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GEOLOGY

Taramelliceras minax and *Popanites paturattensis* (Ammonoidea) from the Oxfordian in the Vicinities of Cracow

by

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Summary. Two species, *Taramelliceras minax* (Buk.) and *Popanites paturattensis* (Grepp.), are described from the Lower and Middle Oxfordian in the vicinities of Cracow. Attention is paid to the possibilities of their use in biostratigraphic correlations and even in biostratigraphic zonation.

Introduction. Ammonites of the species *Taramelliceras minax* (Buk.) and *Popanites paturattensis* (Grepp.) are fairly common in the Lower and Middle Oxfordian in Poland. They are known from the margin of the Holy Cross Mts, from the vicinity of Częstochowa, from Kruhel Wielki near Przemyśl and from Cracow [1, 4, 9–12, 15].

A large collection of representatives of the two species has been gathered in the course of field works in the vicinity of Cracow. The material makes possible a detailed analysis of the variability of the species. It is kept at the Laboratory of Paleontology and Stratigraphy, Academy of Mining and Metallurgy, Cracow.

Systematic part

Family Oppeliidae Bonarelli 1894
Genus *Taramelliceras* del Campana 1904
Taramelliceras minax (Bukowski 1887)
(Pl. I, Figs 1–6; Pl. II, Figs 1–4; Text-Fig. 1)

1887 *Oppelia minax* n.f; Bukowski [1], p. 105, Pl. XXV, Figs. 1a, b, c.
1928 *Taramelliceras minax* Bukowski; Maire [7], p. 25.
non 1951 *Taramelliceras* cf. *minax* Bukowski; Jeannet [5], p. 90, Pl. 22, Fig. 15, Pl. 28, Fig. 7.
1963 *Taramelliceras minax* (Bukowski); Malinowska [9], p. 32, Pl. III, Figs 17a, b, Pl. V, Figs 37, 38a, b.
1977 *Taramelliceras minax* (Bukowski); Matyja [11], Pl. 3, Figs 3–4.
1981 *Taramelliceras minax* (Bukowski); Matyja and Tarkowski [12], Pl. 2, Figs 7a, b.

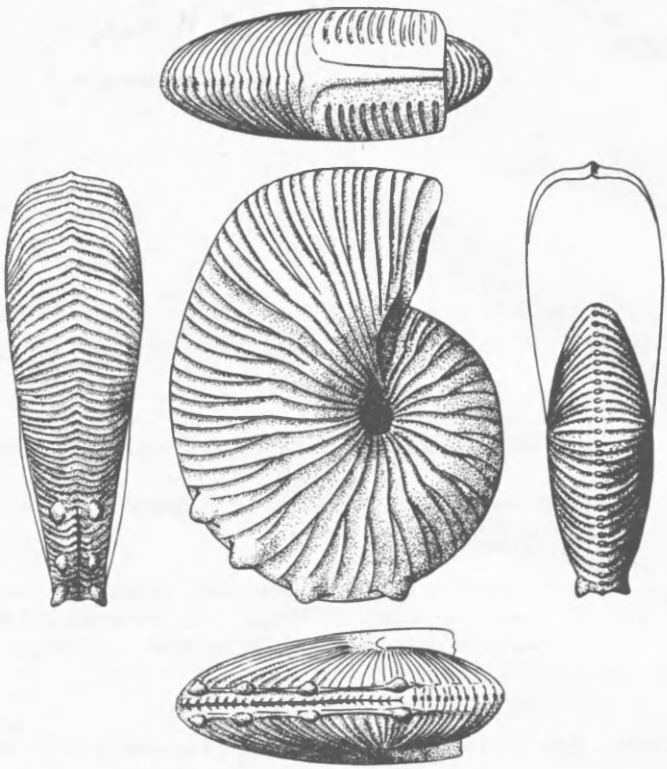

Fig. 1. *Taramelliceras minax* (Buk.)—sketch drawing of lateral and ventral sides and subperistomal part of the specimen with preserved final body chamber

Material: Thirty-six specimens, including 8 with preserved peristome.

