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Foraminifers and conodonts in the Viséan deposits of the Lublin Upland

ABSTRACT: Foraminifer and conodont faunas recorded in the carbonate deposits found in the boreholes Rudno and Podedwórze situated on the Lublin Upland, are analysed for biostratigraphic purposes. The foraminifers as well as conodonts are indicative of the uppermost Viséan (*V3c*). The two borehole sections are representative of distinct conodont biofacies.

INTRODUCTION

The borehole sections Rudno *IG-1* and Podedwórze *IG-2*, northeastern Lublin Upland (*see* Fig. 1; *cf.* Cebulak & Porzycki 1976), show Mesozoic strata and the underlying Lower Carboniferous deposits. The latter strata were subject to various petrographic, palynologic, and macropaleontologic investigations. They yielded macrofaunal assemblages indicative of the Visean (Musiał 1976) and spore assemblages indicative of the Upper Viséan (Jachowicz & Jachowicz 1976). The present authors recorded in those strata abundant foraminifers and some biostratigraphically important conodonts, which permits a more precise biostratigraphic analysis of the Lower Carboniferous of the Lublin Upland.

The foraminifer fauna was studied in three hundred thin sections. The density of foraminifers ranged between 1 and 200 specimens per thin section. The preservation state was very good as a rule. Twenty samples of 1—3 kg in weight were studied for conodonts. Three samples were barren, and the others yielded at most 30 conodont specimens per kilogram of the rock.

GEOLOGICAL SECTIONS OF THE INVESTIGATED BOREHOLES

The Lower Carboniferous deposits of Rudno-Podedwórze area accumulated in a marine nearshore environment. Marine and nearshore to lacustrine sedimentary conditions were changing cyclically, which is

reflected in lithology by the alternation of carbonate-clayey and sandy--coal-bearing strata. Carbonate beds ranging from a few up to a dozen or so meters in thickness are usually good correlation markers (*cf.* Cebulak & Porzycki 1966) but nevertheless, the two investigated borehole sections were correlated on this basis only equivocally and imprecisely. Actually, the recognition of transgressive-regressive cycles in the sections and the distribution of the algae *Calcifolium okense,* indicative of the uppermost Viséan (*V3c*), have appeared more promising for the stratigraphic correlation (Skompski 1980).

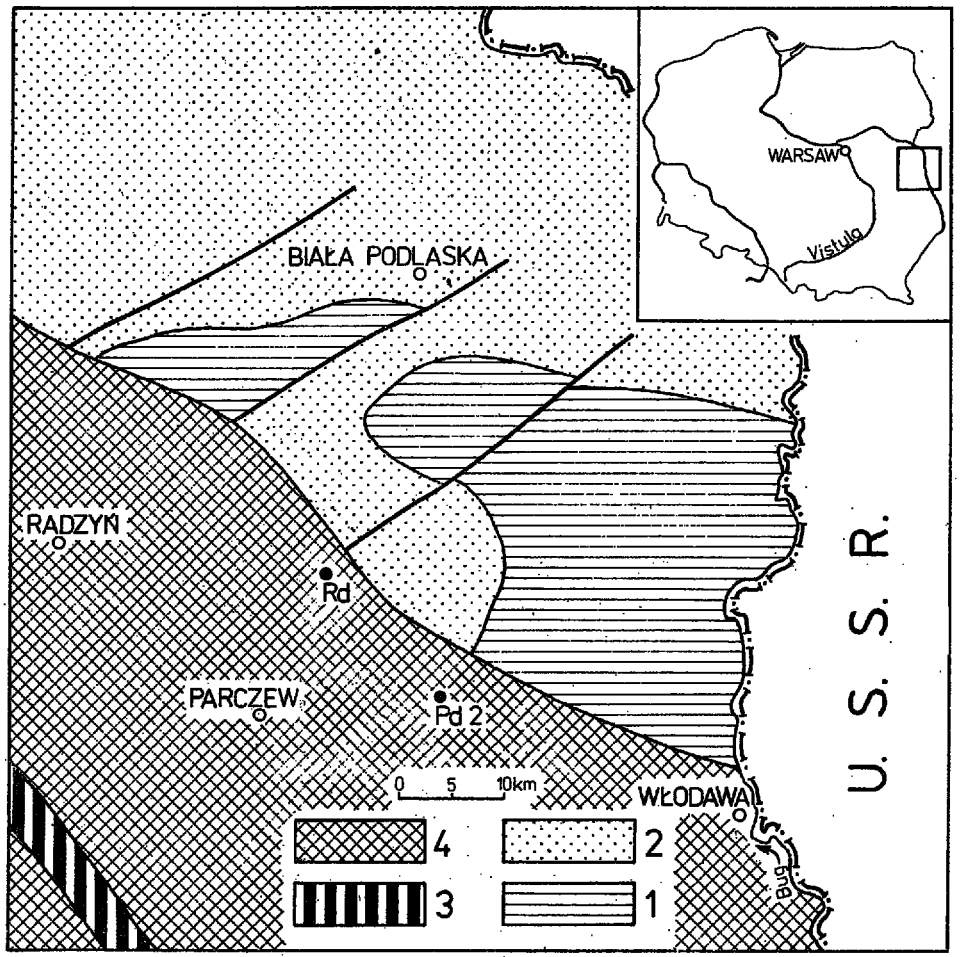


Fig. 1. Geological sketch map of the NE part of the Lublin Upland (without Cainozoic, Mesozoic and Permian formations; *after* Pożaryski & Radwański 1972); inset shows location of the area in Poland

Investigated boreholes are marked with black spots: Rd Rudno *IG-1*, Pd 2 Podedwórze *IG-2* 1 Upper Eocambrian (Wendian); 2 Cambrian, Ordovician and Silurian; 3 Middle and Upper Devonian; 4 Lower and Upper Carboniferous

In both the investigated borehole sections, the lowermost carbonate beds (depth interval 789.0—791.0 m in Rudno *IG-1*; depth interval 602.5—606.0 m in Podedwórze *IG-2*; *see* Fig. 2) comprise very large amounts of fragmented coral colonies, bivalves, brachiopods, and crinoids. These sediments accumulated probably in a high-energy reef core or forereef zone. All the overlying carbonate beds are crinoid-foraminifer biomicrites variable in intensity of skeletal fragmentation and contents of clay matter; commonly, these are marly limestones to marls.

