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Tournaisian conodonts from the basinal carbonates of the Krzeszowice area, southern Poland

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ABSTRACT:

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The Lower Carboniferous succession, exposed in the Krzeszowice area of southern Poland, is predominantly composed of shallow-water carbonates. Only one lithological unit of spiculitic limestones was deposited in a basinal environment. The conodont fauna recovered from this unit is indicative of the *Gnathodus cuneiformis* Zone. Although the unit is lithologically monotonous, the conodonts show an irregular distribution through the section. This distribution was most probably controlled by the influence of the environmental factors and it does not reflect the evolution of the conodont fauna.

INTRODUCTION

An extremely thick carbonate platform succession (nearly 1000 m) forms the NE margin of the Upper Silesian Coal Basin in southern Poland. The exposures are located in the Krzeszowice area, in the western and eastern limbs of the Dębnik Anticline (Text-fig. 1). During the Late Devonian and Early Carboniferous this area was a part of the Moravia - Silesia Basin. Three sedimentary domains can be distinguished here: the zone of immature siliciclastics in the west, a starved basin in the middle and the carbonate platform (investigated in this study) in the east (BEŁKA 1987). Carbonate sedimentation started during the Eifelian and terminated before the end of the Viséan.

The major part of the Lower Carboniferous carbonate sequence represents the carbonate ramp and platform environments, among them an open and restricted lagoon, intertidal and sabha facies-dominated environments. In the entire succession there is only one lithological unit deposited in an intra-shelf basin and composed of graded, spiculitic limestones. It was provisionally termed the Przy Granicy Quarry Formation by PASZKOWSKI (1995), but he did not provide a precise description and definition of this unit (Text-fig. 2). Recently, APPELT (1995) described these carbonates from the large Czatkowice Quarry and gave the first, preliminary stratigraphic information on this section. In the present paper, the conodont fauna recoverd from the spiculitic limestone unit exposed in this quarry as well as in the Przy Granicy Quarry (near the village of Szklary) is described (Text-fig. 1).

The general stratigraphy of the Lower Carboniferous succession in the Krzeszowice area was established by JAROSZ (1926), who recognized the Tournaisian and Viséan stages on the basis of the macrofauna, mainly brachiopods. His conclusions were completed later by foraminiferal (SOBOŃ-PODGÓRSKA 1972, 1975; ALEXANDROWICZ & MAMET 1973), and conodont data (GROMCZAKIEWICZ-ŁOMNICKA 1975, 1979). The latter author studied single outcrops in the Racławka and Szklarka valleys. Unfortunately, the poorly documented position of samples in

sections studied by GROMCZAKIEWICZ-ŁOMNICKA, makes it almost impossible to relate her data to the present well exposed succession.

METHODS

Twenty samples from the Czatkowice Quarry (Text-fig. 3) and four from the Przy Granicy Quarry were dissolved in acetic acid. Most of the samples were 1 to 4 kg, with the exception of sample Cz1 from Czatkowice Quarry and all of the samples from Szklary, which were about 1 kg.

Conodonts were present in 15 samples (Table 1), from which 810 platform elements were recovered.

LITHOLOGY AND DEPOSITIONAL ENVIRONMENT

The spiculitic limestone unit is perfectly exposed in the northern wall of the Czatkowice Quarry on the exploitation level 370. It overlies a 40 m thick peritidal unit, composed of pelitic and fine-grained limestones with caliches, emersion surfaces, fenestral structures, and algal mats (Pstrągarnia Formation - Text-fig. 2). The topmost part of this unit contains thick-bedded, coarse-grained limestones with a considerable admixture of quartz sand and bioclasts. These sandy layers are a useful marker, facilitating recognition of the base of the spiculitic limestone unit, in which clastic material is very rare (Text-fig. 3).

