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Neogondolelliform Conodonts of Early and Middle Pennsylvanian Age

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Abstract

Neogondolelliform conodont elements having morphological features identical to those of the conodont genus *Neogondolella* are increasingly being reported from strata of Pennsylvanian age. It has been suggested that *Neogondolella*, which until now has been considered to be Permian and Triassic in age, is probably polyphyletic. While it is possible to interpret geologically younger species as homeomorphs of Early and Middle Pennsylvanian taxa at present without satisfactory generic assignment, it is doubtful to us, in the light of known cases of homeomorphy, that homeomorphy of such an exact nature took place. Since we cannot distinguish these two groups morphologically and because phylogenetic lineages have not been convincingly demonstrated for them, at present we consider Pennsylvanian neogondolelliform conodonts to be species of *Neogondolella*, *sensu stricto*. The irregular occurrence of neogondolelliform conodonts in the Pennsylvanian is believed to reflect environmental restrictions even more stringent than those noted previously for species of *Gondolella*.

Neogondolelliform conodonts appear near the base of the Pennsylvanian and are therefore considerably older than the first species of *Gondolella*. A common ancestor for the two morphologically similar groups has not been found but the possibility remains that species of *Gondolella* sprang from those of *Neogondolella*, rather than the reverse, as has been proposed.

Introduction

Species of *Neogondolella* Bender and Stoppel (1965) have come to be thought of as Permian and Triassic and those of *Gondolella* Stauffer and Plummer (1932) as primarily of Middle and Late Pennsylvanian age. Indeed, Clark (1972) suggested the phylogenetic derivation of a species of *Neogondolella*, *N. bisselli* (Clark and Behnken), from a species of *Gondolella*, which he identified as *G. bella* Stauffer and Plummer, in the early Wolfcampian. With such a suggested phylogeny it is paradoxical that conodont elements with the morphology of those of species of *Neogondolella* are increasingly being reported from strata of Pennsylvanian age (Table 1). The question arises whether these neogondolelliform conodonts can reasonably be referred to the genus *Neogondolella* or whether they are rather exact heterochronous homeomorphs of "true" species of *Neogondolella* and hence should be assigned to a new genus.

Materials and Methods

Neogondolelliform conodont elements collected by G.K. Merrill from the Lower Pennsylvanian of Texas and discussed by Merrill and King (1971) were studied. Similar neogondolelliform conodont elements from the Pennsylvanian of the Canadian Arctic were examined through the courtesy of Dr. P.K. Bender of Philipps Universität, Marburg/Lahn, West Germany. Neogondolelliform conodonts occurring in rocks of Pennsylvanian age elsewhere have been tabulated in Table 1 and were not examined first hand. Our understanding of species of *Gondolella* is based not only on the relevant literature, but is also derived from our independent studies of these Pennsylvanian conodonts (von Bitter, 1972, 1976; Merrill, 1975).

Neogondolelliform Conodonts in the Pennsylvanian

Ellison and Graves (1941) in their work on the conodont faunas of the Lower Pennsylvanian Dimple Formation of Texas were the first to record a conodont, which we recognize as having a neogondolelliform morphol-

ogy, from strata of Pennsylvanian age. This and subsequent reports of conodonts interpreted by us as having this morphology and occurring in the Middle and Lower Upper Carboniferous are summarized in Table 1. With the possible exception of *Gondolella fujimotoi* Igo and Kobayashi, the types of which are poorly preserved and could represent a species of *Gondolella* similar to *G. laevis* Kosenko and Kozitskaya, each of these occurrences documents Pennsylvanian elements with the morphology characteristic of species of *Neogondolella*.

Definition of *Neogondolella*

Neogondolella was defined by Bender (1967: 516) as "a conodont genus of the form that develops from the genus *Spathognathodus* in the lowermost Triassic. . . According to the principles of the artificial system the genus would be placed in the form-genus *Gondolella*" [von Bitter's translation]. Sweet (1970; Teichert, Kummel, and Sweet, 1973) gave a more objective definition. He noted that elements of *Neogondolella*, in contrast to those of [the Sp elements of] *Gondolella*, have a finely to coarsely pitted platform, a platform that is continued around the posterior side of the cusp as a more or less pronounced brim, and anteriorly thin growth lamellae. He further noted that Clark and Mosher (1966) showed that conspicuous differences in undersurface morphology existed between elements of the two genera. Finally, Sweet (1970) stated that the skeletal apparatus of *Gondolella*, in contrast to that of *Neogondolella*, contained elements of more than a single type.

