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Foraminifers from the Muschelkalk of southern Poland

ABSTRACT: Seventy one foraminifer taxa (including the two new ones: *Endothyra salaji* Gaździcki, sp. n. and *Involutina eomesozoica praecursor* Gaździcki, ssp. n.) are recognized in the Muschelkalk (Anisian — Lower Ladinian sequence) of southern Poland. Representatives of the family Involutinidae are shown to have appeared much earlier than it was previously assumed. The *Meandrospira? deformata* Zone is proposed for the Lower Anisian, and the *Glomospira densa* Zone is modified. The foraminifer assemblage described does not differ from contemporaneous assemblages of the Tethys.

INTRODUCTION

This paper presents results of studies on foraminifers from the Muschelkalk of the Holy Cross Mts and from the environs of Opole, Upper Silesia (*cf.* Fig. 1). The stratigraphic position of the Muschelkalk sequence from these regions is fairly accurately determined by recent conodont studies (Zawidzka 1970, 1974a, b, 1975; Trammer 1971, 1972, 1975; Kozur 1972, 1974; Kozur & Mostler 1972a), which make it possible to determine the age of foraminifer-bearing samples (*cf.* Fig. 2–3) and to correlate the stratigraphic ranges of foraminifers in Poland and other regions.

The foraminifers were studied primarily in approximately 370 thin sections, but some specimens isolated from the rock were also available. Discussion and location of the sampled profiles from the Holy Cross Mts and from Opole Silesia are given by Trammer (1975), and Zawidzka (1975) respectively.

From the Holy Cross Mts (*coll.* J. Trammer and W. R. Kowalski) 120 thin sections were available, 36 of which contained foraminifers. From Opole Silesia (*coll.* K. Zawidzka) 250 thin sections were available, 80 of which contained foraminifers. Foraminifers are fairly common in the Lower Muschelkalk of these regions (Figs 2–3). The Middle Muschelkalk of the Holy Cross Mts yields no foraminifers because of unfavourable facies conditions (Trammer 1975); in this region foraminifers do not reappear before the Upper Muschelkalk. In Opole Silesia foraminifers are

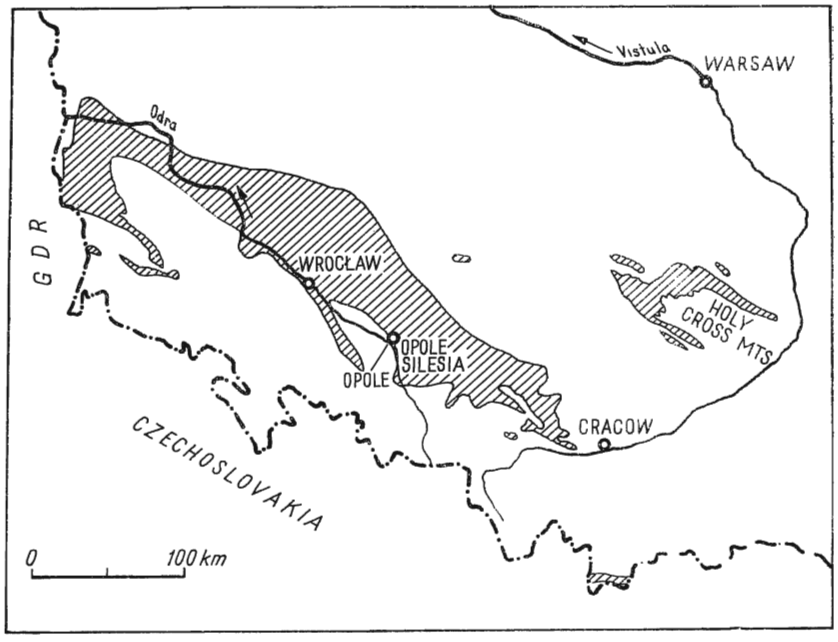


Fig. 1. Occurrence zone of the Triassic deposits (hatched) in southern Poland beneath the Quaternary and Tertiary cover

still common in the lower Middle Muschelkalk; they were not recorded from higher parts of the profiles.

Muschelkalk foraminifers were previously reported from Poland by Bielecka (1956), Styk (1958, 1965, 1972) and Głazek, Trammer & Zawidzka (1973).

Acknowledgements. Thanks are due to Docent J. Kutek, Warsaw University, for discussions on stratigraphy and to W. R. Kowalski, M. Sc., for the loan of thin sections. It is also a pleasure to thank Dr. J. Salaj, Geological Survey of Czechoslovakia (Bratislava), for valuable suggestions.

Photographs were taken by Dr. A. Gaździcki (Pls 1—11) and L. Łuszczewska, M. Sc. (Pl. 12).

LIST OF FORAMINIFERS

The recomendations made by Loeblich & Tappan (1964), Kristan-Tollmann (1960, 1970), Koehn-Zaninetti (1969), Koehn-Zaninetti & al. (1969), Wendt (1969) and others were followed both in systematics and paleontological descriptions.

The assemblage comprises the following taxa:

Ammodiscus incertus (d'Orbigny, 1839) — Pl. 1, Fig. 3
Ammodiscus multivolutus Reitlinger, 1949 — Pl. 1, Figs 1-2
Ammodiscus parapriscus Ho, 1959
Ammodiscus sp. — Pl. 1, Fig. 4 and Pl. 12, Fig. 13
Glomospira articulosa Plummer, 1944

Glomospira sinensis Ho, 1959 — Pl. 1, Figs 9-11
Glomospira tenuifistula Ho, 1959
Glomospira densa (Pantić, 1965) — Pl. 2, Figs 5-9
Glomospira sp. *A* — Pl. 1, Figs 6-8
Glomospira sp. — Pl. 1, Fig. 5 and Pl. 12, Figs 3, 11-12
Glomospirella spirillinoides Grozdilova & Glebovskaya, 1948 — Pl. 3, Figs 15—16
Glomospirella facilis Ho, 1959
Glomospirella vulgaris Ho, 1959
Glomospirella cf. *vulgaris* Ho, 1959 — Pl. 3, Fig. 4
Glomospirella semiplana (Kochansky-Devidé & Pantić, 1966)
Glomospirella grandis (Salaj, 1967) — Pl. 2, Figs 1-2
Glomospirella cf. *grandis* (Salaj, 1967) — Pl. 2, Figs 3-4
Glomospirella aff. *grandis* (Salaj, 1967) — Pl. 3, Figs 5-6
Glomospirella amplificata Kristan-Tollmann, 1970 — Pl. 3, Figs 1-3, 7
Glomospirella hoi Kristan-Tollmann, 1970
Glomospirella triphonensis Baud, Zaninetti & Brönnimann, 1971 — Pl. 3, Figs 11-12
Glomospirella elbursorum Brönnimann, Zaninetti, Bozorgnia & Huber, 1972
Glomospirella sp. — Pl. 3, Figs 8-10, 13-14 and Pl. 12, Figs 6-7
Tolypammina? gregaria Wendt, 1969 — Pl. 4, Figs 2, 7-11
Tolypammina? sp. — Pl. 4, Figs 3-6 and Pl. 12, Figs 2, 9
Ammodiscella sp. — Pl. 12, Fig. 10
Textularia sp. — Pl. 6, Fig. 3
Trochammina almtalensis Koehn-Zaninetti, 1969 — Pl. 7, Fig. 7
Trochammina sp. — Pl. 12, Figs 4-5, 8
Earlandia dunningtoni (Elliott, 1958)
Earlandia tintinniformis (Mišik, 1971) — Pl. 8, Fig. 6
Earlandia? amplimuralis (Pantić, 1972) — Pl. 8, Fig. 8
Earlandia? gracilis (Pantić, 1972)
Earlandia sp. *A* — Pl. 8, Figs 3-4, 7
Earlandia sp. — Pl. 8, Figs 1-2, 5
Nodosinella rostrata Trifonova, 1972 — Pl. 11, Figs 1-2
Nodosinella siliqua Trifonova, 1972 — Pl. 11, Fig. 3
Nodosinella sp. — Pl. 11, Fig. 4
Endothyra salaji Gaździcki, sp. n. — Pl. 5, Figs 1-6
Endothyra sp. — Pl. 5, Figs 7-9
Endothyranella wirzi (Koehn-Zaninetti, 1969) — Pl. 8, Figs 13-15
Endothyranella? sp. *A* — Pl. 8, Figs 10-12
Endothyranella sp. — Pl. 8, Fig. 9
Agathammina judicariensis Premoli Silva, 1971 — Pl. 6, Figs 1-2
Hemigordius? chialingchiangensis (Ho, 1959)
Meandrospira pusilla (Ho, 1959) [= *Citaella iulia* Premoli Silva, 1964]
Meandrospira dinarica Kochansky-Devidé & Pantić, 1966 — Pl. 9, Figs 5-9
Meandrospira? deformata Salaj, 1967 — Pl. 7, Figs 9—16
Meandrospira sp. — Pl. 9, Figs 3-4
Meandrospiranella irregularis Salaj, 1967
Meandrospiranella sp. — Pl. 7, Fig. 8 and Pl. 9, Fig. 1
Meandrospiranella? — Pl. 9, Fig. 2
Rectocornuspira kalhori Brönnimann, Zaninetti & Bozorgnia, 1972
Calcitornella? sp.
Planiinvoluta carinata Leischner, 1961 — Pl. 4, Fig. 1
Planiinvoluta sp. — Pl. 7, Fig. 5
Planiinvoluta? mesotriasica Baud, Zaninetti & Brönnimann, 1971
Planiinvoluta? sp. — Pl. 7, Fig. 6
Nodosaria ordinata Trifonova, 1965
Nodosaria sp. — Pl. 11, Fig. 8
Frondicularia woodwardi Howchin, 1895
Dentalina hoi Trifonova, 1967
Dentalina sp. — Pl. 11, Figs 5-7
Diplotremina astrofimbriata Kristan-Tollmann, 1960 — Pl. 6, Figs 4-7
Diplotremina sp. *A* — Pl. 7, Figs 1-4
Diplotremina sp. — Pl. 6, Figs 8-9
Variostoma sp.
Involutina sinuosa pragsoides (Oberhauser, 1964) — Pl. 10, Fig. 9
Involutina gaschei praegaschei Koehn-Zaninetti, 1969 — Pl. 10, Figs 4-7
Involutina eomesozoica praecursor Gaździcki, ssp. n. — Pl. 10, Figs 1-3
Involutina sp. — Pl. 10, Fig. 8

Stratigraphic ranges of the listed foraminifers are shown in summary profiles (Figs 2—3); micrographs of selected sections of the foraminifers are presented in Plates 1—11, whereas in Plate 12 — general views of some isolated specimens.

SYSTEMATIC DESCRIPTION

Family **Ammodiscidae** Reuss, 1862
Subfamily **Ammodiscinae** Reuss, 1862
Genus *GLOMOSPIRA* Rzehak, 1885
Glomospira sp. *A*
(Pl. 1, Figs 6—8)

Material. — About 30 well-preserved specimens.

Association. — Usually with *Ammodiscus multivolutus, A. incertus, Nodosaria* sp. and *Frondicularia woodwardi*.

Description. — Test small, circular in cross-section. Proloculus spheroidal. Tubular second chamber initially irregular in coiling (about 3—4 whorls); the ultimate whorl planispiral (*cf.* Pl. 1, Figs 6—8). The second chamber gradually increasing in thickness, and thickest in the last whorl.

Dimensions of the test (*in microns*): diameter — 150—230, diameter of the proloculus — 30—35, thickness of the tubular second chamber — 35—50.

Occurrence. — Lower Muschelkalk (Lower Anisian and Pelsonian) of the Holy Cross Mts (Wolica, Łukowa and Zajączków profiles).

Family **Moravamminidae** Pokorný, 1951
Subfamily **Earlandiinae** Cummings, 1955
Genus *EARLANDIA* Plummer, 1930
Earlandia sp. *A*
(Pl. 8, Figs 3—4, 7)

Material. — Over 30 well-preserved specimens.

Association. — Commonly with *Ammodiscus* sp., *Glomospira* sp., *Nodosinella* sp., *Meandrospira? deformata, Meandrospira* sp. and *Nodosaria* sp.

