

Middle Devonian acritarch biostratigraphy of North America

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ABSTRACT—The known stratigraphic ranges of 66 acritarch species from eight independently dated Middle Devonian sections in North America are plotted. Twenty seven species are restricted to the Middle Devonian in North America, yet only 12 species occur in more than one section. None of these 12 species is, as yet, known to occur outside North America. This apparent endemism is believed to be due partly to the lack of study of contemporaneous assemblages from elsewhere in the world.

INTRODUCTION

Devonian acritarchs are well known from numerous localities in the world, particularly North America, Europe, Africa, and South America (Downie, 1979). The world-wide published record for Middle Devonian acritarch assemblages, is however, sparse (Downie, 1979; Wicander & Wood, 1981). This is equally true for North America (Fig. 1).

If acritarchs are to be biostratigraphically useful, their stratigraphic ranges must be determined as precisely as possible. This can be achieved by using independently dated (conodonts, shelly faunas, etc.), continuous sections, although unfortunately, there have been few such studies carried out. While some regional zonations have been proposed (e.g., Vanguetaine *et al.*, 1983), insufficient assemblages from contemporaneous, yet widely separated geographical areas have been studied to provide any type of comprehensive Devonian zonation.

As part of an ongoing study of Devonian acritarch biostratigraphy, Wicander (1983) provided a compilation of all known validly named North American Devonian acritarchs, their North American stratigraphic ranges, and geographical distribution.

The present paper specifically analyses the current state of knowledge of North American Middle Devonian acritarch biostratigraphy. I hope this will stimulate further biostratigraphic and palaeogeographic research on Middle Devonian acritarchs, with the ultimate goal to provide a global biostratigraphic framework based on the recognition of endemic and cosmopolitan acritarch species and their delineation into various floral provinces.

PREVIOUS STUDIES OF MIDDLE DEVONIAN NORTH AMERICAN ACRITARCHS

The first record of Middle Devonian North American acritarchs is by Baschnagel (1942). He described and

figured several taxa from the Middle Devonian Onondaga Formation cherts around the Syracuse area of New York. These taxa were assigned to extant genera and families of freshwater algae. Examination of the figures indicates that the specimens are indeed marine acritarchs. Unfortunately, the specimens are from thin sections and poorly preserved. Furthermore, the collection cannot be more precisely dated than Middle Devonian, and thus his paper is mainly of historical interest and of no use for biostratigraphic work.

Sediment from the corallum of the tabulate coral *Favosites turbinata* provided the material for a series of papers by Deunff (1954, 1955, 1961, 1966, 1971) describing the acritarch assemblage recovered. Deunff stated that the samples came from the Onondaga Limestone of Decew, Ontario, Canada. However, there is some uncertainty as to the formation and geographical location of the samples, and hence their precise age (Playford, 1977). While Deunff named many new species from these samples, unless they are found elsewhere in documented samples, they cannot be used for precise biostratigraphic work due to the uncertainty of the formation and its location.

Audretsch (1968) briefly described and illustrated six acritarch species from the Bituminous Shale and Limestone Members and the Buffalo River Member of the Pine Point Formation, Great Slave Lake area, Northwest Territories, Canada. The associated fauna indicates a Givetian age for the Pine Point Formation.

Peppers & Damberger (1969) recorded three "acritarch" species (*Leiosphaeridia* sp., *Tasmanites huronensis*, and *Stellinium octoaster* = *S. micropolygonale*) from the Davenport Limestone Member of the Wapsipinicon Formation, Illinois. This formation has been well established as Early Givetian by its invertebrate fauna and its stratigraphic relationships.