FORAMINIFER FAUNA

Previous studies of the Lower Carboniferous foraminifer faunas of Poland (*cf.* Jurkiewicz & Żakowa 1978) were only partly concerned with the Lublin Upland (Liszka 1960, 1962; Ozonkowa & Soboń-Podgórska 1972; Woszczyńska 1972; Soboń-Podgórska 1978, 1979).

Three carbonate complexes can be distinguished in the investigated borehole sections after a variation in taxonomic composition of the foraminifer assemblages and mostly, the proportions of particular foraminifer taxa. The lowermost complex (depth interval 791.0—789.0 m in Rudno, 606.0—602.5 m in Podedwórze; *see* Fig. 2) shows the poorest foraminifer assemblage including 15 species indicative of the Upper Viséan. The foraminifer assemblage recorded in the overlying carbonate complexes is very abundant and diverse. It includes *Endothyra spirilliniformis, Globivalvulina parva, Novella* sp., *Rectocornuspira issatchkensis regularis, Endothyranella* sp., *Loeblichia ukrainica, L. ammonoides, Archaediscus cornuspiroides, Neoarchaediscus parvus,* and *Janischewskinia operculata* associated with representatives of the genera *Howchinia, Bradyina, Valvulinella, Planoarchaediscus, Tetrataxis, Endothyranopsis, Cribrostomum,* and *Asteroarchaediscus* (see Table 1). The assemblage is indicative of the foraminifer zones *16i* and *16s* of Mamet (1974) and *Novella* & *Neoarchaediscus incertus* Zones of Paproth (1969; *see* Table 2), that is of the uppermost Viséan (*V3c*). There are no taxa typical of any zone lower than the *16* foraminifer zone of Mamet (1974) or of the zone *17* (lowermost Namurian). The recorded genera, species, and subspecies have also been reported from other regions of Poland (*see* Jurkiewicz & Żakowa 1978), Western and Southern Europe (Conil & Lys 1964, Conil & Dvořak 1969, Hallett 1970, Mamet 1973), Soviet Union (Brazhnikova & *al.* 1967, Ajzenverg & *al.* 1968, Vdovenko 1979), America and Australia (Mamet 1968, Mamet & Skipp 1970).

Table 1

Upper Viséan foraminifers occurring in boreholes Rudno and Podedwórze

AMMODISCIDAE
Ammodiscus volgensis Rauser

PARATHURAMMINIDAE
Diplosphaerina inaequalis (Derville)
Draffania biloba Cummings
Saccaminopsis carteri (Brady)

PALAEOTEXTULARIDAE
Climacammina sp.
Cribrostomum eximium eximiformis Lipina
C. bradyi Moeller
C. recurrens Vissarionova
C. stalinogorski Lipina
Palaeotextularia breviseptata Lipina
P. consobrina Lipina
P. gibbosa minima Lipina
P. longiseptata crassa Lipina

TETRATAXIDAE
Globivalvulina parva Tchernousova
Globivalvulina sp.
Tetrataxis angusta Vissarionova
T. decurrens Brady
T. minuta Brazhnikova
T. paraminima Vissarionova
T. pressulus gigantea Conil & Lys
Tetrataxis ex gr. *T. angusta* Vissarionova
Valvulinella angulata Brazhnikova
V. tchotchiai Grozdilova & Lebedeva
V. youngi (Brady)

CORNUSPIRIDAE
Rectocornuspira issatchkensis regularis Brazhnikova, Roztovceva & Karpova

TOURNAYELLIDAE
Forschiella grandis Brazhnikova
F. subangulata (Moeller)
Lituotubella glomospiroides Rauser

ENDOTHYRIDAE
Bradyina cribrostomata Rauser & Reitlinger
B. rotula (Eichwald)
Cribrospira mira Rauser
C. panderi Moeller
Endothyra obsoleta (Rauser)
E. omphalota involuta Brazhnikova
E. omphalota minima (Rauser & Reitlinger)
E. prisca (Rauser & Reitlinger)
E. pulchra Brazhnikova & Potevskaja
E. pseudobradyi Brazhnikova
E. similis Rauser & Reitlinger
E. spirilliniformis (Brazhnikova & Potevskaja)
Endothyranopsis compressa (Rauser & Reitlinger)
E. convexus (Rauser)
E. crassus sphaerica (Rauser & Reitlinger)
E. hirosei Okimura
Endothyranella sp.
Globoendothyra elegantula (Durkina)
G. globulus (Eichwald)
G. ischimica (Rauser)
Janischewskinia operculata (Rauser & Reitlinger)
Loeblichia ammonoides Brady
L. ukrainica (Brazhnikova)
Mikhailovella sp.
Novella sp.