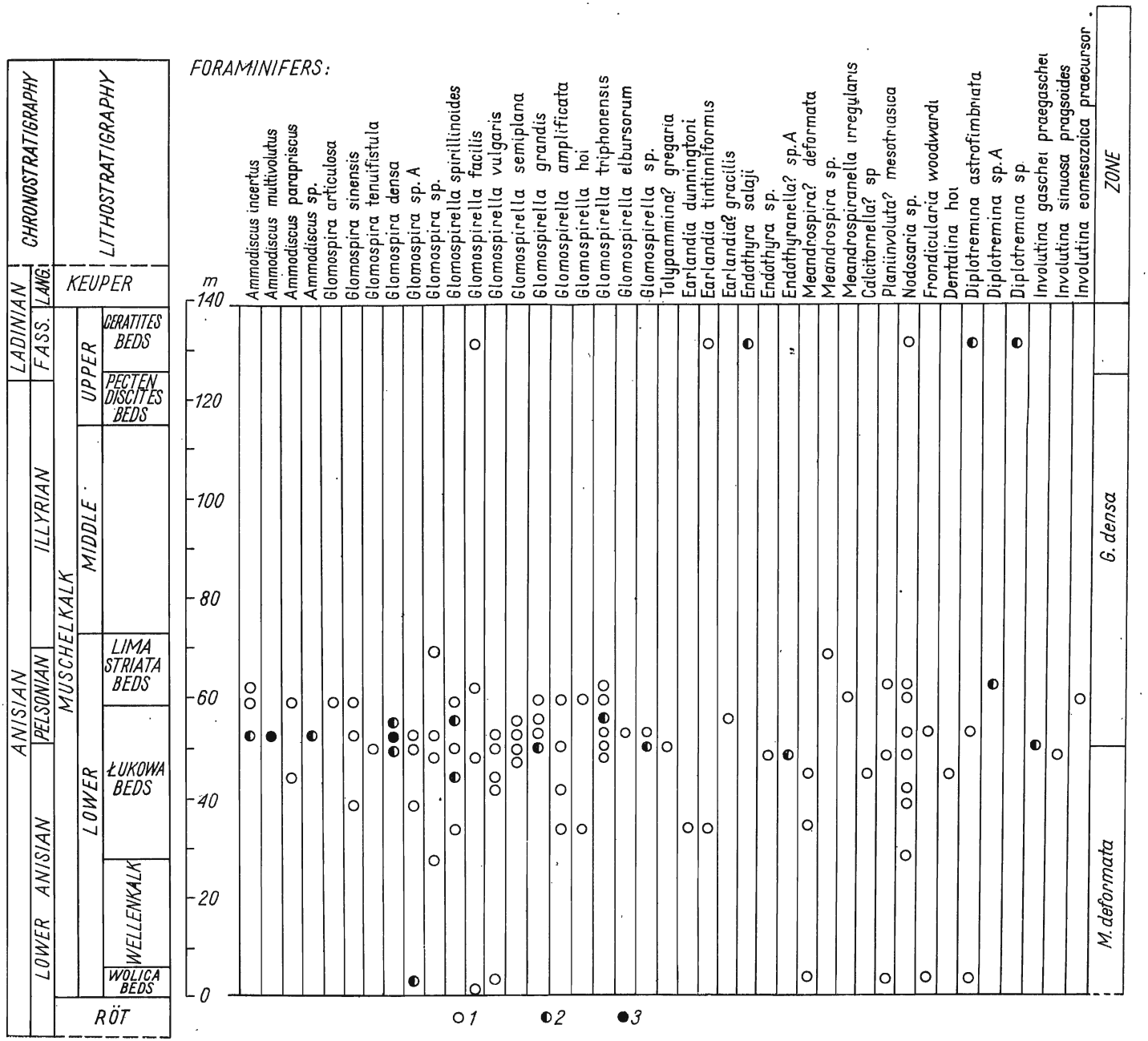
Description. — Test of spherical proloculus and tubular deuteroloculus, initially constricted and later somewhat expanded and elongated (*cf.* Pl. 8, Fig. 3). The deuteroloculus is *S*-shaped in most of the investigated forms (*cf.* Pl. 8, Figs 4, 7).

Dimensions of the test (*in microns*): length — 400—900, diameter of the proloculus — *c.* 70, thickness of the deuteroloculus — 50—70, thickness of the wall — *c.* 10.

Remarks. — The specimens differ from the representatives of the genus *Earlandia* previously described (*cf.* Elliott 1958; Radoičić 1959, 1967; Mišik 1971; and Pantić 1972) in the well-marked spherical proloculus, and in being fairly long despite the relatively small diameter of deuteroloculus. They most closely resemble the forms coming from the Upper Anisian of the Préalpes médianes rigides, Switzerland, identified as *Earlandia sp. 1* by Zaninetti & al. (1972b, Pl. 6, Fig. 27; Pl. 9, Figs 3—4).

Foraminifer frequency and distribution in the Muschelkalk sequence of the Holy Cross Mts

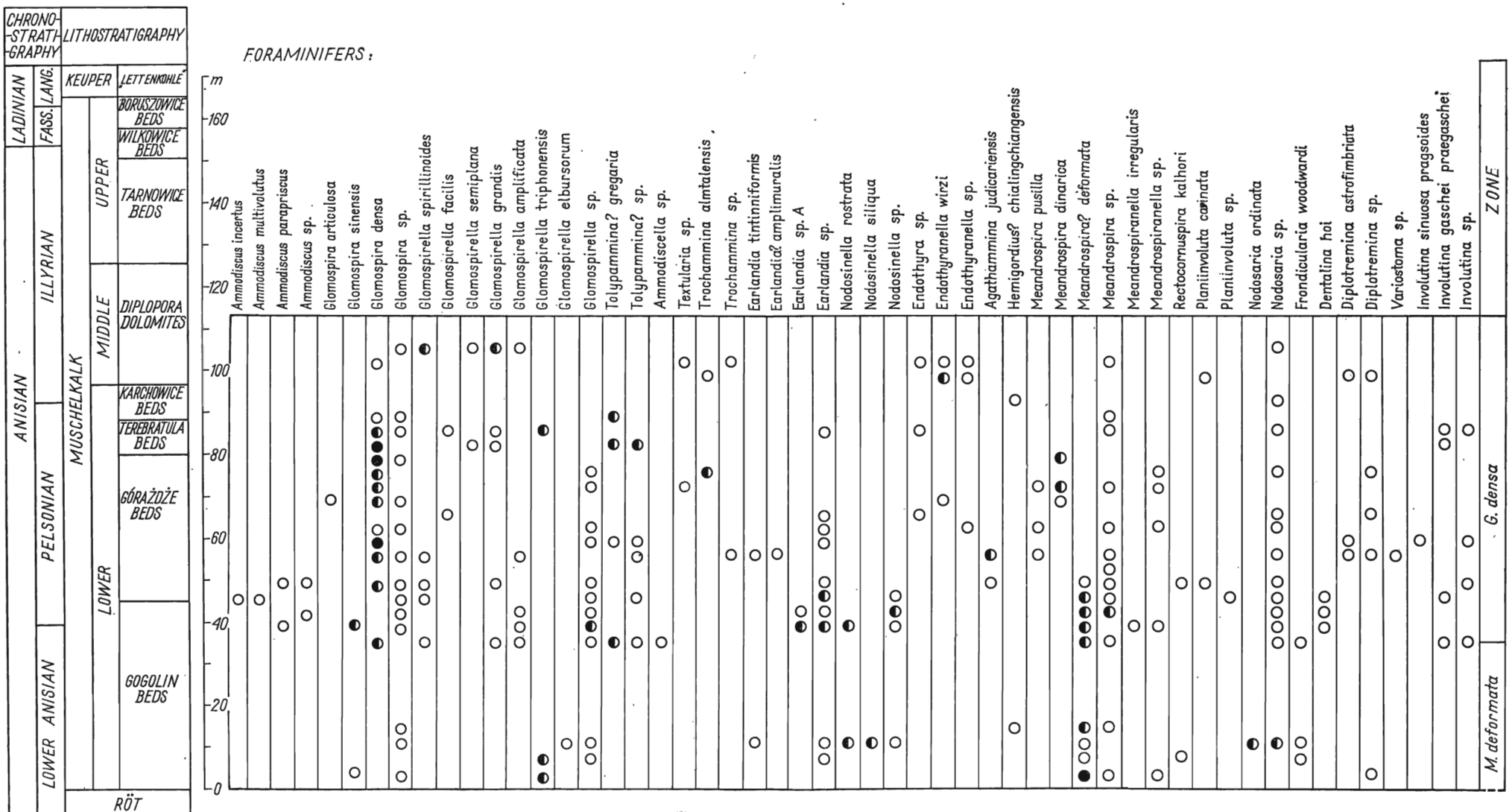
(localities Zajączków, Polichno, Łukowa and Wolica; lithostratigraphic schema according to Senkowiczowa 1957; chronostratigraphic setting according to Trammer 1971, 1972, 1975)



Frequency of foraminifers: *1* 1-10 specimens, *2* 11-25 specimens, *3* more than 25 specimens

Foraminifer frequency and distribution in the Muschelkalk sequence of Opole Silesia

(localities Górażdże, Gogolin, Kamień Śląski, Strzelce Opolskie, Wierchlesie borehole, Jemielnica borehole; lithostratigraphic schema according to Assmann 1944; chronostratigraphic setting according to Zawidzka 1970, 1974a, b, 1975, and Kozur 1972, 1974).



Occurrence. — Lower Muschelkalk (Lower Anisian and Pelsonian) of Opole Silesia (Górażdże profile).

Family **Endothyridae** Brady, 1884
Subfamily **Endothyrinae** Brady, 1884
Genus *ENDOTHYRA* Phillips, 1846
Endothyra salaji Gaździcki, sp. n.
(Pl. 5, Figs 1—6)

Holotype: the specimen presented in Pl. 5, Fig. 1
Type horizon: Ceratites Beds (Fassanian).
Type locality: Zajączków near Kielce (Holy Cross Mts).
Derivation of the name: salaji — in honour of Dr. J. Salaj, Geologický Ústav Dionýza Štúra, Bratislava.

Diagnosis. — Test small, enrolled, with circular equatorial cross-section, initially tightly coiled with short plectogyral arrangement of chambers; the ultimate whorl planispiral, composed of four chambers, with a tendency to uncoiling.

Material. — About 20 well-preserved specimens.

Association. — Most often occurring with *Diplotremina astrofimbriata, Diplotremina* sp., *Earlandia tintinniformis, Glomospirella facilis* and *Nodosaria* sp.

Description. — Proloculus spherical, very short; initially plectogyral arrangement of chambers. The ultimate, incomplete whorl markedly planispiral, evolute in the equatorial section (*cf.* Pl. 5, Figs 1, 3—5), composed of four chambers gradually increasing in size; the last chamber markedly larger than the others. Wall dark, formed of a single layer, with finely microgranular texture, becoming thickest in the last chamber.

Dimensions of the test (*in microns*): diameter — 130—170, diameter of the proloculus — 34—40, thickness of the wall — 17—20.

Remarks. — The new species, *Endothyra salaji* Gaździcki sp. n., differs from all the Triassic endothyras hitherto described in smaller diameter of the test, arrangement of chambers of the last whorl, and in a tendency to uncoiling of that whorl. This tendency brings the new species close to the genus *Endothyranella* Galloway & Harlton, 1930.

The representatives of the new species appear somewhat similar to those described as *Endothyra or Endothyranella?* sp. by Brönnimann & Zaninetti (1972, Pl. 5, Figs 1, 8; Text-fig. 12A-I) from the lowermost Upper Muschelkalk of Hyères, western Basse-Provence, southern France.

Occurrence. — Known from the type locality only.

Genus *ENDOTHYRANELLA* Galloway & Harlton *in* Galloway & Ryniker, 1930
Endothyranella? sp. *A*
(Pl. 8, Figs 10—12)

Material. — About 20 specimens.

