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Upper Devonian deposits at Górno in the Holy Cross Mts

ABSTRACT: The lithology of the Upper Devonian carbonate deposits of the environs of Górno, along with their conodont stratigraphy gave a basis for recognition of the sedimentation and paleogeography of the region within the Upper Devonian basin of the Holy Cross Mts. The tectonic gaps recognized between the Givetian and Frasnian, as well as between the Devonian and Carboniferous deposits, led to the corrections in the regional tectonics. Three species of conodonts, viz. *Polygnathus ancyrognathoideus* Ziegler, *Schmidtognathus* aff. *pietzneri* Ziegler and *Spathognathodus sannemanni treptus* Ziegler, so far unknown from the Devonian of the Holy Cross Mts, have been described.

INTRODUCTION

General stratigraphic framework, based on the conodonts, was presented for the Upper Devonian deposits of the Holy Cross Mts by Szulczewski (1971). The scope of the present contribution is to apply the conodont stratigraphy to a more detailed recognition of the brachyanticline of Górno, having a complex tectonic structure in the central part of the Holy Cross Mts (*see* Tex-fig. 1; *and* Małkowski 1971). Most of so far available data on the stratigraphy and facies development of the Devonian deposits in this area come from regional works covering extensive areas of the Holy Cross Mts (Siemiradzki 1887; Czarnocki 1938, 1948; Wolska 1967; Szulczewski 1971), whereas the Carboniferous deposits were investigated by Żakowa (1962).

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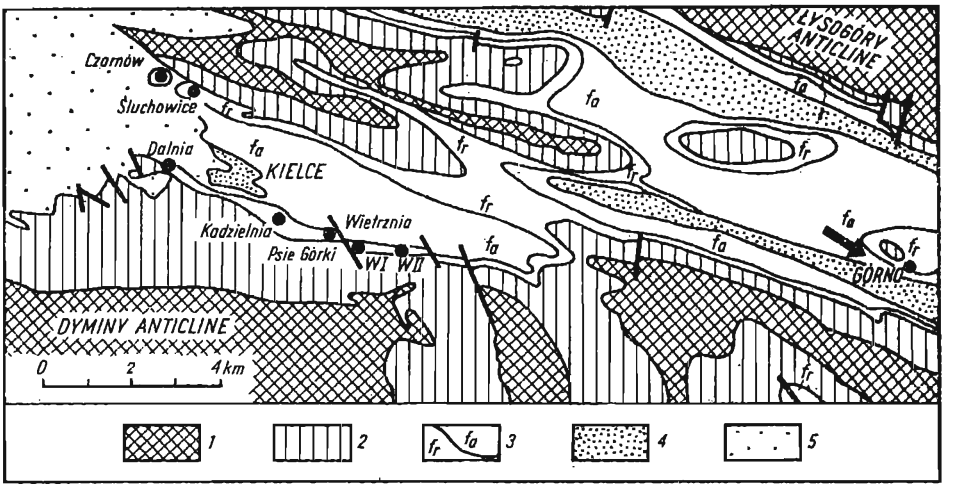


Fig. 1. Geological sketch map of the central part of the Holy Cross Mts, to show situation of the investigated area at Górno (*after* Szulczewski 1971, Fig. 1; for the detailed map *see* Text-fig. 4)

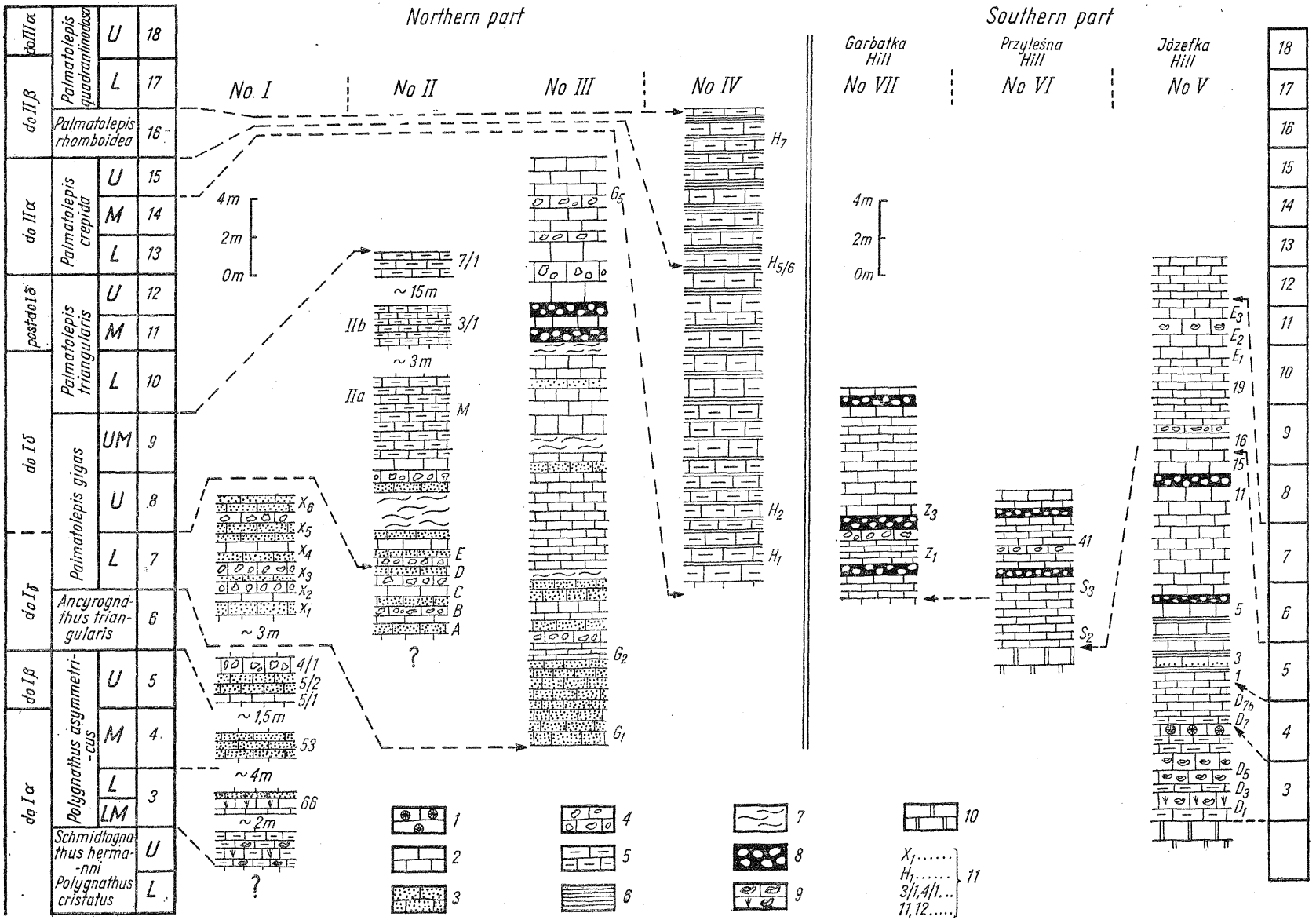
1 Cambrian, Ordovician and Silurian, *2* Lower and Middle Devonian, *3* Frasnian (*fr*) and Famennian (*fa*), *4* Lower Carboniferous (Culm facies), *5* post-Variscan cover (Zechstein and Mesozoic)

