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GONIATITINA FROM THE UPPER VISEAN (GAŁĘZICE SYNCLINE, HOLY CROSS MTS)

(Pl. I—IV and 10 Figs.)

Goniatitina z serii wapiennej i wapienno-iłowcowej górnego wizenu synkliny gałęzickiej (Góry Świętokrzyskie)

(Tabl. I—IV i 10 fig.)

Abstract: The organodetritic and organogenic limestones under study have been assigned to Goα Zone and $Go\beta_{mu}$ Subzone. In the systematic part the following species have been described: *Goniatites crenistria* Phill., *G.* ex gr. *crenistria* Phill., *G. sphaericostriatus* Bisat, *G. robustus* Moore et Hod., *G.* cf. *mucronatus* (Knopp), *Goniatites* sp., *Muensteroceras truncatum* (Phill.), *M.* sp. cf. *fournieri* (Delépine), *Nomismoceras vittiger* (Phill.), *Glyphiolobus pseudodiscrepans* (Moore). Correlation of discussed profiles is based on both paleontological and geological investigations.

INTRODUCTION

Notwithstanding a considerable advance in the studies on the Gałęzice syncline (e.g. Żakowa 1970 a, b, 1971 a; Jachowicz, Żakowa, 1969; Jurkiewicz, Żakowa, 1972), not all the problems concerning the stratigraphy of the Carboniferous rocks have been satisfactorily elucidated. The present paper deals with the stratigraphy of the Upper Visean calcareous rocks (visible in outcrops) and their lateral equivalents, i.e. calcareous-clayey rocks (known from boreholes).

According to Czarnocki (1965) and Kwiatkowski (1959), the calcareous rocks represent the whole Visean, whereas Czarnecki, Kostecka and Kwiatkowski (1965) are of the opinion that they belong to D_{1-2} zones only. These views are based on the benthonic fauna. Basing mainly on two facts, the present author has recognized the calcareous and calcareous-clayey deposits to be the equivalent of Goα and Goβ zones of the Upper Visean. The Upper Visean macro- and microfauna have been found in the lowest part of the deposits in question, which in Gałęzice are underlain by the Tournaisian. The overlying deposits, on the other hand, belong to Goγ zone (Żakova 1971 a). Investigating Tetracoralla from the calcareous rocks, Fedorowski (1971) has recently substantiated the present author's concepts. Jurkiewicz and Żako-

wa (Żakowa, 1970 b) found in the calcareous and calcareous clayey deposits two foraminiferal assemblages which make possible to subdivide this sequence into two stratigraphical units.

The presence of goniatites in the Gałęzice Carboniferous rocks was mentioned by Czarnocki (1916, 1922, 1928; see Czarnocki 1965). He recorded *Glyphioceras sphaericum* (?) Martin in the limestones occurring in outcrops, and *Glyphioceras striatum* Sowerby in the Upper Visean of the borehole Rykoszyn-Skałka (about 1350 m north of Gałęzice, Fig. 1). Goniatites are extremely rare in the limestones of Gałęzice, constituting only about 0.2 per cent of the fauna collected by the present author from these deposits (Żakowa, 1974). Being free-swimming animals, their presence here is purely accidental. They appear in greater quantities in some clay intercalations in calcareous-clayey deposits found in bore-holes only.

The goniatites described from limestones belong to cat. no. OS-120, those from boreholes to cat. no. OS-75 and OS-77. All the specimens are stored in the archival collections of the Holy Cross Mts. Branch of the Geological Institute in Kielce.

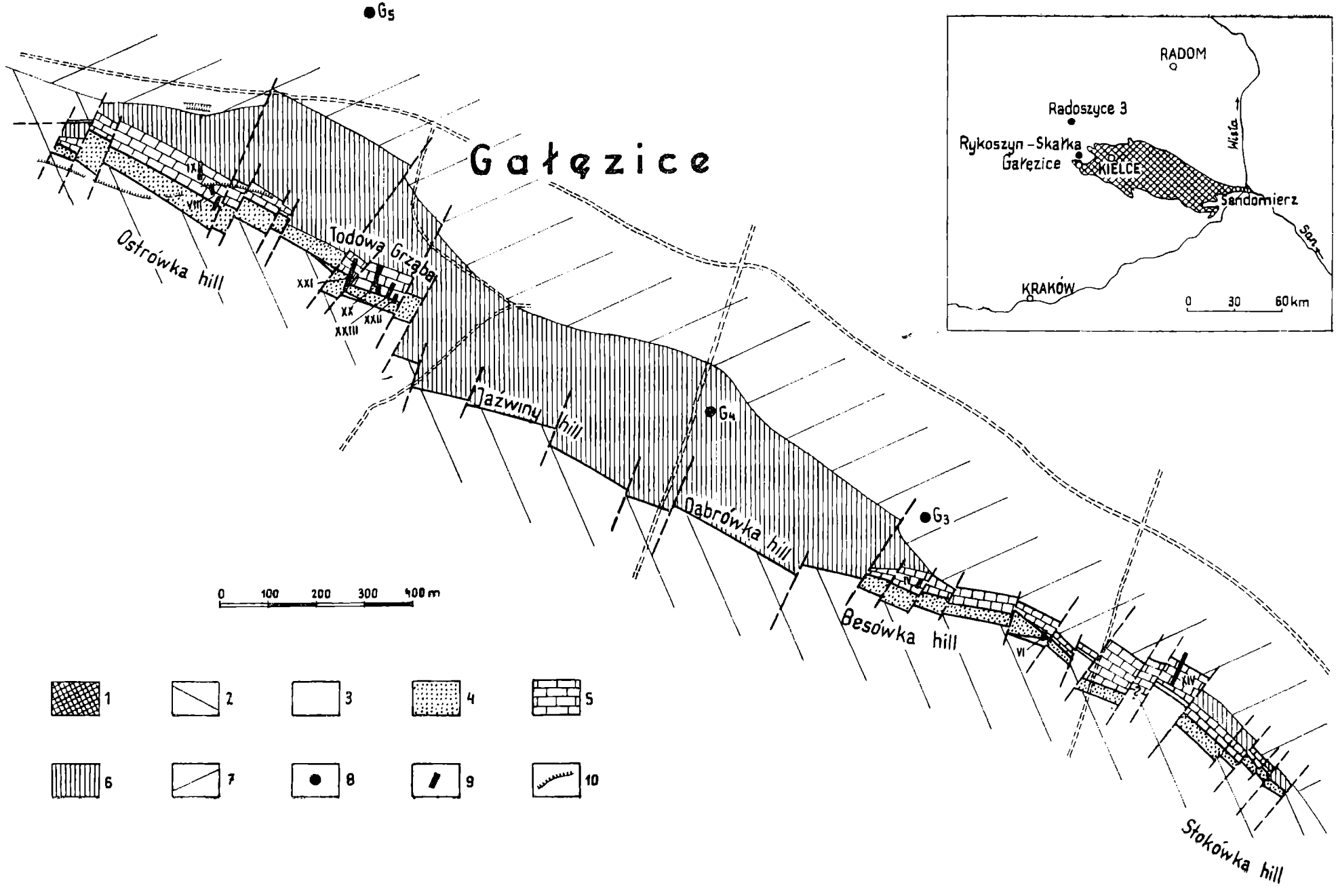
The author wishes to thank Professor F. Hodson for his valuable methodical and taxonomic advice. She is particularly indebted to Halina Topaczewska for preparing photographs with utmost care, and to Alfreda Maszońska for drawing the figures.

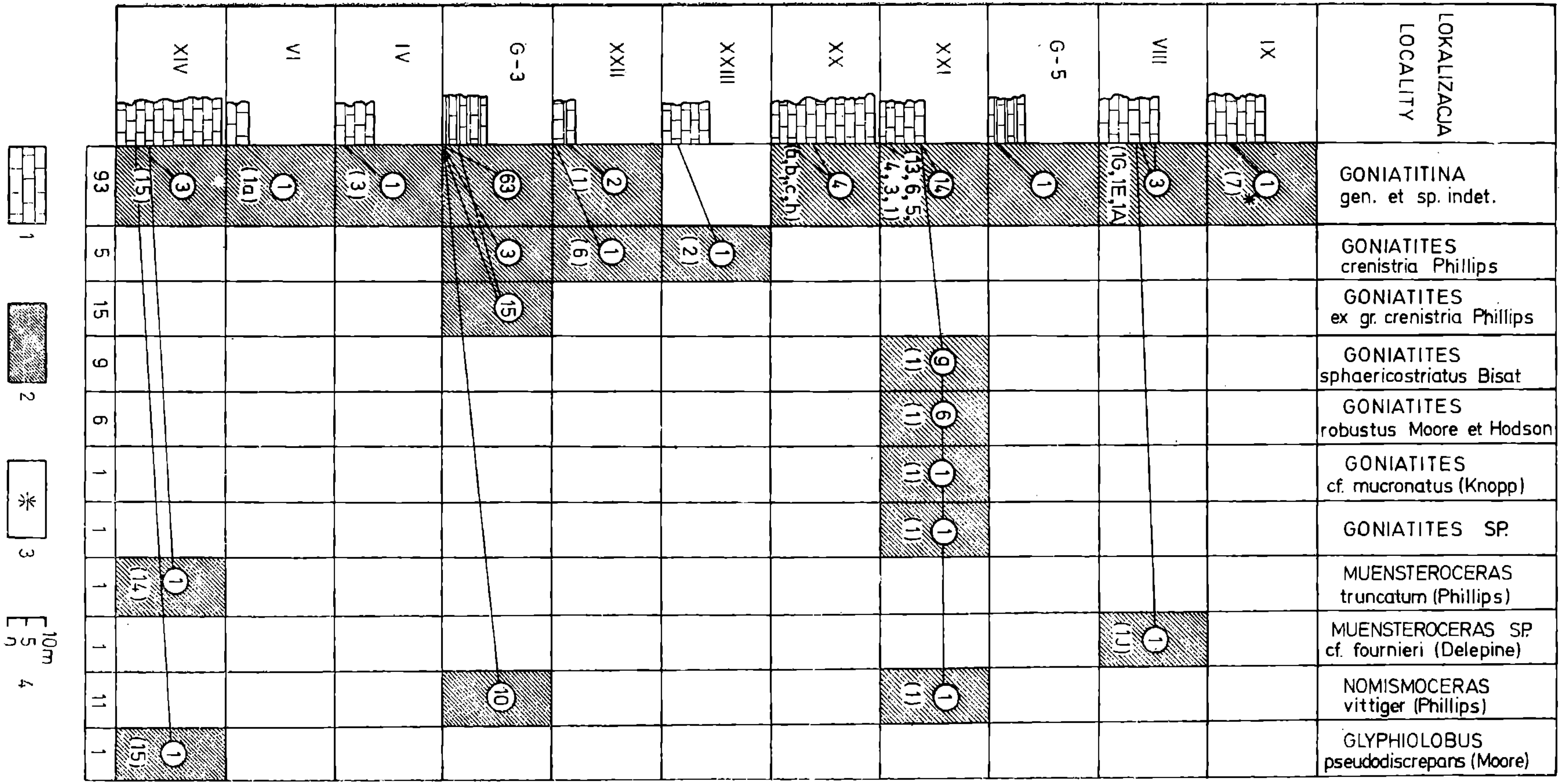
GEOLOGICAL SETTING

In the Gałęzice syncline, situated at the south-western extremity of the Palaeozoic massif of the Holy Cross Mts. (Fig. 1), the Carboniferous-Tournaisian and Upper Visean formations crop out at its southern flank. The Carboniferous occurs in a narrow strip, about 3000 m in length, concordant to the axis of the syncline, generally dipping to the north or north-east. It overlies the Givetian except a few places where there appear tectonic wedges of the Famennian. The contacts of the Carboniferous with Givetian are tectonic, just as in many places with the overlying Permian (mainly in the SE part of the syncline). The present form of the Carboniferous resulted from complicated and superimposed tectonic processes (Żakowa, 1970a; 1971a). Due to this fact

