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THE SIGNIFICANCE OF DEVONIAN CONODONT FAUNAS FOR THE STRATIGRAPHY OF EPI-METAMORPHIC ROCKS OF NORTH-EASTERN PART OF THE GÓRY KACZAWSKIE

CONTENTS

Abstract

The stratigraphy of Devonian rocks of the northern part of the Góry Kaczawskie was recognized through conodont studies. The presence of Emsian, Eifelian, Frasnian and Famennian stages is evidenced by conodont fauna. This dating led to the revision of prior stratigraphic scheme and opinions on the age of folding and metamorphism in the Góry Kaczawskie. 26 species of platform conodonts belonging to 8 genera, were recorded. The paleontological chapter of the present paper discussed 7 stratigraphically important species placed here in open nomenclature.

INTRODUCTION

The stratigraphy of epi-metamorphic series of the Góry Kaczawskie (the Kaczawa Mts) was based till now upon few paleontological discoveries dating the Middle Cambrian, Silurian, and lowermost Devonian. The rock series were mostly dated by means of comparing their position to that of the graptolite-bearing rocks or by lithostratigraphic correlations with various series from Thuringia, Lusatia, and Bohemia. Based on such criteria the stratigraphic division of the Góry Kaczawskie metamorphic complex, was a matter of permanent controversy which to be inescapable because of lack of any fossils useful for the stratigraphic purposes. Baranowski's discovery of conodonts in thin sections of siderite rocks from the Świerzawa region was a true turning-point (Baranowski, Urbanek 1972). The present author started in 1971 her detailed studies of slates coming from northeastern part of the Góry Kaczawskie, and examined some 150 samples from 29 exposures. Devonian conodont fauna was found in 12 exposures, while 7 exposures provided samples bearing conodonts not older than the Emsian. Cono-

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donts discovered in 6 exposures were unrecognizable. Rich assemblages of Ordovician conodonts, which will be described in the future, were obtained from the remaining 4 exposures. More than 1,500 Devonian conodonts were obtained, and nearly 750 individuals were assignable at least to the genera; unfortunately, all the specimens were more or less broken.

The presence of paleontologically evidenced metamorphic rocks, assigned to the Devonian, enabled the revision of the hitherto held opinions on the stratigraphy of the Kaczawa metamorphic series and the age of the main folding and metamorphism of these series. The latter subject was more extensively discussed in the earlier paper (Urbanek 1975).

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PRIOR STRATIGRAPHIC CONCEPTS: A REVIEW

The first informations on the age of epi-metamorphic rocks of the Góry Kaczawskie date back to the last century, and they refer to Silurian deposits bearing the graptolite fauna (Peck 1865 *fide* Schwarzbach 1936; Roemer 1868; Gürich 1882).

Extensive geological mapping (scale 1:25 000) started in the Góry Kaczawskie at the beginning of the century; it resulted in the issuing of several sheets supplemented by explanations (e. g. Berg 1935; Kühn, Zimmermann 1918; Zimmermann 1936, 1941). Their authors presented a detailed lithological division of the whole epi- metamorphic complex ascribing it to the Older Paleozoic, and only the Silurian was distinguished within this complex.

Based on prior works (most of all Zimmermann and Schwarzbach), Bederke (1933) and Dahlgrün (1934) elaborated the first tentative stratigraphic division of the Góry Kaczawskie metamorphic rocks.

Dahlgrün's (1934) stratigraphic scheme, though slightly modified and even questioned, is commonly used up to the present days. This scheme is as follows:

— Radzimowice slates and siliceous rocks	— Algonkian**
— Wojcieszów limestones and porphyroids	— Lower Cambrian
— stage of greenstones with porphyroids	— Upper Cambrian
— stage of mica-rich light clayey and sandy slates with the Tarczyn quartzite	— Lower Ordovician
— stage of gray blue clayey slates poor in mica	— Upper Ordovician
— siliceous and alum slates bearing graptolites	— Silurian

Neither Dahlgrün (1934) nor most of his successors took into account the possibility of occurrence, in the Kaczawa complex, of rocks younger than the Silurian. It was Schwarzbach (1936), however, who suggested the Early Carboniferous age of some limestones (e. g. limestones of Lubań) and accompanying graywackes, but he did not support and unambiguonsly confirm this view in the next paper (Schwarzbach 1939, pp. 6 and 14). Jaeger's recognition (1963, 1964) of *Monograptus hercynicus*, reported from graptolite slates of the Lubań region, extended automatically the stratigraphic range of the Kaczawa complex up to the upper part of Gedinnian (cf. Jaeger 1964, 1970). This fact as well as new biostratigraphic data from the Lusatian Paleozoik rocks (references cited in Brause 1965; Freyer 1965) significantly changed the views on the stratigraphy of the Góry Kaczawskie metamorphic rocks. Till now, the problem how long lasted the geosynclinal sedimentation in the Kaczawa basin, was a matter of two concurrent hypotheses.

H. Teisseyre (1967b, 1968) and Oberc (1966, 1967, 1972, 1973) claimed that the sedimentation ended in the Middle Devonian (for details see Urbanek 1975). The Lower and Middle Devonian was to be represented, according to Oberc's (1966, 1973) lithological correlation, by the „Wojcieszyn beds". Also based on the lithological correlation, Urbanek *et al.* (1975) suggested rather Ordovician age of at least part of these „beds". Similar view was earlier expressed by Quitzow (1939).

The others authors (Jaeger 1963, 1964; Hirschmann 1964; Brause 1965) comparing the Kaczawa rocks to the paleontologically evidenced rocks in Lusatia, stated that the sedimentation in the discussed region went on up to the Late Devonian and even Early Carboniferous.

According to Hirschmann (1964) and Brause (1965) the "quartzite of Tarczyn", considered till now as Lower Ordovician rocks (e. g. Dahlgrün

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** H. Teisseyre (1956) supposes that the Radzimowice slates "... are not a unit in a stratigraphical meaning, but they represent the formation which was developed owing to a tectonic shuffling of the Eocambrian elements with the rocks of Cambrian, Ordovician, and Silurian age".

1934; Schwarzbach 1936, 1939; Teisseyre 1967a; Oberc 1973), is the time equivalent of the Lusatian "Mönauquartzite", the stratigraphic position of which is well paleontologically established as lying between Middle and Upper Devonian rocks. Previously, the "quartzite of Tarczyn" was commonly assigned to the Lower Ordovician because of its lithological similarities to the Lusatian quartzite of Dubrau (cf. Schwarzbach 1936).

On the basis of conodont fauna, Reichstein (1961) recognized the Late Devonian age of the Lusatian limestones of Kunnersdorf. Thus, Jaeger (1964) suggested the limestones of Lubań to be of the same age. Recently, in the latter rocks, Chorowska (1975) mentioned her findings of some fossils pointing to the Early Carboniferous age. Unfortunately, Chorowska neither described her findings nor published the list of discovered fossils.

Brause (1965) supposed that the "graywackes of Jenków" are likely of the Early Carboniferous age whereas other authors assigned these rocks to the Algonkian, Ordovician, or Silurian (e. g. Schwarzbach 1936; Fabian 1938, 1939; Jerzmański 1965).

Serious doubts were casted upon the views of Jaeger, Hirschmann and Brause as they were not paleontologically evidenced. Thus, the actual existence of rocks representing the interval from the Sigennian to the Lower Carboniferous was uncertain. This gap has gradually been tightened by means of biostratigraphic data preliminary reported by the present author (Urbanek 1975; Urbanek, *et al.* 1975) and featured in details in the further sections of this article. Moreover,the conodont discoveries in limestones of the Gryfów region (western part of the Góry Kaczawskie) evidenced Late Devonian and Early Carboniferous age of these rocks (Chorowska, Sawicki 1975).

It is evident from the above cited concepts that stratigraphy of the Góry Kaczawskie metamorphic rocks was based upon greatly arbitrary criterions; accordingly, these concepts must have been remarkably divergent. Therefore, it seems to be necessary to discuss the usefulness and significance of the individual criterions for stratigraphic reconstruction in the questioned region.

Biostratigraphic correlation is severely hampered by almost lack of the leading fossils. In practice, such a correlation has long been possible only by means of graptolites in Silurian strata; and recently also owing to the presence of corals of genus *Cambrotrypa* in Cambrian deposits (Gorczyca-Skała 1966; Gunia 1967).

The present state of the biostratigraphy of Silurian in the Góry Kaczawskie seems to be questionable in some respects.

The graptolite fauna long known in the region, as yet is not elaborated in details and in a modern fashion. The only detailed works done by Hundt (1922, 1924) should be subject to a thorough revision in the light of a great advance in the knowledge of graptolites (taxonomic changes, new taxa, definition of stratigraphic ranges). However, most of the recent papers contain mere lists of the graptolites recognized in the individual localities but lack illustrations and paleontological descriptions (e. g. Miszczuk in Jerzmański 1965, Kornaś 1963, 1974). Obviously, the correct correlation has to be based upon a complete and verified paleontological documentation; then, diverget conclusions of various authors may properly be revised (e. g. locality of graptolite fauna at the railway cutting in Różana) (cf. Hundt 1922; Kornaś 1963).

At present, the lithostratigraphy in the Góry Kaczawskie is badly recognized, because of the lack of correlative horizons (monotonous lithology), strong refoldings, obliteration of the primary sedimentary structures, etc. Therefore, the Góry Kaczawskie metamorphic rocks cannot be successfully correlated with the Lusatian Paleozoic rocks. No wonder that the geologists working on this problem did not succeed in obtaining any reliable lithostratigraphical scheme. The more so that the same lithological member of the Kaczawa complex was frequently compared to the Lusatian members characterized by quite different ages (e. g. the problem of the "quartzite of Tarczyn").

The recognition of the chronostratigraphy of the Kaczawa complex on a basis of the principle of superposition, which most frequently is used in common with the questioned above lithostratigraphic correlation to the remote areas, seems to be impossible or strongly doubtful (e. g. the problem of age of the siliceous slates and associated beds discussed by Zimmermann 1936, pp. 16 - 18). It is due to strong refoldings of the Kaczawa rocks and shortage of paleontological data.

GEOLOGICAL SETTING

Epi-metamorphic rocks built the so-called lower structural stage of the Góry Kaczawskie — one of the large geological units of the Western Sudetes (Teisseyre in Teisseyre *et al.* 1957). The author has studied only a small part of the Góry Kaczawskie, namely the western portion of the Rzeszówek—Jakuszowa unit (figs. 1—2). This unit was distinguished by Jerzmański (1965). It abuts on the north against

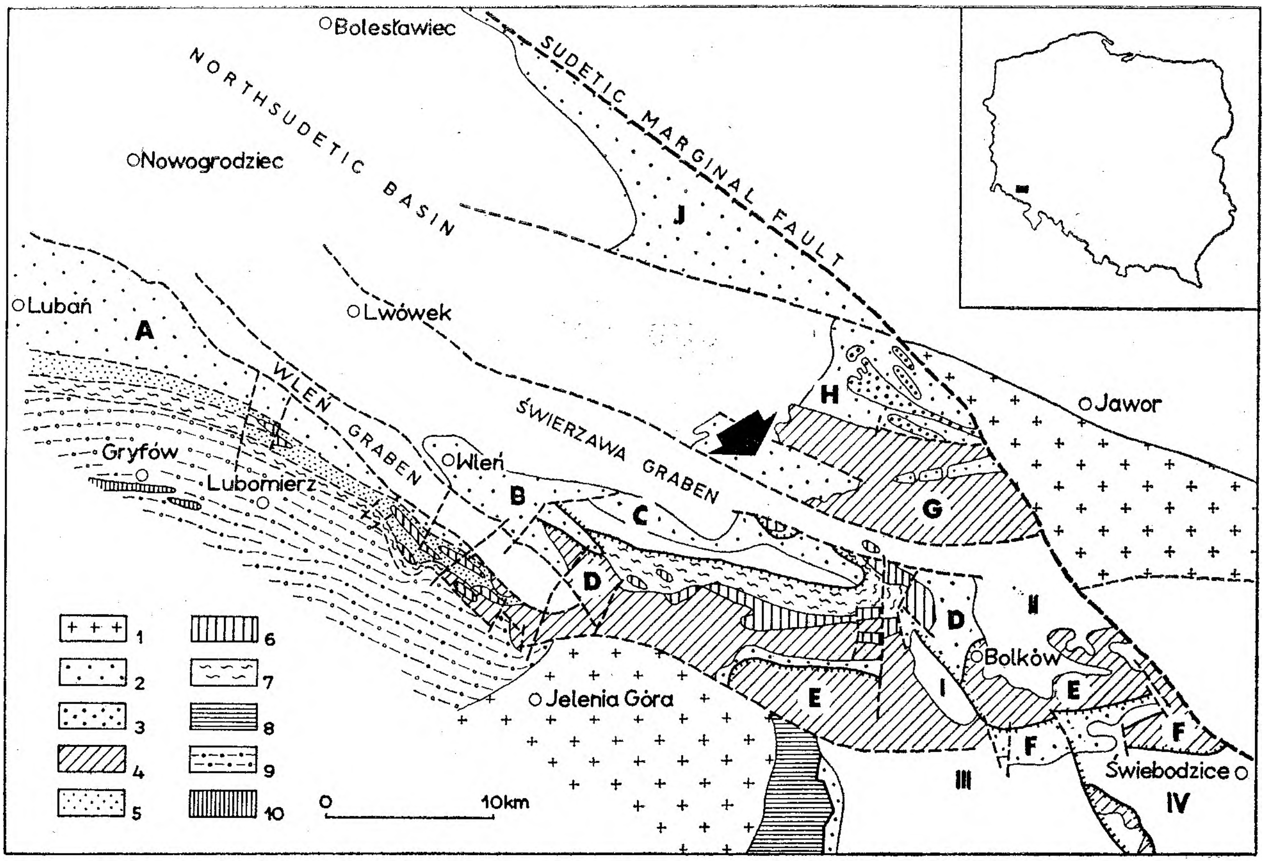

Fig. 1

Geological sketch of the Góry Kaczawskie (the Kaczawa Mts.) and adjacent areas according to Teisseyre (1967a), partly modified by the author

1 — Hercynian granite; *2* — Silurian and Ordovician; *3* — Ordovician greenstones and diabases; *4* — Upper and Middle Cambrian-volcanic stage; *5* — Cambrian in general — slates; *6* — Lower and Middle Cambrian — the Wojcieszów limestones; *7* — Eocambrian — slates; *8* — metamorphic series of the eastern Karkonosze Mts.; *9* — Isera gneisses; *10* — mica schists (Precambrian); *A* — Pilchowice unit, *B* — Wleń unit, *C* — Świerzawa unit, *D—D* — Bolków unit, *E—E* — Dobromierz unit, *F—F* — Cieszów unit, *G* — Rzeszówek—Jakuszowa unit, *H* — Chełmiec unit, *J* — Złotoryja—Luboradz unit (the Sudetic part); *I* — Wierzchosławice trough, *II* — Wolbromek trough, *III* — northern part of the Intrasudetic Basin, *IV* — Świebodzice depression

Szkic geologiczny metamorfiku kaczawskiego i obszarów ramowych według Teisseyre'a (1967a), częściowo zmieniony przez autorkę

1 — granit waryscyjski; *2* — sylur i ordowik; *3* — zieleńce i diabazy ordowiku; *4* — kambr górny i środkowy — piętro wulkaniczne; *5* — kambr w ogólności — metałupki; *6* — kambr dolny i środkowy — wapienie wojcieszowskie; *7* — eokambr — metałupki; *8* — metamorfik wschodnich Karkonoszy; *9* — gnejsy izerskie; *10* — łupki łyszczykowe (prekambr); *A* — jednostka Pilchowic, *B* — jednostka Wlenia, *C* — jednostka Świerzawy, *D—D* — jednostka Bolkowa, *E—E* — jednostka Dobromierza, *F—F* — jednostka Cieszowa, *G* — jednostka Rzeszówek—Jakuszowa, *H* — jednostka Chełmca, *J* — jednostka Złotoryja—Luboradz (część sudecka); *I* — zapadlisko Wierzchosławic, *II* — zapadlisko Wolbromka, *III* — północna część depresji śródsudeckiej, *IV* — depresja Świebodzic

metamorphic rocks of the Chełmiec unit and on the northwest and west against Permian deposits of the Northsudetic Basin. On the south the Rzeszówek—Jakuszowa unit is separated by the northern Świerzawa fault from the Świerzawa graben, and on the east it is bordered by the marginal Sudetic fault.

