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# BRACHIOPODS AND CONODONTS FROM THE FRASNIAN OF THE DEBNIK ANTICLINE, SOUTHERN POLAND (plates 1-23)

Abstract. — The stratigraphy of the Upper Devonian of the Dębnik area (Cracow region, southern Poland) is revised and the conodont stratigraphy of the area established for the first time. The Frasnian brachiopods comprise 38 species and three subspecies of seven orders. Two species, Corbicularia cracoviensis sp. n. and Bergalaria guerichi sp. and one subspecies, Calvinaria albertensis minor subsp. n., are new. Twelve species are recognized for the first time in Poland: Barroisella campbelli, Schizophoria iowaensis, Parapugnax schucherti, Calvinaria albertensis albertensis, C. variabilis athabascensis, Caryorhynchus tumidus, Anatrypa alticola, Desquamatia (Seratrypa) oneidensis, D. (Neatrypa) velikaja, Iowatrypa markovskii, Spinatrypa (Spinatrypa) semilukiana and Tenticospirifer cyrtiniformis. The Spiriferida (16 species) and the Rhynchonellida (10 species and 3 subspecies) are the groups most abundantly represented. Seven local biostratigraphic range, partial range and assemblage zones of brachiopods are recognized and, from the associated condonts, correlated with the standard conodont zones. The Frasnian platform conodonts belong to four stratigraphically important genera (Ancyrodella, Icriodus, Palmatolepis and Polygnathus) and 27 species.

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## INTRODUCTION

The main object of the present study was to revise the brachiopods described by GÜRICH (1903) from the Dębnik area (Cracow region, southern Poland) and to correlate the ranges of the brachiopods with the standard conodont zones. The Devonian strata of the Dębnik anticline have been of interest to geologists since the early part of the eighteenth century (reviewed by RUTKOWSKI 1928 and SIEDLECKI 1954). However, ZARĘCZNY (1889, 1894) was the first to make a general survey of the area. His works were followed by GÜRICH's (1903) detailed stratigraphical division of the Devonian. In his monograph GÜRICH included a description of the brachiopods and associated fauna, distinguishing several new species and varieties. JAROSZ (1918, 1926) continued studies on the Devonian with a revision of GÜRICH's stratigraphical scheme. This was not received without criticism (RUTKOWSKI 1928, CZARNOCKI 1935). Subsequent studies on the Devonian of the Dębnik anticline (SIEDLECKI 1954; KLIMEK and KO-SZARSKI 1955; ZAJĄCZKOWSKI 1964, 1968) have introduced no significant changes to GÜRICH's and JAROSZ's scheme. Recently NOWIŃSKI (1976) has revised the Tabulata.

This paper on the Frasnian brachiopods and conodonts of the Dębnik anticline together with the earlier author's report (BALIŃSKI 1977) completes the first stage of studies begun in 1971. The next stage will include a revision of the Famennian brachiopods and conodonts.

It is hoped that this study will assist correlation of the many deep borings in the Upper Silesian Coal Basin. The present lack of such data poses considerable problems in determining the stratigraphy of the Upper Devonian of that area (ŻAKOWA 1965; SLÓSARZ and ŻAKOWA 1975; CHOROWSKA 1975).

Brachiopods and conodonts described in this paper are housed at the Institute of Paleobiology of the Polish Academy of Sciences in Warsaw, abbreviated ZPAL: Bp XXIII (brachiopods) and C VIII (conodonts).

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## ABBREVIATIONS USED

Abbreviations used in the tables of dimensions of brachiopod shells:

Aa — apical angle
Cvv — convexity of pedicle valve
HArvy — height of the interarea of pedicle valve
Ldy — length of brachial valve
1t — length of the tongue of pedicle valve
l vy length of pedicle valve
Nb/1 $-$ number of concentric strips per 1 mm pear the anterior margin
Nc/1 — number of capillae per 1 mm pear the anterior margin
Nr/5 — number of costae per 5 mm pear the anterior margin
Nr/10 — number of costae per 10 mm near the anterior margin
Nr/fo = number of costae on fold
Nr/su
Sha shoulder angle
Sha — shoulder angle
T — thickness of shell
W — width of shell
wfo — width of fold near the anterior margin
wsu — width of sulcus near the anterior margin
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# GENERAL PART

## GEOGRAPHICAL AND GEOLOGICAL SETTING

The Paleozoic deposits of the environs of Dębnik district form a not very extensive anticline, modified by faults and being of intrusive origin (ZAJĄCZKOWSKI 1968). It forms part of the Dębnik anticline, connected structurally with the north-eastern margin of the Upper Silesian Coal Basin. The oldest deposits, outcropping in this area, are Middle Devonian dolomites and limestones. The Upper Devonian is developed as marly or, less frequently, dolomitic limestones, containing a fairly abundant and diverse fauna. The Devonian deposits are overlaid by Carboniferous, Jurassic and Quaternary sediments.

The outcrops of the Devonian rocks are irregularly distributed over an area of about 8 sq.km 23 km west of Cracow. The village of Dębnik is situated in the middle of this area (fig. 1).

#### Central and northern outcrops (fig. 1)

In the central part of the area the most important Frasnian outcrops are the Main Carmelite quarry (now connected with New Tumidalski's quarry), a quarry above Rokiczany Dół ravine and a small quarry (also called Old Tumidalski's quarry), now largely infilled. In the northern part, the most important Frasnian outcrops are in the Rokiczany Dół ravine and several tranches dug to the north on the slopes of Żarnówka Hill. Famennian and Carboniferous rocks outcrops occur north of Żarnówka Hill and adjacent to Żarnówczany Dół ravine.

#### The Main Carmelite quarry (fig. 2)

This quarry is one of the oldest and largest Devonian outcrops in the Dębnik area. Much of the section profile (fig. 2) is of bedded, dark biopelmicrites, which are slightly marly and generally poorly fossiliferous, locally known as the "Dębnik marble". A few layers in the lower part yield stromatoporoids, tetracorals, gastropods and ostracods but only exceptionally, brachiopods (*Crurithyris jurkowicensis* BALIŃSKI).

Fossils are more frequent in the upper part, particularly gastropods with less numerous, stromatoporoids, tetracorals and pelecypods. Brachiopods are represented primarily by *Des-quamatia (Seratrypa) oneidensis* (BEUS) (a layer containing the ŁK-2 conodont sample) and, in the uppermost part of the section, by *Spinatrypina (Spinatrypina)* sp. D. (S.) oneidensis occurs in only one layer about 50 cm thick with the greatest number of its specimens at the



#### Fig. 1

A — General map of Poland (the area presented in fig. *B* indicated by arrow). *B* — Sketch-map of the Dębnik area enclosing sectors *C*, *D* and *E* studied in details. *C*, *D* and *E* — Sketch-maps of the Frasnian (black circles) and Famennian (light circles) trenches and quarries.





Lithological and paleontological profile of the Main Carmelite Quarry. Legend: 1 – limestones, 2 – marly limestones and marls, 3 – nodular limestones, 4 – conodont samples (positive), 5 – conodont samples (negative), 6 – occurrences and range of brachiopod species, 7 – coquina, 8 – massive stromatoporoids, 9 – ramose stromatoporoids (Amphipora), 10 – rugose corals, 11 – gastropods, 12 – pelecypods, 13 – crinoids

top of the layer. This section represents the Upper Givetian and the lowermost Frasnian up to the Lowermost *asymmetricus* Zone.

Conodonts were found in two samples, ŁK-2 and ŁK-3.

#### The quarry above the Rokiczany Dól ravine (fig. 3)

This quarry is situated about 200 m north of the Main Carmelite quarry, close to the upper slope of Rokiczany Dół ravine. The beds exposed here mainly correspond with those of the Main Carmelite quarry. Younger strata (3.5 m unit) are also present in the west wall of the quarry. As in the quarry described above a bed with many valves and complete shells



Fig. 3

Lithological and paleontological profile of the quarry above Rokiczany Dół ravine. For explanation see fig. 2

of D. (S.) oneidensis and 7 m higher beds with Spinatrypina (S.) sp. occur and, in the uppermost part of the section, an abundant fauna of brachiopods including Spinatrypa (S.) semilukiana LJASCHENKO, Cyrtospirifer bisellatus (GÜRICH) and Douvillina (D.) sp. In addition to brachiopods, stromatoporoids, tetracorals, gastropods and pelecypods occur in the lowermost part of the section. In the uppermost part of the section, in the western part of the quarry, gastropods and pelecypods are as frequent as brachiopods. The profile represents the Givetian and lowermost Frasnian up to the Lower asymmetricus Zone.

Conodonts were found in samples K/RD-1 to 4.

#### The tip west of the quarry above Rokiczany Dól ravine

The tip stretches west of the quarry above Rokiczany Dól ravine along the southern slope of the ravine and is composed of material including that derived from the uppermost layers of the quarry. Some boulders are mainly composed of *Cyrtospirifer hisellatus* (GÜRICH), *Eleutherokomma zarecznyi* (GÜRICH), *Spinatrypa* (S.) *semilukiana* LJASCHENKO and *Douvillina* (D.) sp. Others contain *Corbicularia cracoviensis* sp. n. and *Desquamatia* (*Neatrypa*) *velikaja* (NALIVKIN). Conodonts characteristic of the Lower *asymmetricus* Zone are associated with the brachiopods.

#### Old Tumidalski's quarry (fig. 4)

This outcrop is situated about 15 m north-west of the Main Carmelite quarry and close to the Dębnik-Paczółtowice road. It is partly filled and overgrown. The section comprises medium-bedded, sometimes nodular biopelmicritosparites of the Lower *asymmetricus* Zone with



Fig. 4 Lithological and paleontological profile of the Old Tumidalski's Quarry. For explanation see fig. 2

Cyrtospirifer bisellatus, Eleutherokomma zarecznyi and Spinatrypa (S.) semilukiana, together with sponges, gastropods, tentaculites and fish remains. Conodonts were found in samples S&T-1 and 2.

#### Rokiczany Dól ravine (fig. 1)

Situated about 0.8 km north of Dębnik and runs eastwards to join the valley of the Racławka River. Outcrops of Famennian and Carboniferous sediments occur in the lower and middle parts of the ravine. The Famennian is in direct tectonic contact with dark, micritic Givetian limestones (RUTKOWSKI 1928). In the filled and overgrown upper part of the ravine, fragments of Frasnian limestone occur (nearly *in situ*) on its bottom. Fragments with *Desquamatia* (S.) oneidensis and, somewhat higher, fragments containing Spinatrypa (S.) semilukiana and Cyrtospirifer bisellatus were found; species characteristic of the uppermost beds in the quarry above the ravine and in Old Tumidalski's quarry (the conodont Lower asymmetricus Zone).

Fragments of biopelmicrites, biopelsparites and light-gray crinoid biopelintrasparites occur in the uppermost (westernmost) part of the ravine. A small, but diverse fauna of brachiopods, and other invertebrates (cf. — the faunal list from the *Calvinaria cracoviensis* Zone), occurs in these limestones which undoubtedly represent various parts of the Middle and Upper *asymmetricus* Zone.

# Trench Żar-I (fig. 1)

This trench was dug into the southern slope of the Żarnówka Hill about 50 m north of Rokiczany Dół ravine. The thin-bedded, light-gray, spotty intrasparites are probably referable to the conodont *Ancyrognathus triangularis* Zone. Fossils are rare but include stromatoporoids, tabulate corals, crinoids (columnals), conodonts (in sample Żar-I) and the brachiopods *Calvinaria albertensis albertensis* (WARREN), *Warrenella euryglossa* (SCHNUR), *Biernatella polonica* BALIŃSKI and *Iowatrypa markovskii* (LJASCHENKO).

# Trench Żar-III (fig. 1)

Dug into the northern slope of Żarnówka Hill 15 m east of the Dębnik-Paczółtowice road. Medium and thin-bedded, light-gray intrasparites (probably the *Ancyrognathus triangularis* or *gigas* Zone) yield only *Amphipora* and massive Tabulata.

#### Southern outcrops

The area, south of Dębnik, is covered by forest and devoid of natural outcrops of Upper Devonian sediments. Disused and mainly infilled quarries are the only natural exposures. In addition 40 trenches were dug. Frasnian limestones were exposed in eleven and Famennian in twenty-nine.

## Quarry Z-II (fig. 5)

Quarry Z-II is one of the two large (called New Quarries) exposures south of Dębnik on the northern slope of Żbik ravine. Medium and thin-bedded, dark-gray, to nearly black, marly micrites yield brachiopods, mostly *Leiorhynchus laevis* GÜRICH and *Cyrtospirifer minor* (GÜRICH). The section probably, as a whole, belongs to the conodont Lower *triangularis* Zone. Another assemblage of brachiopods, different specifically, occurs in the uppermost part of the section which is assigned in the present paper to the Famennian.

Conodonts were found in samples Z-II-1 to 4.



Fig. 5

Lithological and paleontological profile of the quarry Z-II. Legend: 1 — no outcrop, 2 — very poor outcrop. For additional explanation see fig. 2

## Quarry Z-III (fig. 7)

In an outcrop situated about 60 m north of quarry Z-II, close to the forest road from Siedlec to Dębnik several thin-bedded micrites, like those in quarry Z-II, yielded the characteristic brachiopods *L. laevis* and *C. minor* (probably the conodont Lower *triangularis* Zone).

### Trench Z-IV (fig. 6)

It was situated about 100 m south of quarry Z-II and about 40 m south of a clearing the forest road from Siedlec to Dębnik. This trench exposed thin-bedded, light-gray, somewhat brownish, very well sorted biopelintrasparites filled with common brachiopods, primarily of *Calvinaria albertensis minor* subsp. n., *Iowatrypa markovskii* (LJASCHENKO) and *Biernatella polonica* BALIŃSKI, accompanied by tentaculites, gastropods, crinoids (columnals), conodonts (sample Z-IV) and fish remains. These limestones represent the *gigas* Zone.



Lithological and paleontological profile of the trenches Z-IV, Z-V, Z-VII to Z-IX, Z-XI to Z-XIV. For explanation see figs 2 and 5

#### Trenches Z-V and Z-VII (fig. 6)

They were situated 8 m north (Z-VII) and 20 m north-east (Z-V) of trench Z-IV and exposed light-gray and gray intrasparites interbedded with nodular intramicritosparites (gigas Zone), containing stromatoporoids, tetracorals, tabulate corals, brachiopods, gastropods, crinoids (columnals), conodonts (samples Z-V and Z-VII) and fish remains. Brachiopods are mainly represented by *Calvinaria albertensis albertensis* (WARREN) and *Caryorhynchus tumidus* (KAYSER).

#### Trench Z-VI (fig. 7)

It was dug about 70 m north of outcrop Z-III. The thin- to medium-bedded, almost black, strongly marly biopelmicritosparites of the uppermost part of the conodont gigas Zone were



found at a depth of 0.6 m. Brachiopods are here represented almost exclusively by *Caryorhynchus tumidus*, which is abundant in some layers and very well preserved. The accompanying fauna includes foraminifera, tentaculites, conodonts (sample Z-VI) and fish remains.

## Trenches Z-XI and Z-XIB (fig. 6)

They were situated about 1.5 m south-west f trench Z-IV and exposed thin-bedded, gray, dark-gray and, less frequently, spotty, marly biopelintramicrites (gigas Zone), containing brachiopods, stromatoporoids, tabulate corals, solitary and colonial tetracorals, and, less

Table 1 Correlation chart of GÜRICH'S (1903), JAROSZ'S (1926) and present author's stratigraphical schemes of the Upper Devonian of the Dębnik anticline and conodont zonation

GÜRICH 1903

**JAROSZ** 1926

PRESENT AUTHOR

	Southern area	Northern area	Southern area	Northern area			·					<del></del>
			Limestones with Spirifer Archiaci Var. orbeliana					P	Protognath 2	odus 2	do VI	
			ella) praelongus					27 26	Upper Middle	status .	do VI	
			Limestones with Spirifer Verneuili typ. and var. tenticulum	Limestones (stromatopo- rold rocks) with Spiri- fer Verneuili typ. and Var.tenticulum and with Productus (Productella) praelongus				25 24 23 22	Lower Upper Middle Lower	· styriacus co:	do V/VI? do V do IV	
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A I					· · · · · · · · · · · · · · · · · · ·	Intrasparudites with a poor fauna		18	Upper	ifera	do III¤	×
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R N						Limestones with Leio- productus	s	16 Ь	Upper	oidea	do IIB	× س
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F	?Beds with Athyris re- ticulata					fer orbelianus" Limestones with "Spiri-	mal	15	Upper			F A
					X	Limestones from tren- ches Z-orb-VI to VIII	nfor	14	Middle	crepidi	do Ìľα	
	Beds with <i>Spirifer Mur-</i> chisoni	Limestones from Pałkowa Góra Quarry with Spiri- fer Murchisonianus Var. globosa and angustiros-					·~	13	Lower			
		tris	Beds with Spirifer Mur- chisoni	Limestones from Pałkowa Góra Quarry with Spiri- fer Murchiscni Var. glo-	[/ \ 	Limestones with Tenti- cospirifer		12	Upper	aris	-do Iớ	
				bosa dilu angustirostris		Limestones with Cyrto- spirifer aff. minor		11	Middle	riangula	post	_2-
	Beds with Leiorhynchus	Beds with <i>Leiorhynchus</i>		Limestones with Mantico- cers intumescens		Leiorhynchus laevis Zone		10	Lower	t		
	laevis	laevis				Caryorhynchus tumidus Zone ——————————————		9	Uppermost		do Iơ	
			Beds with Leiorhynchus	Beds with Leiorhynchus			nes	8	Upper	gigas	do I %/ð	
A					ļ	Calvinaria albertensis Zone	d z 0	7	Lower	athus		A
N	Spotted limestones with Phillipsastrea		Spotted limestones with				1 0 P 0	6	triangula	aris	do I(a)X	Z
S		Beds with Leiorhynchus cracoviensis	friinpsastrea )	Beds with Leiorhynchus	 	Calvinaria cracoviensis. ≁Zone	a c h	5	Middle	sus		A S
R				,		Cyrtospirifer bisella-	p   p	36	lower	ymmetrio	do I	a
ш	±	Beds from Tumidalski's (	Limestones with spirifa-	ן Beds from Tumidalski's)		tus Zone Spinatrypina (Spinatry-		30	Lowermost	as	<b>υυ Ια</b>	<b>LL</b>
		Old Quarry with Spirifer Archiaci var. bisellata	Archiaci Var. bisellata	Old Quarry with Spirifer Archiaci Var. bisellata		barren interzone Desquamatia (Seratrypa)		2ь	Upper	i- tus	?do Ia	
						Site and the second sec		2.	∟ower	hermann crista		Give

frequently, gastropods and crinoids (columnals). The few brachiopods are represented mostly by *Anatrypa alticola* (FRECH), *Tenticospirifer cyrtiniformis* (HALL and WHITFIELD) and *Athyris concentrica* (BUCH). Conodonts were found in samples Z-XI-1 to 3 and Z-XIB.

## Trench Z-XII (fig. 6)

It was dug 4 m south of trench Z-XI and exposed at a depth of about 1.5 m, thin-bedded, almost black, very marly micrites, practically devoid of any fauna except for a single indeterminable specimen of *Cyrtospirifer*. These limestones probably represent the conodont *gigas* Zone.

#### Trench Z-XIII (fig. 6)

It was dug 5 m north of a forest road from Siedlec to Dębnik and about 28 m west of trench Z-III. This trench exposed, at a depth of 0.8–1.0 m fragments of dark-gray, marly micrites, practically devoid of fauna, except for a single, fragmentary pedicle valve probably of *Leiorhynchus laevis*. No conodonts were found but *Leiorhynchus laevis* probably indicates the conodont Lower *triangularis* Zone.

## Trench Z-XIV (fig. 6)

It was situated 4 m south of the Siedlec-Dębnik forest road opposite trench Z-XIII. It exposed thin-bedded, dark-gray, nearly black, marly micrites (probably the conodont Lower *triangularis* Zone) with a poor fauna represented by the brachiopod *Cyrtospirifer minor* (GÜRICH) and conodonts (sample Z-XIV).

# Trenches Z-XV and Z-XVI (fig. 7)

They were dug between outcrop Z-III and trench Z-VI, 10 m (Z-XVI) and 24 m (Z-XV) north of Z-III. The two trenches exposed thin-bedded, dark-gray, marly micrites (probably the conodont Lower *triangularis* Zone) similar to those in outcrops Z-II and Z-III. Also similar is the assemblage of brachiopods of which the most characteristic species are *Leiorhynchus laevis* GÜRICH and *Cyrtospirifer minor* (GÜRICH). The accompanying fauna is represented by foraminifera, conodonts (samples Z-XV and Z-XVI) and fish remains.

### Trench S-I (fig. 1)

It was situated about 300 m south-east of trench Z-IV, close to the Dębnik-Siedlec road and exposed medium-bedded, light-gray biopelintrasparites rather poor in fossils, but containing some tentaculites, holothurids, fish remains and conodonts (sample S-I) characteristic of the conodont gigas Zone.

#### STRATIGRAPHY

#### GENERAL REMARKS

As mentioned above, GÜRICH (1903) was the first to divide the Upper Devonian of the Dębnik area. The profile he compiled included the entire Frasnian and the Lower Famennian. In 1904, he described a "stromatoporoid reef", north-east of Dębnik, composed mostly of *Stromatoporella cracoviensis* GÜRICH, which he assigned to the Carboniferous.

GÜRICH's stratigraphical table was extended by JAROSZ (1918, 1926), who recognized new zones in the Famennian and assembled an almost complete profile to include the Lower Carboniferous. GÜRICH's "stromatoporoid reef" was placed in the Upper Famennian (Etroeungt) and correlated with "limestones with *Spirifer verneuilli* typ. and var. *tenticulum*", which he found south of Dębnik (in the Żbik ravine). Above the Etroeungtian "reef", but still Famennian, were, according to JAROSZ (1926: 142–143, 149), "limestones with *Spirifer Archiaci* var. *Orbeliana* and *Productus (Productella) praelongus*" outcropping in the lower part of the Żbik ravine.

JAROSZ' stratigraphic division of the Devonian of Dębnik was not received without criticism from RUTKOWSKI (1928) and CZARNOCKI (1935).

Revision of the Devonian brachiopods, combined with the study of the conodonts has enabled the stratigraphy to be revised (Table I), and GÜRICH's and JAROSZ'S stratigraphical units to be redefined. Their scheme is replaced by seven local biostratigraphical brachiopod range, partial range and assemblage zones which are correlated, with a variable degree of certainty, with the standard conodont zones defined by ZIEGLER (1962, 1965, 1971) for the Upper Devonian. The extent of the revision can be seen from table 1. For example the "limestones with *Spirifer Archiaci* var. *bisellata*" from the Żbik ravine (JAROSZ 1926: 143, plate 1: 8a) which were assigned to the lowermost Frasnian have turned out to belong to the Lower Famennian.

#### BRACHIOPOD ZONES

#### Desquamatia (Seratrypa) oneidensis Range Zone (figs 8, 9)

Outcrops and boundaries. — This zone outcrops in the Main Carmelite quarry (a stratum with conodont sample LK-2) and in the quarry above Rokiczany Dół ravine (a stratum with conodont sample K/RD-1), while the zone can also be recognized in the upper part of the Rokiczany Dół ravine. The limits of the zone correspond with the range of the index species which occurs only in one 50-55 cm thick layer.

*Fauna.* — Brachiopods are represented only by the index species (Table 2), the accompanying fauna comprises conodonts (Table 3) and very few scolecodonts and crinoids (columnals).

Age and correlation. — D. (S.) oneidensis occurs in the lower part (Hyrum Member) of Jefferson Formation (the Givetian-Frasnian boundary) in central Blue Spring Hills, USA (BEUS 1965). According to BEUS, the fauna of Blue Spring Hills corresponds in age to the Allanaria allani fauna from the Waterways Formation which UYENO (1974) determined on the basis of conodonts, as Frasnian: Spathognathodus insitus fauna — the asymmetricus Zone. The species D. (S.) oneidensis is externally very similar to D. tatarica LJASCHENKO (LJASCHENKO, oral communication) from the uppermost part of the Timan horizon of the Russian Platform (according to OVNATANOVA 1974: 139, the uppermost part of the Upper hermanni-cristatus Zone).

Of the two species of conodonts occurring in the D. (S.) oneidensis Zone, Polygnathus pennatus is characteristic of the lowermost part of the Frasnian (Upper hermanni-cristatus Zone to Lower asymmetricus Zone). The absence of P. asymmetricus from this assemblage, allows one to suppose that the zone may be older than the Lowermost asymmetricus Zone. Taking into account the data cited above, the age of the D. (S.) oneidensis Zone is likely to correspond to the conodont Upper hermanni-cristatus Zone. However, the absence of diagnostic hermanni-cristatus Zone faunas in this section precludes the certain definition of the age.

#### Desquamatia (Seratrypa) oneidensis to Spinatrypina (Spinatrypina) sp. barren interzone

The beds representing the barren interzone outcrop in the Main Carmelite quarry and in the quarry above the Rokiczany Dół ravine and include about 7 m between the upper boundary Palaeontologia Polonica, No. 39, 1979



Fig. 8 Main Carmelite Quarry. Marked conodont samples and brachiopod zones. A – Desquamatia (Seratrypa) oneidensis Zone, B – barren interzone, C – Spinatrypina (Spinatrypina) sp. Zone

A. Baliński



Fig. 9

General view of the quarry above Rokiczany Dół ravine (a) and more detailed view of its western part (b) with rhythmically interbedded limestones and marls. Marked conodont samples and brachiopod zones. A — Desquamatia (Seratrypa) oneidensis Zone, B — barren interzone, C — Spinatrypina) sp. Zone, D — Cyrtospirifer bisellatus Zone

Ancyrognathus triangularis hermanniasymmetricus gigas triangularis cristatus Conodont Zones OWENTIO: Jppermo Middle Upper Z Upper Lower Lower Upper Lower Lower iddie Spinatrypina (5.) sp. Zone barren interz. Desguamatia (5.) oneiden-sis Zone Brachiopod Zones Calvinaria cracoviensis Zone *Calvinaria albertensis* Zone *Leiorhynchus laevis* Zone Cyrtosp. sellatus tumidus Caryorhynchus tumidus Zone I Brachiopod species bi− Zone LINGULIDA Lingula sp. Barroisella campbelli Lingulipora sp. ACROTRETIDA Orbiculoidea sp. ORTHIDA Schisophoria iowaensis STROPHOMENIDA Douvillina (Douvillina) sp. Retichonetes sp. Corbicularia cracoviensis sp.n. Praewaagenoconcha cf. speciosa Spinulicosta aff. herminae Chonetipustula cf. petini Devonoproductus sp. PENTAMERIDA Gypidula sp. RHYNCHONELLIDA Hypothyridina ascendoides H. sp. Parapugnax schucherti P. sp. Calvinaria cracoviensis C. variabilis athabascensis C. albertensis albertensis C. albertensis minor subsp.n. Caryorhynchus tumidus Leiorhynchus laevis Bergalaria guerichi sp.n. SPIRIFERIDA Anatrypa alticola Desquamatia (Seratrypa) oneidensis D. (Neatrypa) velikaja Atryparia (Costatrypa) cf. uralica Iowatrypa markovskii Spinatrypina (Spinatrypina) sp. Spinatrypa (Spinatrypa) semilukiana Biernatella polonica Athyris concentrica Eleutherokomma zarecznyi Theodossia cf. hungerfordi Cyrtospirifer bisellatus C. minor Tenticospirifer cyrtiniformis Thomasaria simplex Warrenella euryglossa

Table 2 Ranges of brachiopod species in the Frasnian of the Dębnik anticline. Index species and other species defining the brachiopod zones are marked by thicker lines

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of the Desquamatia (Seratrypa) oneidensis Zone and the lower boundary of the Spinatrypina (Spinatrypina) sp. Zone. Only gastropods have so far been found.

Spinatrypina (Spinatrypina) sp. Partial-range Zone

Outcrops and boundaries. — This zone outcrops in the Main Carmelite quarry and in the quarry above the Rokiczany Dół ravine. Its lower boundary is determined by the appearance of the index species S. (S.) sp. and the upper boundary by the appearance of C. bisellatus. The zone is 1.4 m thick.

Fauna. — The fauna comprises the index species (Table 2), together with scolecodonts, gastropods, pelecypods, conodonts and fish remains.

Age and correlation. — The very poor brachiopod fauna precludes correlation with the Russian Platform and other regions. The most characteristic of conodonts are *Polygnathus* asymmetricus asymmetricus, *P. dubius* and *P. incompletus* (sample ŁK-3). These conodonts and the absence of the genus Ancyrodella are indicative of the conodont Lowermost asymmetricus Zone.

## Cyrtospirifer bisellatus Assemblage Zone (fig. 9)

Outcrops and boundaries. — The beds of this zone outcrop in the quarry above the Rokiczany Dół ravine (the uppermost part of the profile), and in Old Tumidalski's quarry. Loose material (almost *in situ*), occurs in the upper part of the Rokiczany Dół ravine, and on the tip west of the quarry above the Rokiczany Dół ravine. An further outcrop was described by JAROSZ (1926: 42, pl. 1: 8a) in the upper part of the Żbik ravine, but the present study shows that these horizons belong to the Lower Famennian and the cyrtospiriferoid they contain represents a species related to *C. minor*.

The lower boundary of the *C. bisellatus* Zone is determined by the appearance of the index species and *Spinatrypa (Spinatrypa) semilukiana*. About 3 m higher *Eleutherokomma zarecznyi* appears. The brachiopods characteristic of this zone are composed of: *C. bisellatus* (index species), *Corbicularia cracoviensis*, *Desquamatia (Neatrypa) velikaja*, *Spinatrypa (S.) semilukiana* and *E. zarecznyi*. The upper boundary of the *C. bisellatus* Zone (not exposed) corresponds with the appearance of *Calvinaria cracoviensis*. Since the index species of the *C. bisellatus* Zone was not in the *C. cracoviensis* Zone, the upper boundary of the range of these species seems to correspond with the upper boundary of the zone described.

Due to the lack of outcrops, it is impossible to establish the thickness of the C. bisellatus Zone, which is approximately about 25 m.

Fauna. — The brachiopods comprise Lingula sp., Douvillina (D.) sp., Corbicularia cracoviensis, Desquamatia (Neatrypa) velikaja, Spinatrypina (S.) sp., Spinatrypa (S.) semilukiana, Eleutherokomma zarecznyi and C. bisellatus (Table 2). They are accompanied by gastropods, pelecypods, nautiloids and conodonts (Table 3).

Age and correlation. — The brachiopod fauna from the C. bisellatus Zone displays some similarity to the faunas of the lower part of the Frasnian of the Russian Platform, where Desquamatia (Neatrypa) velikaja is known from the ust'yaregskiye Beds, and sargayevskyi and hvorostanskyi horizons (according to OVNATANOVA 1974: 139 — the Lower and Middle asymmetricus Zone). Representatives of the genus Dmitrispirifer LJASCHENKO (probably a synonym of Eleutherokomma CRICKMAY), which correspond to E. zarecznyi (GÜRICH) in the zone described, are known from these same beds and horizons. Spinatrypa (S.) semilukiana occurs in the Russian Platform in the somewhat higher rudkinskyi horizon and semilukskiye Beds (according to OVNATANOVA 1974: 139 — the Upper asymmetricus Zone to the Ancyrognathus triangularis Zone). The general character of the brachiopod fauna is closest to the sargayevskyi horizon (and its equivalents) of the Russian Platform (the Lower and Middle asymmetricus Zone).

