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Late Devonian–Early Carboniferous foraminifera of the Upper Silesian Block (Kraków Region, southern Poland)

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Forty foraminifera taxa belonging to the class Fusulinata are described from Upper Devonian to Lower Carboniferous carbonates of the Dębnik anticline (Upper Silesian Block, southern Poland). Twenty-three species of foraminifera within the subclasses Afusulinana and Fusulinana have been recognized in thin sections. They belong to the three orders: Archaediscida, Endothyrida and Fusulinida. The order Archaediscida contains two superfamilies Archaediscoidea and Tournayelloidea, whereas the order Endothyrida encompasses three suborders (Lituotubellina, Endothyrina, Palaeotextulariina) with eight superfamilies: Lituotubelloidea, Septabrunsiinoidea, Quasiendothyroidea, Endothyroidea, Bradyinoidea, Loeblichioidea, Palaeotextularioidea and Tetrataxoidea. However, the order Fusulinida (*sensu* Vachard et al., 2010) contains the superfamily Ozawainelloidea restricted to the Ozawainellidae and Eostaffellidae. The foraminiferal assemblages represent the late Famennian, middle Tournaisian, and the later part of the middle Visean. The foraminifers described are also known from Famennian–Visean carbonate platforms of the Dinant Region, the Moravian Karst, various regions of Russia, and the Dębnik anticline. These significant microfossils supplement data on foraminifera from the Upper Silesian Block.

Key words: benthic foraminifera, Lower Carboniferous limestone, carbonate platform, Upper Silesian Block, southern Poland.

INTRODUCTION

Benthic foraminifera evolved rapidly during the Late Devonian and Early Carboniferous (e.g., Hance et al., 2011; Boudaugher-Fadel, 2018; Vachard and Le Coze, 2021). These microfossils provide excellent stratigraphic index species, especially in strata representing shallow sedimentary environments, complementing the use of conodonts (e.g., Vachard, 1994; Kalvoda, 2002; Kulagina et al., 2003).

This study describes the foraminiferal assemblages within the limestone succession of the Devonian–Carboniferous carbonate platform that formed in the former Silesian-Moravian basin. It is part of the folded rocks of the so-called Upper Silesian Block (USB). These rocks have been the subject of previous palaeontological research (e.g., Gürich, 1903; Jarosz, 1926; Liszka, 1962, Soboń-Podgórska, 1972, 1975; Tomaś et al., 2011), however, the biostratigraphic resolution of previous studies was low and did not allow for refined paleoenvironmental analysis. The rocks studied outcrop in the folded carbonate succession of the Upper Silesian Block, in its southeastern part, i.e., within the Dębnik anticline, near the town of Krzeszowice (Kraków Region). Taxonomic and biostratigraphic studies of the foraminifera were carried out.

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GEOLOGICAL SETTING

The research area is located in the southern part of the Kraków-Częstochowa Upland between the Czernka and Szklarka valleys, a few kilometres north of Krzeszowice (Fig. 1A). These valleys are situated in the Dębnik anticline that forms the northern margin of the Kraków Block (*sensu* Paszkowski, 1995), which in turn is a part of the Upper Silesian Block (USB).

The USB is the northern part of the larger unit known as the Brunovistulicum Terrane that in the west shares its border with the Bohemian Massif (Dudek, 1980; Buła and Żaba, 2005; Żelaźniewicz et al., 2011). The southern border is situated below the Carpathians, and it is thought that it conforms to the Peri-Pieniny Fault Zone that separates the Outer and Inner Carpathians (Buła and Żaba, 2008). The northeastern border of the USB with the Małopolska Block corresponds to the Kraków-Lubliniec Fault Zone (KLFZ; Buła et al., 1997).

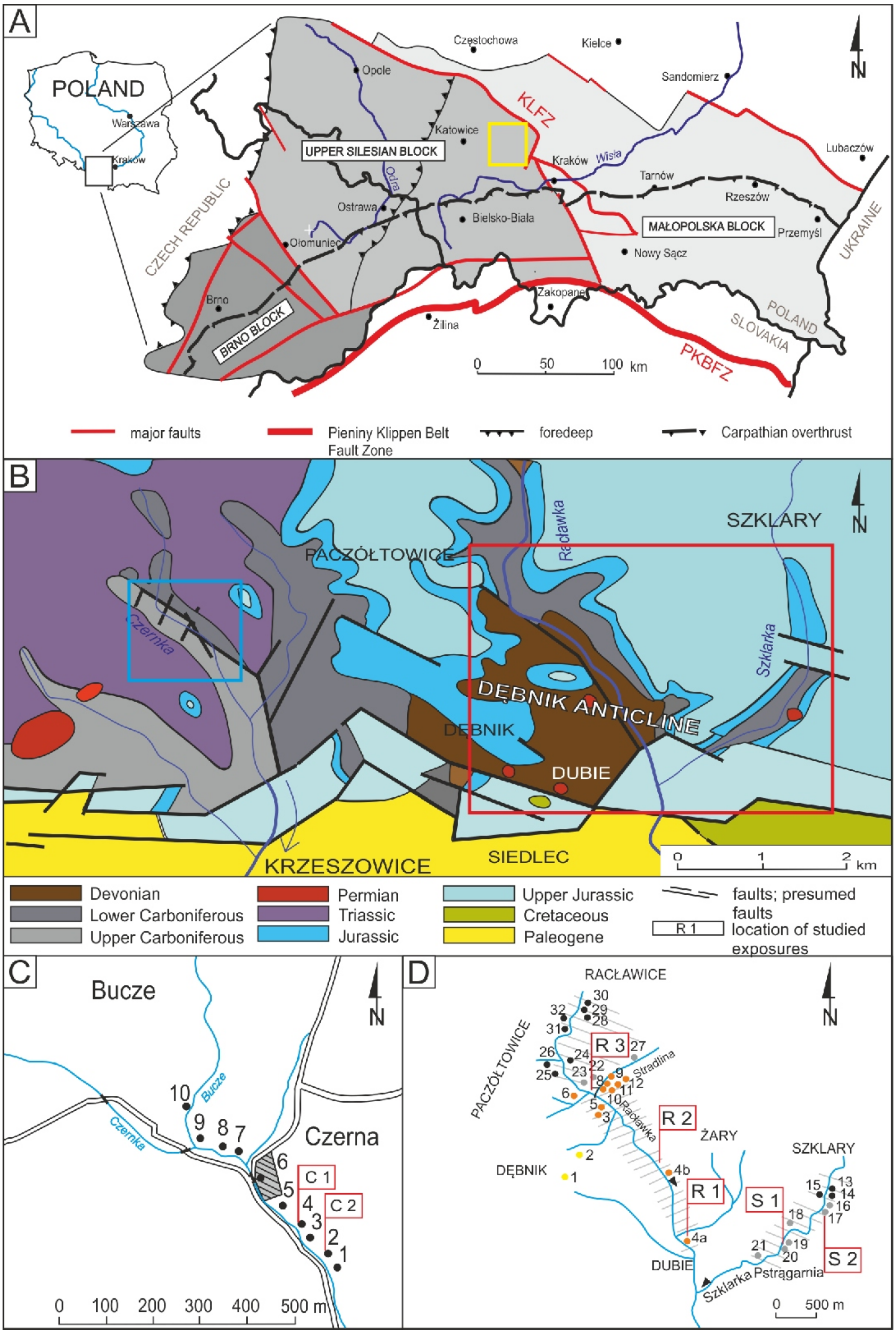

Fig. 1A – location of southern and southeastern Poland (without the Permian-Mesozoic deposits) along with the structure of the Upper Silesian Block as well as associated geological units (after Żelaźniewicz et al., 2011; simplified): KLFZ – Kraków-Lubliniec Fault Zone, PKBFZ– Pieniny Klippen Belt Fault Zone, yellow rectangle represents the research area shown in 1B; B –- geological map of the southern part of the Krakow Upland with the study area (after Gradziński, 1972, simplified and modified), blue rectangle – area of the Czernka Valley, red rectangle – part of the Szklarka Valley; C – sketch map with previously analyzed sections in the Czernka Valley (labelled black dots; Soboń-Podgórska, 1972, 1975) and profiles C1 and C2 analyzed in this paper; D – map with sections analyzed so far in the Racławka and Szklarka valleys (labelled coloured dots; Tomaś et al., 2011) and profiles S1, S2 and R1, R2, R3 analyzed in this paper; R1, R2, R3 – Racławka Valley, S1, S2 – Szklarka Valley, C1, C2 – Czernka Valley

The basement of the USB is known primarily from several deep boreholes, located (i) in the southern sub-Carpathian sector of the USB, (ii) in the area of the Bielsko-Andrychów High; and (iii) on the Rzeszotary Horst (Żelaźniewicz et al., 2011). The lithological profile of the basement of the western part of the USB contains primarily Neoproterozoic paragneisses, whereas the eastern part includes Paleoproterozoic amphibolites with Archean protolith (Buła and Żaba, 2005, 2008). These rocks, formed during the Cadomian Orogeny (Finger et al., 2000), are overlain by metamorphosed Ediacaran flysch deposits and various undeformed Paleozoic units (Moczydłowska, 1997; Buła and Żaba, 2005; Buła et al., 2015).

The activity of KLFZ is directly linked to Late Paleozoic magmatism and granitoid plutons forming the marginal part of the Małopolska Block (Buła et al., 1997; Żaba, 1999). Moreover, the KLFZ has been active since the earliest Paleozoic until the present (Żaba, 1999; Matyszkiewicz et al., 2015).

The Upper Devonian–Lower Carboniferous (Givetian– Namurian) lithological profile of the Dębnik anticline comprises strata 1000–1200 m thick (Paszkowski, 1995, Paszkowski et al., 2008; Hoffmann et al., 2009). The Devonian formations that crop out in the central part of the research area in the vicinity of the Dębnik, Dubie, Siedlec and Żbik villages are represented by dolomites and black, dark grey, or brown marly limestones (Fig. 1B). Lower Carboniferous carbonate strata of Tournaisian– Visean age are known from the villages of Szklary, Paczółtowice, Racławice, Czerna and Czatkowice (Fig. 1C, D). The transition from the Visean to the Namurian takes place within clastic layers (claystones, mudstones, and sandstones of the Miękinia beds) of the Malinowice beds (Bogacz, 1977, 1980). A lithostratigraphic subdivision of the upper Famennian to Tournaisian–Visean rocks has been proposed by Paszkowski (1995), who distinguished informal unit known as the Rudawa Group, which includes eleven lithostratigraphic divisions (Fig. 2). The sedimentary succession starts with Famennian deposits composed of black nodular limestones. Higher within the succession, there are stromatoporoid limestones of the Dubie Formation with detrital limestones of the Góra Żarska Member at the top. The next unit (with a boundary between the Famennian and Tournaisian), the Racławka Formation, is represented by cyclic deposits of Lofer type (Paszkowski et al., 2008). The remaining part of the Tournaisian succession consists of four units, in ascending order: (i) crinoidal limestone of the Szklary Formation; (ii) pelitic limestone of the Pstrągarnia Formation; (iii) detrital limestone of the Paczółtowice Formation; and (iv) spiculite-bearing limestone of the Przy Granicy Quarry Formation. According to Paszkowski (1995) and Paszkowski et al. (2008), the rock succession represents shallow marine sediments deposited in a high-energy environment with a deepening trend at the base of the carbonate platform. The lower Visean deposits are represented by the Mazurowe Doły Formation (detrital limestone with corals), whereas the middle Visean is composed of the Wądole Formation (limestone with pseudomorphs after evaporites, with stromatolites, fenestral limestone, oolitic limestone). Pelitic limestone of the Czatkowice Formation and limestone of the Eliaszówka Formation are of the same age. The upper Visean is represented by detrital limestone of the Czerna Formation (the upper part of the formation is a member of the Łom Gminny breccia limestone, the Łom Gminny Quarry Member). The top of the Rudawa Group consists of the Czerwona Ścianka Formation (red limestone and marl).

The succession of carbonate deposits described by Paszkowski (1995) and Paszkowski et al. (2008) in this part of the research area represents diverse depositional environments that include open shelf/ramp and lagoonal/intertidal platform settings, as well as sabkha and deeper-water facies.

The Dębnik anticline was formed by several periods of tectonic activity from the Devonian to the Miocene. Faulting and folding associated with magmatic intrusions played a significant role in its structural evolution (Bogacz, 1977, 1980).

HISTORY OF STRATIGRAPHIC RESEARCH

The area of the Dębnik anticline has been studied since the early 19th century. Among the publications of historical importance are those of Römer (1863), Zaręczny (1889, 1890) and Gürich (1903). According to Römer (1863), black limestones called "marble" from Dębnik are Devonian. The "marble" from Dębnik became the first lithostratigraphic unit within the Dębnik anticline. Zaręczny (1889, 1890) divided the Devonian deposits into the Zbrza deposits (thick, grey and black limestone with dolomite) and "marble" from Dębnik understood as very dark to blackish limestone and dolomite. Zaręczny also delineated in detail the lithology of the Devonian deposits exposed at the surface in this area. Gürich (1903) described stromatoporoidal limestone and Givetian, Frasnian, and lower Famennian strata. He was one of the first to undertake biostratigraphic correlation of selected profiles in the Dębnik anticline using different fossil groups, including stromatoporoids and brachiopods (Gürich, 1903).

Jarosz (1926) used the brachiopod faunas together with tectonic observations to establish the stratigraphy of the Tournaisian and Visean rocks of the Kraków area. He distinguished six lithostratigraphic units, and observed that the brachiopod faunas are similar to Early Carboniferous faunas fossil described from southern England and southern Belgium.

Based on borehole data and outcrop observations, Łaptaś (1983) distinguished eight lithostratigraphic units for the Middle Devonian–lower Tournaisian deposits. These are from the bottom to the top: (i) Eifelian Unit A (black, marly dolomite); (ii) Givetian Units: B (Zbrza dolomite) and C (Dębnik limestones; (iii) Frasnian Units: D (black, nodular limestone) as well as E (brown, pelitic limestone and dolomite; Fig. 2). The brown oncolitic limestone was considered as probably lower Tournaisian (Łaptaś, 1983).

Narkiewicz and Racki (1984) published another version of six lithostratigraphic units, whose Eifelian to early Tournaisian age was determined on the basis of conodonts, brachiopods and stromatoporoids. These authors distinguished the Eifelian–lower Givetian Zbrza dolomite, the upper Givetian Dębnik limestone, Frasnian nodular and detrital limestones, and a platy limestone of upper Frasnian to lower Famennian age, as well as a detrital pelitic limestone which belongs to the upper Famennian, and is presumed to extend into the lower Tournaisian (Narkiewicz and Racki, 1984; Narkiewicz and Petecki, 2017; Fig. 2).

A lithostratigraphic subdivision of Upper Devonian and Lower Carboniferous (Mississippian) strata in the research area was also described by Paszkowski et al. (1995). The proposed subdivision includes eleven informal lithostratigraphic units (of the so-called Rudawa Group) of Famennian, Tournaisian, and Visean age (Paszkowski et al., 1995) and is

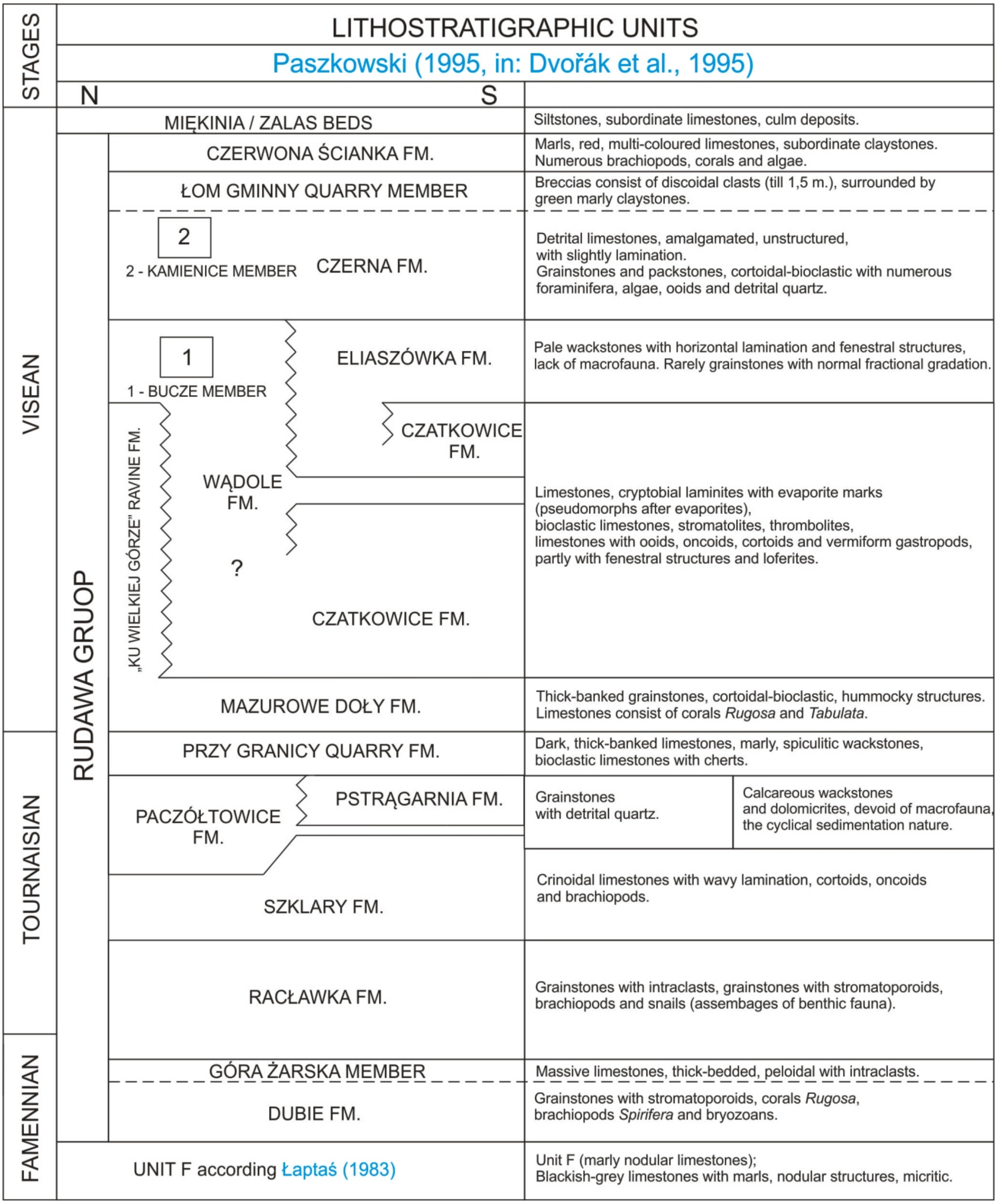

Fig. 2 Correlation of lithostratigraphic units of Famennian–Visean strata in the Kraków region (after Dvořák et al., 1995; Paszkowski et al., 2008)

based on facies characters (Paszkowski, 1983; Paszkowski and Szydłak, 1986), sedimentological parameters and biostratigraphic data (Paszkowski, 1988). The lithostratigraphic units were not precisely documented by microfacies or microfauna, though pseudomorphs after evaporites, some fossil assemblages (vermiform gastropods, calcispheres, ostracods, and algae), coniatolite and coniatoid crusts and laminated dolomicrites were found in Dinantian limestone of the research area and examined in thin section (Paszkowski and Szydłak, 1986). These lithostratigraphic units and their boundaries were not precisely defined by Paszkowski (1995), which makes them difficult to recognise in the field due to sedimentary facies changes and emergence events. Paszkowski (1995) together with Szulczewski and Malec (Dvořák et al., 1995) correlated the Kraków Upland with the Moravian Karst and Holy Cross Mountains as an example of the evolution of Polish-Moravian carbonate platforms in the Late Devonian and Early Carboniferous (Dvořák et al., 1995).

