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Gertruda BIERNAT

UPPER SILURIAN BRACHIOPODS FROM THE HOLY CROSS MOUNTAINS (ŁĘŻYCE-BEŁCZ SECTION), POLAND

(Pl. I—XII and 2 Figs.)

Górnosylurskie ramienionogi z Gór Świętokrzyskich (profil Łężyce-Bełcz)

(Pl. I—XII i 2 fig.)

Gertruda Biernat: Upper silurian brachiopods from the Holy Cross Mountains Łężyce—Bełcz section). Poland. Ann. Soc. Geol. Poloniae, 51—1/2: 209—239, 1981 Kraków.

Abstract: Twenty four brachiopod species are described from the Upper Silurian (Łężyce—Bełcz section) of the Holy Cross Mts. The fossil assemblage is brachiopod-dominated and indicative of a Ludlow age. The brachiopods are associated with rugose corals, trilobites, molluscs and ostracodes. The most abundant are *Homoeospira baylei, Ancillotoechia ancillans* and *Nucleospira inelegans.*

Key words: brachiopods, paleoecology, stratigraphy, taxonomy, Ludlow, (Central Poland)

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Treść: Opisano 24 gatunki ramienionogów z górnosylurskich marglistych wapieni (dolne warstwy rzepińskie) występujących w profilu Łężyce—Bełcz). Ramienionogi w tych wapieniach występują bardzo licznie, tworząc zlepy muszlowe, a towarzysząca im fauna reprezentowana jest przez korale (Rugosa), trylobity, mięczaki i małżoraczki. Szczególnie licznie spośród ramienionogów występują *Homoeospira baylei, Ancillotoechia ancillans* i *Nucleospira inelegans.* Zespół ramienionogów charakterystyczny jest dla ludlowu.

INTRODUCTION

Upper Silurian strata are exposed in the northern Holy Cross Mountains along the Łysogóry range and Samsonowicz (1934), was the first to recognize the Upper Silurian in the Łężyce-Bełcz section.

Most geologists working on the Lower Paleozoic of the Holy Cross Mts (e.g. Czarnocki 1942; Tomczykowa 1959; 1962a, b; Tomczyk 1962; Różkowska 1962) agree that the Łężyce-Bełcz section is among the most interesting in the area, due mainly to its rich and diverse fossil fauna. The richness of the fauna is important because graptolites are very rare or even completely absent from the Silurian of the Łysogóry region and the Łężyce-Bełcz section and hence, other fossils must be used for biostratigraphy; furthermore, there are no species of short stratigraphic range in the strata.

Brachiopods are among the most abundant faunal groups recorded in the Łężyce-Bełcz section and have been used for biostratigraphy. This was noted by Samsonowicz (1934), Czarnocki (1942), and Tomczykowa (1959, 1962a), among others, who also gave a list of the recognized brachiopod species.

The brachiopods from the Łężyce-Bełcz section have never been studied in detail; this is partly due to their poor preservation state.

The brachiopod collection includes more than 600 specimens. They are poorly preserved like the associated fossils. Most brachiopods are preserved as moulds. Some specimens show variably exfoliated shells (e.g. *Homoeospira baylei, Atrypa nieczlaviensis, Delthyris elevata*). In general, the moulds bear imprints of radial ornamentation, the pedicle foramen (e.g. the leptenids), and some delthyrial elements. Some muscle scars, traces of dorsal septum and/or hinge structure (cardinal process), and brachiophores are also sometimes partly preserved. Because of the fragility of the moulds, many casts cannot be taken, even though the brachiophores and supporting plates may be important as diagnostic features (e.g. in the dalmanellids).

A preparation needle was used, but rarely, because the specimens were too fragile. The interiors of articulated shells (e.g. *Ancillotoechia ancillans, Delthyris elevata*) were investigated by serial peels; however, the internal structures were considerably obscured by recrystallization.

The present paper describes the brachiopod collection made by Dr. E. Tomczykowa in 1956—1957 near Opatów. The study was carried out at the Institute of Paleobiology of the Polish Academy of Sciences, Warszawa, and the collection is housed at the Museum of the Geological Institut, Warszawa (catalogue number IG-1369.II).

REMARKS ON LOCAL GEOLOGY AND STRATIGRAPHY

The Łężyce-Bełcz section occurs in the northeastern Holy Cross Mts. some 7 km from Opatów (Fig. 1). The section was studied in detail by Tomczykowa, who presented a lithological sequence (Fig. 2, Tomczykowa 1959, 1962a).

The Upper Silurian strata exposed in the section start with shale-greywacke rocks with sandy and muddy-calcareous intercalations at the top. Similar rocks are widely distributed in the Holy Cross Mts but this lithostratigraphic unit, assigned by Tomczykowa (1962a) to the Wydrzyszów beds, remains poorly known.

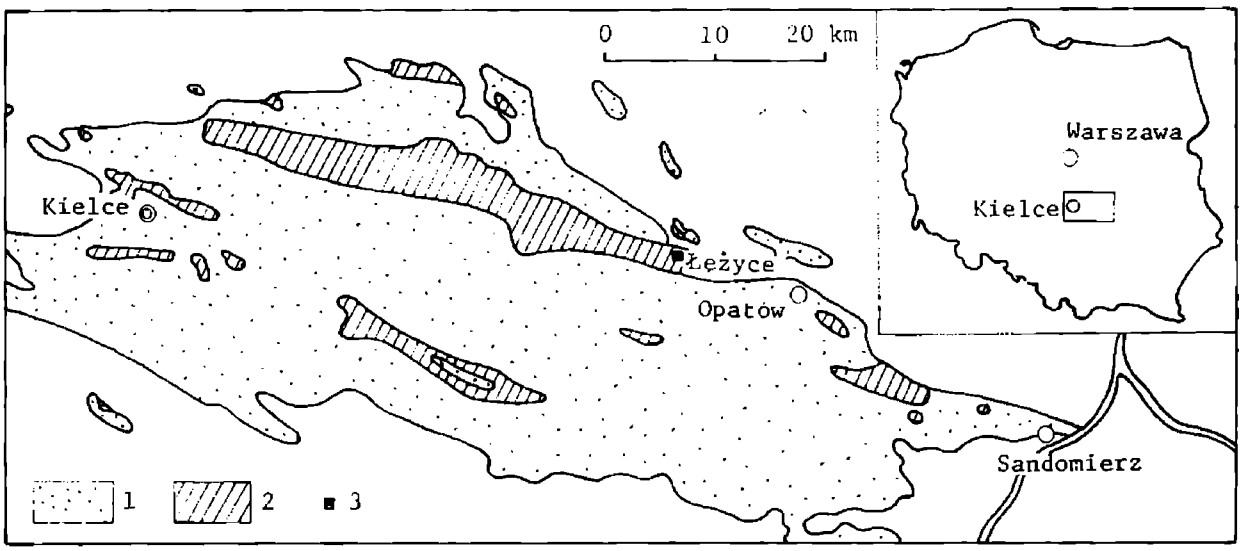

Fig. 1. Geological sketch map (after Tomczykowa, 1959) showing: 1 — in general, the Palaeozoic deposits of the Holy Cross Mountains; 2 — Ordovician and Silurian; 3 — section and collecting locality (Łężyce-Bełcz) for the Ludlovian brachiopods
Fig. 1. Szkic geologiczny Gór Świętokrzyskich (wg Tomczykowej, 1959): 1 — utwory paleozoiczne, ogólnie; 2 — ordowik i sylur; 3 — profil (Łężyce-Bełcz), z którego pochodzi kolekcja ludlowskich brachiopodów

Northwards the shaly-greywacke strata are overlain by the Rzepin beds of Czarnocki (1942). The rocks are fairly variable in lithology and sporadically fossiliferous. The Rzepin beds are dominated by reddish to bur coloured shales intercalated with grey shales and sandstones in the Łężyce-Bełcz section. In general, the fauna is sparse and brachiopods are represented mostly by poorly preserved specimens of chonetids and strophеodontids (Tomczykowa 1959).

Higher in the section, detritic limestones 2.5 m thick appear. They are highly fossiliferous and yielded the investigated brachiopod assemblage (Tomczykowa 1959, 1962a; Różkowska 1962). The abundant fossils form coquinas. The fauna is dominated by brachiopods (up to 70%) and trilobites. Less common are gastropods, bivalves, ostracodes, tentaculites, and tabulates. Bryozoans occur sporadically.

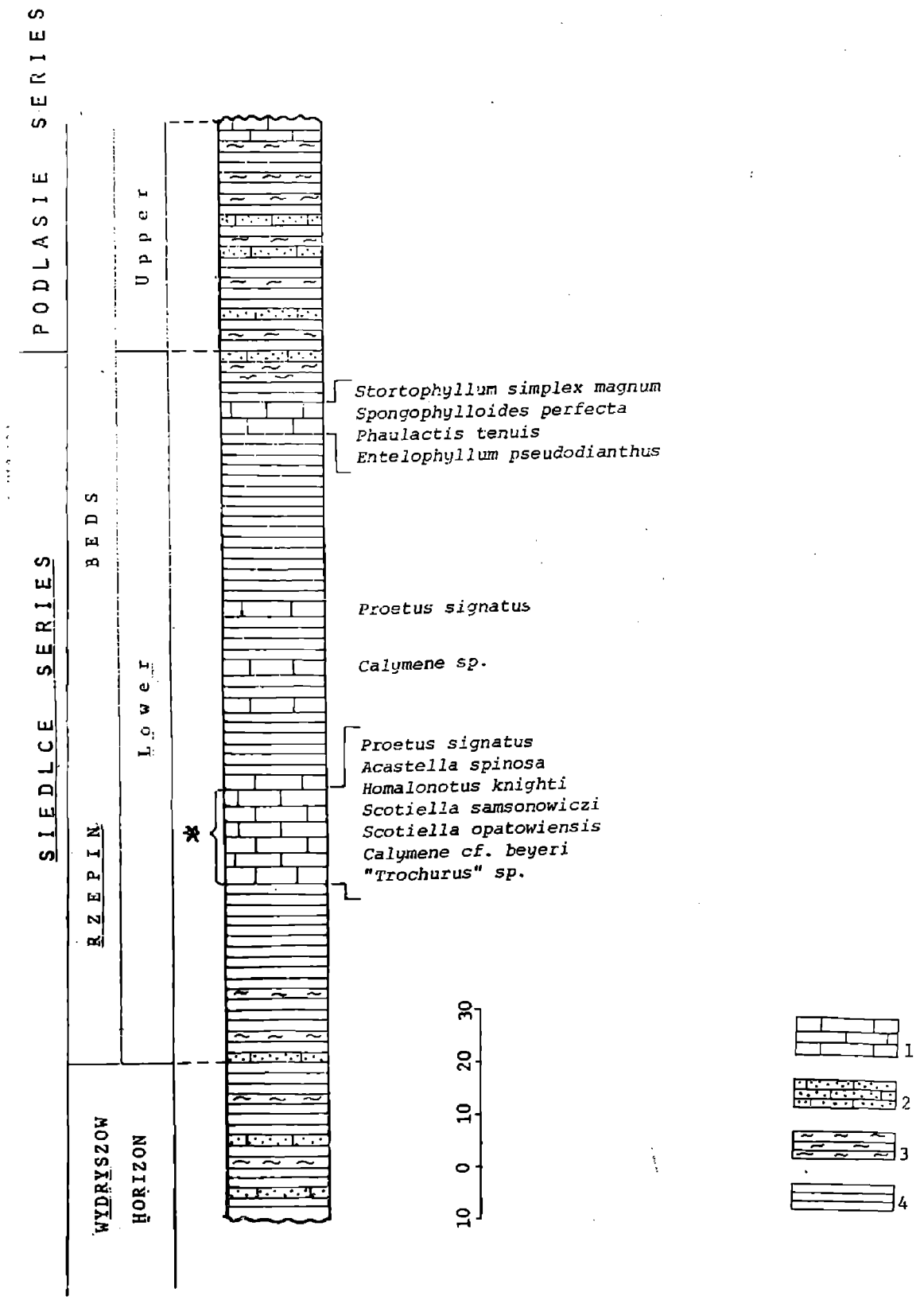

Fig. 2. Łężyce-Bełcz Section (after E. Tomczykowa, in preparation): 1 — marly limestones; 2 — greywackes; 3 — mudstones; 4 — siltstones. * — marly limestone, 2.5 m thick (cocquina) containing rich brachiopods considered in the present paper

Fig. 2. Profil Łężyce—Bełcz (wg E. Tomczykowej, w przygotowaniu do druku): 1 — wapienie margliste; 2 — szarogłazy; 3 — mułowce; 4 — iłowce. * — wapienie margliste, 2,5 m miąższości muszlowiec zawierający bogatą faunę brachiopodów opisaną w pracy

The detritic limestones are overlain by a set of claystones, shales, and marly limestones interbedded with marls. The fauna decreases gradually in abundance. At the top, marly-detritic limestones appear which yielded Silurian rugose corals (pit I of Tomczykowa 1962a; Różkowska 1962; 117). This is, up to now, the only locality that has yielded these fossils. The marly-detritic limestones are interbedded with marls and claystones with some fragments of fossils.

When mapping the survey sheet Opatów, Samsonowicz (1934) assigned the Silurian strata recorded in the Łężyce-Bełcz section to the Upper Silurian (?Upper Ludlow). His list of the fossils found in the section includes mostly brachiopods, e.g. *"Spirifer" elevatus* Dalm., *Stropheodonta corrugatella* Salter [1], *Atrypa reticularis* Lin., and trilobites *Acaste* sp. Czarnocki (1942) assigned the strata under discussion as the Rzepin Beds of Middle Ludlow age.

Later studies on various elements of the fossil assemblage (corals, brachiopods, trilobites) confirmed the Late Silurian age of the strata exposed in the Łężyce-Bełcz section (Fig. 2). Tomczykowa (1962a, b) recorded the following trilobite species: *Acaste dayiana* Richter and Richter, *Acastella spinosa* (Salter), *Scotiella samsonowiczi* Tomczykowa, *Calymene beyeri* Richter and Richter, *Homalonotus knighti* König, and others. The occurrence of *Homalonotus knighti* is especially remarkable because apart from the Holy Cross Mts (Łężyce-Bełcz section: Tomczykowa 1962a, Lipniczek, east of Opatów: Samsonowicz 1934; Rzepin: Tomczykowa 1962a, Tomczyk 1962, 1970) this species has also been recorded in the eastern Peribaltic syneclise (borehole Gołdap 1, upper Siedlce Series, strata that yielded also *Formosograptus formosus* (Bouček). The lower Rzepin Beds can be considered as time equivalent to the upper Siedlce Series and by implication, to the Upper Silurian of Great Britain (Whitcliffian) and Nova Scotia (Moydart and Stonehouse Formations (Tomczykowa 1975). Trilobites are among the most important stratigraphically fossil groups. There are trilobite species recorded from graptolite-bearing Upper Silurian strata of the western margin of the East-European platform, as well as in other parts of Europe (Tomczykowa 1962a, b; 1975). The trilobite assemblage under discussion shows also much affinity to the coeval faunas of England, Czechoslovakia, Lithuania, Latvia and Scandinavia (Tomczykowa 1962a, 1975).

As well as the trilobites, rugose corals have been described (Różkowska 1962). Eight species of five rugose coral genera were recognized, all of them characteristic of the Silurian. The genera *Pilophyllum* Wedekind and *Stortophyllum* Wedekind seem to be restricted to the Upper Silurian. *Phaulactis* Ryder occurs in the Middle to the Upper

[1] This is a Caradocian ptycholeptid form (Williams 1953, p. 39).

Silurian; while *Entelophyllum* Wedekind and *Spongophylloides* Meyer range from the Middle Silurian to the Lower Devonian (Różkowska 1962). The assemblage closely resembles that of the *Pilophyllum* stage recognized by Wedekind in Southern Gotland (comp. Różkowska 1962).

The brachiopod assemblage fits the interpretation of the Łężyce—Bełcz section as Upper Silurian. Some species of short stratigraphic range, e.g. *Isorthis canaliculata* (Lindström), *I. fornicatimcurvata* (Fuchs), *Shaleria ornatella* (Davidson), *Protochonetes ludloviensis* Muir-Wood, are restricted to the Ludlow. Some others, e.g. *Resserella canalis* (J. de C. Sowerby), *Leptaena amelia* (Havlíček), and *Ancillotoechia ancillans* (Barrande), range from the Wenlock to the Ludlow. *Mesodouvillina seretensis* (Kozłowski) occurs in the Ludlow to the ? Gedinnian, and *Atrypa nieczlaviensis* Kozłowski in the Ludlow to the Gedinnian. These brachiopod species are widely distributed in Great Britain, Estonia, Czechoslovakia, Podolia, and Gotland, which is consistent with distribution of the associated fossils, e.g. trilobites (Tomczykowa 1962) and rugose corals (Różkowska 1962).

One can thus conclude that the specific composition of the three analysed segments of the fauna permits assignement of the strata of the Łężyce—Bełcz section to the Upper Silurian (Ludlow). The corals could be of Middle or Upper Ludlow age. The trilobites are indicative of the Upper Siedlce age (Tomczykowa 1975), and the brachiopods confirm this stratigraphic attribution. A final stratigraphic dating of the strata is hampered by the high lithological variability and the absence of graptolites, which are good biostratigraphic indices.