The western part of the discussed unit is built of metamorphic rocks of sedimentary and volcanic origin. These rocks were metamorphosed under the conditions of the lower range of low metamorphic stage (Baranowski 1975a, 1975b). The formation of sedimentary origin was divided by Baranowski (*op. cit.*) into two lithofacies: of normal flysch developed in the eastern part of the area, and of shaly flysch recognized in the western part (fig. 2). Baranowski emphasizes a facial character of the above divisions and suggests that these facies cut obliquely the chronostratigraphic boundaries. His opinion was based on biostratigraphical data; Silurian graptolites were reported from the shaly flysch (Hundt 1922; Kornaś 1963; Teller in Baranowski 1975b) whereas rocks of the normal flysch contained Ordovician conodonts (Baranowski, Urbanek 1972).

Recently A. Haydukiewicz (1977) reports that the Rzeszówek-Jakuszowa unit sensu Jerzmański (1965) is, in fact, composed of two different tectonic units separated by an overthrust plane. The lower unit, named the Rzeszówek unit, is built of metasedimentary rocks corresponding to the shaly flysch lithofacies of Baranowski (1975b). The upper one, called the Jakuszowa unit, consists of rocks of the greenstone formation and the normal flysch lithofacies of Baranowski (*op. cit.*).

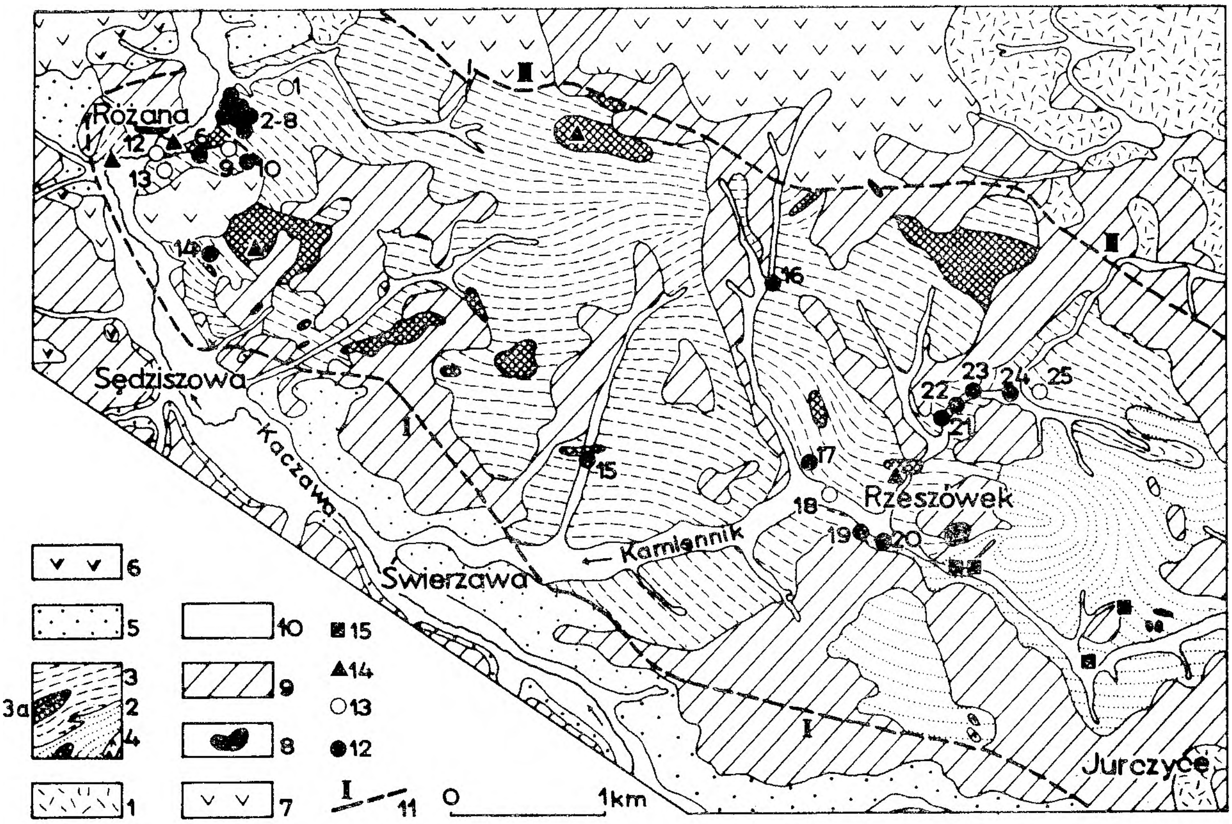

Fig. 2

Schematic geological sketch of western part of the Rzeszówek—Jakuszowa unit (after Baranowski 1975b). The stratigraphy in part corrected by the author

1 — greenstones (Upper Cambrian-Silurian?); *2* — normal flysch (Ordovician at last in part); *3* — shaly flysch (mostly Silurian and Devonian); *3a* — lidites (Silurian); *4* — keratophyries and porphyroids (Ordovician-Silurian?); *5* — conglomerates, sandstones, and shales (uppermost Carboniferous-Lower Permian); *6* — melaphyries (Lower Permian); *7* — porphyries (Lower Permian); *8* — basalts (Tertiary); *9* — fluvio-glacial deposits (Pleistocene); *10* — alluvial deposits; *11* — faults (*I—I* — the northern Świerzawa fault, *II—II* — the Muchów fault); *12* — localities of the Devonian conodont fauna; *13* — localities of unrecognized conodont fauna; *14* — localities of the Silurian graptolite fauna; *15* — localities of the Ordovician conodont fauna

Zgeneralizowany szkic geologiczny zachodniej części jednostki Rzeszówek—Jakuszowa (według Baranowskiego 1975b). Stratygrafia częściowo poprawiona przez autorkę

1 — zieleńce (górny kambr-sylur?); *2* — flisz normalny (przynajmniej częściowo ordowik); *3* — flisz łupkowy (w większości sylur i dewon); *3a* — czarne łupki grafitowe i lidyty (sylur): *4* — keratofiry i porfiroidy (ordowik-sylur?); *5* — zlepieńce, piaskowce i łupki (najwyższy karbon — dolny perm); *6* — melafiry (dolny perm); *7* — porfiry (dolny perm); *8* — bazalty (trzeciorzęd); *9* — utwory wodno-lodowcowe (plejstocen); *10* — utwory aluwialne; *11* — uskoki (*I—I* — północny uskok Świerzawy, *II—II* — uskok Muchowa); *12* — stanowiska dewońskiej fauny konodontowej; *13* — stanowiska fauny konodontowej nieokreślonego wieku; *14* — stanowiska sylurskiej fauny graptolitowej; *15* — stanowiska ordowickiej fauny konodontowej

DESCRIPTION OF THE SELECTED LOCALITIES OF CONODONT FAUNA

Only 7 of 25 fauna localities (*cf.* fig. 2) were described in the present paper. It is these localities that provided the richest and the best preserved conodonts. A description of each locality comprises data on lithology and general tectonic features (for more detailed data — see A. Haydukiewicz 1977). All the rocks whose descriptions are given below, were included in Dahlgrün's (1934) "stage of gray blue clayey slates poor in mica".

Situation of the conodont bearing samples is denoted on the photographs of the individual localities (figs 4—8). Samples are with capital letters. Only the samples containing the best preserved specimens were taken into account in the course of stratigraphic analysis of the conodont faunas.

LOCALITY 2

1. Situation: natural exposure (fig. 4) in the village of Różana, right bank of the Kaczawa river (cf. figs 2—3).

2. Lithology: microquartzites (recrystallized siliceous rocks) of light gray colour (pl. I, *4*) intercalated with dark gray or nearly black microquartzites rich in organic material. Black microquartzites contain numerous recrystallized organic fragments, most probably radiolarians (pl. I, *1*).

3. Tectonics: bedding of microquartzites dips monoclinnaly south-westwards at an angle 45° in the middle part of the exposure; a fragment of the fold closure is visible in southern part of the exposure; slaty

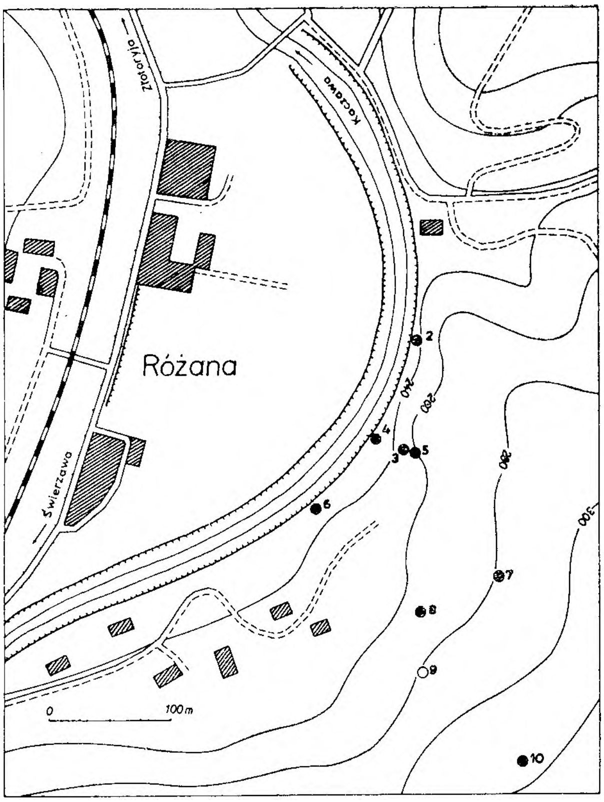

Fig. 3
Location of conodont fauna nearly Różana
Lokalizacja stanowisk fauny konodontowej w rejonie Różanej

cleavage is oblique to the sedimentary bedding; the cleavage is faint in light gray microquartzites and distinct in dark varieties of these rocks.

LOCALITY 4

1. Situation: natural exposure (fig. 5) at the right bank of the Kaczawa river, the village of Różana (cf. figs 2—3).
2. Lithology: light gray microquartzites (pl. I, *3*) containing a great deal of recrystallized silica and detritic quartz grains reaching nearly 0,7 mm in diameter; the rock is strongly impregnated with iron oxides and carbonates.
3. Tectonics: intensely folded beds dip steeply to the WSW direction; distinct slaty cleavage oblique to the sedimentary bedding.

LOCALITY 5

1. Situation: natural exposure (fig. 6) in the village of Różana, NW slope of the hill of 375 m, right bank of the river of Kaczawa, 35 m from the river (cf. figs 2—3).
2. Lithology: light gray sericite-quartz slates (pl. II, *2*) having their grains smaller than 0,01 mm; thin laminae display a microquartzitic structure. This lamination is parallelled by iron oxide-sericite streaks of 0,5—2 mm thickness.
3. Tectonics: visible fragments of the fold closures; well developed slaty cleavage parallel to the sedimentary bedding in the place where sample **B** has been taken.

LOCALITY 6

1. Situation: natural exposure almost completely hidden under a thick layer of weathered stuff, the village of Różana, right bank of the river of Kaczawa (cf. figs 2—3).
2. Lithology: light gray sericite-quartz slates (pl. II, *3*) alternating with dark gray or black ones (pl. I, *2*) rich in organic material; fraction less 0,01 mm; impregnation with iron oxides.
3. Tectonics: intensely folded beds dip generally steeply to the WSW direction; sedimentary bedding recognizable only in few places where intercalations of quartz-rich slates appear; well developed slaty cleavage parallel to the axial planes of folds.

LOCALITY 8

1. Situation: natural exposure almost completely covered with a thick layer of weathered stuff, the village of Różana, right bank of the river of Kaczawa, NW slope of the hill of 375 m, 130 m from the river (cf. figs 2—3).
2. Lithology: light, greenish quartz-sericite slates rich in iron oxides; grain fraction less 0,01 mm (pl. II, *4*).
3. Tectonics: sedimentary bedding unvisible; slaty cleavage intensely produced.

LOCALITY 17

1. Situation: natural exposure (fig.7) on SW slope of the hill of 350,6 m, western part of the village of Rzeszówek (cf. fig. 2).
2. Lithology: sericite-quartz layered slates strongly impregnated with iron oxides: grain fraction less 0,01 mm (pl. II, *1*).
3. Tectonics: beds dipping monoclinally to SE at an angle of 25°; sedimentary bedding distinctly seen; slaty cleavage parallel to the bedding.

LOCALITY 20

1. Situation: natural exposure (fig. 8) at the bend of the creek of Kamiennik, the village of Rzeszówek (cf. fig. 2).

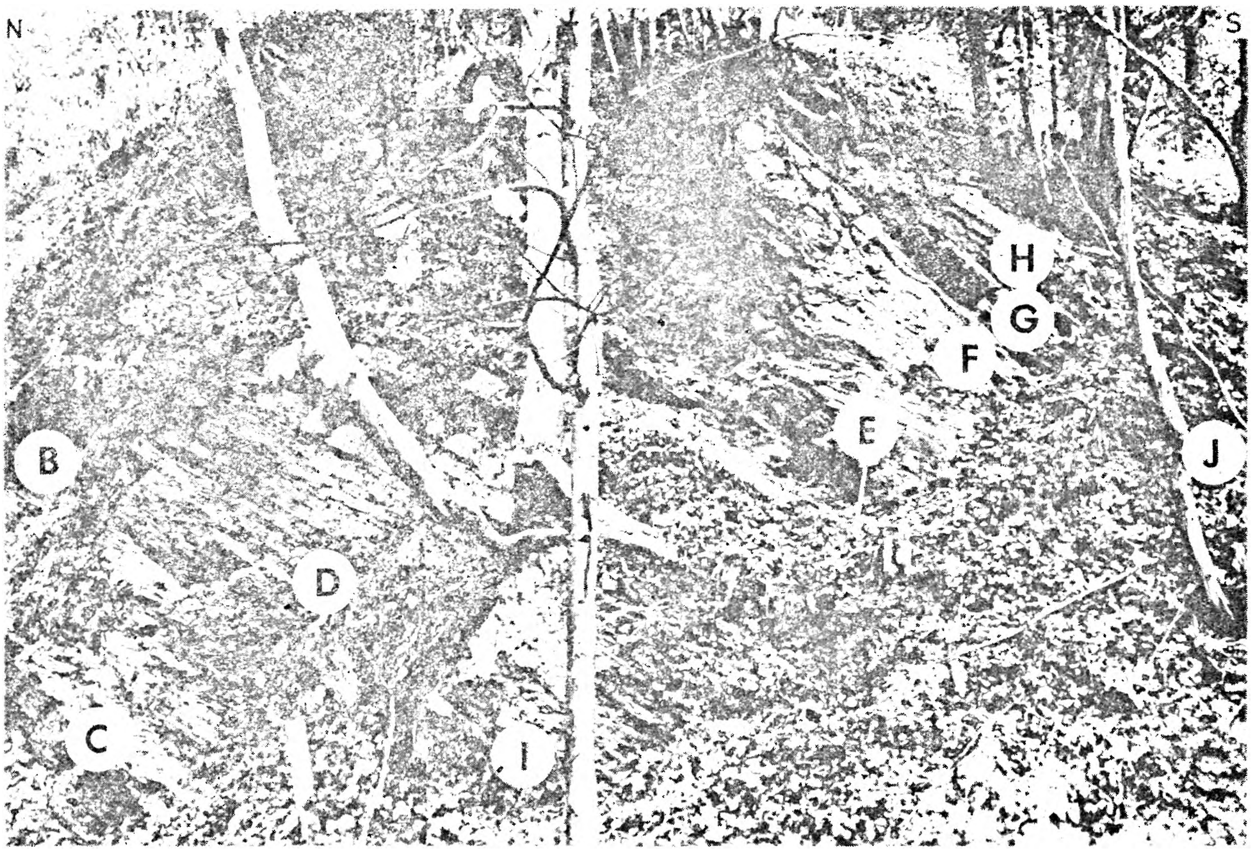

Fig. 4
Locality 2 at Różana; letteral symbols of samples the same as in table 2 (figs. 4—8 were taken by J. Stachowiak)
Stanowisko 2 w Różanej; symbole prób takie jak w tabeli 2 (fig. 4—8 wykonał J. Stachowiak)