DESCRIPTION OF CONODONTS

About 120 conodont samples have been taken from the profiles at intervals of 1 to 2 m. The conodonts were found only in 51 samples, while the remaining samples yielded negative results[1]. The conodonts were well preserved and frequently had a basal plate. Particular samples contained mostly from a few to a dozen or so conodonts and less frequently several scores of them. Samples in which specimens were most abundant came from the Frasnian detrital limestones. All platform conodonts and those of the remaining ones which are of stratigraphic importance have been identified. The material collected contains about 700 specimens, among which nine genera and 36 species or subspecies have been distinguished (Table 1). Three forms, *Polygnathus ancyrognathoideus* Ziegler, *Schmidtognathus* aff. *pietzneri* Ziegler and *Spathognathodus sannemanni treptus* Ziegler illustrated here (Pls 1—2), have not so far been known from the Devonian of the Holy Cross Mts (*cf.* Szulczewski 1971). The present author's view on taxonomic position of the species identified are in conformity with those expessed by Ziegler (1958) and Szulczewski (1971).

[1] Some samples contained holothurian sclerites of the genus *Eocaudina* Martin described by Matyja, Matyja & Szulczewski (1973).

Correlation of the investigated profiles at Górno



1 crinoid limestones, *2* micritic limestones, *3* calcarenites, *4* intraformational breccias, *5* marly limestones, *6* marly shales, *7* wavy-bedded micritic limestones, *8* knobby limestones, *9* fossiliferous limestones (brachiopods and corals), *10* dolomites, *11* condont samples (symbols the same as in Table 1), *12* numbers of the investigated profiles (for their location *see* Text-fig. 4)

Genus *POLYGNATHUS* Hinde, 1879

Type species: *Polygnathus robusticostatus* Bischoff & Ziegler, 1957

Polygnathus ancyrognathoideus Ziegler, 1958
(Pl. 1, Figs 5—6, 8 and Pl. 2, Figs 1—2, 4)

1958. *Polygnathus ancyrognathoidea* n. sp.; Ziegler, p. 69, Pl. 9, Figs 8, 11, 16—20; and Text-fig. 7.
1966. *Polygnathus ancyrognathoidea* Ziegler; Glenister & Klapper, p. 827, Pl. 87, Figs 14—15.
1967. *Polygnathus ancyrognathoideus* Ziegler; Müller & Clark, p. 915, Pl. 115, Fig. 9.

Description. — The specimen without a free blade; platform symmetric or with a developed lateral lobe provided with a secondary carina; carina straight, composed of several nodular teeth; keel and small basal cavity occur on the lower surface of platform.

Remarks. — The specimen illustrated has a part of platform broken-off and the margin of the lateral lobe distinctly rounded.

Occurrence. — Givetian through the Lower Palmatolepis gigas Zone (Ziegler 1971). The specimen under study comes from sample 5/2.

Genus *SCHMIDTOGNATHUS* Ziegler, 1965

Type species: *Schmidtognathus hermanni* Ziegler, 1965

Schmidtognathus pietzneri Ziegler, 1965

1965. *Schmidtognathus pietzneri* sp. n.; Ziegler, 1965, p. 666, Pl. 2, Figs 11—25.

Occurrence. — Upper hermanni-cristatus Zone through lowermost Polygnathus asymmetricus Zone (Ziegler 1965).

Schmidtognathus aff. *pietzneri* Ziegler, 1965
(Pl. 1, Figs 1—2, 9 and Pl. 2, Fig. 3)

Description. — The specimen has an asymmetric and flat platform, the widest in the central part; free blade straight, consisting of fused teeth; carina straight; basal cavity very large, asymmetrically developed; swollen part of basal cavity corresponds to the wider, internal part of platform.

Remarks. — The specimen described being a juvenile form, displays a distinct similarity to that illustrated by Ziegler (1965, Pl. 2, Fig. 20) considered by him as a transitional to *Schmidtognathus hermanni*, from which it, however, differs in a stronger asymmetry of platform and basal cavity and in the lack of a distinct ornamentation.

Occurrence. — The specimen under study comes from sample D_1.

Genus *SPATHOGNATHODUS* Branson & Mehl, 1941 [2]

Type species: *Spathognathodus primus* (Branson & Mehl, 1933)

Spathognathodus sannemanni treptus Ziegler, 1958
(Pl. 1, Figs 3—4, 7)

1958. *Spathognathodus sannemanni treptus* sp. n.; Ziegler, p. 72, Pl. 13, Figs 1—3.

Description. — The specimen has a distinct basal cavity in the central part of blade; margins of basal cavity without ornamentation; denticles of blade fused, and of equal height; anterior part of blade laterally bent at an angle of about 80°

[2] In the multielement taxonomy of conodonts this form is a spathognathodian (P.) element of the *Ozarkodina* (Branson & Mehl, 1933) apparatus (*cf.* Klapper 1973).