Biostratigraphic studies based on calcareous foraminifera in the Upper Devonian and Lower Carboniferous rocks of the research area were published by Liszka (1962), Soboń-Podgórska (1972, 1975), Ślósarz and Żakowa (1975), Poty et al. (2003) and Tomaś et al. (2011). These analyses are mostly local studies with the low or unknown resolution. These authors listed foraminiferal taxa from individual exposures, except for the Czernka Valley; some describe systematic palaeontology (e.g., Soboń-Podgórska, 1972, 1975).

In the Szklarka Valley within the Tournaisian beds, very rare and poorly preserved foraminifera of the genera *Plectogyra* sp., *Endothyra* sp., *Omphalotis* sp., *Globoendothyra* sp. were found in grey limestone (Liszka, 1962). From the Czernka Valley, Liszka (1962) described numerous foraminiferal assemblages totalling ~32 taxa (e.g., *Brunsia* sp., *Endothyra* sp., *Endothyranopsis* sp., *Bradyina* sp., *Palaeotextularia* sp., *Cribrostomum* sp., *Archaediscus* sp., etc).

Soboń-Podgórska (1972, 1975) recognized 122 taxa in foraminiferal assemblages from Tournaisian and Visean rocks, 46 of these from two exposures (Czerwona Ścianka and Łom Gminny) where research was also conducted for this study (Appendix 1). Micropalaeontological study was made of ten field exposures located primarily in the Czernka Valley (location of exposures in Fig.1).

Based on borehole data from the area between Kraków and Olkusz, Ślósarz and Żakowa (1975) described Frasnian and Famennian foraminiferal faunas, from which 21 taxa (Appendix 1) were listed from the Devonian deposits of the Dębnik anticline, mostly represented by unilocular and bichambered foraminifera. These authors also provided information on brachiopods and corals (Ślósarz and Żakowa 1975).

Poty et al. (2003) published the foraminiferal and coral biostratigraphy of the sedimentary succession exposed in the Czatkowice quarry (part of the Dębnik anticline). Figure 3 shows the stratigraphic correlation between the Czatkowice Quarry and the Dinantian of southern Belgium (Poty et al., 2003). These authors used lithostratigraphic units designated previously by Paszkowski (1995) and correlated these units biostratigraphically using foraminifera and corals. Not all the foraminifera described were illustrated. These foraminiferal assemblages are shown in Appendix 1.

Tomaś et al. (2011) described the distribution of Famennian and Tournaisian deposits within the Dębnik anticline from a series of exposures located in the Racławka and Szklarka valleys between the villages of Dębnik and Szklary (W–E) and Dubie and Racławice (S–N) (Appendix 1). They recognized foraminifera from the upper Famennian to the upper Tournaisian. Unilocular foraminifera were also described from the middle and upper Tournaisian deposits (Tomaś et al., 2011).

Biostratigraphic studies were also made on conodonts and brachiopods (Gromczakiewicz-Łomnicka, 1974, 1979; Baliński, 1979, 1986, 1995; Appelt, 1998).

Gromczakiewicz-Łomnicka (1974, 1979) described Late Devonian and Early Carboniferous conodont faunas from the Racławka and Szklarka Valleys (Dębnik anticline). Eight conodont zones (Table 1) were compared with brachiopod zones previously described by Jarosz (1926). Gromczakiewicz-Łomnicka (1979) described exposures of different age than Jarosz.

Baliński (1979) described brachiopods (38 species) and conodonts (27 species) from the Frasnian deposits of the Dębnik anticline and also provided a stratigraphic analysis of the Frasnian deposits and systematic descriptions of the brachiopods and conodonts. He formulated a brachiopod (39 species) and conodont (49 species) biostratigraphy for the Famennian deposits (Baliński, 1986, 1995) from the Dębnik anticline. Based on palaeontological analysis, Baliński (1995) inferred transgression-regression cycles, anoxia events, and sea level fall events within the Frasnian and Famennian. Like many authors before (e.g., Gürich, 1903; Jarosz, 1926), Baliński (1995) observed a decreasing number of brachiopods in relation to stromatoporoids in the upper Famennian.

Appelt (1998) provided data on Tournaisian conodonts from the basinal carbonates (spiculitic limestones) of the Krzeszowice area. Late Tournaisian conodonts of the *Gnathodus cunei-*

Table 1

Conodont zones in the uppermost Famennian to Visean–uppermost Visean (Gromczakiewicz-Łomnicka, 1979) for the study area (Racławka and Szklarka Valleys)

Conodont Zones	Periods			
	uppermost Famennian	lower Tournaisian	upper Tournaisian	Visean–uppermost Visean
Middle or Upper *costatus*	X			
Protognathodus kockeli–Siphonodella sulcata		X		
Siphonodella–Pseudopolygnathus triangulus inaequalis		X		
Siphonodella–Pseudopolygnathus triangulus triangulus		X		
Siphonodella crenulata		X		
Polygnathus communis carinus			X	
Gnathodus semiglaber			X	
Cavusgnathus–Apatognathus				X
Gnathodus mononodosus				X
Gnathodus girtyi collinsoni				X

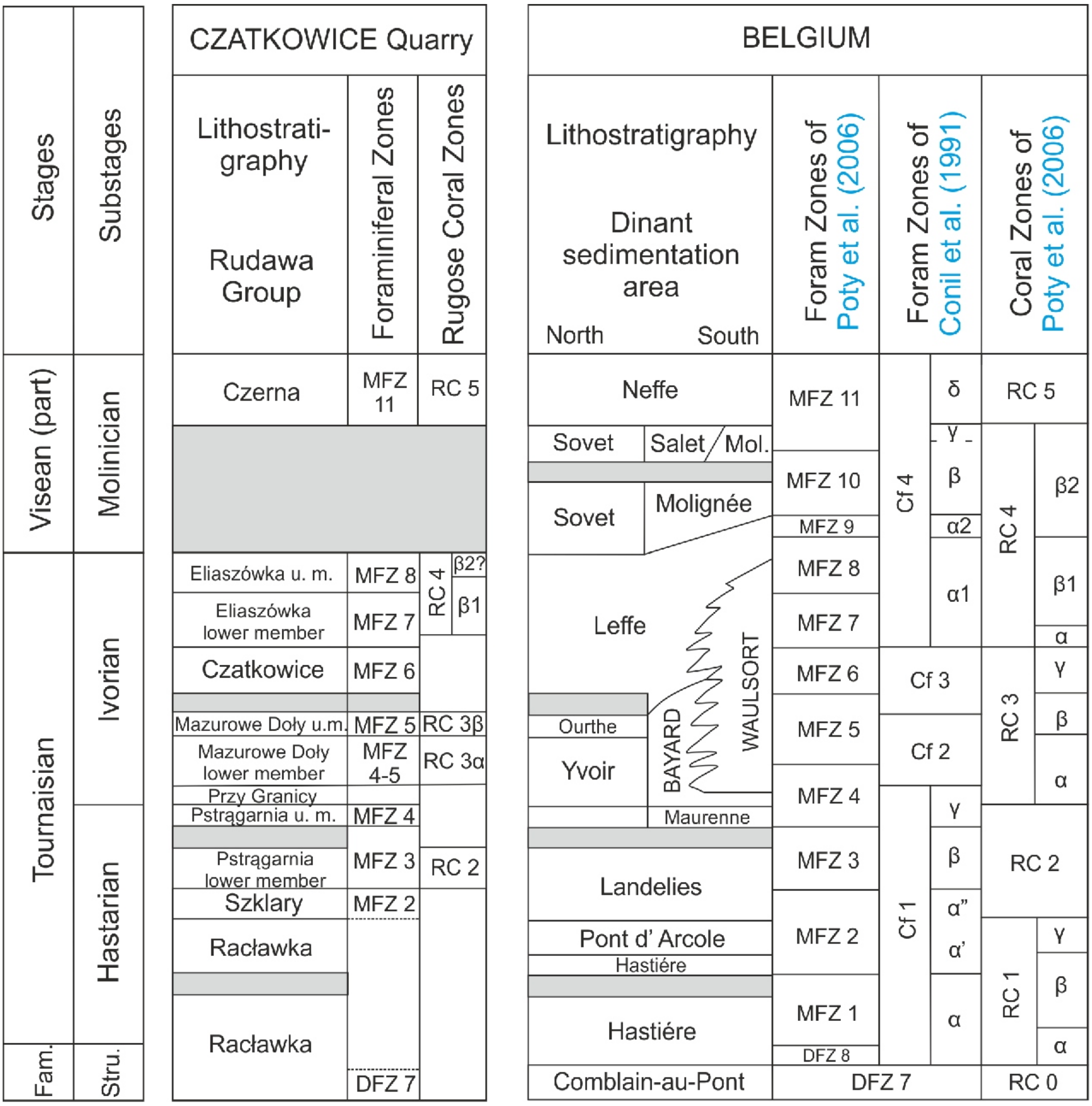

Fig. 3. Correlation of lithostratigraphic and biostratigraphic subdivision of the Rudawa Group with the Dinantian sedimentary area (after Poty et al., 2003)

Fam. – Famennian, Stru. – Strunian; u.m. – upper member

formis Zone were identified in two quarries, at Czatkowice and Przy Granicy. Analysis of the conodonts showed their irregular distribution (decreasing upwards) in the monotonous lithology of the spiculitic limestone (Appelt, 1998). According to Appelt (1998), this was caused by (undefined) environmental rather than evolutionary changes.

Zajączkowski (1975) described a 200 m Dinantian sequence of platform carbonates (Tournaisian, Visean) based on exposures and boreholes at Czerna in the vicinity of Krzeszowice. He described relationships between brachiopods (e.g., *Gigantoproductus giganteus* and *G. latissimus*) and corals (e.g., *Syringopora*, *Lithostrotion*, *Siphonodendron*, *Amygdalophyllum*, *Paleosmilia*, and *Dibunophyllum*) from the Visean deposits, and reconstructed the environment and conditions of sedimentation on the Visean carbonate platform.

MATERIAL AND METHODS

The samples were taken from seven exposures, three of which R1 (Skałka przy Mostku), R2, and R3 are situated on the edge of the Racławka Valley, on the slopes of the Widoma, Opalona and Komarówka hills (Fig. 4). Two, S1 and S2 (Łom przy Granicy, Łom z intruzją), are located within the edge of the Szklarka Valley (Fig. 5) and two more, C1 (Czerwona Ścianka) and C2 (Łom Gminny) are in the Czernka Valley (Fig. 6). Detailed information about the thickness of the profiles, coordinates and numbers of samples or thin sections are shown in Table 2.

Foraminifera were studied on 159 thin sections. A *Nikon SMZ 25* optical microscope was used, and specimens were photographed using a *DS-Fi3* microscope camera. The thin sections are housed in the European Micropalaeontological Reference Center, Micropress Europe, Kraków, Poland (cabinet 20, drawers 1–5).

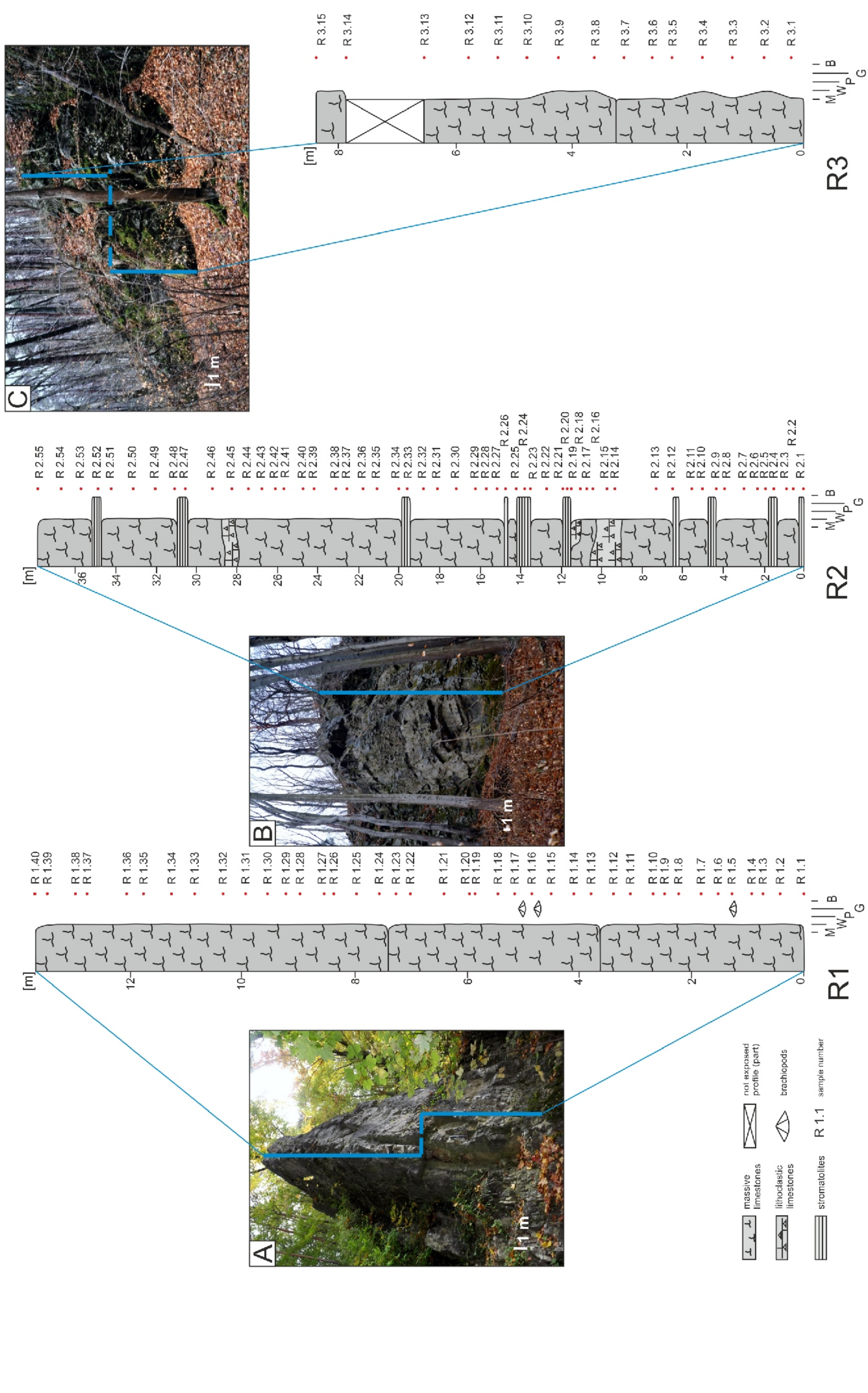

Fig. 4. Exposures with profiling lines marked and lithological columns of the profiles studied

M – mudstone, W – wackestone, P – packstone, G – grainstone, B – boundstone, R1 – profile number; each of the profiles is at a different scale; R1, R2, R3 – Racławka Valley

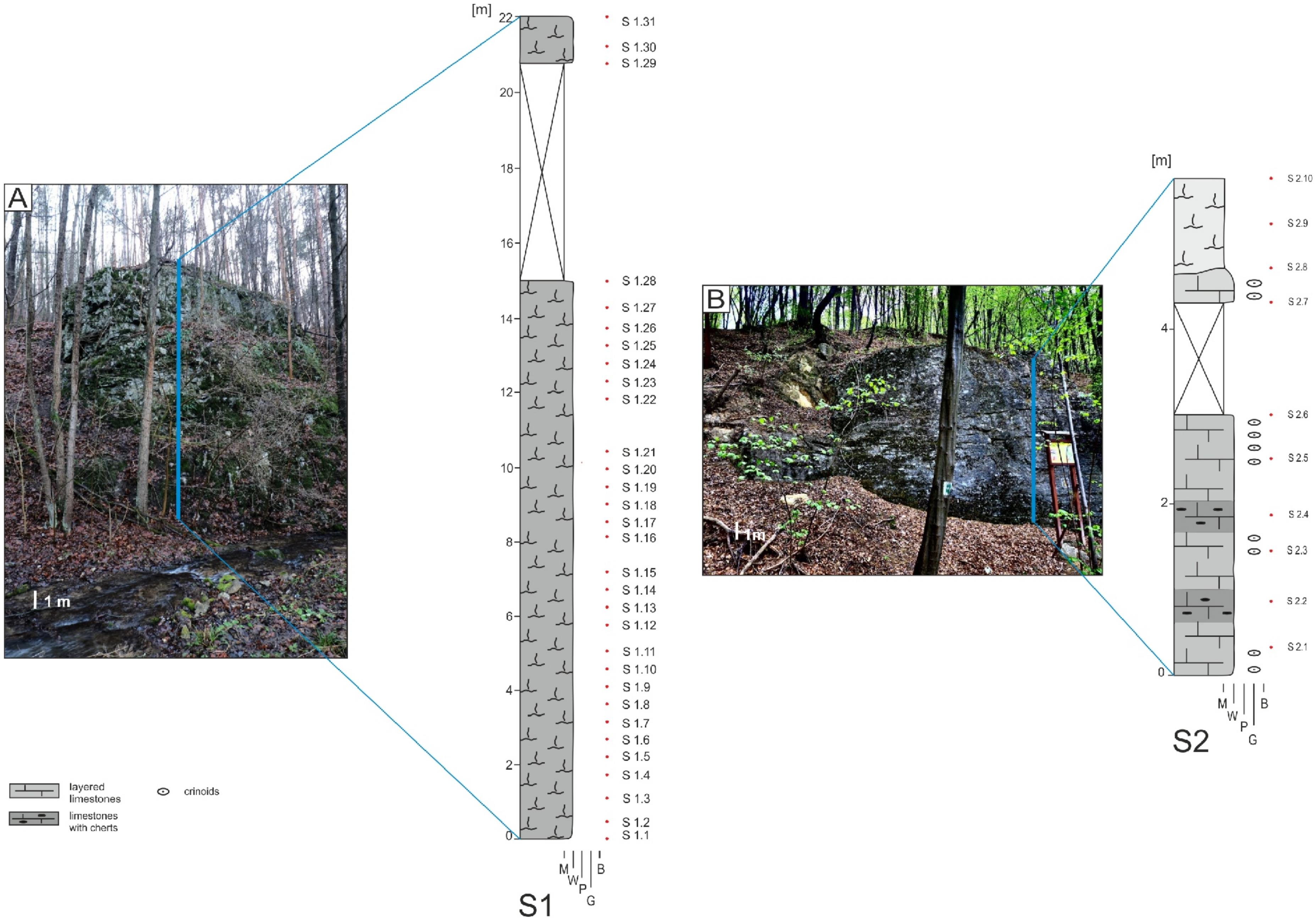

Fig. 5. Exposures with profiling lines marked and their lithological columns of the profiles studied

