

GERTRUDA BIERNAT

MIDDLE DEVONIAN ATRYPACEA (BRACHIOPODA)
FROM THE HOLY CROSS MOUNTAINS, POLAND

Abstract. — 20 species of the superfamily Atrypacea (6 new) belonging to 5 genera from the Middle Devonian of Łysogóry region, the localities of Wydryszów, Skały, Miłoszów and Pokrzywianka-Kamieniec, in the Holy Cross Mountains (Góry Świętokrzyskie), are described. Two species are of Lower Eifelian age, the remaining ones are of ?Upper Eifelian and Givetian. A morphological analysis of the interior and exterior is carried out and the growth stages of the shells of some species are studied.

INTRODUCTION

The present paper is based on a study of Eifelian — Givetian atrypids of the superfamily Atrypacea from Wydryszów, Skały, Miłoszów and Pokrzywianka-Kamieniec in the eastern part of the Bodzentyn syncline in the Łysogóry region. In the examined collection two families are represented: the Atrypidae Gill, 1871, with 18 species, grouped in 4 genera, and the Paraferellidae Spriestersbach, 1942, represented by 2 species of the genus *Gruenewaldtia* Tschernyshev, 1885.

In the Devonian of the Holy Cross Mountains (Góry Świętokrzyskie) several species of atrypids have been listed or described by Gürich (1896) and Sobolev (1904, 1909). They briefly discussed certain differences, observed as a rule in the species of *Atrypa reticularis* (L.) from the Devonian of Skały. Gürich has recognized 3 varieties: *Atrypa reticularis* var. *trigonalis*, *A. reticularis* var. *elongata* and *A. reticularis* var. *orbicularis*. Unfortunately, his descriptions are inadequate and there are no illustrations. Gürich's collection from the Holy Cross Mountains can no longer be found.

In addition to Gürich's new forms, Sobolev (1904) has also distinguished two other varieties: *Atrypa reticularis* var. *A* and *Atrypa reticularis* var. *ellipsoidea*, but only a part of Sobolev collection is preserved in Leningrad (VSEGEI Museum). Besides the above atrypids, those authors also described *Atrypa aspera* (Schlotheim), *A. desquamata* (Sow.), *Gruenewaldtia latilinguis* (Schnur), *A. plana* Kayser and others.

The present material was collected between 1948—1954, partly by the writer and partly by the late Prof. R. Kongiel and his collaborators from the Museum of the Earth (Muzeum Ziemi) in Warszawa.

The present studies have been supplemented by comparative material, examined during the author's stay at the Senckenberg Museum in Frankfurt a.M. in 1963. Unfortunately, only a small part of the German collection of atrypids was available for comparison at that time. The abbreviation SMF is used for this collection. The here studied collection is deposited at the Institute of Palaeozoology of the Polish Academy of Sciences in Warszawa, for which the abbreviation Z. Pal. Bp. VI is used.

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STRATIGRAPHY

The Middle Devonian deposits in the eastern part of the Bodzentyn syncline in the Łysogóry region outcrop at Wydryszów, Skały, Miłoszów and Pokrzywianka-Kamieniec (Text-fig. 1.). Within the Bodzentyn syncline these deposits lie on sandy Emsian sediments containing poor fauna, represented chiefly by brachiopods. In the above mentioned localities, the Devonian deposits display strong lithological differences both in the vertical and horizontal extent. Lower Eifelian (Wydryszów and Grzegorzowice) is represented by marly calcareous deposits; ?Eifelian-Givetian (Skały, Miłoszów, Pokrzywianka) by silty, marly and calcareous deposits. In

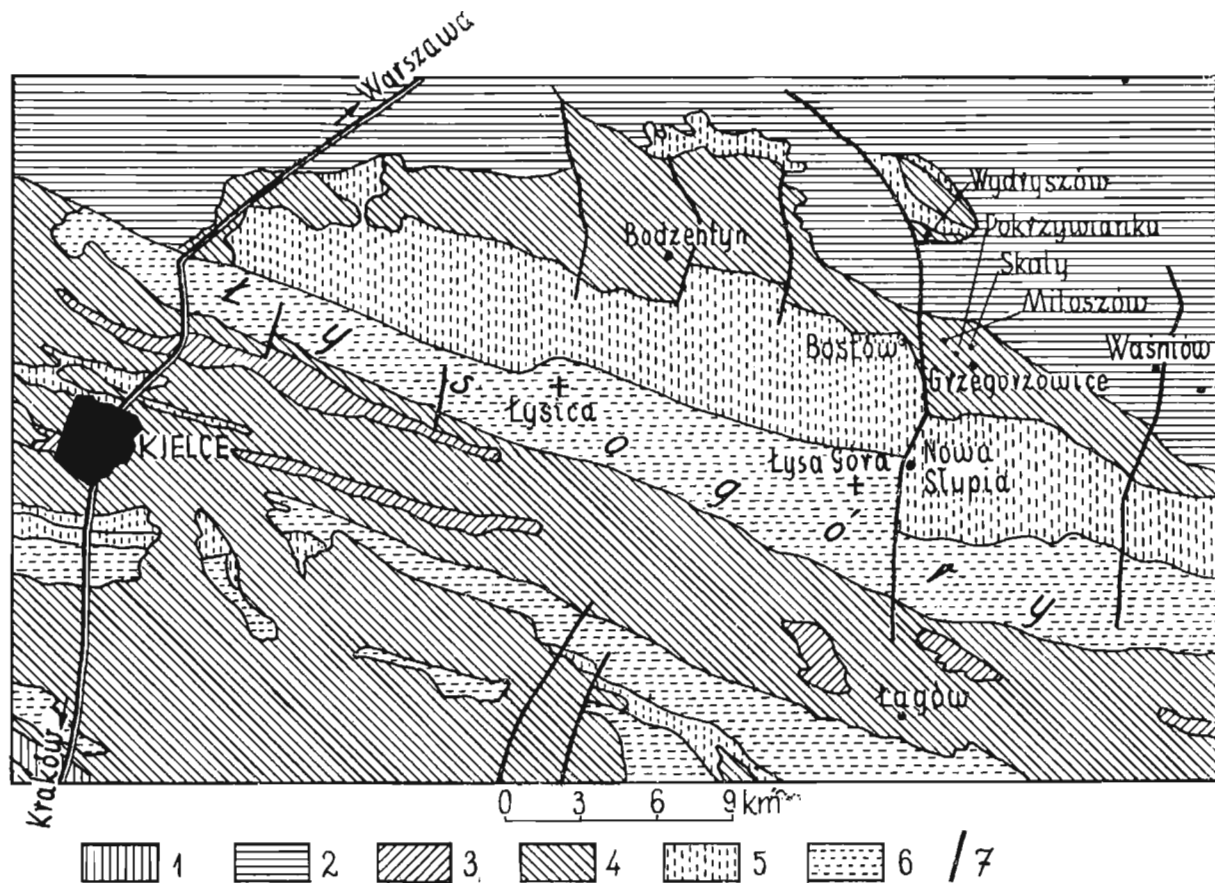


Fig. 1. — Geological sketch map of the central part of the Holy Cross Mountains (Góry Świętokrzyskie), after Czarnocki, 1950 (emended by Zakowa, 1962)

1 Jurassic, 2 Triassic, 3 Carboniferous, 4 Devonian, 5 Ordovician and Silurian, 6 Cambrian, 7 Faults

some cases, e.g. in Miłoszów, these sediments show a strong tectonic disturbance, as they occur in one of the main dislocation zones that traverses the eastern part of the Palaeozoic massif of the Holy Cross Mountains. A number of minor longitudinal dislocations shortening some portions of the section are also observed in the locality of Skały. The stratigraphy and fauna of the mentioned Middle Devonian deposits have been described by Zeuschner (1869), Gürich (1896), Sobolev (1901, 1904, 1909), Samsonowicz (1936), Czarnocki (1950), Biernat (1953, 1959), Kielan (1954), Stasińska (1954), Rózkowska (1954, 1956), Adamczak (1956), Osmólska (1957), and Pajchel (1957).

DESCRIPTION OF OUTCROPS

The general (provisional) interpretation of stratigraphy of the Middle Devonian deposits of the discussed successions is shown in Table 1.

RANGES OF SPECIES IN THE MIDDLE DEVONIAN OF THE BODZENTYN SYNCLINE, ŁYSOGÓRY REGION IN THE HOLY CROSS MOUNTAINS

In vicinity of Wydryszów the Lower Eifelian deposits consist of dolomites, marls, mudstones and calcareous deposits. The faunal assemblage is represented mainly by corals, bryozoans, brachiopods, trilobites and ostracods.

The *Skały beds* (the Skały series, according to Czarnocki, 1950), outcropping in Skały and Miłoszów, are differentiated lithologically and comprise a thick sequence of interbedded silty, marly and calcareous sediments. Pajchel (1957) has recognized there 12 lithological-faunal assemblages of layers or complexes (numbered XIII—XXV), in which certain lithological types are repeated several times. The lowermost part of Skały beds are "brachiopod shales" which discordantly overlie the limestone. The shales are greatly disturbed, in the lower part they are crushed and compressed, indicating longitudinal dislocation. Towards the top the shales pass into siltstones, marls and limestones. In the upper part of the Skały beds, which end in organogenic coral limestone, limestone and crinoid marls occur (Pajchel, 1957).

This great lithological differentiation as well as the diversified fauna give rise to considerable difficulties in stratigraphic interpretation. Czarnocki (1950) suggested an Upper Givetian age; more recently Pajchel (1957) favoured a presumably Givetian age. The present writer inclines to the opinion that they are of Lower Givetian age, even though the presence of some Upper Eifelian species common to Poland and Germany such as: *Spinatrypa fasciplicata* (Struve, 1961), *Gruenewaldtia latilinguis latilinguis* (Schnur, 1851), index fossils for Upper Eifelian, may

TABLE 1

Stage	Beds	Localities	Lithology	Species
G I V E T I A N	Pokrzywianka	Pokrzywianka; Kamieniec	limestone	<i>Desquamatia prisca</i> (Schlotheim) <i>Desquamatia zonatoides</i> n.sp. <i>Desquamatia</i> sp.
	Świętomarz	Świętomarz	argillaceous, greywacke shales	—
	S k a ł y	Skaly	limestones, marls, argillaceous shales, siltstone	<i>Atrypa squamifera</i> (Schnur) <i>Atrypa subtrigonalis</i> n. sp. <i>Atrypa depressa</i> Sobolev <i>Spinatrypa asperoides</i> n. sp. <i>Spinatrypa fasciplicata</i> (Struve) <i>Spinatrypa aspera</i> (Schlotheim) <i>Desquamatia</i> aff. <i>zonata</i> (Schnur) <i>Desquamatia subzonata</i> n. sp. <i>Carinatina</i> sp. <i>Carinatina plana</i> (Kayser) <i>Gruenewaldtia latilinguis latilinguis</i> (Schnur)
		Miłoszów	limestone	<i>Spinatrypa aspera</i> (Schlotheim) <i>Desquamatia circulareformis</i> n. sp. <i>Desquamatia subzonata</i> n. sp. <i>Carinatina plana</i> (Kayser) <i>Carinatina</i> aff. <i>arimaspa</i> (Eichwald) <i>Gruenewaldtia</i> sp.
E I F F E L I A N	Wojciechowice	Wojciechowice	dolomites	
	Grzegorzowice	Grzegorzowice	limestone marls, mudstone shales	<i>Desquamatia varistriata</i> (Biernat)
	Un-named local series	Wydryszów	limestone mudstone marls	<i>Desquamatia varistriata</i> (Biernat) <i>Spinatrypa dorsata</i> n. sp.

suggest Upper Eifelian age. However, this is insufficient evidence for close dating.

In Miłoszów, the deposits of the Skały beds are not completely developed and a lithostratigraphic correlation of the Devonian deposits of Skały and those of Miłoszów is difficult due mainly to the strong tectonic disturbances in the latter area. On palaeontological data it may be considered that they correspond to the middle part of the Skały beds.

The *Pokrzywianka* beds overlie the sandy *Świętomarz* beds (Pajchel's complex XXVII, 1957). The former occur within a limited area, confined to the eastern part of Bodzentyn syncline and consist of dark-red and poorly bedded limestones, forming many lenses containing corals and brachiopods. At present, the beds are considered to be of Upper Givetian age (Pajchel, 1957, 1962), and this age can also be confirmed by the assemblage of large atrypids of the genus *Desquamatia*, characteristic of Givetian of Rhine region (Bilveringsen, Reffrath, Leidhold, 1928; Schlotheim, 1820, 1822), of Ural and China (Alekseeva, 1961; Grabau, 1931).

REVIEW OF CHARACTERISTIC FAUNA OF ATRYPIDS

Each of the above mentioned stratigraphic units is characterized by very prolific and diversified atrypids. As a rule, some species of one lithological assemblage do not pass into the other. This was also observed in the case of trilobites (Kielan, 1954; Osmólska, 1957). In the marly presumably Lower Eifelian deposits of Wydryszów two atrypid species have been recorded. They are: *Desquamatia varistriata* (Biernat, 1954) common for both the Grzegorzowice and Wydryszów deposits, and *Spinatrypa dorsata* n.sp. The Skały beds are fossiliferous to a varying degree, each layer carrying a rather characteristic fauna. In general, it might be suggested that the species or their assemblages are connected with lithofacies. The atrypids are numerous and, as a rule, show a marked change in their composition at the specific and generic level throughout the sequence. In the "brachiopod shales", known as highly fossiliferous, many species are represented by a large number of specimens of different sizes, representing the progressive growth stages. The atrypids are the following: *Atrypa depressa* Sobolev, *Atrypa subtrigonalis* n.sp., *Spinatrypa aspera* (Schlotheim) and *Desquamatia subzonata* n.sp. In the lowermost part of shales, where the rock is strongly disturbed, a few specimens of *Spinatrypa fasciplicata* (Struve) together with more numerous *Atrypa subtrigonalis* n.sp. have been found. The former species appears to be restricted in stratigraphical range, not being found in other beds. *Atrypa subtrigonalis* n.sp., *A. depressa* Sobolev, *A. squamifera* (Schnur) and *Desquamatia subzonata* n.sp. are more common, being recorded in a few layers, in the shales and marls (mostly in XV and XVII complexes of beds). In addition,

a few specimens of *Spinatrypa aspera* (Schlotheim) have been recorded in the limestone of Miłoszów. Some species such as *Desquamatia* aff. *zonata* (Schnur), *Gruenewaldtia latilinguis latilinguis* (Schnur) appear to be connected with the limestone layer, collected in the limestone (XV, XVII, XXI complexes of beds). Some species such as: *Atrypa squamifera* (Schnur), *Spinatrypa aspera* (Schlotheim), *Spinatrypa fasciplicata* (Struve), *Gruenewaldtia latilinguis latilinguis* (Schnur) are common for both, the Łysogóry and Rhine regions.

The Pokrzywianka calcareous beds (complex XXVI) abound chiefly in stromatoporoids and corals (representatives of genera *Alveolites*, *Chaetetes*, *Pachyphyllum* etc.). There are also numerous shells of large atrypids of the genus *Desquamatia*, namely *D. prisca* (Schlotheim) and *D. zonatoides* n.sp. These display very close similarities with the Givetian species of Germany (Rhine region), e.g. *Desquamatia zonata* (Schnur), also with those from Volhynia (Kelus, 1939), as e.g. "*Atrypa*" *reticularis* var. *parazonata* Kelus (recte *Desquamatia parazonata* (Kelus)), *Atrypa reticularis* var. *ventricosa* Kelus (recte *Desquamatia ventricosa* (Kelus)).

MATERIAL AND METHODS

The studied collection contains about 800 specimens of different size and individual age. The majority of shells are free, those partly embedded in rock are few. There are also present casts of shells, some of them showing preserved concentric lamellae. Separate pedicle valves are frequent, while brachial valves are rare and preserved in fragments. The state of preservation is mostly good. There are many complete or only a little damaged specimens, suitable for studying the internal structure by serial sections and thin slides, external morphology and for measurements. In "brachiopod shales" (complex XIV) deformed specimens are rare, while in the Pokrzywianka limestone (complex XXVI) they are fairly numerous. Nevertheless, this last material is suitable for observation of the surface ornamentation and structure of the posterior portion of the shell. In the collection are also numerous dwarfed specimens. They represent mature or gerontic individuals, but their shells are half (or even less) the size of specimens whose progressive growth is normal. The small shell dimensions of these specimens, the incomplete pattern of surface ornamentation and the strongly thickened shell walls suggest that they are dwarfed individuals.

Most specimens come from soft shales, hence their cleaning is not difficult, by using water, brushes and needles. The interior of atrypids was studied by the method of serial sectioning. A number of drawings of these sections were made, using a *camera lucida* with a magnification of about 12 diameters.

Features, considered to be of diagnostic value for genera and species of atrypids, were carefully studied. Special attention was paid to some features of internal morphology (dental plates, presence or absence of the functional pedicle). Observations of the growth stages of several species provided some picture of the changes connected with progressive growth of shells.

GENERAL PART

MORPHOLOGY

Exterior — Surface ornamentation

The ornamentation in atrypids displays a fairly strong differentiation. It consists of radial costulae or costae, concentric lamellae, more or less distinct concentric microlines and spines, the latter being usually represented by spine bases. Each of the mentioned elements of ornamentation is regarded as significant for generic identification.

Radial costulae

The studied atrypids show three types of radial ornamentation which could be defined as follows:

1) the *atrypid type* — costulae in general thick and distinct, bifurcation and intercalation frequent (*Atrypa subtrigonalis* n.sp., *A. depressa* Sobolev; see Pl. I, II);

2) the *spinatrypid type* — costae thick, as a rule simple, bifurcation or intercalation rare (*Spinatrypa aspera* (Schlotheim), *S. dorsata* n.sp., *S. fasciplicata* (Struve), and tentatively ornamentation of *Carinatina*; see Pl. IV, V, VI, XIII);

3) the *desquamatia type* — delicate, subtubular to tubular costulae, bifurcation intensive, intercalation slightly less common (*Desquamatia subzonata* n.sp., *D. aff. zonata*, *D. zonatoides* n.sp., tentatively the ornamentation of *Gruenewaldtia*; see Pl. VIII, X, XI, XII).

Small deviations from the mentioned types of ornamentation are considered here as having a diagnostic value for species and subspecies. The differences are to be found in size of costulae or costae, in their thickness hence in their number and spacing. One of the differences in ornamental features is the transition between relatively thick and fewer costulae over the posterior portion of the shell and much finer and therefore more numerous costulae over its anterior part. In some cases the transition is abrupt and characteristic differences in the size and number of costulae are marked (*Desquamatia varistriata* (Biernat), *Atrypa varicostata* Stainbrook, 1945).

Alekseeva (1962) also considered the size of costulae, namely their height, width and shape, as diagnostic for species and this, together with some characters of the internal morphology, as diagnostic for genera.

Observations of the studied material show fairly wide variation within the three mentioned types of ornamentation; this is particularly significant in *Atrypa*. It concerns the size, height and to some extent number of costulae. In *Spinatrypa* and *Desquamatia* the ornamentation appears to be more constant than in *Atrypa*, retaining a rather uniform ornamental pattern.

Radial costae and costulae

The smallest atrypids of the different species here studied, about 0.6 mm. long, have the same number of initial radial costulae, expressed

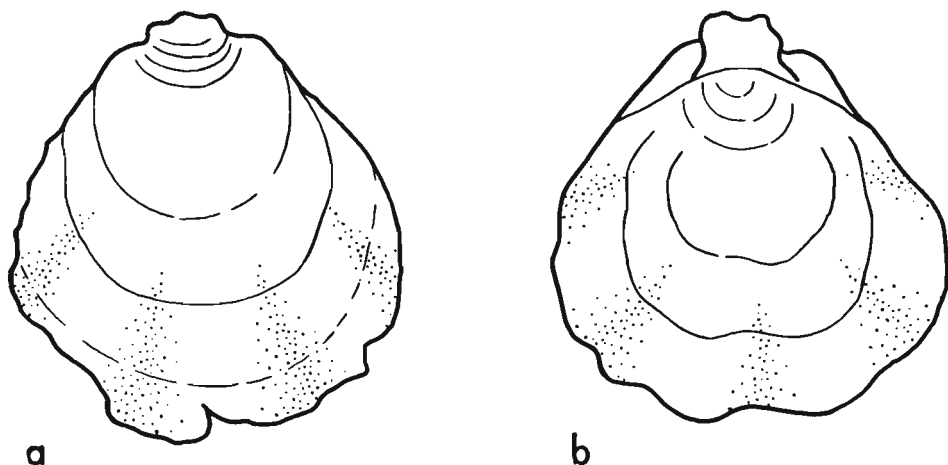


Fig. 2. — *Spinatrypa aspera* (Schlotheim), appearance of radial primary costae observed in youthful stage; approx. $\times 41.5$
a pedicle valve view, b brachial valve view.

as very delicate foldings of antero-lateral parts of the shell (Text-fig. 2). There are five foldings on the pedicle valve, one median and four lateral. On the brachial valve there are four foldings, two on each side of the valve.

The development of initial radial ornamentation starts early in the growing shell, and some characteristic differences in size and number appear. Kozłowski (1929) has observed in Silurian atrypids from Podolia some differences in the size as well as in the number of radial costae in the studied forms, just at a distance of about 2.2-2.7 mm. from their apexes. Kelus (1939) mentions similar differences in Givetian atrypids from Volhynia, occurring at a distance of about 1.5-2 mm. from apexes.

The costae in the studied immature atrypids of about 3 mm. in length show a tendency to increase in number chiefly by addition of new costae

on the lateral slopes of both valves, which is more intensive in *Desquamatia*, and rather insignificant in *Atrypa* and *Spinatrypa*.

Process of bifurcation of the median incipient costula on the pedicle valve is considered to be one of the most important features (Text-fig 3). Undoubtedly it appears to be connected with the general pattern of orna-

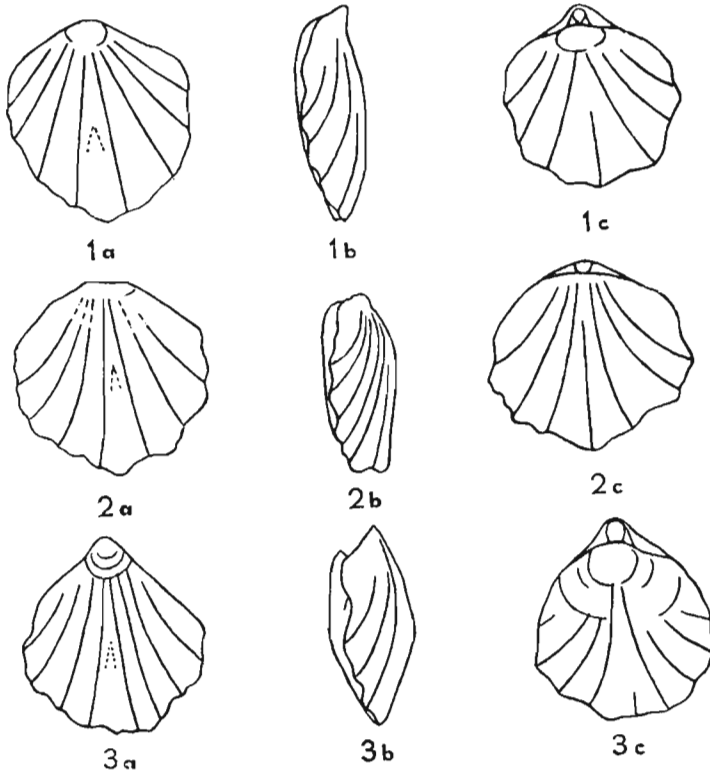


Fig. 3. — Appearance of immature individuals of 3 genera: 1 *Atrypa depressa* Sobolev (Bp. VI/11), 2 *Spinatrypa aspera* (Schlotheim) (Bp. VI/370), 3 *Desquamatia subzonata* n.sp.; $\times 15$

a pedicle valve, b side, c brachial valve view.

mentation which characterizes each of the three above mentioned types of surface ornamentation (p. ...). Dichotomous bifurcation of the initial median costula occurs early, e.g. at a distance of about 0.5-0.6 mm. from the ventral apex. Kozłowski (1929) has distinguished three different ways of bifurcation, observed at a distance of about 2.2-2.7 mm. from the pedicle valve apexes of the forms from Podolia. They are as follows:

1) single bifurcation of the median costula in *Atrypa reticularis* var. *dzwinogrodensis* Kozłowski (l.c., p. 171, Text-fig. 56A);

2) double bifurcation, occurring over a short distance: the median costula bifurcates as above with both branches bifurcating again very soon — *Atrypa reticularis* var. *tajnensis* Kozłowski (l.c., p. 171, Text-fig. 56B);

3) almost simultaneous double bifurcation — *Atrypa reticularis* var. *nieczlavensis* Kozłowski (*l.c.*, p. 171, Text-fig. 56C).

In the studied atrypids the first two types of bifurcation were present. Single bifurcation (1, p. 286) can be observed in the *Spinatrypa* group, in which all radial costae are, as a rule, simple, with bifurcation very rare. The two median costae, formed by the bifurcation of the incipient median costa, are often very marked, as a characteristic "double keel-like elevation". This last has been recognized by Struve (1961) as one of the most important diagnostic features for the newly erected genus *Invertrypa* with *Spinatrypa kelusiana* Struve as a type species (Struve, 1961, p. 334, pl. 2, fig. 9—11). Double bifurcation (2, p. 286) of the incipient median costula is proper to the *Atrypa* and *Desquamatia* groups. Bifurcation of all the radial costulae usually occurs. The two median costulae (originating by the bifurcation of the incipient single one) bifurcate several times and can be of the 2nd, 3rd, or even 4th order, depending on the stage of shell growth. In general, they seem to be more distinct than the remaining surface costulae, separated by a furrow of about equal width along all the shell length.

Concentric lamellae

The concentric lamellae have attracted the attention of many students in an attempt to explain the development, presence and usefulness of this ornamental feature in atrypids (Hall & Clarke, 1894; Thomas, 1916; Fenton & Fenton, 1932*b*; Ivanova, 1962). The correct interpretation is, however, difficult, because of infrequent and poor preservation of this element of ornamentation in fossils.

In the present collection traces of concentric lamellae have been observed on specimens of different individual age of various species of the genera *Atrypa* and *Desquamatia*. As a rule, they are preserved as more or less thickened and distinct lines of lamellae, representing the bases of concentric lamellae. Often, minute and fragile fragments of lamellae, to about 4 mm. long, are preserved in immature and mature specimens of e.g. *Atrypa subtrigonalis* n.sp. and *A. depressa* Sobolev, from the shales. They clearly reflect the characteristic surface ornamentation.