Pennsylvanian Neogondolelliform Elements and their Phylogenetic Significance
Conodonts from the Morrowan of Texas show all the features (Fig. 1) characteristic of species of *Neogondolella*. These include the coarsely pitted platform, the distinctive undersurface morphology, and the pronounced brim around the posterior side of the element, all of which were given as definitive features by Sweet (*in* Ziegler, 1973) in his revised diagnosis of *Neogondolella*. Speci-

Table 1. Summary of reported occurrences of neogondolelliform conodont elements in rocks of Carboniferous age.

Identification	Author	Number of Neogondolelliform Elements		Associated Conodont Genera	Further Information on Associated Fauna	Unit	Age	Location
<i>Gondolella</i> sp.	Ellison & Graves (1941)	1	*	<i>Polygnathodella</i> (= <i>Idiognathoides</i>)	Ellison & Graves (1941, text-fig. 1)	Dimple Fm.	Morrowan	Texas
<i>Gondolella clarki</i>	Koike (1967)	262		<i>Polygnathodella</i> (= <i>Idiognathoides</i>)	Koike (1967, Table 3)	Kodani Fm.	Atokan	Honshu, Japan
<i>Gondolella clarki</i>	Merrill & King (1971)	4		<i>Idiognathoides</i> , <i>Idioproniodus</i> , <i>Streptognathodus</i> , <i>Anchignathodus</i>	—	Marble Falls Ls.	Late Morrowan	San Saba Co., Texas
<i>Gondolella</i> sp.	P.K. Bender (pers. comm., 1977)	81+		<i>Idiognathoides</i> , <i>Idiognathodus</i> , <i>Streptognathodus</i> , <i>Neognathodus</i> , <i>Anchignathodus</i> , <i>Idioproniodus</i>	—	Hare Fiord and Nansen Fms.	Atokan- Desmoinesian	Arctic Is. Canada
? <i>Gondolella fujimotoi</i>	Igo & Kobayashi (1974)	5+		<i>Oxinagathus</i> (= <i>Idiognathoides</i>)	Igo & Kobayashi (1974, text-fig. 3)	Mitsuzawa Ls.	Morrowan?	Honshu, Japan
<i>Gondolella clarki</i>	Furduj (1975)	?30+		<i>Idiognathoides</i> , <i>Idiognathodus</i> , <i>Neognathodus</i>	Furduj (1975; 106-107)	Middle Bashkirian- Middle Moskovian	Atokan- Desmoinesian	S. Urals, U.S.S.R.
<i>Gondolella donbassica</i>	Kosenko (1975)	34		—	Kosenko (1975)	Middle and Upper Moskovan	Desmoinesian	Donets Basin U.S.S.R.
<i>Gondolella clarki</i>	H.R. Lane** (pers. comm., 1976)	1		<i>Idiognathoides</i> , <i>Idiognathodus</i> , <i>Adeognathus</i>	Lane & Straka (1974, fig. 29)	Trace Creek Mbr.	Morrowan- Derryan	Evansville Mountain, Arkansas, U.S.A.

*H.R. Lane (pers. comm., 1977) recovered "at least two additional specimens" at this locality.

**H.R. Lane (pers. comm., 1976) stated that he recovered a conodont identified by him as *G. clarki*

mens from strata of Atokan-Desmoinesian age from the Canadian Arctic show a similar structure to the figured specimens from Texas and could not be distinguished from those of species of *Neogondolella* by Sweet (pers. comm., 1975) or by von Bitter.

