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ON SOME REPRESENTATIVES OF THE FAMILY
NODOSARIIDAE (FORAMINIFERIDA) FROM THE MIDDLE
JURASSIC OF POLAND

Pl. CIII—CVII and 8 Figs.

O niektórych przedstawicielach rodziny *Nodosariidae*
(*Foraminiferida*) środkowej jury Polski

Tabl. CIII—CVII i 8 fig.

Abstract. Three new species, *Frondicularia (Ichtyolaria) nympa* sp.n., *Lenticulina (Astacolus) kujaviana* sp.n. and *L. (A.) argonauta* sp.n., as well as new subspecies, *L. (A.) polymorpha arachne* subsp.n., have been distinguished in an assemblage of foraminifers occurring in the epicontinental Kuiavian and Bathonian sediments of Poland. The first two species are common in Kuiavian stage (Upper Bajocian and Lower Bathonian sensu anglico) of the Pomeranian Swell, Fore-Sudetic Monocline, Rawa-Gielniów Anticline and Cracow-Wieluń Jura. *Lenticulina (Astacolus) polymorpha arachne* subsp.n. and *L. (A.) argonauta* sp.n. have so far been distinguished only in the Kuiavian and Bathonian of the Cracow-Wieluń Jura.

INTRODUCTION

During the period of the greatest intensity of transgressive movements, the epicontinental sedimentation basin of the Middle Jurassic covered more than 3/4 of the territory of the present Poland. The general Middle Jurassic transgression, originated in the Aalenian and covering a fairly narrow zone of activity, reached its maximum range in higher parts of the Dogger, that is, in the Kuiavian and Bathonian. In the area of Northern and Central Poland, the sediments of these stages are mostly characterized by a clayey lithofacies rich in fossils. The palaeontological material, described in the present paper, comes precisely from those formations. It was obtained only from boring samples which came from both classical outcrops (Cracow-Wieluń Jura) and areas in which Middle Jurassic sediments are sunken to fairly large depths (Polish Lowland).

Some of the new species here described such as, *Frondicularia (Ichtyolaria) nympa* sp.n. and *Lenticulina (Astacolus) kujaviana* sp.n., have for many years now played the role of index foraminifers stratigraphically important for the Middle and Upper Kuiavian of Poland. According to the stratigraphic schema in force in Poland, the two species referred to above are recorded in the following ammonite zones: *Parkinsonia suba-*

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rietis, *P. parkinsoni*. *P. schloenbachi* (Middle Kuiavian), as well as *Parkinsonia compressa* and *P. ferruginea* (Upper Kuiavian). The former three ammonite zones correspond, in Western Europe, to a standard zone of *Parkinsonia parkinsoni* (upper part of the Upper Bajocian) and the latter two — to the *Zigzagiceras zigzag* zone (Lower Bathonian sensu anglico).

Lenticulina (Astacolus) polymorpha arachne subsp. n. and *L. (A.) argonauta* sp. n. have a slightly wider stratigraphic range (from Middle

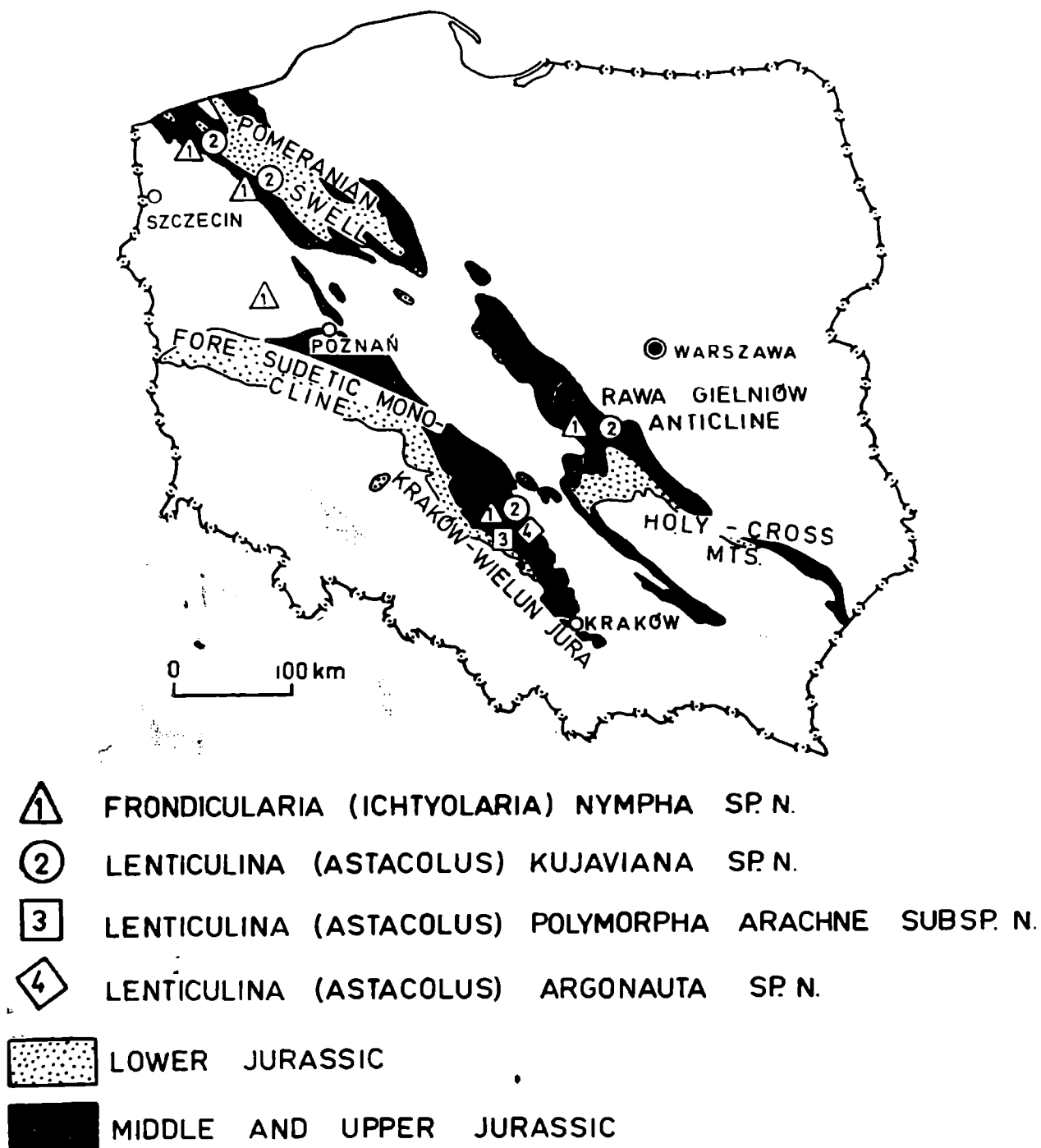


Fig. 1. Localities in which new species of *Lenticulina* and *Frondicularia* occur in Poland, shown against the background of sub-Cenozoic outcrops of the epicontinental Jurassic

Kuiavian to Lower or Middle Bathonian). As to their number, they also are not as abundantly represented as the two former species. For these reasons, therefore, their stratigraphic value as index species is smaller by far despite the fact that their geographical range (on European scale) seems to be considerably wider than that of *Frondicularia* (*Ichtyolaria*) *nympha* sp. n. and *L. (A.) kujaviana* sp. n.

STRATIGRAPHIC UNITS				FRONDICULARIA (ICHTYOLARIA) NYMPHA SP. N.	LENTICULINA (ASTACOLUS) KUJAVIANA SP. N.	LENTICULINA (ASTACOLUS) POLY- MORPHA ARACHNE SUBSP. N.	LENTICULINA (ASTACOLUS) ARGONAUTA SP. N.
WEST EUROPE		POLAND					
BATHONIAN	UPPER	BATHONIAN	UPPER				
	MIDDLE		MIDDLE	CADOMITES AFF. DESLONGCHAMPSI			
BAJOCIAN	UPPER	KUIAVIAN	MIDDLE	PARKINSONIA SCHLOENBACHI	█	█	█
			MIDDLE	PARKINSONIA PARKINSONI	█	█	█
BAJOCIAN	UPPER	KUIAVIAN	MIDDLE	PARKINSONIA SUBARIETIS	█	█	█
			UPPER	PARKINSONIA FERRUGINEA	█	█	
BATHONIAN	LOWER	BATHONIAN	UPPER	PARKINSONIA COMPRESSA	█	█	
			LOWER	GRACILISPHINCTES PROGRACILIS		█	█
BATHONIAN	MIDDLE	BATHONIAN	LOWER	MORRISICERAS MORRISI			█
			UPPER				█

Fig. 2. Vertical occurrence of some species of *Lenticulina* and *Frondicularia* in the epicontinental sediments of the Middle Jurassic of Poland

PALAEONTOLOGICAL PART

Legend (symbols used in Tables):

- L — the largest length of the test,
- W — the largest width of the test,
- T — the largest thickness of the test,
- Dc₁ — diameter of initial chamber (proloculum),
- C — number of chambers (proloculum included),
- L/W — length-width ratio,
- W/T — width-thickness ratio.

Order Foraminiferida Eichwald, 1830

Family Nodosariidae Ehrenberg, 1838

(nom. corr. Lister in Lankester, 1903)

Subfamily Nodosariinae Ehrenberg, 1838

(nom. corr. Chapman, 1900)

Genus *Frondicularia* DeFrance (in d'Orbigny, 1826)

Subgenus *Ichtyolaria* Wedekind, 1937

(emend. Sellier de Civrieux & Dessauvagie, 1965)

(Type species: *Frondicularia bicostata* d'Orbigny, 1849)

Frondicularia (Ichtyolaria) nympa sp. n.

(Pl. CIII, Figs. 1—13; Text-figs. 3a—c, 4a—d)

? 1922 *Frondicularia intumescens* Bornemann; Paalzow R.: p. 19, tabl. 2, Fig. 12.

? 1959 *Frondicularia spissa* Terquem; Ziegler J.H.: p. 111, tabl. 4, Fig. 8.

Material. Fifty specimens from the Middle and Upper Kuiavian of Cracow-Wieluń Jura, Pomeranian Swell and Rawa-Gielniów Anticline. **Holotypus:** Pl. CIII, Fig. 2, Text-fig. 3b; Coll. 5,602/68/F, Geological Institute, Warsaw.

Stratum typicum: Middle Kuiavian (Upper Bajocian sensu anglico).

Locus typicus: Korwinów 136 bore-hole, depth 99.8 m (Cracow-Wieluń Jura, Poland).

Derivatio nominis: Greek νύμφα = nymph, after a characteristic appearance of the test, similar to nymph.