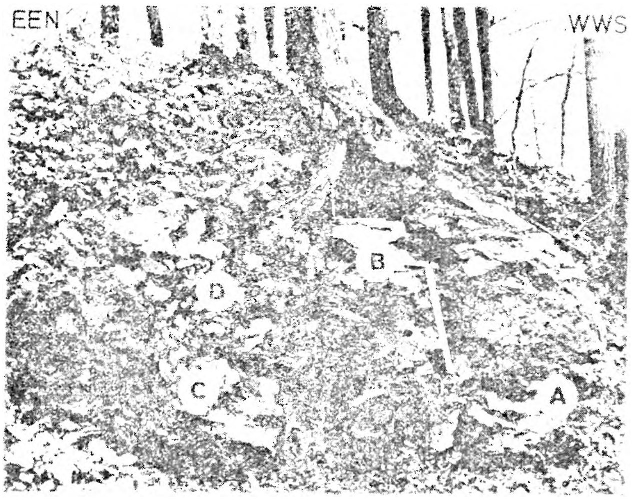

Fig. 5
Locality 4 at Różana; letteral symbols of samples the same as in table 2
Stanowisko 4 w Różanej; symbole prób takie jak w tabeli 2

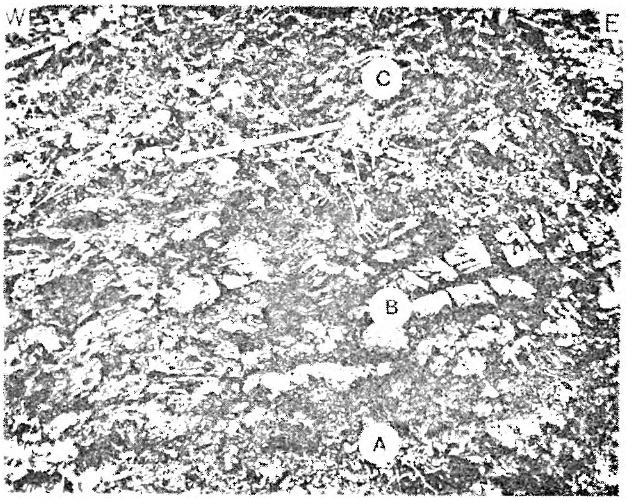

Fig. 6
Locality 5 at Różana, letteral symbols of samples the same as in table 4
Stanowisko 5 w Różanej; symbole prób takie jak w tabeli 4

2. Lithology: light (pl. II, *6*) to dark gray microquartzites (pl. II, *5*); abundant secondary carbonates replacing quartz; variant but usually small amount of sericite.

3. Tectonics: northern part of the exposure — faintly developed sedimentary bedding dips to NE at an angle of 40°; well visible slaty cleavage is oblique to the bedding. Eastern part of the exposure — good

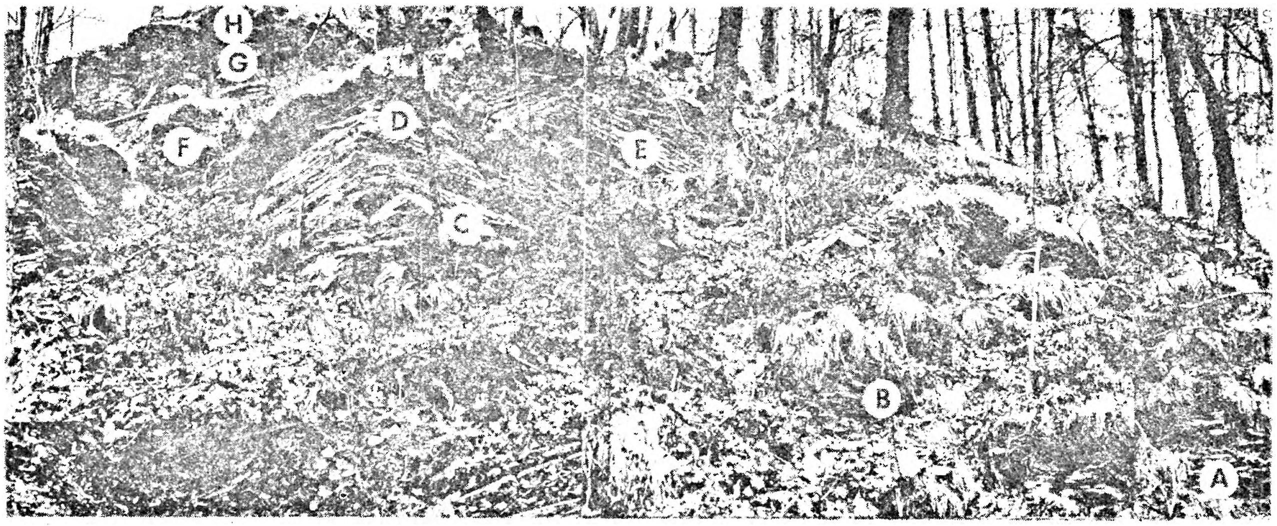

Fig. 7
Locality 17 at Rzeszówek; letteral symbols of samples the same as in table 5
Stanowisko 17 w Rzeszówku; symbole prób takie jak w tabeli 5

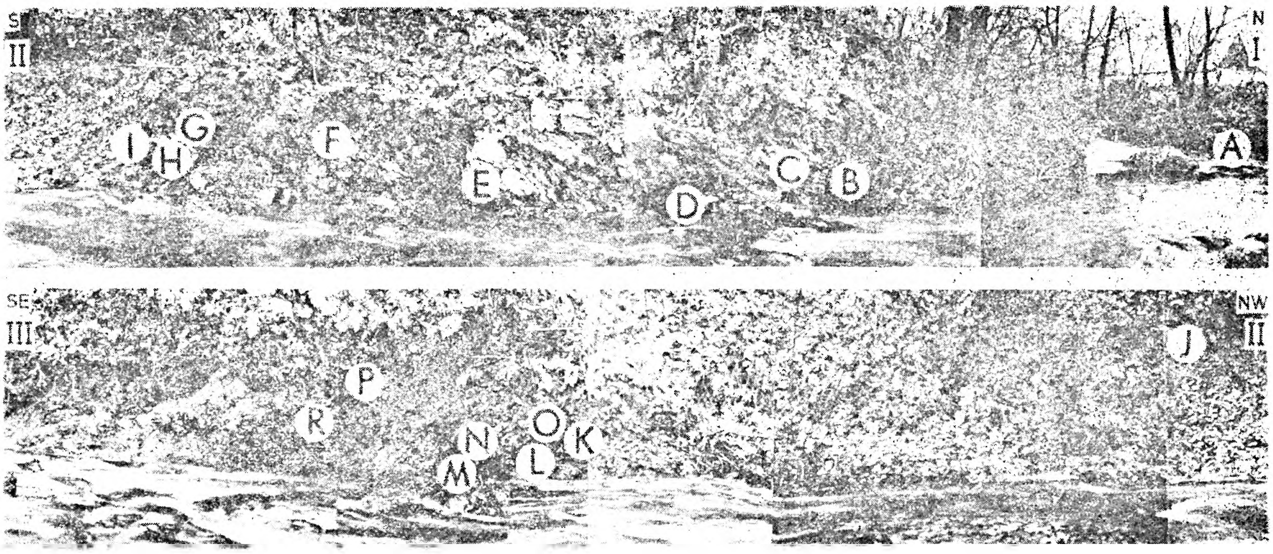

Fig. 8
Locality 20 at Rzeszówek; *I—II* — northern, *II—III* — eastern part of the outcrop; letteral symbols of samples the same as in table 6 and 7
Stanowisko 20 w Rzeszówku, *I—II* — północna, *II—III* — wschodnia część odsłonięcia; symbole prób takie jak w tabeli 6 i 7

developed sedimentary bedding is parallelled by thin layers (several millimetres in thicknesses) of quartz-sericite slates, the bedding dips SE at an angle of 30°; slaty cleavage is parallel to the sedimentary bedding. The two parts of the exposure are most probably separated by a fault (A. Haydukiewicz 1977; fig. 2).

CONODONT SPECIMEN PROCESSING

It is commonly known how to obtain conodonts from carbonate rocks. Rather rarely conodonts are processed from clay and siliceous shales (i. a. Müller, Müller 1957; Winder 1966; J. Haydukiewicz 1974). Conodonts discovered in slates have been identified only on the foliation surfaces (cf. Freyer 1965) but never separated from these rocks. Therefore, it was a task to find a suitable method of maceration of noncarbonate metamorphic rocks.

The author examined both chemical and mechanical methods. The best results, though not always satisfactory, were obtained by digesting of the rocks in hydrofluoric acid. Concentration of the acid (5 to 40%) and time of the digesting (several minutes to several hours) were governed by a rock composition, dimensions of mineral constituents, as well as direction and spacing of cleavage planes. Generally, the more intensively rock cleaved is and the poorer in quartz and iron compounds, the less concentrated acid (20%) and the shorter time (several to some tens minutes) of processing are applied. Such a sample relationships greatly complicated by varying degree of recrystallization and variable directions and amount of small tectonic structures recorded by a rock. Therefore every processed rock necessitates an individual treatment as well as repeated maceration at different time periods and acid concentrations. Diluted hydrofluoric acid (5—8%) may be applied to thinly laminated quartz-sericite slates in which conodonts are visible on the laminae surfaces and covered only with a fine lid of rock. Several hours processing is needed in such instances (*vide* Hayashi 1969).

Each sample was processed several times. The least corroded conodont specimens were, as a rule, obtained at the initial stages of the digesting. The difference in the degree of corroding of the conodonts obtained in the successive stages of this process, was the most distinct when rock processed was strongly fractured. The weight of the samples ranged from 0,5 to 3 kg. Nearly 50% of each sample became usually dissolved and desintegrated, only rarely it was 80%.

The above described methods resulted in obtaining both the conodont specimens removed entirely from rock and the conodont specimens accessible on the rock surface. The first specimens were usually from microquartzites, the others — from slates.

TAPHONOMY AND PRESERVATION OF CONODONTS

The environment in which the Kaczawa conodonts have been deposited is hard to be reconstructed because of tectonic and metamorphic processes. Nevertheless, the primary sedimentary structures preserved locally, distribution of conodonts in the strata, and frequence of conodonts, provide some informations on taphonomic factors.

Devonian conodonts were discovered in quartz-sericite and sericite-quartz slates as well as in microquartzites. According to Baranowski (1975a, 1975b), these rocks represent the shaly flysch facies containing less than 15% of sandy and silty material. This author states that microquartzites and slates (siliceous and sericite slates in Baranowski's nomenclature) do not display any structures indicative of turbidite currents and may be regarded as a pelagic deposit. This view seems to be supported by the present author's observation:

1. Conodonts are evenly distributed in the beds characterized by a well developed sedimentary bedding. The longer axes of the conodonts are parallel to planes of this bedding.
2. Conodonts are often accompanied by radiolarians. Their recrystallized fragments were previously described by Baranowski (1975b) and observed by the present author in microquartzites from localities 2, 4, and 20 (cf. pl. I, *1*).
3. The real frequency of conodonts is hard to be estimated because the specimens are badly broken and some may be dissolved in hydrofluoric acid. Thus the recorded frequency is lower than the real one. 1 kg of a sample provides approximately: 20—30 specimens from Lower Devonian slates, 20—80 specimens from Middle Devonian microquartzites, over 100 specimens from Upper Devonian rocks. The most abundant conodont assemblages are ascertained (over 200 individuals) in Upper Devonian light gray sericite-quartz slates at localities 6 (sample B) and 17 (all samples). The frequence of conodonts recorded in the metamorphic rocks of the Góry Kaczawskie is similar or slightly exceeds that reported from lithologically similar deposits (cf. Lindström 1964, p. 70; Winder 1966, Text — fig. 9).
4. The author did not recognize any undoubtedly mixed fauna, although its presence in sample L from locality 20 cannot be excluded.

The above observations indicate that the Kaczawa Devonian conodonts were deposited under conditions of quiet and rather slow sedimentation.

The state of preservation and colour of specimens may be treated as additional information on taphonomic factors, especially when a redeposition of fauna is suspected (e. g. Klapper 1966, p. 12). Numerous instances are known, however, when the redeposited conodonts have the same colour and are as good preserved as the indigenous forms. This is the case of a submarine redeposition (cf. Lindström 1964, pp. 71—74; Krebs 1964, p. 276).

Insufficient preservation of the Kaczawa specimens is not a matter of taphonomic factors. All the conodonts from the Góry Kaczawskie are more or less broken but this is due to tectonic and metamorphic agents as well as by processing. Some conodonts have the obliterated details of ornamentation or corroded previously smooth surface. It is difficult to decide whether these injuries were evoked by maceration or metamorphism. Similar changes of attitudes of Silurian conodonts from the Phyllonite-zone of the Eastern Alps, were accounted for by metamorphic agents (Schönlaub, Zezula 1975, pp. 259—261). It seems, however, that these injuries of the Kaczawa conodonts are rather due to processing than to metamorphic agents, for some specimens remain unbroken (e. g. pl. IV, *6a—b*) if only shortly bathed in the acid. Nevertheless, the marginal parts of specimens are undoubtedly subject to corrosion connected with the recrystallization of rock-forming minerals. Especially destructive is the growth of quartz. The directions and degree of quartz recrystallization appear to be most important. The specimens are only insignificantly broken when quartz recrystallizes in parallel to the planes of sedimentary bedding (cf. pl. VI).

Fracturing and flattening of the specimens are due to tectonic deformation. The most fractured conodonts occur in the rocks characterized by slaty cleavage cutting the sedimentary bedding (e. g. locality 5, sample C; locality 20, samples A—J; localities 8, 19). The specimens provided by the closely cleaved slates are so sliced that they cannot be determined even as genera (e. g. localities 12, 13). The conodonts contained in the slates cleaved parallel to bedding are, as a rule, sufficiently preserved (e. g. pl. VI, *4*; pl. IV, *1a—c, 5a—b*). Occasional quartz veinlets do not impede the discrimination of species (cf. pl. V, *5—7*; pl. VI, *6*). The flattened specimens are encountered in less competent beds of those rocks in which slaty cleavage and bedding are concordant. Such conodonts are especially frequent in sericite laminae of the sericite-quartz slates from locality 17 (pl. V, *2—7, 9*) and of the microquartzites exposed in eastern part of locality 20 (pl. III, *2*; pl. V, *10*).

All the Devonian conodonts from the Góry Kaczawskie are dark, usually black, more rarely dark gray. Their colour is greatly influenced by hydrofluoric acid. Previously black specimens become light when kept in the acid.

Black colour of the conodonts has been variously interpreted (i. a. Lindström 1964, pp. 29—30; Schönlaub, Zezula 1975; Klapper 1966, p. 12) but this problem lies beyond the scope of the present paper. It should be mentioned, however, that Ordovician conodonts from the Góry Kaczawskie may greatly contribute to the discussion. These conodonts will be featured in the separate paper.

STRATIGRAPHIC ANALYSIS OF CONODONT FAUNAS

METHODOLOGICAL REMARKS

Established in numerous sections from many regions, the succession of Devonian conodont faunas as well as the biostratigraphic units inferred from this succession (Wittekindt 1965; Ziegler 1962a, 1971; Sandberg, Ziegler 1973), provide the basis for arranging and dating the conodont faunas obtained from the Góry Kaczawskie (cf. tab. 1).