ARCHAEDISCIDAE
Archaediscus chernousoviensis Mamet
A. convexus Grozdilova & Lebedeva
A. cornuspiroides Brazhnikova & Vdovenko
A. enormis Schlykova
A. karreri Brady
A. krestovnikovi koktjubensis Rauser
A. moelleri gigas Rauser
A. postmoelleri Potevskaja
Asteroarchaediscus ex gr. *A. baschkiricus* Krestovnikov & Teodorovitch
Neoarchaediscus parvus (Rauser)
N. subbaschkiricus (Reitlinger)
Planoarchaediscus ex gr. *P. gregorii* (Dain)

LASIODISCIDAE
Howchinia exilis compressa (Brazhnikova)
H. gibba longa (Brady)

OZAWAINAELLIDAE
Eostaffella radiata (Brady)
Mediocris mediocris Vissarionova
M. breviscula Ganelina
Pseudoendothyra ornata Brady
P. struvei (Moeller)

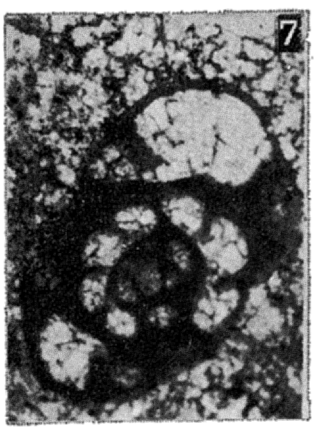
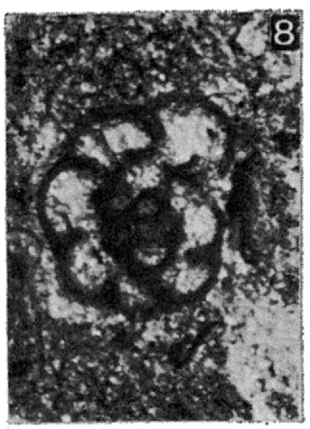
CONODONT FAUNA

The uppermost Viséan conodonts of Poland were subject to only a few investigations. Actually, the only conodont fauna of that age that has thus far been studied in detail derived from Krzeszowice area, Cracow Upland (Gromczakiewicz-Łomnicka 1974). The Viséan strata found in the Gałęzice syncline in the Holy Cross Mts are of virtually

