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Halina ŻAKOWA

UPPER VISEAN GIGANTOPRODUCTOID BRACHIOPODS FROM THE GÓRY ŚWIĘTOKRZYSKIE, POLAND

(Pl. I–VIII and 2 Figs.)

Górnowizeńskie gigantoproduktusy (Brachiopoda) z Gór Świętokrzyskich

(Pl. I–VIII i 2 fig.)

Halina Żakowa: Upper Visean gigantoproductoid brachiopods from the Góry Świętokrzyskie, Poland. Ann. Soc. Geol. Poloniae, 55–1/2: 105–126, 1985, Kraków.

Abstract: Fourteen taxons (6 thick- and 8 thin-shelled) from the family Gigantoproductidae Muir-Wood et Cooper were described. Specimens were collected from organodetritic limestones of the Gałęzice syncline in the Góry Świętokrzyskie (Mts.). The species and subspecies found are characteristic of the Upper Visean of Western and Central Europe. Their occurrence has confirmed the including of the Gałęzice limestones among the Upper Visean, already evidenced on the bases of index goniatites and foraminiferan assemblages (at present the *Goniatites crenistra* Zone and *G. striatus* Zone, and the incomplete zones 15 and 16i), some Rugosa, brachiopods from the family Semiplanidae, pelecypods and conodonts. For the first time *Gigantoproductus janischewskyi* (Sarytcheva) and *G. submaximus* (Bolkhovitinova) were described from Poland.

Key words: brachiopods, palaeoecology, biostratigraphy, taxonomy, Upper Visean, Góry Świętokrzyskie (i.e. Holy Cross Mts.), Poland.

Halina Żakowa: Instytut Geologiczny. Oddział Świętokrzyski im. J. Czarnockiego, ul. Zgoda 21, 25-953 Kielce (Poland).

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Treść: Opisano 14 taksonów (6 grubo- i 8 cienkoskorupowych) z rodziny Gigantoproductidae Muir-Wood et Cooper. Okazy zebrano z wapieni organodetrytycznych synkliny gałęzickiej w Górach Świętokrzyskich. W wapieniach obficie występuje makro- i mikrofauna, a szczątki gigantoproduktusów najliczniej na wzgórzu Todowa Grząba, gdzie zgrupowane są taksony gruboskorupowe. Stwierdzone gatunki i podgatunki są charakterystyczne dla wizenu górnego Europy zachodniej i środkowej. Ich obecność potwierdza zaliczenie wapieni z Gałęzic do wizenu górnego udowodnionego już na podstawie: indeksowych goniatytów i zespołów otwornic (obecne poziomy *Goniatites crenistria* i *G. striatus* oraz niepełny poziom 15 i 16i), niektórych Rugosa, ramienionogów z rodziny Semiplanidae, małżów i konodontów. Po raz pierwszy z Polski opisano *Gigantoproductus janischewskyi* (Sarytcheva) i *G. submaximus* (Bolkhovitinova).

INTRODUCTION

The paper discussed a part of studies, already terminated, on brachiopods of the Suborder Productidina Waagen, 1883, on the basis of a collection containing a few thousand specimens. The author completed the collection in the years 1960 – 1972 during her geological studies on the Lower Carboniferous of the Gałęzice syncline situated in the south-western part of the Góry Świętokrzyskie (Fig. 1A, B). A characteristic feature of the Carboniferous profile of this syncline is the occurrence of microfacially differentiated limestones in the Upper Visean. Their stratigraphic position has already been well defined on the evidence of goniatites and foraminiferan assemblages found in the limestones (Czarniecki, 1973; Żakowa, 1974, 1976; Jurkiewicz, Żakowa, 1978), as well as on the basis of data obtained from the already described Rugosa, trilobites, pelecypods and conodonts. On the whole, all these findings permitted a biostratigraphic division of limestones and equivalent argillo-calcareous deposits from boreholes (Fig. 1C), i.e. a differentiation of the goniatite zones – *Goniatites crenistria* (Go α) and *G. striatus* (Go β) and the foraminiferan ones (incomplete zones 15 and 16i). At the bottom the limestones are in a dislocational contact with argillo-siliceous deposits of the Zaręby Beds; at the top they contact sedimentarily, as a rule, with clayey-silty-sandy deposits of the *G. granosus* Zone (Go γ) (Lechówek Beds), or are in a discordant sedimentary or dislocational contact with the Permian.

The paper comprises the first descriptions and illustrations of gigantoproductoids from the Góry Świętokrzyskie. Their presence, as well as the occurrence of other brachiopods were already reported by Czarnocki (1916 – this author cited *Productus giganteus* Martin) and Kwiatkowski (1959). The latter author also observed the occurrence of the type species, *Productus (Gigantoproductus) gigantoides* Paeckelmann, *P.* (*Gigantoproductus*) sp., *P. (G.) edelburgensis* Phillips and *P. (G.) latissimus* Sowerby. At present it is well known that the two latter taxons belong to the family Semiplanidae Sarytcheva, 1960 (Żakowa, in press). It should be added that the present paper considered all the available revisions, made so far, of gigantoproductoid determinations from other regions of Poland, assuming an attitude towards the data from the Sudetes, the Silesia – Cracow Upland and the Lublin Coal Basin. All these facts are crucial for determination of the occurrence and vertical extent of the family Gigantoproductidae, important from the point of view of stratigraphy and general correlation. Despite the fact that in Poland collections of specimens from this family are relatively rich, the published paleontological studies are either outdated (the vicinity of Cracow – Jarosz, 1909, 1918) or refer to selected areas only (the Sudetes – e.g. Paeckelmann, 1931; Żakowa, 1958, 1966; Żakowa, Żak, 1962; the Lublin Coal Basin – Schwarzbach, 1949).

The collections under description are housed in the Museum of the Świętokrzyskie Branch of the Geological Institute, Kielce (cat. no. OS-10, OS-176).

I am greatly indebted to Ms. Halina Topaczewska for taking accurate photographs, and to Ms. Alfreda Maszońska and Ms. Jadwiga Krężołek for preparing drawings for this paper.

OCCURRENCE AND GENERAL CHARACTERISTICS OF INVESTIGATED MATERIAL

The gigantoproductoids under description come from limestone horsts preserved in the north-western and south-eastern parts of the Gałęzice syncline where, in most cases, they are morphologically exposed. The limestones were investigated in an outcrop and in trenches and ditches. There were collected all fossils found in particular beds. Localities, drawings, photographs, as well as the biostratigraphic correlation of profiles have already been published (Żakowa, 1976, fig. 1, 4, 5, 8, 13, 14; Szulczewski, Żakowa, 1976, fig. 2; Jurkiewicz, Żakowa, 1978, fig. 1).

Gigantoproductoids were collected from one outcrop, 13 trenches and 2 ditches. These localities are found within 5 sections. Section "a" comprises an outcrop profile at a non-working narrow-gauge railway, as well as profiles of trenches VIII and IX. The total thickness of limestones amounts here to ca. 30 m. A section of the Todowa Grząba hill (TG) combines the profiles of trenches 20–23, and the total thickness of limestones reaches ca. 26 m. In section "b" there are profiles of trenches II and IV; section "c" comprises profiles of trenches VI, XIII and XV, made in the vicinity of the Besówka hill where, according to the author, the limestone thickness is the greatest, amounting to ca. 36 m. A similar thickness is found for the limestones of section "d" which was made across unnamed hills east of Besówka. The brachiopods under description were collected from trenches XIV and XIVa and ditches 22 and 29. The occurrence of gigantoproductoids in these sections was presented in a generalized form (Fig. 1C), in respect of biostratigraphy and quantity (Table 1), and treated on a broad basis, it was used for the correlation of vertical extents known in the world of species and subspecies (Fig. 2).

The state of preservation of the described fauna is good enough, though complate shells and valves with ears are relatively rare. This is due to difficulties connected with extracting them from the rock, especially as regards specimens whose width amounts to 100–150 mm or more. A common phenomenon is strong recrystallization of valves, blurring the elements of sculpture, internal structure and, frequently, making the evaluation of thickness of valves and visceral cavity difficult. Besides, there are numerous fragments of pedicle valves, brachial ones, internal and external moulds. All these findings had a substantial effect on classification of specimens of the family Gigantoproductidae of which, all together, 222 specimens were collected. About 40% of this number were classified only as a genus (Table 1), which comprises fragments of valves of thick-shelled species (occasionally up to 11 mm thick) and thin-shelled ones (usually visible valve thickness – 1–2 mm). There are also remnants belonging to specimens of various sizes, geniculated and regularly curved, as well as with traces if intensive, deep, longitudinal plication suggesting affiliation to the group *Gigantoproductus giganteus* (Sowerby).

The remaining specimens were included within 16 taxons (Żakowa, 1983), of which 6 are thick-shelled and 10 thin-shelled species. Among the latter there occurs a new species – *Gigantoproductus moderatisimilis* sp. n. and a specimen of a probably new taxon – *Gigantoproductus* sp. 1, which were described in a

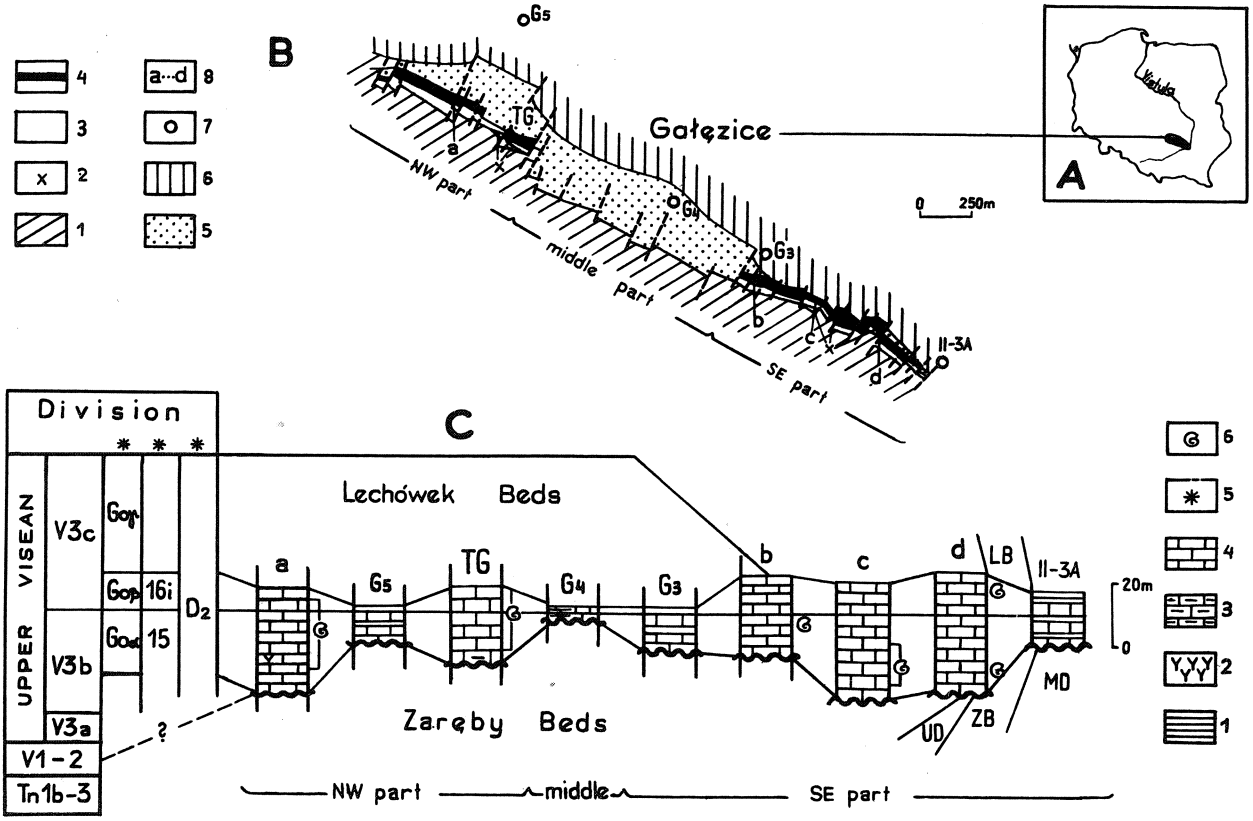

Fig. 1. Occurrence and stratigraphy of Lower Carboniferous in the Gałęzice syncline. A – localization of investigated area (outline of the Góry Świętokrzyskie, Palaeozoic). B – geological map of Carboniferous, after the author; *1* – Givetian, *2* – Famennian, *3* – mainly Tournaisian, *4* – Upper Visean limestones (*Goniatites crenistria* and *G. striatus* Zones), *5* – Upper Visean clastic deposits (*G. granosus* Zone), *6* – Permian, *7* – boreholes, *8* – localization of sections under description; TG – Todowa Grząba hill. C – correlation of limestone profiles and their equivalents with marked occurrence of fauna under description; *1* – claystones, *2* – piroclastic deposits, *3* – marls, *4* – limestones, *5* – biostratigraphic zones, *6* – occurrence of specimens of the family Gigantoproductidae; LB – Lechówek Beds, ZB – Zaręby Beds, UD – Upper Devonian (Famennian), MD – Middle Devonian

Fig. 1. Występowanie i stratygrafia dolnego karbonu w synklinie gałęzickiej. A – lokalizacja obszaru badań (zarys wychodni paleozoiku Gór Świętokrzyskich) w Polsce. B – mapa geologiczna karbonu według autorki: *1* – żywet, *2* – famen, *3* – głównie turnej, *4* – wapienie wizenu górnego (poziomy *Goniatites crenistria* i *G. striatus*), *5* – utwory klastyczne wizenu górnego (poziom *G. granosus*), *6* – perm, *7* – otwory wiertnicze, *8* – lokalizacja dyskutowanych przekrojów, TG – Todowa Grząba. C – korelacja profilów wapieni i ich ekwiwalentów z oznaczeniem występowania opracowanej fauny; *1* – iłowce, *2* – utwory piroklastyczne, *3* – margle, *4* – wapienie, *5* – udowodnione poziomy biostratygraficzne, *6* – występowanie okazów z rodziny Gigantoproductidae; LB – warstwy z Lechówka, ZB – warstwy zarębiańskie, UD – dewon górny (famen), MD – dewon środkowy

separate study (Żakowa, 1984). The greatest amount of taxons and specimens is found in the north-western part of the Gałęzice syncline and, above all, on the Todowa Grząba hill (ca. 87% of all the specimens, Table 1). Limestones of this section, particularly those visible in trench 21 preserved up to the present (Żakowa, Fedorowski, 1979), are abundant in diversified organic material of special paleontological and stratigraphic importance.