Occurrence. — Upper Polygnathus asymmetricus Zone through lower part of the Ancyrognathus triangularis Zone (Ziegler 1958). The specimen under study comes from sample 3.

STRATIGRAPHY

Most conodont assemblages collected from particular samples (Table 1) allowed to determine their age with an accuracy to one or two subzones. This provided an adequate basis for presenting a stratigraphic division of the area (Text-figs 2—4). The range of the profiles described includes the members from the Lowermost Polygnathus asymmetricus Zone to the undivided Palmatolepis rhomboidea Zone, that is, in correla-

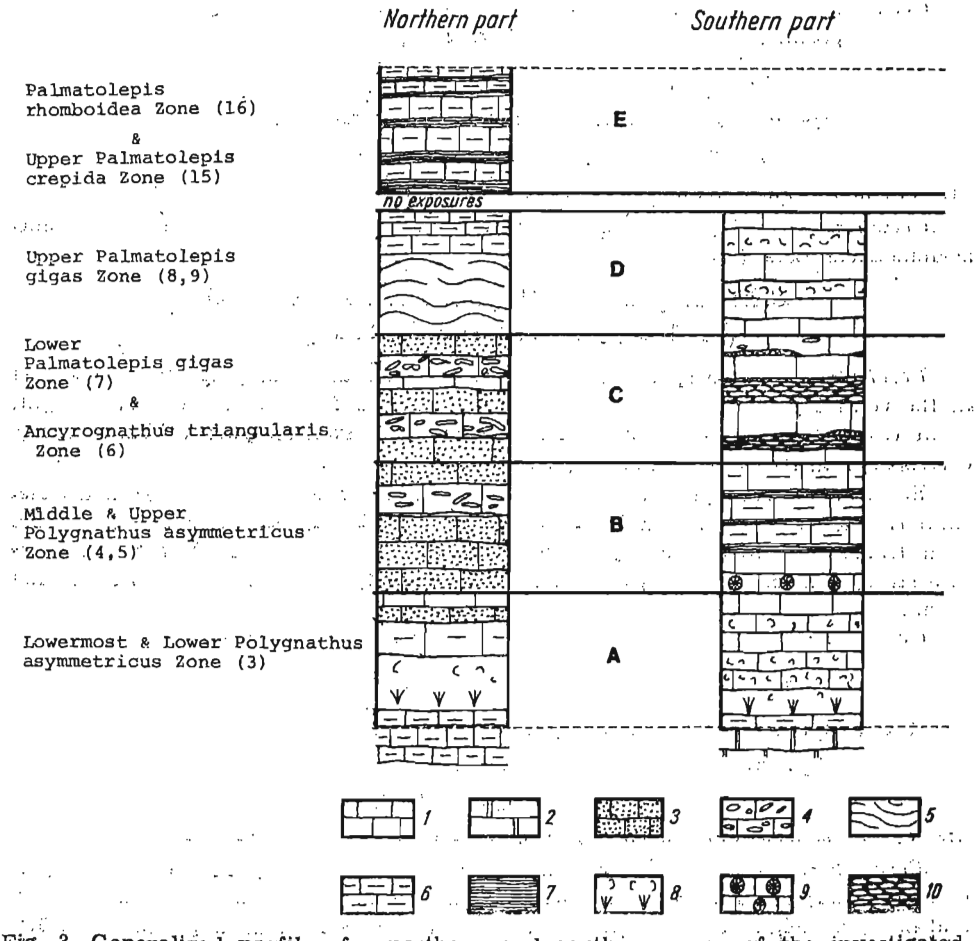


Fig. 3. Generalized profiles for northern and southern areas of the investigated region at Górno.

1 micritic limestones, 2 dolomites, 3 calcarenites, 4 intraformational breccias, 5 wavy-bedded micritic limestones, 6 marly limestones, 7 marly shales, 8 fossiliferous limestones (brachiopods and corals), 9 crinoid limestones, 10 knobby limestones

Distribution and frequency of conodonts in the environs of Górno

Southern part

Number of conodont zone /cf. Text-fig. 2/	3	3 - 4			4		5					6-7					6	6-10		7-8	
Conodonts / Number of sample	D_1	D_3	D_5	D_7	D_{7B}	D_8	1	3	5	11	15	16	19	E_1	E_2	E_3	S_2	S_3	41	Z_1	Z_3
Schmidtognathus aff. pietzneri	1																				
Icriodus symmetricus	1				1	1				4	1			1							
Icriodus nodosus		1																		1	
Polygnathus decorosus		1	9	1	4			1	11				2	2		4		1			14
Nothognathella klapperi	1				1			1													
Ancyrodella rotundiloba rotundiloba				1																	
Ancyrodella rotundiloba alata																					
Polygnathus asymmetricus asymmetricus					2																
Polygnathus asymmetricus ovalis					6												1				
Playfordia primitiva					10																
Ancyrodella gigas									1												
Ancyrodella buckeyensis					1																
Ancyrodella lobata												3		1							4
Polygnathus brevilaminus					2			1													
Ancyrodella curvata							1	1													2
Polygnathus ancyrognathoideus																					
Palmatolepis transitans												2	2								
Palmatolepis punctata							2							1		2					
Polygnathus webbi								1		1	1	4	1	14							
Spathognathodus sannemanni treptus								1													
Icriodus alternatus									1					2		1				1	
Palmatolepis subrecta											1	2		5	1	4		3	8	1	5
Palmatolepis proversa																					
Palmatolepis hassi												2	1	3			1				
Ancyrognathus triangularis												1		2	1	2	1				
Palmatolepis gigas																			1	1	
Palmatolepis foliacea																					
Ancyrodella nodosa													3								
Nothognathella typicalis																					
Palmatolepis unicornis																					
Palmatolepis glabra glabra																					
Palmatolepis minuta minuta																					
Nothognathella sublaevis																					
Polygnathus glaber glaber																					
Palmatolepis subperlobata																					
Palmatolepis rhomboidea																					