Paratypus: Pl. CIII, Fig. 3, Text-fig. 4a (5,603/68/F), Middle Kuiavian, Dargoszewko bore-hole, depth 209.5 m (Pomeranian Swell).

Diagnosis. Tests calcareous, ortho- and uniserial, middle-sized, variable in shape (rhomboidal to oval). Inter-chamber sutures thick, raised, shaped like a blunt chevron. Margins of test having a blunt or a slightly sharpened slat or keel. Transverse section lenticulate or oval. Tests smooth or with a small number of fine „costae”. In general appearance, tests resemble larvae of an insect. Two to eight chambers.

Description. Terminal aperture round, radiate, situated on a more or less strongly developed cone. Inter-chamber sutures shaped like chevrons with gently diverging arms, thick and raised, widening towards the middle of the test. Test margin has a blunt or, sometimes, somewhat sharpened slat, frequently in the form of a keel, which at an acute angle contacts thick and projecting sutures. Transverse section lenticulate to oval. Initial chamber variable in size, round, mostly markedly isolated,

Table 1

Fronidicularia (Ichtyolaria) nympha sp.n., dimensions in mm:

Specimen	Locality, depth	Stage	L	W	T	Do ₁	C	L/W	W/T
5,613/68/F Pl. CIII, Fig. 10	Odrzykoń 3/XII 189.0 m	Middle Kuiavian	1.02	0.35	0.19	0.17	7	2.9	1.84
5,610/68/F Pl. CIII, Fig. 11	Odrzykoń 3/XII 186.0 m	Middle Kuiavian	0.97	0.42	0.21	0.11	7	2.31	2.00
5,601/68/F Pl. CIII, Fig. 1	Góra Włodowska 2/XVI 63.0 m	Upper Kuiavian	0.86	0.47	0.21	0.20	6	1.83	2.24
5,611/68/F Pl. CIII, Fig. 12	Korwinów 1/XII 58.9 m	Middle Kuiavian	0.82	0.34	0.17	0.09	8	2.41	2.00
5,602/68/F Pl. CIII, Fig. 2, holotype	Korwinów 136 99.8 m	Middle Kuiavian	0.80	0.42	0.21	0.17	7	1.90	2.00
5,600/68/F Pl. CIII, Fig. 3, paratype	Dawgossawka 209.5 m	Middle Kuiavian	0.72	0.39	0.22	0.15	6	1.85	1.82
5,605/68/F Pl. CIII, Fig. 5	Korwinów 1/XII 65.8 m	Middle Kuiavian	0.64	0.32	0.17	0.15	5	2.00	1.88
5,607/68/F Pl. CIII, Fig. 7	Korwinów 1/XII 78.1 m	Middle Kuiavian	0.52	0.37	0.20	0.17	4	1.4	1.85

Fig. 3. *Fronidicularia (Ichtyolaria) nympha* sp. n.; a — frontal and apertural view (Pl. CIII, Fig. 1), 5,601/68/F, Upper Kuiavian; b — frontal and apertural views, holotype (Pl. CIII, Fig. 2), 5,602/68/F, Middle Kuiavian; c — frontal view (Pl. CIII, Fig. 10), 5,613/68/F, Middle Kuiavian

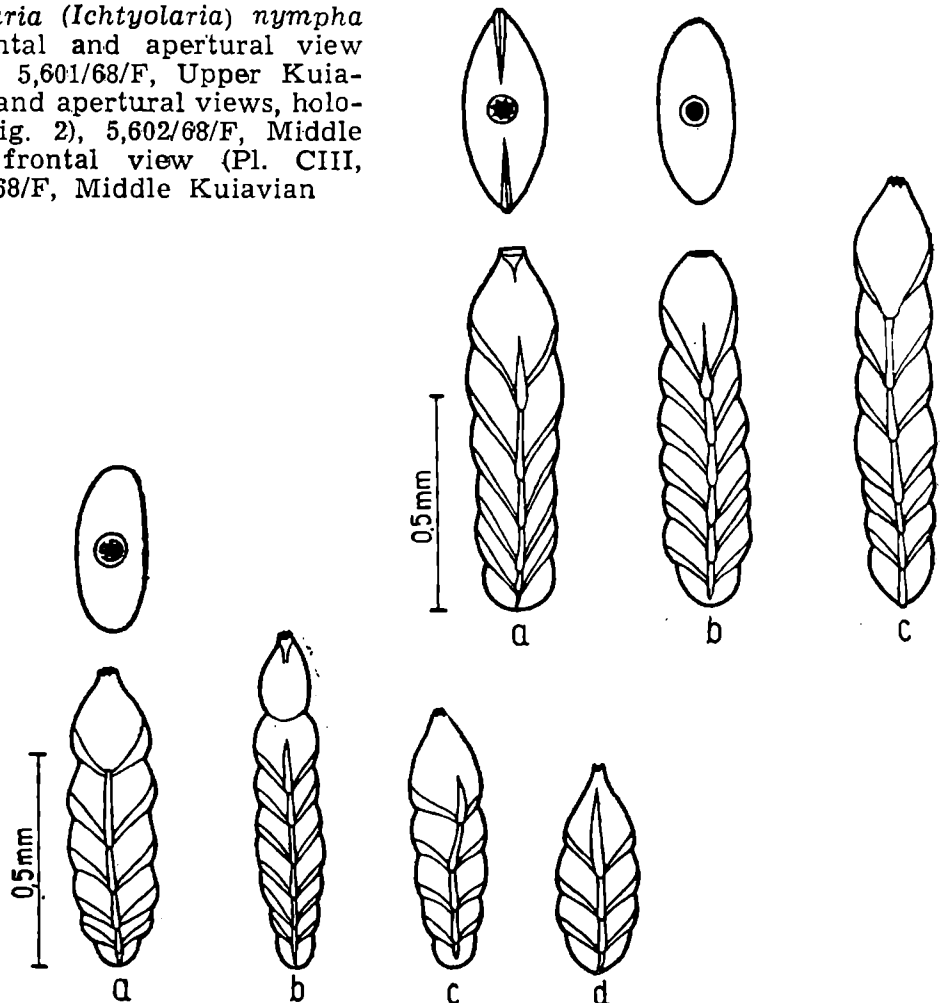


Fig. 4. *Fronidicularia (Ichtyolaria) nympha* sp. n., Middle Kuiavian. a — frontal and apertural views, paratype (Pl. CIII, Fig. 3), 5,603/68/F; b — frontal view (Pl. CIII, Fig. 12), 5,611/68/F; c — same (Pl. CIII, Fig. 5), 5,605/68/F; d — same (Pl. CIII, Fig. 7), 5,607/68/F

frequently bordered by a peripheral slat. The last formed chamber either poorly outlined or clearly separated from the preceding chambers, variable in size, frequently strongly indented and devoid of the peripheral slat. Surface of test smooth or, rarely, with a few, poorly visible, thin and short „costae”. Number of chambers: 2—8. Holotype (Pl. CIII, Fig. 2, Text-fig. 3b) belongs to a group of specimens which are marked by the presence of a poorly individualized, although visible and large initial chamber (0.07 mm in diameter). It has a test whose margin, together with a small part of the last formed chamber, are bordered by a peripheral slat. Its surface is covered with a fine and scarce, radial ornamentation of the type of „costae”. The lack of the apertural cone is probably a result of mechanical damage. Paratype (Pl. CIII, Fig. 3, Text-fig. 4a) has a smooth test, more indented, blunt peripheral margin and a slightly smaller and conspicuously individualized initial chamber. *Variability.* The variability is very distinctly expressed by different size and shape of tests, shape of individual chambers, thickness of inter-chamber sutures and presence or absence of the traces of ornamentation of the type of „costae”. Despite these differences, all specimens, regardless of the stratigraphic range of their occurrence (Middle to Upper Kuiavian), display several invariable characters as, chevron-shaped, thick sutures, slightly undercut chambers, bordering of the peripheral parts of the test with a marginal slat, conelike aperture and an initial chamber which on the whole is individualized. A small number of individuals of the microspherical generation was the reason why no detailed comparison of the forms having a differentiated size of initial chamber could be made. *Comparative remarks.* *Frondicularia „spatulata”* Terquem¹ differs from *F. (I.) nympa* sp. n. in a different cross section of the test, concave sides, very dense and fine ribbing (specimens considered by M. O. Terquem, 1870 to be typical: Pl. XXII, Figs. 11 and 12) and a lack of strong, raised inter-chamber sutures.

Frondicularia spissa Terquem (1870, Pl. XXII, Fig. 10), sometimes related with *F. spatulata* Terquem (H. Bartenstein & E. Brand, 1937; R. Cifelli, 1959) displays a somewhat larger similarity to *F. (I.) nympa* sp. n. (shape of test, thickened inter-chamber sutures). These two species differ from each other in the following characters: the presence of convexities in the middle of the sides of test in Terquem's species, the lack of any traces of ornamentation, the absence of peripheral slats, the presence of „mucro” on the initial chamber and the occurrence, in the initial portion of the test, of three oval chambers, arranged in the form of a triangle (spiral part?). In connection with the last-named character, a certain doubt may arise concerning either the correctness of the assignment of this species to the genus *Frondicularia* or the accuracy of M. O. Terquem's illustration. *F. spissa* Terquem sensu Ziegler, 1959, described from the Upper Bathonian of Bavaria, seems to be more strongly related to *F. (I.) nympa* sp. n. than to the typical specimen from Fontoy.

Likewise, some Lower Jurassic species of the genus *Frondicularia* (*Ichtyolaria*) may be partly compared with the specimens from the Kuiavian of Poland. Thus, for instance, *F. (I.) intumescens* Bornemann, 1854 displays a similar shape of test and the presence of a

¹ The specific name used by M. O. Terquem (1870) is a younger homonym of the name *Frondicularia spatulata* Costa, 1855.

peripheral slat, but differs in a plano-arcuate outline of chambers and the lack of projecting inter-chamber sutures. The rapid evolution of the Jurassic species of the genus *Frondicularia* being a well-known fact, the difference in the stratigraphic position of both these forms is of a considerable importance.

F. intumescens Bornemann sensu Paalzow (1922, Pl. 2, Fig. 12), described from the „marls from *Parkinsonia*” of Southern Germany, considerably deviates from the Liassic species of Bornemann, displaying at the same time a similarity to some, non-typical forms of *F. (I.) nympa* sp. n.

Finally, *F. inermis* Kübler et Zwingli sensu Hofman, 1967, described from the Bajocian of the Caucasia, is probably also more strongly related to the Middle Jurassic specimens of *F. (I.) nympa* sp. n. than to the Lower Liassic species described by J. Kübler & H. Zwingli (1870) from the Swiss Jura Mts.