The conodonts *Icriodus nodosus s. l.* and *Polygnathus dubius* were found in the lowermost part of the zone described (sample K/RD-3 from the quarry above Rokiczany Dół ravine), while *Ancyrodella rotundiloba rotundiloba*, *I. symmetricus* and *P. dubius* were present (fig. 9) somewhat higher (K/RD-4). This suggests that the lower boundary of the *C. bisellatus* Zone runs somewhat below that of the range of *A. rotundiloba rotundiloba*, that is, within the limits of the Lowermost *asymmetricus* Zone. Correlation of the upper boundary of the *C. bisellatus* Zone, is more difficult because of the lack of appropriate outcrops. The presence of *Ancyrodella rotundiloba alata* (sample SŁT-2 from Old Tumidalski's quarry and H-1 from the tip west of the quarry above the Rokiczany Dół ravine) whose range is limited to the Lower and Middle *asymmetricus* Zones and of *Polygnathus spatulatus* from the same localities, which in the Canning Basin occurs only in the Lower *asymmetricus* Zone, is, however, indicative that this brachiopod zone probably lies mainly within the Lower *asymmetricus* Zone. This is confirmed to a certain extent by the absence of the genus *Palmatolepis*, which appears only in the overlying *Calvinaria cracoviensis* Zone.

#### Calvinaria cracoviensis Assemblage Zone

Outcrops and boundaries. — The Rokiczany Dół ravine is the only locality for this zone in the Dębnik area, where loose, almost *in situ* fragments occur in the uppermost part of the ravine. Obviously, the boundaries and thickness of this assemblage zone cannot be determined but the brachiopod assemblage is so characteristic that it is felt to be justified, in recognising it as a zone. The characteristic assemblage of brachiopods of the C. cracoviensis Zone includes the following species: Retichonetes sp., Spinulicosta aff. herminae, Hypothyridina ascendoides, Parapugnax schucherti, P. sp., Calvinaria cracoviensis (index species), C. variabilis athabascensis, Bergalaria guerichi sp. n., Atryparia (Costatrypa) aff. uralica and Thomasaria simplex.

The zone probably amounts to about 70 m, most of which outcrops in the Rokiczany Dół ravine.

Fauna. — In addition to the brachiopods mentioned above the zone contains: Lingula sp., Barroisella campbelli, Lingulipora sp., Orbiculoidea sp., Douvillina (Douvillina) sp., Schizophoria iowaensis, Chonetipustula aff. petini, Gypidula sp., Hypothyridina sp., and Warrenella euryglossa (Table 2) together with sponges, tabulate corals (Cladopora gracilis, C. sp., Aulopora sp., Alveolites rarispinosa — Nowiński 1976), tetracorals, receptaculids, tentaculites, crinoids (columnals), nautiloids (Pachtoceras sp. — J. DZIK, oral communication), conodonts (Table 3) and fish remains.

Age and correlation. — The brachiopod fauna of the C. cracoviensis Zone contains taxa known in western Europe, Canada and the USSR. C. variabilis athabascensis occurs below C. albertensis albertensis (as in Dębnik) in the upper part of Maligne Formation and in the basal part of Perdrix Formation (and its equivalents) (MCLAREN 1962), and corresponding with the conodont Middle and Upper asymmetricus Zone (POLLOCK 1968: 418).

Bergalaria guerichi sp. n. is one of the most characteristic species of the Zone. In the Rhenish Slate Mountains Bergalaria bergica occurs in the Frasnian do I $\alpha$  (SCHMIDT 1975: 105).

There are several species closely related to or identical with taxa in the Semilukskiye Beds of the Russian Platform (according to OVNATANOVA 1974: 139 — the Ancyrognathus triangularis Zone): Chonetipustula aff. petini, Hypothyridina ascendoides and Atryparia (Costatrypa) aff. uralica.

Conodonts from the C. cracoviensis Zone (samples RD-2, 3, 4, 7: Table 3) give a correlation with the Middle and Upper asymmetricus Zone. Samples RD-1, 8 and 9, with Polygnathus asymmetricus ovalis and P. timanicus indicate the Upper asymmetricus Zone.

*Remarks.* — The *C. cracoviensis* Zone corresponds to "the lower leiorhynchoid layers from the Rokiczany Dół ravine containing *Leiorhynchus cracoviensis*" (*sensu* GÜRICH 1903 and JAROSZ 1926).

Table 3 Distribution and frequency of conodonts in the samples from the Frasnian of the Dębnik anticline. Numbers of conodont zones the same as used in table 1

Conodont Zones	$\prod$	72b	За	2ь	За					35							_			4-5						?6				7-	9							?	210				11:
<u> </u>							5			2	a															Т						2	Źbi	k r	avi	ne	(Z	)					
Conodont samples Conodont species	Main	Carmel te	Quarry (£K)	outer above	Rokiczany Doł	Lavine (N/ Ku)	Old Tumidalski'	Quarry (SLT)		Tin west of the	quarry above	Rokiczany Doł	(II) autor		1			R	loki r	icza nav (R(	any ine ))	Dó	Y			-I trench Zar-I	trench S-I	trench Z-V	II trench Z-VII	trench 2-IV	B trench 2-XIB	7	trench Z-XI		I trench Z-VI	<pre>IV trench Z-XIV</pre>	V trench Z-XV	/I trench Z-XVI	[] outcrop Z-III		quarry Z-II	(11-2)	
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A. nodusa				+	+					+	t	1	t			-+	1	+	+	- 1	+		1	1	1	╉	2	+		+	+	+	1	-	-								-
A. rotundiloba rotundiloba					+	2				+	1			1		+	t	+	+	-			1		3	+		+	+	+	t	+	1	-	-+								
A. rotundiloba alata						1		2	4	1		t				1	1	1	+			1		1	-	-		t	+			+		1	1								
Icriodus alternatus	-					+			-	+	+	+	1			-	+	-	+	-	+				1	-+	-		-	+			1		1	1	16	12		13	22	1	
I. aff. brevis		9		4	+	+				+	-	1		-		-+	-	+	1	-	+	1	1	1				t	1			1	1	-	-1								
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P. subrecta	-				+					-	-	1			1		-	1	+	-	-	-				-+	4	+	4 8	14	9	2	4	2	118					r +			
P. triangularis					+	1				1	-	+		1			+	-	-		+		1	1		-+	-†	-	-	1	+	-	-+	-		106	10	49	1	14	7	7	7
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Polygnathus aff, annustipennatus			22		5	-				1	1			1			+	1	+	-	1		-	-	-	+		+				-		1	1		-	1	H				
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P. dubius			20		4 2	2137	1					1			1.1																												
P. incompletus			4		7			-				1					1	-	2					1			1	1	-	1	1			-							212	11 P 12	2.00
P. pennatus		57	1	64						1		T		1			1	t			1			1	1		1	1	1	t	1			-	1								
P. pollocki		Γ				1.1			11	5	2	13	5			4 1	11	372	02	5	14		16	13	4	T					1	1		T	1	1					T		
P. spatulatus		T			1	1	3	29	10	5	4	16	5	6	7		1	T	1		1											1				-							
P. timanicus					1	-	1			1	1	1				35	1	1	1	-	1		1	34	1	1		-†		+	-+	1	7			1	1		-1		-+	-	
P. webbi																	5	3			2	9	1			1 1	6	1	8 7	31	4	3	6	3	50				1		-		$\square$

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#### Calvinaria albertensis Assemblage Zone

*Outcrops and boundaries.* — Strata assigned to the *C. albertensis* Zone have been located in the trench Żar-I on Żarnówka Hill north of Dębnik, on the Dębnik-Paczółtowice field road and probably in trench Żar-III. South of Dębnik, they were located in trenches Z-IV, V and VII and probably in S-I.

The lower and upper boundaries of the *C. albertensis* Zone probably correspond with the range of the index species represented here by the two subspecies: *C. albertensis albertensis*, which occurs from the base through a considerable part of the zone, and *C. albertensis minor* subsp. n., which occurs in the uppermost part of the zone replacing the nominate subspecies. *Iowatrypa markovskii*, *Calvinaria albertensis albertensis*, *C. albertensis minor*, *Caryorhynchus tumidus*, *Anatrypa alticola* and *Biernatella polonica* are characteristic taxa of the *C. albertensis* assemblage, the last three continuing into the overlying zone.

The thickness of the zone probably amounts to about 140 m.

Fauna. — The brachiopods comprise, in addition to those given above, Lingula sp., Lingulipora sp., Orbiculoidea sp., Devonoproductus sp., Theodossia cf. hungerfordi, Tenticospirifer cyrtiniformis, Athyris concentrica and Warrenella euryglossa (Table 2). The accompanying fauna consists of the stromatoporoids, tabulate corals (according to Nowiński 1976: Squamofavosites (Dictyofavosites) pachyfavositoides and Alveolitella ramosa), tetracorals, gastropods, tentaculites, crinoids (columnals), conodonts (Table 3) and fish remains.

Age and correlation. — The brachiopod fauna of the C. albertensis Zone displays a considerable similarity to the North American faunas from the Independence Shale, Iowa, USA and the Ireton Formation (and its equivalents), Alberta, Canada (Ancyrognathus triangularis to gigas Zones: MÜLLER and MÜLLER 1957; MCLAREN 1962; POLLOCK 1968; MOUND 1968). The closeness is indicated by such species as C. albertensis albertensis, Iowatrypa markovskii (a species very similar to I. americana), Theodossia cf. hungerfordi and Tenticospirifer cyrtiniformis.

Conodonts indicate that the age of the *C. albertensis* Zone correlates with the gigas and, probably, Ancyrognathus triangularis Zones: Ancyrodella curvata, Palmatolepis gigas, P. subrecta, Polygnathus brevis and P. webbi (sample Z-IV), as well as, in the lowermost part of the profile (sample Żar-I), Palmatolepis hassi and Icriodus symmetricus.

*Remarks.* — The *C. albertensis* Zone probably corresponds to "the spotty limestone with *Phillipsastrea*" of GÜRICH'S (1903) and JAROSZ'S (1926) stratigraphic table.

MCLAREN (1954) who recognized the Nudirostra albertensis Zone in the Canadian Rocky Mountains redesignated it later (MCLAREN 1962) as Calvinaria albertensis albertensis Zone. This zone was defined on the basis of the index subspecies range. The presently recognized local C. albertensis Zone is defined on the basis of C. albertensis range which is represented in the Dębnik by two subspecies: C. albertensis albertensis and C. albertensis minor subsp. n.

#### Caryorhynchus tumidus Partial-range Zone

Outcrops and boundaries. — The C. tumidus Zone is recognised in the trenches Z-VI, Z-XI, Z-XIB and, probably, in Z-XII, south of Dębnik.

This zone is marked by the occurrence of the index species which is not associated with *Calvinaria albertensis*. It is also characterized by the rare occurrence (also without *C. albertensis*) of *Anatrypa alticola*, *Biernatella polonica* and *Tenticospirifer cyrtiniformis*. The lower boundary of the *C. tumidus* Zone corresponds, therefore, with the disappearance of *C. albertensis*. The upper boundary of the *C. tumidus* Zone corresponds with the first appearance of the *Leiorhynchus laevis*.

The thickness of the section probably amounts to about 10 m.

Fauna. — The brachiopods are represented by Lingula sp., Lingulipora sp., Caryorhynchus tumidus (index species), Anatrypa alticola, Biernatella polonica, Athyris concentrica, Cyrtospirifer

minor and Tenticospirifer cyrtiniformis (Table 2). The species C. tumidus, B. polonica, A. alticola and T. cyrtiniformis do not transgress the upper boundary of the zone. The accompanying fauna comprises foraminifers, stromatoporoids, tabulate corals (according to Nowiński 1976: Squamofavosites (Dictyofavosites) pachyfavositoides, Cladopora gracilis, C. sp., Tyrganolites frasnianus, Alveolitella rarispinosa. A. ramosa and Aulopora sp.,), tetracorals, gastropods, tentaculites, crinoids (columnals), conodonts (Table 3) and fish remains.

Age and correlation. — The C. tumidus Zone correlates with beds with C. tumidus in the stratotypic profiles of the Upper Devonian of Belgium (BOUCKAERT et al. 1972). C. tumidus occurs, both at Dębnik and Senzeille, Belgium in an analogous stratigraphic position, below the Frasnian-Famennian boundary.

The conodont assemblage of the *C. tumidus* Zone contains such characteristic species as *Ancyrodella curvata*, *Palmatolepis gigas*, *P. subrecta* (conodont sample Z-VI) and *Polygnathus brevis* (conodont sample Z-XI-I). Since *Palmatolepis triangularis* occurs immediately above strata with *C. tumidus* the zone must correspond with the uppermost part of the gigas Zone.

*Remarks.* — Recently SARTENAER (1974) recognized the *C. turnidus* Zone in the upper part of the Frasnian in Belgian and French "Fagne", the western "Famenne" and near Aachen. This zone, however, is a range-zone (biozone) in the contrary to the partial-range-zone now recognized.

## Leiorhynchus laevis Range Zone

Outcrops and boundaries. — Strata assigned to the L. laevis Zone outcrop in quarries Z-II and Z-III and were located in trenches Z-XIII to XVI south of Dębnik. The thickness of this zone probably amounts to about 30 m.

The lower and upper boundaries of the zone under study are determined by the range of *L. laevis*. In addition to the index species, *Cyrtospirifer minor* is very characteristic of the zone, although a few specimens were obtained from the underlying zone.

Fauna. — The brachiopods are represented by Barroisella campbelli, Lingulipora sp., Orbiculoidea sp., Praewaagenoconcha cf. speciosa, Leiorhynchus leavis (index species) and Cyrtospirifer minor (Table 2), and are associated with foraminifers, conodonts (Table 3) and fish remains.

Age. — Palmatolepis triangularis is the most characteristic conodont (samples Z-XIV to XVI and Z-II-1). The L. laevis Zone represents the lowermost part of the conodont triangularis Zone.

*Remarks.* — The *L. laevis* Zone corresponds approximately to "the upper leiorhynchoid layers with *L. laevis*" of GÜRICH'S (1903) and JAROSZ'S (1926) stratigraphic table.

# CONODONT ZONES AND BOUNDARIES OF CHRONOSTRATIGRAPHIC UNITS (fig. 10)

#### The Middle-Upper Devonian boundary

The Middle-Upper Devonian boundary in the Dębnik area was not determined accurately by earlier authors. GÜRICH (1903) and later JAROSZ (1926) and others, assigned what they called "the layers of Old Tumidalski's quarry with *Spirifer Archiaci* var. *bisellata*" ( $\equiv$  *Cyrtospirifer bisellatus*) to the lowermost Frasnian. But it is now clear (e.g. conodont samples SŁT-1 and 2 from Old Tumidalski's quarry and K/RD-4 from the quarry above the Rokiczany Dół ravine) that this horizon represents the conodont Lower *asymmetricus* Zone. Thus the Givetian-Frasnian boundary runs considerably lower than the lower boundary of the *C. bisellatus* Zone.

Strata representative of the Uppermost Givetian and Lowermost Frasnian have been found in the Main Carmelite quarry and in the quarry above the Rokiczany Dół ravine. Precise determination of the Givetian-Frasnian boundary possess considerable problems, primarily resulting from the lack of appropriate paleontological evidence. The boundary runs undoubtedly below

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strata of the Spinatrypina (Spinatrypina) sp. Zone, in which Polygnathus asymmetricus asymmetricus appears (sample &K-3 from the Main Carmelite quarry). In the middle part of the Main Carmelite quarry (with conodont sample &K-1) Crurithyris jurkowicensis BALIŃSKI has been recognized, a species known so far from the Stringocephalus burtini Beds (the upper part of the Givetian) of Jurkowice-Budy in the Holy Cross Mts. (BALIŃSKI 1973). Between beds with C. jurkowicensis and the Frasnian Spinatrypina (S.) sp. Zone, occurs the Desquamatia (Seratrypa) oneidensis Zone, in which the conodonts Polygnathus penatus and Icriodus aff. brevis occur. This fauna most likely represents the conodont Upper hermanni-cristatus Zone.

According to ZIEGLER (1971) the Givetian-Frasnian boundary runs between the Lower and Upper *hermanni-cristatus* Zones. Some of the Belgian geologists locate this boundary much higher i.e. between F1 and F2 (ERRERA *et al.* 1972; BULTYNCK 1974). Thus, in the Dębnik area this boundary may be placed provisionally between the *D. (S.) oneidensis* Zone and the bed with *C. jurkowicensis*.

#### The lowermost Frasnian

The lowermost part of the Frasnian is represented by paleontologically insufficiently charaterized layers of the D. (S.) oneidensis Zone and the barren interzone. It is possible that the strata immediately underlying the D. (S.) oneidensis Zone may belong to the Frasnian but the paleontological evidence is insufficient.

#### The asymmetricus Zone

The lowermost part of the zone is represented by the 1.4 m thick Spinatrypina (Spinatrypina) sp. Zone which yields conodonts characteristic of the Lowermost asymmetricus Zone (conodont samples ŁK-3 from the Main Carmelite quarry and K/RD-2 from the quarry above the Rokiczany Dół ravine; Table 3). Overlying, belonging to the Cyrtospirifer bisellatus Zone, may be best assigned to the conodont Lower asymmetricus Zone (conodont samples K/RD-4 from the quarry above the Rokiczany Dół ravine; SŁT-1 and 2 from the Old Tumidalski's quarry and from the tip west of the quarry above the Rokiczany Dół ravine; Table 3) and, in the lowermost part (sample K/RD-3 from the quarry above Rokiczany Dół ravine; Table 3) probably also to the Lowermost asymmetricus Zone. The overlying Calvinaria cracoviensis Zone, outcrops only in the upper part of the Rokiczany Dół ravine, and represents the conodont Middle and Upper asymmetricus Zone. Most of the conodont samples from these zones contain species that are, on the whole, characteristic of the Middle and Upper asymmetricus zones (samples RD-2 to 4, 7; Table 3). However, samples RD-1, 8, 9 which include Polygnathus asymmetricus Zone.

#### The Ancyrognathus triangularis Zone

The presence of this zone in the Dębnik area has not been proved paleontologically. Probably, it includes the lowermost beds of the *Calvinaria albertensis* Zone (located in trench Żar-l on the southern slope of the Żarnówka Hill, conodont sample Żar-l; Table 3).

### The gigas Zone

Strata that can be correlated with this zone are the *Calvinaria albertensis* Zone and the overlying *Caryorhynchus tumidus* Zone, but the conodonts obtained do not allow firm correlation with any of the *gigas* subzones.

#### The triangularis Zone

The lower part of the *triangularis* Zone is represented in the *Leiorhynchus laevis* Zone (layers in quarry Z-II and in a few trenches on the eastern slope of the Żbik ravine numbered Z-XIV

to XVI). These layers yield *Icriodus alternatus*, *Palmatolepis triangularis* and *Polygnathus brevilaminus* (conodont samples Z-XV, Z-XVI and Z-II-1, 2; Table 3). This assemblage is, however, insufficient for more precise correlation.

The L. laevis Zone is overlain by limestones containing Cyrtospirifer aff. minor (probably a distinct species related to C. minor and very similar to the Famennian C. asiaticus BRICE) and various species of the genera Tenuisinurostrum, Spinulicosta and Praewaagenoconcha. The fauna of the layers is clearly Lower Famennian in character.

#### The Frasnian-Famennian boundary at Dębnik

The Frasnian-Famennian boundary was until recently been believed to run (BOUCKAERT and ZIEGLER 1965; ZIEGLER 1971) between the Lower and Middle *triangularis* Zone (the uppermost part of the *Manticoceras*-Stufe, post do  $1\sigma$  in the ammonoid stratigraphy). However, conodonts characteristic of the Lower *triangularis* Zone were discovered by BOUCKAERT *et al.* (1972) just above the Frasnian-Famennian boundary in the Hony profile, Belgium.

The separation of subzones within the *triangularis* Zone in the Devonian of Dębnik is, for the time being, impossible. Only in the lowermost part of the zone, the conodont fauna represented by *Icriodus alternatus*, *Palmatolepis triangularis* and *Polygnathus brevilaminus* (conodont samples Z-XV, Z-XVI and Z-II-1, 2) is more abundant. The brachiopod *Leiorhynchus laevis* Zone corresponds to the lower part of conodont *triangularis* Zone. The overlying beds with the Lower Famennian brachiopod *Tenuisinurostrum* are undoubtedly Famennian. Taking into account problems now posed in the stratotypic profile in Belgium, we may suppose that this boundary in the Dębnik area lies within the limits of the *L. laevis* Zone or between it and the layers containing *Tenuisinurostrum*.

Below the *L. laevis* Zone *Caryorhynchus tumidus* and numerous conodonts are characteristic of the *gigas* Zone (e.g., conodont sample Z-VI). In the Senzeille, Belgium profile, *C. tumidus* occurs in an identical stratigraphic position, i.e. below the Frasnian-Famennian boundary (BOUCKAERT *et al.* 1972).

# SYSTEMATIC PART

#### BRACHIOPODS

#### General remarks

This section contains descriptions of 38 species and 3 subspecies of the brachiopods of seven orders. Three of the forty taxa are new: *Corbicularia cracoviensis* sp. n., *Bergalaria guerichi* sp. n. and *Calvinaria albertensis minor* subsp. n. Spiriferids and rhynchonellids are the most common types of brachiopod and play the largest role in the Frasnian fauna of the Dębnik area.

The brachiopods are variably preserved but are mostly fragmentary exfoliated valves. Only a few species, e.g., *Caryorhynchus tumidus*, *Leiorhynchus laevis* and *Cyrtospirifer minor* are represented by well preserved specimens with both valves and complete sculpture.

The frequency of the brachiopods through the sections is also variable. They are least frequent in the *Spinatrypina (S.)* sp., and *Calvinaria cracoviensis* Zones and, in part, in the *Calvinaria albertensis* Zone. In some beds of *Desquamatia (Seratrypa) oneidensis* and *Caryorhynchus tumidus* Zones, the brachiopods occur in abundance (pl. 11: 7).

Phylum Brachiopoda DUMÉRIL, 1806 Class Inarticulata HUXLEY, 1869 Order Lingulida WAAGEN, 1885 Superfamily Lingulacea MENKE, 1828 Family Lingulidae MENKE, 1828 Genus Lingula BRUGUIÈRE, 1797 Lingula sp. (pl. 1: 4)

Material. — 110 mostly fragmentary specimens.

Occurrence. — Old Tumidalski's Quarry (Lower asymmetricus Zone), upper part of the Rokiczany Dół ravine (Middle and Upper asymmetricus Zone), and trenches Z-IV to Z-VII, Z-XI and Z-XII (gigas Zone).

# Genus Barroisella HALL and CLARKE, 1892 Barroisella campbelli COOPER, 1942 (pl. 1: 7-8, 10)

1942. Barroisella campbelli n. name; G. A. COOPER: 228.

Material. — 20 fragmentary, mostly brachial valves; some specimens preserved in the form of internal impressions.

*Description.* — Valves up to 8 mm long, longitudinally oval to ovate in outline, posteriorly more acute; anterior margin gently rounded.

A median, triangular, elongate muscle scar, reaching halfway the length of valve, occurs inside pedicle valve. A low, long median ridge bifurcating near middlength of valve, characteristic of this genus, occurs in brachial valve. Another ridge, elongate and romboidal (pl. 1: 7-8) is inserted in the bifurcation.

*Remarks.* — The specimens studied are almost identical with those of *Barroisella campbelli* COOPER from the Upper Devonian of the USA (ROWELL 1965: H263, fig. 158–2). The presence of a characteristic median ridge in brachial valve facilitates the generic identification of specimens, provided that they are well preserved. If, however, the specimen is embedded in rock with its internal side and is well preserved externally (without exfoliation), the generic identification is very difficult or impossible at all. For this reason, it is likely that some species, described formerly under the generic name *Lingula*, may in fact be of the genus *Barroisella* or of the related genus *Langella* MENDES.

Occurrence. — Known from the Upper Devonian of the USA; in Poland not recorded so far. The material under study comes from dark-gray, marly micrites of Z-II outcrop (Leiorhynchus laevis Zone; lower part of the conodont triangularis Zone); single specimens come from gray, marly biopelmicrites from the upper part of Rokiczany Dół ravine (Calvinaria cracoviensis Zone; the conodont Middle and Upper asymmetricus Zones).

> Genus Lingulipora GIRTY, 1898 Lingulipora sp. (pl. 1: 1-3, 11)

Material. - 40 specimens, preserved mostly in the form of valve fragments separated by maceration of the limestone in acetic acid.

*Remarks.* — Despite the fact that the specimens come from various stratigraphical horizons they are only slightly differentiated macroscopically. However, as shown by preliminary examination under a scanning electron microscope, they probably belong to two different genera. This problem cannot be solved at present primarily due to the lack of sufficiently reliable data on the type species *Lingulipora willimsiana* GIRTY and the fractionation of the material under study.

Occurrence. — The specimens representing the genus Lingulipora (as termed so far) occur almost in the whole Frasnian profile of Dębnik, being particularly numerous in the upper part of Rokiczany Dół ravine (Calvinaria cracoviensis Zone; a conodont Middle and Upper asymmetricus Zone) and in trench Z-VI (Caryorhynchus tumidus Zone; uppermost part of the conodont gigas Zone).

> Order Acrotretida KUHN, 1949 Suborder Acrotretidina KUHN, 1949 Superfamily Discinacea GRAY, 1840 Family Discinidae GRAY, 1840 Subfamily Orbiculoideinae SCHUCHERT and LEVENE, 1929 Genus Orbiculoidea D'ORBIGNY, 1847 Orbiculoidea sp. (pl. 1: 5, 9)

Material. - 6 fragmentary valves.

Occurrence. — In the Frasnian of Dębnik, the genus Orbiculoidea is represented very unnumerously. GÜRICH (1903: 134) described O. sp. from Rokiczany Dół ravine. The present writer's material comes from this same outcrop (*Calvinaria cracoviensis* Zone; the conodont Middle and Upper *asymmetricus* Zone) as well as from trench Z-IV (*Calvinaria albertensis* Zone; a conodont gigas Zone) and outcrops Z-II and Z-III (*Leiorhynchus laevis* Zone; the lower part of the conodont *triangularis* Zone).

Class Articulata HUXLEY, 1869 Order Orthida SCHUCHERT and COOPER, 1932 Suborder Orthidina sCHUCHERT and COOPER, 1932 Superfamily Enteletacea WAAGEN, 1884 Family Enteletidae WAAGEN, 1884 Subfamily Schizophoriinae SCHUCHERT and LEVENE, 1929 Genus Schizophoria KING, 1850 Schizophoria iowaensis HALL, 1858 (pl. 1: 6, 12)

1956. Schizophoria iowaensis HALL; P. S. WARREN and C. R. STELCK: pl. 18: 22–25. 1959. Schizophoria iowaensis HALL; A. I. LJASCHENKO: 130–131, pl. 21: 1–2. 1973. Schizophoria iowaensis (HALL); A. I. LJASCHENKO: 25–26, pl. 3: 1–5.

Material. - 4 incomplete shells with exfoliated valves and ten small fragments of shells and valves.

Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	w	Т
291 a	19.8	21.1	(24.0)	12.5
291 d	20.5	20.8	_	13.3
291 b	_	22.1	(24.5)	13.5

Description. — Sheil medium-sized (within the range of the genus), dorsibiconvex, rounded in outline, somewhat wider than long, the widest near midlength; cardinal margin straight, equalling a half of the width of shell, anterolateral margins rounded, anterior commissure uniplicate; usually slightly acute.

Pedicle valve slightly convex, with the strongest convexity occurring in the umbonal region, in the anterior part flat, with a wide and shallow sulcus; interarea 25 mm high, regularly concave; delthyrium open.

Brachial valve longer than pedicle valve; fold absent, umbo distinct, beak straight and projecting over the cardinal margin, interarea strongly concave.

Interior not examined.

Shell ornamented with 11 to 16 costellae per 5 mm near anterior margin; punctation distinct on exfoliated valves (pl. 1: 12); punctae concentrated on costellae.

Remarks. — The specimens under study are externally identical with those of Schizophoria iowaensis HALL from the Frasnian of West Canada (WARREN and STELCK 1956, pl. 18: 22–25) and Lower Frasnian of North Timan, the USSR (LJASCHENKO 1973: 25–26, pl. 3: 1–5). They are also externally similar to the species S. striatula (SCHLOTHEIM), related morphologically to S. iowaensis. SCHLOTHEIM's species (see STRUVE 1965: 194–197, pl. 19: 1, text-fig. 1) is different in a slightly wider shell which is more rectangular in outline and in a more rounded anterior commissure. A specimen of S. striatula, illustrated by KRYLOWA (1962, pl. 1: 14) from the Uppermost Givetian (Yuktinskiye Beds) of the Russian Platform may belong to S. iowaensis.

Occurrence. — This species is known from the Frasnian of North America (Canada, the USA) and from the Lower Frasnian (Ustyaregskiye Beds) of North Timan and the Volga-Ural

Region, the USSR. In Poland, not recorded so far. The material studied comes from dark-gray, marly biopelmicrites of the upper part of Rokiczany Dół ravine (*Calvinaria cracoviensis* Zone; the conodont Middle and Upper *asymmetricus* Zones).

Order Strophomenida Öрік, 1934 Suborder Strophomenidina Öрік, 1934 Superfamily Strophomenacea King, 1846 Family Stropheodontidae Caster, 1939 Subfamily Douvillininae Caster, 1939 Genus Douvillina OEHLERT, 1887 Douvillina (Douvillina) sp. (pl. 2: 1-2)

1903. Douvillina (Oehlert 1887) sp. cf. Ferquensis RIGAUX; G. GÜRICH: 136–137, pl. 2: 9–10. ?1903. Douvillina (?) cf. asella de Vern.; ibid.: 137.

*Material.* – 60 fragmentary specimens, mostly with exfoliated valves.

Description. — Shell medium-sized (within the range of the genus), up to 20 mm long, concavo-convex, semicircular in outline, with long ears.

Interarea of pedicle valve apsacline to orthocline; delthyrium narrow, covered by a convex deltidial plate. Interarea of brachial valve hypercline.

Due to a poor state of preservation, the interior of specimens not very accurately recognized, except for a muscle field typical for the subgenus, found in the pedicle valve.

Ornamentation of the parvicostellate type, 7 to 9 sharp costae occurring over a stretch of 5 mm near the anterior margin, two to five striae occurring in intercostal grooves.

*Remarks.* — Similar specimens from Rokiczany Dół ravine were described by GÜRICH (1903) as *Douvillina* sp. cf. *Ferquensis* RIGAUX (GÜRICH O. C.: 136–137, pl. 2: 9–10) and those from Tumidalski's Quarry as *Douvillina* (?) cf. *asella* de VERN. (GÜRICH O. C.: 137). As shown by the present writer's studies, the specimens from the two outcrops are probably of one and the same species. However, due to a poor state of preservation of his collection, their accurate identification is impossible.

The specimens under study are externally similar to those of the type species *Douvillina* dutertrii MURCH. from the Rudkinskyi horizon (Lower Frasnian) of the Russian Platform (LJASCHENKO 1959: 147–148, pl. 30: 1–3), from which they slightly differ in the ornamentation of shell, that is, in a larger number of intercostal striae.

In the size and ornamentation of their shells, the specimens from Dębnik are also similar to those of *Stropheodonta (Douvillina) inaequistriata* HALL (HALL and CLARKE 1892; pl. 14: 1-6) from Hamilton Group (Middle Devonian), West New York State, from which they differ only in a slightly wider shell.

Occurrence. — Douvillina (Douvillina) sp. fairly frequently occurs in gray, marly biopelmicrites (Cyrtospirifer bisellatus Zone; the conodont Lower asymmetricus Zone), together with Cyrtospirifer bisellatus (GÜRICH), Eleutherokomma zarecznyi (GÜRICH) and Spinatrypa (S.) semilukiana LJASCHENKO. The specimens come from detached parts of these beds found in a tip west of a quarry above Rokiczany Dół ravine and in the upper part of Rokiczany Dół ravine. D. (D.) sp. also occurs in detached blocks in the upper part of Rokiczany Dół ravine representing the beds of Calvinaria cracoviensis Zone (the conodont Middle and Upper asymmetricus Zones). Suborder Chonetidina MUIR-WOOD, 1955 Superfamily Chonetacea BRONN, 1862 Family Chonetidae BRONN, 1862 Subfamily Retichonetinae MUIR-WOOD, 1962 Genus Retichonetes MUIR-WOOD, 1962 Retichonetes sp. (pl. 2: 3-4)

1903. Chonetes crassitesta n. sp.; G. GÜRICH: 136 (parts).

*Material.* -20 specimens, mostly preserved in fragments. Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	Т	Nc/1
271 b	4.2	5.1	2.0	7
271 f	4.5	5.4	1.7	6.5—7
271 c	(5.2)	6.0	2.2	7—8
271 a	5.2	6.8	2.3	8.5

*Description.* — Shell small (within the range of the genus), strongly concavo-convex, semicircular in outline, wider than long; cardinal margin long; short ears extend in some specimens to form spiny processes; anterolateral margins rounded.

