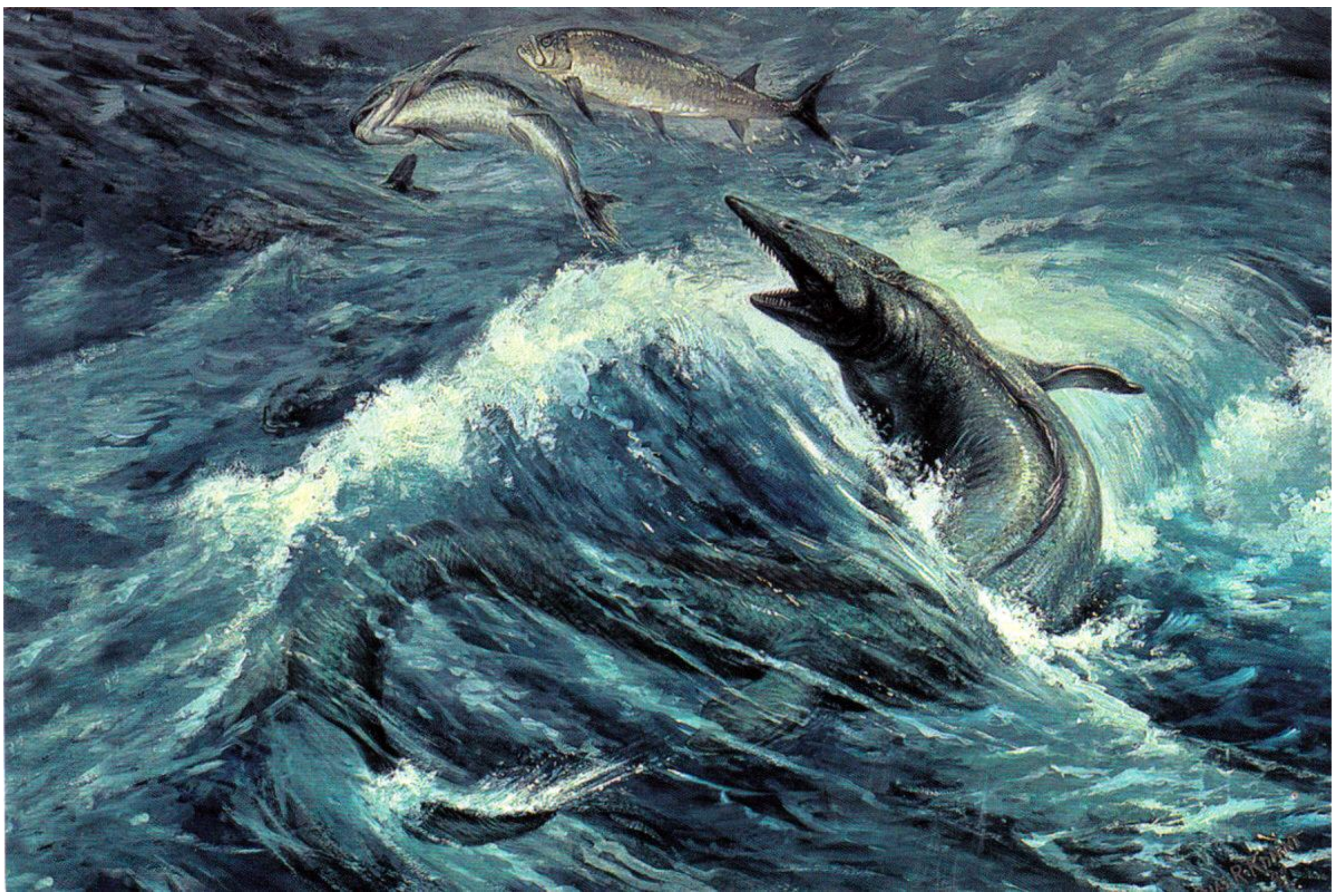
M·A·P·S Digest

Official Publication of
<u>M</u>id-<u>A</u>merica <u>P</u>aleontology <u>S</u>ociety
http://www.midamericapaleo.org

