is questionable. Its pertinence to foraminifers cannot be excluded. Long tubes may indicate an infaunal organism.

D i s t r i b u t i o n: common in different palaeonvironments and stratigraphical levels, such as the Gorstian (Na břekvici section), Ludfordian (Mušlovka Quarry, Cephalopod Quarry, Smoking Quarry, Kosov Quarry), Lochkovian (Barrandova skála section, Srbsko section, V rokli Quarry), Pragian (Dvorce-Prokop Lst.: Údolí Hluboké Valley, Opatřilka Quarry, Homolka Quarry, V rokli Quarry, Stydlé vody Quarry, Braník Quarry; Loděnice Lst.: Srbsko section), Zlichovian (Údolí Hluboké Valley, Stydlé vody Quarry, section below Barrandov), Dalejan (Třebotov Lst.: Chýnice – old quarry, Údolí Hluboké Valley, Prastav Quarry, Suchomasty Lst.: Koněprusy area, Červený lom Quarry), Eifelian (Choteč Lst.: Chýnice – old quarry, Kačák Creek Valley)

Incertae sedis 2

Pl. 21, fig. 14

Incertae sedis 2 is represented by a fragment of U-turned tube with a tube-like protuberance.

D i s t r i b u t i o n: Aeronian (Hlásná Třebaň)

(?) Inorganic pseudofossils

Pl. 22, fig. 18

Probable inorganic pseudofossils represent subsphaeras without floor with an opening in the centre of subsphaera. Subsphaeras are interconnected. Borders can be observed around the whole object and around openings.

D i s t r i b u t i o n: Ludfordian (Mušlovka Quarry)

Besides the above described organic rests, the following shells occur in washing residua:

– small fragments of Tabulata (Pl. 22, fig. 17) distribution: Aeronian (Hlásná Třebáň) juveniles of molluscs (Pl. 22, figs 5, 6, 9); distribution: Gorstian (Na břekvici section), Homerian (U Drdů section), Ludfordian (Mušlovka Quarry, Koledník Quarry), Pragian (Dvorce-Prokop Lst.: Homolka Quarry, Údolí Hluboké Valley), Dalejan (Suchomasty Lst.: Červený lom Quarry), Eifelian (Choteč Lst.: Kačák Creek Valley, Chýnice – old quarry
– juveniles of brachiopods (Pl. 22, figs 9, 13); distribution: Gorstian (Na břekvici section), Ludfordian (Cephalopod Quarry, Koledník Quarry, Smoking Quarry), Přídolí (Požáry section), Lochkovian (Na bříči section), Pragian (Dvorce-Prokop Lst.: Old Quarry, Stydlé vody Quarry, Homolka Quarry, section below Barrandov; Řeporyje Lst.: Srbsko section), Dalejan (Daleje Sh.: Údolí Hluboké Valley; Třebotov Lst.: Nad tratí Quarry, Prastav Quarry)
– tentaculites; distribution: Pragian (Dvorce-Prokop Lst.: Braník Quarry, Homolka Quarry, V rokli Quarry, Stydlé vody Quarry), Zlichovian (Údolí Hluboké Valley, Stydlé

Litostrati-graphical unit	Lithology	Color	$CaCO_3$ content	Paleoecology	*	**
Radotín Lst.	platy limestones with intercalations of calcareous shales	dark grey to black	60–80 %	deeper-water, current influenced environment (assemblages 4 to 5 of Boucot' s classification)	27/10/0	4/400
Kotýs Lst.	crinoid well-bedded limestones	light grey	79–68 %	shallow subtidal environment with variable turbulence (assemblages 2 to 3 of Boucot's classification)	2/3/0	3/120
Dvorce-Prokop Lst. micritic or	biomicritic well-bedded nodular or platy limestones	grey	70–90 %	low-energy, deeper-water environment bellow the wave-base and muddy bottom (assemblages 4 to 5 of Boucot' s classification)	4/32/10	34/300
Řeporyje Lst.	micritic or biomicritic distinctly nodular limestones	red and red-brown"	?	? similar to Dvorce-Prokop Lst.	3/3/2	7/?
Loděnice Lst.	platy biomicritic up to finely - bioclastic limestones	variable (red, violet, rose, grey, greenish)"	67–92 %	similar to Dvorce-Prokop Lst., redeposition of organic remains	3/2/0	2/?
Slivenec Lst.	coarsely bedded, crinoidal limestones	reddish and rose-coloured	90–98 %	shallow-water, high energy (assemblages 3 of Boucot's classification) – crinoid “forest”	7/1/1	5/?
Koněprusy Lst.	indistinctly bedded or massive bioclastic limestones	white or light grey	97–98 %	reef complex	5/1/0	1/500
Chapel Coral Horizon	coarsely bioclastic limestones with slump structures	grey	?	shallow-water sessile benthic forms transported from reef and peri-reef environment	0/0/2	5/200
Zlichov Lst.	finely bioclastic sparry limestones with irregular bedding surfaces with common cherts and intercalations of calcareous shales	grey and dark grey	72–93 %	deeper-water, medium to low-energy environment (assemblages 4 to 5 of Boucot's classification)"	16/9/0	7/?
Daleje Shale	calcareous shales	greenish, grey-green, reddish		deeper-water (lower part of photic zone), low-energy environment with muddy bottom (assemblages 4 to 5 of Boucot's classification)	4/4/5	2/?
Třebotov Lst.	micritic to biomicritic, well-bedded, distinctly nodular limestones	red passing upwards to light-grey	! 30 % of insoluble residues	probably deeper-water, low-energy environment, in upper part shallowing (assemblages 4 to 5 of Boucot' s classification)	0/7/46	40/?
Suchomasty Lst.	well-bedded biomicritic and bioclastic limestones	red and grey	87–96 %	shallow-water, high energy environment (assemblages 3 (± 2) of Boucot's classification)	7/9/0	3/?
Choteč Lst.	well-bedded micritic and biomicritic or bioclastic sparitic limestones	grey to dark grey"	83–98 %	deeper-water environment with current activity (? turbidity currents, storm) (assemblages 4 to 5 even 6 of Boucot's classification)	8/11/2	5/?
Acantopyge Lst.	platy or thick-bedded bioclastic limestones	light grey	94–97 %	shallow-water, subtidal environment, transport of organic remains in some layers (assemblages 2 to 3 of Boucot's classification)	1/2/0	1/?
Kačák Mb.	thinly laminated calcareous shales	dark grey to black		assemblages 6 of Boucot's classification	4/0/0	0
Roblín Mb.	flysh-like laminated siltstones, sandstones and clastones	grey-green		unfavourable living condition (?low salinity)	2/0/0	0

* Number of samples without foraminifers/number of samples with rare occurrence of foraminifers/number of samples with abundant foraminifers

** Number of foraminiferal morphotypes/total number of available species of all organic groups

Text-fig. 43. Lithological and palaeoecological characteristics of the Devonian lithotypes in the Barrandian area in comparison with the distribution of foraminifers (all data with the exception of numbers of foraminiferal morphotypes according to Chlupáč et al. 1998).

vody Quarry), Dalejan (Daleje Sh.: Údolí Hluboké Valley) fragments of Bryozoa (Pl. 22, figs 7, 16); distribution: Pragian (Homolka Quarry, Stydlé vody Quarry), Zlichovian (section below Barrandov), Eifelian (Choteč Lst.: Kačák Creek Valley)

– crinoids; distribution: Sheinwoodian (section Bubovice-Loděnice), Homerian (U Drdů section), Gorstian (Na břekvici section), Ludfordian (Mušlovka Quarry, Požáry section, Koledník Quarry, Kosov Quarry, Smoking Quarry), Přídolí (Na bříči section, Požáry section, Cephalo-

pod Quarry), Lochkovian (Na bříči section, Srbsko section, Údolí Hluboké Valley), Pragian (Loděnice Lst.: V rokli Quarry, Srbsko section; Dvorce-Prokop Lst.: Braník Quarry, Stydlé vody Quarry, Homolka Quarry, Údolí Hluboké Valley; Koněprusy Lst.: Srbsko section, Koněprusy area), Zlichovian (Kačák Creek Valley), Dalejan (Třebotov Lst.: Údolí Hluboké Valley, Chýnice – old quarry, Opatřilka Quarry; Suchomasty Lst.: Červený lom Quarry, Koněprusy area), Eifelian (Choteč Lst.: Kačák Creek Valley, Chýnice – old quarry)

– conodonts; distribution: Ludfordian (Mušlovka Quarry, Koledník Quarry, Smoking Quarry, Kovárovic mez section, Kosov Quarry), Lochkovian (Na bříči section, Barrandova skála section, Srbsko section), Pragian (Dvorce-Prokop Lst.: Opatřilka Quarry, Homolka Quarry, V rokli Quarry; Koněprusy Lst.: Srbsko section), Zlichovian (Stydlé vody Quarry), Dalejan (Třebotov Lst.: Nad tratí Quarry, Chýnice Quarry, Prastav Quarry; Suchomasty Lst.: Červený lom Quarry, Koněprusy area); Eifelian (Choteč Lst.: U jezírka Quarry, Chýnice – old quarry)

– Leiospheras; distribution: Zlichovian (Kačák Creek Valley), Dalejan (Daleje Sh.: Údolí Hluboké Valley)

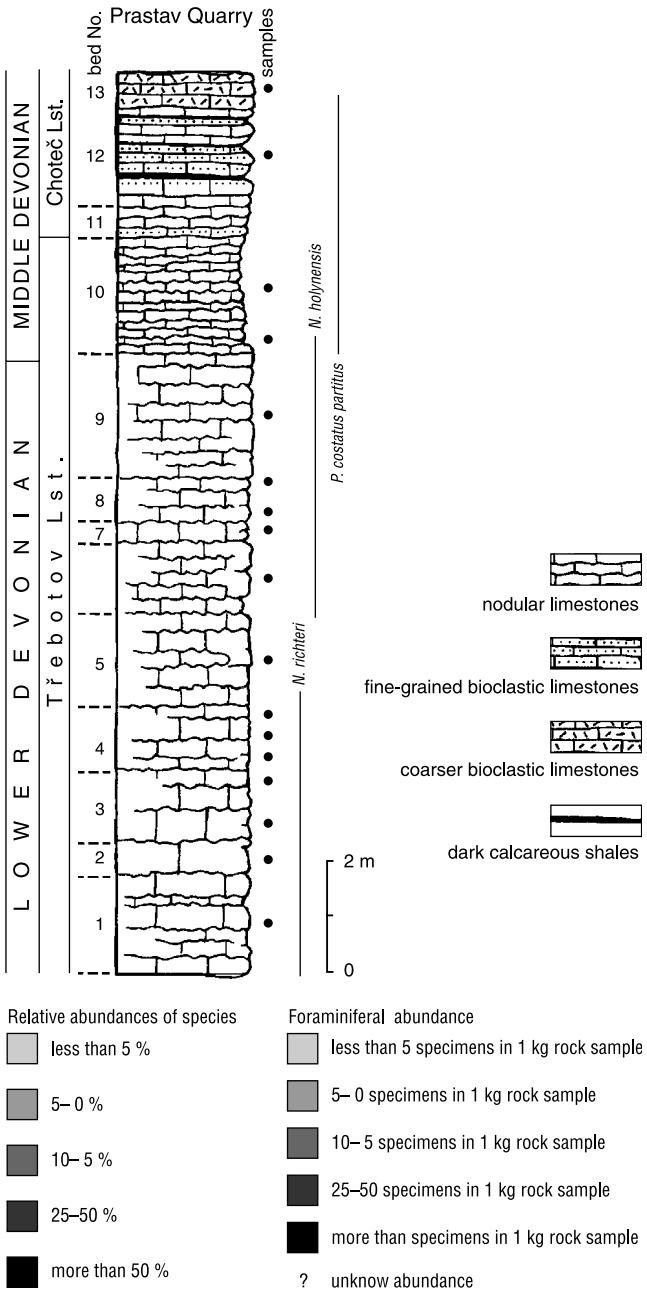
Biostratigraphy

Biostratigraphical significance of Palaeozoic foraminifers was systematically studied in North America. The synthesis of their stratigraphical ranges from the Ordovician to Permian was presented by Conkin and Conkin (1982). Stratigraphical ranges of Australian foraminifers of Wenlock to Frasnian age were summarized by Bell (1999). Russian micropalaeontologists (Bykova, 1952; 1953; Bykova and Polenova, 1955) also summarized stratigraphical ranges of Devonian foraminifers from the Russian Platform and Ordovician and Silurian foraminifers of the Baltic region.

Stratigraphical ranges of the Barrandian foraminifers based on the analysis of Silurian and Devonian sections are given in Text-fig. 41. In the studied time interval, periods with abundant foraminiferal assemblages alternate with periods of rare occurrence of foraminifers (Text-fig. 42). Therefore, the occurrence of foraminifers is influenced by palaeoecological conditions, and Palaeozoic foraminiferal biostratigraphy has merely an ecostratigraphic value in a limited area.

The first diversified foraminiferal assemblages were described from the Ludfordian (Upper Ludlow). In the older samples, only 10 cosmopolitan species of the families Sacamminidae and Psammosphaeridae and *Hyperammina* sp. were found. All these taxa are known from the Ordovician or Cambrian. Bubík (1996) described foraminifers of families Ammodiscidae and Hormosinidae from the Barrandian Ordovician, which occurred only in the Ludfordian (Upper Ludlow) or Devonian in my material.

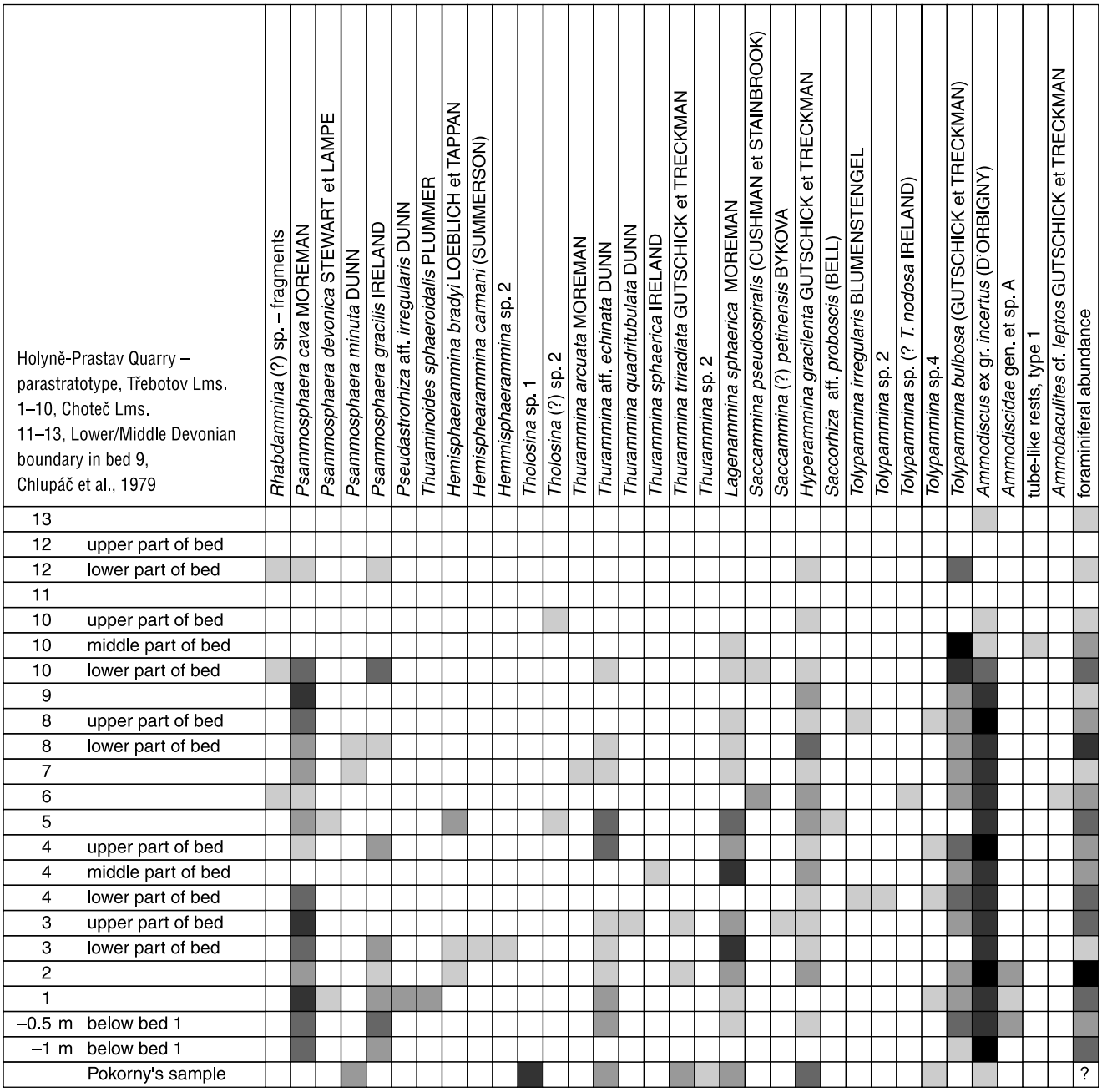
Twenty-six foraminiferal taxa were recognized in the Ludfordian (Upper Ludlow). The assemblages are characterized by hemisphaeramminas and thuramminas. First Ammodiscidae were described. *Amphitremoida* (also Holcová, 1999) and *Thurammina tubulata* occur only at this stratigraphical level and do not appear in the Devonian.



Text-fig. 44. Holyně - Prastav Quarry, lithology and ranges of selected fossils from Chlupáč et al. 1979. Continued on p. 125.

Přídolí foraminifers are rare again.

The oldest Devonian assemblages (Lochkovian) contain 8 species. The first tolypamminas were found. Based on the studied material, *Tolypammina tortuosa*, which appeared in this time interval, functions as a good marker of the Lochkovian – Zlichovian interval because it was found in all the lithotypes of this interval. Pragian foraminifers are the most diversified with 54 morphotypes described from



Text-fig. 44. Continued from p. 124.

this time interval. The following species firstly appeared: *Thurammina* aff. *quadritubulata*, *Th.* sp. 1, *Th.* sp. 2, *Hyperammina gracilenta* and *H. rockfordensis* (these FADs may serve as good biostratigraphical markers because *H. rockfordensis* is a common species in different facies), *Ammobaculites* sp. and small-sized *Ammodiscus* sp. The assemblages are characterized by common and diversified tolypamminas (14 morphotypes were distinguished).

Assemblages from the Zlíchov Limestone and Daleje Shale are a little diversified. The youngest diversified Barrandian foraminiferal assemblages were found in the Dalejan Třebotov Lst. The assemblages can be characterized by common occurrence of *Ammodiscus incertus*. The FADs of *Ammodiscus incertus*, *Ammobaculites* aff. *leptos*, *A. minutus*, *Tolypammina bulbosa*, *Thurammina sphaerica* were described.

Eifelian assemblages of the Choteč Formation in the western and central part of the Prague Basin are very poor (Chýnice – old quarry, Prastav Quarry, Nad tratí Quarry, Údolí Hluboké Valley near Karlštejn).

No foraminifers were found in the Givetian sediments.

Stratigraphical ranges of the Barrandian foraminifers substantially differ from those of North America (Conkin and Conkin, 1982). Ammodiscidae and some tolypamminas

Paleoenvironment	Species																												
	Ammodiscella sp.	*Hormosinidae* gen. et sp.indet.	*Webbinelloidea* sp.	*Psammosphaera devonica*	*Tholosina* (?) sp. 2	*Thurammina triradiata*	*Hemisphaerammna* sp.	*Hemisphaerammina carmani*	*Sorosphaerella* sp.	*Thurammina papillata*	*Tolypammina* - fragments	*Tolypammina sperma*	*Tolypammina* sp. 5	*Tolypammina* sp. 6	*Tolypammina* sp. (? *T. nodosa*)	*Tolypammina tortuosa*	*Hyperammina* (?) sp.	*Hyperammina rockfordensis*	*Psammophaera gracilis*	*Psammophaera minuta*	*Lagenammina sphaerica*	*Pseudastrorhiza* aff. *irregularis*	*Hemisphaerammina bradyi*	*Thurammina* aff. *echinata*	*Saccammina pseudospiralis*	*Psammosphaera cava*	*Thuraminoides sphaeroidalis*		
shallow-water, high energy																■							■		■		■	Kotýs Lst.	Silurian
	■								■												■				■	■	■	Suchomasty Lst.	
																						■			■	■		Acantopyge Lst.	
deeper water with current activity						■															■	■	■	■	■	■	■	Radotín Lst.	
													■	■	■			■									■	Choteč Lst.	
deeper-water, medium to low energy		■						■						■		■		■		■		■		■	■	■	■	Zlichov Lst.	
															■			■		■				■	■	■	■	Řeporyje and Loděnice Lst.	
deeper-water, low energy						■	■	■	■	■	■	■		■	■	■		■		■	■	■	■	■	■	■	■	Dvorce-Prokop Lst.	
				■	■	■	■	■		■			■		■			■	■	■	■		■	■	■	■	■	Třebotov Lst.	
										■	■	■						■							■	■	■	Daleje Sh.	
					■	■	■	■	■	■									■	■	■	■	■	■	■	■	■	bioclastic Lst.Ludfordian	Devonian
				■																		■				■	■	platy Lst.with shales Přídolí	
			■																								■	massive limestone Přídolí	
							■																			■	■	siliceous shales Aeronian	
																	■		■					■			■	green claystone Telychian	
																								■		■		calc.shales Sheinwoodian	
																	■						■			■	■	shales Hommerian	
																	■						■	■		■	■	tuffitic shales Gorstian	

Text-fig. 45. Distribution of abundant foraminiferal taxa in the Silurian and Devonian lithotypes.

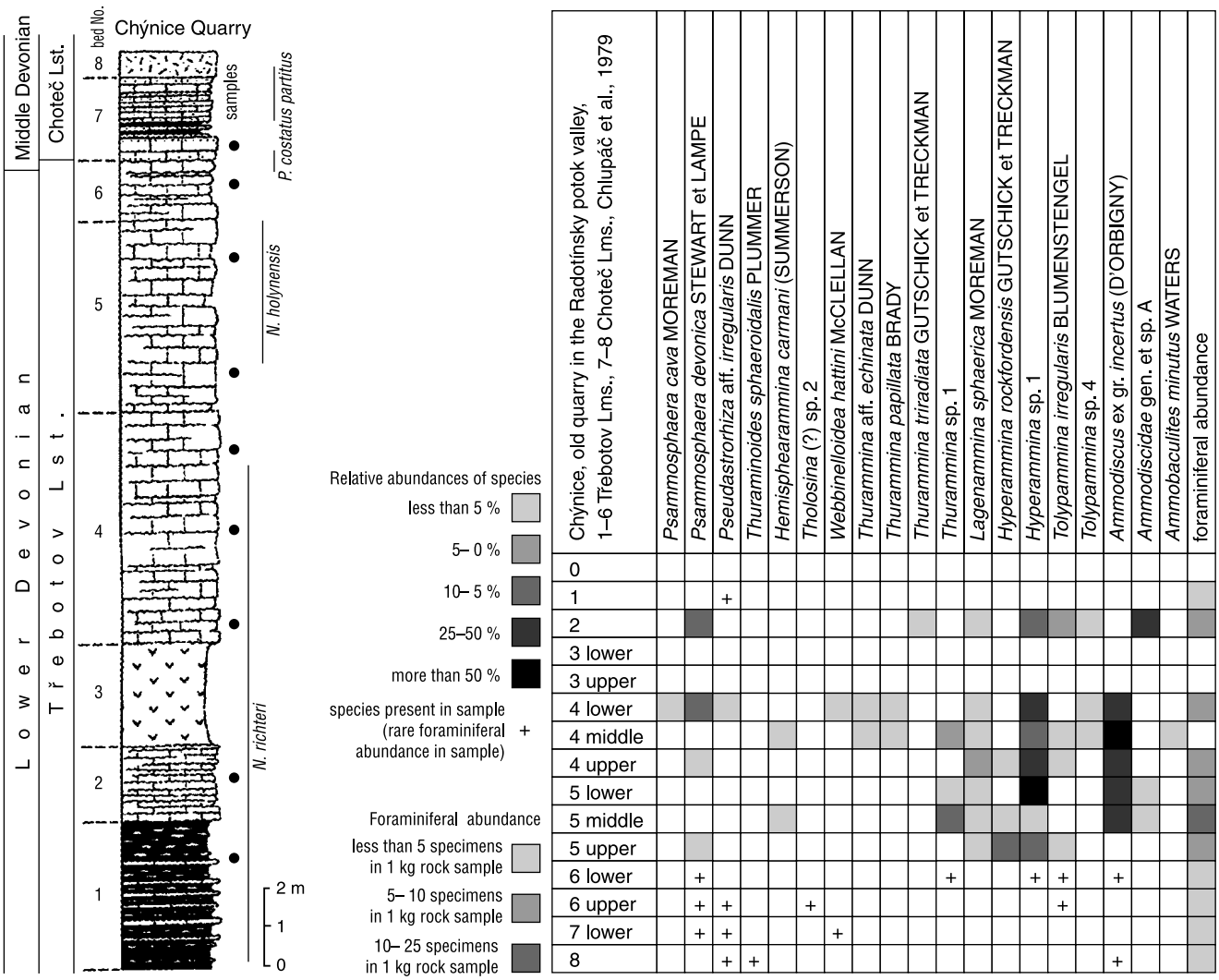
described in diversified assemblages from the Silurian of North America appear only in the Devonian in the Barrandian area. On the other hand, other Barrandian Lower Devonian species (*Ammobaculites*, some tolypamminas) appear only in the Mississippian of North America. The North American Devonian assemblages are of low diversity.