Pedicle valve with a robust, strongly marked umbo; sulcus lacking. Brachial valve deeply concave, with flattened ears.

The interior not recognized accurately. A median septum occurs in pedicle valve. Brachial valve has a long and low median septum situated in a narrow, median depression limited laterally by accessory septa.

The surface of shell displays fine, irregular, radial capillae (6 to 8.5 of them per 1 mm near anterior margin) and concentric growth lines. Posterolateral parts of valves (ears) are devoid of radial ornamentation, displaying only distinct growth lines.

*Remarks.* — The specimens under study are related to GÜRICH's species (1903: 136) *Cho*netes crassitesta, described (but not illustrated) from Rokiczany Dół ravine. Some of the characters, given in the description of *Ch. crassitesta*, e.g., the density of concentric growth lines, allow one to suppose, however, that GÜRICH's collection might also include specimens of the genus *Corbicularia* (LJASCHENKO), whose occurrence in Rokiczany Dół ravine has now been stated. At present, the elucidation of this problem is, however, impossible since GÜRICH did not illustrate his species and the collection he described got mislaid.

The specimens of R. sp. are externally slightly similar to those of the type species R. armatus (BOUCHARD-CHANTEREAUX), illustrated by MUIR-WOOD (1962, pl. 4: 12–15; text-fig. 13) from the Frasnian of Boulonnais, France. The specimens from Dębnik are, however, somewhat smaller, usually slightly wider, and having finer capillae and a more distinctly marked ventral umbo.

The specimens of R. sp. are in many respects identical with a specimen of Ch. minuta v. BUCH, described by de KONINCK (1847: 219–220, pl. 20: 8) from the Middle Devonian of Germany. They display an identical outline and shape of shell and a convexity in the umbonal part of pedicle valve. The specimen, illustrated by de KONINCK is, however, twice as large as those studied by this writer and has much coarser capillae.

The specimens under study probably belong to a new species, but the insufficiency of material precludes their accurate identification.

Occurrence. — The specimens of R. sp. were collected from detached blocks in the upper part of Rokiczany Dół ravine, representing beds of the Calvinaria cracoviensis Zone (the conodont Middle and Upper asymmetricus Zones).

Subfamily? Rugosochonetinae MUIR-WOOD, 1962 Genus Corbicularia LJASCHENKO, 1973 Corbicularia cracoviensis sp. nov. (pl. 2: 5-10; pl. 3: 8-9)

?1903. Chonetes crassitesta n. sp.; G. GÜRICH: 136 (parts).

Holotype: ZPAL Bp XXIII/277c; illustrated on pl. 2: 9. Type horizon: Cyrtospirifer bisellatus Zone, the condont Lower asymmetricus Zone. Type locality: Debnik, upper part of Rokiczany Dół ravine. Derivation of the name: cracoviensis — found in Cracow Region.

Diagnosis. — Shell to 5 mm in length, wider than long, ellipsoidal to rectangular in outline; pedicle valve convex posteriorly, flattened laterally and anteriorly. Ornamentation formed by irregular radial, slightly marked capillae (6.5 to 8 per 1 mm); concentric strips of very thick (14 to 16 per 1 mm), transparent elements of the internal structure of valves; spines on ventral area almost perpendicular to cardinal margin. A distinct brachial ridge occurs inside brachial valve. Median septum lacking.

*Material.* — Seven complete and sixty fragmentary specimens embedded in rock. Dimensions (in mm):

ZPAL Bp XXIII	Lvv	W	Т	Nc/1	Nb/1
278a-2	2.4	3.4		8	16
277 c	2.9	3.7	(0.9)	8	16
278a-1	3.4	4.2	(1.0)	6.5—7	16
277 a	4.2	6.8		8	16

Description. — Shell small (to 5 mm in length), concavo-convex, ellipsoidal to rectangular in outline, wider than long; cardinal margin long, ears short; lateral margins nearly straight, anteriorly curving and gradually turning into an arcuate anterior margin.

Pedicle valve convex posteriorly and slightly flattened laterally and anteriorly; a wide, gentle depression (a slight sulcus) occurs sometimes in the anterior part of valve.

Brachial valve concave, in posterolateral parts, i.e. near ears, flattened.

A short median septum occurs inside pedicle valve.

Short anderidia and long accessory septa are visible in brachial valve. Median septum lacking. A low, median elevation, slightly resembling a septum (pl. 2: 8), occurs in one specimen in a depression between accessory septa. An alveolus is present at the base of cardinal process. An ellipsoidal brachial ridge is strongly developed (pl. 3: 9).

Both valves are ornamented by fine capillae, their number increasing by bifurcation or insertion. Capillae rounded, low, not very distinct, irregular, disappearing in posterolateral parts of valves. On ventral area, spines are almost perpendicular to cardinal margin and only very rarely slightly slanting medially or laterally.

As shown by the present writer's studies, characteristic concentric strips, whose presence is a diagnostic character for the genus, are not related with the ornamentation but with an inner structure of valves. These strips are formed as a result of a varying reflection of light from strongly concentrically wrinkled layers of calcite underlying an outer, relatively smooth surface of valves (pl. 2: 10). For this reason, they are very distinct in specimens whose valves are transparent or exfoliated and weathered (pl. 2: 5, 9b; pl. 3: 8) and only poorly visible on well-preserved valves coated with ammonium chloride (pl. 2: 6–7, 9a).

Intraspecific variability. — The convexity of pedicle valve is the most variable character of C. cracoviensis sp. nov., which depends, to a considerable extent, on the ontogenetic age. In young individuals, pedicle valve is relatively very convex. With the growth, the younger

parts of valve become flatter and flatter. A wide, median depression (a very gentle sulcus) may be formed in the anterior part of valve in adult individuals.

**Remarks.** — In having very distinct, characteristic, concentric strips, slightly outlined radial capillae, and no median septum in brachial valve the specimens under study decidedly differ from most other representatives of the family Chonetidae. *C. cracoviensis* sp. nov. is most closely related to *C. menneri* (LJASCHENKO) from the upper part of the Lower Frasnian of North Timan and the Volga-Ural region, the USSR (LJASCHENKO 1973: 29–31, pl. 5: 1–5). The two forms display the same type of ornamentation and internal structure of shell. The specimens under study are, however, somewhat larger, more rectangular in outline, with a finer costation and spines, which are not oblique but nearly perpendicular to cardinal margin, and, finally, sometimes having a shallow sulcus on pedicle valve. In the size of its shell and lack of median septum on brachial valve, *C. cracoviensis* sp. nov. is similar to *Pliocochonetes nanus* (VERN.) (SOKOLSKAYA 1950: 69–73, pl. 10: 1–12, text-fig. 22) from the Upper Devonian of the Russian Platform. The shells of *P. nanus* are, however, more elongate, less rectangular and rather semicircular in outline, while its radial ornamentation, quite different in type, is composed of very distinct, regular and high capillae.

Occurrence -- Corbicularia cracoviensis sp. nov. occurs in light- and dark-gray biopelsparites in the tip west of a quarry above Rokiczany Dół ravine and in the upper part of Rokiczany Dół ravine (Cyrtospirifer bisellatus Zone; the conodont Lower asymmetricus Zone).

Suborder Productidina WAAGEN, 1883 Superfamily Productacea GRAY, 1840 Family Productellidae SCHUCHERT and LEVENE, 1929 Subfamily Productellinae SCHUCHERT and LEVENE, 1929 Genus Praewaagenoconcha SOKOLSKAYA, 1948 Praewaagenoconcha cf. speciosa (HALL, 1867) (pl. 3: 3, 6)

cf. 1892. Productella speciosa HALL; J. HALL and J. M. CLARKE: pl. 17: 25-26.

cf. 1961. Praewaagenoconcha speciosa (HALL); M. V. MARTYNOVA: 91-92, pl. 6: 1-3.

*Material.* — One, almost complete pedicle valve, embedded in rock and two impressions of brachial valve, one of them very fragmentary.

Dimensions: Pedicle valve (ZPAL Bp XXIII/301b): Lvv = 14.1 mm; W = about 18.0 mm; T = about 5.1 mm.

Description. — Shell medium-sized for the genus, concavo-convex, transversally elliptical in outline, cardinal margin rectilinear, markedly shorter than the largest width of the shell; anterolateral margin rounded.

Pedicle valve with its umbonal part projecting more than 1 mm above the cardinal margin. Brachial valve equally concave to a depth of about 2.5 mm.

Interior not examined.

Pedicle valve ornamented by irregular, concentric rugae and fine, pustulose spine bases; spines thin, closely spaced according to a not very regular, hexagonal pattern.

Brachial valve ornamented by dense, concentric rugae and radially elongate pits; thin spines present.

*Remarks.* — The specimens under study are similar in the size and development of their ventral umbo to those of *Productella speciosa* HALL (HALL and CLARKE 1892, pl. 17: 25-26) from Chemung Group, USA, from which they differ in a slightly more elliptical outline of shell and more widely spaced spines on pedicle valve. They are also similar to those of *Praewaagenoconcha speciosa* (HALL) from the Famennian of Kazakhstan, USSR (MARTYNOVA 1961:

91-92, p. 6: 1-3), but, due to the fragmentary state of their preservation, it is impossible to compare these forms accurately.

Occurrence. — Praewaagenoconcha speciosa (HALL) is known from the Upper Devonian of Chemung Group, USA, and from the Famennian of Kara-Tau and Kazakhstan, USSR, where they occur in the Sulciferovye and Myeysterovskye beds. The specimens under study, similar to this species, occur in the Uppermost Frasnian of trench Z-XVI and quarry Z-II (*Leiorhynchus laevis* Zone, the lower part of the conodont *triangularis* Zone).

# Genus Spinulicosta NALIVKIN, 1937 Spinulicosta aff. herminae (FRECH, 1891) (pl. 3: 4-5, 7)

aff. 1891. Productella Herminae nov. sp.; F. FRECH: 677-678, pl. 47: 3, 5-5c, 6, 10-11. 1903. Productella Herminae FRECH; G. GÜRICH: 135, (parts).

Material. - 20 pedicle and 2 brachial valves, along with more than 40 fragments and impressions.

Dimensions (in mm):

ZPAL Bp XXIII	Lvv	w	Т
280c	11.2	15.0	(6.7)
282 a	12.5	16.9	(7.2)
281 e	14.3	18.7	(10.0)
280 0	15.7	18.8	(9.2)

Description. — Shell medium-sized for the genus, concavo-convex, transversally elliptical in outline; cardinal margin long, straight; anterolateral margins rounded; ears small.

Pedicle valve strongly convex, umbo distinct, beak small; a shallow sinusoidal depression frequently occurring in the anterior part of valve. Brachial valve semicircular in outline, concave, with a strong, nearly geniculate bend in its anterior part.

Pedicle valve ornamented by concentric rugae, particularly distinct in its posterior part, and radially elongate, pustulose spine bases. Distinct, irregularly distributed radial costae are developed in the extension of spine bases from midlength of valve. Brachial valve ornamented by concentric rugae and radially elongate pits.

Interior not examined.

*Remarks.* — Irregular but distinct, radial costae, occurring in the anterior part of pedicle valve, are visible in original illustrations of the species *Productella Herminae* FRECH (1891, pl. 47: 3, 5b, 11a). Such an ornamentation, characteristic of the genus *Spinulicosta* NALIVKIN, does not occur in the representatives of the genus *Productella* HALL (MUIR-WOOD and COOPER 1960: 147, 154). On the basis of this character, FRECH's species has been assigned, in the present paper, to the genus *Spinulicosta*.

Productella Herminae FRECH was described by GÜRICH (1903: 135) from the Upper Devonian outcrops in Rokiczany Dół ravine and Żbik ravine. As shown, however, by the present studies, the specimens from Rokiczany Dół ravine belong to S. aff. herminae, while those from the Lower Famennian of Żbik ravine, morphologically related to the Lower Frasnian specimens, but considerably larger and more elongate, undoubtedly represent another species.

The specimens from Rokiczany Dół ravine are externally very similar to those of *Productella Herminae* from the Frasnian (Iberger Kalk) of Eastern Alps (FRECH 1891). The shells of the two forms are identical in size, ornamentation, and the degree of convexity of their valves. Particularly characteristic of the two forms are irregular, radial costae occurring in the anterior part of their pedicle valve. The specimens under study differ from those from Iberger Kalk in considerably shorter and wider ears and a wider shell. The specimens from the Lower Frasnian of Rokiczany Dół ravine seem to belong to a new species closely related to *Spinulicosta herminae*. The poor state of preservation of these specimens and the impossibility of comparing their internal structure preclude an accurate specific identification of the forms from Dębnik.

Occurrence. — The species Spinulicosta herminae FRECH is understood fairly broadly and, consequently, it has a relatively extensive stratigraphic range. It has been recorded from the Lower Frasnian of Eastern Alps, as well as from the Famennian of the USSR (Yelets horizon) and Poland. The specimens under study, closely related with S. herminae, come from the upper part of Rokiczany Dół ravine (Calvinaria cracoviensis Zone; the conodont Middle and Upper asymmetricus Zones).

## Subfamily Chonopectinae MUIR-WOOD and COOPER, 1960 Genus Chonetipustula PAECKELMANN, 1931 Chonetipustula cf. petini (NALIVKIN, 1930) (pl. 3: 1-2)

cf. 1930b. Productus petini n. sp.; D. V. NALIVKIN: 71-72, pl. 6: 3-4.

cf. 1952. Chonetipustula petini NALIVKIN; T. G. SARYCHEVA and SOKOLSKAYA: 83-84, pl. 13: 79.

cf. 1959. Chonetipustula petini NALIVKIN; A. I. LJASCHENKO: 169, pl. 47: 1-3; pl. 55: 1b; pl. 56: 2.

Material. — One incomplete shell, five fragmentary pedicle, and one brachial valve. Description. — Shell small to medium-sized for the genus, concavo-convex, transversally elliptical in outline, wider than long; cardinal margin straight, long, equalling the largest width of shell; anterolateral margins rounded.

Pedicle valve with an umbo truncated by a cicatrix; interareas narrow, with almost parallel margins; delthyrium covered by a triangular, slightly convex pseudodeltidium.

Brachial valve with interareas lower than in pedicle valve, notothyrium completely covered by a four-lobed cardinal process (pl. 3: 1d); median septum low and short.

Both valves ornamented by irregular, concentric rugae; widely spaced and irregularly distributed spines occur on pedicle valve and pits — on brachial valve; several spines are also visible on the posterior margin of ventral area.

*Remarks.* — According to MUIR-WOOD and COOPER (1960: 159), the occurrence of the genus *Chonetipustula* PAECKELMANN is limited to the Lower Carboniferous only. However, some forms very similar morphologically were also described from the Upper Devonian of the USSR (NALIVKIN 1947; SARYCHEVA and SOKOLSKAYA 1952; LJASCHENKO 1955, 1973) and Australia (VEEVERS 1959). Thus, the stratigraphic range of the genus *Chonetipustula* should be revised on the basis of detailed comparative studies of the Lower Carboniferous and Upper Devonian forms.

The specimens described are very similar in ornamentation and shape of shell to *Chonetipustula petini* (NALIVKIN) from Semilukskiye Beds (Middle Frasnian) of the Central Devonian Field and central areas of the Russian Platform (NALIVKIN 1930b; LJASCHENKO 1959), from which they differ in smaller shells only. The fractionation of the material has precluded a more detailed identification.

Occurrence. — The species Ch. petini (NALIVKIN) is known from Semilukskiye Beds (Middle Frasnian) of the Central Devonian Field and central areas of the Russian Platfom, USSR. The specimens described occur in dark-gray, marly biopelmicrites of the upper part of Rokiczany Dół ravine (Calvinaria cracoviensis Zone; the conodont Middle and Upper asymmetricus Zones).

#### ANDRZEJ BALIŃSKI

# Family Leioproductidae MUIR-WOOD, 1960 Subfamily Devonoproductinae MUIR-WOOD and COOPER, 1960 Genus Devonoproductus STAINBROOK, 1943 Devonoproductus sp. (pl. 4: 9-10)

(pl. 4. 9-10)

Material. — Seven, strongly fragmentary specimens.

Description. — Shell medium-sized for the genus, concavo-convex, wider than long, subrectangular in outline; cardinal margin long, equalling the largest width of shell. A median septum and distinct lateral ridges occur inside the brachial valve; other internal details are unknown.

Pedicle valve low, with fine, low, nodular, radial capillae and irregularly distributed spine bases, forming its ornamentation characteristic of this genus. Brachial valve, anteriorly slightly geniculate, is ornamented by narrow, protruding growth layers, whose ornamentation is formed in turn by radial capillae.

Occurrence. — The specimens of Devonoproductus sp. come from spotty intrasparites of trench Z-VII (Calvinaria albertensis Zone; the conodont gigas Zone).

Order **Pentamerida** SCHUCHERT and COOPER, 1931 Suborder **Pentameridina** SCHUCHERT and COOPER, 1931 Superfamily **Pentameracea** M'COY, 1844 Family **Pentameridae** M'COY, 1844 Subfamily **Gypidulinae** SCHUCHERT and LEVENE, 1929 Genus *Gypidula* HALL, 1867 *Gypidula* sp. (pl. 8: 8-9)

Material. — Four fragmentary pedicle valves.

*Description.* — Shell medium-sized for the genus, to 18 mm in length. Pedicle valve strongly convex, regularly bent, with a robust umbonal part; beak strongly incurved.

Ornamentation: umbonal part smooth; fold appears at one-third of the length of valve from beak; 3 to 4 distinct costae visible on fold, which is sometimes divided by a deep median groove. Costae are visible on lateral parts of valves only in the anterior part.

Dental plates, supported by a high median septum, occur inside the pedicle valve.

Remarks. — The specimens under study display a considerable similarity to Ivdelina krestovnicovi ANDRONOV from the Frasnian of the environs of the Sosva River (Ural, USSR) (ANDRONOV 1961). In their external appearance and ornamentation, they are also similar to some forms from the Devonian of Bergisch, W. Germany, in particular to Gypidula (Ivdelina) rectangularis quadruplicata (TORLEY) from the Uppermost Givetian and Gypidula (Ivdelina) montana inflata JUX from the Couvinian (JUX 1969).

Occurrence. — The specimens described come from dark-gray, marly biopelmicrites of the upper part of Rokiczany Dół ravine (*Calvinaria cracoviensis* Zone; the conodont Middle and Upper *asymmetricus* Zones).

Order Rhynchonellida KUHN, 1949 Superfamily Rhynchonellacea GRAY, 1848 Family Uncinulidae RZHONSNITSKAYA, 1956 Subfamily Hypothyridiniae RZHONSNITSKAYA, 1956 Genus Hypothyridina BUCKMAN, 1906 Hypothyridina ascendoides NALIVKIN, 1951 (pl. 4: 1-2, 8; fig. 11A)

1896. Rhynchonella cuboides Sow. var. minor; G. GÜRICH: 287-288 (nomen nudum).

1903. Rhynchonella cuboides Sow. var. minor; G. GÜRICH: 148 (nomen nudum).
- 1951. Hypothyridina (?) ascendoides sp. n.; D. V. NALIVKIN: 11-12, pl. 1: 10.
- 1971. Hypothyridina nana Nalivkin; G. Biernat: 143-144, pl. 2: 1-3; pl. 3: 1; text-fig. 3.

Material. — ·	4 complete	and	one	damaged	shell
Dimensions	(in mm):				

ZPAL Bp XXIII	Lvv	Ldv	w	Т	Sha	Aa	Nr/su	Nr/ľo
190d	7.4	6.9	8.9	6.2			_	_
190b	7.5	7.2	9.9	6.2	_	(131)	4	5
190a	(8.8)	8.4	9.9	7.5		_	6	7
190e	9.0	8.6	10.7	7.6	113	132	(4)	(5)

*Description.* — Shell small for the genus, dorsibiconvex, square to pentagonal in outline, slightly wider than long; cardinal margin short, slightly curved; anterior commissure uniplicate; tongue long, its anterior margin nearly straight.

Pedicle valve moderately convex; beak erect.



Fig. 11

Transverse serial sections. A — Hypothyridina ascendoides NALIVKIN. Rokiczany Dół ravine; Calvinaria cracoviensis Zone. B-C — brachial (B) and pedicle (C) valve sections of the Parapugnax schucherti (STAINBROOK). Rokiczany Dół ravine; Calvinaria cracoviensis Zone. D — Parapugnax sp. Rokiczany Dół ravine; Calvinaria cracoviensis Zone. Numbers refer to distance in mm from ventral (A, C, D) or dorsal (B) apex

Brachial valve more convex in umbonal part, fold wide, with 5 to 7 costae.

In its posterior half shell smooth, in anterior covered with distinct, rounded costae; in the anterior part of tongue costae display longitudinal median grooves (probably resulting from exfoliation); marginal spines present. Very regular, fine, concentric growth lines cover the entire surface of shell.

Very distinct, thin dental plates occur in pedicle valve (fig. 11 A). Median septum in brachial valve lacking; hinge plates long, bent dorsally, probably connected with a poorly visible cardinal process.

Remarks. — In their shape, ornamentation, and internal structure, the specimens described correspond accurately to those of *H. ascendoides*, described by NALIVKIN (1951) from the koltubansk limestones of Mugojary, USSR. They also display a certain similarity to *H. cuboides* var. *nana* NALIVKIN from the Frasnian of Ural (NALIVKIN 1951: 11, pl. 3: 6). The shells of *H. nana* differ, however, to a considerable extent in their ornamentation in the form of costae covering nearly the whole shell and not the marginal parts only.

The specimens from Dębnik differ from *H. coronula* DREVERMAN, described from the Frasnian of Langenaubach, W. Germany (DREVERMAN 1901: 156–157, pl. 15: 12–13) primarily in smaller shells and a lower number of costae on fold and sulcus.

Occurrence. — H. ascendoides was described from the Koltubansk limestones of Mugojary (eastern slopes of the Bashkirian part of Ural, USSR) (NALIVKIN 1951). Similar specimens were described from the Kadzielnia limestones of the Holy Cross Mountains, Poland as H. nana NALIVKIN (BIERNAT 1971: 143-144, pl. 2: 1-3, pl. 3: 1).

At Dębnik, specimens of this species occur only in dark-gray, marly biopelmicrites of the upper part of Rokiczany Dół ravine (*Calvinaria cracoviensis* Zone; the conodont Middle and Upper *asymmetricus* Zones). *Rhynchonella cuboides* Sow. var. *minor* GÜR. (= *nomen nudum*) was described from the same outcrop by GÜRICH (1903: 148).

### Hypothyridina sp. (pl. 4: 6)

*Material.* — One fragmentary shell.

*Description.* — Shell medium-sized for the genus, dorsibiconvex, high; sulcus and fold wide; except for umbonal part, the entire shell costate; costae distinct, rounded, in the anterior part somewhat angular.

Dental plates occurring in pedicle valve; other details of interior not examined.

*Remarks.* — The specimen described displays a considerable similarity to those of *H. pro-cuboides* (KAYSER) from the Middle Devonian of Eifel, Germany (KAYSER 1871: 513-514, pl 9: 3) and of *H. emmonsi* (HALL and WHITFIELD) from the Lower Frasnian of Iowa, USA (STAINBROOK 1945: 42-43, pl. 4: 10-14).

Occurrence. — This specimen comes from dark-gray, marly biopelmicrites of the upper part of Rokiczany Dół ravine (Calvinaria cracoviensis Zone; the conodont Middle and Upper asymmetricus Zones).

Family Pugnacidae RZHONSNITSKAYA, 1959 Genus Parapugnax SCHMIDT, 1964 Parapugnax schucherti (STAINBROOK, 1945) (pl. 4: 4-5, 7; fig. 11B-C)

1945. Pugnoides schucherti Stainbrook, n. sp.; M. Stainbrook: 43, pl. 4: 15-19; fig. 2: 13.

*Material.* — One almost complete shell and 10 fragments of shells and valves. Dimensions (in mm): Lvv = 15.5; Ldv = 14.6; W = 18.1; T = 14.8.

*Description.* — Shell medium-sized for the genus, dorsibiconvex, wider than long, transversally elliptical in outline; cardinal margin curved, lateral margins rounded, anterior margin truncate, anterior commissure uniplicate; tongue long, fold low and short.

Pedicle valve shallow, sulcus wide, deep, gently concave. Brachial valve deep, with lateral parts strongly extended ventrally.

Anterolateral parts of shell costate: 3 to 4 costate on sulcus, 4 to 5 on fold, and 3 to 5 on lateral parts. Costae rounded, in the middle of shell high, on lateral parts wide. A micro-ornamentation, consisting of regular, concentric growth lines and indistinct radial striae is visible on the surface of well-preserved specimens.

Brown, radially elongate spots covering the shell in both the costate and smooth parts are visible in some specimens, forming a characteristic, radial pattern, probably corresponding with the original coloration of shell.

Distinct dental plates (fig. 11C) occurs inside the pedicle valve, and a low, median ridge inside the brachial valve; hinge plates long, flat (fig. 11B).

*Remarks.* — Specimens from Dębnik are identical in external morphology and internal structure with those of *Pugnoides schucherti* from Independence Shell (Iowa, USA, the lower-most Upper Devonian) (STAINBROOK 1945). They are also externally similar to *Purapugnax* sp. from the Frasnian  $\alpha$  of Morocco (DROT 1971), differing only in a slightly smaller number of costae on sulcus and fold.

The specimens under study are also similar to *Pugnax* cf. *pugnus* (MARTIN) from the Frasnian of Western Australia (VEEVERS 1959) in the size, proportions and internal structure of shell, differing from it in a less curved cardinal margin, slightly smaller number of costae on sulcus and fold, and the presence of distinct costae on lateral parts of shell.

Occurrence. — Parapugnax schucherti is known from the Lower Frasnian of Iowa (Independence Shell); in Poland, it has been known so far only from Dębnik, where it occurs in the upper part of Rokiczany Dół ravine (*Calvinaria cracoviensis* Zone; the conodont Middle and Upper *asymmetricus* Zones).

*Parapugnax* sp. (pl. 4: 3; fig. 11 D)

Lvv	Ldv	W	Т	Sha	Aa	Nr/su	Nr/fo
9-2	8.6	11.3	8.6			3	
9.7	9.0	12.2	9.1	117	121	3	4
11.0	10.5	13.7	10.6	110	120	4	5
11.5	10.4	13.0	(10.0)	113	(121)	5	(6)
		Lvv Ldv 9·2 8·6 9·7 9·0 11·0 10·5 11·5 10·4	Lvv         Ldv         W           9·2         8·6         11·3           9·7         9·0         12·2           11·0         10·5         13·7           11·5         10·4         13·0	Lvv         Ldv         W         T           9·2         8·6         11·3         8·6           9·7         9·0         12·2         9·1           11·0         10·5         13·7         10·6           11·5         10·4         13·0         (10·0)	Lvv         Ldv         W         T         Sha           9·2         8·6         11·3         8·6            9·7         9·0         12·2         9·1         117           11·0         10·5         13·7         10·6         110           11·5         10·4         13·0         (10·0)         113	Lvv         Ldv         W         T         Sha         Aa           9·2         8·6         11·3         8·6         -         -           9·7         9·0         12·2         9·1         117         121           11·0         10·5         13·7         10·6         110         120           11·5         10·4         13·0         (10·0)         113         (121)	Lvv         Ldv         W         T         Sha         Aa         Nr/su           9·2         8·6         11·3         8·6         —         —         3           9·7         9·0         12·2         9·1         117         121         3           11·0         10·5         13·7         10·6         110         120         4           11·5         10·4         13·0         (10·0)         113         (121)         5

*Material.* — 5 complete or slightly damaged shells. Dimensions (in mm):

*Description.* — Shell small for the genus, dorsibiconvex, wider than long, heart-shaped in outline; cardinal margin curved, lateral margins rounded, anterior margin truncate, anterior commissure uniplicate; tongue long, fold low.

Pedicle valve shallow, sulcus wide, deep, beak projecting, suberect to ercct.

Brachial valve swollen in the anterior part; fold low, developed only in the anterior part of valve.

Anterolateral parts of shell costate: 3 to 5 costae on sulcus, 4 to 5 on fold, 3 to 6 on lateral parts; costae high, rounded.

Long, thin dental plates occur in pedicle valve and long, flat hinge plates (fig. 11D) in the brachial one.

*Remarks.* — The specimens described are marked by an internal structure characteristic of the genus *Parapugnax* and small dimensions of their shells. In this respect, they strongly resemble specimens of *Pugnax kayseri* RIGAUX from the Koltubansk limestones (Frasnian) of Ural, USSR (NALIVKIN, 1951: 16, pl. 2: 9–10), from which they differ, however, in the ornamentation of the lateral parts of valves, on which 3 to 6 costae occur, while the specimens from Ural have only two, thicker costae.

Specimens from Dębnik differ from typical specimens of *P. kayseri* from the Frasnian of Belgium (RIGAUX 1908: 24, pl. 1: 12) primarily in a larger number of costae on lateral parts of valves, on sulcus and fold, as well as in a different outline of shell. The specimens from Dębnik probably represent a new species, but a new taxon cannot be erected due to the fragmentary character of the collection.

Occurrence. — The specimens of P. sp. were collected from gray, marly biopelmicrites in the upper part of Rokiczany Dół ravine (Calvinaria cracoviensis Zone; the conodont Middle and Upper asymmetricus Zones).

# Family Camarotoechiidae SCHUCHERT and LEVENE, 1929 Subfamily Camarotoechiinae SCHUCHERT and LEVENE, 1929 Genus Calvinaria STAINBROOK, 1945

*Remarks.* — Representatives of this genus are among the most characteristic fossils that occur in the Frasnian deposits of the environs of Dębnik. Numerous representatives of *C. cracoviensis* (GÜRICH), an index species of the horizon, which occurs there, and much rarer ones of *C. variabilis athabascensis* (KINDLE) occur in the Lower Frasnian beds outcropping in Rokiczany Dół ravine, while its overlaying beds contain numerous representatives of *C. albertensis albertensis* (WARREN), which at the end of its existence dwarfed and produced a local, short-lived variety called *C. albertensis minor* subsp. nov. The two subspecies are index fossils characteristic of the middle part of the Frasnian which outcrops in the environs of Żbik ravine and on Żarnówka hill.

Two of these four forms, that is, *C. cracoviensis* and *C. albertensis minor* are probably local varieties. The remaining two subspecies, that is, *C. variabilis athabascensis* and *C. albertensis albertensis*, which are forms very characteristic of the Frasnian of Canada, are indicative of a very close faunal relationship between the Polish and Canadian Frasnian basins.

Calvinaria cracoviensis (GÜRICH, 1903) (pl. 5: 1-5; fig. 12A, B)

1903. Leiorhynchus Cracoviensis GÜR.; G. GÜRICH: 149–150, pl. 2: 14, fig. 3. Neotype: ZPAL Bp XXIII/181b, illustrated in pl. 5: 4.