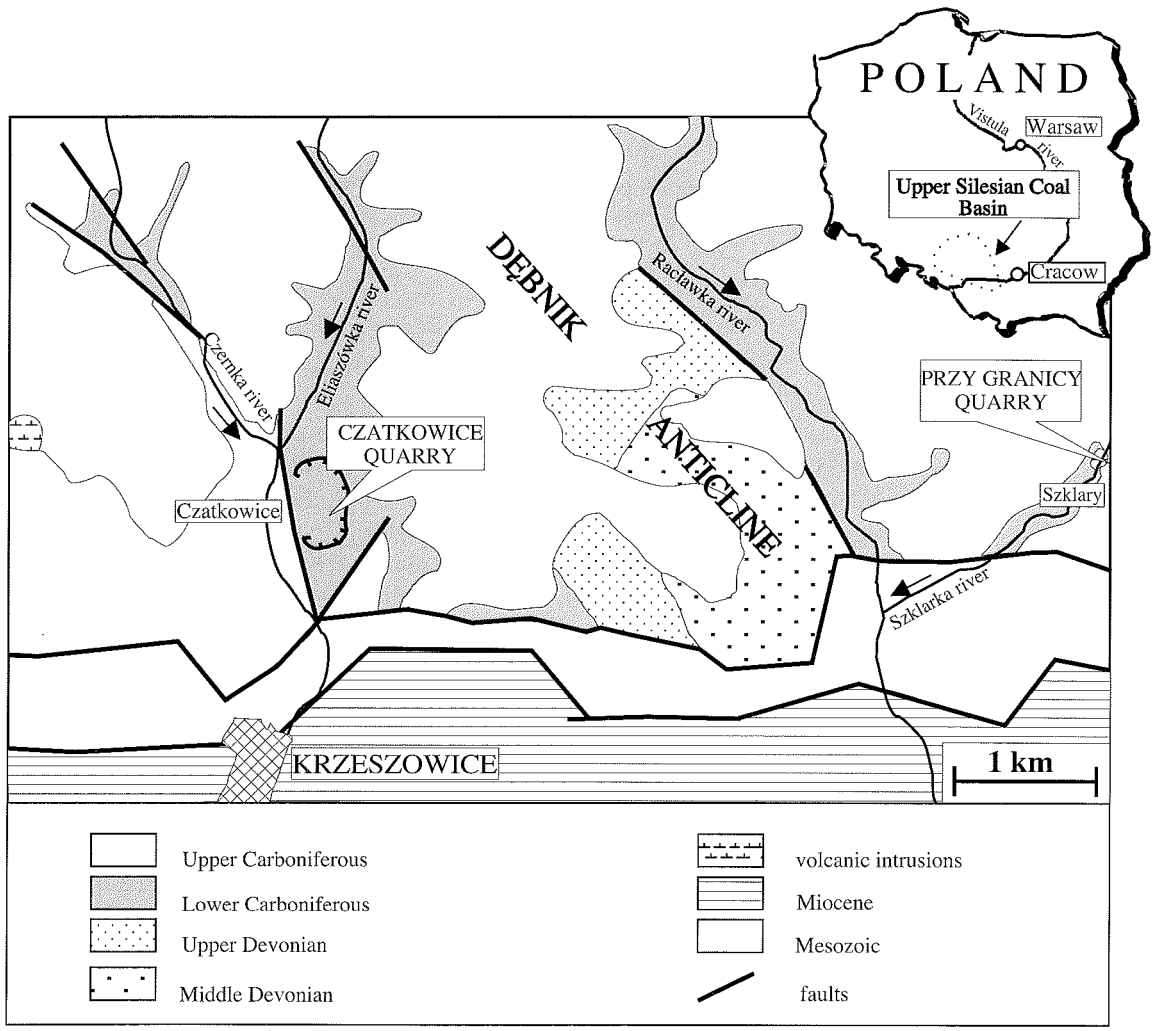


Fig. 1. Location of the studied outcrops on a simplified geological map of the Krzeszowice area (map *after* S. DOKTOROWICZ-HREBNICKI 1954)