Volume 43, Number 1
Jan.-Mar., 2020



"A LOVE OF FOSSILS BRINGS US TOGETHER"

Calendar

2020

January 11
The January MAPS meeting will be held in Room 125 of Trowbridge Hall, Univ. of Iowa.
MAPS member Tom Williams will present the program: "Mosasaurs: Kings of the Late Cretaceous Seas" at 1:00 p.m. The regular MAPS meeting will be at 2:00 p.m.
www.midamericapaleo.org

March 28-28
CVRMS Gem, Mineral, and Fossil Show.
Hours: Sat.: 8:30 am-6:00 pm;
Sun.: 9:30 am-4:00 pm.
Theme: Meteorites
Location: Hawkeye Downs, Cedar Rapids
www.cedarvalleyrockclub.org

April 17-19
MAPS EXPO XLII
Location: Sharpless Auctions
Exit 249 I-80
Iowa City, Iowa
Theme: Ordovician II
Keynote Speaker: Dr. Dennis R. Kolata
Topic: The Platteville Formation Fauna of the Upper Midwest U.S. - A Snapshot of the Great Ordovician Biodiversification Event
www.midamericapaleo.org

Contributions to Digest Needed

The Digest editors encourage the members to submit articles for publication in the Digest issues. The Digest is for the members and should reflect their interests. If you have specimens that you collected and would like to share with other members or would like to describe a favorite collecting site, please write an article in Word, Times New Roman size 12 font, single spaced with one inch margins, and send to the editors. Photos and diagrams can be e-mailed separately or incorporated in the article.
John: Fossilnautiloid@aol.com
Chris: CDCozart@aol.com

Call for Papers

The theme for the **2020 EXPO** is the **Ordovician II**. Any paper dealing with fossils, stratigraphy, or site-specific paleontology of the Ordovician Period would be appreciated. The papers should be in Word, Times New Roman, size 12 Font, single spaced with one inch margins, and e-mailed to one of the Digest Editors by the **last week of February 2020**. Diagrams/Photos can be sent separately or imbedded in text.

John: Fossilnautiloid@aol.com
Chris: CDCozart@aol.com

DUES INFO

Please send your $20 2020 MAPS dues to:

Dale Stout
2237 Meadowbrook Drive S.E.
Cedar Rapids, Iowa 52403

About the Cover

This issue features a cover of a Charles Knight painting of *Tylosaurus proriger*. Tom Williams will present a program on Mosasaurs at the January MAPS meeting.

Biodiversification Events

John A. Catalani

In paleontology, when one speaks of explosions of biodiversity it is generally assumed one is speaking of the Cambrian Explosion. This is understandable since this "initial" radiation in both morphological disparity (range in utilized body plans) and diversity of taxa set the stage for the subsequent players in the game of life on Earth. However, we now recognize two other "explosions" in the early history of life--one that occurred before the Cambrian Explosion, named the Avalon Explosion (the time of origin of the Ediacara Biota), and one after, called the Great Ordovician Biodiversification Event (GOBE). Even though the Cambrian Explosion gets most of the press, each of these diversifications was significant for several reasons. The first because it occurred at or near the beginning of multi-cellular life and the second because of the enormous increase in taxonomic diversity that filled environmental niches that were partitioned out by environmental factors resulting in a high level of Paleozoic diversity.

The Ediacara Biota has been, since its discovery in 1946 in Australia (although examples of the fauna were found early in the 20th Century in Namibia), enigmatic in terms of body-plan organization and relationship to present-day organisms. The Ediacaran fossils occur in rocks of the upper Ediacaran Period deposited approximately 575-542 million years ago (Ma) and have now been found at dozens of localities across five continents. Forms range from small (centimeter-size), somewhat amorphous blobs to very large (meter-size) fronds and discs. The frond and disc fossils reveal a structure quite unlike anything alive today. These organisms consisted of a quilted surface sometimes described as having an "air-mattress" morphology and, as far as can be determined, lacked a mouth and gut. It has been proposed that gas exchange (as well as food intake) in these organisms occurred by diffusion through their external surface instead of through internal surfaces as occurs in most animals today. This unique morphological architecture led Adolf Seilacher to suggest that these animals were a "failed experiment" in biological organization that had no analogue with present-day life forms. He proposed that the Ediacaran organisms should be placed in a separate phylum that he originally termed "Vendozoa" (the Ediacaran Period has also been referred to as the Vendian) and then later renamed it Vendobionta.