*Material.* — 11 complete shells and 80 fragmentary shells and valves. Dimensions (in mm):

Lvv	Ldv	W	Т	Sha	Aa
18.4	19.1	(28.0)	17.6	125°	(129°)
19.3	20.1	24.7	18.9	118°	132°
20.1	20.1	26.2	15.7	122°	135°
21.4	21.4	28.3	19-2	115°	129°
22.8	22-8	30.1	18-5	107°	126°
(23.0)	(23.6)	(30.0)	19.4	119°	134°
20.0	18.7	26.5	16.7	(122°)	(128°)
	Lvv 18·4 19·3 20·1 21·4 22·8 (23·0) 20·0	Lvv         Ldv           18·4         19·1           19·3         20·1           20·1         20·1           21·4         21·4           22·8         22·8           (23·0)         (23·6)           20·0         18·7	Lvv         Ldv         W           18·4         19·1         (28·0)           19·3         20·1         24·7           20·1         20·1         26·2           21·4         21·4         28·3           22·8         22·8         30·1           (23·0)         (23·6)         (30·0)           20·0         18·7         26·5	Lvv         Ldv         W         T           18·4         19·1         (28·0)         17·6           19·3         20·1         24·7         18·9           20·1         20·1         26·2         15·7           21·4         21·4         28·3         19·2           22·8         22·8         30·1         18·5           (23·0)         (23·6)         (30·0)         19·4	Lvv         Ldv         W         T         Sha           18·4         19·1         (28·0)         17·6         125°           19·3         20·1         24·7         18·9         118°           20·1         20·1         26·2         15·7         122°           21·4         21·4         28·3         19·2         115°           22·8         22·8         30·1         18·5         107°           (23·0)         (23·6)         (30·0)         19·4         119°           20·0         18·7         26·5         16·7         (122°)

*Description.* — Shell medium-sized for the genus, dorsibiconvex, transversally elliptical in outline, very thick; cardinal margin nearly straight but fairly short, lateral margins rounded; anterior margin truncate, anterior commissure uniplicate.

Pedicle valve fairly shallow, with a long tongue; beak small, incurved; lateral parts of valve flattened.

Brachial valve deeper and usually somewhat longer than pedicle valve, the deepest halfway the length; umbonal part strongly convex.

Ornamentation consisting of fairly strongly marked costae on fold and sulcus, whose number increases by bifurcation (in large specimens, the number of costae near the anterior



Fig. 12

Transverse serial section. A-B — Sections of shell (A) and pedicle valve (B) of *Calvinaria cracoviensis* (GÜRICH). Rokiczany Dół ravine; *Calvinaria cracoviensis* Zone. C — Sections of pedicle valve of *Calvinaria variabilis athabascensis* (KINDLE). Rokiczany Dół ravine; *Calvinaria cracoviensis* Zone. Numbers refer to distance in mm from ventral apex

margin amounts on the average to 5 to 6). Similar costae occur on lateral parts of valves. Costae are mostly gently rounded, although in some specimens they may be sharper (pl. 5: 5). They appear in umbonal regions or at a certain distance from beaks.

Very short dental plates (fig. 12A, B), which tend to fuse to each other, occur in pedicle valve.

V-shaped, narrow hinge plates, supported by a high, thin and long medium septum, are visible in brachial valve (fig. 12A).

Remarks. — C. cracoviensis is slightly similar in ornamentation to C. variabilis insculpta (MCLAREN) and C. variabilis jobensis MCLAREN from the lower part of the Frasnian of West Canada (MCLAREN 1962). The shells of C. variabilis insculpta are smaller, quite differently shaped and have a very long tongue. Those of C. variabilis jobensis are also smaller, more flattened and with a more distinctly marked ornamentation.

The specimens described are very similar externally to *Liorhynchus megistianus* (LE HON) from the Frasnian of West Bashkiria (MIKRYUKOV 1955: 232, pl. 3: 9). The differences between them are rather small, the Polish specimens being larger, wider and with a more convex dorsal umbo. *Terebratula* (*Atrypa* d'ORB.) *megistiana* LE HON from the Frasnian of Belgium (LE HON 1870: 496–497, pl. 11: 7–8) differs from the specimens under study in having a less developed pedicle valve ornamentation and a flatter shell.

Specimens of *Camarotoechia cracoviensis* (GÜRICH) from the *Camarotoechia turanica* Zone of Turkestan, USSR (NALIVKIN 1930a: 56-57, pl. 3: 9, 15) are certainly not of this species. They are smaller and have a different ornamentation. In addition, the accompanying fauna (including *Productus praclongus* var. *simplicior* WHIDB., *Spirifer (Cyrtospirifer) Verneuili* MURCH., *Athyris angelica* HALL, *Camarotoechia turanica* ROM. is indicative of the upper part of Famennian (NALIVKIN 1930a: 170) and, consequently, the form from Turkestan seems to belong to quite a different species.

Occurrence. — C. cracoviensis GÜRICH has hitherto been known only from Dębnik, where it occurs in thick-bedded, dark-gray, marly biopelmicrites in the upper part of Rokiczany Dół ravine, for which it is an index species (*Calvinaria cracoviensis* Zone; the conodont Middle and Upper *asymmetricus* Zones).

## Calvinaria variabilis athabascensis (KINDLE, 1924) (pl. 6: 1-3; fig. 12C)

1956. Nudirostra athabascensis KINDLE; P. S. WARREN and C. R. STELCK: pl. 14: 20-25. 1962. Calvinaria variabilis athabascensis (KINDLE); D. J. MCLAREN: 39-43, pl. 4: 3-8; pl. 5: 1-3; flg. 9. 1962. Calvinaria variabilis athabascensis (KINDLE); D. J. MCLAREN et al.: pl. 11: 4-10.

*Material.* -9 complete or slightly damaged and 13 fragmentary shells. Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	W	Т	Sha	Aa
182c	9.0	8.2	10.0	4.8	94°	106°
183 k	12.3	11.2	15.1	7.7	116°	127°
182e	12.9	11.7	17.0	8.7	112°	135°
183 j	15.2	15.2	21.9	13.0	108°	137°
182 d	20.0	20.0	(34.4)	22.5	129°	(144°)
182 b	20.9	20.9	29.5	17.3	144°	138°
182a	(26.3)	(26.3)	41.4	28.0	119°	139°

*Description.* — Shell medium-sized for the genus, dorsibiconvex, transversally elliptical to pentagonal in outline; cardinal margin subrectilinear; lateral margins rounded, anterior margin truncate, anterior commissure uniplicate. Fold and sulcus with several distinct, frequently bifurcating costae.

Pedicle valve with a long tongue; beak small, convex, erect to incurved.

Brachial valve deep, V-shaped in transverse section, with a strongly convex umbonal part. Ornamentation distinct only on the bottom of sulcus and on fold. Lateral parts of valves and umbonal parts and slopes of sulcus almost completely smooth. Slightly marked radial costae are visible on lateral parts of valves in some specimens.

Dental plates occur in pedicle valve (fig. 12C) and hinge plates, supported by a high and thin median septum in brachial valve.

*Remarks.* — The specimens described are externally identical with *C. variabilis athabascensis* from the lower part of the Frasnian of Western Canada (MCLAREN 1962: 39–43, pl. 4: 3–8, pl. 5: 1–3).

Occurrence. — This subspecies occurs in the upper Flume or Maligne Formations and in the basal beds of the Perdrix Formation of the Rocky Mountains, Alta, Canada; in the Fairholme group. British Columbia; in the basal bed of the Escarpment member of the Hay River section; in the Cooking Lake or Duvernay Formations, Central Alberta (MCLAREN 1962).

In Poland, it is known only from Dębnik, where it occurs in the upper part of Rokiczany Dół ravine (*Calvinaria cracoviensis* Zone; the conodont Middle and Upper *asymmetricus* Zones).

#### Calvinaria albertensis (WARREN, 1928)

*Remarks.* — This species is represented at Dębnik by two subspecies directly following each other in time and belonging to one and the same phylogenetic line. *C. albertensis albertensis* (WARREN), whose shells reach 18 mm in length, is the older of the two subspecies. *C. albertensis minor* subsp. nov., externally and internally identical with *C. albertensis albertensis*, but considerably smaller, occurs a few meters higher-up in the profile (trench Z-IV). Its shells are only 8–10 mm long, with a simultaneous high index of convexity, which indicates that they certainly represent an adult stage (fig. 14).

C. albertensis minor subsp. nov., which may be called a miniature of C. albertensis albertensis, occurs together with Iowatrypa markovskii and Biernatella polonica, also marked by small dimensions of their shells. The dwarfing of C. albertensis minor was probably connected with a change in environmental conditions, expressed by lithological differences between the beds containing C. albertensis albertensis (trenches Z-V and Z-VIII) and those containing C. albertensis minor (trench Z-IV).

## Calvinaria albertensis albertensis (WARREN, 1928) (pl. 6: 4-5; figs. 13A, B, 14)

1954. Nudirostra albertensis (WARREN); D. J. MCLAREN: 179, pl. 1: 14-18.

1956. Calvinaria albertensis albertensis (WARREN); P. S. WARREN and C. R. STELCK: pl. 17: 26-34 (non pl. 18: 26-29).

1962. Calvinaria albertensis albertensis (WARREN); D. J. MCLAREN: 26-30, pl. 1: 1-11; fig. 6B-C.

cf. 1971. Calvinaria cf. albertensis albertensis (WARREN); G. BIERNAT: 146, pl. 3: 2-4.

Material. — 25 complete or slightly damaged shells and 31 fragments of shells and single valves.

ZPAL Bp XXIII	Lvv	Ldv	w	Т	Sha	Aa
14g	_	11.9	16.3	7.6		_
14h	13.4	12.5	17.1	8.0	125°	126°
14b	14.4	13.9	18.7	10.2	(106°)	(118°)
14c	16.0	15.2	20.0	10.4	134°	141°
14 f	16.2	15.6	20.9	12.7	135°	134°
14e	16.2	14.9	20.6	13.9	124°	137°
14d	18.6	17.5	21.9	13.8	127°	133°

Dimensions (in mm):

*Description.* — Shell medium-sized for the genus; biconvex to dorsibiconvex, transversally elliptical in outline; cardinal margin nearly straight, apical angle between 126° and 141° in adult individuals; lateral margins rounded, anterior margin truncate, anterior commissure sulciplicate.

Pedicle valve strongly curved, with a fairly long tongue. Sulcus with a single, rather slightly marked costa; in the umbonal part, sulcus is only slightly marked or lacking at all; it becomes distinct at midvalve. Lateral parts of valve somewhat flattened. Beak small, erect to incurved.

Brachial valve deepest in its anterior half; fold with two distinct, rounded costae, forms halfway the length of valve.

Ornamentation: except for fold and sulcus the shell is smooth.

Very short dental plates (fig. 13A) occur in pedicle valve. V-shaped hinge plates, supported by a thin, high and long median septum are visible in brachial valve (fig. 13A, B).

*Remarks.* — The specimens described display a close similarity to *C. albertensis albertensis* (WARREN) from the middle part of the Frasnian of Canada (MCLAREN 1962: 26–30, pl. 1: 1–11), from which they slightly differ phenotypically in being usually somewhat larger (on the

average not more than by about 2 to 3 mm) and having a not so strongly developed fold on the bottom of the sulcus of pedicle valve.

The specimens from Dębnik are similar, in the size and shape of shell, and character of ornamentation, to *C*. cf. *albertensis albertensis* from the Frasnian of Kadzielnia, Holy Cross Mts., Poland (BIERNAT 1971: 146, pl. 3: 2-4), from which they differ, however, in a deeper pedicle valve, less convex umbo of brachial valve, more distinct sulcus and fold, and, finally, a somewhat larger shoulder angle.

Occurrence. — C. albertensis albertensis is extensively distributed in the middle part of the Frasnian of Western Canada (MCLAREN 1962: 30). In Poland, a related form was described



Fig. 13

Transverse serial sections. A-B — Sections of shell (A) and brachial valve (B) of Calvinaria albertensis albertensis.
 Trench Z-V; Calvinaria albertensis Zone. C-D — Sections of two shells of Calvinaria albertensis minor subsp. n. Trench Z-IV; Calvinaria albertensis Zone. Numbers refer to distance in mm from ventral apex

from the Kadzielnia limestones in Kielce, Holy Cross Mts (BIERNAT 1971: 146). At Dębnik, this subspecies is most abundant in gray, spotty, marly, thin-bedded biopelintrasparites (Z-V and Z-VII trenches), occurring in the beds, of which, together with *C. albertensis minor* subsp. nov., it is an index form (*Calvinaria albertensis* Zone; the conodont gigas Zone). North of Dębnik, this form occurs locally in the biopelintrasparites of Żar-I trench (the lowermost part of *C. albertensis* Zone; probably the conodont *Ancyrognathus triangularis* Zone).

Calvinaria albertensis minor subsp. nov. (pl. 7: 1-3; figs 13C-D, 14)

Holotype: ZPAL Bp XXIII/28b; illustrated in pl. 7: 2. Type horizon: Calvinaria albertensis Zone; the conodont gigas Zone, Upper Devonian, Frasnian. Type locality: Dębnik, trench Z-IV. Derivation of the name: minor — smaller, a subspecies of diminished dimensions.

*Diagnosis.* — Shell externally and internally identical with that of *C. albertensis albertensis* (WARREN), but considerable smaller (on the average by 8 to 10 mm in length).

Material. -27 complete and damaged shells and several fragmentary valves. Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	W	т	Sha	Aa
28 e	5.9	5.5	6.9	2.9	118°	130°
1521	6.8	6.6	7.9	4.0		(126°)
28 f	7.9	7.3	9.2	4.4	(116°)	128°
152e	8.0	7.2	10.0	5.0	118°	(132°)
28 đ	8.4	7.8	9.9	5.3	121°	129°
28 a	9.0	7.3	11.2	6.0	122°	136°
28 c	9.2	8.7	11.0	7.1	(130°)	132°
28 b	9.6	9.1	12.0	6.2	126°	140°
28 g	11.2	10.6	14.3	6.9	121°	131°

Description. — Shell small for the genus, biconvex, transversally elliptical in outline; cardinal margin nearly straight; apical angle between 126° and 140° in adult individuals; lateral margins rounded, anterior margin truncate, anterior commissure sulciplicate. Fold with two fairly distinct, rounded costae, sulcus with a single costa, umbonal and lateral parts of shell quite smooth.



Fig. 14

Diagram illustrating length (L) to thickness shell index (T/L) ratio in Calvinaria albertensis albertensis (WARREN) and C. albertensis minor subsp. n.

Pedicle valve as deep as brachial valve, gently curved, with a medium-sized tongue. In the umbonal region, sulcus slightly marked or absent; it becomes distint at midlength to one-third of valve (from umbo). Lateral parts of valve slightly flattened.

Brachial valve the deepest at midvalve, gently curved. In the umbonal part, fold lacking; it starts forming distinctly at midlength to one-third of valve.

Ornamentation: except for fold and sulcus, shell smooth.

Dental plates occur in pedicle valve and V-shaped hinge plates, supported by a thin, fairly high and long median septum, in brachial valve (fig. 13C, D).

Remarks. — The specimens under study display a close similarity to the subspecies C. albertensis albertensis (WARREN), which occurs in the studied profile a few meters below the beds with C. albertensis minor subsp. nov. The two forms are identical in shape, proportions, and ornamentation of shell. On the other hand, they considerably differ in size of shell which in C. albertensis minor subsp. nov. is much smaller, reaching usually only 8 to 10 mm in length (fig. 14). Larger specimens are very rare, the largest of them not exceeding 12 mm.

Occurrence. — C. albertensis minor subsp. nov. has so far been known at Dębnik only from trench Z-IV (the uppermost part of C. albertensis Zone; the conodont gigas Zone).

### Genus Caryorhynchus CRICKMAY, 1952

Remarks. — The genus Caryorhynchus has been erected in 1952 by CRICKMAY for two leiorhynchoid species, Leiorhynchus carya CRICKMAY and Rhynchonella castanea MEEK. According to CRICKMAY's diagnosis, this genus considerably differs from Leiorhynchus in its much shorter dental plates which do not reach the bottom of valve. If, however, no dental plates are observed in L. carya, they are well developed in Rhynchonella castanea. This inconsistency was at first the reason why CRICKMAY's genus could not be accepted (cf. MCLAREN 1962). The separate character of the genus Caryorhynchus was later confirmed by the studies of SARTENAER (1968).

The separate character of this genus is also accepted by the present writer, whose studies conducted on abundant material of *C. tunidus* from the environs of Dębnik did not reveal the presence of dental plates in this species. Such plates could not be covered by secondary layers of shell, since they also do not occur in young individuals. The lack of dental plates in the genus *Caryorhynchus* may be considered an only diagnostic character, differing it from the genus *Leiorhynchus*. Other morphological characters, helpful in the identification of the representatives of the genus *Caryorhynchus*, such as a strong thickening of valves in umbonal parts and a considerable convexity of the posterior part of brachial valve, which may become higher than the umbo of pedicle valve, occur sporadically also within the range of the genus *Leiorhynchus* (e.g., in *L. castanea* and *L. manetoe*).

Caryorhynchus tumidus (KAYSER, 1872) (pl. 8: 1-7, 11; fig. 15)

- 1872. Camarotoechia tumida n. sp.; E. KAYSER: 695-696, p. 27: 10a-f.
- 1929. Leiorhynchus tumidus (KAYSER) var. tricostata nov. var.; E. MAILLIEUX: 108, pl. 3: 3a-b.
- 1929. Leiorhynchus tumidus (KAYSER) var. quadricostata nov. var.; ibid.: 108-109, pl. 3: 4a-b.
- 1968. Caryorhynchus tumidus (KAYSER); P. SARTENAER: 1-21, pl. 1: 1-10; pl. 2.

?1971. Caryorhynchus aff. tumidus (KAYSER); J. DROT: 85, pl. 2: 6.

*Material.* -33 complete shells and 300 single valves and fragments of shells and valves. Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	W	т	Sha	Aa
7 a	5.7	5.2	5.9	2.8	84°	100°
146c	8.5	8.0	9.5	4.6	119°	126°
146 a	9.1	8.4	10.1	(5.2)	110°	126°
145 b	11.0	10.0	12.5	6.3	114°	126°
145a	11.0	10.2	12.0	(6.2)	116°	121°
145c	11.2	10.3	12.6	7.5	109°	120°
144 a	13.4	13.4	14.5	10.4	108°	119°
144 b	13.7	13.4	13.8	10.8	114°	118°
144 c	15.4	14.9	16.0	10.3	$110^{\circ}$	135°
144 d	16.2	15.8	17.7	12.6	105°	110°
3	16.5	16.8	19.8	14.3	110°	115°
144 e	17.1	17.1	19.0	14.1	113°	125°
16a	17.8	17.8	19.0	13.6	99°	
16c	(19.0)	(18.1)	(20.0)	13.4	105°	110°
1	19.0	19.4	22.1	16.6	$100^{\circ}$	132°
156	21.5	21.1	21.7	15.0	102°	110°

Description. — Shell medium-sized for the genus, strongly dorsibiconvex, subpentagonal to oviform in outline, somewhat wider than long; cardinal margin curved; apical angle in adult individuals between 110° and 135°; anterolateral margins trapezoidal or rounded, anterior margin truncate, anterior commissure uniplicate. Fold and sulcus present.

Pedicle valve considerable more shallow than brachial valve, with flat lateral parts similar to those in *Calvinaria*; tongue varying in length; sulcus marked at one-third to midvalve from umbo in adult and gerontic individuals. Beak robust, strongly incurved; interareas narrow, frequently concealed.

Brachial valve strongly convex, particularly so in posterior part, which forms a strong distension sometimes exceeding the size of umbo in pedicle valve (pl. 8: 6c); the deepest at midvalve. Fold low or very low, developed in the anterior two-thirds to midvalve. Beak distinct, incurved, hidden by beak of pedicle valve.

Ornamentation in the form of poorly developed costae (five at most) on sulcus and a fold, visible only in the anterior part of the shell or close to the anterior margin. In some specimens, costae are not developed at all. Umbonal and lateral parts quite smooth.

No dental plates occur inside pedicle valve (fig. 15); umbonal part strongly swollen (pl. 8:11), teeth strong, thick, supported by thickened internal edges of delthyrium.

A massive, high median septum, sometimes club-shaped in transverse section, occurs in brachial valve; hinge plates not separated even in young individuals as a result of a strong swelling of the posterior part of valve (fig. 15A). Crural bases, at first almost connected, running in a longitudinal groove over a massive median septum (pl. 8: 11) and then gradually deviating laterally and ascending over septum.

Ontogeny and intraspecific variability. — The collection studied includes complete specimens of growth stages ranging between 5 and 19 mm in length. Small specimens are biconvex, flat, lenticular, transversally elliptical in outline, without sulcus and fold, and with a suberect to erect beak of pedicle valve (pl. 8: 1–3). Sulcus and fold (as well as a curvature of anterior commissure) occur in more than 10 mm long specimens. Costae occur on sulcus and fold in specimens longer than 15 mm; at first only slightly outlined, they become more distinct only in the largest specimens.

Internal structure of young specimens is in principle identical with that of the adults; a strong swelling is observed in the posterior parts of valves; dental plates and differentiated hinge plates do not occur at all (fig. 15A).

The intraspecific variability is rather slight only; small differences are observed between

specimens coming from various horizons. On the whole, specimens geologically older (trench Z-V) have a slightly more projecting umbo, which is expressed in a somewhat smaller shoulder and apical angle (pl. 8: 4).

*Remarks.* — The specimens studied are identical with *Caryorhynchus tumidus* (KAYSER) from the Upper Frasnian of Western Europe and display a considerable similarity to *C*. aff. *tumidus* from the Frasnian  $I_{\Upsilon}$  of Morocco (DROT 1971: 85, pl. 2: 6) and to *Leiorhynchus rossicus* LJASCH. from the Middle Frasnian of Timan (LJASCHENKO 1959: 154, pl. 35: 4–8). From



Fig. 15

Transverse serial sections of young (A) and adult (B) shell of Caryorhynchus tumidus (KAYSER). Trench Z-VI; Caryorhynchus tumidus Zone the last-named they differ in smaller dimensions, wider shell and the presence of slightly outlined costae in the anterior part of sulcus and fold. *L. rossicus* is probably a representative of the genus *Caryorhynchus*, as it may be presumed on the basis of the external morphology; unfortunately, the internal structure of this species remains unknown.

Occurrence. — C. tunidus is known from the Upper Frasnian of Germany, Belgium and France (SARTENAER 1968: 17–18). A related form was also described from the Frasnian I $\gamma$  of Morocco (DROT 1971: 85).

At Dębnik, C. tumidus occurs in gray, spotty, marly biointrasparites in trench Z-V (Calvinaria albertensis Zone; the conodont gigas Zone) and in black, marly biointramicrites in trenches Z-VI and Z-XIB of which it is an index form (Caryorhynchus tumidus Zone; the uppermost part of conodont gigas Zone). This species also occurs in slightly outcropped klippen near the western road from Dębnik to Siedlec about 100 m SE of the outcrop of Z-IV (C. albertensis Zone; the conodont gigas Zone).

## Genus Leiorhynchus HALL, 1860 Leiorhynchus laevis Gürich, 1903 (pl. 9: 1-7; fig. 16)

1903. Leiorhynchus laevis GÜR.; G. GÜRICH: 150, pl. 2: 12, 15. ?1903. Leiorhynchus laevis var. lentiformis GÜR.; ibid., 150, pl. 2: 13. non 1955. Leiorhynchus laevis GÜRICH; K. I. ADRIANOVA: 355, pl. 3: 4. Neotype: ZPAL Bp XXIII/158a; illustrated in pl. 9: 4.

Material. - 21 complete and 23 damaged shells, as well as 150 fragments. In addition, 14 specimens (some of them with preserved elements of internal structure) obtained by dissolving limestones in acetic acid (conodont samples Z-II-1 and Z-II-4 from quarry Z-II. Externally, the specimens are fairly well preserved, with their interior frequently filled with calcite.

ZPAL Bp XXIII	Lvv	Ldv	w	Т	Sha	Aa	Nr/fo
160 f	5.5	5.2	5.9	2.6	119°		0
158 d	6.1	5.6	6.8	3.0	116°	124°	(4)
160a	8.4	8.0	9.5	4.4	100°	111°	(3)
158c	8.5	8.1	10.0	4.6	121°	136°	3
159h	11.0	10.2	11.8	8.0	112°	120°	6
158b	13.2	12.2	(14.3)	9.6	107°	(118°)	5
l59b	13.9	12.8	15.5	7.3	105°	(125°)	5
158a	14.0	13.0	16.4	10.5	114°	125°	4
159a	15.7	14.8	16.7	9.7	118°	(124°)	6
156g	15-3	14.7	15.9	8.2	116°	(120°)	4
155b	15.3	14.5	16.2	11.1	125°	128°	6
155 a	16.1	15.3	18.4	13.8	123°	126°	5

Dimensions (in mm):

Description. — Shell small to medium-sized for the genus, dorsibiconvex, round in outline, somewhat wider than long; cardinal margin fairly short, slightly curved; apical angle 111° to 136°; anterolateral margins rounded, in adult individuals anterior margin sometimes truncate; anterior commissure usually uniplicate, sometimes sulciplicate.

Pedicle valve slightly shallower than brachial valve; tongue small or medium-sized. Sulcus, usually with 3 to 5 costae, occurs at about a quarter of the length from umbo. Lateral parts of valve slightly flattened. Beak fairly small, erect or incurved.

Brachial valve regularly convex, round to transversally elliptical in outline. Fold distinct, fairly wide, rather low, although in some specimens it may be particularly high; costae on

fold, usually slightly outlined, appear already numbering 4 to 6 and continued to occur rarely bifurcating, up to the anterior margin.

Ornamentation of shell is mostly limited to fold and sulcus, although some costae may also appear on lateral parts of valves near sulcus and fold (pl. 9: 4).



Fig. 16

Transverse serial sections of two shells of *Leiorhynchus laevis* GÜRICH. Quarry Z-II (A) and trench Z-XVI (B); *Leiorhynchus laevis* Zone. Numbers refer to distance in mm from ventral apex

Short dental plates, whose ventral edges do not tend to fuse, occur in pedicle valve.

Short hinge plates and long crural bases form, together with median septum, a Y-shaped septalium in brachial valve. Crural bases fairly massive, long, ventrally arcuate. Median septum thin, considerably varying intraspecifically in length and height (fig. 16).

Ontogeny and intraspecific variability. — The collection under study includes complete specimens 5 to 16 mm long. Shells of young individuals are flat, lenticular, roundish or heart-

-shaped in outline, without distinctly developed sulcus and fold. The first appearance of rudimentary elements of ornamentation may be observed exceptionally in 6 mm-long specimens. Distinctly developed fold, sulcus and costae appear in 8 to 9 mm-long specimens. On fold and sulcus, costae appear already numbering 4 to 6 and continue to occur up to the anterior margin; dichotomy rare. The disappearance of costae in adult stage is only exceptionally observed in some specimens (pl. 9: 5).

Certain morphological differences are observed in particular specimens coming from various geological horizons. Specimens from older horizons (trench Z-XVI) are on the whole larger, more convex, usually with a high fold on the brachial and low beak on the pedicle valve (pl. 9: 5). Specimens from younger horizons (most of quarry Z-II and trench Z-III) are smaller (a similar reduction in shell size is also observed in *Cyrtospirifer minor* — see below), with a lower fold on brachial and with a slightly larger beak on pedicle valve (pl. 9: 1–3). In addition, a general tendency is observed to an increase in the distinctness of costae on fold and in sulcus and to a decrease in their number (pl. 9: 1–4). This evolution in external morphology leads to the separation, in the lowermost Famennian, of a new form marked by the presence of, on the average, three very distinct costae on the fold of brachial valve (uppermost part of quarry Z-II and trenches Z-VIII and Z-IX).

*Remarks.* — Leiorhynchus laevis GÜRICH is a fairly characteristic Upper Frasnian brachiopod. Externally, it is similar to *Caryorhynchus tumidus tafilaltensis* DROT from the Frasnian I<sub>Y</sub> of Morocco (DROT 1971: 85–88, pl. 2: 5, 7–8; text-figs 5–6), but considerable differences are observed in internal structure: the Moroccan form is devoid of dental plates and has strongly thickened cardinalia, characteristic of the genus *Caryorhynchus*.

The specimens studied are somewhat similar in shape, size and the proportions of shell to *L. awokanak* MCLAREN from the Givetian of Canada, whose shells are, however, more distinctly costate not only on fold and in sulcus, but also on lateral parts of valves. Specimens of *Leiorhynchus laevis* GÜRICH from the Frasnian of the Kolvo-Vishersk area (ADRIANOVA 1955: 355, pl. 3: 4) are considerably wider and with a less strongly marked fold on brachial valve, which make them similar rather to the genus *Calvinaria* STAINBROOK.

Several specimens of the collection under study, particularly those coming from quarry Z-II, display a considerable similarity to *L. laevis* var. *lentiformis* Gürich described from the Frasnian of Żarnówczany Dół ravine (Gürich 1903: 150–151, pl. 2: 13). No such form has, however, been found in this locality during the present studies.

Occurrence. — L. laevis was cited by GÜRICH (1903: 150) from the Żbik, Rokiczany Dół and Żarnówczany Dół ravines and from Pałkowa Góra quarry. In the light of the present studies, the autochthonous occurrence of this species in the three outcrops, mentioned above, seems to be impossible. At Rokiczany Dół ravine, there are no beds at all ranging from the Upper Frasnian to lower zones of the Famennian inclusively; in Żarnówczany Dół ravine is devoid of zones older than the middle part of the Lower Famennian; the faunal assemblage from the Pałkowa Góra quarry is as a whole of the Lower Famennian age (do II $\alpha$ ).

On the other hand, the Upper Frasnian beds, in which *L. laevis* was found, occur probably on Żarnówka hill, that is, between Rokiczany Dół and Żarnówczany Dół ravines, from which its fragments could be transported for a considerable distance. Also unlikely seems to be that *L. laevis* might occur in an outcrop of the field road from Dębnik to Paczółtowice off Żarnówczany Dół (JAROSZ 1926: 144, pl. 1: 12a). Limestones from which JAROSZ cites fauna characteristic of the beds from what is known as Nowe Lomy (new quarries at the Żbik ravine), were probably brought there to improve and reinforce this sector of the field road.

The collection of *L. laevis* comes mostly from outcrop Z-II (one of the new quarries) and from trenches Z-III, Z-XIII, Z-XV and Z-XVI. Stratigraphically these are beds which represent the uppermost Frasnian and, partly, maybe also transitional Frasnian-Famennian beds (*Leiorhynchus laevis* Zone; lower part of the conodont *triangularis* Zone).

#### ANDRZEJ BALIŃSKI

# Subfamily Septalariinae HAVLIČEK, 1960 Genus Bergalaria SCHMIDT, 1975

**Remarks.** — The genus Bergalaria SCHMIDT, externally very similar to the genus Septalaria LEIDHOLD, differs from it in a characteristic micro-ornamentation of the shell. The presence of dental plates and platelike, extended crura were also mentioned by SCHMIDT (1975) as diagnostic characters of the Bergalaria. A comparison of the internal structure of B. bergica SCHMIDT and that of B. guerichi sp. n., described below, allows one to presume, however, that the internal structure of pedicle valve in the former species was incorrectly interpreted by SCHMIDT. Thin, light-coloured lines ("dünne, helle Linien"), visible in the specimen with a recrystallized interior, illustrated by SCHMIDT (1975, pl. 7: 36), were considered as dental supports (*ibidem:* 103, fig. 9). These lines may, however, correspond to inner surfaces of valve (umbonal thickening), which could be in complete conformity with the internal structure of pedicle valve of B. guerichi sp. nov. (fig. 17B-C) which is devoid of dental plates. The solution of this problem and revision of the diagnosis of the genus Bergalaria should, however, be preceded by repeated studies on the internal structure of the type species B. bergica SCHMIDT. The platelike extension of crura (diagnostic character) is not displayed by all specimens and maybe it also depends on the state of preservation.

#### *Bergalaria guerichi* sp. nov. (pl. 7: 4-7; pl. 8: 10; fig. 17)

Holotype: ZPAL Bp XXIII/184i; illustrated in pl. 7: 5.

Type horizon: Calvinaria cracoviensis Zone; the conodont Middle and Upper asymmetricus Zone (Upper Devonian, Frasnian).

Type locality: Rokiczany Dół ravine, north of Dębnik, Cracow region, Southern Poland.

Derivation of the name: in honour of GEORGE GÜRICH, a researcher of the Devonian deposits at Debnik.

*Diagnosis.* — Shell dorsibiconvex, pentagonal in outline, distinctly wider than long, ornamented by rounded costae occurring only in the anterior part, the rest of shell being covered with fine, flat striae (about 20 per 5 mm); no dental plates occur inside pedicle valve.