The importance of the pitted ultra-sculpture covering the upper surface of the platforms of species of *Neogondolella* cannot be overemphasized. These pits cover much of the upper surface of elements of every known species of *Neogondolella* (see for example Behnken, 1975, pls. 1 and 2; von Bitter, 1976, fig. 5), but are either lacking or restricted to the lateral margins (von Bitter, 1976) of the corresponding elements, the platform or Sp elements, in species of *Gondolella*. That is true even in the oldest known fully platformed species of *Gondolella*, *G. laevis* Kosenko and Kozitskaya [= *Gondolella* n. sp. A of Merrill and King, 1971 and *G. pulchra* of Merrill, 1975, as shown in Fig. 2. This species was a contemporary of Pennsylvanian neogondolelliform conodont species similar to *Neogondolella clarki* (Koike).

The recovery over the years (Table 1), by a number of authors, of neogondolelliform conodont elements seemingly indistinguishable from species of *Neogondolella*, from strata of Early and Middle Pennsylvanian age, can be interpreted in two ways:

- a) Species of *Neogondolella* are not restricted to strata of Permian and Triassic age, but ranged from the Early Pennsylvanian to the Triassic.
- b) Permian and Triassic species of *Neogondolella* are homeomorphs of Early and Middle Pennsylvanian taxa that at present are without satisfactory generic assignment.

Discussion

The first interpretation of the irregular occurrences of these Pennsylvanian *Neogondolella*-like forms is that they were subject to environmental restrictions similar to those noted for species of *Gondolella* (Merrill and von Bitter, 1976). Indeed, with no known occurrences of elements like these from rocks of Missourian or Virgilian age worldwide, the restriction would need to be considerably more confining and might include zoogeographic as well as ecologic controls. What the nature of these controls might have been is at present unknown, but there is no compelling reason to believe that it was similar to the environmental restraints upon the distribution of species of *Gondolella*, *sensu stricto*.

The second interpretation would be consistent with the concept put forward by Sweet (*in* Ziegler, 1973: 128) that "the group of species herein assigned to *Neogondolella* may be polyphyletic" and "It is likely that several unnamed stocks are represented by the more or less isolated species here assigned to *Neogondolella*". Although Sweet may be correct in his view that species at present assigned to *Neogondolella* are polyphyletic, we remain sceptical that homeomorphy of such an exact nature could have taken place. Even in well-documented instances of homeomorphy, as for example that between species of *Patrognathus*, *Clydagnathus*, and *Cavusgnathus* (Austin, 1973), it is important to note that the degree of homeomorphy was never as exact as in the case under discussion. Because we cannot distinguish Pennsylvanian neogondolelliform conodonts from similar Permian and Triassic forms and because phylogenetic lineages have not been demonstrated for

Fig. 1 A-F. *Neogondolella clarki* (Koike), Texas, San Saba Co., Marble Falls Limestone (Morrowan), ROM 30680, 30681.

A. Oral view, ROM 30680.

B. Enlarged view of anterior portion, ROM 30680.

C. Lateral oral view of side of denticle, ROM 30680.

D. Enlarged view of anterior portion showing anterior brim, ROM 30681.

E. Enlarged view of aboral edge microsculpture, ROM 30680.

F. Aboral view, ROM 30680.

them, at present we consider Pennsylvanian neogondolelliform conodonts to represent species of *Neogondolella*, *sensu stricto*. Further study of Pennsylvanian occurrences of neogondolelliform elements may make it possible to demonstrate that the animals involved bore more than one kind of element in their apparatuses. In both the Texas and the Canadian Arctic occurrences (Table 1) a few poorly preserved ramiform elements, possibly belonging in the apparatus of a species of *Neogondolella*, were found associated with the neogondolelliform conodont elements. If Sweet's conclusion (1970; in Ziegler, 1973), since challenged by Kozur (1976), that Permian and Triassic species of *Neogondolella* possessed an apparatus consisting of only a single kind of element, proves to be correct; possession of multiple elements by the Pennsylvanian forms would constitute sufficient ground for removing them to a separate genus.