The investigation confirmed opinions of Czarnocki (1916) and Kwiatkowski (1959) on the occurrence of a type species and *G. gigantoides* (Paeckelmann) at

Table – Tabela 1

Occurrence and stratigraphic distribution of the family Gigantoproductidae in Upper Visean organodetritic limestones of the Gałęzice syncline
Występowanie i rozprzestrzenienie stratygraficzne rodziny Gigantoproductidae w górnowizeńskich wapieniach organodetrytycznych synkliny gałęzickiej

Taxonomy / Biostratigraphy / Loc.	Zones								number of specimens
	Goα, 15		Goβ, 16i			Goα, 15			
	north-west part			south-east part					
	section	Todowa Grząba Hill		sections					
	a			a	d		c	b	
Gigantoproductus giganteus (Sowerby)	–	2	11	–	–	–	–	–	13
G. cf. *elongatus* (Sarytcheva)	–	–	1	–	–	–	–	–	1
G. crassus (Fleming)	–	–	3	–	–	–	–	–	3
G. janischewskyi (Sarytcheva)	–	–	3	–	–	–	–	–	4
G. semiglobosus (Paeckelmann)	–	2	9	–	–	–	–	–	12
G. striatosulcatus (Schvetzov)	–	–	3	–	–	1	–	–	4
G. bisati (Paeckelmann)	–	3	16	–	–	–	–	–	19
G. gigantoides (Paeckelmann)	–	–	5	–	–	–	–	–	5
G. gigantoides aequalicostus (Paeckelmann)	–	–	4	–	–	–	1	–	5
G. gigantoides applanatus (Paeckelmann)	3	5	11	–	1	–	–	–	20
G. gigantoides regularis (Paeckelmann)	1	–	5	1	–	–	–	–	7
G. moderatisimilis sp. n.	–	–	26	–	–	–	–	–	26
Gigantoproductus sp. 1	–	–	–	–	–	–	1	–	1
Gigantoproductus div. sp. ind.	6	22	56	4	–	2	1	1	92
G. sarytchevae (Paeckelmann)	–	1	2	–	1	1	–	–	5
G. striatellus (Paeckelmann)	–	–	1	–	–	–	–	–	1
G. submaximus (Bolkhovitinova)	–	1	3	–	–	–	–	–	4

1
2
3
4
5
6
7
8
9
MIDDLE VISEAN
UPPER VISEAN
LOWER NAMURIAN
V2
V3a
V3b
V3c
A
Holkerian
Asbian
Brigantian
Pendleian
Alp. Choc. Arn.
E2+H
E1
P2
P1
B
Pe3
Go γ
Go β
Go α
Pe δ
?
D2
D1
S2
S1
mirus
maximus
gigantheus
glabra
Venev
Mikhailov
Aleksin
Toula
SERPUKHOWIAN
Upper
Tarussa
Steshevo
Protva
latissimus
edelburgensis *
Western Europe
USSR
Standard divisions
Giganto productus
gigantheus
crassus
janischewskyi
semiglobosus
striatosulcatus
bisati
gigantoides
gigantoides aequalicostus
gigantoides applanatus
gigantoides regularis
sarytchevae
striatellus
submaximus
Middle
Upper

Gałęzice. Other taxons, found by the author, were not cited from that place nor described paleontologically, similarly as those mentioned the introduction. It should be noted that there occur numerous representatives of subspecies of the group *G. gigantoides* (Paeckelmann), regarded for a long time as endemic forms of the Western Sudetes. It is not unlikely that in the future they will be raised to the rank of species. The two subspecies of this group: *aequalicostus* and *regularis* have not been known, so far, outside Western and Central Europe. The remaining taxons of the family Gigantoproductidae occur both in the regions cited above and in the European and Asiatic part of the USSR. It is also noteworthy that in the assemblage of brachiopods under description there are no taxons known from North Africa (Legrand-Blain, 1973). The two species *G. janischewskyi* (Sarytcheva) and *G. submaximus* (Bolkhovitinova) were described for the first time from the Upper Visean of Poland.

Studies, carried out up to the present, with various organic groups, in particular Coelenterata (Żakowa, Fedorowski, 1979), as well as preliminary microfacial investigation (Jurkiewicz, Żakowa, 1978) proved that the depositing medium was agitated. For example, there commonly occur biosparites, whereas fauna remnants most frequently depict an "ecological disorder" (co-occurrence of representatives of various biotopes) and are, in general, redeposited at short distances, without traces of rounding and current segregation. The above findings were also supported by a biostratonomic analysis of specimens of the family Gigantoproductidae which, though occasionally grouped in some beds (this usually refers to thick-shelles taxons), are not found *in situ*.

REMARKS ON STRATIGRAPHIC VALUE

The gigantoproductoids under description occur at Gałęzice in a stratigraphically narrow section corresponding to two goniatite zones of the Upper Visean (Fig. 1C, 2). In other discoveries from the territory of Poland, except the Western Sudetes, the biostratigraphic position of the found taxons is not precisely determined (as a rule, their occurrence in the Upper Visean is reported). Therefore determina-

Fig. 2. Correlation of stratigraphic extents of the species and subspecies under description. *1* – Poland, Góry Świętokrzyskie, *2* – Poland, other regions: Western Sudetes, Silesia–Cracow Upland, Lublin Coal Basin, *3* – Western Europe (Great Britain, Belgium, Federal Republic of Germany), *4* – German Democratic Republic, *5* – European part of USSR (Moscow Syneclise, Donetz Basin, Novaja Zeml'a, Ural), *6* – Asiatic part of USSR (Fergana, Kazakhstan), *7* – Asia (without USSR), *8* – North America, *9* – hypothetical occurrence; asterisks – biostratigraphic zones

Fig. 2. Korelacja zasięgów stratygraficznych opisanych gatunków i podgatunków. *1* – Polska, Góry Świętokrzyskie, *2* – Polska, inne obszary: Sudety Zachodnie, Wyżyna Śląsko-Krakowska, lubelski basen węglowy, *3* – Europa zachodnia (Wielka Brytania, Belgia, Niemiecka Republika Federalna), *4* – Niemiecka Republika Demokratyczna, *5* – europejska część ZSRR (synekliza moskiewska, basen doniecki, Nowa Ziemia, Ural), *6* – azjatycka część ZSRR (Fergana, Kazachstan), *7* – Azja (bez ZSRR), *8* – Ameryka Północna, *9* – przypuszczalne występowanie; gwiazdki – poziomy biostratygraficzne

tion of a thorough biostratigraphic extent of gigantoproductoids in the territory of Poland still remains an open question.

Taxons, including a type species of the genus *Gigantoproductus,* do not occur below the Upper Visean in Western and Central Europe (GDR, Poland). Except for (?) *G. striatosulcatus* (Schvetzov), no taxons have been found in deposits overlying the Upper Visean in the regions mentioned above. However, in Eastern Europe (the Moscow Syneclise, the Donetz Basin, the Ural Mts.) the type species *G. striatosulcatus* (Schvetzov), *G. sarytchevae* (Paeckelmann) and *G. striatellus* (Paeckelmann) also occur in the lower part of the Upper Carboniferous. Besides, the following species are also found: *G. bisati* (Paeckelmann), *G. submaximus* (Bolkhovitinova) which, if the correlation of Western Europe divisions with the division used in the USSR is correct and still up-to-date, already occur in the latter area in equivalents of the Middle Visean of Western Europe. According to the author, wider stratigraphic extents of the species mentioned above do not have a significant bearing on the stratigraphic value of the whole assemblage of species and subspecies under description. In the case of profiles of Western and Central Europe they are characteristic and even indicatory of the Upper Visean.

In connection with the above findings, the presence of this assemblage in organodetritic limestones of Gałęzice confirms the Upper Visean age of those deposits. This is in complete conformity with the dating of limestones on the evidence of goniatites, foraminiferans, some Rugosa and brachiopods of the family Semiplanidae (Żakowa, in press), pelecypods and conodonts.

In conclusion, it should be added that there is an interesting conformity of the stratigraphic position of *Gigantoproductus crassus* (Fleming) and *G. giganteus* (Sowerby) at Gałęzice (chiefly Goβ Zone) to that found in the Moscow Syneclise (chiefly the Mikhailov horizon), which stresses the importance of the species as valuable index forms for regionally wider stratigraphic correlations.This refers, to a slightly smaller degree though, to *G. janischewskyi* (Sarytcheva) and *G. semiglobosus* (Paeckelmann), as well as to *G. striatosulcatus* (Schvetzov). It cannot be excluded that the occurrence of the latter species in Poland also in equivalents of the Russian horizons Aleksin and Mikhailov puts some problems of correlation and division of the Upper Visean of North England in a slightly different light than it was proposed by Pattison (1981). The latter author analyzed stratigraphically wider profiles and had at his disposal fauna whose position was more differentiated stratigraphically than that described from the Gałęzice syncline. For those reasons Pattison investigated more thoroughly, e.g., the sequence of species and even of thin- and thick-shelled forms on the grounds of data obtained from only some studies by Russian geologists. In the case of the Upper Visean organodetritic limestones from Gałęzice no such analyses are possible.

SYSTEMATIC DESCRIPTION

The below characteristics of the material from Gałęzice refer to thick-shelled species: *Gigantoproductus giganteus* (Sowerby), *G. striatosulcatus* (Schvetzov)

and, subsequently, to thin-shelled ones: *G. bisati* (Paeckelmann), *G. submaximus* (Bolkhovitinova). Descriptions were made only in the case of taxons that had not such characteristics in the Polish bibliography as yet. Synonymies, reduced to an indispensable minimum, contain, however, all the verifiable information about classification of materials from the regions of Poland other than the Góry Świętokrzyskie.

Family: **Gigantoproductidae** Muir-Wood et Cooper, 1960
Genus: *Gigantoproductus* Prentice, 1950

Type species: *Productus giganteus* Sowerby, 1822 = *Conchyliolithus Anomia (Anomites) giganteus* Martin, 1793, 1809; Lower Carboniferous, Visean; Great Britain.

Gigantoproductus giganteus (Sowerby, 1822)

Pl. I, Fig. 1a–b, 2

1909 *Productus giganteus* Martin; ? Jarosz, pl. 11, fig. 10
non 1918 *Productus giganteus* Martin; Jarosz, p. 68, pl. 1, fig. 1; pl. 4, fig. 17a–b, 19
1931 *Productus (Gigantella) giganteus* (Martin); Paeckelmann, p. 238, pl. 22, fig. 1a–c; pl. 25, fig. 1a–b (*cum synon.*)
1941 *Productus (Gigantella) giganteus* (Martin); Rotaj, p. 100, pl. 18, fig. 6–7; pl. 19, fig. 1
non 1961 *Productus (Gigantella) giganteus* (Martin); Pareyn, p. 201, pl. 24, fig. 3
1949 *Gigantella gigantea gigantea* (Martin); Schwarzbach, p. 31, pl. 2, fig. 10, text- fig. 12
1962 *Gigantoproductus giganteus* (Martin); Żakowa and Żak, p. 204, pl. 10, fig. 1; pl. 11, fig. 1; pl. 12, fig. 1; pl. 13, fig. 1a–b; pl. 14, fig. 1a–c
1972 *Gigantoproductus giganteus* (Martin); Korejwo and Teller, pl. 6, fig. 4
1960 *Gigantoproductus giganteus* (Sowerby); Muir-Wood and Cooper, pl. 128, fig. 4–6; pl. 129, fig. 1–3
1974 *Gigantoproductus giganteus* (Sowerby); Kalashnikov, p. 88, pl. 32, fig. 1 (*cum synon.*)
1980 *Gigantoproductus giganteus* (Sowerby); Musiał and Tabor, pl. 2, fig. 1
1981 *Gigantoproductus giganteus* (Sowerby); Pattison, p. 6, pl. 6, fig. 2; pl. 9, fig. 13

Material: 13 specimens (100–150 mm width): 7 damaged (mostly on ears and trail) pedicle valves, occasionally with preserved internal moulds; 2 external moulds of pedicle valves; 2 incomplete brachial valves with internal moulds; 2 fragments of unidentified valves; cat. no. OS-176/29-36.
Dimensions[1] of 3 specimens:

cat. no.	Wx	W_1	L	W:L	number of costae	valve
176/29	117	82	70?	1.7?	d/10	pedicle
176/30a	123	100	–	–	–	brachial
176/31c	140	115?	–	–	b/13	pedicle

Remarks: Lack of complete trail and ears makes length measurements and orientation in the W:L ratios difficult. In the pedicle valve interior there are traces of large dendrite adductors; diductors dis-

[1] W – maximal width in mm; W_1 – width beneath ears; L – length; CL – curved length; c – convexity; a, b, c, d – succesively at 10, 20, 30, 40–50 mm from the hinge line and at the anterior margin, (e) at a width of 10 mm; x – approx. after reconstruction.

tinctly longitudinally striated in the anterior part; traces of round median concavities between the diductors; traces of locations of brachial cones of the brachial valve; also very densely arranged, relatively large endospines. The brachial valve interior reveals only traces of the median septum, fragments of a dendrite field of adductors and numerous endospines. The Gałęzice specimes resemble best those reported from the USSR and the Sudetes, particularly from Kamionki, in general morphology, structure of longitudinal plications (most prominent in the anterior and ventral parts; as a rule, 30 – 40 mm off the umbo), and radial sculpture; however, the former specimens have less distinct spines. The thickness of pedicle valve is up to 3 mm in the umbonal part and on flanks, and up to 9 mm on the venter.

Occurrence: Cosmopolitan. Upper Visean – Great Britain (Asbian-Brigantian), Federal Republic of Germany, Belgium, Poland: Góry Świętokrzyskie (Gałęzice), Western Sudetes (Wałbrzych, Sokolec, Jugów, Kamionki, Czerwieńczyce), Silesia – Cracow Upland (Czernka valley, after? Jarosz, 1909 and Zajączkowski, 1975), borehole Puńców 1, after Konior and Tokarski, 1959, Lublin Coal Basin (boreholes Kock 14, Sawin IG 2, Strzyżów, Łuków IG 1, after Bojkowski, 1966); Upper Visean – Lower Namurian – USSR; Moscow Syneclise, Donetz Basin, Ural, Novaja Zeml'a?, Fergana?, Kazakhstan?, also after Smirnov *et al.*, 1979 (Aleksin – Venev horizons – remarkably in Mikhailov horizon, rarely in Toula and lower part of Serpukhovian), China after Feng Ru-lin, 1981; ?North America (Pacific cricle).