Fig. 1. Geological map of the Gałęzice syncline with localization of places where goniatites were found (pits, boreholes Gałęzice 3 and 5). 1 — outline of the Palaeozoic Massif of the Holy Cross Mts.; 2 — Givetian; 3 — Famennian; 4 — Tournaisian; 5—6 — Upper Visean (5 — limestones of Goα and Goβ zones; 6 — clastic rocks Goγ zone); 7 — Permian; 8 — boreholes; 9 — pits; 10 — escarpment

Fig. 1. Mapa geologiczna synkliny gałęzickiej z lokalizacją punktów gdzie znaleziono goniatyty (przekopy, wiercenia Gałęzice 3 i 5). 1 — zarys masywu paleozoicznego Gór Świętokrzyskich; 2 — żywet; 3 — famen; 4 — turnej; 5—6 — górny wizen (5 — wapienie należące do poziomów Goα i Goβ, 6 — seria klastyczna — poziom Goγ); 7 — perm; 8 — wiercenia; 9 — przekopy; 10 — skarpy


G5
Gałęzice
Todowa Grząba
Ostrówka hill
Jazwiny hill
Dąbrówka hill
Besówka hill
Słokówka hill
G4
G3
VIII
XXI
XX
XXII
XXIII
VI
XIV
0 100 200 300 400 m
1
2
3
4
5
6
7
8
9
10
RADOM
Radoszyce 3
Rykoszyn - Skałka
Gałęzice
KIELCE
Wisła
Sandomierz
San
KRAKÓW
0 30 60 km


LOKALIZACJA
LOCALITY
IX
VIII
G-5
XXI
XX
XXIII
XXII
G-3
IV
VI
XIV
GONIATITINA gen. et sp. indet.
GONIATITES crenistria Phillips
GONIATITES ex gr. crenistria Phillips
GONIATITES sphaericostriatus Bisat
GONIATITES robustus Moore et Hodson
GONIATITES cf. mucronatus (Knopp)
GONIATITES SP.
MUENSTEROCERAS truncatum (Phillips)
MUENSTEROCERAS SP. cf. fournieri (Delepine)
NOMISMOCERAS vittiger (Phillips)
GLYPHIOLOBUS pseudodiscrepans (Moore)
93
5
15
9
6
1
1
1
1
11
1
1
2
3
4
10m
5
0

the carboniferous deposits are tectonically reduced and locally some horizons are lacking.

The Tournaisian is composed of siliceous-clayey rocks (Zaręby Beds) with tuffites and phosphorites. It contains microflora of the Upper Tournaisian, rare plant and faunistic remains, conodonts, sponge spicules and many radiolaries. In the boreholes Gałęzice 3, 4 and 5 (Fig. 1), the Tournaisian is from 6 to about 60 m thick.

The Upper Visean overlies directly the Tournaisian, the contacts between these zones being tectonic. In its lower part the Upper Visean consists of calcareous or calcareous-clayey rocks discussed in the present paper, whereas the upper part is made up almost entirely of clastic deposits. The latter represent the Goniatites granosus Zone (Ż a k o w a, 1971a). There are concordant contacts between these zones.

Thickness of the calcareous rocks in the individaul cross-sections of the syncline varies from some to several dozen metres. The limestones are organodetritic and organogenic, rarely crystalline, marly, bituminous or porous. They contain fragments of mudstones, phosphorites (redeposited), and thin tuffite intercalations. Abundant organic material consists predominantly of benthos (brachiopods, corals, crinoids, bryozoa, trylobites, gastropods, foraminifers, algae). Cephalopods, pelecypods, worms and fish remains are uncommon. Brachiopods, crinoids and corals are prevalent (Ż a k o w a, 1971b).

In the Carboniferous limestones 16 pits (denoted by Roman numerals) and several dozen unnumbered excavations were made. Goniatites were found in 9 pits, indicated in Fig. 1. Each bed in a pit was designated by numeral or literal symbols. Designations of beds in which goniatites have been recorded are given together with the explanations of tables and in Figs. 2 and 10. For detailed descriptions of the profiles and benthonic fauna complexes from the separated beds the reader is referred to an unpublished paper of the present author (Ż a k o w a, 1970c). The calcareous-clayey deposits found in bore holes Gałęzice 3, 4, and 5 (Fig. 1) contain limestone and claystone intercalations. The goniatite fauna is accompanied by pyritized flora remains, gastropods, molluscs and crinoids. Upper Visean foraminifers and conodonts were found also. The lower part of the calcareous-clayey deposits is correlated by means of microflora with the Goα Zone present in Łagów Syncline.

←

Fig. 2. Quantitative comparison of goniatites from individual Upper Visean sites of the Gałęzice syncline with approximate indication of their occurrence in the vertical profiles of these sites. 1 — limestones; 2 — claystones; 3 — in brackets notation of beds in which goniatites were found; 4 — scale of lithological profiles

Fig. 2. Ilościowe zestawienie goniatytów z poszczególnych stanowisk górnego wizenu synkliny gałęzickiej z orientacyjnym oznaczeniem występowania ich w profilach pionowych tych stanowisk. 1 — wapienie; 2 — iłowce; 3 — w nawiasach oznaczenie warstw, w których znaleziono goniatyty; 4 — skala profilów litologicznych

SYSTEMATIC PART

Terms for morphological features as well as the methodology of measurements follow those of Gordon (1957, 1964).

Suborder: Goniatitina Hyatt 1884
Superfamily: Goniatitaceae de Haan 1825
Family: Goniatitidae de Haan 1825
Genus: Goniatites de Haan 1825

Goniatites crenistria Phillips 1836

(Pl. I, Figs. 5a—b, 6a—b, 7, Text fig. 3)

1957. *Goniatites crenistria* Phillips; Gordon, p. 42, pl. 5, figs. 1—16, text figs. 17A—D (earlier synonymics is given in the paper)
1958. *Goniatites crenistria* Phillips; Żakowa, p. 119, pl. 9, figs. 2a—d
1963. *Goniatites crenistria* Phillips; Nicolaus, p. 98, pl. 1, figs. 1, 3, text figs. 26—32
1966. *Goniatites crenistria* Phillips; Żakowa, p. 115, pl. 19, figs. 12a—b, 13a—b; pl. 20, figs. 2, 7, text fig. 24

Material: 2 slightly damaged shells, 1 mould fragment (cat. no. OS-75/749a), 2 fragmentary imprints (cat. no. OS-75/749b, OS-75/752). The shells come from pit XXII, bed 6 and pit XXIII, bed 2, whereas the other specimens were found in the borehole Gałęzice 3, at a depth of 183.45—184.50 m. The dimensions of two specimens (shells) in mm and proportions are as follows:

cat. no.	Diameter D	Width of last whorl W	Width of umbilicus U	U/D	W/D
OS-120/40	7·2	6·8	0·7	0·09	0·94
OS-120/36	>14·0	?	1·8?	0·12?	—

Notes: The smaller shell is regularly globose with the umbilicus diameter being about 1/10 of the shell diameter. The shape of the bigger shell is nearly globose and the last whorl is missing. The suture line (text fig. 3) is characterized by differences in the end parts of the first lateral saddles. In sharply ended lateral lobes the sides are distinctly in-

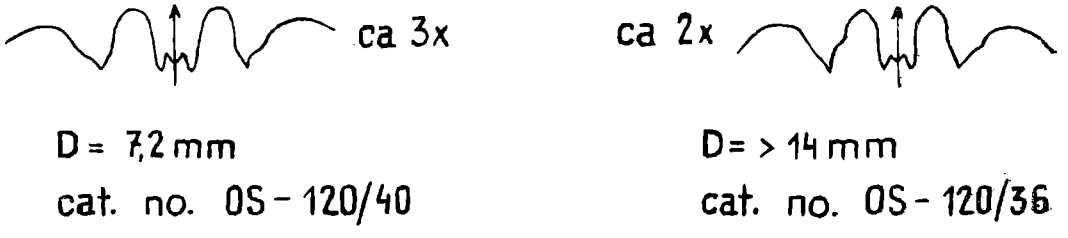


Fig. 3. Suture lines of *Goniatites crenistria* Phillips of different size
Fig. 3. Linie przegrodowe różnej wielkości okazów *Goniatites crenistria* Phillips

clined, and median saddles in external lobes are relatively low. Transverse striae are not crenulate and run almost straight (shell with D = 7.2 mm), or else they form a subtle hyponomic sinus on the venter and are crenulate (bigger shell). On the mould of the flattened specimen the umbilicus width is 6 mm. It is very likely a fragment of a shell having some dozen mm in diameter. Transverse striae on flattened specimens are crenulate, with forward inclination and slightly marked lateral sinus. Near the umbilicus there are traces of spiral striae. At a distance of 5 mm from the edge, 22—30 transverse striae were ascertained on a length of 5 mm.

Comparisons: Suture lines of the shells correspond to those described for juvenile specimens (e.g. Smith 1903, pl. 16, fig. 1). The lack of crenulate transverse striae on the smaller shell should not be regarded as a singular feature since it was already Gordon (1957) who noticed that crenulation becomes visible only in specimens with D over 9 mm. The shells reveal substantial resemblance to the early form of *Goniatites crenistria* Phillips (Bisat 1952, pl. 1, figs. 5—6), which Nicolaus (1963, p. 103, pl. 1, fig. 2; pl. 4, figs. 4—5, text figs. 27—31) recognized as a new subspecies — *Goniatites crenistria schmidtianus*.

Surface sculpture of the flattened specimens from the borehole Gałęzice 3 is very similar to that of the late form of *Goniatites crenistria* Phillips (Bisat 1952, pl. 1, fig. 4), or *G. crenistria intermedius* (Kobold), or else *G. concentricus* Hodson et Moore (Nicolaus 1963, p. 105, pl. 1, figs. 4—5; pl. 7, fig. 1; Hodson, Moore 1959, p. 385, pl. 64, figs. 1—3, 5—8; pl. 65, fig. 6). The flattened specimens from Gałęzice have the sculpture and outline of the umbilicus similar to those of the specimen from Jugów (Żakowa 1966, pl. 19, fig. 13a), which resembles *G. crenistria intermedius* (Kobold).

Occurrence: *G. crenistria* Phillips sensu lato is the predominant fossil in the lowermost zone of the Upper Visean. In Poland it occurs in the West Sudeten (Żakowa 1966), on the Fore-Sudetic Monocline (Korejwo, Teller 1967), at the borders of the Upper Silesian Coal Basin (Bojkowski, Bukowy 1966), and in the Holy Cross Mts. (Żakowa 1966, 1970a, 1971a).

Goniatites ex gr. *crenistria* Phillips 1836

(Pl. I, Fig. 1)

Material: 15 fragments of whorls (cat. no. OS-75/704, OS-75/748, OS-75/751, OS-75/754a—g) from the borehole Gałęzice 3, depth 174.20—175.00 m and 183.45—185.45 m.