In comparison with Australian foraminiferal biostratigraphy (Bell, 1996), species composition of Australian foraminifers differs from that of the Barrandian foraminifers, but generic composition is similar. Generally, Silurian assemblages of Australia are little diversified similarly to the Barrandian ones. Diversification of the assemblages started in the Devonian, much like in the Barrandian.

Palaeoecology

Only few data exist on the palaeoecology of Lower Palaeozoic foraminifers. Occurrences of foraminiferal species in different lithotypes were studied by Gutschick and Treckman (1959) and Bell (1996). The best data on the life habitat of Palaeozoic foraminifers are available for assemblages where the palaeoenvironment is interpreted from another fossil group or from the character of sediment (e.g., Mound, 1968; McClellan, 1973; Olempska, 1983; Watkins et al., 1999). A relation between the composition of foraminiferal assemblages and their life habitat is observable as early as in the Silurian (McClellan, 1973; Watkins et al., 1999).

Out of the 387 samples analysed within this study, foraminifers were present in 198 samples (51.7 %). 72 samples (18.6 %) contained abundant foraminiferal assemblages. Comparable data were reported from the Australian Devonian: out of 350 analysed samples, 90 samples contained some foraminifers and in only 14 samples foraminifers were frequent (Bell 1996). These numbers evidence higher abundance of foraminifers in the Barrandian area when compared to the Australian Devonian. Abundances in rock samples correspond to data from other areas (10 specimens/kg of rock sample: Bell, 1966; 25/kg: Gutschick, 1986; 85/kg: Ireland, 1956; 100/kg: Browne and Scott, 1963) with the exception of Prastav Quarry (Dalejan, Třebotov Lst.) where hundreds of tests occur in 1 kg of rock sample at some levels.



Text-fig. 46. Chýnice – old quarry, lithology and ranges of selected fossils from Chlupáč et al. 1979.

In the Silurian, foraminifers are "randomly" concentrated in thin horizons of sedimentary complexes, often lithologically monotonous; therefore; the explanation of the causes for their occurrence is difficult.

Abundance and composition of foraminiferal assemblages are similar in all lithostratigraphical units in the Devonian (Text-fig. 43). These units can be subdivided into 4 groups according to the abundance and diversity of their assemblages:

(i) foraminiferal assemblages are the most abundant and diversified in the Třebotov and Dvorce-Prokop Lst. Both members are characterized by micritic to biomicritic, well-bedded nodular limestones. Low-energy, deeper-water environment (below the wave base) was interpreted for both facies (Chlupáč et al., 1998). Kukal (1975) showed that the genesis of nodular limestones is necessitated by the primary content of 15–25 % of insoluble residue (practically clay) in calcareous muds and by diagenetic differentiation of carbonate and argillaceous components. High abundance and diversity of foraminifers in the Třebotov and Dvorce-Prokop members reflect the fact that these limestones represent a combination of several optimum environmental conditions for foraminifers: low-energy shelf setting and content of clastic components in bottom sediments necessary for building agglutinated tests.

Both these stratigraphical units with abundant foraminifers have an identical position in second-order cycles defined by Chlupáč (2000) in the Barrandian area. This may reflect long-range climatic oscillations.

(ii) the second group is represented by the Zlíchov, Radotín, Řeporyje, Loděnice and Choteč Lst. in the Kačák Creek Valley and by the Daleje Shale with relatively abundant and diversified foraminiferal assemblages (more than 8 taxa). All these lithotypes were deposited in deeper-water environment of low to high energy and contain assemblages from 4 to 5 of Boucot's classification (Chlupáč et al., 1998)

(iii) Low abundance of foraminiferal tests and the presence of maximum 6 foraminiferal taxa characterize foraminiferal assemblages from the Kotýs, Suchomasty and Acanthopyge Lst. These members are represented by

biomicritic to biodetrital limestones deposited in a shallow-water, high or medium-energy environment with assemblages from 2 to 3 of Boucot's classification (Chlupáč et al., 1998).

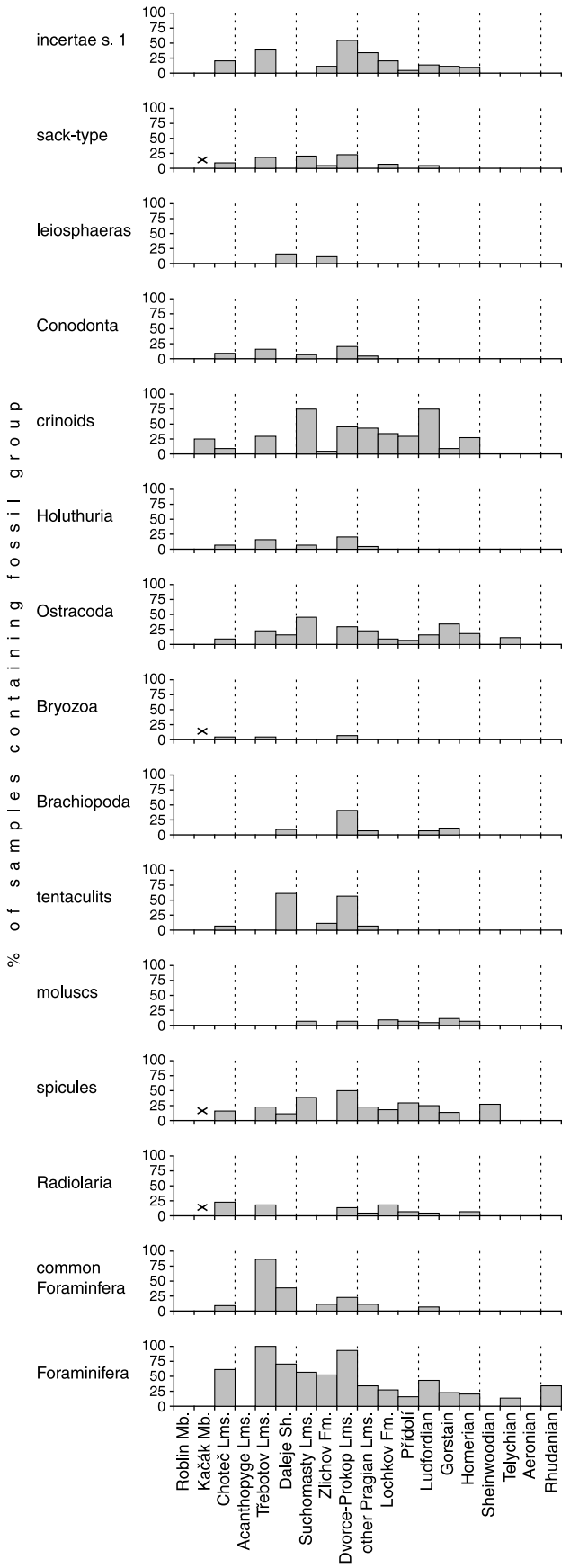
(iv) No foraminifers were found in the Koněprusy and Slivenec Lst. and Kačák and Roblín Mb. Reefal environment (Koněprusy Lst.) is not favourable for Palaeozoic foraminifers, as confirmed also by Mound (1968). The absence of foraminifers may be caused by abundant crinoids. Both the Koněprusy and Slivenec Lst. have also very high $CaCO_3$ content; hence, they are almost devoid of clasts necessary for building agglutinated tests. Unfavourable living conditions (?decrease in O_2 content, salinity) did not allow survival of foraminifers during the sedimentation of the youngest Barrandian Kačák and Roblín Mbs.

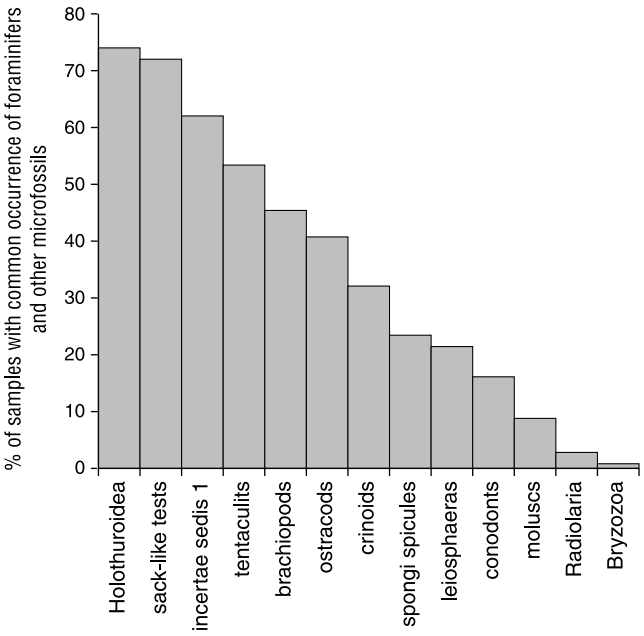
The distribution of foraminiferal taxa was summarized for different lithotypes (Text-fig. 45); the taxa were classified to the following groups:

(i) taxa occurring in diversified assemblages only (deeper-water, low-energy environment): *Ammodiscus* div. sp., *Ammobaculites* div. sp., *Tolypammina irregularis*, *T. polyverta*, *Thurammina* aff. *quadritubulata*, *Th.*sp. 1, *Th.* sp. 2, *Webbinelloidea hattini*;

(ii) taxa from the Devonian deeper-water limestones (low to high energy) such as *Hyperammina rockfordensis, Psammosphaera minuta, Tolypammina nodosa, T.* sp. 5, *T.* sp. 6, *T. sperma;*

(iii) taxa commonly present in most of the types of palaeoenvironments, such as *Thuramminoides sphaeroidalis, Psammospaera cava, Sacammina pseudospiralis, Thurammina* aff. *echinata, Hemisphaeram-*





Text-fig. 47. Correlation between the distribution of foraminifers and the distribution of other organic rests in acid-insoluble residua.

mina bradyi, Pseudastrorhiza aff. *irregularis, Lagenammina sphaerica;*

(iv) taxa rarely present in different palaeoenvironments, such as *Tolypammina tortuosa, Thurammina papillata, Sorosphaerella* sp., *Hemisphaerammina carmani, H.* sp. 1*, Thurammina triradiata, Tholosina* sp. 2, *Psammospahaera devonica, Bathysiphon* sp., *Amphitremoidea* sp. Other taxa occur rarely in one of the facies only.

A correlation was evaluated between the occurrence of foraminifers and other microfossils (Text-fig. 47). The best correlation was observed between the occurrences of foraminifers and sclerites of Holothuroidea, sack-like tests and incertae sedis 1. Holothuroidea are benthic, stenohaline, mainly shallow-water organisms. There are no data about palaeoecology of other two groups.

Low correlation was observed between the occurrences of foraminifers and sponge spicules, leiosphaeras, conodonts, bryozoans, radiolarians and molluscs. Among these groups, leiosphaeras are nearshore organisms, conodonts are nectonic and radiolarians planktonic organisms. Low correlation between the occurrences of foraminifers and the above mentioned groups also may be caused by the different postmortem transport and accumulation of their tests.

Palaeogeography

Data available for palaeogeographical interpretation are based on a comparison of species compositions of foraminiferal assemblages from different areas. Reliability of such comparisons depends on two factors:

(1) techniques used for the study of microfauna (study of isolated foraminifers from acid-resistant residua, slides ...) and the number of analysed samples. High similarity was observed between areas with similar quality and quantity of micropalaeontological analyses. Literature data enable to compare the Barrandian foraminiferal assemblages with the assemblages from the following areas: North American Palaeozoic, East Thuringian Slate Mts., Rhine Slate Mts., Holy Cross Mts., Carnic Alps, Siberia, Australia, Baltic region and the Russian Platform.

(2) Similar species composition of assemblages from different areas may result from the sea connections among these areas as well as similar palaeoenvironments. Poor knowledge of the palaeoecology of Lower Palaeozoic foraminifers sometimes accounts for our problems with understanding the most probable causes of similarity of foraminiferal assemblages.

Only the safely determined species were chosen for the summary of palegeographic data. Cosmopolitan species were excluded from this analysis. Safely determined and non-cosmopolitan species found in the Barrandian area and in other areas are summarized in Text-fig. 49:

(i) species described from the North American Silurian gradually appear in the Barrandian Ludfordian (Upper Ludlow) (*Thurammina papillata, Hemisphaerammina bradayi, Webbinelloidea hattini*), Pragian (*Tolypammina tortuosa*) and Dalejan (*Ammodiscus incertus, A. excertus, Thurammina sphaerica*);

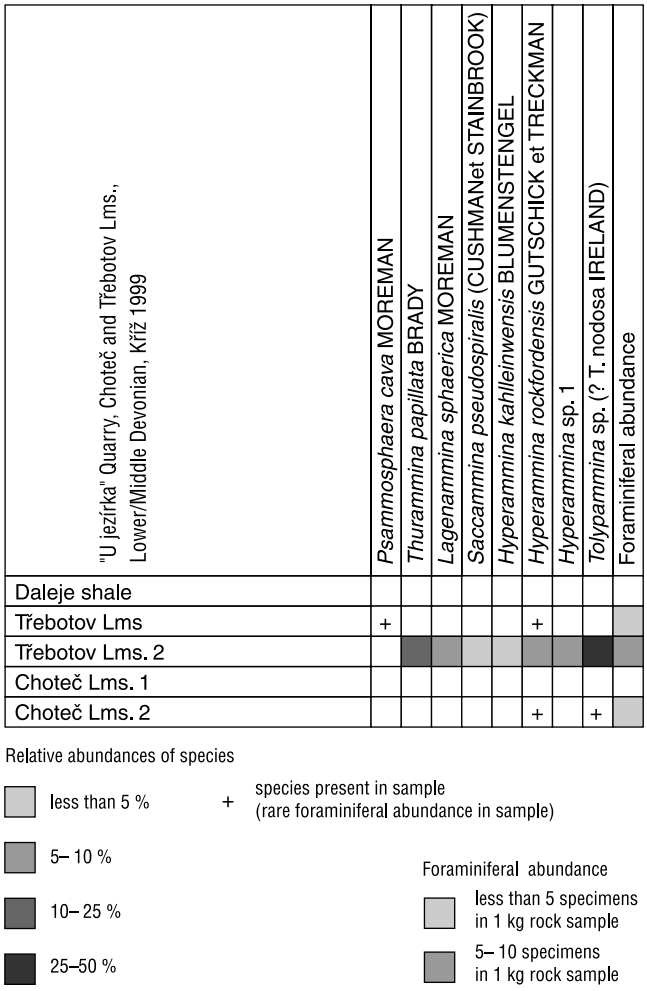
(ii) Ammodiscidae described from the Siberian Ludlow (*Serpenulina uralica*, *Ammovolummina* sp.) were found in the Barrandian Ludlow and Pragian;

(iii) *Serpenulina uralica* and *Lagenammina ovata* occurring in the Barrandian Upper Ludlow were described from the Australian Early Devonian;

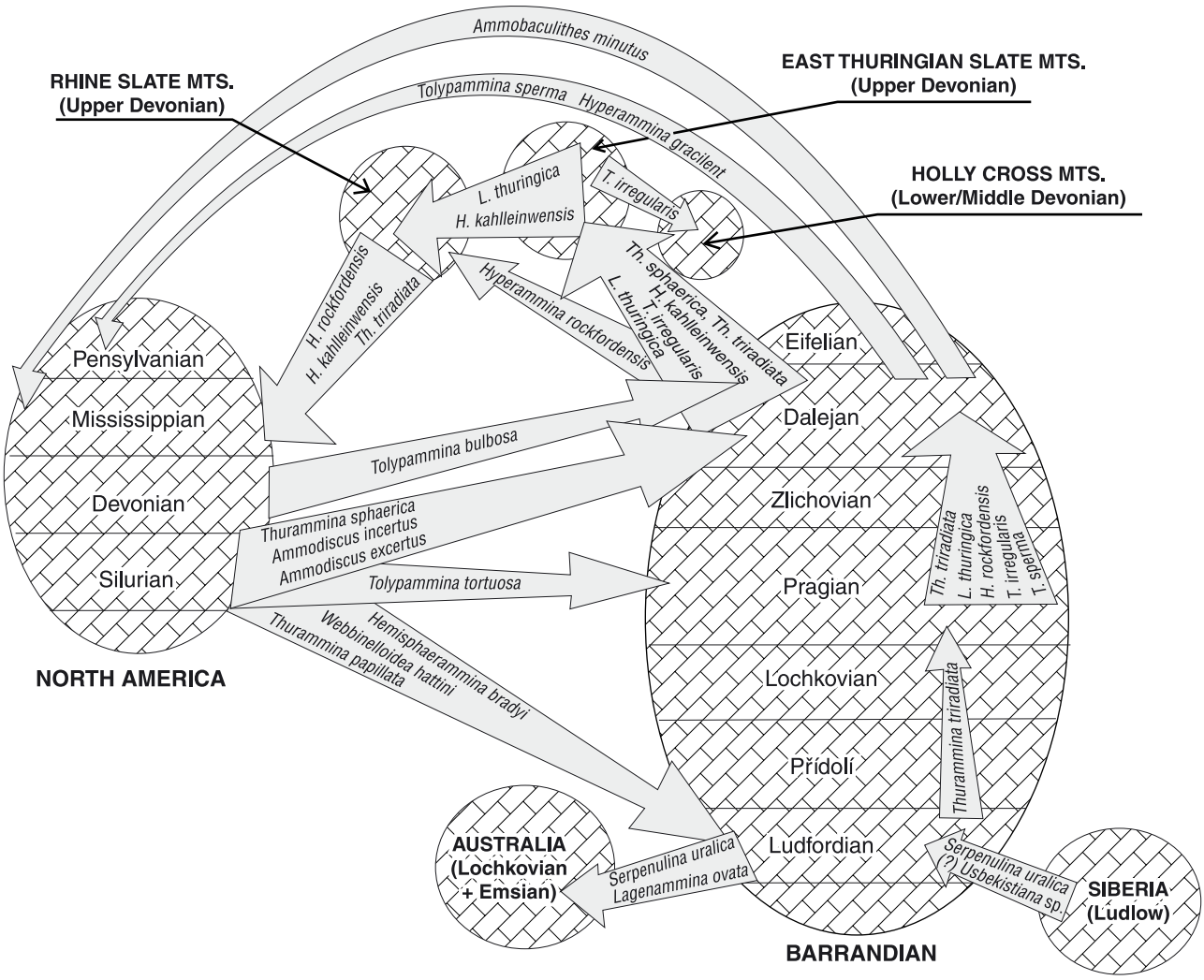
(iv) *Tolypammina bulbosa* described from the North American Devonian occurs in the Barrandian Dalejan;

(v) The closest connection was found between the Barrandian Dalejan and the Upper Devonian from the Thuringian Slate Mts. and Rhine Slate Mts. The following species from the Barrandian Dalejan were also determined (or described) in Germany: *Hyperammina rocfordensis*, *H. kahlleinwensis*, *Thurammina sphaerica*, *Th. triradiata*, *Tolypamina irregularis*). With the exception of *H. kahlleinwensis,* all these species were determined also in the Barrandian Pragian;

(vi) Three of these species (*Hyperammina rocfordensis*, *H. kahlleinwensis*, *Th. triradiata*) are known from the North American Mississippian. Besides these species,



Text-fig. 48. "U jezírka" Quarry.



Text-fig. 49. Possible migration pathways of well-determinable and non-cosmopolitan Palaeozoic foraminiferal species occurring in the Silurian and Devonian of the Barrandian.

Hyperammina gracilenta and *Tolypammina sperma* found in the Barrandian Dalejan were described in the North American Mississippian;

(vii) *Tolypammina irregularis* found in the Barrandian Pragian and Dalejan and described from the Upper Devonian of the East Thuringian Slate Mts. were recorded in the Upper Devonian of the Holy Cross Mts.

Occurrences of identical foraminiferal species in different areas indicate the existence of a migration pathway between these areas. These pathways represented "corridors" with suitable palaeoenvironment for the Silurian and Devonian foraminifers: stenohaline, neritic, low-energy. Usually, identical species occur in discrete areas at different stratigraphical levels and migration "history" of these species between these horizons remains unknown.

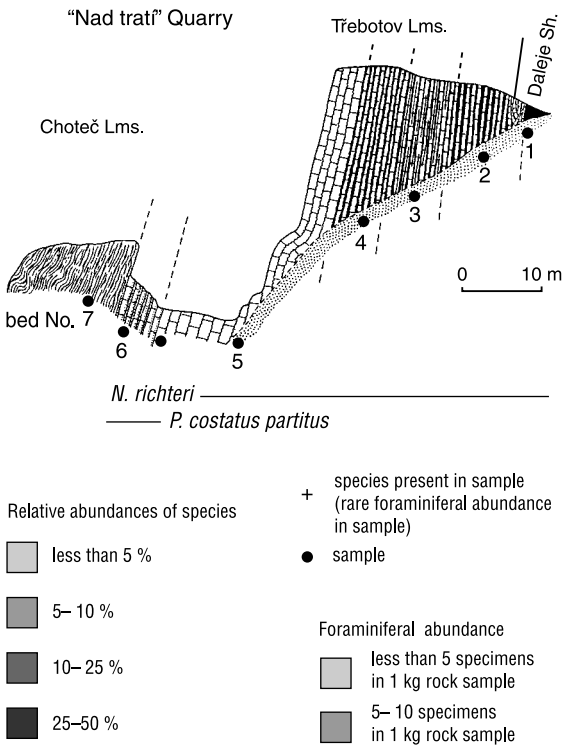
The above mentioned data (i-vii) suggest a possible existence of the following pathways:

(1) between Siberia and the Barrandian area in the Ludlow;

(2) between the Barrandian area and E Victoria (Australia) a certain time level from Upper Ludlow to Lochkovian. While Australia and the Bohemian Massif were incorporated in Gondwana (Scotese and McKerrow, 1990), Siberia was situated on the northern hemisphere, although some relations between their faunas were observed (Chlupáč, 1994);

(3) some of the North American Silurian foraminifers penetrated successively to the Barrandian area from the Ludfordian to the Dalejan. Their migration pathways are not clear. Contrastingly, migration of foraminiferal species from the Barrandian area to North America was realized from the Dalejan to the Mississippian (probably across the Rhenohercynicum – see below);

(4) a broad migration of foraminiferal fauna was expected between the Barrandian area and the Saxothuringicum as these units were situated on the northern shelf (Barrandian) and slope (Saxothuringicum) of Gondwana (Chlupáč, 1994). Species which appeared in the Barrandian area in the Pragian and Dalejan were described from the Upper Devonian of the Saxothuringicum. Palaeoenvironment in the Saxothuringicum suitable for these species existed only at this time level. No data exist on the survival of this species from the Dalejan to the Upper Devonian.