Gigantoproductus cf. *elongatus* (Sarytcheva, 1928)

Material: 1 fragment of pedicle valve (anterior part) cat. no. OS-176/37.

Remarks: The specimen belongs to a large shell and is characterized by a considerably elongated longitudinal profile, moderate convexity and the shell thickness of 2 – 3 mm at the anterior margin, rising to 6 – 7 mm towards the posterior part. Distinct longitudinal plications, densely located on a relatively narrow, slim ventral part. The above features point to some similarity to *Gigantoproductus elongatus* (Sarytcheva), reported from the Mikhailov horizon of the Moscow Syneclise (Sarytcheva, Sokolska, 1952, p. 127, pl. 29, fig. 165). The Gałęzice specimen also resembles in general morphology a specimen of this taxon from the Upper Visean (Brigantian) of North England (Pattison, 1981, p. 4, pl. 8, fig. 1; pl. 9, fig. 8).

Occurrence: Upper Visean – Poland: Góry Świętokrzyskie (Gałęzice).

Gigantoproductus crassus (Fleming, 1828)

Pl. II, Fig. 1

1952 *Gigantoproductus crassus* (Martin); Sarytcheva and Sokolska, p. 125, pl. 25, fig. 161
1954 *Productus (Gigantella) giganteus* (Martin) var. *crassa* (Martin); Janischevsky, p. 52, pl. 10, fig. 1, text-fig. 6 – 9 (*cum synon.*)
1966 *Gigantoproductus inflatus* (Sarytcheva); e.p. Żakowa, p. 79, pl. 6, fig. 1b (non pl. 5, fig. 1 – 2; pl. 6, fig. 1a)

Material: 3 specimens (70 – 80 mm width): 2 shells, 1 incomplete internal mould of pedicle valve; cat. no. OS-176/38 – 39.

Dimensions of 2 specimens:

cat. no.	W	L	W:L	number of costae	valve
176/38b	75	65?	1.15?	c/14, d/12	pedicle
176/39	80	70	1.14	–	pedicle

Description: Shell large, triangular-oval in shape, regularly curved, with a narrow umbonal part, small triangular, flattened and demarcated ears. Pedicle valve strongly and uniformly convex, with steep flanks and a small umbo considerably projecting beyond the hinge line in agreement with the greatest width of the shell. Longitudinal plications distinct on the venter and the anterior margin (2 – 3 mm at the width of 20 mm, diverging in places), already visible at a distance of ca. 30 mm from the umbo.

Costae inconsiderably convex, rounded, relatively wide somewhat irregular, separated by narrow intercostal sulci with dense growth lines. In the pedicle valve interior large swellings corresponding to brachial cones of the brachial valve.The valve thickness in the centaral part – ca. 6 mm, slightly smaller at ears and in the anterior part.

Remarks: The Gałęzice specimens are smaller then those described from the Sudetes and the USSR; moreover, their length is smaller than width – in this respect they correspond to the Sudetic specimens (Paeckelmann, 1931, p. 244; Żakowa, 1966) and at the same time, differ from the Russian ones. In the latter the width is equal to the length or the length slightly exceeds the width. Sculpture and longitudinal plication do not differ from respective data in the taxon descriptions.

Occurrence: Upper Visean – England: Derbyshire, Poland: Góry Świętokrzyskie (Gałęzice), Western Sudetes (Wałbrzych, Jugów), USSR: Moscow Syneclise, Ural (mainly Mikhailov horizon).

Gigantoproductus janischewskyi (Sarytcheva, 1928)

Pl. II, fig. 3

1954 *Productus (Gigantella) striato-sulcatus* Schvetzov var. *janischewskyi*, Sarytcheva; Janishevsky, p. 61, pl. 14, fig. 1a – b, 2, text-fig. 16 – 18 (*cum synon.*)

1981 *Gigantoproductus janischewskyi* (Sarytcheva); Pattison, p. 7, pl. 6, fig. 1; pl. 9, fig. 5 (*cum synon.*)

Material: 4 specimens (75 – 100 mm width), demaged chiefly in the anterior part of pedicle valves; cat. no. OS-176/40 – 42.

Dimensions of one specimen (cat. no. OS-176/40a): W – 75, L – 60, W:L – 1.25, a – b/15, d/16.

Description: Shell large with indistinct, small and flattened ears. Pedicle valve most markedly convex in the median part limited by steep flanks (in the transverse section assuming the shape of a hump), with a wide and flat umbonal part and umbo not projecting beyond the hinge lime – relatively short but in agreement with the greatest shell width. In the anterior part indistinct, scattering, relatively wide and irregular longitudinal plications. Concentric rugae on flanks, indistinct on ears and very rare on the venter. Costae straight and thin in the umbonal part, having an irregular course towards the anterior part. Rare spines on the venter. The valve thickness at the anterior margin up to 2 mm; in the ventral part – 4 – 5 or even 6 – 7 mm.

Remarks: The Gałęzice specimens are, as a rule, smaller than those known from the USSR and England. They also have a slightly thinner shell, but correspond to the latter in morphology, especially in structure of the median part, ornamentation and longitudinal plication. However, costae in the posterior part of valves of the Gałęzice specimens are somewhat less frequent than in the Russian specimens, and valve flanks in the ventral part are certainly steeper than it was demonstrated by Pattison (1981) for the English specimens. It should be added that poor development of ears and a relatively short hinge line liken externally the Gałęzice specimens to the thin-shelled specimens of *Productus (Gigantella) striato-sulcatus* Schvetzov aff. var. *janischewskyi* Sarytcheva, described from the equivalents of the Mikhailov horizon in the NW part of the Moscow Syneclise (Janischevsky, 1954, p. 63, pl. 15, fig. 1a – b, text-fig. 19 – 20).

Occurrence: Upper Visean – England (Asbian and Lowest Brigantian), Poland: Góry Świętokrzyskie (Gałęzice), USSR: Moscow Syneclise (characteristic for the Aleksin and locally Mikhailov horizons).

Gigantoproductus semiglobosus (Paeckelmann, 1931)

Pl. III, Fig. 1a – c; Pl. IV, Fig. 1a – b

1931 *Productus (Gigantella) striato-sulcatus* Schvetzov var. n. *semiglobosa;* ? e.p. Paeckelmann, p. 246, pl. 24, fig. 1a – c (? non pl. 21, fig. 5a – c) – syntypes

1962 *Gigantoproductus striato-sulcatus* (Schvetzov) var. *semiglobosa* Paeckelmann; Żakowa and Żak, p. 206, pl. 14, fig. 2; pl. 15, fig. 1; pl. 16, fig. 1; pl. 17, fig. 1; pl. 18, fig. 1

1966 *Gigantoproductus striato-sulcatus* (Schvetzov) var. *semiglobosa* Paeckelmann; e.p. Żakowa, p. 80, pl. 7, fig. 1a, 1c, 1d, 2; pl. 9, fig. 1a – b; pl. 13, fig. 2? (*non* pl. 7, fig. 1b; pl. 8, fig. 1a – d; pl. 13, fig. 1a – b; pl. 20, fig. 1);

1980 *Gigantoproductus striato-sulcatus* (Schvetzov) var. *semiglobosa* Paeckelmann; Musiał and Tabor, pl. 2, fig. 3
1974 *Gigantoproductus semiglobosus* (Paeckelmann); Kalashnikov, p. 85, pl. 27, fig. 1
1981 *Gigantoproductus semiglobosus* (Paeckelmann); Pattison, p. 8, pl. 1, fig. 4; pl. 9, fig. 10

Material: 12 specimens (90 – 170 mm width): 2 slightly demaged shells, 10 incomplete pedicle valves; cat. no. OS-176/48 – 55.
Dimensions of 2 specimens:

cat. no.	W	L	WL	CL	c	number of costae	valve
176/48	105	81	1.30	145	56	b – c/12, d/10	pedicle
176/49	ca. 110	83	1.32	–	44	c/12, d/9 – 10	pedicle

Remarks: The Gałęzice specimens (large and gigantic) are characterized by a slight variability in convexity, small and separated ears with rugae slightly passing onto flanks and a diverse valve thickness – of 5 – 7 mm in the ventral part, 3 – 4 mm in the umbonal one, up to 3 mm at the anterior margin. Pedicle valves are regulary, semicircularly curved, with large swellings corresponding to brachial cones of the brachial valve in the interior. As regards the general morphology, they particularly correspond to that illustrated by the species creator for the specimens on Pl. 24, Fig. 1 which, according to Kalashnikov, should represent exclusively the taxon under description. In this connection it may be problematic to include in the taxon the specimens with features visible on Pl. 21, Fig. 5 in Paeckelmann's study. It cannot be excluded that the illustrated specimen, which on the other hand, comes from argillaceous deposits, is somewhat deformed, which is indicated by its smaller convexity. In this specimen also the presence of more distinct longitudinal plications as it is assumed by a verified diagnosis of the species, is possibly due to a specific state of preservation. If this is the case, the specimen under description might be regarded as a representative of the taxon with secondary features. Irrespective of this question, revision of the Sudetic specimens described by the author from Sokolec and Jugów points to the necessity to eliminate some of them from the species under description. Longitudinal folds on the Gałęzice specimens are rather indistinct, blurred, irregular, found only on the trail at the anterior margin (1 – 2 within the width of 20 mm). According to the author, their presence is characteristic of the species; this opinion is questioned by Kalashnikov and Pattison, though. It comes out from the material under description that variability within the species certainly refers to the width of shells which can be wider (these known from Kamionki in the Sudetes and from the Ural) and narrower – like those reported from Gałęzice, from other localities in the Sudetes and from England. Specimens from the latter region correspond best, in both the description of characteristic features and illustrations, to the specimen presented by Paeckelmann in Plate 24, Fig. 1, and not the one found in Plate 21, Fig. 5, which gave grounds for Pattison's determinations (1981). The above consideration could, possibly, influence his remarks on correlation.
Occurrence: Upper Visean – England (Asbian)?, Belgium, Poland: Góry Świętokrzyskie (Gałęzice), Western Sudetes (Wałbrzych, Sokolec, Jugów, Kamionki, Czerwieńczyce, ? Wojbórz, after Gunia and Górecka, 1960), Silesia-Cracow Upland (Czernka valley, after Zajączkowski, 1975), Lublin Coal Basin (borehole Parczew IG 4), USSR: Ural (Aleksin horizon).

Gigantoproductus striatosulcatus (Schvetzov, 1922)

Pl. II, Fig. 4a – b; Pl. V, Fig. 2

1954 *Productus (Gigantella) striato-sulcatus* Schvetzov; Janischevsky, p. 59, pl. 12, fig. 1a – b; pl. 13, fig. 1a – b, text-fig. 14 – 15 (*cum synon.*)
1952 *Gigantoproductus striatosulcatus* (Schvetzov); Sarytcheva and Sokolska, p. 126, pl. 27, fig. 164
1959 *Gigantoproductus striatosulcatus* (Schvetzov); Konior and Tokarski, pl. 4, fig. 15
1966 *Gigantoproductus striatosulcatus* (Schvetzov); Kalashnikov, p. 39, pl. 4, fig. 1
1968 *Gigantoproductus striatosulcatus* (Schvetzov); Korejwo and Teller, pl. 7, fig. 1
1974 *Gigantoproductus striatosulcatus* (Schvetzov); Kalashnikov, p. 86, pl. 30, fig. 1

Material: 4 specimens (100 – 170 mm width): 1 slightly deformed shell, damaged on trail; 2 incomplete pedicle valves; 1 external mould of the brachial valve with fragments of one; cat. no. OS-10/22a, OS-176/43 – 47.
Dimensions of 3 specimens:

cat. no.	W	number of costae	valve
176/43	100?	b/18	pedicle
176/45	120	b/16 – 18, d/17	pedicle
176/46, 10/22a	170	– d/14	pedicle

Description: Shell large to gigantic. Pedicle valve unevenly convex, geniculated in the median part, flat in the posterior one, with a small flattened umbo not projecting beyond the hinge line; flanks steep enough; poorly separated, small and flattened ears. Brachial valve almost flat in the posterior part, geniculated, with a distinctly flattened median part. Longitudinal plications marked chiefly below the geniculation (up to 5 mm wide on trail). Costae somewhat irregular, vide, rounded, separated by narrow intercostal sulci. Their number slightly diminishes in bigger specimens and new costae usually occur by intercalation. Concentric rugae only on ears and in the umbonal area (occasionally up to 5 – 6 mm wide). Dense growth lines and scarce spines. Thickness of pedicle valve in the geniculation area – 7 – 8 mm; in the biggest specimens – up to 3 mm); on trail – 5 mm.
Remarks: The Gałęzice specimens are analogous with those described from the USSR as regards longitudinal and transverse profiles, characteristic different intensity of rugae and density of growth lines. A small difference consists in the course of longitudinal plications. In the Russian specimens the latter is observed exclusively below the geniculation area; in one specimen from Gałęzice they slightly overrun backwards this geniculation.
Occurrence: Upper Visean – Poland: Góry Świętokrzyskie (Gałęzice), Western Sudetes (Jugów, Czerwieńczyce, after Paeckelmann, 1931), Silesia-Cracow Upland (borehole Puńców 1), Lublin Coal Basin (borehole Niedrzwica 3); Upper Visean – Lower Namurian – England (Brigantian, after Ferguson, 1978; lower part of Pendleian – mentioned by Pattison, 1981); USSR: Moscow Syneclise, Ural (Aleksin – Venev horizons, lower part of Serpukhovian).