According to Merrill and King (1971), advanced Desmoinesian species of *Gondolella*, and by extension Missourian ones including *Gondolella elegantula* Stauffer and Plummer, the type species, were descendants of *G. gymna* Merrill and King. Depending upon locality, the beds from which *G. gymna* were recovered are either uppermost Atokan or lowermost Desmoinesian, but in either case, species of *Neogondolella* appearing near the base of the Pennsylvanian evolved earlier than did species of *Gondolella*. Since the groups are morphologically much more similar to each other than to other conodonts with which they are associated, it is not unreasonable to interpret, as has already been done by Clark (1972), that they are phylogenetically related. A common ancestor for the two groups has not been found but the strong possibility remains that species of

Gondolella sprang from species of *Neogondolella*, rather than the reverse as has been proposed (Clark, 1972).

The suggested xaniognathid origin for species of *Neogondolella* proposed by Sweet (1970; in Ziegler, 1973) will be discussed for the sake of completeness in considering the origin(s) of *Neogondolella*. *Xaniognathus* Sweet (1970) was based on ozarkodiniform blade-like conodont elements which were "not closely associated in range and frequency of occurrence with any other elements" (Sweet, 1970: 262) and were interpreted to have been "the only components of the skeletal apparatus of the conodonts that secreted them" (ibid.). The fact that species of both *Neogondolella* and *Xaniognathus* were interpreted to have borne elements of only one kind was a strong factor in leading Sweet to suggest a phylogenetic derivation of *Neogondolella* from *Xaniognathus*.

The proposed xaniognathid origin for species of *Neogondolella* appears unlikely to us, particularly in light of the conclusion (Kozur, 1976) that species of the latter bore conodont elements of more than one type and that these species had an element makeup directly comparable to that of species of *Gondolella* as shown by von Bitter (1972, 1976) and by Merrill (1975). Instead it seems more probable to us that xaniognathodiform conodont elements, rather than being ancestors, were in fact biological components of one or more species of *Neogondolella*. This suggestion is supported by the similar overall distribution (range) of species of *Xaniognathus* and *Neogondolella* (Sweet, 1970, table 1). The difference in frequency noted by Sweet is believed to represent the normal under- and over-representation of ramiform and platform conodont elements, respectively, that are com-

Fig. 2 A-E. *Gondolella laevis* Kosenko and Kozitskaya, Illinois, Rock Island Co., Seville locality 11 of Merrill and King (1971), "Seville" Limestone Member (Atokan or Desmoinesian), ROM 34444.

A. Lateral view.

B. Enlarged lateral view of anterior denticles.

C. Enlarged oral view of anterior denticles.

D. Aboral view.

E. Enlarged view of basal cavity.

mon in Late Palaeozoic conodont faunas (von Bitter, 1972, 1976). It is significant that Sweet (1970: 263) observed that *Neogondolella carinata* (Clark) and some large specimens of *Xaniognathus curvatus* Sweet shared certain platform characteristics, but that the latter are distinguished from *N. carinata* by

retention of a short posterior process. We believe this to represent a symmetry transition among anatomical associates much like that reported between the Sp and Oz elements of *Gondolella denuda* Ellison (von Bitter, 1972) and *Gondolella gymna* Merrill and King (Merrill, 1975).

