acta
geologica
polonica

Vol. 22, No. 2 Warszawa 1972

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Stratigraphical and paleogeographical significance of conodonts from the Muschelkalk of the Holy Cross Mts

ABSTRACT: Fifteen conodont species are noted for the first time from the Muschelkalk of the SW Mesozoic margin of the Holy Cross Mts. An attempt to correlate the Muschelkalk series with those of the Alps and Germany on the basis of these new findings, as well as previous ones, is presented. The heterochroneity of lithostratigraphical units hitherto proposed is demonstrated. Differences in the conodont assemblages point to the fact that three different conodont provinces successively influenced the Muschelkalk basin of the Holy Cross Mts.

INTRODUCTION

The paper is a successive one dealing with the results of the author's studies on conodonts of the Muschelkalk in the Holy Cross Mts (*cf.* Trammer 1971).

In searching of conodonts, 51 samples of Middle Triassic limestones were dissolved. Among 11 samples collected from the Lower Muschelkalk section at Pierzchnica (Fig. 1), nine were conodont-bearing. One of these samples yielded an average of 10 conodonts per 300 g of rock. Moreover, the section at Wolica (Trammer 1971) was partially resampled.

The only sample collected from the Middle Muschelkalk section at Pierzchnica appeared to be negative.

All 39 samples collected from the Upper Muschelkalk sections at Pierzchnica, Stare Chęciny and Lesica (Fig. 1) were positive and yielded an average of 50 specimens per 300 g of rock.

LIST OF CONODONTS

Besides those previously recorded (Trammer 1971), 15 other species were found in the investigated area. These species are listed below and their stratigraphical ranges are given in Figs 2 and 3.

Cornudina tortilis (Kozur & Mostler, 1970; 10 specimens — Pierzchnica and Wolica (Wolica Beds, Wellenkalk, Łukowa Beds) — Pl. 1, Figs 6—7.

Enantiognathus incurvus Kozur, 1968; 15 specimens — Pierzchnica, Stare Chęciny and Lesica (*Ceratites* Beds) — Pl. 1, Fig. 3.

Hibbardella bicuspidata (Kozur, 1968); 8 specimens — Pierzchnica (*Ceratites* Beds) — Pl. 1, Fig. 1.

Hindeodella (Metaprioniodus) suevica (Tatge, 1956); 17 specimens — Pierzchnica, Stare Chęciny and Lesica (*Ceratites* Beds) — Pl. 2, Figs 8 and 10.

Hindeodella (Metaprioniodus) bicuspidata Kozur & Mostler, 1970; 18 specimens — Pierzchnica, Stare Chęciny and Lesica (*Ceratites* Beds) — Pl. 2, Fig. 6.

Hindeodella (Metaprioniodus) sp.; 1 specimen — Wolica (Łukowa Beds) — Pl. 2, Fig. 5.

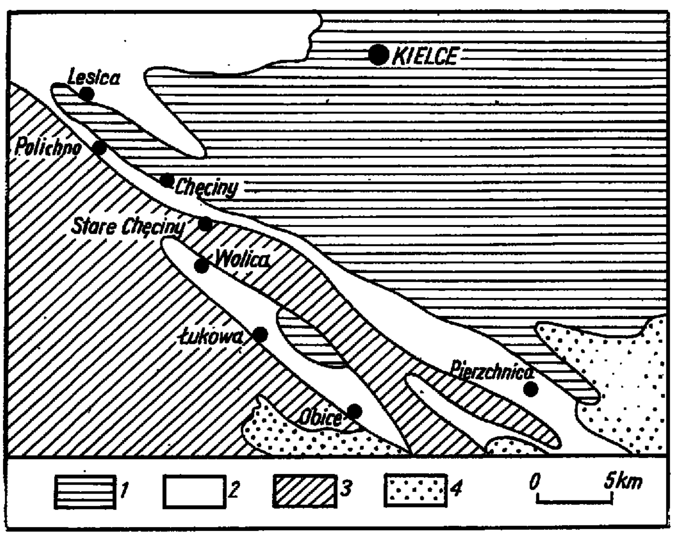


Fig. 1

Location map of the conodont bearing profiles in the Muschelkalk of the SW margin of the Holy Cross Mts