Association. — Commonly occurring with *Glomospirella facilis, G. triphonensis, G. semiplana, Endothyra* sp., *Planiinvoluta? mesotriasica, Nodosaria* sp. and *Involutina sinuosa pragsoides.*

Description. — Test elongated; proloculus spherical, with early portion presumably plectogyrally enrolled (Pl. 8, Fig. 10) and with later part becoming uncoiled

and rectilinear. The coiled part consists of 3—4 chambers, whereas the uncoiled part is not divided into chambers. Wall unilayered, microgranular.

Dimensions of the test (*in microns*): height — 290—400, thickness of the coiled part — 120—150, thickness of the wall — *c.* 18.

Occurrence. — Lower Muschelkalk (Lower Anisian) of the Holy Cross Mts (Polichno profile).

Family **Fischerinidae** Millett, 1898
Subfamily **Cyclogyrinae** Loeblich & Tappan, 1961
Genus *MEANDROSPIRA* Loeblich & Tappan, 1946
Meandrospira? deformata Salaj, 1967
(Pl. 7, Figs 9—16)

1967. *Meandrospira deformata* Salaj, nov. sp.; Salaj, Biely & Bystrický, p. 122, Pl. 2, Fig. 3*a-d*.
1968. *?Glomospira* sp.; Dimitrijević, Pantić, Radoičić & Stefanovska, Pl. 8, Fig. 2.
1970. *Glomospira* sp.; Pantić, Pl. 1, Figs 2—3.
1970. *?Glomospirella* aff. *shengi* Ho; Pantić, Pl. 1, Fig. 6.
1970. *Meandrospira iulia* (Premoli Silva); Pantić, Pl. 1, Fig. 7.
1971. *?Meandrospira* sp.; Urošević, Pl. 1, Figs 1—3.
1971. *Meandrospira dinarica* Kochansky-Devidé & Pantić; Urošević, Pl. 2, Figs 10—11.
1972b. *Meandrospira deformata* Salaj; Trifonova, Pl. 2, Figs 4—5.

Material. — Over 80 well-preserved specimens.

Association. — Commonly with *Glomospira sinensis, Glomospira* sp., *Glomospirella spirillinoides, G. triphonensis, Earlandia* sp. *A, Nodosinella rostrata, Meandrospira* sp., *Meandrospiranella irregularis* and *Nodosaria* sp.

Description. — As given by Salaj (*in* Salaj & al. 1967) and Trifonova (1972b).

Dimensions of the test (*in microns*): diameter — 170—220.

Remarks. — The forms included in this taxon match well the diagnosis given by Salaj (*in* Salaj & al. 1967). They are particularly common in the Lower Anisian of the Polish Muschelkalk. It should be noted however that they are allocated to the genus *Meandrospira* Loeblich & Tappan, 1964, with reservation, because of an irregular arrangement of chambers and the meandrospiroid stage poorly marked. It should also be noted that some sections of the forms studied (*e.g.* Pl. 7, Fig. 12; *cf.* also Dimitrijević & al. 1968, Pl. 8, Fig. 2; and Pantić 1970, Pl. 1, Fig. 6) appear to be close to those of the representatives of the genus *Glomospira* Rzehak, 1885.

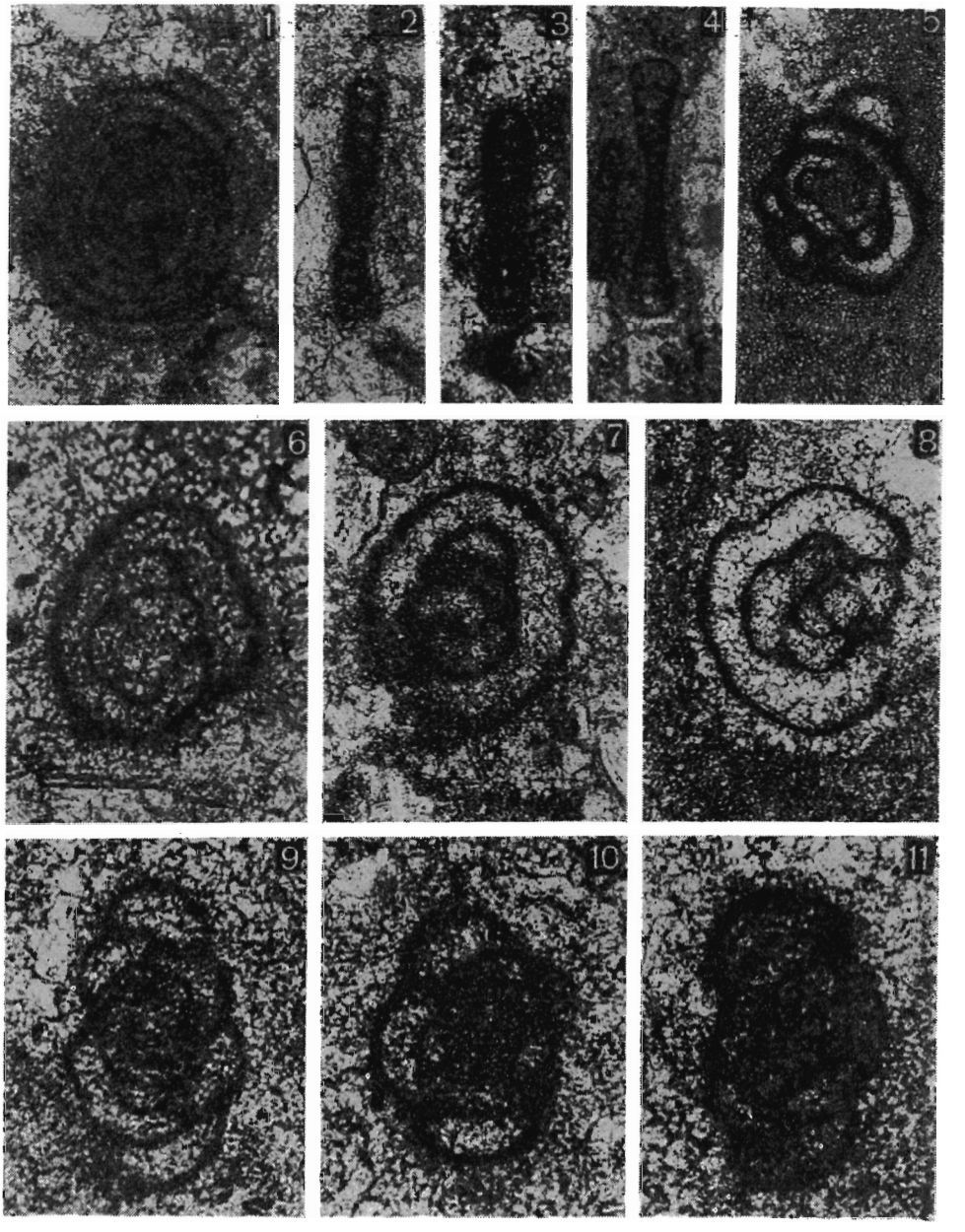
Occurrence. — Lower Muschelkalk (Lower Anisian) of the Holy Cross Mts (Łukowa and Wolica profile) and Lower Muschelkalk (Lower Anisian and Pelsonian) of Opole Silesia (Strzelce Opolskie, Górażdże and Gogolin profiles).

Family **Duostominidae** Brotzen, 1963
Genus *DIPLOTREMINA* Kristan-Tollmann, 1960
Diplotremina sp. *A*
(Pl. 7, Figs 1—4)

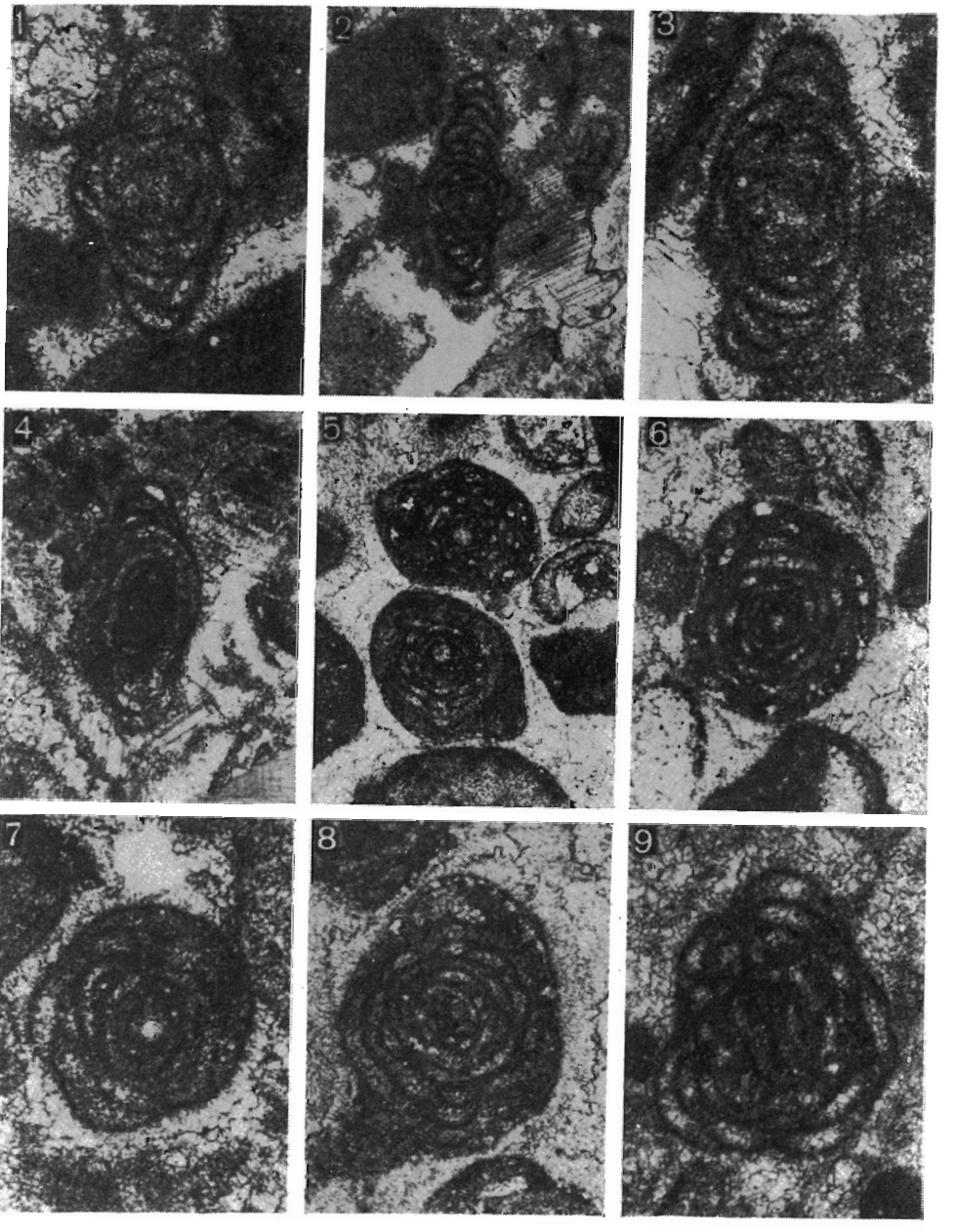
Material. — About 20 specimens.

Association. — Occurring exclusively with *Ammodiscus incertus, Glomospirella facilis, G. triphonensis, Planiinvoluta? mesotriasica* and *Nodosaria* sp.

Description. — Test small, with circular equatorial cross-section. Large umbilicus marked in the center. Chambers spirally arranged, gradually increasing in size, about six in number in equatorial section (*cf.* Pl. 7, Fig. 2). Suture line between chambers straight.