"Nad tratí" Quarry: (1) Třebotov Lms. with intercalations of shales (2–4), Třebotov Lms. (5), Choteč Lms. (6–7); road "Ke hřbitovu": Dalejan (Daleje Sh.) Chlupáč et al. 1979		*Psammosphaera cava* MOREMAN	*Psammosphaera minuta* DUNN	*Psammosphaera gracilis* IRELAND	*Thuraminoides sphaeroidalis* PLUMMER	*Hemmisphaerammina* sp. 2	*Thurammina* aff. *echinata* DUNN	*Thurammina papillata* BRADY	*Lagenammina sphaerica* MOREMAN	*Saccammina* (?) *petinensis* BYKOVA	*Hyperammina kahlleinwensis* BLUMENSTENGEL	*Hyperammina* sp. 1	*Tolypammina* sp. (? *T. nodosa* IRELAND)	*Tolypammina* sp.4	*Ammodiscus* ex gr. *incertus* (D'ORBIGNY)	*Archaesphaeridae* gen. et sp.1	foraminiferal abundance
Road "Ke hřbitovu"		+						+							+		
"Nad tratí" Quarry:	1	+		+													
	2																
	3											+					
	4																
	lower part of bed 5																
	middle part of bed 5																
	upper part of bed 5				+				+				+				
	lower part of bed 6																
	upper part of bed 6		+												+		

Tab. 50 "Nad tratí" Quarry, section and ranges of selected fossils from Chlupáč et al. 1979.

Assemblages from the Lower/Middle Devonian boundary from the Holy Cross Mts. (Malec, 1992) are completely different from the Barrandian ones. Rhenohercynian Lower Devonian foraminifers also differ from the Barrandian assemblages (Beckmann, 1952).

Different foraminiferal assemblages were described by Pokorný (1951) from the Givetian of the Moravo-Silesian part of northern Gondwana shelf. Faunal differences were observed also in other organic groups (Ficner and Havlíček, 1978; Chlupáč, 1992; Galle et al. 1993). This assemblage is similar to the Eifelian assemblages from the Holy Cross Mountains (Duszynska, 1956);

(5) close affinities of foraminiferal assemblages between the Dalejan of the Barrandian area, Upper Devonian of the Saxothuringicum and Rhenohercynicum (Eickhoff, 1970) confirm the hypothesis about the closure of the Rheic Ocean in the Late Devonian (Chlupáč, 1994). Foraminifers migrated to the Rhenohercynicum probably from the Saxothuringicum during the Late Devonian. Similar assemblages appeared at this time level also in the Holy Cross Mts. (Olempska, 1983), which may indicate the existence of a migration pathway among the Saxothuringicum, Rhenohercynicum and the Holy Cross Mts. in the latest Devonian. In the time interval, from the Upper Devonian to the Lower Mississippian, the assemblages penetrated to North American basins through an unknown way. Affinities of foraminiferal assemblages from the Rhenohercynicum, Saxothuringicum and North America were already noted by Eickhoff (1970).

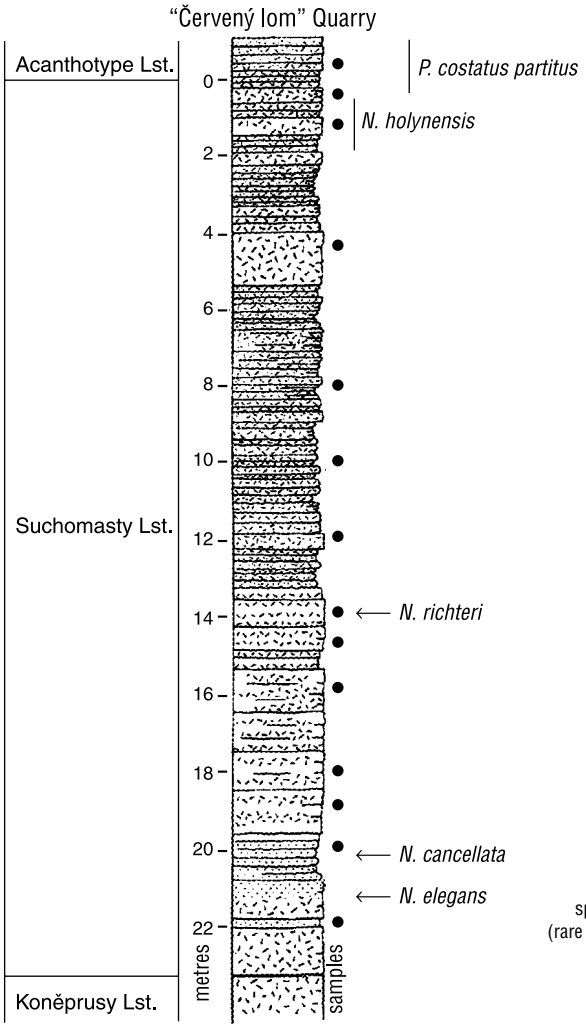
Conclusions

(1) The first systematic study of Silurian and Devonian foraminifers of the Barrandian area included the analysis of 387 samples from 14 Silurian and 24 Devonian sections including stratotypes and auxiliary stratotypes of stages: Požáry Quarry, Klonk section, Budňany rock section, Homolka Hill at Velká Chuchle, Prastav Quarry. Foraminifers were studied from acid-insoluble residua. Foraminifers were found in 200 samples (51.7 %), and were abundant in 72 samples (18.6 %).

(2) Eighty morphotypes of agglutinated foraminifers from families Psammosphaeridae, Hemisphaeramminidae, Saccamminidae, Hippocrepinidae, Ammodiscidae and Lituolidae and 6 morphotypes of calcareous foraminifers were distinguished. Thirty-two morphotypes can be well correlated with the earlier described species, 10 morphotypes can be partly correlated , other morphotypes belong to new species or are represented by poorly preserved specimens which cannot be determined more accurately.

(3) Together with the foraminifers, the following organic remains were found in washing residua: radiolarians, ostracodes, sponge spicules, conodonts, sclerites of Holothuroidea, leiosphaeras, tentaculites, juveniles of brachiopods and molluscs, bryozoans, columnals of crinoids and Incertae sedis.

(4) In the Silurian sediments, foraminifers are rare and concentrate to thin horizons only in the sections. Foraminifers are the most abundant in the Ludfordian. In



"Červený lom" Quarry near Suchomasty 0–22 m Suchomasty Lms., base of the Acanthopyge Lms., Chlupáč et al.1979	*Psammosphaera cava* MOREMAN	*Psammosphaera gracilis* IRELAND	*Saccammina pseudospiralis* (CUSHMAN et STAINBROOK)	tube-like rests, type 2	foraminiferal abundance
Acanthopyge Lms. +					
0.5 m					
1.5 m				+	
4.5 m				+	
8 m	+				
10 m					
12 m			+		
13 m					
14 m					
16 m					
18 m	+		+		
19 m					
20 m			+		
22 m					

Tab. 51 "Červený lom" Quarry near Suchomasty, lithology and ranges of selected fossils from Chlupáč et al. 1979.

the Devonian sediments, foraminifers are common to abundant (with the exception of reefal limestones and the youngest Kačák and Roblín Mbs.). They are the most abundant in the Dalejan Třebotov Lst. and Pragian Dvorce-Prokop Lst.

(5) Stratigraphical ranges of the Barrandian Silurian and Devonian foraminifers were summarized with the following species being of biostratigraphical value: (i) *Amphitremoida* and *Thurammina tubulata* occur only in the Ludlow; (ii) *Tolypammina tortuosa* appeared in the Lochkovian and can be a good marker of the Lochkovian–Zlichovian interval; (iii) *Thurammina* aff. *quadritubulata*, *Th.* sp. 1, *Th.* sp. 2, *Hyperammina gracilenta* and *H. rockfordensis* (these FADs may serve as good biostratigraphical markers because *H. rockfordensis* is a common species in different facies), *Ammobaculites* sp. and small-sized *Ammodiscus* sp. first appeared in Pragian; (iv) the Dalejan assemblages can be characterized by the common occurrence of *Ammodiscus incertus*. FADs of *Ammodiscus incertus*, *Ammobaculites* cf. *leptos*, *A. minutus*, *Tolypammina bulbosa*, *Thurammina sphaerica* were described in the Dalejan.

As the distribution of foraminifers was influenced by palaeoecological conditions, the stratigraphical ranges represent only ecostratigraphical data for the Barrandian area.

(6) High abundance and diversity of foraminifers in the Třebotov and Dvorce-Prokop limestones reflect the fact that nodular limestones were deposited under optimum environmental conditions for foraminifers: low-energy, deeper water environment (below the wave base) with clastic components necessary for building agglutinated tests. Low abundances of foraminiferal tests characterize biomicritic to biodetrital limestones deposited in shallow-water, high or medium-energy conditions. No foraminifers are present in reefal limestones. During the sedimentation of the youngest Barrandian Kačák and Roblín Mbs., unfavourable living conditions (?lowering of O_2-content, salinity) did not enable survival of foraminifers.

(7) Foraminifers may pose a good palaeogeographical indicator. The occurrence of identical foraminiferal species (well-determinable, non-cosmopolitan) in different areas indicates the existence of the following migration path-

ways: (i) between Siberia and the Barrandian area in the Ludlow; (ii) between the Barrandian area and E Victoria (Australia) at a certain time level from the Ludfordian to Lochkovian; (iii) some of the North American Silurian foraminifers successively penetrated to the Barrandian area from the Ludfordian to the Dalejan. Their migration pathways are unclear; (iv) the broad migration of foraminiferal fauna between the Dalejan of the Barrandian area and Upper Devonian of the Saxothuringicum; (v) close affinities of foraminiferal assemblages between the Dalejan of the Barrandian area, Upper Devonian of the Saxothuringicum and Rhenohercynicum confirm the hypothesis on the closure of the Rheic Ocean in the Late Devonian. Foraminifers migrated to the Rhenohercynicum (and also to Holy Cross Mts. where similar assemblages also appeared in the Late Devonian) probably from the Saxothuringicum in the Late Devonian. In the period of the Upper Devonian to the Lower Mississippian, the assemblages penetrated to the North American basins through an unknown pathway.

Acknowledgments

The author wishes to acknowledge the extensive helpful information about the Barrandian Devonian provided by Ivo Chlupáč (Charles University Prague) and the discussions about Palaeozoic foraminifers with Miroslav Bubík (Czech Geological Survey Brno). This research was supported by grant project No. MSM 113100006

References:

Adegoke, D. S., Dessauvagie, T. F. J., and Yoluye, V. L. A. (1969): Hemmisphaerammina-like egg capsules of Neritina (Gastropoda) from Nigeria. – Micropaleontology., 15: 102–106.

Alexandrowicz, S. W. (1969): Thuramminoides sphaeroidalis Plummer (Foraminifera) from Cambrian beds of the vicinity of Sandomierz. – Ann. Soc. Geol. Poloniae, 39, 1–3: 27–33.

Barnard, T. A. (1958): Some Mesozoic adherent foraminifera. – Palaeontology 1(2): 116–124.

Bartenstein, H. (1937): Neue Foraminiferenkunde aus dem Mitteldevon der Eifel. – Senckenbergiana, 19:334–338.

Beckmann, H. (1952): Foraminiferen aus dem Unterdevon des Rheinlandes. – N. Jb. Geol. Paläont. Abh., Monatshefte 52: 364–370.

Bell, K. N. (1996): Early Devonian (Emsian) agglutinated foraminiferans from Buchan and Bindi, Victoria,Australia. – Proc. Roy. Soc. Victoria, 108 (2): 73–106.

Bell, K. N. (1999): Taxonomy and biostratigraphy of Silurian-Devonian Foraminifera from Eastern Australia. – Disertation, Macquarie University. Manuscript.

Bell, K. N. and Burn, R. F. (1979): On the identity of Webbinella bassensis Parr. – The Victorian Naturalist, 96: 198–199.

Birina, L. M. (1948): Novyje vidy izvestkovych vodoroslej i foraminifer pogranicnych slojev devona i karbona. – Sovetskaja geologija, 28: 87–93.

Blumenstengel, H. (1961): Foraminiferen aus dem Thuringer Oberdevon. – Geologie., 10: 316–335.

Blumenstengel, H. (1963): Zur Mikrofauna des Thuringer Ockerkalkes (Silur). – Geologie., 12: 349–354.

Bouček, B. (1941): Geologické výlety do okolí pražského. – Melantrich, Praha, 202 pp.

Browne, R. G. and Schott, V. J. (1963): Arenaceous Foraminifera from the Osgood Formation at Osgood, Indiana. – Bull. Amer. Paleont., 46, 209: 187–243.

Bubík, M. (1995): Nález foraminifer v ordoviku Barrandienu. – Zpr. geol. vyzk., 1995: 17–19.

Bubík, M. (1996): Nové nálezy aglutinovaných foraminifer v ordoviku Barrandienu. – Zpr. geol. vyzk., 1996.

Bykova, E. V. (1952): Foraminifery devona Russkoj platformy i Priuralja. – Mikrofauna SSSR., 60: 5–64.

Bykova, E. V. (1953): Foraminifery devonskich otlozenij Russkoj platformy i Volgo-Uralskoj oblasti. – In: Devon Russkoj platformy, 274–279. VNIGRI, Leningrad, Moskva.

Bykova, E. V. and Polenova, E. N. (1955): Foraminifery, radioljarii i ostrakody devona Volgo-Uralskoj oblasti. – Trudy VNIGRI, Leningrad, 287 pp.

Bykova, E. V. (1956): Foraminifery ordovika i silura sovetskoj Pribaltiki. – Trudy VNIGRI, 98: 6–27.

Chlupáč, I., Jaeger, H., and Zikmundová, J. (1972): The Silurian-Devonian boundary in the Barrandian. – Bull. Canad. Petrol. Geol., 20: 104–174.

Chlupáč, I., Lukeš, P., and Zikmundová, J. (1979): The Lower/Middle Devonian boundary beds in the Barrandian area, Czechoslovakia. – Geologica and Palaeontologica, 13: 125–156.

Chlupáč, I., Lukeš, P., Paris, F., and Schönlaub, H. P. (1985): The Lochkovian-Pragian boundary in the Lower Devonian of the Barrandian Area (Czechoslovakia). – Jb. Geol. B. –A., 128(1): 9–41.

Chlupáč, I. (1986): Barrandian—Moravian Karst. – Ústředni ústav geologický, Praha, 34 pp.

Chlupáč, I. (1988): Geologické zajímavosti pražského okolí. – Academia, Praha, 249 pp.

Chlupáč, I. and Oliver, W. A. Jr. (1989): Decision on the Lochkovian-Pragian boundary stratotype (Lower Devonian). – Episodes, 12(2): 109–112.

Chlupáč, I. (1992): Middle Devonian trilobites from Čelechovice in Moravia (Czechoslovakia). – Sbor. geol. Ved. Paleont., 32: 123–161.

Chlupáč, I. (1994): Facies and biogeographic relationship in Devonian of the Bohemian Massif. – Cour. Forsch. –Inst. Senckenberg, 169: 299–317.

Chlupáč, I., Havlíček, V., Kříž, J., Kukal, Z., and Štorch, P. (1998): Paleozoic of the Barrandian (Cambrian to Devonian). – Czech Geological Survey, Prague, 183 pp.

Chlupáč, I. and Lukeš, P. (1999): Pragian/Zlichovian and Zlichovian/Dalejan boundary sections in the Lower devonian of the Barrandian area, Czech Republic. – Newsl. Stratigr., 37(1/2): 75–100.

Chlupáč, I. (1999): Vycházky za geologickou minulostí Prahy a okolí. – Academia, Praha, 279 pp.

Chlupáč, I. (2000): Cyclicity and duration of Lower Devonian stages: Observations from the Barrandian area, Czech Republic. – N. Jb. Geol. Paläont. Abh., 215 (1): 97–124.

Conkin, J. E. (1961): Mississipian smaller foraminifera of Kentucky, southern Indiana, northern Tenessee and South/central Ohio. – Bull. Amer. Paleont., 43: 131–368.

Conkin, J. E. and Conkin, B. M. (1964): Devonian foraminifera: Pt 1, The Louisiana limestone of Missouri and Illinois. – Bull. Amer. Paleont., 47: 53–105.

Conkin, J. E., Conkin, B. M., and Pike, J. W. (1965): Mississippi-

an foraminifera of the United States. Part 2 – The Hannibal Formation of northeastern Missouri and western Illinois. – Micropaleontology., 11,3: 335–359.

Conkin, J. E., Conkin, B. M., and Canis, W. F. (1968): Mississippian foraminifera of the United States. Part 3 – The limestones of the Chouteau Group in Missouri and Illinois. –Micropaleontology., 14,2: 133–178.

Conkin, J. E. and Conkin, B. M. (1982): North American Paleozoic Agglutinate Foraminifera. – In: M. A. Buzas (ed.): Foraminifera, Notes for a short course. – Univ. of Tennessee, Dept. Geological Science, Studies in Geology 6: 177–191.

Crespin, I. (1961): Upper Devonian foraminifera from Western Australia. – Palaeontology., 3,4: 397–409.

Cushman, J. A. (1910): A monograph of the foraminifera of the North Pacific Ocean. – U. S. National Mus. Bull., 71, 134 pp.

Cushman, J. A. and Stainbrook, M. A. (1943): Some Foraminifera from the Devonian of Iowa. – Contr. Cushman Lab. Foram. Res., 19: 73–79.

Dunn, P. H. (1942): Silurian foraminifera of the Mississippi Basin. – J. Paleont., 16,3: 317–342.

Duszynska, S. (1956): Foraminifers from the Middle Devonian of the Holly Cross Mountains. – Acta paleont. pol., 1(1): 23–34.

Duszynska, S. (1959): Devonian foraminifers from Wydryszow (Holy Cross Mountains). – Acta paleont. pol., 4: 71–85.

Eickhoff, G. (1970): Foraminiferen aus dem Wocklumer Kalk am Borke-Wehr bei Balve (Oberdevon, Rheinisches Schiefgebirge). – N. Jb. Geol. Paläont. Abh., 135: 227–267.

Eickhoff, G. (1971): Mikrofaunen aus dem Top und Handgenden des Massenkalk bei Menden (Oberdevon, Reinisches Sciefergebirge). – Z. Deutsch. Geol. Ges., 124: 273–294.

Eisenack, A. (1932): Neue Mikrofossilien des baltischen Silurs. II. – Paläont. Z., 14: 257–277.

Eisenack, A. (1937): Neue Mikrofossilien des baltischen Silurs. IV. – Paläont. Z., 19: 217–243.

Eisenack, A. (1954): Foraminiferen aus dem baltischen Silur. – Senck. leth., 35, 1/2: 51–72.

Eisenack, A. (1959): Chitinose Hullen aus Silur und Jura des Baltikums als Foraminiferen. – Paläont. Z., 33,1/2: 90–95.

Eisenack, A. (1967): Foraminiferen aus dem Ordovizium und Gotlandium des baltischen Gebietes. – N. Jb. Geol. Paläont. Abh., 128, 3: 244–274.

Eisenack, A. (1969): Einige ordovizische und silurische Foraminiferen des baltischen Gebietes. – Paläont. Z., 43, 3/4: 199–204.

Eisenack, A. (1971): Weitere Mikrofossilien aus dem Beyrichienkalk (Silur). – N. Jb. Geol. Paläont. Abh., Monatshefte: 449–461.

Ficner, F. and Havlíček, V. (1978): Middle Devonian brachiopods from Čelechovice, Moravia. – Sbor. geol. Ved. Paleont., 21: 49–106.

Flugel, E. and Hotzl, H. (1971): Foraminiferen, Calcisphaeren und Kalkalgen aus dem Schwelmer Kalk (Givet) von Letmathe im Sauerland. – N. Jb. Geol. Paläont. Abh., 137, 3: 358–395.

Galle, A., Hladil, J., and Isaacson, P. E. (1993): Middle Devonian faunal relations and faunal dispersal of closing south Laurussia – North Gondwana Variscides. Examples from the Bohemian Massif with emphasis on Horní Benešov. – Palaios, 10:221–232.

Grubbs, D. M. (1939): Fauna of the Niagaran nodules of the Chicago area. – J. Paleont., 13,6: 543–546.

Gutschick, R. C. and Treckman, J. F. (1959): Arenaceous Foraminifera from the Rockford limestone of Northern Indiana. – J. Paleont., 33,2: 229–250.

Gutschick, R. C., Weiner, J. L., and Young, L. (1961): Lower Mississipian arenaceous foraminifera from Oklahoma, Texas and Montana. – J. Paleont., 35(6): 1193–1221.

Gutschick, R. C. (1962): Arenaceous foraminifera from oncolites in the Mississipian Sappington Formation of Montana. – J. Paleont., 36(6): 174–175.

Gutschick, R. C. and Wuellner, D. (1983): An unusual benthic agglutinated foraminiferan from Late Devonian anoxic basinal black shales of Ohio. – J. Paleont., 57(2): 308–320.

Gutschick, R. C. (1986): Middle Ordovician agglutinated foraminifera including Reophax from the Mifflin Formation Platteville Group of Illinois. – J. Paleont., 60: 229–250.

Holcová, K. (1999): Foraminifers from the the Barrandian: a revision of micropaleontological collection of the Department of Paleontology, Charles University, Prague. – Časopis Národního Musea, 168 (1–4): 37–51.

Ireland, H. A. (1939): Devonian and Silurian Foraminifera from Oklahoma. – J. Paleont., 13,2: 190–202.

Ireland, H. A. (1956): Upper Pennsylvanian arenaceous foraminifera from Kansas. – J. Paleont., 30: 831–864.

Ireland, H. A. (1966): Silurian arenaceous foraminifera from subsurface strata of northeastern Kansas. – Micropaleontology., 12,2: 215–234.

Kristan-Tollmann, E. (1971): Sandschalige Foraminiferen aus dem Silur der Nordlichen und Sudlichen Grauwackenzone Österreichs. – N. Jb. Geol. Paläont. Abh., 137,2: 249–283.

Kristan-Tollmann, E. (1971): Revision der altpaläozoischen Sorosphaeren (Foram.). – N. Jb. Geol. Paläont. Abh., Monatshefte 1971: 171–180.

Kříž, J. (1961): Průzkum zaniklé paleontologické lokality Joachima Barranda, označované jím jako "Butowitz". – Čas. Miner. Geol., 6(2): 173–178.

Kříž, J. and Jaeger., H., Paris, F., Schönlaub, H. P. (1986): Přídolí – the fourth subdivision of the Silurian. – Jb. Geol. B. –A., 129: 291–360.

Kříž, J. (1992): Silurian Field Excursions: Prague Basin (Barrandian), Bohemia. – Nat. Mus. Wales, Geol. Ser. No. 13: 1–111.

Kříž, J. (1999): Geologické památky Prahy. – Český geologický ústav, Praha, 278 pp.

Kukal, Z. (1975): On the origin of nodular limestones. – Čas. Mineral. Geol., 20(4): 359–367.