In the mentioned deposits, the concentric lamellae in *A. depressa* and *A. subtrigonalis* may not have been broad, this is, however, difficult to prove on the basis of the available material. Their presence on specimens of different individual age confirms the supposition, that lamellae could cover the whole shell surface of the living animal (Hall & Clarke, 1894; Fenton & Fenton, 1932*b*; Ivanova, 1962). On mature shells from Skały the preserved lamellar fragments are crowded anteriorly, being arranged subparallel one above the other. In that way, the lamellae, often fragile, are reinforced, having a chance of, at least, fragmentary preservation in

fossil state. On shells of young individuals the lamellar appearance of concentric lines is often retained. They are widely but evenly spaced over the entire shell surface. It is evident, that with growth the lamellae in the posterior half of the shell were gradually wiped away, while those in the anterior part of the shell, being stronger, probably persisted during a considerable part of the animals life.

A few only specimens of *Atrypa depressa* Sob. and *Desquamatia zonatoides* n.sp. show large concentric fringes, impressed in the limestone and reflecting the surface radial ornamentation of atrypids (Pl. I, fig. 14). They enlarge the shell dimensions, extending anteriorly, from the antero-lateral margins. As has been shown by Fenton & Fenton (1932, Pl. 21, fig. 5; Pl. 23, fig. 7) the fringes can be very large, greatly exceeding in breadth the shell dimensions. Ivanova (1962) states that on well preserved specimens of *Atrypa vulgariformis* Alekseeva, the length of fringes may be even three times the length of shell, probably acting as supports for the living brachiopod in the soft sea bottom.

As is shown by the present material, the state of preservation of concentric lamellae appears to be connected with the lithofacies, while their degree of development is dependent upon the environmental conditions. The presence of concentric lamellae, together with some internal features, are considered as diagnostic for genera (as is also suggested by Alekseeva, 1962), while their degree of development and arrangement on the shell surface are one of the features diagnostic for species.

Spines

Spines are important and a diagnostic element of ornamentation of the genus *Spinatrypa* (Stainbrook, 1945; Alekseeva, 1962). Together with the concentric lamellae and pedicle they apparently served as support to the shell of the living animal. Their function seems to be similar to that of the hinge spines of the chonetids or surface spines of productids.

The present collection contains several specimens of different species of the genus *Spinatrypa*, with fragments of spines. They are observed also in *Spinatrypa fasciplicata* (Struve), in which even small fragments of concentric lamellae are rarely preserved. The fragments of spines vary in length, occasionally being 3-4 mm. long. In *Spinatrypa aspera* (Schl.) the spines are hollow and very delicate as are the concentric lamellae in the representatives of *Atrypa* and *Desquamatia*, collected from marly shales (p. 287). In *Spinatrypa dorsata* n.sp. e.g. the spines have somewhat thicker walls and their lumen is often closed, possibly as a result of fossilization. The spines vary in diameter, often being about equal to the thickness of the costae, but sometimes are half their thickness or even less. According to Jux (1962, fig. 1) the spines may be thin, thick, irregularly curved, long, sometimes branching.

In *Spinatrypa aspera* (Schlotheim) and *S. dorsata* n.sp. (in the present

collection) the spines are observed mostly in the anterior portion of the shell and anterior to the hinge angles. During life they have been directed laterally and probably posteriorly, thus really facilitating the shell balance.

The number of spines and their spacing are connected with the number of radial costulae and concentric lines, e.g. with the individual age of the animal. They are formed at the crossing points of radial costulae with the concentric lines. Some small thickenings, often observed at the crossings, may suggest traces of spines.

In all probability, the spines never covered the whole shell surface of the living animal. No fragments of spines have been observed on the posterior portion of the shell, either in youthful or mature individuals. On a separate brachial valve of immature *Spinatrypa aspera* (Schl.) — about 4 mm. in length, there are 9 distinct spine fragments, occupying the anterior portion of the shell. Their number corresponds exactly to that of radial costulae. Jux (1962), on the posterior portion of the shell of „*Atrypa aspera*”, has observed only concentric lamellae and, therefore, supposes a complete lack of spines on that part of the shell of the living animal.

Thus it may be said, that with progressive growth the spines were developed along the antero-lateral margins of the shell, but were destroyed during the life of the growing animal.

Interior — Teeth and dental plates

All studied atrypids show the teeth well developed. They are in general large, crenulated, similarly as the deep dental sockets. The crenulation obviously strengthened the hinge of the living animal.

The dental plates in atrypids can be more developed or less (*Desquamatia*, *Spinatrypa*) or be obsolete (*Atrypa*). Immature individuals of the genus *Atrypa* have dental plates poorly developed, becoming obsolete in maturity (Text-fig. 5, 6). Adult specimens show thick and very short supports, approaching the walls of the pedicle valve, which seem to correspond to the “stout pedestals” observed in *Atrypa reticularis* by Alexander (1949, p. 210) or to the supporting plates of Alekseeva (1962, p. 22).

Within the genera *Spinatrypa* and *Desquamatia* the dental plates are preserved in maturity. They appear to be less distinct in *Spinatrypa*, while in *Desquamatia* they are well developed (Text-fig. 18). But in none of the studied species of *Desquamatia* are the dental plates as well developed as those in the Volhynian representatives of this genus (Kelus, 1939, Text-fig. 19, 22-24), such as e.g. *Desquamatia parazonata* (Kelus), *Desquamatia ventricosa* (Kelus) and *Desquamatia regularis* (Kelus).

According to some authors (Ivanova, 1943, p. 274; Alekseeva, 1962, p. 22) the dental plates served as the place of attachment of the pedicle

muscles. This opinion is confirmed by the present author's observations. Species showing developed dental plates, e.g. *Desquamatia subzonata* n.sp. and *Spinatrypa aspera* (Schlotheim), have an apical pedicle foramen. The apical cavity is deep without any traces of secondary thickening usually observed in atrypids (see Pl. V, fig. 5; IX, fig. 3,5). One may conclude that the pedicle was functional almost throughout the animals lifetime — except probably in the gerontic stage. This would account for the presence of dental plates to which the pedicle muscles were attached. On the contrary, in atrypids, e.g. *Atrypa subtrigonalis* n.sp. or *Atrypa depressa* Sobolev, with obscured or lacking dental plates, a functional pedicle is absent. The pedicle probably disappeared early in the growth process, before maturity was attained. With age the pedicle foramen became obsolete, the apical cavity strongly thickened, filled by a shelly substance (Pl. XV; Text-fig. 7, 8).

These observations can support the statement of Alekseeva (1962, p. 22) who connects the presence of dental plates with the degree of incurvature of the ventral beak, hence with the presence of a functional pedicle. Its connection should also be stressed with the convexity of the shell. One may suggest from the here studied material, that the pedicle could be functional as long as a certain "equilibrium" was preserved in the convexity of both valves of the shell. Thus the pedicle was functional as long as the shell was moderately biconvex and small ventral beak was suberect, e.g. immature individuals of *Atrypa subtrigonalis*, immature and mature specimens of *Desquamatia subzonata* n.sp. (Text-fig. 9, 16; Pl. I, fig. 3, 9; VIII, fig. 2, 6). With growth this "equilibrium" was disturbed, e.g. the convexity of the brachial valve gradually but slowly exceeded the convexity of the pedicle valve and finally the shell became dorsi-biconvex (Text-fig. 7, 8). As a result, the small beak of the pedicle valve is more and more incurved, so as to almost overlap the brachial valve. Thus the pedicle foramen was concealed and the pedicle atrophied.

Muscle area

The brachial muscle area in the genera *Atrypa*, *Spinatrypa* and *Desquamatia* displays a close resemblance. As a rule, it is always smaller than the pedicle muscle area, being situated in the posterior third and in general occupying one third or a little over of all the valve length. The size of the brachial valve muscles seems to be connected above all with the general dimensions of the shell. This last feature varies greatly in many species.

The brachial muscle area may be nearly ovate or subrounded in outline with antero-lateral margins rounded, being divided by a low median septal ridge. In all the atrypids, except the genus *Carinatina*, this ridge is medially grooved, only the length of groove varying (Pl. XV, fig. 8-10). It is on the whole uniformly narrow and distinctly marked throughout

its length. In some cases, e.g. in *Desquamatia subzonata* n.sp. (Pl. IX, fig. 8) it can deepen slightly and widen anteriorly. It appears that this groove has not been observed by Alexander (1948), as she does not mention it in *Atrypa reticularis* (L.). As a rule, it is lacking in atrypids from the Devonian of U.S.S.R. (Minusinsk Basin) being very faintly marked only in *Atrypa (Desquamatia) kurbesekiana* Ržonsnickaja (Alekseeva, 1962). Its trace can be observed also in *Atrypa reticularis teicherti* Coleman (Veevers, 1959, Text-fig. 70, section 4,5).

The septal ridge, in general, begins about the base of the crural plates as a very flat and broad median platform, which is continued anteriorly as a narrow, distinctly grooved median ridge. In some genera there are but very small differences in its appearance. In *Atrypa* and *Spinatrypa* this septal ridge is rather short, usually starting near the boundary of the posterior and anterior adductor scars, slightly bordering the front edge of the posterior adductor muscles (Pl. XV, fig. 7, 9, 10). In *Desquamatia (D. subzonata)* it is much longer, dividing the whole muscle area and extending beyond the front end of the anterior muscles (Pl. IX, fig. 8).

This difference is small, based on insufficient material (only two separate brachial valves of *D. subzonata*). It may be possible that it is a constant feature and thus would have additional diagnostic value on the generic level, at the same time emphasizing some differences between *Desquamatia* and *Atrypa*.

The muscle area of the investigated brachial valves of atrypids closely resembles the brachial myodiagram of *Atrypa reticularis* (L.) from the Lower Couvinian argillaceous limestone of Belgium (Vandercammen & Lambiotte, 1962, fig. 4). On the whole, it corresponds to the muscle area of *Atrypa reticularis* (L.) as reconstructed by Alexander (1948, fig. 2). Some differences are small and concern the arrangement and size of each pair of muscles. The general outline and size of adductors in the brachial valve is almost the same in all atrypids. It seems, however, that the relation of the size of the posterior adductors to that of the anterior ones is not so constant as is shown by Vandercammen (1962, fig. 4). These two pairs of adductor muscles may be of equal size, as has been shown by Alexander (1949, fig. 2) or, as indicate the here studied specimens, the anterior adductors may be larger than the posterior ones.

Pedicle muscle scars have been not observed in *Atrypa*. Their probable absence in maturity may be explained by the early atrophy of the pedicle in this genus (see p. 290). Very faint traces of the mentioned muscles can be observed in separate brachial valves of e.g. *Spinatrypa aspera* (Schl.) and *Desquamatia subzonata* n.sp.

The scars of two pairs of diductor muscles are distinct in the posterior portion of the notothyrial cavity and also on posterior parts of the crural plates (Text-fig. 4). The principal diductor muscles

seem to be always well preserved, probably due to their placement in the notothyrial cavity. They were attached in a groove, between the posterior crural bases (this would support Alexander's interpretation, 1949, p. 212) and also probably on the lateral walls of these bases. Vandercammen & Lambiotte (1962, p. 9) suggest that the brachial pedicle muscle could be attached to these walls, however, no trace of myophores were observed in their specimens.

In our material, e.g. *Atrypa depressa* Sob., *A. subtrigonalis* n.sp. the myophores of principal diductor muscles are marked as longitudinal, sub-parallel incisions and uniformly faint ridges (Text-fig. 4). They would correspond to Vandercammen's "lamelles verticales" (1962, p. 5), but differ, however, in being always simple, of almost equal thickness, throughout their length, without a tendency to thin out or bifurcate posteriorly, as has been stated by the authors just mentioned.

The accessory diductor muscles are small and rather indistinct, being in general very rarely preserved. Their traces have been observed in several separate brachial valves. They are placed higher in comparison with the principal diductor muscles never being in the groove, but always on the upper posterior surfaces of the crural plates (Text-fig 4). These myophores are distinct, expressed as transverse incisions, nearly perpendicular or slightly oblique to the principal diductor muscles. Hence the position of these two diductor pairs is slightly different, i.e. they do not directly overlie one another as is shown by Vandercammen & Lambiotte (1962, fig. 4), but the accessory diductor muscles are placed on either side of the principal diductors. On many serial sections of the studied atrypids the scars of the two mentioned muscles are well marked as a fairly thick layer of calcareous substance (lighter than the remaining elements of internal structure), with numerous incisions, covering the bottom of the notothyrial cavity, its lateral sides and upper surfaces of the crural plates.

Cardinal process

The presence of the cardinal process is considered here to be one of the characteristic features of atrypids. Vandercammen and Lambiotte (1962) were the first to observe this process in *Atrypa reticularis* (L.) it being placed in the posterior part of the notothyrial cavity, laterally bordered by the internal walls of the brachiophores, marked as a short, concave element covered by vertical lamellae. According to the above authors, the principal and accessory diductor muscles were attached to the lamellar surface of the cardinal process. These data were, however, based on scanty material: 18 moulds of *Atrypa reticularis* (L.).

In our atrypid genera (*Atrypa*, *Spinatrypa*, *Desquamatia*, *Gruenewaldtia*) the cardinal process is similarly developed and was observed both in separate brachial valves and in sectioned shells. It is placed in

the notothyrial cavity, somewhat similar as in spiriferoids (Vandercammen, 1963, i.e. fig. 81. 89) and consists of distinct incisions extending down the notothyrial cavity, spreading laterally on the brachioophores (Text-fig. 4), its surface serving as an area for diductors attachment (Pl. XV, fig. 7-11). The notothyrial cavity is, as a rule, fairly deep and regularly concave, gradually becoming shallower in old individuals, when a faint median longitudinal ridge can occasionally appear. This latter is a sign of gerontic stage and should not be mistaken for some element of internal structure.

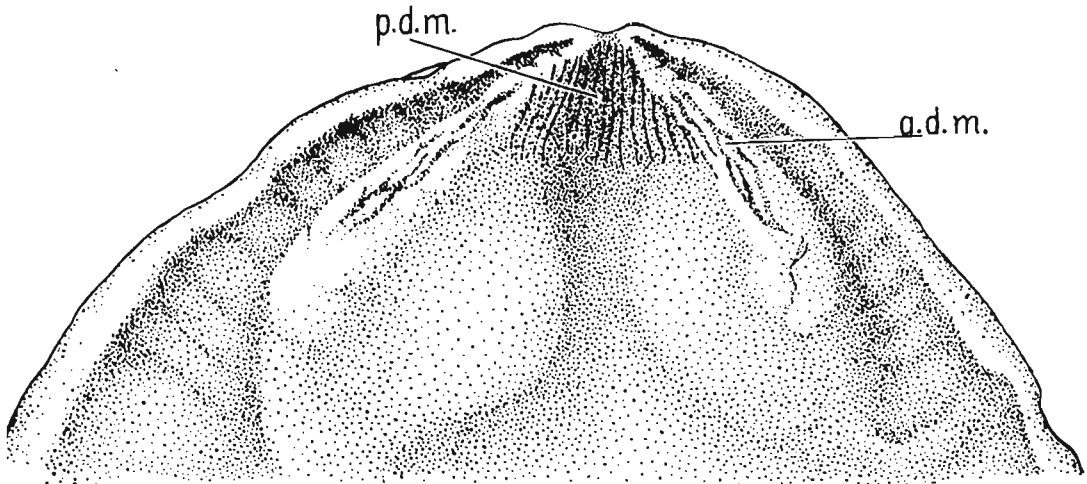


Fig. 4. — *Atrypa depressa* Sobolev (Bp. VI/34), appearance of brachial valve posterior diductors attachment; $\times 15$

p.d.m. scars of principal diductor muscles, a.d.m. scars of accessory diductor muscles.

In the genus *Carinatina* Nalivkin the cardinal process is also developed. As far as can be judged from literature, this has not previously been observed in this genus. Nalivkin, in the diagnosis of *Carinatina* (1930), and recently Siehl (1962) and Alekseeva (1962), made no mention of it. In *Carinatina plana* (Kayser) from the Skaly beds the cardinal process observed in serial sections is low, in the form of a longitudinal and broad thickening, showing a distinct myophore for diductors. The myophore is marked as longitudinal incisions and low ridges, analogous to those observed in the notothyrial cavity of other atrypids (Text-fig. 5). On serial and thin sections this myophore is expressed as a crenulated calcareous layer (e.g. Text-fig. 19).

Vascular system

The pallial sinuses in the studied specimens are partly preserved only on the pedicle valves of *Atrypa depressa* (Pl. XV, fig. 3-6), *Desquamatia subzonata* n.sp. and *Spinatrypa aspera* (Pl. V, fig. 11). In the above species the pattern of sinuses seems very much the same and resembles

greatly that of "*Atrypa reticularis*" Gmelin, figured by Sandberger on the Pl. 33, fig. 1 (1852—54), and of *Atrypa reticularis* (L.) figured by Vandercammen & Lambiotte (1962, Text-fig. 5).

In the pedicle valve of *Atrypa depressa* a pair of vascula media is clearly visible between the anterior margin of the muscle area and anterior margin of the valve. The vascula media branches off 2-4 times on either side of the valve, at first a small distance from the principal diductor muscles, then each of these branches bifurcates once again towards the antero-lateral margins of the shell (Pl. XV). The separate brachial valves of atrypids are fragmentary and show a poorly preserved part of vascula media (see Pl. XV, fig. 9).

The vascular system in the majority of brachiopods and also in atrypids is not as yet systematically and comparatively studied.

Growth changes in some atrypids

In atrypids as in other brachiopods changes during growth are fairly strong. These concern above all the ornamentation, convexity of the shell, shell outline and to some extent the appearance of the pedicle valve beak. Obviously these changes become particularly great when immature specimens (up to 3 mm. long) are compared with mature ones (up to 24 mm. long). A fairly accurate picture of the growth changes is also obtained by comparing specimens of about 1.4 mm. long, with those 8-9 mm. long. Specimens 7-8 mm. of length greatly resemble shells of mature individuals and identification of the species is rather not too difficult.

The observations regarding the growth process in atrypids concern shells of *Atrypa subtrigonalis* n.sp., *A. depressa* Sob., *Spinatrypa aspera* (Schlotheim), *Desquamatia subzonata* n.sp. — all from shales, complex XIV (see p. 280, 282), showing the successive growth stages fairly preserved. Juvenile specimens, 0.6-2.5 mm. in length, are not numerous. Each of the studied species is represented by only a score or so specimens. The numerous are shells in adult and gerontic stages. In general, the representatives of 3 genera, which are 0.9-1.5 mm. long, are almost identical (externally) in:

- 1) convexity of shell — all specimens being gently ventri-biconvex;
- 2) number and appearance of the primary costulae;
- 3) nearly contemporaneous dichotomous bifurcation of the median costula and the corresponding intercalation on the brachial valve, starting about 0.4-0.5 mm. from both apices;
- 4) faint sulcus and keel;
- 5) subround to round shell outline.

With growth all these features are more changeable or less.

In spite of these great similarities, it is possible to distinguish the representatives of the 3 studied genera (even before the shells have reached

full size) by the size and position of the pedicle valve beak, shape of the pedicle foramen and the degree of development of area.

Immature specimens of the genus *Desquamatia* differ from *Atrypa* and *Spinatrypa* in some external features. Thus, in contrast to the two latter genera, the outline in e.g. *D. subzonata* is nearly ovate, with more prominent and suberect the pedicle valve beak, and relatively large pedicle foramen. With growth the shell has length nearly equal to the width, being biconvex to ventri-biconvex with ovate pedicle foramen, limited by the deltidial plates tending to be fused together. The developing delicate radial ornamentation is one of the distinguishing features of *Desquamatia*.

The juvenile specimens of *Atrypa* and *Spinatrypa* are nearly inseparable morphologically, as is shown by the present material and some observations of Alekseeva (1962, p. 31). It is expressed in the pattern of ornamentation and appearance of the pedicle valve beak, which is small and tilts backwards instead of being incurved (Text-fig. 3 (1, 2), 9 (1c), 13 (2b)). It is not until the shell attains a length of 2.1 mm. that the beak rises slightly above the hinge. With a weakly developed beak seems to be connected a subrounded shell outline in *A. subtrigonalis* and a rounded in *S. aspera*. In both species the keel is present, being more distinct in *A. subtrigonalis*. With growth the differences are more marked, especially with regard to the pattern of ornamentation and the outline of the pedicle foramen (apical and rounded in *Spinatrypa aspera*).

In review of the above growth changes it can be said that the 3 genera, although are related, but constitute distinct taxonomic units, differing in the external (and also internal) morphology. Their differentiation, not very strong during juvenile stages, is accentuated at the end of the shell morphogeny (up to 5-7 mm. of length). Genus *Desquamatia* differs from *Atrypa* and *Spinatrypa* already in immature stage (up to 3 mm. of length) in its external appearance. In addition, it seems reasonable to include the all group of "*Atrypa zonata*" Schnur into a separate genus *Desquamatia*, according to Alekseeva, 1962: *Atrypa (Desquamatia)*.

SYSTEMATIC PART

Superfamily **Atrypacea** Schuchert & Le Vene, 1929

Family **Atrypidae** Gill, 1871

Subfamily **Atrypinae** Waagen, 1883, emend. Poulsen, 1943

Genus ***Atrypa*** Dalman, 1828

Type species: Atrypa reticularis (Linnaeus, 1758); see Alexander, 1949, p. 208-213, Pl. 9, figs. 1 a-d; Silurian, ?Mulde Margelstein of Gotland.

Atrypa depressa Sobolev, 1904

(Pl. I, fig. 1-8, 9, 11, 13, 14; XV; Text-fig. 3 (1), 4, 5)

1904. *Atrypa reticularis* L.; D. Sobolev, Devonskija otloženija, p. 82, Pl. 9, fig. 3-5.1904. *Atrypa depressa* Sobolev; D. Sobolev, *Ibid.*, p. 85, Pl. 9, fig. 9.?1909. *Atrypa reticularis* L.; D. Sobolev, Srednij Devon..., p. 487.

Material. — 250 free, almost entire shells, 20 separate pedicle valves, 4 brachial ones. Some of specimens greatly deformed to allow measurements. All specimens come from Skaly: Skaly beds, complex XIII, outcrop 72; complex XIV, outcrop 73; complex XV, outcrop 75; complex XVII, outcrop 83; Lower Givetian (?Upper Eifelian).

Dimensions of 10 specimens (in mm.):

Cat. No. Z. Pal. Bp. VI/	Length	Width	Thickness	Number of costulae in 1 mm	
				posteriorly	anteriorly
1	7.0	8.5	3.3	—	—
2	11.7	12.1	4.7	3	2
3	15.0	16.8	6.7	3	2
4	17.0	17.2	7.9	—	—
5	18.4	19.8	10.9	3	2
6	20.8	19.0	16.8	—	—
7	21.4	21.7	12.7	3	2
8	21.5	21.6	12.5	—	—
9	22.4	24.3	11.9	—	—
10*	24.4	21.0	18.1	—	—

Number of concentric microlines in 1 mm.: 10—13

* gerontic specimen

Description. — Shell of medium size, subquadrate to longitudinally ovate in outline; length greater or less than width, widest about midlength. *Pedicle valve* moderately convex umbonally, depressing anteriorly by a shallow sulcus; beak slightly projecting. *Brachial valve* regularly arched along midline with the greatest convexity posterior to the midlength.

Ornamentation. Branching radial costulae distinct, intercalation present, concentric lamellae usually prominent at the anterior commissure, in some cases 3-4 mm. long, reflecting the radial ornamentation.

Interior (Text-figs. 4, 5; Pl. I. fig. 13, Bp VI/14). *Pedicle valve*: teeth large; dental plates not preserved; apical cavity thickened; scars of adductors and diductors distinct; vascular sinuses well preserved in a few valves (Pl. XV). *Brachial valve*: myophores in notothyrial cavity and posteriorly on the crural plates usually preserved, scars of adductors well marked.

Growth changes (Text-fig. 3, 1 a-c, Bp. VI/11; Pl. I, fig. 1-7, 9, Bp. VI/26-31, Bp. VI/32). — The changeable features during growth (specimens from about 1.1 mm. to about 25.5 mm. in length) are the following:

1. *Shape*. Shells to about 7 mm. long are nearly gently biconvex and subcircular in outline. With growth, to about 18 mm. long or more they become proportionally wider with the brachial valve deeper and the pedicle valve depressed anteriorly. Mature specimens have in general rather flattened pedicle valve with shallow and narrow sulcus.

2. *Posterior part of the shell*. Specimens to about 1.5 mm. long are faintly convex umbonally and have moderately rounded posterior margin of the pedicle valve, beak not pointed. With growth, to about 8 mm.

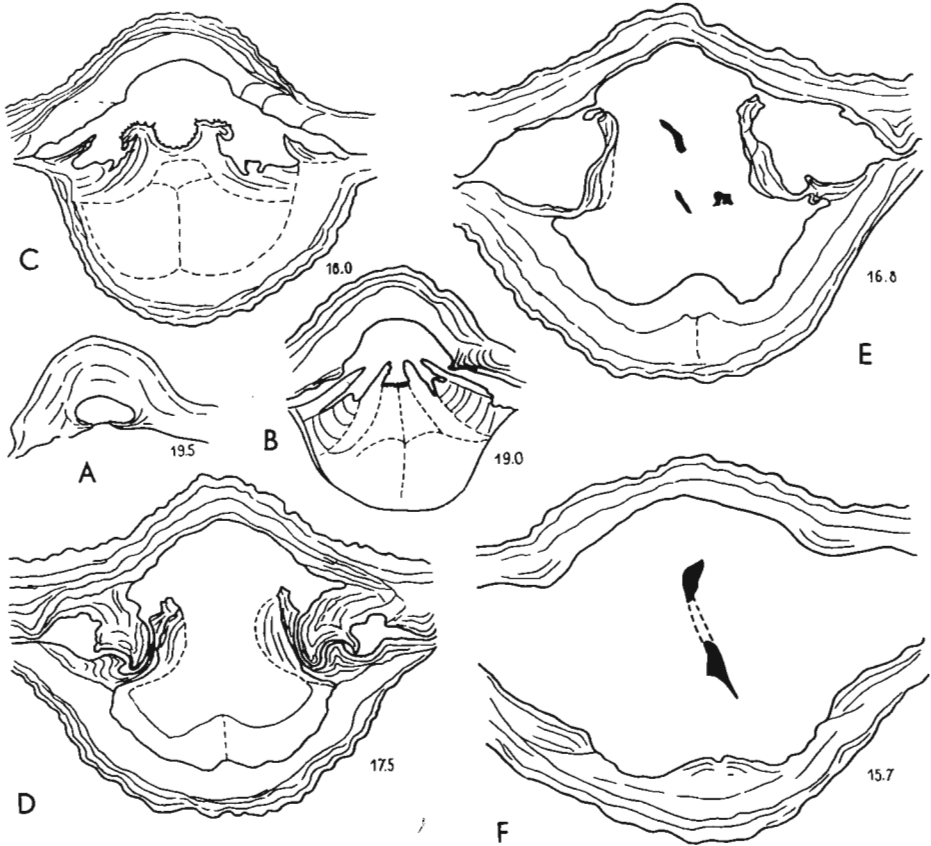


Fig. 5. — *Atrypa depressa* Sobolev, serial sections of a specimen from Skały: A length 20.8 mm., width 18.9 mm., thickness 13.5 mm. Sections show myophores in the notothyrial cavity (B), myophores of diductors on the crural plates and in the notothyrial cavity (C), teeth (D), grooved median septal ridge (F); approx. $\times 5.2$

long, the pedicle valve beak slightly enlarges, being more acute. In maturity it is incurved, pressing down to the brachial valve in an older stage. Pedicle foramen subovate in immature growth stage becomes finally nearly rounded in specimens to about 18 mm. of length and obsolete in mature specimens.