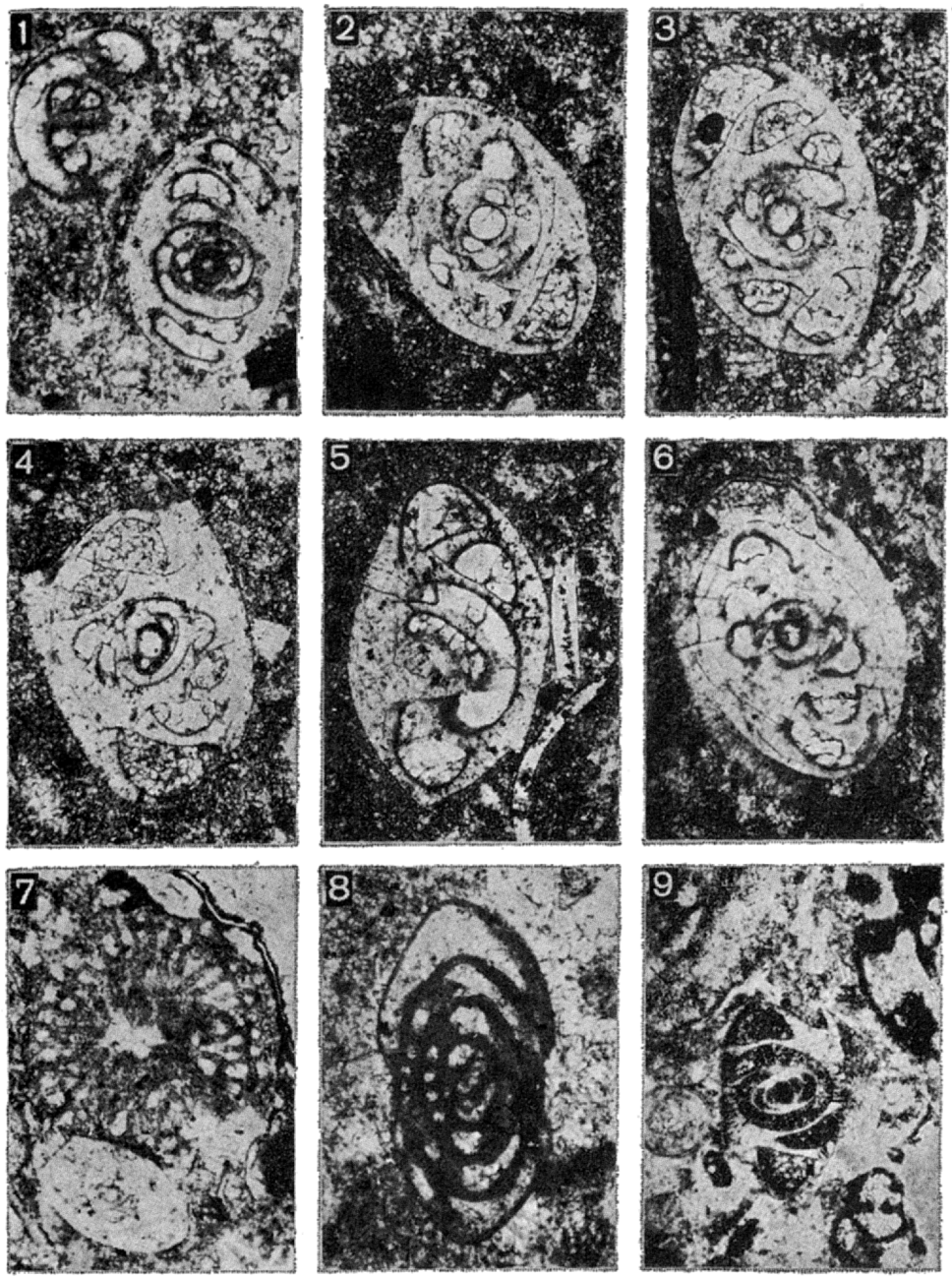




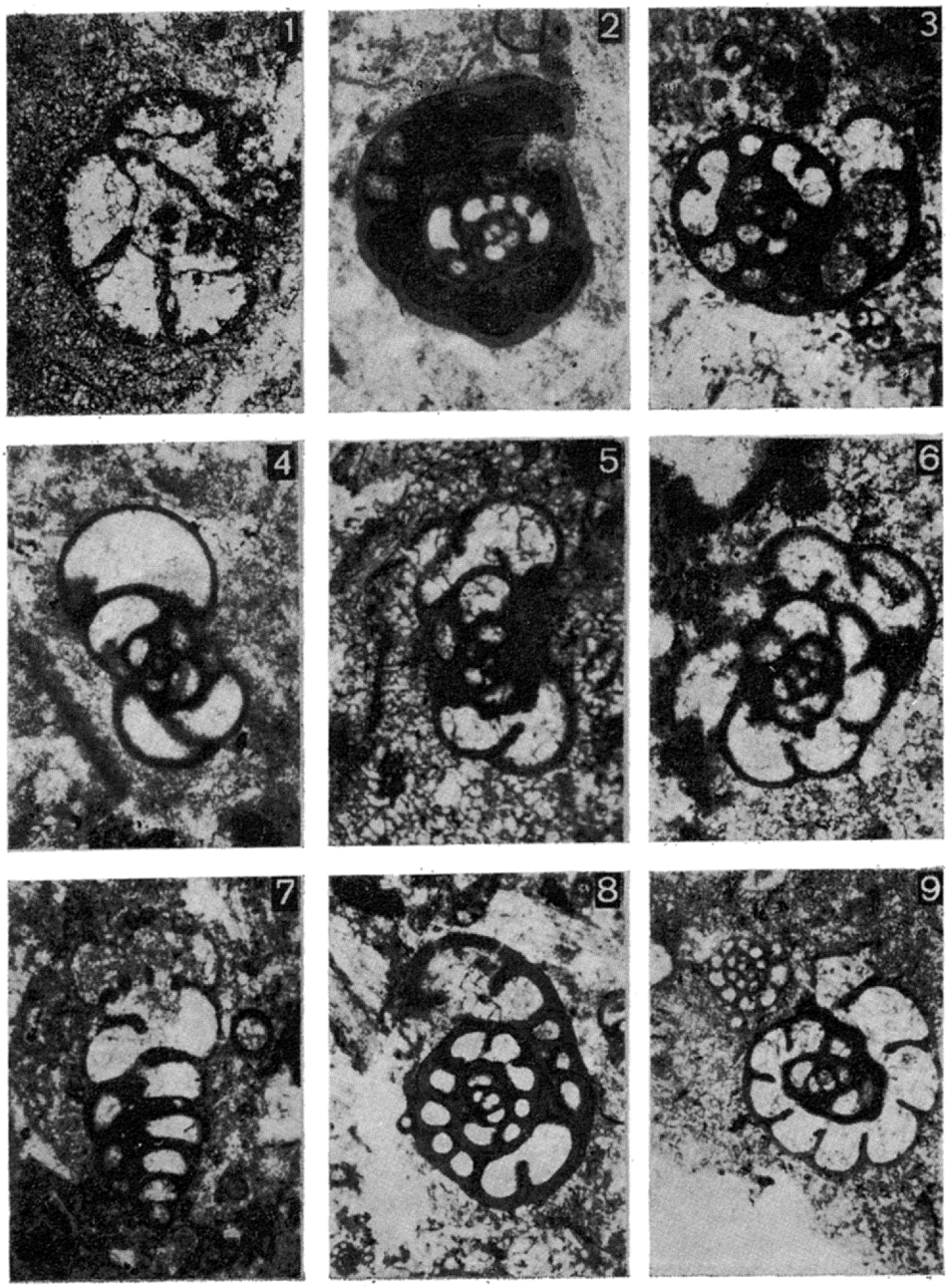


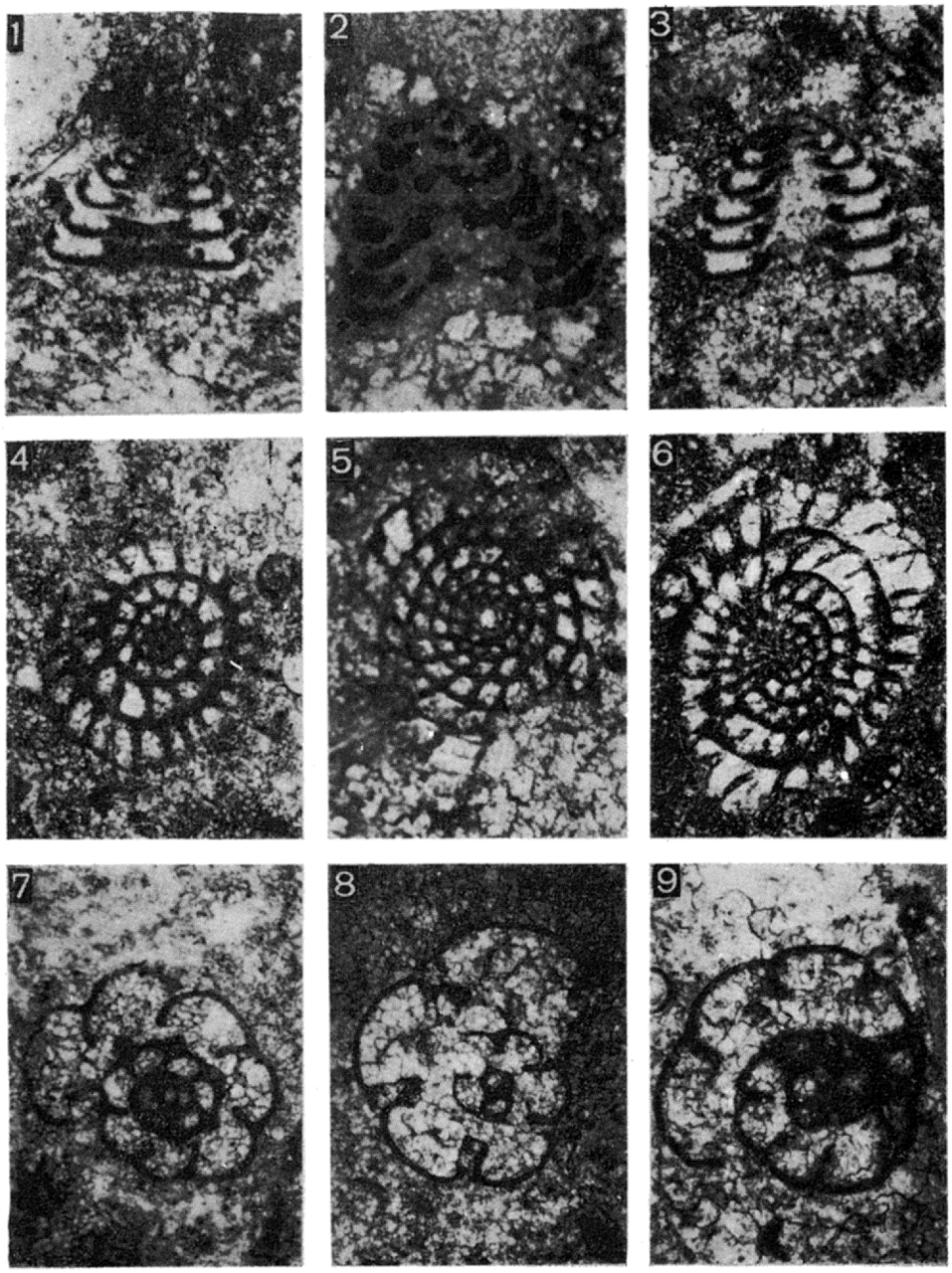

1 — *Palaeotextularia consobrina* Lipina; borehole Rudno (depth 759 m), ×90
2 — *Planoarchaediscus eospirillinoides* Brazhnikova; Podedwórze (depth 560 m), ×80
3 — *Loeblichia ammonoides* Brady; Rudno (depth 738 m), ×90
4 — *Climacammina* sp.; Podedwórze (depth 571 m), ×40
5 — *Rectocornuspira issatchkensis regularis* Brazhnikova, Rostovceva & Karpov; Podedwórze (depth 586 m), ×100
6 — *Bradyina rotula* (Eichwald); Rudno (depth 744 m), ×30
7 — *Endothyra omphalota minima* (Rauser & Reitlinger); Podedwórze (depth 586 m), ×100
8 — *Endothyra pulchra* Brazhnikova & Potevskaja; Podedwórze (depth 561 m), ×100
9 — *Janischewskinia operculata* (Rauser & Reitlinger); Podedwórze (depth 564 m), ×40



1 — *Archaediscus convexus* Grozdilova & Lebedeva; borehole Podedwórze (depth 561 m), ×90
2—3 and 6 — *Archaediscus moelleri gigas* Rauser; Rudno (depth 760 m), ×60
4—5 — *Archaediscus enormis* Schykova; Rudno (depth 760 m), ×60
7 — *Archaediscus* sp. and *Valvulinella youngi* (Brady); Rudno (depth 736 m), ×75
8 — *Eostaffella radiata* (Brady); Rudno (depth 744 m), ×90