Langer, W. (1991): Über Charophyta und einige Foraminiferen aus dem westdeutschen Mitteldevon. – N. Jb. Geol. Paläont. Abh., 5: 307–318.

Liebus, A. and Wahner, F. (1904): Foraminiferenfauna in den Schichten der Etage Gg. 3. – Sitz. –Ber. Lotos (Prag), 52,NF 24: 11.

Lipina, O. A. (1959): Nachodka foraminifer v silure i ordovike Sibiri. – Dokl. AN SSSR, 128,4: 823–826.

Loeblich, A. R. Jr. and Tappan, H. (1957): Eleven new genera of Foraminifera. – U. S. National Museum Bull., 215: 223–232.

Loeblich, A. R. and Tappan, H. (1987): Foraminiferal genera and their classification. – Van Nostrand Reinhold Co., New York, 2047 pp.

Malec, J. (1992): Arenaceous Foraminifera from Lower--Middle Devonian Boundary Beds of Western Part of the Gory Swietokrzyskie Mts. – Ann. Soc. Geol. Poloniae, 62: 269–287.

McClellan, W. A. (1966): Arenaceous Foraminifera from the Waldron Shale (Niagaran) of Southeast Indiana. – Bull. amer. paleont., 50,230: 447–518.

McClellan, W. A. (1973): Siluro-Devonian Microfaunal Biostratigraphy in Nevada. – Bull. amer. paleont., 62,274: 231–375.

Miller, H. W. (1956): The index value of silurian foraminifera and

some new forms from wells in Kansas. – J. Paleont., 30,6: 1350–1359.
Moreman, W. L. (1930): Arenaceous Foraminifera from Ordovician and Silurian limestones of Oklahoma. – J. Paleont., 4,1: 42–59.
Moreman, W. L. (1933): Arenaceous Foraminifera from the Lower Paleozoic rocks of Oklahoma. – J. Paleont., 7,4: 393–397.
Mound, M. C. (1961): Arenaceous Foraminifera from the Brassfield Limestone (Albion) of Southeastern Indiana. – Indiana Dep. Cons.,Geol. Survey,Bull., 23: 1–38.
Mound, M. C. (1968): Arenaceous Foraminiferida and Zonation of the Silurian Rocks of Northern Indiana. – Dep. Nat. Resources,Geol. Surv. Bull., 38: 1–126.
Olempska, E. (1983): The Uppermost Devonian foraminifers of the Swietokrzyskie (Holy Cross) Mts., Poland. – Acta paleont. pol., 28(3–4): 393–416.
Parr, W. J. (1942): Foraminifera and a tubiculus worm from the Permian of the North-West Division of Western Australia. – Royal Soc. West Australia Journal, 27: 103
Petránek, J. (1950): Petrografická studie o nejmladších devónskych vrstvách v Dalejském údolí u Prahy. – Rozpr. Čes. Akad. Ved. Umeni, 60,19: 1–16.
Pichler, R. (1971): Mikrofossilien aus dem Devon der sudlichen Eifeler Kalkmulden. – Senck. leth., 52,(4): 315–357.
Plummer, H. J. (1945): Smaller foraminifera in the Marble Falls, Smithwick and lower Strawn strata around Llano uplift in Texas. – University of Texas,Publication 4401, 209–271.
Pokorný, V. (1951): The Middle Devonian Foraminifera of Čelechovice, Czechoslovakia. – Věst. Král. Čes. Společ. Nauk,Tř. mat.-prirodoved., 9: 1–28.
Pokorný, V. (1959): Nálezy foraminifer v souvrství vápenců hlubočepských (eifel). – Čas. Mineral. Geol., 4,2: 167–169.
Prantl, F. (1947): Výskyt rodu Psammosiphon Vine,1882 v českém devonu. – Vest. St. geol. Úst. Čs. Republ., 22: 225–234.
Pronina, T. V. (1963): Foraminifery i nekotorye soputstvujuscie im mikroorganizmy silura Ufimskogo amfiteatra. – Paleont. Ž., 4: 3–13.
Pronina, T. V. (1968a): Rod Earlandia i nekotorye drugije silurijskije foraminifery Urala. –Paleont. Ž., 4: 38–46.
Pronina, T. V. (1968b): Novye silurijskie i devonskie foraminifery Urala. – Paleont. Ž., 2: 26–33.
Reytlinger, E. A. (1957): Sfery devonskich otlozenij ruskoj platformy. – Dokl. AN SSSR, 115(4): 774–776.
Riegraf, W. and Niemeyer, J. (1996): Agglutinierte Foraminiferen aus Graptolithen-Schwarzschiefern des Llanvirnium (Ordovizium) von Plettenberg im Sauerland (Nordrhein-Westfalen), NW-Deutschland). – Paläont. Z., 70, 1/2: 19–36.
Schubert, R. J. and Liebus, A. (1902): Vorlaufige Mittheilung uber Foraminiferen aus dem Böhmischen Devon (Etage Gg3 Barr.). – Verh. Geol. Reichsanst., 2: 66
Scotese, C. R. and McKerrow, W. S. (1990): Revised world maps and introduction. – In: McKerroe, W. S., Scotese, C. R. (eds.): Palaeozoic palaeogeography and biogeography. Geol. Soc. London Mem., 12, 1–21, London.
Simpson, A. J., Bell, K. N., Mawson, R., and Talent, J. A. (1993): Late Silurian (Ludlow) conodonts and foraminifers from Cowombat, SE Australia. – Mem. Ass. Australas. Palaeontols, 15: 141–159.
Stewart, G. A. and Priddy, R. R. (1941): Arenaceous Foraminifera from the Niagaran rocks of Ohio and Indiana. – J. Paleont., 15, 4: 366–375.
Stewart, G. A. and Lampe, L. (1947): Foraminifera from the Middle Devonian bone beds of Ohio. – J. Paleont., 21,6: 529–536.
Summerson, C. H. (1958): Arenaceous Foraminifera from the Middle Devonian Limestones of Ohio. – J. Paleont., 32: 544–588.
Trifonova, E. (1964): Foraminifera from the pebbles included in the early Paleozoic breccia conglomerates in NW Bulgaria. – Spis. Balg. geol. Druz., 25, 2: 117–127.
Tschernych, V. V. (1965): Novye pozdnesilurijskie foraminifery Urala. – Paleont. Ž., 2: 37–43.
Tschernych, V. V. (1969): Pervaja nachodka iskopaemych dendrofriin (Foraminifera) v silure vostocnogo sklona Urala. – Paleont. Ž., 3: 136–139.
Waters, J. A. (1927): A group of foraminifera from the Dornick Hills Formation of the Ardmore Basin. – J. Paleont. 1: 129–133.
Watkins, R., Walsch, K., and Kuglitsch, J. J. (1999): Silurian (Llandovery/Wenlock) Foraminiferida in carbonate environments of southeastern Wisconsin. – J. Paleont., 73(3): 540–546.
Winchester-Seeto, T. and Bell, K. N. (1994): Microforaminiferal linings from the Early Devonian of Eastern Australia, and their generic placement. – J. Paleont., 68 (2): 200–207.

Explanation of plates

PLATE 1

1–10. Kozolupy, Smoking Quarry, Ludfordian
1. *Thuramminoides sphaeroidalis* PLUMMER, Kozolupy 81
2. *Thuramminoides sphaeroidalis* PLUMMER, Kozolupy 63
3. *Webbinelloidea hattini* McCLELLAN., Kozolupy 57 (lenght of scale bar 50 µm)
4. *Thuramminoides sphaeroidalis* PLUMMER, Kozolupy 63
5. *Hemisphaerammina carmani* (SUMMERSON), Kozolupy 81
6. *Thuramminoides sphaeroidalis* PLUMMER, Kozolupy 100 (lenght of scale bar 33 µm)
7. *Lagenammina ovata* BELL, Kozolupy 63
8. *Hemisphaerammina* aff. *casteri* MCCLELLAN, Kozolupy 72
9. *Psammosphaera* sp., Kozolupy 63
10. *Glomospira* (?) sp., Kozolupy 60

11–16. Kační Quarry, Na břekvici Section, Hommerian-Gorstian
11. *Hemisphaerammina bradyi* LOEBLICH et TAPPAN., Na břekvici, tuffite, Gorstian
12. *Thurammina* aff. *echinata* DUNN, Na břekvici, tuffite, Gorstain
13. *Hemisphaerammina bradyi* LOEBLICH et TAPPAN, Kační Quarry, Hommerian
14. *Hyperammina* (?) sp. 2, fragment of proloculus, Kační Quarry, Hommerian
15. *Hemisphaerammina bradyi* LOEBLICH et TAPPAN, Kační Quarry, Hommerian

Lenght of scale bar 100 µm, if not given other.

PLATE 2

1. S*erpenulina uralica* TSCHERNICH, Kosov Quarry, Ludfordian, zone with *A. fecunda*

2, 3. *Thurammina* aff. *tubulata* MOREMAN, Kosov Quarry, Ludfordian, zone with *A. fecunda* (two different specimens)

4. *Pseudastrorhiza* sp., Kosov Quarry, Ludlow, zone with *E. beaumonti*
5. *Hyperammina* cf. *gracilenta* GUTSCHICK et TRECKMAN, fragment of proloculus, Kosov Quarry, Ludfordian, zone with *A. fecunda*
6. *Thuramminoides sphaeroidalis* PLUMMER, Klonk Section 20, Silurian/Devonian
7. *Psammosphaera devonica* STEWART et LAMPE, Klonk Section 20, Silurian/Devonian
8. *Thuramminoides sphaeroidalis* PLUMMER, Na bříči Section 2, Pridoli, lenght of scale bar 200 µm
9. *Webbinelloidea* sp., Na bříči Section 2, Pridoli, lenght of scale bar 400 µm
10. *Webbinelloidea* sp., Na bříči Section 2, Pridoli, lenght of scale bar 200 µm
11. *Webbinelloidea* sp., Na bříči Section 2, Pridoli, lenght of scale bar 200 µm
12. *Psammosphaera gracilis* IRELAND, Litohlavy Reservoir, 2.5 m, Telychian
13. *Paratikhinellidae* (?) gen. et sp. 2, Koledník Quarry 6, Ludfordian
14. *Thuramminoides sphaeroidalis* PLUMMER, Hlásná Třebaň, 0.5 m, Rhuddanian
15. *Psammosphaera* sp., Hlásná Třebaň, 4.5 m, Aeronian

Lenght of scale bar 100 µm, if not given other.

PLATE 3

Požáry Section, Ludlowian/Pridoli
1. *Hemisphaerammina bradyi* LOEBLICH et TAPPAN, Požáry 100, Pridoli
2. *Hemisphaerammina bradyi* LOEBLICH et TAPPAN, Požáry 100, Pridoli
3. *Colonammina* sp., Požáry 93, Ludfordian, zone with A. fecunda
4. tube-like rest, type 2, Požáry 158, Pridoli, lenght of scale bar 200 µm
5. *Webbinelloidea hattini* McCLELLAN, Požáry 28, Ludlow, zone with *E. beaumonti*
6. *Sorosphaerella* sp., Požáry 2, Ludlow

7–14. Koledník Quarry, Ludfordian
7. *Hemispaerammina bradyi* LOEBLICH et TAPPAN, broken specimen, Koledník 22, lenght of scale bar 200 µm
8. *Amphitremoidea* sp., Koledník 6
9. *Hemisphaerammina carmani* (SUMMERSON), Koledník 6
10. *Tholosina* (?) sp. 2, specimen attaching other one, Koledník 8
11. *Hemisphaerammina carmani* (SUMMERSON), Koledník 7
12. *Hemisphaerammina carmani* (SUMMERSON), Koledník 6
13. *Amphitremoidea* sp., Koledník 21, lenght of scale bar 75 µm
14. *Thuramminoides sphaeroidalis* PLUMMER, Koledník 5
15. *Nodosinellidae* (?) gen. et sp. 1, Vyskočilka near Malá Chuchle, Wenlock

Lenght of scale bar 100 µm, if not given other.

PLATE 4

Homolka near Velká Chuchle, Lochkovian/Pragian
1. *Tolypammina* sp. 6 (fragment of proloculus), Homolka 18, Pragian, lenght of scale bar 200 µm
2. *Lagenammina sphaerica* MOREMAN, Homolka 20, Pragian
3. *Thurammina triradiata* GUTSCHICK et TRECKMAN, Homolka 20, Pragian
4. *Hemisphaerammina carmani* (SUMMERSON), attached side, Homolka 20, Pragian
5. *Hemisphaerammina carmani* (SUMMERSON), convex side, Homolka 20, Pragian
6. *Saccammina pseudospiralis* (CUSHMAN et STAINBROCK), Homolka 20, Pragian
7. *Hemisphaerammina carmani* (SUMMERSON), convex side, Homolka 6, Lochkovian
8. *Saccammina* sp. 1, Homolka 18, Pragian
9. *Tolypammina* sp. 1, Homolka 18, Pragian, lenght of scale bar 200 µm
10. *Tolypammina* sp. 1, Homolka 20, Pragian, lenght of scale bar 300 µm
11. *Tolypammina* aff. *tornella* (IRELAND), Homolka 1, Lochkovian

Lenght of scale bar 100 µm, if not given other.

PLATE 5

1–13 Barrandov, Dvorce-Prokop Lst.,Pragian
1. *Hemisphaerammina carmani* (SUMMERSON), basal part partly missing, Old Quarry (section bellow Barrandov)
2. Moravamminidae gen. et sp. indet., Old Quarry (section bellow Barrandov)
3. *Saccammina* sp. 1, Old Quarry (section bellow Barrandov)
4. *Soroshaerella* sp., Old Quarry (section bellow Barrandov)
5. *Tolypammina* sp. 3, Old Quarry (section bellow Barrandov), lenght of scale bar 200 µm
6. *Lagenammina* aff. *sphaerica* MOREMAN, Old Quarry (section bellow Barrandov)
7. *Tolypammina* sp.8, Old Quarry (section bellow Barrandov)
8. *Ammovolummina* sp., Old Quarry (section bellow Barrandov)
9. *Tolypammina* sp., fragment of tubular second chamber, Old Quarry (section bellow Barrandov)
10. tube-like rest, type 3, Old Quarry (section bellow Barrandov)

11. tube-like rest, type 4, Pod terasami Quarry (section bellow Barrandov)
12. *Hemisphaerammina carmani* (SUMMERSON), Pod terasami Quarry (section bellow Barrandov)
13. *Tolypammina* sp. 7, Pod terasami Quarry (section bellow Barrandov)
14. *Thurammina* aff. *diforamens* IRELAND, V rokli Quarry, Dvorce-Prokop Lst., Pragian
15. Paratikhinellidae gen. et sp. 1, Pod terasami Quarry (section bellow Barrandov), Dvorce-Prokop Lst., Pragian
16. *Tolypammina* sp., fragment of tubular chamber, V rokli Quarry, Dvorce-Prokop Lst., Pragian
17. *Saccammina pseudospiralis* (CUSHMAN et STAINBROCK), Srbsko, Řeporyje Lst., Pragian
18. ? Paratikhinellidae gen. et sp. 1, Pod terasami Quarry (section bellow Barrandov), Dvorce-Prokop Lst., Pragian
19. isolated chamber of Nodosinellidae, V rokli Quarry, Loděnice Lst., Pragian

Lenght of scale bar 100 µm, if not given other.

PLATE 6

1–6. Údolí Hluboké Valley near Karlštejn, house No. 27, Dvorce-Prokop Lst., Pragian
1. *Hemisphaerammina bradayi* LOEBLICH et TAPPAN, lenght of scale bar 75 µm
2. *Lagenammina sphaerica* MOREMAN
3. *Hyperammina rockfordensis* GUTSCHICKetTRECKMAN
4. *Tolypammina sperma* GUTSCHICK, WIENER et YOUNG, lenght of scale bar 200 µm
5. *Ammobaculites* (?) sp.1, lenght of scale bar 200 µm
6. *Saccammina cumberlandiae* (CONKIN), lenght of scale bar 200 µm

7–9. *Psammosphaera devonica* STEWART et LAMPE, Karlík Valley, Dvorce-Prokop Lst., Pragian

10–13. Braník Quarry, Dvorce-Prokop Lst., Pragian
10. *Hemisphaerammina carmani* (SUMMERSON), basal part missing
11. *Hemisphaerammina carmani* (SUMMERSON), basal part, lenght of scale bar 200 µm
12. *Thurammina* aff. *echinata* DUNN, lenght of scale bar 75 µm
13. fragment of monoserially arranged test, lenght of scale bar 75 µm
14. *Saccammina* aff. *ligula* (GUTSCHICK, WIENER et YOUNG), Opatřilka-Červený lom Quarry, Dvorce-Prokop Lst., Pragian
15. *Saccammina* aff. *ligula* (GUTSCHICK, WIENER et YOUNG), Srbsko, Řeporyje Lst., Pragian

Lenght of scale bar 100 µm, if not given other.

PLATE 7

Stydlé vody Quarry, Pragian
1. *Thurammminoides sphaeroidalis* PLUMMER, section 1/13, Dvorce-Prokop Lst.
2. *Lagenammina sphaerica* MOREMAN, iron ore horizon, , Dvorce-Prokop Lst., lenght of scale bar 200 µm
3. *Lagenammina sphaerica* MOREMAN, section 1/2, Řeporyje Lst.
4. *Lagenammina sphaerica* MOREMAN, section 1/12, Dvorce-Prokop Lst, lenght of scale bar 200 µm
5. *Lagenammina sphaerica* MOREMAN, Section 1/12, Dvorce-Prokop Lst.
6. *Lagenammina sphaerica* MOREMAN, iron ore horizon, , Dvorce-Prokop Lst., lenght of scale bar 200 µm
7. *Pseudastrorhiza* sp., below the iron ore horizon, Dvorce-Prokop Lst., lenght of scale bar 50 µm
8. ? *Lagenammina* sp., Section 1/2, Řeporyje Lst.
9. *Thurammina* aff. *echinata* DUNN, section 1/12, Dvorce-Prokop Lst., lenght of scale bar 75 µm
10. *Thurammina* aff. *quadritubulata* DUNN, section 2/1, Dvorce-Prokop Lst.
11. *Pseudastrorhiza* aff. *irregularis* DUNN, section 2/3, Dvorce-Prokop Lst., lenght of scale bar 200 µm
12. *Pseudastrorhiza* aff. *irregularis* DUNN (broken specimen), section 1/23, Dvorce-Prokop Lst., lenght of scale bar 50 µm
13. *Psammosphaera* sp., section 1/32, Dvorce-Prokop Lst.
14. *Webbinelloidea hattini* McCLELLAN, section 1/21, Dvorce-Prokop Lst.
15. *Hemisphaerammina* aff. *casteri* McCLELLAN, section 2/4, Dvorce-Prokop Lst., lenght of scale bar 200 µm
16. *Webbinelloidea hattini* McCLELLAN, section 1/2, Řeporyje Lst.

Lenght of scale bar 100 µm, if not given other.

PLATE 8

Stydlé vody Quarry
1–11. Dvorce-Prokop Lst., Pragian
1. *Bathysiphon* sp., above iron ore horizon, lenght of scale bar 200 µm
2. *Hyperammina rockfordensis* GUTSCHICK et TRECKMAN, section 1/14, lenght of scale bar 200 µm
3. *Hyperammina rockfordensis* GUTSCHICK et TRECKMAN, section 1/13, lenght of scale bar 200 µm
4. *Hyperammina rockfordensis* GUTSCHICK et TRECKMAN, below iron ore horizon
5. *Hyperammina rockfordensis* GUTSCHICK et TRECKMAN, section 1/12
6. *Ammodiscus* sp., section 1/14
7. *Tolypammina tortuosa* DUNN, section 1/33, lenght of scale bar 200 µm
8. *Tolypammina tortuosa* DUNN, Section 1/31, lenght of scale bar 75 µm
9. *Tolypammina polyverta* IRELAND, above iron ore horizon, lenght of scale bar 200 µm
10. *Tolypammina polyverta* IRELAND, above iron ore horizon
11. *Tolypammina polyverta* IRELAND, section 1/15, lenght of scale bar 400 µm

12–15. Zlíchov Lst., Zlichovian
12, 13. *Thurammminoides sphaeroidalis* PLUMMER, Zlichovian 10 (two different specimens)
14, 15. *Thurammminoides sphaeroidalis* PLUMMER, Zlichovian 2, lenght of scale bar 75 µm (two different specimens)

Lenght of scale bar 100 µm, if not given other.

PLATE 9

1–3, 5–9. Opatřilka-Červený lom Quarry, Pragian
1. *Thurammminoides sphaeroidalis* PLUMMER, Dvorce-Prokop Lst., lenght of scale bar 50 µm
2. (?) *Thurammina* aff. *echinata* DUNN, Dvorce-Prokop Lst., lenght of scale bar 33 µm
3. *Thurammina* aff. *echinata* DUNN, Řeporyje Lst.
4. *Hyperammina rockfordensis* GUTSCHICK et TRECKMAN, Stydlé vody Quarry, above iron ore horizon
5. *Tolypammina* sp., fragment of tubular chamber, Řeporyje Lst.
6. *Sorosphaera tricella* MOREMAN, Dvorce-Prokop Lst.
7. *Tolypammina* sp. 5, Dvorce-Prokop Lst., lenght of scale bar 50 µm
8. *Hyperammina rockfordensis* GUTSCHICK et TRECKMAN, Dvorce-Prokop Lst.
9. *Tolypammina irregularis* BLUMENSTENGEL, Dvorce-Prokop Lst., lenght of scale bar 50 µm

10. *Psammosphaera cava* MOREMAN, Jiráskův lom Quarry, Acantopyge Lst., Eifelian
11. *Saccammina pseudospiralis* (CUSHMAN et STAINBROOK), U jezírka Quarry, Třebotov Lst., Dalejan
12. *Ammodiscella* sp., Hergetův lom Quarry, Suchomasty Lst., Dalejan

13–16. Dalej Shales, Dalejan
13. Archaesphaeridae gen. et sp. indet., Road "Ke hřbitovu", Hlubočepy, lenght of scale bar 50 µm
14. Archaesphaeridae gen. et sp. indet., Road "Ke hřbitovu", Hlubočepy, lenght of scale bar 33 µm
15, 16. *Thuramminoides sphaeroidalis* PLUMMER, Údolí Hluboké Valley near Karlštejn, house No. 130, lenght of scale bar 33 µm (two different specimens)
17. *Ammobaculites* (?) sp., Údolí Hluboké Valley near Karlštejn, house No. 130, lenght of scale bar 50 µm

Lenght of scale bar 100 µm, if not given other.

PLATE 10

Chýnice – old quarry, Třebotov Lst. (Dalejan), Choteč Lst. (Eifelian)
1. *Psammosphaera devonica* STEWART et LAMPE, Chýnice 4, Třebotov Lst.
2. *Hemisphaerammina carmani* (SUMMERSON), Chýnice 2, Třebotov Lst., lenght of scale bar 200 µm
3. *Hemisphaerammina carmani* (SUMMERSON), Chýnice 2, Třebotov Lst.
4. *Webbinelloidea hattini* McCLELLAN, Chýnice 4, Třebotov Lst.
5. *Webbinelloidea hattini* McCLELLAN, Chýnice 7, Choteč Lst.
6. *Psammosphaera cava* MOREMAN, Chýnice 4, Třebotov Lst., lenght of scale bar 300 µm
7. *Thuramminoides sphaeroidalis* PLUMMER, Chýnice 8, Choteč Lst.
8. *Psammosphaera cava* MOREMAN, Chýnice 4, Třebotov Lst.
9. *Psammosphaera devonica* STEWART et LAMPE, Chýnice 5, Třebotov Lst.
10. *Psammosphaera devonica* STEWART et LAMPE, Chýnice 4, Třebotov Lst.
11. *Thurammina* sp.1, Chýnice 2, Třebotov Lst.
12. *Thurammina* sp.1,, Chýnice 4, Třebotov Lst.
13. *Thurammina* sp.1,, Chýnice 2, Třebotov Lst., lenght of scale bar 200 µm

Lenght of scale bar 100 µm, if not given other.