The fossil assemblage

The fossil assemblage is dominated by brachiopods in terms of both individuals and species. Trilobites rank second in species number. The associated fossil groups (tabulates, tetracorals, bivalves, tentaculites, gastropods, crinoids and ostracodes) are represented by a few genera and species. There are representatives of three tabulate genera: *Mesofavosites* (*M. imbellis* Klaamann) *Syringopora* (*S. schmidti* Tschernyschev), and *Aulopora* (*A. enodis* Klaamann) stated by Stasińska (1970). Among the rugose corals, there are species of *Pilophyllum* showing lonsdaleoidal septa and dome-like arranged tabulae (*P. veissermeli* Wedekind and *P. progressum* Wedekind) associated with *Stortophyllum simplex* magnum Różkowska, *Spongophylloides perfecta* Wedekind and *S. intermedia* Różkowska (Różkowska 1962).

Bryozoans are only a minor proportion of the invertebrate fauna. Only two genera have been recognized *Hallopora*, and *Fenestella* with reticulate zoaria (oral communication of dr M. Kiepura). This rarity of bryozoans may be an artifact due to the poor preservation state.

Several traces suggestive of bryozoans, but unidentifiable occur on brachiopod shells. Poorly preserved fragments of nautiloid orthocones, occur, but very rarely.

In a preliminary report on the Middle to Upper Silurian stratigraphy of the Holy Cross Mts Tomczykowa (1959) listed seventy fossil species belonging to nine invertebrate groups found in the Łężyce-Bełcz section. Half of that list made up of brachiopods, and 24 brachiopod species have been recognized in the present study. In several cases, the preservation state and the small sample size do not allow the identification of a taxon or recognition of a new one. Only a few species occur very abundantly. These are: *Homoeospira baylei* — the dominant species, *Ancillotoechia ancillans, Delthyris elevata,* and *Nucleospira inelegans.* Some species are rare, represented each by few specimens or even only one: *Lingula* cf. *rugosa* Kozłowski, *Orbiculoidea* cf. *rugata* (J. de C. Sowerby), *Sphaerirhynchia wilsoni* (J. de C. Sowerby), *Hemitoechia* cf. *undvaensis* Rubel, *Stegerhynchus* cf. *borealis* (L. v. Buch).

PALEOECOLOGICAL REMARKS

The brachiopods in question occur in only some parts of the Łężyce-Bełcz section, although the thickness of sediments is rather great attaining, in all probability, to about 300 meters (Tomczyk 1970).

These deposits show some lithological variability suggestive of temporary shallowing and/or deepening of the basin to a limited degree. A set of detritic marly limestones, the richest in fossils are the shallow water sediments deposited under conditions of more or less moderate water turbulence (Tomczykowa 1962a; Różkowska 1962).

The brachiopods are the main components of the marly limestone fauna. Most of the brachiopods are adults except *Iridistrophia praeumbracula, Howelella* cf. *angustiplicata,* and *Delthyris elevata* which are also rarely represented by juveniles forms (pl. 2, fig. 1—4).

All adults, compared with those from the other regions i.e. Czechoslovakia (Havlíček 1961, 1967, 1977), England (Muir-Wood 1962; Holland and al. 1963), Estonia (Rubel 1970, Rubel, Rozman 1977), Podolia (Kozłowski 1929; Nikiforova 1954) are of small dimensions. In the case of i.e. *Protochonetes ludloviensis* (Muir-Wood 1962, pl. 3, fig. 1—5), *Atrypa nieczlaviensis* (Kozłowski 1929, pl. 8, fig. 14—17) the adult shells are rather much below average size. The shells of i.e. *Homoeospira baylei, Ancillotoechia ancillans* are, in addition, rather of low variability in their size, outline and pattern of the surface ornament. Gerontic individuals are almost absent.

The relative rarity or even absence (for many brachiopod species)

of juveniles from the Łężyce-Bełcz deposits finds some explanations in the environmental factors. The juveniles have, in general, much less opportunity to be preserved in fossil state. One of the reasons is that i.e. they could be washed out from the bottom sediments and their delicate shells damaged due to, even moderate turbulency of water. It is also probable that these animals, in their early post-larval stages would find some difficulties for settlement in a moderately high-energy environment. Hence, it is possible that only a small percent of young individuals did become attached to a suitable substrate.

As a rule the dimensions of shells are also an expression of environmental conditions and small sized specimens could be associated with some environmental stresses (Watkins 1978). Recent brachiopods are recognized as intolerant of i.e. sedimentation rate, oxygen deficiency, fluctuations of bottom, water temperature and salinity but do tolerate water turbulency (Rudwick 1962). As stated for the atrypids these animals possessed some abilities to adapt to sub-optimal conditions (Copper 1966), including some deficiency of nutrient supply. The availability of food appears to be one of the main factors in determining i.e. growth rates (Jones 1978). The brachiopods were filter feeders and/or could feed on dissolved nutrients (McCommon 1969; Cowen 1971). The filtering capacity of a lophophore — part of the food gathering system, its properties and functionality were considered by some authors (Rudwick 1962; Fürsich and Hurst 1974). With regards to the Łężyce-Bełcz brachiopods responsible for their comparatively small shell size could be some insufficiency of food supply, for rather moderate turbulency of water and much limited influx of nourishment.

The Łężyce-Bełcz brachiopods comprise the active and passive sessile benthos. In the former group majority of shells remains articulate (except i.e. orthids, howelellids) and sufficiently well preserved (i.e. *Homoeospira baylei, Ancillotoechia ancillans, Atrypa nieczlaviensis, Nucleospira inelegans*). This might be due partly to their stronger hinge mechanism, comparatively thick surface ornament and possibly rapid burial with little or no post-mortem transport. (Amsden 1963; Fürsich 1978).

Disarticulation is especially common within the passive, sessile benthos i.e. strophomenids, chonetids, and the differences in the number of particular valves, pedicle/brachials are minimal. That means, the turbulency and agitation of the water was not sufficient to differentially sort the brachial and pedicle valves. To mention, the hinge structure of strophomenids or chonetids appears to be too weak for maintaining their shells closed especially in post-mortem conditions.

In addition, the considered brachiopod assemblage shows only some examples of minor shell deformations (including some asymmetry) effecting the general shell shape or outline but never to any considerable

degree. Asymmetry of the frontal commissure occasionally occurs in *Nucleospira inelegans, Sphaerirhynchia wilsoni.* Some deformations are also observed in leptenids, orthids and delthyrids, and are due to mechanical stresses such as compaction of sediment.

These are only very few general considerations on the brachiopods from the Łężyce-Bełcz deposits but they do throw some light on the existed environmental conditions. More detailed paleoecological studies will be presented in future.

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DESCRIPTIONS

Family Lingulidae Menke, 1828
Genus *Lingula* Brugière, 1797

Lingula cf. *rugosa* Kozłowski, 1929

(Pl. I, fig. 6)

Material: One incomplete specimen of brachial (?) valve preserved as an external mould.
Remarks: The specimen is comparatively large (length about 53.2 mm, width at the midlength 24.6 mm) in comparison with the other known Upper Silurian lingulids. It is extremely like *L. rugosa,* from the Czortków horizon of Podolia, but is two times larger (Kozłowski 1929, pl. I, fig. 1—2).

Family Discinidae Gray, 1840
Genus *Orbiculoidea* d'Orbigny, 1847

Orbiculoidea cf. *rugata* (J. de C. Sowerby, 1839)

(Pl. I, fig. 4)

Material: External and internal moulds of one incomplete brachial valve.
Remarks: The specimen has thickened concentric growth lines of

regular arrangement and is like *O. rugata* from the Whitcliffian of the Ludlow District (Holland et al. 1963, pl. 6 : 10) and *O.* cf. *rugata* from the Borszczów horizon of Podolia (Kozłowski 1929, pl. I, fig. 8).

Family Dalmanellidae Schuchert, 1913
Genus *Isorthis* Kozłowski, 1929

Isorthis fornicatimcurvata (Fuchs, 1919)

(Pl. I, fig. 8—11)

1975 *Isorthis (Protocortezorhis) fornicatimcurvata* (Fuchs); Walmsley and Boucot, pl. 5, fig. 1—26.
1978 *Isorthis fornicatimcurvata* (Fuchs, 1919); Hurst and Watkins, pl. 2, fig. 1—4.

Material: Twenty-four internal casts and external moulds of brachial and pedicle valves (10).
Description: Quadripartite large dorsal muscle field, straight to slightly oblique furrows dividing the posterior adductors from the anterior ones, and wide median ridge. Cardinal process simple and somewhat bulbous, brachiopohores well divergent and of slightly varying thickness. Ventral dental plates thin, median ridge low, widening anteriorly.
Remarks: The specimens appear to be subequally biconvex and similar to topotypes of *I. fornicatimcurvata* from the Huinghauser Schichten (Johnson and Talent 1967, pl. 21: 14—22), mainly in the size of their dorsal adductors and less elevated lateral margins of muscles. The Podolian *I. szajnochai* Kozłowski (1929) from the Borszczów horizon (median beds) is much larger, with straight horizontal furrows separating the dorsal adductors.
Occurrence: Upper Silurian: Stonehouse Formation (Pridoli) Nova Scotia; Huisinger Schichten, Germany; Holy Cross Mts (Łężyce-Bełcz), Poland.

Isorthis canaliculata (Lindström, 1861)

(Pl. I, fig. 12, 13)

1975 *Levaena canaliculata* (Lindström, 1861); Walmsley and Boucot, 93, pl. 10, fig. 12—18.
1978 *Isorthis canaliculata* (Lindström, 1861); Hurst and Watkins, p. 95.

Material: Two internal casts of brachial valves.
Description: The specimens are sulcate with an elongate muscle field, the adductors of slightly unequal size, with the posterior ones

somewhat smaller; median ridge short but broad and low, extending anteriorly from about a half the muscle field length; brachiophores thick, the plates bounding the muscles quite distinct.
Remarks: The specimens are comparable with *I. canaliculata* from the Ludlow of Gotland (Walmsley and Boucot 1975, pl. 10, fig. 12, 14b, 17) in the general shell outline and internal details.
Occurrence: Upper Silurian (Ludlow): Hemse marls to Sundre beds of Gotland; Estonia; Holy Cross Mts (Łężyce-Bełcz), Poland.

Isorthis clivosa Walmsley, 1965

(Pl. I, fig. 1—3)

1965 *Isorthis clivosa* Walmsley; Walmsley, pl. 62, fig. 19—20.
1972 *Isorthis clivosa* Walmsley; Bassett, pl. 8, fig. 11.
1978 *Isorthis clivosa* Walmsley; Hurst and Watkins, p. 93, pl. 1, fig. 1—9.

Material: Two pedicle valves, one with muscle scars, and two brachial valves.
Remarks: The specimens correspond to *I. clivosa* from the Upper Leintwardinian Beds, coquinoid siltstone facies (Shaleria ornatella Association) as defined by Hurst and Watkins (1978, p. 93, pl. 1, fig. 9), Ludlow area, Welsh Borderland.
Occurrence: Upper Silurian: Welsh Borderland, England (Leintwardinian Beds); Holy Cross Mts (Łężyce-Bełcz), Poland.

Genus Resserella Bancroft, 1928

Resserella canalis (J. de C. Sowerby, 1839)

(Pl. I, fig. 7)

1971 *Resserella canalis* (J. de C. Sowerby); Walmsley and Boucot, p. 497, pl. 97, fig. 4—7.
1977 *Resserella canalis* (Sowerby, 1839); Havlíček, p. 163, pl. 35, fig. 19, 20; pl. 36, fig. 20—25.

Material: One internal mould of the brachial valve, well preserved, a few small fragments of pedicle valve.
Remarks: The specimen is small, plane with divergent anteriorly brachiophores and median ridge narrow and long. Although the material is extremely poor, it agrees in its general appearance with specimens of this species figured by Walmsley and Boucot (1971, pl. 97, fig. 4—7) from the Welsh Borderland.

Occurrence: Upper Silurian: Wenlock and Ludlow of the Welsh Borderland and Gotland; Wenlock (Motal Formation) of Czechoslovakia; Holy Cross Mts (Łężyce-Bełcz), Poland.

Family Schizophoriidae Schuchert and LeVene, 1929
Genus *Salopina* Boucot, 1960

Salopina cf. *lunata* (J. de C. Sowerby, 1839)

(Pl. II, fig. 12, 13)

Material: Six badly preserved moulds of the pedicle valve, many small fragments of moulds.
Remarks: From the outline of the shell, the multicostellae, and probably the short dental lamellae, the specimens largely agree with those from the Late Whitcliffian siltstone, Ludlow area (Walmsley, 1965, pl. 65, fig. 1—12).
Occurrence: Upper Silurian: Great Britain — Lower Leintwardinian to the highest Whitcliffian; Gotland — Hemse group (Early Ludlowian, probably mid Eltonian; Holy Cross Mts (Łężyce-Bełcz), Poland.

Family Chlidiopsidae Boucot, 1959
Genus *Iridistrophia* Havlíček, 1965

Iridistrophia praeumbracula (Kozłowski, 1929)

(Pl. II, fig. 1—6)

1929 Schellvienella praeumbracula sp. n.; Kozłowski, p. 105, pl. 5, fig. 3—6.

Material: Twelve pedicle and brachial valves preserving shell ornamentation and some details of the hinge region.
Remarks: This form resembles those included by Havlíček in his genus *Iridistrophia*, and is close to *I. iris* (Barrande, 1879) from the Lochkov limestone of Lochkov-Bohemia (Havlíček, 1965, pl. 45, fig. 5—8, 13), differing a little in being less transverse and in having the radial costellae slightly thinner. *I. eodevonica* from the Pragian of Bohemia is larger and the radial costellae are thinner (Havlíček 1961, pl. 45, fig. 9—12, 16). The specimens appear the closest to the Podolian *I. praeumbracula (Kozłowski* 1929, p. 105, pl. 5, fig. 3—6).
Occurrence: Upper Silurian-Lower Devonian. Widespread.

Family Stropheodontidae Caster, 1939
Genus *Stropheodonta* Hall, 1850

Stropheodonta sp.

(Pl. II, fig. 7)

Material: The exterior of one pedicle valve, few small fragments.
Remarks: The surface ornamentation, which is characteristic of the genus, of radial parvicostellae is supplemented by secondary plications and concentric rugae on the posterior third of the shell. *Eostropheodonta siluriana* (Davidson) has a similar surface ornamentation (Williams 1953, pl. 7, fig. 3), however, the material at hand is too poor for more detailed comparison.

Genus *Amphistrophia* Hall and Clarke, 1892

Amphistrophia sp.

(Pl. II, fig. 8—9)

Material: Two incomplete pedicle valve interiors.
Remarks: Only a few features are preserved, but they appear to be characteristic of the genus *Amphistrophia*. The shell is resupinate, with subequally parvicostellate surface ornament. The delthyrium has a small pseudodeltidium, the muscle field, which is bordered by faint ridges, is bisected by a thin myophragm; the median third of the hinge is denticulated.

Our specimen is like *A. funiculata* (McCoy) from the Wenlock Limestone, old quarry at Cwm (Bassett 1971, pl. 58, fig. 14). This great similarity is partly due to the much the same preservation of the Polish and English specimens (Pl. II, fig. 8—9). The lectotype of *A. funiculata* comes from the late Wenlock or early Ludlow, Doonquin Dingle (Cocks 1978, p. 124). The surface ornament of our shell is like that of *A. whittardi* Cocks from the Upper Llandovery (Telychian C_6), Carmarthenshire (Bassett 1977, pl. 41, fig. 13). There is also an external similarity to *A. podolica* (Siemiradzki) from the Borszczów horizon of Podolia (Kozłowski 1929, pl. 5, fig. 1, 2), and the difference is the smaller dimensions of the Łężyce-Bełcz specimens.

Family Douvillinidae Caster, 1939
Genus *Mesodouvillina* Williams, 1950

Mesodouvillina seretensis (Kozłowski, 1929)

(Pl. II, fig. 10, 11; Pl. III, fig. 3—10)

1929 *Stropheodonta* (*Brachyprion*) *subinterstrialis* var. *seretensis*, var. n.; Kozłowski, p. 98, pl. 4, fig. 7.

Material: Thirteen brachial and pedicle valves of slightly different individual age, all preserving surface ornamentation; internal structure not preserved.
Remarks: The specimens show a wide range of variability in the shell outline and surface ornament. All show a tendency to be auriculate and subtransverse in outline like specimens from Podolia (Kozłowski 1929, pl. 3, fig. 9, 10). The surface ornament is subequally parvicostellate; primary and partly secondary parvicostellae two to three times thicker than the remaining thinner ones lead to slight folds in the anterolateral third of the adult shell (pl. 2, fig. 10; pl. 3, fig. 7). The number of thin parvicostellae varies even in the same specimen (pl. 3, fig. 9) independently of the individual age. In some specimens there are distinctive small corrugations (pl. 3, fig. 8). No interior is preserved. One specimen, included here in the species, preserves hinge denticulation over its median third and the deltidium (pl. 2, fig. 11).
Occurrence: Upper Silurian-Lower Devonian; the species is known from Czortków, Sosołówka of Podolia, common in the Łężyce-Bełcz, Holy Cross Mts, Poland.