*Material.* — 9 complete and 4 damaged shells, along with 17 fragments. Shells externally well preserved, their interior frequently recrystallized.

ZPAL Bp XXIII	Lvv	Ldv	W	Т	Sha	Aa	Nr/su	Nr/fo
184a	9.7	8.7	11.1	5.5	116°	123°	5	6
184 g	11.0	10.5	14.5	9.2	121°	126°	3	4
184 i	11.7	11.2	13.8	9.7	116°	124°	4	5
184 f	12.7	12.0	15.6	10.2	120 <sup>o</sup>	$130^{\circ}$	3	4
184 e	12.9	12.0	14.4	10.0	114°	122°	6	
184 b	13.0	12.5	15.9	11.7	$112^{\circ}$	119°	5	5
184c	13-4	12.8	16.1	11.4	_		3	4
184 h	14.3	13.3	17.5	12.2	119	J 22°	4	5
184 d	17.6	17.3	19.6	12.2		_	4	5

Dimensions (in mm):

*Description.* — Shell medium-sized, dorsibiconvex, pentagonal in outline, wider than long; cardinal margin fairly long, curved; apical angle 119° to 130°; lateral margines rounded, anterior margin slightly truncate; anterior commissure uniplicate; marginal spines present.

Pedicle valve shallower than brachial valve; tongue small or medium-sized. Sulcus appearing at halfway the length of valve. Beak medium-sized, incurved.

Brachial valve square in outline; fold distinct but fairly low, appearing at halfway the length of valve.

Ornamentation distinct, but only in the anterior half of shell, composed of conspicuous, radial, rounded costae covering the lateral parts of shell, sulcus and fold. Their number is usually constant, but sometimes it increases by bifurcation or intercalation. On fold and sulcus, they are slightly thicker than on the lateral parts of shell. The posterior, non-costate part of shell is covered by a characteristic, fine, radial micro-ornamentation, formed by radial, flat and wide striae (on the average about 20 of them per 5 mm), which occur on valves from beaks to midlength of shell and further on disappear gradually, replaced by costae (pl. 8: 10).

Interior. — No dental plates occur inside the pedicle valve; umbonal parts thick. Muscle field deeply depressed (fig. 17B-C). Flat, long hinge plates occur in brachial valve; septalium



Fig. 17

Transverse serial sections of brachial valve (A) and two shells (B-C) of *Bergalaria guerichi* sp. n. Rokiczany Dół ravine; *Calvinaria cracoviensis* Zone. Numbers refer to distance in mm from dorsal (A) or ventral (B-C) apex reduced, shallow, supported by a thin and high median septum (fig. 17A). Cardinal process large, trilobate, sometimes having long, lateral lobes in its posterior part (fig. 17C).

Remarks. — The characteristic, pentagonal, extended outline of shell of *B. guerchi* sp. nov. allows one to distinguish it easily from a single, so far known, representative of this genus, that is, *B. bergica*, described from the Lower Frasnian (Adorfium, do Ia) of Bergisches Land, W. Germany (SCHMIDT 1975: 102–106, pl. 5: 14–26; pl. 6: 28–30; pl. 7: 31–36). The shells of *B. bergica* are more strongly heart-shaped and elongate, their length-to-width ratio amounting to 0.94 (in *B. guerichi* — 0.84). The differences observed in the internal structure of the two species may result from an erroneous interpretation of the sections of poorly preserved specimens of *B. bergica*.

The species described are also similar externally to some species of the genus Septalaria, for example, to S. subtetragona tarfayensis Drot from the Lower Eifelian and S. lehmani DROT from the Upper Givetian of Morocco (DROT 1964: 159–161, pl. 20: 1, 4–6; figs 66; 163–164; pl. 20: 7–9, 13; fig. 67). The Moroccan forms have quite differently shaped shells (triangular in outline), a much smaller apical angle and distinctly developed dental plates.

*B. guerichi* sp. nov. also resembles externally specimens described from the Upper Givetian of Bilveringsen, W. Germany by TORLEY (1934: 81, pl. 3: 41-42) as hybrids of *Septalaria*? *crenulata* and *Uncinulus parallelepipedus*, but unfortunately the internal structure of these specimens remains unknown so far.

*Occurrence.* — *B. guerichi* sp. nov. has so far been known only from dark-gray marly biopelmicrites of the upper part of Rokiczany Dół ravine (*Calvinaria cracoviensis* Zone; the conodont Middle and Upper *asymmetricus* Zones).

Order Spiriferida WAAGEN, 1883 Suborder Atrypidina MOORE, 1952 Superfamily Atrypacea GILL, 1871 Family Atrypidae GILL, 1871 Subfamily Atrypinae GILL, 1871 Genus Anatrypa NALIVKIN, 1941 Anatrypa alticola (FRECH, 1891) (pl. 10: 1-3)

1891. Atrypa desquamata Sow. var. nov. alticola; F. FRECH: 680, pl. 44: 1.

1947. Atrypa alticola FRECH; D. V. NALIVKIN: 100-101, pl. 22: 14-15.

1951. Atrypa alticola Frech; D. V. Nalivkin: 17, pl. 4: 1.

1955. Atrypa alticola Frech; M. F. Mikryukov: 240-241, pl. 5: 4.

Material. — One complete and five slightly damaged shells, with nine fragments of shells and detached valves. Most valves exfoliated, some of them partially silicified.

Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	W	Т	Nr/5
25 a	19-1	17.7	(16.7)	9.5	12
26e	20.8	19-1	19.5	9.9	13
237a			24.5	15.0	10
237c	(25.2)	23.1	25.0	15.0	11

Description. — Shell medium-sized for the genus, biconvex, less frequently ventri- or dorsi--biconvex, roundish to oviform in outline, usually wider than long; cardinal margin short, curved; anterolateral margins regularly rounded; anterior commissure slightly curved, uniplicate. Pedicle valve with a very shallow, wide sulcus, marked only in the anterior parts of large specimens; a short tongue occurs sometimes. Interarea preserved only in two young specimens, high, apsacline; beak straight.

Brachial valve longitudinally elliptical to roundish in outline; fold visible only in the anterior part of large shells.

Costae fine, 10 to 13 of them per 5 mm, measured at the anterior margin; growth layers not preserved, poorly visible in one specimen only.

Interior insufficiently studied due to a small number of specimens and partial damage done to interior by the process of silification. Very distinct, long dental plates visible in the thin section of one specimen.

*Remarks.* — The specimens described are almost identical externally with those of *Atrypa* alticola FRECH from the Givetian of the Carnic Alps (FRECH 1891: 680, pl. 44: 1) and the Frasnian of Mugodzhar and Ural (NALIVKIN 1947: 100–101, pl. 22: 14–15; 1951: 17, pl. 4: 1).

From the stratigraphic viewpoint, it seems unlikely that the specimens under study, coming from *gigas* Zone, might be of the same species as type specimens of Frech's species coming from the Givetian. However, in regard to morphology, they are so similar to each other that they can be hardly assigned to two different species.

Occurrence. — The species is known from the Givetian of the Carnic Alps and from the Upper Frasnian (askynskiye Beds) of Central Asia, western slopes of the Ural Mountains and eastern part of the Russian Platform. In Poland, this species has not so far been recorded; the present material comes from gray biopelintrasparites and intrasparites of trenches Z-V, Z-VII and Z-XIB (*Calvinaria albertensis* Zone and *Caryorhynchus tumidus* Zone; the conodont gigas Zone).

Genus Desquamatia ALEKSEEVA, 1960 Subgenus Desquamatia (Seratrypa) COOPER, 1967 Desquamatia (Seratrypa) oneidensis (BEUS, 1965) (pl. 11: 1-9, figs 18-19)

1965. Atrypa oneidensis n. sp.: S. S. BEUS: 25-26, pl. 9: 1-11, fig. 4E, F.

*Material.* — 16 complete and seventy damaged shells, together with 100 fragments. In addition, 30, usually fragmentarily preserved, single valves. The preserved elements of their internal structure have been obtained by dissolving limestones in acetic acid.

Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	W	т	Nr/5
133a	11.9	10.9	11.9	6.1	10
132z	14.9	13.4	14.9	9.2	11
132 d	15-3	14.4	15.9	7.6	8
132 m	16.3	15.2	18.0	9.0	8
132 t	16.4	15-1	16.8	8.0	8
242 b	18.2	16.8	20.1	10.8	8
132 p	19.4	18.3	20.3	11.8	8
132s	20.6	19.1	21.9	13.6	8

*Description.* — Shell medium-sized for the genus, biconvex, more frequently dorsibiconvex, roundish to transversally elliptical in outline, somewhat wider than long (fig. 19); cardinal margin curved, anterolateral margins rounded, anterior commissure rectimarginate to uniplicate.

Pedicle valve convex, with slightly flattened lateral parts; sulcus shallow, marked only in the anterior part; a short tongue occurs sometimes. Interarea distinct, high, orthocline to ana-

cline; beak suberect to slightly incurved. Deltidial plates fused together, pierced, in the upper part, by a roundish foramen.

Brachial valve transversally elliptical in outline, usually strongly convex; fold, present in some specimens only, low, visible close to the anterior margin.

Costae fine, tubular, 8 to 11 per 5 mm, near the anterior margin of adult specimens. Growth lamellae in well preserved specimens deflected, distributed at 1 to 3, mostly 2 mm intervals (pl. 11: 9).

Distinct dental plates visible in the interior of pedicle valve (pl. 11: 4; fig. 18). Narrow, long hinge plates occurring in brachial valve (pl. 11: 5).

*Remarks.* — The specimens described display a close relationship with *Atrypa oneidensis* BEUS from the lower part of Jefferson Formation (Hyrum Member) in Utah and Idaho, USA



Fig. 18

Transverse serial sections of *Desquamatia (Seratrypa) oneidensis* (BEUS). Quarry above Rokiczany Dół ravine; *Desquamatia (Seratrypa) oneidensis* Zone. Numbers refer to distance in mm from ventral apex

(BEUS 1965). The two forms are similar to each other in size, shape, outline, the ornamentation of shell and internal structure. Insignificant differences are expressed in a somewhat larger interarea of pedicle valve and stronger convexity of shell, occurring in our specimens.

Atrypa nalivkini LJASCH. from the Lower Frasnian of the Russian Platform (LJASCHENKO 1959: 138, pl. 24: 11–14) is on the whole similar to D. (S.) oneidensis from Dębnik, from which it differs, however, in a more rectilinear cardinal margin, lower and smaller interarea of pedicle valve and, usually, less convex brachial valve.

The species from Dębnik also displays a considerable external similarity to Atrypa (Desquamatia) prisca gladbachensis Jux from Unteren Plattenkalkes (Upper Givetian) in the Rhine Slate Mountains, Germany (Jux 1965). A more strongly incurved beak of pedicle valve, overlapping brachial valve, displayed by the specimens from Germany makes up a fundamental difference between the two forms.

Occurrence. — Desquamatia (Seratrypa) eneidensis is known from the lower part of Jefferson Formation (Hyrum Member), USA; in Poland, it has not been known so far. The age of the Jefferson Formation remains as yet debatable. According to BEUS (1965), the fauna from the Jefferson Formation comes partly from the Middle and partly from the Upper Devonian and corresponds to that of Allanaria allani fauna from Waterways Formation, Alberta, Canada. The age of Waterways Formation has recently been settled by UYENO (1974), on the

basis of conodonts, as the lowermost Upper Devonian (Spathognathodus insitus fauna and asymmetricus Zone).

The material described comes from a quarry above the Rokiczany Dół ravine, from the Main Carmelite quarry and from detached blocks in the upper part of the Rokiczany Dół ravine, where specimens occur in a large, monospecific accumulation (pl. 11: 7), forming an about 15 cm thick layer in the roof part of one bed (layer with sample K/RD-1 from the quarry



Diagram illustrating length (L) to width (B) shell ratio in Desquamatia (Seratrypa) oneidensis (BEUS)

above Rokiczany Dół ravine and layer with sample &K-2 from the Main Carmelite quarry) (D. (S.) oneidensis Zone; probably the conodont Upper hermanni-cristatus Zone).

Subgenus Desquamatia (Neatrypa) STRUVE, 1964 Desquamatia (Neatrypa) velikaja (NALIVKIN, 1940) (pl. 12: 1, 4-5)

1947. Atrypa velikaja Nalivkin; D. V. Nalivkin: 101, pl. 23: 3-4.
1955. Atrypa velikaja Nalivkin; M. F. Mikryukov: 238, pl. 4: 3.
1959. Atrypa velikaja Nalivkin; A. I. Ljaschenko: 137-138, pl. 25: 1-3.

*Material.* -4 complete or slightly damaged shells and 9 fragments. Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	W	Т	Nr/5
256 a	(23.1)	(22.8)	25.1	16.0	7
256 b	25.0	24.2	(27.0)	17.0	8
258 a	(26.0)	24.6	24.6	16.9	6.5
258 b	(29-7)	28.9	29.5	19.0	6
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*Description.* — Shell medium-sized to large for the genus, dorsibiconvex to planoconvex, oviform and tapering anteriorly, as wide as long, the widest at one-third to halfway the length of shell from beak; cardinal margin curved to subrectilinear, lateral margins rounded, anterior margin somewhat truncate; anterior commissure uniplicate.

Pedicle valve slightly convex in posterior part, laterally flat or even slightly concave; interarea small, low; beak erect to slightly incurved. Sulcus developed in the anterior half of shell, distinct, tapering anteriorly; a short tongue may be formed.

Brachial valve strongly convex, particularly in the posterior part; the strongest convexity occurs at about one-third to halfway the length of valve from beak; fold visible only in the anterior part of valve, slightly marked.

Costae of medium thickness, 6 to 8 per 5 mm, near the anterior margin of shell. Growth lines poorly preserved as a result of the exfoliation of valves.

Very slightly marked dental plates are present inside the pedicle valve; lateral cavities very small, almost invisible. In brachial valve, hinge plates massive, dental sockets crenulated.

*Remarks.* — The specimens described are very similar externally to those of *Atrypa velikaja* NALIVKIN from the pskovskiye and chudovskiye beds of the Main Devonian Field (NALIVKIN 1947: 101, pl. 22: 3–4) and the hvorostanskyi horizon of the Russian Platform (LJASCHENKO 1959: 137–138, pl. 25: 1–3). The two forms are similar in size, ornamentation and a characteristic, oviform outline of shell, as well as in the convexity of both valves.

Specimens from Dębnik are also similar to *Atrypa grosheimi* LJASCHENKO from the pestotsvetnyi horizon of the Russian Platform (LJASCHENKO 1959: 121, pl. 13: 1–3). The differences between Nalivkin's and Ljaschenko's species are insignificant and, therefore, they may be conspecific forms.

Occurrence. — This species is known from the Lower Frasnian of the area of the USSR, that is, the chudovskiye and pskovskiye beds of the Main Devonian Field, the hvorostanskyi and sargayevskyi horizons of the Russian Platform and Ural, ust'yaregskiye beds of Timan and kynovskiye beds of Bashkiria.

In Poland, it has not been recorded so far; the material described comes from detached blocks found on the tip west of a quarry situated above the Rokiczany Dół ravine and from the upper part of the Rokiczany Dół ravine. Stratigraphically, the beds containing D. (N.) velikaja are probably situated in the upper part of Cyrtospirifer bisellatus Zone (the conodont Lower asymmetricus Zone).

Genus Atryparia COPPER, 1966 Subgenus Atryparia (Costatrypa) COPPER, 1973 Atryparia (Costatrypa) cf. uralica (NALIVKIN, 1930) (pl. 13: 4, 6)

cf. 1947. Atrypa uralica Nalivkin; D. V. Nalivkin: 101, pl. 23: 1–2. 1959. Atrypa cx gr. uralica Nalivkin; A. J. Lyaschenko: 157, pl. 37: 3–4; pl. 42: 1b.

Material. -- One shell almost complete, 2 damaged and 6 fragments of shells and single valves.

Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	w	Т	Nr/5
261 a	13.5	13.2	(17.7)	8.2	6
261 c		14.5	(18.0)	8.3	7
261 b		(17.3)	22.2	11.6	6

*Description.* — Shell small for the genus, dorsibiconvex to planoconvex, transversally elliptical in outline, wider than long; cardinal margin long, straight, lateral margins rounded, anterior margin slightly truncate; anterior commissure uniplicate.

Pedicle valve slightly convex, sometimes, only in the posterior part, laterally flat to slightly concave. Sulcus marked in the anterior part of valve, sometimes deep, terminating in a tongue. Interareas poorly developed; beak inconspicuous, erect.

Brachial valve regularly convex, slightly inflated in the umbonal part. Fold poorly visible, developed only in the anterior part of valve.

Costae, 6 to 7 of them per 5 mm, near the anterior margin. Growth lines fairly closely spaced, at 1 to 2 mm intervals, on some specimens deflected in a frill-like manner (pl. 13: 6).

Interior insufficiently recognized due to the scarcity of material; dental plates not found.

*Remarks.* — The specimens under study are similar externally to *Atrypa uralica* NALIVKIN from the semilukskiye and buregskiye beds (Frasnian) of the USSR (NALIVKIN 1947: 101, pl. 23: 1-2), from which they differ in fact only in smaller shells. The specimens from the semilukskiye beds of the Russian Platform (LJASCHENKO 1959: 172, pl. 49: 3-6) differ from those from Dębnik in a more elongate shell and its rectangular or trapezoidal outline, while the specimens of *Atrypa* ex gr. *uralica* from the rudkinskyi horizon of the Russian Platform are externally identical with them.

Occurrence. — This species is widely distributed in the Lower and Middle Frasnian of the USSR; in Poland unknown so far. The specimens described, related to this species, occur at Dębnik in dark-gray, marly biopelmicrites of the upper part of Rokiczany Dół ravine (Calvinaria cracoviensis Zone; the conodont Middle and Upper asymmetricus Zones).

# Genus Iowatrypa COPPER, 1973 Iowatrypa markovskii (LJASCHENKO, 1959) (pl. 14: 1-5, fig. 20)

1959. Anatrypa timanica Макк. var. markovskii Ljaschenko; А. I. Ljaschenko: 141, pl. 26: 5-6. 1973. Anatrypa markovskii Ljaschenko; А. I. Ljaschenko: 80-82, pl. 23: 1-8; pl. 49: 5.

*Material.* - 8 complete or almost complete shells, 23 damaged and 40 fragments. Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	W	Т	T Lvv	Nr/5
262a	9.4	8.8	9.8	5.3	0.56	14
2626	10.7	9.9	11.3	6.5	0.61	15
234 n	10.7	10.0	10.2	5.3	0.50	15
234 a	15.6	14.4	(16.5)	10.0	0.64	10
234 c	16.2	15.0	16.7	11.2	0.69	14

Description. — Shell medium-sized for the genus, ventribiconvex, square in outline, as wide as long; cardinal margin straight, long, but somewhat shorther than the largest width of shell; anterolateral margins rounded or, more frequently, slightly angular; anterior commissure uniplicate.

Pedicle valve with a strongly convex umbonal part; sulcus very shallow, wide, marked in the anterior half of valve; a short tongue occurs in large specimens. In adult and gerontic individuals, interareas invisible, in juvenile specimens long, very low and with sharp lateral borders; beak very low, erect to strongly incurved (in gerontic specimens), overlapping the brachial valve.

Brachial valve posterolaterally flattened or slightly concave, with a poorly visible fold in the anterior part of valve; a shallow median groove, as a rule not reaching the anterior margin of valve (except for some specimens in which a slight flattening is marked in the median part of fold) is visible in the posterior part of valve.

No dental plates observed inside the pedicle valve; teeth strong, massive. In the posterior part, valve strongly thickened, in gerontic specimens reaching even 2.5 mm in thickness.

Massive hinge plates are present in brachial valve; a median, wide, triangular ridge occurring on bottom of valve (fig. 20).

Remarks. — In regard to external morphology and internal structure, the specimens described exactly correspond to the species Anatrypa markovskii (-= Iowatrypa markovskii) from



Fig. 20

Transverse serial sections of two shell *Iowatrypa markovskii*. Trench Z-JV; *Calvinaria albertensis* Zone. Numbers refer to distance in mm from ventral apex

the Frasnian of North Timan and the Volga-Ural area (LJASCHENKO 1973). Insignificant differences are sometimes marked in a more finely costate shell and considerably less frequent median groove on the brachial valve of the specimens under study.

A considerable similarity relates the specimens from Dębnik to those of *Grünewaldtia* americana STAINBROOK (== Iowatrypa americana) from Independence Shale of Iowa, USA. (STAINBROOK 1945: 52, pl. 5: 18-23, 27-28; fig. 1: 6). The differences between them are small and consist only in a more finely costate shell and more massive ventral umbo in the former species. The species *I. americana* and *I. markovskii* are probably closely related.

Occurrence. — I. markovskii is known from ust'yaregskiye Beds of North Timan and from the sargayevskyi horizon of the Volga-Ural area and western slopes of the Ural Mountains, USSR. In Poland, this species has never been recorded so far. The specimens under study come from Dębnik, where they occur in trenches Z-IV, Z-V, Z-VII, Żar-I and in a roadside outcrop of the Dębnik-Paczółtowice road on the western slope of the Żarnówka Hill (*Calvinaria albertensis* Zone; the conodont gigas and probably also Ancyrognathus triangularis Zones).

# Genus Spinatrypina RZONSNITSKAYA, 1964 Subgenus Spinatrypina (Spinatrypina) RZONSNITSKAYA, 1964 Spinatrypina (Spinatrypina) sp. (pl. 13: 1-3)

*Material.* — 5 complete and 14 slightly damaged shells and 30 fragments. Specimens poorly preserved, with exfoliated valves.

Dimensions (in mm):

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ZPAL Bp XXIII	Lvv	Ldv	W	Т	T Lvv	Nr/5
136e	(11.8)	(11.0)	12.4	6.2	(0.53)	4
137 h	14.6	13.7	15.4	7.6	0.52	4-4.5
136 h	15.6	14.4	(16.0)	8.0	0.51	3.5-4
136f	17.6	16.1	17.9	9.3	0.53	5-6
1360	17.8	J6·2	(18.3)	11.9	0.67	4
136c	17.9	16.6	(19.0)	7.8	0.44	4
250a	23.0	21.7	(22.4)	17.0	0.73	4-5

*Description.* — Shell medium-sized for the genus, dorsibiconvex or, very rarely, biconvex, transversally elliptical in outline, somewhat wider than long; cardinal margin subrectilinear or, more frequently, angularly curved; anterolateral margins rounded; anterior commissure uniplicate.

Pedicle valve with a wide and shallow sulcus marked only in the anterior part of shell of adult specimens. Interareas distinct, high, apsacline to anacline; beak suberect to erect. Del-thidial plates fused; pedicle foramen roundish.

Brachial valve transversally elliptical in outline; fold absent or very poorly developed. Costae tubular, on the average 4 to 5 per 5 mm near the anterior margin of adult specimens. Growth lamellae closely spaced, usually at 1-2 mm intervals.

Dental plates are marked by small, long lateral cavities. The interior of brachial valve typical for the genus.

Intraspecific variability. — The specimens display a considerable variability in some of their morphological characters such as, e.g., the convexity of shells. In addition to specimens marked by flat shells (convexity index = 0.44 to 0.48), there are specimens having very convex shells (0.71 to 0.73). In most shells, this index amounts, however, from 0.51 to 0.58.

The ornamentation of shells (density of costae) is also variable. The collection includes single specimens with finer (about 6 per 5 mm) and coarser (about 3.5 per 5 mm) costae, while the typical ones have about 4 to 5 costae per 5 mm.

*Remarks.* — The poor state of its preservation precludes a more accurate identification. Some elements of external morphology such as the convexity of shell, its dimensions and lengthto-width proportions are indicative of the subgenus *Spinatrypina (Spinatrypina)*.

The specimens under study are externally similar to those of *Spinatrypa* ex gr. *tubaecostata* PAECK. from the semilukskiye Beds of the central areas of the Russian Platform (LJASCHENKO 1959: 175, pl. 51: 3-4). This similarity is primarily expressed in a similar size, outline and ornamentation of shells. It is also in size and ornamentation that the specimens described are similar to *Spinatrypa communis* LJASCHENKO from the uppermost Givetian (rozayevskyi horizon) of the Russian Platform (LJASCHENKO 1969: 41-42, pl. 8: 4). In this case, a more accurate comparison is precluded by the fragmentary character of specimens both from Dębnik and those of the holotype of *S. communis*. It is likely that the specimens described represent a new species.

Occurrence. — Spinantrypina (Spinatrypina) sp. occurs in the upper part of the profile in a quarry above Rokiczany Dół ravine and of the Main Carmelite quarry, as well as in detached blocks found in the upper part of Rokiczany Dół ravine and on a tip west of the quarry above Rokiczany Dół ravine (*Spinatrypina (Spinatrypina)* sp. Zone; the conodont Lowermost *asymmetricus* Zone). Specimens from Rokiczany Dół, assigned by GÜRICH (1903: 147) to *Atrypa aspera* SCHLOTH. should perhaps be referred to this species.

# Genus Spinatrypa STAINBROOK, 1951 Subgenus Spinatrypa (Spinatrypa) STAINBROOK, 1951 Spinatrypu (Spinatrypa) semilukiana LJASCHENKO, 1951 (pl. 13: 5, 7-10; pl. 14: 6)

1903. Atrypa bifidaeformis TSCHERNYSCHEW; G. GÜRICH: 146-147, pl. 2: 14.
1930b. Atrypa bifidaeformis TSCHERNYSCHEW; D. V. NALIVKIN: 74, pl. 7: 1-2.
1947. Atrypa bifidaeformis TSCHERNYSCHEW; D. V. NALIVKIN: 101-102, pl. 23: 5-6.
1959. Spinatrypa semilukiana LJASCHENKO; A. I. LJASCHENKO: 174, pl. 51: 1-2; pl. 55: 1v; pl. 56: 1g.

*Material.* — 8 complete, 6 damaged shells and 20 fragments; in addition, 12 single pedicle and brachial valves with preserved elements of internal structure, etched from rocks by means of acetic acid.

Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	w	Т	Nr/10
138 d	(15.3)	14.2	16.3	7.4	6
2521	16.1	14.9	17.7	8.9	5
252g		18.8	21.9	10.5	4-5
252 d	(20.2)	(19-1)	23.9	13.9	5
252e	24·7	23.6	(28.0)	18.6	6
138 c	26.9	24.8	26.7	15.3	5

*Description.* — Shell medium-sized for the genus. dorsibiconvex, roundish to transversally elliptical in outline, slightly wider than long; cardinal margin straight, anterolateral margins rounded, anterior commissure uniplicate.

Pedicle valve with a shallow, wide sulcus visible, in adult specimens, in the anterior part of shell; interareas small, orthocline to anacline; beak erect to slightly incurved. Deltidial plates fused and, in the upper part, pierced by a roundish pedicle foramen.

Brachial valve with a low, gentle fold developed in the anterior part of shell in adult specimens.

Short dental plates, distinct in young specimens are developed inside the pedicle valve (pl. 13: 7); in later stages, dental plates may be embedded in the shell.

In brachial valve, hinge plates are short and dental sockets crenulate (pl. 13: 10).

Ornamentation in the form of distinct, thick, undulating ribs (5 to 6 per 10 mm near the anterior margin in adult specimens), which, at the intersection with growth lines, form nodular spine bases. Spines long, rarely preserved (pl. 13: 9).

**Remarks.** — This species was described by GÜRICH (1903) from Dębnik as Atrypa bifidaeformis TSCHERNYSCHEW. Recently, attention has been called by some authors (NEFEDOVA 1955 and LJASCHENKO 1959) to the fact that specimens of other species are assigned to Tschernyschew's species. They emphasize that the presence of a median groove on brachial and a distinctly defined fold on pedicle valve is an important diagnostic character of *S. bifidaeformis*. This is in conformity with the present writer's observations on type specimens made by him at the VSEGEI Museum in Leningrad. The specimens from Dębnik do not display these morphological elements, except for a median flattening in the umbonal part of brachial valve marked only in some of them.

The specimens under study display a considerable external similarity to Spinatrypa semilukiana LJASCHENKO from the semilukskiye Beds and rudkinskyi horizon (Middle Frasnian) of the Russian Platform (LJASCHENKO 1959: 174, p. 51: 1-2; pl. 55: 1v; pl. 56: 1g) and are identical with Atrypa bifidaeformis (sensu NALIVKIN, 1947) ( $\equiv$  Spinatrypa (S.) semilukiana) from the semilukskiye Beds (according to NALIVKIN — the Lower Frasnian) of Voronezh.

Occurrence. — Spinatrypa (S.) semilukiana is known from the Middle Frasnian of the Russian Platform and, recently, also from the Lower Frasnian of Poland. At Dębnik, this species occurs in the uppermost part of the profile of a quarry above Rokiczany Dół ravine and in Old Tumidalski's quarry; some specimens come from detached blocks found on a tip west of a quarry above Rokiczany Dół ravine (Cyrtospirifer bisellatus Zone; the conodont Lower asymmetricus Zone). Atrypa bifidaeformis (= S. (S.) semilukiana) was also cited by GÜRICH (1903) from the upper part of Rokiczany Dół ravine.

Suborder Dayioidea JOHNSON, 1974 Superfamily Dayiacea WAAGEN, 1883 Family Biernatellidae BALIŃSKI, 1977 Genus Biernatella BALIŃSKI, 1977 Biernatella polonica BALIŃSKI, 1977 (pl. 10: 4)

1977. Biernatella polonica gen. et sp. nov.; A. BALIŃSKI: 179-183, pl. 9: 1-4; pl. 10: 1-4; figs 2-4.

*Material.* -20 complete, 30 damaged shells and 80 fragments. Several single valves were separated by etching with acetic acid (conodont samples from trench Z-IV).

Description and remarks. - See BALIŃSKI 1977.

Occurrence. — This species has been known so far from Dębnik only, where it occurs in trenches Z-IV, Z-VII and Żar-I, in a roadside outcrop of the Dębnik-Paczółtowice road (*Calvinaria albertensis* Zone; the conodont gigas and, probably, *Ancyrognathus triangularis* Zones) and in trench Z-VI (*Caryorhynchus tumidus* Zone; the uppermost part of the conodont gigas Zone).

> Suborder Athyrididina BOUCOT, JOHNSON and STATON, 1964 Superfamily Athyridacea M'COY, 1844 Family Athyrididae M'COY, 1844 Subfamily Athyridinae M'COY, 1844 Genus Athyris M'COY, 1844 Athyris concentrica (v. BUCH, 1834) (pl. 12: 2-3)

1834. Terebratula concentrica; L. v. BUCH; 103.

1934. Athyris concentrica (BUCH); K. TORLEY: 119, pl. 8: 63-64.

1947. Athyris concentrica BUCH; D. V. NALIVKIN: 129, pl. 31: 16.

1951. Athyris concentrica BUCH; D. V. NALIVKIN: 25, pl. 6: 7.

1961. Athyris concentrica (BUCH); E. A. IVANOVA: 19-21, pl. 1: 1-2; fig. 4.

1966. Athyris concentrica (v. BUCH); G. BIERNAT: 143-144, pl. 31: 1-2.

*Material.* -5 complete or slightly damaged shells and 6 fragments. Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	w	Т	wsu	lt
233f	10.4	9.2	(12.3)	5.7	5.0	1.3
233 h	11.8	10.8	13.0	(6.7)	5.9	1.0
233 a	13.4	12.2	15-2	9.0	7.4	5.0
233 d	15.0	14.0	(18.0)	10.8	7-4	6.2

*Description.* — Shells medium-sized for the genus, biconvex, transversally elliptical to subround in outline, somewhat wider than long; cardinal margin curved; lateral margins rounded; anterior margin usually truncate; anterior commissure uniplicate.

Pedicle valve regularly convex, umbo massive, thick, beak pierced by a round, pedicle foramen; sulcus shallow, starting at one-quarter of the length of valve from beak; tongue long, rounded.