PLATE 11

1–11. Chýnice – old quarry, Třebotov Lst. (Dalejan), Choteč Lst. (Eifelian)
1. *Lagenammina sphaerica* MOREMAN, Chýnice 5, Třebotov Lst., lenght of scale bar 33 µm
2. *Lagenammina sphaerica* MOREMAN, Chýnice 5, Třebotov Lst.
3. *Lagenammina sphaerica* MOREMAN, Chýnice 5, Třebotov Lst., lenght of scale bar 50 µm
4. *Tholosina* (?) sp. 2, Chýnice 6, Třebotov Lst.
5. *Ammodiscus incertus* ORBIGNY, Chýnice 2, Třebotov Lst.
6. *Hyperammina* sp. 1, Chýnice 2, Třebotov Lst.
7. *Hyperammina rockfordensis* GUTSCHICK et TRECKMAN, Chýnice 5, Třebotov Lst.
8. *Hyperammina rockfordensis* GUTSCHICK et TRECKMAN, Chýnice 2, Třebotov Lst.
9. *Ammobaculites minutus* WATERS, Chýnice 4, Třebotov Lst.
10, 11. *Tolypammina* sp. 4, Chýnice 2, Třebotov Lst. (two different specimens)

12–14. Červený lom Quarry near Koněprusy, Suchomasty Lst. (Dalejan)
12. *Lagenammina sphaerica* MOREMAN, Červený lom 18, lenght of scale bar 50 µm
13. *Psammosphaera cava* MOREMAN, Červený lom 18, lenght of scale bar 33 µm
14. *Saccammina pseudospiralis* (CUSHMAN et STAINBROOK), Červený lom 18, lenght of scale bar 50 µm

Lenght of scale bar 100 µm, if not given other.

PLATE 12

1–8. Kačák Valley, Choteč Lst. Eifelian
1. *Hemisphaerammina carmani (*SUMMERSON), lenght of scale bar 75 µm
2. *Psammosphaera gracilis* IRELAND, lenght of scale bar 200 µm
3. *Thuramminoides sphaeroidalis* PLUMMER
4. *Ammodiscus* ex gr. *incertus* ORBIGNY, lenght of scale bar 200 µm
5. *Saccammina pseudospiralis* (CUSHMAN et STAINBROOK)
6. *Saccammina pseudospiralis* (CUSHMAN et STAINBROOK), optical microscope, lenght of scale bar 180 µm
7. *Tolypammina* sp. 5, lenght of scale bar 200 µm
8. *Tolypammina* sp., fragment of tubular second chamber, optical microscope, lenght of scale bar 180 µm

9–11. Údolí Hluboké Valley near Karlštejn, Třebotov Lst., Dalejan
9. *Ammodiscus exsertus* CUSHMAN, Hluboké e6
10. *Ammodiscus exsertus* CUSHMAN, Hluboké e6, lenght of scale bar 75 µm
11. *Webbinelloidea tholus* (MOREMAN), Hluboké e2

Lenght of scale bar 100 µm, if not given other.

PLATE 13

Údolí Hluboké Valley near Karlštejn, Třebotov Lst., Dalejan
1. *Psammosphaera devonica* STEWART et LAMPE, Hluboké e5, lenght of scale bar 50 µm
2. *Psammosphaera devonica* STEWART et LAMPE, Hluboké e5, lenght of scale bar 33 µm
3. *Psammosphaera minuta* DUNN, Hluboké e4, lenght of scale bar 33 µm
4. *Psammosphaera cava* MOREMAN, Hluboké e4, lenght of scale bar 33 µm
5. *Thuramminoides sphaeroidalis* PLUMMER, Hluboké e6, lenght of scale bar 50 µm
6. *Lagenammina sphaerica* MOREMAN, Hluboké e4, lenght of scale bar 33 µm
7. *Thurammina* sp. 1, Hluboké e2, lenght of scale bar 50 µm
8. Ammodiscidae gen. et sp. indet., Hluboké e4
9. Ammodiscidae gen. et sp. indet., Hluboké e1
10. *Tolypammina sperma* GUTSCHICK, WIENER et YOUNG, Hluboké e4
11. (?) *Tolypammina sperma* GUTSCHICK, WIENER et YOUNG, Hluboké e2
12. *Hyperammina gracilenta* GUTSCHICK et TRECKMAN, Hluboké e6
13. *Hyperammina kahlleinwensis* BLUMENSTENGEL, Hluboké e6, lenght of scale bar 300 µm
14. *Hemisphaerammina bradyi* LOEBLICH et TAPPAN, Hluboké e2, lenght of scale bar 33 µm
15. *Tholosina* (?) sp. 2, Hluboké e6
16. *Tholosina* (?) sp. 2, missing attached wall, Hluboké e6

Lenght of scale bar 100 µm, if not given other.

PLATE 14

1–5. Nad tratí Quarry, Třebotov Lst., Dalejan
1. *Lagenammina sphaerica* MOREMAN, Nad tratí 1
2. *Psammosphaera gracilis* IRELAND, Nad tratí 1
3. *Saccammina* (?) *petinensis* BYKOVA, Nad tratí 5, lenght of scale bar 75 µm
4. *Tolypammina* sp. 4, Nad tratí 5, lenght of scale bar 300 µm
5. *Hyperammina* sp. 1, Nad tratí 1

6–12. original stratotype of Pragian/Zlichovian boundary – section below Barrandov
6. *Psammosphaera minuta* DUNN, Zlichovian 1
7. *Psammosphaera minuta* DUNN, Pragian 5
8. *Thuramminoides sphaeroidalis* PLUMMER, Pragian 2

9–11. *Thuramminoides sphaeroidalis* PLUMMER, Chapel Corral Horizon (three different specimens)
12. *Bathysiphon* sp., Pragian 5, lenght of scale bar 200 µm
13. Paratikhinellidae gen. et sp. 1, Homolka 18, Pragian, lenght of scale bar 75 µm
14. Hormosinidae gen. et sp. indet., Chapel Corral Horizon, lenght of scale bar 200 µm
15. *Tholosina* sp. 1, Prastav Quarry, Praha-Holyně, Třebotov Lst., Dalejan, Pokorný's sample
16. *Tholosina* sp. 1, Prastav Quarry, Praha-Holyně, Třebotov Lst., Dalejan, Pokorný's sample
17. *Bisphaera* (?) sp., Pod terasami Quarry (section bellow Barrandov), Dvorce-Prokop Lst., Pragian

Lenght of scale bar 100 µm, if not given other.

PLATE 15

Prastav Quarry, Praha-Holyně. Třebotov Lst., Dalejan
1. *Psammosphaera cava* MOREMAN, Prastav 3
2. *Psammosphaera devonica* STEWART et LAMPE, Prastav 1
3. *Psammosphaera devonica* STEWART et LAMPE, Prastav 5, lenght of scale bar 75 µm
4. *Psammosphaera cava* MOREMAN, Prastav 5
5. *Psammosphaera minuta* DUNN, Prastav 1
6. *Psammosphaera minuta* DUNN, Prastav 2
7. *Psammosphaera minuta* DUNN, Prastav 12, Choteč Lst.
8. *Psammosphaera minuta* DUNN, Prastav 5, lenght of scale bar 75 µm
9. *Psammosphaera devonica* STEWART et LAMPE, Prastav 5, lenght of scale bar 60 µm, light microscope
10. *Psammosphaera devonica* STEWART et LAMPE, Prastav 5, lenght of scale bar 60 µm, light microscope
11. *Psammosphaera devonica* STEWART et LAMPE, Prastav 5, lenght of scale bar 60 µm, light microscope
12. *Psammosphaera cava* MOREMAN, Prastav 3, lenght of scale bar 60 µm, light microscope
13. *Psammosphaera minuta* DUNN, Prastav 1, lenght of scale bar 60 µm, light microscope
14. *Hemisphaerammina* sp., Prastav 3
15. *Hemisphaerammina carmani* (SUMMERSON), Prastav 3
16. *Hemisphaerammina carmani* (SUMMERSON), Prastav 3, lenght of scale bar 60 µm, light microscope

Lenght of scale bar 100 µm, if not given other.

PLATE 16

Prastav Quarry, Praha-Holyně. Třebotov Lst., Dalejan
1. *Lagenammina sphaerica* MOREMAN, Prastav 3
2. *Lagenammina sphaerica* MOREMAN, Prastav 8
3. *Lagenammina sphaerica* MOREMAN, Prastav 3
4. *Thurammina triradiata* GUTSCHICK et TRECKMAN, Prastav 3
5. *Thurammina sphaerica* IRELAND, Prastav 3
6. *Thurammina arcuata* MOREMAN, Prastav 7
7. *Thurammina* aff. *echinata* DUNN, Prastav 1, lenght of scale bar 75 µm
8. *Thurammina* aff. *quadritubulata* DUNN, Prastav 4, lenght of scale bar 200 µm
9. *Thurammina* sp. 2, Prastav, Pokorný's sample
10. *Thurammina* aff. *tubulata* MOREMAN, Prastav 3
11. *Thurammina papillata* BRADY, Prastav, Pokorný's sample
12. *Saccammina* (?) *petinensis* BYKOVA, Prastav 3

Lenght of scale bar 100 µm, if not given other.

PLATE 17

Prastav Quarry, Praha-Holyně. Třebotov Lst., Dalejan

Fig. 1 *Hyperammina gracilenta* GUTSCHICK et TRECKMAN, Prastav 4, lenght of scale bar 33 µm
Fig. 2 *Saccorhiza* aff. *proboscis* (BELL), Prastav 5, lenght of scale bar 50 µm
Fig. 3 tube-like rest, type 1, Prastav 10
Fig. 4 tube-like rest, type 1, fragments, Prastav 2
Fig. 5 *Hyperammina gracilenta* GUTSCHICK et TRECKMAN, Prastav 10
Fig. 6 *Hyperammina gracilenta* GUTSCHICK et TRECKMAN, Prastav 8
Fig. 7 *Tolypammina* sp. 4, Prastav 1
Fig. 8 *Tolypammina* sp. 4, Prastav 8
Fig. 9 *Tolypammina* sp. 5, Prastav 3, lenght of scale bar 50 µm
Fig. 10 *Tolypammina* sp. 4, Prastav 4
Fig. 11 *Tolypammina bulbosa* (GUTSCHICK et TRECKMAN), Prastav 4
Fig. 12 *Tolypammina bulbosa* (GUTSCHICK et TRECKMAN), Prastav 3
Fig. 13 *Tolypammina* sp. 2, Prastav 4
Fig. 14 Ammodiscidae gen. et sp. indet., Prastav 2
Fig. 15 *Tolypammina* sp. (? *T. nodosa* IRELAND), Prastav 4
Fig. 16 *Tolypammina irregularis* BLUMENSTENGEL, Prastav 8
Fig. 17 *Ammobaculites* aff. *leptos* GUTSCHICK et TRECKMAN, Prastav 6

Lenght of scale bar 100 µm, if not given other.

PLATE 18

Prastav Quarry, Praha-Holyně. Třebotov Lst., Dalejan

Fig. 1 *Tholosina* (?) sp. 2, Prastav 10, lenght of scale bar 200 µm
Fig. 2 *Tholosina* (?) sp. 2, Prastav 5, lenght of scale bar 75 µm

3. *Hemisphaerammina bradyi* LOEBLICH et TAPPAN, Prastav 5, lenght of scale bar 75 µm
4. *Saccammina pseudospiralis* (CUSHMAN et STAINBROOK), Prastav 4
5. *Saccammina pseudospiralis* (CUSHMAN et STAINBROOK), Prastav 1
6. *Saccammina pseudospiralis* (CUSHMAN et STAINBROOK), Prastav 10
7. *Ammodiscus* ex gr. *incertus* ORBIGNY, Prastav 8
8. *Ammodiscus* ex gr. *incertus* ORBIGNY, Prastav, Pokorný's sample
9. *Ammodiscus* ex gr. *incertus* ORBIGNY, Prastav, Pokorný's sample

Lenght of scale bar 100 µm, if not given other.

PLATE 19 Sack-like tests

1. Požáry 63, Ludfordian, zone with *A. fecunda*
2. Kozolupy 72, Ludfordian

3–7. Hergetův lom Quarry, Suchomasty Lst., Dalejan (five different specimens)
8–9. Prastav Quarry 10, Třebotov Lst., Dalejan (two different specimens)
10. Prastav Quarry 10, Třebotov Lst., Dalejan
11. Prastav Quarry 3, Třebotov Lst., Dalejan
12. Prastav Quarry 12, Choteč Lst., Eifelian
13. original stratotype of Pragian/Zlichovian boundary – section below Barrandov, Zlichovian 5
14. Nad tratí Quarry 5, Třebotov Lst., Dalejan
15. Nad tratí Quarry 7, Choteč Lst., Eifelian
16. Chýnice - old quarry 4, Třebotov Lst., Dalejan
17. Chýnice - old quarry 5, Třebotov Lst., Dalejan
18. Nad tratí Quarry 1, Třebotov Lst., Dalejan
19. Údolí Hluboké Valley near Karlštejn e6, Třebotov Lst., Dalejan
20, 21. Opatřilka-Červený lom Quarry, Dvorce-Prokop Lst., Pragian, (two different specimens)
Lenght of scale bar 100 µm.

PLATE 20

1–6. Radiolaria
1, 2. Nad tratí Quarry 7, Choteč Lst., Eifelian (two different specimens)
3. Kosov Quarry, Ludfordian, zone with *A. fecunda*
4. Stydlé vody Quarry 10, Dvorce-Prokop Lst., Pragian, lenght of scale bar 75 µm
5. Chýnice – old quarry 4, Třebotov Lst.
6. Kačák Valley, Choteč Lst., lenght of scale bar 75 µm
7, 8, 15. Polychaeta
7. Stydlé vody Quarry 10, Dvorce-Prokop Lst., Pragian
8. Stydlé vody Quarry 14, Dvorce-Prokop Lst., Pragian
15. Homolka 18, Pragian
9–14. Incertae sedis 1
9, 10. Old Quarry (section bellow Barrandov), Dvorce-Prokop Lst. (two different specimens)
11. Požáry 26, Ludlow, zone with *E. beaumonti*
12. Opatřilka-Červený lom Quarry, Dvorce-Prokop Lst., Pragian
13. original stratotype of Pragian/Zlichovian boundary – section below Barrandov, Zlichovian 5
14. Mušlovka Quarry 11, Ludfordian
16-22. spongi spicules
16. Srbsko, Řeporyje Lst., lenght of scale bar 75 µm
17. Prastav Quarry 8, Třebotov Lst., Dalejan
18. Prastav Quarry 3, Třebotov Lst., Dalejan
19. Opatřilka-Červený lom Quarry, Dvorce-Prokop Lst., Pragian
20. Prastav Quarry 10, Třebotov Lst., Dalejan., lenght of scale bar 200 µm
21. Opatřilka-Červený lom Quarry, Dvorce-Prokop Lst., Pragian
22. Old Quarry (section bellow Barrandov), Dvorce-Prokop Lst., Pragian
Lenght of scale bar 100 µm, if not given other.

PLATE 21

1–4. Ostracoda
1, 2. Old Quarry (section bellow Barrandov), Dvorce-Prokop Lst., Pragian, lenght of scale bar 200 µm (two different specimens)
3, 4. Prastav Quarry 10, Třebotov Lst., Dalejan., lenght of scale bar 200 µm (two different specimens)
5, 6. juvenile Gastropoda, Old Quarry (section bellow Barrandov), Dvorce-Prokop Lst., Pragian, (two different specimens)
7. Bryozoa, Chýnice 7, Třebotov Lst., Dalejan
8. sclerite of Holothuria, Homolka 18, Pragian
9. juvenile Gastropoda, Požáry 26, Ludlow, zone with *E. beaumonti*, lenght of scale bar 200 µm
10. (?) spongi spicule, Mušlovka Quarry 5, Ludfordian
11. *Psammosiphon remesi* PRANTL, Hlásná Třebaň, 0.5 m, Rhuddanian
12. juvenile Brachiopoda, Cephalopod Quarry 5, Ludlow, cephalopod limestones
13. juvenile Brachiopoda, Stydlé vody Quarry 26, Dvorce-Prokop Lst., Pragian
15. (?) spongi spicules, Old Quarry (section bellow Barrandov), Dvorce-Prokop Lst.
16. ? Bryozoa, Opatřilka-Červený lom Quarry, Dvorce-Prokop Lst., Pragian
17. Tabulata, Mušlovka Quarry 11, Ludfordian
18. (?) Inorganic pseudofossil Mušlovka Quarry 5, Ludfordian
Lenght of scale bar 100 µm, if not given other.

PLATE 22

1. Incertae sedis – sphaeras, Opatřilka-Červený lom Quarry, Dvorce-Prokop Lst., Pragian, lenght of scale bar 75 µm
2. Incertae sedis - sphaeras, Prastav Quarry 1, Třebotov Lst., Dalejan, 2a – whole specimen, 2b – detail of wall
3. undeterminable strongly recrystalized test, Cephalopod Quarry 5, Ludlow, cephalopod limestones
4. undeterminable strongly recrystalized test, Kační Quarry, Hommerian, lenght of scale bar 75 µm
5–10. (?) *Proastrum* div. sp.
5. Kační Quarry, Hommerian
6. V rokli Quarry, Loděnice Lst.
7. Opatřilka-Červený lom Quarry, Dvorce-Prokop Lst., Pragian
8. Old Quarry (section bellow Barrandov), Dvorce-Prokop Lst., Pragian
9. Prastav Quarry 5, Třebotov Lst., Dalejan
10. Prastav Quarry 10, Třebotov Lst., Dalejan, optical microscope, lenght of scale bar 180 µm
11–13. spongi spicules
11. Opatřilka-Červený lom Quarry, Dvorce-Prokop Lst., Pragian, lenght of scale bar 75 µm
12. Prastav Quarry 10, Třebotov Lst., Dalejan, lenght of scale bar 75 µm
13. Stydlé vody Quarry 23, Dvorce-Prokop Lst., Pragian, lenght of scale bar 75 µm
14. Incertae sedis 2, Hlásná Třebaň, 3.5 m, Aeronian, lenght of scale bar 200 µm
Lenght of scale bar 100 µm, if not given other.

Cover: *Ammodiscus incertus* ORBIGNY, Chýnice 2, Třebotov Lms., (pl. 11, fig. 5), × 100