Twelve acritarch species were recovered by Legault (1973) from the subsurface Hamilton Formation in



Fig. 1. Geographical locations of North American Middle Devonian acritarch assemblages: 1. Great Slave Lake, Northwest Territories, Canada (Audretsch, 1968). 2. Alberta, Canada (Nautiyal, 1975). 3. Saskatoon, Saskatchewan, Canada (Nautiyal, 1975). 4. Illinois, U.S.A. (Peppers and Damberger, 1969). 5. Ohio, U.S.A. (Wicander and Wood, 1981; Wicander and Wright, 1983). 6. Ontario, Canada (Legault, 1973). 7. Moose River Basin, Ontario, Canada (Playford, 1977). 8. Syracuse area, New York, U.S.A. (Baschnagel, 1942).

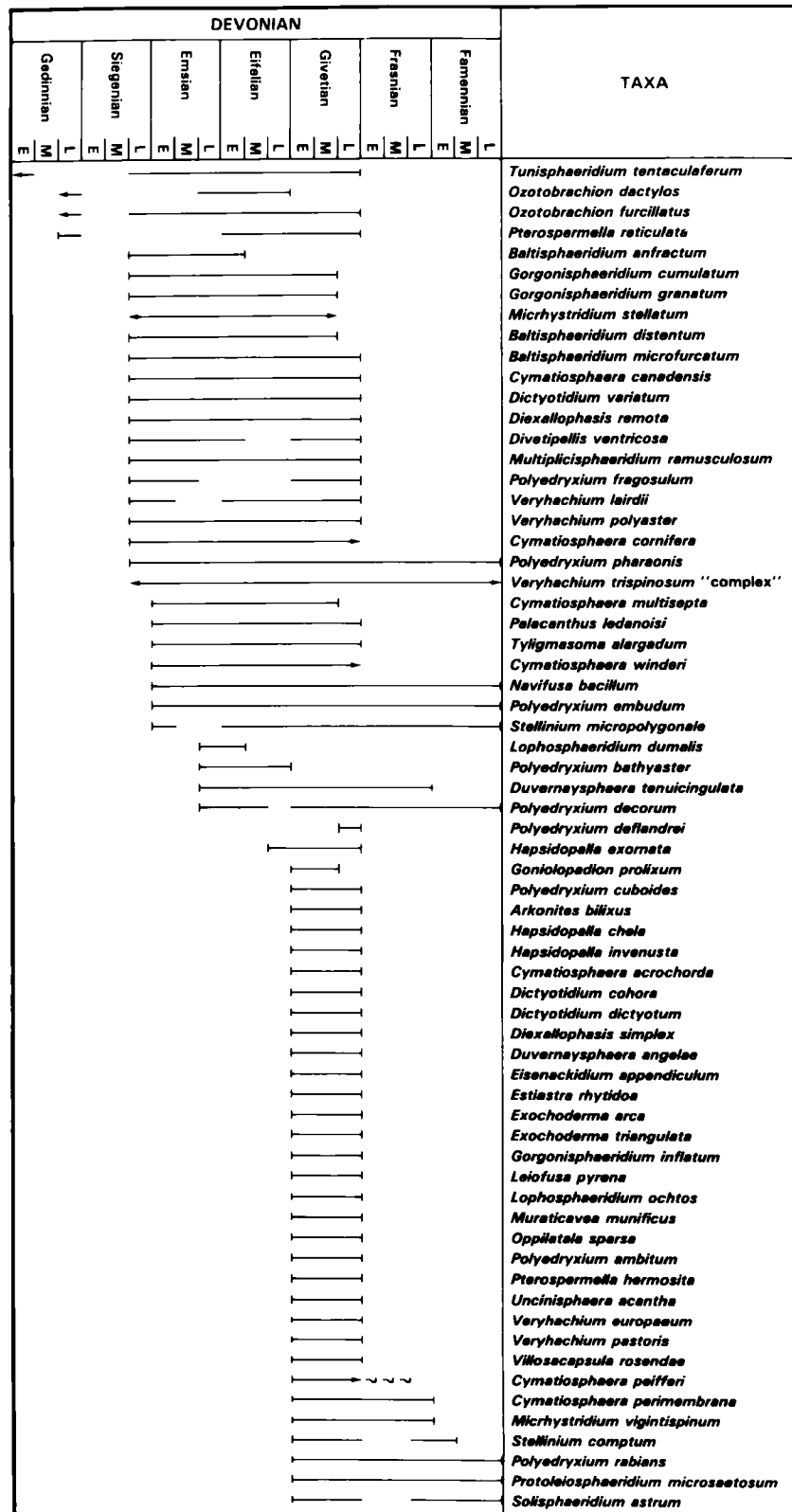


Fig. 2. Stratigraphic ranges of Middle Devonian North American acritarchs, based on sections from the geographical locations in Fig. 1. Arrows indicate stratigraphic range extends lower or higher in North America.

southwestern Ontario, Canada. This formation contains an invertebrate fauna and is commonly assigned to the Givetian.

Nautiyal (1975) reported and illustrated a number of named acritarch species from the subsurface Elk Point Group of Saskatchewan and Alberta, Canada. He stated the Elk Point to be Givetian at these two localities.

Playford (1977) described and illustrated a total acritarch flora of 53 species recovered from the Jaab Lake No. 1 well, Moose River Basin, Ontario, Canada. The middle and upper Kwataboahagan, Moose River, Murray Island, and Williams Island Formations span the Eifelian-Middle Givetian, based on megafauna, conodont, spore, and stratigraphic information. Thirty eight acritarch species occur in this interval at this locality.

Wicander & Wood (1981) described, illustrated, and provided biostratigraphic information on 61 acritarch species from the Silica Formation of Ohio, U.S.A. This formation is dated as Givetian on the basis of its contained conodonts and macrofauna.

Most recently, Wicander & Wright (1983) illustrated and recorded 43 acritarch species from the Eifelian-Lower Givetian Columbus and Delaware Limestones of Ohio, U.S.A.

DISCUSSION