The Ediacara Biota, which appeared just after the end of the Gaskiers glaciation (the last glaciation of the so-called "Snowball Earth") and disappeared around the start of the Cambrian Period, actually consisted of three distinct assemblages. The oldest (approx. 575-560 Ma) is termed the Avalon Assemblage. Fossils show that these organisms were constructed of modular elements forming, among others, frond-shaped colonies that lived in deep water. The shallow-water White Sea Assemblage (approx. 560-542 Ma) displayed the most diverse biota composed of frond-shaped as well as segmented organisms. The Nama Assemblage (approx. 549-542 Ma) also consisted of shallow-water organisms but of relatively low diversity. Speculations that attempt to explain the appearance and diversification of the Ediacara Biota include the presence of significant amounts of oxygen that reached deep water for the first time, the Acraman bolide impact event (South Australia), and the breakup of the supercontinent Rodinia.

The radiation of body plans of the Ediacara Biota has been compared to that of the Cambrian Explosion. They termed this rapid increase in disparity the "Avalon Explosion" in which virtually the complete range of Ediacaran body plans evolved in the Avalon Assemblage and was maintained with little change in the two subsequent assemblages. Taxonomic diversity, however, increased gradually reaching its peak in the White Sea Assemblage then decreased in the Nama Assemblage. The Avalon Explosion, it is generally agreed, represents a failed experiment in animal morphology.

The Cambrian Explosion (approx. 542-520 Ma, although some researchers speculate that the actual "explosion" was compressed in time at around 530-520 Ma) documented the initial emergence of life in its more-or-less familiar morphologic form. During this radiation event, all but one of the phyla that characterize life on Earth today made their first appearance. From studies of trilobites, it appears that variation in morphologic form was particularly strong at this time leading to an explosion in disparity. As with the Ediacara Biota, the process of innovation and diversification of body plans was rapid at the beginning of the Cambrian Explosion. Subsequent preening of body forms resulted in many that became the foundation for succeeding animals as well as some that, for one reason or another, did not survive. Other studies suggest that at this time the rates of molecular evolution were exceptionally high. Some paleontologists have proposed that many of the morphologic forms that arose during the Cambrian Explosion cannot readily be assigned to an existing phylum. This is generally considered a period of experimentation in body form and not necessarily separate and distinct phyla. Others maintain that most of the problematic forms can be assigned to existing phyla and that the morphologic disparity evident in the Cambrian is not much different than that seen today. It is obvious that there was an unprecedented radiation of body forms at the expense of taxonomic diversity during the Cambrian Explosion.

Several theories have been proposed to explain the Cambrian Explosion including high rates of molecular evolution (as mentioned above), continued oxygenation of the oceans, and the acquisition by animals of the ability to secrete hard shells (biomineralization) in response to predation. It is also possible that the seeds for the Cambrian Explosion were sown well before the Cambrian Period and, therefore, before the advent of biomineralization, which would have severely limited the formation of recognizable fossils. Some have even suggested that the "Cambrian Explosion" is merely an artifact of the invention of biomineralized.

Needless to say, although I am fascinated with the earlier two "explosions", the Great Ordovician Biodiversification Event (GOBE) is of greater personal interest due to my research in Ordovician nautiloids. The Ordovician (approx. 485-443 Ma) radiation is different than either the Ediacaran or Cambrian "Explosions" for several reasons. First, the earlier two both experienced a radiation of body plans, disparity, at the expense of taxonomic diversity whereas during the GOBE only one new phylum, Bryozoa, originated but taxonomic diversity increased dramatically. Second, the Ediacaran and Cambrian radiation events were restricted in time, geologically speaking, with all groups diversifying at about the same time for each event whereas the GOBE radiations, although occurring in definite pulses, were spread pretty much throughout the entire Ordovician. Therefore, the origination of most of the phyla and classes of animals, as well as a varied set of body plans, in the Cambrian set the stage for the Ordovician radiations to fill niche spaces with a diversity of genera and species. The GOBE, it is generally acknowledged, was characterized by the greatest increase in biodiversity in the history of life--there was a two-fold increase in taxonomic orders, a three-fold increase in families, and a nearly four-fold increase in genera. Nautiloids, for example, were represented at the beginning of the Ordovician by only one order but, by the time the Late Ordovician rolled around, had radiated into at least ten orders.