Diagnosis: Ventral margin with 3–4 pairs of tubercles; scaphitoidal whorl outline in specimens with preserved peristome.

Dimensions: RT 350: D = 42.0 mm, H/D = 0.51, T/D = 0.30, O/D = 0.08; RT 351: D = 41.0 mm, H/D = 0.51, T/D = 0.37, O/D = 0.11; RT 356: D = 42.1 mm, H/D = 0.48, T/D = 0.28, O/D = 0.10.

Description. Form involute. Inner whorls ovate in cross-section, regular in outline. Whorl sides convex, thickest close to the umbilical margin, covered with fine, closely spaced ribs. Ribs somewhat flexuoidal, biplicating and thickening at the mid-height. Middle part of ventral side ornamented with a row of fine tubercles.

Whorls of mature individuals scaphitoidal in outline, subrectangular in cross-section. Height and thickness of the last whorl varying. The beginning of the last chamber, a half of whorl long, ornamented with 3–4 pairs of tubercles and, sometimes, a thin keel in the middle of the venter. The appearance of tubercles coincides with a marked decrease in thickness of whorl, best visible at the ventral margin. The final body chamber ornamented with one to four pairs of tubercles. Whorl sides slightly convex, covered with marked ribs, more loosely spaced than on inner whorls. Pairs of second order ribs separated by the intercalary. Ribs bending forward at the venter.

Subperistomal part of the outer whorl flat-sided, rectangular in cross-section, with well-marked margins of ventral side, whorl sides ornamented with furrows followed by

lips widening from the umbilicus towards venter. Ventral keel short, triangular in outline, with two shallow furrows on its sides.

Remarks. Bukowski [1] figured a single specimen of the species *Taramelliceras minax* (holotype). In the studied material, only one specimen (Pl. II, Figs 1a, b) is identical as that figured by Bukowski [1] (Pl. XXV, Fig. 1), whereas the majority of specimens gathered by the authors are characterized by the final body chamber markedly scaphitoidal in outline and with a more flattened ventral side.
Attention should be paid to the specimen figured in Plate II. Fig. 3, differing from typical representatives of this species in very narrow umbilicus and small thickness of the last whorl.

Specimens described by Jeannet [5] (Pl. 22, Fig. 15, Pl. 28, Fig. 7) cannot be assigned to the species *Taramelliceras minax* (Bukowski) as they are characterized by three rows of tubercles at ventral side, unknown in that species.

Makowski [8] interpreted *Taramelliceras minax* (Bukowski) as a dimorphic counterpart of *Popanites paturattensis* (Grepp.). Despite a marked similarity of the relevant forms, that interpretation is not reliable as they have not been proven to be coeval. In the Oxfordian sections of the Cracow area, the stratigraphic position of *Taramelliceras minax* (Bukowski) appears to be different from that of *Popanites paturattensis* (Grepp.) and the two species have never been found to occur together.

Occurrence: Zalas, Szklary

Genus *Popanites* Rollier 1909

Popanites paturattensis (Greppin 1870)

(Pl. II, Figs 5–21; Text–Figs 2–4)