Gigantoproductus bisati (Paeckelmann, 1931)

Pl. II, Fig. 5; Pl. VII, Fig. 3

1938 *Productus (Gigantella) bisati* Paeckelmann; Demanet, p. 82, pl. 8, fig. 8
1958 *Gigantoproductus bisati* (Paeckelmann); Żakowa, p. 57, pl. 2, fig. 3a – b (*cum synon.*)
1966 *Gigantoproductus bisati* (Paeckelmann); Żakowa, p. 85, pl. 7, fig. 6; pl. 8, fig. 2, 3a – b; pl. 10, fig. 2
1966 *Gigantoproductus bisati* (Paeckelmann); Bojkowski, pl. 2, fig. 13
1969 *Gigantoproductus bisati* (Paeckelmann); Litvinovitch *et al.*, p. 171, pl. 12, fig. 1, 3, text-fig. 42

Material: 19 specimens (42 – 64 mm width): 13 damaged pedicle valves, 2 incomplete brachial valves, 4 external and internal moulds of both valves; cat. no. OS-176/88 – 96.
Dimensions of 3 specimens:

cat. no.	Wx	L	W:L	c	number of costae	valve
176/92a	54	–	–	–	– d/14	pedicle
176/94	60	40	1.50?	–	b – c/16, e/14	pedicle
176/89a	64	–	–	13	b – c/16, d/12	pedicle

Remarks: The specimens under examination display, e.g. densely distributed growth lines, traces of spines at the hinge line and in the anterior part of pedicle valves, the hinge line shorter than the

greatest width: concentric rugae of diverse intensity on the visceral disc of brachial valve, on ears and in the ventral part of pedicle valves; on the latter indistinct irregular longitudinal plications; visceral cavity up to 2 mm, and in the pedicle valve interior diductors longitudinally striated in the anterior part; thickness of this valve up to 1 mm in the umbonal part and 0.5 mm on flanks; thickness of brachial valve always smaller in analogous places. In contrast to Paeckelmann's (1931) data, concentric rugae in the Gałęzice specimens run more regularly and their density changes to an inconsiderable extent only. Asiatic specimens are less convex and their rugae are less distinct. The material from Gałęzice does not allow assuming an attitude as regards structural differences in the ontogenetic development, this point having been discussed by Litvinovitch *et al.* (1969) and to include the specimens into the genus *Moderatoproductus* (Litvinovitch, Voroncova, 1983).

Occurrence: Upper Visean – Belgium, German Democratic Republic (borehole Doberlug-Kirchhain after Weyer, 1965 – *Goniatites crenistria* Zone); Poland: Góry Świętokrzyskie (Gałęzice), Western Sudetes (Wałbrzych, Sokolec, Jugów, Czerwieńczyce), Silesia-Cracow Upland (Czernka valley, after Zajączkowski, 1975), Lublin Coal Basin (boreholes Strzyżów, Teptiuków IG 1, Husynne IG 1, Kosmów IG 1, Chełm after Korejwo, 1960); ? Middle Visean – USSR (Kazakhstan).

Gigantoproductus gigantoides (Paeckelmann, 1931)

Pl. V, fig. 1a–c

1931 *Productus (Gigantella) gigantoides* sp. n.; Paeckelmann, p. 250, pl. 26, fig. 1a–c; pl. 27, fig. 1a–c (syntypes)
non 1961 *Productus (Gigantella) gigantoides* Paeckelmann; Pareyn, p. 203, pl. 24, fig. 9
1966 *Gigantoproductus gigantoides* (Paeckelmann); Żakowa, p. 80, pl. 9, fig. 5a–b; pl. 10, fig. 1
1973 *Gigantoproductus gigantoides* (Paeckelmann); Nalivkin and Foteva, p. 49, pl. 13, fig. 1–3
1974 *Gigantoproductus gigantoides* (Paeckelmann); Kalashnikov, p. 88, pl. 30, fig. 2; pl. 41, fig. 2
non 1981 *Gigantoproductus gigantoides* (Paeckelmann); Pattison, p. 6, pl. 3, fig. 6, pl. 9, fig. 7

Material: 5 specimens (80–116 mm width): 3 damaged pedicle valves, 2 incomplete moulds of pedicle valves, 1 fragment of brachial valve; cat. no. OS-176/60–62.

Dimensions of one specimen (OS-176/60 – pedicle valve): Wx – 89, Lx – 57, W:L – 1.56?, c – 29, b–c/14, d/12.

Remarks: As regards external characteristics (morphology ornamentation), the Gałęzice specimens are in complete agreement with the taxon creator's diagnosis. He stressed a remarkable convexity of the pedicle valve with a rounded venter and concavity of the median part of the brachial valve, the presence of a deute and small umbo, relatively distinct and irregular concentric rugae on large and well defined ears and on flanks, the lack of longitudinal plications, and the thinnes of valves. In the Gałęzice specimens there have been preserved numerous spine traces on ears and near the hinge line where they occur in a row. Pedicle valve in the umbonal part up to 1–1.5 mm thick. Our specimens do not differ from those reported from the Ural in which, according to Kalashnikov (1974), there occasionally occur very indistinct traces of longitudinal plications near the anterior margin. Big differences in the diagnostic interpretation of the taxon are observed as regards the English specimens (Pattison, 1981). They refer, above all, to longitudinal and transverse profiles of shells, structure of ears, distribution of spines, longitudinal plications and concentric rugae (their suggested presence only). It follows from the above data that the English specimens do not represent a type species of the group *Gigantoproductus gigantoides* sensu Paeckelmann and, maybe, do not belong at all to this group of gigantic brachiopods.

Occurrence: Upper Visean – Federal Republic of Germany (Rheinische Schiefergebirge); Poland: Góry Świętokrzyskie (Gałęzice), Western Sudetes (Jugów, probably Kamionki after Żakowa and Żak, 1962), ? Lublin Coal Basin, USSR (Ural).

Gigantoproductus gigantoides aequalicostus (Paeckelmann, 1931)

Pl. IV, Fig. 2; Pl. VI, Fig. 2a–b

1931 *Productus (Gigantella) gigantoides* Paeckelmann n. var. *aequalicosta;* Paeckelmann, p. 252, pl. 26, fig. 2; pl. 29, fig. 4a–d (syntypes)

1966 *Gigantoproductus gigantoides* (Paeckelmann) var. *aequalicosta* Paeckelmann; Żakowa, p. 81, pl. 10, fig. 6; pl. 11, fig. 1a–c, 2, 3

Material: 5 specimens (85–110 mm width): 1 slightly damaged shell, 2 incomplete pedicle valves with internal moulds, 1 fragment of brachial valve interior; cat. no. OS-176/77–79.

Dimensions of 3 specimens:

cat. no.	W	L	W:L	c	number of costae	valve
176/77c	–	–	–	–	b–c/14	brachial
176/79	80	60	1.33	29	b–c/14–16	pedicle
176/77a	110	–	–	28	–	pedicle

Description: Shell large, resembling a square in outline, with flanks declining straight, perpendicular to the hinge line – agreement with the greatest shell width. Pedicle valve fairly convex with a slight flattening in the ventral part, approximately geniculated in the anterior part, with a small umbo projecting beyond the hinge line, with relatively large and slightly separated ears. Brachial valve somewhat concave, geniculated. Irregular concentric rugae, distinct on ears and flanks. Costae fairly regular, not changing their density. Rare spines. Dendrite adductors with a distinct median ramification; diductors wide and longitudinally striated. In the brachial valve markedly protruding brachial ridges and relatively flat brachial cones. Infrequent endospines. Thickness in the median part up to 2 mm (pedicle valve) and 1 mm (brachial valve).

Remarks: Morphology, ornamentation and traces of internal structure correspond with the taxon creator's data, the Gałęzice specimens being rather square than circular, though. Although the latter feature, as well as sculpture and structure of ears bring the subspecies under description closer to *Gigantoproductus protvensis* (Sarytcheva), described from Lower Namurian (Protva horizon) of the Moscow Syneclise, yet e.g. the longitudinal profile and the shape of umbo are different. The Gałęzice material does not give grounds for discussion whether the cited species is conspecific with the subspecies under description, as it is suggested by Pattison (1981). According to the author of this study, his specimens of *G. protvensis* (Sarytcheva) differ from specimens of this species from the USSR; the same conclusion is acquired at when both taxon diagnoses are compared.

Occurrence: Upper Visean – German Democratic Republic (borehole Doberlug-Kirchhain after Weyer, 1965 – *Goniatites crenistria* Zone); Poland: Góry Świętokrzyskie (Gałęzice), Western Sudetes (Wałbrzych, Sokolec, Jugów, ? Kamionki).

Gigantoproductus gigantoides applanatus (Paeckelmann, 1931)

Pl. II, Fig. 2; Pl. VII, Fig. 1

1931 *Productus (Gigantella) gigantoides* Paeckelmann n. var. *applanata;* Paeckelmann, p. 255, pl. 28, fig. 1a–c (holotype)

non 1961 *Productus* (*Gigantella*) *gigantoides* Paeckelmann n. var. *applanata;* Pareyn, p. 203, pl. 24, fig. 10

1966 *Gigantoproductus gigantoides* (Paeckelmann) var. *applanatus* Paeckelmann; Żakowa, p. 82, pl. 10, fig. 3a–b, 5

Material: 20 specimens (90–150 mm width): 1 fragment of shell, 4 damaged pedicle valves, 11 various preserved internal moulds of pedicle valves, 1 incomplete brachial valve, 3 internal moulds of brachial valves; cat. no. OS-176/63–76.

Dimensions of 5 specimens:

cat. no.	Wx	Lx	W:L	c	number of costae	valve
176/65	120	–	–	22	–	pedicle
176/67b	120	–	–	–	b–c/16–17	pedicle
176/74	120	68	1.80?	22	–	brachial
176/71a	135	70	1.93?	20	a/18–20	pedicle
176/72a	150	72	2.08?	33	–	pedicle

Description: Shell large, semicircular in shape, with large elongated ears – fairly separated from flanks, with a wide and flattened median part and visceral cavity up to 3 mm. Pedicle valve with a curved umbonal part, a somewhat bent anterior part, without geniculation; wide umbo slightly preojecting beyond a long hinge line equal to the greatest shell width. Brachial valve inconsiderably concave. Fairly dense, flat rounded costae, with narrow intercostal sulci. Distinct concentric rugae on ears and flanks, less frequent in the median part. Spines on ears; in places dense growth lines. In the brachial valve interior inconsiderably convex brachial cones, a fairly narrow median septum and adductors distinctly dendritic in their posterior part. In the interior of both valves scarce endospins. Thickness of pedicle valve usually 1 – 1.2 mm in the median part (smaller in brachial valve), becoming thinner forward, backward and towards the flanks.
Remarks: The Gałęzice specimens are more convex that the Sudetic ones but in both this and the remaining features they correspond with those reported by the taxon creator.
Occurrence: Upper Visean – German Democratic Republic (borehole Doberlug-Kirchhain, after Weyer, 1965 – *Goniatites crenistria* Zone); Poland: Góry Świętokrzyskie (Gałęzice), Western Sudetes (Wałbrzych, Sokolec); USSR: Donetz Basin (Aleksin – Venev horizons after Aizenverg *et al.*, 1963).

Gigantoproductus gigantoides regularis (Paeckelmann, 1931)

Pl. IV, Fig. 3

1931 *Productus (Gigantella) gigantoides* Paeckelmann n. var. *regularis;* Paeckelmann, p. 254, pl. 30, fig. 1a – d (holotype)
1966 *Gigantoproductus gigantoides* Paeckelmann var. *regularis* Paeckelmann; Żakowa, p. 82, pl. 9, fig. 2

Material: 7 specimens (60 – 90 mm width): 4 fragments of pedicle valves, 3 internal moulds of pedicle valves; cat. no. OS-176/80 – 84.
Dimensions of 2 specimens:

cat. no.	Wx	Lx	W:L	c	number of costae	valve
176/80	62	48	1.29?	18	b – c/12	pedicle
176/82	60 – 65?	50	–	20	b/14, d/14	pedicle

Description: Shell large, approximately circular, with the hinge line shorter than greatest width. Pedicle valve regularly convex in the longitudinal and transverse profiles, with only somewhat decreased ears passing into valve flanks with a small umbo slightly projecting beyond the hinge line. Costae straight; concentric rugae on ears and flanks, rarely and poorly marked in the ventral part. The valve thickness up to 1.5 mm on the venter. Traces of diductors, slightly longitudinally striated.
Remarks: Differences in relation to the creator's diagnosis refer to the shape of costae which in the Gałęzice specimens have a more regular course and inconsiderably increase in number towards the anterior part.
Occurrence: Upper Visean – ?Belgium, Poland: Góry Świętokrzyskie (Gałęzice), Western Sudetes (?Wałbrzych, Sokolec, Jugów, ?Konradów).

Gigantoproductus sarytchevae (Paeckelmann, 1931)

Pl. III, Fig. 2; Pl. VI, Fig. 3; Pl. VII, Fig. 2a – b; Pl. VIII, Fig. 2

1931 *Productus (Gigantella) sarytscheffi* sp. n.; Paeckelmann, p. 258, pl. 31, fig. 1a – c (holotype)
1962 *Gigantoproductus sarytscheffi* (Paeckelmann); Żakowa and Żak, p. 208, pl. 13, fig. 2
1966 *Gigantoproductus sarytscheffi* (Paeckelmann); Żakowa, p. 82, pl. 7, fig. 3
1970 *Gigantoproductus sarytscheffi* (Paeckelmann); Gandl, p. 81, pl. 3, fig. 18 – 19

1974 *Gigantoproductus (?) sarytchevae* (Paeckelmann); Kalashnikov, p. 95, pl. 38, fig. 1–3; pl. 39, fig. 1–2, text-fig. 10

Material: 5 specimens: 1 damaged shell, 1 incomplete pedicle valve, 2 external moulds of brachial valves, 1 fragment of ? brachial valve; cat. no. OS-176/85–87, OS-176/98.
Dimensions: Wx – 75–120, a/20 and a/12–14, c/14, d–e/12–14.
Remarks: The Gałęzice specimens are large shells with a very narrow visceral cavity; geniculated; having steep flanks with a wide, somewhat convex or concave posterior part, distinct rugae on ears and flanks (weak in median parts); with fairly numerous spines on the ear and at the hinge line. The valve thickness amounts in places to 1.5 mm. As a rule, damage to anterior parts makes length measurements difficult; moreover, there are no traces of the internal structure. In this connection it is impossible to assume an attitude towards some details reported by Gandl (1970). It seems, however, that the Gałęzice specimens are certainly wider than those described from Frankenwald and, as a rule, also bigger. The density of costae is analogous in the latter and Gałęzice specimens at the cited distance from the umbo. However, in the Gałęzice specimens whose width exceeds 80 mm costae are scarcer in the umbonal part (a/12–14), similarly as it is observed in the specimens described by the species creator. The former specimens do not differ in general shape and ornamentation from those reported by Kalashnikov from the Ural (e.g. they are also wide, with a very narrow visceral cavity), which come up to gigantic sizes.