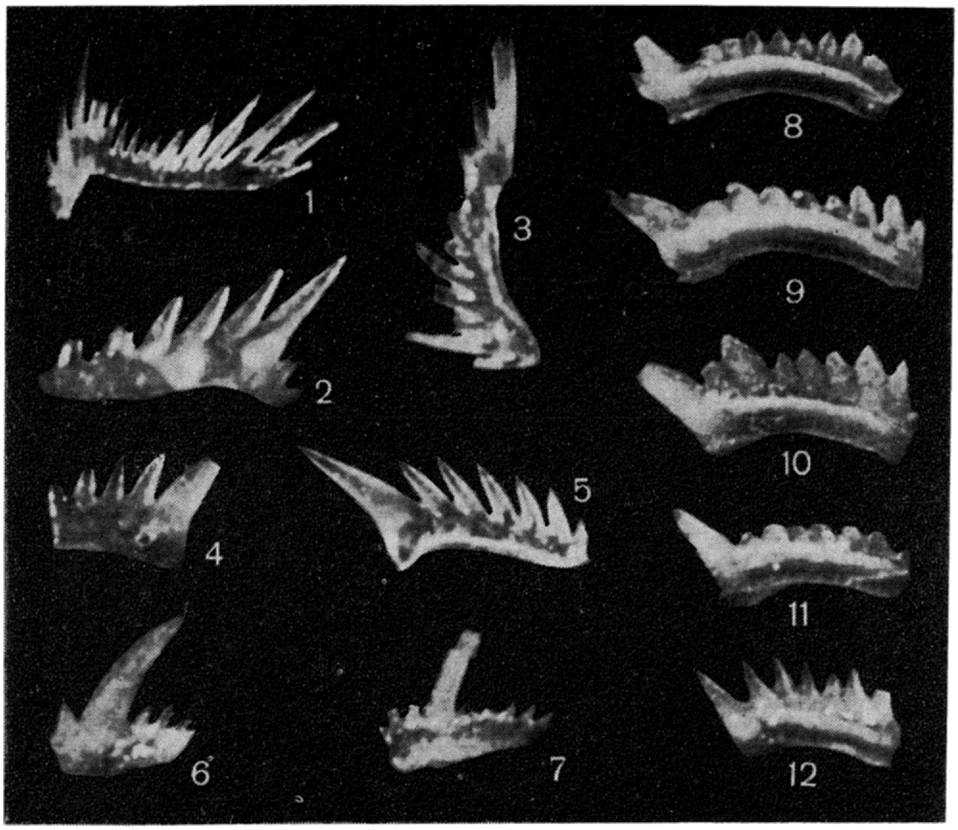
1 Palaeozoic, *2* Triassic, *3* Jurassic and Cretaceous, *4* Miocene

Neohindeodella nevadensis (Müller, 1956); 14 specimens — Pierzchnica and Wolica (Wellenkalk, Łukowa Beds) — Pl. 2, Fig. 3.

Neohindeodella riegeli (Mosher, 1968) = *Hindeodella triassica a* in: Hirschmann 1959; 2 specimens — Pierzchnica (*Ceratites* Beds) — Pl. 2, Fig. 4.

Neohindeodella sp.; 1 specimen — Wolica (Łukowa Beds) — Pl. 2, Fig. 1.

Pollognathus germanicus (Kozur, 1968); 31 specimens — Pierzchnica, Stare



1 — *Hibbardella bicuspidata* (Kozur), Pierzchnica (*Ceratites* Beds).
2 — *Pollognathus germanicus* (Kozur), Stare Chęciny (*Ceratites* Beds).
3 — *Enantiognathus incurvus* Kozur, Stare Chęciny (*Ceratites* Beds).
4 — *Gondolella (Celsigondolella) watznaueri praecursor* Kozur, Pierzchnica (*Ceratites* Beds).
5 — *Pollognathus sequens* (Kozur), Pierzchnica (*Ceratites* Beds).
6 — *Cornudina tortilis* Kozur & Mostler, Pierzchnica (Łukowa Beds).
7 — *Cornudina tortilis* Kozur & Mostler, Wolica (Wellenkalk).
8 — *Gondolella haslachensis* Tatge, Stare Chęciny (*Ceratites* Beds).
9 — *Gondolella haslachensis* Tatge, Lesica (*Ceratites* Beds).
10 — *Gondolella haslachensis* Tatge, aberrant form, Stare Chęciny (*Ceratites* Beds).
11 — *Gondolella haslachensis* Tatge, Pierzchnica (*Ceratites* Beds).
12 — *Gondolella haslachensis* Tatge, a form transitional to *G. (Celsigondolella) watznaueri*, Stare Chęciny (*Ceratites* Beds).

All figures × 100; taken by L. Łuszczewska, M. Sc.

area studied, corresponds to the Lower Anisian (Hydaspian) and Pelsonian of the Alps (Fig. 2). The youngest bed yielding conodonts characteristic of the Lower Anisian is separated from the oldest bed with forms characteristic of the Pelsonian by a part of section, about 10 m long (Fig. 2); hence the Lower Anisian/Pelsonian boundary cannot be precisely delineated, but it may be only inferred to continue somewhere in the middle part of the Łukowa Beds.