Due to the recognition of GOBE, a concentrated effort to determine a global stratigraphic framework and a standard timescale that would allow Ordovician taxonomic studies to be compared was initiated. In 2007 the International Subcommission on Ordovician Stratigraphy (ISOS) finally agreed on a set of names for these global stages after almost 30 years of deliberation. Defining these units was complicated by the highly provincial nature of Ordovician faunas, the uneven occurrence and distribution of reliable radiometric dates, and the search for appropriate type sections that would suitably illustrate each stage. It is now possible to place local, regional, and continental series and stage names into a global context. Consequently, the Platteville rocks (which were probably deposited in only 1-2 million years) that contain the abundant and diverse molluscan fossils that I collect are part of the Turinian Stage of the Mohawkian Series (North American designation), the Caradoc Series (British terminology still used as a point of common reference), and the Sandbian Stage of the Upper Ordovician Series (global designation).

As stated above, the GOBE occurred in definite pulses of radiations. Although the most intense diversification took place during the Mid to Late Ordovician (a duration of around 28 million years), taxonomic radiations lasted virtually the entire period (nearly 42 million years). Additionally, the GOBE was taxonomically selective--some groups diversified robustly whereas others experienced only moderate diversification. The highest diversity peak in the entire Ordovician occurred just before the end-Ordovician mass extinction--an event second only to the end-Permian mass extinction in severity. A post-Ordovician recovery initiated a period of relatively stable diversity (the so-called “Paleozoic Plateau”), broken significantly only by the Late Devonian mass extinction, which lasted until the massive end-Permian extinction event.

As with the other two radiation events, a plethora of possible causal factors have been proposed to explain the GOBE. These factors include, but are not limited to, intrinsic biological factors, increased volcanism that resulted in an influx of continental nutrients into the oceans, an areal increase in hard substrates, plate movements, and escalation in the partitioning of marine habitats. The most fragmented land masses in the Paleozoic occurred in the Ordovician resulting in extremely provincial faunas. Recently, another scenario has been advanced to explain the GOBE. The initial phase of diversification occurred around 470 Ma. Coincidently, 470 Ma Earth experienced an elevated rate of meteorite bombardment which lasted for 10-30 million years resulting from the largest asteroid breakup in the past billion or so years. Evidence for this event includes abundant fragments of the meteorites that were incorporated into the rocks that were laid down at this time and recovered in quarries in Sweden. Brachiopod diversification in Baltoscandia appears to have coincided with this bombardment.

So, how can impacts cause faunal diversifications instead of the extinctions that are popularly presumed to have resulted from them? It turns out that hard evidence for impact-caused extinctions for all but the end-Cretaceous event is tenuous at best. Apparently, there is a size threshold below which impacts disrupt ecosystems but do not initiate mass extinctions. Smaller and more numerous impacts could have initiated diversification by creating new niches across a wide range of environments in a process termed niche partitioning. In other words, the niche partitioning initiated by the numerous impacts resulted in more diverse environments that, in turn, fostered speciation events.

I consider myself fortunate to have been exposed (no pun intended) to Ordovician rocks in my formative years. The collecting I began as a hobby has escalated into a passion for the nautiloid (and other molluscan) fossils contained in Ordovician rocks of the Platteville Formation. Little did I know then that I was collecting fossils that resulted from the greatest taxonomic diversification of animal life in the history of life on Earth. The nearly 50+ species of nautiloids that I have amassed over the years are a testament to this unique event.