Family Shaleriidae Williams, 1965
Genus *Shaleria* Caster, 1939

Shaleria ornatella (Davidson, 1871)

(Pl. III, fig. 1, 2; Pl. IV, fig. 10; Pl. VIII, fig. 6)

1963 *Shaleria ornatella* (Davidson); Holland and al., pl. 3, fig. 1.
1967 *Shaleria ornatella* (Davidson); Havlíček, pl. 32, fig. 1.
1978 *Shaleria ornatella* (Davidson, 1871); Cocks, p. 129.

Material: One ventral interior and three exteriors of both valves.
Description: Shell subquadrate with fairly acute hinge extremities, ornamented by numerous corrugations (pl. 3, fig. 2), and subequal parvicostellae, with 3—6 thinner ones between the thicker parvicostellae. There is also tendency for the shell to be plicate anteriorly. The ventral

interior shows the muscle area characteristic of the genus, which is narrowly elongate, bounded laterally by ridges, with a median dividing ridge which tends to bifurcate anteriorly (pl. 4, fig. 10).
Remarks: These specimens are like *Sh. ornatella* from the Ludlow of Great Britain in the ornament and development of the ventral muscle area (Holland and al., 1963, pl. 3, fig. 1; Havlíček, 1967, pl. 36, fig. 1—2).
Occurrence: Upper Silurian (Ludlow): England, Upper Ludlow Beds (probably Leintwardinian), Whitcliff, Ludlow, Salop; Holy Cross Mts (Łężyce-Bełcz), Poland, rare.

Family Leptaenidae Hall and Clarke, 1892
Genus *Laptaena* Dalman, 1828

Leptaena amelia (Havlíček, 1967)

(Pl. IV, fig. 1—9)

1967 Laptagonia amelia; Havlíček, p. 99, pl. 15, fig. 3, 6, 7; pl. 19, fig. 1—6, 10—11; **text-fig. 41E, 42, 42G.**

Material: More than 40 moulds of pedicle valves with some features of internal structure; a few small fragments of brachial valves. All specimens incomplete.
Remarks: The specimens show some variability in the muscle area outline and size (pl. 4, fig. 1—9) and also in the appearance of the myophragm which is variably impressed. The concentric corrugations, usually 3—5 in number, can be discontinuous and irregular. In some moulds a small collar pedicle "tube" is preserved (pl. 4, fig. 4) with the supraapical foramen round to slightly transverse in outline and the encircling rim well developed and thickened (pl. 4, fig. 2, 5—6). The shell is usually small with a visceral part approximately 8.5 mm long and 14.6 mm wide at the hinge line and a geniculated part up to about 5.9 mm — 9.8 mm long. The visceral part is usually the same size and the geniculated part varies somewhat in length. Lateral parts usually flaring, especially in specimens with a slightly shorter geniculated part, like *Leptaena lepidula* (Barrande) in Havlíček (1967, text-fig. 45).

The form is close to *Leptaena, Leptagonia* or *Leptaenopyxis* (Havlíček 1967, p. 90). It appears to be closest to *L. amelia,* differing only in being somewhat smaller, in having thinner radial striae, and in the ventral muscle area being more variable in outline (Havlíček 1967, pl. 15, fig. 3, 6—7). It is also similar to *Leptaenopyxis bouei* (Barrande) in general shell shape and outline as also the ventral muscle area (Havlíček 1967, pl. 13) and to *Laptaena goldfussiana* Barrande from the Pragian in having a similar pedicle foramen and pedicle collar,

a distinctly geniculated shell and often in having widely flaring posterolateral parts of the geniculation (Havlíček 1967, p. 103, pl. 4, fig. 19—18). The same features characterize the Australian members of this species from the Mandagary Park Formation of New South Wales (Savage 1973, pl. 74, fig. 1—3). The ventral muscles are like those of *Leptaena rhomboidalis* (Wilckens) figured by Holland from the Lower Leintwardine Beds of the Ludlow District, England (Holland and al. 1963, pl. 4, fig. 9).

Occurrence: Wenlock-Ludlow: Bohemia-Lítěn formation; Sedlec together with Cyrtia petasus; the Carnidla Hill near Lodenice together with abundant *Ischadites koenigi*; Tachlovice, "Kozle" near Kostin; Lodenice with abundant *Aulacopleura konincki*; Holy Cross Mts (Łężyce-Bełcz), Poland.

Family Chonetidae Bronn, 1862
Genus *Protochonetes* Muir-Wood, 1962

Remarks: This genus has been mostly discussed in connection with its systematic position and subfamilial rank, and its relation with the genus *Strophochonetes* Muir-Wood (1962), e.g. Boucot and Harper (1968), Brunton (1972), Harper (1973), Bassett and Cocks (1974), Racheboeuf (1976). Muir-Wood assigned these genera to two different subfamilies: Strophochonetinae Muir-Wood and Devonochonetinae Muir-Wood (Muir-Wood 1962, p. 40, 43) but they are very close to each other: the differences being in the orientation of the hinge spines-straight in *Strophochonetes* and inclined in *Protochonetes* as stated by Harper (1973). The author agrees with the opinion of Racheboeuf, that the genera are closely related and can not be included in two different subfamilies.

Protochonetes ludloviensis Muir-Wood, 1962

(Pl. V, fig. 1—14)

1962 *Protochonetes ludloviensis* Muir-Wood, p. 51, pl. 3, fig. 1—5.
1978 *Protochonetes missendenensis ludloviensis* Muir-Wood, 1962; Cocks, p. 135.

Material: Forty incomplete and disarticulated specimens preserved as moulds of the pedicle (the majority) and dorsal valves and many small fragments.

Description: Shell of varying outline, cardinal extremities obtuse, both interareas apsacline and the dorsal one planar. Surface capillae inserted and/or bifurcated, 3—5 in number per 1 mm medially at the anterior margin. Cardinal spines directed posterolaterally, the angles

of their emergence somewhat variable but still acute. The spines are fragmentarily preserved, the longest up to 1 mm in length. Teeth small, a median ridge extends for about the posterior third of the valve length and is divided posteriorly at about one mm. Cardinal process bilobed, chilidial plates short, socket ridges straight to somewhat curved, median septum extending anteriorly one third or slightly more of the valve length, anderidia divergent and short.

Remarks: This form is like both *Protochonetes ludloviensis*, the Ludlow species from Shropshire (Muir-Wood 1962, pl. 3, fig. 1—5) and *P. striatellus* Dalman (the Upper Silurian species of Gotland) Muir-Wood 1962, pl. 3, fig. 6—7; Böger 1968, text-fig. 1, 2); it is more similar to *P. ludloviensis* in its less acutely directed hinge spines and similar thickness of capillae. *P. ludloviensis* is judged by Cocks (1978) to be a subspecies of *P. missendenesis*, the Pridoli species from Buckinghamshire (Straw 1933). However, *P. missendenensis* is poorly known, being found from the Little Missenden Borehole, England (Cocks 1978, p. 135). More material is needed to justify this close relationship and so the specific name *P. ludloviensis* is here retained.

Occurrence: Upper Silurian (Ludlow): England—Shropshire; Holy Cross Mountains (Łężyce-Bełcz), Poland.

Family Atrypidae Gill, 1871
Genus *Atrypa* Dalman, 1828

Atrypa nieczlaviensis Kozłowski, 1929

(Pl. VI, fig. 1—6)

1929 *Atrypa nieczlaviensis* (Linnaeus) var. *nieczlaviensis* var. n.; Kozłowski, pl. 8, fig. 14—17; pl. 9, fig. 2—4.
1978 *Atrypa nieczlaviensis* Kozłowski; Rubel and Teller, pl. 3, fig. 10—18.

Material: Forty incomplete and deformed moulds of pedicle valves and a few incomplete fragments.

Description: Shell small to about 16 mm long, biconvex, subelliptical to subcircular in outline, about as long as wide, anterior commissure somewhat sulcate (pl. 6, fig. 1—2). Ornament of costae bifurcating and inserting, concentric lamellae present but often indistinct. Interior badly preserved; teeth well developed, rounded muscle field, dorsal myophragm low.

Remarks: This form is close to *Atrypa nieczlaviensis* described by Kozłowski from the Borszczów Horizon (Kozłowski 1929), but our specimens are smaller. The same difference is observed in *A. nieczlaviensis* figured by Nikiforova from the Malinovets Horizon (Nikiforova

1954, p. 118, pl. 12, fig. 6) and from the Gedinnian strata in eastern Poland, borehole Bachus 1 (Rubel and Teller 1978, pl. 3, fig. 10—18). They are also very similar to specimens from Nevada attributed to *A. nieczlaviensis* by Johnson and al., (1973, p. 47, pl. 24, fig. 14—27). Our form is also like *A. hedei* from marls at Visby, Gotland (Struve 1966, pl. 15, fig. 3—6) and from Estonia (Adavierskij and Rajkiulaskij Horizons; Rubel 1970, p. 36, pl. 18) differing mostly in the thinner radial ornamentation and the weaker sulcation at the anterior margin.
Occurrence: The species has previously been recorded from Lower Gedinnian strata in Podolia and Nevada; eastern Poland and from the Upper Silurian of the Holy Cross Mts (Łężyce-Bełcz), Poland.

Family Trigonirhynchiidae McLaren, 1965
Genus *Ancillotoechia* Havlíček, 1959

Ancillotoechia ancillans (Barrande, 1879)

(Pl. VII, fig. 2—4; Pl. VIII, fig. 4)

? 1929 *Camarotoechia nucula* (Sowerby); Kozłowski, p. 150, pl. 6, fig. 17—32, text-fig. 42A, 43—47.
1961 *Ancillotoechia ancillans* (Barrande, 1879); Havlíček, p. 59, pl. 6, fig. 8—11, text-fig. 15.

Material: Thirty well preserved shells, all completely or partly exfoliated, all about the same size; separate valves rare and fragmentary.
Description: Subtriangular to triangular in outline, about 10 mm long and 12 mm wide; tongue-like extension moderate, delthyrium open. Ornament of subangular costae, 1—3 in ventral sulcus, 3—4 on dorsal fold and 4—5 on lateral flanks of both valves. The interior shows small teeth with dental plates thin, subparallel to slightly divergent; dorsal septalium small, wide, covered; distinct septum extending to a half of the valve length or slightly more (pl. 8, fig. 4).
Remarks: The known species of the genus are few and all display much the same morphology. External differences are small and chiefly consist of shell size and outline, number of costae and the degree of anterior sulcation. The number of costae in the sulcus — fold, and on the lateral flanks, together with some changes in the shell outline, shape and size are used as specific criteria. Of the internal features only the appearance of dental plates and of the plate covering the septalium (flat, almost flat to evenly arched) and the stoutness of the dorsal septum are important in specific identification.

Our specimens correspond very well with *A. ancillans*, the Ludlowian species from Bohemia (Havlíček 1961, pl. 6, fig. 8—11) but are slightly wider. They are also close to the Podolian "*Camarotoechia nucula*", especially to some specimens figured by Kozłowski (Kozłowski 1929, pl. 6, fig. 27—29). The Podolian species shows a much wider range of individual variability than our form, and has more costae on the lateral flanks. *A. gutta*, the Lower Gedinnian species from Roberts Mountains-Nevada (Johnson and al. 1973, pl. 1, fig. 1—14) differs from our form in being slightly larger and narrower. *A.? ancillans* figured by Kulkov (1963, pl. 3, fig. 14) from the Lowermost Devonian of Gornyj Ałtai is more subtriangular in outline and the surface costae are finer. The same features occur in *A. cooperensis*, a species from the Zappla Formation (? Wenlockian) of Northern Argentina (Amos and al. 1971, pl. 1, fig. 1—14).

Occurrence: Upper Silurian-Ludlow: Bohemia, Base of Kopanina Limestone; ? Silurian of Harz; Holy Cross Mts (Łężyce-Bełcz), Poland.

Genus *Hemitoechia* Nikiforova, 1970

Hemitoechia cf. *undvaensis* Rubel and Rozman, 1977

(Pl. VIII, fig. 1, 2)

Material: One complete articulated specimen.

Remarks: The specimen is similar to a Wenclock (J_1) species from Estonia figured by Rubel in its bioconvexity, and in having its subdued radial costae which become stronger anterioly, costae 10—12 in number, anterior commissure moderately sulcate (Rubel and al. 1977, pl. 10, fig. 8; pl. 11, fig. 1—2). Our specimen is slightly wider.

Family Uncinulidae Rzhonsnitzkaya, 1956

Genus *Sphaerirhynchia* Cooper and Muir-Wood, 1951

Sphaerirhynchia cf. *wilsoni* (J. de C. Sowerby, 1816)

(Pl. VIII, fig. 3)

Material: One complete, articulated specimen, 1 fragment.

Remarks: This specimen is smaller in comparison with e.g. those from Podolia (Kozłowski 1929, pl. 7, fig. 27—34). The elongate shell, marked biconvexity, appearance and number of radial costae and anterior commissure are like those from Podolia.

Family Rhynchotrematidae Schuchert, 1913
Genus *Stegerhynchus* Foerste, 1909

Stegerhynchus cf. *borealis* (L. v. Buch, 1834)

(Pl. VII, fig. 1; Pl. VIII, fig. 5)

Material: One complete specimen and one imprint of an incomplete shell.
Remarks: The specimens are like the Wenlock species of *S. borealis* figured from Estonia (Rubel and al., 1977, pl. 6, fig. 4—5) differing in being slightly narrower. They are also similar to *Stegerhynchus* sp. from the Ludlow of Northern Yukon Territory and Cornwallis Island (Jackson and al., 1978, pl. 3, fig. 27—29).

Family Rhynchospirinidae Schuchert, 1894
Genus *Homoeospira* Hall and Clarke, 1893

Homoeospira baylei (Davidson, 1848)

(Pl. IX, fig. 1—8)

1970 *Homoeospira baylei* (Davidson, 1848); Rubel, p. 43, pl. 24, fig. 12, 14; pl. 34, fig. 1—20.
1978 *Homoeospira baylei* (Davidson, 1848); Cocks, p. 161.

Material: More than 100 articulated shells, all exfoliated to a different degree, but preserving the external morphology and some internal details, and also many shell fragments.
Description: Shell small, moderately biconvex, pentagonal in outline with pointed ventral beak, round pedicle foramen and uniplicate anterior commissure. Ornament of strong radial costae rarely bifurcating on the lateral flanks, the median ones of which there are 1—3 in number, being weaker. Internally, teeth small, no dental plates, dorsal median septum short, extending to about a half the valve length, cardinal plates almost quadrate in outline, dental sockets relatively deep, adductors scarce, weakly expressed.
Remarks: The specimens in question show the features of *Homoeospira baylei* figured by Davidson (1848, pl. 12, fig. 29). The number of radial costae lies between 11—15, sometimes reaching 17 in adults. They are also similar to specimens from Podolia (Kozłowski 1929, pl. 5, fig. 25—26) and Estonia (Rubel 1970, pl. 14, fig. 1—20) except that the latter ones are about twice as long. The shell outline is variable, widely pentagonal to narrowly pentagonal.

Occurrence: The species is characteristic of the Upper Silurian (Wenlock- Ludlow) and is widely distributed. It is known from the Wenlock of England (Upper Wenlock Shale and Wenlock Limestones); The Ludlow of Gotland (Eke Beds, Halla and Hamra Beds); Podolia-Skalski Horizon (Kozłowski 1929; Nikiforova 1954); Estonia-Kuressareskij, Kałgatumskij and Ohesareskij Horizons; Holy Cross Mts (Łężyce-Bełcz), Poland.

Family Delthyrididae Waagen, 1883
Genus *Delthyris* Dalman, 1828

Remarks: *Delthyris* is relatively common and shows some variability in external features. Two groups are recognizable on the basis of the shell size, outline, the appearance of ventral area, and somewhat in the radial plications and the distinctness of concentric lamellae. The plicae are more acutely developed or rounded, the dorsal median fold slightly varies from uniformly arched to distinctly flattened and furrowed anteriorly. This furrow appears late in ontogeny, at about 5 mm in length with a corresponding ventral ridge which is weak. There are one to three plicae.

One group of specimens appears to be similar to *Delthyris elevata* Dalman and is considered here as conspecific with it. The second group is close to *Delthyris magna* (Kozłowski 1929), but shows a tendency for the dorsal fold to become medially furrowed.

Delthyris elevata Dalman, 1828

(Pl. X, fig. 1—3, 5—6, 9—12; Pl. XI, fig. 7)

1970 *Delthyris elevata* Dalman, 1828; Rubel, p. 62, pl. 38, figs. 6—11.

Material: Forty five disarticulated specimens, the majority are damaged and somewhat deformed; complete shells with both valves closed are rare.

Description: Shell medium size, moderately biconvex, delthyrium open, deltidial edges bordered by narrow thickenings; ventral area occupying about one-third of the valves length, sulcus quite deep. Ornament of 4—5 folds on each lateral slope of valve with rounded backs; concentric lamellae distinct with well marked edges bearing slight traces suggestive of the surface spinule bases. Internally, ventral median septum thick, almost as long as the dental plates; plates slightly divergent; dental plates and septum more than one-third valve length. Dorsal dental sockets slit-like, cardinal process low, massive, median septal ridge weak and short.

Remarks: The species is represented mostly by separate brachial valves, often fragmentary, ranging in size from 6 mm — 14 mm in length. There is variation in length/width ratio from about one-third to about a half. The cardinal extremities in the smallest specimens are usually well rounded in contrast to the adults where they are slightly more acute. The number of radial plicae does not increase much with shell growth, remaining limited.
Occurrence: Upper Silurian: Estonia, Kuressareskij, Kałgatumskij and Ohesareskij Horizons; Latvia-Zalegiajskij, Minijajskij Horizons; Podolia, from Kitaigorod up to Skala Horizons; Gotland, Hemse, Eke and Hamra Beds, Mulde Beds (Djupvik; Holy Cross Mts (Łężyce-Bełcz), Poland.