Presently, eight accurately dated North American Middle Devonian sections containing acritarchs have been published. Of these, however, only five are primarily concerned with their contained acritarch assemblages (Legault, 1973; Nautiyal, 1975; Playford, 1977; Wicander & Wood, 1981; Wicander & Wright, 1983). The acritarch assemblages from two other independently dated sections are currently being studied: the Rapid Member (Upper Givetian) of the Cedar Valley Formation of Iowa, U.S.A. by Wicander & Wood; and

the Hungry Hollow Formation (Givetian) of Ontario, Canada by Wicander, Merwin, & Newman. In a paper in press, Wood & Clendening have analysed the acritarch assemblage from the Boyle Dolomite (Givetian) of Kentucky, U.S.A. This formation contained 27 acritarch species, 23 of which can be assigned to named species, with all of the named species occurring in the Silica Formation of Ohio, U.S.A.

The stratigraphic ranges of the named acritarch species recovered from the aforementioned 11 sections are plotted in Fig. 2. While it appears that many species have restricted Middle Devonian ranges, it should be noted that only Playford (1977) analysed a section that had older sediments below the Eifelian (Upper Siegenian-Middle Givetian) while Wicander & Wright (1983) studied an Eifelian-Lower Givetian section. All of the other previously mentioned sections were restricted to the Givetian stage or a portion of it. Even though North American Frasnian and Famennian sections have been studied, the upper range of many of the acritarch species is still uncertain.

From this compilation, there is presently no acritarch species that is restricted to the Eifelian in North America. However, only two sections containing Eifelian acritarch species that is restricted to the Eifelian in North America. & Wright, 1983). Twenty six species appear to be restricted to the Givetian, yet caution is advised in so far as no continuous Givetian-Upper Devonian sections have been studied. Several of these apparently restricted species (e.g. *Duvernaysphaera angelae*, *Pterospermella hermosita*, *Veryhachium europaeum*, *V. pastoris*, *V. polyaster*, and *Villosacapsula rosendae*) are known to have longer stratigraphic ranges outside North America (Wicander & Wood, 1981; Playford, 1981).