S1, S2 – Szklarka Valley; other explanations as in Figure 4

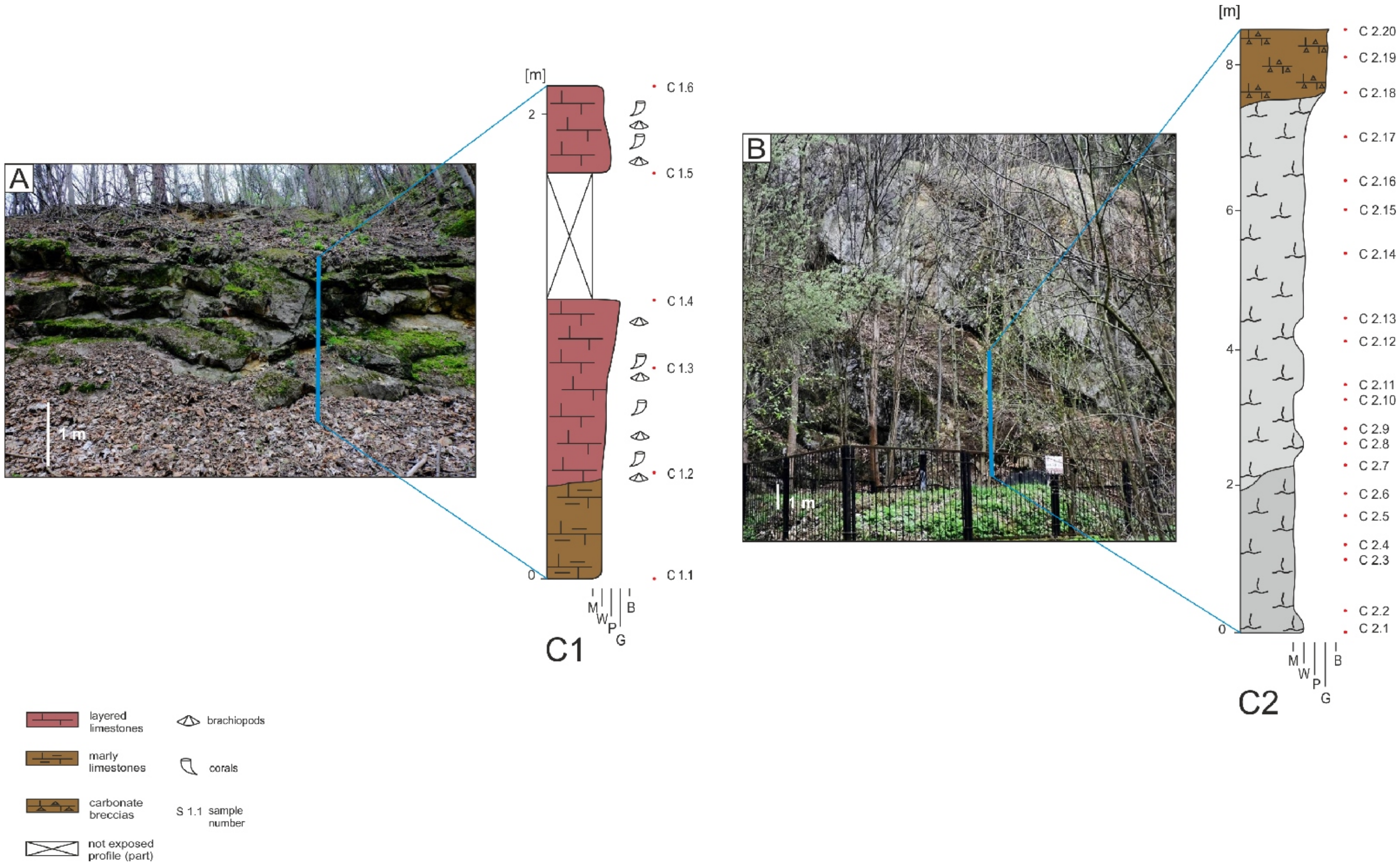

Fig. 6. Exposures with profiling lines marked and their lithological columns of the profiles studied

C1, C2 – Czernka Valley other explanations as in Figure 5

Table 2

Profiles studied with coordinates and numbers of collected samples or thin sections

Studied outcrop	Coordinates WGS-84	Length of the profile	Number of samples/ thin sections
R1	N:50°09'26,6"; E:19°41'34,5"	13,6 m	40/40
R2	N:50°10'08,4"; E:19°41'05,7"	37,7 m	55/28
R3	N:50°10'28,9"; E:19°40'26,7"	8,7 m	15/15
S1	N:50°09'29,7"; E:19°42'47,1"	22 m	31/29
S2	N:50°09'41,3"; E:19°43'01,0"	5,6 m	10/14
C1	N:50°10'12,9"; E:19°37'22,1"	2,1 m	6/8
C2	N:50°10'09,7"; E:19°37'24,2"	8,5 m	20/25

R1 – Skałka przy Mostku (Widoma Hill, Racławka Valley); R2, R3 – profiles situated at the edge of the Racławka Valley (Opalona and Komarówka Hills); S1 – Łom przy Granicy, S2 – Łom z intruzją (both located within the edge of the Szklarka Valley); C1 – Czerwona Ścianka, C2 – Łom Gminny (left bank orographically of the Czernka Valley)

SYSTEMATIC PALAEONTOLOGY

For the classification and description of the foraminifera in this paper (Table 3), the systematic framework of Vachard and Le Coze (2021) was applied. The author used additional publications of Vdovenko et al. (1993), Rauzer-Chernousova et al. (1996), Brenckle and Grelecki (1993), Brenckle (2005), Hance et al. (2011), and the Ellis and Messina catalogue of foraminifera with supplements (1941–2021).

Phylum **FORAMINIFERA** d'Orbigny, 1826; emend. Cavalier-Smith, 2002 (as subphylum) and 2003 (as phylum)
Class **FUSULINATA** Maslakova, 1990 [nom. translat. Gaillot and Vachard, 2007]; emend. Vachard, Krainer and Lucas, 2013
Subclass **AFUSULINANA** Vachard, Pille and Gaillot, 2010
Order **ARCHAEDISCIDA** Cushman, 1928 [nom. translat. Poyarkov and Skvortsov, 1979]

Tests without septa, lenticular, conical, oval, discoidal, involute in shape, with proloculus covered with following second chamber, coiled in planispiral, streptospiral or trochospiral whorls. Wall is calcareous, composed of layers, often an inner layer microgranular, and the outer is radial and fibrous. Occurrence from middle Devonian to early Serpukhovian, Palaeotethys and Urals Provinces, rare in Siberia and North America (Hance et al., 2011).

Superfamily **ARCHAEDISCOIDEA** Cushman, 1928 [nom. translat. Piller, 1978]
Family **ARCHAEDISCIDAE** Cushman, 1928 [nom. translat. Chernysheva, 1948]
Subfamily **ARCHAEDISCINAE** Cushman, 1928
Genus: ***Archaediscus*** Brady, 1873
Type species: *Archaediscus karreri* Brady, 1873

Archaediscus moelleri Rauzer-Chernousova, 1948b
(Fig. 7A)

1948b. *Archaediscus moelleri* nov. sp. – Rauzer-Chernousova, p. 231, pl. 15, figs. 14–15.
1964. *Archaediscus moelleri* subsp. *moelleri* Rauzer-Chernousova – Conil and Lys, p. 124–125, pl. 19, fig. 6.
1967. *Archaediscus moelleri* Rauzer-Chernousova – Brazhnikova et al., pl. 14, fig. 6; pl. 17, fig. 6.
1968. *Archaediscus moelleri* Rauzer-Chernousova – Aizenverg et al., pl. 17, fig. 4, 6.
1972. *Archaediscus* aff. *moelleri* Rauzer-Chernousova – Soboń-Podgórska, p. 224, pl. 8, fig. 4.
1988. *Archaediscus moelleri* Rauzer-Chernousova – Soboń-Podgórska, pl. 1, fig. 5.
1993. *Archaediscus moelleri* Rauzer-Chernousova – Brenckle and Grelecki, p. 19–20, pl. 3, figs. 3, 4, 9.

M a t e r i a l. – Two specimens.

D e s c r i p t i o n. – Test calcareous, lenticular. Round proloculus followed by open, sigmoidially coiled tubular chamber. Initial volutions oriented annularly around proloculus. Interior coiling involute, outer volution evolute (5 volutions in the test). Wall hyaline radial. Diameter is 300 μm, width 200 μm.

R e m a r k s. – *Archaediscus moelleri* differs from *Archaediscus gigas* Rauzer-Chernousova, 1948b, by its much smaller dimensions. Axial section.

D i s t r i b u t i o n. – Upper Visean; Upper Silesian Block (Czerwona Ścianka Formation), Holy Cross Mountains, Lublin Carboniferous Basin, Poland (Soboń-Podgórska, 1972, 1988); France, Belgium (Conil and Lys, 1964); Russia, Moscow Basin (e.g., Rauzer-Chernousova, 1948b; Brazhnikova et al., 1967; Aisenverg et al., 1968).

Archaediscus sp.
(Fig. 7B)

M a t e r i a l. – One specimen.

D e s c r i p t i o n. – Test calcareous, elongated, discoidal in shape. Opaque mineral is present in the last volution lumen. Coiling oscillatory with 3 volutions. Wall hyaline radial. Diameter is 150 μm, width 60 μm.

R e m a r k s. – Only identifiable as *Archaediscus* sp. – very oblique section, not possible to make a specific identification.

D i s t r i b u t i o n. – Upper Visean; Upper Silesian Block (Czerwona Ścianka Formation).

Asteroarchaediscus cf. *rugosus* (Rauzer-Chernousova, 1948c)
(Fig. 7C)

Table 3

Taxa of benthic foraminifera described in this paper

Foraminifer taxa	Expo-sure R1	Expo-sure R2	Expo-sure R3	Expo-sure S1	Expo-sure S2	Expo-sure C1	Expo-sure C2
Archaediscus moelleri Rauzer-Chernousova, 1948b						X	
Asteroarchaediscus cf. *rugosus* (Rauzer-Chernousova, 1948c)						X	
Archaediscus sp.						X	
Septatournayella (?) sp.		X					
Tournayella sp.		X					
Chernyshinella (?) sp.				X			
Septabrunsiina cf. *minuta* (Lipina, 1948b)				X			
Septabrunsiina sp.				X			
Laxoendothyra paracosvensis (Lipina, 1955)				X			
Laxoendothyra concavocamerata (Lipina, 1960)							X
Globoendothyra sp.						X	
Eoendothyra communaeformis Grozdilova, 1973	X						
Eoendothyra sp.	X						
Omphalotis cf. *omphalota* (Rauzer and Reitlinger in Rauzer-Chernousova and Fursenko, 1937)				X			
Spinoendothyra sp.				X			
Endothyranopsis crassus (Brady, 1870)							X
Endothyranopsis cf. *crassus* subsp. *crassa* (Brady, 1876)						X	
Endothyranopsis sp.							X
Latiendothyranopsis sp.						X	
Eoendothyranopsis sp.							X
Cribrospira mikhailovi Rauzer-Chernousova, 1948a						X	
Bessiella sp.				X			
Dainella cf. *elegantula* Brazhnikova, 1962				X			
Dainella cf. *chomatica* (Dain in Brazhnikova, 1962)				X			
Loeblichia ammonoides subsp. *paraammonoides* (Brazhnikova, 1956)						X	
Eoparastaffella simplex Vdovenko, 1954						X	
Eoparastaffella ovalis Vdovenko, 1954							X
Eoparastaffella sp.							X
Climacammina sp.						X	
Cribrostomum sp.						X	
Palaeotextularia cf. *longiseptata* Lipina, 1948a						X	
Palaeotextularia cf. *longiseptata* subsp. *crassa* Lipina, 1948a						X	
Palaeotextularia cf. *breviseptata* Lipina, 1948a						X	
Tetrataxis sp.						X	
Ozawainella cf. *alchevskiensis* Potievskaya, 1958						X	
Eostaffella parastruvei Rauzer-Chernousova, 1948b							X
Eostaffella mosquensis Vissarionova, 1948						X	
Eostaffella singularia Vissarionova, 1948							X
Eostaffella cf. *nalivkini* Malakhova, 1957							X
Eostaffella sp.						X	

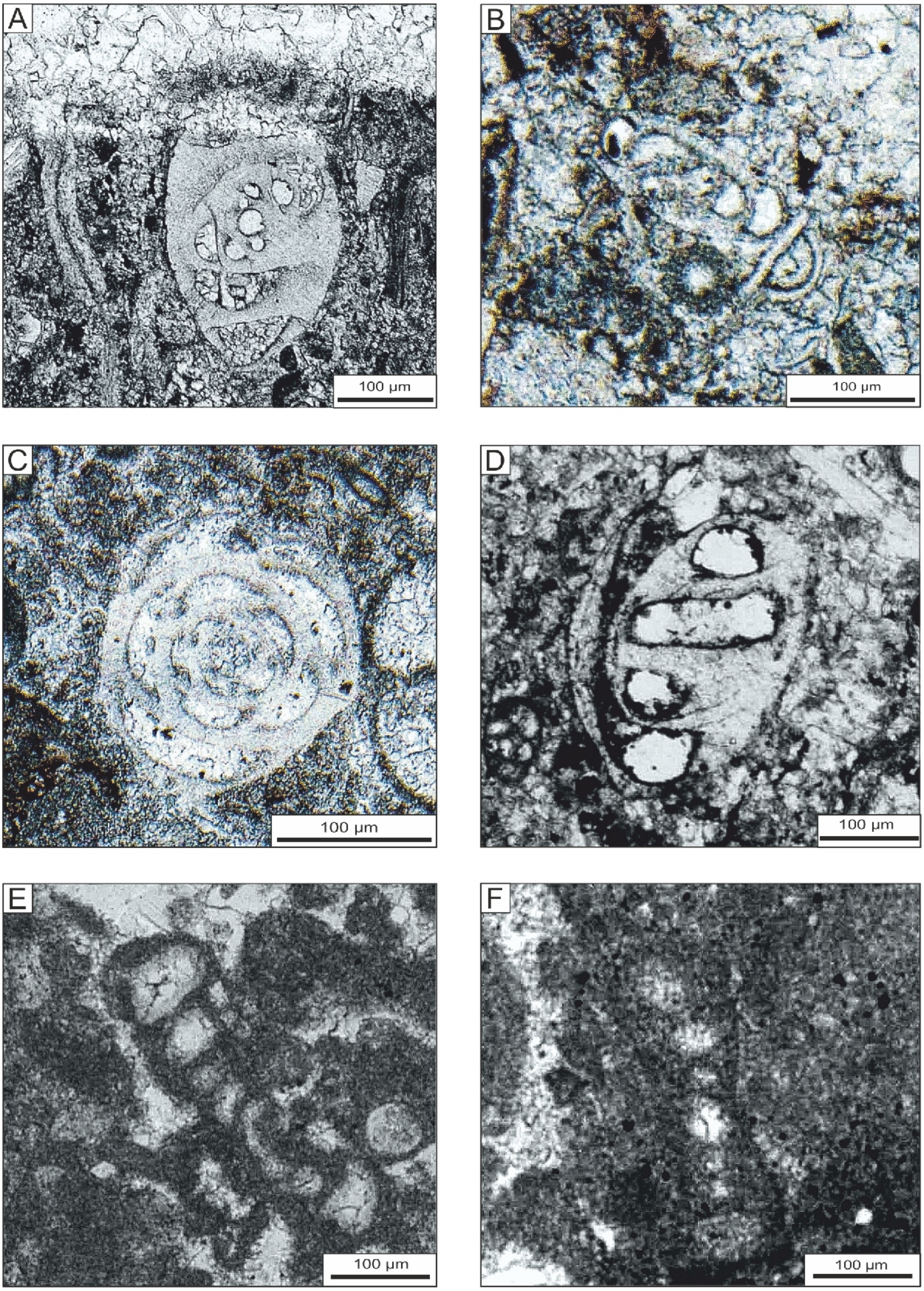

Fig. 7. Foraminifers from the Racławka and Czernka sections

A – *Archaediscus moelleri* Rauzer-Chernousova, 1948b, sample C 1.1; **B** – *Archaediscus* sp., sample C 1.3; **C** – *Asteroarchaediscus* cf. *rugosus* (Rauzer-Chernousova, 1948c); **D** – *Archaediscus* sp., sample C 1.4; **E** – *Septatournayella* (?) sp., sample R 2.3; **F** – *Tournayella* sp., sample R 2.11

1948c. *Archaediscus rugosus* nov. sp. – Rauzer-Chernousova, p. 11, pl. 3, figs. 4–6.
1993. *Archaediscus rugosus* Rauzer-Chernousova – Brenckle and Grelecki, p. 16–17, pl. 2, figs. 3–5.

M a t e r i a l. – One specimen. Well-preserved form.

D e s c r i p t i o n. – Test calcareous, oval. Proloculus round, following by an undivided second chamber. Tubular chamber open in last volution. Coiling pattern and volution number indeterminate because of orientation. Wall thick and fibrous. Diameter is 200 µm.

R e m a r k s. – Observation of diagnostic features is difficult because of sagittal section. Recommended name *Asteroarchaediscus* cf. *rugosus* (Rauzer-Chernousova, 1948c) has been applied (after Brenckle and Grelecki, 1993).

D i s t r i b u t i o n. – Upper Visean–Serpukhovian (?); Upper Silesian Block (Czerwona Ścianka Formation); central Kazakhstan (Rauzer-Chernousova, 1948c; Brenckle and Grelecki, 1993).

Archaediscus sp.
(Fig. 7D)

M a t e r i a l. – One specimen.

D e s c r i p t i o n. – Test calcareous, lenticular, involute, slightly oval. Proloculus not observed. An undivided second tubular chamber is sigmoidal coiled. Thick and fibrous wall, composed of an inner microgranular layer and a radial outer layer. Diameter 400 µm, width 200 µm.

R e m a r k s. – Very oblique section, not identifiable to species level.

D i s t r i b u t i o n. – Upper Visean; Upper Silesian Block (Czerwona Ścianka Formation).