Delthyris cf. *magna* Kozłowski, 1929

(Pl. XI, fig. 1—6)

Material: Incomplete 22 disarticulated specimens, the majority damaged and compressed.
Description: Shell of medium size, about twice as wide as long, cardinal extremities angular, ventral valve somewhat concave for about one-fourth of the whole shell length. Ornament of radial plicae, 10—12 on each valve with angular to rounded crests, median furrow variably present, the corresponding median sulcal ridge indistinct. Concentric lamellae with rather thickened edges, usually 3 per 1 mm. Internally, dental plates and median septum varying from long to about one-third of the whole valve length; dental cavities narrow and deep.
Remarks: The specimens show most of the features characteristic of *Delthyris magna* Kozłowski from the Skala Limestone and marls of Dźwinogród, Podolia (Kozłowski 1929, pl. 10, fig. 4—9), but they differ in being of smaller size and in the furrowing of the dorsal fold being more weakly developed.
Occurrence: Upper Silurian, Holy Cross Mts (Łężyce-Bełcz), Poland.

Genus *Howelella* Kozłowski, 1946

Howelella cf. *angustiplicata* (Kozłowski, 1929)

(Pl. X, fig. 4, 7; Pl. XI, fig. 13, 14)

Material: Fifteen specimens in different state of preservation, mostly disarticulated, deformed and damaged.
Remarks: The specimens are close to *H. angustiplicata* from the Borszczów Horizon of Podolia (Kozłowski 1929, pl. 10, fig. 10—19), but

the main differences lie in the more roundly outlined and fewer crests of radial plications and in the smaller shell size.
Occurrence: Upper Silurian: Holy Cross Mts (Łężyce-Bełcz), Poland.

Family Nucleospiridae Davidson, 1881
Genus *Nucleospira* Hall, 1859

Nucleospira inelegans (Barrande, 1879)

(Pl. XII, fig. 1—5)

1879 *Atrypa inelegans*; Barrande, pl. 83, fig. 1; pl. 84, fig. 4.
1963 *Nucleospira inelegans* (Barrande); Kulkov, pl. 10, fig. 1.

Material: Thirty specimens, all partly exfoliated and a few fragments.
Description: Shell small, about 10 mm in length, moderately biconvex, of rounded outline; hinge margin straight, short, about one-third of the greatest shell width; sinuses on both valves very narrow and delicate. Internally teeth are well developed, the median septal ridge is long, extending to about a half of the valve length; cardinal plates distinct, thick; crura small and straight; brachidium only partly preserved due to strong recrystallization.
Remarks: These specimens are like those of *N. inelegans* from the Upper Silurian (Kopanina Horizon) of the Middle part of Bohemia, but they differ in being more equally biconvex like specimens figured by Kulkov (1963) from the Soloviksinskij layer of the Upper Altai. The specimens of *N. robusta* described by Kozłowski from Podolia, Borszczów Stage, are much larger and more biconvex (Kozłowski, 1929, pl. 11, fig. 24—35).
Occurrence: Upper Silurian: Bohemia-Kopanina Limestone; Gornyj Altai-Soloviksinskij Horizon, near locality of Soloviksi; Holy Cross Mts (Łężyce-Bełcz), Poland.

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EXPLANATION OF PLATES — OBJAŚNIENIA PLANSZ

Plate I — Plansza I

Fig. 1, 2. *Isorthis clivosa* Walmsley: Two dorsal interiors preserved as moulds with traces of muscle area, brachiophores and cardinal process (Dwa wewnętrzne odlewy skorupek ramieniowych ze śladami pola mięśniowego, brachioforów oraz wyrostka zawiasowego). Fig. 1: IG.1369.II—205; Fig. 2: IG.1369.II—206; × approx. 4.

Fig. 3. *Isorthis clivosa* Walmsley: Ventral interior (mould) with traces of radial ornamentation (Odlew skorupki nóżkowej z śladami ornamentacji powierzchni muszli). IG.1369.II—207; × approx. 5

Fig. 4. *Orbiculoidea* cf. *rugata* (J. de C. Sowerby): Internal cast of the brachial valve (Wewnętrzny odcisk skorupki ramieniowej). IG.1369.II—46; × approx. 4.

Fig. 5. Fragment of "lumachelle" (Fragment zlepu muszlowego). IG.1369.II—54; × approx. 3.

Fig. 6. *Lingula* cf. *rugosa* Kozłowski: External view of? brachial valve (Skorupka ? ramieniowa od zewnątrz). IG.1369.II—220; nat. size.

Fig. 7. *Resserella canalis* (J. de S. Sowerby): Pedicle valve interior preserved as mould (Odlew wewnętrzny skorupki nóżkowej). IG.1369.II—51; × 3.

Fig. 8. *Isorthis fornicatimcurvata* (Fuchs): Ventral interior with traces of muscle area and pallial sinuses (Wnętrze skorupki nóżkowej z śladami pola mięśniowego oraz kanałów płaszczowych). IG.1369.II—25; × approx. 4.

Fig. 9. *Isorthis fornicatimcurvata* (Fuchs): Dorsal interior with scarcely preserved

muscle area (Skorupka ramieniowa ze śladami pola mięśniowego). IG. 1369.II—27; × approx. 5.

Fig. 10, 11. *Isorthis fornicatimcurvata* (Fuchs): Two dorsal interiors with partly preserved quadripartite muscle area, traces of brachiophores and cardinal process (Dwie skorupki ramieniowe od wewnątrz z częściowo zachowanym polem mięśniowym, brachioforami i wyrostkiem zawiasowym). Fig. 10: IG.1369.II—216; Fig. 11: IG.1369.II—217; × approx. 5.

Fig. 12, 13. *Isorthis canaliculata* (Lindström): Two dorsal interiors of different specimens (Dwa wnętrza skorupki ramieniowej). Fig. 12: IG.1369.II—41; Fig. 13: IG.1369.II—42; × 4.

Plate II — Plansza II

Fig. 1—4. ***Iridistrophia praeumbracula* (Kozłowski): Ventral valve view of four** specimens (Cztery skorupki nóżkowe). Fig. 1: IG.1369.II—54a; Fig. 2: IG.1369.II—55; Fig. 3: IG.1369.II—56; Fig. 4: IG.1369.II—57; × 3.

Fig. 5, 6. *Iridistrophia praeumbracula* (Kozłowski): Dorsal valve view of two different specimens (Dwie różne skorupki ramieniowe od zewnątrz). Fig. 5: IG.1369.II—210; Fig. 6: Ig.1369.II—211; Fig. 5 × 3; Fig. 6 × 6.

Fig. 7. *Strophodonta* sp.: Pedicle valve with ornamentation of parvicostellae and plicae (Skorupka nóżkowa z ornamentacją drobnych żeberek oraz fałdek). IG.1369.II—53; × 3.

Fig. 8, 9. *Amphistrophia* sp.: Two ventral interiors with partly preserved muscle area (Dwie skorupki nóżkowe z częściowo zachowanym polem mięśniowym). Fig. 8: IG.1369—39; Fig. 9: IG.1369.II—5; × 3.5.

Fig. 10. *Mesodouvillina seretensis* (Kozłowski): Exterior of the pedicle valve (Skorupka nóżkowa od zewnątrz). IG.1369.II—2; × 3.5.

Fig. 11. *Mesodouvillina seretensis* (Kozłowski): Cast of the pedicle valve interior with ventral interarea and hinge denticulation (Odcisk skorupki nóżkowej, widoczna interarea oraz ząbkowany brzeg zawiasowy). IG.1369. II—56; × 3.

Fig. 12, 13. *Salopina* cf *lunata* (J. de C. Sowerby): Two ventral moulds with traces of ornamentation (Dwa odlewy skorupki nóżkowej z śladami ornamentacji). Fig. 12: IG.1369.II—49; Fig. 13: IG.1369.II—66; × 3.

Plate III — Plansza III

Fig. 1. *Shaleria ornatella* (Davidson): Interior of the pedicle valve (Skorupka nóżkowa od wewnątrz). IG.1369.II—11; × 3.

Fig. 2. *Shaleria ornatella* (Davidson): Surface ornamentation of the branchial valve (Ornamentacja skorupki ramieniowej). IG.1369.II—60; × 3.

Fig. 3, 4, 6, 8. *Mesodouvillina seretensis* (Kozłowski): Exterior of four different brachial valves (Cztery różne skorupki ramieniowe od zewnątrz). Fig. 3: IG.1369.II—58; Fig. 4: IG.1369.II—57 f; Fig. 6: IG.1369.II—57 c; Fig. 8: IG.1369.II—57 d; × approx. 3.

Fig. 5, 10. *Mesodouvillina seretensis* (Kozłowski): Casts of two different brachial valves (Odlewy wewnętrzne 2-ch różnych skorupek ramieniowych) Fig. 5: IG.1369.II—57 c; Fig. 10: IG.1369.II—57 b; × approx. 3.

Fig. 7, 9. *Mesodouvillina seretensis* (Kozłowski): External view of two pedicle valves of different size (Dwie różne skorupki nóżkowe od zewnątrz). Fig. 7: IG.1369.II—57 a; × 3; Fig. 9: IG.1369.II—58 b; × 4.

Plate IV — Plansza IV

Fig. 1—6. *Leptaena amelia* Havlíček: Six moulds of the dorsal interior showing some variability of the muscle area (Sześć różnych skorupek nóżkowych — widoczna pewna zmienność pola mięśniowego). Fig. 1: IG.1369.II—28; Fig. 2: IG.1369.II—86; Fig. 3: IG.1369.II—84; Fig. 4. IG.1369.II—4; Fig. 5: IG. 1369.II—89; Fig. 6: IG.1369.II—80; × 4.

Fig. 7. *Leptaena amelia* Havlíček: Side view of adult specimen (Okaz dorosły widziany z boku). IG.1369.II—90; × 4.

Fig. 8a, b. *Leptaena amelia* Havlíček: a — Anterior (geniculated part) view of adult specimen; b — pedicle valve view of the same specimen (Okaz dorosły widziany od a — strony brzegu przedniego, b — skorupki nóżkowej). IG.1369.II—5; × 4.

Fig. 9. *Leptaena amelia* Havlíček: Pedicle valve view of adult specimen (Okaz dorosły widziany od strony skorupki nóżkowej). IG.1369.II—92; × 4.

Fig. 10. *Shaleria ornatella* (Davidson): Ventral interior with preserved muscle area (Wnętrze skorupki nóżkowej z widoczną areą mięśniową). IG.1369. II—23; × 2.

Plate V — Plansza V

Fig. 1. *Protochonetes ludloviensis* Muir-Wood: Internal cast of pedicle valve (Odcisk wewnętrzny skorupki nóżkowej). IG.1369.II—178; × 3.

Fig. 2, 3, 7, 9. *Protochonetes ludloviensis* Muir-Wood: Four adult pedicle valves in different state of preservation (Cztery dorosłe skorupki nóżkowe w różnym stanie zachowania). Fig. 2: IG.1369.II—170; Fig. 3: IG.1369. II—180; Fig. 7: IG.1369.II—173; Fig. 9: IG.1369.II—185; × 3.7.

Fig. 4, 5, 8. *Protochonetes ludloviensis* Muir-Wood: Three different pedicle valves with fragments of marginal spines (Trzy skorupki nóżkowe z fragmentami zawiasowych kolców). Fig. 4: IG.1369.II—176; Fig. 5: IG.1369. II—169; Fig. 8: IG.1369.II—183; × 2.5.

Fig. 6, 10. *Protochonetes ludloviensis* Muir-Wood: Two ventral exteriors with fragments of hinge spines (Dwie skorupki nóżkowe z fragmentami kolców zawiasowych). Fig. 6: IG.1369.II—37; Fig. 10: IG.1369.II—59; × 4.

Fig. 11, 12, 14. *Protochonetes ludloviensis* Muir-Wood: Three adult pedicle valves slightly deformed (Trzy dorosłe skorupki nóżkowe nieco zdeformowane). Fig. 11: IG.1369.II—181; Fig. 12: IG.1369.II—184; Fig. 14: IG.1369.II—104; × 3.

Fig. 13. *Protochonetes ludloviensis* Muir-Wood: Two casts of ventral interior (Dwa odlewy wewnętrzne skorupki nóżkowej). IG.1369.II—179; × 3.

Plate VI — Plansza VI

Fig. 1a, b, c, d. *Atrypa nieczlaviensis* Kozłowski: Adult shell in a — brachial valve, b — side, c — pedicle valve, d — anterior views (Okaz dorosły od strony a — skorupki ramieniowej, b — z boku, c — skorupki nóżkowej, d — komisury przedniej). IG.1369.II—198; × 3.

Fig. 2a, b c. *Atrypa nieczlaviensis* Kozłowski: Adult shell in abrachial valve, b — side, c — anterior margin views (Okaz dorosły widziany: a — od strony skorupki ramieniowej, b — z boku, c — brzegu przedniego). IG.1369. II—197; × 3.

Fig. 3. *Atrypa nieczlaviensis* Kozłowski: Brachial valve view of slightly deformed specimen (Skorupka ramieniowa nieco zdeformowana). IG.1369. II—195; × 3.

Fig. 4, 5, 6. *Atrypa nieczlaviensis* Kozłowski: Three external casts of pedicle valves (Trzy zewnętrzne odlewy skorupek nóżkowych). Fig. 4: IG.1369.II—190; Fig. 5: IG.1369.II—28; Fig. 6: IG. 1369.II—192; × 4.

Plate VII — Plansza VII

Fig. 1a—d. *Stegerhynchus* cf. *borealis* (L. v. Buch): Complete adult shell in a — brachial valve, b — anterior margin, c — side, d — pedicle valve views (Dorosły okaz widziany od strony a — skorupki ramieniowej, b — brzegu przedniego, c — z boku, d — skorupki nóżkowej). IG.1369.II—203; × 3.

Fig. 2a—d. *Ancillotoechia ancillans* (Barrande): Adult shell in a — brachial valve, b — side, c — anterior margin, d — pedicle valve views (Okaz dorosły widziany od strony a — skorupki ramieniowej, b — z boku, c — brzegu przedniego, d — skorupki nóżkowej). IG.1369.II—201; × 3.

Fig. 3a—c. *Ancillotoechia ancillans* (Barrande): Adult shell in a — brachial valve, b — pedicle valve, c — anterior margin views (Okaz dorosły widziany a — od strony skorupki ramieniowej, b — nóżkowej, c — brzegu przedniego). IG. 1369. II-202; × 3.

Fig. 4a—c. *Ancillotoechia ancillans* (Barrande): Complete adult shell in a — brachial valve, b — pedicle valve, c — anterior commissure views (Okaz dorosły widziany od strony a — skorupki ramieniowej, b — nóżkowej, c — komisury przedniej). IG.1369.II—200; × 5.

Fig. 4a—c. *Ancillotoechia ancillans* (Barrande): Well preserved adult shell in a — brachial valve, b — pedicle valve, c — anterior commissure, d — side, e — umbonal part views (Dobrze zachowany okaz dorosły widziany od strony a — skorupki ramieniowej, b — nóżkowej, c — komisury przedniej, d — z boku, części tylnej muszli). IG.1369.II—210; × 5.

Plate VIII — Plansza VIII

Fig. 1a—b. *Hemitoechia* cf. *undvaensis* Rubel and Rozman: Adult specimen in a — brachial valve b — pedicle valve, views (Okaz dorosły widziany od strony a — skorupki ramieniowej, b — nóżkowej). IG.1369.II—231; × 2.

Fig. 2a—c. *Hemitoechia* cf. *undvaensis* Rubel and Rozman: Adult shell in a — brachial valve, b — pedicle valve, c — side, d — anterior commissure, e — umbonal part views (Okaz dorosły widziany a — od strony skorupki ramieniowej, b — nóżkowej, c — z boku, d — komisury przedniej, e — części umbonalnej). IG.1369.II—232; × 3.

Fig. 3a—d. *Sphaerirhynchia* cf. *wilsoni* (J. de C. Sowerby): Adult shell in a — brachial valve, b — pedicle, c — anterior commissure, d — side views) Okaz dorosły widziany od strony a — skorupki ramieniowej, b — nóżkowej, c — komisury przedniej, d — z boku). IG.1369.II—233; × 5.

Fig. 4. *Ancillotoechia ancillans* (Barrande): Cross section (peel) of adult shell showing dental plates and covered septalium (Przekrój poprzeczny dorosłego okazu, widoczne płytki zębowe oraz przykryte septalium). IG.1369.II—20; × 7.

Fig. 5. *Stegerhynchus* cf. *borealis* (L. v. Buch): Incomplete shell with preserved umbo (Niekompletna muszla z zachowanym dziobem wentralnym). IG.1369.II—234; × 5.

Fig. 6. *Shaleria ornatella* (Davidson): Fragment of dorsal interior showing muscle area (Fragment skorupki ramieniowej z polem mięśniowym). IG.1369.II—23; × 6.

Plate IX — Plansza IX

Fig. 1a—c. *Homeospira baylei* (Davidson): Adult shell in a — brachial valve, b — anterior commissure, c — umbonal views (Dorosła muszla widziana od strony skorupki a — ramieniowej, b — komisury przedniej, c — części umbonalnej). IG.1369.II—199; × 5.