3. *Ornamentation* (Text-fig. 3, 1 a-c). The first costulae appear at a distance of about 0.4 mm. from the apex, 5 on the pedicle and 4 on the

brachial valves. The median on the pedicle valve is especially noticeable, tending to be enlarged, more elevated and to be bifurcated in specimens to about 1 mm. in length. Further development of radial ornamentation is similar to that in *Atrypa subtrigonalis* n.sp., as shown on the Text-fig. 9. It might be mentioned that the ornamentation in the younger growth stages is distinct and the costulae increase in a rather regular way. The species has that feature in common with *Spinatrypa aspera* (Schlotheim), see Text-fig. 13. In a mature stage the radial costulae in *Atrypa depressa* Sob. differ rather markedly in comparison with those in *Spinatrypa aspera* (Schlotheim), being more numerous, increasing by bifurcation and intercalation.

Individual variability. — One of the variable feature of the species is appearance of the costulae. This variability concerns their size and number. In some specimens the costulae are larger and thicker, in others — one to two times narrower and more numerous.

There are also changes in the shell outline which varies in keeping with some variation of the hinge-line width. Specimens are subtrigonal in outline, show the greatest shell width lying anterior to the hinge-line. Their cardinal angles are gently obtuse, or show small alar extensions. Specimens of subquadrate outline have the greatest width almost across the middle or anterior to it. Lateral margins can be gently rounded, being always convergent anteriorly.

Remarks. — *Atrypa depressa* Sobolev is the commonest species in the outcrops of the Skaly beds. It differs from *Atrypa subtrigonalis* n.sp. in having less convex pedicle valve and much more distinctly expressed radial costulae. In comparison to *Atrypa vulgaris* Ljaschenko (Aleksieva, Pl. 2, 1962) from the Devonian of Kusbas, *Atrypa depressa* Sob. differs mainly in being smaller and in having a less convex brachial valve.

Atrypa subtrigonalis n.sp.

(Pl. II; Text-fig. 6, 7, 8 (1 a-c), 9)

1896. *Atrypa reticularis* var. *trigonalis* Gürich; G. Gürich, Das Paläozoicum..., p. 270 nomen nudum).

Type specimen: Bp. VI/251, figured on Pl. II, fig. 3.

Type horizon: Lower Givetian (?Upper Eifelian), Skaly beds, shales, complex XIII, outcrop 72.

Type locality: Skaly, Lysogóry region, Holy Cross Mountains.

Derivation of name: *subtrigonalis* — nearly triangular in outline.

Diagnosis. — *Atrypa* of nearly trigonal outline with median keel on the pedicle valve; radial costulae subdued, in general nearly of the same size on the umbonal part and at the anterior margin.

Material. — 80 free specimens of different size, 2 brachial valves of younger individuals with preserved internal details; some shells greatly

deformed. All material comes from Skaly: Skaly beds, Lower Givetian (?Upper Eifelian-Lower Givetian), shales and marles; complex XIII, outcrop 72; complex XIV, outcrop 73; complex XV, outcrop 76. The species occurs together with *Spinatrypa fasciplicata* (Struve), index fossil for Upper Eifelian in Rhine region.

Dimensions of 8 specimens (in mm.):

Cat. No. Z. Pal. Bp. VI/	Length	Width	Thickness	Breadth of sulcus	Number of costulae in 1 mm.	
					posteriorly	anteriorly
255	16.0	17.1	8.5	—	3	3
254	16.5	17.0	8.9	—	3	3
253	19.4	18.8	11.5	—	3	3
259	20.4	20.8	13.0	8.5	3	3
251*	20.4	19.7	11.7	8.6	—	—
260	22.4	22.0	11.5	12.9	3	3
257	23.0	22.6	14.9	12.5	3	3
256	23.7	25.3	15.0	13.0	3	3

* holotype

Description. — Outline subtrigonal to trigonal; shell width nearly equal to the length or a little smaller; lateral margins rounded, anterior commissure uniplicate, forming in adults a tongue. *Pedicle valve*: median keel observed on the posterior half of the valve; beak small, in olds nearly pressed to the brachial valve. *Brachial valve* deeper than the opposite valve, regularly convex.

Ornamentation. Radial costulae are lowly rounded, subdued, increasing by intercalation and bifurcation. They are close together, 3 occupying 1 mm. of the shell surface at the umbo and anterior margin. Concentric lamellae prominent, arranged at nearly regular intervals (1-1.5 mm.) over about 3/4 of the shell length, crowded anteriorly; flatly costulate lamellar extensions sometimes about 2-3 mm. long. Concentric microlines if preserved closely spaced, numbering about 9-12 in 1 mm. of the shell surface.

Interior (Text-fig. 6; Pl. II, fig. 6, 7; Bp. VI/262-263). *Pedicle valve*: umbonal cavity thickened; deltidial plates scarcely observed in cross sections. *Brachial valve*: median septal ridge low, grooved medially on its anterior third.

Growth changes (Text-fig. 7, Bp. VI/251, 257, 258; Text-fig. 8, (1 a-c), Bp. VI/259; Text-fig. 9, Bp. VI/264-268). — The collection includes specimens from a length of about 1.4 mm. long and 1.4 mm. wide to about 24 mm. long and 26 mm. wide. There are several features undergoing to some changes with growth:

1. *Outline.* Shell is rounded in immaturity, from a length of about 4 mm. it becomes more ovate or nearly subtrigonal, with antero-lateral

margins broadly rounded or narrowing anteriorly. The final subtrigonal to trigonal outline may be reached at widely different sizes, by specimens of a length from about 6 to 22 mm.

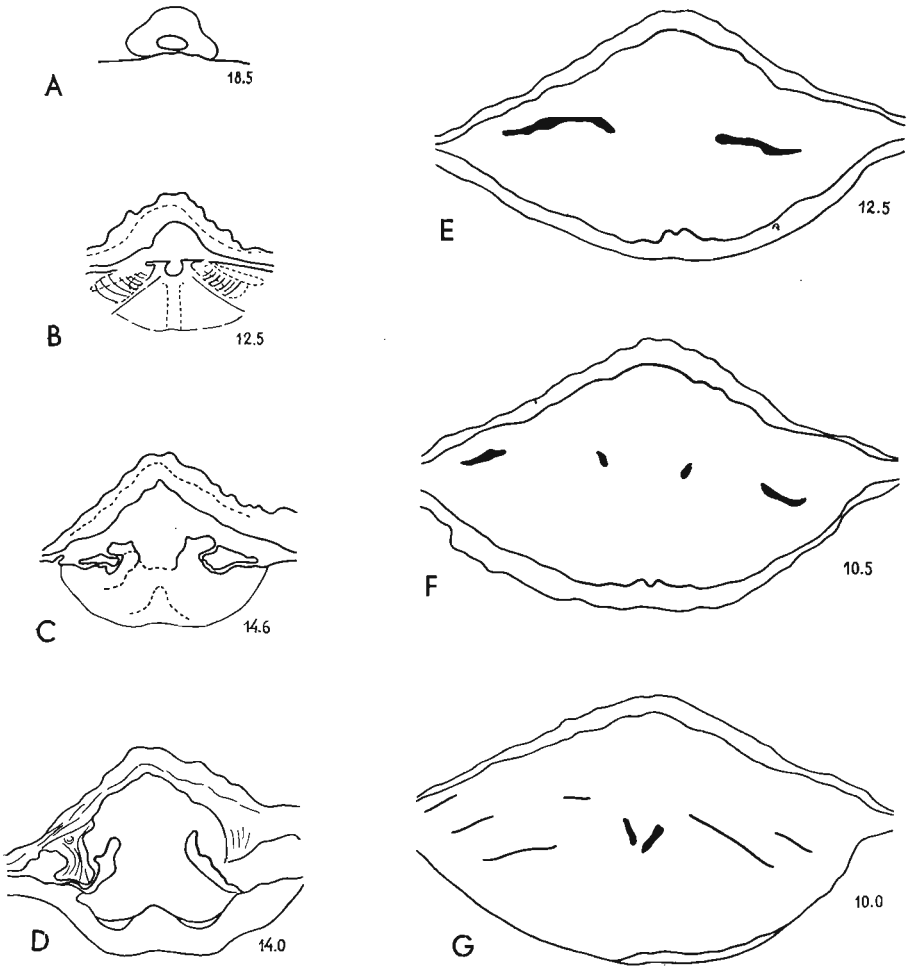


Fig. 6. — *Atrypa subtrigonalis* n.sp., serial section of 2 specimens from Skaly (Bp. VI/261): A length 18.4 mm., width 19.2 mm.; section shows thickened umbonal cavity. B-G length 15.7 mm., width 15.8 mm.; sections show divided hinge plate (B), teeth (C,D), grooved median septal ridge (E,F); $\times 5.2$.

2. *Anterior commissure*, straight in immature stage, becomes with growth more uniplicate. The tongue is a gerontic feature, beginning in immaturity, and may attain a different degree of development.

3. *Pedicle valve beak*. In specimens about 1.4 mm. long is not or scarcely prominent. With growth it very slowly enlarges. Mature specimens have small beak but greatly incurved, pressing down to the brachial valve.

4. *Ornamentation.* It is not very changeable. The costulae appear on a distance of about 0.3-0.4 mm. from both apexes, with growth increasing by bifurcation and intercalation, and appear to be of nearly equal width during the growth.

Individual variability. — The species does not appear to be very variable in its features of external morphology. Variation in the shell outline is insignificant for specimens of about the same size and individual age.

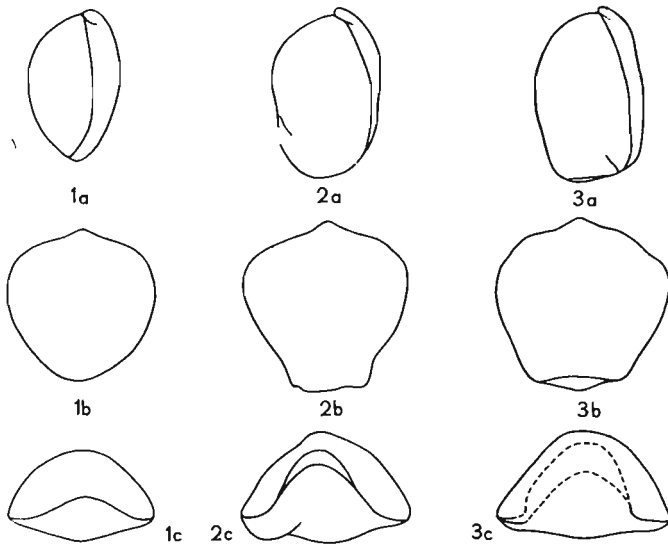


Fig. 7. — *Atrypa subtrigonalis* n.sp. (Skaly), three mature specimens of different thickness, in side, ventral and anterior views, showing trigonal to subtrigonal shell outline (1b-3b) and linguiform extension of the anterior margin (2b-3b); nat. size (Bp. VI/251, 257, 258).

A little variation can be observed in the thickness of the shell. Surface ornamentation is rather constant, much more than in other species of atrypids.

Remarks. — The new species in comparison with *Atrypa reticularis* (L.) figured by Alexander (1949, Pl. 9, fig. 1 a-d), differs slightly in the shell outline, having finer radial costulae and a more acute beak of the pedicle valve. It bears some external resemblance to *Atrypa (Atrypa) tenuicostata* Alekseeva (1962, p. 47, Pl. 2, fig. 7) from the Middle Devonian (Eifelian) of Kusbas, in having low and flat radial costulae, but it differs in a more trigonal shell outline and more closely spaced concentric lamellae. It seems to be very close to *Atrypa reticularis* (L.) from China, Wangchia formation of the Middle Devonian of Changuli, Kansu (Grabau, 1931, p. 183, Pl. 21, fig. 1). Distinguishing features are more ovate outline, thicker pedicle valve umbo and concentric lamellae closely set in the Chinese species.

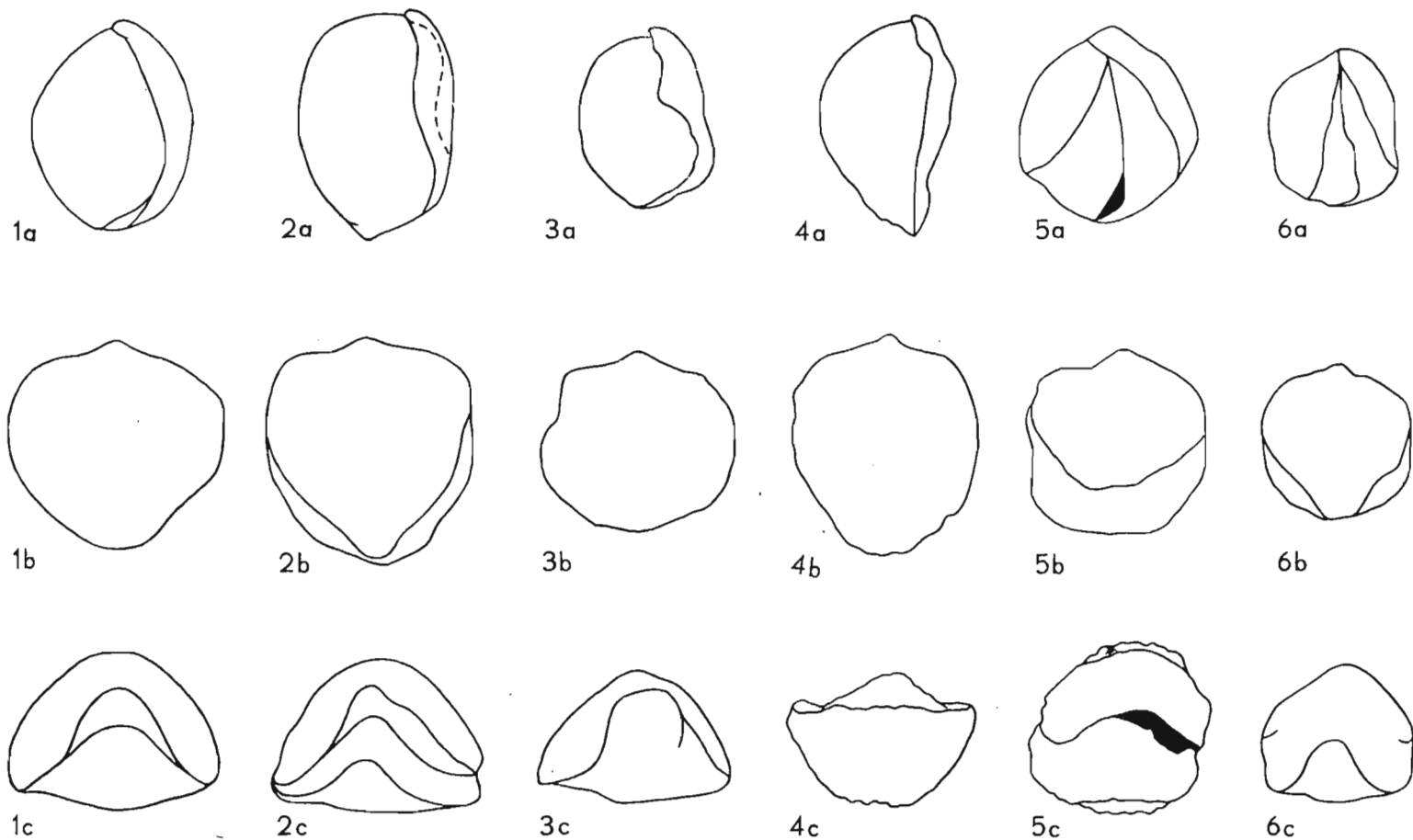


Fig. 8. — Six gerontic specimens: 1 *Atrypa subtrigonalis* n.sp. (Bp. VI/259), 2 *Atrypa depressa* Sobolev, 3 *Desquamatia subzonata* n.sp. (Bp. VI/462), 4 *Spinatrypa dorsata* n.sp. (Bp. VI/343), 5 *S. aspera* (Schlotheim) (Bp. VI/360), 6 *S. asperoides* n.sp. (Bp. VI/382); $\times 2$.
 a lateral view, b pedicle valve view, c anterior view.

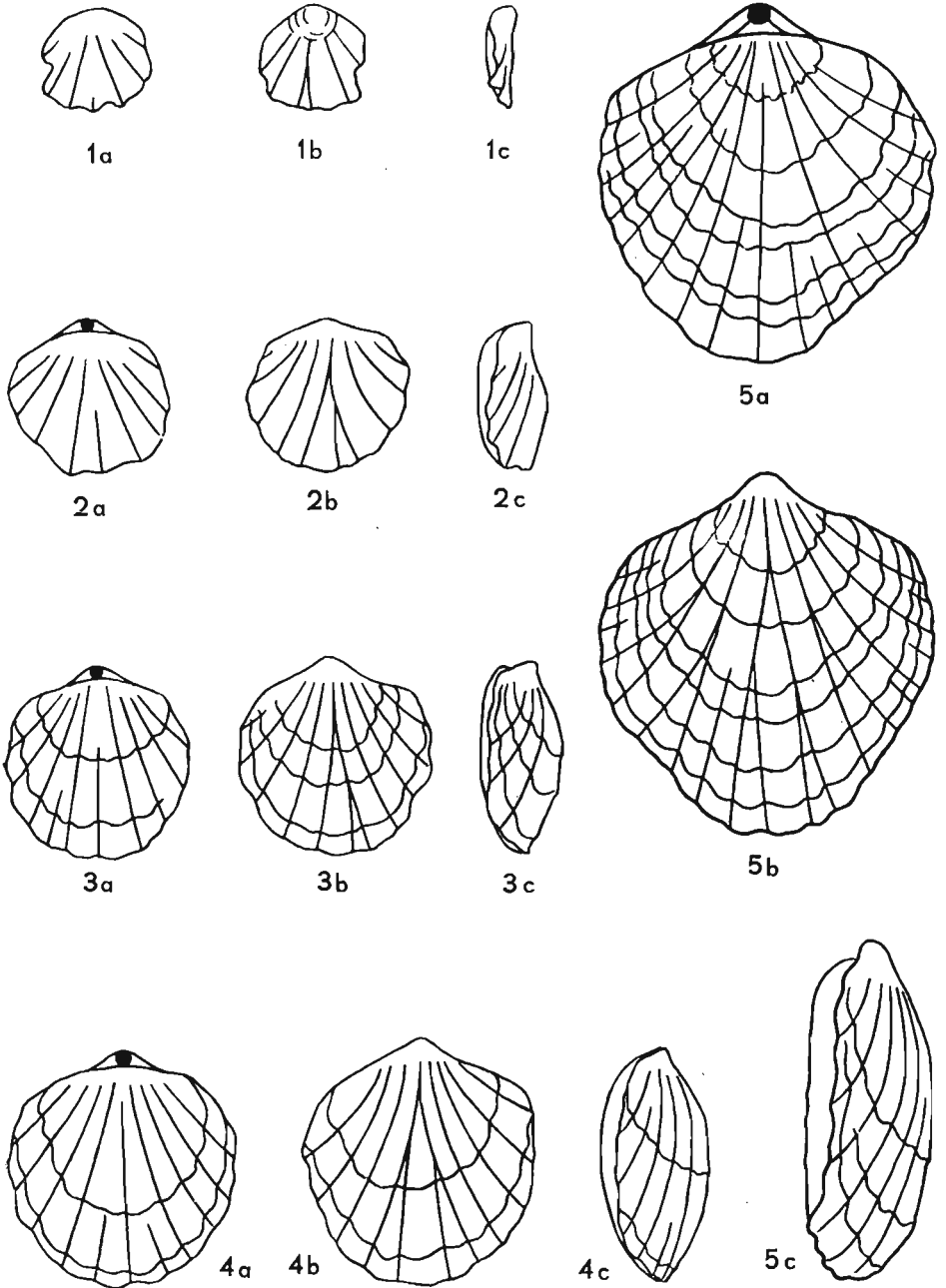


Fig. 9. — *Atrypa subtrigonalis* n.sp., 1—4 appearance of the radial costulae during the growth, 5 adult individual (Bp. VI/264—268); $\times 10.2$
 a brachial valve view, b pedicle valve view, c lateral view.

Atrypa squamifera (Schnur, 1853)

(Pl. I, fig. 10, 12)

1853. *Terebratula squamifera* Schnur; J. Schnur, Zusammenstellung..., p. 181, Pl. 24, fig. 4 a-d.

Diagnosis. — Shell of medium size, dorsi-biconvex, subquadrate in outline, with small beak and without area, anterior commissure unipli- cate, radial costulae numerous, of medium size, dichotomous and intercalated, shell surface densely and distinctly squamous.

Material. — 60 free, almost entire shells. All specimens come from Skaly: Skaly beds, shales, complex XIV, outcrop 73, and complex XVII, outcrop 83. Lower Givetian (?Upper Eifelian).

Dimensions of 3 specimens (in mm.):

Cat. No. Z Fal. Bp. VI/	Length	Width	Thickness	Number of costulae in 2 mm.	
				posteriorly	anteriorly
330	31.0	31.8	24.5	3	2
331	30.8	30.9	23.5	4	3
332	24.0	24.9	14.9	3	2

Description (Pl. I, fig. 10, 12). — Medium size, wider than long, anterior commissure uniplicate, varying from narrowly to widely uniplicate. *Pedicle valve*: moderately convex; beak very small, in olds strongly incurved. *Brachial valve* strongly, but regularly arched along midline.

Ornamentation. Radial costulae are numerous, distinct but low, dichotomy and intercalation common. Concentric lamellae prominent, distinctly marked over the whole shell surface, making its very characteristic.

Interior. *Pedicle valve*: teeth well developed, apical cavity thickened, muscle area deeply excavated. *Brachial valve*: dental sockets deep.

Individual variability. — The shell outline vary slightly from nearly subquadrate to more ovate. The other features of external morphology are rather stable.

Remarks. — The type species of *Atrypa squamifera* (Schnur) is insufficiently defined both by figures and description (Schnur, 1853, p. 181, Pl. 24, figs. 4 a-d). In the small Schnur's collection of atrypids examined by the present author at the Senckenberg Museum, there are three somewhat different specimens labelled as *Atrypa squamifera*. They all differ slightly in the thickness and distinctness of radial costulae and rather less in the shell outline. It is probable that Schnur gave rather wide limits to his species, having in mind the atrypids of medium size with densely squamiferous shell surface and distinct radial costulae of moderate thickness.

According to Schnur (1853, p. 181) the dichotomous costulae of *Atrypa squamifera* are of medium size in comparison with the thick costulae which are developed in his *T. squamifera* var. *aspera* (Schnur, 1853, Pl. 24, fig. 4 f-k), in Schlotheim's *Terebratulites asper* (Schlotheim, 1813, Pl. 1, fig. 7), and *Atrypa squamosa* Sowerby (Sowerby, 1840, Pl. 57, fig. 1). Judging from the Schnur's specimens, description and figures and also from the rich collection of atrypids from the Łysogóry and Rhine regions, Schnur's species *Atrypa squamifera* is considered here as a valid species.

A. squamifera (Schnur) externally can be compared to *Atrypa* (*Atrypa*) *vulgaris* Liaschenko, from the Middle and Upper Devonian of Kusbas (Aleksieva, 1962, Pl. 2, fig. 1, 2), but it differs mainly by smaller dimensions and a less convex pedicle valve. It seems to be very near to *Atrypa* (*Atrypa*) *vulgariformis* Aleksieva from the Middle Devonian of Kusbas (Aleksieva, 1962, Pl. 2, fig. 3-6), differing only by a flatter pedicle valve, variable shell outline and ornamentation.

Occurrence. — Middle Devonian; Poland: Łysogóry region; Germany: Rhine region.

Atrypa? sp.
(Pl. XII, fig. 1)

Type specimen: Bp. VI/700, figured on Pl. XII, fig. 1.

Type horizon: Lower Givetian, Skaly beds, complex XVII, outcrop 97, limestone.

Type locality: Skaly, Łysogóry region, Holy Cross Mountains.

Diagnosis. — Shell of medium size, subquadrate in outline, dorsi-biconvex, radial costae distinct, corrugate, with spine bases, bifurcating a few times and giving anteriorly an appearance of bundles.

Material. — 2 nearly complete specimens with both valves closed.

Dimensions of type specimen (in mm.):

Cat. No. Z Pal. Bp. VI/	Length	Width	Thickness	Number of costae in 1 mm.	
				posteriorly	anteriorly
700	38.3	38.9	25.9	2	1

Description. — Shell dorsi-biconvex, with lateral margins rounded, and anterior commissure narrowly uniplicate. *Pedicle valve* moderately convex with sulcus deeply marked at the anterior margin. *Brachial valve* evenly convex.

Interior. *Pedicle valve* with short dental plates. *Brachial valve:* muscle occupying the posterior third of the valve, divided by a short

median septal ridge; the cones of the brachidium high, each composed of 12 or more spires.

Ornamentation. The costae, being quite distinctive, have a corrugate appearance. Nearly each of costae bifurcates anteriorly a few times giving an appearance of bundles (Pl. XII, fig. 1b). On a fragment of the shell surface are probably preserved spine bases.