Description: All the specimens represent small fragments; those better preserved show that they may be parts of a shell with a diameter from 12 to 14 mm. Outlines of umbilicus are visible on some of them. Transverse striae are crenulate and frequently displaced in relation to one another.

Goniatites have been classified into this group basing on a general similarity of the visible features to *G. crenistria* Phillips (flattened forms). Occurrence: Apart from Gałęzice, analogically classified specimens have been recorded in Poland in boreholes in the Nida Trough (Bednarczyk, Korejwo, Łobanowski, Teller 1968) and on the foreland of the Carpathian Mts. (Kicuła, Żakowa 1972).

Goniatites sphaericostriatus Bisat 1924

(Pl. II, Figs. 1, 3, 4, 5a—b; Pl. III, Fig. 3, Text fig. 4)

1924. *Goniatites sphaerico-striatus* Bisat; Bisat, p. 36
1928. *Goniatites waddingtoni* Bisat; Bisat, p. 131, pl. 6A, figs. 5, 5a
1933. *Glyphioceras striatum waddingtoni* Bisat; Kobold, p. 492, pl. 22, figs. 9—10
1936. *Goniatites sphaerico-striatus* Bisat; Moore, pl. 1, figs. 6—7
1958. *Goniatites sphaericostriatus* Bisat; Moore et Hodson, p. 99, pl. 10, figs. 6—7, text fig. 13—17

Material: 1 only slightly damaged shell; 3 incomplete shells; 5 fragments of internal casts (cat. no. OS-120/26, OS-120/23). The specimens were found in pit XXI, bed 1.
Dimensions of 7 specimens in mm and proportions are as follows:

cat. no	Diameter D	Width of last whorl W	Width of umbilicus U	U/D	W/D
OS-120/24	18·0?	—	—	—	—
OS-120/30	20·0?	13·0	—	—	0·65?
OS-120/22	22·0?	14·0	—	—	0·63?
OS-120/28	22·5	14·8	4·5	0·20	0·65
OS-120/27	28·0?	17·4	—	—	0·62?
OS-120/20	30·0?	20·0?	—	—	—
OS-120/21	33·0?	20·0?	—	—	0·62?

Description: The shell is involute of thick-discoidal (ellipsocone according to Bisat), most likely somewhat variable, shape. It should be noted that except for one shell (cat. no. OS-120/28), all the other D and W measurements were obtained from shape reconstruction. Shell flanks are approximately parallel at a great length, and the venter is fairly wide and slightly flattened. The umbilicus is relatively large, its width amounting to 1/5 D. The edges are sharply delineated.

Suture line (text fig. 4) is characterized by narrow, sharpened lateral lobe, narrow, high and sharply ended first lateral saddle, fairly high second lateral saddle, and by the sharpening of the external lobe basis, which is also relatively narrow. In the external lobe there is a fairly high, conspicuously bipartite median saddle. In ontogenetic development, the first lateral saddle becomes narrower and its borders straighten.

Hence the shape of the lateral lobe is slightly changed (as the specimens are growing, the dorsal border becomes less inclined). It is probable that the second lateral saddle becomes higher as well. In smaller specimens the height of median saddles is less than 1/2 the height of the first lateral saddles; in bigger specimens (D = 28 and 33 mm), it amounts to, or exceeds, this height. Simultaneously, the sides of median saddles somewhat bulge at the top.

The preserved fragment of surface sculpture (cat. no. OS-120/26) is made up of distinct spiral striae and less distinct dense and crenulate transverse striae. There fall 4—5 spiral and about 10 transverse striae on

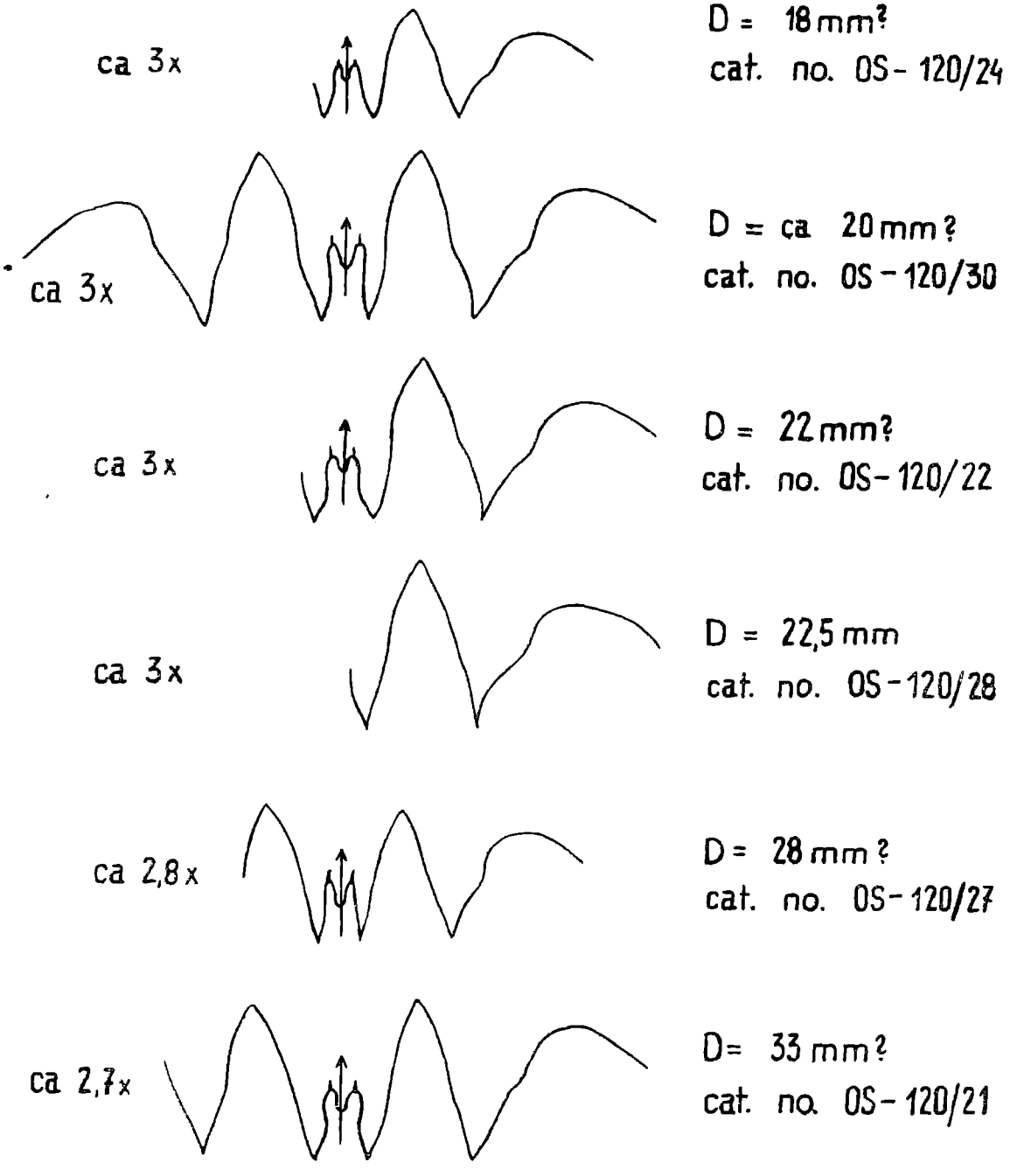


Fig. 4. Suture lines of *Goniatites sphaericostriatus* B i s a t of different size

Fig. 4. Linie przegrodowe różnej wielkości okazów *Goniatites sphaericostriatus* B i s a t

1 mm. Striae of the two types are more or less uniformly distant from one another. On the shell (cat. no. OS-120/28, pl. II, fig. 4) with a fragment of sculpture of an earlier whorl, spiral striae predominate over the transverse ones. The latter are crenulate and densely set. Near the umbilicus there are 8—10 such striae on 1 mm, whereas only 3—5 spiral striae.

Comparisons: Bisat (1924), does not furnish any illustrations or drawings of suture line. Such drawings given for Irish specimens with D from 18 to 22 mm correspond to those observed in the Gałęzice specimens with the same diameter. In the literature there are no descriptions or drawings of suture line for specimens with a diameter greater than 22 mm.

The present author's observations regarding both the change in the shape of shell with growth and the lack of constrictions are in accordance with Bisat's opinion (1924), though he based his studies mainly on larger specimens. Calculations demonstrate that the specimen shown by Moore and Hodson (1958) has the proportion W/D = 0.75 when D is about 20 mm. This would suggest a little more stouter shell than that of the Gałęzice specimens with a similar diameter. Wider as well are *Goniatites sphaericostriatus* Bisat described by Moore (1936), for which, as appears from calculations, proportions W/D in specimens with D = 22 and 32 mm are 0.77 and 0.69, respectively. From comparisons of U/D ratios it appears that the umbilicus width also slightly diminishes with the growth of a specimen. Thus, for D = about 20 mm (Irish specimen) U/D ratio = 0.22, for D = 22.5 mm (Gałęzice specimen) the same ratio is 0.20, whereas for English specimens with D = 22 and 32 mm (see Moore 1936) and D = 27 and 48 mm (see Bisat 1924) this ratio is 0.27, 0.22, 0.18 and 0.16, respectively. Specimens belonging to the species under study found in Germany (Kobold 1933; Haubold 1933) can hardly be compared with the material from Gałęzice because of their bad state of preservation.

Similarities to *Goniatites sphaericus* (Sowerby) (see e.g. Bisat 1924, pl. 18, fig. 2, text fig. 6) concern U/D ratio, sculpture in the particular stages of ontogenetic development and, to some extent, suture line. Differences are observed in the first place in the shape of shells. Analogies to *G. striatus* (Sowerby) (see e.g. Bisat 1934, p. 301, pl. 18, fig. 1; pl. 19, figs. 1—2; pl. 21, fig. 1; Delépine 1940, p. 79, pl. 5, figs. 16—17; Hodson, Moore 1959, p. 388, pl. 65, figs. 1—3) are manifested in a similar shape of shells and partly sculpture. Differences are seen in the umbilicus width, internal structure and some elements of sculpture. *G. sphaericostriatus* Bisat resembles in shape the late form of *G. hudsoni* Bisat (Bisat 1952, pl. 2, figs. 1—3, text figs. 3c, 3f) known from B_2 subzone in England. However, differences in suture line, sculpture and U/D ratio are conspicuous.

Occurrence: The species has been recorded in England, in the Upper Visean of Dinckley. In England and Ireland it occurs in subzone P_1c

(Bisat 1928, 1952, Moore 1936; Moore, Hodson 1958), in North Africa in series S^{3a} of Sud-Oranais Sahara (Pareyn 1961), in Rheinische Schiefergebirge and Harz in subzone $Go\beta_{mu}$ (Haubold 1933; Kulick 1960; Kobold 1933; Fuhrmann 1952), where it accompanies *G. mucronatus* (Knopp). The species under study has been reported by Kumpera (1971a, 1971b) in Czechoslovakia, in the upper part of Goβ zone. In Poland it has been found only in Gałęzice.

Goniatites robustus Moore et Hodson 1958

(Pl. II, figs. 2a—b; pl. 3, figs. 1, 6, 7a—b; pl. IV, figs. 1a—b, 3a—b, text fig. 5)

1958. *Goniatites robustus* Moore et Hodson; Moore and Hodson, p. 98, pl. 8, figs. 1—3, text fig. 18.