Upper Ordovician Graptolites of the Cincinnati Area

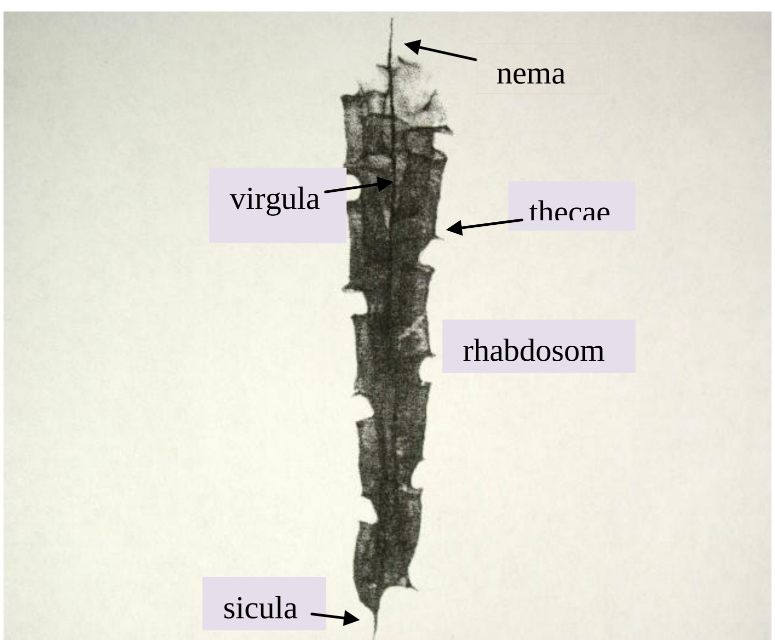
Rich Fuchs
Dry Dredgers

Graptolites belong to a class of extinct, colonial animals found in marine (salt water) Paleozoic rocks. Over the years, they have been placed in many different orders and phyla. But, currently they are in the Phylum Hemichordata.

The name “graptolite” means “writing on the rocks” or “rock writing;” because most of them look like pencil or ink drawings or lettering on the surface of rocks. Most have been distilled by pressure, heat, and decomposition to a carbon film, black in color. However, some have been phosphatized and appear white, usually on black shales.

Richmondian Stage	**Drakes Fm**
	Saluda Fm
	Whitewater Fm
	Liberty Fm
	Waynesville Fm
	Arnheim Fm
Maysvillian Stage	**Grant Lake Fm**
	Fairview Fm
Edenian stage	**Kope Fm**
	Fulton Beds

A simplified version of the Cincinnatian Stratigraphy.



The colony consists of many individual animals (**zooids**) living in tubes or cups (**thecae**) connected together by a thin, threadlike structure called the **virgula**. All of this forms the **rhabdosome** or colony. The first thecae is called the **sicula** and all of the rest are dependent on the first. Sixty years ago, Kozlowski suggested that sicular identification was the way to differentiate genera. Lately, this has been the norm in classifying the graptolites and has led to major reclassifications in the last 35 years. Depending on the type of graptolite, and extension of the virgula, the **nema**, was attached to something on the sea floor, to some floating material such as sea weed, or to a float structure. Nemas are hard to find because they are so delicate. Float structures are even more rare, but some have been found.

Approximately 15 genera and 31 species of graptolites lived during the Cincinnatian Series of the Upper Ordovician Period. Graptolites are classified in seven orders, but we will concentrate on just two of those: the Dendroidea and Graptoloidea.

Dendroidea

Dendroid graptolites were generally bush-like structures, attached to the sea bottom (benthonic). Some could have been attached to floating sea weed, etc. Because they were attached, species were generally localized. These were the longest lasting graptolites, ranging from the middle Cambrian until their extinction in the Mississippian Period. However, a recent paper reports a species of Dictyonema from the Permian Period.

There are only two dendroid graptolites found in the Cincinnatian. These are:

Dictyonema arbusculum – this is a small net-like bush structure which attached to some hardground.
Acanthograptus ulrichi – a small, thicker, bush-like structure, usually found in pieces.

Dictyonema arbusculum

Acanthograptus ulrichi

Graptoloidea

These represent the most common and the greatest number of types of graptolites in the Cincinnatian. They seemed to have liked deeper water and are frequently found in shales or in thin limestone bedding. These graptolites are generally restricted to the Ordovician and Silurian, although a few extend into the Devonian. An ice-age at the end of the Ordovician wiped out most species of graptolites.