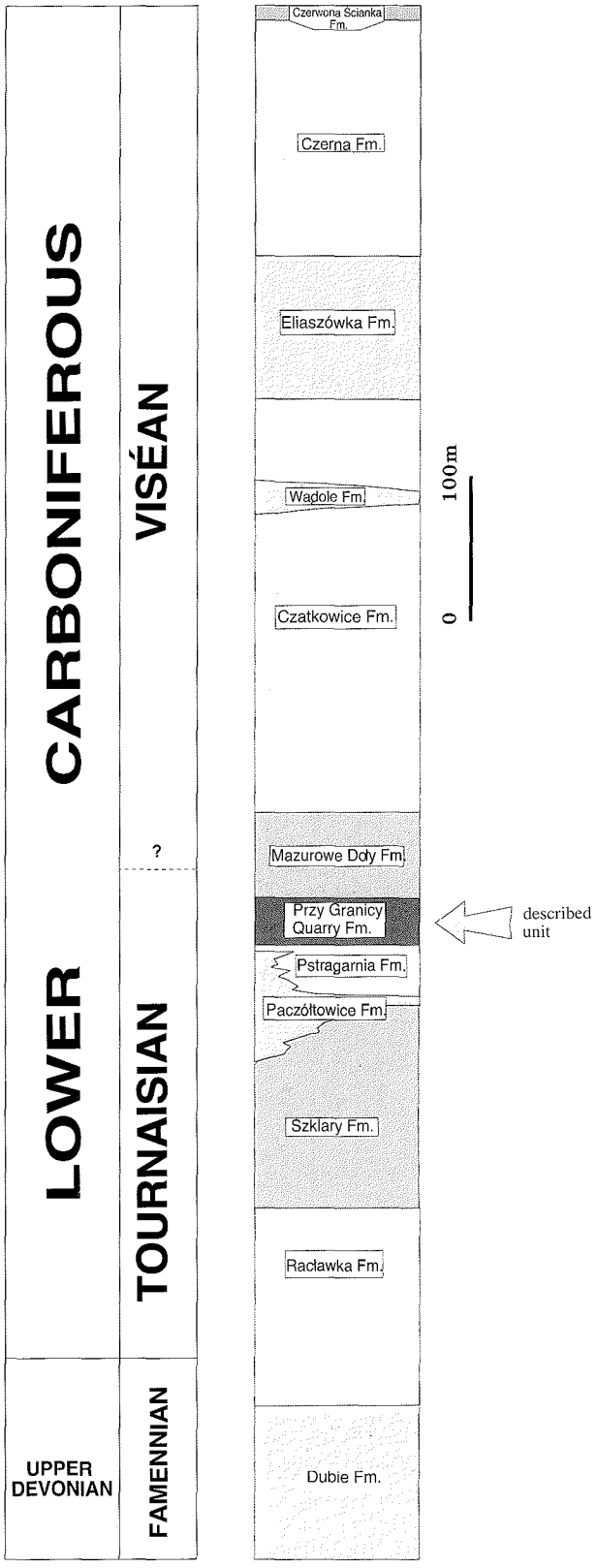


Fig. 2. Lithostratigraphy of the Lower Carboniferous in the Krzeszowice area (*after* PASZKOWSKI 1995)

The spiculitic limestone unit (30 m thick) is composed of alternations of calcilutites and fine-grained, graded calcarenites. In the lower and upper parts of this unit, the limestones are thick-bedded, massive and pale coloured; in the middle they are thin-bedded, dark and contain abundant cherts. A scattered fauna of fenestral bryozoans, brachiopods, solitary rugose corals and crinoids has been found throughout the unit. The graded calcarenite layers display more or less sharp basal contacts, and pass gradually into calcilutites (Pl. 1, Fig. 1), which are strongly bioturbated by *Zoophycos* or *Chondrites*. Sporadically, when bioturbation is absent, a horizontal lamination occurs. In the lower part of the spiculitic limestone unit, there is a pyroclastic layer (1 m thick), composed of red/grey and yellow silt with zircons, pyro-quartz and pseudomorphs after feldspars and/or volcanic glass (Text-fig. 3). The upper boundary of the unit is not very clearly defined and it is arbitrarily placed at the base of the interval in which thick-bedded, coarse-grained limestones with cross stratification start to dominate. According to PASZKOWSKI (1995), the cross-stratified beds are included to the younger Mazurowe Doły Formation (Text-fig. 2).

The calcilutites of the Przy Granicy Quarry Formation are characterised by the appearance of two microfacies: peloidal wackestone/packstone (Pl. 1, Fig. 2) and spiculitic wackestone. The graded calcarenite beds are composed of bioclastic wackestone/packstone at the base (Pl. 1, Fig. 3), followed by peloidal wackestone/packstone (Pl. 1, Fig. 4). The bioclasts usually comprise crinoids and other echinoderms, broken brachiopods, bryozoans, rare foraminifers and ostracods. Scolecodonts and common fish fragments were found in several samples (Cz2, Cz3, Cz4, Cz10, Cz11, Cz14, Cz15, and Cz17).

In the Przy Granicy Quarry, only the upper part of the spiculitic limestone unit is exposed. It consists of about 5 m of thick-bedded calcilutites with cherts. The texture corresponds to spiculitic wackestone with a relatively high content of peloids. Scattered and rare brachiopods, solitary corals and crinoids are subordinate.

The spiculitic limestones are interpreted as basinal sediments. The high amount of micritic matrix indicates a relatively low-energy environment below the normal wave base. Common bioturbation, ichnofossils and a rich benthic fauna in growth-position point to normal oxygenation. The graded accumulations of bioclastic detritus are composed of material which was probably

derived from a shallower environment as a result of downslope transport. The general lithology, deep-water ichnofossils, autochthonous and allochthonous fossils, as well as some sedimentary structures e.g. fining upward and horizontal lamination, are typical of the basinal environment (WILSON 1975).

CONODONT FAUNA AND BIOSTRATIGRAPHY

Previous data

The first information on the Early Carboniferous conodonts in the Krzeszowice area was

