



# PALEONTOLOGY

<http://www.biltek.tubitak.gov.tr/bilgipaket/jeolojik/index.htm>



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Department of Geology

**Lecture 13**



**ANKARA UNIVERSITY**

# Topics

1. Hemicordata
  - General characteristics
  - Classification
  - 1.1 Graptolithina
    - General characteristics
    - Terminology
    - Selected genera
2. Vertebrata
  - General characteristics
  - Important genera for Türkiye
3. Using of paleontological data for geology with examples from Türkiye



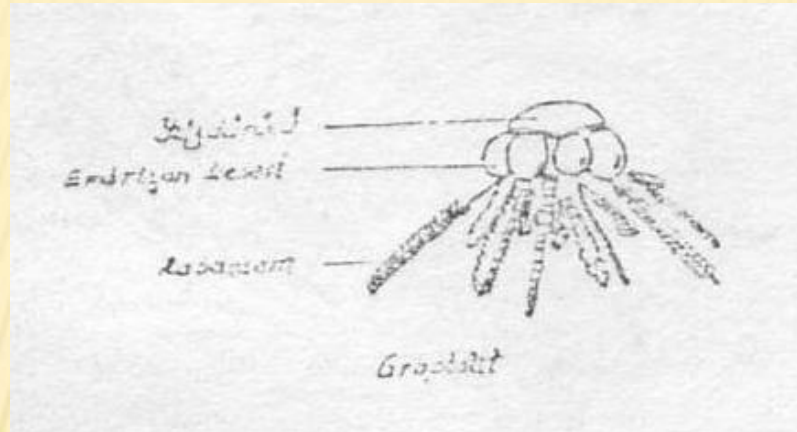
# Hemicordata

*Rectograptus* sp. please  
see the website for scale

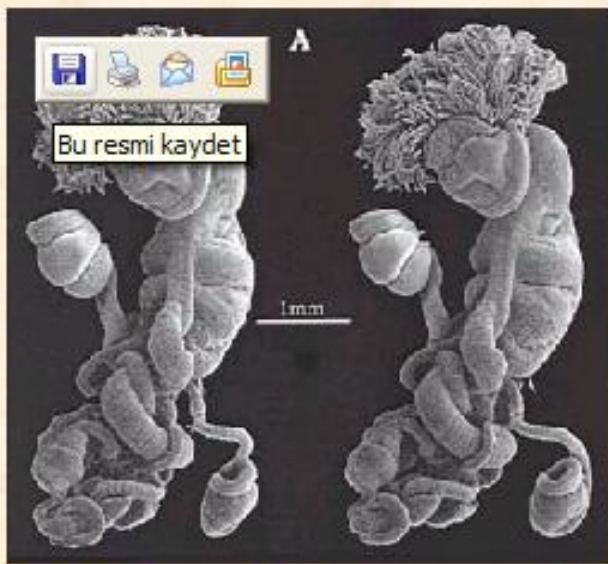
[http://www.mcz.harvard.edu/Departments/InvertPaleo/Trenton/Intro/  
PaleoPage/TrentonFauna/MiscGroups/Graptolithina/Graptolite%20Images/MCZ145787.jpg](http://www.mcz.harvard.edu/Departments/InvertPaleo/Trenton/Intro/PaleoPage/TrentonFauna/MiscGroups/Graptolithina/Graptolite%20Images/MCZ145787.jpg)