The correlation outlined above differs from that hitherto proposed for the Lower Muschelkalk of the Holy Cross area. Previously, Senkowiczowa (1962, Chart 2), included the Wolica Beds and Wellenkalk series in the Lower Anisian, lower part of the Łukowa Beds in the Pelsonian, and upper part of the Łukowa and *Lima striata* Beds in the Illyrian [1].

Neohindeodella triassica triassica (Müller) is a very common form both in the Lower and Upper Muschelkalk in Germany (Tatge 1956, Kozur 1968b), whereas in Poland it is similarly common in the Lower Muschelkalk, but later disappears and barely a single specimen was hitherto reported from the Upper Muschelkalk at Pierzchnica. On the other hand, other conodonts occurring in large numbers in the Upper Muschelkalk of Germany, *e.g.* those of the genus *Gondolella*, are equally common in contemporaneous deposits of the Holy Cross Mts. Therefore

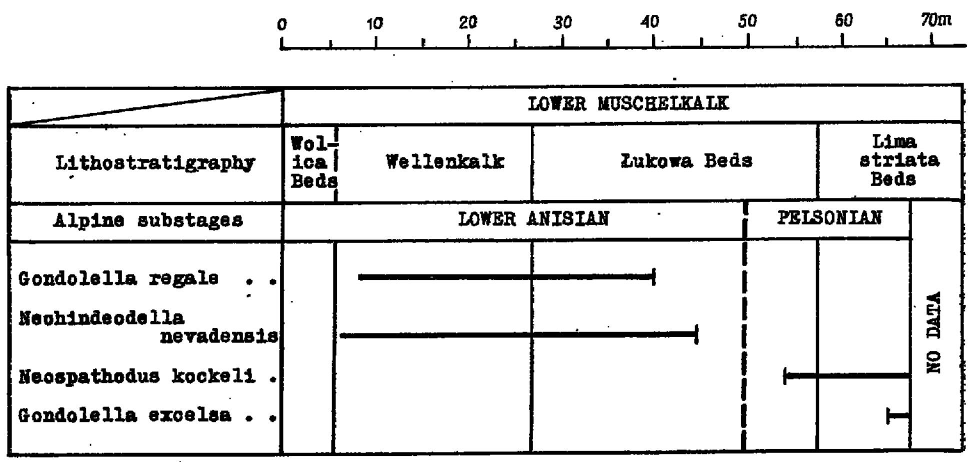


Fig. 2

Stratigraphical ranges of the index conodonts for the Lower Muschelkalk in the Holy Cross Mts (lithostratigraphic schema according to Senkowiczowa, 1957)

[1] It may be assumed that future studies will enable to subdivide the section of the Lower Muschelkalk more accurately and, particularly, to reduce correlation-error interval in the case of Lower Anisian/Pelsonian boundary. Moreover, the finding of a cosmopolitan form, *Neospathodus homeri newpassensis* Mosher, appearing in the upper Lower Anisian and continuing to the end of the Pelsonian (Kozur 1971), seems very probable.

it may be assumed that facial conditions precluding normal development of *N. triassica triassica* and permitting the existence of other species, predominated in the area of the Holy Cross Mts during the Upper Muschelkalk. The exact nature of these conditions is unclear. However, this mass occurrence of *N. triassica triassica* may be applied in local parallelization as an "index" and diagnostic feature of the Lower Muschelkalk in the Holy Cross area.

The lack of *Cornudina minor* Kozur and *Gondolella mombergensis mombergensis* Tatge in the Lower Muschelkalk of Germany may similarly have resulted from unsuitable facial conditions (*cf.* also Kozur 1971, Kozur & Mostler 1971). These species were noted there in the Upper Muschelkalk, exclusively, and therefore were accepted as fossils characteristic of that complex (Kozur 1968b). Nevertheless, in the Holy Cross Mts and Lower Silesia these specimens have recently been noted in the Lower Muschelkalk (Zawidzka 1970, Trammer 1971).

STRATIGRAPHICAL IMPORTANCE OF CONODONTS FROM THE UPPER MUSCHELKALK

The stratigraphical importance of conodonts significantly increases in the Upper Muschelkalk in comparison with the Lower Muschelkalk. They served as indices for establishing seven conodont zones in Germany (Kozur 1968b).