Fig. 2a—c. *Homeospira baylei* (Davidson): Adult shell in a — brachial valve, b — pedicle valve, c — side views (Okaz dorosły widziany od strony a — skorupki ramieniowej, b — nóżkowej, c — z boku). IG.1369.II—109; × 5.

Fig. 3a—d. *Homeospira baylei* (Davidson): Adult shell in a — brachial valve, b — pedicle valve, c — side, d — anterior commissure views (Dorosły okaz widziany od strony a — skorupki ramieniowej, b — nóżkowej, c — z boku, d — komisury przedniej). IG.1369.II—111; × 5.

Fig. 4. *Homeospira baylei* (Davidson): Brachial valve view of adult shell (Skorupka ramieniowa dorosłego okazu). IG.1369.II—87; × 4.

Fig. 5. *Homeospira baylei* (Davidson): Brachial valve view of adult shell (Skorupka ramieniowa dorosłego okazu). IG.1369.II—2; slightly enlarged.

Fig. 6. *Homeospira baylei* (Davidson): Brachial valve view of adult shell (Dorosły okaz od strony skorupki ramieniowej). IG.1369.II—26; × 3.

Fig. 7. *Homeospira baylei* (Davidson): Enlarged fragment of shell with punctate surface (Powiększony fragment muszli z widoczną porowatością). IG. 1369.II—3k; × 20.

Fig. 8. *Homeospira baylei* (Davidson): Adult shell with exposed delthyrial part (Muszla dorosła z uwydatnioną częścią deltyrialną). IG.1369.II—110; × 8.

Plate X — Plansza X

Fig. 1a—c. *Delthyris elevata* Dalman: Adult shell in a — brachial valve, b — side, c — pedicle valve views (Okaz dorosły widziany od strony a — skorupki ramieniowej, b — z boku, c — skorupki nóżkowej). IG.1369.II—101; × 2.

Fig. 2, 3. *Delthyris elevata* Dalman: Anterior commissure view of two different adult shells (Dwie różne dorosłe muszle od strony komisury przedniej). Fig. 2: IG.1369.II—102; Fig. 3: IG.1369.II—103; × 2.

Fig. 4, 7. *Howelella* cf. *angustipliacata* (Kozłowski): Two dorsal exteriors (Dwie skorupki ramieniowe). Fig. 4: IG.1369.II—71; Fig. 7: IG.1369.II—72; × 2.

Fig. 5, 9, 10. *Delthyris elevata* Dalman: Three brachial valves from exterior (Trzy skorupki ramieniowe od zewnątrz). Fig. 5: IG.1369.II—73; Fig. 9: IG. 1369.II—160; Fig. 10: IG.1369.II—165; × 2.

Fig. 6. *Delthyris elevata* Dalman: Side view of adult shell (Muszla dorosła z boku). IG.1369.II—104; × 2.

Fig. 8. *Howelella* cf. *angustiplicata* (Kozłowski): Ventral exterior (Skorupka nóżkowa od zewnątrz). IG.1369.II—74; × 2.

Fig. 11a—b. *Delthyris elevata* Dalman: Adult specimen in a — ventral interarea view, b — pedicle valve view (Dorosły okaz widziany od strony a — wentralnej area, b — skorupki nóżkowej). IG.1369.II—74; × 5.

Fig. 12a—c. *Delthyris elevata* Dalman: Fig. 12a, b — two cross sections (peels) showing ventral septum and dental plates; Fig. 12c — the sectioned

shell from the anterior margin view (Fig. 12a, b — dwa przekroje poprzeczne, widoczne septum wentralne oraz płytki zębowe; Fig. 12c — szlifowany okaz widziany od strony brzegu przedniego). IG.1369.II—75; Fig. 12ab × 4.5; Fig. 12c × 2.

Plate XI — Plansza XI

Fig. 1a—c. *Delthyris* cf. *magna* Kozłowski: Slightly damaged adult shell in a — brachial valve, b — anterior commissure, c — pedicle valve views (Nieco uszkodzony okaz dorosły widziany od strony a — skorupki ramieniowej, b — komisury przedniej, c — skorupki nóżkowej). IG.1369.II—1; × 2.

Fig. 2—6. *Delthyris* cf. *magna* Kozłowski: Five dorsal exteriors in different state of preservation (Pięć różnie zachowanych skorupek ramieniowych). Fig. 2: IG.1369.II—76; Fig. 3: IG.1369.II—77; Fig. 4: IG.1369.II—91; Fig. 5: IG. 1369.II—99; Fig. 6: IG.1369.II—15; × 2.

Fig. 7. *Delthyris elevata* Dalman: Ventral exterior with some abnormality in the process of shell growth (Skorupka nóżkowa — widoczne pewne nieprawidłowości wzrostowe). IG.1369.II—230; × 2.

Fig. 8a—c. *Howelella* cf. *angustiplicata* (Kozłowski): Adult shell in a — dorsal, b — ventral, c — anterior commissure views (Dorosła muszla od strony a — dorsalnej, b — wentralnej, c — komisury przedniej). IG.1369.II—15; × 3.

Fig. 9, 10, 12. *Howelella* cf. *angustiplicata* (Kozłowski): Three brachial valves of different size (Trzy różnych rozmiarów skorupki ramieniowe). Fig. 9: IG.1369.II—231; Fig. 10: IG.1369.II—232; Fig. 12: IG.1369.II—233; approx. × 3.

Fig. 11. *Howelella* cf. *angustiplicata* (Kozłowski): Internal cast of brachial valve (Odlew wewnętrzny skorupki ramieniowej). IG.1369.II—231; × 3.

Fig. 13, 14. *Howelella* cf. *angustiplicata* (Kozłowski): Two pedicle valves (Dwie skorupki nóżkowe). Fig. 13: IG.1369.II—232; Fig. 14: IG.1369.II—233; approx. × 3.

Plate XII — Plansza XII

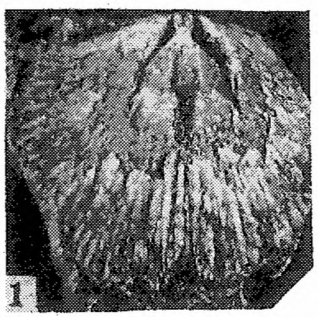
Fig. 1. *Nucleospira inelegans* (Barrande): Brachial valve view of adult shell, distinctly furrowed (Dorosła muszla od strony skorupki ramieniowej, z wyraźną bruzdą). IG.1369.II—234; × 3.

Fig. 2a—b. *Nucleospira inelegans* (Barrande): Adult shell in a — brachial valve, b — pedicle valve views (Dorosła muszla od strony a — skorupki ramieniowej, b — nóżkowej). IG.1369.II—235; × 5.

Fig. 3a—e. *Nucleospira inelegans* (Barrande): Adult shell in a — brachial valve, b — umbonal part, c — pedicle valve, d — anterior commissure, e — side views (Dorosły okaz od strony a — skorupki ramieniowej, b — dzioba wentralnego, c — skorupki nóżkowej, d — komisury przedniej, e — z boku). IG.1369.II—236; × 5.

Fig. 4a—b. *Nucleospira inelegans* (Barrande): Adult shell in a — dorsal and b — ventral views (Muszla dorosła od strony a — dorsalnej, b — wentralnej). IG.1369.II—237; × 5.