9 — *Archaediscus convexus* Grozdilova & Lebedeva and *Endothyranopsis* sp.; Rudno (depth 738 m), ×40



1 — *Bradyina cribrostomata* Rauser & Reitlinger; borehole Rudno (depth 758 m), ×30
2 — *Endothyra omphalota involuta* Brazhnikova; Podedwórze (depth 593 m), ×40
3 and 8 — *Globoendothyra elegantula* (Durkina); Podedwórze (depth 593 m), ×30
4—5 — *Endothyra spirilliniformis* (Brazhnikova & Potevskaja); Podedwórze (depth 589 m), ×60
6 — *Endothyra pulchra* Brazhnikova & Potevskaja; Podedwórze (depth 593 m), ×80
7 — *Cribrostomum eximium paraeximia* Lipina; Podedwórze (depth 537 m), ×30
9 — *Endothyra similis* Rauser & Reitlinger and *Eostaffella* sp.; Podedwórze (depth 560 m), ×50



1 and 3 — *Howchinia gibba longa* (Brady); borehole Podedwórze (depth 573 m), ×100
2 — *Valvulinella tchotchiai* Grozdilova & Lebedeva; Podedwórze (depth 554 m), ×100
4—5 — *Loeblichia ammonoides* Brady; Podedwórze (depth 573 m), ×75
6 — *Pseudoendothyra ornata* Brady; Podedwórze (depth 561 m), ×50
7 — *Endothyra obsoleta* Rauser; Podedwórze (depth 586 m), ×70
8 — *Janischewskinia operculata* (Rauser & Reitlinger); Podedwórze (depth 569 m), ×30
9 — *Endothyranopsis crassus* (Brady); Podedwórze (depth 569 m), ×50