Previously, only the two lowest conodont zones were distinguished by the present author (Trammer 1971), because the *Ceratites* Beds were not sampled. During the last field season, the whole sequence of the Upper Muschelkalk was studied in the Holy Cross area, but it appears that only the four lowest German zones may be identified here. The three upper zones (Zones nos 5—7) of the German sequence do not occur here (*cf.* discussion below). The stratigraphical ranges of conodonts characteristic of these 4 zones are tabulated in Fig. 3. Correlation of conodont and *Ceratites* zones was given by Kozur (1968b) and Trammer (1971, Fig. 3).

As to the boundaries between particular zones proposed by Kozur (*op. cit.*), some following remarks should be taken into account. The boundary between Zones nos *1* and *2* is often very difficult to trace, because conodonts characteristic of Zone no. *1* (*cf.* Fig. 3) are rare in the Upper Muschelkalk in the Holy Cross area. Moreover, the base of Zone no. *2* (as defined by Kozur 1968b) is delineated by extinction of a few conodont species, without appearance of any new one, and thus an additional difficulty arises. It is often uncertain whether the lack of conodonts characteristic of Zone no. *1* is because they became extinct or simply because they were not found in the section.

The boundary between Zones nos *2* and *3* is also difficult to define, as statistical evaluations are necessary for its identification, because ranges of *Gondolella mombergensis mombergensis,* characteristic of Zone

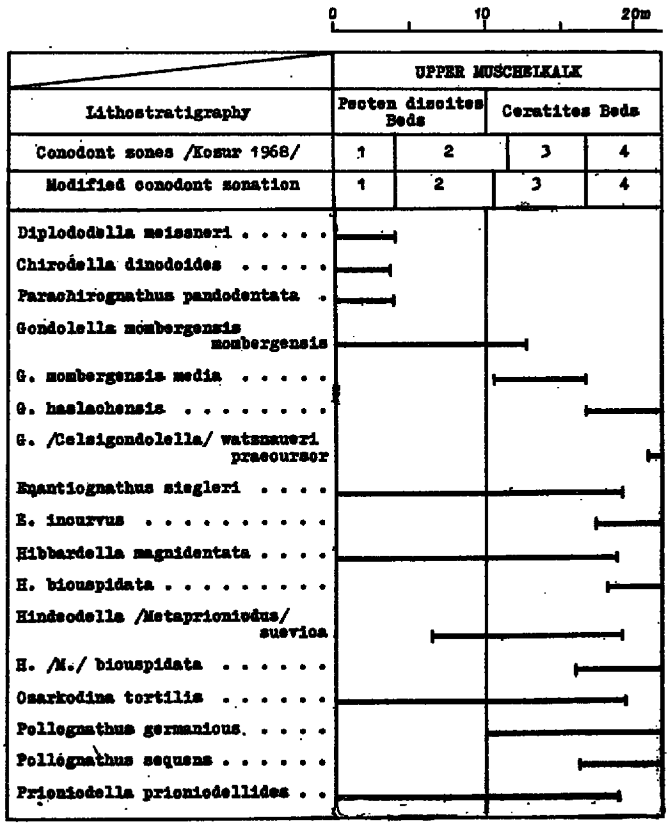


Fig. 3

Stratigraphical ranges of the index conodonts for the Upper Muschelkalk in the Holy Cross Mts (lithostratigraphic schema according to Senkowiczowa, 1957)

no. *2* and *G. mombergensis media,* characteristic of Zone no. *3,* partly overlap (*cf.* Fig. 3). The same overlap is observed in Germany, hence Kozur (1968b) who proposed the conodont zonation of the German Muschelkalk, has taken the base of Zone no. *3* at the base of a bed where contribution of *G. mombergensis media* exceeds 50 per cent of gondolellids. This does not seem convenient and therefore the present author lowers the base of this zone to the place where *G. mombergensis media* first appears (*cf.* Fig. 3). Zone no. *3,* so defined, will extend from the middle Compressus/Evolutus to the middle Spinosus Zone inclusively, and will include total stratigraphical range of its characteristic species (*cf.* Kozur 1968a, b). The boundary between Zones nos *3* and *4* is distinctly marked by evolution of *G. mombergensis media* into *G. haslachensis*.

BOUNDARIES OF LITHOSTRATIGRAPHICAL MEMBERS

The boundary between conodont Zones nos *2* and *3* continues within the *Ceratites* Beds at Pierzchnica and Stare Chęciny; these beds are defined as dark-grey, somewhat crumpled limestones yielding various *Ceratites* species. The course of this boundary is based on field data from Pierzchnica and Stare Chęciny (*cf.* Fig. 3).

In section at Lesica this boundary was traced in the *Pecten discites* Beds (light-coloured lumachelle with numerous scallop shells). It follows that the lithostratigraphical boundary between the *Pecten discites* and *Ceratites* Beds is heterochronous and a facial change has taken place between Pierzchnica — Stare Chęciny and Lesica areas. Where, on the former, the deposition of dark-grey, somewhat crumpled limestones begins, in the latter, deposition of scallop lumachelle continues.