Fig. 5a—b. *Nucleospira inelegans* (Barrande): Adult shell in a — dorsal view, b — ventral view (Dorosła muszla od strony a — dorsalnej, b — wentralnej). IG.1369.II—238.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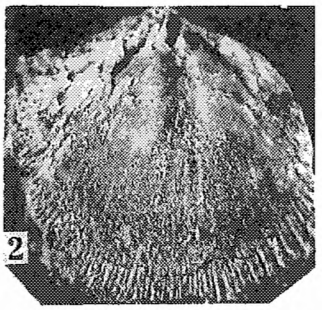
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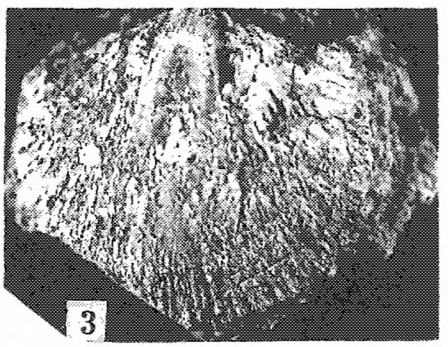
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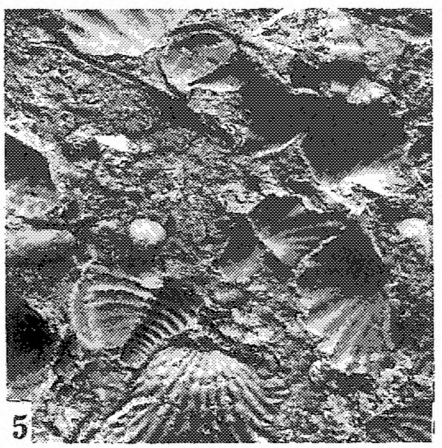
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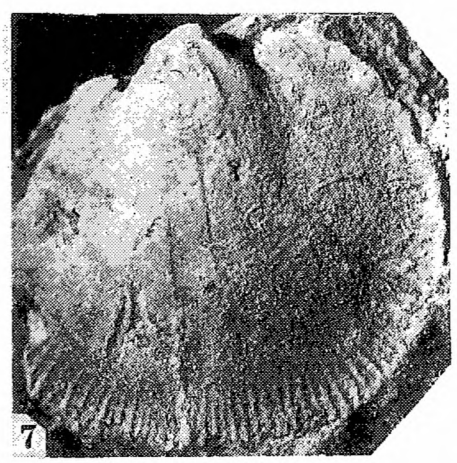
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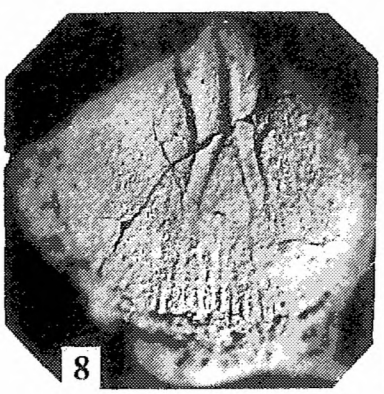
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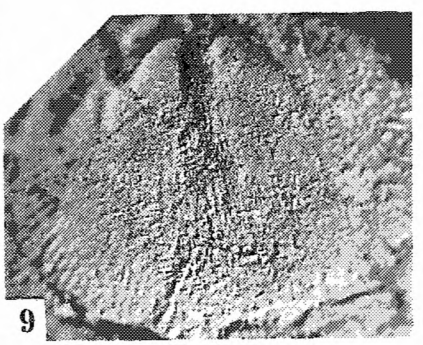
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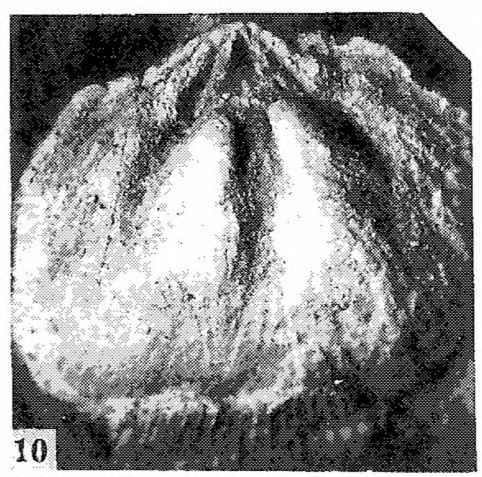
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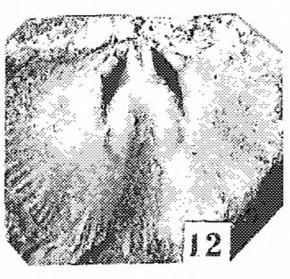
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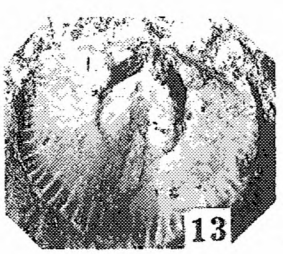
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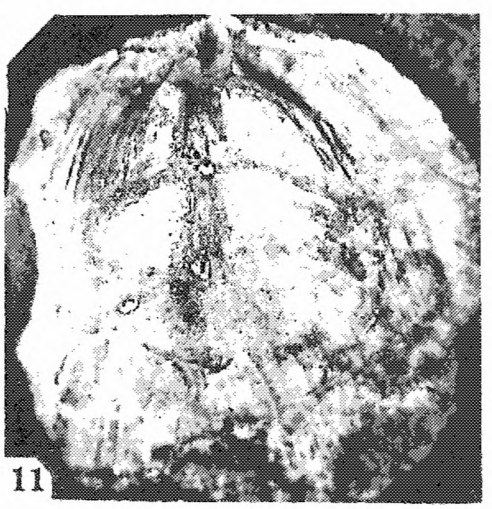
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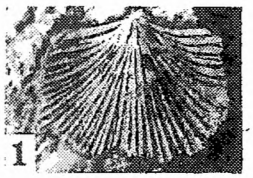
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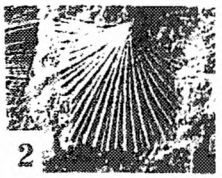
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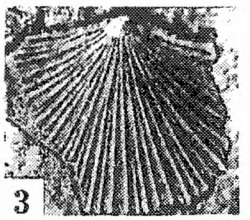
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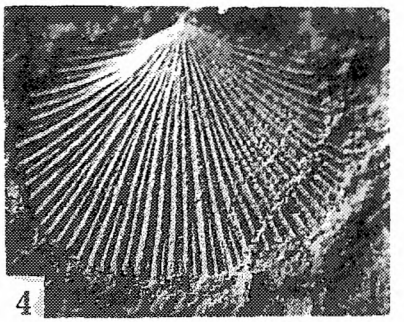
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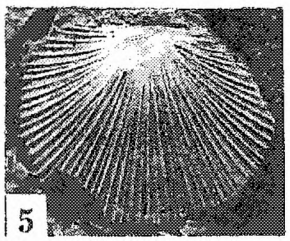
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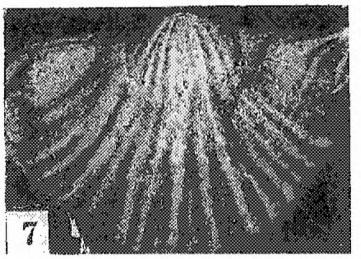
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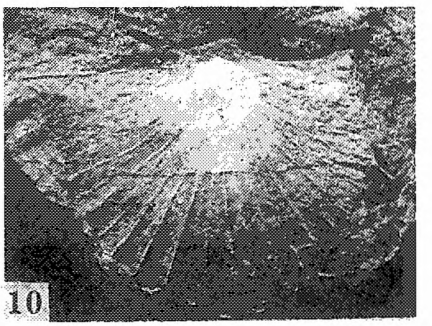
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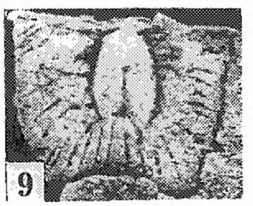
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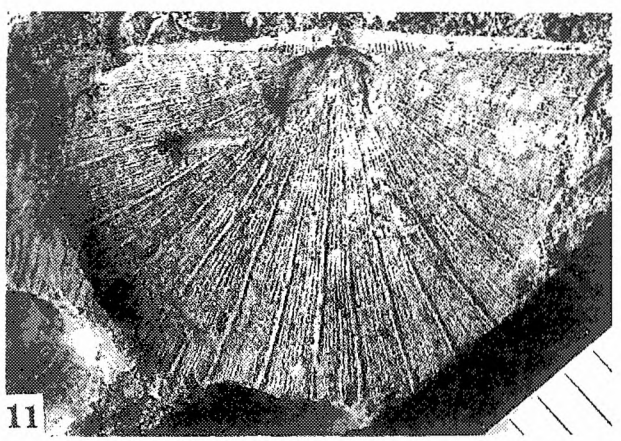
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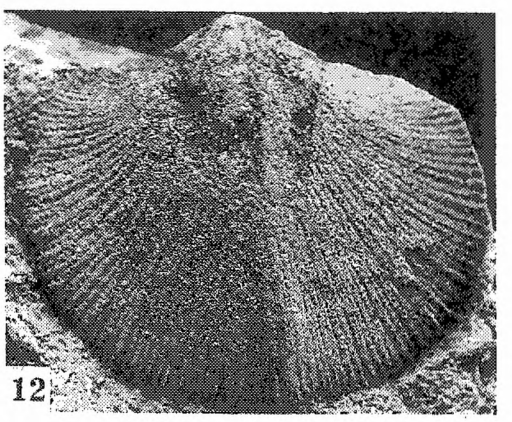
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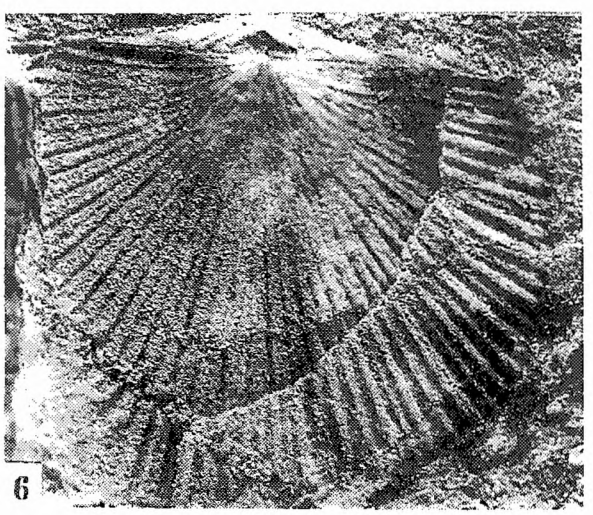
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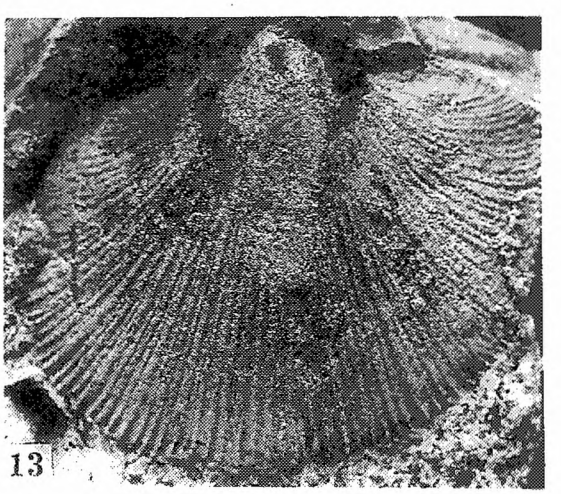
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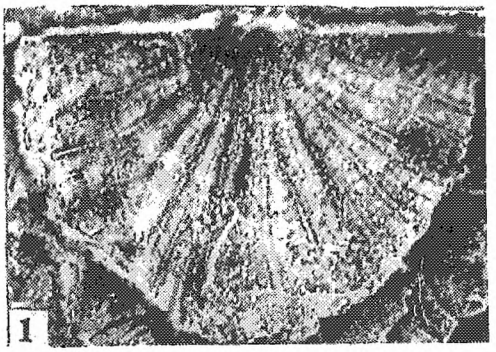
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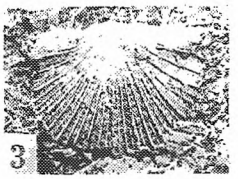
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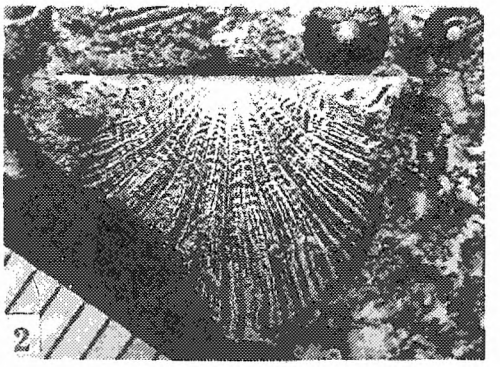
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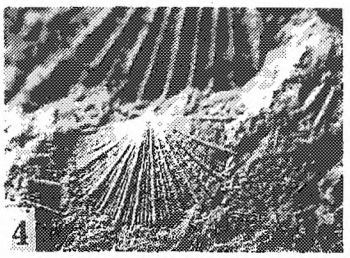
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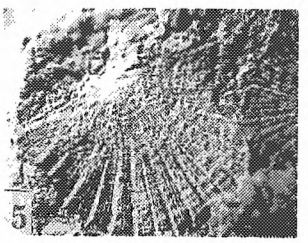
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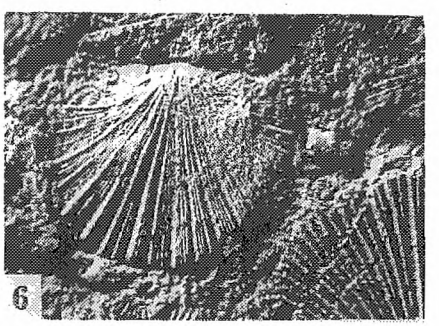
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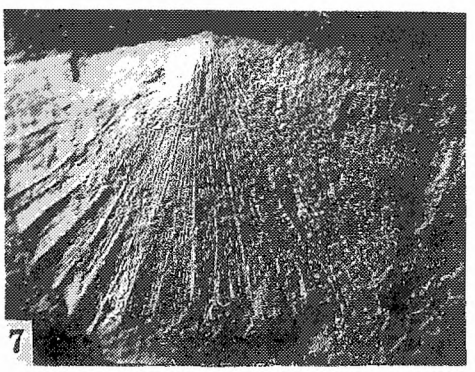
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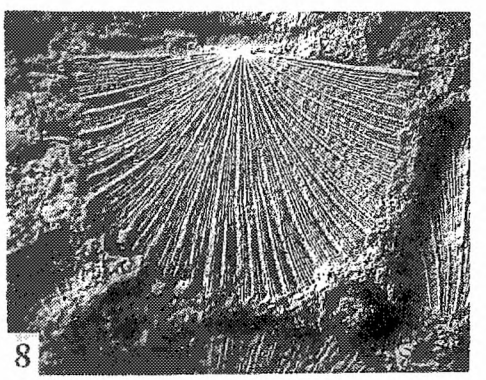
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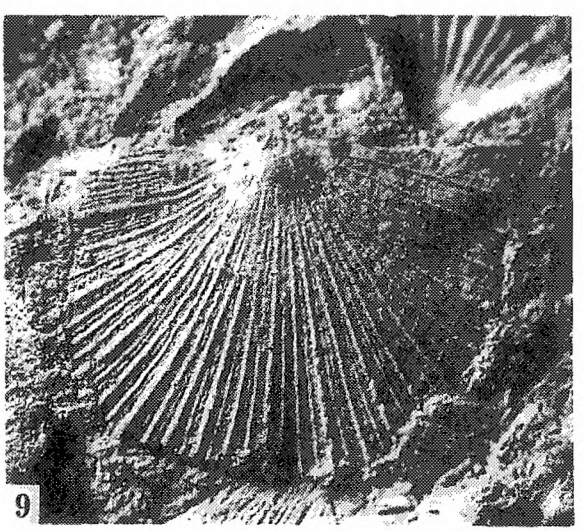
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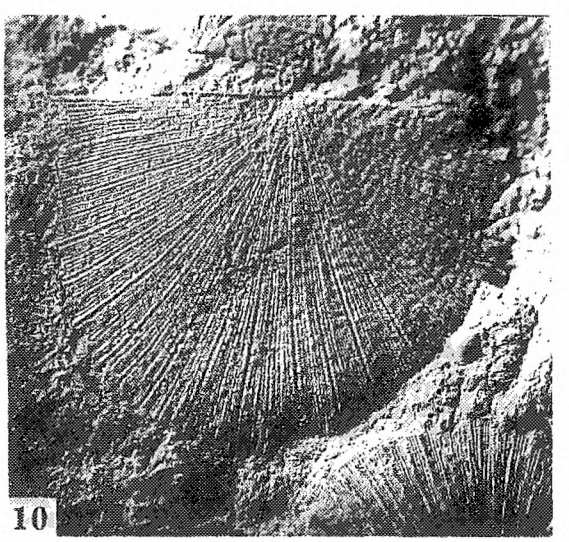
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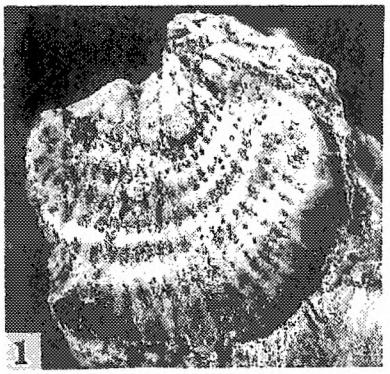
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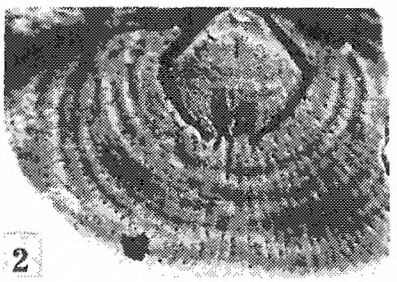
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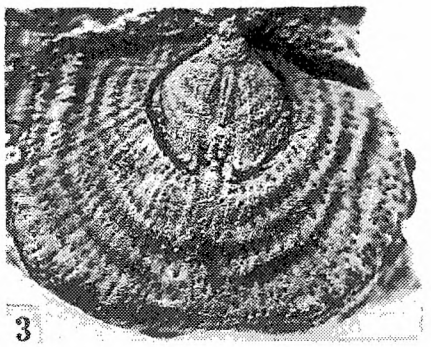
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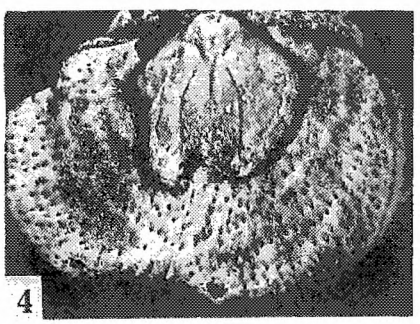
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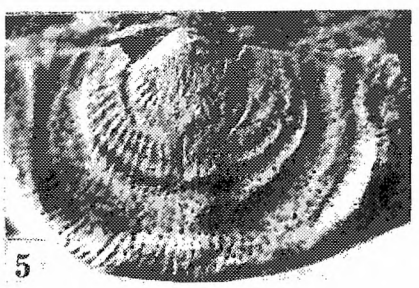
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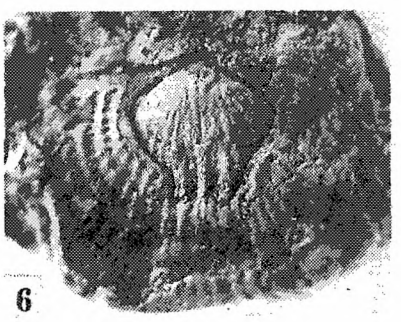