1887 *Oppelia paturattensis* Greppin; Bukowski [1], p. 123, Pl. XXVI, Figs 10–13
1891 *Oppelia polonica* Oppel; Siemiradzki [13], p. 18,
1892 *Oppelia polonica* Oppel; Siemiradzki [14], p. 451.
1901 *Oppelia paturattensis* Greppin; Loriol [6], p. 17, Pl. I, Figs 8, ?9.
1913 *Oppelia polonica* Oppel var. czenstochoviensis n. v.; Wójcik [15], p. 62.
1913 *Oppelia polonica* Oppel var. krukelensis n. v.; Wójcik [15], p. 63, Pl. XXVIII, Figs 5a, b.
1913 *Oppelia polonica* Oppel var. paturattensis, n.v.; Wójcik, p. 62.
1951 *Popanites paturattensis* Greppin; Jeannet [5], p. 102, Pl. 30, Fig. 9, Pl. 31, Figs 12–15, text-Figs 231–232.
1963 *Popanites paturattensis* (Greppin); Malinowska [9], p. 28, Pl. III, Figs 13–16.
1963 *Popanites paturattensis* (Greppin) var. vrzosoviensis n. var.; Malinowska [9], p. 28, Pl. IV, Figs 19–20.
1980 *Popanites paturattensis* (Greppin); Malinowska [10], p. 31, Pl. I, Figs 1–13.
1980 *Popanites kruhelensis* (Wójcik); Malinowska [10], p. 33, Pl. II, Figs 3a, b.
1980 *Popanites wojciki* sp. n.; Malinowska [10], p. 33, Pl. II, Figs 1a, b, 2a, b.
1980 *Popanites wrzosoviensis* Malinowska; Malinowska [10], p. 34, Pl. II, Figs 4–9.
1980 *Popanites paturattensis* (Greppin); Garlicka and Tarkowski [4], Pl. II, Fig. 5.
1981 *Popanites paturattensis* (Greppin); Matyja and Tarkowski [12], Pl. II, Figs 2–3.

Material: About 300 specimens, including 70 with preserved peristome.

Diagnosis: Characteristic peristome, scaphitoidal whorl section.

Dimensions: RT 360: D = 25.8 mm, H/D = 0.55, T/D = 0.34, O/D = 0.09; RT 361; D = 31.0 mm, H/D = 0.52, T/D = 0.37, O/D = 0.10; RT 362: D = 22.0 mm, H/D = 0.55, T/D = 0.43, O/D = 0.07; RT 363: D = 25.8 mm, H/D = 0.50, T/D = 0.35, O/D = 0.09; RT 373: D = 28.0 mm, H/D = 0.50, T/D = 0.37, O/D = 0.08; RT 377: D = 16.5 mm, H/D = 0.49, T/D = 0.39, O/D = 0.08; RT 375: D = 17.5 mm, H/D = 0.49, T/D = 0.38, O/D = 0.07.

Description. Form involute. Juvenile specimens with whorls regular in outline, and the mature—scaphitoidal, especially in the case of specimens 25–30 mm in size. Whorl sides ornamented with fine, flexuoidal ribs, dividing into two or three secondary ribs at the mid-height. Mould smooth when ribbing not preserved. Ventral side rounded, with ribs bent forward.

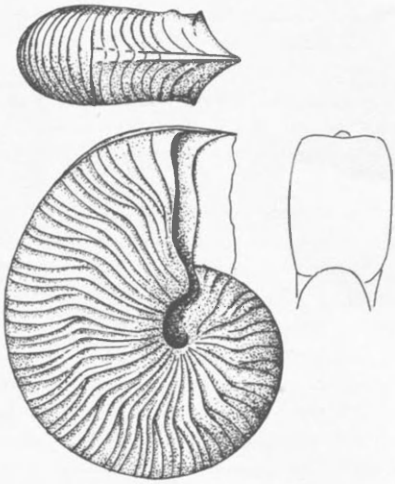

Fig. 2. *Popanites paturattensis* (Grepp.)
—morphotype *A*

Subperistomal part of the final body chamber highly varying (Figs 2–4). Whorl sides displaying one or two radial folds and ventral side—a sharp-pointed keel. Whorl sides bent outwards, forming outwards-directed lips. Peristome varying in outline from ovate to rectangular. Suture line turning forward from the umbilicus, bent backwards thereafter, sometimes subtriangular in outline in the proximity of keel. Ribs bent forwards at the venter, gradually thickening in mature individuals, in which they form a ridge passing into a sharp keel. Keel delineated by furrows situated between it and ventral margins. Figures 2–4 show changes in arrangement or ribs in subperistomal area in the gerontic stage.