Northern part

Number of conodont zone /cf. Text-fig. 2/	3	4-5	6			7						7-8			7				8-9				15		16	
Conodonts / Number of sample	66	53	5/1	5/2	4/1	X_1	X_2	X_3	X_4	X_5	X_6	G_1	G_2	G_5	A	B	C	D	E	M	3/1	7/1	H_1	H_2	$H_{5/6}$	H_7
Schmidtognathus aff. pietzneri	1																									
Icriodus symmetricus									1	30	3	4		1												
Icriodus nodosus			1																							
Polygnathus decorosus	7	20	2	14	8	2	2	1	2	4	6		1	1	2							5				
Nothognathella klapperi												1														
Ancyrodella rotundiloba rotundiloba																										
Ancyrodella rotundiloba alata	1																									
Polygnathus asymmetricus asymmetricus		3																								
Polygnathus asymmetricus ovalis	4	15																								
Playfordia primitiva																										
Ancyrodella gigas		5														8										
Ancyrodella buckeyensis		1																								
Ancyrodella lobata		3	6	3				1			2	3	2				3	2								
Polygnathus brevilaminus			1								1						1									
Ancyrodella curvata			1	4																						
Polygnathus ancyrognathoideus				1																						
Palmatolepis transitans				5																						
Palmatolepis punctata			3					1		3						2										
Polygnathus webbi		2		7	1		1			15	2	8			1	22	95	10		1						
Spathognathodus sannemanni treptus																										
Icriodus alternatus			1					1			1															
Palmatolepis subrecta			1			1		3	2		2		3	1	2	7	3	11	2	3	1	5				
Palmatolepis proversa							3	1	2	26	1					1		3								
Palmatolepis hassi											2	1	1			2		3				1				
Ancyrognathus triangularis																										
Palmatolepis gigas							1	1	2		1				1											
Palmatolepis foliacea								1																		
Ancyrodella nodosa										2							4	4								
Nothognathella typicalis																					1					
Palmatolepis unicornis																						1				
Palmatolepis glabra glabra																							8	7	2	
Palmatolepis minuta minuta																							5	4		1
Nothognathella sublaevis																							1			
Polygnathus glaber glaber																								1		
Palmatolepis subperlobata																								1		
Palmatolepis rhomboidea																									1	

Place of sampling in the profiles and numerical symbols of conodont zones shown in Text-fig. 2

tion with cephalopod zones, from *do I* to *do II*. Due to the lack of the outcrops of certain parts of the profile and not always precise dating of samples with a low conodont frequency, the author did not succeed to separate all conodont horizons occurring in this interval. In the environs of Górno, it was impossible to separate the beds belonging to the hermanni-cristatus Zones, but it is likely that these beds are situated just under the surface in the Górno brachyanticline. On the other hand, the Lowermost Polygnathus asymmetricus Zone of Ziegler (1971), an age equivalent of the North American Polygnathus dengleri Zone of Klapper & Johnson (1980; *cf.* Johnson, Klapper & Trojan 1980), has been recognized for the first time in the Holy Cross Mts.

In the environs of Górno, the Upper Devonian deposits form two belts separated by the Carboniferous ones; in the northern area, within the Górno brachyanticline, they are exposed in quarries *I, IIa, IIb, III* and *IV* (see Text-fig. 4) in which the conodont zones have been distinguished from the Lowermost Polygnathus asymmetricus to the undivided Palmatolepis rhomboidea, while in the southern area the zones from the Lowermost Polygnathus asymmetricus to the Upper Palmatolepis gigas have been distinguished in outcrops *V, VI* and *VII* (see Text-fig. 4). Due to the stratigraphic division it was possible to correlate deposits of different ages formed in these two areas, and four sets in common for both regions were distinguished (Text-figs 2—3), along with the fifth, the deposits of which occur only in the northern region.

Particular sets, corresponding to successive conodont zones, are marked by a varying lithological development. In the northern area (*cf.* Table 1 and Text-figs 2—3) these are as follows:

A — Lower most and Lower Polygnathus asymmetricus Zone: marly limestones, containing poor benthic fauna, colonial corals *Disphyllum* and brachiopods *Productella*; intercalations of detrital limestones appear in the higher part of the profile; strongly bituminous deposit; thickness *c.* 6 m.

B — Middle and Upper Polygnathus asymmetricus Zone: detrital limestones with poor fauna of brachiopods and fragmentary crinoid ossicles; intraformational breccia appear; thickness *c.* 3 m.

C — Ancyrognathus triangularis and Lower Palmatolepis gigas Zones:[3] detrital limestones, turbidity and intraformational breccia (*cf.* Szulczewski 1968), intercalated by a pelitic, marly limestone; thickness *c.* 12 m.

[3] Deposits from quarry IIa, regarded by Szulczewski (1971) as *to I/II*, have been included in the Palmatolepis gigas Zone. In addition to the Frasnian conodonts, Szulczewski found Famennian species in these beds. However, the presence of Famennian forms has nor been confirmed by the present studies and, in addition, the position of this profile among Frasnian beds gives evidence for its being a part of this stage. No tectonic dislocations which might lead to the position of the Famennian beds among the outcrops of the Frasnian have been found. Likewise, the lithological development of these beds is typical of the Palmatolepis gigas Zone in the area under study.

D — Upper Palmatolepis gagas Zone: wavy-bedded marly limestones, overlain with thin-bedded marly limestones; detrital limestones or intraformational breccia appear sporadically; bituminous deposit devoid of macrofauna; thickness *c.* 20 m.

E — Upper Palmatolepis crepida and Palmatolepis rhomboidea Zones[4]: marly, slightly bituminous limestones, intercalated by marly shales; thickness *c.* 25 m.

In the southern area (*cf.* Table 1, Pl. 2, Figs 1—2, and Text-figs 2—3) the following sets are distinguished:

A — Lowermost and Lower Polygnathus asymmetricus Zone: thinbedded, slightly marly limestones containing commonly the colonial corals *Peneckiella szulczewskii* Różkowska and *Pterorrhiza berdensis* (Soshkina) described by Różkowska (1979); brachiopods — atrypids, pugnaxids, pentamerids, dalmanellids, as well as the endemic species *Phlogoiderhynchus polonicus* (Roemer) revised by Biernat & Szulczewski (1975); gastropods, crinoids, ostracodes (Olempska 1979), and the receptaculitids[5]; thickness *c.* 5 m.