# Phylum Hemicordata

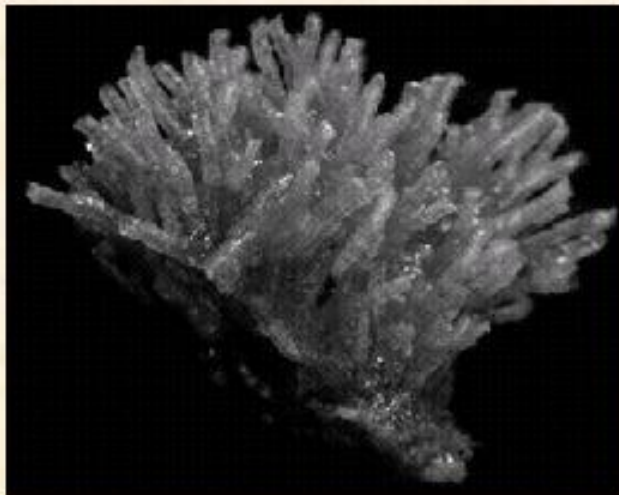
## General characteristics



- **Hemichordata** is a phylum of marine **wormlike animals**, generally considered the sister group of the echinoderms.
- Cambrian to Recent,
- The extinct class is Graptolithina known from Paleozoic
- They generally live in burrows and are deposit feeders, but some species are pharyngeal filter feeders.



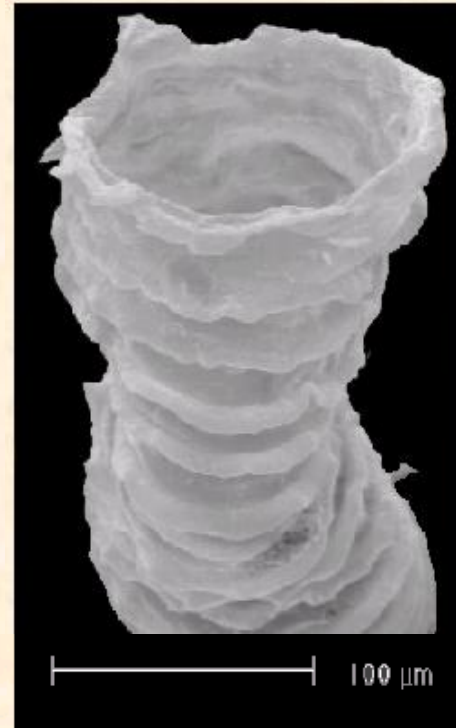
*Cephalodiscus densus* Andersson. Recent.  
SEM stereopair micrograph of a zoid.  
From Mierzejewski, Kulicki & Schiaparelli.



Colony of the Recent pterobranch  
*Cephalodiscus densus*.  
From Schiaparelli, Cataneo-Vietti & Mierzejewski.



Colony of the Ordovician pterobranch  
*Melanostrophus fokini*.  
From Zessin & v. Puttkamer.



Zoidal tube of the Jurassic pterobranch  
*Rhabdopleura kozlowskii*  
From Mierzejewski & Kulicki