After publishing by Ziegler (1971) his conodont biostratigraphy of the Devonian in Europe, the papers were issued a little correcting the conodont/ammonoid interzonation. Based on new discoveries of goniatites in the Rhenish Schiefergebirge (Kullmann, Ziegler 1970), the Upper *hermanni-cristatus*-Zone may presently be precisely correlated with the lowermost *Manticoceras* Stufe (do I α) and thus it may be assigned to the Upper Devonian. The Middle and Upper *P. triangularis* zones have so far be correlated, though with some restrictions, to the upper *Manticoceras* Stufe (post do I δ), (cf. Ziegler 1971, pp. 270—271; Chart 4). On the basis of recent discoveries of goniatites in Marocco (Tafilalt, Antiatlas), the higher Upper *P. triangularis*-Zone should be referred to the *Cheiloceras* Stufe and the *Manticoceras* /*Cheiloceras* boundary should be identified with the boundary of the Middle and the Upper *P. triangularis*-Zone or with the lowermost part of the Upper *P. triangularis*-Zone (Buggisch, Clausen 1972). Mouravieff and Bouckaert (1973) report that ***Manticoceras intumescens*** appears in the Frasnian stratotype (Nismes, Belgium) at the top of the Middle *asymmetricus*-Zone, thus earlier than in the Germany where the first occurrence of this species is recorded in the Upper *asymmetricus*-Zone. So, the do I α/do I β/γ boundary of the ammonoid succession does not coincide in Belgian section with the boundary between the Middle and the Upper *asymmetricus*-Zone of the conodont succession (Mouravieff, Bouckaert *op. cit.*).

Moreover, the index species of the Upper Devonian *Spathognathodus costatus* was subject to revision. The mentioned species was included to the genus of *Bispathodus* (Ziegler ***et al.*** 1974). Therefore, the former *Spathognathodus costatus*-Zone is cited in the present paper as the *Bispathodus costatus*-Zone. Although Sandberg, Ziegler (1973) gave up the usage of generic prefixes in the zone names until establishing the taxonomy of Devonian conodont apparatuses, the present author still uses the binominal nomenclature to avoid misunderstandings.

The individual conodont zones cannot be distinguished in metamorphic rocks of the Góry Kaczawskie on the basis of the specimens collected. The author has been succeeded in distinguishing conodont

Table 1
Tabela 1

Relation between the conodont zones and the Devonian stages

Korelacja poziomów konodontowych i pięter dewonu

	STAGES	AMMONOID STUFEN		CONODONT ZONES or FAUNAS		Referenced
UPPER DEVONIAN	FAMENNIAN	*Gonioclymenia*- *Wocklumeria*	do VI	*Bispathodus costatus*	Upper	Ziegler 1962, 1971 Sandberg, Ziegler 1973
		?	do V/VI ?		Middle	
			do V		Lower	
				Polygnathus styriacus	Upper	
		do IV/V ?			Middle	
		Platyclymenia	do IV		Lower	
			do III β	*Scaphignathus velifer*	Upper	
					Middle	
			do III α		Lower	
		Cheiloceras	do II β	*Palmatolepis marginifera*	Upper	
					Lower	
				Palmatolepis rhomboidea	Upper	
					Lower	
			do II α	*Palmatolepis crepida*	Upper	
					Middle	
					Lower	
		Manticoceras	post-do I δ	*Palmatolepis triangularis*	Upper	
					Middle	
	FRASNIAN				Lower	
			do I δ	*Palmatolepis gigas*	Uppermost	
			do I γ/δ		Upper	
					Lower	
			do I γ	*Ancyrognathus triangularis*		
			do I (β) γ	*Polygnathus asymmetricus*	Upper	
			do I α		Middle	
					Lower	
					Lowermost	
				Schmidtognathus hermanni-*Polygnathus cristatus*	Upper	
MIDDLE DEVONIAN	GIVETIAN				Lower	Wittekindt 1966; Ziegler 1971 Ziegler, Klapper, Johnson 1976
				Polygnathus varcus	Upper	
					Middle	
					Lower	
				Icriodus obliquimarginatus	Upper	
					Lower	
	EIFELIAN			*Polygnathus kockelianus*		
				Spathognathodus bidentatus		
				Icriodus corniger		
LOWER DEVONIAN	EMSIAN Upper			*Non-latericrescid Icriodus-Polygnathus*		Ziegler 1971
	EMSIAN Lower			*I.b. bilatericrescens-steinhornensis-Polygnathus*		
	SIEGENIAN			*I. huddlei curvicauda - I. h. huddlei*		
				I. huddlei curvicauda-rectangularis s.l.-angustoides		
	Boundary Zone			*Ancyrodelloides-Icriodus pesavis*		
	GEDINNIAN Upper			*Icriodus w. postwoschmidti*		
	GEDINNIAN Lower			*Icriodus w. woschmidti*		
SILURIAN				*Spathognathodus s. eosteinhornensis*		

zones in several samples of Lower and Middle Devonian rocks. These defined zones are: Lower Devonian the *Icriodus bilatericrescens bilatericrescens-Spathognathodus steinhornensis steinhornensis-Polgnathus*-Fauna and Middle Devonian the *Polygnathus kockelianus*-Zone. The intervals embracing several zones and defined by the ranges of the ascertained taxa, have been distinguished in other instances.

LOWER DEVONIAN

The *Icriodus bilatericrescens bilatericrescens-Spathognathodus steinhornensis steinhornensis-Polygnathus*-Fauna. Light greenish quartz-sericite slates cropping out at locality 8 (figs 2—3) may belong to this informal biostratigraphic unit distinguished by Ziegler (1971, pp. 244—248, Chart 1). These rocks contain *Polygnathus* cf. *foveolatus* Philip and Jackson (pl. III, 3) and *Spathognathodus steinhornensis steinhornensis* Ziegler (pl. III, *4a—b*). The investigated assemblage lacks representatives of genus *Icriodus* whose species determine best the Lower Devonian conodont "faunas" distinguished by Ziegler. Similary, Philip and Jackson (1967) did not recognize any form of the mentioned genus in the Australian fauna.

According to Ziegler (1971) *Polygnathus foveolatus* and *Spathognathodus steinhornensis steinhornensis* co-exist from the upper Lower Emsian into the Upper Emsian, but do not reach the upper boundary of the Emsian. The lower boundary of the range of these taxa is not defined ultimately. This problem is extensively discussed by Ziegler (op. cit., 244—248) and Klapper *et al.* (1971, pp. 291—292).

In her previous paper (Urbanek *et al.* 1975), the present author provisionally determined the assemblage of conodonts from the Góry Kaczawskie (the Kaczawa Mts) as a counterpart of the *I. b. bilatericrescens-steinhornensis-Polygnathus*-Fauna. Now this recognition seems to be quite certain, though the illustrated specimen of *Polygnathus* cf. *foveolatus* has the aboral surface (Urbanek *et al.* 1975; pl. II, *1*) which greatly, in fact, resembles that of *Polygnathus webbi* Stauffer (cf. Stauffer 1938, pl. 53, fig. 28). Still, the collected specimen of *P.* cf. *foveolatus* are characterized by a large basal cavity indicative of *P. foveolatus*.

MIDDLE DEVONIAN

The *Polygnathus kockelianus*-Zone. This zone coincides with the range of the name-giver and *Polygnathus trigonicus* Bischoff and Ziegler (Wittekindt 1965, T. 1; Ziegler 1971, pp. 255—256, Chart 2).

The *kockelianus*-Zone is undoubtedly represented by such samples as F, G, and H (tab. 2) from locality 2 (fig. 4) as well as sample A (tab. 2) from locality 4 (fig. 5). The sample E coming from locality 2 can likely also be assigned to the described zone as it contains forms very similar to *Polygnathus kockelianus* Bischoff and Ziegler.

Table 2

Conodonts from localities 2 and 4	Locality 2						4
	Samples						
	C	E	F	G	H	I	A
Polygnathus costatus cf. *costatus*	×						
Polygnathus pseudofoliatus				×	×	×	
Polygnathus cf. *intermedius*		×		×	×		
Polygnathus kockelianus		cf.	×	×	×		×
Polygnathus trigonicus			×	cf.	cf.		
Polygnathus spp.	×	×	×	×	×	×	×
Spathognathodus sp.		×					×

There are light gray, dark gray and black microquartzites exposed in the lower part of locality 2 (fig. 4). These rocks contain the broken representatives of a genus of *Polygnathus*. Only one specimen (pl. III, *8a—b*) from sample C (tab. 2) may probably be identified with a subspecies of *Polygnathus costatus costatus* Klapper. The stratigraphic range of the mentioned subspecies is not recognized definitely, although undoubtedly it does not overcome the Early Middle Devonian (Eifelian), (Klapper 1971; Ziegler 1973).

The interval from the upper part of the *Icriodus bilatericrescens bilatericrescens-Spathognathodus steinhornensis steinhornensis-Polygnathus*-Fauna to the Upper *Polygnathus asymmetricus*-Zone. This interval is defined by the stratigraphic range of *Polygnathus linguiformis linguiformis* Hinde. The range of this subspecies is taken from Ziegler (1971, Charts 1—3, 5).

Polygnathus linguiformis linguiformis and undeterminable fragments of conodonts of genera of *Icriodus* and *Polygnathus* have been found in the sample of dark gray siderite (fig. 2, locality 16). Such siderites are abundant in a weathered stuff derived from dark gray clayey slates occurring north of Rzeszówek (oral communication, A. Haydukiewicz). These slates are probably intercalated with the siderites.

UPPER DEVONIAN

The interval from the base of the *Ancyrognathus triangularis*-Zone to the lower part of the Upper *Palmatolepis gigas*-Zone. This interval can be recognized in light and dark gray sericite-quartz slates rich in organic material, exposed at locality 6 (figs 2, 3). The stratigraphic range of a species of *Ancyrognathus triangularis* Youngquist (Ziegler 1971, Chart 5) may be used to define the discussed interval. The investigated assemblage (tab. 3) includes forms very similar to the mentioned species (pl. IV, *3a—b*), the forms being accompanied by the representatives of genera of *Ancyrodella* (pl. IV, *4*), *Icriodus* (pl. IV, *2a—c*), *Palmatolepis* and *Polygnathus*. But no species can be identified to narrow the interval in question.

Table 3

Conodonts from locality 6	Samples	
	A	B
Ancyrodella nodosa vel *A. gigas*	×	
Ancyrodella spp.	×	×
Ancyrognathus cf. *triangularis*	×	×
Icriodus cf. *symmetricus*	×	×
Palmatolepis spp.	×	×
Polygnathus spp.	×	×

The Upper and Uppermost *Palmatolepis gigas*-Zones. The sample B (tab. 4) of light gray sericite-quartz slates from locality 5 (figs 2, 3, 6) belongs to this interval as the form of *Ancyrognathus asymmetricus* Ulrich and Bassler (pl. VI, 6) is present. According to Ziegler (1973, pp. 41—44) the range of *A. asymmetricus* is restricted merely to the above mentioned zones.

Table 4

Conodonts from locality 5	Sample
	B
Ancyrodella curvata	×
Ancyrognathus asymmetricus	×
Icriodus alternatus	×
Nothognatella sp.	×
Palmatolepis gigas	×
Palmatolepis subrecta vel *P. gigas*	×
Palmatolepis subrecta vel. *P unicornis*	×
Polygnathus spp.	×

The first occurrence of *Palmatolepis linguiformis* Müller is taken to indicate the base of the Uppermost *gigas*-Zone. Although the author's collection lacks such a form, the discussed interval cannot be referred only to the Upper *gigas*-Zone for the discovered conodonts are scarce and badly broken.

There is not doubt that Frasnian deposits also occur at locality 3 (figs 2, 3). Light gray sericite-quartz slates contain conodonts belonging to the genera of *Ancyrodella, Icriodus, Palmatolepis,* and *Polygnathus*. Such an assemblage of conodonts is typical for the Frasnian. The specimens, however, are so broken as no zones can be recognized.

The interval from the Upper *Palmatolepis triangularis*-Zone to the Middle *Palmatolepis crepida*-Zone. Sericite-quartz layered slates (sample H, tab. 5) exposed at the top of locality 17 (figs 2, 7) can be most likely assigned to this interval. The conodont specimens are badly broken (strong flattening, fracturing, etching), (cf. pl. VI, *8, 11*; pl. V, *11, 12*). Therefore their species cannot be determined satisfactorily, even provisionally. Because of such difficulties the interval in question has been established on the basis of the whole assemblage of conodonts, especially here abundant. Positive recognition of this interval is based particulary on the representatives of a genus *Palmatolepis* displaying distinctly diversified morphology. The lack of certain forms characteristic of the zones occurring beneath and over the discussed interval, has been applied as an additional criterion.

Table 5

Conodonts from locality 17	Samples		
	H	D	A
Icriodus sp.	×		
Palmatolepis spp.	×		
Palmatolepis minuta minuta		×	×
Palmatolepis perlobata subsp. indet.		×	×
Palmatolepis glabra prima		×	
Palmatolepis glabra pectinata			×
Palmatolepis cf. *rhomboidea*		×	
Polygnathus glaber glaber		×	×
Palmatolepis distorta distorta			×
Palmatolepis marginifera marginifera			×
Polygnathus spp.	×	×	×

The described interval was distinguished for the following reasons:

1. The presence of the representatives of a genus *Palmatolepis* characterized by a large outer lobe and undoubtedly ornamented upper surface. The ornamentation, however, is obliterated by a corrosion. Nevertheless, there are specimens with ornamentation over the whole surface (cf. pl. V, *11*); the others are certainly ornamented only at margins of the platform (cf. pl. V, *12*).
2. The co-existence of forms having an elongated, most probably smooth platform with a small distinct outer lobe (cf. pl. VI, *8, 11*).
3. The lack of specimens of the *Palmatolepis* genus characterized by a long, slender platform devoid

of outer lobe, the features being typical of the genus of *Palmatolepis* appearing at the higher zones of the Famennian (starting from the Upper *Palmatolepis crepida*-Zone).

4. Relatively high percentage of undetermined forms of the *Icriodus* genus.

5. The lack of any fragments assignable to a genus of *Ancyrodella*, the genus being abundantly represented beneath the interval in question.

The interval from the Lower *Palmatolepis rhomboidea*-Zone to the Lower *Palmatolepis marginifera*-Zone. To this interval belongs sample D of sericite-quartz layered slates occurring at locality 17 (figs 2, 7). The interval in question is distinguished owing to the presence of forms very similar to *Palmatolepis rhomboidea* Sannemann (pl. V, *2*). According to Sandberg and Ziegler (1973, p. 106, Text-fig. 3) *P. rhomboidea* occur from the base of the Lower *rhomboidea*-Zone to the Lower *marginifera*-Zone. This form is accompanied by other ones whose ranges (tab. 5), however, are greater than the described interval.

The interval from the Lower *Palmatolepis marginifera*-Zone to the Middle *Scaphignathus velifer*-Zone. The boundaries of this interval are marked by the first occurrence and disappearance of *Palmatolepis marginifera marginifera* (cf. Dressen, Dusar 1974). The presence of this subspecies in the collection from the Góry Kaczawskie (pl. V, *4*) allows to include the part of sericite-quartz layered slates (sample A, tab. 5) exposed at locality 17 (figs 2, 7) in the interval mentioned above. The upper boundary of this interval is additionally marked by the upper range of *Polygnathus glaber glaber* (cf. Ziegler 1971, Chart 6).

The sericite-quartz slates occurring at locality 17 refer to the three above described intervals. The obtained assemblages of conodonts indicate that these slates belong at least to the zones ranging from the Middle *crepida*-Zone to the Lower *marginifera*-Zone. The first of the three last described intervals is defined by the conodonts occurring in sample H (fig. 7; tab. 5) taken from the uppermost part of the exposure, the second interval — in sample D coming from the middle part of the exposure, and the third one — in sample A collected at the bottom of the exposure. Thus it is obvious that the sericite-quartz layered slates show a reverse sequence.