Apart from the problems connected with including the taxon in the genus *Gigantoproductus*, the latter author expresses an opinion that *Productus (Gigantella) sarytscheffi* var. *lata* (Paeckelmann, 1931, p. 260, pl. 32, fig. 1a–b) is conspecific with the species under description. Both these questions certainly require further detailed studies of the creator's original material.
Occurrence: Upper Visean – Federal Republic of Germany: Frankenwald (*Goniatites crenistria* Zone); Poland: Góry Świętokrzyskie (Gałęzice), Western Sudetes (Wałbrzych, Sokolec, Jugów, Kamionki, Konradów, after Jerzykiewicz, 1965, Czerwieńczyce); USSR: Donetz Basin (partly in Toula, Aleksin-Mikhailov horizons, after Aizenverg *et al.*, 1963); Upper Visean – Lower Namurian – USSR: Ural (frequently in Protva horizon).

Gigantoproductus striatellus (Paeckelmann, 1931)

Pl. V, Fig. 3

1931 *Productus (Gigantella) striatellus* sp. n.; Paeckelmann, p. 257, pl. 28, fig. 2a–c; pl. 29, fig. 5a–b (syntypes)

Material: 1 damaged, pedicle valve; cat. no. OS-176/97.
Dimensions: W_1 – 90, L – 57, W:L – 1.58, c – 24, b–c/22, d/20–22.
Description: Pedicle valve large, transversely oval, very thin (thickness under 1 mm), markedly convex – though less so in the posterior part, with a wide and flattened umbo not projecting beyond the hinge lime approximately equal to the greatest width; declining flanks and ill-defined ears. Costae thin, somewhat rounded, straight; new costae formed by intercalation. Intercostal sulci thinner than costae. Concentric rugae on ears, flanks, ventral and even anterior parts.
Remarks: The above characteristics do not differ from those reported by the species creator; only the number of costae is inconsiderably smaller on the whole valve.
Occurrence: Upper Visean – German Democratic Republic (*Goniatites crenistria* Zone, borehole Doberlug-Kirchhain, after Weyer, 1965); Poland: Góry Świętokrzyskie (Gałęzice), Western Sudetes (Sokolec, Jugów, ?Czerwieńczyce); Upper Visean – Lower Namurian – USSR: Donetz Basin (Venev – Tarussa horizons after Aizenverg *et al.*, 1963).

Gigantoproductus submaximus (Bolkhovitinova, 1932)

Pl. VI, Fig. 1a–b; Pl. VII, Fig. 4; Pl. VIII, Fig. 1a–c

1974 *Gigantoproductus submaximus* (Bolkhovitinova); Kalashnikov, pl. 85, pl. 28, fig. 1a–b (*cum synon.*)
1981 *Gigantoproductus submaximus* (Bolkhovitinova); Pattison, p. 8, pl. 1, fig. 6; pl. 9, fig. 16

Material: 4 specimens (90 – 130 mm width): 3 slightly damaged pedicle valves, 1 interior mould of pedicle valve; cat. no. OS-176/56 – 59.
Dimensions of 3 specimens:

cat. no.	W	L	W:L	number of costae	valve
176/59	100	50	2.00	b – c/14, d/14	pedicle
176/56	125	66	1.89	b – c/14, d/14	pedicle
176/57	130	72	1.80	–	pedicle

Description: Pedicle valve large, transversely oval, nearly twice as wide as long, most convex in the umbonal part, which, like the ventral one, is wide and slightly flattened. Umbo not projecting beyond a long hinge line equal to the greatest width. Ears somewhat curved, ill-defined gradually passing into gently declining flanks. From the midlength of valve there occur shallow longitudinal plications, discernible at the anterior margin. Costae rounded, occasionally irregular, separated by narrow sulci, bent at spine bases; the latter are scarce, at the hinge line set up in a row. In distinct concentric rugae on ears, occasionally discernible on flanks. In the valve interior diductors longitudinally striated and numerous small endospines. The valve thickness up to 3 mm in the median part, 1.5 – 2 mm in the umbonal one, 2 mm at the anterior margin and ca. 1 mm on ears.
Remarks: In their longitudinal profile the Gałęzice specimens resemble the specimens described from the USSR better than those from England. They also differ from the latter in lack of geniculation at the gerontic stage, whose presence is stressed by Pattison (1981). The complete concurrence of features with those revealed by the English specimens and the specimens from the Moscow Syneclise refers to the W:L ratio thickness of valves, density of costae and shape of longitudinal plications. Spines on the Gałęzice specimens are less frequent and costae more regular than in the specimens from the above mentioned region of the USSR (Moscow Syneclise). On the other hand, these features of the Gałęzice specimens are in agreement with those reported for the Ural specimens; however, the latter differ from them in having poorly developed (or no) longitudinal plication (which can be seen in illustrations), yet there is no mention of this fact in Kalashnikov's (1974) diagnosis. On the other hand, the latter author remarks that the width is in agreement with the length; this observation differs from the data on this subject found in other studies, including the creator's original diagnosis (Bolkhovitinova, 1932). It is noteworthy that there is great similarity in morphology of the Gałęzice specimens (e.g. longitudinal profile, W:L ratio, longitudinal plication) to that of *Gigantoproductus glabratus* (Janischevsky), described from Upper Visean (Venev horizon) of the NW part of the Moscow Syneclise (Janischevsky, 1954, p. 67, pl. 16, fig. 2; pl. 17, fig. 1 – 2; pl. 18, fig. 1 – 2; Pl. 19, fig. 1 – 2; pl. 20, fig. 1 – 2, text-fig. 21 – 25).
Occurrence: Upper Visean – England (Asbian – Lower Brigantian); Poland: Góry Świętokrzyskie (Gałęzice); ?Middle – Upper Visean – USSR: Moscow Syneclise, Ural (characteristic in Toula horizon, rare in Aleksin one).

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EXPLANATIONS OF PLATES

All specimens in natural size, except those illustrated in Pl. VI, Fig. 1a – b and Pl. VII, Fig. 4 – approx. natural size

Plate I

Fig. 1a – b. *Gigantoproductus giganteus* (Sowerby): damaged pedicle valve exterior with internal mould showing median swelling, swellings corresponding to brachial cones of brachial valve, diductor scars finely striated in anterior and traces of adductor scars in: a – posterior view, b – ventral view. Cat. no. OS-176/29, trench XXI, bed 5, *Goniatites striatus* Zone.

Fig. 2. *Gigantoproductus giganteus* (Sowerby): ventral view of damaged pedicle valve exterior with partly visible mould of umbonal part interior showing traces of diductor scars. Cat. no. OS-176/35, trench XXIII, bed 3, *Goniatites crenistria* Zone.

Plate II

Fig. 1. *Gigantoproductus crassus* (Fleming): damaged shell viewed from pedicle valve exterior in ventral part. Cat. no. OS-176/39, trench XXI, bed 5.

Fig. 2. *Gigantoproductus gigantoides applanatus* (Paeckelmann): incomplete internal mould of pedicle valve with fragments of the valve in side view. Cat. no. OS-176/73, trench XX, bed p.

Fig. 3. *Gigantoproductus janischewskyi* (Sarytcheva): pedicle valve exterior in posterior part. Cat. no. OS-176/40a, trench XXI, bed 5.

Fig. 4a – b. *Gigantoproductus striatosulcatus* (Schvetzov): damaged pedicle valve exterior viewed: a – from trail, b – side Cat. no. OS-176/44, trench XXII, bed 8.

Fig. 5. *Gigantoproductus bisati* (Paeckelmann): Ventral part of a damaged pedicle valve exterior. Cat. no. OS-176/94, trench XX, bed s.

All specimens from the *Goniatites striatus* Zone.

Plate III

Fig. 1a – c. *Gigantoproductus semiglobosus* (Paeckelmann): shell viewed from pedicle valve exterior seen: a – in ventral part, with partly visible interior revealing swellings corresponding to brachial cones of brachial valve, traces of diductor scars and endospines, b – side view, c – in posterior part with fragmentarily preserved interior showing traces of diductor scars. Cat. no. OS-176/48, trench XXI, bed 5.

Fig. 2. *Gigantoproductus sarytchevae* (Paeckelmann): damaged mould of brachial valve exterior visible in posterior part. Cat. no. OS-176/86, ditch 22.

All specimens from the *Goniatites striatus* Zone.

Plate IV

Fig. 1a – b. *Gigantoproductus semiglobosus* (Paeckelmann): shell viewed from pedicle valve exterior: *a* – in posterior view, *b* – in ventral part. Cat. no. OS-176/49.

Fig. 2. *Gigantoproductus gigantoides aequalicostus* (Paeckelmann): damaged pedicle valve interior showing traces of dendrite adductor scars, diductor scars and endospines. Cat. no. OS-176/78.

Fig. 3. *Gigantoproductus gigantoides regularis* (Paeckelmann); damaged pedicle valve exterior in ventral view. Cat. no. OS-176/82.

All specimens from trench XXI, bed 5 – *Goniatites striatus* Zone.

Plate V

Fig. 1a – c. *Gigantoproductus gigantoides* (Paeckelmann): damaged pedicle valve exterior: a – in ventral view, b – in posterior view, c – side view. Cat. no. OS-176/60, trench XXI, bed 5, *Goniatites striatus* Zone.

Fig. 2. *Gigantoproductus striatosulcatus* (Schvetzov): posterior part of incomplete brachial valve mould viewed from the exterior. Cat. no. OS-176/22a, trench XIV, bed 17, *Goniatites crenistria* Zone.

Fig. 3. *Gigantoproductus striatellus* (Paeckelmann): ventral part of damaged pedicle valve viewed from the exterior. Cat. no. OS-176/97, trench XXI, bed 6, *Goniatites striatus* Zone.

Plate VI

Fig. 1a – b. *Gigantoproductus submaximus* (Bolkhovitinova): pedicle valve exterior with internal mould: a – in ventral view, b – side. Cat. no. OS-176/59, trench XX, bed i.

Fig. 2a – b. *Gigantoproductus gigantoides aequalicostus* (Paeckelmann): slightly damaged pedicle valve exterior in: a – ventral view, b – posterior view. Cat. no. OS-176/79, trench XV.

Fig. 3. *Gigantoproductus sarytchevae* (Paeckelmann): side view of incomplete brachial valve. Cat. no. OS-176/87, ditch 29, bed B.

All specimens from the *Goniatites crenistria* Zone.

Plate VII

Fig. 1. *Gigantoproductus gigantoides applanatus* (Paeckelmann): dorsal part of damaged brachial valve interior revealing traces of internal structure. Cat. no. OS-176/74, trench XX, bed r, *Goniatites striatus* Zone

Fig. 2a – b. *Gigantoproductus sarytchevae* (Paeckelmann): incomplete brachial valve exterior in: a – posterior view, b – side view. Cat. no. OS-176/98b, trench XXI, Bed 5, ibidem.

Fig. 3. *Gigantoproductus bisati* (Paeckelmann): damaged pedicle valve exterior in ventral view. Cat. no. OS-176/89a, ibidem.

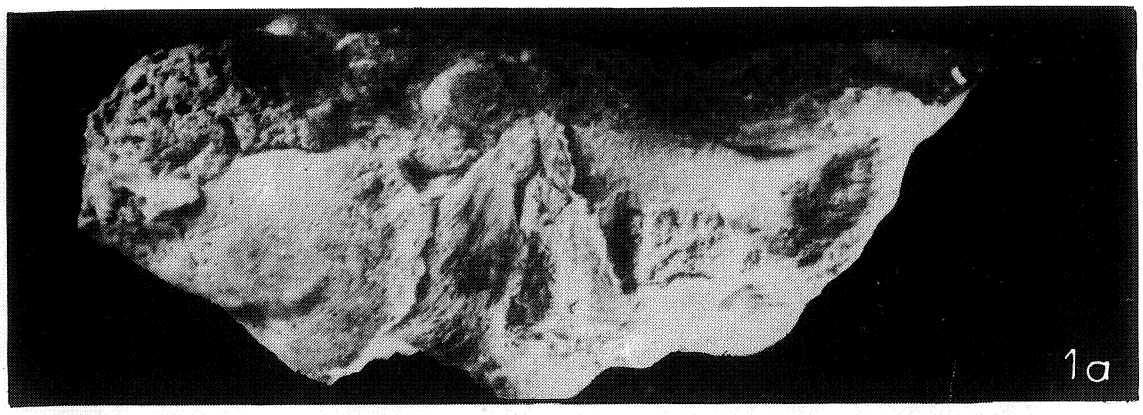
Fig. 4. *Gigantoproductus submaximus* (Bolkhovitinova): posterior part of pedicle valve exterior with internal mould and traces of diductor scars. Cat. no. OS-176/59, trench XX, bed i, *Goniatites crenistria* Zone.

Plate VIII

Fig. 1a – c. *Gigantoproductus submaximus* (Bolkhovitinova): damaged pedicle valve exterior in: a – posterior view, b – ventral view, c – side view. Cat. no. OS-176/56.

Fig. 2. *Gigantoproductus sarytchevae* (Paeckelmann): damaged shell viewed from pedicle valve exterior visible in posterior part. Cat. no. OS-176/98a.