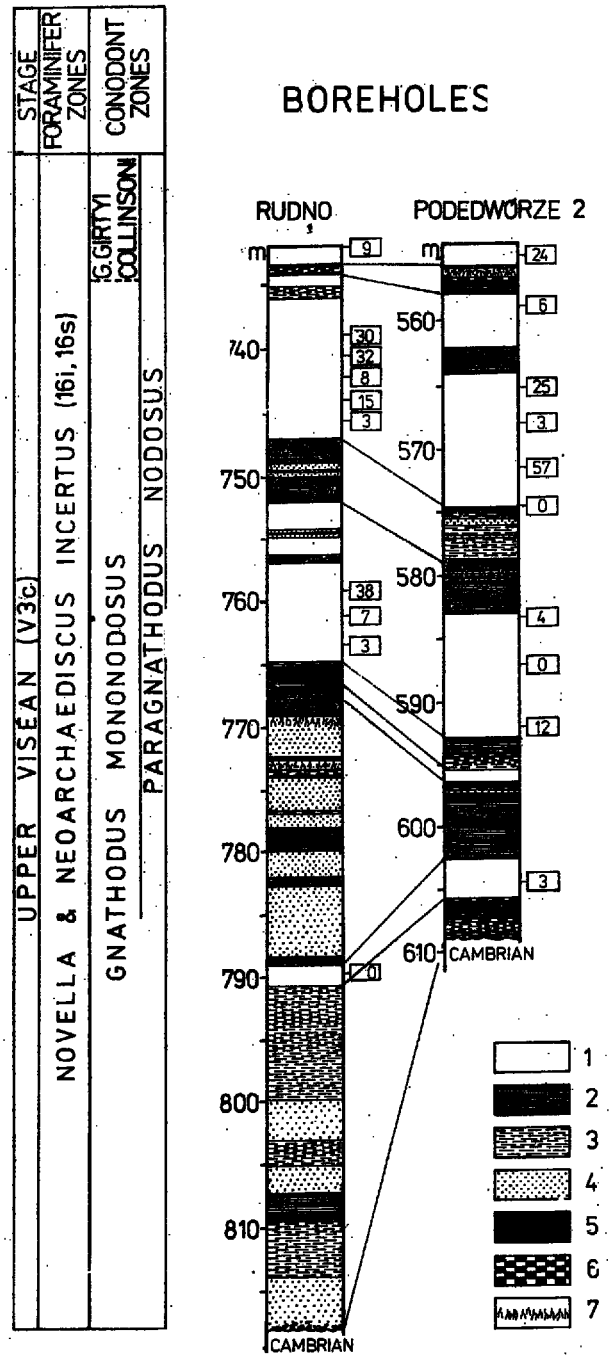


Fig. 2. Correlation of Viséan borehole profiles Rudno and Podedwórze 2; frequences of conodonts are given at the right side of each profile

1 Viséan carbonate rocks, 2 claystones, 3 mudstones, 4 sandstones, 5 coal measures, 6 carbonaceous shales, 7 *Stigmaria*-bearing seat earth

the same age (*cf.* Jurkiewicz & Żakowa 1978). The other studies of the Viséan conodonts of Poland (Chorowska 1972, 1978; Matyja & Narkiewicz 1979) are not concerned with the uppermost part of the stage. Therefore, one has to compare the material derived from the investigated borehole sections of the Lublin Upland to the conodont zonation established in other countries, namely Great Britain and Ireland, Belgium and northern France, West Germany. The uppermost Visean conodont faunas show a considerable uniformity in biofacies and hence, one is allowed to consider areas representative of the basin and shelf facies as well (*cf.* Austin 1974, p. 11).

The upper boundary of the Viséan cannot be traced precisely in Belgium and northern France because there are no lowermost Namurian strata in that area (Higgins & Bouckaert 1968). The classical section at Tramaka, Belgium, includes the Viséan to Namurian transitional beds but nevertheless, there is no possibility to trace unequivocally the upper