Further studies on sections located close to one another will presumably make possible a more precise evaluation of these facial changes.

MUSCHELKALK/KEUPER BOUNDARY

The conodont Zone no. *4* is the uppermost stated in the Holy Cross area. In Germany, this zone correlates with upper Spinosus and Enodis/Laevigatus Zones of the ceratid zonation (Kozur 1968b). Deposits assigned to Zone no. *4* are overlayed by the Keuper in the Holy Cross area, hence Zone nos *5—7* of Germany are missing. Incompleteness of the Muschelkalk in the Holy Cross area was noted by Senkowiczowa (1957, 1961), but it was assumed that carbonate sedimentation ceased in the Spinosus Zone (Senkowiczowa 1957, 1961; followed by Trammer 1971). However, conodonts recently found in the uppermost Muschelkalk indicate the occurrence of at least a part of the next ceratid zone, *viz.* the Enodis/Laevigatus Zone. This is evidenced by the occurrence of *Gondolella haslachensis* transitient to *G. (Celsigondolella) watznaueri* and single specimen of *G. (C.) watznaueri praecursor*. These forms are known from the uppermost part of Zone no. *4*, *i.e.* the part corresponding to the Enodis/Laevigatus Zone, and are absent in the lower part of Zone no. *4*, corresponding to the Spinosus Zone.

Conodont Zones nos *5—7*, which are missing in the Holy Cross Mts, correspond to ceratid Nodosus and Discoceratiten Zones of Germany (Kozur 1968b). The above facts point to heterochroneity of the Muschelkalk/Keuper boundary within the German Basin. During the deposition of the uppermost *Ceratites* Beds in Germany, the Keuper facies already dominated in the Holy Cross area.

In view of the above data, Senkowiczowa's (1970) opinion that the Upper Muschelkalk section is complete in the Holy Cross Mts, seems unsubstantiated.

CONODONT PROVINCES

Kozur & Mostler (1971) distinguished a few Triassic provinces on the basis of differences in conodont assemblages.

During the Lower Anisian (Wolica Beds, Wellenkalk, lower part of the Łukowa Beds) the Holy Cross basin was transitional between the Asiatic and German provinces. The Asiatic province is characterized by occurrence of the genus *Gondolella* and multielement *Gladigondolella tethydis,* which are unknown in the German province, according to Kozur & Mostler (1971). In the Lower Anisian of the Holy Cross Mts, *Gondolella* was found (*cf.* also Trammer 1971), whereas multielement *Gladigondolella tethydis* is missing. In the Lower Anisian of both Austro-Alpine and Western-Mediterranean provinces, no conodonts were noted (Kozur & Mostler 1971).

During the Pelsonian (upper part of the Łukowa Beds, *Lima striata* Beds) the Holy Cross area belonged to the Austro-Alpine province, which is evidenced by the occurrence of the genus *Gondolella* (*cf.* Trammer 1971). These conodonts are known from the Austro-Alpine province and have not been found in the German province (Kozur & Mostler 1971). Therefore, the earlier hypothesis on closer connections of the Holy Cross basin with Austro-Alpine than German province during the Lower Muschelkalk (*cf.* Łuniewski 1923; Samsonowicz 1929; Senkowiczowa 1962; Trammer 1971, 1972) is confirmed.

During the Upper Muschelkalk, the Holy Cross basin belonged to the German province. This is evidenced by the occurrence of endemic, German evolutionary series: *Gondolella mombergensis mombergensis* — *G. mombergensis media* — *G. haslachensis* — *G. (Celsigondolella) watznaueri praecursor* (*cf.* Fig. 4) and a number of other species, known exclusively from Germany.

CONTRIBUTION TO THE PROBLEM OF EVOLUTION OF TRIASSIC CONODONTS

The phenomenon of phylogenetic increment in size is known to take place in many faunal groups. This regularity is commonly termed as "Depéret's Law" (*cf.* Kuźnicki & Urbanek 1970). This phenomenon was also noted in the evolution of Middle Triassic ceratids, being expressed by an increase in size of ceratids from one zone in relation to those from the previous zone (*cf.* Wenger 1957).

The opposite process may be observed in conodonts of the genus *Gondolella* from the Upper Muschelkalk. These conodonts evolve rapidly, but this is accompanied by the decrement of succesively younger forms in size (Fig. 4). Hence this phenomenon may be termed as "phylogenetic decrement in size".