Remarks. In discussing the genus *Popanites* Rollier, 1909, Malinowska [9, 10] differentiated the following species: *P. paturattensis* (Greppin), *P. wojciki* Malinowska, *P. kruhelensis* (Wójcik), and *P. wrzosoviensis* Malinowska (= *P. paturattensis*) (Greep.) var. *vrzosoviensis* Malinowska [9]. However, the descriptions given by her as well as the accompanying comparative tables and figures appear insufficient for the identification of the species differentiated there. The terms used in the descriptions fail to yield precisely the differences between individual species and, therefore, to give an unequivocal basis for the identification of a given one. In the Table and comments on individual features, terms are used such as "section of the last whorl almost rectangular in one species and markedly rectangular in the other", "ventral side flattened in one species and almost flat in the other". Such terms are too imprecise to say anything definite about the actual shape. Moreover, the analysis of the available material of the genus *Popanites* (over 300 specimens) showed that the variability of features listed by Malinowska in her Table 1 [10] is very high and has hitherto been underestimated. Almost every specimen shows a dependence of the transversal section on the shape of the ventral side of the shell. The section is always ovate in the juvenile stage, changing to subrectangular in the gerontic stage in connection with a flattening of the venter. Whorl sides may also vary from flattened to convex. They are usually convex in the early stages of growth, becoming markedly flattened in the shell part scaphitoidal in outline. Ribbing is always very similar. In some specimens it may be very pronounced while in others obscure but this depends on the mode of preservation. In the case of the only our specimen preserved with shell, the mould

displays a very well-preserved ribbing in the proximity of the ventral margin and obscure or poorly marked ones at the umbilical margin and inner whorls. It follows that the strength of ribbing cannot be treated as a diagnostic feature.

Thus, there arise some major questions to which we would like to give the answers: what features of ammonites of the genus *Popanites* are diagnostic at the species level? How many species of that genus actually lived in the Early and Middle Oxfordian? Which species hitherto proposed are valid and which should be treated as synonymous?

Our analyses show that the whole population of ammonites of the genus *Popanites* should be treated as belonging to a single, highly variable species. The ammonites, as

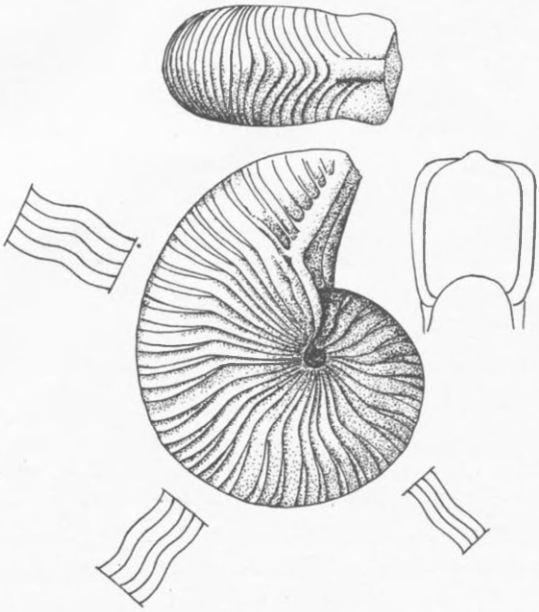

Fig. 3. *Popanites paturattensis* (Grepp.)—morphotype *B*

mentioned above, appear markedly varying in appearance of the body chamber in the gerontic stage. However, it should be noted that keel, radial fold and subperistomal lips, although varying, always display the same nature.

The recorded differences appear insufficient to differentiate separate species within the population of the genus *Popanites*. Thus, it follows that only one species of that genus lived in the Oxfordian marine reservoir. Within the population of that species, three morphotypes may be differentiated: *A*, *B*, and *C*, differing from one another in the outline of shell, character of subperistomal part, and shape of keel (Figs 2–4).