Brachial valve transversally elliptical in outline, with a somewhat protruded umbonal part; fold developed in the anterior half of valve, low, except for adult individuals in which it is high close to the anterior margin.

Due to the exfoliation of the valves, ornamentation poorly preserved, only concentric growth lines, 12 to 16 of them per 5 mm, are visible.

Interior not studied.

*Remarks.* — In their size, general outline, shape of shells and development of the ventral sulcus and dorsal fold, the specimens under study are very similar to *Athyris concentrica* (BUCH), in particular to its specimens from the yeletskiye Beds (Famennian) and the Koltubansk limestones (Frasnian) of Ural (NALIVKIN 1947, 1951). A considerable external similarity also relates them to *A. concentrica* from the Middle Devonian of Skały, Holy Cross Mts., Poland (BIER-NAT 1966) and from the Upper Givetian of Bilveringsen near Iserlohn, W. Germany (TORLEY, 1934). The specimens from Dębnik differ from them only in a somewhat less closely spaced growth lines.

Specimens of *A. intermedia* NALIVKIN from the Upper Famennian of Afghanistan (BRICE 1970: 225–226, pl. 14: 22), externally similar to the species from Dębnik, differ from them in an insignificantly lower fold on brachial valve, more massive ventral umbo and the presence of a median costa on the bottom of the sulcus of pedicle valve. *A. vittata* from Hamilton Group, Ohio, USA (HALL and CLARKE 1894, pl. 45: 1–5) is externally similar to *A. concentrica*, but the American specimens have a somewhat more rectilinear cardinal margin and a slightly deeper sulcus on pedicle valve.

Occurrence. — Frequent in the Middle and Upper Devonian of Eurasia.

The specimens under study come from trenches Z-VII (*Calvinaria albertensis* Zone; the conodont *gigas* Zone), Z-VI and Z-XI (*Caryorhynchus tumidus* Zone; the upper part of the conodont *gigas* Zone) and from quarry Z-II (*Leiorhynchus leavis* Zone; the lower part of the conodont *triangularis* Zone).

Suborder Spiriferidina WAAGEN, 1883 Superfamily Spiriferacea KING, 1846 Family Delthyrididae WAAGEN, 1883 Subfamily Acrospiriferinae TERMIER and TERMIER, 1949 Genus Eleutherokomma CRICKMAY, 1950

1950. Eleutherokomma CRICKMAY, n. gen.; C. H. CRICKMAY; 219–220. 1970. Eleutherokomma CRICKMAY; D. BRICE: 101.

Remarks. — This genus was erected by CRICKMAY (1950) for several species on the whole similar to the representatives of the genus *Mucrospirifer*, but differing in the character of the micro-ornamentation of shells. Several species of this genus are known from the uppermost Givetian and Lower Frasnian of North America and Afghanistan.

Similar species were described in the USSR under the generic names Lamellispirifer (= Mucrospirifer) or Mucrospirifer. Reaching the conclusion that the Upper Devonian forms from the USSR differ from the representatives of the Middle Devonian Mucrospirifer, LJA-SCHENKO (1970) erected a new genus which he called Dmitrispirifer. Comparing the genera Eleutherokomma and Dmitrispirifer, one can notice that they are marked by an identical

internal structure, as well as shape, size and macro- and micro-ornamentation of their shells. The lack of spiny processes (mucrones) of the cardinal margin, a characteristic feature of *Eleutherokomma*, observed in *D. nalivkini* LJASCHENKO (a type species of the genus) and in *D. aliger* LJASCHENKO from the Lower Frasnian of the USSR (LJASCHENKO, 1973: 126–129, pl. 43: 1–5) may result from the poor state of preservation. The genera *Eleutherokomma* and *Dmitrispirifer* seem, therefore, to be synonyms, but any ultimate elucidation of this problem will only be possible after an accurate examining of type specimens of *E. hamiltoni* and *D. nalivkini*.

Eleutherokomma zarecznyi (GÜRICH, 1903) (pl. 15: 1-10)

Neotype: ZPAL Bp XXIII/202e; illustrated in plate 15: 2.

1903. Spirifer Zaręcznyi. Var. angustior.; G. GÜRICH: 139, text-fig. 1. 1903. Spirifer Zaręcznyi. Var. latior.; ibid., 139–140, pl. 1: 15, text-fig. 2.

*Material.* — 9 complete or almost complete and 14 damaged shells, as well as 50 fragments of shells and valves externally preserved fairly well, but mostly with exfoliated valves. Several pedicle and brachial valves with preserved elements of internal structure were obtained from limestones dissolved in acetic acid (conodont samples) from Old Tumidalski's quarry (SŁT-1 and SŁT-2).

Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	w	T
205 a	13.0	12.0	27.3	11.4
202 e	16.3	15.0	(28.8)	13.4
202 б	16.3	14.7		14-3
202 a	18.2	16.2		15.6

*Description.* — Shell medium-sized for the genus, biconvex, pentagonal to transversally elliptical in outline; cardinal margin very long, ears extending to form long spines, lateral margins slightly curved, anterior margin truncate, anterior commissure uniplicate.

Pedicle valve regularly convex; interareas concave, anacline; beak incurved; sulcus deep, distinctly limited by thicker plicae, smooth, marked even in the umbonal part.

Brachial valve semicircular to triangular in outline, more strongly convex in the posterior part; fold distinctly limited by two deeper grooves, flat or with a median, gentle groove.

Ornamentation of shell composed of 8 to 15 plicae on each lateral side of valve. Growth lines forming projecting lamellae. Micro-ornamentation composed of very fine, radial striae (about 16 per 1 mm) and concentric growth microlines forming together a characteristic reticular pattern (pl. 15: 9).

Long, massive, diverging dental plates occur in pedicle valve; a very low median ridge (pl. 15: 5) preserved in some specimens. No delthyrial plate observed; an umbonal callus and ridges on umbonal, internal parts of dental plates are only visible (pl. 15: 5, 7).

A striated cardinal process occurs in brachial valve; hinge plates fairly long, subrectangular, slightly extending anteriorly (pl. 15: 8); crural plates and median septum lacking.

Intraspecific variability. — Two varieties of the species Spirifer Zaręczny GÜRICH were erected by GÜRICH: one of them, S. Zaręczny var. angustior GÜRICH for elongate specimens, collected in the Old Tumidalski's quarry and S. Zaręcznyi var. latior GÜRICH for strongly extended, lenticular specimens, with thicker plicae, wider sulcus and higher interarea, found in Rokiczany Dół ravine. The present collection, coming mostly from a tip west of the quarry above Rokiczany Dół ravine, includes shells of the angustior and latior types, as well as of the transitional type both in regard to the shape and ornamentation of their shells. Noteworthy is the fact that shells of the two varieties occur sometimes together. No correlation has been observed between the shape of shell and its ornamentation and the height of interarea of pedicle valve. Thus, now there is no foundation for maintaining the varieties, separated by GÜRICH. The two forms should be recognized as one species, but marked by a considerable intraspecific variability. A similar variability (probably polymorphism) has frequently been observed in other representatives of this group of spiriferoids (e.g., BIERNAT 1954: 522; VAN-DERCAMMEN 1959; STRUVE 1963: 481; ROBERTS 1971: 190–196).

Remarks. — E. zarecznyi displays a considerable similarity in external morphology (ornamentation and micro-ornamentation, convexity of valves, long spinal processes of cardinal margin) and internal structure (median ridge in pedicle valve) to species of the genus *Eleutherokomma* described by CRICKMAY (1950, 1963, 1967) from the Middle and Upper Devonian of Alberta, Canada, in particular to *E. aechmophora* CRICKMAY (1967: 16, pl. 3: 14-15; pl. 11: 9-13), whose shells are similar in shape, proportions and ornamentation and differ in a slightly higher and flatter area of pedicle valve and smaller dimensions.

*E. zarecznyi* is externally similar to some species of the genus *Alatiformia* STRUVE, in particular to *A.*? *dorsocava* (SPRIESTERBACH) from "*Cultrijugatus*-Zone", Wildenkuhlen near Kierspe, W. Sauerland, W. Germany (STRUVE 1964: 339, text-figs 8–12). The specimens from Wildenkuhlen have, however, a catacline interarea of pedicle valve and a strongly developed median ridge on fold.

*E. zarecznyi* (GÜRICH) is similar in the shape and ornamentation of shell to *Chimaerothyris* hotzi PAULUS, STRUVE and WOLFRAT (1963: 465-486, pl. 63-65; pl. 66: 18-23; text-figs 2-15) from the Eifelian of the Eifel area. The specimens from Eifel are, however, mostly larger, with a flatter interarea of pedicle valve and elongate cardinal extremities. Other details of internal structure and external morphology of the representatives of the genus *Chimaerothyris* are on the whole identical with those of the specimens under study and representatives of *Eleutherokomma*.

Spirifer mesacostalis Hall from Chemung Group, New York, USA (HALL and CLARKE, 1894, pl. 34: 32-34) differs from *E. zarecznyi* primarily in the presence of a distinct plica on the bottom of sulcus; a groove running over the entire length of fold and a median septum in pedicle valve. Also considerably related to *E. zarecznyi* is *Spirifer mucronatus* var. *posterus* HALL also from Chemung Group (HALL and CLARKE 1894: 361, pl. 34: 27-31). Differences in the outer appearance of these two forms are insignificant and are mostly expressed in a considerably lower interarea of pedicle valve and smaller shells of the American species.

Occurrence. — E. zarecznyi has so far been known only from the environs of Dębnik. GÜRICH (1903) cites some specimens of this species from the Old Tumidalski's quarry and from the upper part of Rokiczany Dół ravine. JAROSZ (1926) includes Sp. Zarecznyi var. angustior and var. latior in the list of fauna from the upper part of Rokiczany Dół ravine, together with Leiorhynchus cracoviensis (= Calvinaria cracoviensis) (the species cited in this list come, however, from different geological horizons!). The specimens here described were collected in the Old Tumidalski's quarry and on a tip west of the quarry above Rokiczany Dół ravine (Cyrtospirifer bisellatus Zone; the conodont Lower asymmetricus Zone).

> Family Costispiriferidae TERMIER and TERMIER, 1949 Genus Theodossia NALIVKIN, 1925 Theodossia of. hungerfordi (HALL, 1894) (pl. 18: 5-8)

cf. 1894. Spirifer hungerfordi n. sp.; J. HALL and J. H. CLARKE: pl. 37: 26-30.

*Material.* — 7 fragmentary shells and single valves. Dimensions (in mm): Lvv = 9.5; Ldv = 7.6; W = 11.0; T = about 5.9 (young specimen). *Description.* — Shell to 28 mm in width, ventribiconvex, heart-shaped in outline; the widest

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at midlength of shell; cardinal margin straight, constituting two-thirds of the width of shell; anterolateral margins rounded, anterior commissure uniplicate. Pedicle valve with a high, somewhat concave interarea; beak erect to incurved; sulcus very shallow, indistinctly separated laterally and starting in the umbonal region. Brachial valve transversally elliptical in outline; fold very low, indistinct. Fold, sulcus and lateral parts of valves covered with straight very fine costae (9 to 20 per 5 mm near anterior margin); micro-ornamentation preserved in the form of closely-spaced, concentric growth lines.

Long dental plates occur in pedicle valve; the interior of brachial valve was not examined.

*Remarks.* — The specimens described have a very characteristic, fine ornamentation, which pronouncedly differs them from most species of the genus *Theodossia* NALIVKIN. In the density of costae they are most closely related to the specimens of *Th. superba* (EICHWALD) from the Middle Devonian of Ural and Central Asia (NALIVKIN 1947: 119, pl. 30: 3-4), but the latter's shells are considerably larger (to 60 mm in width) and have a smaller interarea of pedicle valve and flat costae.

The specimens from Dçbnik are externally most closely related to *Th. hungerfordi* (HALL) from the Upper Devonian of Rockford, Iowa, USA (HALL and CLARKE 1894, pl. 37: 26–30), from which they differ, however, in somewhat thinner costae (about 8 per 5 mm).

It is likely that the specimens described belong to a new species, but, due to the very fragmentary collection, it is impossible to study this form accurately.

Occurrence. — Th. hungerfordi is known from the Upper Devonian of Iowa, USA. All the specimens now studied come from gray, spotty intrasparites of trench Z-VII (Calvinaria albertensis Zone; the conodont gigas Zone).

Family Cyrtospiriferidae TERMIER and TERMIER, 1949 Genus Cyrtospirifer NALIVKIN, 1919 Cyrtospirifer bisellatus (GÜRICH, 1903) (pl. 16: 1-6; fig. 21)

1903. Spirifer Archiaci MURCH. var. biselluta GÜR.; G. GÜRICH: 141–142, pl. 1: 1-2. Neotype: ZPAL Bp XXIII/194c; illustrated on pl. 16: 2.

*Material.* — 8 complete shells, 9 fragments and 40 single valves, all of them fairly well preserved except for mostly exfoliated valves.

Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	W	Т	wfo
194 d	26.0	22.2	33.5	20.7	13.5
194 c	26.0	23.6	38.6	22.0	15.0
194 b	30.0	26.2	37.0	23.7	16.2
196a	35.0	30.0	44.3	26.3	21.4
194 a	34.0	28.5	46.5	27.1	19.0

*Description.* — Shell large, medium-sized for the genus, biconvex to ventribiconvex, wider than long, with greatest width at the hinge line, pentagonal to transversally elliptical in outline; cardinal margin long, straight; lateral margins rounded; anterior margin truncate; anterior commissure uniplicate.

Pedicle valve with a distinct sulcus starting at the umbonal part; interareas wide, concave, anacline. Delthyrium fairly narrow, covered in upper three-quarters by a convex delthyrial plate.

Brachial valve trapezoidal to semicircular in outline, with a strongly marked, convex umbo and fairly high, distinctly separated fold, divided by a median groove.

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Shell ornamented by fine costae (9 to 12 per 10 mm near anterior margin), single on lateral parts of valves and bifurcating on sulcus and fold; 20 to 40 costae occur on each lateral side of valve. Sulcus distinct, wide, deep, gently concave. Fold distinctly separated laterally by deeper and wider intercostal grooves, fairly high, strongly extending anteriorly and divided into two folds by a longitudinal median groove. Interareas of pedicle valve covered with fine, high, vertical striae (6 per 1 mm), which are transversally wrinkled. Micro-ornamentation of shell not preserved.

Long dental plates, diverging in the umbonal part and nearly parallel in the anterior part occur in pedicle valve (fig. 21). A longitudinally oval muscle field with a characteristic



Fig. 21

Transverse serial sections of Cyrtospirifer bisellatus (GÜRICH). Tip west of the quarry above Rokiczany Dół ravine; Cyrtospirifer bisellatus Zone. Numbers refer to distance in mm from ventral apex

sculpture (pl. 16: 4) is visible on internal mould between dental plates end somewhat anteriorly from them.

A cardinal process and hinge plates occur in brachial valve. Impressions of muscle scars are preserved on internal mould (pl. 16: 6).

*Remarks.* — Cyrtospirifer biseltatus (GÜRICH) is a characteristic form differing from many other representatives of this genus in the presence of a distinct, longitudinal groove on the fold of brachial valve. A similar groove occurs in *Spirifer disjunctus* var. *sulcifer* HALL (HALL and CLARKE 1894: 361, pl. 30: 16) from Chemung Group near Olean, New York, USA, which has however, thicker and sharper costae. A poor illustration of this species precludes accurate comparison of the two forms.

C. bisellatus is very similar to C. bisinus (LE HON) from the Middle Frasnian of Belgium (VANDERCAMMEN 1959: 107-114, pl. 4: 7-18), whose specimens are, however, smaller, wider (mucronate), with more rectilinear lateral margins, low and strongly concave interarea of pedicle valve and less convex umbo of brachial valve. It should be emphasized that, despite these differences, the two forms are closely related.

Occurrence. — This species was described by GÜRICH (1903: 141) from the Old Tumidalski's quarry and mentioned by JAROSZ (1926: 143–144, pl. 2: 8a) from the upper part of a Żbik ravine. As shown, however, by the present writer, this species occurs only north of Dębnik, since the specimens were collected from a tip west of the quarry above Rokiczany Dół ravine, from the uppermost layers of the quarry above Rokiczany Dół ravine, from the upper part of Rokiczany Dół ravine and from the Old Tumidalski's quarry (*Cyrtospirifer bisellatus* Zone; the conodont Lower and a top part of Lowermost asymmetricus Zones). Specimens from the upper part of a Żbik ravine, assigned by JAROSZ to this same species, belong in fact to a quite different, Lower Famennian, species, closely related to *C. minor* (GÜRICH).

## Cyrtospirifer minor (GÜRICH, 1903) (pl. 17: 1-11)

1903. Spirifer Archiaci VERN. var. minor GÜRICH; G. GÜRICH; 142–143, pl. 1: 4-7.
1918. Spirifer Archiaci VERN. var. minor GÜR.; J. JAROSZ; pl. 8: 23.
Lectotype: GÜRICH 1903, pl. 1: 4; a specimen deposited in the collections of the University Museum in Wrocław.

*Material.* — 35 complete, 60 slightly damaged shells and 270 single valves and fragmentary shells and valves, all of them fairly well preserved externally, frequently with exfoliated valves. Well preserved interiors, visible in silicified specimens from quarry Z-II, were separated by means of acetic acid.

Dimensions (in mm):

	100	-	A 100 100 100 100		1.11/11/11/12	
ZPAL Bp XXIII	Lvv	Ldv	W	Т	wfo	ΗArvv
2111	6.2	5.0	(7.2)	3.6	2.9	1.3
217h	8.0	7.3	11.6	6.7	(4.8)	2.8
2171	10.6	9.0	13.7	7.5	6.2	2.2
211c	11.2	9.3	14.3	9.2	5.8	4.7
211 a	15.6	13.8	19.4	13.2	(8.6)	5.0
232 b	16.8	15.9	23.7	14.6	10.7	6.0
232a	18.0	17.0	23.8	17.8	14.0	5.9

*Description.* — Shell small to medium-sized for the genus, ventribiconvex, transversally elliptical to pentagonal in outline, wider than long; cardinal margin straight, long; ears, if preserved, small; lateral margins rounded, anterior margin truncate or angularly indented, anterior commissure uniplicate.

Pedicle valve with a deep sulcus, not very distinctly separated laterally and appearing in the umbonal part; interareas concave; beak erect to incurved.

Brachial valve trapezoidal to transversally elliptical in outline; fold low, wide, distinctly separated laterally, convex, flat or with a shallow median groove.

Shell covered with costae, single on lateral parts and bifurcating on sulcus and fold. The number of costae on each lateral part of valve fluctuates between 17 and 26, on sulcus and fold between 11 and 19, depending on the size of valve. A micro-ornamentation, consisting of distinct, radial, parallel striae, about 18 of them per 1 mm (pl. 17: 11) is visible on better preserved, not exfoliated valves.

Strong, long, divergent to subparallel dental plates occur inside the pedicle valve. In the apical part of delthyrium, a triangular, nearly flat delthyrial plate covers delthyrium up to its midheight (pl. 17: 8).

A striated cardinal process occurs in brachial valve; hinge plates rectangular, slightly extending anteriorly; crura long, straight (pl. 17: 9-10).

Intraspecific variability. — The species under study displays a considerable variability within limits of *triangularis* Zone and, therefore, specimens coming from various outcrops and horizons considerably differ from each other. Specimens from older horizons (the lower-most part of *triangularis* Zone, trenches Z-XIV and Z-XVI) are large, reaching to 20 mm or sometimes, even more in length (fig. 22A). Specimens younger stratigraphically (most of quarry Z-II) are small, usually 10 mm long, only very rarely reaching 15 mm (fig. 22B). In the uppermost layers of quarry Z-II and in trenches Z-VIII and Z-IX (the lowermost Famennian), the dimensions of this species increase once again, frequently amounting to more than 20 mm in length (fig. 22C); the specimens are very similar to those from trenches Z-XIV and Z-XVI.

Yet larger dimensions are observed in higher beds belonging to the Lower Famennian (trenches Z-bi-I, Z-bi-IV). Shells from these layers reach sometimes 30 mm in length <sup>5</sup>

(fig. 22D) and more frequently display a well developed median groove on fold of brachial valve. Despite a close similarity to and relationship with the Frasnian specimens of C. *minor*, they seem to represent a different species.

The specimens under study also display a considerable intrapopulational variability. Such characters as the size of shell, size and curvature of ventral interarea, height of fold and presence



Fig. 22

Diagram illustrating time changes of shell size in Cyrtospirifer minor (A, B) and its Famennian descendant C. aff. minor (C, D). L — lenght of the shell, n — numbers of specimens; black triangle indicate the average quantity

or absence of median groove on it, and depth of sulcus are subject to considerable variability, with a simultaneous occurrence of transitional forms.

*Remarks.* — Cyrtospirifer minor (GÜRICH) differs from many species of the genus Cyrtospirifer primarily in its relatively small dimensions, a transversally elliptical outline of shell and a high, concave interarea of pedicle valve.

From *Spirifer archiaci* MURCHISON (1840: 250, pl. 2: 4) it differs in a wider shell and considerably larger interarea of pedicle valve. In addition, a longitudinal groove on fold, very distinct in Murchison's species, occurs here rather sporadically.

Cyrtospirifer minor is most closely related to C. asiaticus BRICE from the Lower Famennian of Afghanistan (BRICE 1970: 123–128, pl. 7: 11, pl. 8: 5–7; text-fig. 25) and to C. archiaci (= C. asiaticus according to BRICE 1970) from the zadoniskiye Beds (Lower Famennian) of the USSR (NALIVKIN 1947: 114, pl. 28: 1–3). These species are similar to each other in the shape, size, proportions of shell and character of ornamentation (the size of shell of C. asiaticus corresponds to that of largest specimens of C. minor). The differences between them are not very large (maybe only of a subspecific rank): the shells of C. minor are thicker and have a lower, more concave interarea of pedicle valve.

Specimens of *C. archiaci* (MURCH.) from the Karniowice 3 boring (about 6 km ESE of Dębnik) (Żakowa 1965) are on the whole very similar to those of *C. minor*, but they undoubtedly represent a separate species, the same as specimens from the Lower Famennian of Dębnik (= C. aff. minor).

Occurrence. — C. minor has so far been known only from the environs of Dębnik, Poland. GÜRICH (1903: 142) cites this species from the Żbik ravine and from the Żarnówczany Dół and Łączany Dół ravines. JAROSZ (1926: 144–145, pl. 1: 12a) cites it, in addition, from an outcrop at the Dębnik-Paczółtowice road, a dozen or so meters NW of Łączany Dół ravine (together with *Leiorhynchus laevis*). The present observations have not confirmed the autochtonous occurrence of C. minor in Żarnówczany Dół and Łączany Dół ravines or in the field road mentioned above.

The present material comes from numerous trenches and outcrops in the upper part of the Żbik ravine, where it occurs in dark-gray, marly micrites and biopelmicrites in trenches Z-VI (*Caryorhynchus tumidus* Zone; the uppermost part of the conodont gigas Zone), Z-II, Z-III, Z-XIV, Z-XV and Z-XVI (*Leiorhynchus laevis* Zone; the lower part of the conodont triangularis Zone). A related species occurs in the Lower Famennian (trenches Z-VIII, Z-IX, Z-bi-II, Z-bi-IV) from which it was erroneously described by JAROSZ (1926: 144, pl. 1: 17) as Spirifer Archiaci var. bisellata GÜR.

# Genus Tenticospirifer TIEN, 1938

Tenticospirifer cyrtiniformis (HALL and WHITFIELD, 1875)

(pl. 18: 1-2)

1894. Cyrtia cyrtiniformis Hall and WHITFIELD; J. HALL and J. M. CLARKE: 42, pl. 25: 26-32.

1955. Cyrtospirifer tenticulum (VERNEUIL); T. I. FEDOROVA: 37-38, pl. 4: 5.

1956. Tenticospirifer cyrtiniformis (Hall and WHITFIELD); P. S. WARREN and C. R. STELCK: pl. 20: 10-13.

1962. "Tenticospirifer" cyrtinaformis (HALL and WHITFIELD); D. J. MCLAREN, A. W. NORRIS and D. C. GREGOR: pl. 13: 11-14.

*Material.* — 2 complete and 2 almost complete shells and 20 fragments of pedicle and brachial valves, mostly poorly preserved, fragmentary and with exfoliated valves.

Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	W	т	wfo	HArvv
228 b	11.2	10.4	16.6	9.8	5.5	7.5
228 a	21.0	15.4	23.4	18.0	10.4	14.7

Description. — Shell medium-sized for the genus, to 4.5 cm in width, ventribiconvex, pyramidal, costate; cardinal margin long, straight; lateral margins rounded, anterior margin slightly truncate; anterior commissure uniplicate.

Pedicle valve pyramidal; interarea flat, catacline to nearly procline. Delthyrium narrow, delthyrial plate concave, occurring in apical part. Sulcus distinct, fairly deep, marked from the umbonal part.

Brachial valve semicircular in outline, very slightly convex; fold low, flat, marked even in the umbonal part.

Sulcus, fold and lateral parts of valves covered with fine costae (6 to 8 of them per 5 mm near anterior margin).

Dental plates occur in pedicle and a striated cardinal process and hinge plates in brachial valve; median septum and crural plates lacking.

Remarks. — The specimens under study display a considerable similarity in the shape of shell, its proportions and costation and in the development of sulcus, fold and interarea of pedicle valve to Cyrtia cyrtiniformis HALL and WHITFIELD from the Upper Devonian of Rockford, Iowa, USA (HALL and CLARKE 1894: 25, pl. 25: 26–32) and to "Tenticospirifer" cyrtiniformis (HALL and WHITFIELD) from the lower part of Mount Hawk Formation (Frasnian), Alberta Rocky Mountains, Canada (McLAREN, NORRIS and GREGOR 1962, pl. 13: 11–14). T. cyrtiniformis from the upper part of Mount Hawk Formation (Upper Frasnian) of Western Canada, illustrated by WARREN and STELCK (1956, pl. 20: 10–13) has a more convex interarea of pedicle valve, which differs it from other representatives of this species. It is difficult to state for certain if this concavity of interarea is a permanent character or one resulting from the considerable intraspecific variability.

T. cyrtiniformis from Dębnik and Cyrtospirifer conoideus (ROEMER) from the Frasnian of Europe are marked by a similarly low fold on brachial valve and ornamentation in the form of fine costae. ROEMER's species differs, however, in a smaller and more concave interarea of pedicle valve, which is procline to anacline (according to VANDERCAMMEN 1959: 151-153).

Specimens from Dębnik are also similar in the character of ornamentation and shape of shells to *Tenticospirifer komi* LJASCHENKO from the middle part of the Frasnian of the Russian Platform (LJASCHENKO 1959: 187–188, pl. 62: 7–13). The Russian specimens have, however, a much smaller and more convex interarea of pedicle valve and a deeper brachial valve.

As compared with *T. tenticulum* de VERN. from *Yunnanella* Beds (Upper Devonian) of Hunan, China (TIFN 1938: 117–121, pl. 17: 4–7; pl. 18: 1–2), the specimens from Dębnik are primarily more finely costate and have a more strongly flattened interarea of pedicle valve. On the other hand, specimens of *T. tenticulum* from the Frasnian of the environs of Saratov (FEDOROVA 1955: 37–38, pl. 4: 5), accurately corresponding to *T. cyrtiniformis* are very similar to the specimens from Dębnik and probably belong to the same species.

Occurrence. — T. cyrtiniformis has so far been known from the Upper Devonian (Frasnian) of the USA and Canada; specimens of this species were probably described also from the environs of Saratov, USSR under the name T. tenticulum (FEDOROVA 1955).

In Poland, this species has not been recorded so far. Now, the specimens under study come from the environs of Debnik, where they occur in gray, marly intrasparites and micrites in trenches Z-V, Z-VII, in an outcrop at the Debnik-Paczółtowice field road on the northern slope of Żarnówka Hill (*Calvinaric albertensis* Zone; the conodont gigas and, probably, Ancyrognathus triangularis Zone), as well as in dark-gray, marly biopelmicrites of trench Z-VI and Z-XI (*Caryorhynchus tunidus* Zone; the uppermost part of the conodont gigas Zone).

Family uncertain

Genus Thomasaria STAINBROOK, 1945

1964. Pyramidalia NALIVKIN; J. DROT: 78.

<sup>1945.</sup> Thomasaria Stainbrook, n. gen.; M. A. Stainbrook: 57.

<sup>1947.</sup> Pyramidalia gen. nov.; D. V. NALIVKIN: 124.
*Remarks.* — The genus *Thomasaria* STAINBROOK has hitherto been known only from North America and represented by two species only: *Th. altumbona* STAINBROOK from Independence shale, Iowa, USA and *Cyrtia rockymontana* WARREN from Minnewanka Group, Crowsnest, Canada. The two species are very similar and, according to CRICKMAY (1967) probably conspecific.

Similar specimens have frequently been described in Europe, Asia and North Africa as *Pyramidalia simplex* (PHILLIPS). According to PITRAT (1965), the genus *Pyramidalia* NALIVKIN, 1947 is probably a synonym of *Cyrtinella* FREDERIKS, 1916. However, the internal structure of the type species *Spirifera simplex* PHILIPPS is different than that of the representatives of the superfamily Suessiacea (primarily, the lack of median septum in pedicle valve). On the other hand, the internal structure of *Spirifera simplex* is identical with that of the genus *Thomasaria* (cf. STAINBROOK 1945; NALIVKIN 1947; VANDERCAMMEN 1957). Externally, the representatives of the genera *Thomasaria* and *Pyramidalia* are so similar to each other that it is even difficult to find any characters differing particular species.

Consequently, the genera *Thomasaria* and *Pyramidalia* should be considered as synonyms, with priority accorded to STAINBROOK'S genus and *Th. altumbona* remaining as a type species. If, however, this species is a synonym of any of the two remaining species (*Cyrtia rockymontana* or *Spirifera simplex*), then the older synonym should be a type species.

Thomasaria simplex (PHILLIPS, 1841) (pl. 18: 3-4; fig. 23)

1841. Spirifera simplex; J. PHILLIPS: 71, pl. 29: 124; pl. 60: 124.

1853. Spirifer pyramidalis m.; J. SCHNUR: 207-208, pl. 36: 1.

1903. Spirifer simplex PHILL; G. GÜRICH: 146.

1908. Spirifer simplex PHILLIPS; K. TORLEY: 16, pl. 3: 9-10.

1947. Pyramidalia simplex Phillips; D. V. Nalivkin: 124-125, pl. 31: 4.

1957b. Plectospirifer simplex (J. PHILLIPS); A. VANDERCAMMEN: 12-21, pl. 2: 3-17; fig. 15-17.

1964. Pyramidalia simplex (PHILLIPS); J. DROT: 78-79, pl. 8: 4.

cf. 1966. Pyramidalia cf. simplex (PHILLIPS); G. BIERNAT: 136, pl. 27: 1.

*Material.* -2 complete shells, one damaged, and 2 specimens of pedicle valve.

Dimensions (in mm): Lvv = 12.4; Ldv = 10.9; W = 14.6; T = 10.7.

*Description.* — Shell medium-sized for the genus, ventribiconvex, transversally oval to trapezoidal in outline. Cardinal margin straight, lateral margins rounded, anterior margin truncate, anterior commissure uniplicate.

Pedicle valve high, pyramidal; area very high, almost flat; delthyrium high, narrow, covered by deltidum at two-thirds of the distance from apex. Sulcus distinct, starting in the umbonal region.

Brachial valve slightly convex; fold very small, visible only near the anterior margin.

Due to exfoliation, ornamentation not preserved, except for very slight plicae near the anterolateral margins of valves.

Strong, fairly long ventrally divergent dental plates present in pedicle valve (fig. 23). Interior of brachial valve not studied.

*Remarks.* — The specimens under study are very similar to *Spirifera simplex* PHILLIPS from the Middle Devonian of England (PHILLIPS 1841), from which they differ only in somewhat smaller dimensions; the specimens illustrated by PHILLIPS display, however, a considerable variability (including that in the size of shell) frequently observed in the species.