Geniculograptus typicalis typicalis: (formerly called *Climacograptus typicalis*) is the most common graptolite found in the Upper Ordovician rocks of the tri-state region, and is one of the first recognized from the Cincinnati area. Hall (1865) listed the graptolite without description or figure. Although officially attributed to Hall, several people have taken credit for its description. It is present throughout the entire Kope Formation and extends into the lower Fairview. It is biserial, i.e., there are thecae which alternate on both sides of the virgula. It is sometimes described as a double sided saw blade. The rhabdosomes are up to 3.5 cm. in length and narrow (up to 2-2.5 mm).

Geniculograptus pygmeaus: As *G. typicalis* is waning, we pick up this graptolite, with much shorter rhabdosomes and an end which appears more rounded. We find this species near the end of the Kope, up through the Fairview.

Geniculograptus typicalis

Geniculograptus pygmeaus

A species is found in a narrow band of strata near the top of the Kope which looks like *G. typicalis*, but is much shorter. It is believed that this represents the intermediate between the two aforementioned species.

Another variety, *Geniculograptus magnificus*, is a exceptionally large form, measuring up to 7 cm. long and 4 mm. wide. This is found in the Fairview Formation.

Geniculograptus typicalis posterus, (formerly *Climacograptus innotatus occidentalis*) is a much smaller form found in the upper portion of the Fairview Formation.

Another genus widely distributed in the Cincinnatian is *Orthograptus*. This has gone by several names, including *Graptolithus quadrimucronatus*, *Glossograptus quadrimucronatus*, *Orthograptus truncates richmondensis*, and *Diplograptus recurrens richmondensis*. It has been reported from the lower Kope to the Arnheim. All of these names were included in *Orthograptus quadrimucronatus* by Mitchell and Bergstrom and Goldman and Mitchell.

The thecae appear more triangular than in *Geniculograptus* and have short thecal spines. Rhabdosomes can be up to 6 cm. in length and 3 mm. wide.

A variation, *Orthograptus quadrimucronatus richmondensis*, is found in the upper portion of the Richmondian.

Orthograptus quadrimucronatus

Arnheimograptus anacanthus

A somewhat recently descrided graptolite from the Arnheim Formation and the lower Waynesville is *Arnheimograptus anacanthus*. It is similar to *Orthograptus*, but smaller (only about 1 cm. long) and does not show the spines seen in *Orthograptus*.

Amplexograptus maxwelli, another graptolite similar to *Geniculograptus*, is reported from the Fulton Beds. But, due to the daming of the Ohio River years ago, these layers are now under water in most places and this species in unavailable to collectors, at least in the Cincinnati area.

The same is true for *Dicranograptus nicholsoni*, *Lasiograptus bimucronatus atimidus*,and *Dicellograptus* sp. Aff. *D. forchammeri* (formerly called *Leptograptus annectans*). All were reported only from the Fulton Beds.

Several "graptolites" from the region have dubius taxonomic positioning. The most common is *Mastigograptus*. This is very common in the Cincinnatian rocks, generally as fragments. Ruedemann said that he found thecae. Most people haven't seen any. Some work in Germany seems to verify that *Mastigograptus* is related to graptolites. Some, including myself, think that is may be related to sea fans or sea whips.

The species depends on the strata in which it is found. *M. gracillimum* is common and is found from the Kope through the Maysville. *M. tenuistriatus* is only found in the lower Kope. *M. multifaciatus* is found in the Fairview. *M. strictus* is abundant in the Arnheim and *M. perexilis* is found in the Waynesville.