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Literature Cited

- AUSTIN, R. L.
1973 Phylogeny and homeomorphy of conodonts in the Lower Carboniferous. —In Rhodes, F. H. T., ed. *Conodont paleozoology*. Special Paper, Geological Society of America, 141: 105–116.
- BEHNKEN, F. H.
1975 Leonardian and Guadalupian (Permian) conodont biostratigraphy in western and southwestern United States. —*Journal of Paleontology*, 49(2): 284–315.
- BENDER, H.
1967 Zur Gliederung der Mediterranen Trias II. Die Conodontenchronologie der Mediterranen Trias. —*Annales Géologiques des pays Helleniques*, 19: 465–540.
- BENDER, H. AND D. STOPPEL
1965 Perm-Conodonten. —*Geologisches Jahrbuch*, 82: 331–364.
- CLARK, D. L.
1972 Early Permian crisis and its bearing on Permo-Triassic conodont taxonomy. —In Lindström, M. and W. Ziegler, eds. *Symposium on conodont taxonomy*. *Geologica et Palaeontologica*, SB1: 147–158.
- CLARK, D. L. AND L. C. MOSHER
1966 Stratigraphic, geographic, and evolutionary development of the conodont genus *Gondolella*. —*Journal of Paleontology*, 40(2): 376–394.
- ELLISON, S. P., JR. AND R. W. GRAVES
1941 Lower Pennsylvanian (Dimple Limestone) conodonts of the Marathon Region, Texas. —University of Missouri School of Mines and Metallurgy, Technical Series, 14: 1–13.
- FURDUJ, R. S.
1975 On the division of the Carboniferous of the South Ural by conodonts. [In Russian] —In Furdj, R. S. and V. S. Zanka-Novatsky, eds. *Stratigraphy and biogeography of the seas and lands of the Carboniferous of the USSR Territory*. The Lenin Order Kiev State Shevchenko University: 104–109.
- IGO, H. AND F. KOBAYASHI
1974 Carboniferous conodonts from the Itsukaichi District, Tokyo, Japan. —Transactions, Proceedings of the Palaeontological Society of Japan, N.S. 96: 411–426.
- KOIKE, I.
1967 A Carboniferous succession of conodont faunas from the Atetsu Limestone in southwest Japan (Studies of Asiatic conodonts, Part VI). —Tokyo Kyoiku Daigaku Science Reports, Section C, 93: 279–318.
- KOSENKO, Z. A.
1975 New species of conodonts from the deposits of the Moskovian Stage in the south-western part of the Donets Basin. [In Russian] —Akademiya Hayk YCCP, *Geological Journal*, 35(5): 126–133.
- KOZUR, H.
1976 Paleocology of Triassic conodonts and its bearing on multielement taxonomy. —In Barnes, C. R., ed. *Conodont paleocology*. Special Paper, Geological Association of Canada, 15: 312–324.
- LANE, H. R. AND J. J. STRAKA, II
1974 Late Mississippian and Early Pennsylvanian conodonts Arkansas and Oklahoma. —Special Paper, Geological Society of America, 152: 1–144.
- MERRILL, G. K.
1975 Pennsylvanian conodont biostratigraphy and paleocology of northwestern Illinois. —Geological Society of America, Microform Publication 3: 1–130.
- MERRILL, G. K. AND C. W. KING
1971 Platform conodonts from the lowest Pennsylvanian rocks of northwestern Illinois. —*Journal of Paleontology*, 45(4): 645–664.
- MERRILL, G. K. AND P. H. VON BITTER
1976 Revision of conodont biofacies nomenclature and interpretations of environmental controls in Pennsylvanian rocks of eastern and central North America. —Royal Ontario Museum Life Sciences Contribution, 108: 1–46.
- STAUFFER, C. R. AND H. J. PLUMMER
1932 Texas Pennsylvanian conodonts and their stratigraphic relations. —*Bulletin, University of Texas*, 3201: 13–50.
- SWEET, W. C.
1970 Uppermost Permian and Lower Triassic conodonts of the Salt Range and Trans-Indus Ranges, West Pakistan. —In Kummel, B. and C. Teichert, eds. *Stratigraphic boundary problems: Permian and Triassic of West Pakistan*. University of Kansas Department of Geology Special Publication, 4: 207–275.
- TEICHERT, C., B. KUMMEL AND W. C. SWEET
1973 Permian-Triassic strata, Kuh-E-Ali Bashi, Northwestern Iran. —*Bulletin, Museum of Comparative Zoology Harvard University*, 145(8): 359–472.

VON BITTER, P.H.

- 1972 Environmental control of conodont distribution in the Shawnee Group (Upper Pennsylvanian) of eastern Kansas. -The University of Kansas Paleontological Contributions, 59: 1-105.
- 1976 The apparatus of *Gondolella sub lanceolata* Gunnell (Conodontophorida, Upper Pennsylvanian) and its relationship to *Illina*

nella typica Rhodes. -Royal Ontario Museum Life Sciences Contribution, 109: 1-44.

ZIEGLER, W., ED.

- 1973 Catalogue of conodonts, volume 1. -Stuttgart, E. Schweizerbart'sche Verlagsbuchhandlung. 504 pp.

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