1963. *Goniatites (Goniatites) robustus* Moore et Hodson; Kullmann, p. 309, pl. 20, fig. 3, text fig. 11a

Material: 4 shells mostly damaged, 2 fragments of whorl (cat. no. OS-120/25).

Dimensions of 5 specimens in mm and proportions are as follows:

cat. no.	Diameter D	Width of last whorl W	Width of umbilicus U	U/D	W/D
OS-120/34	13·0	9·6	4·0	0·30	0·74
OS-120/33	14·0?	10·7	4·0?	0·28?	0·76?
OS-120/17	—	12·0	4·2	—	—
OS-120/31	15·0	12·4	4·2	0·28	0·82
OS-120/29	21·0	17·8	6·0	0·28	0·84

Description: Involute, subglobose shell, this shape however changing with the growth of specimens. W/D ratios show that bigger specimens are stouter while the smaller ones are a little narrower. Flanks of the shell in its central part are more or less parallel and slightly rounded. Ventro-lateral shoulders and ventral areas are uniformly rounded. In smaller specimens, with a diameter from 13 to 15 mm, parallelism of the flanks is more pronounced. The umbilicus is fairly large with the edge narrowly rounded. U/D ratio shows that the umbilicus width is about 1/4 the shell diameter.

Suture line fails to show any essential differences with the growth of specimens (text fig. 5). The relatively wide external lobe has borders far apart and bent when passing into the first lateral saddle. The lateral lobe is sharpened, fairly wide, with inclined sides. The height of median saddle in the external lobe is about 1/3 the height of the first lateral saddles. The later are broad at base and taper gently to form a sharp ending. Broadly outlined and not very high are the second lateral saddles, in which dorsal border is frequently only very weakly rounded.

As regards sculpture, spiral striae prevail over the transverse ones. There are 8—9 spiral striae in 1 mm, i.e. they are 0.11—0.12 mm distant from one another. Transverse striae, more densely set, are characterized by an almost imperceptible forward inclination from the umbilicus, the equally feeble wide lateral sinus, and very shallow ventro-lateral salient. As the full sculpture is lacking, it is impossible to state how transverse striae pass across the venter.

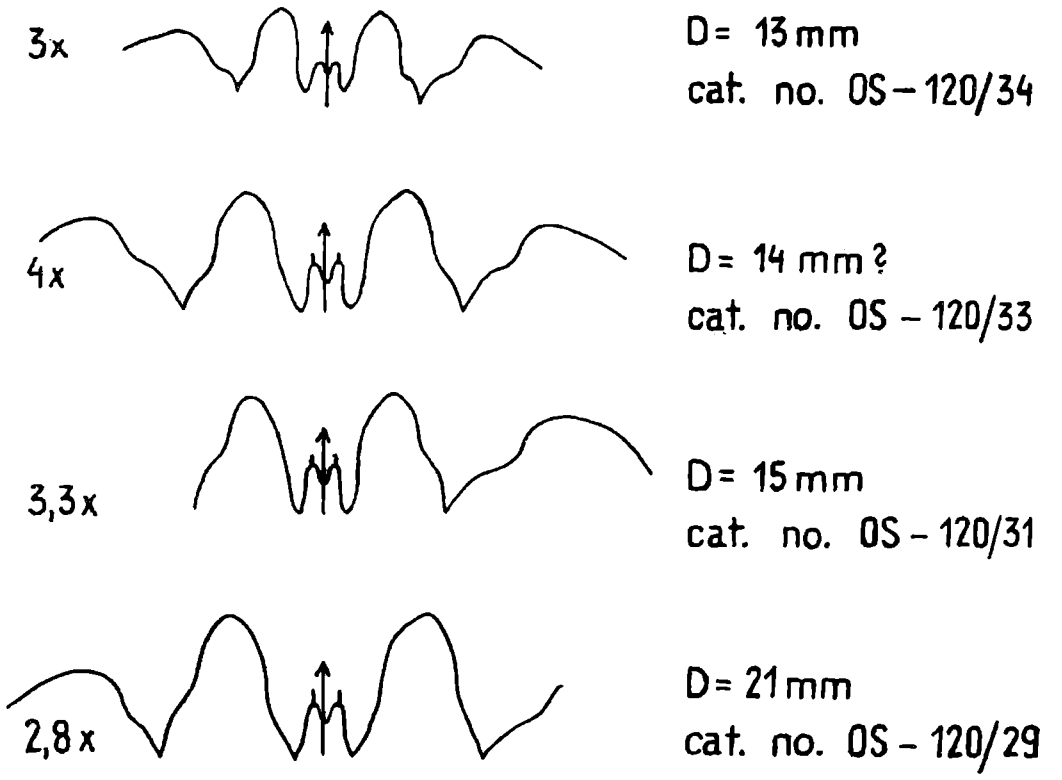


Fig. 5. Suture lines of *Goniatites robustus* Moore et Hodson of different size
Fig. 5. Linie przegrodowe różnej wielkości okazów *Goniatites robustus* Moore et Hodson

Comparisons: The biggest specimen from Gałęzice, whose diameter approximates that of the holotype shell (D—22 mm), reveals the identical shape and outline of suture line. Smaller specimens cannot be compared since they are not mentioned by Moore and Hodson (1958). Proportions U/D for two Irish specimens measured, where for D=20 mm the ratio is 0.30 and for the holotype 0.27, suggest certain decrease in the umbilicus width the growth of specimens. W/D ratios for these specimens (0.82 for the first and 0.86 for the second) would confirm the present author's view concerning the change of shape in stouter specimens with the growth of shell.

Specimens representing both the forms *robustus* and *sphaericostriatus* were found in Gałęzice. This fact supports Moore and Hodson's conclusion (1958) regarding the differences between these closely related species.

Occurrence: In Ireland the species discussed occurs in subzone P_1c of the Upper Visean together with *G. sphaericostriatus* Bisat, which has been also recorded by Bogoslovskaya (1966). In Spain it appears in zones Goα or Goβ (Kullmann 1963) and in Poland this species has been so far encountered only in Gałęzice.

Goniatites cf. *mucronatus* (Knopp 1931)
(Pl. III, figs. 4a—b, text fig. 6)

1931. *Glyphioceras mucronatum* Knopp; Knopp, p. 11, pl. 2, fig. 9, text fig. 8
1935. *Goniatites mucronatus* Knopp; Knopp, p. 68, pl. 2, figs. 4a—b

Material: 1 slightly damaged shell, derived from pit XXI, bed 1.

Its dimensions in mm and proportions are:

cat. no.	Diameter D	Width of last whorl W	Width of umbilicus U	U/D	W/D
OS-120/32	15·0?	11·0	2·0	0·13?	0·73?

Description: Involute shell, most likely of subglobose but already approximating thick-discoidal shape. Proportion U/D would suggest that the umbilicus width ranges from 1/7 to 1/8 of the shell diameter. The flanks and ventral area are gently rounded. The suture line (text fig. 6) has sharpened lateral lobe with the base somewhat lowered in relation to the external lobe. The lateral lobe sides are inclined, and the second lateral saddle is fairly high and broadly rounded. The height of the median saddle is only about 1/3 the height of the first lateral saddle. Surface sculpture consists of widely spaced and, in all likelihood, crenulate transverse striae, the distances between them being 0.5 to 0.6 mm. From the umbilicus they run straight across the lateral and ventrolateral areas and the venter.

Fig. 6. Suture line of the specimen *Goniatites* cf. *mucronatus* (Knopp)
Fig. 6. Linia przegrodowa okazu *Goniatites* cf. *mucronatus* (Knopp)

Comparisons: A comparison of the Gałęzice specimen with those of Czech *G. mucronatus* (Knopp) (Knopp 1931, Humpera 1971a, b) is a difficult problem. There is a similarity in the wide setting of crenulate transverse striae and in the form of lateral lobe (elongation and sharpening of the base) and the second lateral saddle in the suture

line. Differences involve the run of the transverse striae, which on our specimen are straight whereas on the *mucronatus* they form a minimum ventro-lateral salient (Knopp 1931) or a weak double inclination (Knopp 1935; Hartung, Patteisky 1960). Our specimen lacks spiral striae near the umbilicus that have been mentioned by Knopp. It seems feasible that the differences in ornament result from the specimens being in a different stage of growth.

Specimens from other regions, identified with this species and described as *Glyphioceras striatum waldeckense* Haubold from Germany and Spain (Haubold 1933; Kobold 1933; Kullmann 1963) or as *Hibernicoceras waldeckense* (Haubold) from Ireland (Moore, Hodson 1958) are bigger than that from Gałęzice. Only Kobold illustrates a specimen approximate in size, mentioning that transverse striae are inclined. German specimens were collected from G. mucronatus zone — $Go\beta_{mu}$ (Fuhrmann 1952; Kulick 1960). Irish specimens are characterized by the sculpture identical to the ornament of both German and Czech specimens.

Occurrence: Gałęzice.

Goniatites sp.

(Pl. IV, fig. 5, text fig. 7)

Material: 1 fragment of whorl (cat. no. OS-120/16) found in pit XXI, bed 1.

Description: The state of preservation makes impossible any measurements except those of the umbilicus width (3 mm). In all likelihood, the shell is involute. Suture line is shown in text fig.7.

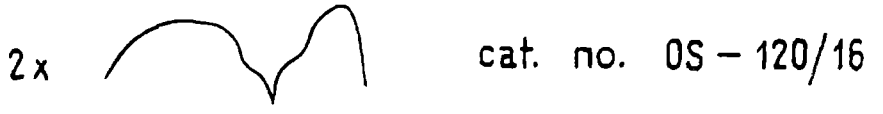


Fig. 7. Suture line of the specimen *Goniatites* sp.

Fig. 7. Linia przegrodowa okazu *Goniatites* sp.

The sculpture is up of fine-crenulate, sigmoidal transverse striae, which are rather irregularly set and from 0.3 to 0.5 mm distant from one another in the lateral sinus. The transverse striae run from the umbilicus with slight forward inclination, forming then a wide, up to 1 mm deep lateral sinus and a distinct ventro-lateral salient. Traces of spiral striae are visible near the umbilicus.

Comparisons: The sculpture shows certain similarity to the ornament of *Hibernicoceras* (?) *kajlovecense* (Patteisky), known from Czechoslovakia (Patteisky 1929, p. 263, pl. 21, figs. 4—8; Hartung, Patteisky 1960; Kumpera 1971a, 1971b), England

(Moore 1950, p. 34, pl. 2, fig. 3) and Ireland (Moore, Hodson 1958, p. 96, pl. 10, fig. 4, text figs. 9—11). Suture line of the Gałęzice specimen resembles in broad outlines that of the Irish specimens with D=10 and 23 mm.

Occurrence: Gałęzice.

Subfamily: Muensteroceratinae Gordon 1964
Genus: Muensteroceras Hyatt 1884

Muensteroceras truncatum (Phillips 1836)
(Pl. I, fig. 2, text fig. 8)

1963. *Muensteroceras truncatum* (Phillips); Nicolaus, p. 114, pl. 3, figs. 6—11; pl. 4, fig. 2 (earlier synonymics is given in the paper)

Material: 1 fragment of whorl from pit XIV, bed 14.
Dimensions in mm are:

cat. no.	Width of last whorl W	Width of umbilicus U
OS-120/46	16·5	4·0?

Notes: The vestigial state of preservation has rendered a determination of the shell diameter or basic proportions impossible. The form of suture line and the shape of the specimen permit, however, to classify it among this species with a good deal of certainty.