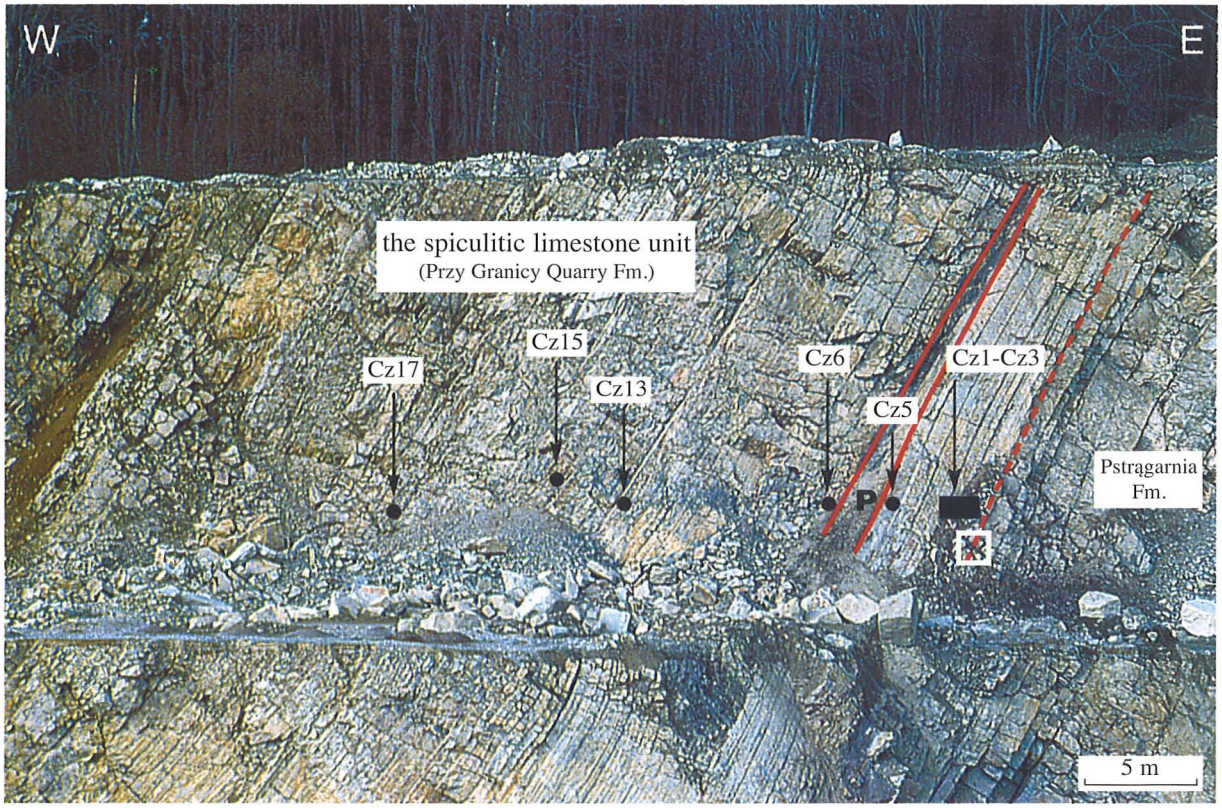
	location of samples above the base of quarry (m)	samples	*G. sp.**	*G. cuneiformis*	*G. delicatus*	*G. delicatus-cuneiformis*	*G. semiglaber*	*G. symmutatus ?*	*G. typicus*	*G. punctatus*	*G. punctatus-semiglaber*	*P. communis communis*	*P. sp.*	*Ps. sp.*	*M. groessensi*	*B. stabilis*	*B. aculeatus aculeatus*	*C. sp*	*C. unicornis*	Total number of conodonts
PRZY GRANICY QUARRY	5,00	Sz4																		-
	3,10	Sz3																		-
	1,05	**Sz2**																1	1	2
	0,60	**Sz1**	1															1		2

	location of samples above the base of formation (m)	samples																		
CZATKOWICE QUARRY	22,00	Cz20																		-
	20,80	Cz19																		-
	20,60	Cz18																		-
	20,30	**Cz17**						2					6		2	1				11
	16,40	Cz16																		-
	15,00	**Cz15**	1				1									1				3
	13,90	Cz14																		-
	13,00	**Cz13**		1								6								7
	12,00	**Cz12**										1								1
	11,10	**Cz11**										22								22
	9,70	**Cz10**										35								35
	8,20	**Cz9**							1			3								4
	7,70	**Cz8**										4								4
	6,10	**Cz7**	2									86				1				89
	5,60	Cz6																		-
		pyroclastic layer																		
	4,12	Cz5																		-
	3,0	**Cz4**	1	1			1			2	2	106				2				110
	0,8	**Cz3**	4	1			1			2	2	154				17				181
	0,12	**Cz2**	5	2					1	3		111				3	1			126
	0,04	**Cz1**	56	6	1	2	2		2	8		133		1		2				213