Some species appear to have restricted vertical ranges and thus may be biostratigraphically important. The

Explanation of Plate 1

All specimens, except fig. 2, are from the Silica Formation, Ohio, U.S.A. (Wicander & Wood, 1981). Fig. 2 is from the Delaware Limestone, Ohio, U.S.A. (Wicander & Wright, 1983). All figures are approx. $\times 800$.

Fig. 1. *Duvernaysphaera angelae* Deunff, 1964..

Fig. 2. *Goniolopadion prolixum* Playford, 1977.

Fig. 3. *Estiastra rhytidoa* Wicander & Wood, 1981.

Fig. 4. *Arkonites bilixus* Legault, 1973.

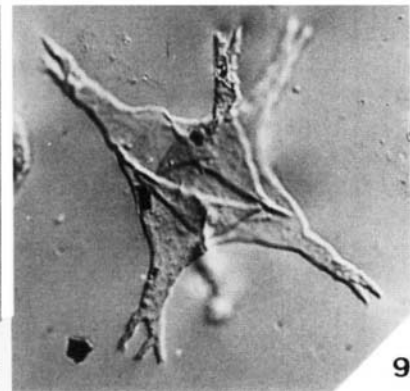
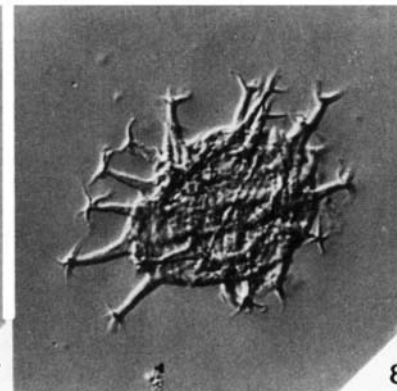
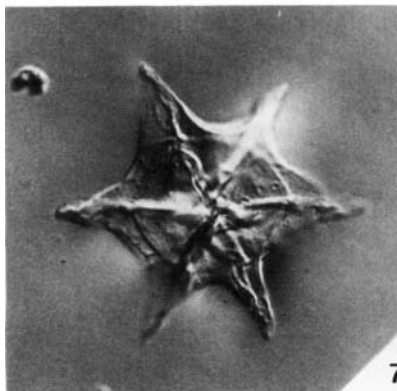
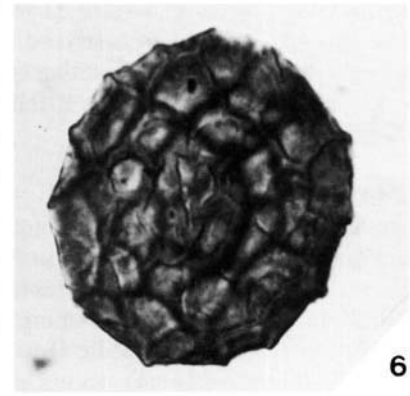
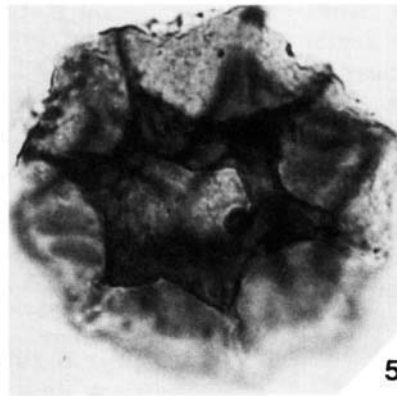
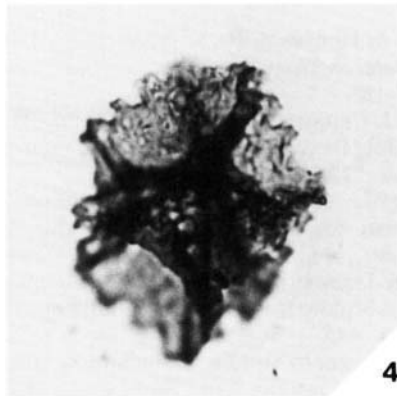
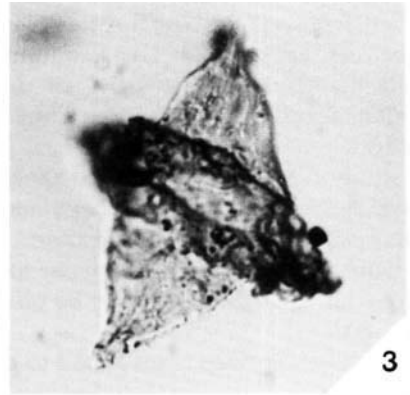
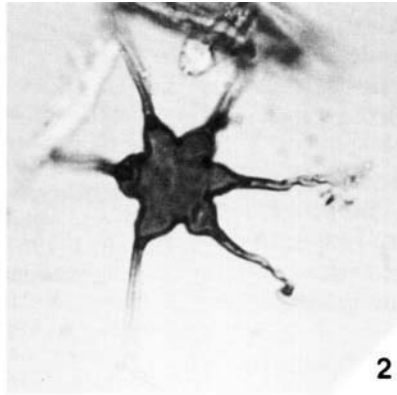
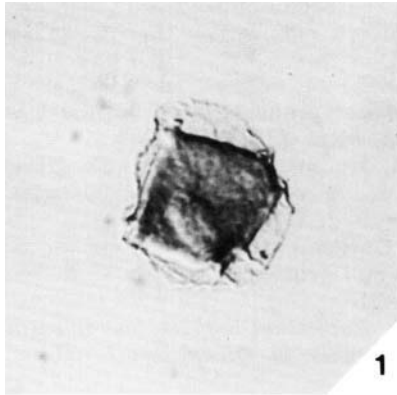
Fig. 5. *Muraticavea munificus* Wicander & Wood, 1981.