# Phylum Hemicordata

## Classification

phylum Hemichordata

class Enteropneusta

class Pterobranchia

order Rhabdopleurida

order Cephalodiscida

class Planctosphaeroidea

class Graptolithina

order Dendroidea

order Tuboidea

order Camaroidea

order Crustoidea

order Stolonoidea

order Graptoloidea

\*order Dithecoidea

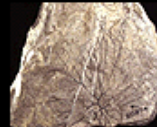
# Classification

## Phylum Hemicordata

### Dendroidea



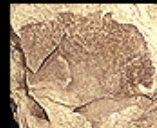
*Anisograptus* sp., YPM 20260



*Clonograptus persistens* Harris & Thomas, YPM 20274



*Dictyonema retiforme* Hall, YPM 34922



undet. Dendroidea, YPM 160992

### Graptoloidea



*Climacograptus riddellensis* Harris, YPM 4003



*Didymograptus denticulatus* Berry, YPM 20252



*Diplograptus foliaceus* Murchison, YPM 160994



*Monograptus* sp., YPM 30241

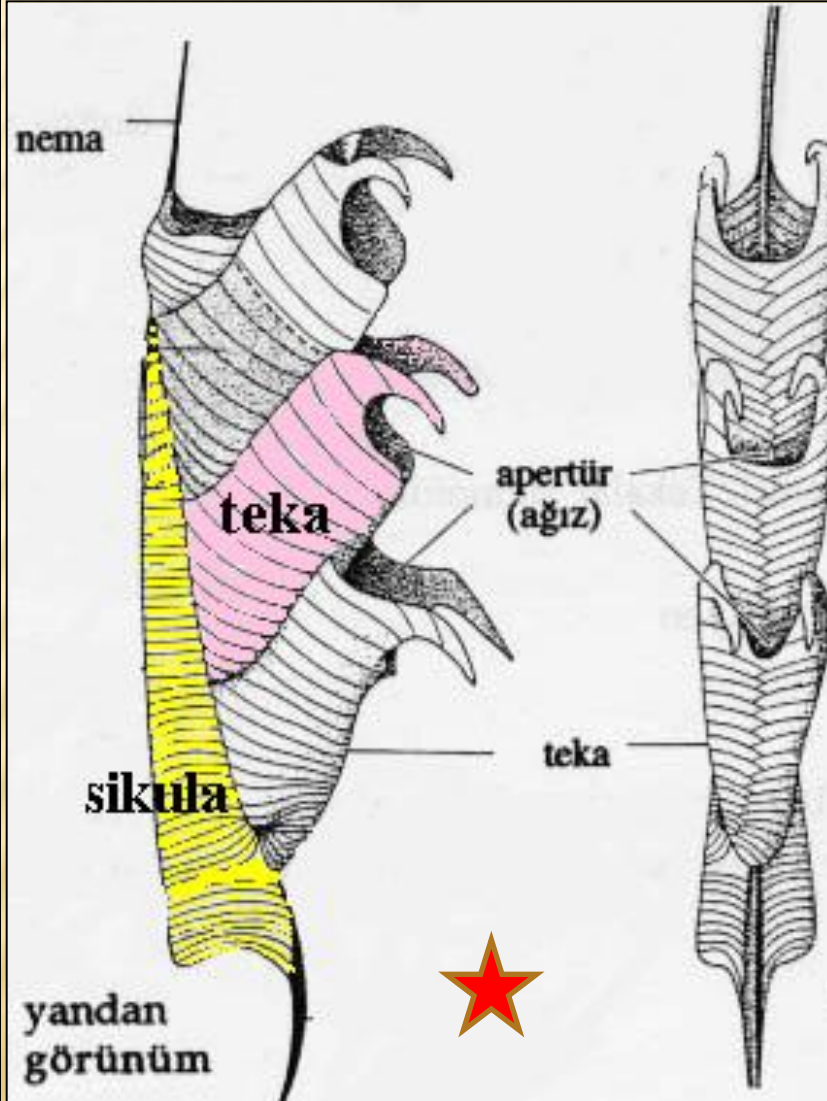


*Tetragraptus approximatus* Nicholson, YPM 20276