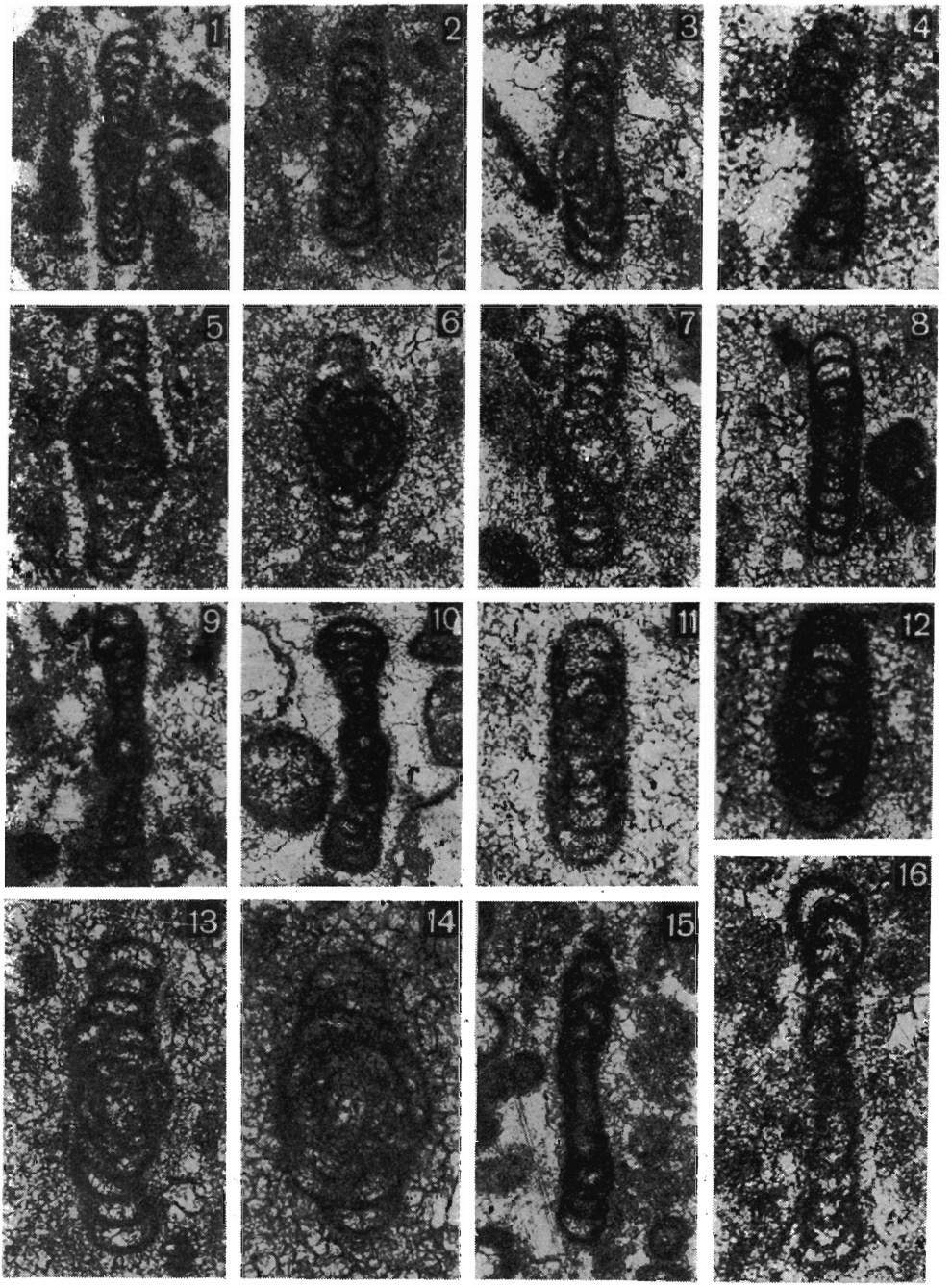
1-2 — *Ammodiscus multivolutus* Reitlinger; Łukowa Beds at Zajączków (Pelsonian), × 125.
3 — *Ammodiscus incertus* (d'Orbigny); Łukowa Beds at Wolica (Pelsonian), × 150.
4 — *Ammodiscus* sp.; Gogolin Beds at Górażdże (Lower Anisian), × 105.
5 — *Glomospira* sp.; *Lima striata* Beds at Zajączków (Pelsonian), × 80.
6-8 — *Glomospira* sp. *A*: *6-7* — Łukowa Beds at Zajączków (Pelsonian); *6* × 200, *7* × 130; *8* — Wolica Beds at Łukowa (Lower Anisian), × 130.
9-11 — *Glomospira sinensis* Ho; Gogolin Beds at Strzelce Opolskie (Lower Anisian), × 160.



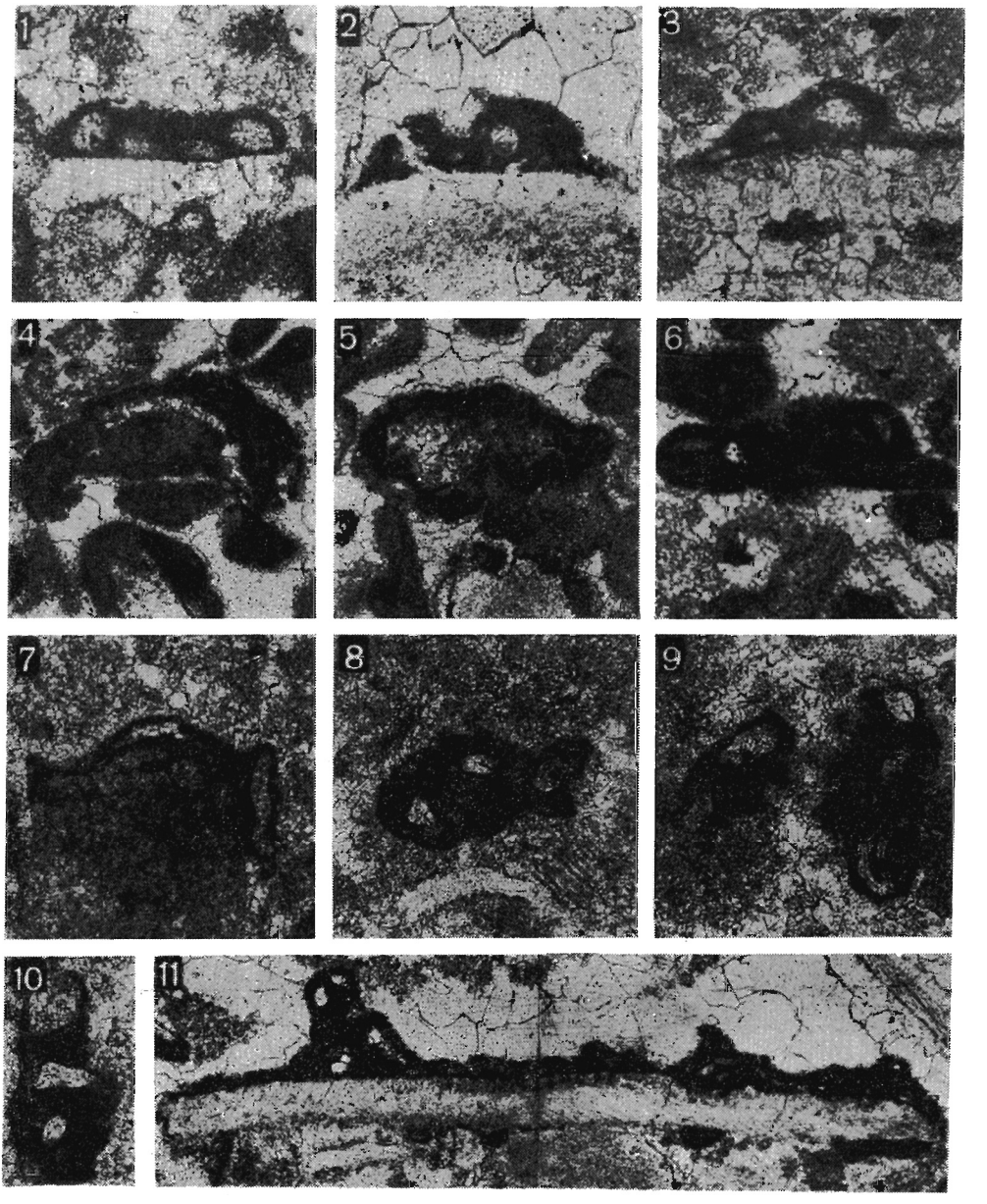
1-2 — *Glomospirella grandis* (Salaj); *1* — Górażdże Beds at Górażdże (Pelsonian); × 80; *2* — *Diplopora* Dolomites at Kamień Śląski (Illyrian), × 55.

3-4 — *Glomospirella* cf. *grandis* (Salaj): *3* — Górażdże Beds at Strzelce Opolskie (Pelsonian), × 80; *4* — Łukowa Beds at Polichno (Lower Anisian), × 60.

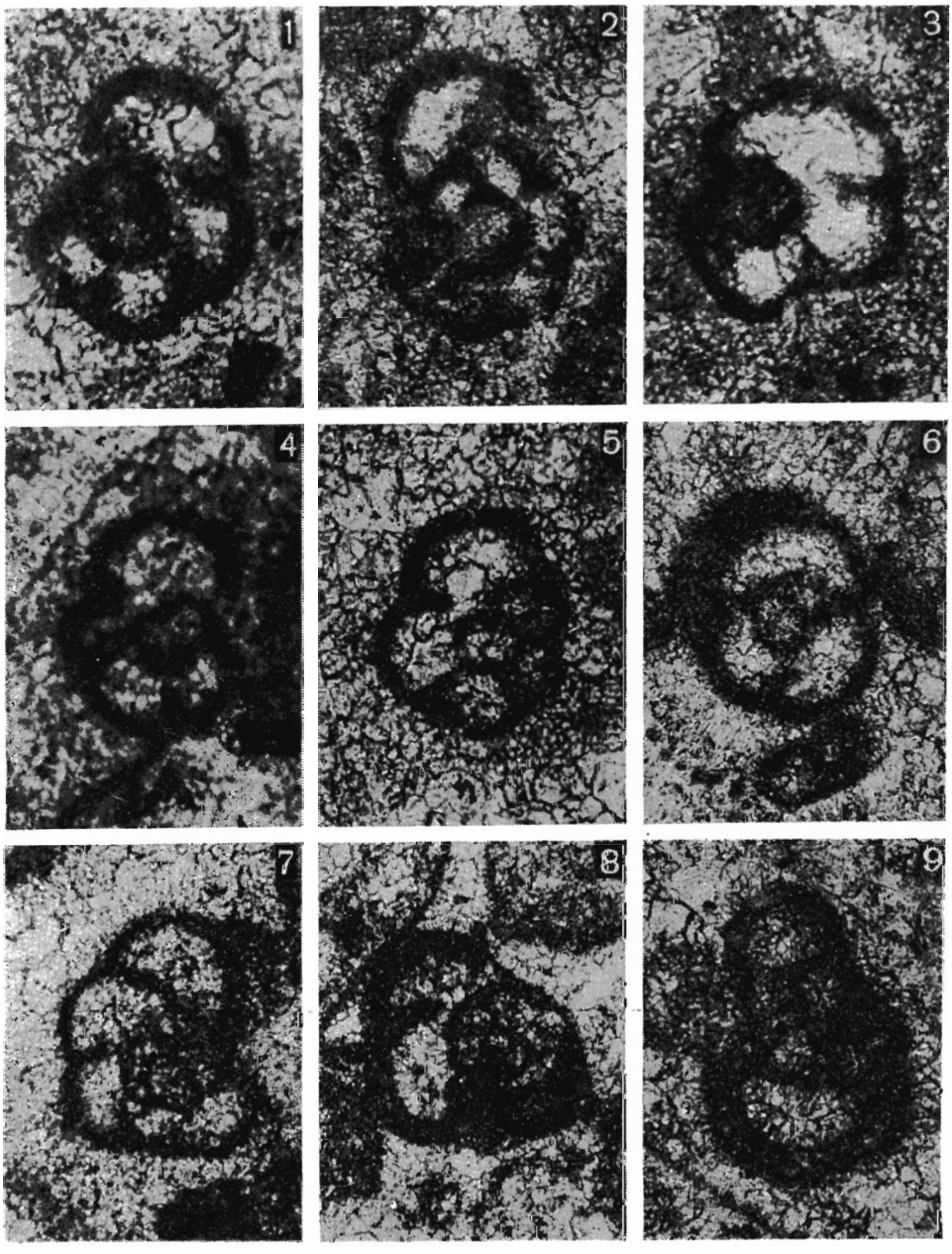
5-9 — *Glomospira densa* (Pantić): Górażdże Beds at Strzelce Opolskie (Pelsonian); *5* × 40, *6-9* × 80.