Occurrence. In Poland, *Frondicularia (Ichtyolaria) nympa* sp. n. occurs only in the Middle (frequently) and Upper (less frequently) Kuiavian. In this country it is considered as an important index fossil. It is recorded in the area of almost entire Polish epicontinental Jurassic (see Fig. 1). Presumably, this species also occurs in the Middle Kuiavian of Southern Germany.

Genus *Lenticulina* Lamarck, 1804

(Type species: *Lenticulites rotulata* Lamarck, 1804)

Subgenus *Astacolus* de Montfort, 1808

(Type species: *Nautilus crepidulus* Fichtel et Moll, 1798)

Lenticulina (Astacolus) argonauta sp. n.

(Pl. CIV, Figs. 1—8; Text-fig. 5a—d)

1869 *Cristellaria polymorpha* Terquem; M. O. Terquem: p. 192—193 (partim), tabl. XIX, Fig. 14.

1937 *Cristellaria (Lenticulina) quenstedti* Gümbel; H. Bartenstein & E. Brand: p. 177 (partim), tabl. 13, Fig. 39a, b, c.

Material. Eighteen specimens from the Middle and Lower Bathonian and Middle Kuiavian of Cracow-Wieluń Jura.

Holotypus: Pl. CIV, Fig. 1, Text-fig. 5a; Coll. 5,614/68/F, Geological Institute, Warszawa.

Stratum typicum: Middle Bathonian.

Locus typicus: Dębowiec 3/XIII bore-hole, depth 106.0 m (Cracow-Wieluń Jura, Poland).

Derivatio nominis: Greek ἀργοναυτης = Argonaut.

Paratypus: Pl. CIV, Fig. 2, Text-fig. 5c (Coll. 5,615/68/F, Geological Institute, Warszawa), Rebielice Królewskie bore-hole, depth 107—110.5 m, Middle Bathonian (Cracow-Wieluń Jura), Pl. CIV, Fig. 8, Text-fig. 5d (Coll. 5621/68/F, Geological Institute, Warszawa), Dębowiec 3/XIII bore-hole, depth 106.0 m, Middle Bathonian (Cracow-Wieluń Jura).

Diagnosis. Tests calcareous, planispiral, middle-sized, fairly flat, coiled in the form of an open spiral. The first 6—7 chambers are fairly tightly coiled, further chambers erect and not adhering to the initial chamber. Ornamentation conspicuous; thick, falciform lateral costae bent posteriorly, contacting a sharp, projecting keel, they take the form of

a chevron. Adult specimens reveal the trace of a single, short, transversal costa. Terminal aperture radiate, opening slightly upwards, situated on a characteristic cone. Six to eleven chambers in all.

Table 2

Lenticulina /Astacolus/ argonauta sp.n., dimensions in mm:

Specimen	Locality, depth	Stage	L	w	T	Do ₁	C	L/W	w/T
5,614/68/F Pl. CIV, Fig. 1, holotype	Dębowiec 3/XIII 106.0 m	Middle Bathonian	1.2	0.8	0.25	0.07	11	1.5	3.2
5,615/68/F Pl. CIV, Fig. 2, paratype	Rębielice Królewskie 107-110.5 m	Middle Bathonian	0.92	0.65	0.22	0.10	8	1.4	2.9
5,616/68/F Pl. CIV, Fig. 3	Kotowiec 3/XVI 170.5 m	Lower Bathonian	0.87	0.60	0.27	0.07	9	1.4	2.2
5,618/68/F Pl. CIV, Fig. 5	Dębowiec 3/XIII 127.8 m	Middle Bathonian	0.82	0.47	0.20	0.07	8	1.7	2.3
5,619/68/F Pl. CIV, Fig. 6	Korwinów 1/XII 88.3 m	Middle Kutavian	0.82	0.47	0.20	0.11	6	1.7	2.3
5,620/68/F Pl. CIV, Fig. 7	Dębowiec 3/XIII 106.0 m	Middle Bathonian	0.65	0.45	0.22	0.07	6	1.4	2.0
5,621/68/F Pl. CIV, Fig. 8, paratype	Dębowiec 3/XIII 106.0 m	Middle Bathonian	0.55	0.40	0.22	0.07	6	1.4	1.8

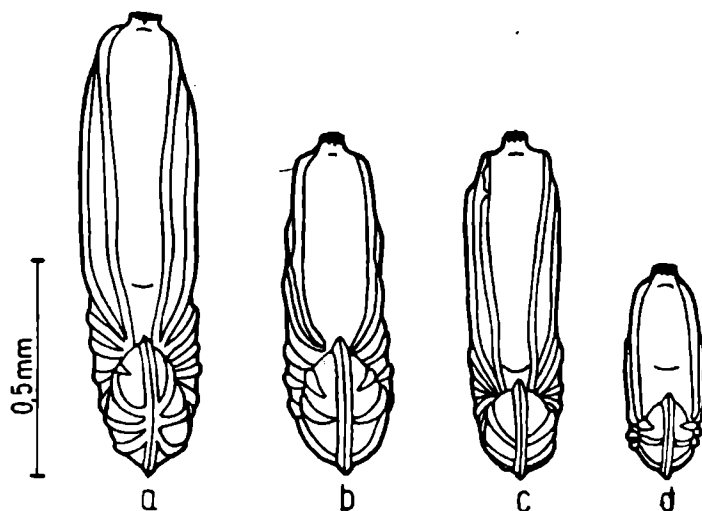


Fig. 5. *Lenticulina (Astacolus) argonauta* sp.n., frontal view. a — holotype (Pl. CIV, Fig. 1), 5,614/68/F, Middle Bathonian; b — (Pl. CIV, Fig. 3), 5,616/68/F, Lower Bathonian; c — paratype (Pl. CIV, Fig. 2), 5,615/68/F, Middle Bathonian; d — paratype (Pl. CIV, Fig. 8), 5,621/68/F, Middle Bathonian

Description. Tests laterally flattened, the thickness at about 2/5 of their length. Coiling fairly loose, tighter in the initial portion, and becoming looser beginning with the 7th—8th chamber. Initial chamber differentiated concerning its size (0.07 mm, 0.10—0.11 mm) completely or partly revealed. Ornamentation of the test conspicuous. Radial, falci-form lateral costae, bent posteriorly, converge near a massive, sharp keel shaped like a chevron. Very rarely, the traces of short, transversal „costae” are observed in some adult specimens (cf. Pl. CIV, Fig. 1). Umbilical depression small, irregular in outline. Terminal aperture radiate, projecting, situated on a characteristic cone.

Variability. Variability consists in a slightly varying outline of tests, extent of their flattening, dimensions of the spiral part and more or less strongly overlapping chambers. Specimens with diameters of initial chambers of the order of 0.10—0.11 mm (few of them occurring) have a smaller number of chambers than those corresponding in dimensions but with initial chambers 0.07 mm in diameter.

Comparative remarks. *Lenticulina* (A.) *polymorpha* (Terquem) and in particular its subspecies *L. (A.) polymorpha arachne* subsp. n. are related to *Lenticulina (Astacolus) argonauta* sp. n. Although there are fairly distinct differences between these species such as, the lack in *L. (A.) argonauta* sp. n. of the peripheral slat¹, a slightly different trace of lateral costae, etc., the principal types of structure of both forms seem to be very similar to each other. Our specimens slightly differ from *L. (A.) volubilis* Dain in the outline of tests, smaller thickness and lack of fine, transversal „costae”.

L. interrumpa Blank, 1961 distinguishes itself by a different type of its ornamentation (convex, strongly undercut chambers) and by a slightly different shape of its test. On the other hand, a considerable similarity in shape and ornamentation is observed between our specimens and *L. (Lenticulina) quenstedti* (Gümbel), in particular some Middle Jurassic specimens (cf. — synonymy) related with this species. Our specimens differ from typical Upper Jurassic representatives of *L. (L.) quenstedti* (Gümbel) in the astacolus type of the coiling of tests, their strong flattening, presence of a distinct keel and lack of a looplike periumbilical slat characteristic of Gümbel's species.

Occurrence. Rare in the Kuiavian, fairly numerous in the Lower and Middle Bathonian. In Poland, this species is primarily recorded in the area of the Cracow-Wieluń Jura. Outside of Poland, *L. (A.) argonauta* sp. n. occurs in the *Parkinsonia parkinsoni* zone of Western France and North-western Germany.

Lenticulina (Astacolus) polymorpha arachne subsp. n.

(Pl. CIV, Figs. 11 and 12; Pl. CV, Figs. 1—9; Text-fig. 6a—d)

1869 *Cristellaria polymorpha* Terquem; M. O. Terquem: p. 192—193 (partim), tabl. XX, Fig. 7?, 8, 9, tabl. XXI, Fig. 11?

1937 *Cristellaria (Astacolus) tricarinella* Reuss; H. Bartenstein & E. Brand: p. 173 (partim), tabl. 13, Fig. 35a, b.

1959 *Lenticulina (Lenticulina) polymorpha* (Terq.); J. H. Ziegler: p. 102, tabl. 4, Fig. 32, 33, 34, 35.

Material. Fifteen specimens from the Middle Kuiavian and Lower Bathonian of the Cracow-Wieluń Jura.

Holotypus: Pl. CV, Fig. 1, Text-fig. 6a; Coll. 5,626/68/F, Geological Institute, Warszawa.

Stratum typicum: Middle Kuiavian (Upper Bajocian sensu anglico).

Locus typicus: Korwinów 136 bore-hole, depth 35.0 m (Cracow-Wieluń Jura, Poland).

Derivatio nominis: Greek αραχνη = web, after a characteristic ornamentation of the test resembling a spider's web.

¹ Traces of a single, transversal costa, observed in some adult specimens of *L. (A.) argonauta* sp. n., may be considered a remainder of this element.

Paratypus: Pl. CV, Figs. 2 and 3, Text-figs. 6b, 6c (Coll. 5,627, 5,628/68/F, Geological Institute, Warszawa), Korwinów 136 bore-hole depth 35.0 m, Middle Kuiavian (Cracow-Wieluń Jura, Poland).