Morphotype A (Fig. 2), most common in the studied material, comprises typical representatives of the species *Popanites paturattensis* (Greep.). It is characterized by a regular whorl outline, somewhat scaphitoidal shape of the body chamber, distinct ribbing as well as well-developed subperistomal part with thin keel in the last part of the ventral side of the body chamber.

Morphotype B (Fig. 3) is somewhat scarcer in our collection. It is characterized by a distinctly scaphitoidal outline of shell, a somewhat different arrangement of lips in the

subperistomal zone in the gerontic stage, a thicker and narrower keel, and a rectangular whorl shape. Moreover, the model of ribbing on whorl sides in subperistomal part is different from that in morphotype *A*.

Morphotype C (Fig. 4) is represented by two specimens with a typical scaphitoidal outline of shell. That morphotype of the species *Popanites paturattensis* appears markedly similar to the representatives of *Taramelliceras minax* in its typical scaphitoidal shell

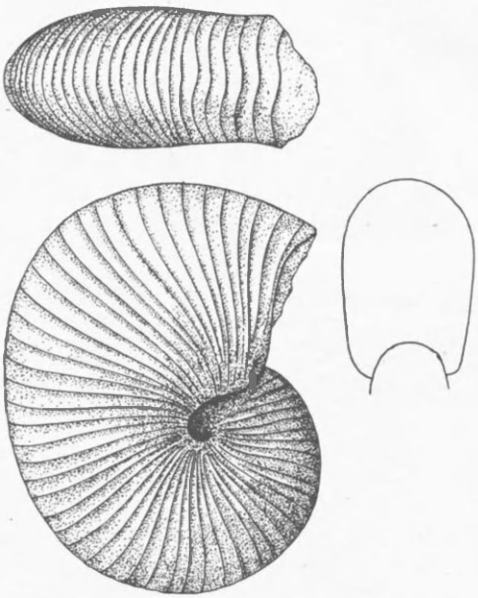

Fig. 4. *Popanites paturattensis* (Grepp.)—morphotype *C*

outline as well as in ribbing and in the character of subperistomal zone. However, the former differ from the latter by the markedly smaller size of fully grown individuals and the lack of characteristic 3–4 pairs of tubercles at the venter. However, the remaining morphological similarity suggests that *Taramelliceras minax* is an ancestor of *Popanites paturattensis*.

Stratigraphic positions of the species *Taramelliceras minax* **and** *Popanites paturattensis*. The two discussed species are fairly common in the Lower and Middle Oxfordian of Poland; they were reported by Bukowski [1], Siemiradzki [13, 14], Wójcik [15], Malinowska [9, 10], Matyja [11], Matyja and Tarkowski [12], and Garlicka and Tarkowski [4]. Their distribution is wider: *Popanites paturattensis* (Grepp.) is also known from France, Switzerland, the FRG, and Czechoslovakia (see [10]), and *Taramelliceras minax* (Buk.)—from France [3, 7).

Representatives of the two species are common in the Oxfordian in the vicinity of Cracow, which is shown by the size of our collection: over 300 specimens of *Popanites paturattensis* (Grepp.) and about 40 of *Taramelliceras minax* (Buk.). Both species are characterized by a highly specific shape, which makes them easy to identify and difficult to mistake for others, as well as by their narrow stratigraphic range. In the vicinity of Cracow, *Taramelliceras minax* (Buk.) was found to occur together with *Cardioceras* (*Scarburgiceras*) sp., *C.* (*Vertebriceras*) sp., *Creniceras crenatum* (Brug.), *Lissoceratoides erato* (d'Orb.), *Neocamphylites delmontanus delmontanus* (Oppel), *N. thirriai* (Petitclerc et Maire), *Perisphinctes (Prososphinctes) consociatus* Buk., *Parawedekindia arduennensis* (d'Orb.), *P. choffati* (Lor.), *Peltoceratoides bodeni* Prieser, *Holcophylloceras zignodianum* (d'Orb.), *Sowerbyceras tortisulcatum* (d'Orb.), *Taramelliceras oculatum* (Phillips) and *T. bacatum* (Buk.), i.e. fossils typical of the Cardioceras bukowskii and C. costicardia Subzones of the C. cordatum Zone. Attention should be paid to the fact that so far this species has not been reported from the Quenstedtoceras mariae Zone. Malinowska [9] and Matyja [11] reported it from the Cardioceras bukowskii Subzone of the Cordatum Zone, and Maire [7]—from the C. praecordatum Subzone of the Quenstedtoceras mariae Zone in Franche-Compte.