The specimens from Dębnik are identical with those of *Pyramidalia simplex* from the Frasnian of the Alay Ridge, USSR (NALIVKIN 1947: 124–125, pl. 31: 4) and from the Middle Devonian of Morocco (DROT 1964: 78–79, pl. 8: 4). In their external morphology and internal structure, they are also very similar to *Plectospirifer simplex* (PHILLIPS) from the Middle and

Upper Devonian (Couvinian — Frasnian) of Belgium (VANDERCAMMEN 1957b: 12–21, pl. 2: 3–17; figs 6–10). Some small differences are only observed in slightly more distinct radial plicae occurring in some specimens from Belgium; the degree of the distinctness of these plicae considerably varies, however, in the process of ontogenic development (VANDERCAMMEN 1957b: 16–17).

Specimens of *Thomasaria simplex* from the territories of Europe, Asia and North Africa correspond to those of *Thomasaria rockymontana* (Warren) and *Th. altumbona* STAINBROOK



Fig. 23

Transverse serial sections of brachial valve of *Thomasaria simplex* (PHILLIPS). Rokiczany Dól ravine; *Calvinaria craco*viensis Zone. Numbers refer to distance in mm from ventral apex

from the Frasnian of North America. Externally, the three species are very similar and it is even difficult to indicate their distinguishing characters. It is very likely that they are synonyms but this problem may be solved only after an accurate study of their types.

Occurrence. — Th. simplex (PHILLIPS) is a widely distributed species, occurring in the Middle and Upper Devonian of England, Belgium and Germany, in the Middle Devonian of Morocco and in the Upper Devonian (Frasnian) of the USSR. In Poland, it is cited from the Lower Frasnian of the environs of Dębnik (Rokiczany Dół ravine) (GÜRICH 1903: 146). Similar specimens were described as *Pyramidalia* cf. simplex from the Middle Devonian of Miłoszów in the Holy Cross Mts. (BIERNAT 1966: 136, pl. 27: 1).

The collection under study comes from dark-gray, marly biopelmicrites of the upper part of Rokiczany Dól ravine (*Calvinaria cracoviensis* Zone; the conodont Middle and Upper *asymmetricus* Zone).

> Superfamily Reticulariacea WAAGEN, 1883 Family Reticulariidae WAAGEN, 1883 Genus Warrenella CRICKMAY, 1953 Warrenella euryglossa (SCHNUR, 1851) (pl. 18: 9-10)

- 1853. Spirifer euryglossus m.; J. SCHNUR: 209-210, pl. 36: 5.
- 1903. Spirifer pachyrhynchus VERN.; G. GÜRICH: 146.

1957a. Minatothyris euryglossa (J. SCHNUR); A. VANDERCAMMEN: 2-6, pl. 1: 1-16.

- 1957c. Minatothyris euryglossa (Schnur); A. VANDERCAMMEN: 178-186, pl. 1: 1-22; pl. 2: 1-7; pl. 3: 1-14; figs 1-6.
- 1971. Warrenella euryglossus (SCHNUR); G. BIERNAT: 156, pl. 7: 1-5; pl. 8: 5-7; fig. 11.

Material. - 2 nearly complete shells and 14 fragments of shells and valves. Dimensions (in mm):

ZPAL Bp XXIII	Lvv	Ldv	W	Т
193 b	28.3	23.7	(32.0)	(19.4)
193 a	29.0	22.8	(35.0)	21.6

*Description.* — Shell large, biconvex, somewhat wider than long, pentagonal in outline; cardinal margin long, straight, lateral margins rounded, anterior margin truncate, anterior commissure uniplicate.

Pedicle valve with a strongly developed, deep sulcus appearing near umbo; umbo massive, beak incurved.

Brachial valve rectangular in outline; fold low, visible only near the anterior margin of valve. Ornamentation exfoliated, not preserved.

Thick, massive dental plates present in pedicle and a large cardinal process in brachial valve. Other details of interior not studied.

Remarks. — The shape and general outline of shell and the degree of the development of sulcus and fold are identical as in *W. euryglossa* (SCHNUR). They are similar in particular to the specimens of *Minatothyris euryglossa* from the Upper Devonian 1 of Germany and Belgium (VANDERCAMMEN 1957*a*, 1957*c*), of *Spirifer euryglossus* from "Oberen Dolomit" near Büdesheim, W. Germany (SCHNUR 1853) and of *Warrenella euryglossa* from the Kadzielnia limestone (Frasnian) in the Holy Cross Mts (BIERNAT 1971).

Occurrence. — This species is known from "Cuboides Schichten" (Eifel, Germany, Frasnian) and from the Middle Frasnian of Belgium (VANDERCAMMEN 1957*a*, *c*). In Poland, it was described from the Kadzielnia limestones (Frasnian) of the environs of Kielce (BIERNAT 1971).

At Dębnik, specimens of *W. euryglossa* were found in dark-gray, marly biopelmicrites of the upper part of Rokiczany Dół ravine (*Calvinaria cracoviensis* Zone; the conodont Middle and Upper *asymmetricus* Zone) and in light-gray, lumpy intrasparites from trench Żar-I (the lower part of the *Calvinaria albertensis* Zone; probably the conodont *Ancyrognathus triangularis* Zone).

#### CONODONTS

# General remarks

The collection of the Frasnian platform conodonts here described, numbering 2,707 specimens of four stratigraphically important genera and twenty-seven species two of them represented by four subspecies, comes from the probably complete Frasnian profile enclosing strata from *hermanni-cristatus* Zone to the lower part of *triangularis* Zone. Altogether, 54 samples, weighing 2 to 10 kg each, were taken. Conodonts were found in 43 of them (see p. 20).

In the profile under study, conodonts occur on the whole rarely, in particular in its lowerand uppermost parts. Their specific differentiation is also fairly small: twenty-four samples contain two to three species and only nineteen — more than three species. The most abundantly represented are the species *Icriodus symmetricus* (511 specimens), *I. nodosus* (259), *Polygnathus pollocki* (342) and *Palmatolepsis subrecta* (264).

The palaeontological descriptions of conodonts are given in an alphabetic order and virtually confined to brief remarks only. They are all described according to the rules of parataxonomy. Their "occurrence" sections include only a general stratigraphic range of a given species and some more detailed data on its occurrence in the profile under study.

Genus Ancyrodella ULRICH and BASSLER, 1926 Type species: Ancyrodella nodosa ULRICH and BASSLER, 1926 Ancyrodella curvata (BRANSON and MEHL, 1934) (pl. 19:3-4)

1934. Ancyrognathus curvata n. sp.; E. B. BRANSON and M. G. MEHL: 241; pl. 19: 6-7.

1971. Ancyrodella curvata (BRANSON and MEHL); M. SZULCZEWSKI: 11-12; pl. 3: 5; pl. 4: 4-5 (here synonymy). 1976. Ancyrodella curvata (BRANSON and MEHL); E. C. DRUCE: 55-57; pl. 1: 3.

*Remarks.* — The specimens under study correspond exactly to *A. curvata*. The upper surface of platform is ornamented in some specimens by thick, projecting nodes, frequently fused together and forming ridges perpendicular to the platform margin. In some others, the ornamentation is very faint and marked only at the margins of platform.

Occurrence. — According to ZIEGLER (1962): from Upper asymmetricus Zone (do  $I(\beta)\gamma$ ) to Lower triangularis Zone (do  $1\delta$ ). In Canning Basin, Western Australia, this species was found only from Ancyrognathus triangularis Zone (do  $1\gamma$ ) to Lower triangularis Zone (do  $1\delta$ ) (DRUCE 1976).

At Dębnik: in trenches Z-IV, Z-VI and Z-XIB.

# Ancyrodella gigas YOUNGQUIST, 1947 (pl. 19: 1)

1947. Ancyrodella gigas Youngquist, n. sp.; W. Youngquist: 96-97; pl. 25: 23. 1976. Ancyrodella gigas Youngquist; E. C. Druce: 57-58; pl. 3: 1-3 (here synonymy).

*Remarks.* — In the character of their platform ornamentation, some specimens are similar to *A. buckeyensis*, from which they, however, differ distinctly in an elongate platform and less projecting lateral lobes. Some single specimens have not fully developed accessory keels, which makes them similar to *A. rotundiloba rotundiloba*.

Occurrence. — According to ZIEGLER (1962): from Middle asymmetricus Zone (do  $I\alpha$ ) to Upper gigas Zone (do  $I\delta$ ). In Canning Basin, Western Australia, this species occur from Lower asymmetricus Zone (do  $I\alpha$ ) to Upper gigas Zone (do  $I\delta$ ) (DRUCE 1976).

At Dębnik: in the upper part of Rokiczany Dół ravine (RD-1 and RD-4 to 9).

# Ancyrodella lobata BRANSON and MEHL, 1934 (pl. 19: 7)

1934. Ancyrodella lobata n. sp.; E. B. BRANSON and M. G. MEHL: 239-240; pl. 19: 14; pl. 21: 22-23. 1971. Ancyrodella lobata BRANSON and MEHL; M. SZULCZEWSKI: 13-14; pl. 3: 1-4; pl. 4: 2-3 (here synonymy). 1976. Ancyrodella lobata BRANSON and MEHL; E. C. DRUCE: 59-61; pl. 5: 1-2; pl. 6: 1-3.

*Remarks.* — The specimens studied exactly correspond to *A. lobata*.

Occurrence. — According zo ZIEGLER (1962): from Middle asymmetricus Zone (do  $I\alpha$ ) to Upper gigas Zone (do  $I\delta$ ). This species was found by DRUCE (1976) in Canning Basin, Western Australia, where they also occur in Lower asymmetricus Zone (do  $I\alpha$ ).

At Debnik: in the upper part of Rokiczany Dół ravine (RD-7).

Ancyrodella nodosa ULRICH and BASSLER, 1926 (pl. 19: 6)

1926. Ancyrodella nodosa n. sp.; E. O. ULRICH and R. S. BASSLER: 48; pl. 1: 10–13. 1971. Ancyrodella nodosa ULRICH and BASSLER; M. SZULCZEWSKI: 14–15; pl. 2: 4; pl. 5: 2–5 (here synonymy). 1976. Ancyrodella nodosa ULRICH and BASSLER; E. C. DRUCE: 61–62; pl. 7: 1–3; pl. 8: 1–3.

*Remarks.* — The specimens under study are contained within the limits of variability of *A. nodosa*.

Occurrence. — According to ZIEGLER (1958): from Ancyrognathus triangularis Zone (do I<sub>γ</sub>) to Upper gigas Zone (do Iδ). At Dębnik: in trench S-I.

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Ancyrodella rotundiloba rotundiloba (BRYANT, 1921) (pl. 20: 6-7)

1921. Polygnathus rotundilobus n. sp.; W. L. BRYANT: 26-27; pl. 12: 1-6.

1976. Ancyrodella rotundiloba rotundiloba (BRYANT); E. C. DRUCE: 62-64; pl. 9: 1-7; pl. 10: 1-3; pl. 12: 1; pl. 71: 8 (here synonymy).

Remarks. — The specimens studied exactly correspond to A. rotundiloba rotundiloba. KLAPPER and PHILIP (1972) have reconstructed the Ancyrodella rotundiloba rotundiloba apparatus.

Occurrence. — According to ZIEGLER (1962): from Lower asymmetricus Zone (sensu ZIEGLER 1971) to Middle asymmetricus Zone (do  $I\alpha$ ). In Canning Basin, Western Australia, it was also recorded in the lowermost part of Upper asymmetricus Zone (do  $I(\beta)\gamma$ ) (DRUCE 1976).

At Dębnik: in the quarry above Rokiczany Dół ravine (K/RD-4) and in a tip west of this quarry (H-3).

Ancyrodella rotundiloba alata GLENISTER and KLAPPER, 1966 (pl. 19: 2, 5)

1966. Ancyrodella rotundiloba alata GLENISTER and KLAPPER, n. subsp.; B. F. GLENISTER and G. KLAPPER: 799-800; pl. 85: 1-8; pl. 86: 1-4.

1976. Ancyrodella rotundiloba alata GLENISTER and KLAPPER; E. C. DRUCE: 64-65; pl. 11: 1-4 (here synonymy).

*Remarks.* — Specimens from Dębnik exactly correspond to *A. rotundiloba alata*, in particular to their type specimens from Gogo Formation, Western Australia (GLENISTER and KLAPPER 1966).

KLAPPER and PHILIP (1972), and PHILIP and MCDONALD (1975) have reconstructed the *Ancyrodella rotundiloba alata* apparatus.

Occurrence. — According to ZIEGLER (1971): from Lower asymmetricus Zone (sensu ZIEGLER 1971) to Middle asymmetricus Zone (do  $I\alpha$ ).

At Dębnik: in Old Tumidalski's quarry (SŁT-2) and in a tip west of the quarry above Rokiczany Dół ravine (H-1).

Genus Icriodus BRANSON and MEHL, 1938 Type species: Icriodus expansus BRANSON and MEHL, 1938 Icriodus alternatus BRANSON and MEHL, 1934 (pl. 20: 1)

1934. Icriodus alternatus n. sp.; E. B. BRANSON and M. G. MEHL: 225-226, pl. 13: 4-6.

1971. Icriodus alternatus BRANSON and MEHL; M. SZULCZEWSKI: 21; pl. 7: 2 (here synonymy).

1975. Icriodus alternatus BRANSON and MEHL; G. KLAPPER (in: W. ZIEGLER, ed.): 69-70; Icriodus - pl. 3: 5-6.

*Remarks.* — The specimens under study exactly correspond to the diagnosis of *I. alternatus*. LANGE (1968) have reconstructed the *Icriodus alternatus* apparatus.

*Occurrence.* — According to ZIEGLER (1958): from *Ancyrognathus triangularis* Zone (do I $\gamma$ ) to Upper *marginifera* Zone (do III $\alpha$ ).

At Debnik: in trenches Z-XV and Z-XVI and quarry Z-II (Z-II-1, 2, 3).

# Icriodus aff. brevis STAUFFER, 1940 (pl. 20: 2)

*Remarks.* — The specimens under study are on the whole similar to *I. brevis*, differing from it primarily in a smaller number of nodes in the median row, situated behind lateral rows. As compared with *I. expansus*, they are smaller, have less nodes in the median and

lateral rows and more separated posterior nodes of the median row. The specimens described are likely to represent a new species.

*Occurrence.* — Dębnik: the Main Carmelite Quarry (kK-2) and a quarry above Rokiczany Dół ravine (K/RD-1).

# Icriodus nodosus (HUDDLE, 1934) sensu lato (pl. 20: 3)

1934. Gondolella? nodosa n. sp.; J. W. HUDDLE: 94; pl. 8: 14-15.

1974. Icriodus nodosus (HUDDLE) sensu lato; T. T. UYENO: 30; pl. 6: 4, 10 (here synonymy).

*Remarks.* — The specimens under study exactly correspond to *I. nodosus s. l.*, in particular to its specimens from Waterways Formation, Alberta, Canada (UYENO 1974: 30; pl. 6: 4, 10).

*Occurrence.* — Dębnik: the Main Carmelite quarry (kK-3) and a quarry above Rokiczany Dół ravine (K/RD-2, 3).

# Icriodus symmetricus BRANSON and MEHL, 1934 (pl. 20: 4-5)

1934. Icriodus symmetricus n. sp.; E. B. BRANSON and M. G. MEHL: 226; pl. 13: 1-3.

1971. Icriodus symmetricus BRANSON and MEHL; M. SZULCZEWSKI: 23; pl. 7: 4-5.

1975. Icriodus symmetricus BRANSON and MEHL; G. KLAPPER (in: W. ZIEGLER, ed.): 151-153; Icriodus — pl. 3: 7-8 (here synonymy).

*Remarks.* — The specimens under study are within the variability range of *I. symmetricus*. They are particularly similar to lectotypes of this species (KLAPPER 1975, *Icriodus* — pl. 3: 8) and hypotypes from Wietrznia II, Holy Cross Mts, Poland, where they occur in Middle *asymmetricus* Zone (SZULCZEWSKI 1971; pl. 7: 4-5).

*Occurrence.* — According to ZIEGLER (1958): from Lower *asymmetricus* Zone (do  $I\alpha$ ) to Upper *gigas* Zone (do  $I\delta$ ).

At Dębnik: in the quarry above Rokiczany Dół ravine (K/RD-4), in Old Tumidalski's quarry (SŁT-1, 2), in a tip west of the quarry above Rokiczany Dół ravine (H-1 to 7), in the upper part of Rokiczany Dół ravine (RD-1 to 7 and 9 to 10) and in trenches Żar-I and S-I.

Genus Palmatolepis ULRICH and BASSLER, 1926 Type species: Palmatolepis perlobata ULRICH and BASSLER, 1926 Palmatolepis gigas MILLER and YOUNGQUIST, 1947 (pl. 21: 7, 9)

1947. Palmatolepis gigas MILLER and YOUNGQUIST, n. sp.; A. K. MILLER and W. YOUNGQUIST: 512-513; pl. 75: 1. 1956. Palmatolepis rhenana n. sp.; G. BISCHOFF: 129-130; pl. 8: 26-28, 30; pl. 10: 7.

1976. Palmatolepis gigas MILLER and YOUNGQUIST; E. C. DRUCE: 151-152; pl. 65: 1-2 (2 = pl. 71: 5) (here synonymy).

*Remarks.* — The specimens described exactly correspond to *P. gigas*, in particular to the specimens of *P. rhenana* (= *P. gigas*), described by BISCHOFF (1956).

Occurrence. — According to ZIEGLER (1962): in the entire gigas Zone (do  $I\gamma$  — do  $1\delta$ ) and probably Lower *triangularis* Zone (do  $1\delta$ ).

At Dębnik: in trenches Z-IV to VI.

Palmatolepis hassi MÜLLER and MÜLLER, 1957 (pl. 20: 8)

1957. Palmatolepis (Manticolepis) hassi MÜLLER and MÜLLER, n. sp.; K. J. MÜLLER and E. M. MÜLLER: 1102-1103; pl. 139: 2; pl. 140: 2-4.

1976. Palmatolepis hassi MÜLLER and MÜLLER; E. C. DRUCE: 158; pl. 65: 3-5 (here synonymy).

*Remarks.* — In the material under study, a continuous morphological transition is observed between *P. hassi* and *P. subrecta* so that the separation of the two species is entirely arbitrary. Some specimens, having elongate platforms, are related to *P. gigas*.

*P. hassi* is the P element of *Palmatodella hassi* apparatus (PHILIP & MCDONALD 1975). *Occurrence.* — According to ZIEGLER (1973): mainly from the base of *Ancyrognathus* triangularis Zone to the lower part of Upper gigas Zone (do I $\gamma$  to I $\delta$ ); very few specimens occur in Upper asymmetricus Zone (do I $(\beta) \gamma$ ).

At Dębnik: in trenches Żar-I and Z-V.

# Palmatolepis punctata (HINDE, 1879) (pl. 20: 11-12)

1879. Polygnathus punctatus n. sp.; G. J. HINDE: 367; pl. 17: 14.

1976. Palmatolepis punctata (HINDE); E. C. DRUCE: 164; pl. 54: 3; pl. 55: 4-5 (here synonymy).

*Remarks.* — Most specimens of the collection under study exactly correspond to the diagnosis of *P. punctata*, but some, very similar to *P. transitans*, probably represent a transitional stage between the two species.

*Occurrence.* — According to ZIEGLER (1962): from Middle *asymmetricus* Zone (do I $\alpha$ ) to Lower *gigas* Zone (do I $\gamma$ ).

At Dębnik: in the upper part of Rokiczany Dół ravine (RD-2 to 7 and 10).

Palmatolepis subrecta MILLER and YOUNGQUIST, 1947 (pl. 20: 9-10)

1947. Palmatolepis subrecta MILLER and YOUNGQUIST, n. sp.; A. K. MILLER and W. YOUNGQUIST: 513-514; pl. 75: 7-11.

1976. Palmatolepis subrecta MILLER and YOUNGQUIST; E. C. DRUCE: 171-172; pl. 59: 1-4 (here synonymy).

*Remarks.* — The specimens display a considerable variability, primarily in the outline of platform, trace of blade-carina and ornamentation of the upper surface of platform. A similar variability was observed by ZIEGLER (1962) and SZULCZEWSKI (1971).

Some specimens (pl. 20: 10) show a transition to *P. unicornis* MILLER & YOUNGQUIST. Occurrence. — According to ZIEGLER (1962): from Upper asymmetricus Zone (do  $I(\beta)\gamma$ ) to Middle triangularis Zone (post-do I $\delta$ ).

At Dębnik: in trenches S-I, Z-IV, Z-VI, Z-VII; Z-XI (Z-XI-1 to 3) and Z-XIB.

Palmatolepis triangularis SANNEMANN, 1955 (pl. 21: 4-5)

1955. Palmatolepis triangularis n. sp.; D. SANNEMANN: 327-328; pl. 24: 3.

1976. Palmatolepis triangularis SANNEMANN; E. C. DRUCE: 174-175; pl. 61: 1-3; pl. 62: 2 (here synonymy).

*Remarks.* — Some specimens from trench Z-XIV are related to *P. subrecta*. Young specimens are frequently similar to *P. delicatula delicatula*.

*P. triangularis* is the P element of *Palmatodella triangularis* apparatus (LANGE 1968; PHILIP & MCDONALD 1975).

*Occurrence.* — According to ZIEGLER (1962): from the base of *triangularis* Zone (do I $\delta$ ) to the top of Middle *crepida* Zone (do II $\alpha$ ).

At Debnik: in trenches Z-XIV to XVI and quarry Z-II (Z-II-1 to 4).

# Palmatolepis sp. (pl. 21: 8)

Description. — A Palmatolepis with a wide, triangular platform ornamented on its upper surface by coarse nodes. Outer lobe long; usually tapering, distinctly separated, particularly so in the anterior part, situated anteriorly of the central node. Blade-carina slightly sigmoidal, sometimes subrectilinear, not reaching the posterior end of platform. Central node distinctly separated. Secondary carina and keel occurring frequently. Posterior part of platform tapering, slightly downward.

Remarks. — The specimens of P. sp. are most similar to those of P. (Manticolepis) flabelliformis STAUFER (= P. gigas) described by MÜLLER and MÜLLER (1957) from Independence Formation, USA. The latter have, however, a distinctly sigmoidal blade-carina and their outer lateral lobe is more distinctly separated in the posterior part. Some specimens of P. sp. are somewhat similar to P. proversa, from which they differ in the outline of platform and in the position of the outer lateral lobe which is not so strongly directed anteriorly. The specimens under study are likely to represent a new species separated from the P. punctata stock.

*Occurrence.* — Dębnik: upper part of Rokiczany Dół ravine (RD-1, 8, 9); Middle and Upper *asymmetricus* Zones (do  $\alpha$  to do  $I(\beta)\gamma$ ).

Genus Polygnathus HINDE, 1879 Type species: Polygnathus dubius HINDE, 1879 Polygnathus aff. angustipennatus BISCHOFF and ZIEGLER, 1957 (pl. 22: 4-5)

*Remarks.* — The specimens under study display a considerable variability in the proportion of the length of platform to the length of blade. Some of them, with particularly elongated blade (pl. 22: 5) are similar to P. *angustipennatus* and differ from it mostly in the ornamentation of platform.

Occurrence. — Dębnik: in the Main Carmelite quarry (ŁK-3) and in the quarry above Rokiczany Dół ravine (K/RD-2).

Polygnathus asymmetricus asymmetricus BISCHOFF and ZIEGLER, 1957 (pl. 21: 1, 3)

1957. Polygnathus dubia asymmetrica n. sp.; G. BISCHOFF and W. ZIEGLER: 88-89, pl. 16: 18, 20-22; pl. 21: 3.

1976. Polygnathus asymmetricus asymmetricus BISCHOFF and ZIEGLER; E. C. DRUCE: 180; pl. 68: 1; pl. 69: 1 (here synonymy).

*Remarks.* — The specimens from Dębnik exactly correspond to *P. asymmetricus asymmetricus.* 

*P. asymmetricus asymmetricus* is the P element of *Mesotaxis asymmetrica asymmetrica* apparatus (KLAPPER & PHILIP 1972; PHILIP & McDonald 1975).

Occurrence. — In the entire asymmetricus Zone (do I $\alpha$  to do I( $\beta$ )  $\gamma$ ) (ZIEGLER 1962).

At Dębnik: in the Main Carmelite quarry (ŁK-3) and Old Tumidalski's quarry (SŁT-2).

Polygnathus asymmetricus ovalis ZIEGLER and KLAPPER, 1964 (pl. 22: 6)

1957. Polygnathus dubia dubia HINDE; BISCHOF and ZIEGLER: 88, pl. 16: 19; pl. 21: 1.

1974. Polygnathus asymmetricus ovalis ZIEGLER and KLAPPER; T. T. UYENO: 37, pl. 3: 2, 5, 7; pl. 4: 1, 3 (here synonymy).

*Remarks.* — The specimens from Dębnik are within the variability range of *P. asymmetricus* ovalis, although some of them display considerable similarity in the symmetry of platform to *P. asymmetricus asymmetricus*.

*P. asymmetricus ovalis* is the P element of *Mesotaxis asymmetrica ovalis* apparatus (KLAPPER and PHILIP 1972; PHILIP and MCDONALD 1975).

*Occurrence.* — According to ZIEGLER (1962): in *asymmetricus* Zone (do I $\alpha$  to do I( $\beta$ )  $\gamma$ ). At Dębnik: in the upper part of Rokiczany Dół ravine (RD-1 to 4 and 7 to 9).

# Polygnathus brevilaminus BRANSON and MEHL, 1934 (pl. 22: 1)

1934. Polygnathus brevilamina n. sp.; E. B. BRANSON and M. G. MEHL: 246; pl. 21: 3-6. 1971. Polygnathus brevilaminus BRANSON and MEHL; M. SZULCZEWSKI: 46-47; pl. 18: 5-6, 10 (here synonymy). 1976. Polygnathus brevilaminus BRANSON and MEHL; E. C. DRUCE: 183-184, pl. 70: 3-5.

Remarks. — The specimens from Dębnik are identical with *P. brevilaminus*, in particular with its specimens from the Holy Cross Mts, Poland (SZULCZEWSKI 1971, pl. 18: 5-6, 10).

Occurrence. — This broadly understood species is marked by a wide stratigraphic range (Frasnian through Famennian).

At Debnik: in quarry Z-II (Z-II-1, 2) and trenches Z-XIV to XVI.

# Polygnathus aff. brevilaminus BRANSON and MEHL, 1934 (pl. 22: 2-3)

*Remarks.* — Specimens of *P*. aff. *brevilaminus* are marked by considerably reduced platform, which differes them from those of *P*. *brevilaminus* described above. The degree of the shortening of platform in *P*. aff. *brevilaminus* is similar as that in *P*. aff. *angustipennatus* from *Spinatrypina* (S.) sp. Zone (cf. p. 78, pl. 22: 4–5).

Occurrence. — Dębnik, Z-II (Z-II-2 to 4) and Z-III quarries.

# Polygnathus brevis MILLER and YOUNGQUIST, 1947 (pl. 22: 7-8)

1947. Polygnathus brevis n. sp.; A. K. MILLER and W. YOUNGQUIST: 514; pl. 74: 9. 1972. Polygnathus brevis MILLER and YOUNGQUIST; M. SZULCZEWSKI; 450-456, pl. 1: 1-7; pl. 2: 1-4 (here synonymy). 1976. Polygnathus sp. A. DRUCE; E. C. DRUCE: 205, pl. 96: 2.

*Remarks.* — *P. brevis* was revised by SZULCZEWSKI (1972) who also discussed its ontogenetic development and stratigraphic range. The specimens under study exactly correspond to *P. brevis* illustrated by SZULCZEWSKI (1972) from the Holy Cross Mts, Poland.

Occurrence. — According to SZULCZEWSKI (1972) and KLAPPER (1973), it occurs from Lower to Upper gigas Zones (do I $\gamma$  to do I $\delta$ ).

At Dębnik: trenches Z-IV, Z-XI (Z-XI-1), Z-XIB and S-I.

Polygnathus dubius HINDE, 1879 (pl. 23: 5-6)

1879. Polygnathus dubius n. sp.; G. J. HINDE: 362-364, pl. 16: 6-17.

1970. Polygnathus dubius HINDE; J. W. HUDDLE: 1037-1038, pl. 138: 1-17 (here synonymy).

*Remarks.* — The specimens under study are almost identical with *P. dubis* revised by HUDDLE (1970), except for a small difference in the development of carina, which may be more thickened in the median and finer in the posterior part of platform.

KLAPPER and PHILIP (1971) have reconstructed the *Polygnathus dubius* apparatus.

Occurrence. — According to KLAPPER (1973): from Upper hermanni — cristatus Zone (the transitional Givetian-Frasnian layers) to Lower asymmetricus Zone (do Ix).

At Dębnik: in the Main Carmelite quarry (kK-3) and the quarry above Rokiczany Dół ravine (K/RD-2 to 4).

# Polygnathus incompletus UYENO, 1967 (pl. 23: 11)

1974. Polygnathus incompletus UYENO; T. T. UYENO; 39, pl. 4: 5; pl. 5: 1 (here synonymy).

*Remarks.* — The specimens described are completely contained within the range of variability of *P. incompletus.* 

Occurrence. — According to UYENO (1974, Table 1): from Lower to Middle asymmetricus Zone (do I $\alpha$ ). The occurrence of this species (one specimen only) in crepida Zone (do II $\alpha$ ) in the Holy Cross Mts (SZULCZEWSKI 1971: 49; pl. 18: 9) requires a revision based on a more numerous material.

At Dębnik: in the Main Carmelite quarry (kK-3) and the quarry above Rokiczany Dół ravine (K/RD-2).

# Polygnathus pennatus HINDE, 1879 (pl. 23: 10)

1879. Polygnathus pennatus n. sp.; G. J. HINDE: 366, pl. 17: 8.

1970. Polygnathus pennatus HINDE; J. W. HUDDLE: 1038-1039, pl. 137: 1-19 (here synonymy).

1971. Polygnathus pennatus HINDE; M. SZULCZEWSKI: 50-51, pl. 18: 2.

*Remarks.* — The specimens described are very similar to those of *P. pennatus* described and illustrated by HUDDLE (1970), from which they usually differ only in a somewhat longer free blade and more anteriorly situated basal cavity.

Occurrence. — According to HUDDLE (1970) and KLAPPER (1973): from Upper hermannicristatus Zone (a boundary between the Middle and Upper Devonian) to Lower asymmetricus Zone (do I $\alpha$ ).

At Dębnik: in the Main Carmelite quarry (LK-2) and the quarry above Rokiczany Dół ravine (K/RD-1).

Polygnathus pollocki DRUCE, 1976 (pl. 23: 7-9)

1968. Polygnathus n. sp. A; C. A. POLLOCK: 436-437, pl. 62: 32-33, 38.
1974. Polygnathus sp. B; T. T. UYENO: 41, pl. 4: 4; pl. 5: 8.
1976. Polygnathus pollocki sp. nov.; E. C. DRUCE: 198, pl. 79: 2-4, fig. 24.

*Remarks.* — The specimens under study exactly correspond to *P. pollocki*, except for their more extensive intraspecific variability, in particular in the ornamentation of platform as compared with DRUCE's specimens (1976, pl. 79: 2–4). The nodes may occur only at the margins of the upper surface of platform (as in type specimens) or may be irregularly distributed over a larger area (pl. 23: 8). One, abnormal specimen displays the presence of a secondary carina and keel (pl. 23: 9). *Polygnathus* sp. B from Waterways Formation (UYENO 1974: 41, pl. 4: 4; pl. 5: 8) is a probably a synonym of *P. pollocki*.

Occurrence. — In Canning Basin, Western Australia it occurs from Middle asymmetricus Zone (do I $\alpha$ ) to Lower gigas Zone (do I $\gamma$ ) (DRUCE 1976); in Alberta, Canada — in asymmetri-

cus Zone (POLLOCK 1968); it is probably in Alberta that is also occurs in *Spathognathodus* insitus-fauna (probably the lowermost Frasnian) to Middle asymmetricus Zone (do I $\alpha$ ).