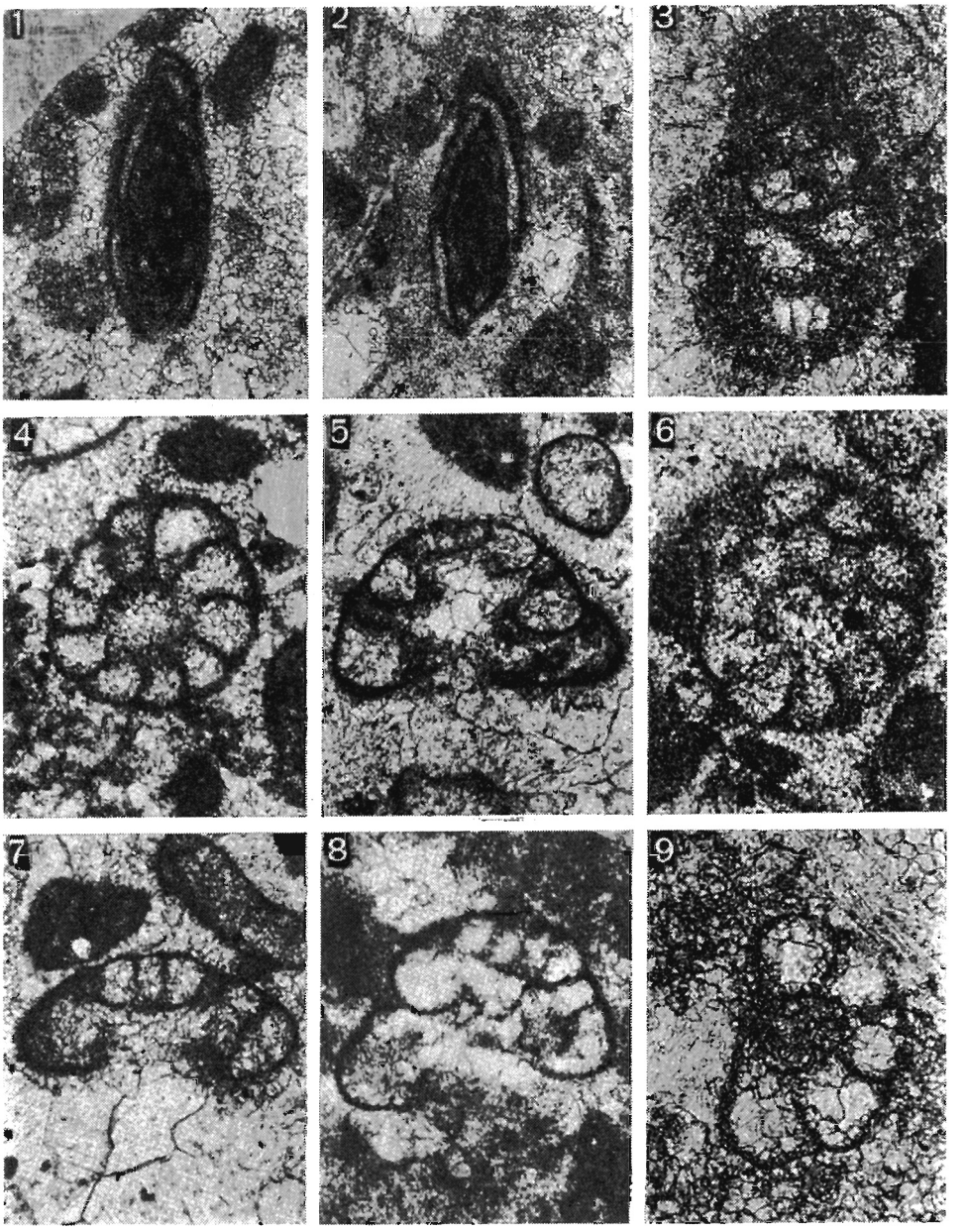
1-3, 7 — *Glomospirella amplificata* Kristan-Tollmann: *1* — *Diplopora* Dolomites at Kamień Śląski (Illyrian), × 60; *2* — Gogolin Beds/Górażdże Beds boundary at Górażdże (Pelsonian), × 60; *3* — Gogolin Beds at Górażdże (Lower Anisian), × 80; *7* — Łukowa Beds at Polichno (Lower Anisian), × 80.
4 — *Glomospirella* cf. *vulgaris* Ho: Łukowa Beds at Wolica (Lower Anisian), × 140.
5-6 — *Glomospirella* aff. *grandis* (Salaj): *5* — *Diplopora* Dolomites at Kamień Śląski (Illyrian), × 70; *6* — Łukowa Beds at Zajączków (Pelsonian), × 130.
8-10, 13-14 — *Glomospirella* sp.: *8, 13, 14* — Łukowa Beds at Wolica (Lower Anisian); *8, 13* × 70, *14* × 130; *9* — Górażdże Beds at Strzelce Opolskie (Pelsonian), × 50; *10* — Górażdże Beds at Górażdże (Pelsonian), × 40.
11-12 — *Glomospirella triphonensis* Baud, Zaninetti & Brönnimann; *11* — Łukowa Beds at Polichno (Lower Anisian), × 130; *12* — Łukowa Beds at Zajączków (Pelsonian), × 130.
15-16 — *Glomospirella spirillinoides* (Grozdilova & Glebovskaya): *15* — Łukowa Beds at Zajączków (Lower Anisian), × 60; *16* — Łukowa Beds at Wolica (Lower Anisian), × 90.



1 — *Planiinvoluta carinata* Leischner: *Diplopora* Dolomites at Kamień Śląski (Illyrian), × 80.
2, 7-11 — *Tolypammina? gregaria* Wendt: *2, 11* — *Terebratula* Beds/Karchowice Beds boundary at Szymiszów (Pelsonian); *2* × 65, *11* × 35; *7* — Gogolin Beds at Strzelce Opolskie (Pelsonian), × 65; *8-10* — Gogolin Beds at Górażdże (Lower Anisian), × 85.
3-6 — *Tolypammina?* sp.; *3* — *Terebratula* Beds/Karchowice Beds boundary at Szymiszów (Pelsonian), × 35; *4-6* — Górażdże Beds at Strzelce Opolskie (Pelsonian); *4-5* × 30, *6* × 85.



1-6 — *Endothyra salaji* Gaździcki, sp. n.; *Ceratites* Beds at Zajączków (Fassanian), × 200.
7-9 — *Endothyra* sp.: 7-8 — *Diplopora* Dolomites at Kamień Śląski (Illyrian); 7 × 130, 8 × 85; 9 — Łukowa Beds at Polichno (Lower Anisian), × 250.

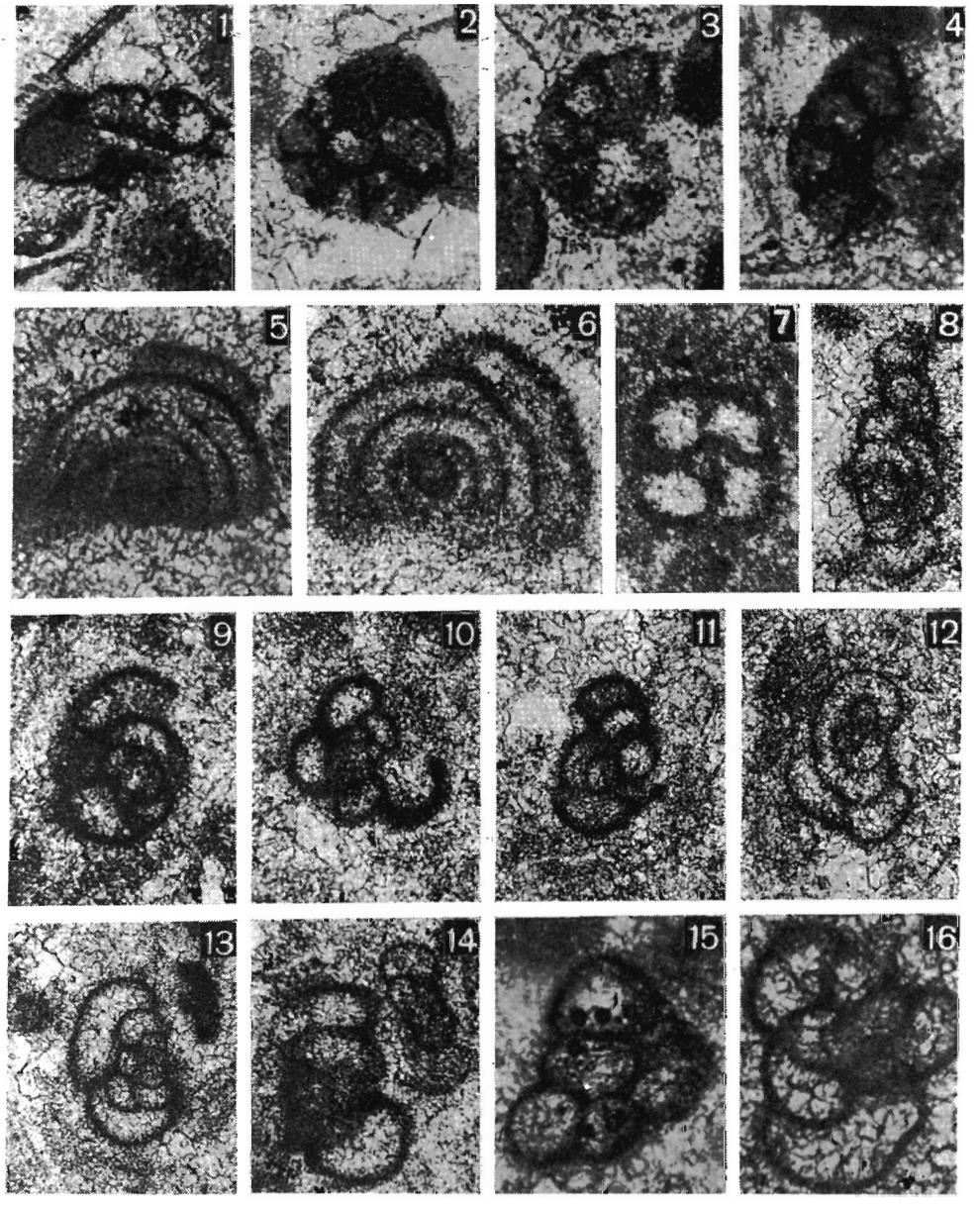


1-2 — *Agathammina judicariensis* Premoli Silva; Górażdże Beds at Strzelce Opolskie (Pelsonian), × 80.