The interval from the Upper *Palmatolepis crepida*-Zone to the Upper *Scaphignathus velifer*-Zone. This interval is defined by the range of *Palmatolepis glabra* (Ziegler 1971, Chart 6; Sandberg, Ziegler 1973). Specimens of *Palmatolepis glabra* subsp. indet. were found in sample C taken from northern part of locality 20 (figs 2, 8) as well as at locality 21, 14, and 15 (fig. 2). Therefore, light gray microquartzites outcropping in these four localities can be assigned to the discussed interval. Its lower boundary may be slightly moved upward (within the Upper *crepida*-Zone) for sample I from locality 20 (tab. 6), since this sample is bearing *Palmatolepis glabra* cf. *lepta* (pl. V, *1a—b*). The upper boundary of the described interval may be lowered to the Middle *velifer*-Zone as in sample A and B from the same locality (tab. 6) the forms of *Palmatolepis glabra* are accompanied by *Polygnathus glaber glaber* Ulrich and Bassler. As yet, the latter is recorded not higher than the Middle *velifer*-Zone (Ziegler 1971, Chart 6). Narrower interval is represented by sample D (locality 20; tab. 6) containing *Polygnathus glaber glaber* and *Palmatolepis glabra* cf. *lepta* (pl. V, *8*) closely related to the typical forms of this subspecies. The presence of these two forms indicates the interval from the Lower *marginifera*-Zone to the Middle *velifer*-Zone (cf. Ziegler op. cit.; Sandberg, Ziegler 1973).

Table 6

Conodonts from N part of locality 20	Samples				
	A	B	C	D	I
Nothognatella sp.		×	×	×	
Palmatolepis ex gr. *glabra*	×	×	×	×	×
Palmatolepis glabra cf. *lepta*				×	×
Polygnathus glaber glaber	×	×		cf.	
Polygnathus spp.	×	×	×	×	×
Palmatolepis spp.	×	×	×	×	×

The uppermost Famennian. The youngest rocks of the study area are exposed in eastern part of locality 20 (figs 2, 8). The individual samples cannot be precisely dated, though the badly preserved fauna is fairly abundant. The only confidently recognized subspecies of *Palmatolepis gracilis gracilis* Branson and Mehl (tab. 7; pl. III, *2*) is known as a long-ranged form (cf. Ziegler 1971, Chart 6). Sample P is assigned to the shortest interval embracing the Upper *Polygnathus styriacus*-Zone and the Lower *Bispathodus costatus*-Zone. The sample contains form closely similar to *Pseudopolygnathus brevipennatus* Ziegler (pl. III, *9a—b*). The above mentioned interval is marked by the stratigraphic range of the last named species (Ziegler 1971, Chart 6 — *Pseudopolygnathus brevimarginatus* [sic!].)

There is the greatest difficulty in dating sample L (tab. 7). This sample may be assigned to the interval from the Upper *Polygnathus styriacus*-Zone to the

Table 7

Conodonts from E part of locality 20	Samples		
	K	L	P
Palmatolepis gracilis gracilis	×	×	
Pseudopolygnathus cf. *brevipennatus*			×
Pseudopolygnathus sp.		×	
Polygnathus spp.	×	×	×
Polygnathus vel *Siphonodella*		×	
Spathognathodus spp.	×	×	×

Upper *Bispathodus costatus*-Zone. The lower boundary of this interval is marked by the presence, in the investigated assemblage, of *Pseudopolygnathus* sp. which certainly cannot be identified with the oldest known species of this genus, i. e. *P. granulosus* Ziegler and *P. micropunctatus* Bischoff and Ziegler (cf. pl. III, *5a—b*). The upper boundary of the discussed interval is defined by the uppermost range of *Palmatolepis gracilis gracilis* (Ziegler 1971, Chart 6) that is abundantly represented in the examined sample. The above named conodonts are accompanied by the specimen cited by the author as *Polygnathus* vel *Siphonodella* (pl. VI, *10*). It is impossible to recognize whether this specimen represents any of the species of *Polygnathus* ex gr. *nodocostatus* or the genus *Siphonodella*. Therefore the above dating of sample L should be treated provisionally till the better preserved specimens will be discovered.

Besides the carefully investigated conodont assemblages (fig. 2; localities 7, 10, 11, 19, 22, 23, 24) there are fragments of conodonts which cannot be precisely and confidently determined, though some of them undoubtedly belong to a genus of *Polygnathus*. It is known that the oldest species of this genus appeared first in the Emsian (Ziegler 1971; Klapper *et al.* 1971). Thus the rocks exposed in the investigated localities cannot be older than the Emsian.

THE SIGNIFICANCE OF CONODONT FAUNAS FOR THE STRATIGRAPHY OF THE REGION

The presence of conodont faunas in metamorphic rocks of the Góry Kaczawskie enables their application to a reliable stratigraphic division of these rocks. Based on such fossils, the stratigraphy of the Kaczawa complex can be far more firmly established than that inferred from the lithologic correlations with remote rock complexes of Lusatia and Thuringia. It is true that the data so far collected cannot be used for a detailed biostratigraphic division of the Devonian in the Góry Kaczawskie but they yield a good base for fairly precise dating of the Kaczawa rocks. A. Haydukiewicz (1977; tab. 1) has already made use of this dating while constructing a lithostratigraphic scheme of metamorphic rocks of northeastern part of the Góry Kaczawskie.

Prior stratigraphic scheme must be subject to change in the light of new biostratigraphic achievements. Dahlgrün's (1934) "stage of blue gray mica-poor clayey slates" includes microquartzites and sericite-quartz slates containing Devonian conodonts. Although these rocks are lithologically compatible with Upper Ordovician rocks of Thuringia (Dahlgrün *op. cit.*), certainly they are not of this age and are assignable only to the Devonian. Thus, the lithologic members of the Góry Kaczawskie and Thuringia cannot be longer correlated to one another and considered to be homochroneic. So, the chronostratigraphy of the Kaczawa metamorphic rocks based merely on lithological resemblances must be abandoned.

For several reasons the criterion of superposition of the individual rock series may no longer be applied either. It is, as a rule, impossible to discriminate between upward and downward facing strata because of the lack of any diagnostic sedimentary structures. Moreover, some rock series are separated by overthrusts. Having taken into account new biostratigraphic dating, A. Haydukiewicz (1977; figs 3, 30) suggests that lydites (probably Silurian) are brought into contact with Upper Devonian rocks owing to the overthrusting process.

The stratigraphic analysis of conodont faunas in a continuous section permits to determine approximately the thickness of single conodont zone recognized in sericite-quartz layered slates. At least three zones (from the Middle *crepida*-Zone to the Lower *marginifera*-Zone) are represented by Famennian deposits as thick as 7 m, exposing at locality 17 (figs 2, 7). The mentioned thickness of these deposits may, however, be reduced as they occur in the fold limb (personal communication, A. Haydukiewicz). For a comparison: one conodont zone from black shales and gray silty shales of the Kettle Point Formation does not exceeds 7 feet in its thickness (Winder 1966).

The presence of Devonian rocks within the Kaczawa complex greatly influences the hitherto presented opinions on the geological history of the Góry Kaczawskie.

Pelagic deposits of the Emsian, Eifelian, Frasnian, and Famennian indicate that geosynclinal sedimentation in the Kaczawa region did not end before the Late Famennian or, according to recent Chorowska's (in Chorowska, Sawicki 1975) report from southwestern Góry Kaczawskie, it lasted even in the Early Carboniferous.

Both Devonian and older rock series are characterized by the lower range of low stage metamorphic transformations (cf. Baranowski 1975b). Therefore, Jaeger's (1963, 1964) concept assuming the existence of sedimentary cover built of Devonian and Lower Carboniferous rocks that were to be spread over the metamorphosed strata, seems to be invalid. Accordingly, Berger's (1934) supposition assuming the Late Devonian transgression on the earlier folded and metamorphosed rocks of the Góry Kaczawskie appears to be unjustified.

The main folding and metamorphism of the Kaczawa rock series had to take place after deposition of the youngest, paleontologically evidenced rocks, but not just after the Middle Devonian as it was suggested by previous authors (H. Teisseyre 1967b, 1968; Oberc 1966, 1967, 1972, 1973).

The problem of the age of folding of the Kaczawa complex as well as the new stratigraphic bases for paleogeographic reconstruction in the areas adjacent to the Góry Kaczawskie, were featured in author's paper (Urbanek 1975).

PALEONTOLOGICAL REMARKS

This chapter discusses several conodont taxa placed by the author in the open nomenclature. It is these taxa that define the distinguished zones and intervals, the latter embracing several zones.

The author applied a form taxonomy to all conodonts. This was due to little knowledge about the Devonian conodont apparatuses in the world, divergent opinions on their basic plan (cf. Lindström 1970; Klapper, Philip 1971, 1972; Ziegler 1972) and incomplete data on the composition of conodont assemblages from the Góry Kaczawskie. Because of the complete lack of compound elements in many samples (e. g. locality 8), it is impossible to group the individual conodont forms from the metamorphic rocks of the Góry Kaczawskie according to Klapper's and Philip's model (1971, 1972). Few compound conodonts discovered in the other samples are, as a rule, strongly broken; therefore they are not discussed in the present paper.

In descriptions of the species of *Ancyrognathus* and *Palmatolepis*, Ziegler's (1973) terminologic changes were taken into account.

All photographs of conodonts published in this paper were taken by L. Łuszczewska, M. Sc.

Genus ANCYROGNATHUS Branson and Mehl, 1934

Type species *Ancyrognathus symmetricus* Branson and Mehl, 1934

Ancyrognathus cf. *triangularis* Youngquist, 1945
(pl. IV, *3a—b*)

Remarks. The examined specimens (one illustrated and one juvenile) are closly similar to *Ancyrognathus triangularis*. Their platform outline, the angle between the main and secondary keel as well as the ornamentation pattern fit well within the range of variation of *A. triangularis* demonstrated by Ziegler (1958, p. 50, Abb. 6). Specimens from the Góry Kaczawskie lack a washed out inner margin. This differs them from *Ancyrognathus bifurcatus* (Ulrich and Bassler) s.s. and *Ancyrognathus "bifurcatus"* (Ziegler 1962a, Abb. 5). The differences between *A. triangularis* and the two last named species are demonstrated by Glenister and Klapper (1966, pp. 802—803) and Ziegler (1958, pp. 47—48).

A. triangularis is also similar to *Ancyrolepis walliseri* (Wittekindt), (cf. Ziegler 1973, p. 53). The latter, however, has larger basal pit and the fourth lobe, usually a very small one. The illustrated specimen seems to lack these features. The broken anterior platform, however, makes impossible to recognize the development of the free blade and the course of the anterior margins of the platform.

Occurrence. Ziegler (1971, Chart 5) recorded the range of *A. triangularis* from the base of the *Ancyrognathus triangularis*-Zone (do I γ) to the lower part of the Upper Palmatolepis gigas-Zone (do I δ). The examined specimens are from locality 6 (samples A and B).

Genus PALMATOLEPIS Ulrich and Bassler, 1926

Type species *Palmatolepis perlobata* Ulrich and Bassler, 1926

Palmatolepis glabra cf. *lepta* Ziegler and Huddle, 1969
(pl. V, *1a—b, 8*)

Remarks. According to the diagnosis of Ziegler and Huddle (1969, pp. 380—381) *Palmatolepis glabra lepta* has a narrow elongated platform whose anterior inner margin is triangular and may possess a small parapet.

Although the both specimens from the Góry Kaczawskie display the above features, they cannot be confidently assigned to the mentioned subspecies because of their insufficient preservation. The specimen illustrated in plate V, 8 has a broken anterior end of the inner margin, thus its previous outline is unrecognizable. Nevertheless, it can be compared rather to typical than to early forms of *P. glabra lepta*. The juvenile specimen illustrated in plate V, 1a—b has the platform resembling that of *Palmatolepis helmsi* Ziegler though differing from the latter in a less sigmoidal blade-carina.

Occurrence. According to Ziegler (1971, Chart 6) and Sandberg, Ziegler (1973, p. 101, Text-fig. 3) the early forms of *P. glabra lepta* occur first within the Upper *Palmatolepis crepida*-Zone (do II *α*), but the typical forms are recorded from the base of the Lower *Palmatolepis marginifera*-Zone (do II *β*) to the Upper *Scaphignathus velifer*-Zone (do III—IV). The specimen under study come from locality 20.

Palmatolepis cf. *rhomboidea* Sannemann, 1955
(pl. V, *2*)

Remarks. The studied specimens display the majority of features diagnostic of *Palmatolepis rhomboidea* described by Sannemann (1955, p. 329). The anterior platform of all specimens from the author's collection is either broken or covered with a rock (e. g. specimen illustrated). The anterior end of the outer margin cannot therefore be examined. This margin appears in *P. rhomboidae* behind the anterior margin of the blade.

Sandberg and Ziegler (1973, p. 106) recorded that a platform of the discussed species is closely similar to that of *Palmatolepis delicatula delicatula* Branson and Mehl, but distinguishes from the latter in having a bulge or low parapet at the anterior end of the inner platform and short flat adcarinal grooves running on both sides of the blade-carina. Moreover, an outline of the platform of some specimens of *Palmatolepis* cf. *regularis* Cooper from Silberstollen (Sandberg, Ziegler *op. cit.*) resembles that of *P. rhomboidea*. Specimens of *P.* cf. *rhomboidea* from the Góry Kaczawskie differ in the platform outline from both *P. delicatula delicatula* and *P.* cf. *regularis*, but still they can be compared to the forms illustrated by Ziegler (1962b, T. 7, figs 14, 16). Moreover, the discussed specimens have a low parapet at the inner anterior platform.

Occurrence. Sandberg and Ziegler (1973, p. 106, Text — fig. 3) recorded the range of *P. rhomboidea* from the base of the Lower *Palmatolepis rhomboidea*-Zone (do II *β*) to the Lower *Palmatolepis marginifera*-Zone (do II *β*). The described specimens come from locality 17 (sample D).

Genus POLYGNATHUS Hinde, 1879

Type species *Polygnathus robusticostatus* Bischoff and Ziegler, 1957

Polygnathus costatus cf. *costatus* Klapper, 1971
(pl. III, *8a—b*)

Remarks. The illustrated specimen display the majority of features diagnostic of the subspecies of *Polygnathus costatus costatus* described by Klapper (1971, p. 63). The specimen from the Góry Kaczawskie is closely similar to this subspecies in having the closely spaced long transverse ridges separated from the carina by narrow deep adcarinal grooves and the distinctly narrow anterior platform. The posterior and in part the inner platform are broken. Thus the course of carina and outline of the inner margin remain unrecognized. For this reason the nominal subspecies cannot be confidently distinguished from *Polygnathus costatus patulus* Klapper.

Occurrence. *P. costatus costatus* is reported from the Eifelian of the United States (Klapper *et al.* 1971, pp. 293—296, fig. 2; Klapper 1971, pp. 59—62). The subspecies (*P. webbi* of Bultynck's 1970 taxonomy) appears in the Couvinian of Belgium from Co 2b III to Co2cIII, which corresponds to the range from the upper part of the *Icriodus corniger*-Zone to the middle part of the *Polygnathus kockelianus*-Zone in the standard conodont zonation (cf. tab. 1). This form (cited as *P. webbi*) is also reported by Wittekindt (1965, p. 641, tab. 1) from the Eifelian of eastern part of Rhenish Schiefergebirge and by Bischoff and Ziegler (1957, pp. 100—101, tab. 5) from the Eifelian and Givetian of Germany. The studied specimen is from locality 2 (sample C).

Polygnathus cf. *foveolatus* Philip and Jackson, 1967
(pl. III, *3*)

Remarks. All specimens from the Góry Kaczawskie assigned to this species are insufficiently preserved. They display, however, features typical of a species of *Polygnathus foveolatus*, to which they are at least provisionally assigned. These features are: the outline of the platform whose outer margin (sharp or rounded) is distinctly arched and the relatively wide basal cavity. A shape and position of the widest part of the basal cavity are hard to be observed in the specimen illustrated. But they are far better visible in other individuals in which, however, the upper surface of the platform is more broken. The only specimen is covered with faint transverse ridges at the posterior end of the platform.

P. foveolatus differs in the shape and size of the basal cavity from *Polygnathus linguiformis linguiformis* Hinde which has a small pit appearing between the anterior end of the platform and its midlenght (cf. Philip and Jackson 1967, pp. 1264—1265; Klapper 1969, pp. 13—14; 1971, p. 64).

Specimens from the Góry Kaczawskie distinguish from a species of *Polygnathus dehiscens* Philip and Jackson, close morphologically to *P. foveolatus*, in having a wider platform and a smaller basal cavity.