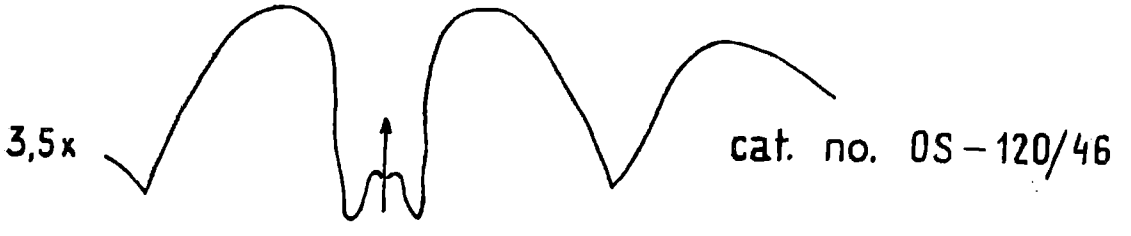


Fig. 8. Suture line of the specimen *Muensteroceras truncatum* (Phillips)
Fig. 8. Linia przegrodowa okazu *Muensteroceras truncatum* (Phillips)

Comparisons: The suture line corresponds to that of species *truncatum* of Belgian, English and German specimens (Delépine 1940, p. 75, text fig. 17, pl. 4, figs. 13—21; Bisat 1934, pl. 20, fig. 4; Nicolaus 1963). In Belgian specimens of W=16 mm, the umbilicus width is smaller than that of the Gałęzice specimen. German specimens are characterized by a larger umbilicus. Our specimen seems wider as well. Its state of preservation does not permit a comparison with Scottish specimens.

Occurrence: The species in question occurs in D_2 zone of the Upper Visean of Belgium, in the upper part of P_1a subzone of England (Bisat 1934, 1952), in P_1 zone and a little higher in Scotland (Currie 1954), in Germany in $Go\alpha_{1-4}$ and $Go\beta_{st-fa}$ subzones (Schmidt 1925; Kobold 1933; Haubold 1933; Kulick 1960; Nicolaus 1963) and in Czechoslovakia in $Go\alpha_{2-3}$ subzones (Kumpera 1971a, 1971b). In Poland, besides Gałęzice, the species occurs in Goα zone of the Sudetes Mts. (Żakowa 1958), in the Upper Visean in the Lublin Trough (Bojkowski 1966) and, questionably, in the Upper Silesian Coal Basin (Bojkowski, Jachowicz, Żołdani 1968). *Beyrichoceratoides* cf. *truncatus* (Phillips) have been recorded in Goα zone in the Nida Trough (Bednarczyk, Korejwo, Łobanowski, Teller 1968).

Muensteroceras sp. cf. *fournieri* (Delépine 1940)
(Pl. IV, figs. 2a—d)

Material: 1 shell (cat. no. OS—120/4), derived from pit VIII, bed 1J.
The dimensions in mm and proportions are:

Diameter D	Width of last whorl W	Width of umbilicus U	Height of last whorl H	U/D	W/D	W/H
12·0	7·7	1·8	5·6	0·15	0·64	1·37

Description: Involute, thick-discoidal shell with small umbilicus, the width of which ranges between 1/6 and 1/7 the shell diameter. The edge of umbilicus is rather sharply rounded. The flanks are parallel, the ventro-lateral shoulder and venter being regularly rounded. The suture line reveals only the outline of external lobe, which is fairly long, narrow, with parallel sides slightly bent in the upper part. The sculpture is made up of transverse striae, which in the flanks run almost straight from the umbilicus. At the mouth they are gently inclined in the form of a very shallow lateral sinus. Farther they form a distinct ventro-lateral salient (about 0.5 mm) and on the venter, a wide and fairly deep (up to 2 mm) hyponomic sinus. In the area of ventro-lateral salient there are about 3 transverse striae in 1 mm. At a considerable magnification, most likely traces of spiral striae are visible between the transverse striae. The latter are at different distances from one another and variable in thickness.

The specimen has been classified as genus *Muensteroceras* basing on the outline of external lobe in the suture line and, partly, on sculpture characteristics. The state of preservation makes an explicit identification of the species difficult. The sculpture is most similar to the ornament of species *fournieri*.

Comparisons: *Beyrichoceras fournieri* Delépine described from the Upper Visean of Belgium is an adult specimen with D = 58 mm (Delépine 1940, p. 67, pl. 4, figs. 1—2). Its correspondence with the Gałęzice specimen concerns the run of transverse striae, approximating falcoid type. The English specimen of this species is also bigger than the Gałęzice one (Bisat 1952, p. 175, pl. 2, figs. 7—8), stouter than the Belgian specimen, with the umbilicus more open. According to Bisat, transverse plications are to be noticeable only beginning with a diameter about 20 mm. If this is the fact, an identification of the Gałęzice specimen with *Muensteroceras* (*Beyrichoceratoides*) *fournieri* (Delépine) cannot be taken into account since in the former a distinct ornament of falcoid type is already visible at D=12 mm.
Occurrence: Gałęzice.

Subfamily: Nomismoceratinae Librovitch 1957
Genus: Nomismoceras Hyatt 1884

Nomismoceras vittiger (Phillips 1836)
(Pl. I, fig. 4; pl. III, fig. 2)

1963. *Nomismoceras vittiger* (Phillips); Nicolaus, p. 128, pl. 2, fig. 13; pl. 3, figs. 1—4; pl. 7, figs. 6—7 (earlier synonymics is given in the paper)
1966. *Nomismoceras vittiger* (Phillips); Żakowa, p. 116, pl. 19, figs. 10a—e, 11.

Material: 1 fragment of internal cast; 10 damaged imprints (cat. no. OS-75/748, OS-75/750, OS-75/751, OS-75/754a-g). The cast comes from pit XXI, bed 1 and the flattened specimens imprints from the borehole Gałęzice 3, depth 183.45—185.45 m.
Dimensions of the cast in mm and proportions:

cat. no.	Diameter D	Width of last whorl W	Width of umbilicus U	U/D	W/D
OS-120/19	22·7?	5·8	7·2	0·31?	0·25?

Notes: The cast evolutely coiled is of discoidal shape and represents the adult stage. The venter is somewhat rounded and truncated keel rather weakly marked, being more distinct in flattened specimens. The surface sculpture consists of densely set transverse striae.
Occurrence: In Europe this species is most abundant in Goα zone and in the lowermost part of Goβ zone. In certain areas it has been also recorded in the Middle Visean and as far as $Go\beta_{mu}$ subzone, the latter being included. It has been found as well in the Upper Visean of the southern Ural Mts. (Ruzhencev, 1966), and similar specimes have been encountered in North Africa (Pareyn, 1961). In Poland it occurs

in the Sudetes Mts. in Goα and the lower part of Goβ zones (Żakowa, 1958, 1966), in the borehole Sułów 1 (Korejwo, Teller, 1967), at the margin of the Upper Silesian Coal Basin (Bojkowski, Bukowy, 1966), in the Western Pomerania, and on the foreland of the Carpathian Mts. (Kicuła, Żakowa, 1972). In the Holy Cross Mts. this species has been encountered in Goα zone (Żakowa 1962, 1970a; Żakowa, Pawłowska, 1965) and in Gałęzice. Specimens very similar to this species have been found in the Nida Trough (Korejwo, Teller, 1968; Kicuła, Żakowa, 1972).

Superfamily: Dimorphocerataceae Hyatt 1884
Family: Dimorphoceratidae Hyatt 1884
Subfamily: Glyphiolobinae Ruzhencev et Bogoslovskaya 1969
Genus: Glyphiolobus Gordon 1964

Glyphiolobus pseudodiscrepans (Moore 1939)
(Pl. IV, fig. 4, text fig. 9)

1939. *Dimorphoceras pseudodiscrepans* Moore; Moore, p. 112, text fig. 9

Material: 1 fragment of whorl from pit XIV, bed 15.
Dimensions in mm and proportions are as follows:

cat. no.	Diameter D	Width of last whorl W	Width of umbilicus U	U/D	W/D
OS-120/47	6·4	3·6?	0·5	0·07	0·56?

Description. The shell is involute with tightly closed umbilicus, the width of which is about 1/13 of the shell diameter. Reconstruction of the venter width and W/D ratio suggests thick-discoidal, already approximating subdiscoidal, shape. The flanks are probably almost parallel and the ventral side slightly rounded and narrowing. Suture line (text fig. 9) is characterized by broad external lobe. The height of the median

Fig. 9. Suture line of the specimen *Glyphiolobus pseudodiscrepans* (Moore)
Fig. 9. Linia przegrodowa okazu *Glyphiolobus pseudodiscrepans* (Moore)

saddle amounts to 1/2 the height of the first lateral saddle, the latter being symmetrical, rounded and separated from the considerably lower and broadly rounded lateral saddle by a relatively wide lateral lobe. Subsidiary saddles in the external lobe are weakly marked. In the lateral

lobe they appear on the ventral side at the level of the external lobe and become lower towards the dorsal side of the shell.

Comparisons. Suture line generally corresponds to that presented for the holotype (Moore 1939). It is characterized, on the other hand, by a greater height of the median and subsidiary saddles, particularly in the external lobe. Since the suture line refers a specimen with D=18 mm, the above differences can be accounted for by changes in the ontogenetic development. Proportion W/D for the holotype is 0.52 (the present author's calculations), so in relation to the Gałęzice specimen its shape is closer to subdiscoidal.

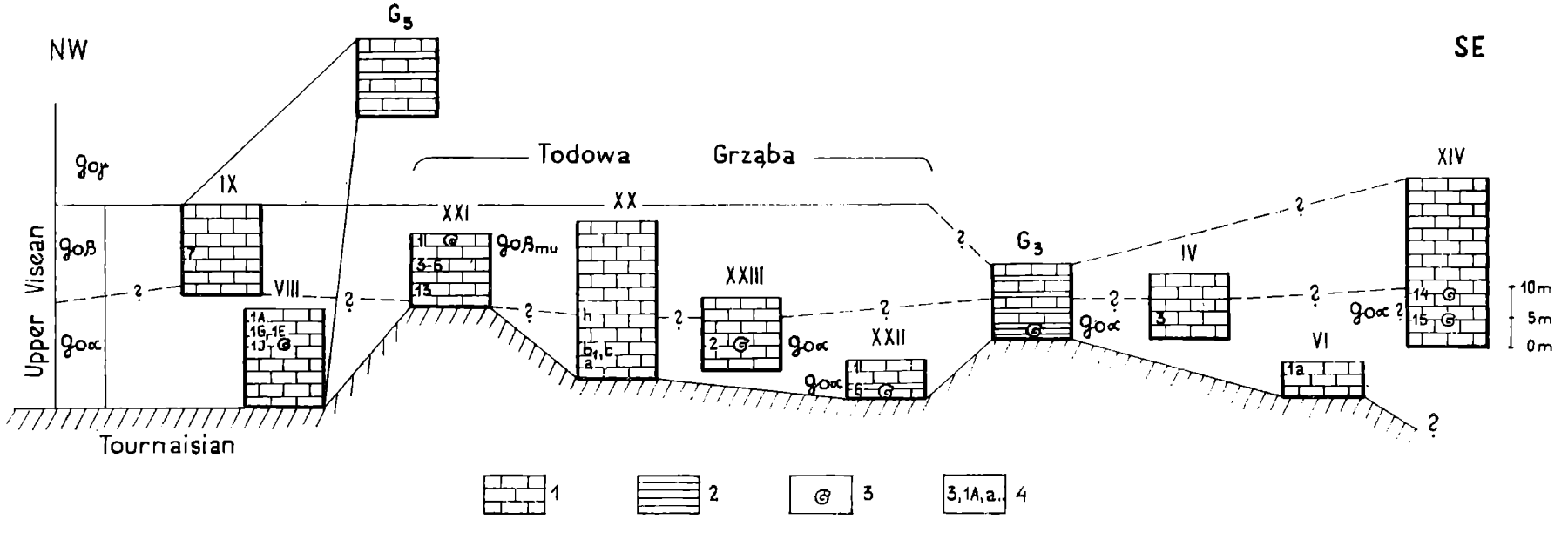
Outline of the suture line of the Gałęzice specimen resembles that of *Dimorphoceras marioni* Moore for specimens with a similar diameter (Currie 1954, p. 590, e.g. text figs. 8 C, G 1). However, their lateral saddles and the apical part of the lateral lobe are somewhat different. There are similar differences and correspondences also in relation to specimens of the same size from the species *lunula* coming from Goγ zone of the Gałęzice syncline (Żakowa 1971a, p. 54, text fig. 10 C, pl. 7, figs. 4a—c, 6a—c). Already Gordon (1964) noticed the affinity of the internal structure of the species *pseudodiscrepans, marioni* and *lunula,* assigning them to subgenus *Glyphiolobus.* Ruzhencev and Bogoslovskaya (1969) raised it to the rank of genus.