Remarks. — The generic position of the described specimens is uncertain. They are tentatively referred to *Atrypa*. The specimens in question have the outline and general appearance of pedicle valve beak of *Atrypa*; dental plates are low as in *Desquamatia*; some external features as narrowed sulcus on the pedicle valve and somewhat the radial costation as in *Vagrana* Alekseeva. Our specimens seem to be close to *Atrypa scabebra* Hodalevitch (1951, Pl. 21, fig. 2) from the Eifelian of Sverdlovsk, Serov region (U.S.S.R.).

The above specimens cannot be precisely identified until we have a more numerous and better preserved material.

Genus *Spinatrypa* Stainbrook, 1951

Type species: *Atrypa hystrix* var. *occidentalis* Hall, 1858; Cedar Valley limestone, Upper Devonian, U.S.A.

Remarks. — *Spinatrypa* Stainbrook is closely related morphologically to *Atrypa* Dalman in many features, but can be distinguished from the latter by the invariable development of spines, hollow (in general) apical cavity of the pedicle valve, dental plates less developed than in *Desquamatia* and a small area. *Spinatrypa* branches off from *Atrypa* probably in the Lower Eifelian or earlier. In the Łysogóry region *Spinatrypa dorsata* n.sp. from the Lower Eifelian deposits of Wydryszów appears to be the earliest or one of the earliest representatives of the genus (see p. 281). The strongly arched brachial valve and greatly thickened apical cavity make *Spinatrypa dorsata* very similar to *Atrypa*.

Genus *Invertrypa* Struve (1961) appears to be almost identical internally and to a great extent externally with *Spinatrypa*. The main features, recognized by Struve (1961) as diagnostic for *Invertrypa* are: more marked double keel on the pedicle valve, single and less distinct costae, narrower shell. In the present writer's opinion, the above cited characters could hardly be regarded as diagnostic at generic level. The differences between the representatives of *Invertrypa* and *Spinatrypa* are not greater than between the species of *Spinatrypa*. For this reason, the present writer regards *Invertrypa* Struve as a junior subjective synonym of *Spinatrypa*.

Spinatrypa dorsata n.sp.

(Pl. III; Text-fig. 8 (4), 10, 11)

Type specimen: Bp. VI/343, figured on Pl. III, fig. 4, 6.*Type horizon*: Lower Eifelian, mudstone.*Type locality*: Wydryszów, Łysogóry region, Holy Cross Mountains.*Derivation of name*: Lat. *dorsata* — brachial valve strongly arched.

Diagnosis. — Spinose with double keel; pedicle valve laterally depressed; brachial valve highly convex, often gibbous; radial costae on both valves differing, almost parallel on the brachial valve and radiating on the pedicle one.

Material. — 15 mature specimens, rather complete, some slightly deformed. All specimens come from Wydryszów: mudstone of Wydryszów, Lower Eifelian.

Approximate shell dimensions of 7 specimens (in mm.):

Cat. No. Z. Pal. Bp. VI/	Length	Width	Thickness	Number of costae in 5 mm	
				posteriorly	anteriorly
345	12.0	10.3	5.6	5	4
348	17.0	16.6	9.7	—	—
347	17.8	18.5	9.3	5	3
343*	20.5	19.3	10.3	5	4
350	22.0	21.4	—	5	3
351	22.2	20.3	—	6	4
349	22.5	19.8	14.3	7	4

* holotype

Description. — Shell of medium size, subquadrate to ovate in outline, broadest as a rule posterior to midlength; antero-lateral margins rounded anterior commissure broadly and weakly rounded or greatly narrowed (Text-fig. 8 (4b), 10). *Pedicle valve* shallow with distinct keel along midline, depressed toward the lateral margins; beak short, incurved; area scarcely visible. *Brachial valve* strongly arched from the midpoint to the beak, highly convex, greatest curvature at midlength or posterior to it.

Ornamentation (Pl. III, fig. 6, 8). Pattern of ornamentation is characteristic by low and rounded costae, which are slightly radiating on the pedicle valve and nearly parallel on the brachial valve. As a rule, the costae are single, rarely bifurcating on the lateral slopes. The separating furrows are shallow being a little narrower in comparison to the width of costulae. Concentric lines spaced at intervals of 1-2 mm. The spine fragments, usually preserved at the antero-lateral commissure, are strong and not hollow. The concentric microlines are widely spaced, numbering to about 10-12 in 1 mm. of the shell surface.

Interior (Pl. III, fig. 7; Text-fig. 11). *Pedicle valve*: thick callus in the umbonal cavity present, dental plates obscured. *Brachial valve*: crural plates slightly divergent; septal ridge short but greatly elevated; each cone of the brachidium composed of about 7-9 coils.

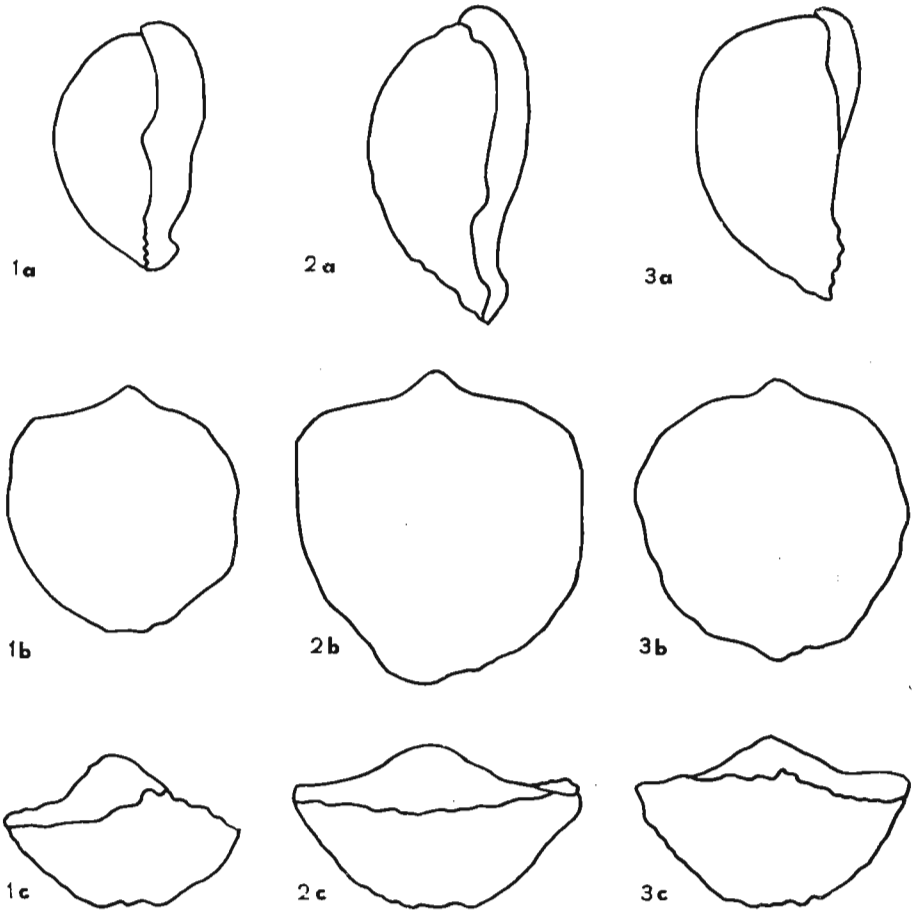


Fig. 10. — *Spinatrypa dorsata* n.sp. (Wydryszów), range of adult specimens showing highly convex dorsal valve (Bp. VI/349, 343, 345); $\times 2$

a side view, b ventral valve view, c anterior view.

Remarks. — *Spinatrypa dorsata* n.sp. may be distinguished from the other species of *Spinatrypa*, e.g. *S. aspera* (Schlotheim) and *S. asperoides* n.sp. mainly by the characteristic arrangement of its radial costae (parallel on the brachial valve and radiate on the pedicle valve) and much more convex brachial valve. It bears some resemblance to *S. fasciplicata* (Struve) by the presence of keel and almost equally sized radial costae, but differs in the arrangement of the costae which is a feature highly cha-

racteristic for the new species. As far as can be judged from the literature and available comparative material, the new species is not easily confused with any other known species.

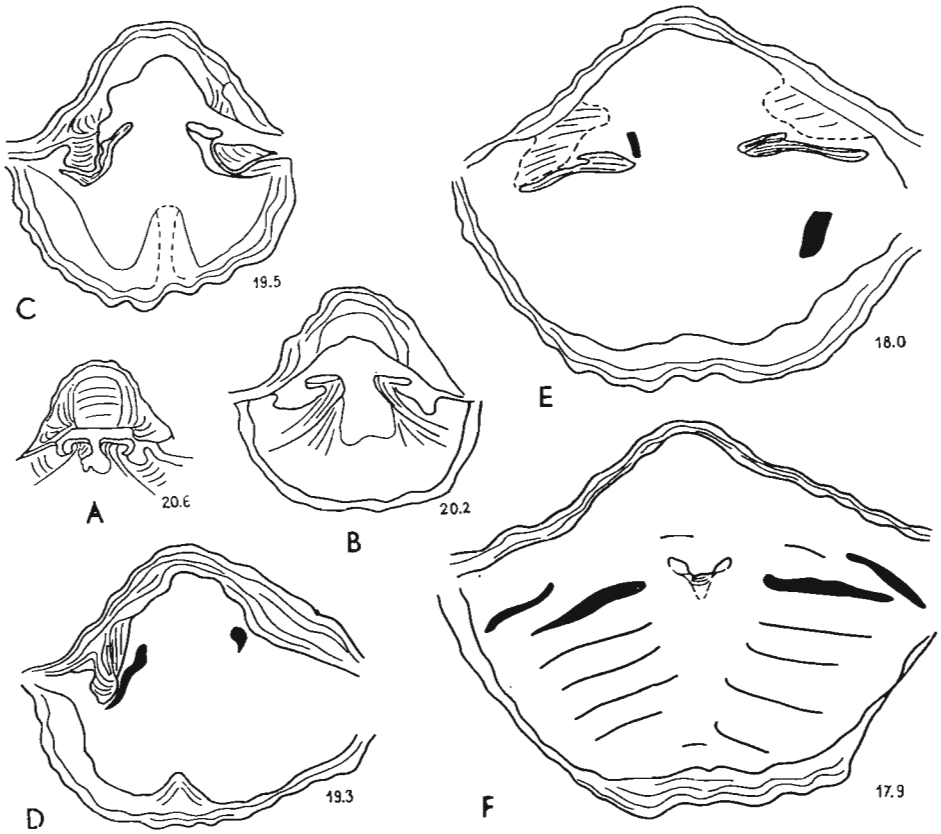


Fig. 11. — *Spinatrypa dorsata* n.sp., serial sections of specimens from Wydryszów of a length 20.9 mm (Bp. VI/344); sections show thickened apical cavity (A), very high (D) and grooved median septal ridge (F); $\times 5.2$.

Spinatrypa aspera (Schlotheim, 1813)

(Pl. IV, V; Text-fig. 2, 8 (5), 12, 13)

1813. *Terebratulites asper* Schlotheim; E. F. Schlotheim, Pl. 1, fig. 7 a-c.
 ?1840. *Atrypa squamosa* (Sow.); J. Sowerby, Explanation..., Pl. 57, fig. 1.
 1896. *Atrypa aspera* (Schloth.); G. Gürich, Das Paläozoicum..., p. 273.
 1904. *Atrypa aspera* Schloth.; D. Sobolev, Devonskija otloženija..., p. 84, Pl. 9, fig. 7.
 1909. *Atrypa aspera* Schloth.; D. Sobolev, Srednij Devon..., p. 487.

Material. — 25 shells of different dimensions, representing young, adult and gerontic stages; 9 brachial valves and 2 separate pedicle valves. All material comes from Skały and Miłoszów: Skały beds, Lower Givetian (?Upper Eifelian), complex XIV, outcrop 73; limestone of Miłoszów.

Dimensions of 9 specimens (in mm.):

Cat. No. Z. Pal. Bp. VI/	Length	Width	Thickness	Number of costae	
				pedicle valve	brachial valve
369	10.0	10.0	5.4	—	—
366	13.9	16.1	7.4	14	16
367	15.7	17.0	9.4	14	15
365	16.2	18.7	7.4	—	—
361	17.0	18.7	9.0	15	16
368	17.2	18.7	8.3	15	15
363	19.3	19.2	9.5	19	19
360	19.4	21.0	11.6	20	18
364	20.0	17.4	17.3	21	22

Description. — Biconvex to dorsi-biconvex, subquadrate in outline, broadest almost at the hinge-angles. *Pedicle valve*: area small; beak slightly prominent, incurved; pedicle foramen rounded, obsolete in old individuals. *Brachial valve* in general more convex than the pedicle valve.

Ornamentation. Surface costulae strong, slightly widening anteriorly, in general single and only occasionally bifurcating. Concentric lines nearly regularly and widely spaced at intervals of about 0.5-1 mm. The concentric microlines often observed, numbering about 10-12 in 1 mm. of

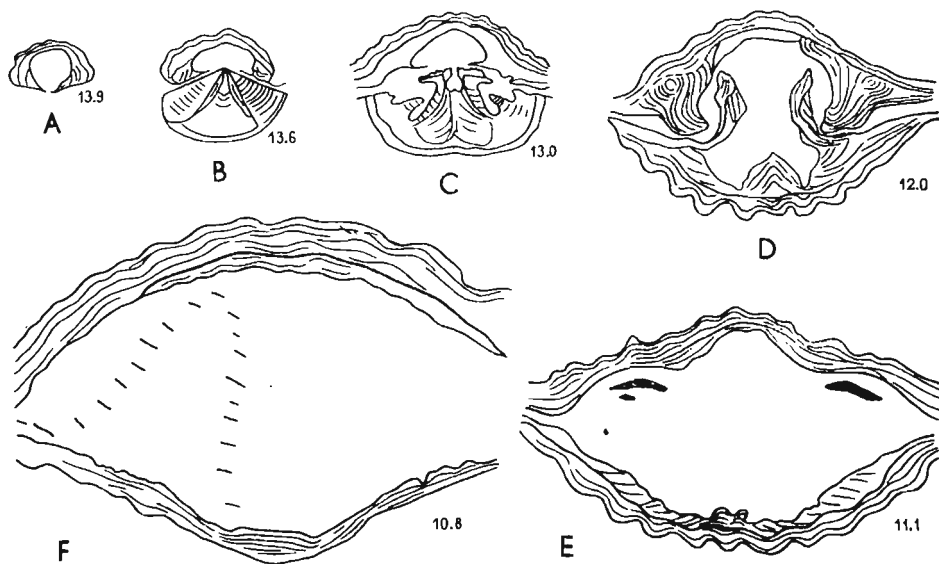


Fig. 12. — *Spinatrypa aspera* (Schlotheim), A-E serial sections of a specimen from Skaly of a length 14.4 mm. and width 14.8 mm. (Bp. VI/381). Sections show: myophores on the crural plates (C), not distinct dental plates (D), grooved median septal ridge (E); section F shows spiral cone of a different specimen (Bp. VI/380; $\times 5.2$).

the shell surface; many fragments of hollow and fragile spines, sometimes to about 4 mm. long.

Interior (Pl. V, fig. 3-11; Text-fig. 12). *Pedicle valve*: delthyrial cavity deep, thickened in gerontic stage; teeth well developed; dental plates not discernible; muscle area largely flabellate, extending to about midlength of the valve, composed of ovate in outline scars of adductors, small and rounded accessories diductors, slightly flabellate principal diductors and not always distinct scars of pedicle muscles; pallial sinuses partly preserved in one pedicle valve (Pl. V, fig. 3-8). *Brachial valve*: crural plates well developed; notothyrial cavity and uppermost edges of cardinals with myophores, marked as numerous, longitudinal incisions for diductors; muscle area deep, posterior and anterior adductors distinct; median septal ridge low, thick, grooved anteriorly (Pl. V, fig. 9-11; Text-fig. 12).

Growth changes (Text-fig. 13). — The smallest specimen in the collection, about 1.2 mm. long, 1 mm. wide, is subrounded in outline, moderately ventri-biconvex, with pedicle valve beak a little pointed, pedicle

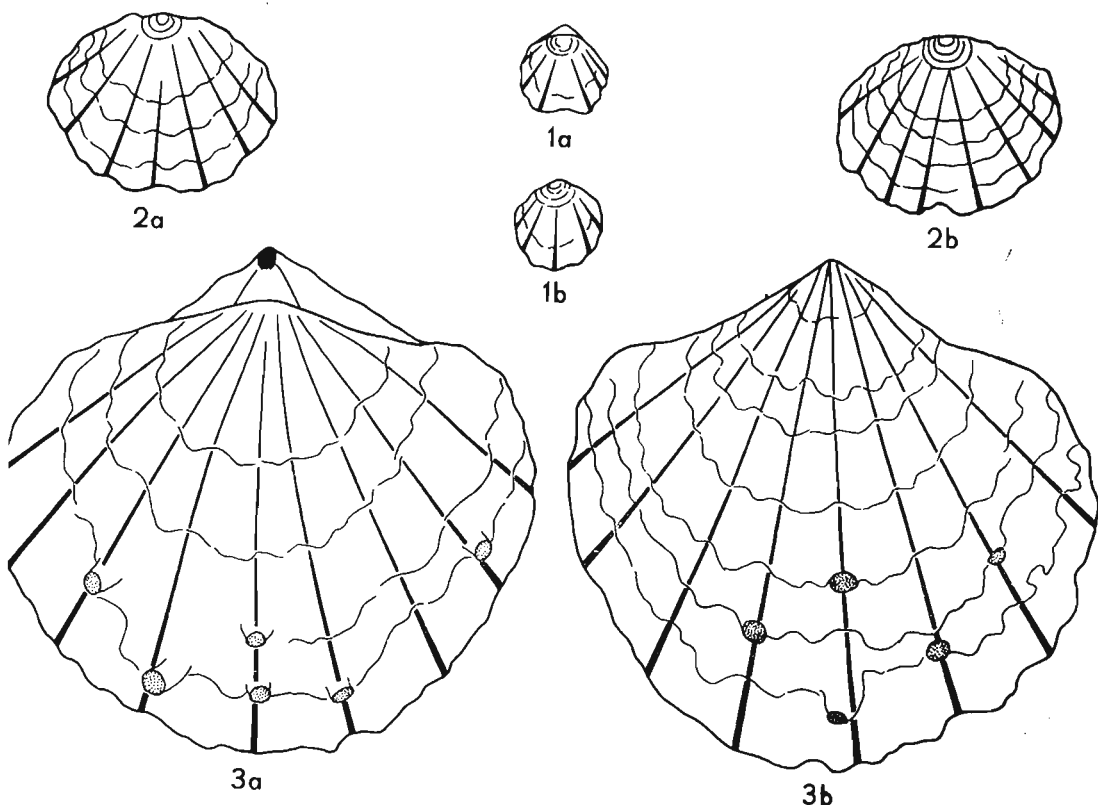


Fig. 13. — *Spinatrypa aspera* (Schlotheim), Skaly; range of young specimens showing development of the radial and concentric ornamentation and traces of preserved spines (2 Bp. VI/384, 3 Bp. VI/385); $\times 10.5$
a brachial valve view, b pedicle valve view.

foramen ovate, bordered by two discrete deltidial plates, small area marked; lines of concentric lamellae distinct, 3-4 in number. There are about 8 costulae on the pedicle valve and 7 on the brachial one. As a rule, they do not change very much during the growth. The costae become more wide and coarse anteriorly. Bifurcation and intercalation are rare.

Judging from the scarce material, immature individuals closely resemble the adults in the external appearance. Changes during the growth seem to be rather small. It may be added that the gerontic stage has been attained by specimens of different sizes, which is probably due to environment. The collection contains a number of separate valves representing old individuals. The valves are of small dimensions, greatly thickened, concentric lines crowded anteriorly and radial costae less distinct.

Individual variability within the species seems to be very limited. There are only some small variations in the shell outline, convexity, number of costae and interiorly in the shape and size of the muscle area of both valves (brachial and pedicle).

Remarks. — In Schlotheim's original collection in the Humboldt University in Berlin there are a few specimens labelled as "*Spinatrypa aspera*" (Schlotheim) which correspond with "*Terebratulites asper*" figured by Schlotheim on Pl. 1, fig. 7 (1813). The specimens are characterized by varying number of radial costae up to 20 on each valve, some of which can be dichotomous or intercalated, and by unequally biconvex shell with a marked beak of the pedicle valve. There are only small differences between it and specimens of *Spinatrypa aspera aspera* (Schlotheim) from Freilinger layers of Sötenich (Struve, 1956, Pl. 1, fig. 2). The collection (SMF No 1129-1145) includes specimens somewhat varying in shell outline, less in the size of shell and thickness of radial costae which in general are single, only rarely bifurcating.

Specimens from the Skały beds are not numerous, but they all show features characterizing *Spinatrypa aspera* as described by Schlotheim. The slightly less numerous radial costae, which in general are single in specimens from Skały, do not appear to be an important difference between Schlotheim's and our specimens. *Spinatrypa aspera* (Schlotheim) from Freilinger layers (Struve, 1956) has slightly lower radial costae and less distinct concentric lamellae which are not arranged so widely in our specimens. Some American species, such as *Hystrocina planosulcata* (Webster), show a great resemblance in shell outline, same number of radial costae and similar concentric lines. *Spinatrypa asperaeformis* Alekseeva from the Devonian of Kusbas (1962, Pl. 6, fig. 9-12) has in general thicker radial costae and more marked beak of the pedicle valve.

Occurrence. — Middle Devonian; Poland: Holy Cross Mountains; Germany: Rhine Basin; France: Bassin d'Ancénis.

Spinatrypa asperoides n.sp.

(Pl. VI, fig. 1-5, 12; VII, fig. 7, 8; Text-fig. 8 (6), 14)

Type specimen: Bp. VI/383, figured on Pl. VI, fig. 5.*Type horizon*: Lower Givetian (?Upper Eifelian), Skaly beds, complex XVII.*Type locality*: Skaly, Łysogóry region, Holy Cross Mountains.*Derivation of name*: Lat. *asperoides* — reminding one of *Spinatrypa aspera* but smaller.

Diagnosis. — Like *Spinatrypa aspera* (Schlothheim) but of smaller size, and much finer radial costae (costulae); shell nearly equally biconvex, with uniplicate anterior commissure and obscured keel on the pedicle valve.

Material. — 40 specimens well preserved, no separate valves. All specimens come from Skaly: Skaly beds, complex XVII, outcrop 84.

Dimensions of 7 specimens (in mm.):

Cat. No. Z. Pal. Bp. VI	Length	Width	Thickness	Number of costulae in 1 mm.	
				posteriorly	anteriorly
390	8.8	8.4	3.9	2	1
388	11.3	10.7	5.4	3	2
386	12.5	12.8	6.0	3	1-2
387	12.8	12.6	5.6	2	2
383*	14.3	14.4	8.2	2	1
382**	15.6	15.3	12.9	—	—
385	15.9	13.7	8.9	—	1

* holotype ** gerontic specimen

Description. — Shell small to about medium size, subcircular to sub-ovate in outline, moderately biconvex, usually longer than wide, in some specimens wider than long, widest posterior to the midlength; cardinal angles and lateral margins rounded, anterior margin uniplicate in adults. *Pedicle valve* gently convex in the umbonal region, slightly depressed anteriorly; beak small; apical foramen round and small. *Brachial valve* slightly more convex than the opposite valve, almost regularly arched from beak to front; fold short, broad but low, marked at the anterior margin.

Ornamentation. Costulae are fine, low and rounded of subdued appearance, in general single, increasing very rarely and irregularly by bifurcation and intercalation, separating furrows of nearly equal width. There are up to about 20 costulae on each valve. Concentric lines of lamellae numerous, farther apart on three fourth of the shell length, crowded at the antero-lateral commissure, where they often preserve a lamellose appearance. The preserved fragments of spines are hollow. The concentric microlines not closely spaced, numbering from about 8-10 in mm.

Interior. Pedicle valve: teeth well developed in proportion to the size of the shell; dental plates very indistinct; deltidial plates observed on cross-section (Text-fig. 14). *Brachial valve:* median septal ridge, appearing anterior to notothyrial cavity, being low and thick, grooved on its anterior half (Text-fig. 14).

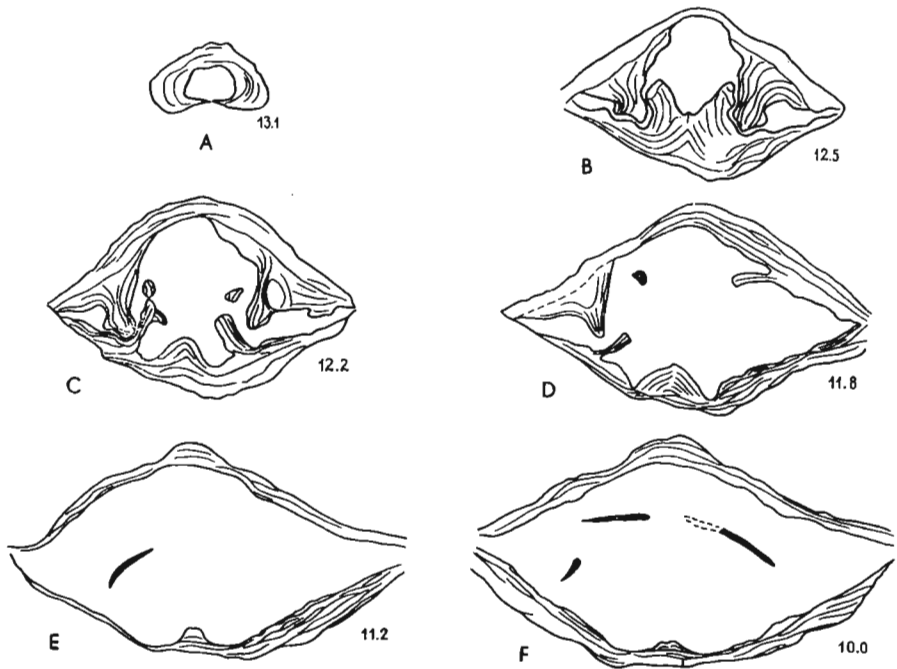


Fig. 14. — *Spinatrypa asperoides* n.sp., serial sections of specimen from Skaly of a length 13.4 mm., width approx. 14.4 mm. (Bp. VI/389). Dental plates and grooved median septal ridge present (C-F); $\times 5.2$.

Variation. — Specimens vary a little in outline from slightly ovate, rounded to subquadrate. If the shell is more ovate or rounded, the cardinal angles are obscured. In specimens with subquadrate outline, cardinal angles are more distinct. The ornamentation is the same in all specimens.