Table 3

Lenticulina /Astacolus/ polymorpha arachne subsp.n. - dimensions in mm:

Specimen	Locality, depth	Stage	L	W	T	Dc ₁	C	L/W	W/T
5,626/68/F Pl. CV, Fig. 1, holotype	Korwinów 136, 35.0 m	Middle Kuiavian	1.35	0.82	0.26	0.16	8	1.6	3.1
5,627/68/F Pl. CV, Fig. 2, paratype	Korwinów 136, 35.0 m	Middle Kuiavian	1.17	0.75	0.27	ca 0.12	8	1.6	2.8
5,628/68/F Pl. CV, Fig. 3, paratype	Korwinów 136, 35.0 m	Middle Kuiavian	0.90	0.62	0.3	0.15	7	1.4	2.1
5,633/68/F Pl. CV, Fig. 8	Dębowiso 3/XIII, 161.5 m	Middle Kuiavian	0.85	0.45	0.25	0.20	5	1.9	1.8
5,630/68/F Pl. CV, Fig. 5	Korwinów 136, 35.0 m	Middle Kuiavian	0.80	0.50	0.27	0.15	7	1.6	1.8
5,63/68/F Pl. CV, Fig. 6	Korwinów 136, 35.0 m	Middle Kuiavian	0.72	0.5	0.24	0.15	6	1.2	2.1
5,625/68/F Pl. CIV, Fig. 11	Dębowiso 3/XIII, 119.0 m	Lower Bathonian	0.42	0.3	0.15	0.07	5	1.4	2.0
5,636/68/F Pl. CVI, Fig. 2, L. /Planularia/ sp.	Olsztyn 2/XIII, 164.0 m	Lower Bathonian	1.22	0.72	0.2	0.07	10	1.7	3.6
5,637/68/F Pl. CVI, Fig. 3, L. /Planularia/ sp.	Dębowiso 3/XIII 131.0 m	Lower Bathonian	1.05	0.65	0.17	0.07	9	1.6	3.7

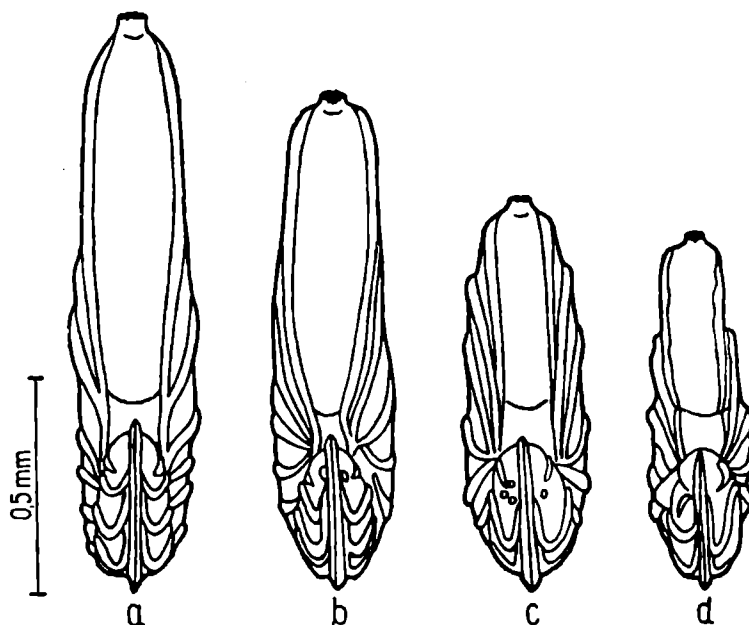


Fig. 6. *Lenticulina (Astacolus) polymorpha arachne* subsp.n., frontal view, Middle Kuiavian. a — holotype (Pl. CV, Fig. 1), 5,626/68/F; b — paratype (Pl. CV, Fig. 2), 5,627/68/F; c — paratype (Pl. CV, Fig. 3), 5,628/68/F; d — (Pl. CV, Fig. 5), 5,630/68/F

Diagnosis. Tests calcareous, middle-sized and large, planispiral, flat, coiled in the form of an open spiral. Initial chamber very slightly convex, in the developing part almost completely flat. Ornamentation very distinct, massive, consisting of arcuate, strong, radiate costae and less frequently of included costae. Another type of costae, with a latitudinal

trace, connected with each other to form a sort of an undulated slat, is bordered on both sides of the test by a strong and wide keel. Four to eight chambers. Terminal aperture radiate, directed obliquely upwards. **Description.** Specimens display a loose type of coiling (in the form of an open spiral), with a marked tendency of the two last formed chambers to be detached. Deviations in the form of a complete uncoiling of the whorl (Pl. CV, Figs. 7 and 8) are pathological in character. Juvenile specimens (or initial portions of whorls in adult specimens) display a smaller degree of flattening of tests and their peripheral slats, bordering the keel, are frequently not yet developed. In some specimens (Pl. CV, Fig. 5), these slats constitute a continuation of strongly bent lateral costae (that is, of the type observed, among other species, in *Lenticulina* (A.) *argonauta* sp. n.), but mostly they make up a separate element of ornamentation. Likewise, as a result of an irregular trace of particular elements, marginal slats, bordering the keel, are frequently discontinuous. Sometimes, two transversal costae appear in the space between two radiate costae. Thick, arcuate, radiate costae are frequently irregular in their trace. In such cases, oblique, included costae appear between them. Near the initial chamber or even on it, radiate costae are mostly reduced up to a half of their size or replaced by detached bosses or by short, bent slats (Fig. 6). Keel sharp, wide, projecting, appearing mostly as early as on the initial chamber. The size of the initial chamber varies within limits of 0.07 and 0.20 mm. Umbilical depression slightly individualized, irregular in outline. Holotype (Pl. CV, Fig. 1, Text-fig. 6a) and paratypes (Pl. CV, Figs. 2 and 3, Text-figs. 6b and 6c) represent a related morphological type, differing from each other only in the number of chambers, very slightly in the thickness of tests and size of initial chamber (cf. — Table 3).

Variability. As mentioned above, the variability of a typical population is not very extensive and mostly amounts to the differentiation of the thickness of tests and degree of uncoiling of the whorl. In addition, specimens are observed which, displaying a relationship to *Lenticulina* (*Astacolus*) *polymorpha* *arachne* subsp. n., at the same time reveal characters recorded in other, quite different species or even subgenera. In our material, particularly distinct were morphological similarities between *L.* (A.) *polymorpha* *arachne* subsp. n. and indeterminate *Planularia* related to it (cf. — Pl. CIV, Figs. 9 and 10; Pl. CVI, Figs. 1—3; Text-fig. 7) or a considerable similarity to the forms belonging to the group of *L.* (A.) *flexuosa* (Brückmann) and *L.* (A.) *tricostata* (Mitianina) (= *L.* (*Planularia*) *tricarinnella*: auct.).

Fig. 7. *Lenticulina* (*Planularia*) sp., frontal view (Pl. CVI, Fig. 3), 5,637/68/F



Comparative remarks. Erecting in 1869 a new species *Cristellaria polymorpha*, M. O. Terquem assigned to it several forms some of which clearly deviating from each other and frequently making up not only quite different subspecies or species but also even different subgenera such as, *L.* (A.) *volubilis* (Dain, 1958), *L.* (A.) *argonauta* sp. n., *L.* (A.) *polymorpha* *arachne* subsp. n., *L.* (*Planularia*) spp., etc. Erecting

by K. I. Kuznetsova (1961) of a lectotype *Cristellaria polymorpha* Terq. (M. O. Terquem, 1869, Pl. XIX, Fig. 2a, b) not only enabled an exact definition of the nominal subspecies but also facilitated the interpretation of those specimens of Terquem which considerably differed from the typical form.

L. (A.) polymorpha arachne subsp. n. differs from the lectotype *L. (A.) polymorpha polymorpha* (Terq.)¹ in a more massive structure of tests, generally larger dimensions, coarser ornamentation and a much more strongly developed and more undulated peripheral slat. Both these forms seem, however, fairly similar to each other in a general type of their structure. Our forms display a larger similarity to the specimens from Fontoy, illustrated by M. O. Terquem (1870) in Pls. XX (Figs. ? 7, 8 and 9) and XXI (Fig. ? 11). Likewise, some of the specimens, described by H. Bartenstein and E. Brand (1937) as *Cristellaria (Astacolus) tricarinella* Reuss (cf. synonymy) seem to correspond to our form. On the other hand, Polish specimens may be identified without any reservations with *Lenticulina (Lenticulina) polymorpha* (Terq.), described by J. H. Ziegler (1959) from Southern Germany.

L. (A.) polymorpha arachne subsp. n. differs from *L. (A.) argonauta* sp. n. and *L. (A.) volubilis* (Dain) primarily in having the peripheral slats, bordering the keel on both sides of the test. The last-named character related the subspecies under study to *L. (A.) tricostata* (Mitianina, 1955)² and *L. (A.) flexuosa* (Brückmann, 1904). *L. (A.) tricostata* (Mitianina) has in turn a slightly different outline of tests and sharp lateral costae without oblique included costae between them. Likewise, peripheral marginal slats in our subspecies have not the form of continuous, sharp marginal keels which, in *L. (A.) tricostata* (Mitianina) makes up an important diagnostic character. The differentiation of a similar type (except for the similarity in the development of peripheral slats) also occurs between *L. (A.) polymorpha arachne* subsp. n. and *L. (A.) flexuosa* (Brückmann).

Occurrence. *L. (A.) polymorpha arachne* subsp. n. is recorded in Poland in the Middle Kuiavian and Lower Bathonian (= Upper Bajocian and Middle Bathonian partim, sensu anglico) sediments of the Cracow-Wieluń Jura. Outside of Poland, it probably occurs in the *Parkinsonia parkinsoni* (Middle Kuiavian) zone of Lorraine, France (M. O. Terquem, 1870), as well as of the North-western (H. Bartenstein & E. Brand, 1937) and Southern (J. H. Ziegler, 1959) Germany.

Lenticulina (Astacolus) kujaviana sp. n.

(Pl. CVI, Figs. 4—7; Pl. CVII, Figs. 2—7; Text-fig. 8a—d)

1961 *Lenticulina (Lenticulina) biexcavata* (Miatluk); O. K. Kaptarenko-Chernousova: p. 17—18, tabl. II, Fig. 1a, b.

? 1967 *Lenticulina badensis* (Kübler, Zwingli); Hofman: p. 60—61, tabl. X, Fig. 1a, b.

¹ A detailed diagnosis of this species is given in the present volume by W. Bielecka & O. Styk (1969).

² M. T. Bastien & J. Sigal (1962) relate with each other the species *L. (A.) tricostata* (Mitianina) and *L. (A.) flexuosa* (Brückmann), but they acknowledge the priority of Brückmann's name.

Material. Fifty specimens from the Middle and Upper Kuiavian of the Cracow-Wieluń Jura, Rawa-Gielniów Anticline and Pomeranian Swell.

Holotypus: Pl. CVII, Fig. 4, Text-fig. 8b, Coll. 5646/68/F, Geological Institute, Warszawa.

Stratum typicum: Middle Kuiavian (Upper Bajocian sensu anglico).

Locus typicus: Grębowo bore-hole, depth 41.5 m (Pomeranian Swell, Poland).