All specimens from trench XXI, bed 5, *Goniatites striatus* Zone.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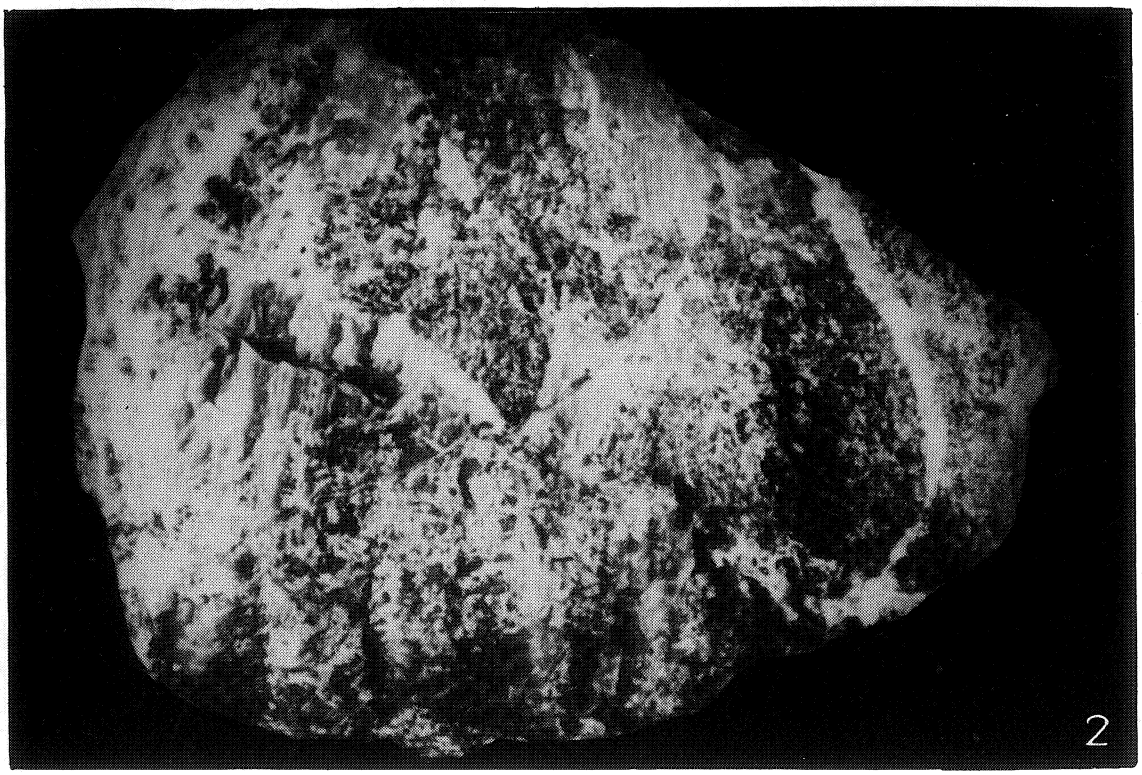
1b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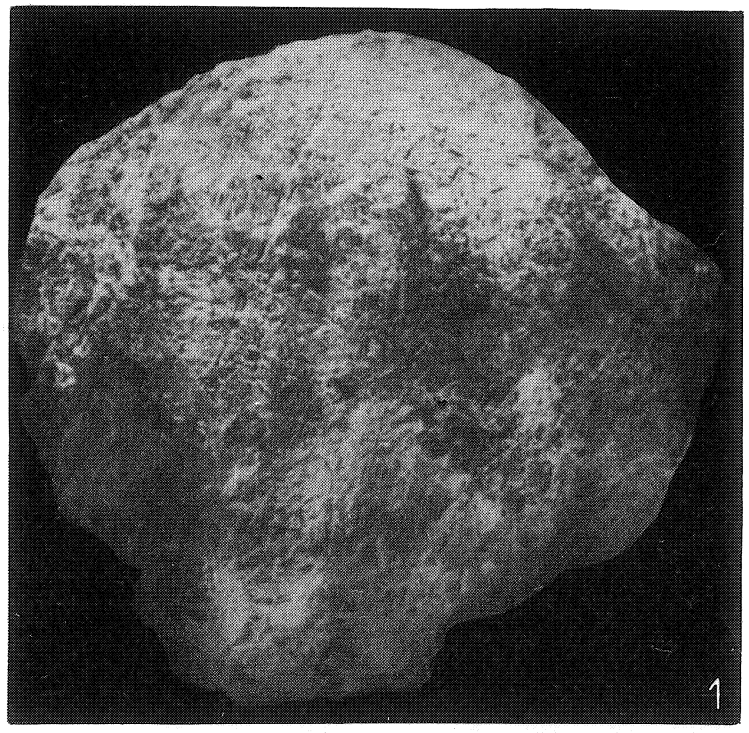
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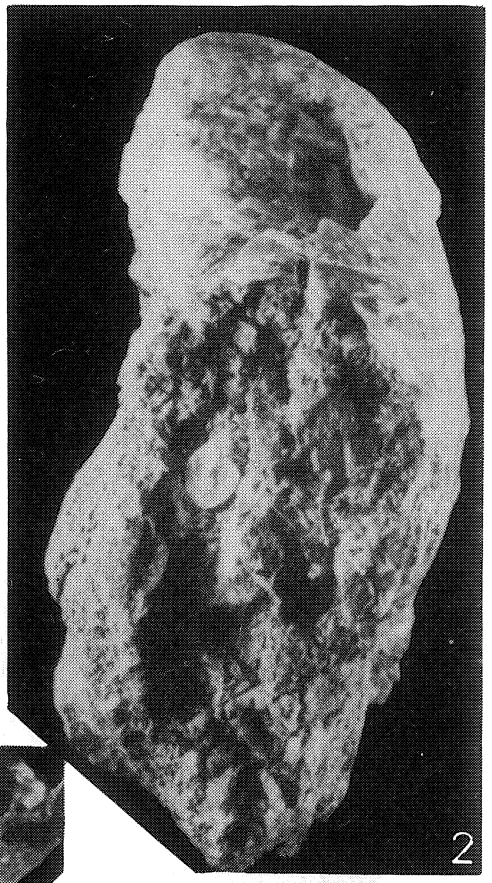
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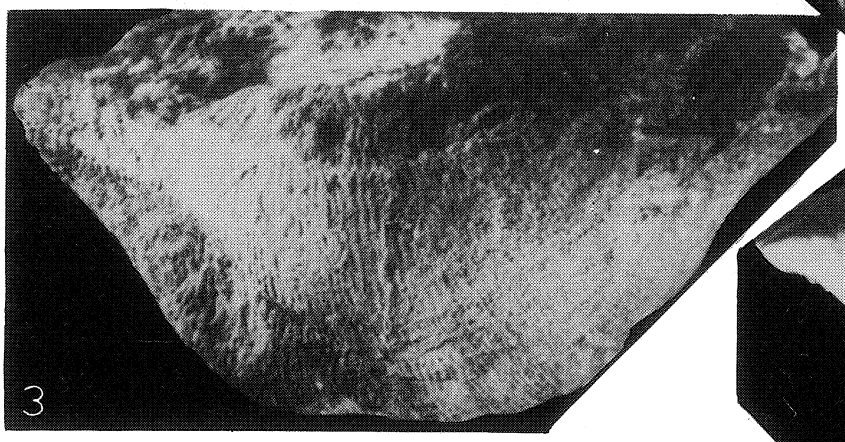
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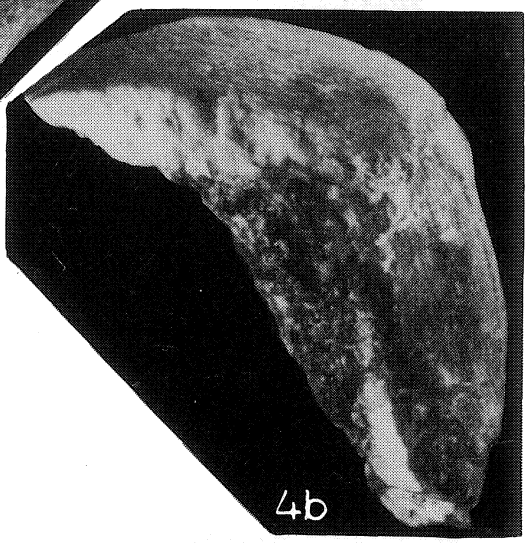
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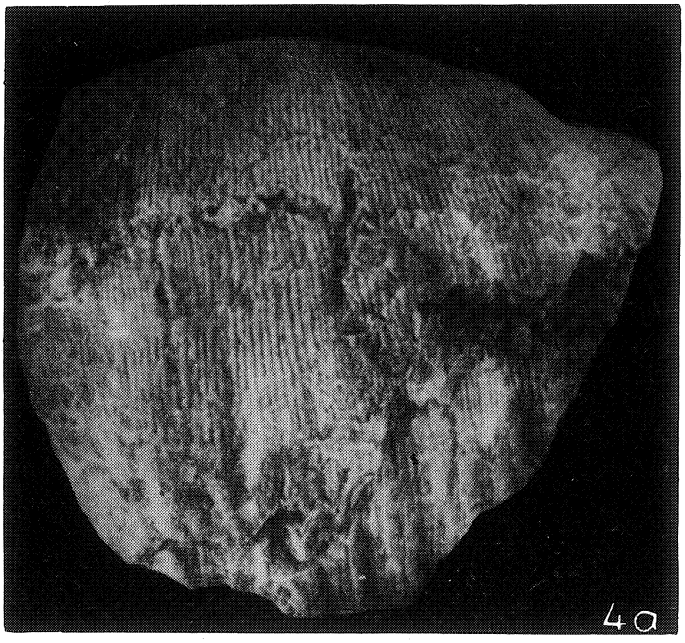
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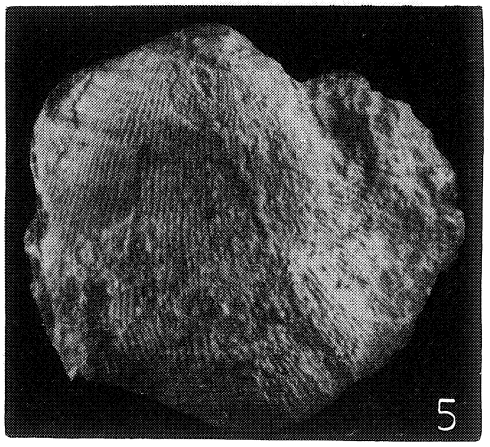
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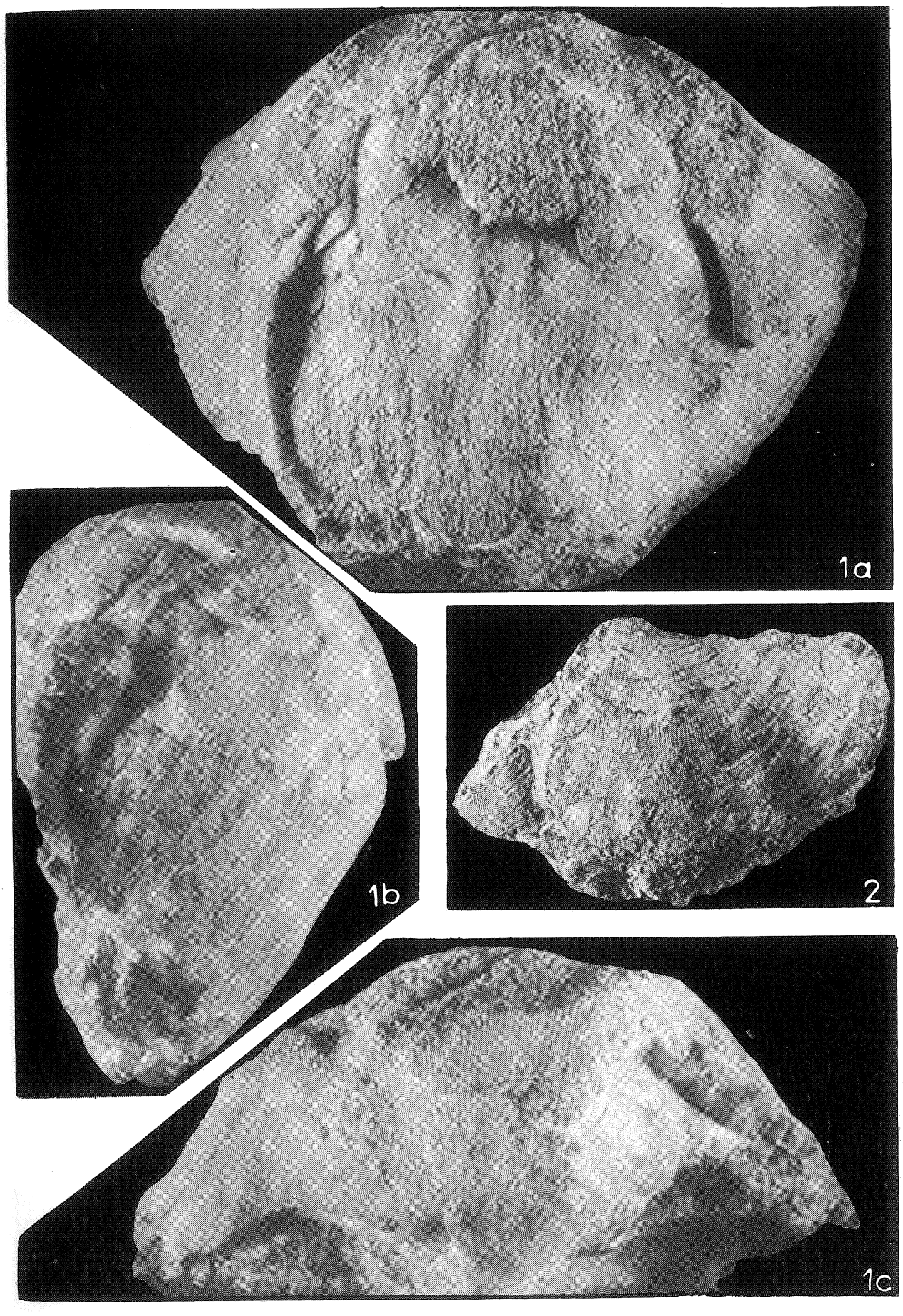