Remarks. — The described specimens are akin to *Spinatrypa aspera* (Schlotheim), but the differences are judged to be taxonomically decisive. The distinction between *S. aspera* (Schloth.) and *S. asperoides* rests on the generally smaller shell size and finer radial costae in the latter. The general pattern of ornamentation is the same of both species. *Spinatrypa kelusiana* Struve is usually more ovate in outline, has fewer and slightly larger radial costae and more distinct keel on the pedicle valve. The new species resembles *Spinatrypa nana* (Khalfin) from Upper Devonian of Kusbas (Alekseeva, 1962, Pl. 6, fig. 13—16), but differs in having more numerous and smaller radial costae and a more variable shell outline.

Spinatrypa fasciplicata (Struve, 1961)
(Pl. VI, fig. 6-11)

1961. *Invertrypa fasciplicata* Struve; W. Struve, Zur Stratigraphie..., p. 334, pl. 2, fig. 7, 8.

Material. — 11 free specimens, all deformed, none of them show internal structure, no separate valves. All specimens come from Skaly: Skaly beds, Lower Givetian (?Upper Eifelian), shales, complex XIII, outcrop 72, and complex XIV, base, outcrop 73.

Dimensions of 5 specimens (in mm.):

Cat. No. Z. Pal. Bp.VI	Length	Width	Number of costae		Number of micro- lines in 1 mm. of the shell surface
			posteriorly	anteriorly	
397	10.5	10.4	8	?	?
394	15.6	15.6	8	16	9-11
393	16.3	18.8	7	18	8-10
395	18.4	17.8	7	17	10-12
396	18.5	17.4	7	17	?

Description. — *Spinatrypa* of medium size, about subovate in outline; broadest about midlength; antero-lateral margins rounded; keel on the pedicle valve present; surface ornamentation marked by about 20 low, not always distinct costae, which in general are single, very rarely bifurcating on the lateral slopes of shell.

Interior not available, all specimens proved unsuitable for sectioning.

Remarks. — The diagnostic features characterizing the genus *Invertrypa* Struve (1961), as shown by a collection at the Senckenberg Museum (SMF No. 12565—12573) — are the following: 1) subovate shell outline in the majority of specimens in *Spinatrypa kelusiana* Struve and *S. fasciplicata* (Struve); 2) subequal to nearly equal biconvex shell; 3) beak acute probably as a result of developed double keel on the pedicle valve, marked by two always parallel central costae; 4) hinge-line less than the maximum width of shell, often subarcuate; 5) the radial costae rather subdued, usually single and not numerous — maximum to about 20 on each valve. The above features are not judged to be taxonomically decisive at the generic level, but they may have a diagnostic value as specific characters.

The described specimens are regarded as conspecific with *Invertrypa fasciplicata* Struve (1961) from Achbach layers of Nohner Mühle. When compared with the holotype (SMF No. 12565) and paratypes (SMF No. 12566—12573) the external similarity is very great. The differences, as a rule, are very small, expressed in slightly narrower radial costae

and a little more thickened beak of the pedicle valve in specimens from Skały. The latter are also close to *Invertrypa kelusiana* (Struve) from Freilinger layers, mainly in the shell size, but the radial costae in our specimens are slightly more distinct and numerous. In general, the observed differences between *Invertrypa fasciplicata* Struve (= *Spinatrypa fasciplicata*) and *Invertrypa kelusiana* (Struve) (= *Spinatrypa kelusiana*) are very small and concern rather the shell size, and to some extent the thickness and number of radial costae and convexity of both valves. Judging from the specimens of the Rhine region, the dimensions of the *Spinatrypa kelusiana* Struve appear to be smaller. The two mentioned species are considered by Struve as good index fossils, *S. kelusiana* Struve being reported from Freilinger layers, and *S. fasciplicata* (Struve) from Achbach layers (Struve, 1961). Judging from the scarce material found in the Skały beds, our specimens are in general smaller than specimens of either German species.

Occurrence. — Middle Devonian; Poland: Łysogóry region; Germany: Rhine region.

Genus *Desquamatia* (Alekseeva, 1960)

Type species: *Atrypa (Desquamatia) khavae* Alekseeva, 1960a, Middle Devonian — Eifelian, Ural, U.S.S.R.

Alekseeva (1960) erected a new subgenus — *Atrypa (Desquamatia)* — for a group of atrypids with distinct dental plates, weak and widely spaced concentric lines, slightly incurved pedicle valve bearing pedicle foramen, deltidial plates well developed (Alekseeva, 1962).

On the base of the studies on numerous representatives of *Desquamatia* from the Middle Devonian of the Holy Cross Mountains, the present writer regards *Desquamatia* as a distinct genus, characterized (in addition to the above mentioned features) by the following characters: 1) distinctive radial ornamentation (see p. ...); 2) apical cavity not thickened; 2) median septal ridge of the brachial valve longer than the muscle area; 4) shell sizes, medium to large; 5) presence of pedicle collar (as also informed by letter of Dr Paul Cooper from Canada).

Judging from available literature, the genus *Desquamatia* is a large group, diversified in the Middle Devonian (Eifelian-Givetian) and probably appearing in the Lower Eifelian as a branch of *Atrypa* (see p. 281). To this genus can be included several species erected earlier by older authors: *Atrypa circularis* Leidhold, 1928 — limestone of Bilveringsen at Iserlohn; *A. globosa* Leidhold, 1928 — limestone of Bilveringsen at Iserlohn; *A. prisca* (Schlothheim, 1813) — limestone of Reffrath.

It seems to be quite probable, that *Atrypa (Atrypa)? schandiensis* Rzonsnickaja, 1951, from the Middle Devonian of Kusbas, belongs to *Desquamatia*. Specimens figured by Alekseeva (1962, Pl. 1, fig. 10) show

some external similarity to specimens of *Desquamatia circulareformis* n.sp., from the Skały beds (Miłoszów), figured on Pl. XII, fig. 2, 3, and also to specimens of *Desquamatia* sp. from Pokrzywianka beds (Pl. XII, fig. 7). All these species (except *Atrypa (Atrypa)? schandiensis*) are rarely if at all mentioned in recent papers, due to the fact that their type species have not been clearly defined and their diagnosis and illustrations are inadequate for specific identification. Also, specimens from limestone are often poorly preserved, especially the radial ornamentation, the latter being one of the external features facilitating identification of atrypids which not always can be taken into consideration (e.g. atrypids from limestone of Bilveringsen — Leidhold, 1928; Torley, 1934).

Species assigned to *Desquamatia* (Alekseeva, 1962, pp. 60-88) — see the present paper, pp. 317-327.

Occurrence. — Devonian (Middle Devonian), throughout the world.

Desquamatia varistriata (Biernat, 1954)

(Pl. VII, fig. 1-6; Text-fig. 15)

1954. *Atrypa varistriata* n.sp.; G. Biernat, Ramienionogi..., p. 514, Pl. 3, fig. 1-5, Text-fig. 14-16.

Diagnosis. — Biconvex *Atrypa* with tubular radial costulae of variable size and developed dental plates.

Material. — 15 free shells, all greatly deformed. All specimens come from Wydryszów, Lower Eifelian, complex III, mudstone.

Approximate dimensions of 5 specimens (in mm.):

C.t. No. Z. Pal. Ep. VI	Length	Width	Thickness	Number of costulae in 1 mm.	
				posteriorly	anteriorly
400	15.0	15.2	6.3	2	2
403	18.0	19.2	?	—	—
404	18.9	21.1	10.5	2	3
401	20.8	21.2	9.0	2	2
402	22.8	23.9	12.3	2	2

Description. — Shell of medium size, almost subquadrate, alar extensions of the cardinal angles often present, anterior commissure unipli-cate. *Pedicle valve* weakly but regularly arched along the midline, gently depressing anteriorly and laterally, beak pointed and incurved, pedicle foramen small. *Brachial valve* regularly arched, median fold weak, marked at the anterior margin.

Ornamentation. Numerous distinct costulae, semitubular to tubular in appearance. In the posterior half of the shell bifurcation and inter-

calation not very common. The costulae in the anterior half of the shell are finer, being twice as numerous, increasing intensively by bifurcation and intercalation. Concentric lamellae distinct, crowded, reflecting the tubular surface costulation.

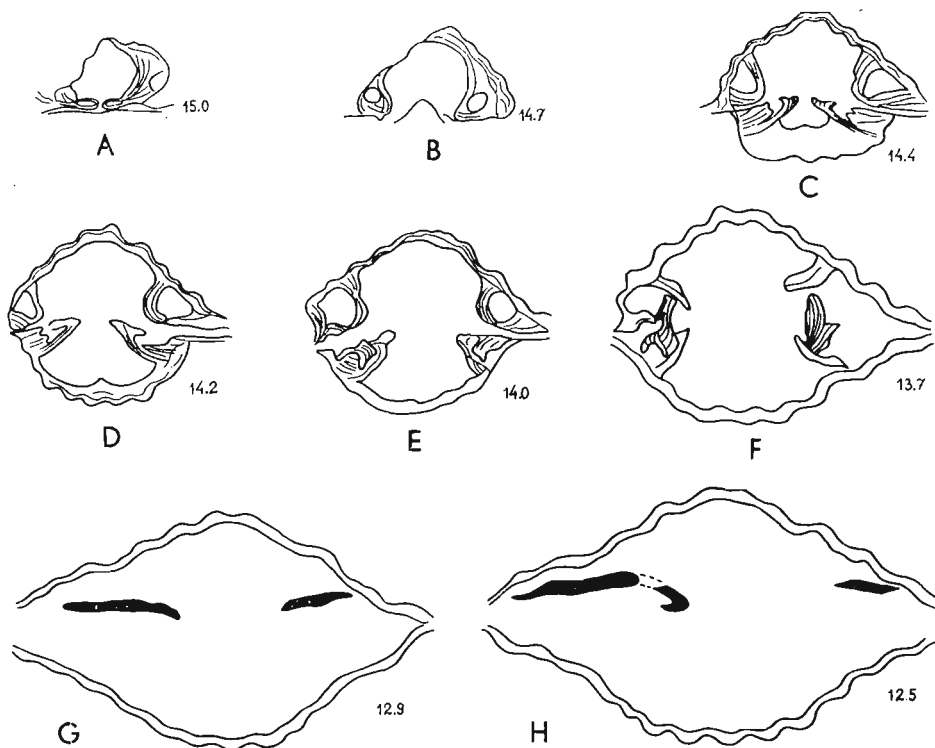


Fig. 15. — *Desquamatia varistriata* (Biernat), serial sections of specimen from Wydryszów (Bp. VI/410); length 15.5 mm., width 16.4 mm. Sections show deltidial plates (A), very distinctly developed dental plates (B-E); $\times 5.2$.

Interior (Text-fig. 15). *Pedicle valve* with developed teeth and dental plates (dental plates not observed earlier; Biernat, 1954). *Brachial valve*: dental sockets deep; crural plates and crura distinct, septal ridge short, low, probably not grooved.

Remarks. — This species is considered to be one of the most interesting in the present collection as it combines the features of 3 genera. Externally, it is very close to *Atrypa* s.str. and *Spinatrypa*, but internally there are fully developed dental plates, which are highly diagnostic for *Desquamatia*. In shell outline and in the variability in size of the radial costulae it is similar to the species of *Atrypa*. In the convexity of shell and to some extent in the appearance of radial costulae in the posterior half of the shell it is close to *Spinatrypa*. The nearly tubular appearance of the radial costulae, most numerous in the anterior half of the shell, the pronounced pedicle valve beak, marked area and the pre-

sence of pedicle collar and dental plates, are sufficient to refer the species to the genus *Desquamatia*. It could be suggested that it is the earliest representative of the genus *Desquamatia*, which may have arisen in the Lower Eifelian.

The most characteristic external features for *Desquamatia varistriata* (Biernat) are: the radial ornamentation, nearly tubular in appearance, and the size of costulae in the posterior half of shells always different from that in anterior half. In its ornamentation it can be compared to *Atrypa varicostata* Stainbrook (1945, Pl. 5, fig. 13-17), Devonian of Iowa, difference being expressed in the shell outline, general size of costulae and convexity of shell. In general appearance *D. varistriata* (Biernat) is similar to *Spinatrypa bachatica* Alekseeva (1962) from the Middle Devonian of Kusbas, USSR.

Occurrence. — Lower Eifelian; Poland: Łysogóry region, Grzegorzowice, Wydrzysów.

Desquamatia subzonata n.sp.

(Pl. VII, fig. 10; VIII, fig. 1-7; IX, fig. 1-8; Text-fig. 3 (3), 8 (3), 16, 17)

1896. ?*Atrypa desquamata* Sow.; G. Gürich, *Das Paläozoicum...*, p. 271.
 1904. *Atrypa desquamata* Sow.; D. Sobolev, *Devonskija otloženija...*, p. 84, Pl. 10, fig. 6.
 1961. *Atrypa zonata* Schnur; G. Biernat, *Diorygma atrypophilia...*, Pl. 3, fig. 1.

Type specimen: Bp. VI/450, figured on Pl. IX, fig. 1.

Type horizon: Lower Givetian (?Upper Eifelian), Skały beds, shales, complex XIV, outcrop 73.

Type locality: Skały, Łysogóry region, Holy Cross Mountains.

Derivation of name: *subzonata* — reminding one of *Desquamatia zonata* (Schnur) but smaller.

Diagnosis. — Like *Atrypa zonata* Schnur but of much smaller size with fine multicostulae of subtubular appearance and greatly narrowed area.

Material. — 250 free specimens of different size, all sufficiently preserved; 20 separate pedicle valves and 3 fragments of brachial valve. All specimens come from Skały: Skały beds, being limited rather to shales and marls (where they are the commonest) of complex XIV, outcrop 73, complex XV, outcrop 86. A few specimens come from the limestone of Miłoszów.

Dimensions of 10 specimens (in mm.) are given on p. 320.

Description (Pl. VIII, fig. 1-7). — Shell of medium size, dorsi-biconvex, in general subcircular to subquadrate in outline, broadest at the hinge-line or just below it; lateral margins rounded, anterior commissure uniplicate. *Pedicle valve* moderately convex; beak slightly prominent and incurved; pedicle foramen small; deltidial plates present; area narrow, linear in adults. *Brachial valve* deep with the greatest convexity poste-

rior to the midlength; beak very small, commonly concealed by incurved beak of the pedicle valve.

Ornamentation is quite distinct, consisting of fine, almost equal in size radiating costulae, increasing by intercalation and dichotomous branching. The costulae are closely spaced, about 3-4 per 1 mm. at the umbo

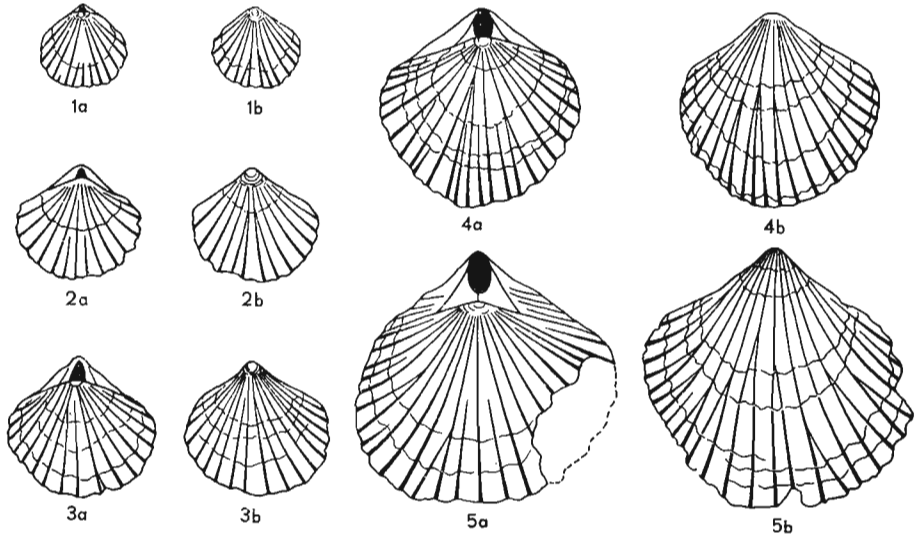


Fig. 16. — *Desquamatia subzonata* n.sp. (Skaly), series of young specimens showing development of radiate surface ornamentation; $\times 7$
a dorsal view, b ventral view.

(5 mm. from the apex) and 2 per 1 mm. at the anterior margin. Concentric lamellae distinct, often greatly extended, their fringes attaining about 3 mm. in length. Concentric microlines observable, nearly regularly spaced, about 20-22 per 1 mm. on the shell surface.

Cat. No. Z. Pal. Bp. VI/	Length	Width	Thickness	Number of costulae in 1 mm.	
				posteriorly	anteriorly
459	6.3	6.4	3.0	—	—
458	7.2	6.8	4.2	—	—
457	9.7	10.6	4.4	4-5	commonly 2
460	11.0	12.0	5.8	—	—
453	14.0	14.1	6.0	—	—
451	16.8	19.4	9.0	—	—
455	18.6	19.6	8.9	—	—
452	19.7	24.2	11.5	—	—
450*	19.8	20.1	14.4	—	—
454	20.7	21.8	12.0	—	—

* holotype

Interior. Pedicle valve (Text-fig. 17): teeth strong, crenulated, nearly parallel to the posterior margin, separated from it by deeply excavated furrows; dental plates small, observed in the young individuals; muscle area broadly flabellate, distinctly separated from the remainder of the valve, the deepest are the scars of diductores posteriores (see Pl. IX, fig. 2-6); a few vascular sinuses are observed. *Brachial valve*: dental sockets deep, crural plates developed with their posterior part and cavity between them having distinct traces of diductores posteriores; muscle area nearly subquadrate, separated by a low, septal ridge, furrowed in its anterior half (see Pl. IX, fig. 7, 8).

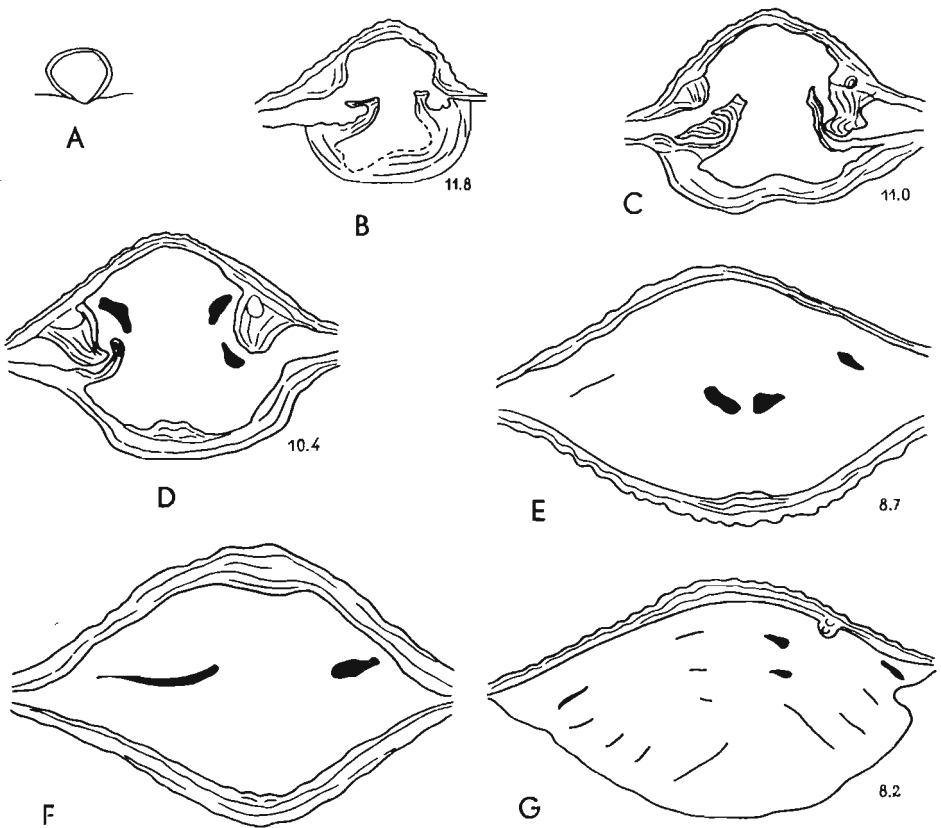


Fig. 17. — *Desquamatia subzonata* n.sp., serial sections of specimen from Skały of a length 12.6 mm. Crural plates (B) and dental plates (C, D) well observable; $\times 5.2$.

Growth changes (Text-fig. 16). — The collection includes specimens between 1.1 to 24.5 mm. long. Shell of the youngest individual is ovate with a pronounced and elevated beak of the pedicle valve and primary costulae at about midlength of shell. With maturity the following features are changing: 1) shell outline, from ovate or nearly pentagonal in youth to subrounded or subquadrate in maturity; 2) convexity of the

shell (in lateral view) moderately biconvex in immature stage, to more or less dorsi-biconvex in adults; 3) pedicle foramen large, filling all the delthyrium in specimens to about 2 mm. long; specimens from about 2.5 mm. have ovate pedicle foramen, bordered by two deltidial plates, which are fused in shells of about 5 mm. long; adult specimens show small and rounded pedicle foramen; 4) radial surface ornamentation fine and subtubular costulae slightly widen anteriorly; with growth increasing quickly, mostly by bifurcation and rarely by intercalation; specimens at about 1.2 mm. long show 5 costulae on the pedicle valve; at a length of about 2.5 mm. 13 fine costulae, of which the median one bifurcates the first time at a distance of about 0.5-0.7 mm. from the apex, and the second time at about 0.8-1.3 mm. from it, giving off costulae on either side (Text-fig. 16); 5) pedicle valve beak being prominent and greatly elevated in immaturity, with age larger and incurved and never lying close to the brachial valve in mature or old specimens; 6) dental plates distinct, but weak in youth, are commonly obscured in maturity.

Remarks. — *Desquamatia subzonata* n.sp. is fairly common in shales of the Skały beds at Skały. It is clearly related to finely costulate *D. zonata* (Schnur) being considered to some extent its miniature. It may be possible that *D. subzonata* is a precursor of Schnur's species in the Ły-sogóry region. This last is suggested by the dental plates (one of the taxonomically decisive features for *Desquamatia*) which probably make their first appearance as a new feature in *Desquamatia subzonata*. Fully formed dental plates are not yet developed in this species. They are distinct in the younger growth stage (Pl. IX, fig. 2), becoming obsolete in older specimens, reminding one of the "dental supports" of *Atrypa*. Other features closely connecting *D. subzonata* to the other species of *Desquamatia* are: deeply excavated delthyrial cavity, preserved also in older growth stages; an elevated pedicle valve beak and a tendency to develop a more distinct area and deltidium, the latter feature being more distinct in younger individuals. In the appearance of the concentric lamellae, their arrangement and to some extent in the character of radial costulae, *Desquamatia subzonata* is similar to *Atrypa squamifera* Schnur. In comparison with a few of Schnur's original specimens of *Atrypa zonata* Schnur (SMF collection), ours are smaller and not so definitely transverse, with less distinct area and concentric lamellae more crowded on the shell surface.

Desquamatia aff. *zonata* (Schnur, 1853)

(Pl. VII, fig. 9; IX, fig. 9, 10)

Material. — 2 specimens free and sufficiently preserved. Specimens come from Skały: Skały beds, limestone, complex XVIII, outcrop 92.

Dimensions (in mm.) are given on p. 323.

Cat. No. Z. Pal. Bp. VI/	Length	Width	Thickness	Number of costulae in 1 mm.	
				posteriorly	anteriorly
416	21.9	24.9	12.7	4-5	2-3
415	31.1	34.6	19.2	4	2

Description. — Shell transverse in outline; cardinal angles rounded, lateral margins convergent anteriorly, anterior commissure broadly uniplicate. *Pedicle valve* moderately convex at the umbo, flattened anteriorly; beak slightly extended. *Brachial valve* convex; fold low, marked at the anterior margin.

Ornamentation (Pl. IX, fig. 10). Subtubular radial costulae very fine posteriorly, greatly widen anteriorly, increasing by bifurcation and intercalation. Concentric lamellae preserved as widely spaced concentric lines of lamellae.

Interior not studied because of scarce material.

Remarks. — The type species of *Desquamatia zonata* (Schnur) is still not clearly defined and, in all probability, this is why in literature the *Atrypa zonata* group (recte *Desquamatia zonata*) is mentioned, but not the species. This group includes both thinner and thicker costulated specimens (Struve, 1955). In the first, the fine radial costulae look like those in *Atrypa zonata* figured by Schnur (1853, Pl. 24, fig. 6) and resemble costulae of our *Desquamatia* aff. *zonata* (Pl. IX, fig. 9). In the second the costulae are about twice as thick as in the first group, and can be compared to those of *Desquamatia magna* (Grabau, 1931; Alekseeva, 1962) and *D. parazonata* (Kelus, 1939). Our specimens are close to the thinner costulated specimens of *D. zonata* (Schnur) in shell outline, uniplicate anterior commissure and in pattern of ornamentation. In comparison with *D. subzonata* n.sp., *D. aff. zonata* (Schnur) is larger, having transverse shell outline, more widely spaced concentric lines and a more uniplicate anterior margin.

Desquamatia zonatoides n.sp.

(Pl. X, fig. 3-7; XI, fig. 4, 5, 7, 8; Text-fig. 18)

Type specimen: Bp. VI/470 figured on Pl. X, fig. 4.

Type horizon: Givetian, argillaceous shales of complex XXVII.

Type locality: Pokrzywianka Dolna, Łysogóry region, Holy Cross Mountains.

Derivation of name: *zonatoides* — similar to representatives of *Desquamatia zonata* (Schnur) group.

Diagnosis. — *Desquamatia* of large size with well marked area, prominent and acute beak of the pedicle valve, dental plates developed.

Material. — 20 shells, partly free and partly embedded in the limestone, some of them deformed. All specimens come from Pokrzywianka Dolna — Kamieniec, argillaceous shales and limestone, complex XXVII.

Dimensions of 5 specimens (in mm.):

Cat. No. Z. Pal. Bp. VI/	Length	Width	Thickness	Number of costulae in 1 mm.	
				posteriorly	anteriorly
474	42.8	42.2	28.6	—	1
471	48.6	46.9	24.4	—	—
470*	49.0	51.3	?27.3	3-4	1-2
472	58.7	?48.3	33.5	3-4	1
473	61.7	—	—	—	—

* holotype

Description. — Large, usually wider than long, antero-lateral margins rounded, anterior commissure uniplicate. *Pedicle valve* gently convex; beak pointed; pedicle foramen present; area distinct. *Brachial valve* convex umbonally, in general more arched than the pedicle valve.