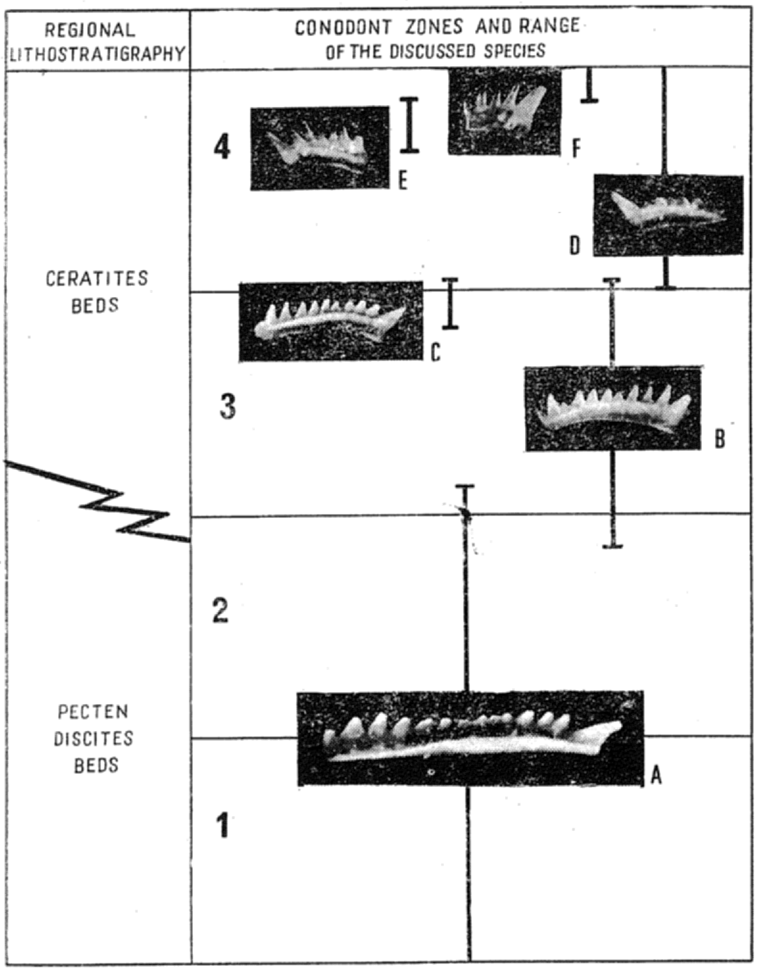


Fig. 4

Phylogenetic development of conodonts of the genus *Gondolella* in the Upper Muschelkalk of the Holy Cross Mts; visible is a phenomenon of 'phylogenetic decrement in size'

A — *Gondolella mombergensis mombergensis* Tatge
B — *Gondolella mombergensis media* Kozur
C — *Gondolella mombergensis media*, a form transitional to *G. haslachensis* Tatge
D — *Gondolella haslachensis* Tatge
E — *Gondolella haslachensis*, a form transitional to *G. (Celsigondolella) watznaueri praecursor* Kozur
F — *Gondolella (Celsigondolella) watznaueri praecursor* Kozur

PROBLEM OF THE SPECIES *GONDOLELLA HASLACHENSIS* TATGE, 1956

Tatge (1956) established two new species of the genus *Gondolella* Stauffer & Plummer, 1932. The first, *G. mombergensis* Tatge, was found in the Trochitenkalk and Lower *Ceratites* Beds; whereas the second one, *G. haslachensis* Tatge, was found in the middle part of the Upper Muschelkalk. Successive authors have included *G. haslachensis* into the synonymy of *G. mombergensis* (*cf.* Huckriede 1958, Hirschmann 1959, Budurov 1962, Budurov & Stefanov 1965, Mosher & Clark 1965, Clark & Mosher 1966, Bender 1967, Cherchi 1967, Wilczewski 1967, Hayashi 1968, Nogami 1968, Mosher 1968). It was supposed that *G. haslachensis* represents a dwarfish form ("Kümmerform") of *G. mombergensis* (*cf.* Huckriede 1958) or its juvenile form (*cf.* Hirschmann 1959). On the other hand, Kozur (1968b) used *G. haslachensis* as an index fossil of Zones nos *4* and *5*, outside the range of *G. mombergensis*, in his conodont zonation of the Upper Muschelkalk of Germany; hence it may be assumed that although Kozur did not discuss the taxonomic position of *G. haslachensis* he accepted the existence of this species. Later, this species was once more cited as a characteristic fossil by Kozur (1970) and Kozur & Mostler (1971).