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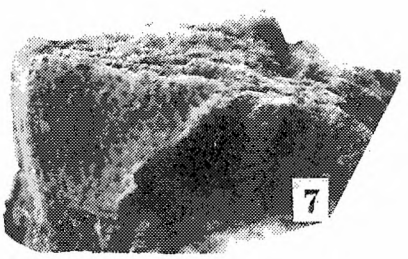
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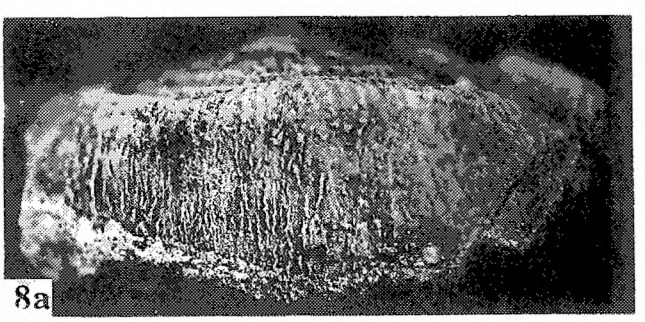
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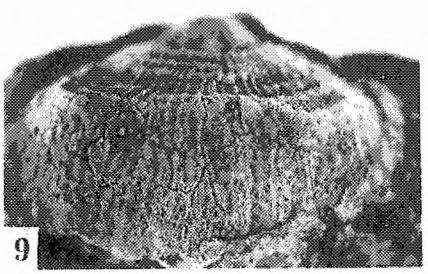
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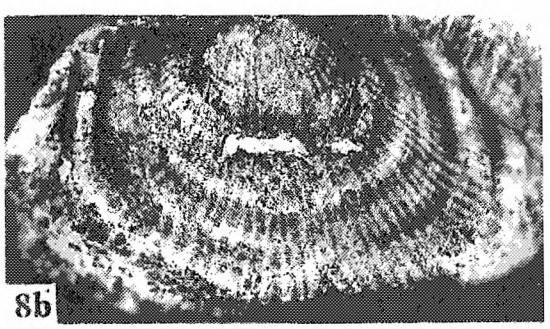
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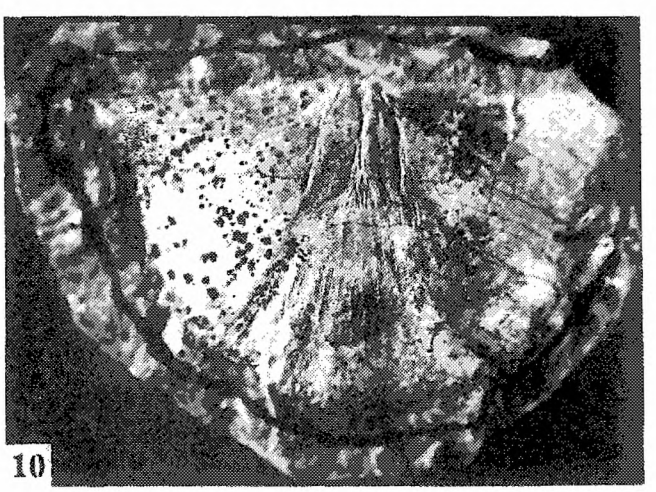
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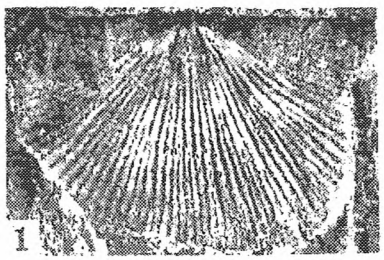
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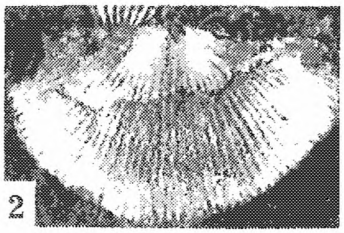
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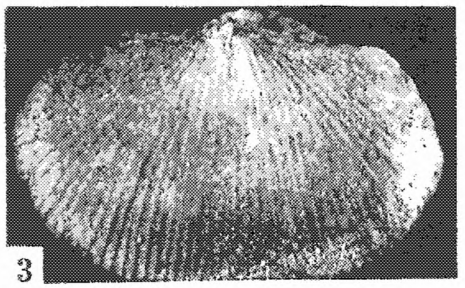
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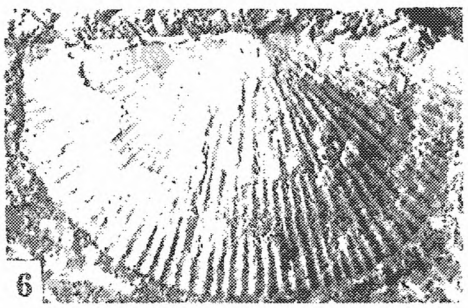
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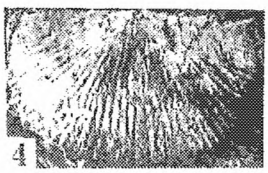
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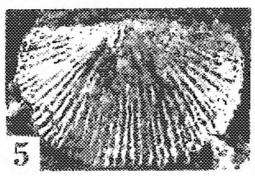
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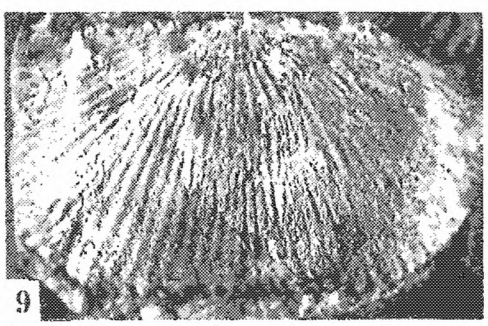
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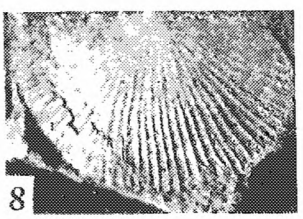
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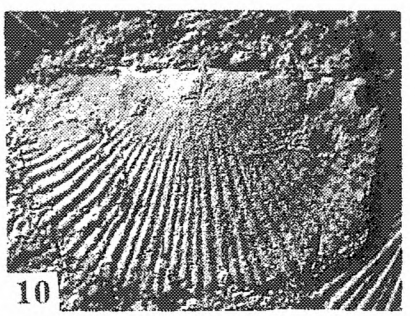
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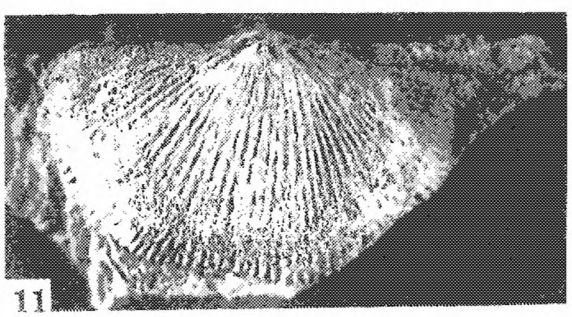
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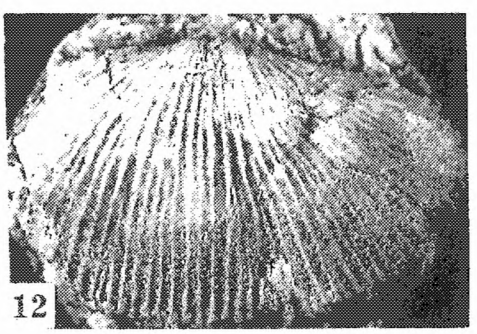
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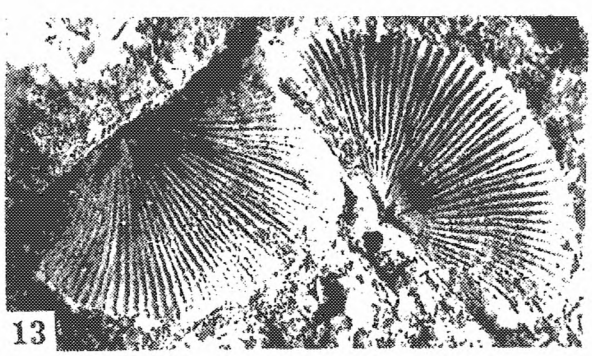
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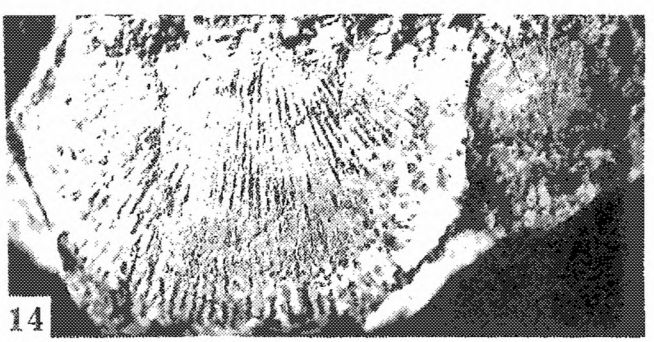
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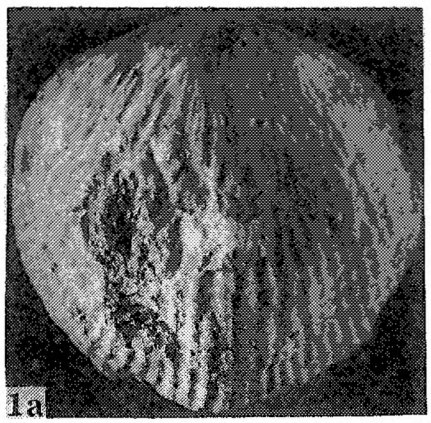
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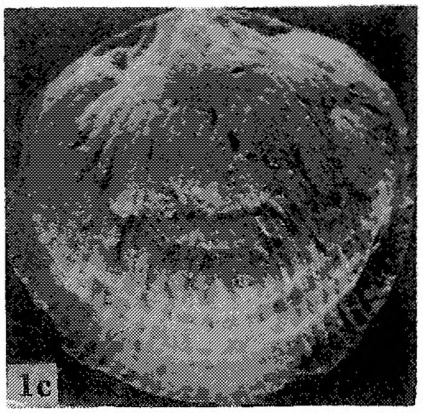
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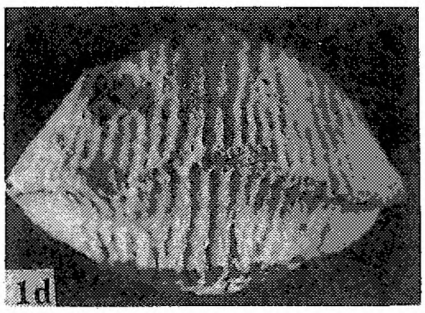
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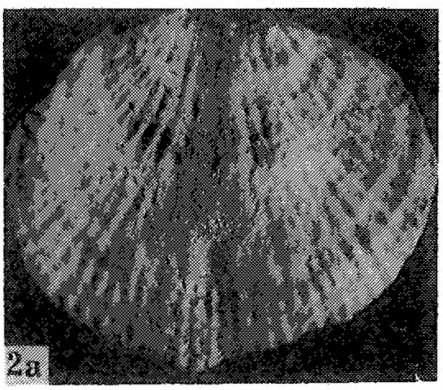
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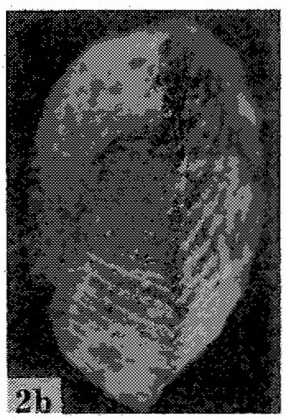
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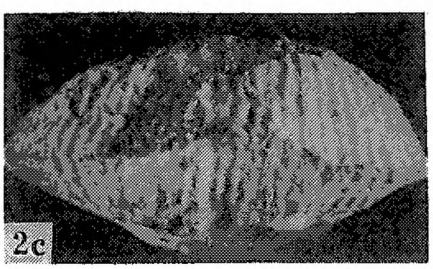
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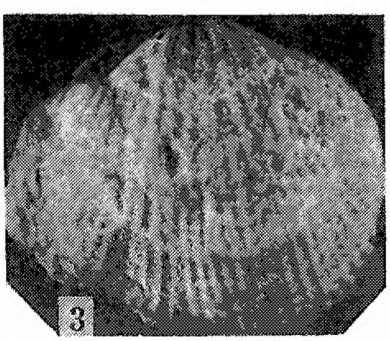
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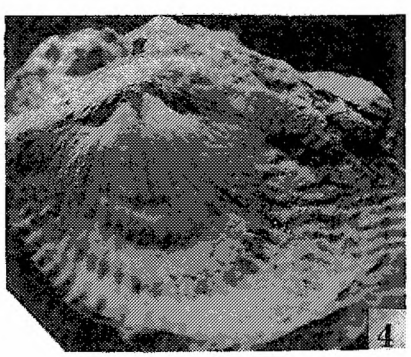
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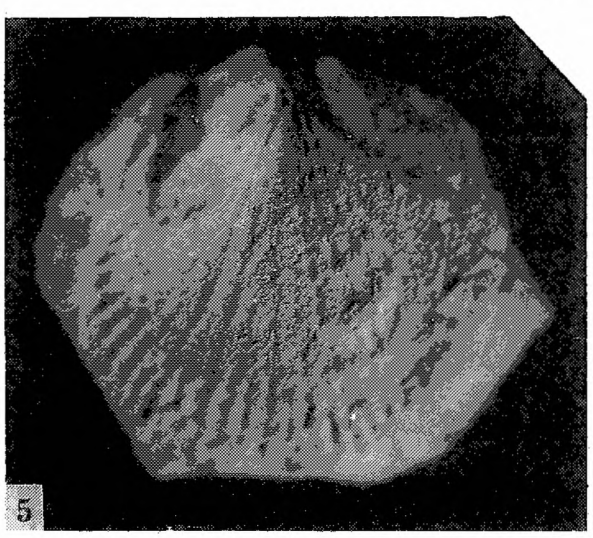
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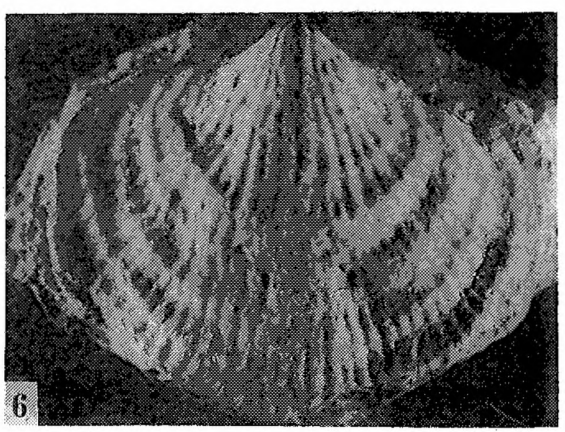
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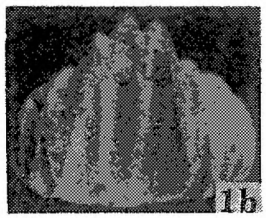
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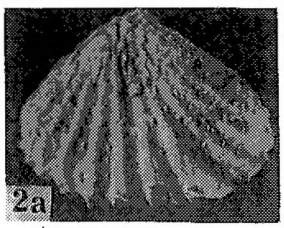
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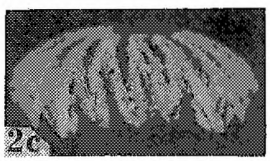
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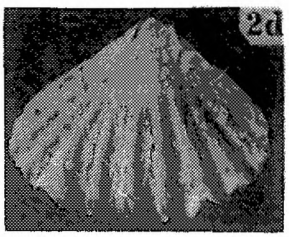
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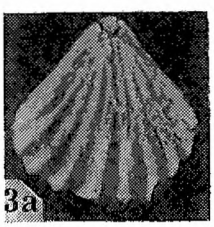
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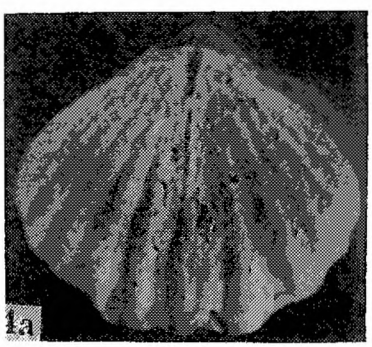
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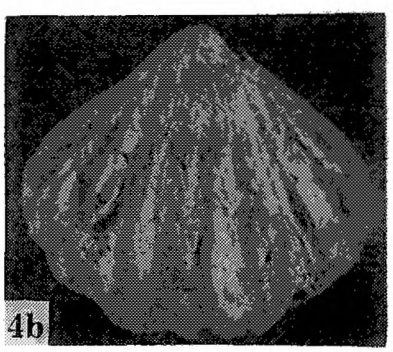
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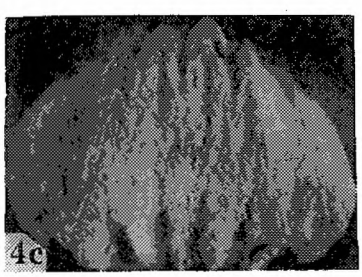
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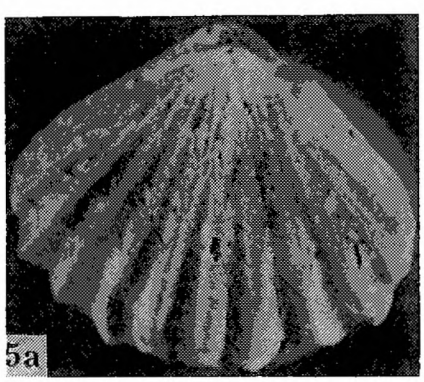
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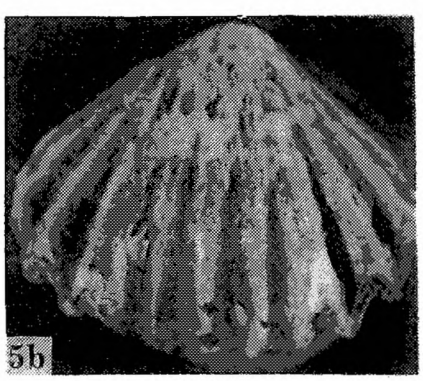
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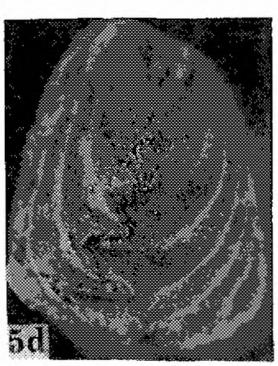
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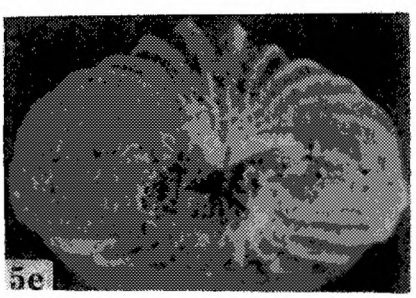