Occurrence. Ziegler (1971, Chart 1) recorded the range of *Polygnathus foveolatus* (*P. linguiformis foveolatus* in Ziegler's taxonomy) only within the *I. b. bilatericrescens-steinhornensis-Polygnathus*-Fauna (cf. tab. 1) in Europe and Australia. Klapper *et al.* (1971, pp. 291—292, fig. 1) reported the occurrence of this species from the "fauna 9" of the United States, which corresponds to the upper part of the Emsian. The studied specimens are from locality 8.

Polygnathus vel *Siphonodella*
(pl. VI, *10*)

Remarks. The illustrated specimen cannot be assigned to any of the distinguished genera because its lower side is covered with a rock. The outline of the preserved part of the platform, remnants of the ornamentation etched with hydrofluoric acid and especially traces of rostral ridges at the anterior platform, allow to compare the questioned specimen with the representatives of the genus of *Siphonodella* on the one hand and with certain species of the *Polygnathus nodocostatus* group on the other, in particular with *Polygnathus perplexus*, *P.* cf. *perplexus*, *P. hassi*, *P.* cf. *hassi*. According to Helms (1961, pp. 684—685 and 692—693) the latter species are distinctly similar to a genus of *Siphonodella* in development of the anterior platform.

It seems to be rather risky to relate the discussed specimen to definite species of the genus of *Siphonodella*. All diagnostic features as an outline of the platform, the number and position of the rostral ridges and an ornamentation of the posterior platform, are greatly obliterated by corrosive influence of hydrofluoric acid.

Occurrence. The questioned specimen is from eastern part of locality 20 (sample L).

Genus PSEUDOPOLYGNATHUS Branson and Mehl, 1934

Type species *Pseudopolygnathus primus* Branson and Mehl, 1934

Pseudopolygnathus cf. *brevipennatus* Ziegler, 1962b
(pl. III, *9a—b*)

Remarks. The illustrated specimen is similar to *Pseudopolygnathus brevipennatus* Ziegler (1962b, p. *98—99*) in outline of its platform and a character of the basal cavity. The questioned specimen differs from the typical representatives of *P. brevipennatus* in having nodes distributed along margins of the platform; the nodes, however, may also be developed at the posterior platform of the mature individuals (cf. Ziegler *op. cit.*).

P. cf. *brevipennatus* is also similar to the Lower Carboniferous species of *Pseudopolygnathus fusiformis* Branson and Mehl, in particular, to the juvenile form illustrated by Szulczewski (1973, pl. 5, figs 4a—b). Nevertheless, the adult forms of *P. fusiformis* (e. g. Rexroad 1969, pl. 4, fig. 18; Huddle 1934, pl. 8, fig. 3; Szulczewski 1973, pl. 5, figs 2a—b) differ from the questioned specimen in having a narrower simple platform and a smaller basal cavity immediately anterior of a thick keel. The questioned specimen represents a further stage of growth than the juvenile form of *P. fusiformis*. Therefore it is more convincing to refer this specimen to P. *brevipennatus*, though the assignment is by no means infalliable.

Occurrence. Ziegler (1971, Chart 6, *P. brevimarginatus* [sic!]) recorded the range of *P. brevipennatus* from the Upper *Polygnathus styriacus*-Zone (do V) to the Lower *Bispathodus costatus*-Zone (do VI). The studied specimen comes from eastern part of locality 20 (sample P).

Translated by Andrzej Żelaźniewicz

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Zdzisława URBANEK*

ZNACZENIE DEWOŃSKICH FAUN KONODONTOWYCH DLA STRATYGRAFII EPIMETAMORFICZNEGO KOMPLEKSU PÓŁNOCNO-WSCHODNIEJ CZĘŚCI GÓR KACZAWSKICH

Streszczenie

Tematem artykułu jest stratygrafia epimetamorficznych utworów dewonu odsłaniających się w zachodniej części jednostki Rzeszówek—Jakuszowa, w północno-wschodniej części Gór Kaczawskich (fig. 1).

Rezultatem prowadzonych przez autorkę badań jest stwierdzenie bogatych dewońskich faun konodontowych w 19 odsłonięciach (por. fig. 2). Obecność konodontów dewońskich w 5 z tych stanowisk zasygnalizowano we wcześniejszych publikacjach (Urbanek *et al.* 1975; Urbanek 1975). Konodonty występują w metamorfiku kaczawskim w różnych rodzajach skał, nie ze wszystkich udało się jednak wypreparować okazy nadające się do identyfikacji. Zastosowana metoda maceracji konodontów, przy użyciu kwasu fluorowodorowego, dała najlepsze rezultaty, aczkolwiek nie zawsze zadowalające, w odniesieniu do fyllitów serycytowo-kwarcowych (pl. II, *1—3*, pl. I, *2*) oraz kwarcowo-serycytowych (pl. II, *4*), mikrokwarcytów (pl. I, *1*, *3—4*; pl. II, *5—6*) i syderytów. Wymienione skały trawiono w kwasie fluorowodorowym o stężeniu 5—40% w czasie od kilku minut do kilkunastu godzin. Obydwa parametry zmieniano w zależności od składu mineralnego (głównie zawartości kwarcu i związków żelaza), wielkości składników mineralnych oraz intensywności i kierunku drobnych struktur tektonicznych (głównie złupkowania). W efekcie uzyskano okazy zarówno całkowicie wypreparowane, jak i odpreparowane na powierzchni skały.

Wszystkie kaczawskie konodonty są w mniejszym lub większym stopniu uszkodzone. Jest to wynikiem procesów tektonicznych i metamorfozy oraz trawienia kwasem fluorowodorowym. Uszkodzenia związane z deformacją skały przejawiają się w postaci popękania oraz spłaszczenia okazów. Szczególnie silnie spękane konodonty występują w skałach o intensywnie rozwiniętym złupkowaniu zorientowanym skośnie względem sedymentacyjnego warstwowania (np. stanowisko 5, wschodnia część stanowiska 20). Przy zgodnej orientacji złupkowania i warstwowania, w bardziej podatnych warstwach, zaznacza się spłaszczenie okazów (np. stanowisko 17 i północna część stanowiska 20). Często obserwuje się również skorodowanie brzeżnej części okazów (pl. IV). Jest to wywołane rekrystalizacją składników mineralnych, szczególnie kwarcu.

Zdeformowane w opisany sposób konodonty ulegają dalszym uszkodzeniom w procesie maceracji. W zależności od czasu trawienia okazy ulegają bądź niemal całkowitemu rozpuszczeniu, bądź tylko nadtrawieniu. W tym ostatnim przypadku obserwuje się zatarcie szczegółów ornamentacji lub skorodowanie pierwotnie gładkiej powierzchni.

Z 1500 uzyskanych okazów 750 oznaczono do szczebla gatunkowego lub rodzajowego. Zidentyfikowano 26 gatunków konodontów, należących do 8 rodzajów (pl. III—VI). Podstawę uszeregowania i datowania kaczawskich faun konodontowych stanowi szeroko rozpoznana na świecie suksecja konodontów i dokonana na jej podstawie biostratygrafia dewonu (Wittekindt 1965; Ziegler 1971; Sandberg, Ziegler 1973). Spośród wyodrębnionych w dewonie poziomów i „faun" konodontowych (tab. 1) w matamorfiku kaczawskim rozpoznano tylko 2. Są to:

— „fauna" *Icriodus bilatericrescens bilatericrescens-Spathognathodus steinhornensis steinhornensis-Polygnathus* (tab. 1) — fyllity kwarcowo-serycytowe w stanowisku 8 (fig. 2—3; pl. III, *3*, *4a—b*);

— poziom *Polygnathus kockelianus* (tab. 1) — mikrokwarcyty (próby F, G, H) w stanowisku 4 (fig. 2—4; tab. 2) oraz mikrokwarcyty (próby A, E) w stanowisku 2 (fig. 2—3, 5; tab. 2).

W pozostałych przypadkach wyróżniono możliwie najwęższe przedziały, obejmujące kilka poziomów, określone przez zasięgi stwierdzonych taksonów. Są to:

— interwał od górnej części „fauny" *Icriodus bilatericrescens bilatericrescens-Spathognathodus steinhornensis steinhornensis-Polygnathus* do górnego poziomu *Polygnathus asymmetricus* — syderyty występujące w bogatej zwietrzelinie ciemnoszarych, słabo zmetamorfizowanych, łupków ilastych w stanowisku 16 (fig. 2);

— interwał od spągu poziomu *Ancyrognathus triangularis* do dolnej części poziomu *Palmatolepis gigas* — fyllity serycytowo-kwarcowe w stanowisku 6 (fig. 2—3, tab. 3);

— interwał obejmujący górny i najwyższy poziom *Palmatolepis gigas* — fyllity serycytowo-kwarcowe (próba B) w stanowisku 5 (kg. 2—3, 6; tab. 4);

— interwał od górnego poziomu *Palmatolepis triangularis* do środkowego poziomu *Palmatolepis crepida* — laminowane

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fyllity serycytowo-kwarcowe (próba H) w stanowisku 17 (fig. 2, 7; tab. 5);

— interwał od dolnego poziomu *Palmatolepis rhomboidea* do dolnego poziomu *Palmatolepis marginifera* — laminowane fyllity serycytowo-kwarcowe (próba D) w stanowisku 17 (fig. 2, 7; tab. 5);

— interwał do dolnego poziomu *Palmatolepis marginifera* do środkowego poziomu *Scaphignathus velifer* — laminowane fyllity serycytowo-kwarcowe (próba A) w stanowisku 17 (fig. 2, 7; tab. 5); oraz mikrokwarcyty (próba D) w stanowisku 20 (fig. 2, 8; tab. 6);

— interwał od górnego poziomu *Palmatolepis crepida* do górnego poziomu *Scaphignathus velifer* — mikrokwarcyty (próba C, J) w stanowisku 20 (fig 2, 8; tab. 6) oraz mikrokwarcyty w stanowiskach 14, 15 i 21 (fig. 2); górną granicę przedziału dla prób A i B (fig. 8; tab. 6) w stanowisku 20 stanowi środkowy poziom velifer;

— najwyższy famen — mikrokwarcyty (próby K, L, P) we wschodniej części stanowiska 20 (fig 2, 7; tab. 7); próba P — interwał obejmujący górny poziom *Polygnathus styriacus* i dolny poziom *Bispathodus costatus*; datowanie prób L i K nie może być dokładniejsze.

Ponadto w stanowiskach 7, 10, 11, 19, 22, 23 i 24 (fig. 2) stwierdzono konodonty wskazujące, że skały, z których one pochodzą nie są starsze od emsu.

Przedstawione dane biostratygraficzne pozwalają na dokonanie rewizji dotychczasowej stratygrafii kompleksu kaczawskiego. Obecność dewońskich konodontów w fyllitach i mikrokwarcytach, wchodzących w skład wydzielonego przez Dahlgrüna (1934) „piętra niebiesko-szarych, ubogich w łyszczyki, łupków ilastych" pozwala na zaliczenie tych skał do dewonu. Dotąd były one zaliczane do górnego ordowiku (Dahlgrün 1934; Schwarzbach 1939; Jerzmański 1965; Teisseyre 1967a; Oberc 1973). Pozycję stratygraficzną wymienionych utworów określono na podstawie korelacji litologicznej z Turyngią (Dahlgrün *op. cit.*).

Występowanie pelagicznych utworów emsu, eiflu, franu i famenu wskazuje, że geosynklinalna sedymentacja w tutejszym basenie trwała co najmniej do późnego famenu, a nawet, jak ostatnio stwierdzono w południowo-zachodniej części Gór Kaczawskich (Chorowska, Sawicki 1975), do wczesnego karbonu.

Zarówno utwory dewońskie, jak i starsze od nich serie wykazują dolny zakres niskiego stadium metamorfizmu (Baranowski 1975b). Wyrażone przez Jaegera (1963, 1964) przypuszczenie, że w Górach Kaczawskich znajduje się (lub została zerodowana) osadowa pokrywa skał dewońskich i ewentualnie dolnokarbońskich, która biorąc udział w fałdowaniu umożliwiła deformacje niżej leżącego kompleksu, nie znajduje zatem uzasadnienia. Niesłuszna jest również hipoteza Bergera (1934), jakoby późnodewońska transgresja objęła uprzednio sfałdowane i zmetamorfizowane utwory staropaleozoiczne Gór Kaczawskich.

Z powyższych stwierdzeń wynika, że główne fałdowanie i metamorfoza kompleksu kaczawskiego odbyły się po osadzeniu najmłodszych, datowanych paleontologicznie utworów, a nie po środkowym dewonie, jak dotąd powszechnie przyjmowano (Teisseyre 1967, 1968; Oberc 1966, 1967, 1972, 1973). Problem wieku fałdowania kompleksu kaczawskiego oraz wynikające z nowych faktów stratygraficznych podstawy do rekonstrukcji paleografii oraz rozwoju strukturalnego sąsiednich obszarów omówiono obszerniej w poprzedniej publikacji (Urbanek 1975).

PLATE I

PLANSZA I

1. Microquartzite. Visible recrystallized radiolarian fragments surrounded by graphitic substance (black). Mag. 175 X. Nicols crossed. Locality 2

Mikrokwarcyt. Widoczne zrekrystalizowane szczątki radiolarii otoczone substancją grafitoidową (czarna). Pow. 175 X. Nikole skrzyżowane. Stanowisko 2.

2. Sericite-quartz slate. Visible light sericite-quartz laminae and black ones composed of graphitic and iron-oxides substance. Within light laminae directional arrangement of sericite scales oblique to the lamination. Mag. 140 X. Nicols parallel. Locality 6

Fyllit serycytowo-kwarcowy. Widoczne jasne laminy serycytowo-kwarcowe i czarne laminy złożone z substancji grafitoidowej i żelazistej. W obrębie jasnych lamin zaznacza się kierunkowe, niezgodne z laminacją, ułożenie blaszek serycytu. Pow. 140 X. Nikole równoległe. Stanowisko 6

3. Microquartzite. Visible individual quartz grains against fine-crystallized quartz background. A rock strongly impregnated with carbonates and iron oxides. Mag. 90 X. Nicols crossed. Locality 4

Mikrokwarcyt. W obrębie drobnokrystalicznego tła kwarcowego widoczne pojedyncze ziarna kwarcu. Skała silnie przepojona węglanami i związkami żelaza. Pow. 90 X. Nikole skrzyżowane. Stanowisko 4

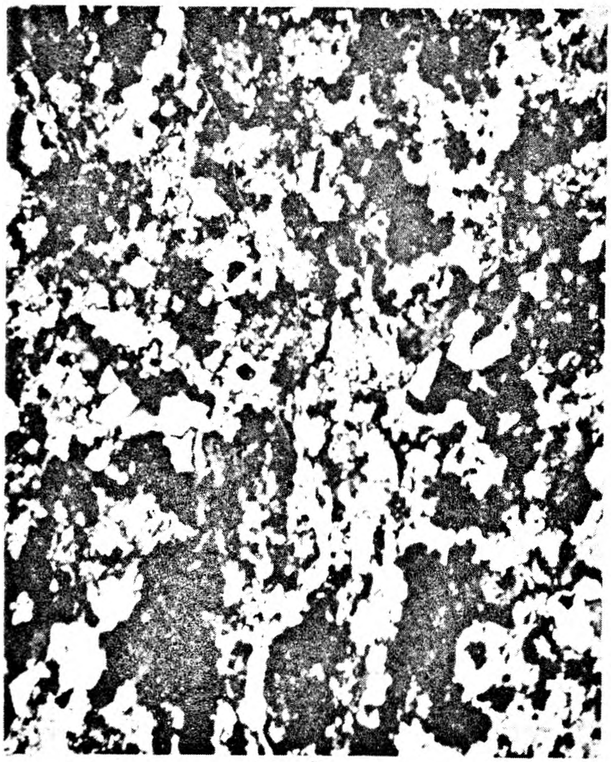
4. Microquartzite. Mag. 100 X. Nicols crossed. Locality 2