Superfamily **TOURNAYELLOIDEA** Dain, 1953 [nom. translat. Dain in Rauzer-Chernousova and Fursenko, 1959]; emend. Hance, Hou and Vachard, 2011; re-emend. Vachard and Le Coze, 2021
Family **TOURNAYELLIDAE** Dain, in Dain and Grozdilova, 1953 [nom. translat. Dain in Rauzer-Chernousova and Fursenko 1959]
Subfamily **TOURNAYELLINAE** Dain, in Dain and Grozdilova, 1953
Genus ***Septatournayella*** Lipina, 1955
Type species: *Tournayella segmentata* Dain in Dain and Grozdilova, 1953.
Septatournayella (?) sp.
(Fig. 7E)

M a t e r i a l. – A rare form in the material studied (one specimen).

D e s c r i p t i o n. – Test calcareous, planispiral, evolute. Wall undifferentiated, dark.

R e m a r k s. – Poorly preserved. Oblique section. Barely seen aperture (terminal, simple, basal?).

D i s t r i b u t i o n. – Early Tournaisian; Upper Silesian Block (Racławka Formation), Carpathian Foredeep, Carpathian Mountains, Poland.

Genus *Tournayella* Dain, in Dain and Grozdilova, 1953
Type species: *Tournayella discoidea* Dain in Dain and Grozdilova, 1953.
Tournayella sp.
(Fig. 7F)

M a t e r i a l. – A rare form in the material studied (one specimen).

D e s c r i p t i o n. – Test calcareous, discoidal, planispiral coiling. Proloculus oval, tubular chamber slightly expanded. Microgranular wall.

R e m a r k s. – Poorly preserved.

D i s t r i b u t i o n. – Early Tournaisian; Upper Silesian Block (Racławka Formation), Carpathian Foredeep, Carpathian Mountains, Poland.

Subclass **FUSULINANA** Maslakova, 1990; emend. Vachard, 2016
Order **ENDOTHYRIDA** Brady, 1884 [nom. translat. Fursenko, 1958]

Tests nautiloid, lenticular, discoid, endothyroidally or planispirally coiled, rarely uncoiled, with small and spherical proloculus. Chambers globular and not numerous. Septa planar. Endoskeleton developed as crusts, hooks, pseudochomata. Wall dark, microgranular, rarely bilayered or multilayered. Aperture terminal simple, basal or central, rare cribrate. FAD in the late Famennian–Tournaisian, acme in the Visean–Gzhelian and rare in the Early and Middle Permian. Genera and families are cosmopolitan during the Carboniferous, rarely endemic (Vachard and Le Coze, 2021).

Suborder **LITUOTUBELLINA** Vachard, 2016
Superfamily **LITUOTUBELLOIDEA** Gaillot and Vachard, 2007; emend. Hance, Hou and Vachard, 2011
Family **CHERNYSCHINELLIDAE** Lipina and Reitlinger in Rauzer-Chernousova et al., 1996
Genus *Chernyshinella* Lipina, 1955
Type species: *Endothyra glomiformis* Lipina, 1948b
Chernyshinella (?) sp.
(Fig. 8A)

M a t e r i a l. – Six specimens, variously preserved.

D e s c r i p t i o n. – Test calcareous, complex coiling; the last two wide whorls with the characteristic shape of the chambers. Distinct partitions (septa) are directed towards the inside of the test. The number of whorls is from 2 to 3. No visible aperture.

D i s t r i b u t i o n. – Early–middle Tournaisian; Upper Silesian Block (Szklary Formation), Poland.

Superfamily **SEPTABRUNSIINOIDEA** Colpaert and Vachard in Colpaert et al., 2017
Family **SEPTABRUNSIINIDAE** Conil and Lys, 1977
Subfamily **SEPTABRUNSIININAE** Conil and Lys, 1977
Genus *Septabrunsiina* Lipina, 1955

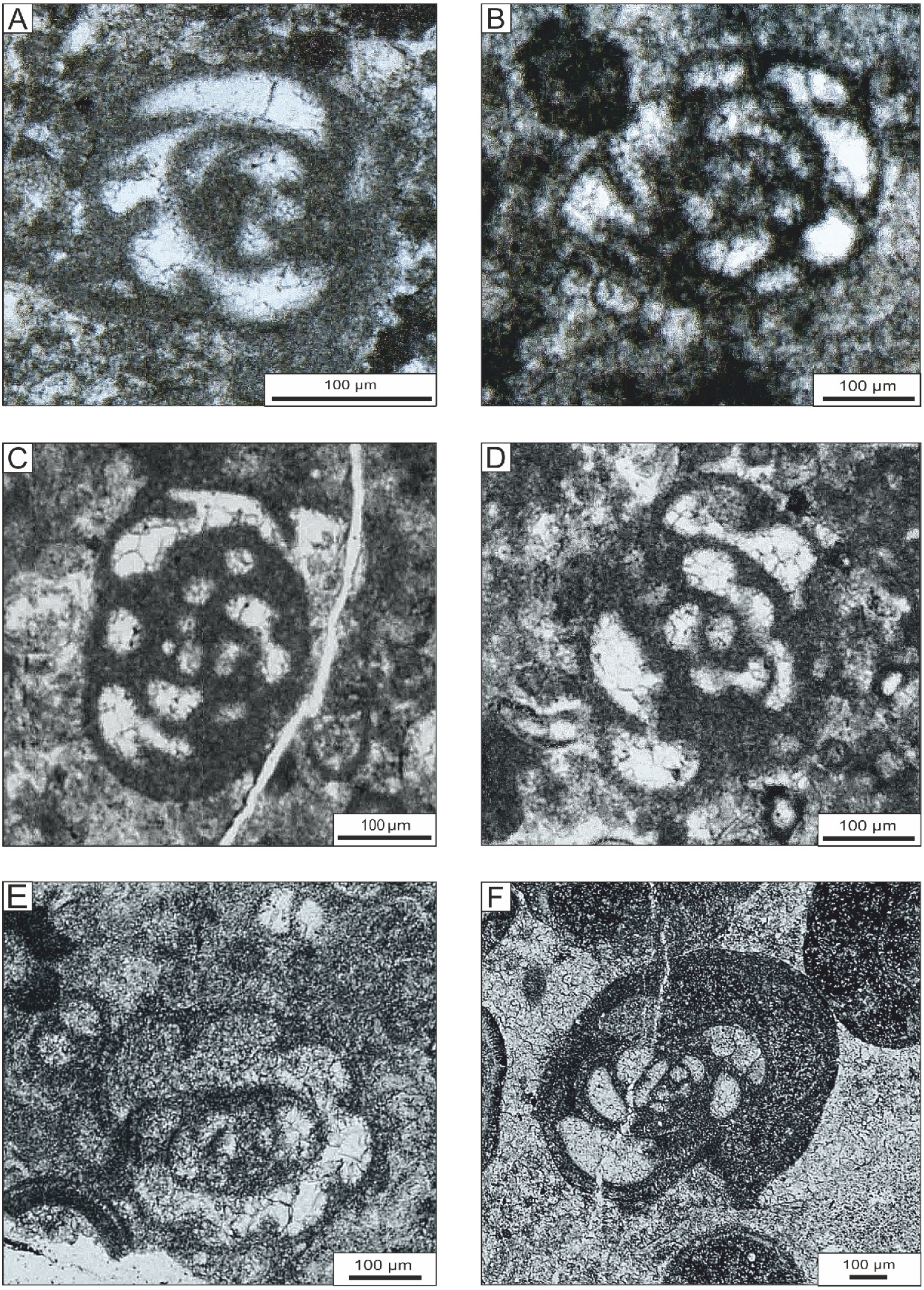

Fig. 8. Foraminifers from the Szklary and Czernka sections

A – *Chernyshinella* (?) sp., sample S 1.19; **B** – *Septabrunsiina* cf. *minuta* (Lipina, 1948b), sample S 1.25; **C** – *Septabrunsiina* sp., sample S 1.9; **D** – *Laxoendothyra paracosvensis* (Lipina, 1955), sample S 1.9; **E** – *Laxoendothyra concavocamerata* (Lipina, 1960), sample C 2.9; **F** – *Globoendothyra* sp., sample C 1.4

Type species: *Endothyra? krainica* Lipina, 1948b
Septabrunsiina cf. *minuta* (Lipina, 1948b)
(Fig. 8B)

1948b. *Endothyra? minuta* nov. sp. – Lipina, p. 255–256, pl. 19, figs. 7, 8.
1954. *Endothyra? minuta* Lipina – Grozdilova and Lebedeva, p. 89–90, pl. 11, fig. 1.
1955. *Septatournayella? minuta* (Lipina) – Lipina, p. 39, pl. 3, figs. 9, 12, 13.
1959. *Endothyra minuta* Lipina – Durkina, p. 162, pl. 8, fig. 1.
1965. *Septabrunsiina minuta* (Lipina) – Lipina, p. 53–54, pl. 11, figs. 9–11, 14–29.
2005. *Septabrunsiina minuta* (Lipina) – Brenckle, p. 87–88, pl. 16, figs. 1–3.

M a t e r i a l. – Rare in the material studied, one specimen.

D e s c r i p t i o n. – Test calcareous, evolute, planispirally coiled. Coiling is tight, expanding slowly throughout growth. No septa in the initial whorls but in the following volutions the test becomes planispiral with distinct septa pointing towards the aperture. 4 volutions. Wall granular to microgranular. Aperture not clearly visible.

R e m a r k s. – Oblique section.

D i s t r i b u t i o n. – Tournaisian; Upper Silesian Block (Szklary Formation), Poland; Russia – Cherepet and Serena River regions (Lipina, 1948b, 1955, 1965; Durkina, 1959; Grozdilova and Lebedeva, 1954; Brenckle, 2005).

Septabrunsiina sp.
(Fig. 8C)

M a t e r i a l. – Two specimens, poorly preserved.

D e s c r i p t i o n. – Test calcareous, oval, planispirally coiled. There are visible septa directed towards the aperture, coiling poorly developed in first planispiral volutions. Wall microgranular.

R e m a r k s. – Observation of diagnostic features is difficult because of oblique section. The species is indeterminate.

Distribution. Tournaisian–early Visean; (Szklary Formation and Łom Gminny Member of the Czernka Formation), Poland.

Family **LAXOENDOTHYRIDAE** Hance, Hou and Vachard, 2011
Genus ***Laxoendothyra*** Brazhnikova and Vdovenko in Vdovenko, 1972
Type species: *Endothyra parakosvensis* Lipina, 1955
Laxoendothyra paracosvensis (Lipina, 1955)
(Fig. 8D)

1955. *Endothyra paracosvensis* nov. sp. – Lipina, p. 68, pl. 9, fig. 11; pl. 10, figs. 1–3.
1970. *Latiendothyra* of the group *L. paracosvensis* (Lipina) – Górecka and Mamet, p. 162, pl. 3, figs. 12, 13.
2001. *Laxoendothyra paracosvensis* (Lipina) – Pajchlowa and Wagner, p. 59, pl. 1, figs. 10, 13.
2005. *Laxoendothyra paracosvensis* (Lipina) – Brenckle, p. 62–63, pl. 11, figs. 3, 4.

M a t e r i a l. – Represented in the material studied by one specimen.

D e s c r i p t i o n. – Test calcareous, asymmetrical, with rounded margins. Initial 2 streptospiral whorls, 2 consecutive planispiral whorls with possibly 8 chambers in the last whorl. Coiling expands rapidly in the last whorl. Septa short, slightly sloping towards the aperture. Wall microgranular. Aperture simple, basal opening.

R e m a r k s. – Observations hindered because of the oblique section. No secondary deposits.

D i s t r i b u t i o n. – Tournaisian; Upper Silesian Block (Szklary Formation), Central Sudetes, Carpathian Foredeep, Carpathian Mountains, Poland (Soboń-Podgórska, 1979; Pajchlowa and Wagner, 2001); Russia (Lipina, 1955, 1963; Vdovenko, 1972).

Laxoendothyra concavocamerata (Lipina, 1960)
(Fig. 8E)

1960. *Plectogyra antiqua* var. *concavocamerata* nov. sp. – Lipina, p. 124, pl. 1, figs. 5–7.
2011. *Laxoendothyra concavocamerata* (Lipina) – Hance et al., p. 246–247, pl. 4, figs. 17–19.

M a t e r i a l. – Rare in the material studied, one specimen.

D e s c r i p t i o n. – Test calcareous. The test has concave sutures and rounded chambers. Initial streptospiral whorls and 1 outer planispiral volution. 8 chambers in the last whorl. Septa are straight, short and thin. Wall granular. Aperture basal.

R e m a r k s. – Oblique section, specimen illustrated has thin wall and thin septa directed towards aperture. *Latiendothyranopsis latispiralis* subsp. *grandis* has thicker wall.

D i s t r i b u t i o n. – Middle Visean; Upper Silesian Block (Łom Gminny Member into Czernka Formation), Poland; Russia (Lipina, 1960).

Family **GLOBOENDOTHYRIDAE** Reitlinger in Voloshinova and Reitlinger, 1959
Genus ***Globoendothyra*** Reitlinger in Voloshinova and Reitlinger, 1959
Type species: *Globoendothyra globula* Reitlinger in Voloshinova and Reitlinger, 1959
Globoendothyra sp.
(Fig. 8F)

M a t e r i a l. – One specimen.

D e s c r i p t i o n. – Test calcareous, robust, squat, inflated, discoidal, rounded chambers, coiling mostly involute, tight in interior volutions with more rapid expansion in the outer two whorls. About 5 whorls. Wall differentiated commonly with an agglutinated layer and a pseudofibrous layer.

R e m a r k s. – Axial section, supplementary deposits generally discrete.

D i s t r i b u t i o n. – Late Tournaisian–early Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member of the Czernka Formation), Poland.

Superfamily **QUASIENDOTHYROIDEA** Hance, Hou and Vachard, 2011
Family **QUASIENDOTHYRIDAE** Rozovskaya, 1961
Genus ***Eoendothyra*** Miklukho-Maklay, 1960
Type species: *Endothyra communis* Chernysheva, 1940
Eoendothyra communaeformis Grozdilova, 1973
(Fig. 9A)

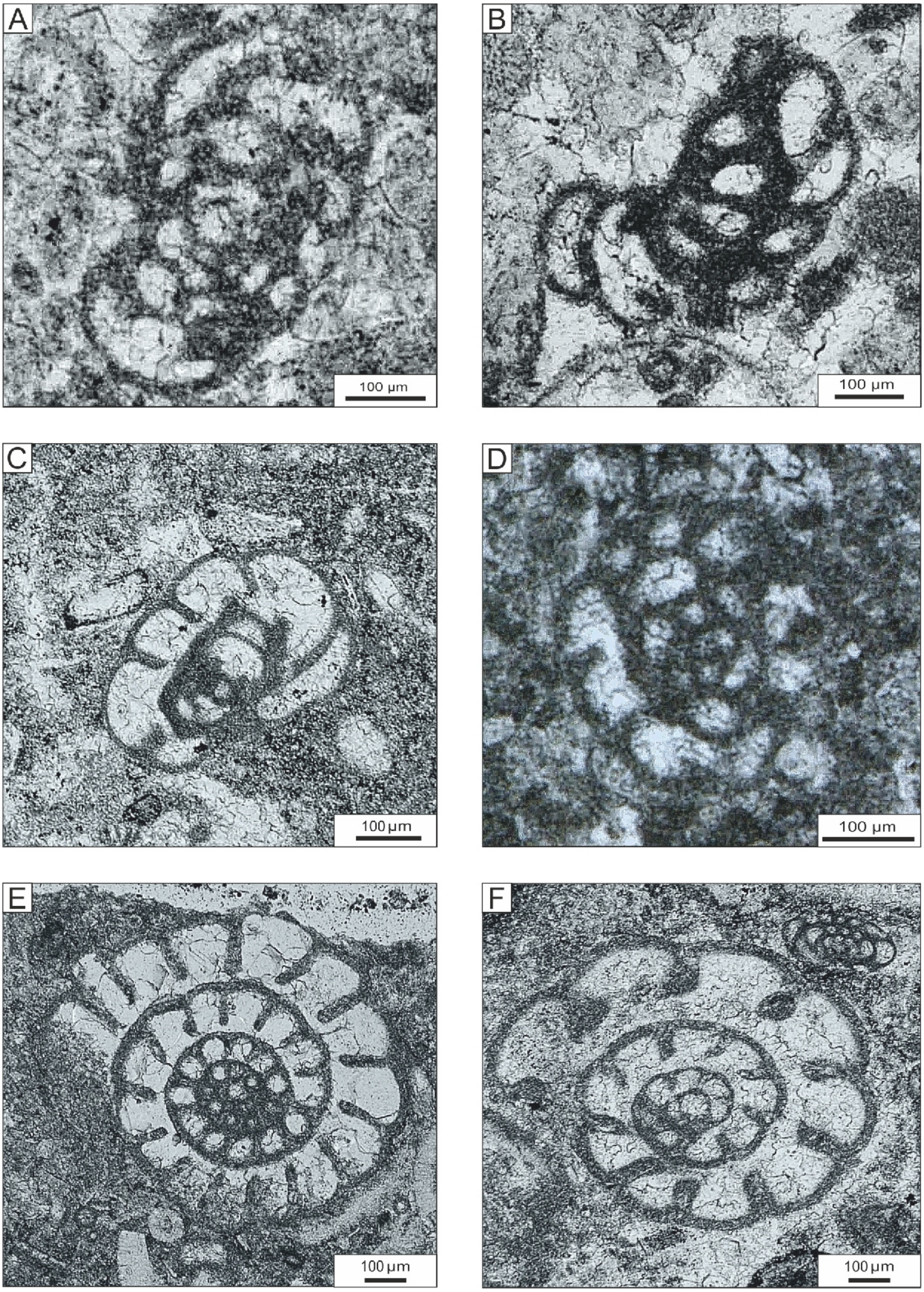

Fig. 9. Foraminifers from the Racławka, Szklary and Czernka sections

A – *Eoendothyra communaeformis* Grozdilova, 1973, sample R 1.36; **B** – *Eoendothyra* sp., sample R 1.24; **C** – *Omphalotis* cf. *omphalota* (Rauzer and Reitlinger in Rauzer-Chernousova and Fursenko, 1937), sample S 1.9; **D** – *Spinoendothyra* sp., sample S 1.25; **E** – *Endothyranopsis crassus* (Brady, 1870), emend. Cummings 1955, sample C 2.9; **F** – *Endothyranopsis* cf. *crassus* subsp. *crassa* (Brady, 1876), sample C 1.4

1973. *Eoendothyra communaeformis* nov. sp. – Grozdilova, p. 80–81, p. 3, figs. 4–5.
2013. *Quasiendothyra communaeformis* Grozdilova – Kulagina, p. 272, pl. 6, figs. AB, AC.

M a t e r i a l. – Two specimens, well-preserved.

D e s c r i p t i o n. – Test calcareous, with a spherical proloculus. Initial volutions are unevenly streptospirally coiled, and planispirally in the last two whorls. Each subsequent whorl covers the earlier, clearly larger chambers. There are up to 8 chambers in the last whorl. The number of whorls varies from 3 to 4. Wall dark, microgranular. No septa and chomata were observed.