In the studied area, *Popanites paturattensis* (Grepp.) was found to occur together with *Cardioceras (Vertebriceras) vertebrale* (Sow.), *Creniceras* sp., *Euaspidoceras* sp., *Sowerbyceras torticulcatum* (d'Orb), *Cardioceras (Scoticardioceras) excavatum* (Sow.), *C. Cardioceras persecans* (Buck.), *C. (Plasmatoceras) tenuistriatum* Bor., *Glochiceras distortum* (Buk.), *Lissoceratoides erato* (d'Orb.), *Neocampylites delmontanus delmontanus* (Oppel), *N. delmontanus helveticus* (Jeannet), *N. thirriai* (Petitclerc et Maire), *Scaphitoides paucirugatus* (Buk.), and *Perisphinctes* (*Mirosphinctes*) sp., all of these species typical of the Cardioceras cordatum Subzone of the Cordatum Zone and lower part of the C. tenuicostatum Subzone of the Perisphinctes plicatilis Zone.

In the Submediterranean biostratigraphic subdivision for the Oxfordian [2], the species *Popanites paturattensis* (Grepp.) is treated as a fossil characteristic of the Cardioceras cordatum Subzone.

Taking into account the frequency of occurrence, wide geographic distribution, narrow stratigraphic range and easy identification, the species *Taramelliceras minax* and *Popanites paturattensis* seem to meet the requirements for quide fossils. They may be used in biostratigraphic correlations and even as the basis for proposing biostratigraphic zones.

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Е. Малэцки, Р. Тарковски, *Taramelliceras minax* и *Popanites paturattensis* **(Ammonoidea) из оксфорда в окрестностях Кракова**

В работе описаны два вида *Taramelliceras minax* (Бук.) и *Popanites paturattensis* (Грепп.), происходящие из нижнего и среднего оксфорда в окрестностях Кракова. Внимание обращается на возможность их использования для биостратиграфических корреляций, а даже для установления биостратиграфических уровней.