Mikrokwarcyt. Pow. 100 X. Nikole skrzyżowane. Stanowisko 2

PLATE I
PLANSZA I

1

2



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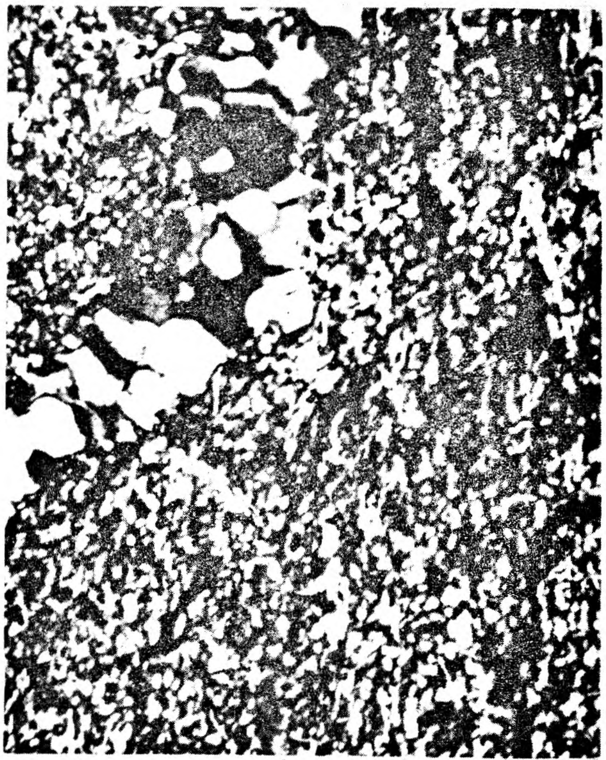

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Znaczenie dewońskich faun konodontowych dla stratygrafii epimetamorficznego kompleksu północno-wschodniej części Gór Kaczawskich

PLATE II

PLANSZA II

1. Fine-laminated sericite-quartz slate. Mag. 160 X. Nicols crossed. Locality 17
Drobnolaminowany fyllit serycytowo-kwarcowy. Pow. 160 X. Nikole skrzyżowane. Stanowisko 17

2. Sericite-quartz slate. Fine-grained sericite-quartz mosaic. Visible microlamination marked by iron oxide-sericite streaks. Mag. 100 X. Nicols crossed. Locality 5
Fyllit serycytowo-kwarcowy. Drobnokrystaliczna mozaika serycytowo-kwarcowa. Zaznacza się mikrolaminacja podkreślona smugami żelazisto-serycytowymi. Pow. 100 X. Nikole skrzyżowane. Stanowisko 5

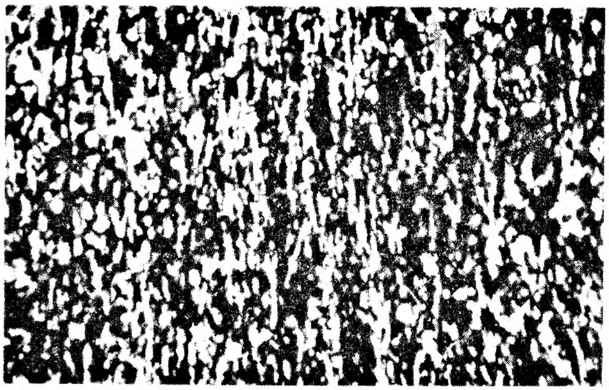
3. Sericite-quartz slate. Visible faint lamination maked by darker streaks richer in sericite. Within lighter lamine sericite scales perpendicular to the lamination. Mag. 180 X. Nicols crossed. Locality 6
Fyllit serycytowo-kwarcowy. Zaznacza się niewyraźna laminacja podkreślona ciemniejszymi smugami bogatymi w serycyt. W obrębie jaśniejszych lamin blaszki serycytu ułożone prostopadle do przebiegu lamin. Pow. 180 X. Nikole skrzyżowane. Stanowisko 6

4. Quartz-sericite slate. Visible fine, broken iron oxide-sericite streaks. Mag. 120 X. Nicols parallel. Locality 8
Fyllit kwarcowo-serycytowy. Widoczne delikatne, poprzerywane smugi żelazisto-serycytowe. Pow. 120 X. Nikole równoległe. Stanowisko 8

5. Microquartzite, Quartz replaced by automorphic secondary carbonates. Mag. 180 X. Nicols crossed. Locality 20
Mikrokwarcyt. Skała zawiera wtórne węglany o automorficznym wykształceniu, wypierające kwarc. Pow. 180 X. Nikole skrzyżowane. Stanowisko 20

6. Microquartzite. Irregular aggregates of carbonates marked by distinct relief. Mag. 180 X. Nicols crossed. Locality 20
Mikrokwarcyt. Nieregularne agregaty węglanów (elementy o wyraźnym reliefie) w tle kwarcowym. Pow. 180 X. Nikole skrzyżowane. Stanowisko 20

PLATE II
PLANSZA II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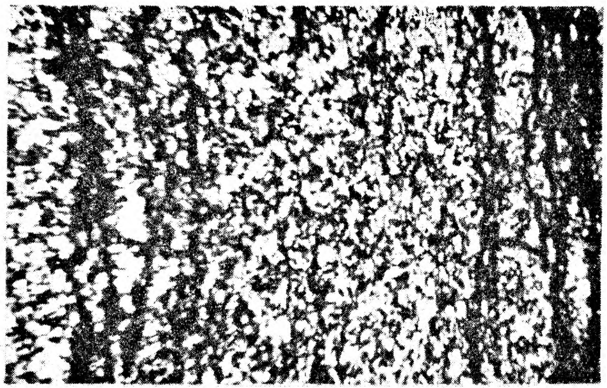
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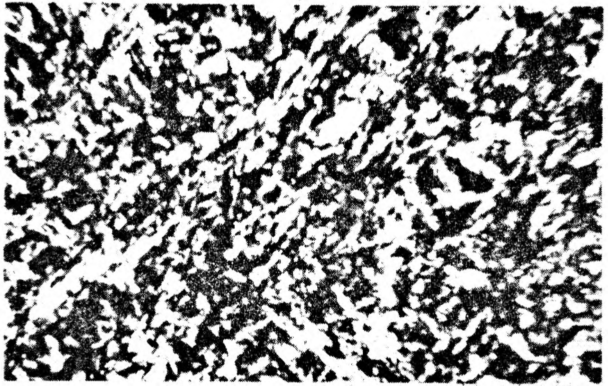
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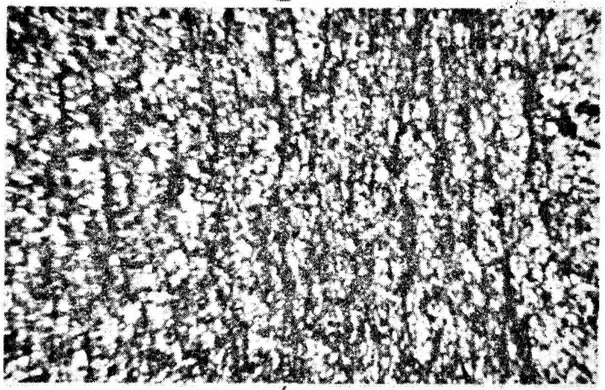
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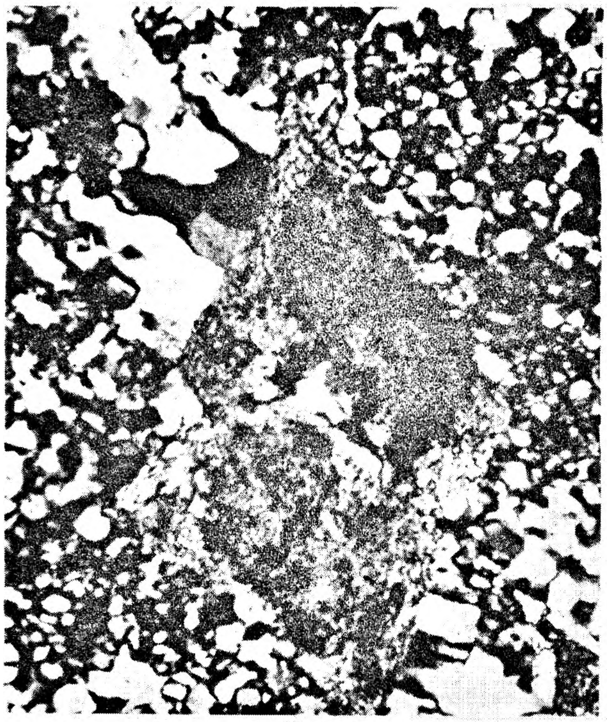
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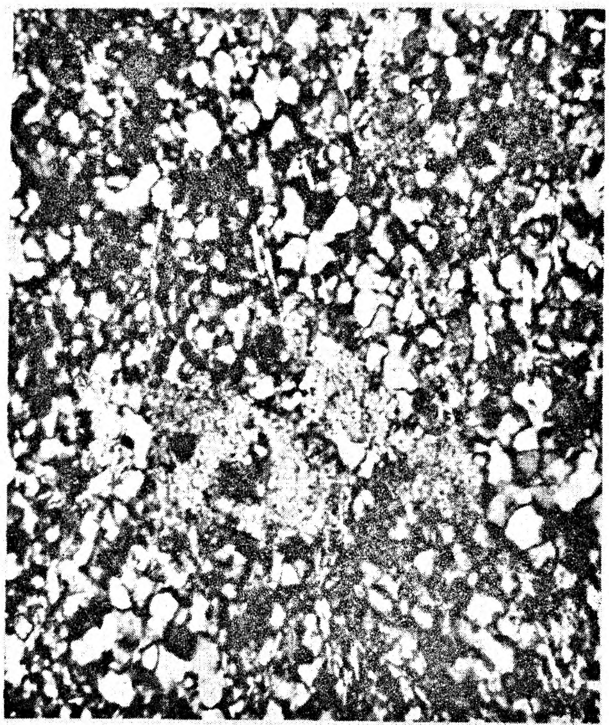
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Zdzisława URBANEK — The significance of Devonian conodont faunas for the stratigraphy of epi-metamorphic rocks of north-eastern part of the Góry Kaczawskie
Znaczenie dewońskich faun konodontowych dla stratygrafii epimetamorficznego kompleksu północno-wschodniej części Gór Kaczawskich

PLATE III

PLANSZA III

1a—c. *Polygnathus* cf. *intermedius* (Bultynck); upper, lower and lateral views of hypotype (ZGS/ U. 47) from locality 2 (G) *Polygnathus* cf. *intermedius* (Bultynck); z góry, z dołu i z boku; ZGS/U. 47. Stanowisko 2 (G)

2. *Palmatolepis gracilis gracilis* Branson and Mehl; lateral view of hypotype (ZGS/U. 75) from locality 20 (L)
Palmatolepis gracilis gracilis Branson and Mehl; z boku; ZGS/U. 75. Stanowisko 20 (L)

3. *Polygnathus* cf. *foveolatus* Philip and Jackson; upper view of hypotype (ZGS/U. 1) from locality 8
Polygnathus cf. *foveolatus* Philip and Jackson; z góry, ZGS/U. 1. Stanowisko 8

4a—b. *Spathognathodus steinhornensis steinhornensis* Ziegler; upper and lower views of hypotype (ZGS/U. 44) from locality 8; specimen broken after identification
Spathognathodus steinhornensis steinhornensis Ziegler; z góry i z dołu; ZGS/U. 44. Stanowisko 8. Okaz uszkodzony po oznaczeniu

5a—b. *Pseudopolygnathus* sp.; upper and lower views of specimen (ZGS/U. 77) from locality 20 (L)
Pseudopolygnathus sp.; z góry i z dołu; ZGS/U. 77. Stanowisko 20 (L)

6a—b. *Polygnathus kockelianus* Bischoff and Ziegler; upper and lower views of hypotype (ZGS/U. 45) from locality 4 (A)
Polygnathus kockelianus Bischoff and Ziegler; z góry i z dołu; ZGS/U. 45. Stanowisko 4 (A)

7. *Polygnathus linguiformis linguiformis* Hinde; upper view of hypotype (ZGS/U. 46) from locality 16
Polygnathus linguiformis linguiformis Hinde; z góry; ZGS/U. 46. Stanowisko 16

8a—b. *Polygnathus costatus* cf. *costatus* Klapper; upper and lower views of hypotype (ZGS/U. 48) from locality 2 (C).
Polygnathus costatus cf. *costatus* Klapper; z góry i z dołu; ZGS/U. 48. Stanowisko 2 (C)

9a—b. *Pseudopolygnathus* cf. *brevipennatus* Ziegler; upper and lower views of hypotype (ZGS/U. 76) from locality 20 (P)
Pseudopolygnathus cf. *brevipennatus* Ziegler; z góry i z dołu; ZGS/U. 76. Stanowisko 20 (P)

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PLATE III
PLANSZA III

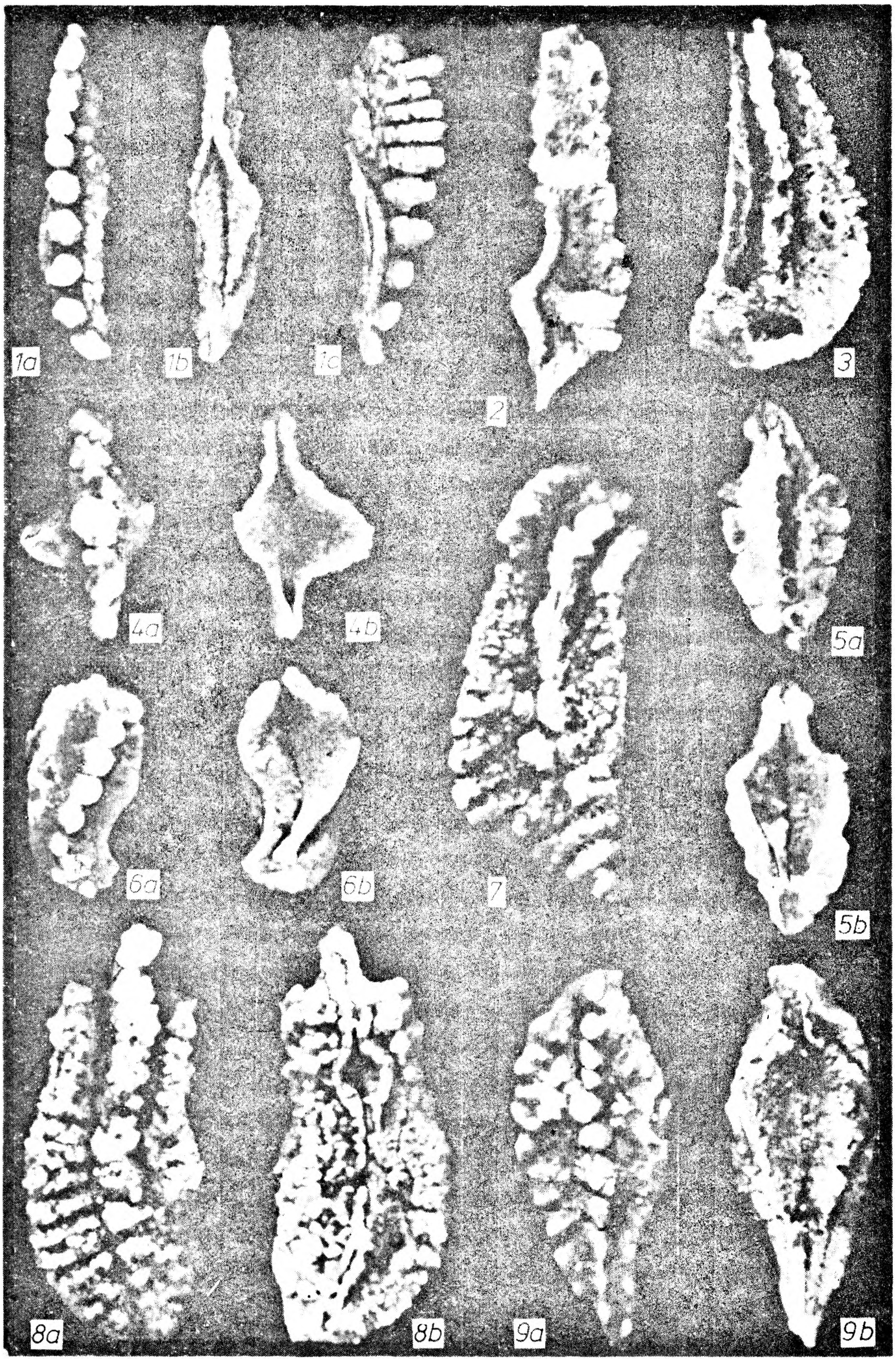

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PLATE IV

PLANSZA IV

1a—c. *Icriodus alternatus* Branson and Mehl; upper, lower and lateral views of hypotype (ZGS/U. 50) from locality 5 (B)