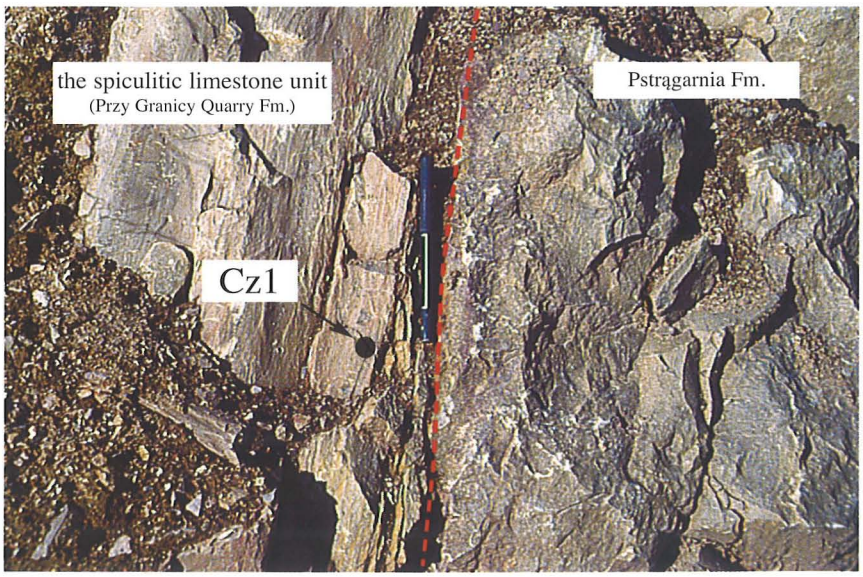
* - broken as well as juvenile elements

G.- Gnathodus, Pr.-Protognathodus, P.- Polygnathus, Ps.- Pseudopolygnathus M.- Mestognathus, C.- Cavusgnathus, B. - Bispathodus.

Table 1. Distribution of platform conodonts in the spiculitic limestones unit



A – Location of selected conodont samples in the spiculitic limestone unit in the Czatkowice Quarry; boxed area indicates the field of Figure B; p – pyroclastic layer; the base of the spiculitic limestone unit is indicated by dotted line



B – Close-up view of the base of the spiculitic limestone unit

provided by GROMCZAKIEWICZ-ŁOMNICKA (1975, 1979). She distinguished the conodont zones proposed by VOGES (1959, 1960) for the Lower Carboniferous of Germany and by GROESSENS (1974) in Belgium. According to these data, the spiculitic limestone unit represents the *Gnathodus semiglaber* Zone and the *Polygnathus communis carinus* Zone, respectively. These zones can be correlated with the *Gnathodus typicus* Zone in the conodont zonation of LANE & *al.* (1980).

Conodont fauna and age

The conodont fauna from the spiculitic limestones in the Czatkowice Quarry is dominated by the long-ranging form *Polygnathus communis communis* (Table 1). This species is associated with representatives of the genera *Gnathodus* and *Bispathodus* (Pl. 2, Figs 1-10). In the upper part of the section, exposed in the Przy Granicy Quarry in the village of Szklary, elements of the shallow-water genus *Cavusgnathus* occur (Pl. 2, Figs 12-15). The conodont fauna is relatively abundant in the lower part of the unit (Table 1), but towards the top the number of conodont elements decreases and the stratigraphically important taxa are very rare or absent. The irregular distribution of conodonts in the section does not seem to be a result of evolutionary trends of conodonts. It is most probably due to population dynamics controlled by environmental factors, which, however, are not reflected in the lithological characters of the sediments.

The conodont fauna recovered from the spiculitic limestone unit of the Czatkowice Quarry is indicative of the *Gnathodus cuneiformis* Zone. This zone corresponds to the *G. typicus* Zone of the Lower Carboniferous conodont subdivision proposed by LANE & *al.* (1980). Because of the rarity of the species *G. typicus* outside of North America sections, the *G. cuneiformis* Zone is used in Europe instead of the *G. typicus* Zone (BEŁKA 1985, BEŁKA & GROESSENS 1986, BEŁKA & KORN 1994). Moreover, in some previous zonations of the Lower Carboniferous the *G. typicus* Zone occurred below the *Sc. anchoralis* Zone, and in another, above this zone, as was pointed out by BEŁKA (1985) and by PERRET & WEYANT (1994). In the Czatkowice Quarry the *G. cuneiformis* Zone is indicated by the co-occurrence of *Gnathodus cuneiformis*, *G. typicus*, *G. delicatus* and *G. punctatus* (Pl. 2, Figs 2-4, 6-8). Unfortunately, among the conodont fauna described from the upper part of the spiculitic limestone unit in the village of Szklary there are only long-ranging species such as *Cavusgnathus unicornis* and *Polygnathus communis communis*. WAHL (1995) found there the following species: *Mestognathus groessensi*, *Cavusgnathus* sp., *Gnathodus punctatus*, *Bispathodus* sp. and *Polygnathus* sp., which are also indicative of the *G. cuneiformis* Zone.

All of the conodonts from the spiculitic limestones in the Czatkowice Quarry display very low CAI values of 1 - 1.5. Conodonts altered to CAI values of 3 - 4, however, have been found in the Przy Granicy Quarry in village of Szklary. The higher maturity is caused by the thermal influence of the post-Variscan porphyric intrusion in this area (*cf.* BEŁKA 1993).