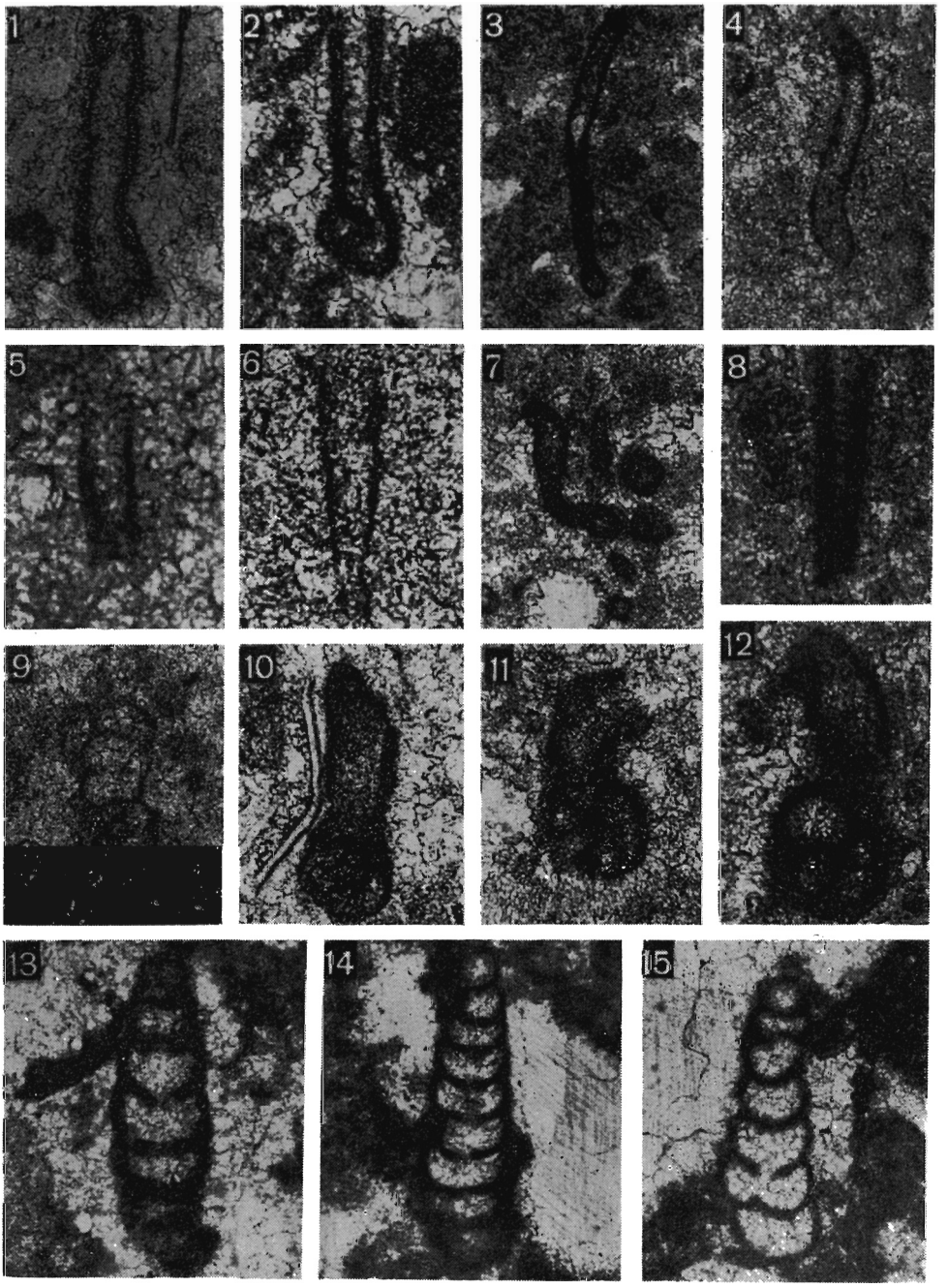
3 — *Textularia* sp.; Górażdże Beds at Strzelce Opolskie (Pelsonian), × 130.

4-7 — *Diplotremina astrofimbriata* Kristan-Tollmann; *Diplopora* Dolomites at Kamień Śląski (Illyrian); *4-5, 7* × 80, *6* × 125.

8-9 — *Diplotremina* sp.: *8* — *Diplopora* Dolomites at Kamień Śląski (Illyrian), × 80; *9* — *Ceratites* Beds at Zajączków (Fassanian), × 125.



1-4 — *Diplotremina* sp. *A; Lima striata* Beds at Wolica (Pelsonian), × 135.
5 — *Planiinvoluta* sp.; Łukowa Beds at Wolica (Lower Anisian), × 110.
6 — *Planiinvoluta*? sp.; Gogolin Beds at Gogolin (Pelsonian?), × 110.
7 — *Trochammina almtalensis* Koehn-Zaninetti; *Diplopora* Dolomites at Kamień Śląski (Illyrian), × 80.
8 — *Meandrospiranella* sp.; Gogolin Beds at Gogolin (Lower Anisian), × 110.
9-16 — *Meandrospira*? *deformata* Salaj: *9-14* Gogolin Beds at Gogolin (Lower Anisian); *9-12*, *14* × 110, *13* × 90; *15-16* Łukowa Beds at Wolica (Lower Anisian), × 200.



1-2, 5 — *Earlandia* sp.: *1* — Łukowa Beds at Zajączków (Lower Anisian), × 100; *2* — Górażdże Beds at Strzelce Opolskie (Pelsonian), × 80, *5* — Łukowa Beds at Wolica (Lower Anisian), × 200.

3-4, 7 — *Earlandia* sp. *A:* Gogolin Beds at Górażdże (Lower Anisian); *3* × 45, *4* × 80, *7* × 60.

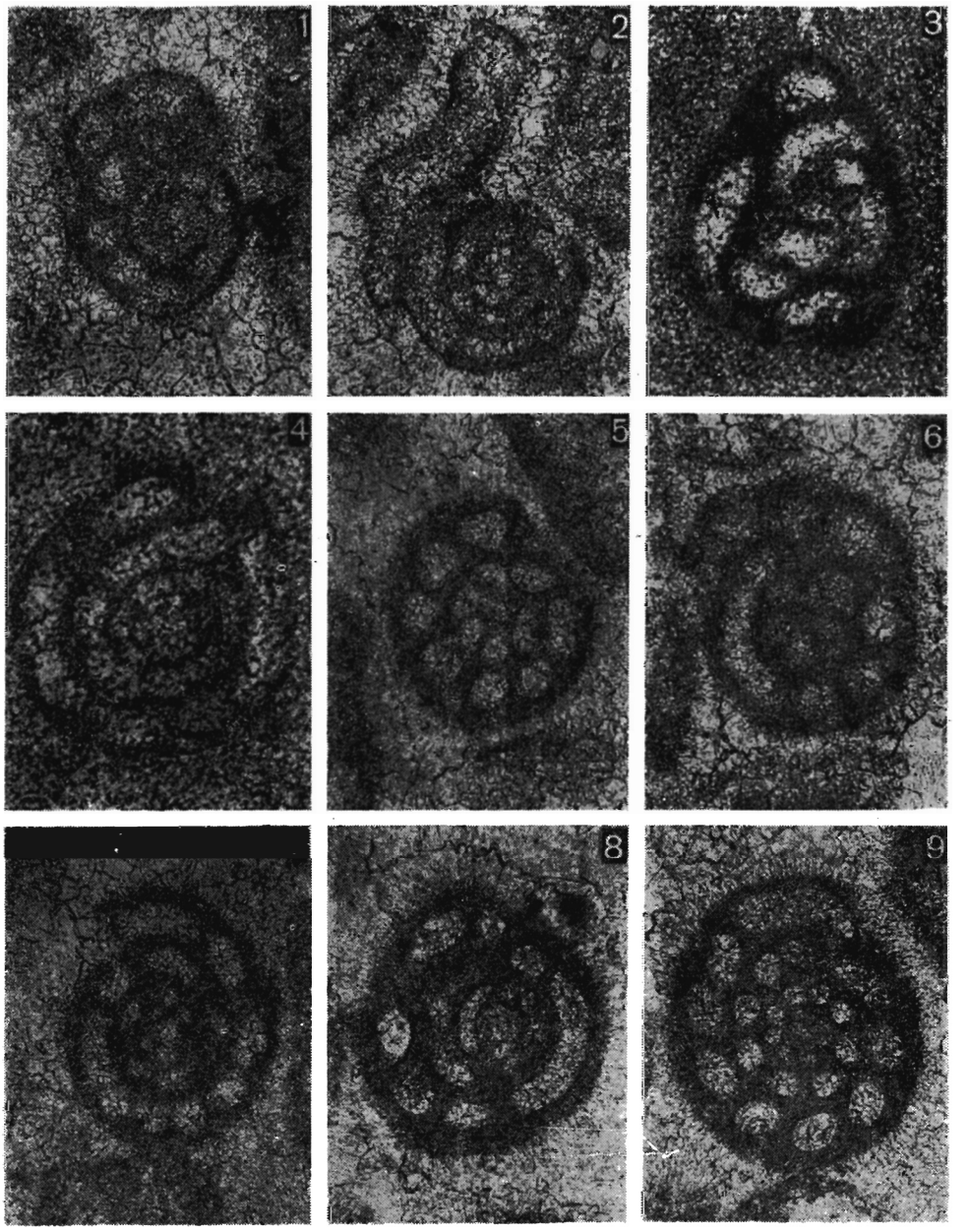
6 — *Earlandia tintinniformis* (Mišik); Gogolin Beds at Gogolin (Lower Anisian), × 200.

8 — *Earlandia? amplimuralis* (Pantić); Łukowa Beds at Zajączków (Pelsonian), × 100.

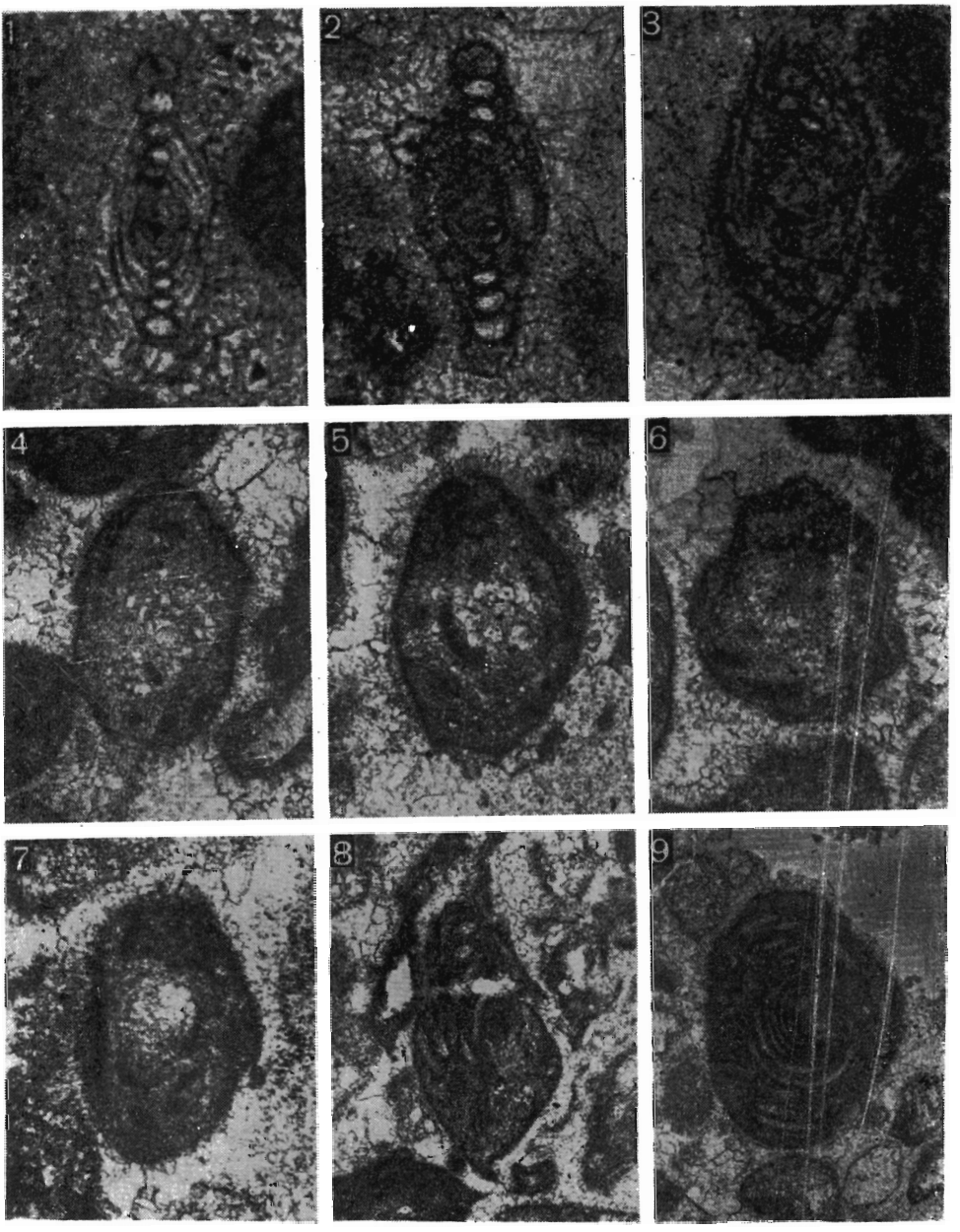
9 — *Endothyranella* sp.; Górażdże Beds at Strzelce Opolskie (Pelsonian), × 90.