Occurrence: The species has been recorded at Lower Bowland Shales in England, in P_1c subzone of the Upper Visean, but has been also found to occur in P_1a subzone (Moore 1939). It is encountered in North Africa (Delépine 1941; Pareyn 1961) in P_1a subzone and P_2 zone. In Poland it occurs in Goα zone of the borehole Radoszyce 3 (Żakowa 1961, 1970a, 1971a) beside *Beyrichoceratoides* aff. *micronotum* (Phillips) and in Gałęzice. Moreover, *Dimorphoceras* (*Metadimorphoceras*) cf. *pseudodiscrepans* Moore has been recorded in the Upper Visean of the borehole Gołonóg in the Upper Silesian Coal Basin (Bojkowski, Jachowicz, Żołdani 1968).

STRATIGRAPHICAL CONCLUSIONS

The thickness of calcareous deposits exposed in pits of the Gałęzice syncline ranges from some to about 50 m whereas that of calcareous-clayey deposits in boreholes from 4 to 11 m. These deposits have been assigned to Goα and Goβ zones of the Upper Visean basing both on the macrofauna found with goniatites and on the stratigraphical sequence investigated limestones. Goα zone has been palaeontologically proved by the presence of *Goniatites crenistria* Phill. in pits XXII and XXIII.

The presence of *Muensteroceras* sp. cf. *fournieri* (Delépine) seems to indicate the Goα zone in the upper part of the pit VIII. Subzone $Go\beta_{mu}$ was proved in the pit XXI, bed 1 by the occurrence of *Goniatites*


NW
SE
G5
G3
Todowa
Grząba
Upper Visean
Tournaisian
goγ
goβ
goα
goβmu
IX
VIII
XXI
XX
XXIII
XXII
IV
VI
XIV
10m
5m
0m
1
2
3
3,1A,a..
4

sphaericostriacus Bisat, *G. robustus* Moore et Hod. and *G.* cf. *mucronatus* (Knopp). Both mentioned pits are localized in the NW part of the Gałęzice Syncline.

In the SE part no index goniatites were found in outcrops. The occurrence of *Muensteroceras truncatum* (Phill.) in the lower part of the pit XIV suggests the Goα zone or the lower part of the Goβ zone. The Goα zone was proved in this region only in limy-clayey deposits in borehole Gałęzice 3.

A preliminary correlation of investigate profiles is shown on Fig. 10.

translated by H. Kisielewska

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Fig. 10. Preliminary correlation of profiles of the sites where goniatites were found. 1 — limestones; 2 — claystones; 3 — occurrence of species of goniatites of stratigraphic importance; 4 — numeration of beds with goniatites

Fig. 10. Wstępna korelacja profilów stanowisk w których znaleziono goniatyty. 1 — wapienie; 2 — iłowce; 3 — występowanie ważnych stratygraficznie gatunków goniatytów; 4 — oznaczenia warstw z goniatytami

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STRESZCZENIE

Praca omawia bardzo ważną dla stratygrafii faunę nektoniczną, która występuje w osadach odpowiadających łącznie poziomom Goα + Goβ wizenu górnego (np. Żakowa, 1970a, b, 1971a; Jachowicz et Żakowa, 1969). Ogniwo to obejmuje serię wapienną znaną z wychodni oraz jej peryferyczne ekwiwalenty — serie wapienno-iłowcowe. Ostatnie uzyskano w wierceniach: Gałęzice 3 (głęb. 160,50—185,45 m), Gałęzice 4 (głęb. 99,10—103,30 m) i Gałęzice 5 (głęb. 347,70—359,00 m). Przyjętą pozycję stratygraficzną argumentowały głównie dwa fakty: występowanie powyżej serii osadów poziomu Goγ oraz obecność makro- i mikrofauny górnego wizenu w najniższym odcinku omawianych serii. W Gałęzicach leżą one bezpośrednio na turneju. Na podstawie fauny bentonicznej omawiane serie nie mogą być rozpoziomowane. Pewne sugestie uzyskano dotąd tylko z wstępnego opracowania przez Jurkiewicza i Żakową otwornic (Żakowa, 1970 b) na podstawie wyróżnienia starszych i młodszych zespołów otwornic.

Seria wapienna w przekrojach synkliny gałęzickiej ma miąższość od kilku do być może 50 m (na E od góry Besówki). Budują ją głównie wapienie organodetrytyczne. Goniatyty znaleziono w 9 różnej długości przekopach (fig. 1), skąd łącznie zebrano 52 okazy (fig. 2) w dość dobrym stanie zachowania (przeważnie muszle z liniami przegrodowymi i rzeźbą). Najważniejsze stratygraficznie formy występują na wzgórzu Todowa

Grząba, gdzie udokumentowano poziom Goα (obecny *Goniatites crenistria* Phillips) i podzonę $Goβ_{mu}$ (fig. 10). Wskaźniki ostatniej: *Goniatites sphaericostriatus* Bisat, *G.* cf. *mucronatus* (Knopp) i *G. robustus* Moore et Hodson nie były dotąd opisane z karbonu Polski.

Serie wapienno-iłowcowe z wierceń (miąższość od 4 do maksymalnie 11 m) zawierają różnej grubości wkładki wapienne z bentosem. Warstewki iłowców są na ogół bardzo cienkie. Znaleziono w nich małże, makro- i mikroflorę, detrytus liliowców, głowonogi i konikonchy. Goniatyty występują tylko w wierceniach Gałęzice 3 i 5, skąd łącznie zebrano 92 okazy. Większość jest nieoznaczalna i reprezentuje odciski oraz odlewy z różnej części spłaszczonych muszli, bez elementów budowy wewnętrznej. Tylko w otworze Gałęzice 3 udowodniono poziom Goα (obecny *G. crenistria* Phillips).

Z zebranych w sumie 144 okazów goniatytów 93 egzemplarze zaliczono do Goniatitina gen. et sp. indet. Pozostałe okazy szczegółowo opisano załączając rysunki linii przegrodowych (fig. 3—9) i fotografie zestawione na 4 tablicach. Goniatyty stanowią zaledwie około 0,2% sumy fauny zebranej z poziomów Goα + Goβ synkliny gałęzickiej.

Wyniki badań stratygraficznych i intepretacja mapy geologicznej pozwoliły wstępnie skorelować profile stanowisk z goniatytami z sugestią rozprzestrzenienia poziomów Goα i Goβ na znacznym obszarze karbonu Gałęzic. Niniejsze opracowanie będzie bardzo pomocne do dalszego ukierunkowania badań otwornic, a zwłaszcza zagadnienia wartości stratygraficznej wstępnie wydzielonych tak zwanych starszych i młodszych zespołów otwornic. Punktem wyjścia powinny być właśnie warstwy z przewodnimi goniatytami, które obfitują w mikrofaunę.

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EXPLANATION OF PLATE
OBJAŚNIENIE TABLIC

Plate — Tablica I

Fig. 1. *Goniatites* ex gr. *crenistria* Phillips; a fragment of lateral area of flattened whorl, ca 3.5 ×, cat. no. OS-75/754a; bore-hole Gałęzice 3, depth 184.50—185.45 m, Goα zone

Fig. 1. *Goniatites* ex gr. *crenistria* Phillips; fragment bocznej części spłaszczonego skrętu, ca × 3,5 cat. no. OS-75/754a; wiercenie Gałęzice 3, głęb. 184,50—185,45 m, poziom Goα

Fig. 2. *Muensteroceras truncatum* (Phill.); a fragment of whorl visible from the ventral side, 2 ×, cat. no. OS-120/46; Gałęzice, pit XIV, bed. 14, Goα? zone

Fig. 2. *Muensteroceras truncatum* (Phill.); fragment skrętu widoczny od strony brzusznej, × 2, cat. no. OS-120/46; Gałęzice, przekop XIV, warstwa 14, poziom Goα?

Fig. 3. *Goniatitina gen.* et sp. indet.; seriously damaged internal cast visible from the lateral side, cat. no. OS-120/38; Gałęzice, pit XXII, bed. 1, Goα zone

Fig. 3. *Goniatitina gen.* et sp. indet.; mocno uszkodzona ośródka widoczna od strony bocznej, w nat., cat. no. OS-120/38; Gałęzice, przekop XXII, warstwa 1, poziom Goα

Fig. 4. *Nomismoceras vittiger* (Phill.); mould of a flattened shell with fragments of surface sculpture, ca 4 ×, cat. no. OS-75/750; borehole Gałęzice 3, depth 183.45—184.50 m, Goα zone

Fig. 4. *Nomismoceras vittiger* (Phill.); odcisk spłaszczonej muszli z fragmentami rzeźby, ca × 4, cat. no. OS-75/750; wiercenie Gałęzice 3, głęb. 183,45—184,50 m, poziom Goα

Fig. 5. *Goniatites crenistria* Phill.; slightly crushed and damaged shell visible from the lateral (5a) and ventral side (5b), ca 3 ×, cat. no. OS-120/36; Gałęzice, pit XXII, bed 6, Goα zone

Fig. 5. *Goniatites crenistria* Phill.; nieco zgnieciona i uszkodzona muszla widoczna od strony bocznej (5a) i brzusznej (5b), ca × 3, cat. no. OS-120/36; Gałęzice, przekop XXII, warstwa 6, poziom Goα

Fig. 6. *G. crenistria* Phill.; slightly damaged shell visible from the lateral (6a, ca 3.5 ×) and ventral side (6b, ca 7 ×), cat. no. OS-120/40; Gałęzice, pit XXIII, bed 2, Goα zone

Fig. 6. *Goniatites crenistria* Phill.; nieco uszkodzona muszla widoczna od strony bocznej (6a, ca × 3,5) i brzusznej (6a, ca × 7), cat. no. OS-120/40; Gałęzice, przekop XXIII, warstwa 2, poziom Goα

Fig. 7. *G. crenistria* Phill.; a fragment of cast of flattened whorl visible from the lateral side, showing details of surface sculpture, ca 2 ×, cat. no. OS-75/749a; borehole Gałęzice 3, depth 183.45—184.50 m, Goα zone