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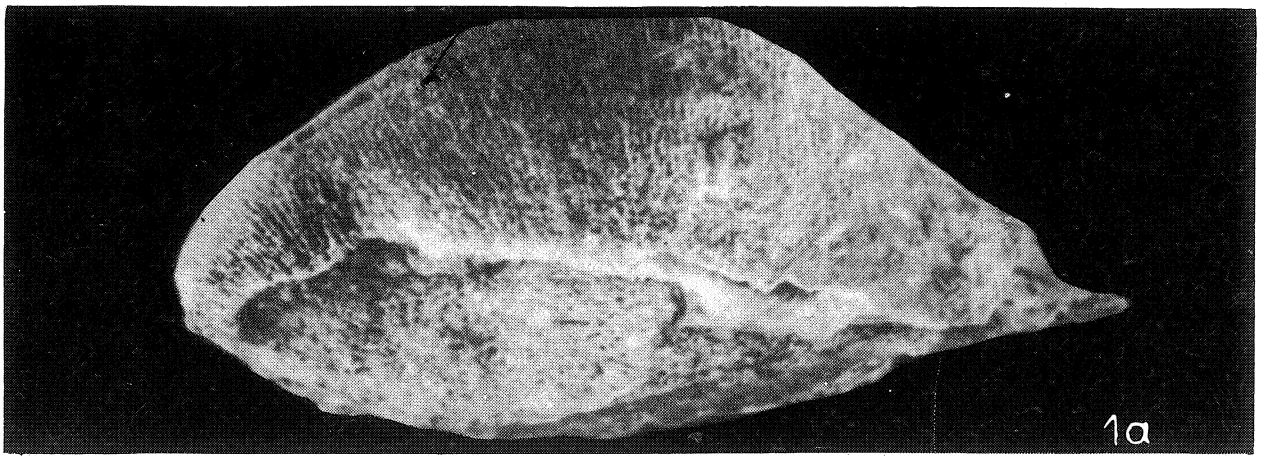
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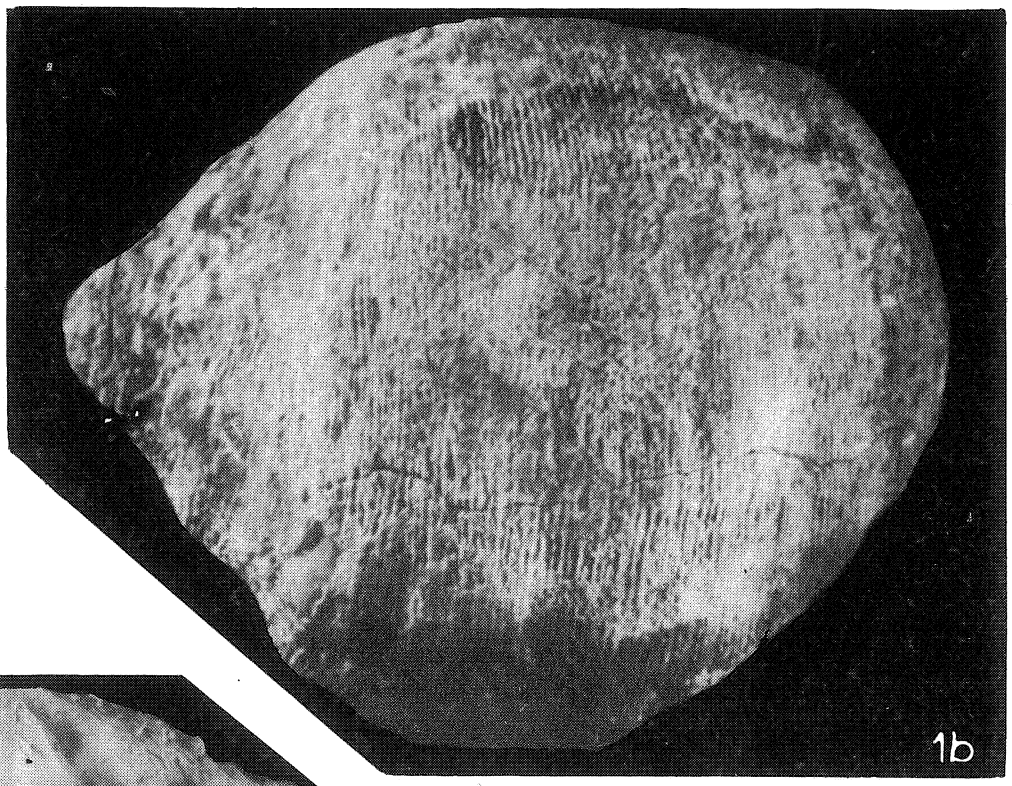
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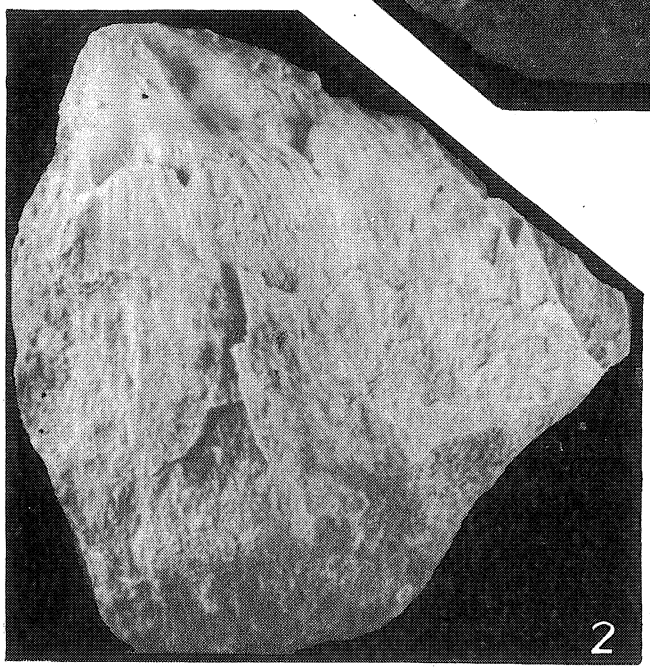
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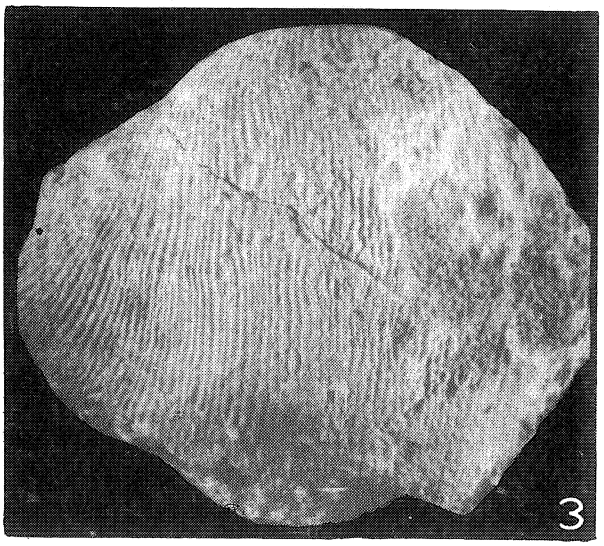
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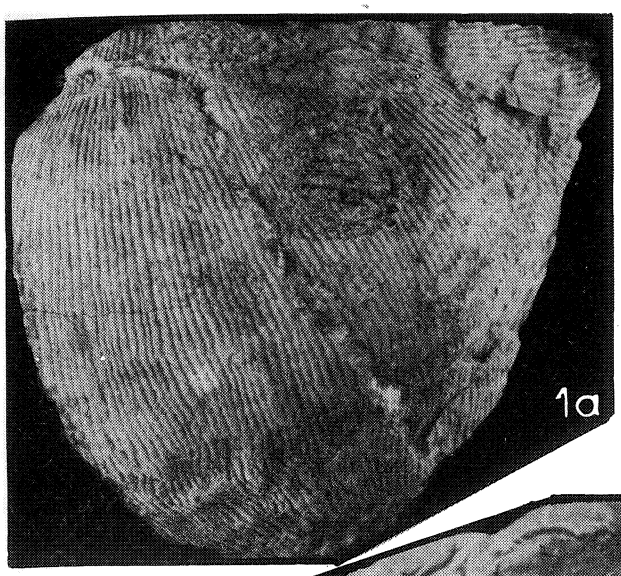
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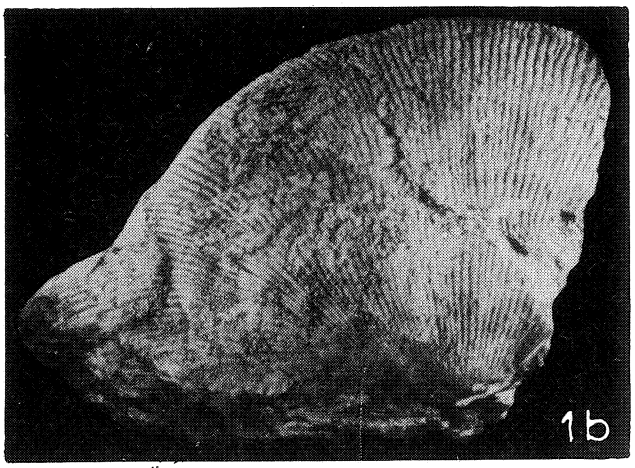
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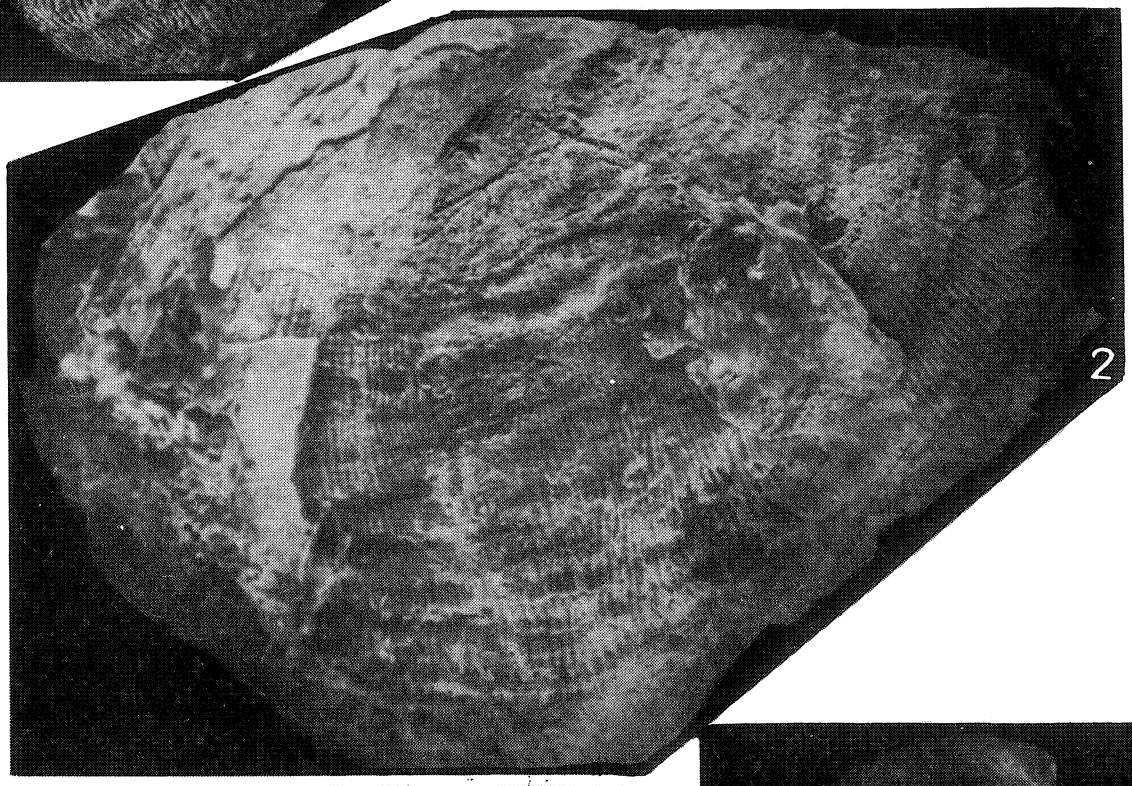
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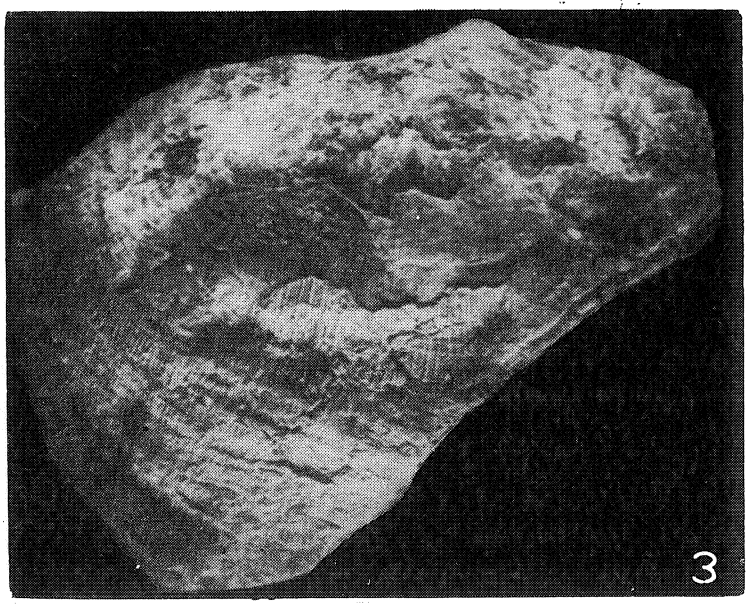
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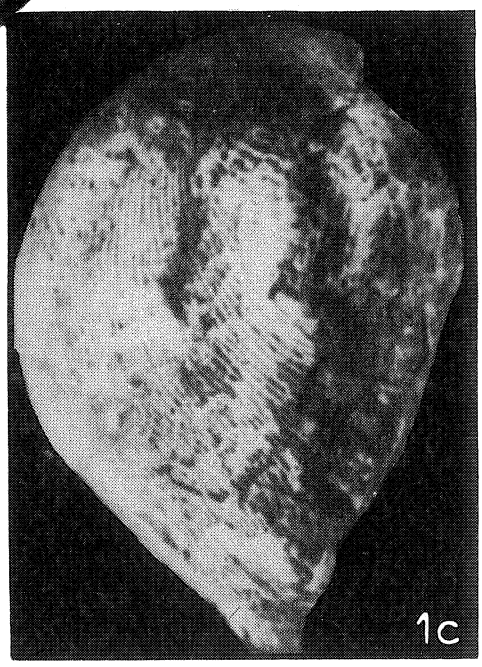