CONCLUSIONS

The conodont fauna, recovered from the spiculitic limestone unit in the Czatkowice Quarry and in the Przy Granicy Quarry in the Krzeszowice area, is indicative of the *G. cuneiformis* Zone. This age is shown by the co-occurrence of the species *Gnathodus cuneiformis*, *G. punctatus*, and *Gnathodus delicatus*.

Despite the monotonous lithology of the whole unit, considerable differences in frequency and a general decrease in the number of conodonts towards the top of unit are observed. This pattern can be explained by the influence of environmental factors rather than by evolutionary changes in the conodont population.

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REFERENCES

ALEXANDROWICZ, S. & MAMET, B.L. 1973. Microfacies du Carbonifére inferieur du Dome de Dębnik (Pologne Meridionale). *Revista Española de Micropaleontologia*, **5**, 447-466. Madrid.

APPELT, J. 1995. Geology of the vicinity of Czatkowice near Cracow. *M.Sc. thesis*, 1-115. Warsaw University. [*In Polish*]

BEŁKA, Z. 1985. Lower Carboniferous conodont biostratigraphy in the northeastern part of Moravia - Silesia Basin. *Acta Geol. Polon.*, **35**, 33-61. Warszawa.

— 1987. The development and decline of a Dinantian carbonate platform: an example from the Moravia-Silesia Basin, Poland. *In:* J. MILLER, A.E. ADAMS & V.P WRIGHT (*Eds*), *European Dinantian Environments*, pp. 177-188. London.

— 1993. Thermal and burial history of the Cracow-Silesia region (southern Poland) assessed by conodont CAI analysis. *Tectonophysics*, **227**, 161-190. Amsterdam.

BEŁKA, Z. & GROESSENS, E. 1986. Conodont succession across the Tournaisian-Viséan Boundary Beds at Salet, Belgium. *Bull. Soc.Belg., Geologie*, **95**, 257-280. Bruxelles.

BEŁKA, Z. & KORN, D. 1994. Re-evaluation of the Early Carboniferous conodont succession in the Esla Area of the Cantabrian Zone (Cantabrian Mountains, Spain). *Courier Forsch.-Inst. Senckenberg*, **168**, 183-193. Frankfurt am Main.

DOKTOROWICZ-HREBNICKI, S. 1954. Geological map of the Upper Silesia Coal Basin (without Quaternary deposits), scale 1:50 000. *Instytut Geologiczny*, Warszawa.

GROESSENS, E. 1974. Distribution de conodontes dans le Dinantian de la Belgique. *Internat. Symposium on Namur*, 1974, **17**, 3-193. Bruxelles.

GROMCZAKIEWICZ-ŁOMNICKA, A. 1975. Upper Viséan conodont fauna from the Carboniferous Limestones north of Krzeszowice (Environs of Cracow, Poland). *Ann. Soc. Gol.Pologne*, **44** (4), 475-481. Warszawa.

— 1979. Conodont stratigraphy of the Uppermost Devonian and Lower Carboniferous rocks in the Racławka and Szklarka valleys west of Cracow. *Ann. Soc. Géol. Pologne*, **29**, 489-499. Warszawa

JAROSZ, J. 1926. Obecny stan badań nad stratygrafią dewonu i karbonu w okręgu krakowskim. *Ann. Soc. Géol. Pologne*, **3**, 115-185. Warszawa.

LANE, H.R., SANDBERG, C.A., & ZIEGLER, W. 1980. Taxonomy and phylogeny of some Lower Carboniferous conodonts and preliminary standard post-*Siphonodella* zonation. *Geologica et Palaeontologica*, **14**, 117-164. Marburg.

PASZKOWSKI, M. 1995. Description of stops - Cracow region. *In:* M. SZULCZEWSKI & J. DVOŘAK (*Eds*), Evolution of the Polish-Moravian Carbonate Platform in the Late Devonian and Early Carboniferous, Holy Cross Mountains, Cracow Upland, Moravian Karst. *XIII International Congress on Carboniferous-Permian - Cracow 1995. Excursion B-4 Guidebook*, 23-28. Kraków.

PERRET, M.F. & WEYANT, M. 1994. Les Biozones á conodontes du Carbonifére des Pyrénées. Comparaisons avec d'autres régions du globe. *Géobios*, **27**, 689-715. Lyon

SOBOŃ-PODGÓRSKA, J. 1972. Otwornice z odsłonięć wizenu w Czernej koło Krzeszowic. *Biul. Inst. Geol.*, **233**, 209-230. Warszawa.

— 1975. Stratygrafia karbonu dolnego w Czernej koło Krzeszowic. *Biul. Inst. Geol.*, **282**, 249-269. Warszawa.

VOGES, A. 1959. Conodonten aus dem Unterkarbon *I* und *II* (*Gattendorfia* und *Pericyclus* – Stufe) des Sauerlandes. *Paläont. Z.*, **33** (4), 266-314. Stuttgart.