# Phylum Hemicordata

## Class Graptolithina

### General characteristics



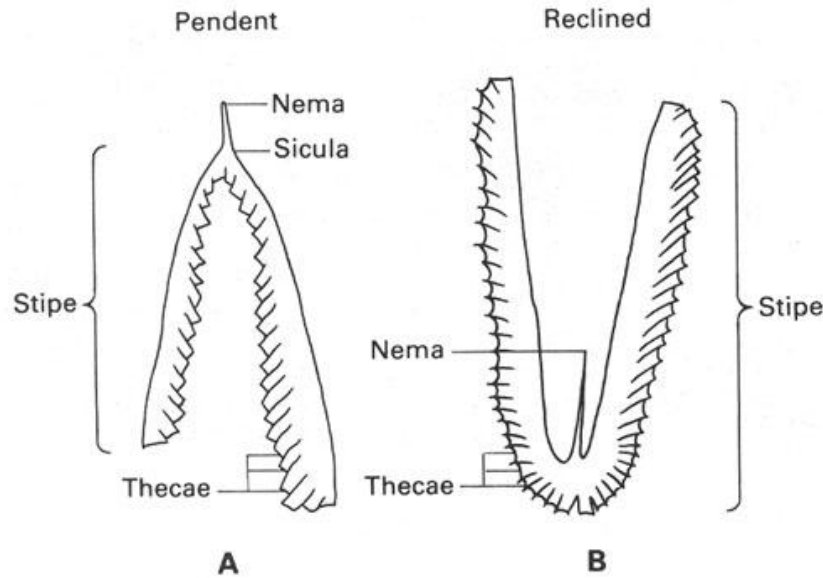
- Graptolithina is a class in the animal phylum Hemichordata,
- Graptolites are known chiefly from the Upper Cambrian through the Lower Carboniferous (Mississippian). A possible early graptolite, *Chaunograptus*, is known from the Middle Cambrian.
- The name graptolite comes from the Greek *graptos*, meaning "written", and *lithos*, meaning "rock"
- Linnaeus originally regarded them as 'pictures resembling fossils rather than true fossils'
- The name "graptolite" originates from the genus *Graptolithus*, which was used by Linnaeus in 1735 for inorganic mineralizations and crustations which resembled actual fossils
- Graptolites are filter-feeders, mostly colonial, living in a collagenous tubular structure called a coenecium



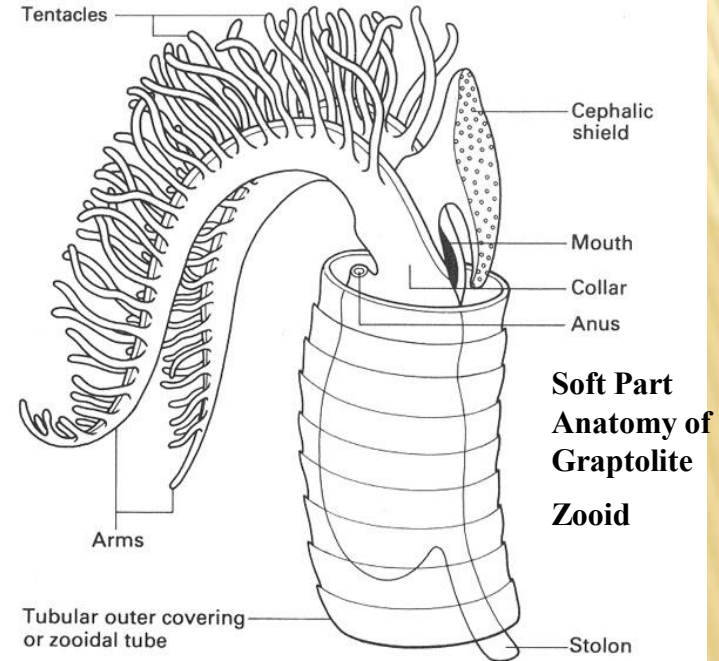
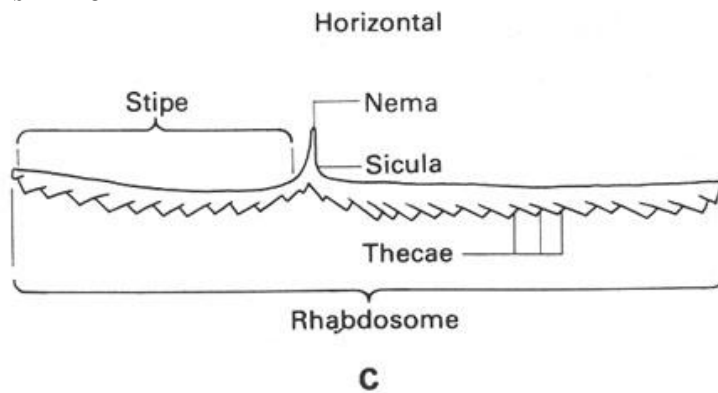
# Phylum Hemicordata