R e m a r k s. – Well-preserved, oblique section. The species is Famennian in age, but is occasionally noted from the lowermost Tournaisian (e.g., Kulagina, 2013).

D i s t r i b u t i o n. – upper Famennian; Upper Silesian Block (Racławka Formation), Poland; Russia (Grozdilova, 1973; Kulagina, 2013).

Eoendothyra sp.
(Fig. 9B)

M a t e r i a l. – Ten specimens.

D e s c r i p t i o n. – Test calcareous, initially irregular streptospiral coiling. The test is tightly coiled. Whorls packed, numerous and chambers are wide, rounded. At least 3 to 4 whorls, last whorl with 10–13 slightly convex chambers. Wall dark, granular.

R e m a r k s. – Poorly preserved, oblique sections.

D i s t r i b u t i o n. – Upper Famennian; Upper Silesian Block (Racławka Formation), Poland.

Suborder **ENDOTHYRINA** Brady, 1884 [nom. translat. Bogush, 1985]
Superfamily **ENDOTHYROIDEA** Brady, 1884 [nom. translat. Glaessner, 1945]
Family **ENDOTHYRIDAE** Brady, 1884 [nom. translat. Rhumbler, 1895]
Subfamily **OMPHALOTINAE** Vdovenko in Rauzer-Chernousova et al., 1996
Genus *Omphalotis* Schlykova, 1969
Type species: *Endothyra omphalota* Rauzer-Chernousova and Reitlinger in Rauzer-Chernousova and Fursenko (1937)
Omphalotis cf. *omphalota* (Rauzer and Reitlinger in Rauzer-Chernousova and Fursenko, 1937)
(Fig. 9C)

1937. *Endothyra omphalota* nov. sp. – Rauzer and Reitlinger in Rauzer-Chernousova and Fursenko, p. 265–266.
1940. *Endothyra omphalota* Rauzer and Reitlinger – Rauzer-Chernousova, p. 42–43, pl. 7, figs. 7–9; pl. 9, figs. 7–8.
1959. *Endothyra omphalota* Rauzer and Reitlinger – Durkina, p. 177, pl. 17, figs. 1, 2; pl. 18, figs. 1, 2.
1969. *Omphalotis omphalota* (Rauzer and Reitlinger) –Schlykova, p. 44, 45, pl. 5, figs. 1, 2.
1973. *Omphalotis omphalota* (Rauzer and Reitlinger) – Brazhnikova and Vdovenko, p. 194, pl. 24, figs. 1, 2.

M a t e r i a l. – Represented in the material studied by one specimen.

D e s c r i p t i o n. – Test calcareous, coiled streptospirally with the last 2 whorls planispiral. Septa facing the aperture. Visible chomata. Chambers gradually increase in the size in the last whorl, with 6-8 chambers. 2-3 coils. Wall fine-grained. Aperture a broad, low basal opening.

R e m a r k s. – Tangential section.

D i s t r i b u t i o n. – Middle–upper Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member into Czernka Formation), Poland; Russia (Durkina, 1959; Schlykova, 1969; Brazhnikova and Vdovenko, 1973).

Subfamily **SPINOENDOTHYRINAE** Cózar and Vachard, 2001
Genus ***Spinoendothyra*** Lipina, 1963
Type species: *Endothyra costifera* Lipina, 1955
Spinoendothyra sp.
(Fig. 9D)

M a t e r i a l. – Rare in the material studied (two specimens) but in good condition.

D e s c r i p t i o n. – Test calcareous, tightly coiled, initially skewed, streptospiral, then planispiral in last 2 volutions, with numerous small chambers, 9 to 10 chambers in the final whorl. Septa long and straight, chomata present. Wall dark, microgranular.

R e m a r k s. – Oblique section, chambers endothyroid in shape (relatively less numerous and more inflated).

D i s t r i b u t i o n. – Middle Tournaisian; Upper Silesian Block (Szklary Formation), Poland.

Superfamily **BRADYINOIDEA** Reitlinger, 1950 [nom. translat. Rauzer-Chernousova, Bensh, Vdovenko, Gibshman, Leven, Lipina, Reitlinger, Solovieva and Chediya, 1996]
Family **ENDOTHYRANOPSIDAE** Reitlinger, 1958 [nom. translat. Rauzer-Chernousova, Bensh, Vdovenko, Gibshman, Leven, Lipina, Reitlinger, Solovieva and Chediya, 1996]
Subfamily **ENDOTHYRANOPSINAE** Reitlinger, 1958; emend. Reitlinger, 1981
Genus ***Endothyranopsis*** Cummings, 1955
Type species: *Involutina crassa* Brady in Moore (1870)
Endothyranopsis crassus (Brady, 1870); emend. Cummings 1955
(Fig. 9E)

1870. *Involutina crassa* nov. sp. – Brady in Moore, p. 97; pl. 5, figs. 15–17.
1948b. *Endothyra crassa* Brady – Rauzer-Chernousova, p. 167; pl. 4, fig. 2.
1956. *Endothyra crassa* Brady – Brazhnikova et al., pl. 6, figs. 4, 5.
1959. *Endothyra crassa* Brady – Durkina, p. 183–184; pl. 11, figs. 4–6; pl. 12, figs. 1–3.
1962. *Endothyranopsis crassus* (Brady) – Bogush and Yuferev, p, 152–153, pl. 5, fig. 6.
1967. *Endothyranopsis crassus* (Brady) – Woszczyńska, p. 82; pl. 1, fig. 11.
1968. *Endothyranopsis crassus* (Brady) – Aizenverg et al., pl. 11, figs. 1, 2.
1972. *Endothyranopsis crassus* (Brady) – Soboń-Podgórska, p. 221, pl. 2, figs. 6, 7; pl. 3, figs. 1–4.

M a t e r i a l. – Three specimens, very well-preserved.

D e s c r i p t i o n. – Test calcareous, spherical, planispiral, involute, multichambered. Round proloculus. The chambers increase in size as added, and the number of chambers in the last whorl reaches more than 12. 3 to 4 whorls . Frequent long and straight septa extending from the wall at right angles and reaching up to $^{2}/_{3}$ of the whorl. The last chambers are broadly rounded. Wall dark, microgranular.

R e m a r k s. – Well-preserved, axial section, a good Carboniferous biostratigraphical marker.

D i s t r i b u t i o n. – Late Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member of the Czernka Formation), Poland (Woszczyńska, 1967; Soboń-Podgórska, 1972); Russia (Rauzer-Chernousova, 1948b; Brazhnikova et al., 1956; Durkina, 1959; Bogush and Yuferev, 1962; Aizenverg et al., 1968).

Endothyranopsis cf. *crassus* subsp. *crassa* (Brady, 1876)
(Fig. 9F)

1876. *Endothyra crassa* nov. sp. – Brady, p. 97; pl. 5, figs. 15–17.
1964. *Endothyranopsis* cf. *crassus* subsp. *crassa* (Brady) – Conil and Lys, p.150; pl. 21, fig. 432; pl. 22, fig. 435.
1967. *Endothyranopsis* cf. *crassus* subsp. *crassa* (Brady) – Brazhnikova et al., pl. 12, fig. 1.
1972. *Endothyranopsis* cf. *crassus* subsp. *crassa* (Brady) – Soboń-Podgórska, p. 222, pl. 3, fig. 5; pl. 4, figs. 1, 2.

M a t e r i a l. – Four specimens, well-preserved.

D e s c r i p t i o n. – Test calcareous, planispiral, involute. Rounded chambers, septa straight, thick and massive, inclined at an angle towards the aperture. $2^{1}/_{2}$ to 3 whorls. The last chambers are broadly rounded. Wall dark, microgranular. Aperture low, basal.

R e m a r k s. – The test is more indented at the sides compared to *Endothyranopsis crassus.* Septa are thick and massive, slightly directed towards the aperture.

D i s t r i b u t i o n. – Late Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member of the Czernka Formation), Poland (Soboń-Podgórska, 1972, 1988), France (Conil and Lys, 1964); Russia (Brazhnikova et al., 1967).

Endothyranopsis sp.
(Fig. 10A)

M a t e r i a l. – Eight specimens, poorly preserved.

D e s c r i p t i o n. – Test calcareous, involute, spherical, planispiral, flattened at the sides. The proloculus is rounded and the following chambers are slightly convex. 8 to 9 chambers in the last whorl. 2 to 3 whorls. Distinct thick and straight septa directed towards the base of the chamber at right angles. Wall dark, microgranular. Aperture is basal.

R e m a r k s. – Poorly visible aperture, rather wide, basal. Oblique sections.

D i s t r i b u t i o n. – Late Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member of the Czernka Formation), Carpathian Foredeep, Carpathian Mountains, Holy Cross Mountains, Lublin Carboniferous Basin, West Pomerania, Poland.

Genus *Latiendothyranopsis* Lipina, 1977; emend. Reitlinger, 1981
Type species: *Endothyra latispiralis* var. *grandis* Lipina, 1955
Latiendothyranopsis sp.
(Fig. 10B)

M a t e r i a l. – Two specimens, poorly preserved.

D e s c r i p t i o n. – Test calcareous, oval. Initially with streptospiral volutions, then planispiral. 3 to 4 whorls. Septa slope towards the aperture. Wall microgranular. Aperture basal.

R e m a r k s. – Oblique section, larger than *Granuliferella* sp. with more chambers per whorl.

D i s t r i b u t i o n. – Middle Visean; Upper Silesian Block (Łom Gminny Member of the Czernka Formation), Poland.

Family **EOENDOTHYRANOPSIDAE** Reitlinger in Rauzer-Chernousova et al., 1996
Genus ***Eoendothyranopsis*** Reitlinger and Rostovtseva in Reitlinger, 1966
Type species: *Parastaffella pressa* Grozdilova in Grozdilova and Lebedeva, 1954
Eoendothyranopsis sp.
(Fig. 10C)

M a t e r i a l. – Six specimens.

D e s c r i p t i o n. – Test calcareous, oval, planispiral, involute, with septa and chomata at the base of the chambers. The largest chambers in the last whorl. Microgranular wall. Aperture basal.

R e m a r k s. – Oblique sections.

D i s t r i b u t i o n. – Middle–late Visean; Upper Silesian Block (Łom Gminny Member of the Czernka Formation and Szklary Formation), Poland.

Family **JANISCHEWSKINIDAE** Reitlinger in Rauzer-Chernousova et al., 1996
Genus ***Cribrospira*** von Möller, 1878; emend. Rauzer-Chernousova, 1948a
Type species: *Cribrospira panderi* von Möller, 1878
Cribrospira mikhailovi Rauzer-Chernousova, 1948a
(Fig. 10D)

1948a. *Cribrospira mikhailovi* sp. – Rauzer-Chernousova, p. 187–188; pl. 7, figs. 2–4.
1956. *Cribrospira* aff. *mikhailovi* Rauzer-Chernousova – Brazhnikova et al., p. 46, 47, pl. 13, figs. 1, 2.
1972. *Cribrospira mikhailovi* Rauzer-Chernousova – Soboń-Podgórska, p. 221, pl. 1, fig. 7.

M a t e r i a l. – Rare in the material studied, one specimen.

D e s c r i p t i o n. – Test calcareous, almost spherical, entirely planispirally coiled. Septa clearly visible but short. Proloculus round. The height of the chambers increases rapidly as the test grows. 5 to 6 chambers in the last whorl. In the last whorl, the septa are clearly visible. Wall dark, microgranular, undifferentiated.

R e m a r k s. – Typically for the genus *Cribrospira*, last whorl generally rapidly enlarged. Wall microgranular, simple, similar to *Janischewskina*.

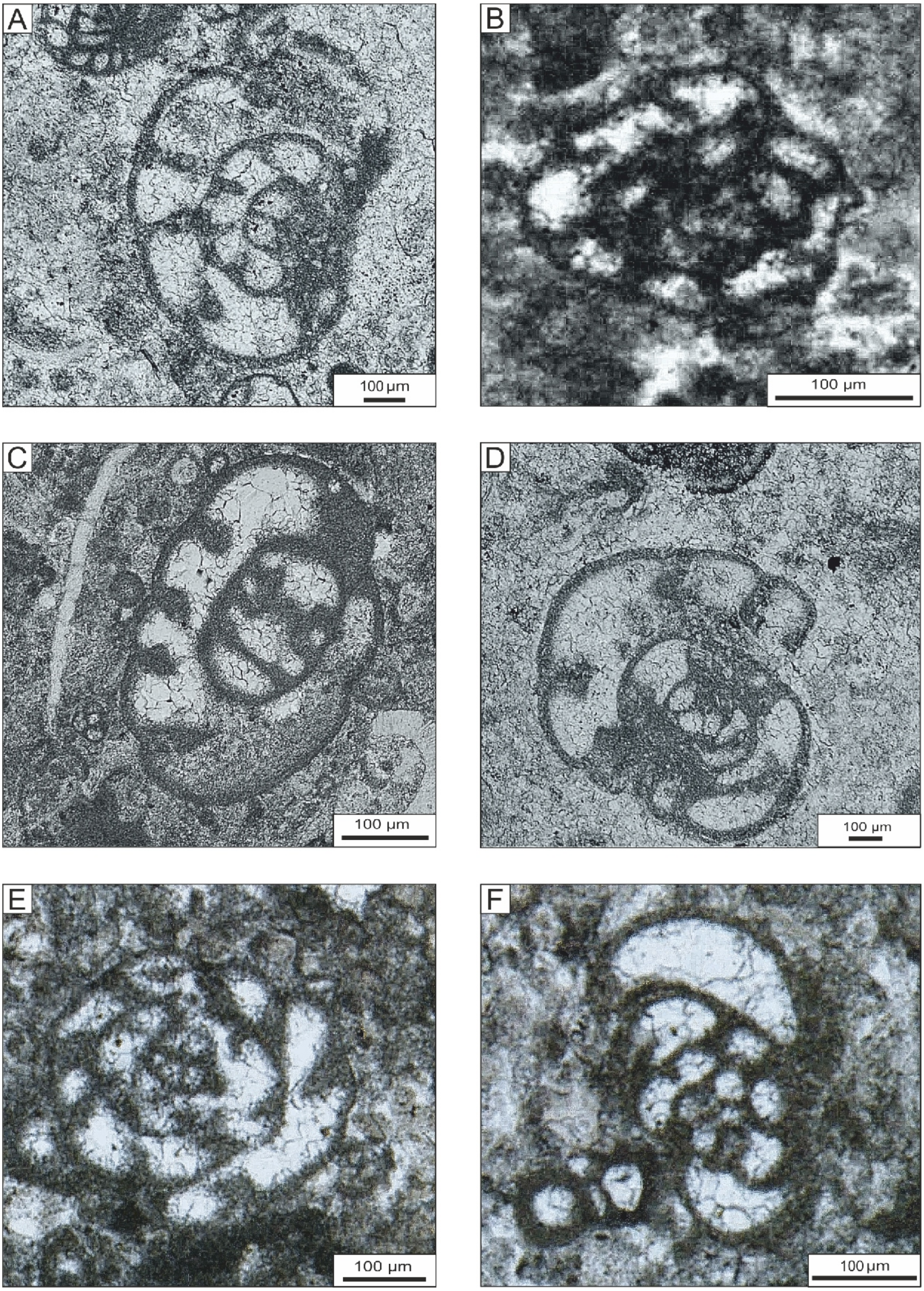

Fig. 10. Foraminifers from the Szklary and Czernka sections

A – *Endothyranopsis* sp., sample C 2.17; **B** – *Latiendothyranopsis* sp., sample C 1.25; **C** – *Eoendothyranopsis* sp., sample C 2.9; **D** – *Cribrospira mikhailovi* Rauzer-Chernousova, 1948a, sample C 1.4; **E** – *Bessiella* sp., sample S 1.25; **F** – *Dainella* cf. *elegantula* Brazhnikova, 1962, sample S 1.9

D i s t r i b u t i o n. – Late Visean; Upper Silesian Block (Czerwona Ścianka Formation), Lublin Carboniferous Basin (Soboń-Podgórska, 1972), Poland; Russia (Rauzer-Chernousova, 1948a; Brazhnikova et al., 1956).

Superfamily **LOEBLICHIOIDEA** Cummings, 1955 [nom. transl. Hance, Hou and Vachard, 2011]
Family **DAINELLIDAE** Cózar and Vachard, 2001 [nom. transl. Hance, Hou and Vachard, 2011]
Genus ***Bessiella*** Conil and Hance in Groessens et al., 1982
Type species: *Bessiella legrandi* Conil and Hance in Groessens et al., 1982
Bessiella sp.
(Fig. 10E)

M a t e r i a l. – Three specimens.

D e s c r i p t i o n. – Test calcareous, initially streptospiral, then planispiral. Septa towards the aperture, straight and short, massive chomata, chambers rounded, wall microgranular.

R e m a r k s. – Similar to *Dainella* but with supplementary deposit in archs. The genera *Bessiella* and *Dainella* are homeomorphs (Hance et al., 2011).

D i s t r i b u t i o n. – Early–middle Visean; Upper Silesian Block (Łom Gminny Member of the Czernka Formation).

Genus *Dainella* Brazhnikova, 1962
Type species: *Endothyra? chomatica* Dain in Brazhnikova, 1962
Dainella cf. *elegantula* Brazhnikova, 1962
(Fig. 10F)

1962. *Dainella elegantula* nov. sp. – Brazhnikova, p. 25–28, pl. 11, figs. 10–12; pl. 12, figs. 1–10; pl. 11, fig. 12.

M a t e r i a l. – Eight specimens.

D e s c r i p t i o n. – Test calcareous, streptospiral, involute. 3 to 4 whorls. Numerous chambers in the whorls, individual chambers high and inflated. A fine-grained wall, with visible chomata.

R e m a r k s. – Difficulties in distinguishing *Lysella*, *Dainella* and *Bessiella* are caused by the difference in the structure of the wall. *Dainella elegantula* is a possible transition between *Lysella* and *Paralysella*. Additionally, in these specimens, difficulties are caused by various oblique sections.

D i s t r i b u t i o n. – Middle Tournaisian; Upper Silesian Block (Szklary Formation), Central Sudetes, Carpathian Foredeep, Carpathian Mountains, Poland; Russia (Brazhnikova, 1962).

Dainella cf. *chomatica* (Dain in Brazhnikova, 1962)
(Fig. 11A)

1962. *Dainella chomatica* (Dain) – Brazhnikova, p. 23–24, pl. 10, fig. 9; pl. 11, figs. 1–4.
1973. *Dainella chomatica* (Dain) – Brazhnikova and Vdovenko, p. 162–163, pl. 13, figs. 2–5.
2001. *Dainella chomatica* (Dain) – Pajchlowa and Wagner, p. 50, pl. 3, fig. 3.

M a t e r i a l. – Four specimens, very well-preserved in thin section.

D e s c r i p t i o n. – Test calcareous, streptospiral, involute, composed of 3 to 4 whorls. Coils very close to each other, numerous chambers in a single whorl, each successive chamber is larger than the previous one. 12 to 13 chambers in the last whorl. Septa are straight and thick at the ends. A single-layered wall, massive chomata facing the aperture, wall dark.