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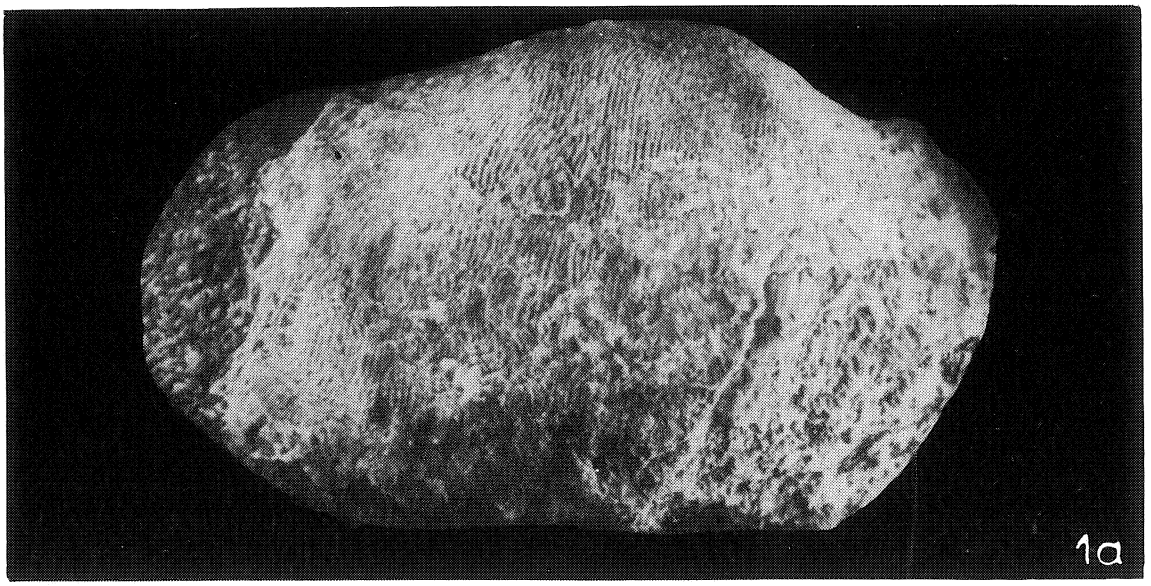
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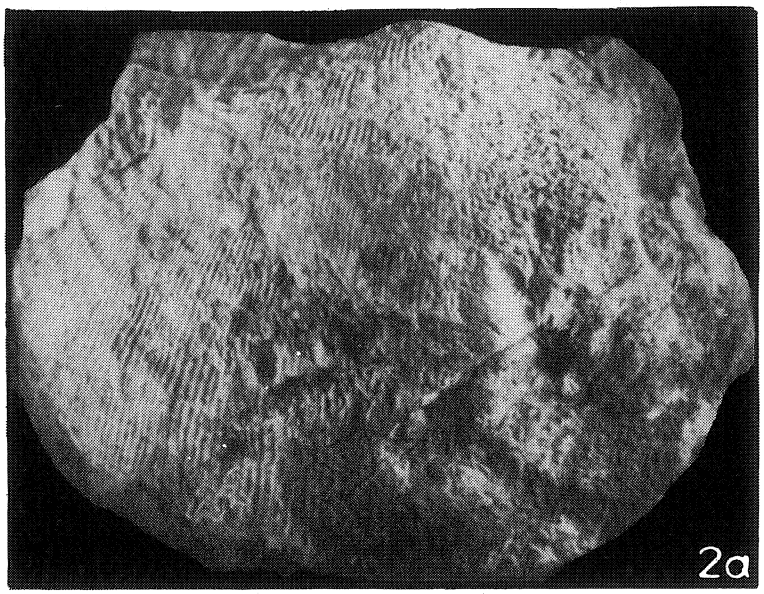
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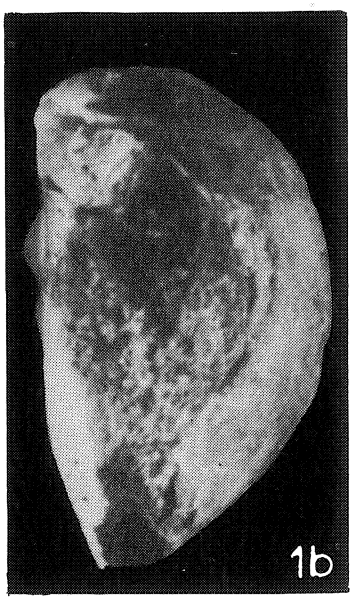
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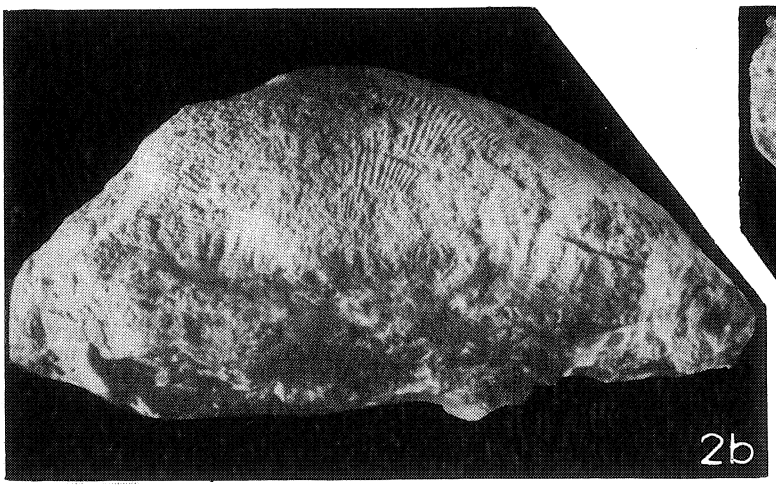
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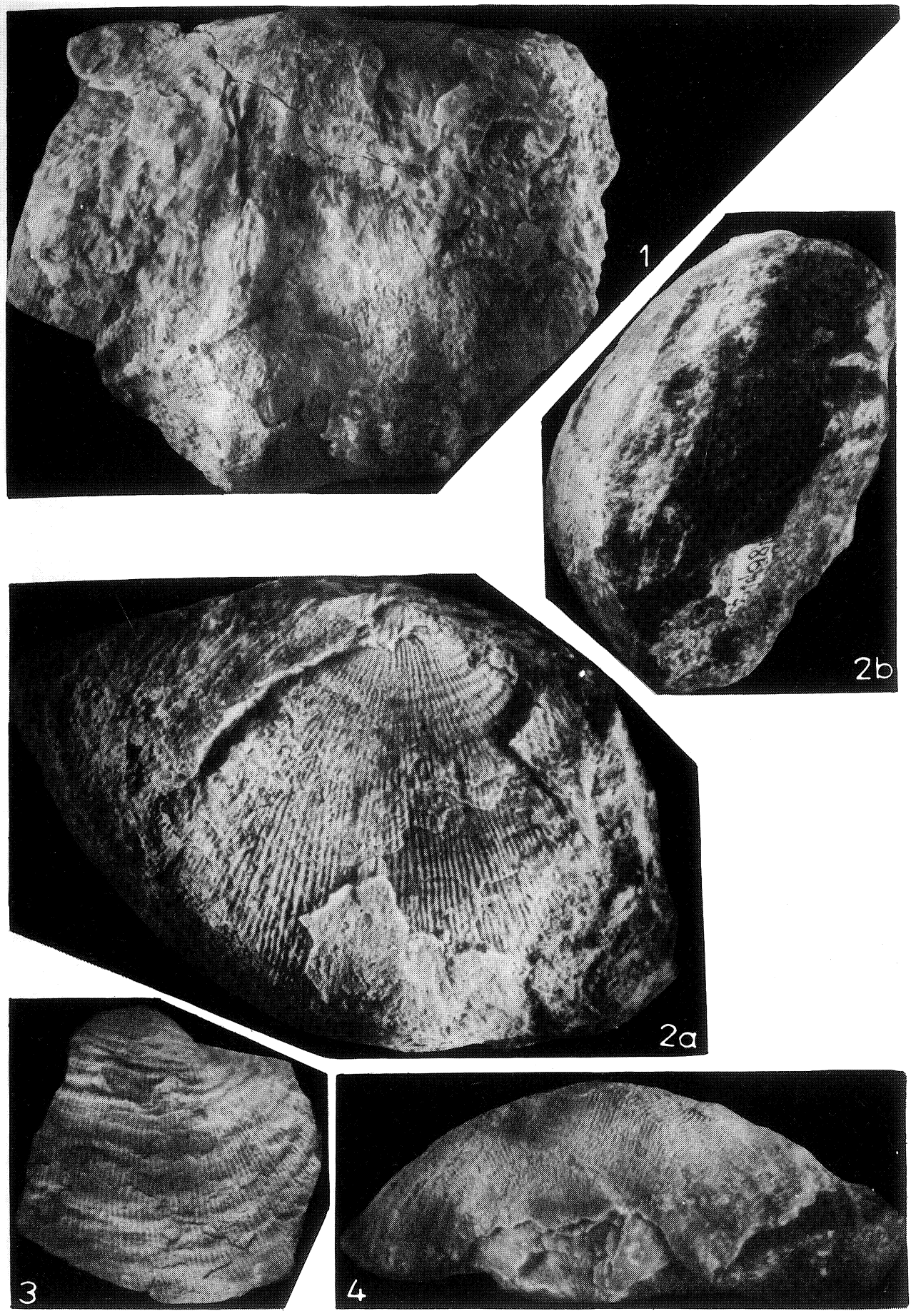
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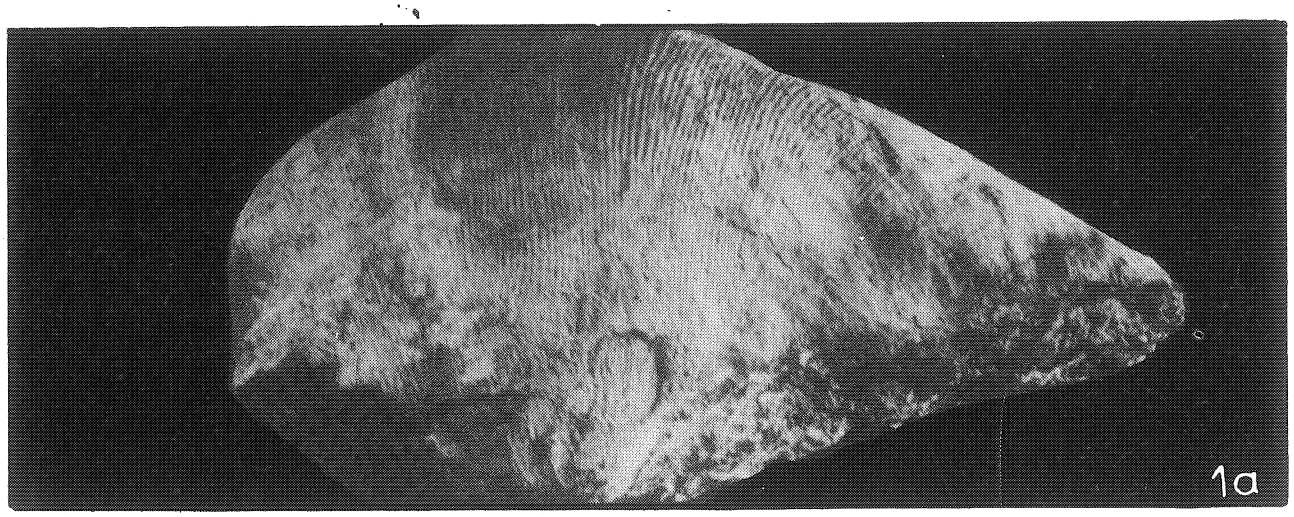
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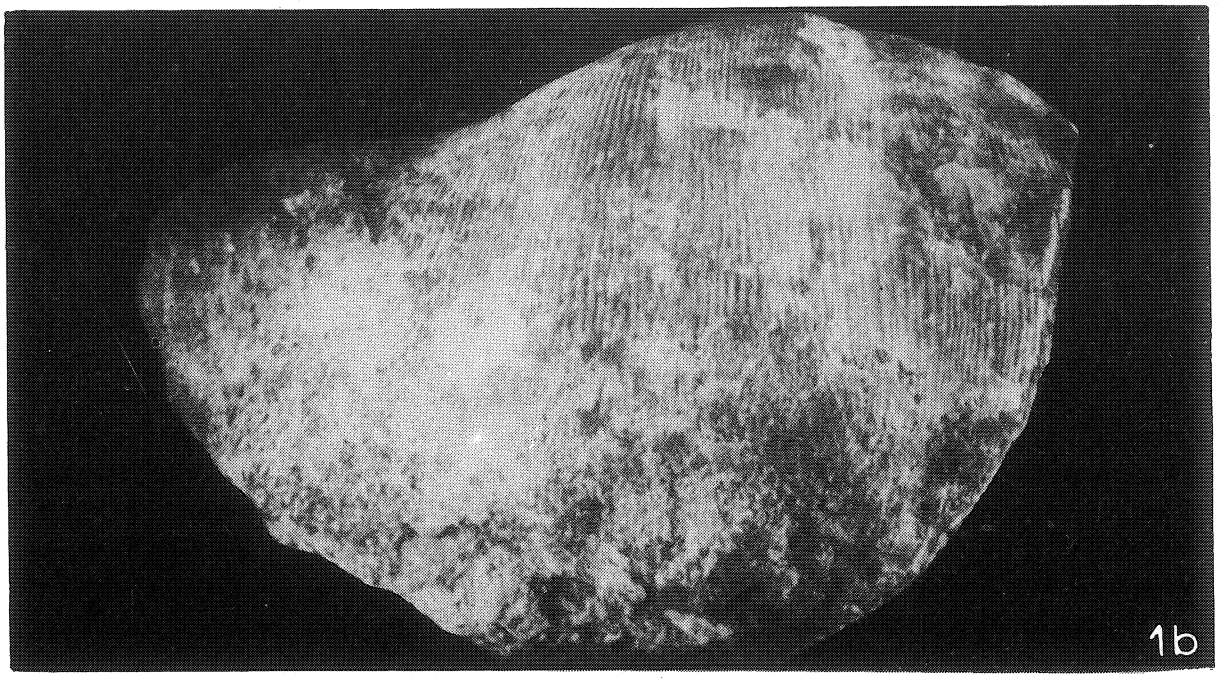
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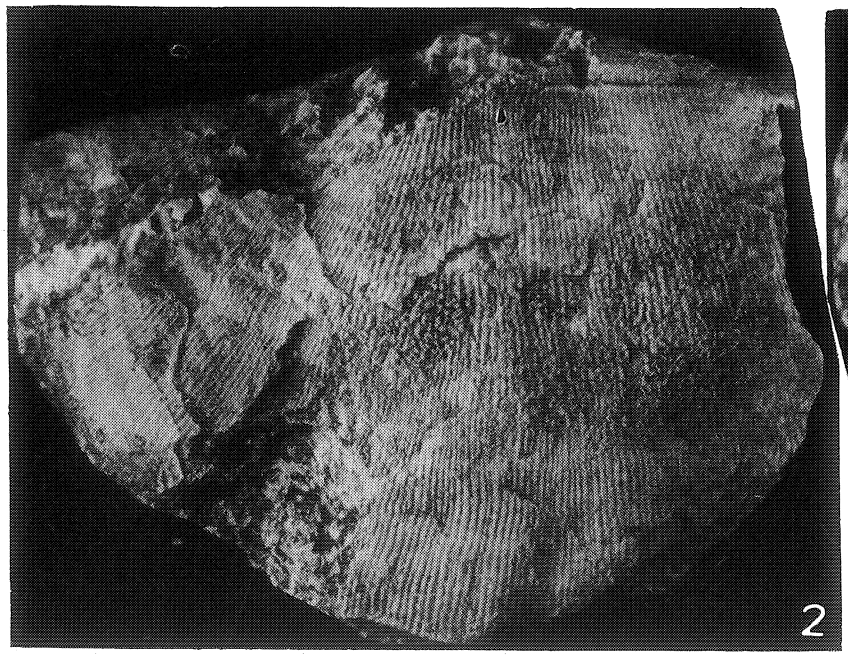
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