At Dębnik: on a tip west of the quarry above Rokiczany Dół ravine (H-1 to 5) and in the upper part of Rokiczany Dół ravine (RD-1 to 6 and 8–10).

# Polygnathus spatulatus YOUNGQUIST, 1947 (pl. 21: 2, 6)

1947. Polygnathus spatulata YOUNGQUIST, n. sp.; W. YOUNGQUIST: 110, pl. 26: 4. 1976. Polygnathus spatulatus YOUNGQUIST; E. C. DRUCE: 202, pl. 80: 6.

*Remarks.* — The specimens under study are very similar to *P. spatulatus* from the State of Iowa, USA (YOUNGQUIST 1947) and from Canning Basin, Western Australia (DRUCE 1976). They display considerable variability primarily in the length of free blade, which may be longer or shorter than platform.

The ornamentation of platform consists of transversal ridges and sometimes, in the posterior part, also of nodes.

Occurrence. — Upper Devonian (Frasnian) of Iowa, USA (YOUNGQUIST 1947) and the Lower asymmetricus Zone (do I $\alpha$ ) in Canning Basin, Western Australia (DRUCE 1976).

At Dębnik: in the Old Tumidalski's quarry (SŁT-1 to 2) and on a tip west of the quarry above Rokiczany Dół ravine (H-1 to 7).

Polygnathus timanicus OVNATANOVA, 1969 (pl. 23: 1-4, 12)

1969. Polygnathus timanicus Ovnatanova sp. nov.; N. S. Ovnatanova: 140, pl. 1: 1-2. 1976. Polygnathus seddoni sp. nov.; E. C. DRUCE: 198-201, pl. 80: 1-4; fig. 25.

*Remarks.* — *P. seddoni* DRUCE displays a close similarity in size, symmetry, the ornamentation of platform and other morphological characters to *P. timanicus* OVNATANOVA. The two species are undoubtedly conspecific, with priority due to OVNATANOVA's species (as an earlier synonym).

The specimens from Dębnik are identical with those of *P. timanicus* and *P. seddoni* (= *P. timanicus*) and display a wide range of variability in their outlines, the ornamentation of platform and trace of carina (which in some specimens may be considerably curved: pl. 23: 4).

Occurrence. — OVNATANOVA (1976) found this species in the domanikovyi horizon (Upper asymmetricus Zone and/or Ancyrognathus triangularis Zone) of North Timan, USSR. In Canning Basin, Western Australia, it occurs from Upper asymmetricus Zone to Ancyrognathus triangularis Zone (do  $I(\beta) \gamma$  to do  $I\gamma$ ) (DRUCE 1976).

At Dębnik: in the upper part of Rokiczany Dół ravine (RD-1, 8 to 9).

Polygnathus webbi STAUFFER, 1938 (pl. 23: 13-15)

1938. Polygnathus webbi STAUFFER, n. sp.; C. R. STAUFFER: 439, pl. 53: 25-26, 28-29.

1971. Polygnathus webbi STAUFFER; G. KLAPPER, 66-67, pl. 1: 25-28 (here synonymy).

1976. Polygnathus normalis MILLER & YOUNGQUIST; E. C. DRUCE: 194-195, pl. 77: 1-3.

Remarks. - The specimens under study are within the variability range of P. webbi.

Occurrence. — According to KLAPPER (1971): from Lower asymmetricus Zone (do I $\alpha$ ) to velifer Zone (do IV).

At Dębnik: in the upper part of Rokiczany Dół ravine (RD-2, 3, 6 to 8) and in trenches Żar-I, S-I, Z-IV to VII, Z-XI (XI-1 to 3) and Z-XIB.

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# EXPLANATION OF THE PLATES

#### PLATE 1

#### Lingulipora sp.

- 1-3. Interior of three valves (Bp XXIII/303-305). 1 incomplete pedicle valve, trench Z-VI, Carvorhynchus tumidus Zone; 2 brachial valve, trench Z-V, Calvinaria albertensis Zone; 3 almost complete pedicle valve; Rokiczany Dół ravine, Calvinaria cracoviensis Zone; × 15.
- 11. Scanning electron micrograph, internal view of punctate valve. Rokiczany Dół ravine, Calvinaria cracoviensis Zone; × 300.

### Lingula sp.

4. Interior of a pedicle valve (Bp XXIII/322): Rokiczany Dół ravine, Calvinaria cracoviensis Zone; ×15.

#### Orbiculoidea sp.

- 5. Pedicle valve (Bp XXIII/296c) in a ventral, b posterior, c lateral views; outcrop Z-III, Leiorhynchus laevis Zone; ×7.
- 9. Interior view of a badly preserved pedicle valve (Bp XXIII/295); quarry Z-II, Leiorhynchus laevis Zone; ×7.

## Schizophoria iowaensis HALL

- 6. Slightly damaged shell (Bp XXIII/291a) in a dorsal, b ventral, c lateral, d posterior and e anterior views; Rokiczany Dół ravine, Calvinaria cracoviensis Zone;  $\times 1.5$ .
- 12. Ornamentation of the exfoliated surface of a shell (Bp XXIII/291d); Rokiczany Dół ravine, *Calvinaria cracoviensis* Zone; × 10.

#### Barroisella campbelli COOPER

- 7-8. Two incomplete brachial valves (Bp XXIII/294f, u) from the interior; muscle scars are visible; quarry Z-II, Leiorhynchus laevis Zone; ×7.
- 10. Pedicle valve (Bp XXIII/297g), exterior; outcrop Z-III, Leiorhynchus laevis Zone; ×10.

# PLATE 2

#### Douvillina (Douvillina) sp.

- 1. Incomplete shell (Bp XXIII/264n) in a dorsal and b ventral views; tip west of a quarry above Rokiczany Dół ravine, Cyrtospirifer bisellatus Zone;  $\times 2$ .
- 2. Incomplete shell (Bp XXIII/2641) in dorsal view; pattern of surface ornamentation partly preserved; locality and horizon as in fig. 1;  $\times 2$ .

#### Retichonetes sp.

3-4. Two pedicle valves (Bp XXIII/271b, c) in external view; (3) in *a* ventral, *b* lateral and *c* posterior views, (4) in ventral view; Rokiczany Dół ravine, *Calvinaria cracoviensis* Zone; × 7.

#### Corbicularia cracoviensis sp. n.

- 5. Strongly corroded pedicle valve (Bp XXIII/275e); tip west of a quarry above Rokiczany Dół ravine, *Cyrtospirifer* bisellatus Zone; × 7.
- 6-7. Two shells (Bp XXIII/278a, 176a) in ventral (6) and dorsal (7) views: Rokiczany Dół ravine (6) and tip west of a quarry above Rokiczany Dół ravine (7), *Cyrtospirifer bisellatus* Zone; × 7.
  - Interior of incomplete brachial valve (Bp XXIII/277a); lateral septa and middle septum-like ridge are visible; Rokiczany Dół ravine, Cyrtospirifer bisellatus Zone; × 7.
  - 9. Ventral view of the holotype (Bp XXIII/277i); *a* dusted and *b* undusted with ammonium chloride; Rokiczany Dół ravine, *Cyrtospirifer bisellatus* Zone;  $\times 10$ .
- 10. SEM micrograph, longitudinal section of a pedicle valve (Bp XXIII/277c); exterior surface of valve at the top of figure; locality and horizon as in fig. 9; × 500.

#### PLATE 3

## Chonetipustula cf. petini (NALIVKIN)

- 1. Incomplete shell (Bp XXIII/289a) in a dorsal, b ventral and c lateral views; d detailed view of the posterior region of a shell; Rokiczany Dół ravine, Calvinaria cracoviensis Zone; × 3, × 10.
- 2. Pedicle valve (Bp XXIII/289b) in ventral view; locality and horizon as in fig. 1;  $\times$  3.

#### Praewaagenoconcha cf. speciosa (HALL)

- 3. Shell (Bp XXIII/301b) in a ventral and b posterior views; trench Z-XVI, Leiorhynchus laevis Zone;  $\times 1.5$ .
- 6. External mould of a brachial valve (Bp XXIII/302); guarry Z-II, Leiorhynchus laevis Zone; ×1.5.

#### Spinulicosta aff. herminae (FRECH)

- 4. Shell (Bp/XXIII/280c) in a ventral and b anterior views; Rokiczany Dół ravine, Calvinaria cracoviensis Zone;  $\times 1.5$ .
- 5. Interior of a strongly exfoliated brachial valve (Bp XXIII/281k); locality and horizon as in fig. 4;  $\times 1.5$ .
- 7. Slightly damaged shell (Bp XXIII/282c) in a ventral, b lateral, c posterior and d anterior views; locality and horizon as in fig. 4;  $\times 1.5$ .

## Corbicularia cracoviensis sp. n.

- 8. Exterior of an incomplete pedicle valve (Bp XXIII/274a), undusted specimen; tip west of the quarry above Rokiczany Dół ravine, *Cyrtospirifer bisellatus* Zone; ×13.
- 9. Interior of a brachial valve (Bp XXIII/277d); Rokiczany Dół ravine, Cyrtospirifer bisellatus Zone; × 13.

## PLATE 4

# Hypothyridina ascendoides NALIVKIN

- 1-2. Two shells (Bp XXIII/190a, e) in a dorsal, b ventral, c lateral, d posterior and e anterior views; Rokiczany Dół ravine, Calvinaria cracoviensis Zone;  $\times 3$ .
  - 8. Same as in fig. 2 in natural size.

#### Parapugnax sp.

3. Shell (Bp XXIII/188c) in a dorsal, b ventral, c lateral, d posterior and e anterior views; locality and horizon as in fig. 1;  $\times 2$ .

### Parapugnax schucherti (STAINBROOK)

- 4. Slightly damaged shell (Bp XXIII/186a) in a dorsal, b ventral, c lateral, d posterior and e anterior views; locality and horizon as in fig. 1;  $\times 2$ .
- 5. Incomplete shell (Bp XXIII/186b) in dorsal view, locality and horizon as in fig. 1;  $\times 2$ .
- 7. Lateral commissure of specimen from fig. 4;  $\times$  5.

# Hypothyridina sp.

6. Incomplete shell (Bp XXIII/189) in a dorsal and b lateral views; locality and horizon as in fig. 1.

#### Devonoproductus sp.

9-10. Two incomplete specimens (Bp XXIII/285a, b) in ventral (9) and dorsal (10) views; trench Z-VII, Calvinaria albertensis Zone; × 3.

#### PLATE 5

## Calvinaria cracoviensis (GÜRICH)

1-5. Five specimens (Bp XXIII/181c, a, e, b, d) (fig. 4 — neotype) in a dorsal, b ventral, c lateral, d posterior and e anterior views; Rokiczany Dół ravine, Calvinaria cracoviensis Zone;  $\times 1.5$ .

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#### PLATE 6

# Calvinaria variabilis athabascensis (KINDLE)

1-3. Three shells (Bp XXIII/182e, d, a) in different size in a dorsal, b ventral, c lateral, d posterior and e anterior views; Rokiczany Dól ravine, Calvinaria cracoviensis Zone; < 1.5.

# Calvinaria albertensis albertensis (WARREN)

4-5. Two shells (Bp XXIII/14d, h) in different size in a dorsal, b ventral, c lateral, d posterior and e anterior views; trench Z-V, Calvinaria albertensis Zonc;  $\times 1.5$ .

#### PLATE 7

# Calvinaria albertensis minor subsp. n.

1-3. Three shells (Bp XXIII/28c, b, g) (fig. 2 — holotype) in a dorsal, b ventral, c lateral, d posterior and e anterior views; trench Z-IV, Calvinaria albertensis Zone;  $\times 3$ .

#### Bergalaria guerichi sp. n.

4-7. Four shells (Bp XXIII/184a, i, g, d) (fig. 5 — holotype) in *a* dorsal, *b* ventral, *c* lateral, *d* posterior and *e* anterior views; Rokiczany Dół ravine, *Calvinaria cracoviensis* Zone; × 2.5 (fig. 4) and × 2 (figs 5-7).

#### PLATE 8

# Caryorhynchus tumidus (KAYSER)

- 1-3. Three juvenile shells (Bp XXIII/7a, 146a, 145c) in a dorsal, b ventral, c lateral, d posterior and e anterior views; trench Z-VI, Caryorhynchus tunnidus Zone;  $\times 3$ .
- 4-6. Three adult shells (Bp XXJII/16a, 144c, 1) in a dorsal, b ventral, c lateral, d posterior and e anterior views; trench Z-V, Calvinaria albertensis Zone (fig. 4) and trench Z-VI, Caryorhynchus tumidus Zone (figs 5-6); ×1.
  - 7. Umbonal region of the shell from fig. 6;  $\times$  3.
- 11. Photograph of acetate peel (Bp XXIII/332) showing internal structure of umbonal region of an adult specimen; locality and horizon as in fig. 1;  $\times 8$ .

# Gypidula sp.

8-9. Two incomplete pedicle valves (Bp XXIII/154d, c) in *a* ventral, and *b* lateral views; Rokiczany Dół ravine, *Calvi* naria cracoviensis Zone;  $\times 2$ .

## Bergalaria guerichi sp. n.

10. Ornamentation of the shell illustrated on pl. 7: 6;  $\times 4$ .

#### PLATE 9

#### Leiorhynchus laevis GÜRICH

- 1-5. Five shells (Bp XXIII/159b, 158a, 159a, 155b, a) in a dorsal, b ventral, c lateral, d posterior and e anterior views; figs 4f and 5f --- dorsal views of shells in nat. size; quarry Z-II (figs 1-3) and trench Z-XVI (figs 4-5), Leiorhynchus laevis Zone; × 1.5.
  - 6. Interior of a brachial valve (Bp XXIII/333); quarry Z-II, Leiorhynchus laevis Zone;  $\times$  20.
  - 7. Very small shell (Bp XX[II]/332) in dorsal view; locality and horizon as in fig. 6;  $\times$  20.

#### PLATE 10

## Anatrypa alticola (FRENCH)

1-3. Three shells (Bp XXIII/25, 26e, 237b) in different size in a dorsal, b ventral, c lateral, d posterior and e anterior views; trenches Z-V (fig. 1), Z-XIB (fig. 2) and Z-VII (fig. 3); Calvinaria albertensis Zone (figs 1 and 3) and Caryorhynchus tumidus Zone (fig. 2); × 2.

## Biernatella polonica BALIŃSKI

4. Shell (Bp XXIII/31g — holotype) in a dorsal, b ventral, c lateral, d posterior and e anterior views; trench Z-IV, Calvinaria albertensis Zone; × 4.

#### PLATE 11

#### Desquamatia (Seratrypa) oneidensis (BEUS)

- 1-2, 6. Three adult shells (Bp XXIII/132z, a, s) in a dorsal, b ventral, c lateral, d posterior and e anterior views; fig. 2f — detailed view of the posterior region of a shell; quarry above Rokiczany Dół ravine, *Desquamatia (Seratrypa) oneidensis* Zone;  $\times 2$  (fig. 2f —  $\times 4.5$ ).
- 3,8. Two incomplete juvenile shells (Bp XXIII/335, 337); Main Carmelite quarry, Desquamatia (Seratrypa) oneidensis Zone; 208.
- 4-5. Interior of pedicle and brachial valves (Bp XXIII/336, 338); locality and horizon as in fig. 3;  $\times 8$  and  $\times 10$ .
- 7. Shells of D. (S.) oneidensis preserved in the rock; locality and horizon as in fig. 1;  $\times 1$ .
- 9. Fragment of a valve (Bp XXIII/339) with preserved ornamentation; locality and horizon as in fig. 3;  $\times 8$ .

## PLATE 12

# Desquamatia (Neatrypa) velikaja (NALIVKIN)

1, 4-5. Three adult shells (Bp XXIII/256b, 258b, a) in a dorsal, b ventral, c lateral, d posterior and e anterior views (fig. 5 in dorsal view only); Rokiczany Dół ravine (fig. 1) and tip wes of a quarry above Rokiczany Dół ravine (figs 4-5), Cyrtospirifer bisellatus Zone;  $\times 2$ .

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# Athyris concentrica (v. BUCH)

2-3. Two shells (Bp XXIII/233b, a) in a dorsal, b ventral, c lateral, d posterior and e anterior views (shell on fig. 2 in dorsal view only); trench Z-XI, Caryorhynchus tunnidus Zone;  $\times$  1.5.

## PLATE 13

# Spinatrypina (Spinatrypina) sp.

- 1-2. Two shells (Bp XXIII/136e, o) in a dorsal, b ventral, c lateral, d posterior and e anterior views; quarry above Rokiczany Dół ravine, Spinatrypina (Spinatrypina) sp. Zone;  $\times 2$ .
  - 3. Juvenile shell (Bp XXIII/136p) in dorsal view; locality and horizon as in fig. 1; 26.

## Atryparia (Costatrypa) cf. uralica (NALIVKIN)

- 4. Adult shell (Bp XXIII/261a) in *a* dorsal, *b* ventral, *c* lateral, *d* posterior and *e* anterior views; Rokiczany D61 ravine, *Calvinaria cracoviensis* Zone; × 2.
- 6. Slightly damaged shell (Bp XXIII/261b) in ventral view with fragmentary preserved frills; locality and horizon as in fig. 4;  $\times 2$ .

# Spinatrypa (Spinatrypa) semilukiana LJASCHENKO

- 5. Slightly damaged shell (Bp XXIII/252g) in a dorsal, b ventral, c lateral, d posterior and c anterior views; tip west of the quarry above Rokiczany Dół ravine, Cyrtospirifer bisellatus Zone;  $\times 2$ .
- 7. Fragment of a pedicle valve (Bp XXIII/340) from the interior; dental plate is visible; Old Tumidalski's quarry, Cyrtospirifer bisellatus Zone;  $\times$  8.
- 8. Exterior of a pedicle valve (Bp XXIII/253); locality and horizon as in fig. 5;  $\times 2$ .
- 9. Single spine (Bp XXIII/341); locality and horizon as in fig. 7;  $\times$  10.
- 10. Brachial valve interior (Bp XXIII/342); locality and horizon as in fig. 7;  $\times$  8.

#### PLATE 14

#### Iowatrypa markovskii (LJASCHENKO)

- 1-3. Three shells (Bp XXIII/234n, a, b) in a dorsal, b ventral, c lateral, d posterior and e anterior views; trench Z-VII, Calvinaria albertensis Zone;  $\times 2$ .
  - 4. Incomplete shell (Bp XXIII/261c) with fragmentary preserved ornamentation; outcrop in the road from Dębnik to Paczółtowice, Żarnówka Hill, *Calvinaria albertensis* Zone: × 5.
  - 5. Adult shell (Bp XXIII/262b) in dorsal view; trench Z-IV, Calvinaria albertensis Zone; > 2.

## Spinatrypa (Spinatrypa) semilukiana LJASCHENKO

6. Exfoliated shell (Bp XXIII/138c) in a dorsal, b ventral, c lateral, d posterior and e anterior views; quarry above Rokiczany Dół ravine, Cyrtospirifer bisellatus Zone;  $\times 2$ .

#### PLATE 15

#### Eleutherokomma zarecznyi (GÜRICH)

1-3. Three shells (Bp XXIII/205a, 202c, a) in a dorsal, b ventral, c lateral, d posterior and e anterior views; tip west of the quarry above Rokiczany Dół ravine, Cyrtospirifer bisellatus Zone;  $\times 1.5$ .

- 4, 6. Two incomplete shells (Bp XXIII/205b, 208a) in dorsal view; locality and horizon as in fig. 1;  $\times 1.5$ .
- 5, 7. Internal view of two fragmentary preserved pedicle valves (Bp XXIII/345, 343); Old Tumidalski's quarry; Cyrtospirifer bisellatus Zone; × 5 (fig. 5) and × 3 (fig. 7).
  - 8. Brachial valve interior (Bp XXIII/144); locality and horizon as in fig. 5;  $\times$  5.
  - 9. Microornamentation (Bp XXIII/202d); locality and horizon as in fig. 1;  $\times$  10.
- 10. Internal mould of a brachial valve (Bp XXIII/204f) with preserved greatly extended (mucronate) hinge line; locality and horizon as in fig. 1;  $\times$  1.5.

#### PLATE 16

# Cyrtospirifer bisellatus (GüRICH)

- 1-3. Three shells (Bp XXIII/194e, c, a) in a dorsal, b ventral, c lateral, d posterior and e anterior views; tip west of a quarry above Rokiczany Dół ravine, Cyrtospirifer bisellatus Zone;  $\times 1$ .
  - 4. Muscle scar on internal mould of a pedicle valve (Bp XXIII/194d); locality and horizon as in fig. 1; × 4.
  - 5. Juvenile shell (Bp XXIII/196b) in dorsal view; locality and horizon as in fig. 1;  $\times 1$ .
  - 6. Exfoliated shell (Bp XXIII/194d) with preserved muscle scars on a brachial valve; locality and horizon as in fig. 1;  $\times 1$ .

#### PLATE 17

# Cyrtospirifer minor (GÜRICH)

- 1. Juvenile shell (Bp XXIII/211f) in a dorsal, b ventral, c lateral, d posterior and e anterior views; quarry Z-II, Leiorhynchus laevis Zone;  $\times 3$ .
- 2. Slightly damaged shell (Bp XXIII/215a) in dorsal view; outcrop Z-III, Leiorhynchus laevis Zone; ×1.5.
- 3-6. Four shells (Bp XXIII/2171, 211c, 232b, 232a) in a dorsal, b ventral, c lateral, d posterior and c anterior views; quarry Z-II (figs 3-4) and trench Z-XIV (figs 5-6), Leiorhynchus laevis Zone;  $\times$  1.5.
  - 7. Broken shell (Bp XXIII/214a) showing interior; locality and horizon as in fig. 1;  $\times$  3.
  - 8. Interior of a fragmentary preserved pedicle valve (Bp XXIII/214b); locality and horizon as in fig. 1;  $\times$  3.
- 9-10. Two brachial valve interiors (Bp XXIII/214c, d); locality and horizon as in fig. 1;  $\times$  6 (fig. 9) and  $\times$  5 (fig. 10).
- 11. Microornamentation (Bp XXIII/346); locality and horizon as in fig. 1;  $\times$  12.

#### PLATE 18

# Tenticospirifer cyrtiniformis (HALL and WHITFIELD)

1-2. Two shells (Bp XXIII/226b, 228a) in a dorsal, b ventral, c lateral, d posterior, and e anterior views; trench Z-XI (fig. 1) and trench Z-VII (fig. 2), Caryorhynchus tumidus Zone (fig. 1) and Calvinaria albertensis Zone; ×1.5.

#### Thomasaria simplex (PHILLIPS)

3-4. Two slightly damaged shell (Bp XXIII/191a, b) in a dorsal, b ventral, c lateral, d posterior and e anterior views; Rokiczany Dół ravine, Calvinaria cracoviensis Zone;  $\times 2$ .

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## Theodossia cf. hungerfordi (HALL)

- 5. Anterior part of a broken shell (Bp XXIII/230a) in a dorsal and b anterior views; trench Z-VII, Calvinaria albertensis Zone;  $\times 1.5$ .
- 6,8. Two incomplete shells (Bp XXIII/230b, c) in a dorsal, and b lateral views; locality and horizon as in fig. 5;  $\times 1.5$ .
- 7. Incomplete shell (Bp XXIII/230g) in a dorsal and b anterior views; locality and horizon as in fig. 5;  $\times 1.5$ .

## Warrenella euryglossa (SCHNUR)

- 9. Damaged shell (Bp XXIII/192a) in a dorsal, b ventral, c lateral, d posterior and e anterior views; Rokiczany Dół ravine, Calvinaria cracoviensis Zone; ×1.
- 10. Incomplete shell (Bp XXIII/193s) in dorsal view; trench Zar-I, Calvinaria albertensis Zone;  $\times 1$ .

## PLATE 19

# Ancyrodella gigas Youngquist

1. Upper view of a specimen (C VIII/1) from Rokiczany Dól ravine (RD-4); Calvinaria cracoviensis Zone.

# Ancyrodella rotundiloba alata GLENISTER and KLAPPER

- 2. Upper view of a specimen (C VIII/2) from tip west of a quarry above Rokiczany Dół ravine (H-1); Cyrtospirifer bisellatus Zone.
- 5. Specimen (C VIII/3) from the same locality and horizon as on fig. 2 in a upper and b lateral views.

#### Ancyrodella curvata (BRANSON and MEHL)

- 3. Specimen (C VIII/4) from trench Z-XIB in a upper and b lower views; Caryorhynchus tunnidus Zone.
- 4. Upper view of a specimen (C VIII/5) from trench Z-VI; Caryorhynchus tumidus Zone.

# Ancyrodella nodosa ULRICH and BASSLER

6. Upper view of an incomplete specimen (C VIII/6) from trench S-1; Calvinaria albertensis Zone.

#### Ancyrodella lobata BRANSON and MEHL

7. Specimen (C VIII/7) from Rokiczany Dół ravine (RD-7) in a upper, and b lower views; Calvinaria cracoviensis Zone.

All figures  $\,\times\,50$ 

#### PLATE 20

#### Icriodus alternatus BRANSON and MEHL

1. Upper view of a specimen (C VIII/8) from quarry Z-II (Z-II-2); Leiorhynchus laevis Zone.

# Icriodus aff. brevis STAUFFER

2. Upper view of specimen (C VIII/9) from Main Carmelite quarry (ŁK-2); Desquamatia (Seratrypa) oneidensis Zone.

# Icriodus nodosus (HUDDLE) s. l.

3. Specimen (C VIII/10) from Main Carmelite quarry (ŁK-3) in a upper and b lower views; Spinatrypina (Spinatrypina) sp. Zone.

#### Icriodus symmetricus BRANSON and MEHL

4-5. Upper views of two specimens (C VIII/11-12) from a tip west of a quarry above Rokiczany Dól ravine (H-1 and H-4); Cyrtospirifer bisellatus Zone.

# Ancyrodella rotundiloba rotundiloba (BRYANT)

- 6. Specimen (C VIII/13) from quarry above Rokiczany Dół ravine (K/RD-4) in a upper, b lateral and c lower views; Cyrtospirifer bisellatus Zone.
- 7. Upper view of broken specimen (C VIII/14) from a tip west of a quarry above Rokiczany Dół ravine; Cyrtospirifer bisellatus Zone.

## Palmatolepis hassi Müller and Müller

8. Upper view of specimen (C VIII/15) from trench Żar-I; Calvinaria albertensis Zone.

# Palmatolepis subrecta MILLER and YOUNGQUIST

- 9. Upper view of specimen (C VIII/16) from trench Z-XIB; Caryorhynchus tumidus Zone.
- 10. Upper view of large specimen (C VIII/17) from trench S-I; Calvinaria albertensis Zone.

# Palmatolepis punctata (HINDE)

# 11-12. Upper view of two specimens (C VIII/18-19) from Rokiczany Dół ravine (RD-10); Calvinaria cracoviensis Zone.

All figures  $\,\times\,50$ 

#### PLATE 21

## Polygnathus asymmetricus asymmetricus BISCHOFF and ZIEGLER

- 1. Specimen (C VIII/25) from Old Tumidalski's quarry (SLT-2) in a upper and b lower views; Cyrtospirifer bisellatus Zone.
- 3. Upper view of a specimen (C VIII/26) from the same locality and horizon as in fig. 1.

# Polygnathus spatulatus YOUNGQUIST

- 2. Upper view of a specimen (C VIII/27) with broken free blade; tip west of a quarry above Rokiczany Dół ravine (H-4); Cyrtospirifer bisellatus Zone.
- 6. Specimen (C VIII/28) from a tip west of a quarry above Rokiczany Dół ravine (H-7) in *a* upper and *b* lateral views; *Cyrtospirifer bisellatus* Zone.

## Palmatolepis triangularis SANNEMANN

- 4. Upper view of a specimen (C VIII/20) from trench Z-XV; Leiorhynchus laevis Zone.
- 5. Upper view of an untypical specimen (C VIII/21) from trench Z-XVI; Leiorhynchus laevis Zone.

## Palmatolepis gigas MILLER and YOUNGQUIST

- 7. Upper view of a broken specimen (C VIII/22) from trench Z-IV; Calvinaria albertensis Zone.
- 9. Upper view of a specimen (C VIII/23) from trench Z-VI; Caryorhynchus tumidus Zone.

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#### Palmatolepis sp.

8. Specimen (C VIII/24) from Rokiczany Dół ravine (RD-8) in a upper and b lower views; Calvinaria cracoviensis Zone.

All figures  $\times 50$ 

#### PLATE 22

# Polygnathus brevilaminus BRANSON and MEHL

1. Specimen (C VIII/29) from trench Z-XVI in a upper and b lateral views; Leiorhynchus laevis Zone.

#### Polygnathus aff. brevilaminus BRANSON and MEHL

2-3. Two specimens (C VIII/30-31) in *a* upper and *b* lateral views; trench Z-XVI (fig. 2) and guarry Z-II (Z-II-3) (fig. 3); *Leiorhynchus laevis* Zone.

# Polygnathus aff. angustipennatus BISCHOFF and ZIEGLER

4-5. Two specimens (C VIII/32-33) in *a* upper and *b* lateral views; quarry above Rokiczany Dół ravine (K/RD-2) (fig. 4) and Main Carmelite quarry (ŁK-3) (fig. 5); *Spinatrypina (Spinatrypina)* sp. Zone.

## Polygnathus asymmetricus ovalis ZIEGLER and KLAPPER

6. Specimen (C VIII/34) from Rokiczany Dól ravine in a upper and b lower views; Calvinaria cracoviensis Zone.

# Polygnathus brevis MILLER and YOUNGQUIST

- 7. Specimen (C VIII/35) from trench Z-XI (Z-XI-1) in a upper and b lateral views; Caryorhynchus tumidus Zone.
- 8. Upper view of broken juvenile specimen (C VIII/36) from trench XIB; Caryorhynchus tumidus Zone.

All figures  $\times$  50

#### PLATE 23

## Polygnathus timanicus Ovnatanova

- 1. Specimen (C VIII/37) from Rokiczany Dół ravine (RD-9) in a upper, b lateral and c lower views; Calvinaria cracoviensis Zone.
- 2-4. Upper view of three specimens (C VIII/38-40) from Rokiczany Dół ravine (RD-8 figs 2-3 and RD-9 fig. 4); Calvinaria cracoviensis Zone.
- 12. SEM micrograph of a specimen (C VIII/41) in upper view; Rokiczany Dół ravine (RD-1), Calvinaria cracoviensis Zone; × 150.

## Polygnathus dubius HINDE

5-6. Upper view of two specimens (C VIII/42-43) from quarry above Rokiczany Dół ravine: (K/RD-4); Cyrtospirifer bisellatus Zone.

# Polygnathus pollocki DRUCE

7. Specimen (C VIII/44) from Rokiczany Dół ravine (RD-9) in a upper and b lateral views; Calvinaria cracoviensis Zone.

- 8. Oblique-upper view of a specimen (C VIII/45) from the same locality and horizon as in fig. 7.
- 9. Pathological specimen (C VIII/46) with secondary carina and keel, in *a* upper and *b* lower views; Rokiczany Dół ravine (RD-8), *Calvinaria cracoviensis* Zone.

# Polygnathus pennatus HINDE

10. Upper view of a specimen (C VIII/47) from Main Carmelite quarry (ŁK-2); Desquamatia (Seratrypa) oneidensis Zone.

# Polygnathus incompletus UYENO

11. Upper view of a specimen (C VIII/48) from quarry above Rokiczany Dół ravine (K/RD-2); Spinatrypina (Spinatrypina) sp. Zone.

# Polygnathus webbi STAUFFER

- 13-14. Upper (fig. 13) and oblique-upper (fig. 14) views of two specimens (C VIII/49-50) from trench Z-VI; Caryorhynchus tumidus Zone.
- 15. Oblique-upper view of a specimen (C VIII/51) from Rokiczany Dół ravine (RD-3); Calvinaria cracoviensis Zone.

All figures  $\geq 50$ (except for fig. 12  $\approx 150$ )



A. BALIŃSKI: FRASNIAN BRACHIOPODS AND CONODONTS FROM S POLAND



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