Derivatio nominis: kujaviana — after Kujaw (Kuiavian) a sub-stage of the Middle Jurassic of Poland.

Paratypus: Pl. CVII, Figs. 3 and 5, Text-figs. 8a and 8d (Coll. 5,645 and 5,647/68/F, Geological Institute, Warszawa), Grębowo bore-hole, depth 41.5 m, Middle Kuiavian (Pomeranian Swell); Pl. CVI, Fig. 4, Text-fig. 8c (Coll. 5,639/68/F, Geological Institute, Warszawa), Dargoszewko bore-hole, depth 196.0 m., Middle Kuiavian (Pomeranian Swell).

Lenticulina /Astacolus/ kujaviana sp.n., dimensions in mm:

Table 4

Specimen	Locality, depth	Stage	L	W	T	Do ₁	C	L/W	W/T
5,645/68/F, Pl. CVII, Fig. 3, paratype	Grębowo, 41.5 m	Middle Kuiavian	1.02	0.56	0.30	?	13 /42?	1.8	1.9
5,646/68/F Pl. CVII, Fig. 4, holotype	Grębowo, 41.5 m	Middle Kuiavian	0.75	0.47	0.22	ca 0.04	12	1.6	2.1
5,639/68/F Pl. CVI, Fig. 4, paratype	Dargoszewko, 196.0 m	Middle Kuiavian	0.71	0.47	0.20	ca 0.04	14	1.5	2.3
5,640/68/F Pl. CVI, Fig. 5	Rębielice Królew- skie, 164-167 m	Middle Kuiavian	0.65	0.47	0.25	ca 0.04	11	1.4	2.4
5,647/68/F Pl. CVII, Fig. 5, paratype	Grębowo 41.5 m	Middle Kuiavian	0.62	0.41	0.19	ca 0.04	11	1.5	2.2
5,648/68/F Pl. CVII, Fig. 6	Grębowo 41.5 m	Middle Kuiavian	0.40	0.34	0.17	ca 0.04	10	1.2	2.0

Diagnosis. Tests calcareous, middle-sized, planispiral, devoid of ornamentation. In juvenile stages whorls are strictly lenticulinately coiled. in later stages — uncoiling. Initial chambers flattened and slightly convex, with the growth of test and loosening of the whorl become more swollen and separated from each other by distinct inter-chamber furrows. Terminal aperture radiate, situated on a not very high cone, in adult specimens directed upwards. Nine to fifteen chambers.

Description. The species under study represented by specimens in different development stages of the test of the same generation (in all specimens measured, the diameter of initial chamber amounted to 0.04 mm). The first 9—10 (sometimes, 12) chambers are tightly coiled, the further two display certain irregularities in their arrangement and, finally, the last three (in adult individuals) are clearly detached from the principal spiral part. With the loosening of the whorl, chambers become more and more swollen and inter-chamber sutures more and more depressed and less and less arcuate. Marginal side of the test, at first with a blunt edge, later becomes flattened; radiate, round aperture

is obliquely situated on a slight elevation and, in the individuals with deflected chambers, directly facing upwards. Umbilicus narrow, slightly depressed or filled.

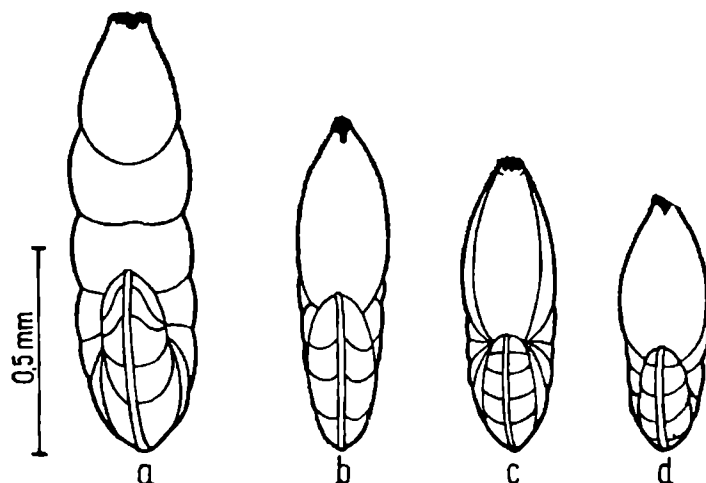


Fig. 8. *Lenticulina (Astacolus) kujaviana* sp. n., frontal view, Middle Kujavian. a — paratype (Pl. CVII, Fig. 3), 5,645/68/F; b — holotype (Pl. CVII, Fig. 4), 5,646/68/F; c — paratype (Pl. CVI, Fig. 4), 5,639/68/F; d — paratype (Pl. CVII, Fig. 5), 5,647/68/F

Holotype (Pl. CVII, Fig. 4, Text-fig. 8b) is represented by a middle-sized specimen with a markedly elongate, oval and slightly convex last formed chamber and with an aperture clearly facing upwards. Inter-chamber sutures, initially flat, near the two last formed chamber are depressed. The same morphological type is represented by two paratypes (Pl. CVI, Fig. 4, Text-fig. 8c; Pl. CVII, Fig. 5, Text-fig. 8d). The last paratype (Pl. CVII, Fig. 3, Text-fig. 8a) already represents a stage with last formed chambers which detach themselves.

Variability. In some specimens, variability is primarily manifested by a varying degree of the loosening of the whorl and a slightly different shape of particular chambers. Small differences are also observed in the umbilical portion which is either filled and not distinguishing itself or distinct and depressed.

The specimen, illustrated in Pl. CVII, Fig. 1, has been considered as slightly deviating from the species described. More oblique sutures (particularly so in the rectilinear portion), a smaller thickness of the test and a rectilinear detachment of the final portion of the whorl allow us to consider this specimen as transitional between *L. (A.) kujaviana* sp. n. and *L. (A.) matutina* (d'Orbigny).

Comparative remarks. The specimens described display a similarity to *Lenticulina (Astacolus) matutina* (d'Orbigny)¹. This species, commonly cited from the Jurassic, differs, however, from *L. (A.) kujaviana* sp. n. in a more rectilinear trace of the last formed, deflecting chambers, greater number of such chambers (at least in the rectilinear portion), sharp-edged outline of the marginal side, more oblique sutures and smaller dimensions of the spiral portion.

Our specimens differ from *L. (Lenticulina) biexcavata* (Miatluk) from the Lower Volgian (Portlandian) of the U.S.S.R. in the uncoiling of whorls, lack of depressed inter-chamber sutures and convex chambers in the initial portion of the test and in a more upwards facing aperture.

Much larger similarity to *L. (Astacolus) kujaviana* sp.n. is, on the other hand, displayed by a specimen from the Upper Bajocian (Middle Kuiavian) of the Ukraine, identified by O. K. Kaptarenko-Chernousova (1961, Pl. II, Figs. 1a, b) with *L. (Lenticulina) biexcavata* (Miatluk). The specimen described by O. K. Kaptarenko-Chernousova probably represents a juvenile development stage, characterized by features of structure very similar to those observed in the analogous development stages of tests of our specimens².

Our specimens may be also, but to a not very great extent, compared with *Cristellaria hybrida* Terquem which in M. O. Terquem's monograph is presented not only as a form including many species but also belonging to different subgenera or genera (*Planularia*, *Marginulinopsis*, etc.).

Likewise, the comparison of *L. (A.) kujaviana* sp.n. with a Callovian species *L. tatariensis* (Miatluk) (fide I. W. Mitianina, 1955, E. W. Miatluk, 1959) allow us to find only remote relationships, mostly concerning the development stages of tests with not detached last formed chambers.

On the other hand, the greatest similarity displayed by our specimens is that to Lenticulines, described by E. A. Hofman (1967) from the Upper Bajocian (Middle or Upper Kuiavian) of the Caucasia and assigned by him to the species *Lenticulina badensis* (Kübler & Zwingli). It is very likely, however, that these specimens should be related to the species *L. (A.) kujaviana* sp.n. rather and not to an Oxfordian form described by J. Kübler and H. Zwingli.

Cristellaria condensa Antonova, 1958 from the Bajocian of the south-western areas of the U.S.S.R. (Krasnodar Region) is also related to our species. The separateness of both these species is expressed in reaching by *L. (A.) kujaviana* sp.n. much larger dimensions, in having more indented inter-chamber sutures and (comparing specimens of equal size) a greater number of chambers.

Occurrence. Like *Frondicularia (Ichtyolaria) nympa* sp.n., *Lenticulina (Astacolus) kujaviana* sp.n. is considered in Poland as an index species of the Middle and Upper Kuiavian. Its geographical range of occurrence in Poland coincides with that of the former species. Except for a rather doubtful locality in the Caucasus and a very likely one in the Middle Kuiavian of the Ukraine, the presence of this species in other European areas has not so far been unequivocally confirmed.

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¹ Sometimes, this species is assigned to the genus *Marginulinopsis*.

² Its length amounts to 41 mm and, therefore, it makes up an equivalent of *Lenticulina* stage of our specimens (cf. Pl. CVII, Fig. 6).

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STRESZCZENIE

WSTĘP

W zespole otwornic występujących w epikontynentalnych osadach kujawu i batonu Polski, wśród licznie reprezentowanych przedstawicieli rodzajów *Fronidularia* i *Lenticulina* wyróżnione zostały trzy nowe gatunki: *Fronidularia (Ichtyolaria) nympa* sp. n., *Lenticulina (Astacolus) kujaviana* sp. n., *L. (A.) argonauta* sp. n. oraz jeden nowy podgatunek *L. (A.) polymorpha arachne* subsp. n. Dwa pierwsze gatunki powszechnie stwierdzone były w utworach kujawu (wezulu) wału pomorskiego, monokliny przedsudeckiej, antykliny rawsko-gielniowskiej i Jury Krakowsko-Częstochowskiej. Dwa pozostałe, jak dotąd, wyróżniane były wyłącznie w kujawie i batonie Jury Krakowsko-Wieluńskiej. Są podstawy do przypuszczeń, że nowo wyodrębnione gatunki nie są formami endemicznymi i że zapewne występują one także na obszarach wschodniej Francji, południowych i północno-zachodnich Niemiec oraz w zachodniej i południowej części ZSRR (Ukraina, Kaukaz).

CHARAKTERYSTYKA PALEONTOLOGICZNA

Fronidularia (Ichtyolaria) nympa sp. n.