— 1960. Die Bedeutung der Conodonten für die Stratigraphie des Unterkarbons I und II (*Gattendorfia* und *Pericyclus* – Stufe). *Forschr. Geol. Rheinld. Westf.*, **3**, 197-228. Krefeld.

WAHL, G. 1995. Lithologie, Facies und Diagenese der unter-karbonischen Karbonate im östlichen Krakauer Palozoikum (Polen). *Unpublished M. Sc. thesis*, Eberhard-Karls-Universität Tübingen.

WILSON, J.L. 1975. Carbonate facies in geologic history, 1-471. *Springer-Verlag*; Berlin - Heidelberg.

Plate 1

1 – Graded calcarenite with sharp basal contact and cherts (the pencil is 12 cm long); middle part of the spiculitic limestone unit; Czatkowice Quarry
2 – Peloidal wackestone with bioturbation (b) and rare bioclasts (bc); sample Cz3; thin section, × 80
3 – Bioclastic wackestone/wackestone with sharp basal contact; bioclasts are represented by: bryozoans (a), brachiopods (b), foraminifers (c), and echinoderms (d); sample Cz2; thin section, × 160
4 – Peloidal packstone with horizontal lamination; 13 m above the base of the spiculitic limestone unit in the Czatkowice Quarry; thin section, × 20


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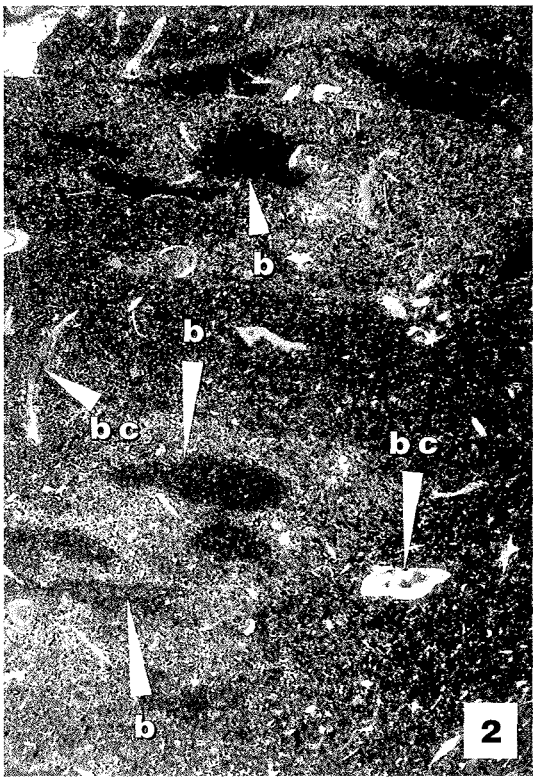
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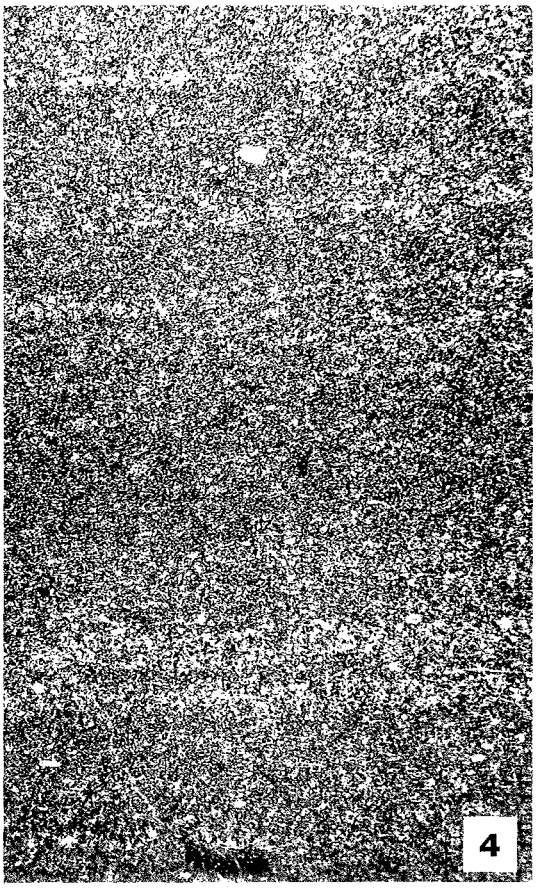
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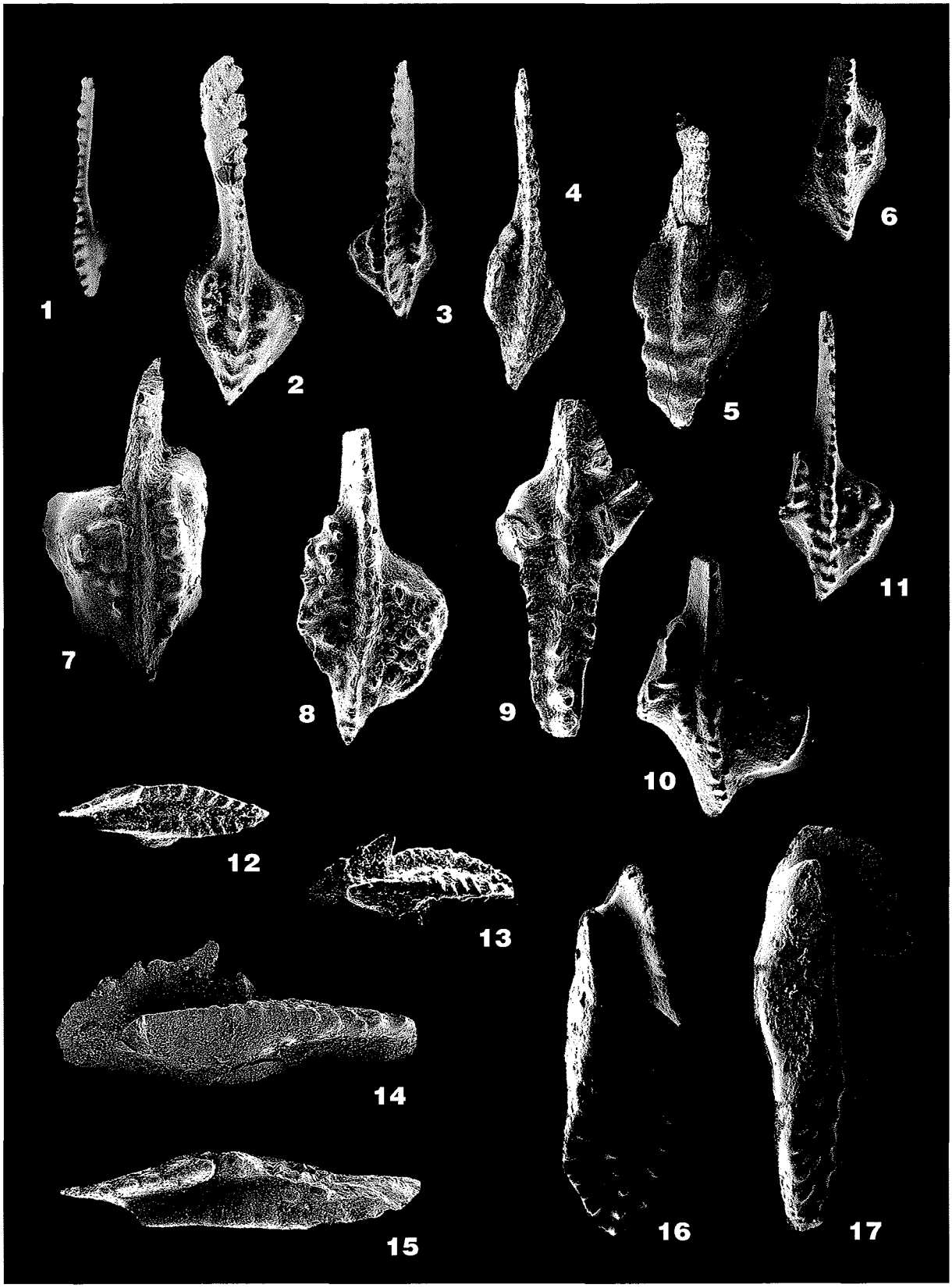
Plate 2