Fig. 7. *G. crenistria* Phill.; fragment odlewu spłaszczonego skrętu widoczny od strony bocznej ze szczegółami rzeźby, ca × 2, cat. no. OS-75/749a; wiercenie Gałęzice 3, głęb. 183,45—184,50 m, poziom Goα

Plate — Tablica II

Fig. 1. *Goniatites sphaericostriatus* Bisat; a fragment of shell visible from the ventral side, 2.7 ×, cat. no. OS-120/21

Fig. 1. *Goniatites sphaericostriatus* Bisat; fragment muszli widoczny od strony brzusznej, × 2,7, cat. no. OS-120/21

Fig. 2. *G. robustus* Moore et Hodson; shell visible from the ventral (2a) and lateral side (2b), 3 ×, cat. no. OS-120/34

Fig. 2. *G. robustus* Moore et Hodson; muszla widoczna od strony brzusznej (2a) i bocznej (2b), × 3, cat. no. OS-120/34

Fig. 3. *G. sphaericostriatus* Bisat; a fragment of internal cast showing details of suture line, visible from the ventro-lateral shoulder, ca 2.5 ×, cat. no. OS-120/22

Fig. 3. *G. sphaericostriatus* Bisat; fragment ośródki ze szczegółami linii przegrodowej widoczny od strony brzuszno-bocznej, ca × 2,5, cat. no. OS-120/22

Fig. 4. *G. sphaericostriatus* Bisat; slightly damaged shell with the surface sculpture and suture line visible from the lateral side, 3.5 ×, cat. no. OS-120/28

Fig. 4. *G. sphaericostriatus* Bisat; nieco uszkodzona muszla z rzeźbą i linią przegrodową widoczną od strony bocznej, × 3,5, cat. no. OS-120/28

Fig. 5. *G. sphaericostriatus* Bisat; damaged shell visible from the ventral (5a, 2.8 ×) and lateral side (5b, 2.2 ×), cat. no. OS-120/27

All the specimens come from Gałęzice, pit XXI, bed 1, $Go\beta_{mu}$ subzone

Fig. 5. *G. sphaericostriatus* Bisat; uszkodzona muszla widoczna od strony brzusznej (5a, × 2,8) i bocznej (5b, × 2,2), cat. no. OS-120/27
Wszystkie okazy pochodzą z Gałęzic, przekopu XXI, warstwy 1, podpoziomu $Go\beta_{mu}$

Plate — Tablica III

Fig. 1. *Goniatites robustus* Moore et Hodson; a fragment of whorl visible from the ventro-lateral shoulder, 2.5 ×, cat. no. OS-120/25
Fig. 1. *G. robustus* Moore et Hodson; fragment skrętu widoczny od strony brzuszno-bocznej, × 2,5, cat. no. OS-120/25
Fig. 2. *Nomismoceras vittiger* (Phillips); a fragment of internal cast visible from the lateral side, nat. size, cat. no. OS-120/19
Fig. 2. *Nomismoceras vittiger* (Phillips); fragment ośródki widoczny od strony bocznej, w nat., cat. no. OS-120/19
Fig. 3. *Goniatites sphaericostriatus* Bisat; damaged shell visible from the ventral side, ca 4 ×, cat. no. OS-120/30
Fig. 3. *Goniatities sphaericostriatus* Bisat; uszkodzona muszla widoczna od strony brzusznej, ca × 4, cat. no. OS-120/30
Fig. 4. *Goniatites* cf. *mucronatus* (Knopp); slightly damaged shell visible from the ventral (4a) and lateral side (4b), 2.5 ×, cat. no. OS-120/32
Fig. 4. *Goniatites* cf. *mucronatus* (Knopp); nieco uszkodzona muszla widoczna od strony brzusznej (4a) i bocznej (4b), × 2,5, cat. no. OS-120/32
Fig. 5. *Goniatitina* gen. et. sp. indet.; seriously damaged shell visible from the ventral side, 3 ×, cat. no. OS-120/18
Fig. 5. *Goniatitina* gen. et sp. indet.; mocno uszkodzona muszla widoczna od strony brzusznej, × 3, cat. no. OS-120/18
Fig. 6. *Goniatites robustus* Moore et Hodson; damaged shell visible from the ventral side, 4 ×, cat. no. OS-120/33
Fig. 6. *Goniatites robustus* Moore et Hodson; uszkodzona muszla widoczna od strony brzusznej, 4 ×, cat. no. OS-120/33
Fig. 7. *G. robustus* Moore et Hodson; a fragment of whorl with the surface sculpture and suture line visible from the ventral (7a) and lateral side (7b), 5 ×, cat. no. OS-120/17
Fig. 7. *Goniatites robustus* Moore et Hodson; fragment skrętu z rzeźbą i linią przegrodową widoczną od strony brzusznej (7a) i bocznej (7b), × 5, cat. no. OS-120/17
All the specimens come from Gałęzice, pit XXI, bed 1, $Go\beta_{mu}$ subzone
Wszystkie okazy pochodzą z Gałęzic, przekopu XXI, warstwy 1, podpoziomu $Go\beta_{mu}$

Plate — Tablica IV

Fig. 1. *Goniatites robustus* Moore et Hodson; slightly damaged shell visible from the lateral (1a, 2 ×) and ventral side (1b, 2.8 ×), cat. no. OS-120/29; Gałęzice, pit XXI, bed 1, $Go\beta_{mu}$ subzone
Fig. 1. *Goniatites robustus* Moore et Hodson; nieco uszkodzona muszla widoczna od strony bocznej (1a, × 2) i brzusznej (1b, × 2,8) cat. no. OS-120/29; Gałęzice, przekop XXI, warstwa 1, podpoziom $Go\beta_{mu}$
Fig. 2. *Muensteroceras* sp. cf. *fournieri* (Delépine): shell visible from the ventral (2a, 3.5 ×; 2d, nat. size) and lateral side (2b, 3.5 ×; 2c, nat. size), cat. no. OS-120/4; Gałęzice, pit VIII, bed 1J, Goα zone

Fig. 2. *Muensteroceras* sp. cf. *fournieri* (D e l é p i n e); muszla widoczna od strony brzusznej (2a, 3,5 ×; 2d, w nat.) i bocznej (2b, 3,5 ×; 2c, w nat.), cat. no. OS-120/4; Gałęzice, przekop VIII, warstwa 1J, poziom Goα

Fig. 3. *Goniatites robustus* M o o r e et H o d s o n; damaged shell visible from the ventral (3a) and lateral side (3b), 3.3 ×, cat. no. OS-120/31; Gałęzice, pit XXI, bed 1, $Go\beta_{mu}$ subzone

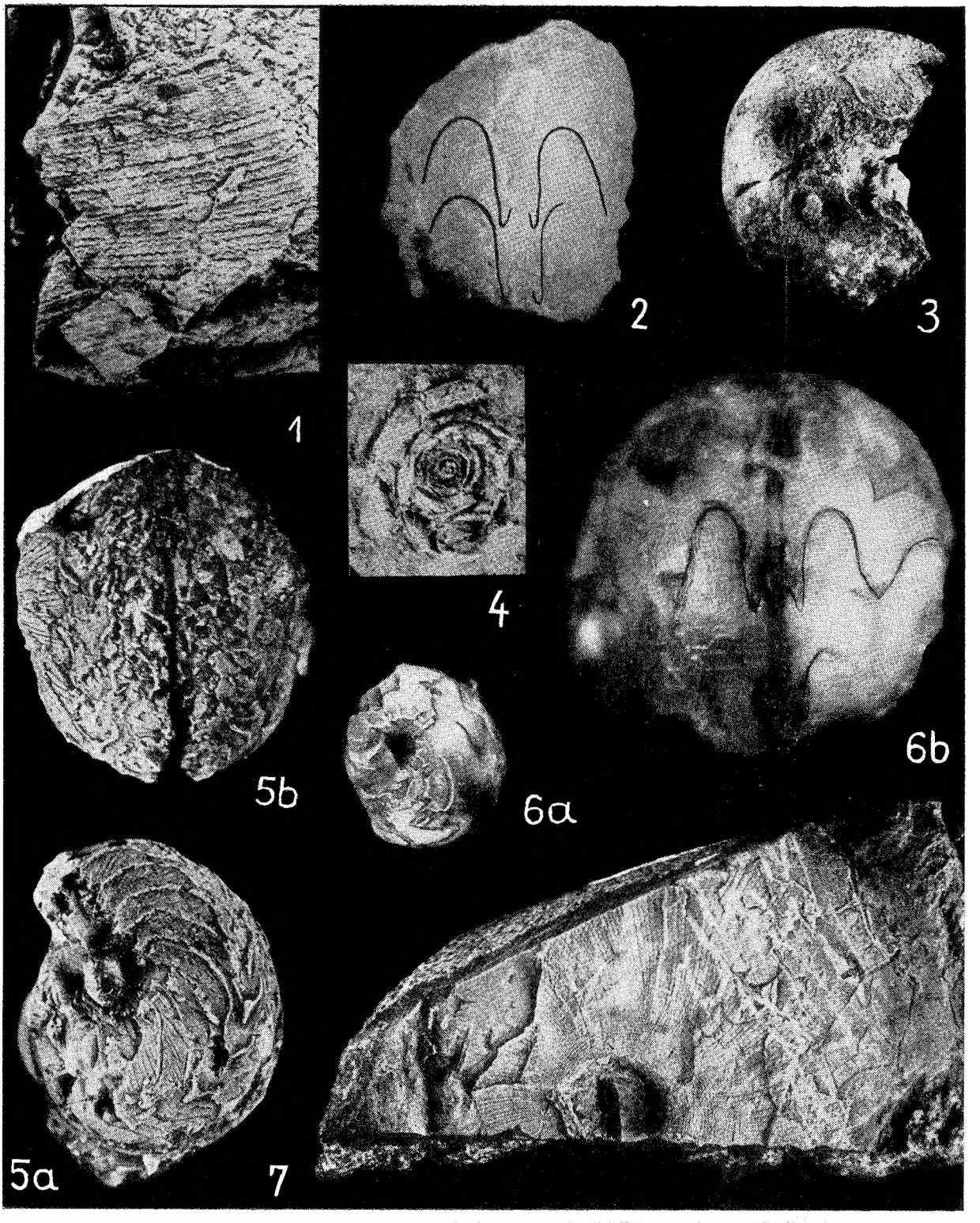
Fig. 3. *Goniatites robustus* M o o r e et H o d s o n; uszkodzona muszla widoczna od strony brzusznej (3a) i bocznej (3b), × 3,3, cat. no. OS-120/31; Gałęzice, przekop XXI, warstwa 1, podpoziom $Go\beta_{mu}$

Fig. 4. *Glyphiolobus pseudodiscrepans* (M o o r e); a fragment of whorl visible from the lateral side, 7 ×, cat. no. OS-120/47; Gałęzice, pit XIV, bed 15, Goα? zone

Fig. 4. *Glyphiolobus pseudodiscrepans* (M o o r e); fragment skrętu widoczny od strony bocznej, × 7, cat. no. OS-120/47; Gałęzice, przekop XIV, warstwa 15, poziom Goα?