Plate 1

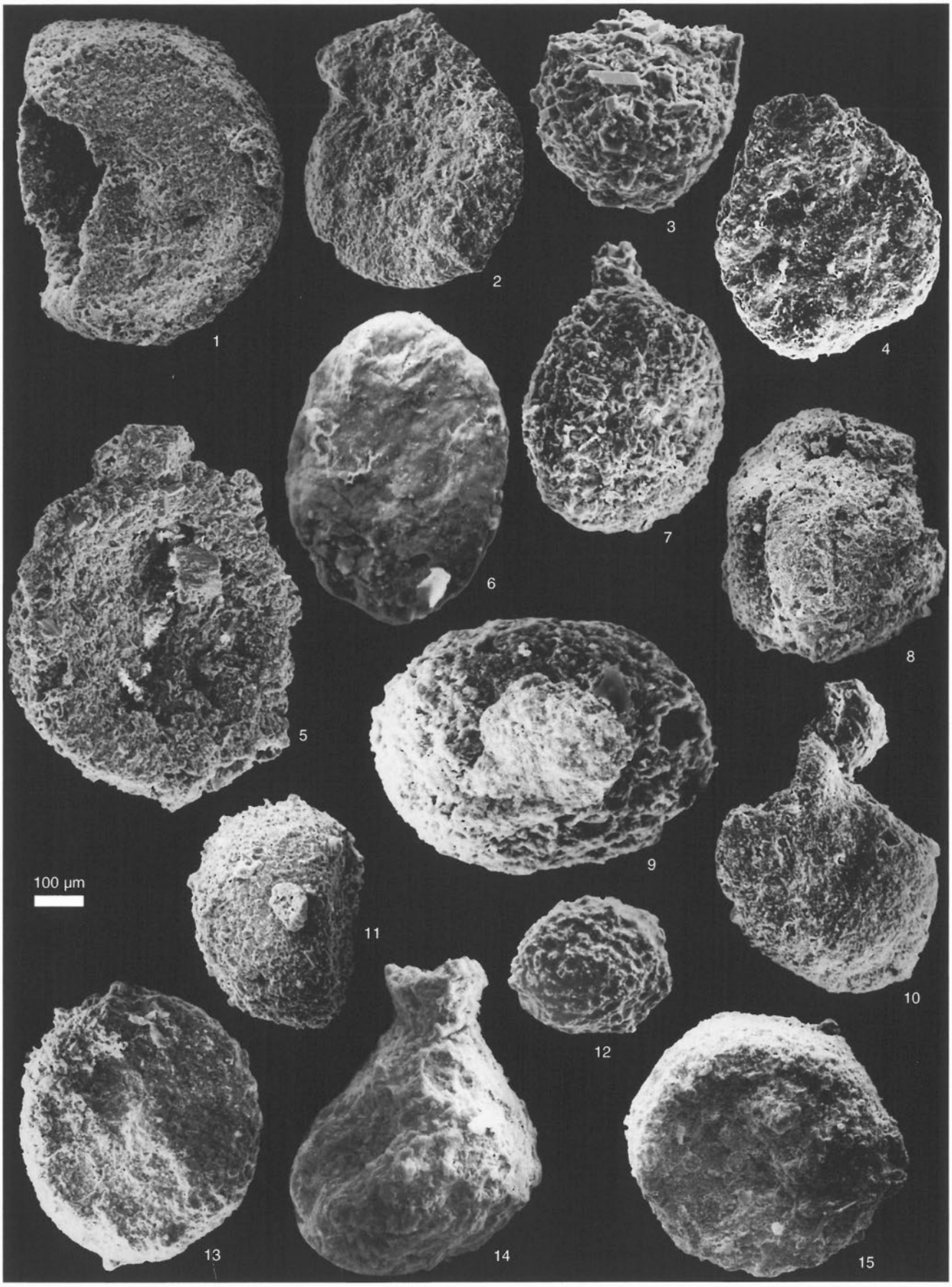


Plate 2

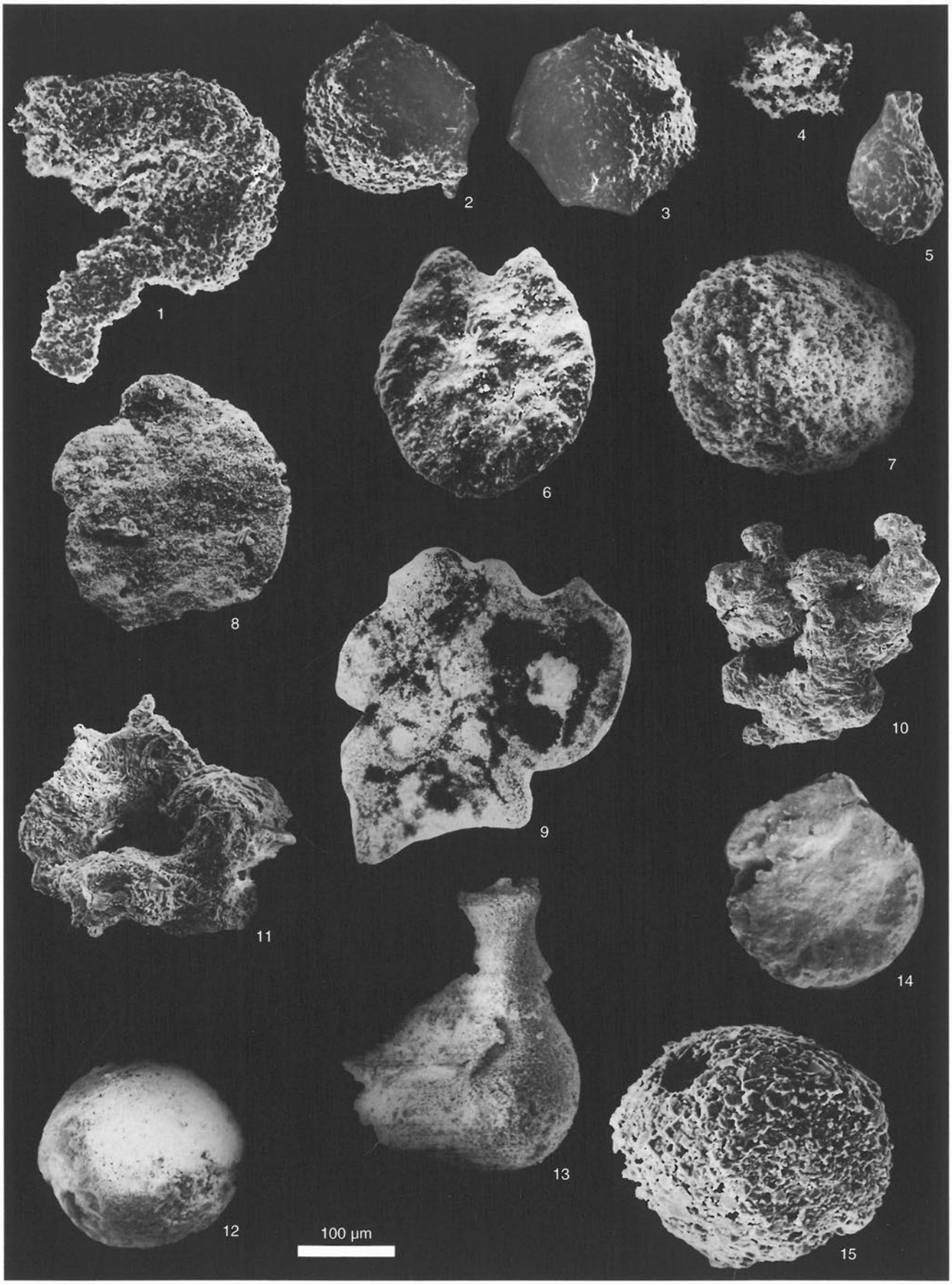


Plate 3

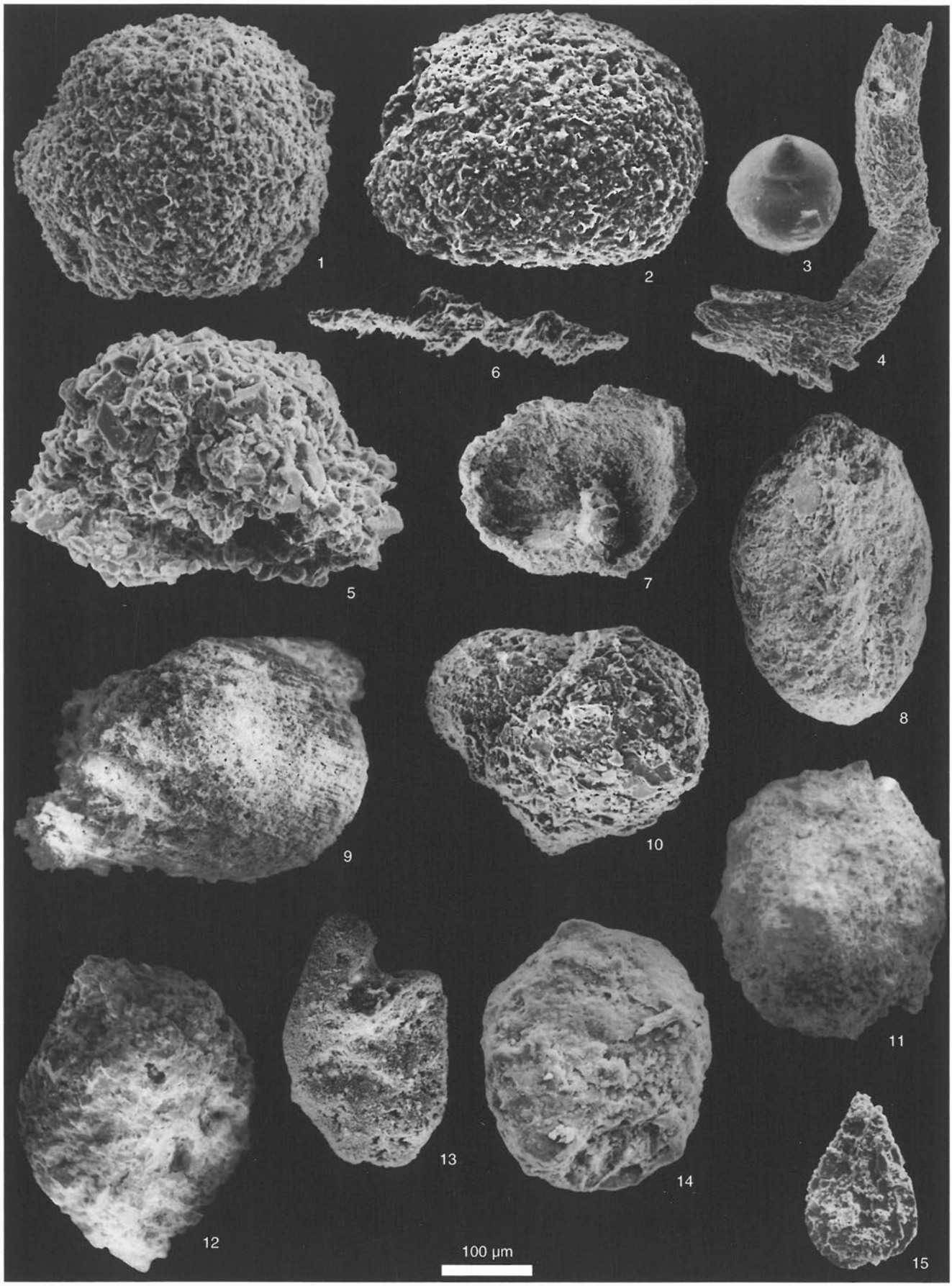


Plate 4

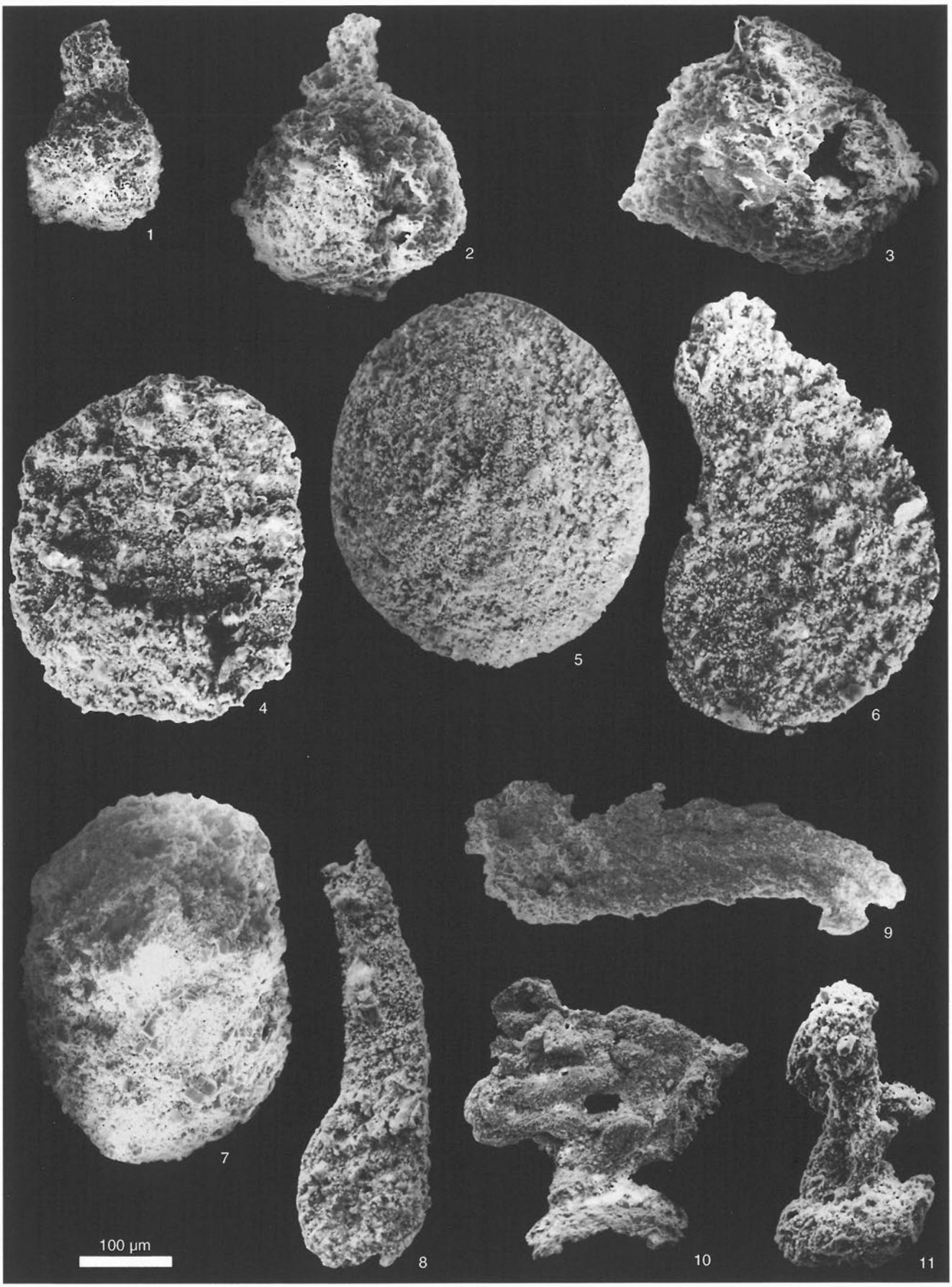


Plate 5

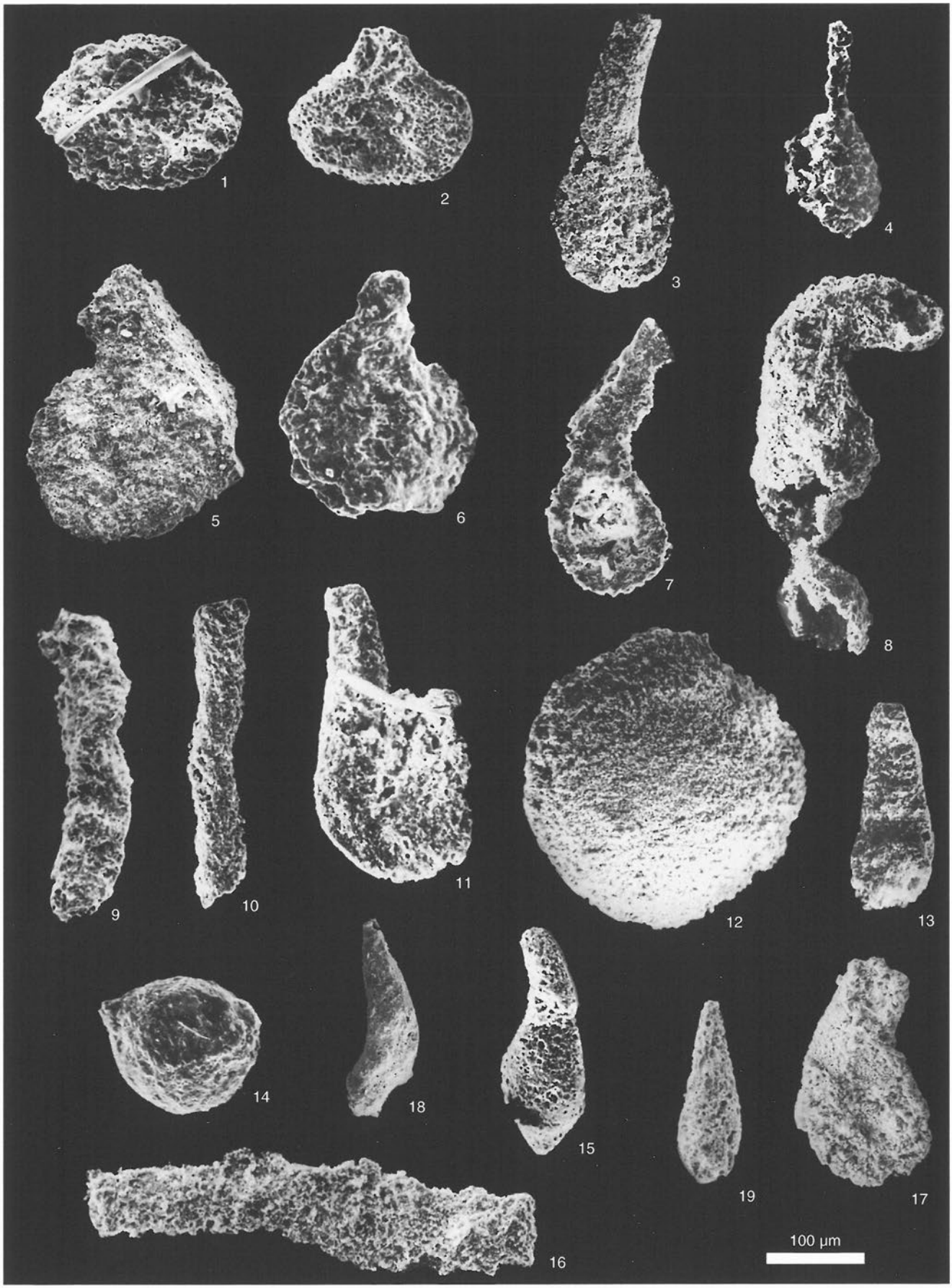


Plate 6

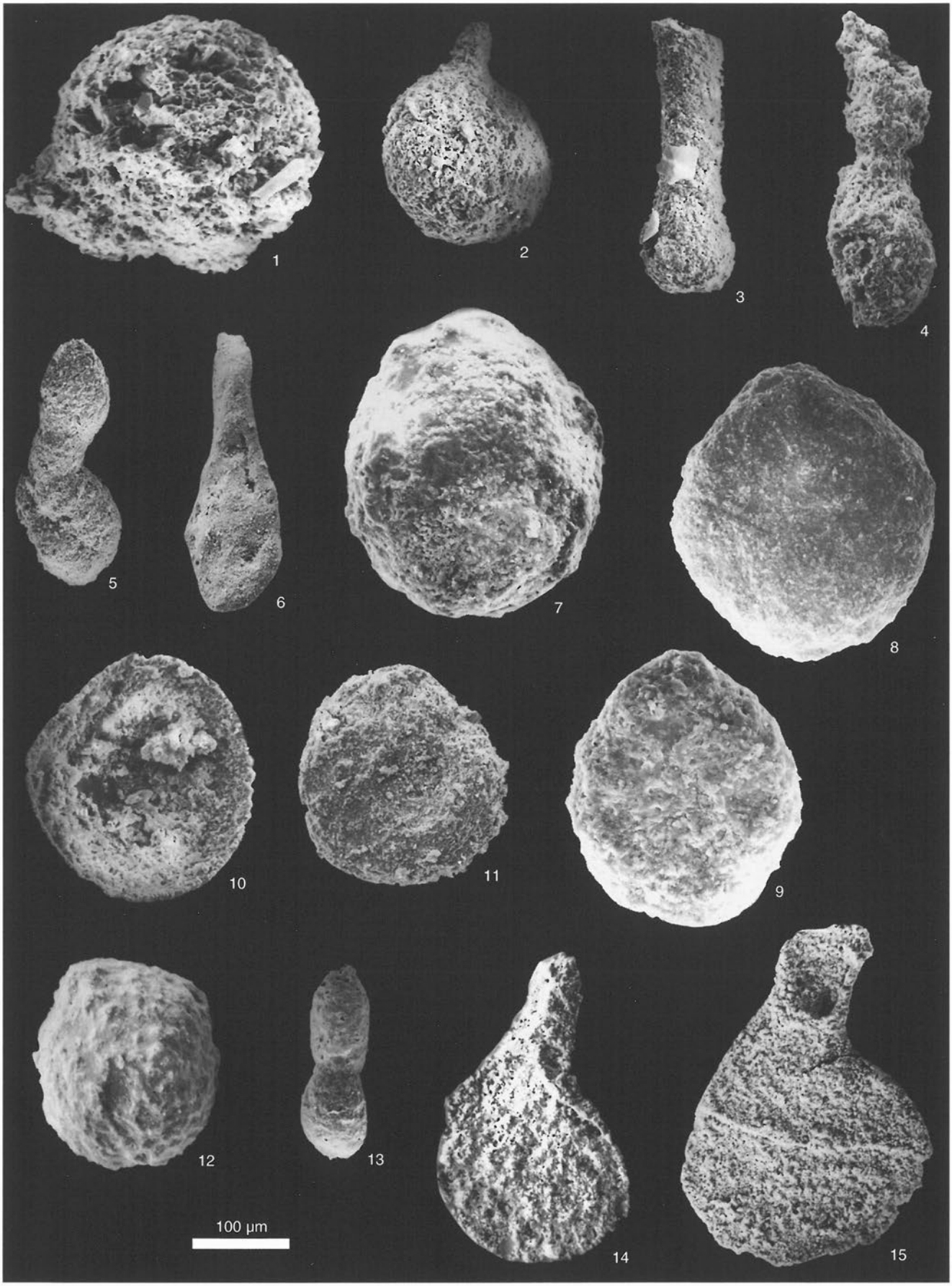


Plate 7

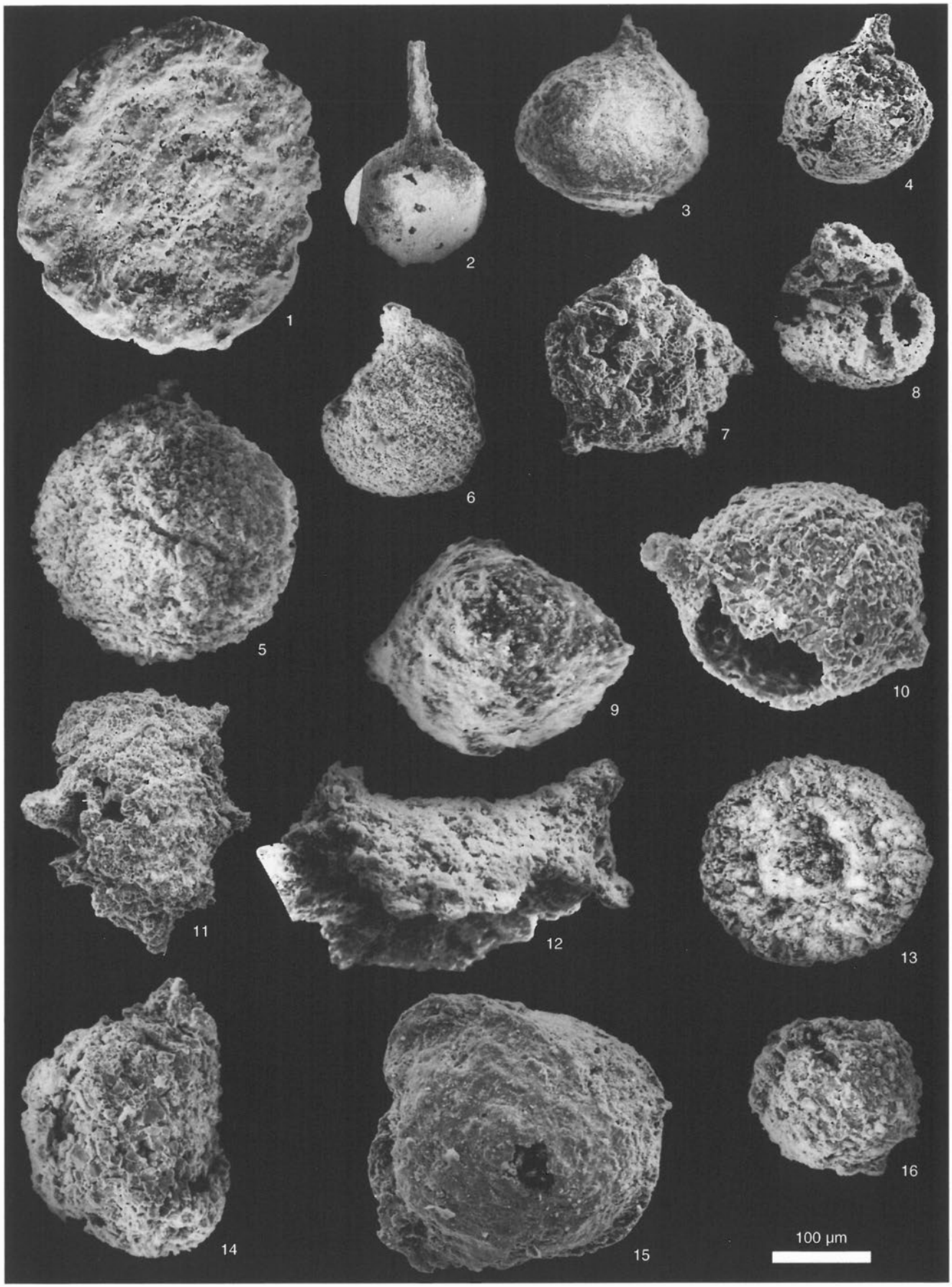
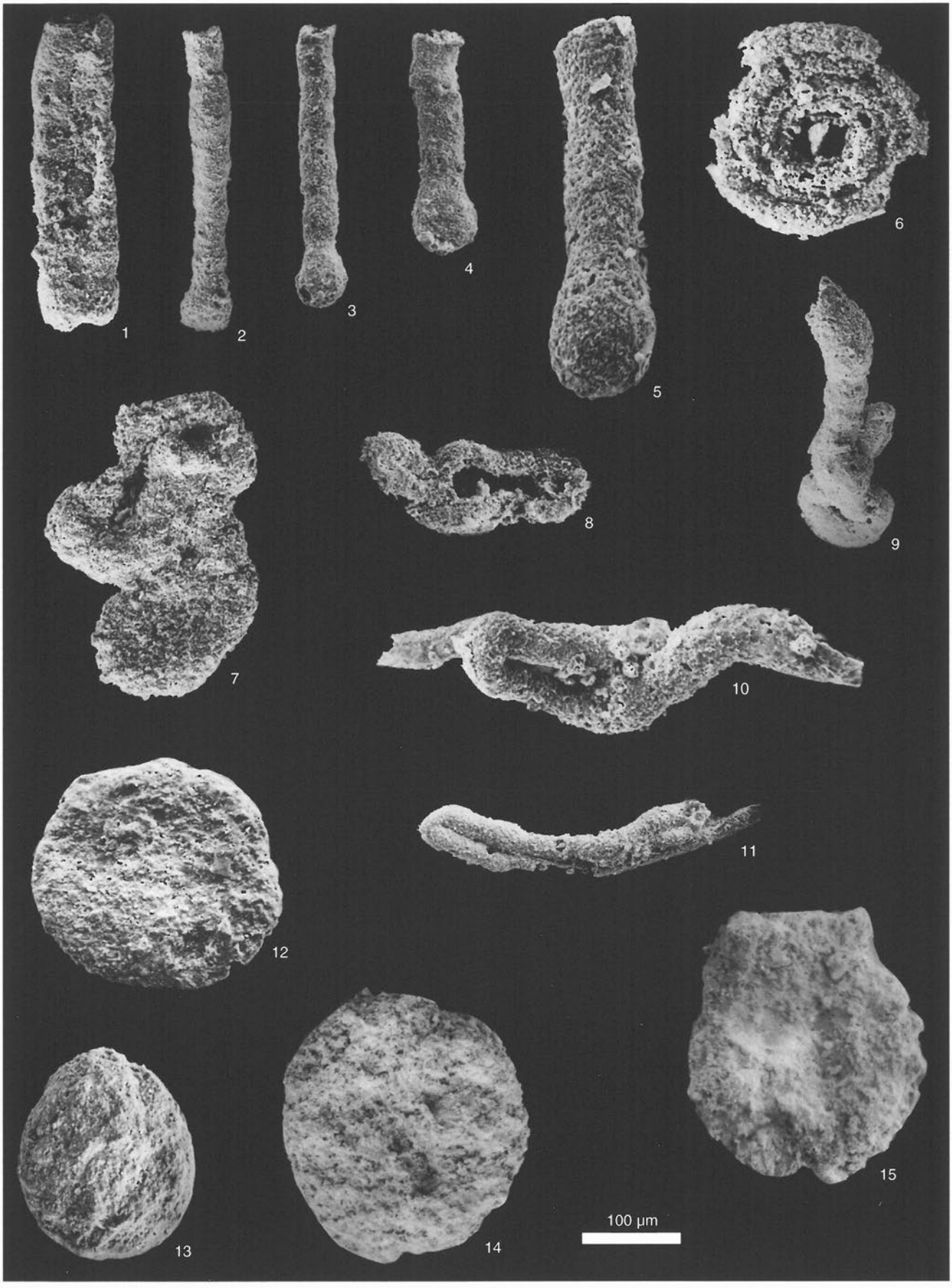