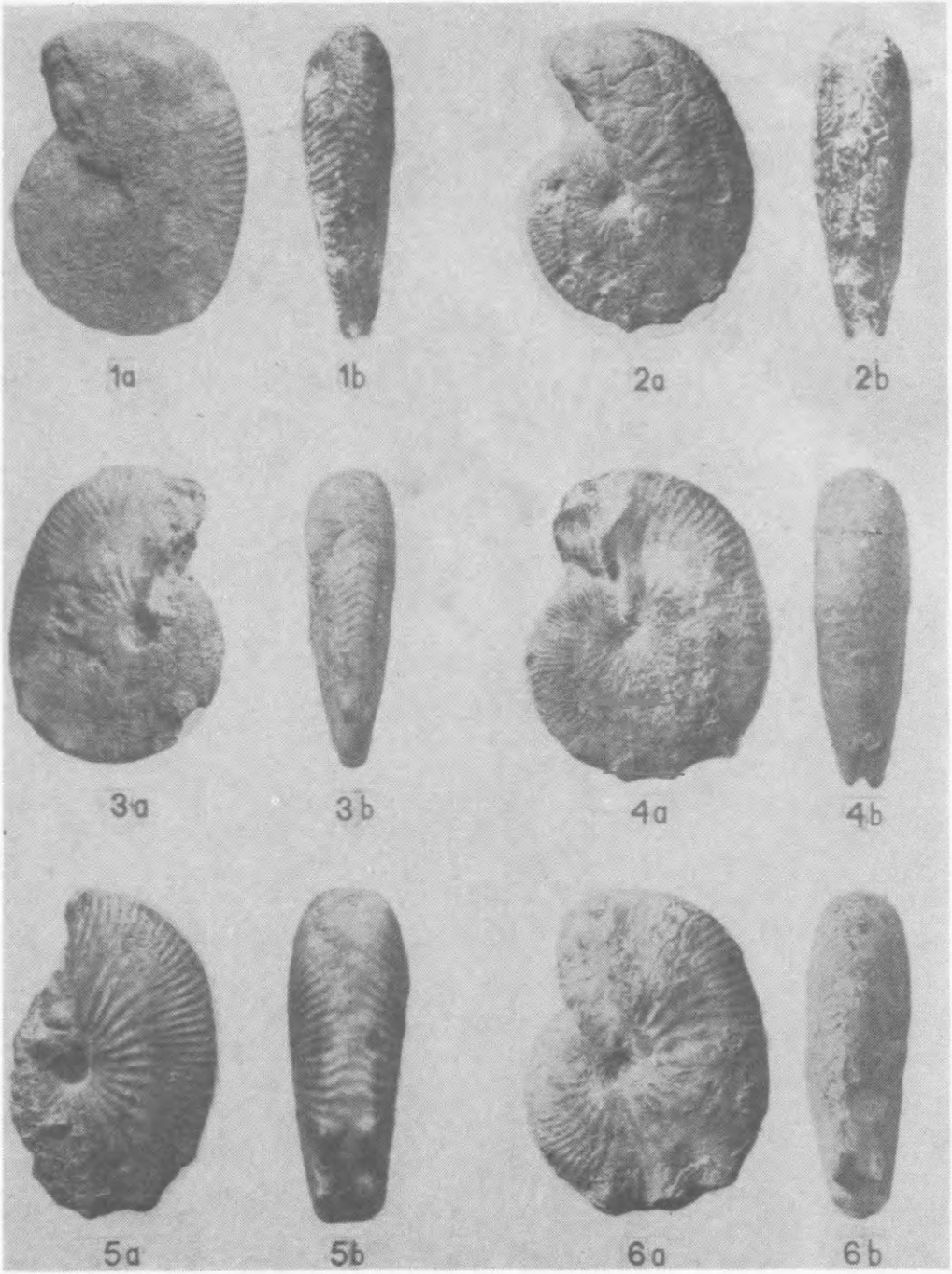

PLATE I

Taramelliceras minax (Buk.): 1a, b—specimen No. RT 356, Zalas, 2a, b—RT 353, Zalas, 3a, b—RT 354, Zalas, 4a, b—RT 350, Zalas, 5a, b—RT 355, Zalas, 6a, b—RT 352, Zalas