Fig. 5. *Goniatites* sp., a fragment of whorl visible from the lateral side, ca 5 ×, cat. no. OS-120/16; Gałęzice, pit XXI, bed 1, $Go\beta_{mu}$ subzone

Fig. 5. *Goniatites* sp.; fragment skrętu widoczny od strony bocznej, ca × 5, cat. no. OS-120/16; Gałęzice, przekop XXI, warstwa 1, podpoziom $Go\beta_{mu}$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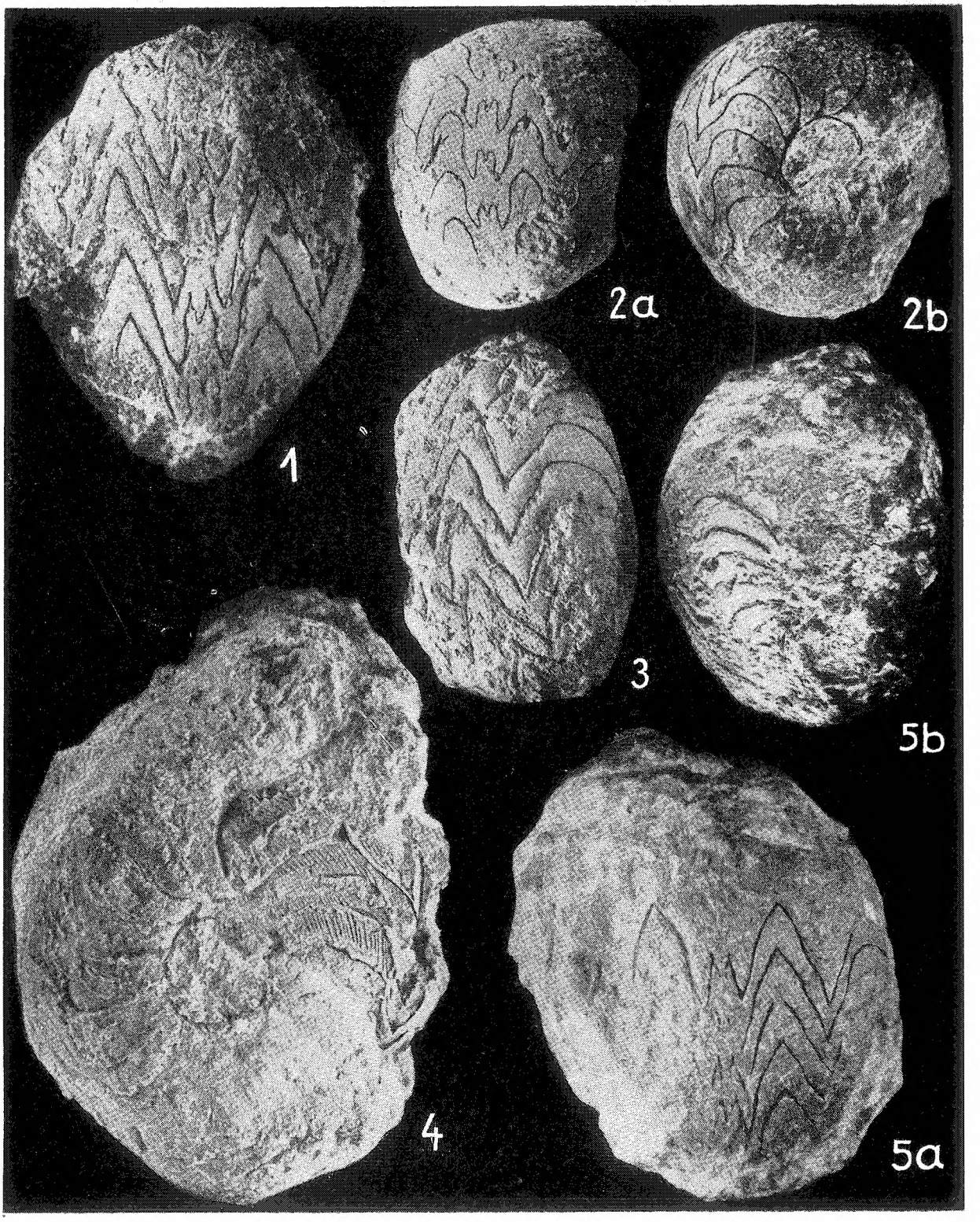

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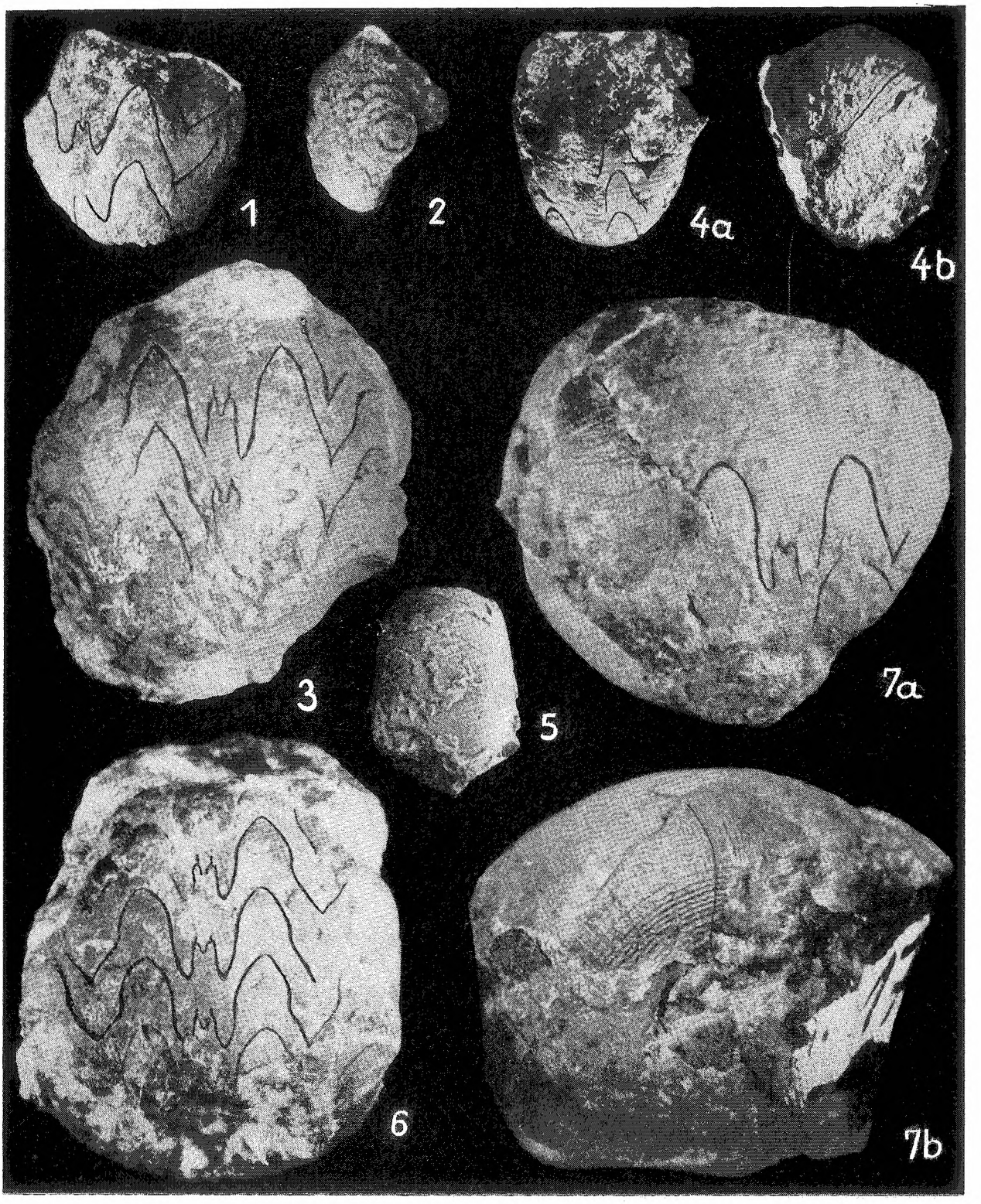

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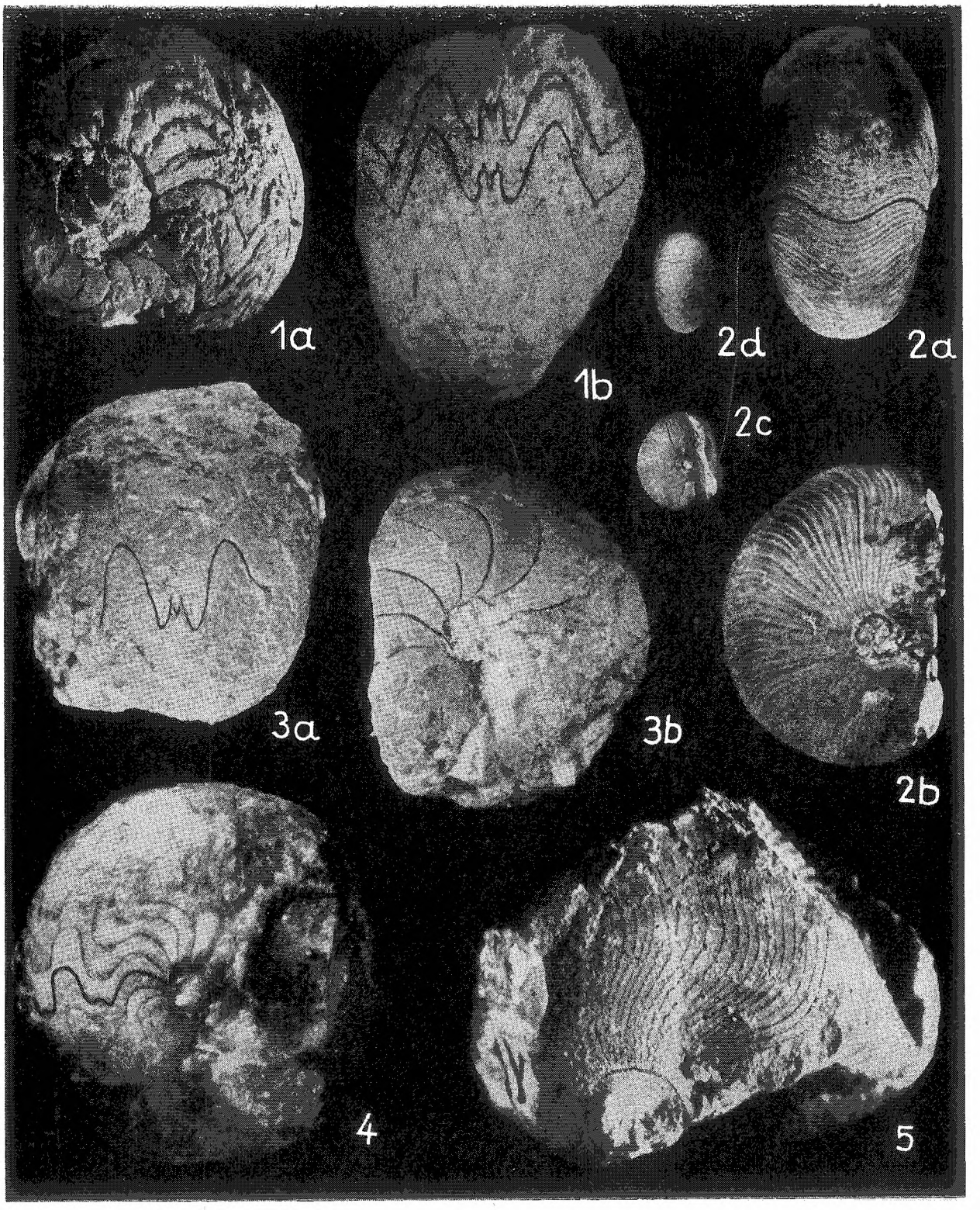
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