Ornamentation. Radial costulae are distinct, varying in thickness, semitubular, greatly widening anteriorly, bifurcating and intercalating. Concentric lines of lamellae well preserved, as a rule widely spaced.

Interior (Text-fig. 18) is very similar to that of *Atrypa* (*Desquamatia*) *magna* Grabau, illustrated by Alekseeva (1962, Text-fig. 36).

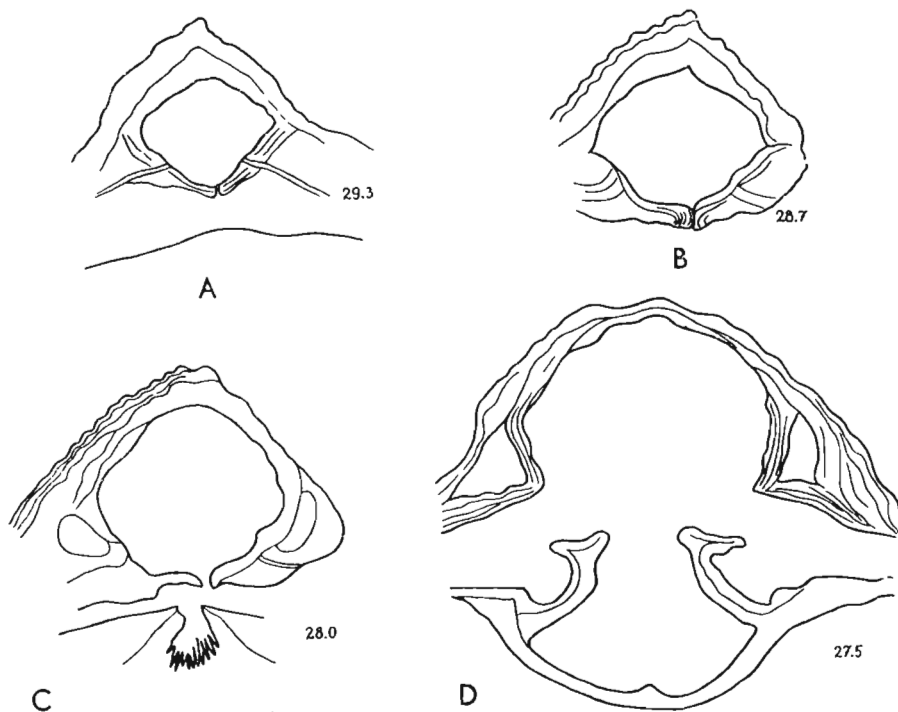


Fig. 18. — Serial sections of specimen from Pokrzywianka beds, length of specimen 30.1 mm.; fig B shows a suture (deltidial plates are fused together), section C shows myophores in the notothyrial cavity, and section D — distinct dental plates; $\times 5.2$.

Remarks. — The collection includes a number of specimens, represented by large shells. Majority of specimens are greatly deformed having strongly flattened shells (Pl. X, fig. 5). In this case they are very transverse in outline reminding one very much of *Desquamatia magna* Grabau (1931). The assignment of our specimens to the new species is based entirely on the external features, such as outline, shape and especially the surface radial ornamentation. In general they are close to *D. zonata* figured by Schnur (1853, Pl. 24, fig. 6), but are much larger and the costulae are more distinct. They are also very similar to *D. zonataeformis* Alekseeva (1962, Pl. 3, fig. 4), but our specimens are larger, probably more transverse and the radial costulae are more distinct and greatly varied in size.

Desquamatia sp.

(Pl. XII, fig. 7)

Material. — 6 specimens, free and partly embedded in the limestone. All specimens come from Pokrzywianka: Pokrzywianka beds, Givetian, complex XXVII.

Dimensions of 4 specimens (in mm.):

Cat. No. Z.Pal.Bp. VI	Length	Width	Thickness	Number of costulae in 1 mm.	
				posteriorly	anteriorly
491	39.3	?42.2	?22.2	2	1
492	—	39.7	?28.6	3	—
493	48.5	46.0	29.6	3	1
495	51.8	?50.5	28.1	3	1

Description. — Like *Desquamatia zonatoides* n.sp. but with higher and more marked area, less acute beak of the pedicle valve and larger pedicle foramen which is roundly outlined; surface costulae thicker and separating furrows correspondingly wider. Internal structure much the same as in *Desquamatia zonatoides* n.sp. (see Text-fig. 18).

Remarks. — The described specimens are closely related morphologically to specimens of *Desquamatia zonatoides* n.sp. A comparison of two samples of *D. zonatoides* and *Desquamatia* sp. allows one to recognize two species because of some differences marked by a thickened pedicle valve beak, larger pedicle foramen and more distinct radial costae in *Desquamatia* sp. The specimens in question resemble those of *D. magna* Grabau (1931, Alekseeva, 1962), but differ in less transverse outline. *Desquamatia ventricosa* (Kelus, 1939) differs from *Desquamatia* sp. in having more accentuated cardinal angles and smaller shell size. These is also a great external resemblance to specimens which Alekseeva

identified as *Atrypa (Atrypa) ?schandiensis* Rzonsnickaja (Alekseeva, 1962, Pl. 1, fig. 10). It is quite possible that our specimens described as *Desquamatia* sp. represent a new species, but this could be shown only by a more complete collection.

Desquamatia circulareformis n.sp.

(Pl. VIII, fig. 8; XII, fig. 2, 3)

Type specimen: Bp. VI/554, figured on Pl. XII, fig. 3.

Type horizon: Lower Givetian (?Upper Eifelian), argillaceous limestone of Miłoszów.

Type locality: Miłoszów, Łysogóry region, Holy Cross Mountains.

Derivation of name: *circulareformis* — similar to *Desquamatia circularis* (Leidhold).

Diagnosis. — *Desquamatia* of larger size, subcircular to circular in outline, biconvex, with brachial valve moderately convex and the pedicle valve weakly convex posteriorly or flattened, tongue small, sulcus on the pedicle valve shallow.

Material. — 8 nearly complete specimens with both valves closed, 3 specimens embedded in the limestone, 3 fragments of the shell.

Approximate dimensions of 4 specimens (in mm.):

Cat. No. Z.Pal. Bp. VI	Length	Width	Thickness	Number of costulae in 1 mm	
				posteriorly	anteriorly
552	39.3	37.3	—	2	1
553	41.5	39.4	21.7	2	1
554*	40.0	38.6	21.0	2	1
555	41.0	?	22.0	—	1

* holotype

Description. — Shell to large size, subcircularly outlined, moderately biconvex or weakly convexo-flattened; lateral margins roundly outlined; anterior commissure somewhat widely uniplicate; tongue short. *Pedicle valve*: beak small but pointed; pedicle foramen round and apical; area marked; deltidial plates fused together. *Brachial valve* regularly but moderately arched.

Ornamentation. Radial costulae although low are distinct, being very fine posteriorly, widening toward the anterior margin. In general, there are 4-5 radial costulae in 5 mm. of the valve surface at the anterior margin. Dichotomous branching and intercalation very common. Concentric lines weakly preserved, are rather widely spaced.

Interior. Pedicle valve: apical cavity slightly thickened; dental plates short but distinct. *Brachial valve*: median ridge thickened but short, dividing the muscle area; cones of the brachidium high, each composed of 15-17 spires.

Remarks. — The described specimens show some features of *Desquamatia circularis* (Leidhold) described from the limestone of Bilveringsen (Leidhold, 1928, Pl. 6, fig. 5; Pl. 7, fig. 2), mainly: unequally biconvex shell, anterior commissure slightly but widely uniplicate, shell outline rounded, radial costulae dichotomous. Because of scarce material, the internal structure of *Desquamatia circulareformis*, especially the appearance of the muscle area, has not been sufficiently studied, and also the tripartite muscle area of the brachial valve has not been observed. Our specimens are smaller in size, about twice as small as specimen figured by Leidhold (1928, Pl. 7, fig. 2).

The smaller shell dimensions, moderately convex brachial valve and more ovate shell outline can distinguish our specimens from Leidhold's *Atrypa circularis*, allowing one to consider the former as a new species — *Desquamatia circulareformis*.

Atrypa (?*Atrypa*) *schandiensis* Rzonnickaja from Eifelian of Kusbas (Aleksieva, 1962, Pl. 1, fig. 10) is close to our species in general shell outline and the appearance of both-radial costulae and beak of pedicle valve.

Desquamatia prisca (Schlotheim, 1820)

(Pl. X, fig. 1-2; XI, fig. 1-3, 6; XII, fig. 5, 6)

1820. *Terebratulites priscus* Schlotheim; E. F. Schlotheim, *Die Petrefactenkunde...*, p. 262.
 1822. *Anomites Terebratulites priscus* Schlotheim; E. F. Schlotheim, *Ibid.*, p. 68, Pl. 17, fig. 2a-c.

Diagnosis. — Shell of large size, thick-walled, biconvex, pedicle valve with regular and moderate curvature, brachial valve strongly arched posteriorly, beak very pointed, hinge line short, slightly arched, anterior margin with a short tongue.

Material. — 40 shells, many of them embedded in limestone; specimens are not very complete, some greatly crushed. All specimens come from Givetian of Pokrzywianka beds (Kamieniec), limestone, complex XXVII.

Dimensions of 5 specimens (in mm.):

Cat. No. Z.Pal. Bp. VI	Length	Width	Thickness	Number of costulae in 1 mm.	
				posteriorly	anteriorly
503	38.3	36.3	19.5	—	1
501	42.3	41.0	28.3	—	1
500	42.7	44.5	25.5	3	1
504	43.0	41.0	27.6	2-3	1
502	47.5	35.5	22.8	3	1

Description. — Shell subequally biconvex, nearly subovate in outline, with hinge-line less than the greatest shell width; anterior commissure moderately uniplicate. *Pedicle valve* gently convex; beak acute, prominent, slightly incurved; pedicle foramen small and rounded; deltidial plates well developed, fused together, area distinctly marked. *Brachial valve* strongly arched posteriorly, lowered anteriorly.

Ornamentation. Radiating costulae are distinct, increasing by bifurcation and rarely intercalation, separating furrows correspondingly well marked. There are 2-3 costulae per 1 mm. at a distance of 5 mm. from the beak, and commonly 1 costula per 1 mm. at the anterior margin. The concentric lamellae are usually prominent at intervals of 4-7 mm. The concentric microlines are rarely observed. In general there are 10-12 microlines in 1 mm. of the shell surface.

Internal structure is the same as in *Desquamatia zonatoides* n.sp. (Text-fig. 18).

Remarks. — Schlotheim based his short description of *Desquamatia prisca* upon specimens from Reffrath (1820, 1822). According to him, the size of specimens can vary, some may be large. Judging from Schlotheim's figures (1822, Pl. 17, fig. 2a-c) specimens of his species are strongly biconvex and more elongated in outline, with pointed pedicle valve beak: concentric lamellae widely spaced and the anterior margin slightly elongated into a short tongue like extension. Specimens from Reffrath, locality of Schlotheim (SMF collection) are much smaller in comparison with specimens from Pokrzywianka limestone. *Desquamatia prisca* (Schlotheim) differs from the known species of *Desquamatia* in outline, shape, shorter hinge-line, and somewhat in the surface radial ornamentation

Occurrence. — Givetian; Poland: Holy Cross Mountains, Pokrzywianka-Kamieniec; Germany: Rhine region, Reffrath. Index fossil of Givetian.

Subfamily **Carinatininae** Rzonnickaja, 1960

Genus *Carinatina* Nalivkin, 1930

Type species: *Orthis arimaspa* Eichwald, 1840; Middle Devonian, Ural, USSR.

Carinatina cf. *arimaspa* (Eichwald, 1840)

(Pl. XIII, fig. 13, 14)

1962. *Carinatina arimaspa* (Eichwald); R. E. Alekseeva, *Devonskie Atripidy...*, p. 151, Pl. 9, fig. 1-2.

Material. — 1 incomplete specimen, embedded in the limestone with partly exfoliated brachial valve. The specimen comes from Lower Givetian (?Upper Eifelian) limestone of Miłoszów.

Description. — Shell of medium size (approximate length = 22.5 mm,) subrounded in outline; the medium sulcus slightly developed.

Ornamentation consists of strong costae about 22-24 in number, rarely increasing by intercalation. There are 10-11 costae at the brachial valve beak.

Because of the scarce material interior not studied.

Remarks. — External appearance of the preserved shells suggests a great similarity to specimens of *Carinatina arimaspa* (Eichwald), figured by Hodalevicz from Eifelian of Ural (1951, — fig 1, 2, Pl. 26). The difference is expressed in the presence of rather single costae on the brachial valve in specimen from Miłoszów.

Occurrence. — Middle Devonian; Poland: Holy Cross Mountains; Germany, France; Lower and Middle Devonian, Kusbas, U.S.S.R.

Carinatina plana (Kayser, 1871)

(Pl. XIII, fig. 10-12)

1871. *Atrypa reticularis* var. *plana* Kayser; E. Kayser, Die Brachiopoden..., p. 545, Pl. 10, fig. 3.

1896. *Atrypa plana* Kayser; G. Gürich, Das Paläozoicum..., p. 272.

Material. — 3 incomplete specimens, some of them embedded in the limestone. Specimens come from Skały, Miłoszów: Lower Givetian (?Upper Eifelian), Skały beds, marls of complex XVII, outcrop 84, and Miłoszów.

Approximate dimensions (in mm.):

Cat. No. Z.Pal.Bp.VI	Length	Width	Thickness	Length of hinge-line
600	22.0	30.0	7.2	28
Number of costae on the distance of about 5 mm. from the beak — 2 in 1 mm., number of costae at the anterior margin — 1 in 1 mm.				

Description. — Shell flattened of medium size, subrounded in outline; antero-lateral commissure rounded; hinge-line straight being nearly equal to the maximum width of the shell. *Pedicle valve* weakly convex umbonally, depressed anteriorly and laterally; beak small, straight, bearing small and round pedicle foramen; deltidial plates fused together; area probably high; median kil-like elevation starting at the beak, distinct but of moderate height. *Brachial valve* with narrow and shallow median sulcus slightly widening anteriorly; valve in profile weakly convex.

Ornamentation consists of rather distinct costae, about 20 on each valve, increasing by bifurcation and very rarely by intercalation. There are 2 costae in 1 mm. posteriorly. The costae appear to have a corrugate appearance. Concentric growth lines not preserved.

Remarks. — The specimens seem to be conspecific with *Atrypa reticularis* var. *plana*, described and figured by Kayser from Crinoid layer in Eifel (1871, Pl. 10, fig. 3, p. 545). The differences are small, expressed in rarer bifurcation or intercalation and in a little wider intercostal furrows in specimens from Skały. The differences appear to be greater when compared with the German collection of *Carinatina plana* (Kayser) e.g. SMF No. 2928 from Rommersheimer layers. They concern mainly the thickness and number of costae. Our specimens are also similar to specimens of *Carinatina plana* (Kayser) from the Middle Devonian of Kuznecki Basin figured by Rzonnickaja (1960, fig. 5, pl. 55), but are of larger dimensions. *Carinatina subplana* Hodalevicz, described and figured from Eifelian of Ural (Hodalevicz, 1951, fig. 7, pl. 5, p. 88) differs mainly in having radial costae of two sizes, narrower and wider. There are no differences in comparison with *Atrypa plana* (Kayser) figured by Maurer (1885, fig. 34, pl. 7). According to Kayser, the species is limited to the Crinoid layer in Eifel (1871, p. 546). Struve (1955, p. 312) mentions the presence of *Carinatina* cf. *plana* in limestone of Rommersheim (Prüm). It is also listed by Gürich from the Middle Devonian of Skały (1896, p. 272).

Occurrence. — Middle Devonian; Poland: Holy Cross Mountains; Germany; U.S.S.R.

Carinatina sp.

(Pl. XIII, fig. 1-9; Text-fig. 19)

Diagnosis. — Like *Carinatina plana* (Kayser) but less elongated transversely, with higher area of the pedicle valve and more numerous and finer radial costulae.

Material. — 10 incomplete shells and fragments of shells, mostly crushed and poorly preserved. All specimens come from Skały: Lower Givetian, Skały beds, complex XVII, outcrop 84, Łysogóry region, Holy Cross Mountains.

Description. — Shell to medium size; subrounded in outline; anterolateral margins rounded; hinge line straight and wide. *Pedicle valve* slightly convex at the umbo, depressed toward the lateral and anterior margins; kil-like elevation moderate but distinct; area high; deltidial plates present. *Brachial valve*: median sulcus narrow and shallow, slightly widening anteriorly.

Ornamentation consists of fine radiating costulae, increasing by bifurcation on the pedicle valve and mostly by intercalation on the brachial valve. Concentric lines not preserved.

Interior. Pedicle valve: fused deltidial plates observed on cross sections; small median ridge present. *Brachial valve:* cardinal process low, elevated medianly, distinctly incised (Text-fig. 19); each coil of the brachidium composed of 6 spires.

Remarks. — The described specimens have many external features in common with *Carinatina plana* (Kayser), but differ notably in having surface ornamentation finer, the costulae coarser and the general shell outline less transverse. They show a great similarity to *Carinatina plana* (Kayser) of the German collection (SMF No. 11815, XVII-2260) from Freilinger beds and Achbach beds (SMF No. 11814), but differ in having a little thinner radial costulae. The above specimens remain unnamed because of scarce, poorly preserved material.

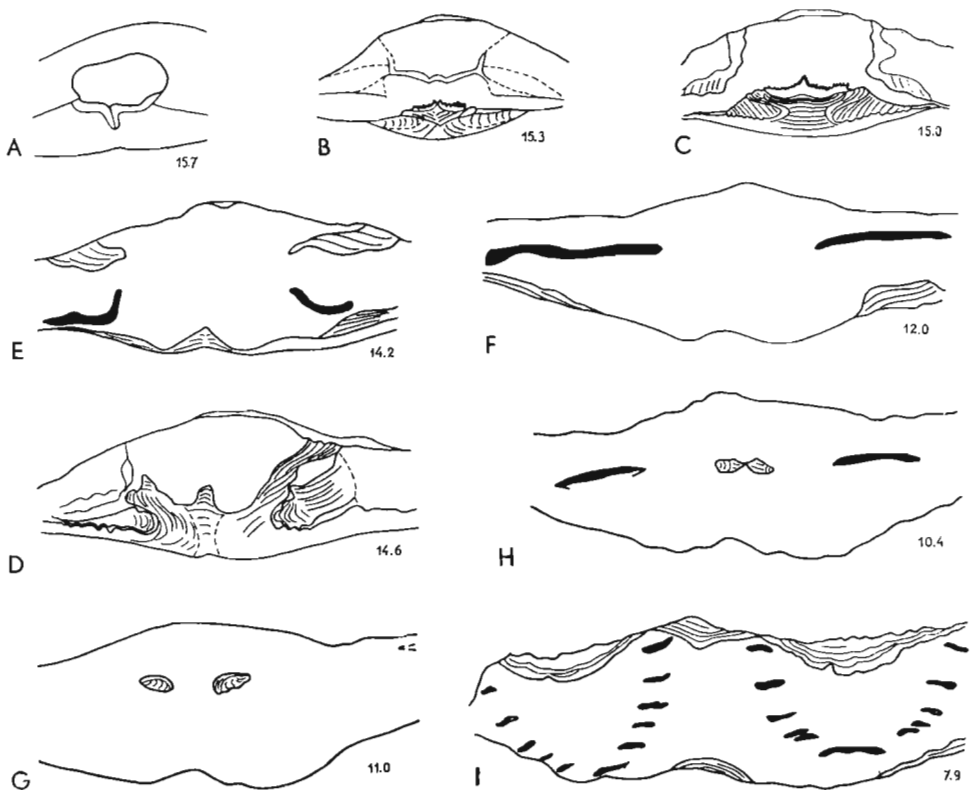


Fig. 19. — *Carinatina* sp. (Skaly); serial section of deformed specimen (Bp. VI/611) of a length 15.9 mm., showing fused deltidial plates (A), myophores on the cardinal process (B, C), jugum (H); $\times 5$.

Family *Paraferrellidae* Spriestersbach, 1942

Genus *Gruenewaldtia* Tschernyshev, 1855

Type species: *Terebratula latilinguis* Schnur, 1851

Gruenewaldtia sp.

(Pl. XII, fig. 4; XIV, fig. 4, 7)

Diagnosis. — *Gruenewaldtia* of medium size, rounded in outline; dorsibiconvex; length nearly equal to the width; internally the muscle platform supported by two lateral septa.

Ornamentation consists of fine radial costulae increasing in general by dichotomous bifurcation.

Material. — 7 adult specimens, mostly embedded in limestone, majority of them not complete. All specimens come from Miłoszów: Givetian (?), limestone of Miłoszów.

Dimensions of 2 specimens (in mm.):

Cat. No. Z. Pa l. Bp. VI	Length	Width	Thickness	Number of costulae in 1 mm.	
				posteriorly	anteriorly
560	29.4	29.6	17.9	3-4	2-1
561	24.6	24.9	10.4	—	—

Remarks. — Only 7 specimens have been collected from the limestone of Miłoszów, which as rule, very closely resemble *Gruenewaldtia* cf. *latilinguis latilinguis* (Schnur) from the limestone of Skały, outcrop 113. Two specimens are free, the other embedded in limestone. Internally they show a muscle platform, supported by two distinct but low lateral septa, a characteristic feature of the genus *Gruenewaldtia* (Ivanova, 1962, p. 74). The species differs from *Gruenewaldtia latilinguis latilinguis* (Schnur) in a markedly less transverse shell outline (almost rounded), less accentuated hinge-angles and slightly more distinct radial costulae. These differences are significant and point to a new species, however the writer is reluctant to name it because of the scarcity of material.

Gruenewaldtia latilinguis latilinguis (Schnur, 1851)

(Pl. XIV, fig. 1-6, 8, 9; Text-fig. 26)

1851. *Terebratula latilinguis* Schnur; J. Schnur, Programm, p. 7.

1853. *Terebratula latilinguis* Schnur; J. Schnur, Zusammenstellung..., p. 183, Pl. 25, fig. 1 a-c.

1955. *Grünewaldtia latilinguis latilinguis* (Schnur); W. Struve, *Grünewaldtia...*, p. 211, Pl. 2, fig. 3.

Material. — 20 specimens mostly embeded in the limestone; 3 free and nearly complete specimens. Shells sufficently preserved. All spec-

imens come from Skaly: Givetian (?Upper Eifelian) of Skaly beds, limestone, complex XXI, outcrop 113.

Approximate dimensions of 4 specimens (in mm.):

Cat. No. Z. Pal. Bp. VI	Length	Width	Thickness	Number of costulae in 1 mm.	
				posteriorly	anteriorly
580	26.8	32.0	?18.0	4	2
582	28.7	41.1	27.2	4	2
581	29.3	—	19.4	4	2
583	35.7	38.0	—	—	—

Description. — Shell of large size; subequally biconvex; subquadrate in mature stage and subrounded in younger individual age (Pl. XIV, fig. 1, 2); wider than long, with the greatest width at midlength or posterior to the hinge-line; antero-lateral margins broadly rounded, anterior commissure faintly uniplicate. *Pedicle valve* moderately arched along midline, depressed anteriorly; sulcus broad and shallow; beak pointed; minute pedicle foramen round; deltidial plates fused, more distinct in younger specimens. *Brachial valve* moderately convex, with gently expressed fold.

Ornamentation. Fine, rounded costellae are always similarly low, separated by narrow furrows, increasing by bifurcation (Pl. XIV, fig. 9).

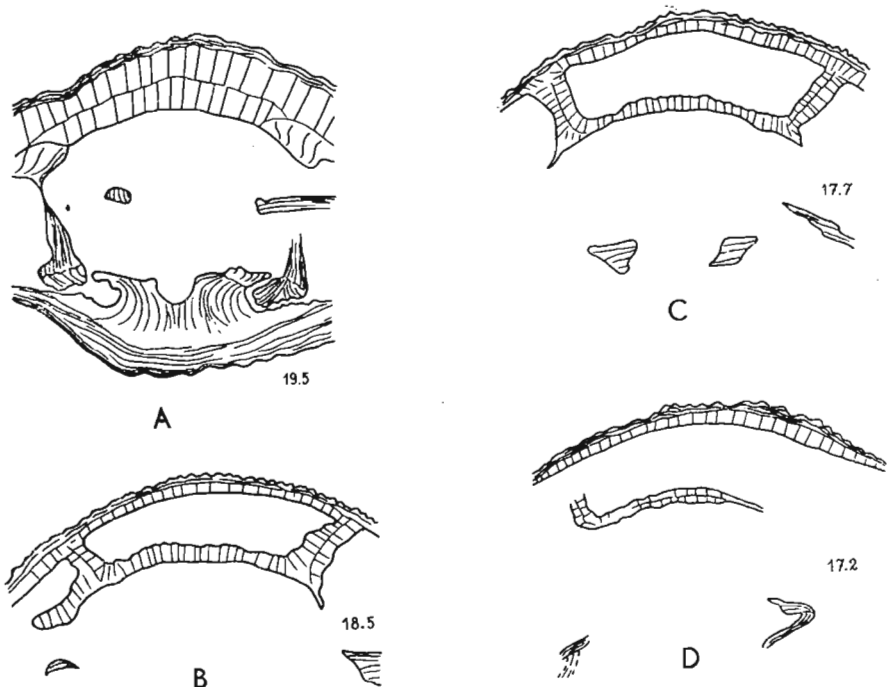


Fig. 20. — *Gruenewaldtia latilinguis latilinguis* (Schnur), serial sections of a damaged specimen from Skaly, of an approximate length 20.3 mm.; $\times 5.2$.

There are 2 costellae in 1 mm. at the anterior margin and 3 in 1 mm. on the distance of 5 mm. from the beak. Growth lines rarely observed at the antero-lateral commissure.

Interior (Text-fig. 20). *Pedicle valve*: teeth well developed; dental plates obscured in adult; muscle platform large, thickened, supported by two low, thick lateral septal ridges. *Brachial valve*: median septum high and very short; muscle platform with two supporting septal ridges.

Growth changes. — Shells, to about 15 mm. long, are rounded in outline, gently ventri-biconvex, with pedicle valve beak of moderate height, rounded apical pedicle foramen, deltidial plates fused together and small area. Shells from about 25 mm. long are wider, subquadrate in outline, with gently and widely uniplicate anterior margin.