B — Middle and Upper Polygnathus asymmetricus Zone: marly limestones with few intercalations of crinoid limestones, the degree of the marly character of this series increases up to the appearance of the intercalations of marly shales in the upper part of the profile; thickness *c.* 15 m.

C — Ancyrognathus triangularis to Lower or Upper Palmatolepis gigas Zones: slightly bituminous, pelitic limestones with a varying degree of the marly character; knobby limestones and less frequently detrital limestones, intraformational breccia occurs locally; thickness *c.* 8 m.

D — Upper Palmatolepis gigas Zone: thin-bedded marly limestones with intercalations containing very numerous spiriferids and crinoid ossicles. The following goniatites have also been reported (Dowgiałło 1969) in outcrop *VII* (conodont samples Z_1, Z_2; see Table 1) on the Garbatka Hill (*cf.* Text-fig. 4): *Manticoceras adorfense* Wedekind, *Gephyroceras* cf. *tuberculatum* Holzapfel, *G.* cf. *undulosum* Wedekind and *G. gerolsteinense* Steininger; thickness *c.* 10 m.

The dated deposits of the lower part of the Frasnian belong to the Lowermost Polygnathus asymmetricus Zone in the both areas. However, int he northern area, they occur over black marly limestones, whereas in the southern one they directly overlie the Middle Devonian dolomites (*cf.* Text-fig. 3). Consequently, in the northern area we can expect

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[4] The goniatite *Sporadoceras biferum* Phillips, found in a waste along the western slope of the Józefka Hill (*cf.* Text-fig. 4), is indicative of a possible higher horizons of the Famennian deposits lying under the Quaternary cover.

[5] Receptaculitids have been regarded as stratigraphically important in the Frasnian (Lecompte 1958), which is confirmed in the Holy Cross Mts by their occurrence in analogous position also in the Wietrznia *II* profile (*cf.* Szulczewski 1971, p. 71).

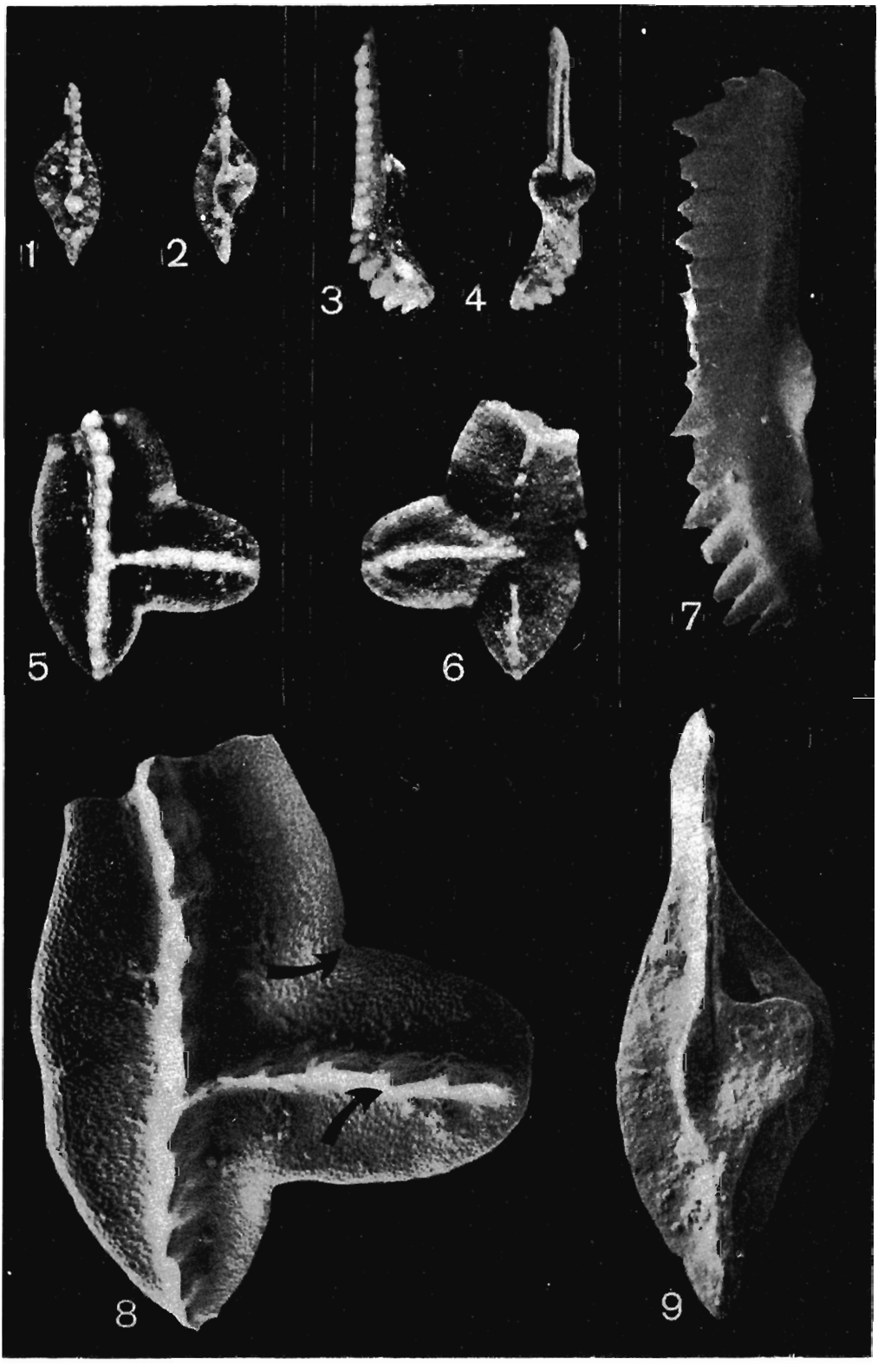
PLATE 1

1-2, 9 — *Schmidtognathus* aff. *pietżneri* Ziegler: *1* upper, *2 9* (SEM × 150) lower view of hypotype (ZPAL/G.1) from Górno (sample D_1)

3-4, 7 — *Spathognathodus sannemanni treptus* Ziegler; *3* upper, *4* lower, *7* lateral (SEM × 80) view of hypotype (ZAPL/G.2) from Górno (sample 3)