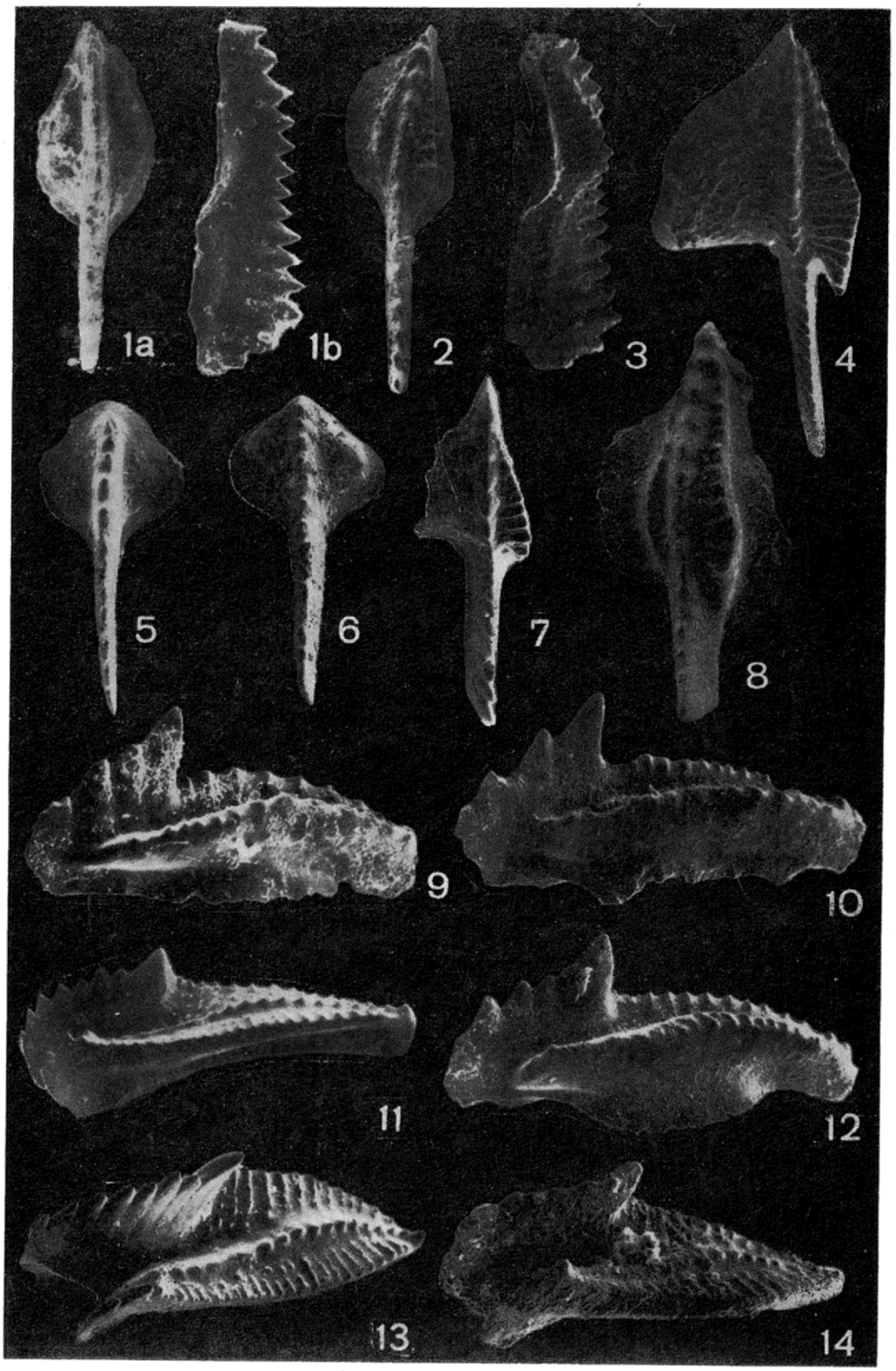
Table 2

Upper Viséan conodonts occurring in boreholes Rudno and Podedwórze

Apatognathus chauliodus Varker
A. geminus (Hinde)
A. minutus Austin & Husri
A. petilus Varker
A. scalenus Varker
Apatognathus sp.
Cavusgnathus naviculus (Hinde)
C. unicornis Youngquist & Miller
Cavusgnathus sp.
Gnathodus bilineatus bilineatus (Roundy)
G. girtyi girtyi Hass
G. girtyi collinsoni Rhodes, Austin & Druce
G. girtyi meischneri Austin & Husri
G. symmutatus Rhodes, Austin & Druce
Gnathodus sp.
Hibbardella (*Roundya*) sp.
Hindeodella ibergensis Bischoff
H. subtilis Ulrich & Bassler
Hindeodella sp.
Ligonodina levis Branson & Mehl
Ligonodina sp.
Lonchodina furnishi Rexroad
L. paraclarki Hass
L. transitans Collinson & Druce
Magnilaterella clarket Rhodes, Austin & Druce
Magnilaterella sp.
Mestognathus bipluti Higgins
Mestognathus sp.
Neoprioniodus montanaensis Scott
N. peracutus (Hinde)
N. scitulus Branson & Mehl
Neoprioniodus sp.
Ozarkodina sp.
Paragnathodus commutatus (Branson & Mehl)
P. mononodosus (Rhodes, Austin & Druce)
P. nodosus (Bischoff)
Prioniodina laevipostica (Rexroad & Collinson)
Spathognathodus cristulus Youngquist & Miller
S. ellisoni Merrill
S. minutus Ellison
S. scitulus (Hinde)

PLATE 5

1 — *Gnathodus symmutatus* Rhodes, Austin & Druce; *a* oral view, b lateral view; borehole Rudno (depth 744 m), ×130
2 — *Gnathodus girtyi girtyi* Hass; oral view; Podedwórze (depth 571 m), ×45
3 — *Gnathodus girtyi girtyi* Hass; inner lateral view; Podedwórze (depth 571 m), ×45
4 — *Gnathodus bilineatus bilineatus* (Roundy); oral view; Podedwórze (depth 571 m), ×50
5 — *Paragnathodus commutatus* (Branson & Mehl); oral view; Rudno (depth 744 m), ×90
6 — *Paragnathodus nodosus* (Bischoff); oral view; Rudno (depth 744 m), ×90
7 — *Gnathodus girtyi collinsoni* Rhodes, Austin & Druce; Rudno (depth 732 m), ×60
8 — *Gnathodus girtyi girtyi* Hass; oral view; Rudno (depth 738 m), ×8
9—10 and 12 — *Cavusgnathus unicornis* Youngquist & Miller; inner lateral view; Rudno (depth 738 m), ×40
11 — *Mestognathus bipluti* Higgins; inner lateral view; Rudno (depth 759 m), ×35
13—14 — *Mestognathus bipluti* Higgins; oral views; Rudno (depth 759 m), ×35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boundary of the Viséan in spite of the abundant conodont fauna (Austin & *al.* 1974). In West Germany, the orthostratigraphic, goniatite-based Dinantian/Silesian boundary occurs (Meischner 1970) within a long-ranging conodont zone, the *Paragnathodus nodosus* Zone. Hence, the only way to trace precisely the upper boundary of the Viséan with application of conodonts is to base upon the stratigraphic pattern established in Great Britain by Rhodes & *al.* (1969) and Higgins (1975). Accordingly to Higgins (1975), the uppermost Viséan conodont zone is the *Gnathodus girtyi collinsoni* Zone of Rhodes & *al.* (1969). The zone was initially meant as equivalent to the uppermost part of the Lower through the Upper Bollandian (*P1d* to *P2a-c* in the goniatite zonation). Later on, Austin (1973, 1974) has restricted its stratigraphic range to the Upper Bollandian only (*P2b-c*). The upper boundary of the *Gnathodus girtyi collinsoni* Zone (*sensu* Higgins 1975), coincident with the upper boundary of the Visean Stage, is marked by the first appearance of *Gnathodus girtyi simplex* Dunn. The *Gnathodus girtyi collinsoni* Zone and the underlying *Gnathodus mononodosus* Zone may be jointly equivalent (*see* Fig. 3) to the widely meant *Paragnathodus nodosus* Zone of West Germany (Meischner 1970).