(tabl. CIII, fig. 1—13, fig. w tekście 3a—c, 4a—d)

Skorupki wapienne, średniej wielkości, zmiennych kształtów — od romboidalnego do owalnego. Szwy międzykomorowe grube i podniesione, rozszerzające się ku środkowi skorupki, ukształtowane w postaci szeroko rozwartego szewronu. Brzegi skorupki z tępą lub nieco ostrzejszą listewką marginalną (kilem). Przekrój poprzeczny soczewkowaty lub owalny. Skorupki gładkie lub z minimalną ilością drobnych „costae”. Komór od 2 do 8. Zmienność przejawia się w zróżnicowaniu kształtów i wiel-

kości skorupki, kształtów poszczególnych komór, grubości szwów komorowych i listewek marginalnych, a także zaznacza się w obecności lub braku śladów ornamentacji.

Frondicularia (Ichtyolaria) nympa sp. n. w Polsce jest ważną skamieniałością przewodnią (kujaw środkowy — górny).

Lenticulina (Astacolus) argonauta sp. n.

(tabl. CIV, fig. 1—8, fig. w tekście 5a—d)

Skorupki wapienne, planispiralne, średniej wielkości, dosyć płaskie, zwinięte w kształcie otwartej spirali. Początkowych 6—7 komór zwiniętych jest dosyć ściśle (jednakże z odsłoniętą komorą początkową), następne komory odginają się. Ornamentacja wydatna; grube, sierpowato ku tyłowi zakrzywione żebra lateralne kontaktują z ostrym, wystającym kilem w postaci szewronu. U okazów dorosłych obserwuje się ślad krótkiego żeberka transwersalnego. Ujście terminalne, promieniste, umieszczone na charakterystycznym słupku. Komór od 6 do 11. Zmienność niewielka, obserwowana najczęściej między okazami odmiennych generacji mikro- i megasferycznej.

L. (A.) argonauta sp. n. w Polsce notowana jest przede wszystkim w dolnym i środkowym batonie (dosyć często) i kujawie (rzadko) Jury Krakowsko-Wieluńskiej. Poza Polską gatunek ten występuje w kujawie środkowym zachodniej Francji i północno-zachodnich Niemiec.

Lenticulina (Astacolus) polymorpha arachne subsp. n.

(tabl. CIV, fig. 11, 12, tabl. CV, fig. 1—9, fig. w tekście 6a—d)

Skorupki wapienne średniej wielkości i duże, planispiralne, zwinięte w kształcie otwartej spirali. Początkowe komory bardzo słabo wypukłe, w części odwijającej się — prawie płaskie. Ornamentacja bardzo wyraźna, masywna, składa się z łukowato zakrzywionych, silnych żeber radialnych, rzadziej — skośnie tnących żeberek wtrąconych. Inne żeberka o przebiegu równoleżnikowym połączone w rodzaj karbowanej listewki obrzeżają z obu stron skorupki mocny i szeroki kil. Komór od 4 do 8. Ujście terminalne, promieniste, skierowane ukośnie ku górze. Zmienność niewielka, sprowadza się głównie do różnic w szczegółach ornamentacji, grubości skorupki oraz stopnia rozwinięcia skrętu. Znane są okazy stanowiące przejścia morfologiczne do bliżej nie określonych gatunków podrodzaju *Planularia* (Tabl. CIV, fig. 9, 10, tabl. CVI, fig. 1—3, fig. w tekście 7) oraz do gatunku *Lenticulina (Astacolus) tricostata* (Mitiana), (= *L. (Planularia) tricarinella*: auctt.). *L. (Astacolus) polymorpha arachne* subsp. n. notowana jest w środkowym kujawie oraz dolnym batonie Jury Krakowsko-Wieluńskiej. Poza Polską znane jest jej występowanie w środkowym kujawie zachodniej Francji oraz północno-zachodnich i południowych Niemiec.

Lenticulina (Astacolus) kujaviana sp. n.

(tabl. CVI, fig. 4—7, tabl. CVII, fig. 2—7, fig. w tekście 8a—d)

Skorupki wapienne, średniej wielkości, planispiralne, pozbawione ornamentacji, w stadiach młodocianych ściśle lentikulinozwinięte, w późniejszych — odwijające się. Początkowe komory lekko spłaszczone z wyraźnym krawędziem marginalnym i płaskimi szwami, słabo wypukłe, w miarę wzrostu skorupki i rozluźniania skrętu stają się bardziej wy-

dęte, oddzielone od siebie bruzdami międzykomorowymi. Ujście terminalne, promieniste, umieszczone na niewysokim słupku, u okazów dorosłych skierowane ku górze. Ilość komór od 9 do 15.

Rozprzestrzenienie pionowe i poziome tego gatunku pokrywa się w Polsce z zasięgiem *Frondicularia (Ichtyolaria) nympa* sp. n. Poza Polską prawdopodobnie występuje on w górnym bajosie (środkowy-górny kujaw) północnego Kaukazu oraz Ukrainy.

EXPLANATION OF PLATES

Plate CIII

Frondicularia (Ichtyolaria) nympa sp. n., $\times 38$

- Fig. 1. Góra Włodawska 2/XVI bore-hole, depth 63.0 m, Upper Kuiavian (Cracow-Wieluń Jura), 5,601/68/F
- Fig. 2. Holotype, Korwinów 136 bore-hole, depth 49.8 m, Middle Kuiavian (Cracow-Wieluń Jura), 5,602/68/F
- Fig. 3. Paratype, Dargoszewko bore-hole, depth 209.5 m, Middle Kuiavian (Pomeranian Swell), 5,603/68/F
- Fig. 4. Korwinów 1/XII, depth 78.5 m, Middle Kuiavian (Cracow-Wieluń Jura), 5,604/68/F
- Fig. 5. Korwinów 1/XII, depth 65.8 m, Middle Kuiavian, 5,605/68/F
- Fig. 6. Dargoszewko bore-hole, depth 209.5 m, Middle Kuiavian (Pomeranian Swell), 5,606/68/F.
- Fig. 7. Korwinów 1/XII bore-hole, depth 78.1 m, Middle Kuiavian (Cracow-Wieluń Jura), 5,607/68/F
- Fig. 8. Korwinów 1/XII bore-hole, depth 60.8 m, Middle Kuiavian, 5,608/68/F
- Fig. 9. Odrzykoń 3/XII bore-hole, depth 202.0 m, Middle Kuiavian (Cracow-Wieluń Jura), 5,609/68/F
- Fig. 10. Odrzykoń 3/XII bore-hole, depth 189.0 m, Middle Kuiavian, 5,613/68/F
- Fig. 11. The same, depth 186.0 m, Middle Kuiavian, 5,610/68/F
- Fig. 12. Korwinów 1/XII bore-hole, depth 58.95 m, Middle Kuiavian, 5,611/68/F
- Fig. 13. Korwinów 1/XII, bore-hole, depth 53.6 m, Middle Kuiavian, 5,612/68/F

Plate CIV

Figs. 1—8. *Lenticulina (Astacolus) argonauta* sp. n., $\times 39$

- Fig. 1. Holotype, Dębowiec 3/XIII bore-hole, depth 106.0 m (Cracow-Wieluń* Jura), Middle Bathonian, 5,614/68/F
- Fig. 2. Paratype, Rębielice Królewskie bore-hole, depth 107—110.5 m (Cracow-Wieluń Jura), Middle Bathonian, 5,615/68/F
- Fig. 3. Kotowice 3/XVI bore-hole, depth 170.5 m (Cracow-Wieluń Jura), Lower Bathonian, 5,616/68/F
- Fig. 4. *Lenticulina (Astacolus)* cf. *argonauta* sp. n., Dębowiec 3/XIII bore-hole, depth 106.0 m, Middle Bathonian, 5,617/68/F
- Fig. 5. Dębowiec 3/XIII bore-hole, depth 127.8 m, Lower Bathonian, 5,618/68/F
- Fig. 6. Korwinów 1/XII bore-hole, depth 88.3 m (Cracow-Wieluń Jura), Middle Kuiavian, 6,619/68/F
- Fig. 7. Dębowiec 3/XIII bore-hole, depth 106.0 m, Middle Bathonian, 5,620/68/F
- Fig. 8. Paratype, as Fig. 7, 5,621/68/F
- Figs. 9 and 10, *Lenticulina (Planularia)* sp., Middle Bathonian (Cracow-Wieluń Jura), $\times 39$
- Fig. 9. Dębowiec 3/XIII bore-hole, depth 106.0 m, 5,622/68/F
- Fig. 10. Żarki 2/XV bore-hole, depth 58.0 m, 5,623/68/F

- Figs. 11 and 12, *Lenticulina (Astacolus) polymorpha arachne* subsp. n., $\times 39$
Fig. 11. Dębowiec 3/XIII bore-hole, depth 119.0 m, Lower Bathonian, 5,625/68/F
Fig. 12. Korwinów 136 bore-hole, depth 35.0 m, Middle Kuiavian, 5,624/68/F

Plate CV

Lenticulina (Astacolus) polymorpha arachne subsp. n., $\times 39$

- Fig. 1. Holotype, Korwinów 136 bore-hole, depth 35.0 m (Cracow-Wieluń Jura), Middle Kuiavian, 5,626/68/F
Fig. 2. Paratype, as Fig. 1, 5,627/68/F
Fig. 3. Paratype, as Fig. 1, 5,628/68/F
Fig. 4. Korwinów 136 bore-hole, depth 35.0 m, Middle Kuiavian, 5,629/68/F
Fig. 5. Korwinów 136 bore-hole, depth 35.0 m, Middle Kuiavian, 5,630/68/F
Fig. 6. Korwinów 136 bore-hole, depth 35.0 m, Middle Kuiavian, 5,631/68/F
Fig. 7. Korwinów 136 bore-hole, depth 35.0 m, Middle Kuiavian, 5,632/68/F
Fig. 8. Dębowiec 3/XIII bore-hole, depth 161.5 m (Cracow-Wieluń Jura), Lower Bathonian, 5,633/68/F
Fig. 9. Korwinów 136 bore-hole, depth 39.4 m, Middle Kuiavian, 5,638/68/F

Plate CVI

Figs. 1—3, *Lenticulina (Planularia)* sp., $\times 39$

- Fig. 1. Korwinów 136 bore-hole, depth 39.4 m (Cracow-Wieluń Jura), Middle Kuiavian, 5,634/68/F
Fig. 2. Olsztyn 2/XIII bore-hole, depth 164.0 m (Cracow-Wieluń Jura), Lower Bathonian, 5,636/68/F
Fig. 3. Dębowiec 3/XIII, depth 131.0 m (Cracow-Wieluń Jura), Lower Bathonian, 5,637/68/F