5-6, 8 — *Polygnathus ancyrognathoideus* Ziegler: *5* (SEM × 100) upper, *6* lower view of hypotype (ZPAL/G.3) from Górno (sample 5/2)

Photos 1—6 are × 36; taken by L. Łuszczewska, M. Sc., SEM photos taken by W. Skarżyński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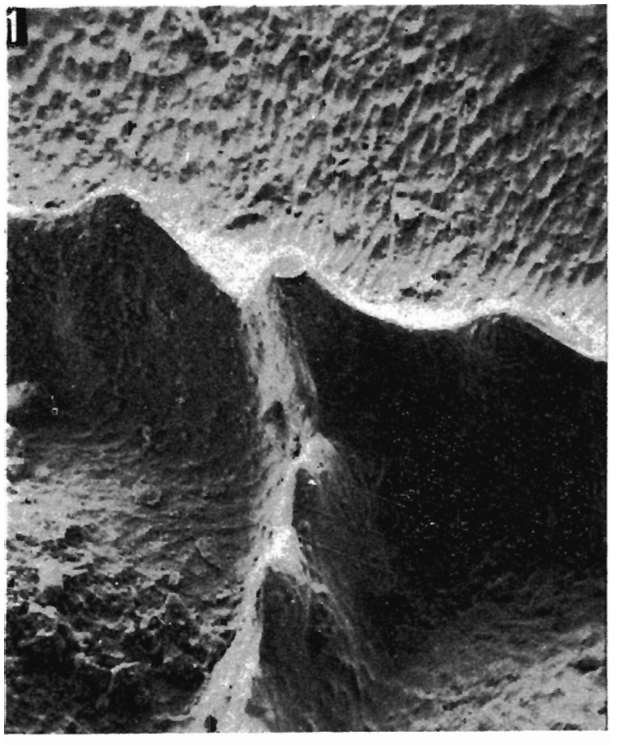
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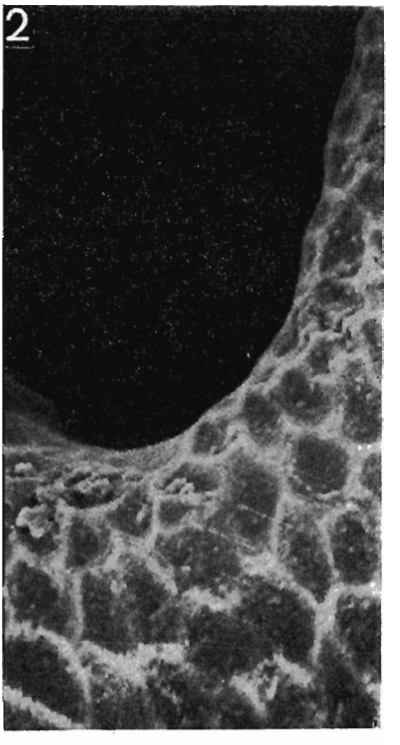
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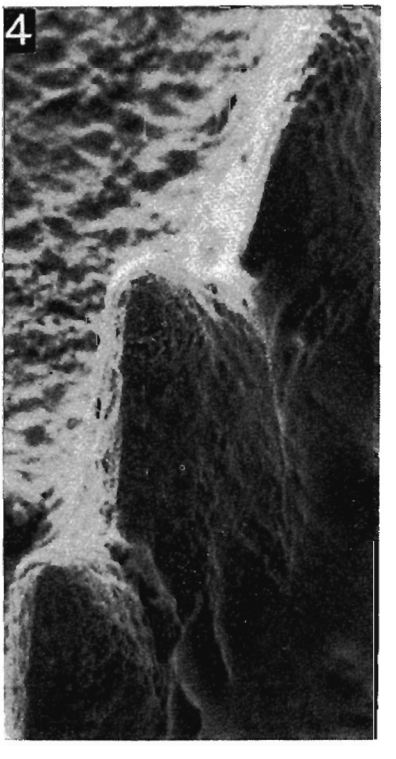
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the occurrence of the Givetian-Frasnian transitional beds developed here as black marly limestones. Since the goniatites *Pharciceras* and *Synpharciceras* belonging to the forms characteristic of the lowermost Frasnian have been found in the stratotype sections together with conodonts of the hermanni-cristatus Zone (Kullmann & Ziegler 1970), the boundary between the Givetian and Frasnian is placed below the upper or whole hermanni-cristatus Zone (House & Ziegler 1977).

The development of the deposits in both parts of the studied region indicates slight changes in their facies. The profiles in both parts make up a depositional cycle of gradually deepening marine basin, and therefore the conodont distribution in the lower part of the profiles might have somewhat been influenced by the nearshore conditions (*cf.* Dreesen & Thorez 1980). Nevertheless, it seems that the southern part was deeper. In northern part, conspicious are the effects of the bottom sloping (Szulczewski 1968, 1971) and/or earthquakes (Kaźmierczak & Goldring 1978). Shallower regions occurred in the west and possible also in the north where shallow-water, reef and transitional facies are recorded (*cf.* Szulczewski 1971).

The sequence of sets *A* and *B* in the southern area is similar to that at Śluchowice and, in particular, at Wietrznia *II* (Szulczewski 1971). Much the same as at Śluchowice, the sedimentation typical of a deeper basin appears only in the Upper Polygnathus asymmetricus Zone, replacing the shallow-water sedimentation of marly limestones containing abundant fauna (Szulczewski 1971). The redeposited sediments (sets *B* and *C*) characteristic of the northern area are similar in development to analogus sediments from Śluchowice and Kostomłoty (*cf.* Szulczewski 1971).

Cephalopods occurring on the Garbatka Hill allow one to date these deposits as *do I γ* (Dowgiałło 1969), which is in conformity with their age determination based on the conodonts.