On the basis of the conodont succession in the Upper Muschelkalk of Germany (Kozur 1968b) and Holy Cross Mts the following conclusions may be presented. The subspecies *Gondolella mombergensis media* Kozur had evolved into *G. haslachensis* Tatge during the middle Spinosus Zone and disappeared itself (Figs 3—4). However, within very variable subspecies *G. mombergensis mombergensis* Tatge, besides typical forms, *i.e.* closest to the holotype of Tatge (1956), some forms representing intraspecific variability had existed. One of these forms was somewhat similar morphologically to *G. haslachensis*, which might have caused misinterpretations. Moreover, some misunderstandings might have resulted from insufficient knowledge of conodont faunas from the upper Spinosus and Enodis/Laevigatus Zones, yielding *G. haslachensis*, which existed until the paper by Kozur (1968b) was published. At present we know that in these ceratid zones only *G. haslachensis* is represented, whereas even a single specimen of *G. mombergensis* has not been found here. This demonstrates the existence of *G. haslachensis* as a separate species, which is endemic of the German basin. On the other hand, within the cosmopolitan species *G. mombergensis*, some variants similar to *G. haslachensis* were reported from the Triassic of the Tethys. Hence, the inclusion of *G. haslachensis* into the synonymy of *G. mombergensis* might have partly resulted from the fact that the majority of the authors studying Triassic conodonts were occuppied with Tethyan forms.

G. haslachensis differs from small varietes of *G. mombergensis* in a strong, long cusp, two or three times larger than the rest of carina teeth. No variety of *G. mombergensis* with such cusp has been found.

SYSTEMATIC DESCRIPTION OF SOME CONODONTS

Only those forms, the taxonomic position of which is changed in the present paper, are described below. The full paleontological descriptions of all conodonts recorded in the Triassic of the Holy Cross Mts will be presented in a separate paper.

Genus *CORNUDINA* Hirschmann, 1959
Type species *Cornudina breviramulis* (Tatge, 1956)
Cornudina minor Kozur, 1968

1959. *Cornudina breviramulis a;* C. Hirschmann, pp. 46—47, Pl. 4, Fig. 4.
1959. *Cornudina breviramulis b;* C. Hirschmann, p. 47, Text-fig. 11.
1968a. *Cornudina breviramulis minor* n. subsp.; H. Kozur, p. 136, Pl. 1, Figs 5, 14—16.
1968. *Parachirognathus breviramulus* (Tatge); L. Mosher, pp. 932—933, Pl. 115, Fig. 16.
1968b. *Cornudina breviramulis minor* Kozur; H. Kozur pp. 1071—1072, Pl. 3, Figs 24, 27, 30.
1970. *Cornudina breviramulis* (Tatge); K. Zawidzka, Pl. 2, Fig. 12 (*non* Fig. 11 = *C. breviramulis*).
1971. *Cornudina breviramulis minor* Kozur; J. Trammer, Pl. 1, Fig. 2.

Remarks. — Kozur (1968a), in his description of a new subspecies *Cornudina breviramulis minor* Kozur, considered it to have evolved from the subspecies *C. breviramulis breviramulis* Tatge in the lowermost *Ceratites* Beds, which itself thereafter disappeared. However, it happens that the form *minor* co-occurs with the latter, *breviramulis breviramulis* (*sensu* Kozur 1968b) already in the Lower Muschelkalk (Zawidzka 1970, Trammer 1971). It seems rather improbable that two subspecies of the same species inhabited the same area in a long span of time. Hence, the form *minor* should be considered a separate species. The probability that "forms" *minor* and *breviramulis breviramulis* resulted from intraspecific variability is rather small, since they always differ distinctly.

Occurrence. — According to Kozur (1968a, b), *Cornudina minor* occurs in Zones nos *2* and *3* of the Upper Muschelkalk in Germany. In the Lower Silesia and the Holy Cross Mts, the form under discussion was found in the Lower Muschelkalk (Zawidzka 1970, Trammer 1971).

Genus *NEOHINDEODELLA* Kozur, 1968
Type species *Neohindeodella triassica* (Müller, 1956)
Neohindeodella hirschmanni (Kozur, 1968)

1959. *Hindeodella triassica a;* C. Hirschmann, p. 58, Text-figs 26—27, Pl. 4, Fig. 14.
1968a. *Hindeodella (Neohindeodella) triassica hirschmanni* n. subsp.; H. Kozur, p. 138, Pl. 1, Fig. 19.
1968b. *Hindeodella (Neohindeodella) triassica hirschmanni* Kozur; H. Kozur, p. 1078, Pl. 2, Fig. 13.
1970. *Hindeodella triassica hirschmanni* Kozur; K. Zawidzka, Pl. 2, Fig. 5.
1971. *Hindeodella (Neohindeodella) triassica hirschmanni* Kozur; J. Trammer, Pl. 1, Fig. 14.