## Class Graptolithina

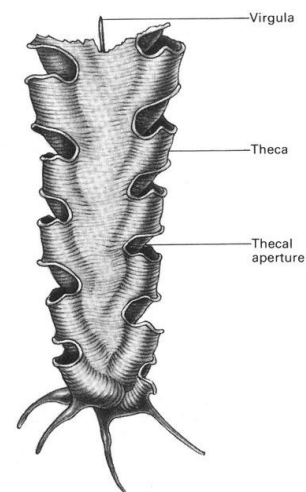
### General characteristics



### Variations in Form



Soft Part  
Anatomy of  
Graptolite  
Zooid



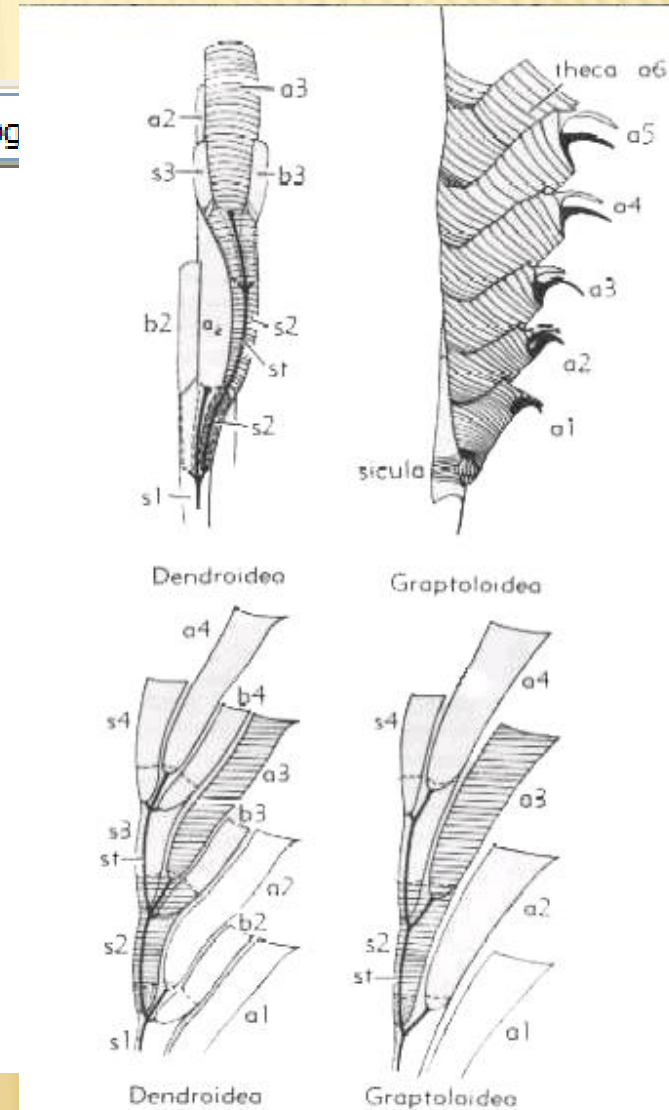
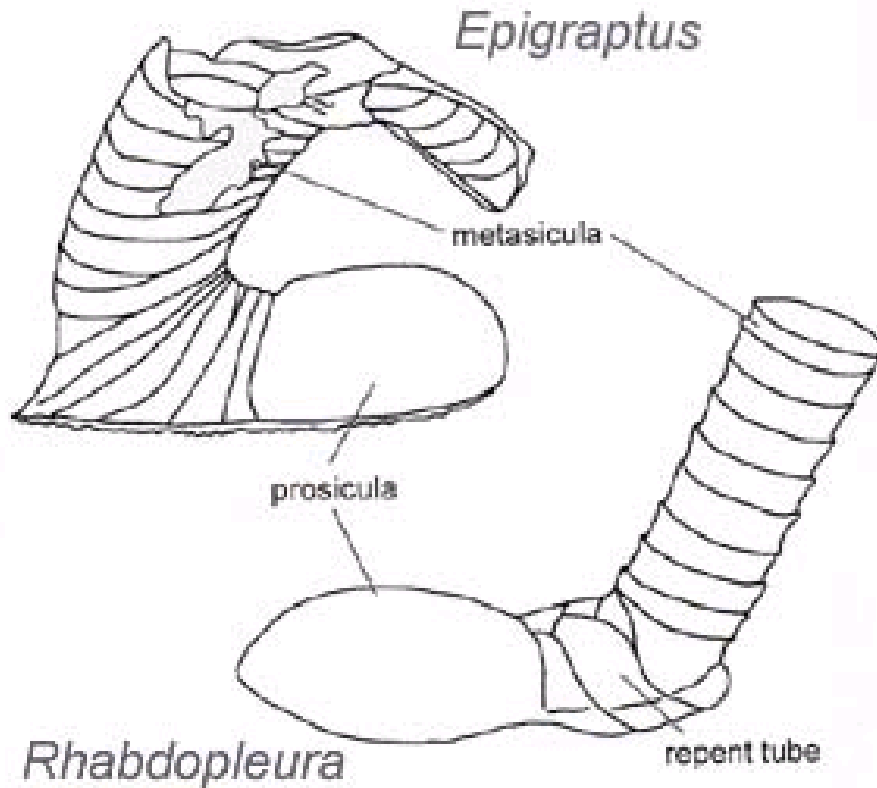
Hard Part  
Morphology of  
Graptolites