Remarks. — The above description is based on a number of specimens from the argillaceous limestone of Skały beds. They are referred to *Gruenewaldtia latilinguis latilinguis* (Schnur) because of great external and internal similarity. When compared with Schnur's Fig. 1 in Pl. 25, illustrating *Terebratula latilinguis* from limestone of Gerolstein (1853), our specimens are slightly smaller. *Gruenewaldtia latilinguis* (Schnur) from Rommersheimer layers (SMF XVII 3062, coll. Struve, 1949) shows some unimportant differences being slightly more convex and less transverse, having not such a broad uniplicate anterior commissure. *Gruenewaldtia elegans* Struve (SMF coll.) from Junkenberg layers of Hillesheimer is more biconvex, has a slightly more pointed pedicle valve beak and less marked sulcatiform flexure of the anterior commissure. *Gruenewaldtia sibirica* Ivanova (Form "lata" and "longa") from Givetian of Kuznecki Basin (1962, Pl. 13) is more robust and oblong, with a greatly thickened and incurved beak of pedicle valve.

Occurrence. — Middle Devonian; Germany: Prümer and Hillesheimer Mulde, Rhine region; Poland: Skały beds, Holy Cross Mountains.

*Palaeozoological Institute
of the Polish Academy of Sciences
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GERTRUDA BIERNAT

ŚRODKOWO-DEWOŃSKIE ATRYPACEA (BRACHIOPODA)
Z GÓR ŚWIĘTOKRZYSKICH

Streszczenie

Devon środkowy Gór Świętokrzyskich regionu łysogórskiego zawiera bogatą faunę atryp, które są przedmiotem niniejszego opracowania. Grupie tych brachiopodów poświęcano dotychczas mało uwagi. Obecnie odczuwa się brak dokładnej re-wizji atryp, szczególnie z Nadrenii, skąd pochodzi szereg gatunków utworzonych w ubiegłym i na początku obecnego stulecia. Jedną z ostatnich większych prac w tej dziedzinie są wyniki badań nad dewońskimi atrypami Uralu (Aleksejeva, 1962).

Atrypy opisane w niniejszej pracy pochodzą z odsłoneń w Wydryszowie, Skal-łach, Miłoszowie i Pokrzywiańce-Kamieńcu (fig. 1). Zasięgiem stratygraficznym obejmują one eifel dolny (warstwy okolic Wydryszowa), żywet dolny lub przypusz-czalnie eifel górny (warstwy skalskie) oraz żywet górny (warstwy pokrzywiańskie). Wiek warstw skalskich jak dotychczas nie jest dokładnie sprecyzowany. Na ogół zalicza się je obecnie do dolnego żywetu (Pajchel, 1957). Obecność pewnych gatun-ków atryp wspólnych dla Polski i Niemiec, jak *Spinatrypa fasciplicata* (Struve, 1961) — przewodnia dla górnego eiflu, czy *Gruenewaldtia latilinguis latilinguis* (Schnur, 1851), pochodząca z górno-eifelskich warstw Nadrenii, sugerują dla warstw skalskich wiek górno-eifelski. Dowód ten nie jest jednak wystarczający. Być może opracowanie dalszych grup brachiopodów ułatwi wyjaśnienie problemu wieku stra-tygraficznego warstw skalskich.

Wiek żywecki (górný żywet) warstw pokrzywiańskich zdaje się nie ulegać wą-pliwości. Potwierdza to zespół atryp dużych rozmiarów rodzaju *Desquamatia*, cha-

rakteryzujących żywet Nadrenii (Bilveringsen, Reffrath; Leidhold, 1928; Torley, 1934; Schlotheim, 1822) oraz Uralu i Chin (Aleksejeva, 1962; Grabau, 1931).

W pracy tej ogółem opisano 20 gatunków należących do 2 rodzin: Atrypiidae Gill i Paraferrellidae Spriesterbach (nadrodziny Atrypacea). Gatunki te należą do 5 rodzajów: *Atrypa*, *Spinatrypa*, *Desquamatia*, *Carinatina* i *Gruenewaldtia*. Wydzielono 6 gatunków nowych: *Atrypa subtrigonalis*, *Spinatrypa dorsata*, *S. asperoides*, *Desquamatia subzonata*, *D. zonatoides* i *D. circulareformis*. Trzy gatunki (*Atrypa* sp., *Carinatina* sp. i *Gruenewaldtia* sp.), prawdopodobnie nowe, nie otrzymały nazwy gatunkowej z powodu niedostatecznej ilości materiału.

Dobry na ogół stan zachowania okazów pozwolił na przeprowadzenie badań dotyczących morfologii zewnętrznej i wewnętrznej poszczególnych gatunków. Dla 3 gatunków: *Atrypa subtrigonalis* n.sp., *Spinatrypa aspera* (Schlotheim) i *Desquamatia subzonata* n.sp., reprezentujących 3 rodzaje, przeprowadzono analizę zmian wzrostowych na podstawie zachowanych serii okazów, o długości od ca. 0,6 do 26,0 mm. W wyniku tych badań stwierdzono, że rodzaje *Atrypa* i *Spinatrypa* oraz *Desquamatia* są ze sobą spokrewnione. Szczególnie duże podobieństwo istnieje między rodzajami *Atrypa* i *Spinatrypa*, zwłaszcza w stadiach młodocianych (okazy do ca. 3 mm długości), wyrażone głównie w kształcie muszli, stopniu wykształcenia dzioba skorupki brzusznej i charakterze urzeźbienia muszli. Natomiast rodzaj *Desquamatia* wykazuje dość dużą odrębność w porównaniu z *Atrypa* i *Spinatrypa*. Zaznacza się ona w kształcie muszli, obecności arei, w wystającym ponad brzeg zawiasowy dziobie skorupki brzusznej oraz w urzeźbieniu. Różnice potęgują się w stadiach dorosłych. Jedną z cech diagnostycznych dla tych 3 rodzajów jest stopień wykształcenia płytek zębowych (p. 289). Cecha ta posłużyła, między innymi, do wydzielenia przez Aleksejewą (1961) podrodzaju *Atrypa* (*Desquamatia*).

Wydaje się prawdopodobne, że *Spinatrypa* i *Desquamatia* pojawiły się niemal jednocześnie w dolnym eiflu regionu łysogórskiego (warstwy wydryszowskie) jako odgałęzienie rodzaju *Atrypa*.

ГЕРТРУДА БЕРНАТ

СРЕДНЕ-ДЕВОНСКИЕ АТРЫПАСЕА (ВРАСЧИОПОДА)
ИЗ СВЕНТОКРЖИСКИХ ГОР (ПОЛЬША)

Резюме

Отложения среднего девона в Лысогорском районе Свентокржиских Гор содержат обильную фауну атрып, которые являются предметом настоящей работы. До сих пор исследователи не обращали должного внимания на эту группу плеченогих. В настоящее время необходима тщательная ревизия атрып, а в осо-

бенности рейнских форм, среди которых многие виды установлены в минувшем столетии или в начале настоящего. Одной из последних работ, большого объема, являются в этой области исследования над девонскими аtryпами Урала (Алексеева, 1961).

Atryпы описанные в настоящей работе происходят из обнажений в Выдрышове, Скалах, Милошове и Покрживянке-Каменьце. (стр. 279, фиг. 1). Стратиграфическим распространением они охватывают низы эйфельского яруса (выдрышовские слои), нижнюю часть живетского яруса или быть может верхи эйфельского (скальские слои) и верхнюю часть живетского яруса (покрживянские слои).

Возраст скальских слоев до сих пор не является точно определенным. В общем их причисляют к нижней части живетского яруса (Пайхель, 1957). Присутствие некоторых видов аtryп общих для Польши и Германии, как например *Spinatrypa fasciplicata* (Struve, 1961), руководящего ископаемого верхнего эйфеля, или *Gruenewaldtia latilinguis latilinguis* (Schnur, 1851), из верхне-эйфельских слоев Рейнских сланцевых гор, говорит в пользу верхне-эйфельского возраста скальских слоев. Однако это не является достаточным доказательством. Возможно, что изучение других групп плеченогих облегчит решение вопроса стратиграфического возраста скальских слоев. Живетский (верхне-живетский) возраст покрживянских слоев кажется быть вне сомнения. Это подтверждается присутствием комплекса больших аtryп рода *Desquamatia*, характерных для живетского яруса Рейнских сланцевых гор (Bilveringsen, Refrath; Leidhold, 1928; Torley, 1934; Schlotheim, 1822), Урала и Китая (Алексеева, 1962; Grabau, 1931).

В настоящей работе описано 20 видов принадлежащих 2 семействам: *Atrypiidae* Gill и *Paraferrellidae* Spriestersbach, надсемейства *Atrypacea* Schuchert. Эти виды принадлежат 5 родам: *Atrypa*, *Spinatrypa*, *Desquamatia*, *Carinatina* и *Gruenewaldtia*. Установлено 6 новых видов: *Atrypa subtrigonalis* n. sp., *Spinatrypa dorsata* n. sp., *S. asperoides* n. sp., *Desquamatia subzonata* n. sp., *D. zonatoides* n. sp., *D. circulareformis* n. sp.; 3 вида (*Atrypa* sp., *Carinatina* sp., *Gruenewaldtia* sp.) являются по всей вероятности новыми, но не получили видового названия ввиду недостаточного количества материала.

Хорошая по большей части сохранность образцов дала возможность изучить внешнюю и внутреннюю морфологию отдельных видов. Для 3 видов: *Atrypa subtrigonalis* n. sp., *Spinatrypa aspera* (Schlotheim) и *Desquamatia subzonata* n. sp., являющихся представителями трех родов, проведен анализ возрастных изменений пользуясь сохранившимися сериями образцов, длиной примерно в 0,6 — 26 мм. В итоге этих исследований установлено, что роды *Atrypa*, *Spinatrypa* и *Desquamatia* являются родственными. В особенности большое сходство обнаруживают роды *Atrypa* и *Spinatrypa*, особенно на ранних стадиях развития (длина образцов ок. 3 мм), выраженное главным образом в форме раковины, степени развития макушки брюшной створки и характере скульптуры. Одновременно род *Desquamatia* обнаруживает довольно большую обособленность.

Это намечается в форме раковины, присутствии ареи, макушки выступающей далеко за пределы замкового края брюшной створки и в скульптуре. Различия усиливаются во взрослых стадиях. Одним из диагностических признаков этих 3 родов является степень развития зубных пластинок (стр. 289). Этот признак послужил, рядом с другими, для выделения Алексеевой (1961) подрода *Atrypa* (*Desquamatia*).

Кажется весьма вероятным, что *Spinatrypa* и *Desquamatia* появились почти одновременно в нижнем эйфеле Лысогорского района (выдрышовские слои), как ответвление рода *Atrypa*.

PLATES

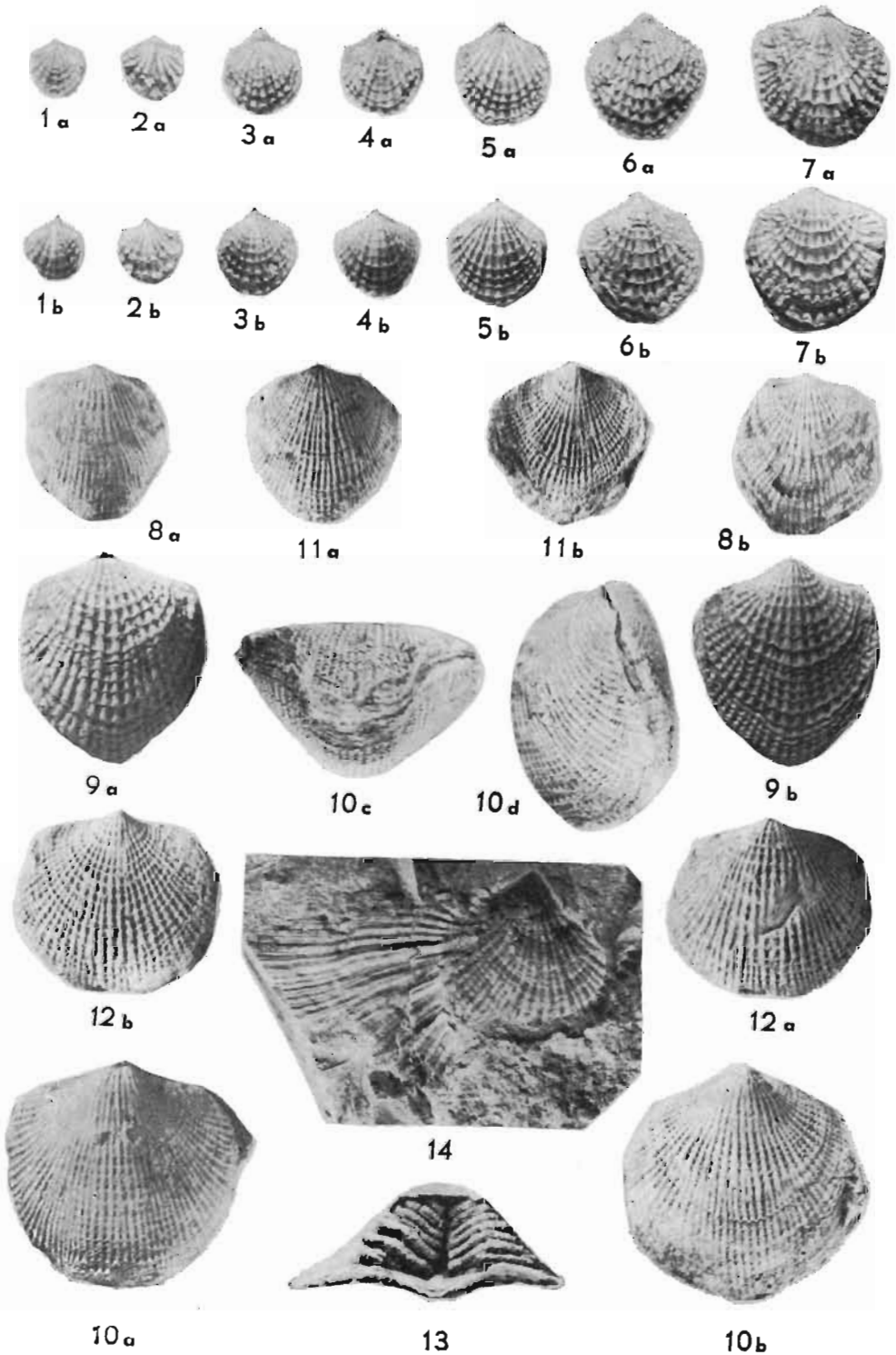
Plate I

Atrypa depressa Sobolev
(Skaly)

- Fig. 1-9. Range of specimens of different size (Bp. VI/25-31, 32), *a* brachial, *b* pedicle valve views; $\times 2$.
Fig. 11. Adult specimen (Bp. VI/33), *a* brachial, *b* pedicle valve views; nat. size.
Fig. 13. Brachidium of adult specimen (Bp. VI/14); nat. size.
Fig. 14. Cast of the pedicle valve with fringe (Bp. VI/13) from limestone of outcrop 83; nat. size.

Atrypa squamifera (Schnur, 1853)
(Skaly)

- Fig. 10. Adult specimen in four views (Bp. VI/331); nat. size.
Fig. 12. Two adult specimens (Bp. VI/332, 333), *a* brachial, *b* pedicle valve views; $\times 2$.



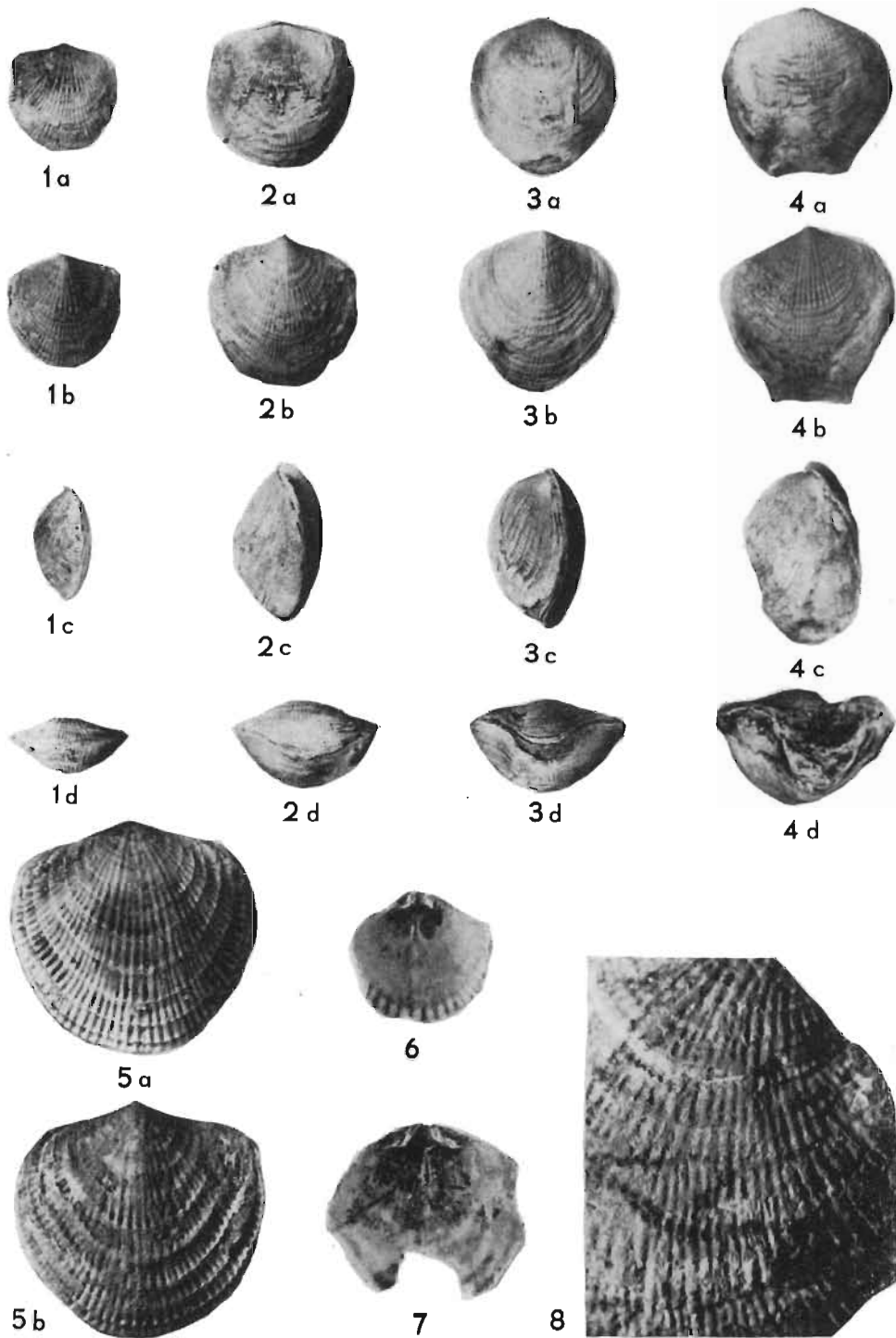


Plate II

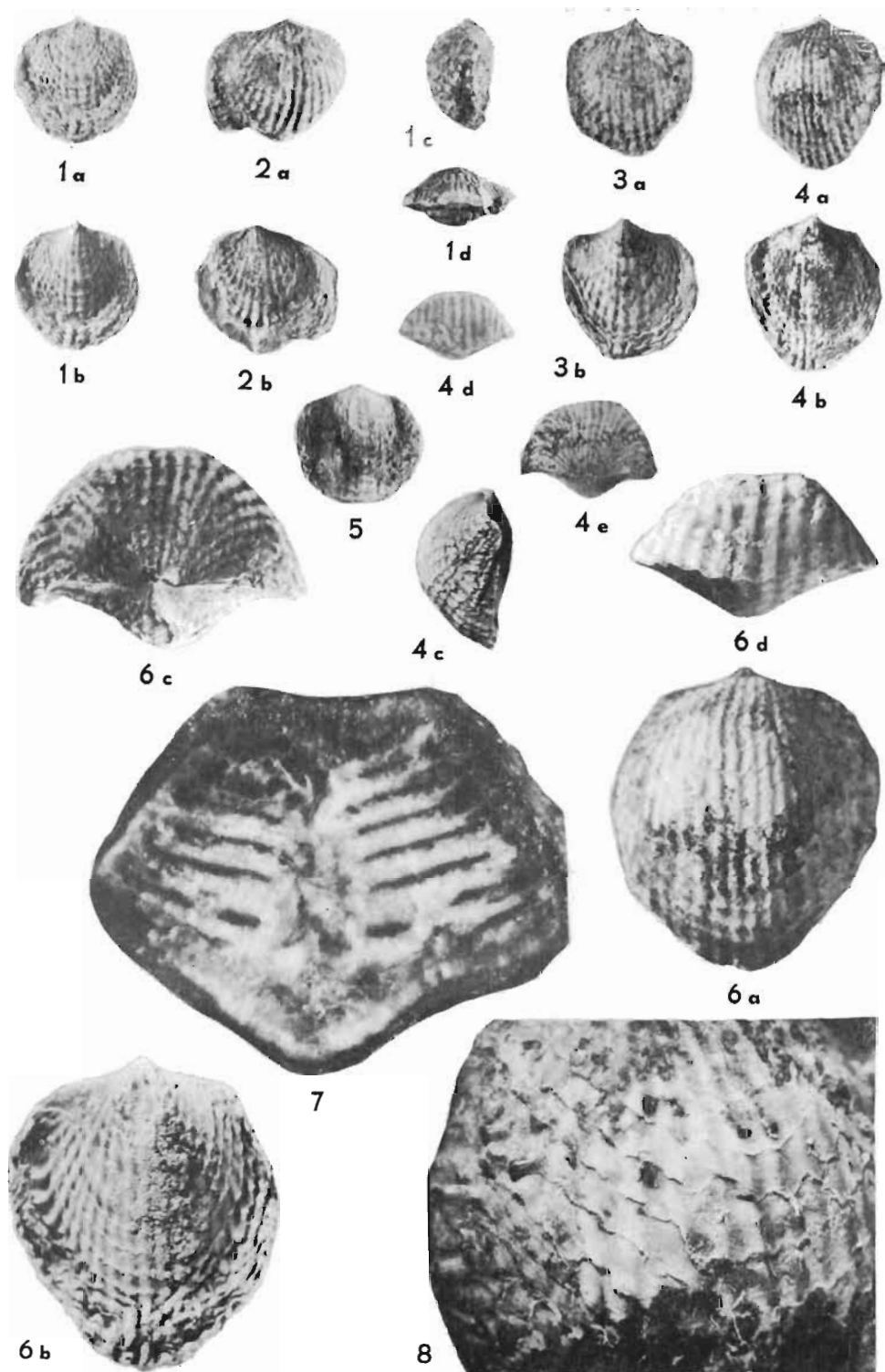
Atrypa subtrigonalis n.sp.
(Skaly)

- Fig. 1, 2, 4. Adult specimens (Bp. VI/252, 253, 257) in four views: *a* brachial, *b* pedicle, *c* lateral, *d* anterior; nat. size.
- Fig. 3. Holotype (Bp. VI/251) in four views (*a-d*); nat. size.
- Fig. 5. Adult specimen (Bp. VI/255) in: *a* brachial, *b* pedicle valve views; $\times 2$.
- Fig. 6, 7. Interior of two brachial valves (Bp. VI/262, 263); $\times 2$.
- Fig. 8. Fragment of the surface ornamentation; $\times 3$.

Plate III

Spinatrypa dorsata n.sp.
(Wydryszów)

- Fig. 1-3. Three different specimens (Bp. VI/345-347), *a* brachial, *b* pedicle, *c* side, *d* anterior views; nat. size.
- Fig. 4 *a-c*, *e*, 6 *a-c*. Holotype (Bp. VI/343); fig. 4 — nat. size in four views, fig. 6 — the same specimen in three views, $\times 2$.
- Fig. 4*d*, 6*d*. Anterior view of specimens (Bp. VI/348); fig. 4*d* — nat. size, fig. 6*d* — $\times 2$.
- Fig. 5. Brachial valve view of adult specimen (Bp. VI/345); nat. size.
- Fig. 7. Cross section of adult specimen with brachidium (Bp. VI/344); $\times 5.5$.
- Fig. 8. Fragment of the surface ornamentation; $\times 3.5$.



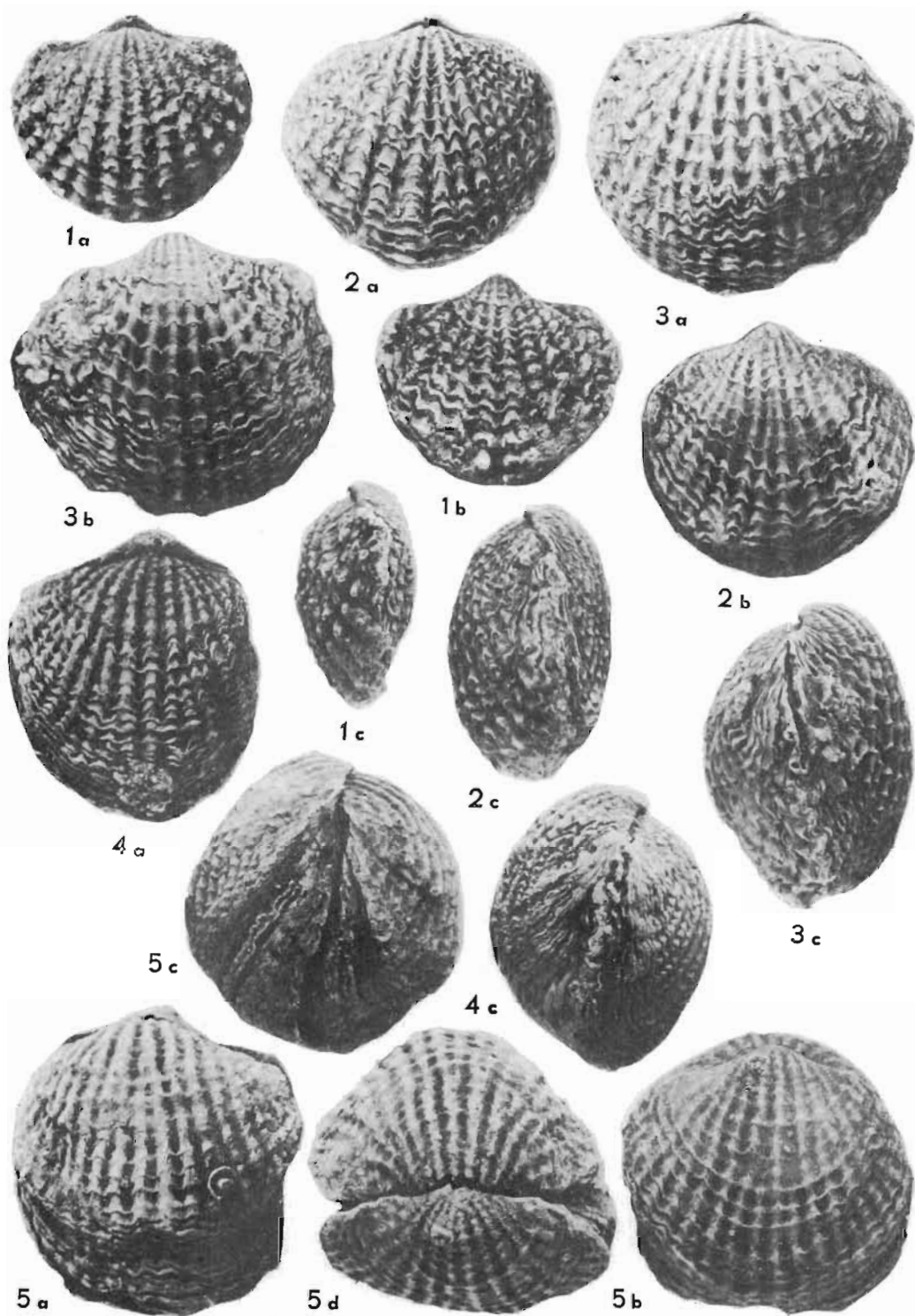


Plate IV.