Figs. 4—7, *Lenticulina (Astacolus) kujaviana* sp. n., $\times 39$

- Fig. 4. Paratype, Dargoszewko bore-hole, depth 196.0 m (Pomeranian Swell), Middle Kuiavian, 5,639/68/F
Fig. 5. Rębielice Królewskie bore-hole, depth 164.0—167.0 m (Cracow-Wieluń Jura), Middle Kuiavian, 5,640/68/F
Fig. 6. Dębowiec 3/XIII bore-hole, depth 170.8 m, Middle Kuiavian, 5,641/68/F
Fig. 7. Lubojenka bore-hole, depth 352.0 m (Cracow-Wieluń Jura), Middle Kuiavian, 5,642/68/F

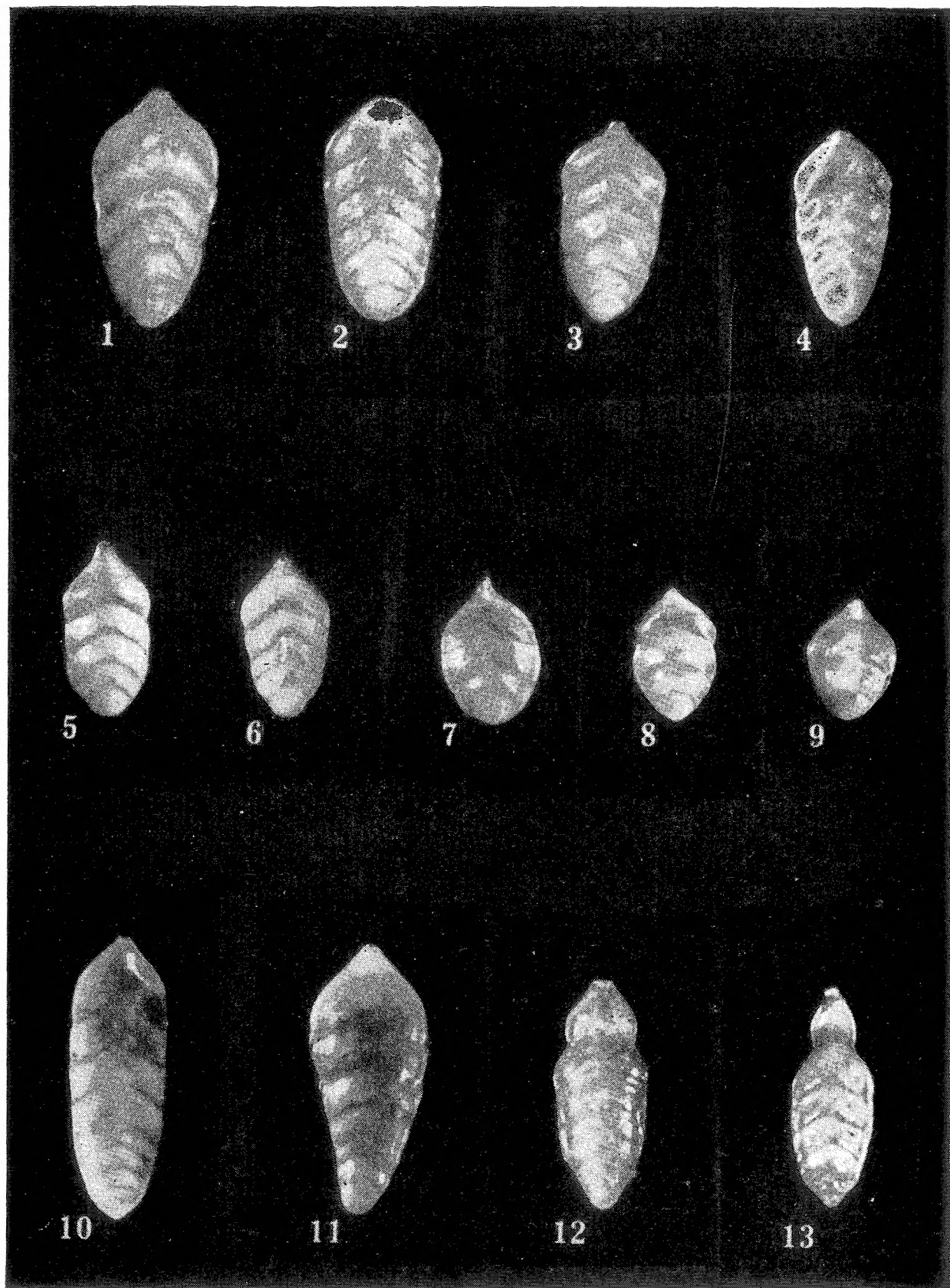
Plate CVII

Fig. 1. *Lenticulina (Astacolus) ex gr. matutina* (d'Orbigny) — *kujaviana* sp. n., Rębielice Królewskie bore-hole, depth 212.0 m (Cracow-Wieluń Jura), Middle Kuiavian, 5,643/68/F, $\times 39$

Figs. 2—7, *Lenticulina (Astacolus) kujaviana* sp. n.

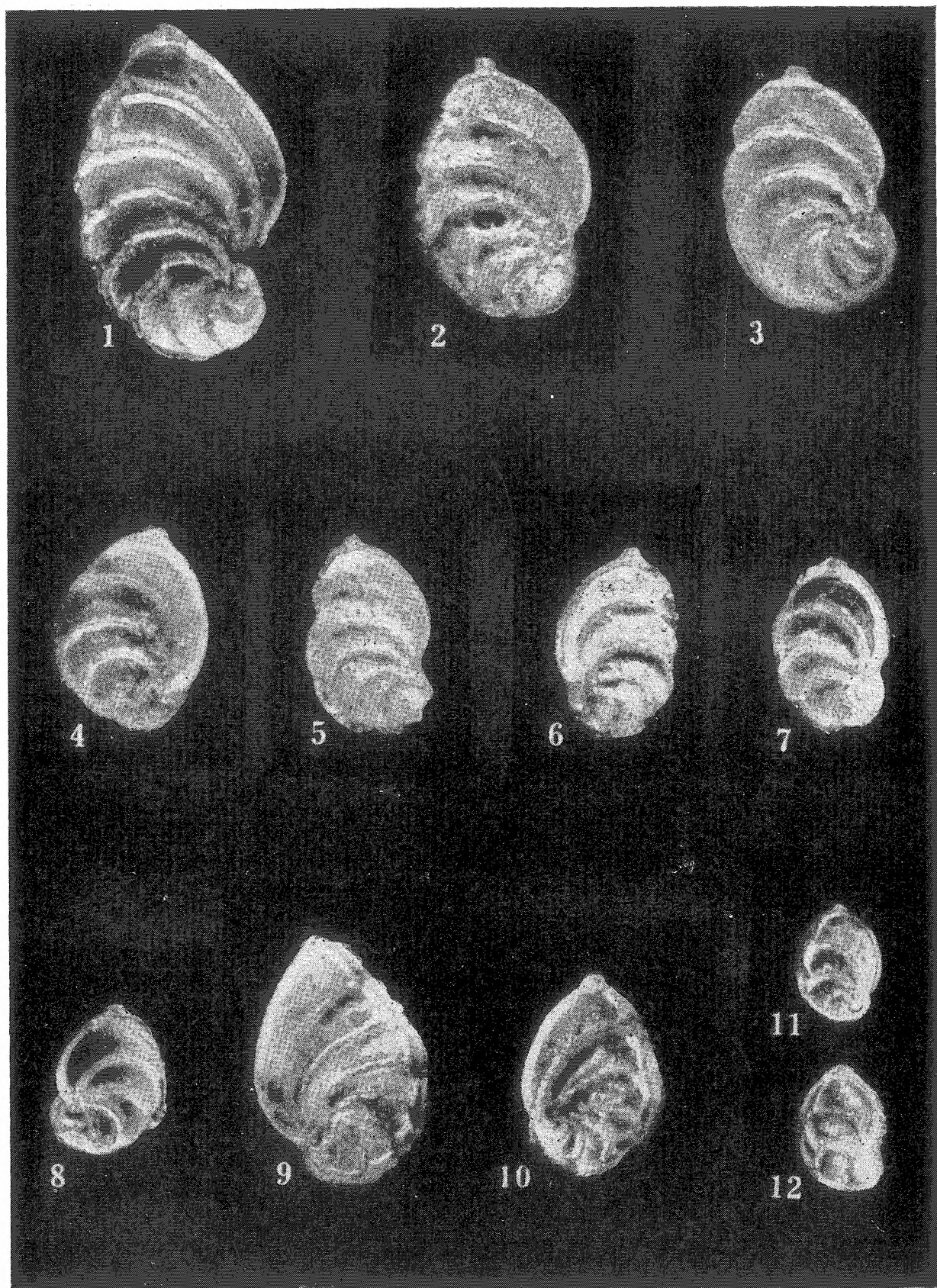
- Fig. 2. Dargoszewko bore-hole, depth 217.6 m (Pomeranian Swell), Middle Kuiavian, 5,644/68/F, $\times 39$
Fig. 3. Paratype, Grębowo bore-hole, depth 41.5 m (Pomeranian Swell), Middle Kuiavian, 5,645/68/F, $\times 42$
Fig. 4. Holotype, as Fig. 3, 5,646/68/F, $\times 40$
Fig. 5. Paratype, as Fig. 3, 5,647/68/F, $\times 40$
Fig. 6. Grębowo bore-hole, depth 41.5 m, Middle Kuiavian, 5,648/68/F, $\times 40$
Fig. 7. Grębowo bore-hole, depth 41.5 m, Middle Kuiavian, 5,649/68/F, $\times 40$

Photographs taken by Mrs. Danuta Oleksiak and Mrs. Janina Modrzejewska. Text-figures drawn by Mrs. Ewa Gadońska.