Conodonts from the spiculitic limestone unit

1 – *Gnathodus symmutatus*? (RHODES, AUSTIN & DRUCE, 1969) × 120, sample Cz17,
2-3 – *Gnathodus cuneiformis* (MEHL & THOMAS, 1947), 2 – × 200, sample Cz3, 3 – × 200, sample Cz2,
4 – *Gnathodus typicus* (COOPER, 1939), sample Cz9, × 160
5 – *Gnathodus* sp. (PANDER, 1856), sample Sz1, × 141
6 – *Gnathodus typicus* (COOPER, 1939), sample Cz2, × 200
7 – *Gnathodus delicatus* (BRANSON & MEHL, 1938), sample Cz1, × 100
8 – *Gnathodus punctatus* (COOPER, 1939), sample Cz1, × 109
9 – *Pseudopolygnathus* sp. (BRANSON & MEHL, 1934), sample Cz1, × 70
10-11 – *Gnathodus punctatus* (COOPER, 1939), sample Cz3, × 140, transitional form to *Gnathodus semiglaber*
12-13 – *Cavusgnathus unicornis* (YOUNGQUIST & MILLER, 1949), Szklary quarry, × 120
14-15 – ?*Cavusgnathus* sp. (HARRIS & HOLLINGSWORTH, 1933) with broken platform and parapet, sample Sz1, × 144
16-17 – *Mestognathus groessensi* (BEŁKA, 1983), sample Cz17, × 200

1-12, 15, 16 – upper views, 13, 14, 17 – inner lateral views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