Icriodus alternatus Branson and Mehl; z góry, z dołu i z boku; ZGS/U. 50. Stanowisko 5 (B)

2a—c. *Icriodus* cf. *symmetricus* Branson and Mehl; upper, lower and latteral views of hypotype (ZGS/U. 6) from locality 6 (B)

Icriodus cf. *symmetricus* Branson and Mehl; z góry, z dołu i z boku; ZGS/U. 6. Stanowisko 6 (B)

3a—b. *Ancyrognathus* cf. *triangularis* Youngquist; upper and lower views of hypotype (ZGS/U. 7) from locality 6 (B)

Ancyrognathus cf. *triangularis* Youngquist; z góry i z dołu; ZGS/U.7. Stanowisko 6 (B)

4. *Ancyrodella* sp.; upper view of specimen (ZGS/U. 5) from locality 6 (A)

Ancyrodella sp.; z góry; ZGS/U. 5. Stanowisko 6 (A)

5a—b. *Polygnathus pseudofoliatus* Wittekindt; upper and lower views of hypotype (ZGS/U. 49) from locality 2 (I)

Polygnathus pseudofoliatus Wittekindt; z góry i z dołu; ZGS/U. 49. Stanowisko 2 (I)

6a—b. *Palmatolepis subrecta* vel P. *unicornis* Miller and Youngquist; upper and lower views of specimen (ZGS/U. 52) from locality 5 (B)

Palmatolepis subrecta vel P. *unicornis* Miller and Youngquist; z góry i z dołu; ZGS/U. 52. Stanowisko 5 (B)

7. *Nothognatella* sp.; lateral view of specimen (ZGS/U. 51) with broken platform from locality 5 (B)

Nothognatella sp.; z boku; ZGS (U. 51). Stanowisko 5 (B). Okaz z uszkodzoną platformą

All photographs are X 75

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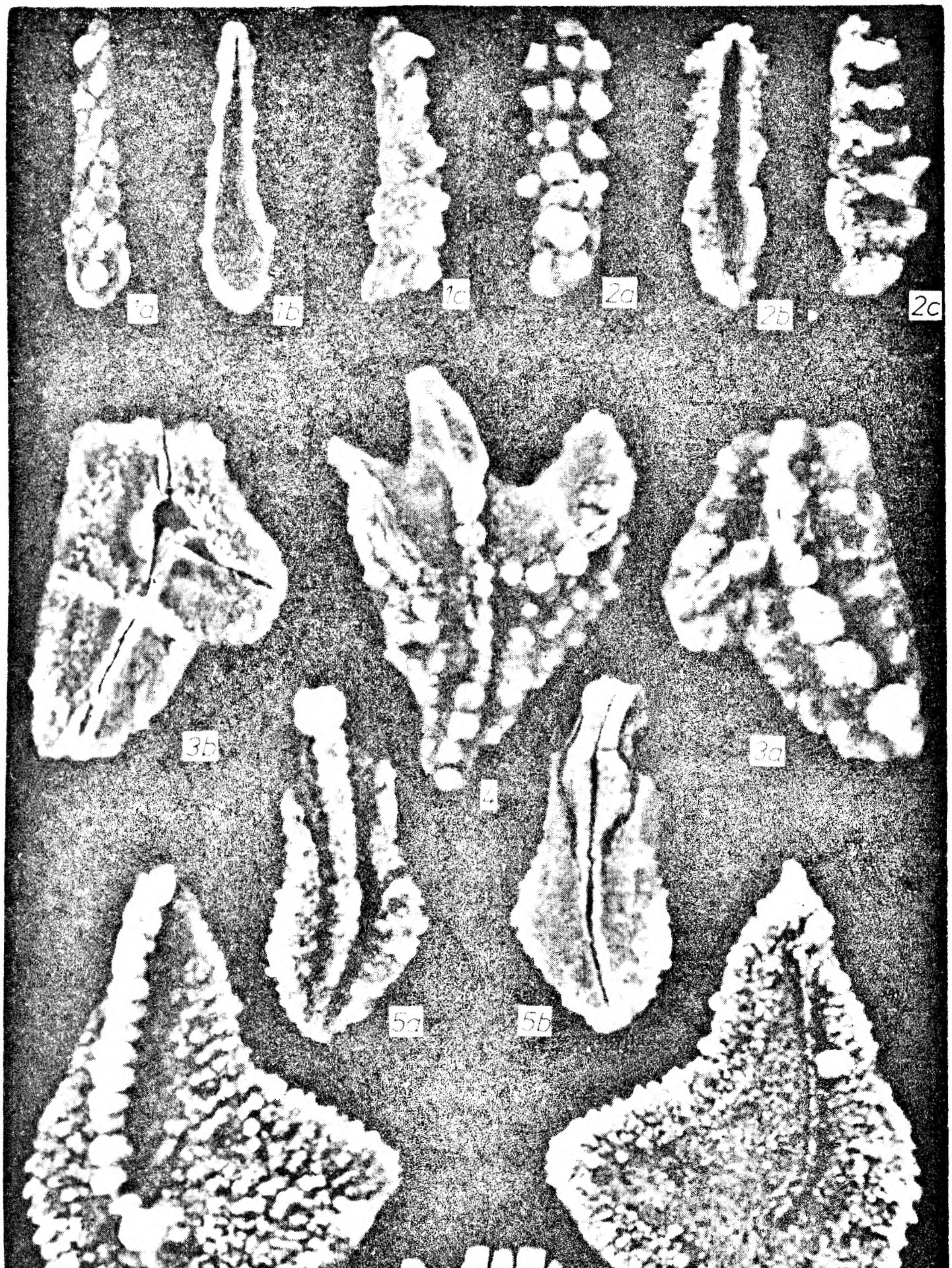
PLATE IV
PLANSZA IV



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Znaczenie dewońskich faun konodontowych dla stratygrafii epimetamorficznego kompleksu północno-wschodniej części Gór Kaczawskich

PLATE V

PLANSZA V

1a–b, 8. ***Palmatolepis glabra*** cf. ***lepta*** Ziegler and Huddle; 1a–b upper and lower views of hypotype (ZGS/U. 68) from locality 20 (I), 8 upper view of hypotype (ZGS/U. 8) from locality 20 (D)
Palmatolepis glabra cf. *lepta* Ziegler and Huddle; 1a–b z góry i z dołu – ZGS/U. 68. Stanowisko 20 (I); 8 – z góry ZGS/U.8. Stanowisko 20 (D)

2. *Palmatolepis* cf. *rhomboidea* Sannemann; upper view of hypotype (ZGS/U. 72) from locality 17 (D), outer anterior platform cut by quartz veinlet.
Palmatolepis cf. *rhomboidea* Sannemann; z góry; ZGS/U.72. Stanowisko 17 (D). Przednia, zewnętrzna część platformy przecięta żyłką kwarcu

3. *Palmatolepis glabra pectinata* Ziegler; upper view of hypotype (ZGS/U. 69) from locality 17 (A); specimen with broken outer anterior platform
Palmatolepis glabra pectinata Ziegler; z góry; ZGS/U.69. Stanowisko 17 (A). Okaz z uszkodzoną przednią, zewnętrzną częścią platformy

4. *Palmatolepis marginifera marginifera* Helms; upper view of hypotype (ZGS/U. 70) from locality 17 (A) with corroded outer anterior margin
Palmatolepis marginifera marginifera Helms; z góry; ZGS/U. 70. Stanowisko 17 (A). Skorodowana przednia, zewnętrzna część platformy

5–6. *Palmatolepis distorta distorta* Branson and Mehl; 5 upper view of hypotype (ZGS/U. 67) from locality 17 (A), 6 upper view of hypotype (ZGS/U. 66) locality 17 (A)
Palmatolepis distorta distorta Branson and Mehl; 5 – z góry ZGS/U. 67; 6 – z góry ZGS/U.66. Stanowisko 17 (A)

7. *Palmatolepis glabra prima* Ziegler and Huddle; upper view of hypotype (ZGS/U. 73) from locality 17 (D)
Pamatolepis glabra prima Ziegler and Huddle; z góry; ZGS/U. 73. Stanowisko 17 (D)

9. *Palmatolepis minuta minuta* Branson and Mehl; upper view of hypotype (ZGS/U. 71) from locality 17 (D)
Palmatolepis minuta minuta Branson and Mehl; z góry; ZGS/U. 71. Stanowisko 17 (D)

10. *Spathognathodus* sp.; lateral view of specimen (ZGS/U. 74) from locality 20 (K)
Spathognathodus sp.; z boku; ZGS/U.74. Stanowisko 20 (K)

11. *Palmatolepis* sp.; upper view of specimen (ZGS/U. 64) with deformed posterior platform and corroded ornamentation from locality 17 (H)
Palmatolepis sp.; z góry; ZGS/U. 64. Stanowisko 17 (H). Okaz ze zdeformowaną tylną częścią platformy i skorodowaną ornamentacją

12. *Palmatolepis* sp.; upper view of specimen (ZGS/U. 65) with corroded ornamentation from locality 17 (H)
Palmatolepis sp.; z góry; ZGS/U.65. Stanowisko 17 (H). Ornamentacja platformy skorodowana

All photographs X 75, only 7 is X 40
Powiększenie 75 X, tylko 7 pow. 40 X

PLATE V
PLANSZA V

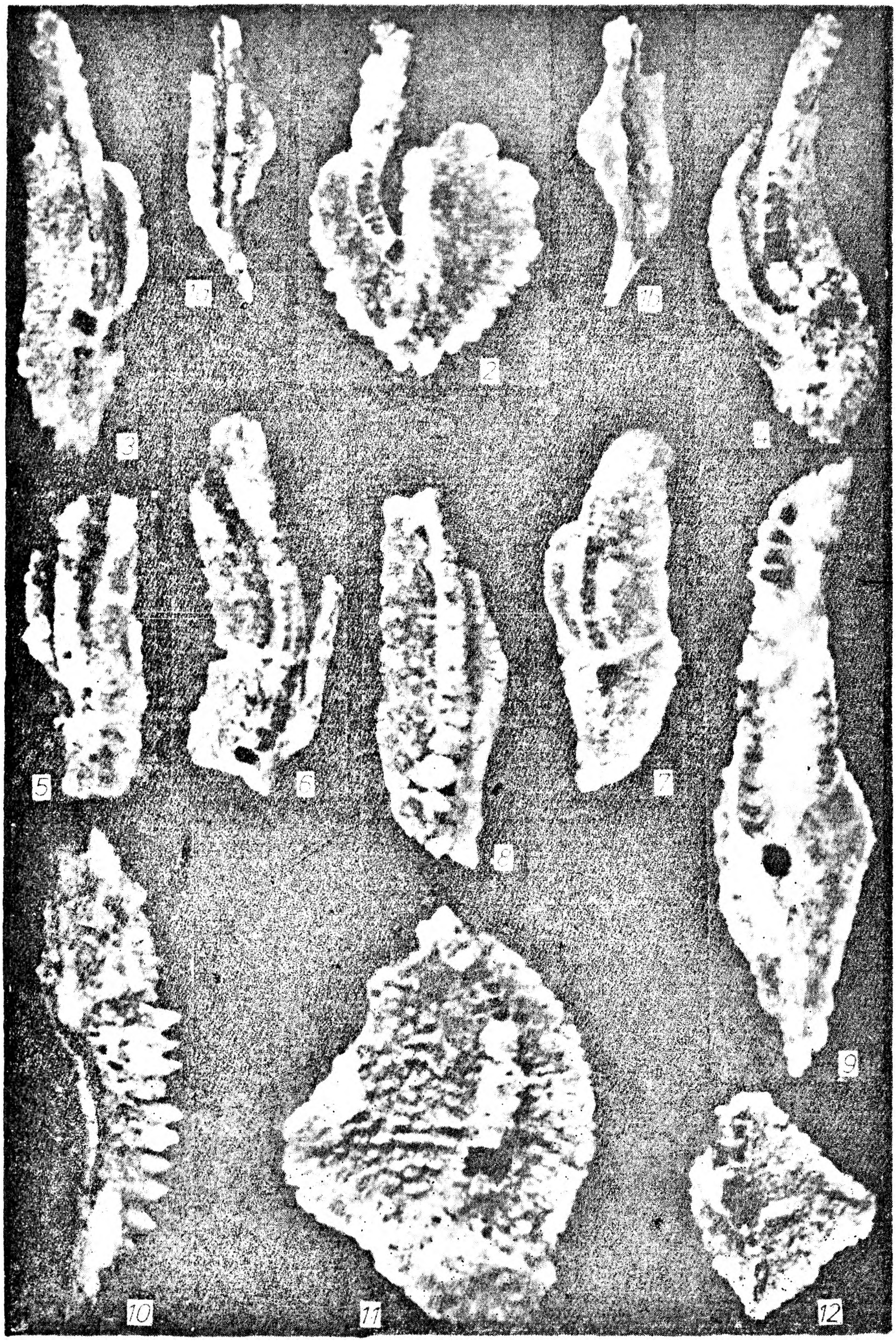

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PLATE VI

PLANSZA VI

1. *Palmatolepis gigas* Miller and Youngquist; upper view of hypotype (ZGS/U. 53) from locality 5 (B)

Palmatolepis gigas Miller and Youngquist; z góry; ZGS/U. 53. Stanowisko 5 (B)

2. *Ancyrodella curvata* (Branson and Mehl); upper view of hypotype (ZGS/U. 54) from locality 5 (B)

Ancyrodella curvata (Branson and Mehl); z góry; ZGS/U. 54. Stanowisko 5 (B)

3, 7, 9. *Palmatolepis subrecta* vel P. *unicornis* Miller and Youngquist; upper views of three specimens (ZGS/U. 55—57) from locality 5 (B); tips of denticles of free blade broken

Palmatolepis subrecta vel P. *unicornis* Miller and Youngquist; z góry; ZGS/U. 55—57. Stanowisko 5 (B). Szczyty ząbków na wolnych ostrzach są złamane

4. *Palmatolepis subrecta* vel P. *gigas* Miller and Youngquist; upper view of specimen (ZGS/U. 58) from locality 5 (B); end of outer lobe broken

Palmatolepis subrecta vel P. *gigas* Miller and Youngquist; z góry; ZGS/U. 58. Stanowisko 5 (B). Zakończenie zewnętrznego płata jest uszkodzone

5. *Palmatolepis perlobata* subsp. indet.; lower view of specimen (ZGS/U. 60) from locality 17 (D)

Palmatolepis perlobata subsp. indet.; od dołu; ZGS/U. 60. Stanowisko 17 (D)

6. *Ancyrognathus asymmetricus* (Ulrich and Bassler); upper view of hypotype (ZGS/U. 59) from locality 5 (B); quartz veinlet cuts across specimen

Ancyrognathus asymmetricus (Ulrich and Bassler); z góry; ZGS/U 59. Stanowisko 5 (B). Okaz przecięty żyłką kwarcu

8. *Palmatolepis* sp.: upper view of specimen cut by quartz veinlets (ZGS/U. 61) from locality 17 (H)

Palmatolepis sp.; z góry; ZGS/U. 61. Stanowisko 17 (H). Okaz przecięty żyłkami kwarcu

10. *Polygnathus* vel *Siphonodella*; upper view of specimen (ZGS/U. 63) from locality 20 (L)

Polygnathus vel *Siphonodella*; z góry; ZGS/U. 63. Stanowisko 20 (L)

11. *Palmatolepis* sp.; upper view of specimen (ZGS/U. 62) cut by quartz veinlets from locality 17 (H)

Palmatolepis sp.; z góry; ZGS/U. 62. Stanowisko 17 (H). Okaz pocięty żyłkami kwarcu

All photographs are X 30

Powiększenie 30 X

PLATE VI
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