10-12 — *Endothyranella?* sp. *A;* Łukowa Beds at Pollchno (Lower Anisian); *10-11* × 90, *12* × 130.

13-15 — *Endothyranella wirzi* (Koehn-Zaninetti); *Diplopora* Dolomites at Kamień Śląski (Illyrian), × 55.



1 — *Meandrospiranella* sp.; Górażdże Beds at Strzelce Opolskie (Pelsonian), × 130.
2 — *Meandrospiranella?* sp.; Górażdże Beds at Strzelce Opolskie (Pelsonian), × 130.
3-4 — *Meandrospira* sp.: 3 — Górażdże Beds at Górażdże (Pelsonian), × 125; 4 — Górażdże Beds at Strzelce Opolskie (Pelsonian), × 180.
5-9 — *Meandrospira dinarica* Kochansky-Devidé & Pantić; Górażdże Beds at Strzelce Opolskie (Pelsonian), × 130.

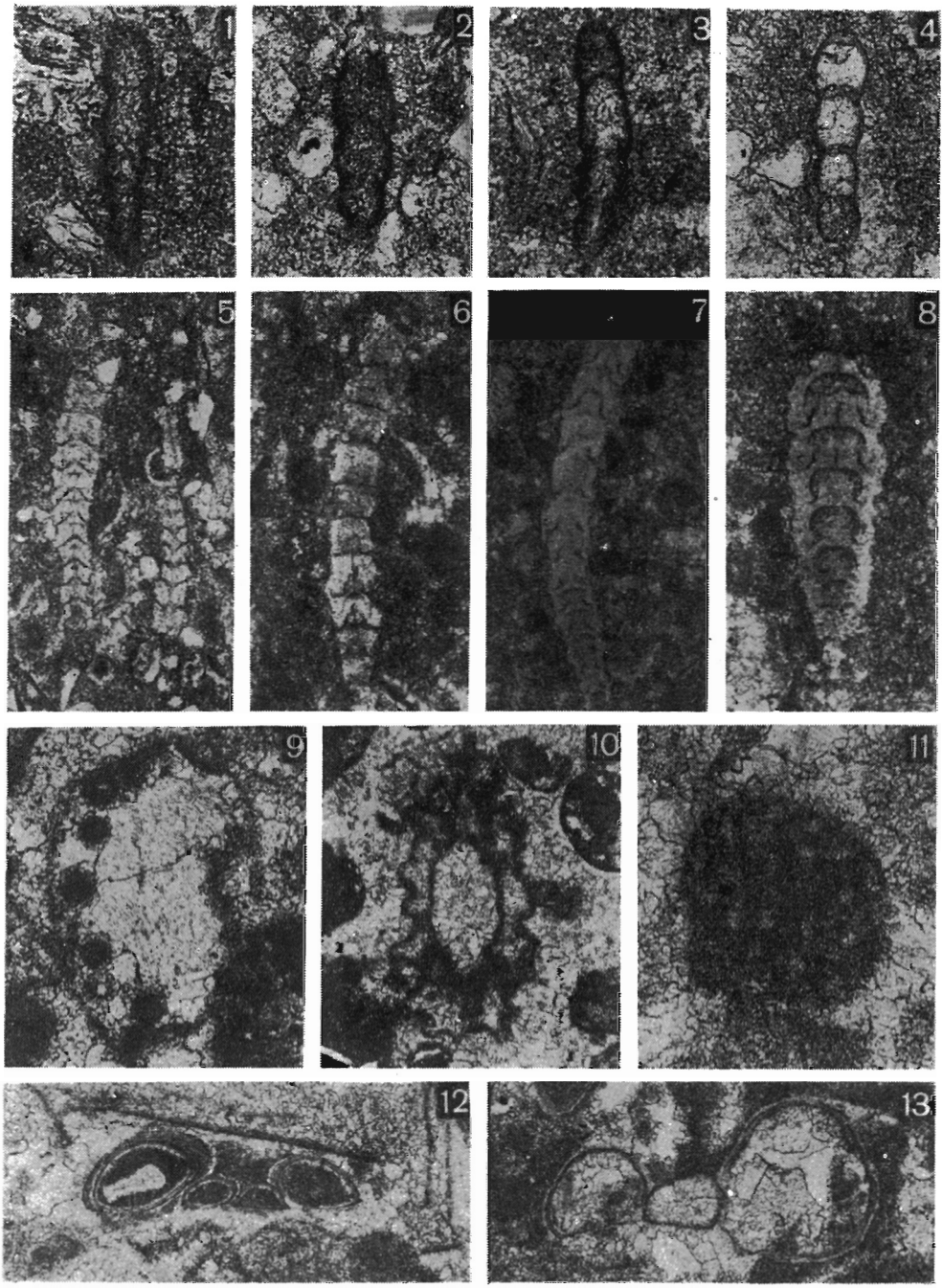


1-3 — *Involutina eomesozoica praecursor* Gaździcki, ssp. n.; Łukowa Beds at Wolica (Pelsonian), × 200.

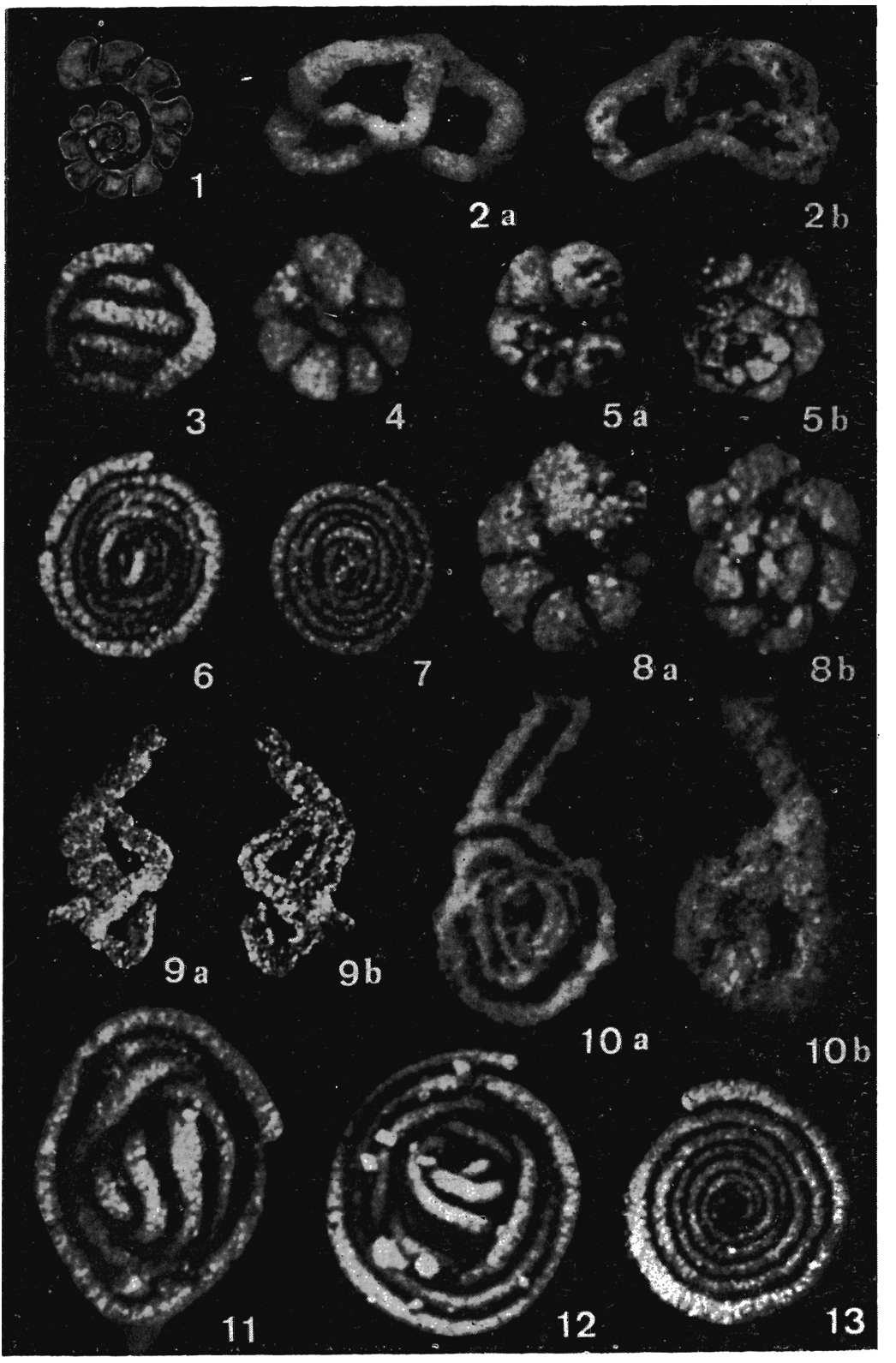
4-7 — *Involutina gaschei praegaschei* Koehn-Zaninetti, × 90: *4-6 Terebratula* Beds at Strzelce Opolskie (Pelsonian); 7 — Łukowa Beds at Polichno (Lower Anisian).

8 — *Involutina* sp.; Górażdże Beds at Górażdże (Pelsonian), × 50.

9 — *Involutina sinuosa pragsoides* (Oberhauser); Górażdże Beds at Strzelce Opolskie (Pelsonian), × 35.



1-2 — *Nodosinella rostrata* Trifonova; Gogolin Beds at Gogolin (Lower Anisian), × 120; **3** — *Nodosinella siliqua* Trifonova; Gogolin Beds at Górażdże (Lower Anisian), × 90; **4** — *Nodosinella* sp.; Gogolin Beds at Gogolin (Lower Anisian), × 120; **5-7** — *Dentalina* sp. (× 50): *5* — Gogolin Beds at Gogolin (Lower Anisian), *6* — Łukowa Beds at Wolica (Lower Anisian), **7** — Łukowa Beds at Zajączków (Pelsonian); **8** — *Nodosaria* sp.; Łukowa Beds at Zajączków (Pelsonian), × 80; **9** — *Acicullella bacillum* Pia; Górażdże Beds at Górażdże (Pelsonian), × 75; **10** — *Diplopora* sp.; *Diplopora* Dolomites at Kamień Śląski (Illyrian), × 35; **11** — coprolite *Favreina* sp.; Górażdże Beds at Strzelce Opolskie (Pelsonian), × 115; **12** — *Spirorbis phlyctaena* Brönnimann & Zaninetti; Gogolin Beds at Gogolin (Pelsonian?), × 35; **13** — *Spirorbis* sp.; *Pecten discites* Beds at Zajączków (Illyrian), × 30.


1
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13

Dimensions of the test (*in microns*): diameter — 150—190.

Occurrence. — Lower Muschelkalk (Pelsonian) of the Holy Cross Mts (Wolica profile).

Family **Involutinidae** Bütschli, 1880

Genus *INVOLUTINA* Terquem, 1862, emend. Koehn-Zaninetti, 1968

Involutina eomesozoica (Oberhauser, 1957)

Involutina eomesozoica praecursor Gaździcki, ssp. n.

(Pl. 10, Figs 1—3)

Holotype: the specimen presented in Pl. 10, Fig. 2.

Type horizon: Łukowa Beds (Pelsonian).

Type locality: Wolica near Kielce (Holy Cross Mts).

Derivation of the name: from Latin *praecursor*, at it is the earliest representative of the species.

Diagnosis. — Test spindle-shaped; axial section ovate, with a central swelling. Coiling flat, involute; 4—6 whorls in the spire.

Material. — Ten fairly well-preserved specimens.

Association. — Exclusively with *Ammodiscus incertus, Glomospirella spirillinoides,* G. *grandis,* G. *triphonensis, Glomospirella* sp. and *Nodosaria* sp.

Description. — Test consisting of spherical proloculus and tubular deuteroloculus. Whorls flat, 4—6 in number; coiling involute. Axial section displaying somewhat elongated, ovate shape and a characteristic, two-sided central swelling (umbilical mass) undivided into pillars (Pl. 10, Figs 1—2); oblique section — ovate (Pl. 10, Fig. 3), and equatorial section — circular.