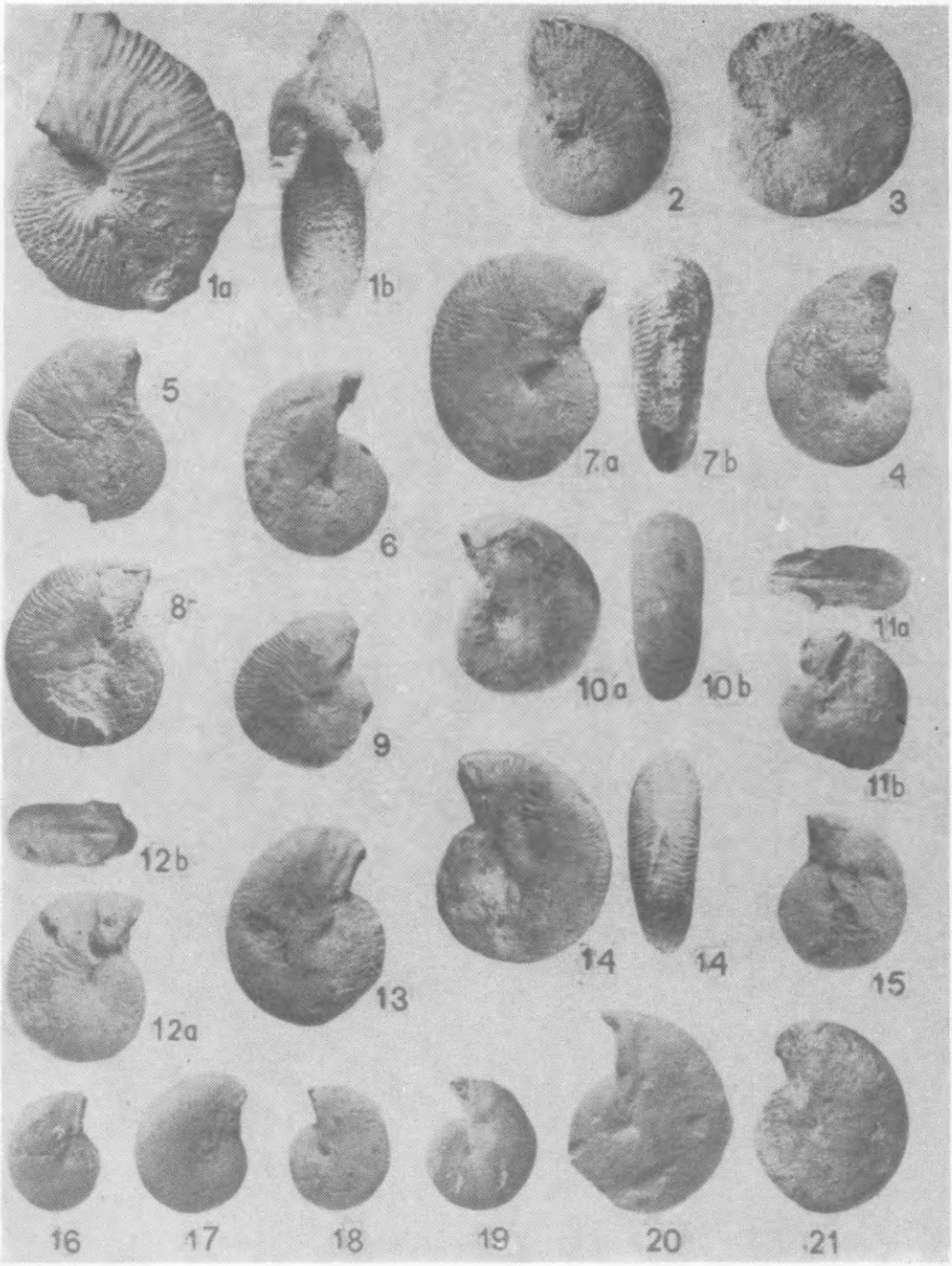

PLATE II

Taramelliceras minax (Buk.): 1a, b—RT 351, Zalas, 2—RT 358, vicinity of Cracow, 3—RT 357, Zalas, 4—RT 359, vicinity of Cracow

Popanites paturattensis (Grepp.): 5—RT 363, vicinity of Cracow, 6—RT 360, Zalas, 7a, b—RT 361, Zalas, 8—RT 365, Szklary, 9—RT 362, Zalas, 10a, b—RT 378, Zalas, 11a, b—RT 371, Zalas, 12a, b—RT 372, Zalas, 13—RT 373, Zalas, 14a, b—RT 379, Zalas, 15—RT 376, Zalas, 16—RT 377, Zalas, 17—RT 374, Radwanowice, 18—RT 375, vicinity of Cracow, 19—RT 380, Zalas, 20—RT 1, Zalas, 21—RT 381, Zalas