# Phylum Hemicordata

## Class Graptolithina

### General characteristics

Adres  [http://www.graptolite.net/sicula\\_Rhabdopleura\\_Epigraptus.jpg](http://www.graptolite.net/sicula_Rhabdopleura_Epigraptus.jpg)



# Class Graptolithina

## Definitions of terms from Bulman, 1970

**Nema** Threadlike extension of apex of prosicula,

**Prosicula** Proximal, initially formed part of sicula,

**Rhabdosome** Sclerotized exoskeleton of entire graptolithine colony.

**Sicula** Skeleton of initial zooid of colony, comprising conical prosicula and tubular distal metasicula.

**Theca (pl., thecae)** Sclerotized tube or cup (other than sicula) enclosing any zooid of rhabdosome.

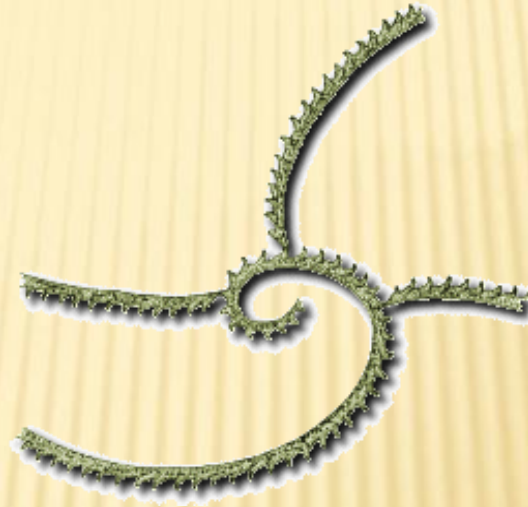
**Uniserial** - Rhabdosome or stipe of graptoloid consisting of single row of thecae only.

**Virgella** Spine developed during growth of metasicula (distal portion of sicula), embedded in sicular wall and projecting freely from its apertural margin.