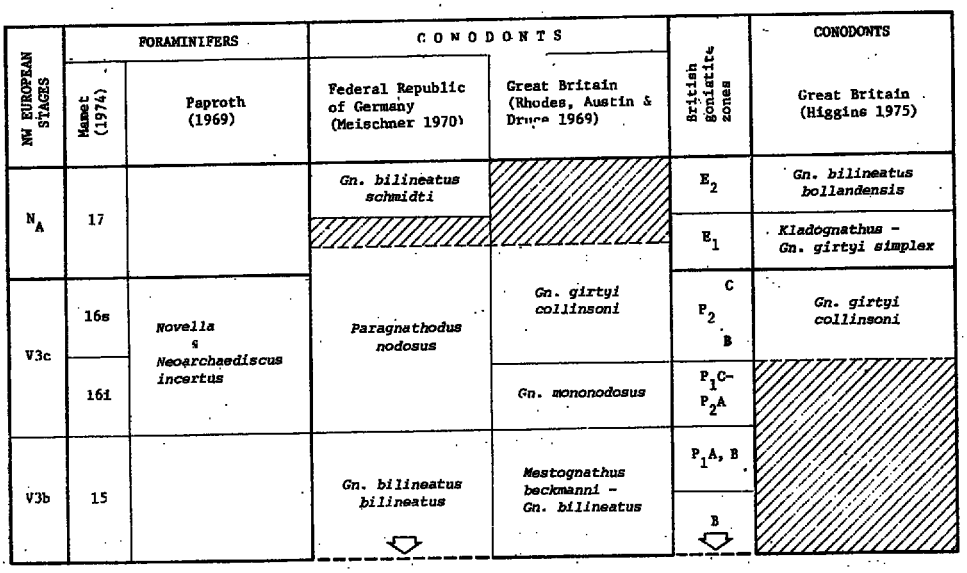

Fig. 3. Scheme of correlations of the Uppermost Viséan divisions based on foraminifers and conodonts

The conodont fauna recorded in the investigated borehole sections (*see* Table 2) includes the following species indicative of the *Paragnathodus nodosus* Zone: *Gnathodus girtyi girtyi* Hass, *Gn. bilineatus bilineatus* (Roundy), *Paragnathodus nodosus* (Bischoff), *Mestognathus bipluti* Higgins, and *Neoprioniodus scitulus* Branson & Mehl. These

forms are associated with index species of the zonation proposed by Rhodes & *al.* (1969), namely: *Gnathodus mononodosus* Rhodes, Austin & Druce and *Gn. girtyi collinsoni* Rhodes, Austin & Druce. The latter species occurs exclusively in the uppermost sample of the section Rudno (depth of 732.0 m). Possibly, this is the only portion of the section being of the latest Viséan age. The subspecies *Gn. girtyi collinsoni* has not been recorded in the section Podedwórze. One may thus conclude that the investigated strata are representative of the uppermost Viséan exclusive of its uppermost part.

The conodont fauna of Rudno includes representatives of the genera *Cavusgnathus* and *Mestognathus* absent from the Podedwórze fauna. This difference in conodont fauna composition may indicate that the sedimentary environment of the carbonates found in the borehole section Podedwórze was more open marine in nature than that prevalent in Rudno area (*cf.* Druce 1973, Austin 1976, Merrill & Martin 1976).

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OTWORNICE I KONODONTY GÓRNEGO WIZENU PÓŁNOCNO-WSCHODNIEJ LUBELSZCZYZNY

(Streszczenie)

Przedmiotem pracy jest analiza fauny otwornicowej i konodontowej, która w wierceniach Rudno i Podedwórze w północno-wschodniej Lubelszczyźnie (fig. 1) dokumentuje obecność najwyższego wizenu (*V3c*). Dokładność z jaką można dokonać klasyfikacji stratygraficznej w przypadku obu faun jest podobna, mimo znacznie częstszego występowania otwornic niż konodontów (*por.* fig. 2). Występowanie w zróżnicowanym zespole otwornicowym form z rodzaju *Asteroarchaediscus, Neoarchaediscus, Novella, Globivalvulina* i *Rectocornuspira* (patrz tab. 1 oraz pl. 1—4), pozwala badane odcinki profilu zaliczyć do zony otwornicowej *Novella & Neoarchaediscus incertus* w podziale Paproth (1969), odpowiadającej zonom *16i* oraz *16s* w podziale Mameta (1974). Znalezione konodonty (patrz tab. 2 oraz pl. 5) reprezentują analogiczny przedział czasowy (*por.* fig. 3), tzn. zonę *Paragnathodus nodusus* w podziale Meischnera (1970). Zespoły otwornicowe znalezione w badanych profilach nie wykazują zróżnicowania regionalnego, natomiast konodonty reprezentują zespoły przynależne do dwóch typów facji: przybrzeżno-morskiej (Rudno) oraz basenowej (Podedwórze).