Remarks. — *Neohindeodella hirschmanni* continues through the whole Muschelkalk, just as *N. triassica*. As stated above, it seems rather improbable that two subspecies of one species can inhabit the same area at the same longer span of time. Hence, it may be assumed that *N. hirschmanni*, contrary to the opinion held by Kozur (1968a) and successors (*cf.* synonymy), is not a subspecies of *N. triassica* but represents a separate species.

Occurrence. — *Neohindeodella hirschmanni* is known from the Muschelkalk of Germany (Kozur 1968a) and from the Lower Muschelkalk of the Holy Cross Mts (Trammer 1971).

Genus *GONDOLELLA* Stauffer & Plummer, 1932
Subgenus *GONDOLELLA* Stauffer & Plummer, 1932
Type species *Gondolella elegantula* Stauffer & Plummer, 1932
Gondolella (*Gondolella*) *prava* Kozur, 1968

1959. Pathologische(?) *Gondolella mombergensis* Tatge; C. Hirschmann, pp. 55—56, Text-figs 21—22, Pl. 4, Fig. 12.
1968a. *Gondolella (Gondolella) mombergensis prava* n. subsp.; H. Kozur, p. 134, Pl. 1, Fig. 2*a*, *b*.
1968b. *Gondolella (Gondolella) mombergensis prava* Kozur; H. Kozur, p. 933, Pl. 2, Fig. 2*a*, *b*.
1971. *Gondolella (Gondolella) mombergensis prava* Kozur; J. Trammer, Pl. 2, Fig. 6.

Remarks. — *Gondolella (Gondolella) prava* occurs from the base of the Upper Muschelkalk till to the Spinosus Zone, therefore its range overlaps the ranges of *G. (G.) mombergensis mombergensis* (from the base of the Upper Muschelkalk up to the Evolutus Zone) and *G. (G.) mombergensis media* (from the Evolutus to Spinosus Zone). Reasoning as above, *G. (G.) prava* is considered a separate species and not a subspecies of *mombergensis*.

Occurrence. — *Gondolella (Gondolella) prava* is known from the Upper Muschelkalk, up to middle Spinosus Zone in Germany (Kozur 1968a, b) and the same in the Holy Cross Mts.

Acknowledgements. The author is greatly indebted to K. Zawidzka, M. Sc., for her helpful remarks and discussion during preparing the present paper.

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ZNACZENIE STRATYGRAFICZNE I PALEOGEOGRAFICZNE KONODONTÓW WAPIENIA MUSZLOWEGO Z GÓR ŚWIĘTOKRZYSKICH

(Streszczenie)

W profilach wapienia muszlowego południowo-zachodniego obrzeżenia mezozoicznego Gór Świętokrzyskich (fig. 1), prócz konodontów znanych stąd poprzednio (Trammer 1971), stwierdzono obecność dalszych 15 gatunków (*vide* lista w tekście angielskim oraz pl. 1—2).

W oparciu o konodonty wykazano, że świętokrzyski dolny wapień muszlowy odpowiada alpejskiemu dolnemu anizykowi (hydaspowi) oraz pelsonowi (fig. 2).

W górnym wapieniu muszlowym stwierdzono istnienie czterech poziomów konodontowych (fig. 3) spośród siedmiu wydzielanych w Niemczech (Kozur 1968b). Trzy najwyższe poziomy (nr *5, 6* i *7)* z niemieckiego górnego wapienia muszlowego w Górach Świętokrzyskich nie występują, zaś nad osadami należącymi do poziomu *4* leży tu bezpośrednio kajper. Powyższe fakty prowadzą do wniosku, że granica między wapieniem muszlowym a kajprem jest w obrębie zbiornika środkowoeuropejskiego (germańskiego) heterochroniczna.

Na obszarze świętokrzyskim heterochroniczna jest także granica między warstwami z *Pecten discites* i warstwami ceratytowymi.

W wapieniu muszlowym obszar Gór Świętokrzyskich należał kolejno do trzech prowincji konodontowych. W dolnym wapieniu muszlowym był on najpierw przejściowym między prowincją germańską oraz azjatycką, następnie zaś należał do prowincji austro-alpejskiej. Natomiast w górnym wapieniu muszlowym obszar świętokrzyski należał do prowincji germańskiej.

Wśród konodontów z rodzaju *Gondolella* stwierdzono w górnym wapieniu muszlowym interesujące zjawisko filogenetycznego zmniejszania rozmiarów (fig. 4).

W pracy opisano także trzy formy, których pozycja taksonomiczna określona przez autora różni się od dotąd przyjmowanej.

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