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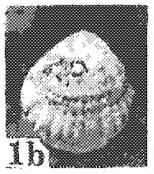
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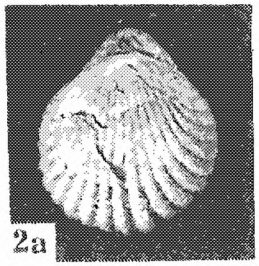
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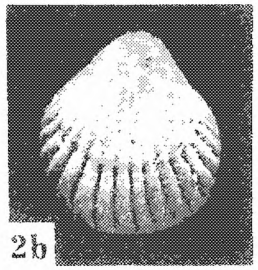
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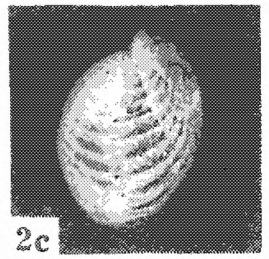
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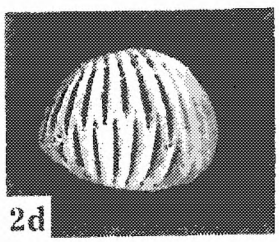
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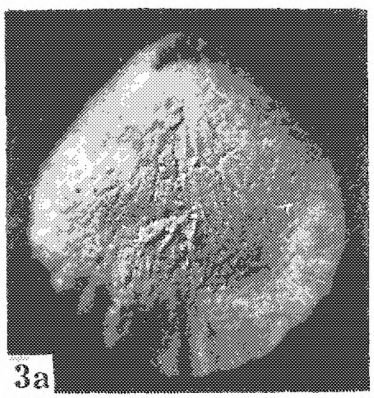
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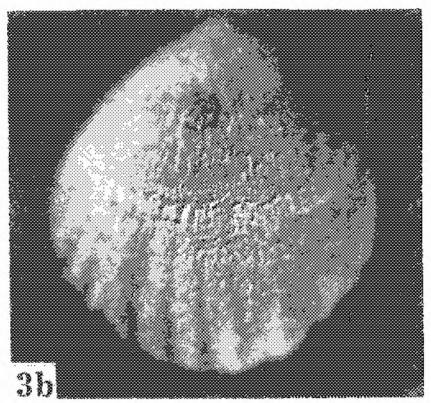
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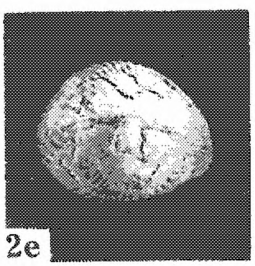
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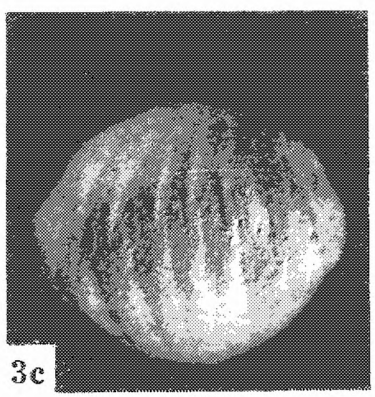
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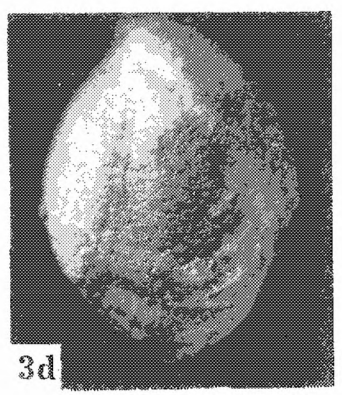
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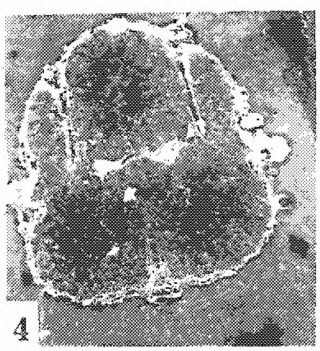
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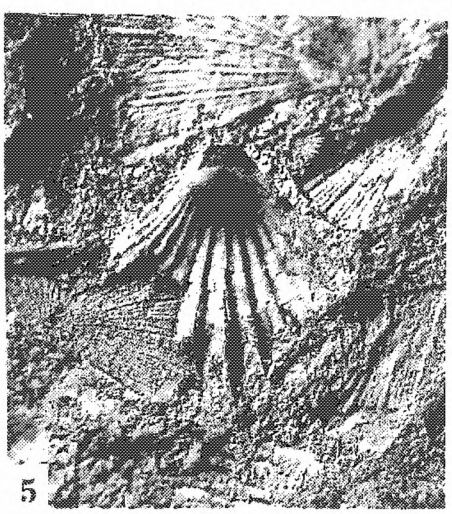
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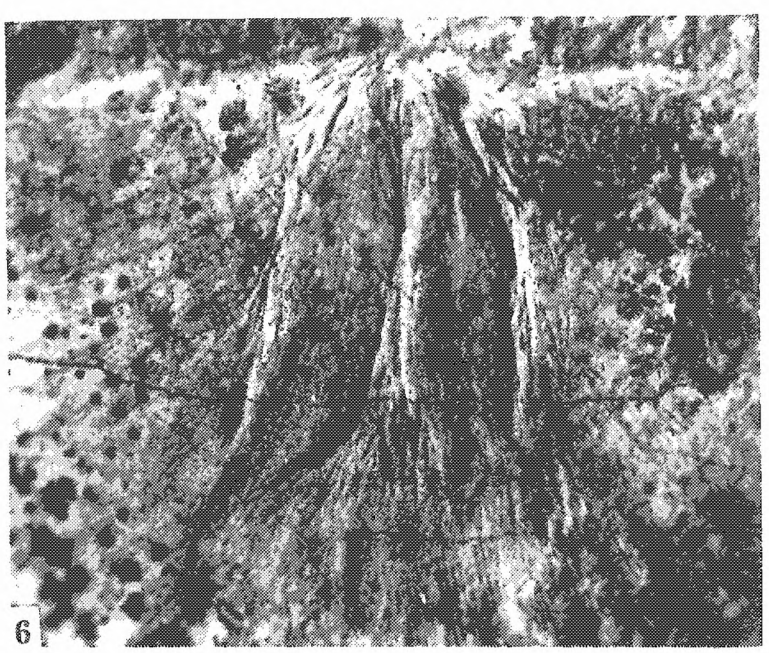
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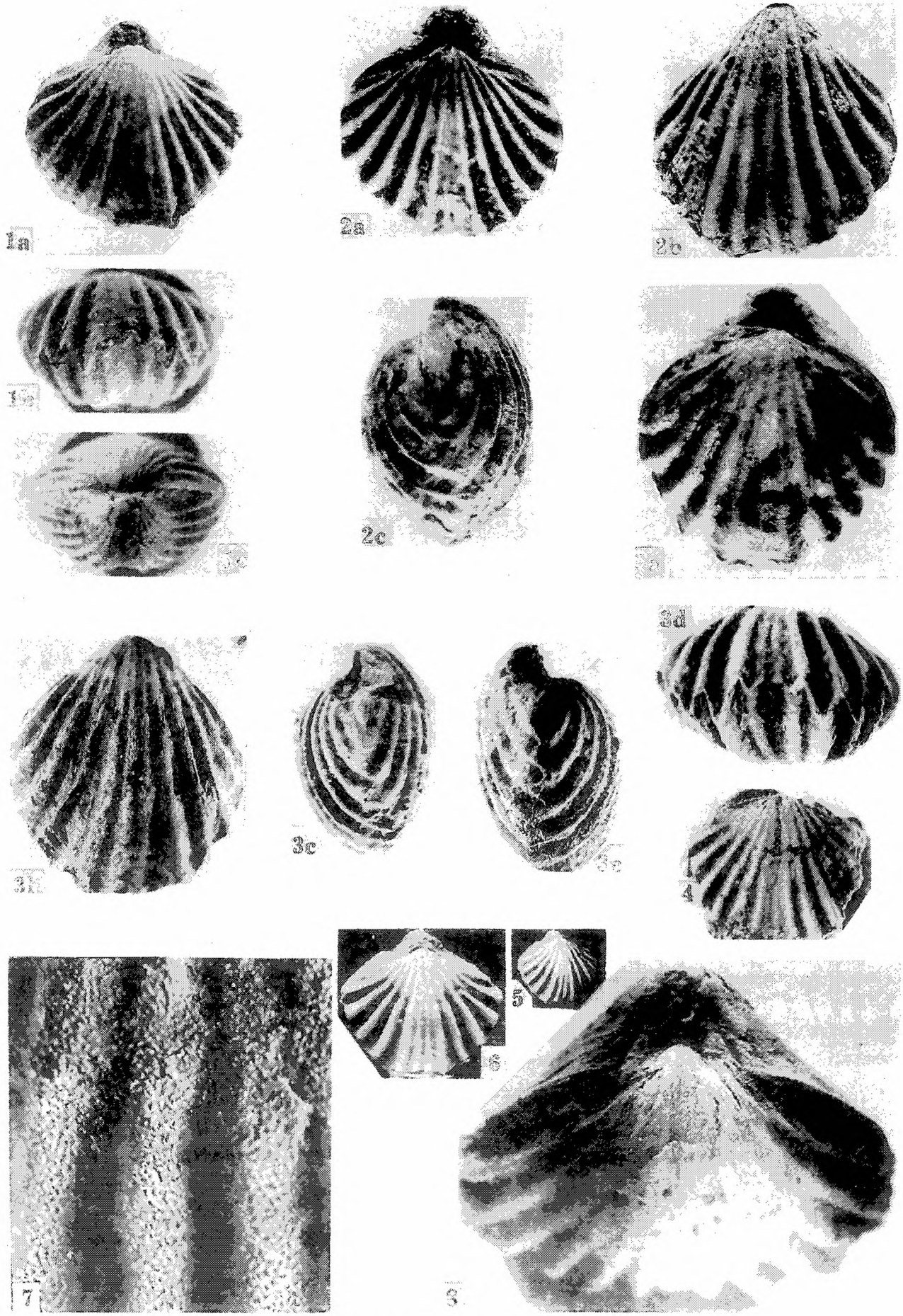
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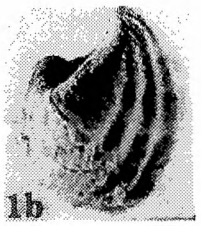
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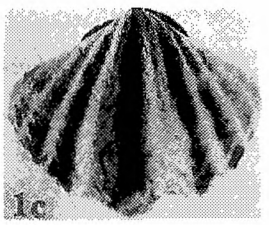
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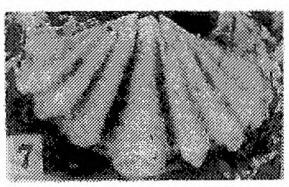
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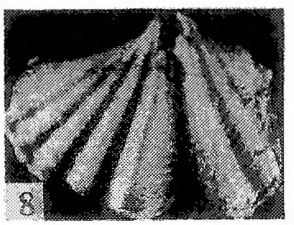
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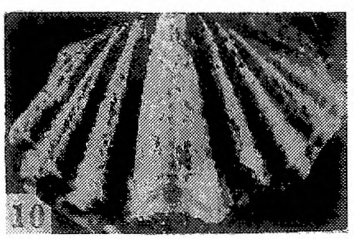
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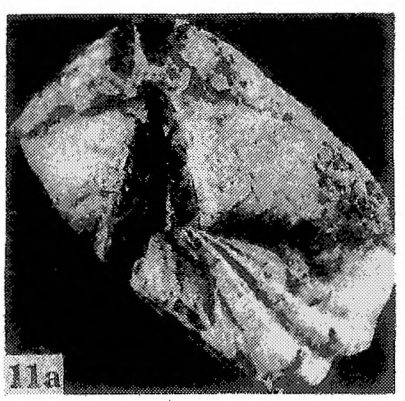
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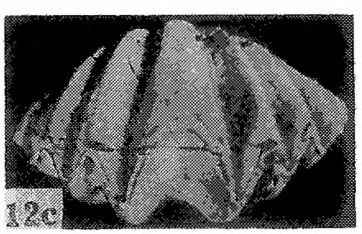
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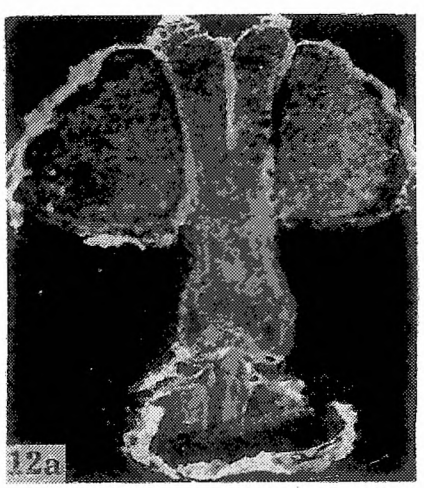
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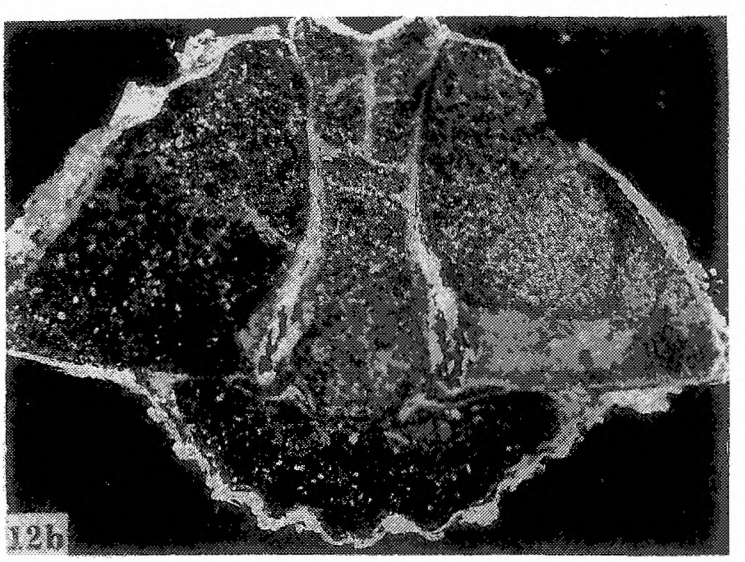
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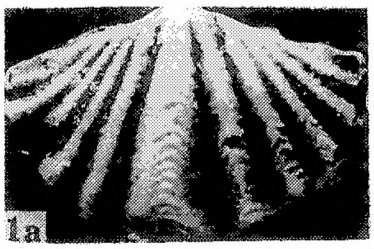
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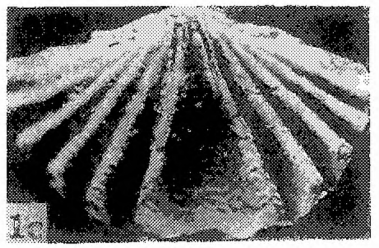
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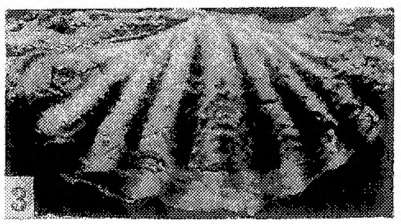
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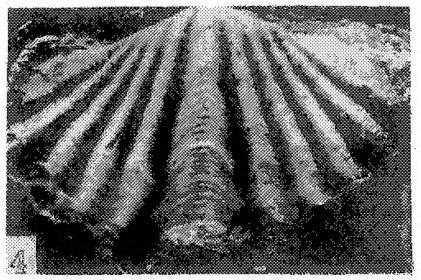
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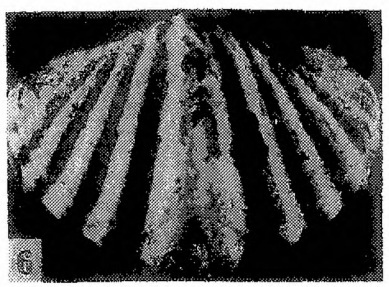
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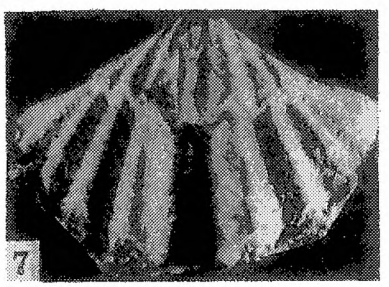
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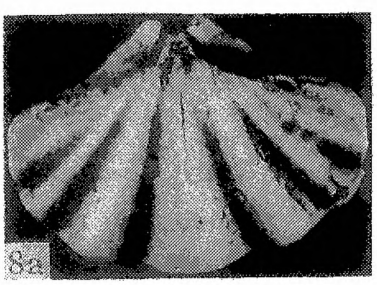
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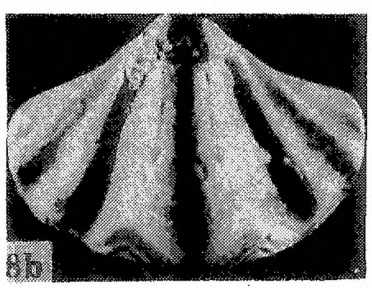
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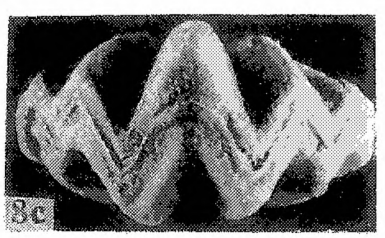
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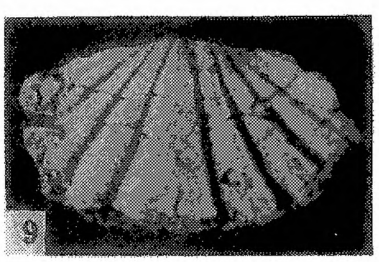
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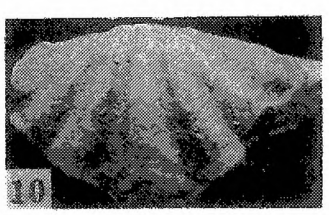
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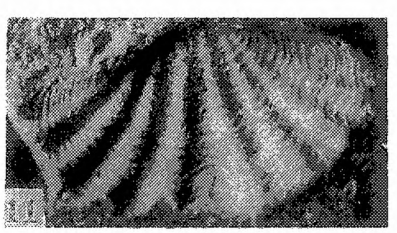
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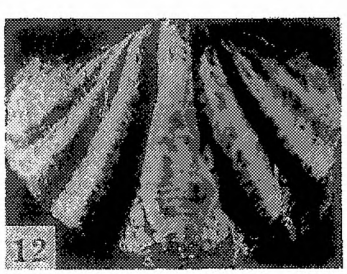
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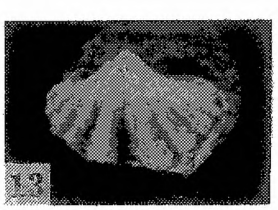
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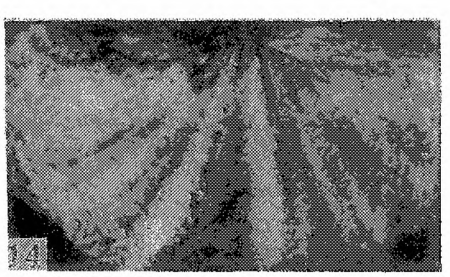
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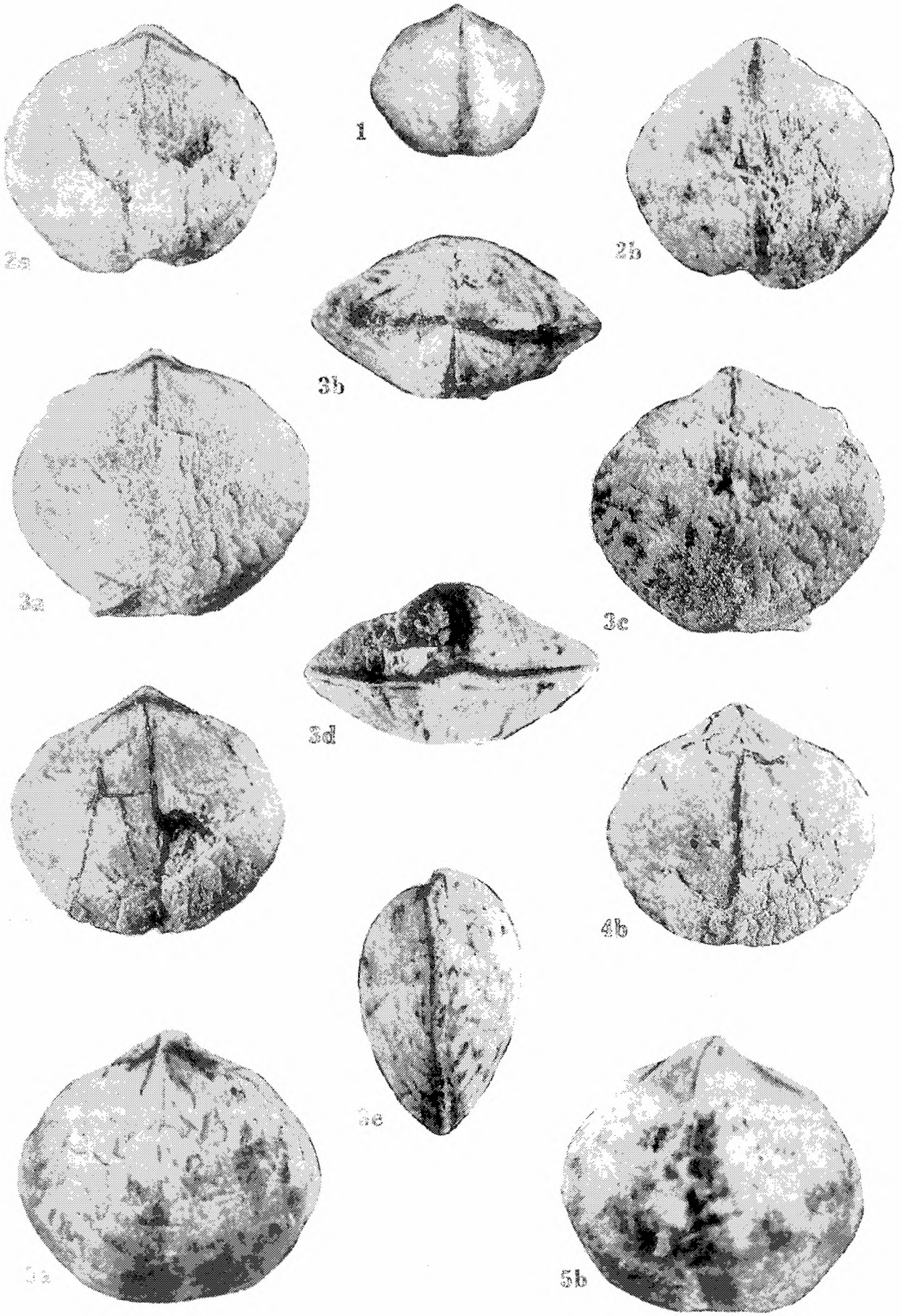
1
2a
2b
3b
3a
3c
3d
4b
3e
5a
5b