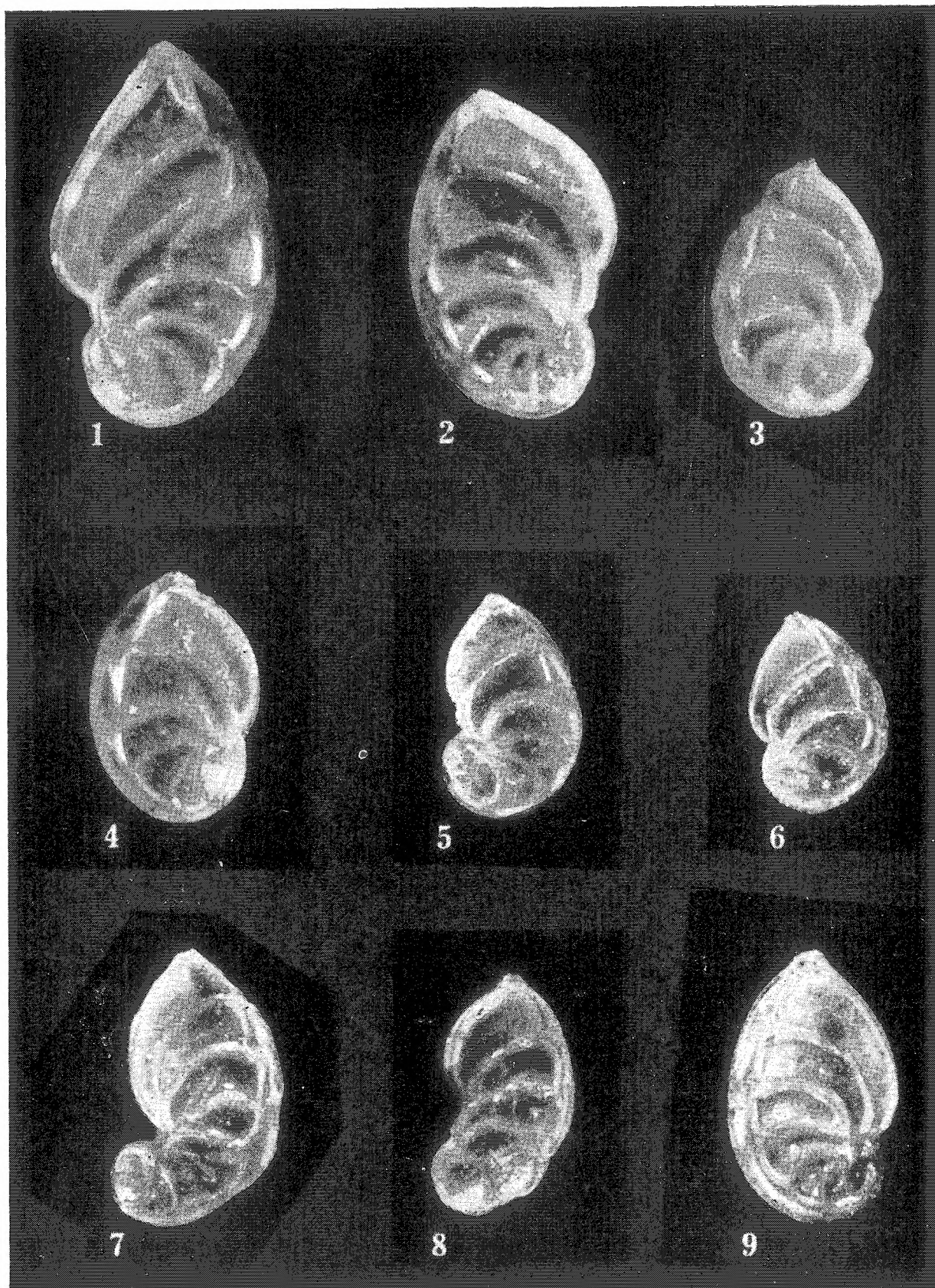
J. Kopik

Fot. D. Oleksiak
J. Modrzejewska



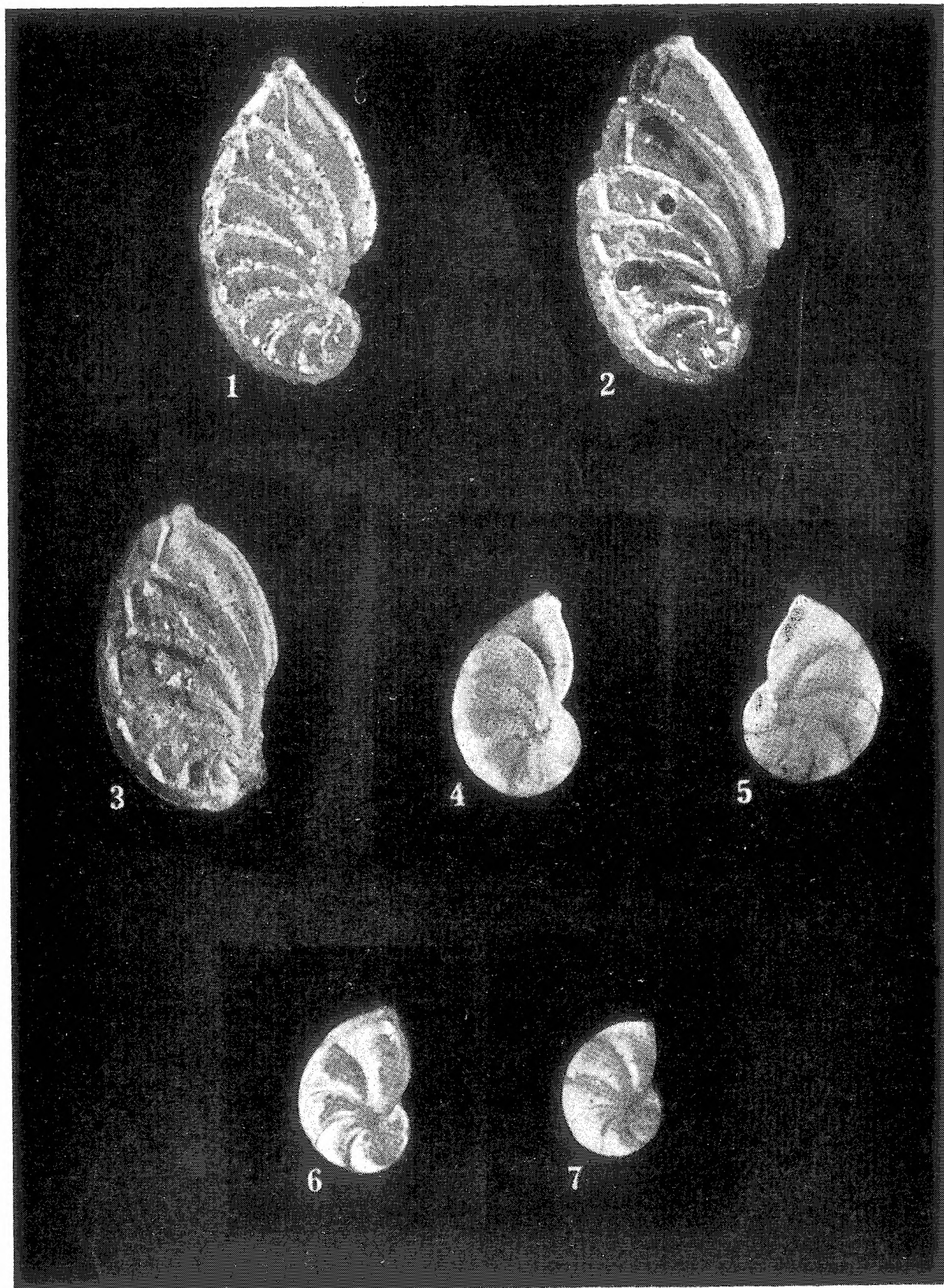
J. Kopik

Fot. D. Oleksiak
J. Modrzejewska



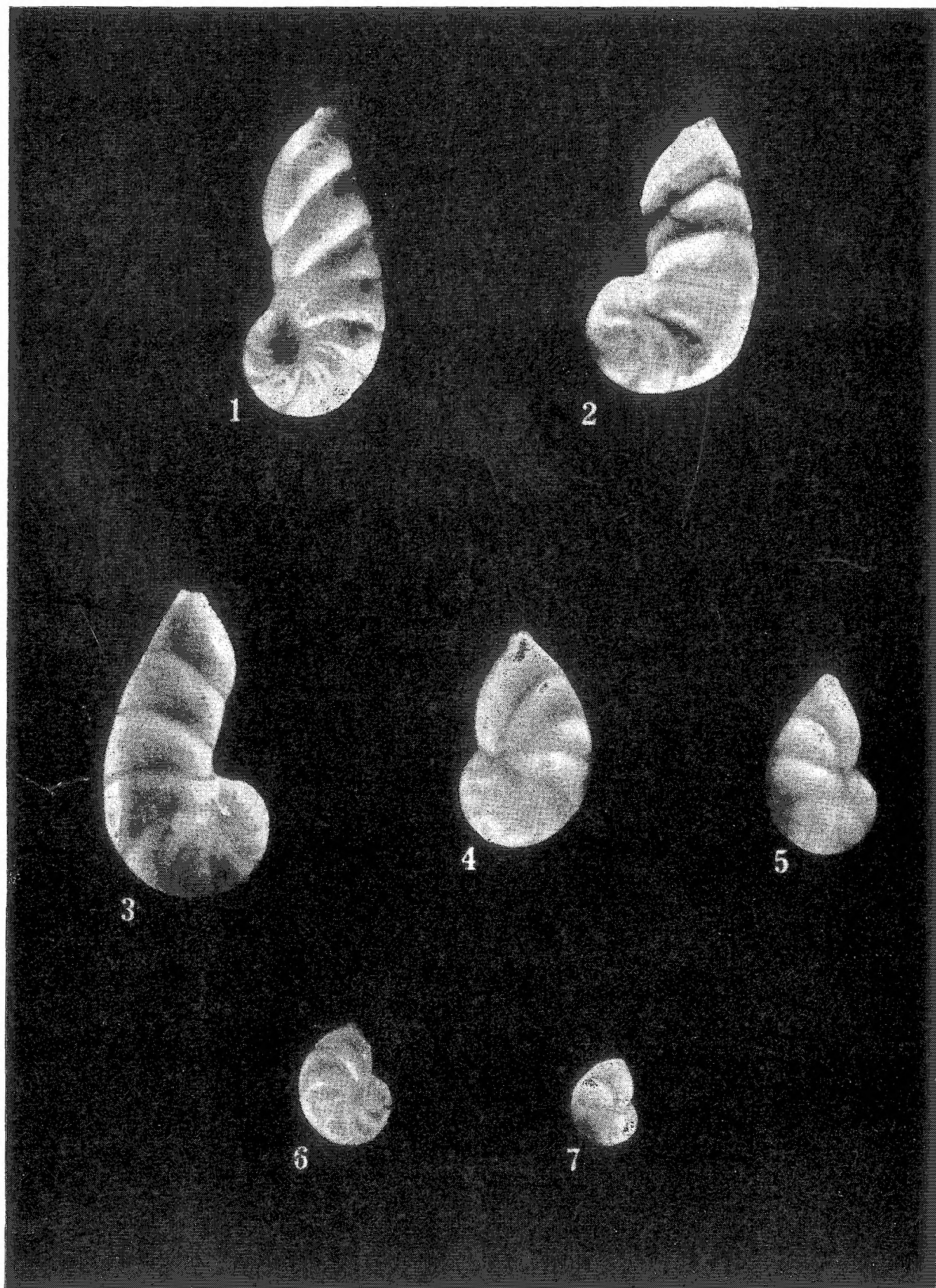
J. Kopik

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J. Modrzejewska



J. Kopik

Fot. D. Oleksiak
J. Modrzejewska