In the two areas discussed, tectonic gaps within the Upper Devonian occur in the places of contact with the Carboniferous. In the north, this gap includes Famennian horizons higher than the Palmatolepis rhomboidea Zone and in the south at least the entire Famennian, but

PLATE 2

1-2, 4 — *Polygnathus ancyrognathoideus* Ziegler: *1* upper view of the central part of the specimen figured in Pl. 1, Figs 5—6, 8 (SEM × 300); *2* ornamentation of the upper marginal part of the specimen figured in Pl. 1, Figs 5—6, 8 (fragment arrowed in Pl. 1, Fig. 8; SEM × 1000); *4* fragment of the secondary carina with nodular teeth (arrowed in Pl. 1, Fig. 8; SEM × 450)

3 — *Schmidtognathus* aff. *pietzneri* Ziegler: basal cavity with the narrow groove (lower part of the specimen figured in Pl. 1, Figs 1—2, 9; SEM × 450)

SEM photos taken by W. Skarżyński

an accurate determination of the range of this gap was difficult due to the lack of conodonts.

TECTONICS

The pattern of outcrops of the Devonian and Lower Carboniferous deposits at Górno led to the conclusion on the existence of a syncline (Czarnocki 1938). As follows from later studies (Żakowa 1962), the Carboniferous infills herein a graben. The map presented (Text-fig. 4) confirms the existence of tectonic gaps near the northern and southern boundary of the Devonian outcrops, which is indicated by various dips of beds.

The occurrence of the Givetian was assumed in the core of the Górno brachyanticline (Czarnocki 1938). This was not, however confirmed since the oldest deposits belong to the Lower Polygnathus asymmetricus Zone. In the southern part of the region, the Devonian deposits are monoclinally inclined northwards (*see* Text-fig. 4; Pl. 3, Figs 1—2). The Givetian/Frasnian boundary on the Józefka Hill has been acknowledged as a sedimentary one, since the lower horizon of the Frasnian found there concordantly overlies the dolomites. On the other hand, a gap including the Polygnathus asymmetricus Zone is recorded on the Przyleśna Hill, which presumably indicates the existence of a fault in this locality. The shift of the Frasnian outcrops between the Przyleśna and Józefka hills was caused by a fault, which suggests a different tectonic interpretation (*cf.* Text-fig. 4) than that given by Czarnocki (1938), who assumed the existence of a fold in this place.

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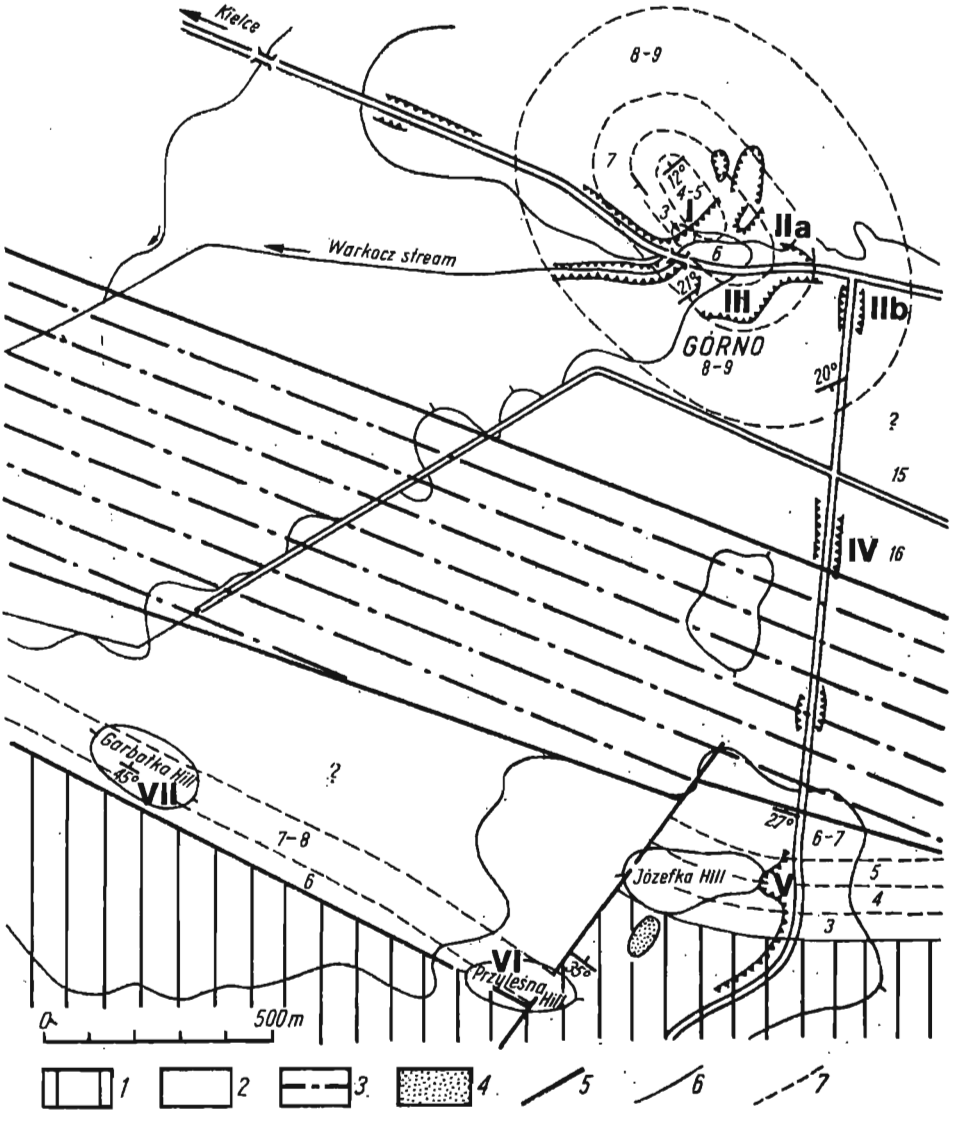
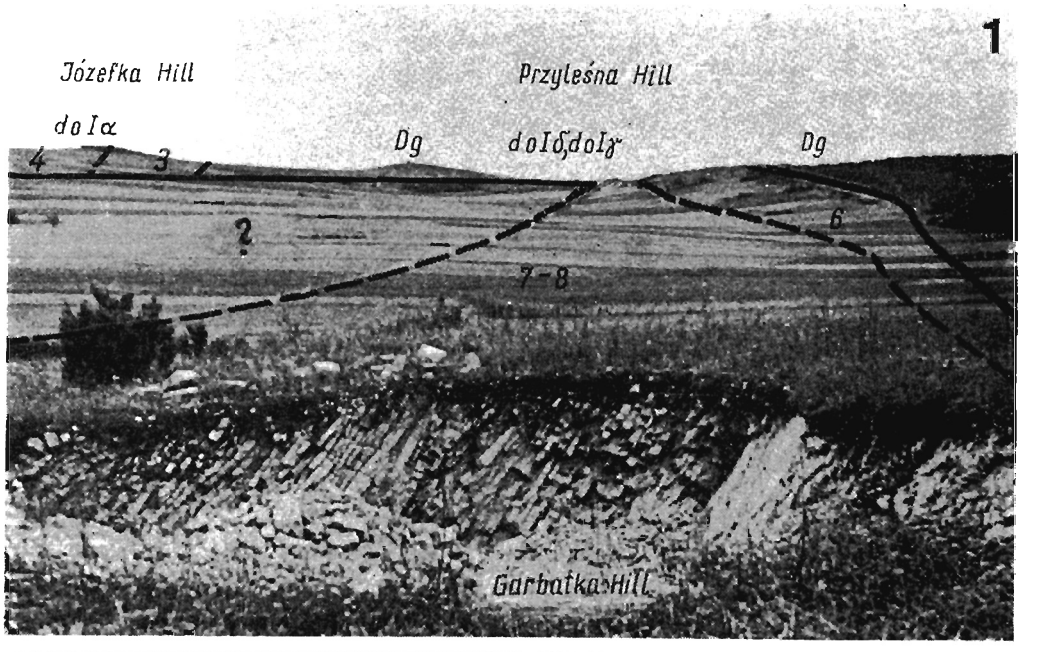
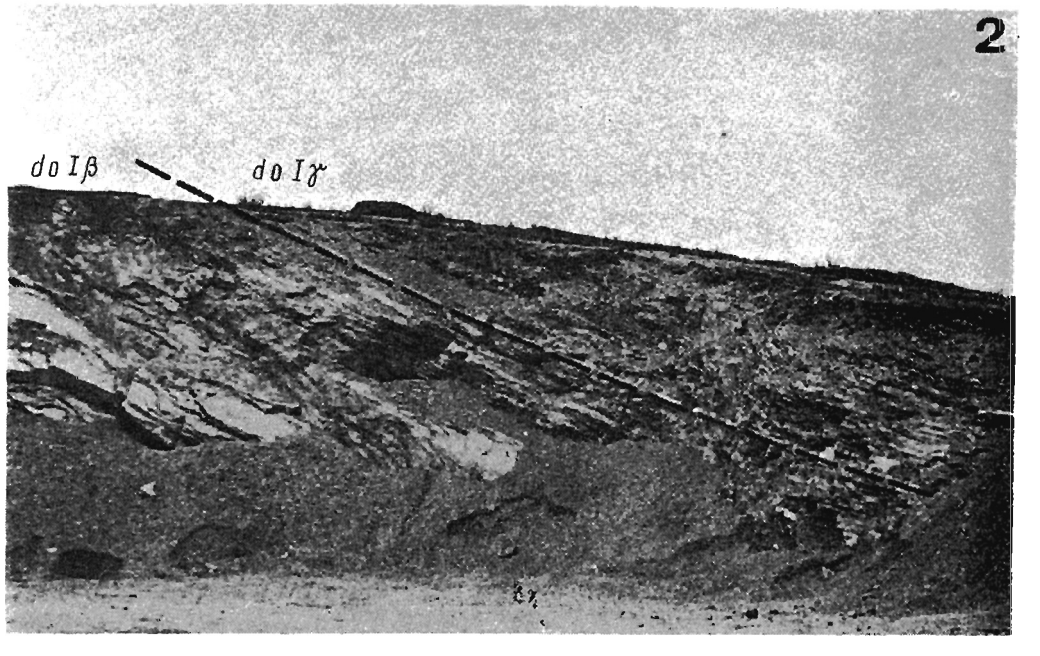