R e m a r k s. – True *Dainella* comprises two groups: *D. chomatica* and *D. elegantula*. *Dainella* are similar in shape to *Pseudostaffella* or *Semistaffella*, the other dainellid forms belong generally to *Bessiella* (Hance et al., 2011).

D i s t r i b u t i o n. – Middle Tournaisian; Upper Silesian Block (Szklary Formation), Central Sudetes, Carpathian Foredeep, Carpathian Mountains, Poland (Głuszek and Tomaś, 1992; Pajchlowa and Wagner, 2001); Russia (Brazhnikova 1962; Brazhnikova and Vdovenko, 1973).

Family **LOEBLICHIIDAE** Cummings, 1955
Subfamily **LOEBLICHIINAE** Cummings, 1955
Genus ***Loeblichia*** Cummings, 1955
Type species: *Endothyra ammonoides* Brady, 1873
Loeblichia ammonoides subsp. *paraammonoides* (Brazhnikova in Brazhnikova et al., 1956)
(Fig. 11B)

1956. *Nanicella ammonoides* subsp. *paraammonoides* nov. sp. – Brazhnikova et al., p. 36–38, pl. 1, figs. 18–20.
1962. *Loeblichia ammonoides paraammonoides* (Brazhnikova) – Liszka, p. 34–35, pl. 1, fig. 3.

M a t e r i a l. – Three specimens.

D e s c r i p t i o n. – Test calcareous, flattened, discoidal, evolute, planispiral in the entire test. Round proloculus and 4 – 5 whorls. 16-20 chambers in the last whorl. The whorls increase uniformly in height and thickness. Wall dark, microgranular. The aperture is terminal.

R e m a r k s. – *Loeblichia ammonoides* subsp. *paraammonoides* has 23–26 chambers in the last whorl.

D i s t r i b u t i o n. – Late Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member of the Czernka Formation), Poland (Liszka, 1962); Russia (Brazhnikova et al., 1956).

Family **EOPARASTAFFELLIDAE** Vachard and Arefifard, 2015 [nom. translat. Vachard and Le Coze, 2021]
Genus ***Eoparastaffella*** Vdovenko, 1954; emend. Devuyst, 2006
Type species: *Parastaffella (Eoparastaffella) simplex* Vdovenko, 1954
Eoparastaffella simplex Vdovenko, 1954
(Fig. 11C)

1954. *Eoparastaffella simplex* nov. sp. – Vdovenko, p. 64–66, pl. 1, figs. 1, 2.
1964. *Eoparastaffella simplex* Vdovenko – Vdovenko, p. 26–27, pl. 2, figs. 1–5, 7–10.
1971. *Eoparastaffella simplex* Vdovenko – Vdovenko, p. 11, pl. 2, figs. 1–8; 14–17.
1973. *Eoparastaffella simplex* Vdovenko – Brazhnikova and Vdovenko, p. 211–212, pl. 33, figs. 1–12.

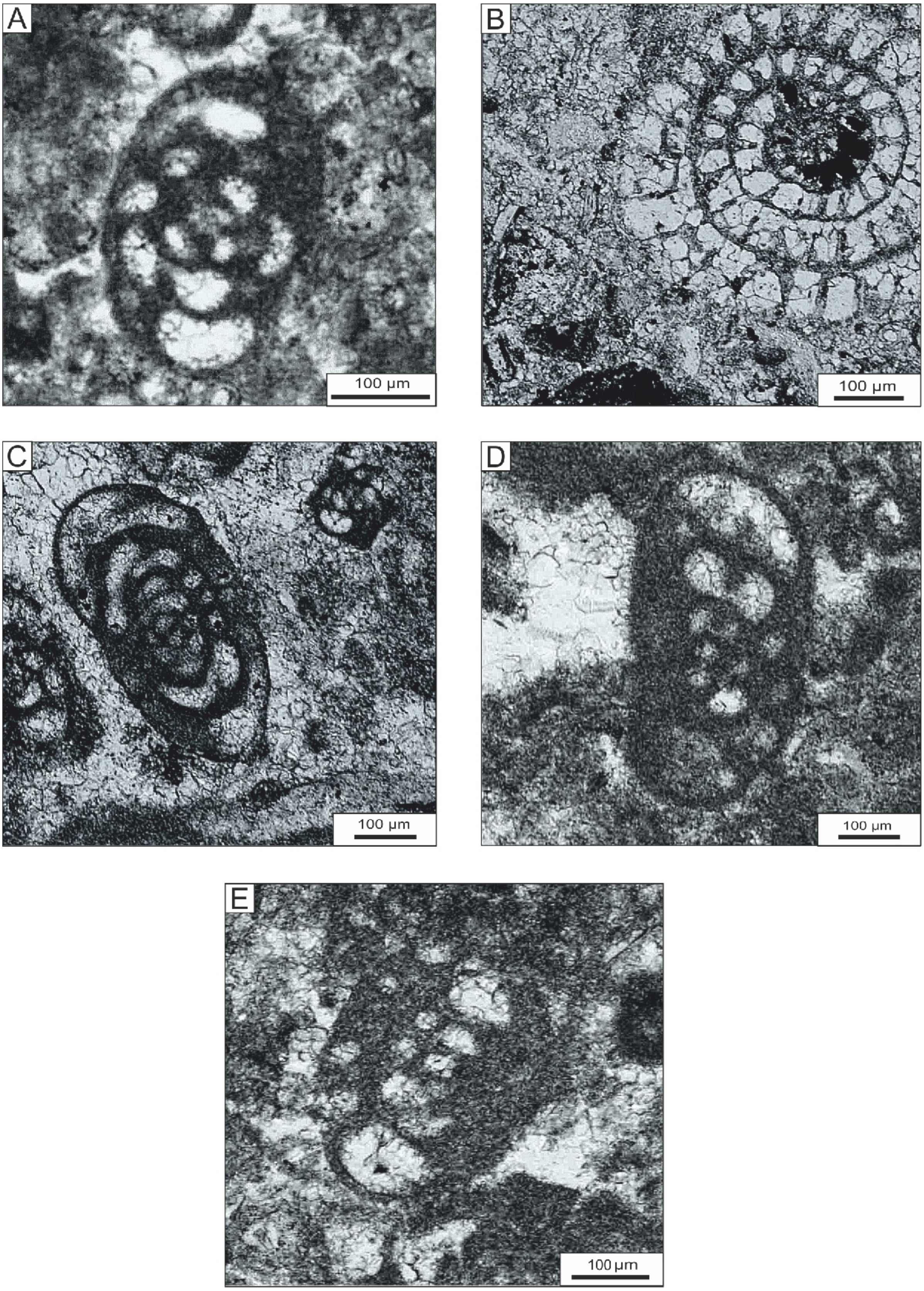

Fig. 11. Foraminifers from the Szklary and Czernka sections

A – *Dainella* cf. *chomatica* (Dain in Brazhnikova 1962), sample S 1.9; **B** – *Loeblichia ammonoides* subsp. *paraammonoides* (Brazhnikova in Brazhnikova et al., 1956), sample C 1.3; **C** – *Eoparastaffella simplex* Vdovenko, 1954, sample C 1.4; **D** – *Eoparastaffella ovalis* Vdovenko, 1954, sample C 2.17; **E** – *Eoparastaffella* sp., sample C 2.11

1992. *Eoparastaffella simplex* Vdovenko – Głuszek and Tomaś, pl. 8, fig. 8.
2001. *Eoparastaffella simplex* Vdovenko – Pajchlowa and Wagner, p. 76, pl. 3, fig. 5.
2015. *Eoparastaffella* ex gr *simplex* Vdovenko – Vachard and Arefifard, p. 207, fig. 8.21.

M a t e r i a l. – Twelve specimens, well-preserved.

D e s c r i p t i o n. – Test calcareous, lenticular, involute, biconvex, with a pointed margin in the last whorl, chambers broadly rounded. 2 to 3 whorls. The last volution comprises 13 to 14 chambers. Well-developed pseudochomata. Wall microgranular. Aperture singular.

R e m a r k s. – The specimens studied are larger than *Eoparastaffella ovalis*. Basal deposits as variably developed pseudochomata.

D i s t r i b u t i o n. – Early Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member of the Czernka Formation), Central Sudetes, Carpathian Foredeep, Poland (Głuszek and Tomaś, 1992); Germany, Ukraine (Pajchlowa and Wagner, 2001), Russia (Vdovenko, 1954, 1964, 1971; Brazhnikova and Vdovenko, 1973), Central Iran (Vachard and Arefifard, 2015).

Eoparastaffella ovalis Vdovenko, 1954
(Fig. 11D)

1954. *Eoparastaffella ovalis* nov. sp. – Vdovenko, p. 66, pl. 1, figs. 3–4.
2005. *Eoparastaffella ovalis* Vdovenko – Brenckle, p. 34, pl. 5, fig. 13.

M a t e r i a l. – Rare in the material studied (one specimen).

D e s c r i p t i o n. – Test calcareous, elongated, initially streptospirally coiled, then planispiral in the two consecutive whorls, involute coiling. Each subsequent whorl covers the previous one. The number of whorls is 3 to 4. Poorly developed septa. Wall single-layered, microgranular, no visible aperture.

R e m a r k s. – The specimens studied are smaller than *Eoparastaffella simplex*.

D i s t r i b u t i o n. – Early Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member of the Czernka Formation), Central Sudetes, Carpathian Foredeep, Poland; Russia (Vdovenko, 1954, 1971; Brenckle, 2005).

Eoparastaffella sp.
(Fig. 11E)

M a t e r i a l. – Eleven specimens, poorly preserved in the material studied.

D e s c r i p t i o n. – Test calcareous, elongated, initially streptospirally coiled, then planispiral following volutions. No chomata. Wall single-layered, microgranular.

R e m a r k s. – Very oblique sections.

D i s t r i b u t i o n. – Early Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member of the Czernka Formation), Central Sudetes, Carpathian Foredeep, Poland.

Suborder **PALAEOTEXTULARIINA** Hohenegger and Piller, 1975; emend. Vachard, 2016
Superfamily **PALAEOTEXTULARIOIDEA** Galloway, 1933
Family **PALAEOTEXTULARIIDAE** Galloway, 1933
Genus ***Climacammina*** Brady, 1873
Type species: *Textularia antiqua* Brady in Young and Armstrong, 1871
Climacammina sp.
(Fig. 12A)

M a t e r i a l. – Four specimens.

D e s c r i p t i o n. – Test calcareous, biserial in the early stage, uniserial in the terminal stage. The chambers enlarge gradually, and some are slightly flattened. The wall is made of two layers. The internal layer is radial and the outer one is microgranular. The cribrate aperture is in the last chamber.

R e m a r k s. – There is a visible transition from a biserial to uniserial chamber arrangement.

D i s t r i b u t i o n. – Late Visean; Upper Silesian Block (Czerwona Ścianka Formation), Lublin Carboniferous Basin, Poland.

Genus *Cribrostomum* von Möller, 1879
Type species: *Cribrostomum textulariforme* von Möller, 1879
Cribrostomum sp.
(Fig. 12B)

M a t e r i a l. – Four specimens, well-preserved.

D e s c r i p t i o n. – Test calcareous, biserial, widens evenly, elongated and narrow, in the terminal stage cylindrical. Proloculus is round, successive chambers are convex. 7 to 8 chambers in each row. Hooked septa. Wall dark, fine-grained, two-layered. Cribrate aperture.

R e m a r k s. – Specimens (oblique sections) in thin sections show a slight curve of the chambers, more pronounced than in other species of the genus *Cribrostomum*. The two-layer wall is thinner than in the Palaeotextularidae. Some authors (e.g., Loeblich and Tappan, 1987) consider the genus *Cribrostomum* and the genus *Climacammina* as synonyms. The type of *Cribrostomum* may be a stage of development of *Climacammina* (e.g., Cushman, 1933) or these may be separate genera (Conil and Lys, 1964). In this study, the specimens are referred to *Cribrostomum* sp. 2 of Soboń-Podgórska (1972).

D i s t r i b u t i o n. – Late Visean; Upper Silesian Block (Łom Gminny Member of the Czernka Formation), Lublin Carboniferous Basin, Poland.

Genus *Palaeotextularia* Schubert, 1921
Type species: *Palaeotextularia schellwieni* Galloway and Ryniker, 1930
Palaeotextularia cf. *longiseptata* Lipina, 1948a
(Fig. 12C)

1948a. *Palaeotextularia longiseptata* nov. sp. – Lipina, p. 199, pl. 9, figs. 1–3, 7.
1956. *Palaeotextularia longiseptata* Lipina – Brazhnikova et al., pl. 8, fig. 6; pl. 9, fig. 3.
1968. *Palaeotextularia* aff. *longiseptata* Lipina – Aizenverg et al., pl. 23, figs. 1, 2.

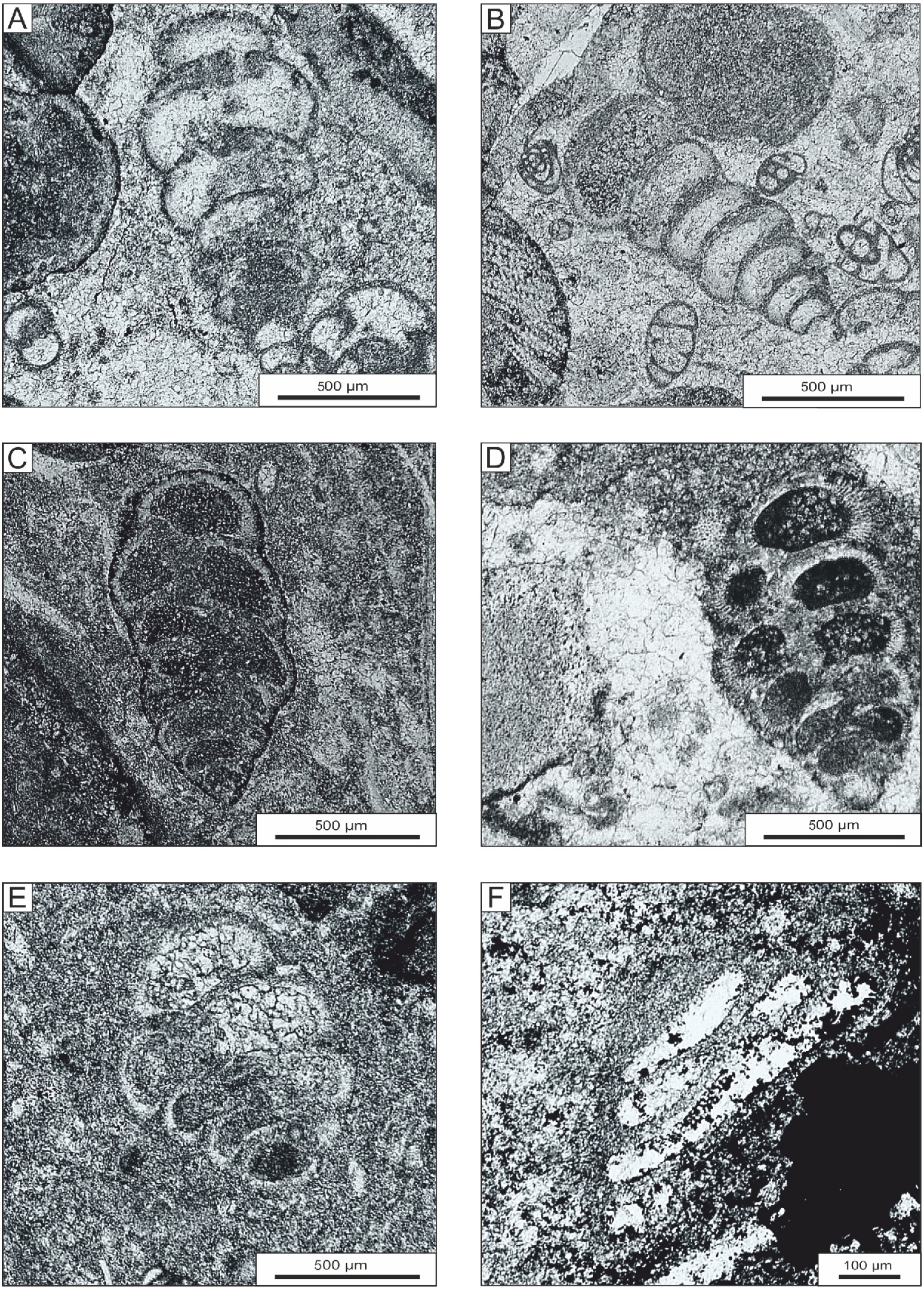

Fig. 12. Foraminifers from the Czernka section

A – *Climacammina* sp., sample C 1.4; **B** – *Cribrostomum* sp., sample C 1.4; **C** – *Palaeotextularia* cf. *longiseptata* Lipina, 1948a, sample C 1.6; **D** – *Palaeotextularia* cf. *longiseptata* subsp. *crassa* Lipina, 1948a, sample C 1.4; **E** – *Palaeotextularia* cf. *breviseptata* Lipina, 1948a, sample C 1.6; **F** – *Tetrataxis* sp., sample C 1.6

1972. *Palaeotextularia longiseptata* Lipina – Soboń-Podgórska, p. 214, pl. 4, figs. 6, 7; pl. 5, figs. 1, 2.

Material. – Six specimens, well-preserved.

Description. – Test calcareous, conical, biserial. Proloculus is rounded. 6 to 9 chambers in a row. The chambers gradually increase in size. Wall two-layered, dark, microgranular external layer and hyaline radial internal. Basal apertures.

Remarks. – *Palaeotextularia longiseptata* has a typically diagnostic bilayered wall with a dark microgranular or granular outer layer with calcareous agglutinate, and an inner pseudofibrous layer.

Distribution. – Late Visean; Upper Silesian Block (Czerwona Ścianka Formation), Lublin Carboniferous Basin, Poland (Soboń-Podgórska, 1972); Russia (Lipina, 1948a; Brazhnikova et al., 1956; Aizenverg et al., 1968).

Palaeotextularia cf. *longiseptata* subsp. *crassa* Lipina, 1948a
(Fig. 12D)

1948a. *Palaeotextularia longiseptata* subsp. *crassa* nov. sp. – Lipina, p. 199–200, pl. 9, figs. 1–3, 7, 9–11.
1956. *Palaeotextularia longiseptata* subsp. *crassa* Lipina – Brazhnikova et al., pl. 9, fig. 2.
1967. *Palaeotextularia longiseptata* subsp. *crassa* Lipina – Brazhnikova et al., pl. 13, fig. 4.
1968. *Palaeotextularia longiseptata* subsp. *crassa* Lipina – Aizenverg et al., pl. 14, fig. 1.
1972. *Palaeotextularia longiseptata* subsp. *crassa* Lipina – Soboń-Podgórska, p. 215, pl. 5, figs. 3–5.

Material. – Three specimens.