**Zooid** Soft-bodied individual inhabiting theca.

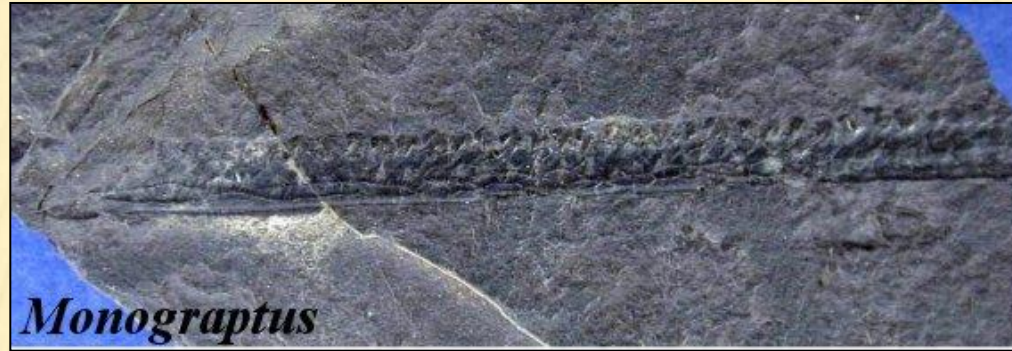
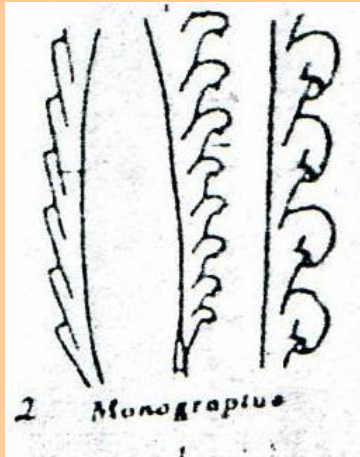
Modified from <http://www.mcz.harvard.edu/Departments/InvertPaleo/Trenton/Intro/PaleoPage/Terminology&Morphology/Terminology&Morphology.htm>

# Some views

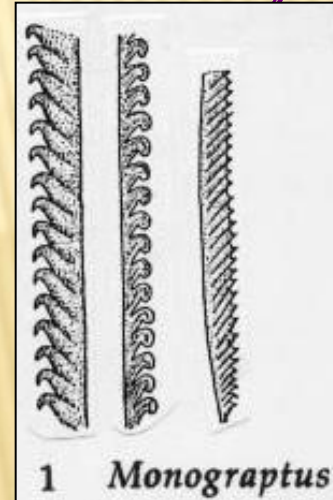


*Füsun Alkaya*

# Monograptus sp. Silurian

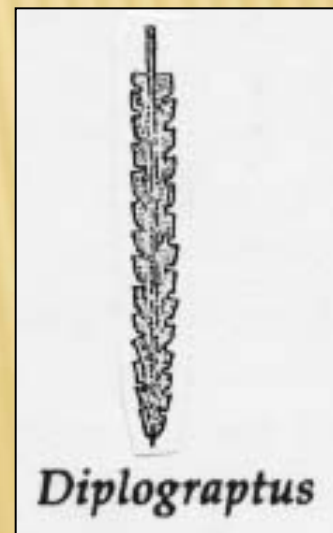


Fusun Alkaya



Class  
Graptolithina

# Diploraptus sp. Ordovic. Early Silurian



# Class Graptolithina



*Monograptus* sp.

YPM 30241

No Locality Data Available.

<http://www.yale.edu/ypmip/taxon/grap/30241.html>

K. Carlson, photo

*Diplograptus foliaceus* Murchison

YPM 160994

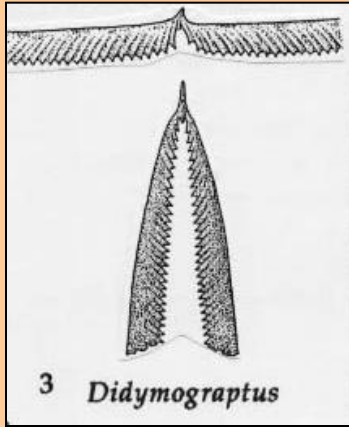
Ordovician, Athens Shale. Near Salem, Catawba Valley, Virginia, USA.