Fig. 4. Geological sketch map of the investigated region in the environs of Górno (*cf.* Czarnocki 1938, Żakowa 1962)

1 Givetian, 2 Frasnian and Famennian, 3 Lower Carboniferous (Culm facies), 4 Lower Triassic (Bunter sandstones), 5 faults, 6 stratigraphic boundaries, 7 boundaries of conodont zones (numerical symbols of conodont zones the same as in Text-figs 2—3 and Table 1)

I—VII numbers and location of the investigated profiles (*cf.* Text-fig. 2)





1 — View of Józefka and Przyleśna hills, taken from Garbatka Hill (*cf.* Text-fig. 4); stratigraphical boundaries (*dashed lines*), faults (*full lines*) as well as designation of cephalopod zones and number of conodont zones are marked

2 — Northern wall of the Józefka Quarry: marly limestones (*cf.* Text-fig. 2) at the *do Iβ/do Iγ* boundary

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GÓRNY DEWON OKOLIC GÓRNA

(Streszczenie)

Przedmiotem pracy jest stratygrafia konodontowa oraz analiza facjalna utworów górnego dewonu okolic Górna (fig. 1 oraz pl. 3). Na podstawie konodontów rozpoziomowano występujące tu utwory franu i famenu w zakresie (*por.* Szulczewski 1971) od najniższego poziomu Polygnathus asymmetricus do poziomu Palmatolepis rhomboidea (*vide* fig. 2—4). Wśród oznaczonych konodontów (tab. 1) występują trzy formy (pl. 1—2): *Polygnathus ancyrognathoideus* Ziegler, *Schmidtognathus* aff. *pietzneri* Ziegler i *Spathognathodus sannemanni treptus* Ziegler, dotychczas nie opisywane z dewonu Gór Świętokrzyskich. Wyróżnienie poziomów konodontowych umożliwiło dokładniejszą korelację utworów górnego dewonu występujących po obu stronach wychodni dolnego karbonu, a różniących się nieco facjalnie (*por.* fig. 3); dzięki temu możliwym było dokonanie korekty niektórych szczegółów budowy tektonicznej badanego obszaru (fig. 4 oraz pl. 3; *por.* także Czarnocki 1938).