Mastigograptus gracillimum

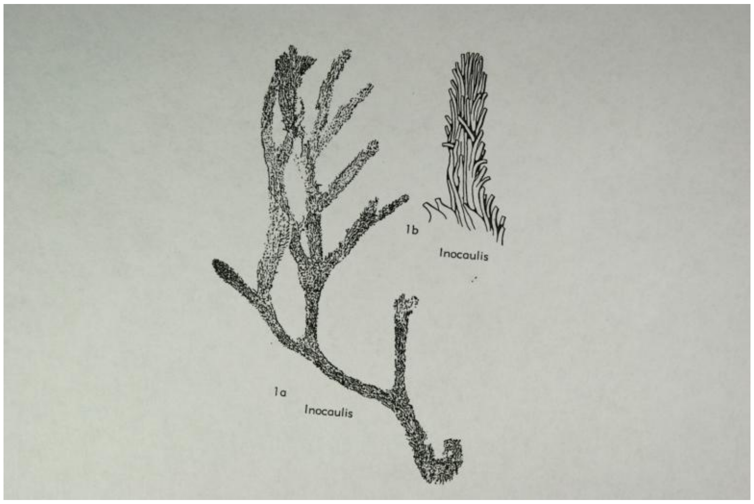
Mastigograptus strictus

Another uncertain "graptolite" is *Chaunograptus*. It is fairly rare. There are only 11 described species, 7 are Ordovician, and 6 are from the Cincinnati area. Those from the local rocks were described based on only one specimen. Most of the types have been lost due to flooding or simply misplacing them. Because of the limited number of specimens, studies of this genus have been difficult. Several examples of this genus have been found by the author.

Chaunograptus contortus

Chaunograptus delicates

Although very rare, example of *Inocaulus*, another questionable "graptolite" are found from time to time. This genus consists of a series of tubes, the thecae, bundled together to form a branched structure. Originally reported from the Kope formation. However, in recent years, multiple specimens have been located at the Arnheim-Waynesville boundary. This genus shows great similarity to some algal genera, and even the hydroid *Grammaria*.



Inocaulus simplex

References

Bergstrom, Stig M. and Charles E. Mitchell. 1986. The graptolite correlation of the North American Upper Ordovician Standard, *Lethaia*, 19:247-266.

Bergstrom, Stig M. and Charles E. Mitchell. 1990. Trans-Pacific Graptolite Faunal Relations: The Biostratigraphic Position of the Base of the Cincinnatian Series (Upper Ordovician) in the Standard Australian Graptolite Zone Succession, *J. Paleont.*, 64:992-997.

Mitchell, Charles E. 1987. Evolution and Phylogenetic Classification of the Diplograptacea, *Palaeontology*, 36:353-405.

Ruedemann, Rudolf. 1947. Graptolites of North America. *GSA Memoir 19*, 652 p.

The **M**id-**A**merica **P**aleontology **S**ociety (MAPS) was formed to promote popular interest in the subject of paleontology; to encourage the proper collecting, study, preparation, and display of fossil material; and to assist other individuals, groups, and institutions interested in the various aspects of paleontology. It is a non-profit society incorporated under the laws of the State of Iowa.

Membership in MAPS is open to anyone, anywhere who is sincerely interested in fossils and the aims of the Society.

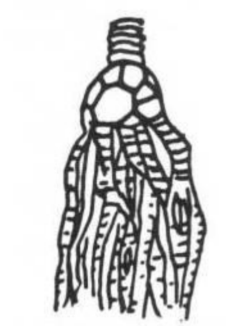
Membership fee: $20.00 per household covers one year's issues of DIGESTS. All Canadian and Overseas members receive the DIGEST by air letter post. For new members and those who renew more than 3 issues past their due date, the year begins with the first available issue. Institution or Library fee is $25.00.

MAPS meetings are held on the 2nd Saturday of October, November, January, and February and at EXPO in March or April. A picnic is held during the summer. October through February meetings are scheduled for 1 p.m. in Trowbridge Hall, University of Iowa, Iowa City, Iowa. One annual International Fossil Exposition is held in late March/early April.

The MAPS official publication, MAPS DIGEST, is published 5 times per year – Jan-Mar, EXPO EDITION, May-August, Sept-Nov, Dec. (EXPO Materials). View MAPS web page at: http://www.midamericapaleo.org

MID-AMERICA PALEONTOLOGY SOCIETY

Mr. John Catalani
MAPS DIGEST Editor
3405 High Trail
Woodridge, IL 60517



CYATHOCRINITES