Plate 8



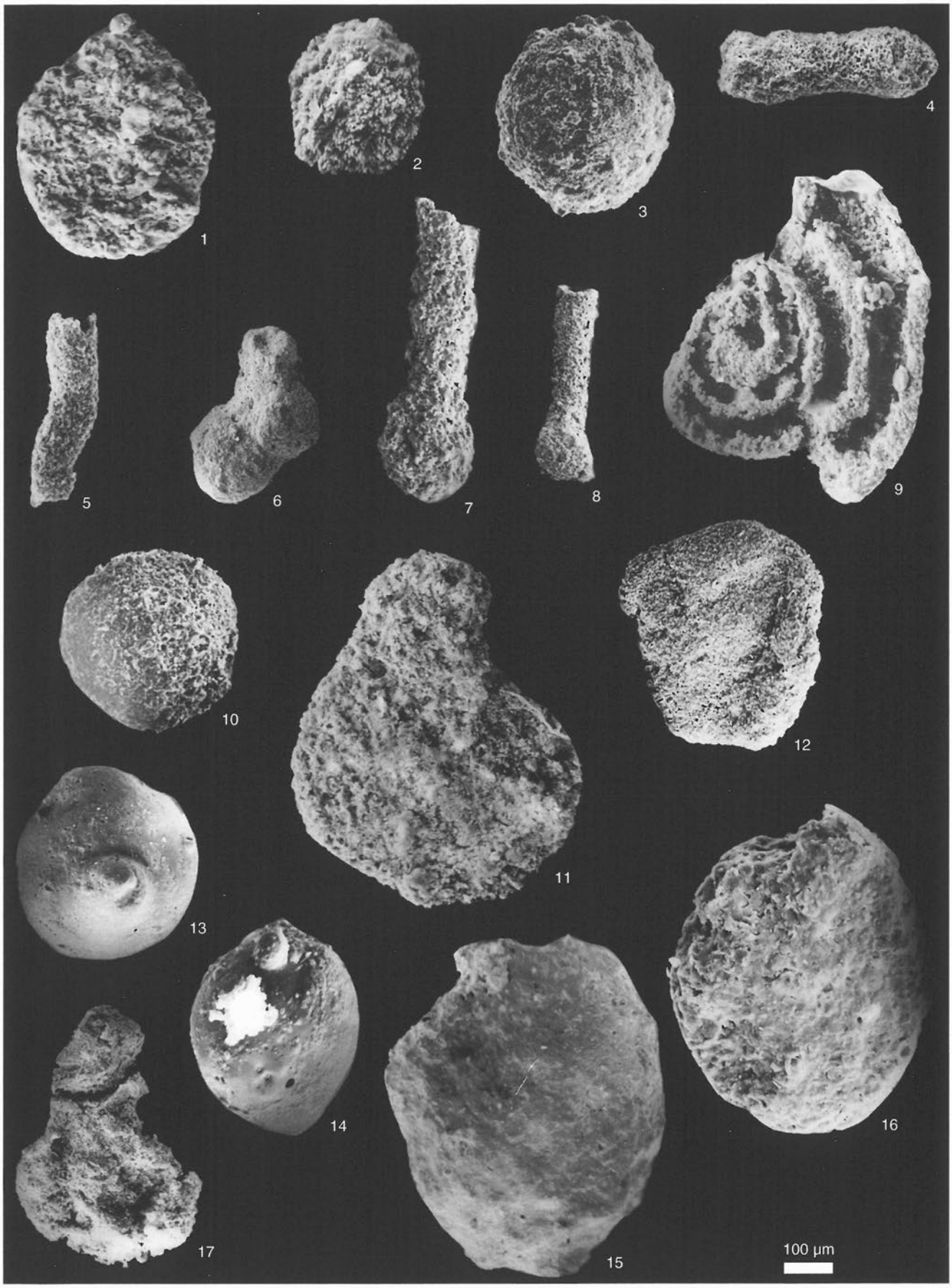

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
100 µm

Plate 10

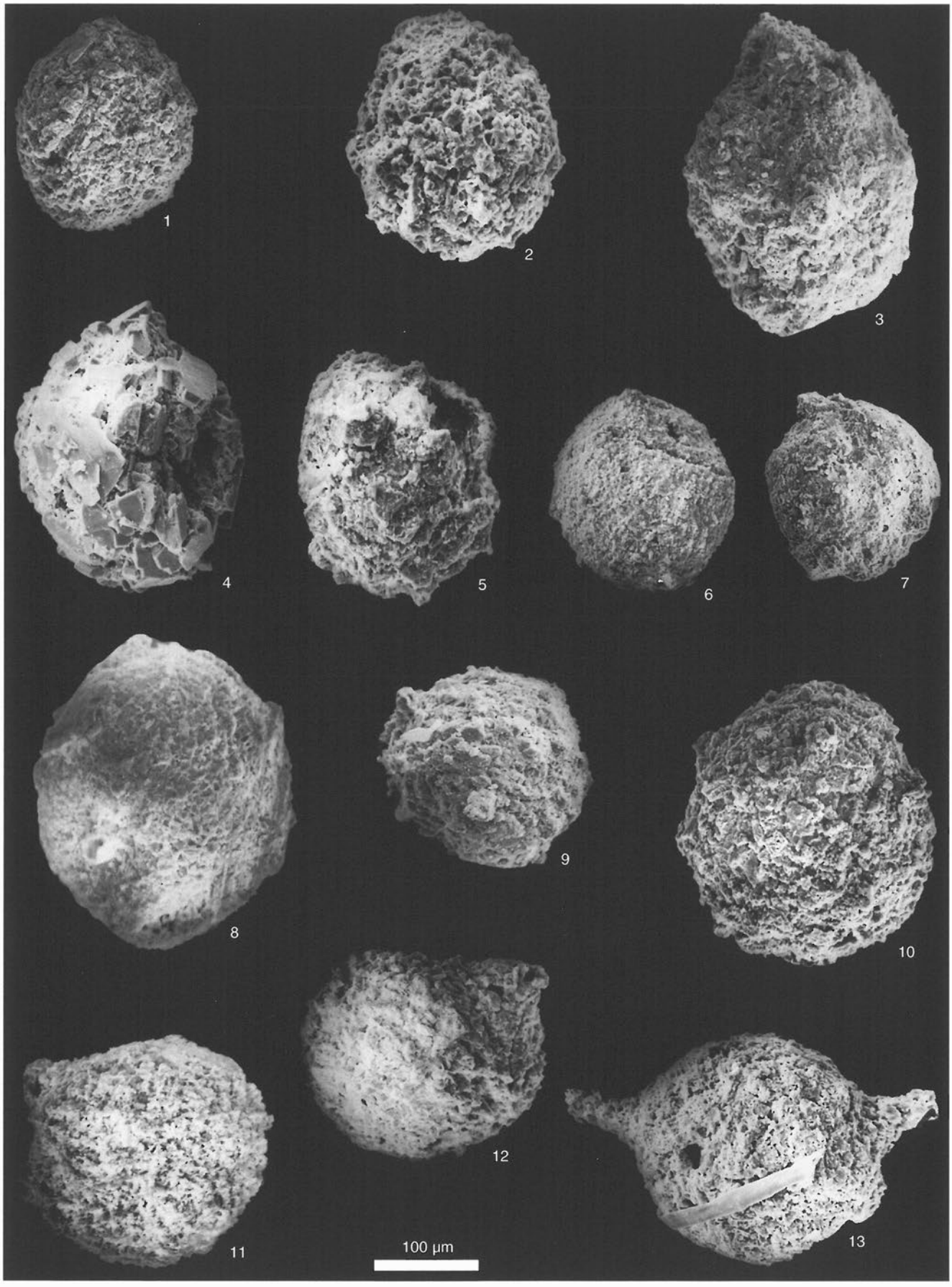


Plate 11

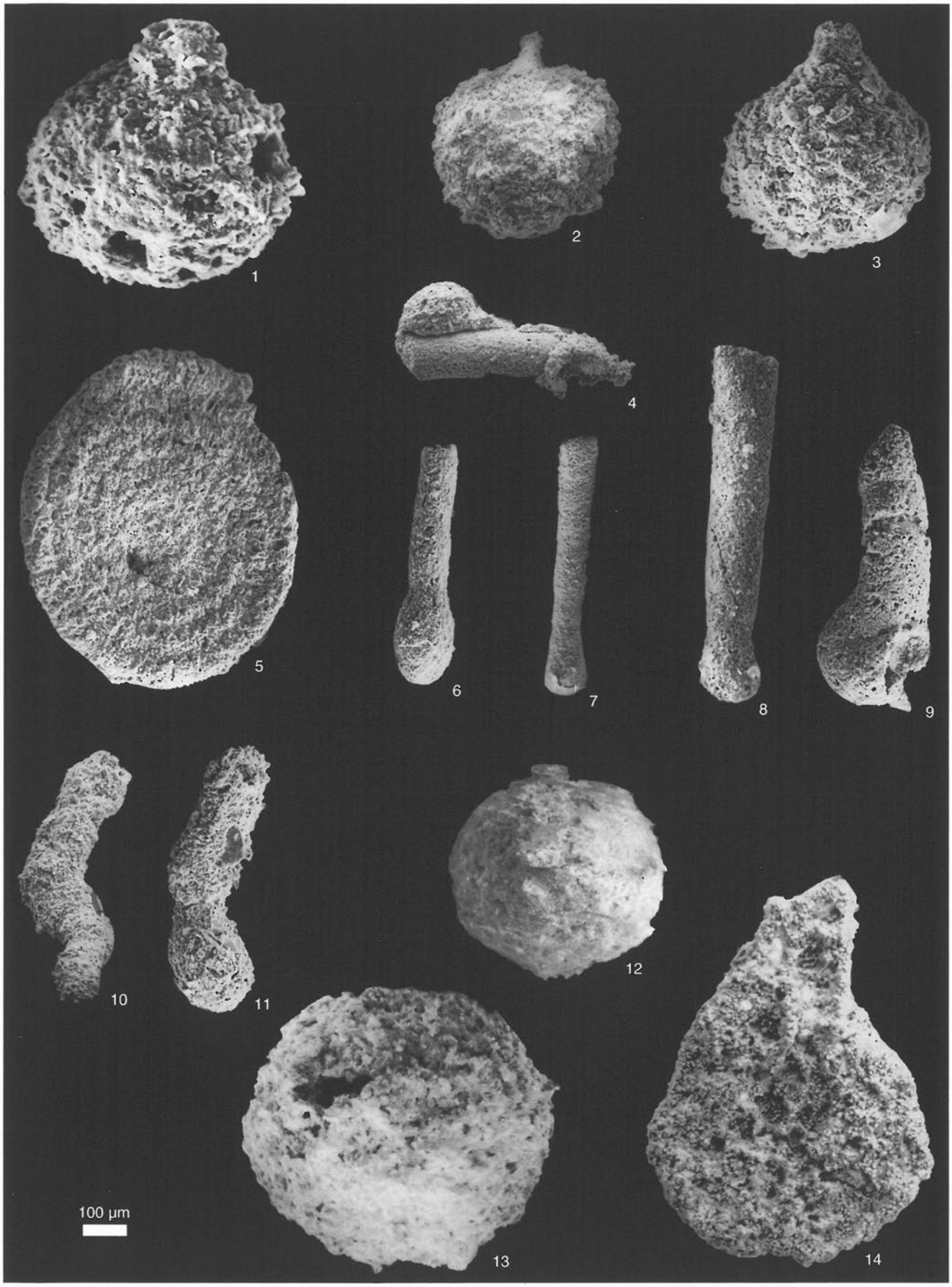


Plate 12

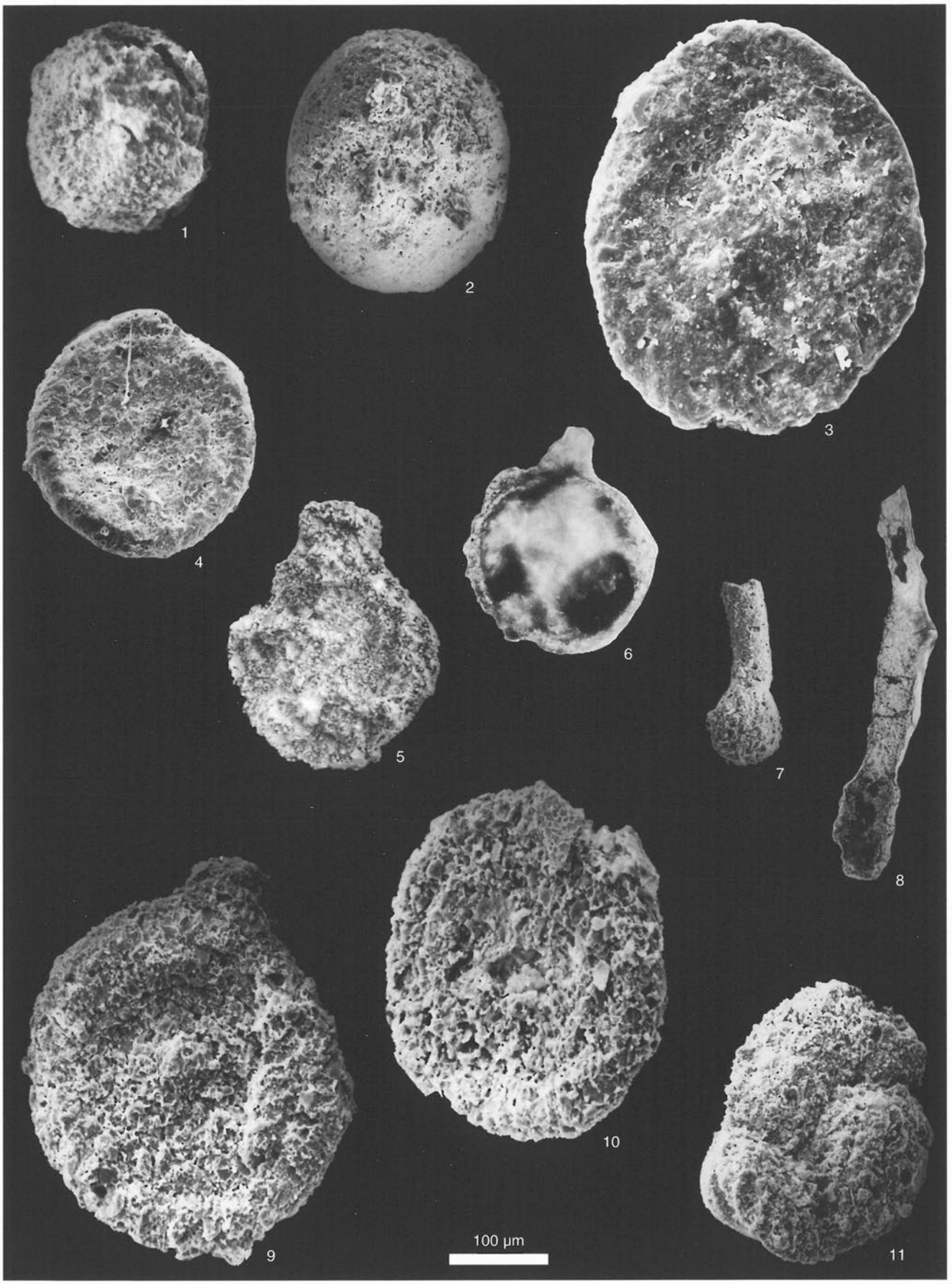
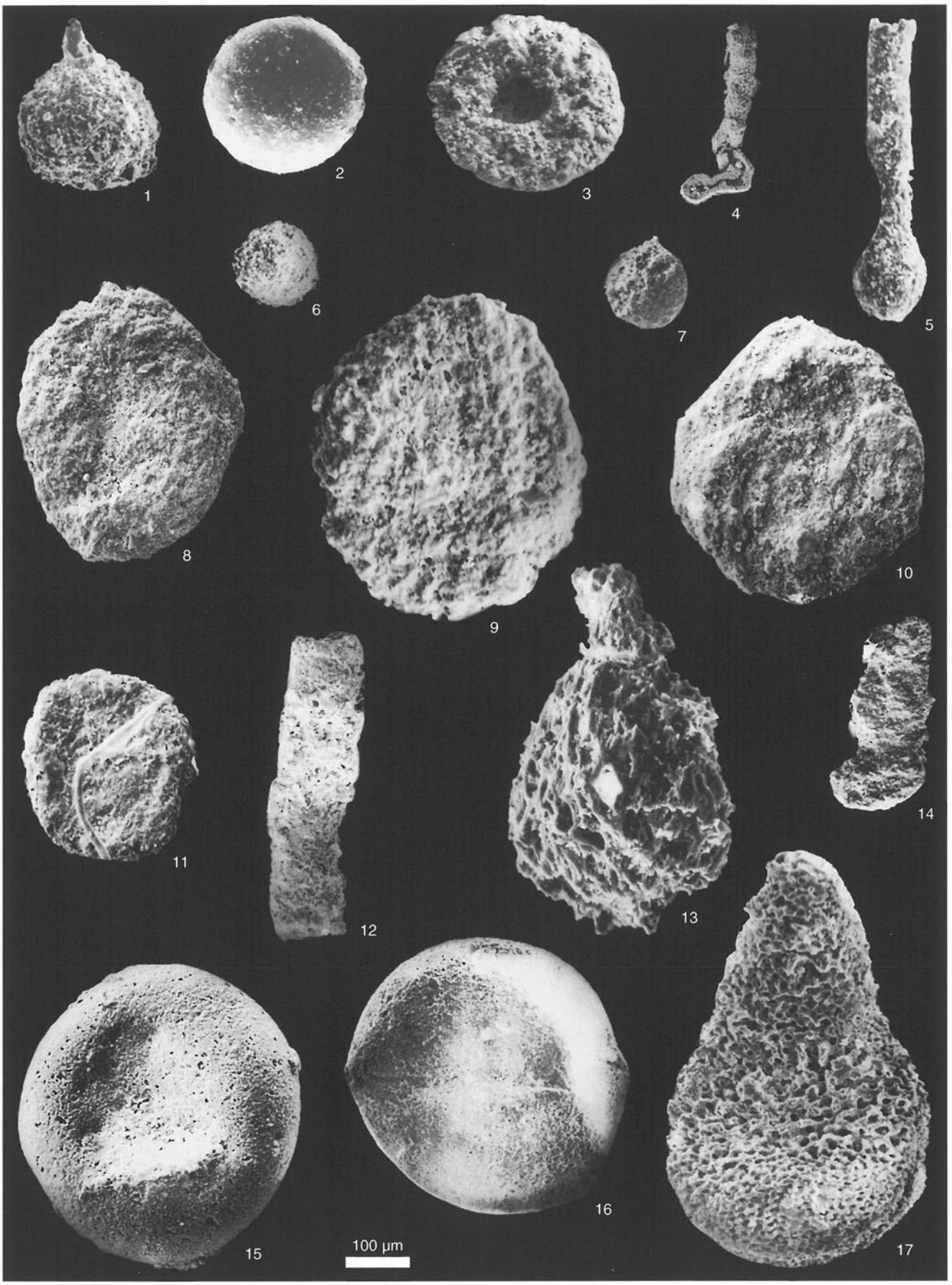