Fig. 6. *Dictyotidium cohora* Wicander & Wood, 1981.

Fig. 7. *Polyedryxium ambitum* Wicander & Wood, 1981.

Fig. 8. *Hapsidopalla chela* Wicander & Wood, 1981.

Fig. 9. *Exochoderma arca* Wicander & Wood, 1981.



species illustrated in Plate 1 occur in several of the previously discussed independently dated formations. Except for *Duvernaysphaera angelae*, which has a longer stratigraphic range outside North America, none of the distinctive species illustrated have been reported in the literature from outside North America. Hence, they may only be regionally useful. This apparent endemism may in part be due to the paucity of described Middle Devonian acritarch assemblages from other regions of the world.

In addition to those illustrated species, only *Diexallophasis simplex*, *Hapsidopalla exornata*, *Lophosphaeridium ochthos*, and *Oppilatala sparsa* are found in at least two sections. They also appear to be restricted to the Givetian, and may prove to be biostratigraphically useful.

No acritarch species is restricted to the Eifelian, and only *Hapsidopalla exornata* is found in the Upper Eifelian and the Givetian. However, the only North American Eifelian sections studied are those described by Playford (1977) and Wicander & Wright (1983). When more Eifelian sections have been analysed for acritarchs, it seems likely that many of the Givetian species mentioned above will extend down into the Eifelian.

SUMMARY

Very little Middle Devonian acritarch biostratigraphic work has been done to date in North America or elsewhere. Of the 66 acritarch species found occurring in the Middle Devonian of North America, 27 species are presently restricted to the Middle Devonian, and all but one (*Hapsidopalla exornata*) occurs exclusively in the Givetian stage. Only *Arkonites bilixus*, *Dictyotidium cohora*, *Diexallophasis simplex*, *Estiastra rhytidoa*, *Exochoderma arca*, *Goniolopadion prolixum*, *Hapsidopalla chela*, *H. exornata*, *Lophosphaeridium ochthos*, *Muraticavea munificus*, *Oppilatala sparsa*, and *Polyedryxium ambitum* are presently found in more than one section.

As more well dated and continuous sections are studied for their acritarch content, the biostratigraphic and palaeogeographic ranges of many of the previously mentioned species will become better defined.