Spinatrypa aspera (Schlotheim)
(Skały)

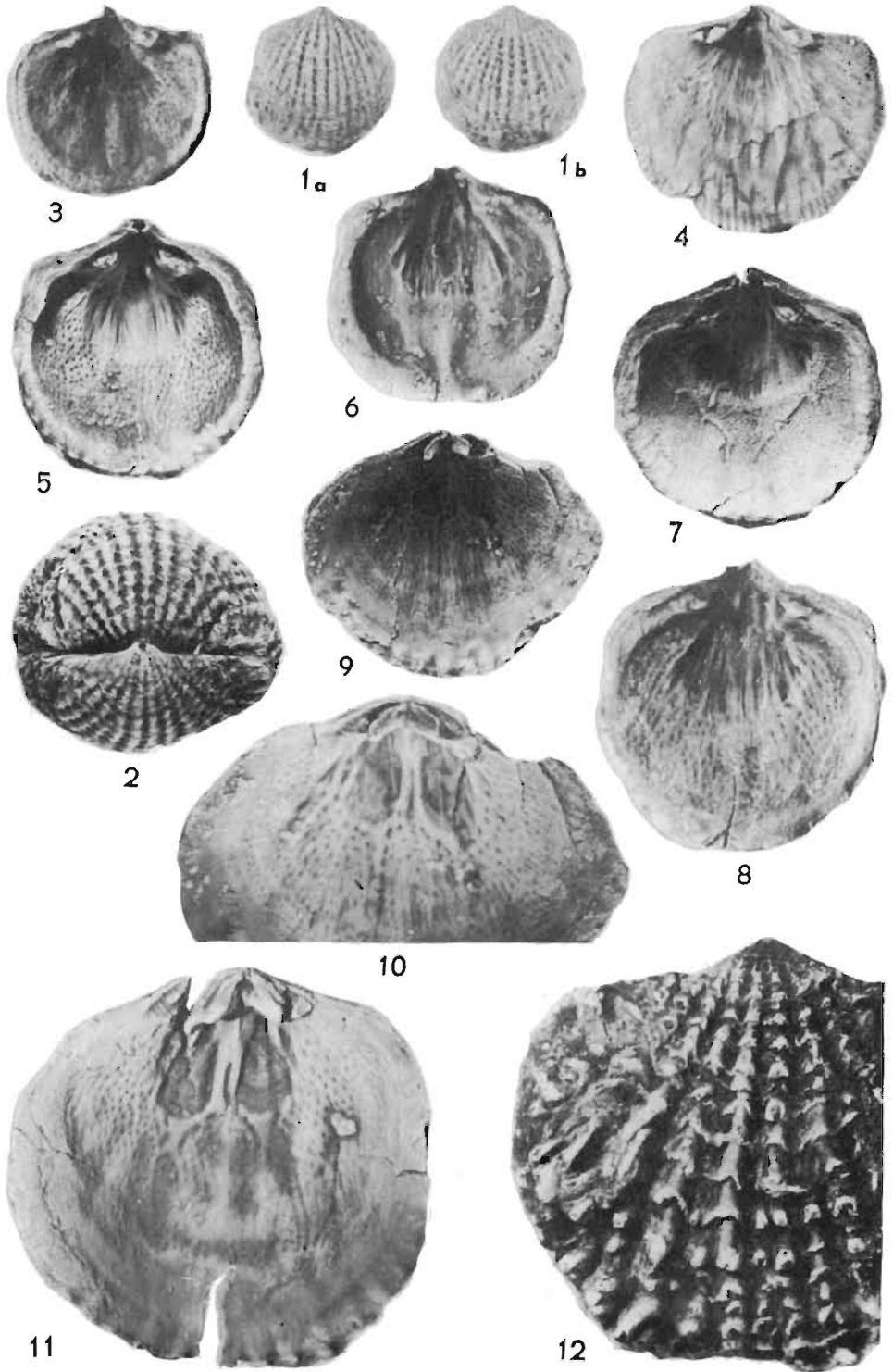
Fig. 1-4. Four different specimens (Bp. VI/366, 367, 363, 379); *a* brachial, *b* pedic-
le, *c* lateral views; $\times 2$.

Fig. 5. Gerontic specimen, in four views (Bp. VI/360); $\times 2$.

Plate V

Spinatrypa aspera (Schlotheim)
(Skały)

- Fig. 1. Adult specimen (Bp. VI/364) in brachial (*a*) and pedicle valve (*b*) views; nat. size.
- Fig. 2. Posterior view of gerontic specimen (Bp. VI/379); $\times 2$.
- Fig. 3-8. Six pedicle valve interiors; $\times 2$.
- Fig. 9-11. Three different brachial valve interiors (Bp. VI/370-372); fig. 9 — $\times 2$, fig. 10, 11 — $\times 3$.
- Fig. 12. Pedicle valve surface with preserved spines (Bp. VI/365); $\times 6$.



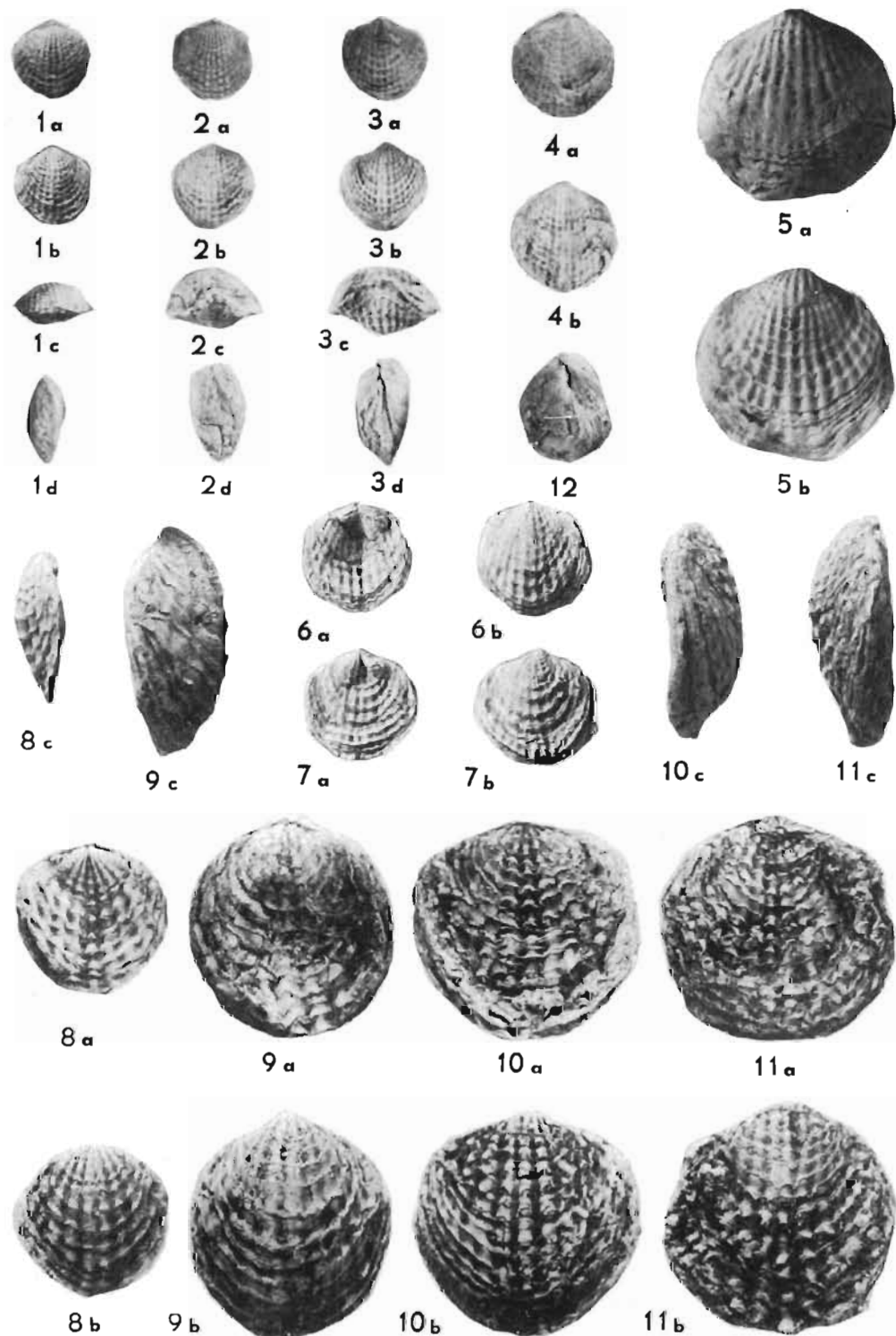


Plate VI

Spinatrypa asperoides n.sp.
(Skały)

Fig. 1-4. Four different adult specimens (Bp. VI/388, 386, 387, 384) in: *a* brachial, *b* pedicle, *c* anterior, *d* lateral views; nat. size.

Fig. 5. Holotype (Bp. VI/383) in: *a* brachial, *b* pedicle valve views; $\times 2$.

Fig. 12. Lateral view of old specimen (Bp. VI/382) nat. size.

Spinatrypa fasciplicata (Struve)
(Skały)

Fig. 6, 7. Two adult specimens (Bp. VI/400, 401) in: *a* brachial, *b* pedicle valve views; nat. size.

Fig. 8-11. Four different specimens (Bp. VI/402-405) in: *a* brachial, *b* pedicle, *c* lateral views; $\times 2$.

Plate VII

Desquamatia varistriata Biernat
(Wydryszów)

Fig. 1-4. Four different specimens (Bp. VI/405, 409, 401, 406) in: *a* brachial, *b* pedicle valve views; nat. size.

Fig. 5, 6. Two adult specimens (Bp. VI/407, 408) in four views (*a-d*); nat. size.

Spinatrypa asperoides n.sp.
(Skały)

Fig. 7. Brachial valve view of adult specimen (Bp. VI/392); $\times 4$.

Fig. 8. Pedicle valve view with traces of spines and concentric lines (Bp. VI/393); $\times 4$.

Desquamatia aff. *zonata* (Schnur)
(Skały)

Fig. 9. Side view of mature specimen (Bp. VI/415); nat. size.

Desquamatia subzonata n.sp.
(Skały)

Fig. 10. Posterior part of the pedicle valve (Bp. VI/475); $\times 4$.



1a



2a



3a



4a



1b



2b



3b



4b



5a



5c



5d



5b



6a



6c



6d



6b



7



9



8



10

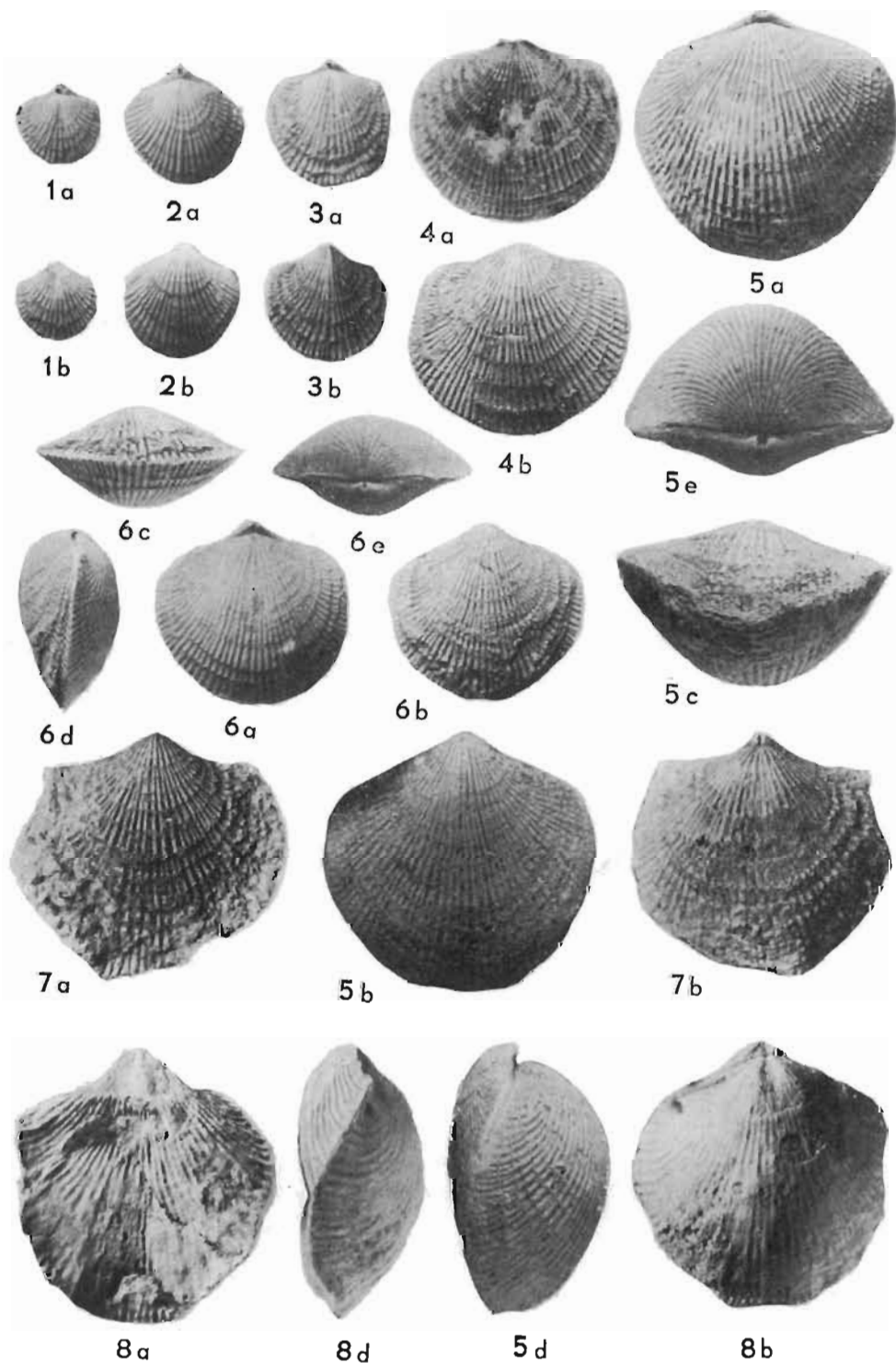


Plate VIII

Desquamatia subzonata n.sp.

(Skały)

Fig. 1-4. Four specimens (Bp. VI/467, 466, 465, 464) in two views (*a, b*); $\times 2.1$.

Fig. 5, 6. Two adult specimens (Bp. VI/463, 468) in five views (*a-e*); $\times 2.1$.

Fig. 7. Adult specimen (Bp. VI/469); *a* — pedicle, *b* — brachial valve views; $\times 2$.

Desquamatia circulareformis n.sp.

(Miłoszów)

Fig. 8. Specimen (Bp. VI/552) in three views (*a-c*); nat. size.

Plate IX

Desquamatia subzonata n.sp.
(Skały)

Fig. 1. Holotype (Bp. VI/450) in: *a* brachial, *b* pedicle valve views; nat. size.

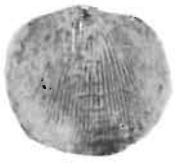
Fig. 2-6. Five pedicle valves interiors (Bp. VI/475, 471-474); fig. 2 — $\times 3$, fig. 3-6 — $\times 2$.

Fig. 7, 8. Two brachial valves interiors (Bp. VI/470); $\times 2$.

Desquamatia aff. *zonata* (Schnur)
(Skały)

Fig. 9. Adult specimen in: *a* pedicle, *b* brachial, *c* anterior and *d* side views (Bp. VI/415); nat. size.

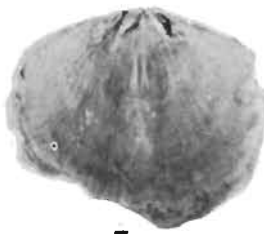
Fig. 10. Fragment of the shell surface; $\times 4.6$.



1a



1b



7



2



3



9a



4



5



9b



6



10



9c



9d



8



1a



1b



2a



3a



2c



3b



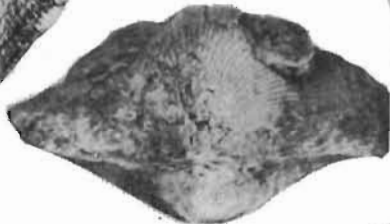
4



2b



7d



7c



5



6

Plate X

Desquamatia prisca (Schlotheim)
(Kamieniec)

Fig. 1, 2. Two young specimens (Bp. VI/704, 705); a brachial, b pedicle, c lateral views; nat. size.

Desquamatia zonatoides n.sp.
(Pokrzywianka-Kamieniec)

Fig. 3, 5-7. Different state of preservation of four adult specimens (Bp. VI/707-710); a brachial, b pedicle, c anterior, d lateral views, fig. 6, 7 — pedicle valve views; nat. size.

Fig. 4. Holotype (Bp. VI/470), pedicle valve view; nat. size.

Plate XI

Desquamatia prisca (Schlotheim)
(Pokrzywianka-Kamieniec)

Fig. 1-3. Three different specimens (Bp. VI/503), a brachial, b pedicle valve views;
nat. size.

Fig. 6. Lateral view of adult specimen (Bp. VI/501); nat. size.

Desquamatia zonatoides n.sp.
(Pokrzywianka)

Fig. 4. Pedicle valve view of adult specimen (Bp. VI/476); nat. size.

Fig. 5. Lateral view of adult specimen (Bp. VI/712); nat. size.

Fig. 7. Cast of the pedicle valve (Bp. VI/713); nat. size.

Fig. 8. Pedicle valve view of adult specimen (Bp. VI/713); $\times 2$.



1a



2a



3a



1b



2b



3b



5



4



6



7



8



1a



4



1b



2



1c



3



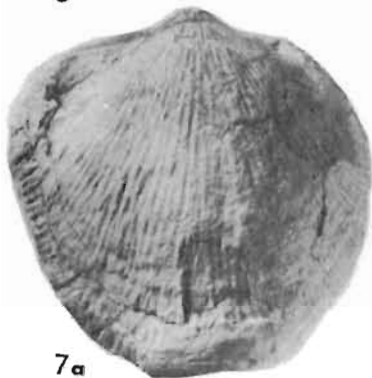
5



1d



6



7a



7c



7b

Plate XII

Atrypa? sp.
(Miłoszów)

Fig. 1. Adult specimen (Bp. VI/700); *a* brachial, *b* pedicle, *c* anterior, *d* lateral views; nat. size.

Desquamatia circulareformis n.sp.
(Miłoszów)

Fig. 2, 3. Pedicle valve view of two specimens (Bp. VI/555, 554), fig. 3 — holotype (Bp. VI/554); nat. size.

Gruenewaldtia sp.
(Miłoszów)

Fig. 4. Lateral view of adult specimen (Bp. VI/715), figured on pl. XIV, fig. 7; nat. size.

Desquamatia prisca (Schlotheim)
(Kamieniec)

Fig. 5, 6. Pedicle valve view of two adult specimens (Bp. VI/508, 500); nat. size.

Desquamatia sp.
(Pokrzywianka)

Fig. 7. Adult specimen (Bp. VI/493) in three views (*a-c*); nat. size.

Plate XIII

Carinatina sp.
(Skaly)

Fig. 1-5. Brachial valve views of five different specimens (Bp. VI/607-610); nat. size.

Fig. 6-8. Pedicle valve of three different specimens (Bp. VI/605, 606, 603); nat. size.

Fig. 9. Lateral view of adult specimen; nat. size.

Carinatina plana (Kayser)
(Skaly)

Fig. 10. Adult specimen (Bp. VI/600) in: *a* brachial, *b* pedicle, and *c* side views;
nat. size.

Fig. 11. Brachial valve view of specimen (Bp. VI/604); nat. size.

Fig. 12. Fig. 10*a*, enlarged $\times 2$.

Carinatina cf. *arimaspa* (Eichwald)
(Miłoszów)

Fig. 13. Brachial valve view of adult specimen (Bp. VI/601); nat. size.

Fig. 14. Fig. 13, enlarged $\times 2$.



1



2



3



4



6



7



9



8



10a



10c



10b



11



5



13



12



14

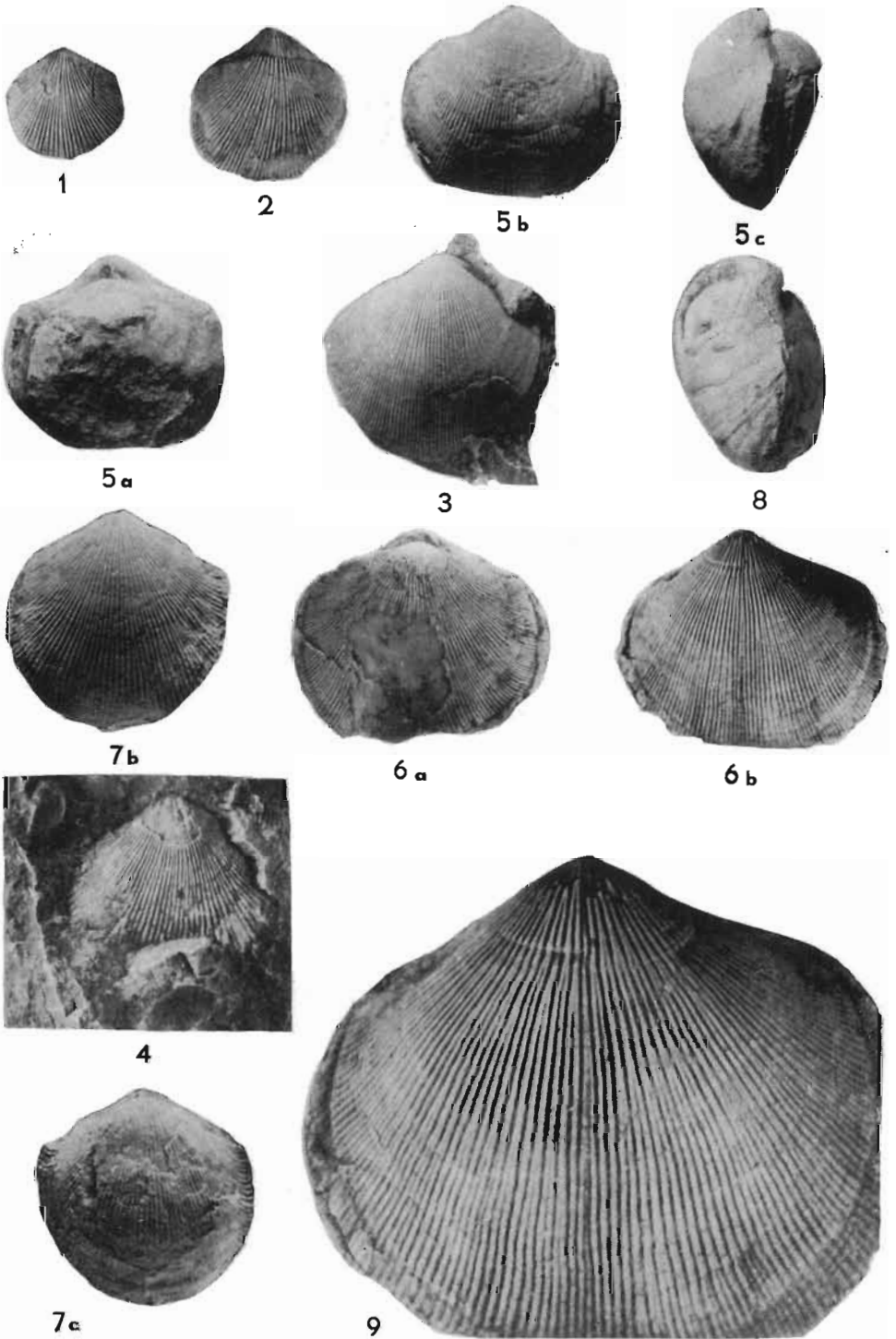


Plate XIV

Gruenewaldtia latilinguis latilinguis (Schnur)
(Skały)

Fig. 1-3. Pedicle valve view of three different specimens (Bp. VI/717-719); nat. size.

Fig. 5, 6. Two adult specimens (Bp. VI/721, 722); *a* brachial, *b* pedicle, *c* lateral views; nat. size.

Fig. 8. Lateral view of adult specimen (Bp. VI/560); nat. size.

Fig. 9. Fig. 6 (Bp. VI/722), enlarged $\times 2.5$.

Gruenewaldtia sp.
(Miłoszów)

Fig. 4. Pedicle valve view of specimen (Bp. VI/724), embedded in limestone; nat. size.

Fig. 7. Adult specimen (Bp. VI/715); *a* brachial, *b* pedicle valve views; nat. size.

Plate XV

Atrypa depressa Sobolev
(Skaly)

Fig. 1-6. Interiors of different pedicle valves (Bp. VI/22-24, 16, 15, 24), showing size and dimensions of the muscle area and partly preserved vascular system; $\times 2$.

Fig. 7-11. Interiors of separate brachial valves: fig. 7 — dwarfed specimen (Bp. VI/25), $\times 2$; fig. 8 — incomplete valve of old specimen (Bp. VI/19). $\times 2$; fig. 9 — old specimen with grooved septal ridge (Bp. VI/20), $\times 2$; fig. 10 — crenulation of dental sockets (Bp. VI/18). $\times 3$; fig. 11 — posterior of the valve (Bp. VI/19). $\times 3.3$.