Description. – Test calcareous, conical and biserial, proloculus is rounded. 6 to 9 chambers in a row. The chambers gradually increase in size. The wall is thicker than in *Palaeotextularia longiseptata*. Wall is two-layered, the outer layer is granular and the inner one is hyaline radial. Aperture basal.

Remarks. – Oblique sections. *Palaeotextularia longiseptata* subsp. *crassa* differs from *Palaeotextularia longiseptata* by its thicker wall and thicker radial layer. The radial layer reaches $^2/_3$ of the wall thickness.

Distribution. – Late Visean; Upper Silesian Block (Czerwona Ścianka Formation), Lublin Carboniferous Basin, Poland (Soboń-Podgórska, 1972); Russia (Lipina, 1948a; Brazhnikova et al., 1956, 1967; Aizenverg et al., 1968).

Palaeotextularia cf. *breviseptata* Lipina, 1948a
(Fig. 12E)

1948a. *Palaeotextularia breviseptata* nov. sp. – Lipina, p. 201, pl. 9, fig. 14; pl. 10, fig. 1.
1972. *Palaeotextularia breviseptata* Lipina – Soboń-Podgórska, p. 215, pl. 6, fig. 1.

Material. – A rare form in the material studied, only two specimens.

Description. – Test calcareous, biserial, wedge-shaped. Proloculus rounded. Moderately convex chambers, 5–6 chambers in each row. Chambers slightly curved. Two-layered wall, internal layer is vitreous-radial and takes up $^1/_3$ to $^2/_3$ of the total wall thickness. Outer layer is dark, granular. Aperture basal.

Remarks. – Oblique sections. Forms have shorter septa compared to *Palaeotextularia longiseptata*.

Distribution. – Late Visean; Upper Silesian Block (Czerwona Ścianka Formation), Lublin Carboniferous Basin, Poland (Soboń-Podgórska, 1972); Russia (Lipina, 1948a).

Superfamily **TETRATAXOIDEA** Galloway, 1933 [nom. translat. Haynes, 1981]
Family **TETRATAXIDAE** Galloway, 1933 [nom. translat. Pokorný, 1958]
Genus *Tetrataxis* Ehrenberg, 1854
Type species: *Tetrataxis conica* Ehrenberg, 1854; emend. Nestler, 1973
Tetrataxis sp.
(Fig. 12F)

Material. – One specimen.

Description. – Test calcareous, conical, trochospiral. The vertex angle is close to a right angle. The chambers are wide, similar to triangles in cross-section. The whorls increase in size as the test grows. 4 whorls. The wall is microgranular.

Remarks. – Oblique section.

Distribution. – Late Visean; Upper Silesian Block (Czerwona Ścianka Formation), Poland.

Order **FUSULINIDA** Fursenko, 1958

Tests lenticular, mainly involute, planispiral with folded septa. Wall is three-layered, composed of a primary tectum and lower, less dense layer covered in the interior volutions by a secondary floor layer that merges into low pseudochomata/chomata. Apertures with basal openings.

Stratigraphic range is Visean–Permian and rare in late Tournaisian (Hance et al., 2011).

Suborder **FUSULININA** Wedekind, 1937 [nom. correct. Loeblich and Tappan, 1961]; emend. Vachard, 2016
Superfamily **OZAWAINELLOIDEA** Thompson and Foster, 1937 [nom. translat. Solovieva, 1978]
Family **OZAWAINELLIDAE** Thompson and Foster, 1937
Genus ***Ozawainella*** Thompson, 1935
Type species: *Fusulinella angulata* Colani, 1924
Ozawainella cf. *alchevskiensis* Potievskaya, 1958
(Fig. 13A)

1958. *Ozawainella alchevskiensis* nov. sp. – Potievskaya, p. 36–37, pl. 5, figs. 9-10.
1969. *Ozawainella alchevskiensis* Potievskaya – Manukalova - Grebenyuk, p. 56–57, pl. 16, figs. 14–15.
1988. *Ozawainella alchevskiensis* Potievskaya – Soboń-Podgórska, pl. 17, fig. 1.
1988. *Ozawainella alchevskiensis* Potievskaya – Skompski et al., p. 468, pl. 6, fig. 3.
2001. *Ozawainella alchevskiensis* Potievskaya – Pajchlowa and Wagner, p. 73, pl. 13, fig. 7.

Material. – One specimen.

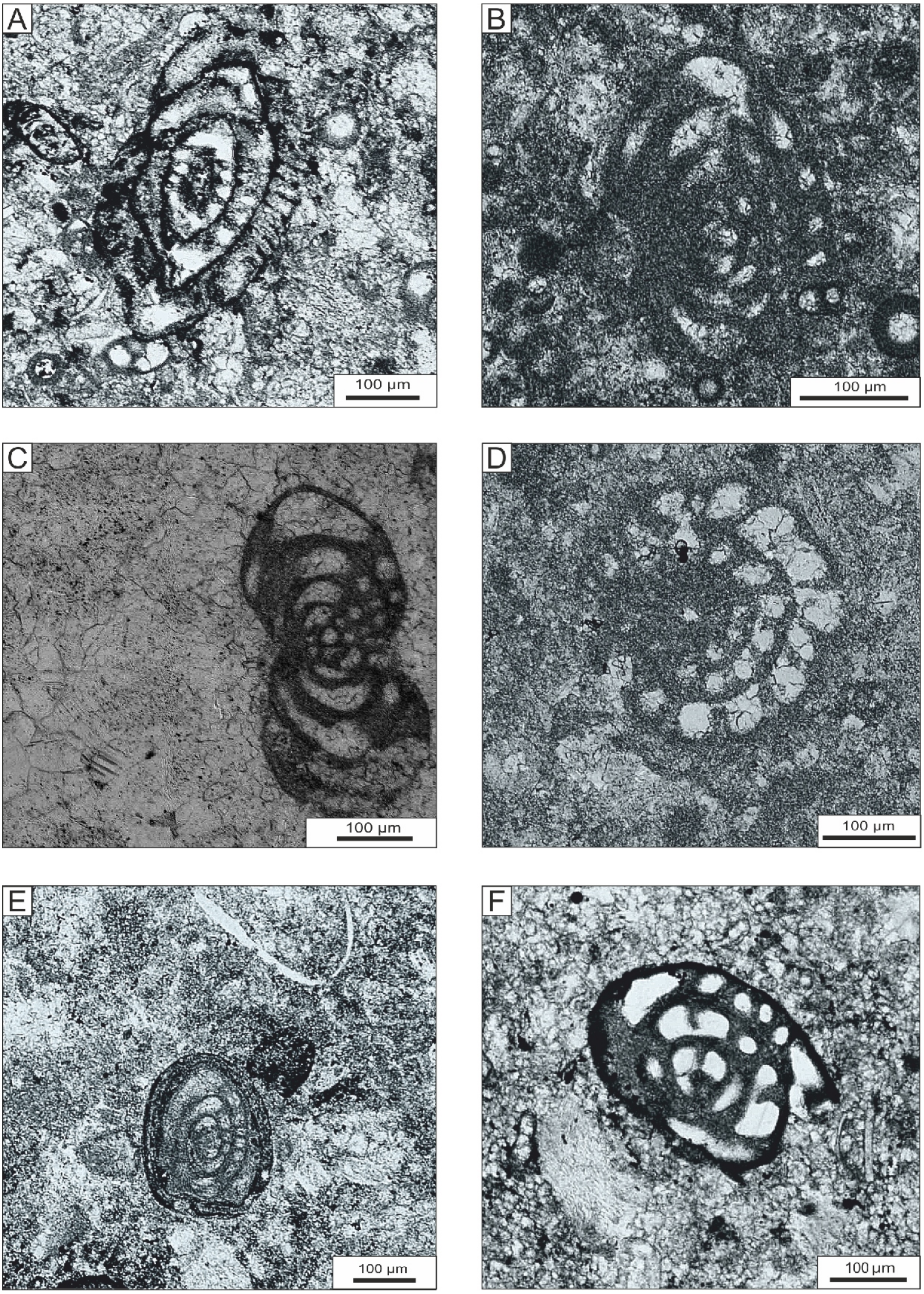

Fig. 13. Foraminifers from the Czernka section

A – *Ozawainella* cf. *alchevskiensis* Potievskaya, 1958, sample C 1.3; **B** – Eostaffella parastruvei Rauzer-Chernousova, 1948b, sample C 2.4; **C** – *Eostaffella mosquensis* Vissarionova, 1948, sample C 1.4; **D** – *Eostaffella singularia* Vissarionova, 1948, sample C 2.12; **E** – *Eostaffella* cf. *nalivkini* Malakhova, 1957, sample C 2.1; **F** – *Eostaffella* sp., sample C 1.3

D e s c r i p t i o n. – Test calcareous, symmetrical, planispiral, involute, lenticular with angular margins. 3 whorls. The last volution is higher than the previous one. Wall dark, microgranular.

R e m a r k s. – Unlike the other Fusulinida (Staffelloidea, Schubertelloidea, Fusulinoidea) this form is characterized by its simple dark wall.

D i s t r i b u t i o n. – Late Visean–Serpukhovian (?); Upper Silesian Block (Czerwona Ścianka Formation), Poland (Soboń-Podgórska, 1988; Skompski, 1988; Pajchlowa and Wagner, 2001); Russia (Potievskaya, 1958; Manukalova-Grebenyuk, 1969).

Family **EOSTAFFELLIDAE** Mamet in Mamet et al. (1970); emend. Hance, Hou and Vachard, 2011

Genus ***Eostaffella*** Rauzer-Chernousova, 1948b

Type species: *Staffella (Eostaffella) parastruvei* Rauzer-Chernousova, 1948b

Eostaffella parastruvei Rauzer-Chernousova, 1948b

(Fig. 13B)

1948b. *Staffella (Eostaffella) parastruvei* nov. sp. – Rauzer-Chernousova, p. 15, pl. 3, figs. 16–18.
1962. *Eostaffella parastruvei* Rauzer-Chernousova – Bogush and Yuferev, p. 168–169, pl. 6, fig. 20.
1964. *Eostaffella parastruvei* Rauzer-Chernousova – Conil and Lys, p. 236, pl. 40, figs. 827–836.
1988. *Eostaffella* cf. *parastruvei* Rauzer-Chernousova – Soboń-Podgórska, pl. 17, fig. 4.
2001. *Eostaffella parastruvei* Rauzer-Chernousova – Pajchlowa and Wagner, p. 74, pl. 4, fig. 9.
2005. *Eostaffella parastruvei* Rauzer-Chernousova – Brenckle, p. 39, pl. 7, figs. 1–2.

M a t e r i a l. – Six specimens- well-preserved.

D e s c r i p t i o n. – Test calcareous, lenticular, planispiral, involute, comprising 4 to 5 whorls. Thick septa inclined at an angle. The initial volutions are short, and the last volution is higher and wider. Final volution appears to be evolute. Wall dark, microgranular.

D i s t r i b u t i o n. – Middle–late Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member of the Czernka Formation), Sudetes, Carpathian Foredeep, Carpathian Mountains, Holy Cross Mountains, Poland (Soboń-Podgórska, 1988; Pajchlowa and Wagner, 2001); Russia (Rauzer-Chernousova, 1948b; Bogush and Yuferev, 1962; Brenckle, 2005); France, Belgium (Conil and Lys, 1964).

Eostaffella mosquensis Vissarionova, 1948

(Fig. 13C)

1948. *Eostaffella mosquensis* nov. sp. – Vissarionova, p. 222, pl. 14, figs. 4–6.
1956. *Eostaffella mosquensis* Vissarionova – Brazhnikova et al., pl. 15, figs. 9–11.
1959. *Eostaffella mosquensis* Vissarionova – Durkina, p. 196, pl. 20, fig. 10.
1962. *Eostaffella mosquensis* Vissarionova – Bogush and Yuferev, p. 172, pl. 6, fig. 26.
1963. *Eostaffella mosquensis* Vissarionova – Rozovskaya, p. 93–94, pl. 16, figs. 16, 17; pl. 17, figs. 1–5.
1964. *Eostaffella mosquensis* Vissarionova var. 1 – Conil and Lys, p. 235, pl. 40, fig. 822.
1968. *Eostaffella mosquensis* Vissarionova – Aizenverg et al., pl. 19, figs. 10, 11.
1969. *Eostaffella mosquensis* Vissarionova – Manukalova-Grebenyuk, p. 25, pl. 9, figs. 9–12.
1972. *Eostaffella* aff. *mosquensis* Vissarionova – Soboń-Podgórska, p. 226, pl. 9, figs. 9, 10.

M a t e r i a l. – Six specimens.

D e s c r i p t i o n. – Test calcareous, elongated, lenticular, flattened and incised on the sides, involute and planispiral. Septa are thick, curved, and commonly with beveled edges. Visible bulges on the wall of the chamber do not turn into chomata. Septa straight. Wall dark, microgranular and undifferentiated.

R e m a r k s. – Oblique section, specimens are similar to *Eoparastaffella*. *E. mosquensis* Vissarionova, 1948 is larger than *E. nalivkini* Malakhova, 1957. *E. nalivkini* constitutes the transition between *Eoparastaffella* and *Eostaffella* (Hance et al., 2011).

D i s t r i b u t i o n. – Middle–late Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member of the Czernka Formation), Poland (Soboń-Podgórska, 1972); Russia (Vissarionova, 1948b; Brazhnikova et al., 1956; Durkina, 1959; Bogush and Yuferev, 1962; Rozovskaya, 1963; Aizenverg et al., 1968; Manukalova-Grebenyuk, 1969); France, Belgium (Conil and Lys, 1964).

Eostaffella singularia Vissarionova, 1948

(Fig. 13D)

1948. *Eostaffella singularia* nov. sp. – Vissarionova, p. 221–222, pl. 14, figs. 2, 3.
1972. *Eostaffella* aff. *singularia* Vissarionova – Soboń-Podgórska, p. 226, pl. 9, figs. 1–8.

M a t e r i a l. – Four specimens.

D e s c r i p t i o n. – Test calcareous, lenticular, disc-shaped, planispiral coiling. Proloculus is round. 3 to $3^1/_2$ whorls. The last whorl has 10 to 16 chambers. Wall microgranular.

R e m a r k s. – Tangential, oblique section. *E. singularia* Vissarionova, 1948 similarly to *E. mosquensis* is bigger than *E. nalivkini* Malakhova, 1957 and constitutes the transition between *Eoparastaffella* and *Eostaffella.*

D i s t r i b u t i o n. – Middle–late Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member of the Czernka Formation), Poland (Soboń-Podgórska, 1972); Russia – Middle Urals (Vissarionova, 1948).

Eostaffella cf. *nalivkini* Malakhova, 1957

(Fig. 13E)

1957. *Eostaffella nalivkini* nov. sp. – Malakhova, p. 7–8, pl. 2, figs. 8–12.
1960. *Eostaffella nalivkini* Malakhova – Grozdilova and Lebedeva, p. 112–113, pl. 13, figs. 6, 7.
2015. *Eostaffella* ex gr *nalivkini* Malakhova – Vachard and Arefifard, p. 208, fig. 11.8.

M a t e r i a l. – Three specimens.

D e s c r i p t i o n. – Test calcareous, lenticular, discoidal, planispiral, with short but thick septa in the last whorl. Regularly arranged chambers with thick septa. 10 to 14 chambers in the last whorl. 3 to 4 whorls. Developed septa and chomata. The wall is made of microgranular calcite.

R e m a r k s. – Oblique sections.

D i s t r i b u t i o n. – Middle–late Visean; Upper Silesian Block (Czerwona Ścianka Formation and Łom Gminny Member of the Czernka Formation), Poland; Russia (Malakhova, 1957; Grozdilova and Lebedeva, 1960), Central Iran (Vachard and Arefifard, 2015).

Eostaffella sp.
(Fig. 13F)

M a t e r i a l. – Five specimens in the material studied.

D e s c r i p t i o n. – Test calcareous, discoidal, planispiral, involute. 4 whorls . Wall single-layered, granular, no chomata.

R e m a r k s. – Very oblique sections.

D i s t r i b u t i o n. – Late Visean; Upper Silesian Block (Czerwona Ścianka Formation), Poland.

MICROPROBLEMATICA

Microscopic organisms with uncertain systematic affinity were also found in thin sections from the limestones studied (Fig. 14). They supposedly belong to unilocular foraminifera (Fig. 14A–C) or calcified radiolaria (Fig. 14D), although these forms have been described in numerous publications as calcispheres (e.g., Poty et al., 2003, 2006; Tomaś et al., 2011).