REFERENCES

- Audretsch, A. P. 1968. In Oswald, D. H. (Ed.), *Proc. Int. Symp. Devonian System, Calgary (1967) (2) Middle Devonian microflora from the Great Slave Lake area, Northwest Territories, Canada*, 837–847.
- Baschnagel, R. A. 1942. Some microfossils from the Onondaga Chert of Central New York. *Buffalo Soc. Nat. Sci. Bull.*, **17**, 1–8.
- Deunff, J. 1954. Sur un microplancton du Dévonien du Canada recélant des types nouveaux d'Hystrichosphaeridés. *C. R. Acad. Sci., Paris*, **239**, 1064–1066.
- Deunff, J. 1955. Un microplancton fossile Dévonien à Hystrichosphères du continent Nord-Américain. *Bull. Microsc. appl.*, sér. 2, **5**, 138–149.
- Deunff, J. 1961. Quelques précisions concernant les Hystrichosphaeridées du Dévonien du Canada. *C. R. Soc. géol., France*, **8**, 216–218.
- Deunff, J. 1966. *Recherches sur les microplanctons du Dévonien (Acritarches et Dinophyceae)*. Thèse Univ. Rennes, 1–168.
- Deunff, J. 1971. In, *Microfossiles organiques du Paléozoïque, fasc. 3, Commission Internationale de Microflore du Paléozoïque. Le genre Polyedryxium Deunff. Révision et observations*, 7–49.
- Downie, C. 1979. In House, M. R., Scrutton, C. T., & Bassett, M. G. (Eds.), *Palaeontology Spec. Papers No. 23, Devonian acritarchs*, 185–188.
- Legault, J. A. 1973. Chitinozoa and Acritarcha of the Hamilton Formation (Middle Devonian), southwestern Ontario. *Geol. Surv. Can., Bull.*, **221**, 1–103.
- Nautiyal, A. C. 1975. Occurrence of microplanktons in the Middle Devonian rocks of Saskatchewan and Alberta, Canada. *Curr. Sci.*, **44**, 851–853.
- Peppers, R. A., & Damberger, H. H. 1969. Palynology and petrography of a Middle Devonian Coal in Illinois. *Ill. State Geol. Surv.*, circ. **445**, 1–36.
- Playford, G. 1977. Lower to Middle Devonian acritarchs of the Moose River Basin, Ontario. *Geol. Surv. Can., Bull.*, **279**, 1–87.
- Playford, G. 1981. Late Devonian acritarchs from the Gneudna Formation in the western Carnarvon Basin, Western Australia. *Geobios*, **14**, 145–171.
- Vanguetaine, M., Declairfayt, T., Rouhart, A., & Smeesters, A. 1983. Zonation par acritarches du Frasnien supérieur-Faménnien inférieur dans les bassins de Dinant, Namur, Herve et Campine (Dévonien supérieur de Belgique). *Ann. Soc. Geol. Belg.*, **106**, 121–171.
- Wicander, R. 1983. A catalog and biostratigraphic distribution of North American Devonian acritarchs. *Am. Assoc. Strat. Palyn. Contrib. Series*, **10**, 1–133.
- Wicander, R., & Wood, G. D. 1981. Systematics and biostratigraphy of the organic-walled microphytoplankton from the Middle Devonian (Givetian) Silica Formation, Ohio, U.S.A. *Am. Assoc. Strat. Palyn. Contrib. Series*, **8**, 1–137.
- Wicander, R., & Wright, R. P. 1983. Organic-walled microphytoplankton abundance and stratigraphic distribution from the Middle Devonian Columbus and Delaware Limestones of the Hamilton Quarry, Marion County, Ohio. *Jour. Ohio Acad. Sci.*, **83**, 2–13.
- Wood, G. D., & Clendening, J. A. In Press. Acritarchs and chitinozoans from the Middle Devonian (Givetian) Boyle Dolomite of Kentucky, U.S.A. *Rev. Palaeobot. Palynol.*