Plate 13

Plate 14



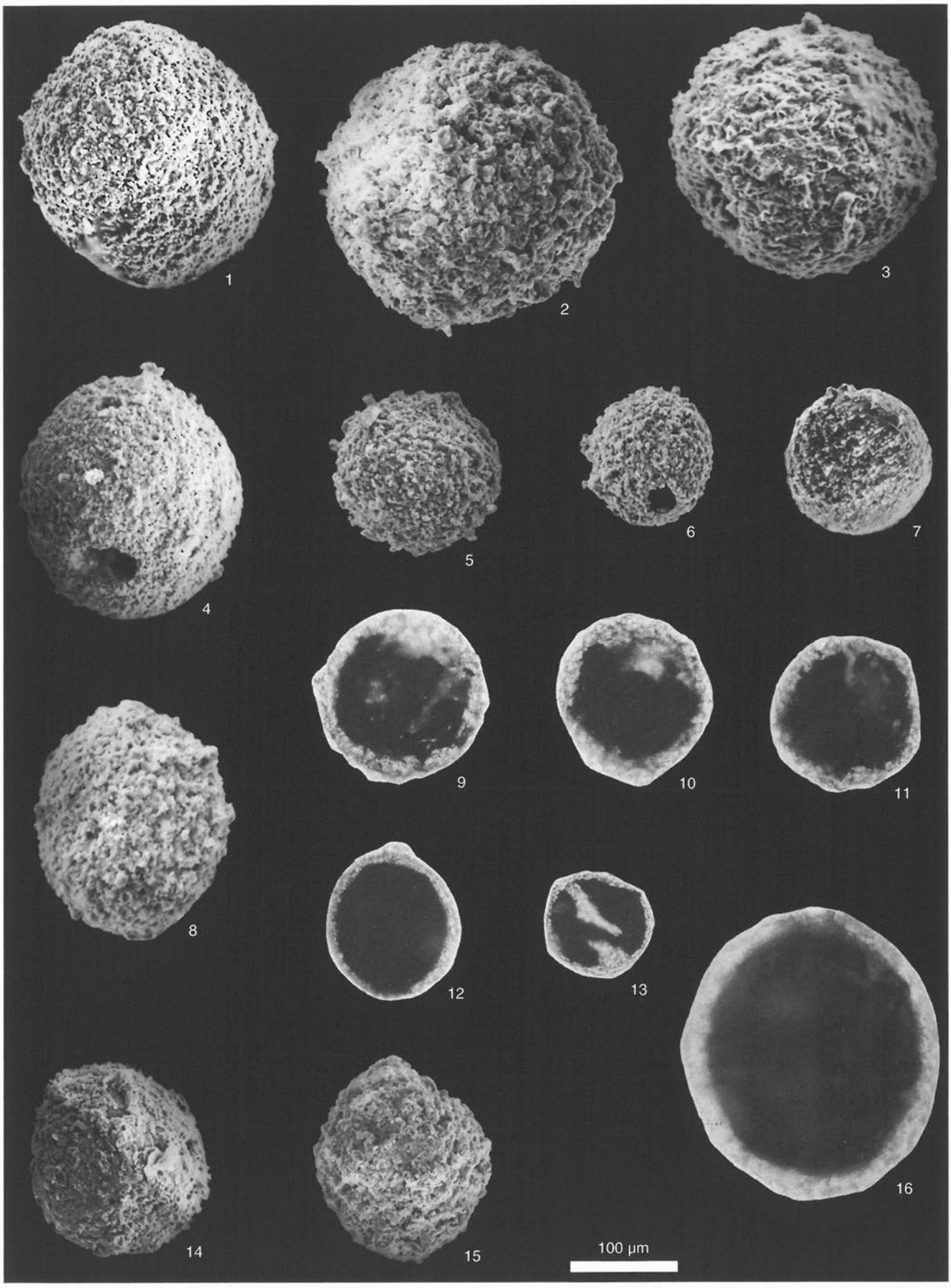
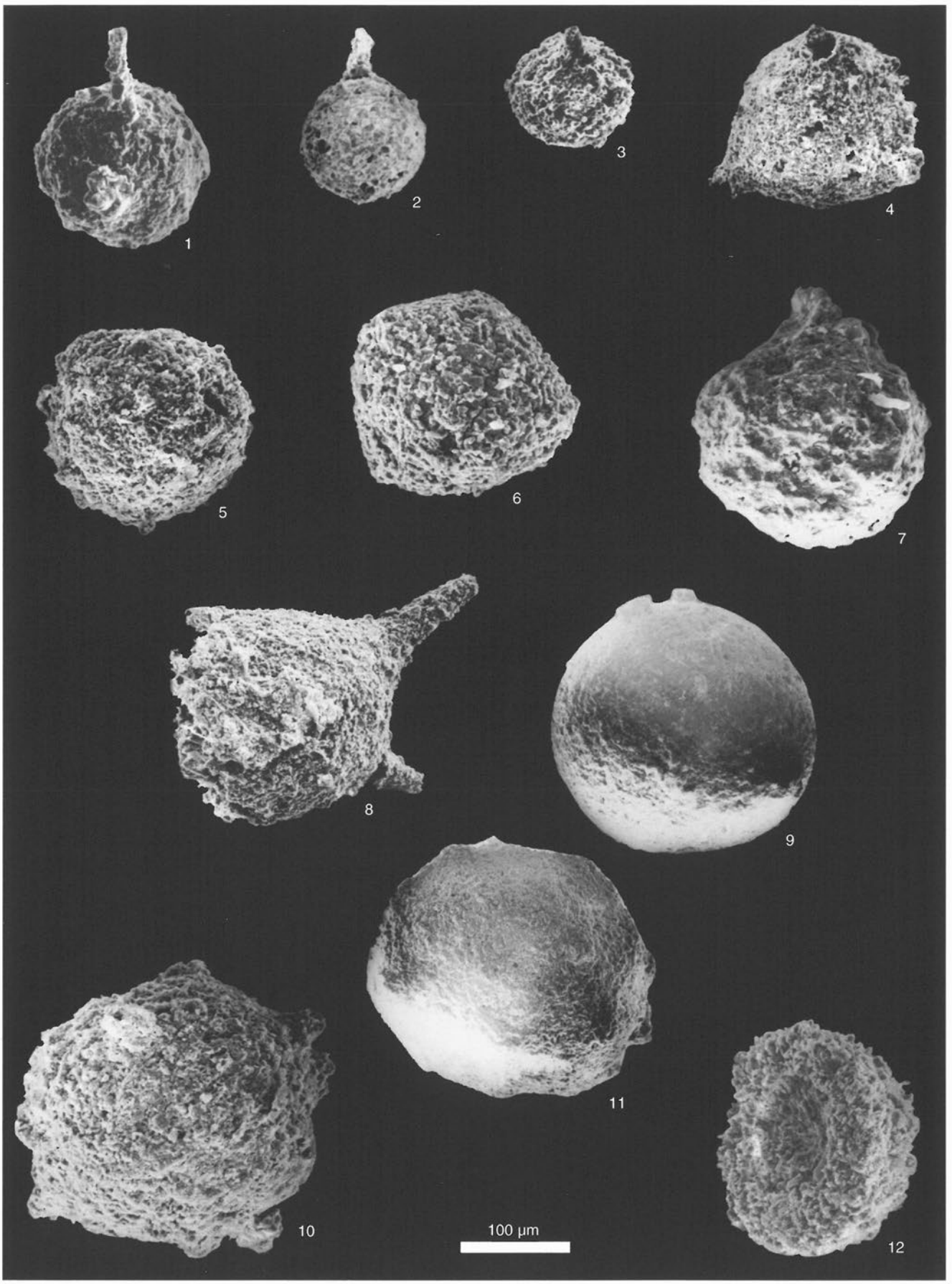

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
100 µm

Plate 16



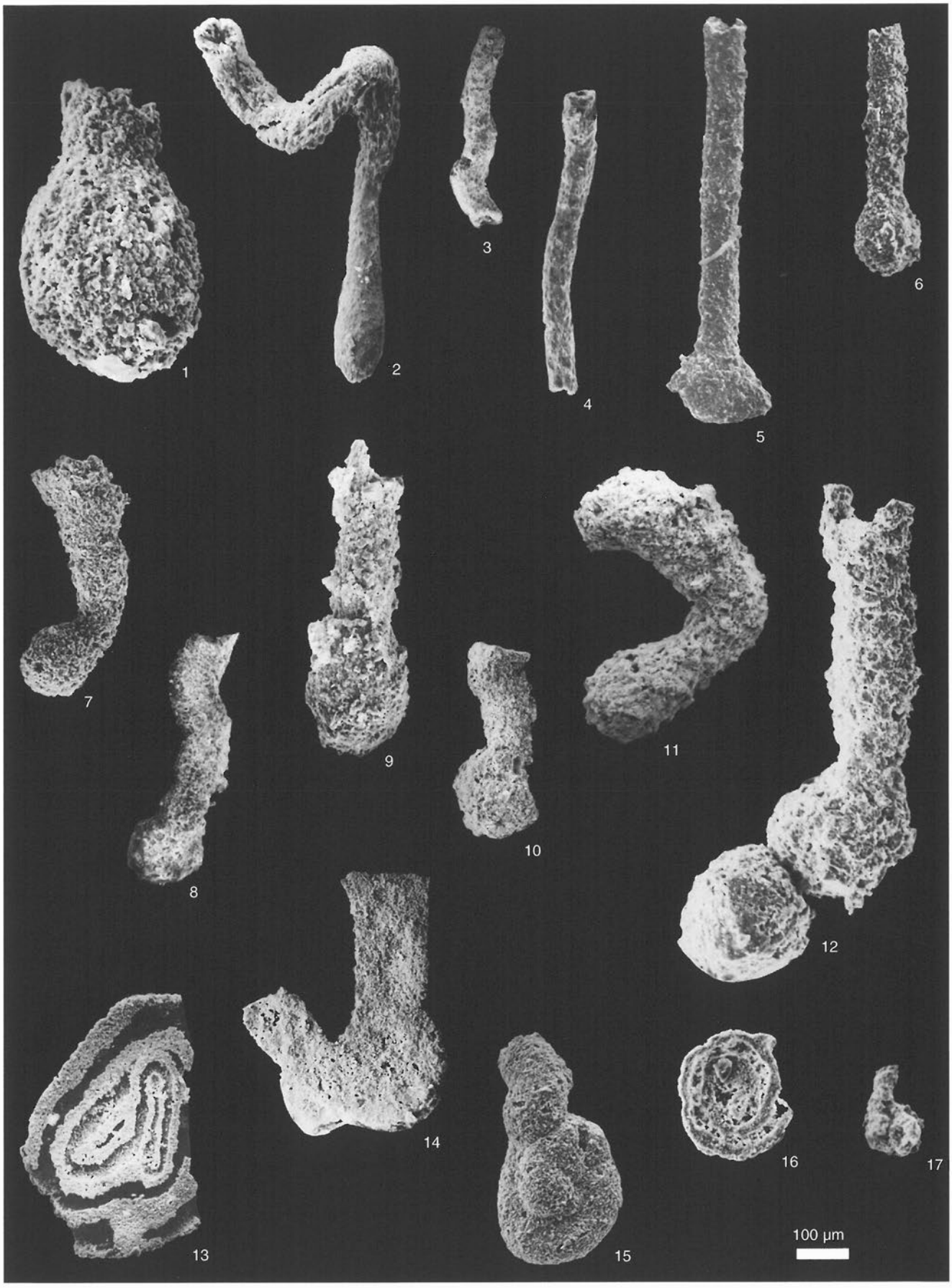
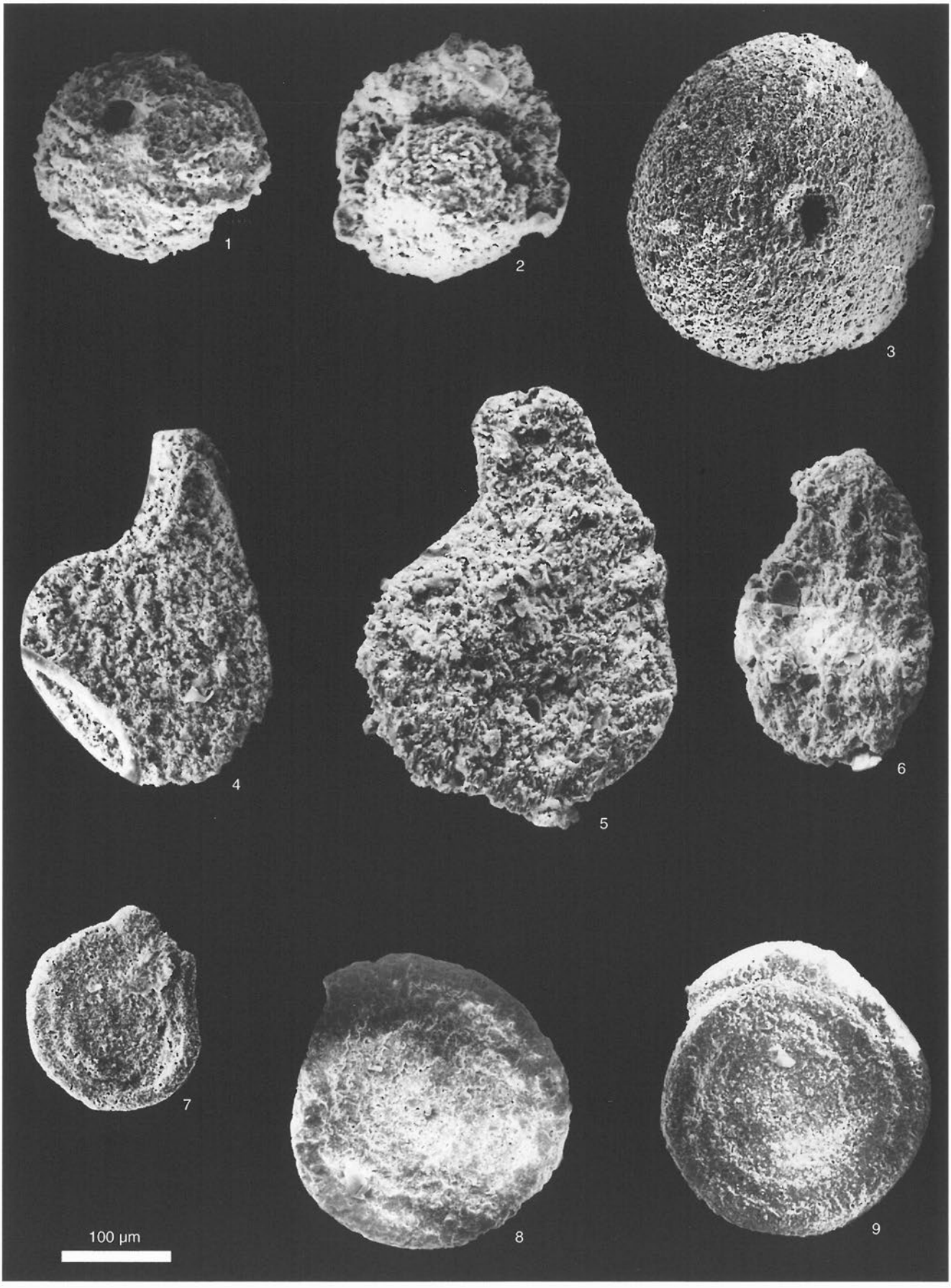

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
100 µm

Plate 18



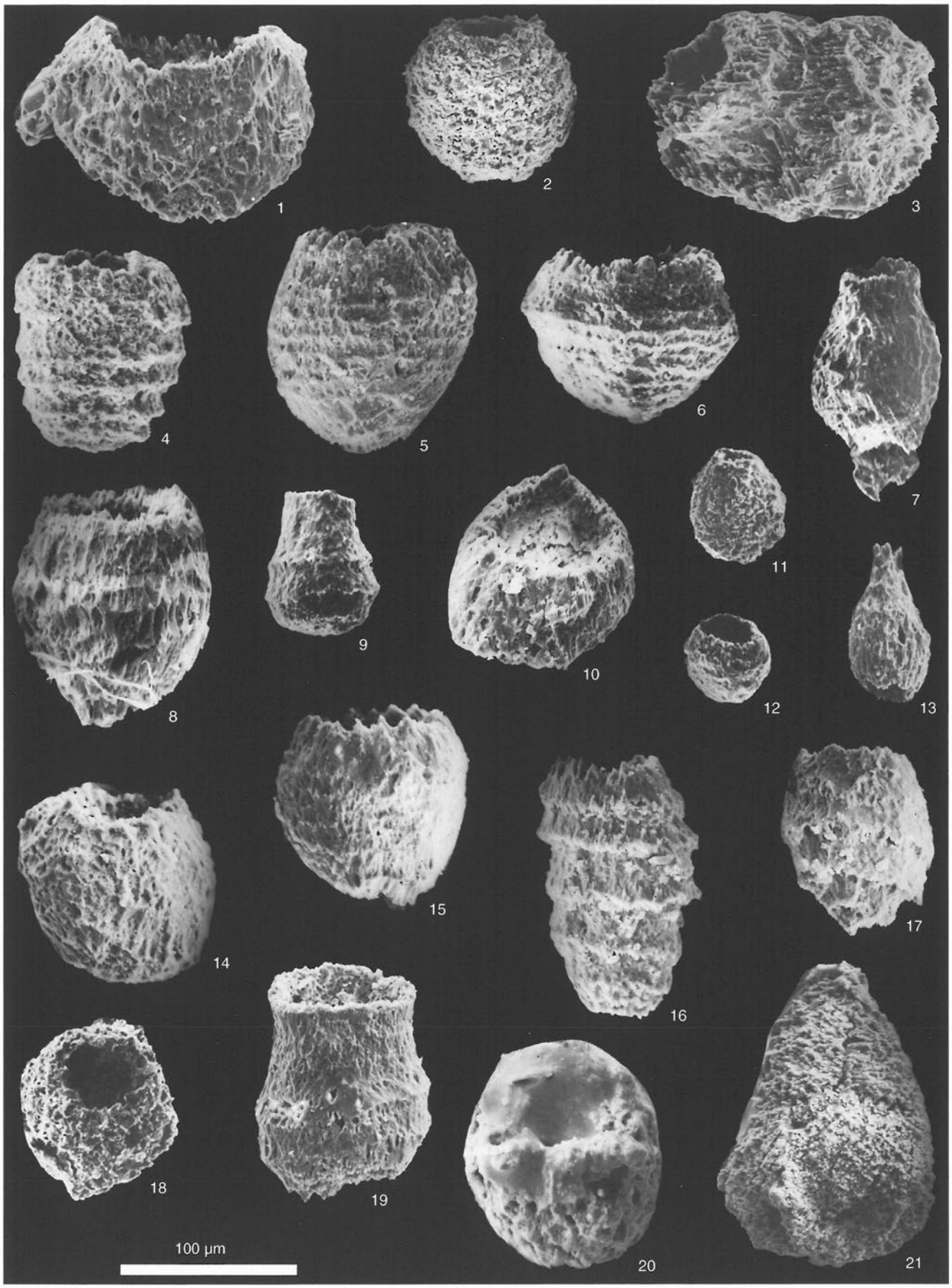
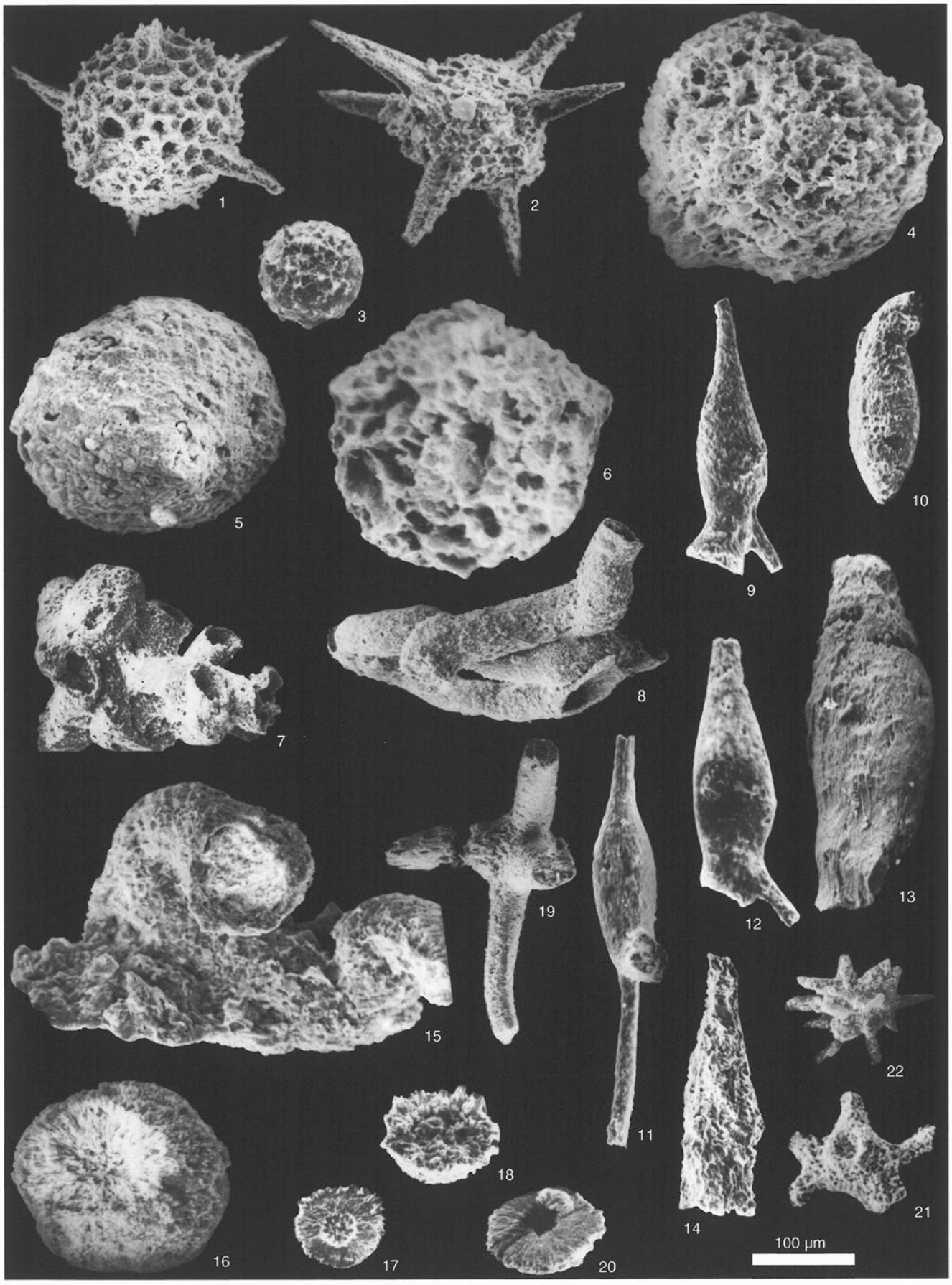

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
100 µm

Plate 20



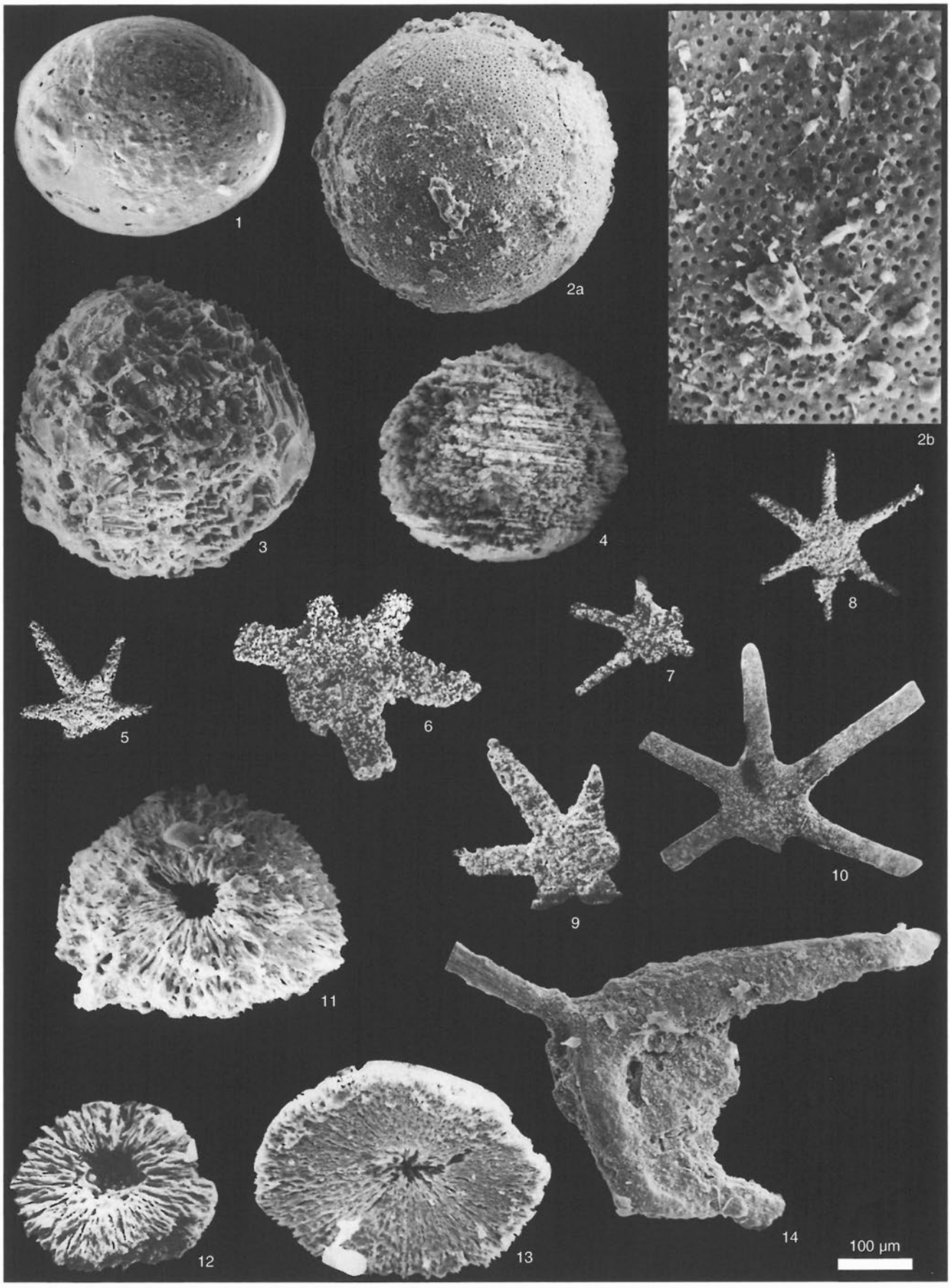

1
2a
2b
3
4
5
6
7
8
9
10
11
12
13
14
100 µm

Plate 22