DISCUSSION

The Class Fusulinata are not as abundant and widespread as are conodonts in the microfauna of the carbonate platform of the eastern part of the Upper Silesian Block, but nevertheless they can be a valuable tool for biostratigraphy and palaeoenvironmental studies. Their development in the area investi-

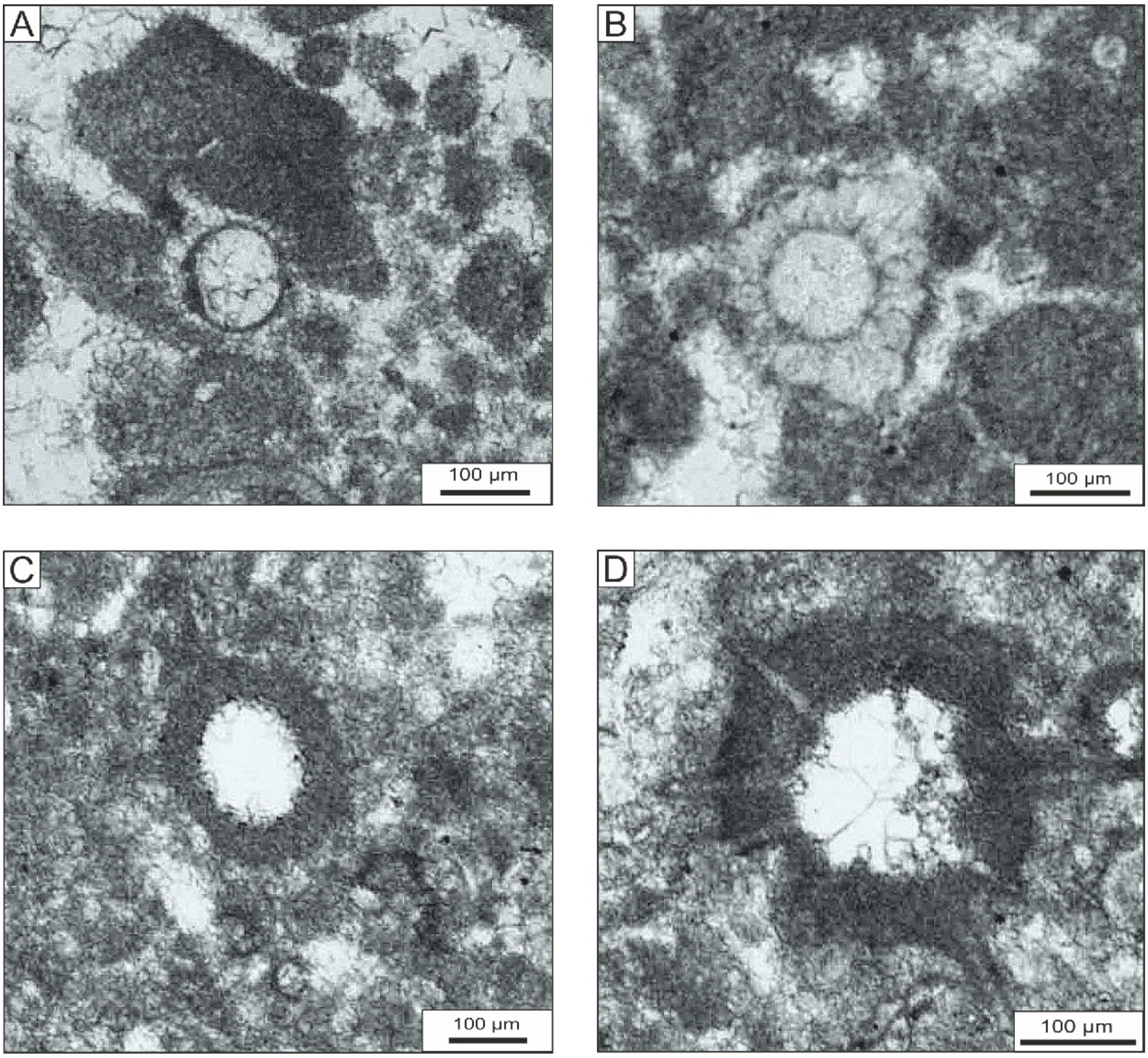

Fig. 14. Microproblematica (or unilocular foraminifera ?) from the Racławka and Szklary sections

A – *Archaesphaera* sp., sample R 3.15; **B** – *Vicinesphaera* sp., sample R 2.17; **C** – *Pachysphaera* sp. (?), sample S 1.27; **D** – *Parathurammina* sp. (?) or calcified radiolaria (?), sample S1 gated is closely connected with the geological history of the Moravian-Silesian Paleozoic Basin (e.g., Paszkowski, 1983, 1988; Kalvoda et al., 1999; Kalvoda, 2001, 2002; Kalvoda et al., 2015), the Dinantian Basin (e.g., Conil et al., 1986; Poty et al., 2003, 2006; Kumpan et al., 2014) and to a lesser extent the Ural Basin (e.g., Kulagina et al., 2003; Kulagina, 2013). In the Silesian-Moravian basin, the Fusulinata underwent three main stages of development. The fauna responded not only to general but also to more subtle changes in ecological conditions that make it possible to discriminate an eco-stratigraphic succession of assemblages upon which the biostratigraphy of the upper Famennian to lower Carboniferous can be based.

The first stage in the development of the Fusulinata in the area investigated corresponds to the late Famennian. The main role in foraminiferal assemblages is played by the family Quasiendothyridae (e.g., Kalvoda, 2002; Vachard et al., 2010; Kulagina, 2013), the presence of which allows for determination of the age of the section studied. Together with numerous unilocular foraminifera such as *Parathurammina* and *Archaesphaera* decribed in this paper as microproblematica, they indicate a shallow water environment (Paszkowski, 1995; Paszkowski et al., 2008). The Famennian foraminifera are relatively poor by comparison with the Carboniferous (except early Tournaisian) assemblages.

The next assemblage (Tournaisian) displays further diversification and an increase in abundance of the foraminifera. This was a period of successive colonization of newly available niches after the Hangenberg Event (Kaiser et al., 2011, 2015), which took place in the latest Famennian. The thin sections examined represent shallow marine facies with emersion episodes that correspond to Lofer cycles (Fischer, 1964; Enos and Samankassou, 1998), a worldwide trend especially in the middle Tournaisian deepening environment. New genera appeared in the family Tournayellidae such as *Tournayella*, *Septatournayella*, and the family of unilocular Parathuramminidae (subclass Afusulinana, *Incertae sedis*). The entire fauna indicates an extremely shallow marine assemblage compared to that of the latest Famennian (Poty et al., 2003; Tomaś et al., 2011). This is the time of distinct reduction of Fusulinata foraminifera in the study area. Only representatives of the most opportunistic families such as Tournayellidae and Parathuramminidae are present.

By the end of the middle Tournaisian, the importance of the Fusulinata increased. This is again reflected the conditions in the Moravian–Silesian Paleozoic Basin, part of the Palaeotethys Ocean (e.g., Conil and Lys, 1977). The worldwide regression at the end of the Famennian and the beginning of the Tournaisian caused mass extinctions of marine organisms, involving the Devonian foraminifera genera. However, middle Tournaisian marine life became diverse, and a rich fauna featuring foraminifera developed. The growing importance of the families Tournayellidae (e.g., *Chernyshinella*), Septabrunsiinidae (e.g., *Septabrunsiina*) and Endothyridae (e.g., *Dainella*, *Latiendothyra*) reflects. coeval trends observed in the Dinant Basin, Moravian Basin, and Ural Basin. The middle Tournaisian foraminiferal groups identified represent a specific episode in the evolution of the Fusulinata: the evolutionary boom of the order Endothyrida.

The third stage in the development of the Fusulinata in the Moravian–Silesian Paleozoic Basin coincides with changes observed in the Dinant region (Conil and Lys, 1967, Conil et al., 1967, 1991; Poty et al., 2003, 2006; Vachard et al., 2010), and the Moravian Karst (Kalvoda, 2002; Kalvoda et al., 2010) and Ural basins (Ganelina, 1951, 1956, 1966; Kulagina, 2013). A zone of mass occurrence of *Eoparastaffella* separates the Tournaisian from the Visean assemblages (Vdovenko, 1964, 1971, 1972; Poty et al., 2003, 2006; Vachard et al., 2010). The Visean fauna differs from the older one in three main features: (1) the family Eoparastaffellidae (e.g., *Eoparastaffella*), (2) within the family Archaediscidae (e.g., *Archaediscus*) and (3) the family Palaeotextulariidae is characterized by its greatest bloom (e.g., *Palaeotextularia, Climacammina, Cribrostomum*). Its abundance at certain intervals has local stratigraphic importance. These families together with the Endothyridae and Loeblichiidae constitute the major elements of the foraminiferal fauna of the middle Visean in the Upper Silesian Block (Kraków Region). A second phase in the evolutionary boom in the Fusulinata occurred during the middle and late Visean when the number of taxa increased twice. Evolutionary changes in the Fusulinata then were influenced by an increase in surface water temperature and prolonged episodes of sea level rise during transgressive-regressive cycles (e.g., Dreesen and Thorez, 1980; Dreesen et al., 1985; Vachard, 1994; Gallagher, 1998).

Calcispheres have been described from the Upper Devonian and Lower Carboniferous from back-reef facies (Mamet 1970), and from lagoonal deposits (Vachard, 1994; Szulczewski et al., 1996). Their abundant presence in the lagoonal, low-energy environment has been taken as evidence that calcispheres originated directly from algae or are their reproductive cysts (Cózar and Rodríguez, 2000). Their coexistence with green algae of the Dasycladacea group indicates that they may have been reproductive forms of these algae, and their accumulation took place in the same environment, i.e., at the bottom of lagoons with limited water exchange (Flügel and Munnecke, 2010). However, in this paper, it has inferred that the forms described may be interpreted as unilocular foraminifera, although they are microfossils of uncertain systematic origin that require further micropalaeontological research, and so are classified as microproblematica herein.

Summarizing, the late Famennian to Early Carboniferous was a time of distinct increase in the Fusulinata in the study area, with an episode of reduction in the numbers of foraminiferal taxa caused by Lofer cycles understood as numerous emergence phases with hostile ecological conditions (Paszkowski and Szydłak, 1986; Paszkowski, 1995; Paszkowski et al., 2008).

CONCLUSIONS

The study of thin sections of Upper Devonian to Lower Carboniferous strata in southern Poland revealed the presence of many significant microfossils, adding to data on the foraminifera from the eastern part of the Upper Silesian Block.

1. The foraminiferal assemblages described in this study represent the late Famennian, middle Tournaisian, and upper part of the middle Visean. However, some taxa such as *Archaediscus* cf. *rugosus* and *Ozawainella* cf. *alchevskiensis* occur in the late Visean. The samples yielded foraminifera that are widely known from Famennian–Visean carbonate platforms of the Dinant Region, Moravian Karst, Ural Basin and the Kraków Region.

2. The transitional (Famennian/Tournaisian) nature of the Racławka Formation is indicated by foraminiferal genera having their first occurrence in the Famennian (e.g., *Eoendothyra*) and the Tournaisian (e.g., *Tournayella*).

3. The episodes of emergence in the early Tournaisian, within shallow carbonate deposits, led to the absence of foraminifera from the study area, in contrast with the unilocular foraminifera (microproblematica herein) and calcareous algae.

4. Analyses of the middle Tournaisian foraminiferal groups identified an episode in the evolution of the class Fusulinata and the evolutionary boom of the order Endothyrida. Successive evolutionary booms in the Fusulinata occurred in the middle and then the late Visean, with increases in the number of taxa in the strata studied.

5. Typical foraminiferal assemblages from middle Tournaisian and Visean deposits are described in the Kraków region and reflect the well-known record of evolutionary development of foraminifera known worldwide.

6. The taxonomic analysis carried out in this study revises the identifications of earlier studies.

7. Characteristic foraminiferal assemblages influenced by environmental conditions display variability within families and genera, which may form the basis for a local foraminiferal biostratigraphy for the area studied.

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APPENDIX 1

Compilation of foraminifer taxa based on previous research obtained from exposures, boreholes, and formations

Foraminifer taxa	**Soboń-Podgórska (1972, 1975)**		**Ślósarz and Żakowa (1975)**				**Poty et al. (2003)**								**Tomaś et al. (2011)**																
	Based on																														
	exposures		**boreholes**				**formations**								**exposures**																
	Czerwona Ścianka	Łom Gminny	Karniowice 3	Będkowice 1	Skotniki 1	Skotniki 2	Racławka	Szklary	Pstrągarnia	Przy Granicy	Mazurowe Doły	Czatkowice	Eliaszówka	Czerna	Exposure nr 4	Exposure nr 8	Exposure nr 9	Exposure nr 12	Exposure nr 13	Exposure nr 15	Exposure nr 18	Exposure nr 19	Exposure nr 20	Exposure nr 21	Exposure nr 22	Exposure nr 24	Exposure nr 25	Exposure nr 26	Exposure nr 27	Exposures nr 29,30	Exposures nr 31,32
Ammodiscus volgensis (Rauzer)	X	X																													
Ammodiscus cf. *glomospiro*ides Rauzer	X	X																													
Archaediscus karreri Brady	X																														
Archaediscus aff. *moelleri* Rauzer	X																														
Archaediscus moelleri subsp. *gigas* Rauzer	X																														
Archaediscus cf. *enormis* Conil and Lys	X																														
Archaediscus aff. *mellitus* Schlykova	X																														
Archaediscus ex gr. *moelleri* Rauzer	X																														
Archaediscus moelleri Rauzer	X																														
Archaediscus	X	X																													

krestovnikovi Rauzer																															
Archaediscus sp.	X																														
Archaesphaera minima Suleimanov						X																									
Archaesphaera grandis Lipina						X																									
Archaesphaera sp.				X	X	X																									
Biseriella cf. *bristolensis* (Reichel, 1946)													X																		
Bessiella sp.													X																		
Bisphaera sp.				X	X	X																							X		
Bisphaera ? sp.				X																											
Bradyina nana Potievskaja	X																														
Bradyina rotula (Eichwald)	X																														
Brunsia pulchra Mikhailov		X																													
Brunsia sp.													X												X					X	X
Brunsiina sp.																		X													
Chernyshinella disputabilis Dain																										X					
Chernyshinella glomiformis (Lipina)																			X	X						X		X		X	
Chernyshinella tumulosa Lipina																					X				X						
Chernyshinella paucicamerata Lipina, 1955									X																						
Chernyshinella sp.								X	X																						X
Climacammina cf. *prisca* Lipina	X																														
Climacammina moelleri Reitlinger	X																														
Climacammina obsoleta Reitlinger	X																														
Climacammina sp.	X	X																													
Condustrella sp.											X																				
Crassisseptela aff. *inflata* (Zeller, 1957)									X																						
Crassisseptella sp.									X																						
Cribrospira mikhailovi (Rauzer)		X																													
Cribrospira sp.	X	X																													
Cribrostomum aff.	X																														

eximium Möller subsp. *regularis* Lipina																															
Cribrostomum eximium Möller subsp. *paraeximia* Lipina	X																														
Cribrostomum commune Möller	X																														
Cribrostomum No 2 Lipina	X	X																													
Cribrostomum sp.	X																														
Dainella sp.		X																													
Earlandia cf. *elegans* (Rauzer and Reitlinger)	X																														
Earlandia vulgaris (Rauzer and Reitlinger)		X																													
Earlandia sp.					X	X		X																							
Earlandia ? sp.				X																											
Eblanaia michoti (Conil and Lys, 1964)											X																				
Endothyra pseudobradyi Brazhnikova	X	X																													
Endothyra similis (Rauzer and Reitlinger)	X	X																													
Endothyra bradyi (Mikhailov)	X	X																													
Endothyra omphalota (Rauzer et Reitlinger)		X																													
Endothyra cf. *pseudobradyi* Brazhnikova,	X	X																													
Endothyra ex gr. *bradyi* (Mikhailov)	X	X																													
Endothyra sp.	X		X																												
Endothyranopsis cf. *crassus* (Brady)	X	X																													
Endothyranopsis cf. *crassus* subsp. *crassa* (Brady)	X	X																													
Endothyranopsis crassus (Brady)	X	X																													

Endothyranopsis crassus (Rauzer and Reitlinger)	X	X																													
Endothyranopsis aff. *paraconvexus* Brazhnikova and Potievskaja	X																														
Eoendothyranopsis donica (Brazhnikova and Vdovenko, 1967)														X																	
Eoforschia moelleri (Malakhova, 1954)											X	X																			
Eoparastaffella simplex (Vdovenko 1954)														X																	
Eoparastaffella aff. *simplex* Vdovenko	X																														
Eoparastaffella aff. *singularia* Vdovenko	X																														
Eoparastaffella sp.	X	X											X																		X
Eostaffella singularia Vissarionova	X	X																													
Eostaffella parastruvei Rauzer	X	X																													
Eostaffella parastruvei subsp. *subvasta* Ganelina	X	X																													
Eostaffella aff. *ikensis* Vissarionova	X																														
Eostaffella aff. *mosquensis* Vissarionova	X																														
Eostaffella sp.	X	X																													
Eotextularia diversa Chernysheva																															X
Eotournayella sp.											X																				
Florennella sp.													X																		
Forschiella subangulata (Möller)		X																													
Geinitzina sp.				X																											
Globivalvulina (?) sp.	X	X																													
Globoendothyra ischimica (Rauzer)	X	X																													
Globoendothyra cf.	X	X																													

ischimica (Rauzer)																															
Glomospiranella spirillinoides (Grozdilova and Glebovskaja)		X																													
Glomospiranella sp.					X											X	X	X	X	X		X		X	X	X				X	
Granuliferella sp.											X	X															X				X
Haplofragmella gracilis (Rauzer)		X																													
Haplofragmella cf. *tetraloculi* Rauzer	X	X																													
Howchinia cf. *gibba* (Möller)	X																														
Inflatoendothyra inflata Lipina																				X											
Inflatoendothyra sp.									X																						
Latiendothyranopsis sp.											X	X	X																		X
Latiendothyra latispiralis Lipina																					X		X								X
Latiendothyra grandis Lipina																					X										
Laxoendothyra. gr. *parakosvensis* (Lipina, 1955)									X						X					X	X		X	X	X	X	X	X		X	
Laxoendothyra laxa (Conil and Lys, 1964)													X																		X
Laxoendothyra sp.										X																					
Lituotuba sp.																															X
Litotubella glomospiroides subsp. *magna* Rauzer	X	X																													
Loeblichia ammonoides Brady subsp. *paraammonoides* Brazhnikova	X																														
Lugtonia monilis (Malakhova, 1956)													X																		
Lysella gadukensis Bozorgnia, 1973													X																		
Mediocris sp.														X																	
Neotuberitina maljavkini (Mikhailov)					X																										
Omphalotis sp.																															X

Parathurammina scitula Czuvasov						X																									
Parathurammina sp.				X	X																										
Palaeospiroplectammina tchernyshinensis (Lipina)																					X			X						X	
Palaeospiroplectammina sp.											X									X						X					X
Palaeotextularia longiseptata Lipina	X	X																													
Palaeotextularia aff. *longiseptata* subsp. *magna* Lipina	X																														
Palaeotextularia cf. *convexa* Brazhnikova	X																														
Palaeotextularia breviseptata Lipina	X																														
Palaeotextularia sp.	X	X																													
Plectogyra paracosvensis (Lipina) cf. var. *imminuta* Conil and Lys					X																										
Plectogyra aff. *paracosvensis* (Lipina)					X																										
Plectogyra sp.?						X																									
Plectogyranopsis sp.																									X						
Pseudoglomospira sp.																															X
Pseudolituotubella sp.																															X
Quasiendothyra communis Rauzer															X	X		X													
Quasiendothyra regularis Lipina															X																
Quasiendothyra konensis (Lebedeva)																X		X													
Quasiendothyra sp.							X																								
Septabrunsiina krainica (Lipina)																			X	X											
Septabrunsiina sp.?				X																											X
Septabrunsiina spp.									X		X									X										X	
Septaforschia sp.											X																				

Septaglomospiranella spp.									X							X		X	X					X	X	X	X			X	X
Septatournayella pseudocamerata Lipina																											X				
Septatournayella sp.											X															X					
Spinobrunsiina spp.													X																		
Spinochernella sp.												X	X																		
Spinoendothyra paracostifera (Lipina)																															X
Spinoendothyra sp.											X		X																		
Spinotournayella sp.											X																				
Tetrataxis regularis Brazhnikova	X																														
Tetrataxis cf. *regularis* Brazhnikova	X																														
Tetrataxis dentata Vissarionova	X																														
Tetrataxis angusta Vissarionova	X																														
Tetrataxis cf. *angusta* Vissarionova subsp. *serpukchoviensis* Reitlinger	X																														
Tournayellina beata (Malakhova)																			X	X	X			X		X	X	X		X	
Tournayellina septata Lipina																			X											X	X
Tournayellina sp.												X							X												
Tournayella discoidea Dain																															X
Tournayella sp.												X				X		X								X				X	
Tuberendothyra tuberculata (Lipina, 1948)											X										X		X	X						X	X
Tuberitina maljavkini Mikhailov	X	X																													
Tuberitina sp.				X		X																									
Umbellina pugatchovensis Bykova				X																											
Umbellina sp.				X	X	X																									
Umbellina ? sp.			X	X		X																									

Uralinia lobata Poty and Boland, 1996									X																						
Uralodiscus rotundus (Chernysheva, 1948)														X																	