Dimensions of the test (*in microns*): diameter — 160—220, thickness — 80—90.

Remarks. — The new subspecies, *Involutina eomesozoica praecursor* Gaździcki ssp. n., is generally similar to *I. eomesozoica eomesozoica* (Oberhauser) in structural pattern, differing in fewer whorls and smaller dimensions. It may therefore be assumed that the new subspecies represents an ancestral form of the species, the nominative subspecies of which is known from the Ladinian and Upper Triassic of the Alps, Dolomites and Iran (*cf.* Oberhauser 1957; Cros & Neumann 1964; Koehn-Zaninetti 1969; Zaninetti & Brönnimann 1974; Brönnimann & al. 1974). The evolution from *I. eomesozoica praecursor* Gaździcki ssp. n. to *I. eomesozoica eomesozoica*

PLATE 12

1 — Chitinous lining, most likely of a representative of the family Duostominidae; *Diplopora* Dolomites at Wierchlesie (Illyrian), × 100.

2-13 — Pyritized moulds of the foraminifers:

2, 9 — *Tolypammina?* sp. (*2a, 9a* dorsal view, *2b, 9b* ventral view): *2* from Gogolin Beds at Górażdże (Pelsonian), *9* from Gogolin Beds at Górażdże (Lower Anisian); × 50.

3, 11-12 — *Glomospira* sp.: *3* from Górażdże Beds at Strzelce Opolskie (Pelsonian), *11-12* from Gogolin Beds at Górażdże (Pelsonian); × 100.

4-5, 8 — *Trochammina* sp. (*5a, 8a* ventral view, *5b, 8b* dorsal view); Gogolin Beds at Górażdże (Pelsonian), × 150.

6-7 — *Glomospirella* sp.: *6* from Górażdże Beds at Strzelce Opolskie (Pelsonian), *7* from Gogolin Beds at Górażdże (Pelsonian); × 100.

10 — *Ammodiscella* sp. (*10a* ventral view, *10b* dorsal view); Gogolin Beds at Górażdże (Pelsonian), × 150.

13 — *Ammodiscus* sp.; Gogolin Beds at Górażdże (Pelsonian), × 100.

All photos taken by L. Łuszczewska, M. Sc.

(Oberhauser) resulted in an increase in the number of whorls and in an enlargement the test.

Occurrence. — Known from the type locality only.

CONCLUSIONS ON FORAMINIFERS

The described foraminifers represent primarily the families Ammodiscidae (26 taxa) and Fischerinidae (15 taxa), as well as some Nodosariidae (5 taxa), Duostominidae (4 taxa), and Involutinidae (4 taxa). Foraminifers of the family Involutinidae appear to be particularly important from the point of view of stratigraphy and paleogeography (*cf.* Salaj 1969a, b; Koehn-Zaninetti 1969), and it should be emphasized that this is their first record from the epicontinental basin. They are recognized here earlier than in the Tethyan geosyncline, in fact, much earlier than it was recently assumed by Jendrejáková (1973) and Zaninetti & Brönnimann (1974). The species *Involutina sinuosa pragsoides* (Oberhauser), reported by Brönnimann, Cadet & al. (1973a) from the Upper Anisian of Yugoslavia, was found in the Lower Anisian of both Holy Cross Mts and Opole Silesia. Similarly, *Involutina gaschei praegaschei* Koehn-Zaninetti, known from the Ladinian of the Alps and from Iran (*cf.* Koehn-Zaninetti 1969; Zaninetti & Brönnimann 1974), was here found in the Lower Anisian. The new subspecies, *I. eomesozoica praecursor* Gaździcki ssp. n., was found in the Pelsonian, whereas its possible successor, *I. eomesozoica eomesozoica* (Oberhauser), was recorded from the Alps and Iran in strata not older than the Ladinian (*cf.* Koehn-Zaninetti 1969; Zaninetti & Brönnimann 1974; Brönnimann & al. 1974).

The analysis of the sections studied shows that foraminifers were more resistant to unfavourable environmental conditions than conodonts. For example, in the lower part of the Gogolin Beds (Lower Anisian) from Opole Silesia when salinity was higher than normal (Kozur & Mostler 1972b; Zawidzka 1975), foraminifers of the *Meandrospira? deformata* Zone are fairly common, but conodonts are absent.

All the foraminifer material collected is derived from carbonate sediments deposited in shallow marine basin up to 20 m deep. These deposits were never subjected to subaerial conditions during the sedimentation of the Muschelkalk sequence (*cf.* Gaździcki & Kowalski 1974; Trammer 1975; Zawidzka 1975).

STRATIGRAPHY

The analysis of distribution of foraminifers in the investigated sections (*cf.* Figs 2—3) indicates that the foraminifer zonation of the Anisian proposed by Salaj (1969a, 1974) and Zaninetti & al. (1972a) are not applicable in Poland. According to these authors, the *Meandrospira dinarica* Zone corresponds to the Pelsonian. The lower boundary of that zone was

defined by the appearance of the index species, and the upper boundary by the appearance of *Glomospira densa* (Pantić). The latter species appears in Poland as early as in the uppermost Lower Anisian (*cf.* Głazek & al. 1973; and Figs 2—3 herein), that is, before *Meandrospira dinarica* Kochansky-Devidé & Pantić.

According to Salaj (1969a, 1974), the lower boundary of the *Meandrospira insolita* Zone, corresponding to the Lower Anisian, is defined by the first appearance of the index species, and the upper one by the appearance of *Meandrospira dinarica*. However, as it was shown by Brönnimann, Cadet & al. (1973a), *Meandrospira insolita* (Ho) is the synonym of *M. pusilla* (Ho) which is known from the Scythian and the whole Middle Triassic (Salaj & al. 1967; Trifonova 1972a; Brönnimann, Cadet & al. 1973a).

It may therefore be concluded that the foraminifer zones proposed by Salaj (1969a, 1974) and Zaninetti & al. (1972a) are of the merozone (*Teilzone*) or even of the topozone character. A modification of the foraminifer zonation, based on the results of studies in southern Poland, is given below.

MEANDROSPIRA? DEFORMATA ZONE

Partial-range Zone; Scythian and Lower Anisian (except of its topmost part)

Definition: The range of this zone is defined by the occurrence of *Meandrospira? deformata* in the absence of *Glomospira densa*. The zone is also characterized by an association of the index species and *Glomospira sinensis, Glomospirella elbursorum, Nodosinella siliqua* and *N. rostrata*.

Lower boundary: Defined by the first appearance of *Meandrospira? deformata*.
Upper boundary: Defined by the first appearance of *Glomospira densa*.

Remarks. — The material from the Muschelkalk of Poland makes it possible to define the Lower Anisian part of this zone only, as data concerning Lower Triassic foraminifers are not available. The Scythian part of this zone is characterized from the data given by other authors (Dimitrijević & al. 1968; Pantić 1970; Urošević 1971; and Trifonova 1972a, b). Similar assemblages of associated foraminifers were reported from Yugoslavia (Pantić & Rampnoux 1972) and Iran (Brönnimann & al. 1973; Baud & al. 1974).

Geographic distribution: Yugoslavia (Dimitrijević & al. 1968; Pantić 1970; Urošević 1971), Bulgaria (Trifonova 1972a, b), Poland.

GLOMOSPIRA DENSA ZONE

Range Zone; uppermost Lower Anisian, Pelsonian, Illyrian

Definition: The range of this zone is defined by stratigraphic range of the species *Glomospira densa*. The zone is also characterized by an association of the index species and *Glomospirella grandis, Meandrospira dinarica* and *Agathammina judicariensis* (only Pelsonian part of the zone).

Remarks. — In Poland, the index species has been recorded from the Lower Anisian, Pelsonian and lowermost Illyrian; it was not found in the Upper Illyrian

because of unfavourable environmental conditions. It is recorded elsewhere up to the end of Illyrian (*cf.* Salaj 1969a, 1974).

The report on *Glomospira densa* from the Scythian/Anisian junction beds (Urošević 1971) seems to be unsubstantiated (*cf.* Głazek & al. 1973).

Geographic distribution: Yugoslavia (Pantić 1965, 1967, 1970; Dimitrijević & al. 1968; Roksandić & Čanović 1970; Urošević 1971; Pantić & Rampnoux 1972; Brönnimann, Cadet & al. 1973a, b), Czechoslovakia (Salaj & al. 1967; Borza 1970), Italy (Gaetani 1969; Premoli Silva 1971), Austria (Koehn-Zaninetti 1969), Switzerland and France (Baud & al. 1971), Greece (Christodoulou & Tsaila-Monopolis 1972), Bulgaria (Trifonova 1972a), Poland (Głazek & al. 1973).

PALEOGEOGRAPHIC REMARKS

The investigated Muschelkalk foraminifer assemblage does not differ from the contemporaneous assemblages of the Anisian of the Tethys, either in specific composition or in stratigraphic distribution of particular associations (*cf.* Figs 2—3).

The assemblage found in the Lower Anisian appears analogous in specific composition to that known only from Bulgaria, and comprising *Nodosinella rostrata* Trifonova, *N. siliqua* Trifonova, *Meandrospira? deformata* (Salaj) and *Hemigordius? chialingchiangensis* (Ho) (*cf.* Trifonova 1972a, b). It is accompanied by some taxa widely known from the Triassic of large areas of the Tethys, as follows: *Glomospira sinensis* (Ho), *Glomospirella triphonensis* Baud & al. (1971), *G. elbursorum* Brönnimann & al. (1972), *Earlandia tintinniformis* Mišik and *Diplotremina astrofimbriata* Kristan-Tollmann (*cf.* Ho 1959; Tollmann & Kristan-Tollmann 1970; Brönnimann & al. 1972).

The Pelsonian-Illyrian foraminifer assemblage of the Polish Muschelkalk does not show any impoverishment in comparison with the contemporaneous assemblages of the Tethys; it even yields such a group as the Involutinidae, not hitherto known from such early strata of the Tethyan areas.

Taking into account the present state of knowledge of Middle Triassic foraminifers, it may be stated that this group of microfauna was equally well adjusted to conditions prevailing in geosynclinal and epicontinental basins of those times.

The presented data support the earlier statements that the extra-Carpathian part of Poland, *i.e.* the Muschelkalk basin, belonged to the Tethyan province in Anisian times (*cf.* Biely & Bystrický 1964; Trammer 1973, 1975; Zawidzka 1975; *see* also Kozur 1974). The contribution of the Tethyan fauna was still detectable in the Ladinian.

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OTWORNICE Z WAPIENIA MUSZLOWEGO POLSKI

(Streszczenie)

W profilach wapienia muszlowego Śląska Opolskiego oraz południowo-zachodniego obrzeżenia mezozoicznego Gór Świętokrzyskich (fig. 1—3) rozpoznano 71 taksonów otwornic (pl. 1—12), wśród których znajdują się dwa dla nauki nowe — *Endothyra salaji* Gaździcki sp. n. oraz *Involutina eomesozoica praecursor* Gaździcki, ssp. n.

Z uwagi na fakt, że pozycja chronostratygraficzna rozpatrywanych profilów rozpoznana jest dokładnie dzięki stratygrafii konodontowej (Trammer 1972, 1975; Kozur 1974; Zawidzka 1974a, b, 1975), można było zasięgi otwornic umiejscowić w standardowym schemacie wiekowym (anizyk—dolny ladyn). Podkreślić należy, że w badanych obszarach już w dolnym anizyku pojawia się kilku przedstawicieli rodziny Involutinidae Bütschli, 1880, którzy dotychczas byli znani dopiero od anizyku górnego oraz ladynu.

W obrębie dolnego anizyku zaproponowano poziom ścieśniony (partial-range zone) *Meandrospira? deformata* oraz zmodyfikowano definicję poziomu całkowitego (range zone) *Glomospira densa* zarówno *sensu* Salaj (1969a, 1974), jak i *sensu* Zaninetti & al. (1972a), a którego zasięg rozciągnąć należy od najwyższego dolnego anizyku aż po illyr. Wykazano ponadto, że zespół otwornicowy wapienia muszlowego Polski nie różni się od równowiekowego zespołu otwornic Tetydy.