<http://www.yale.edu/ypmip/taxon/grap/>



K. Carlson, photo

# *Didymograptus* sp. Ordovician



Class  
Graptolithina



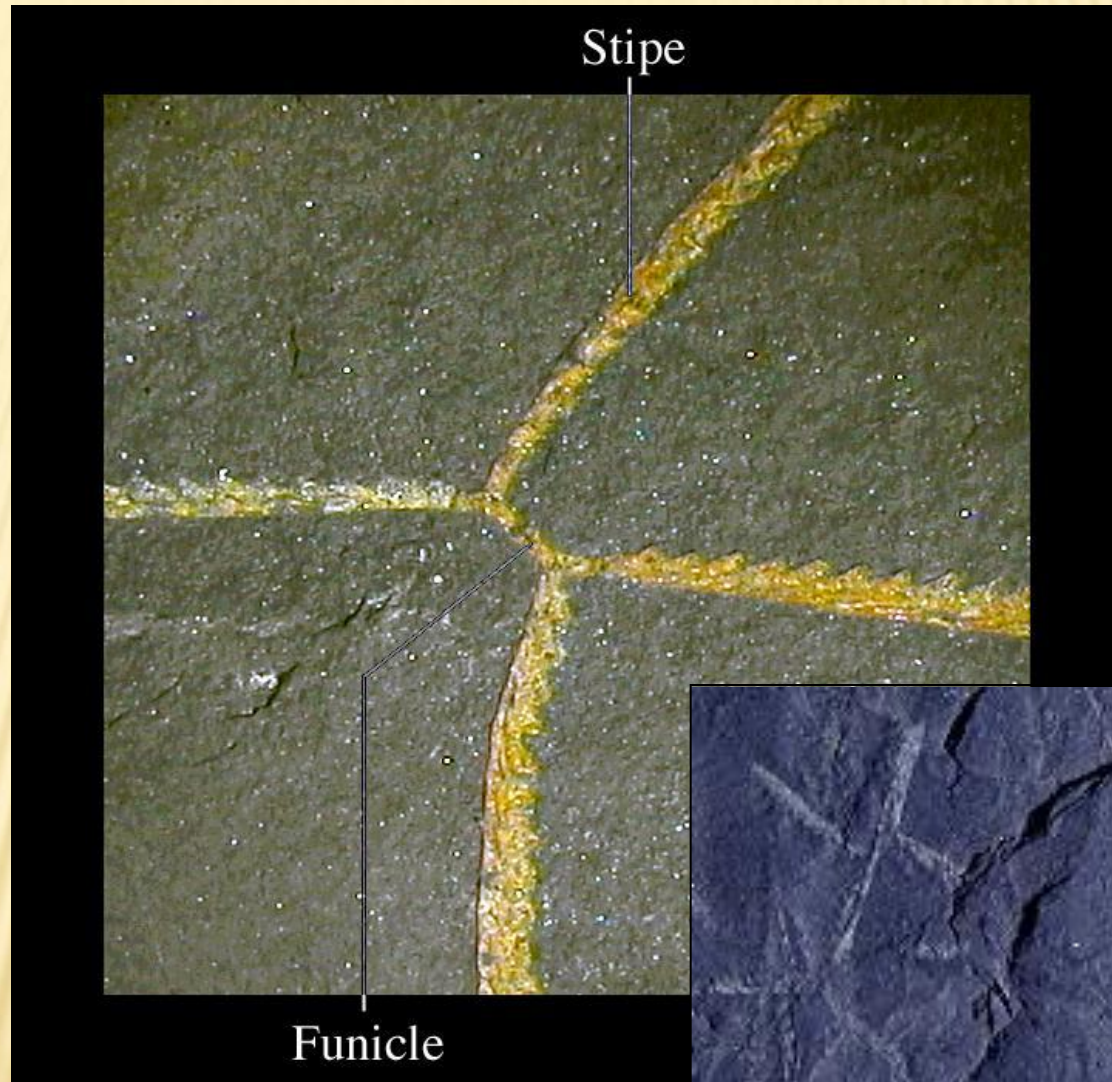
# *Tetragraptus* sp. Early Ordovician



Class  
Graptolithina



6 *Tetragraptus*

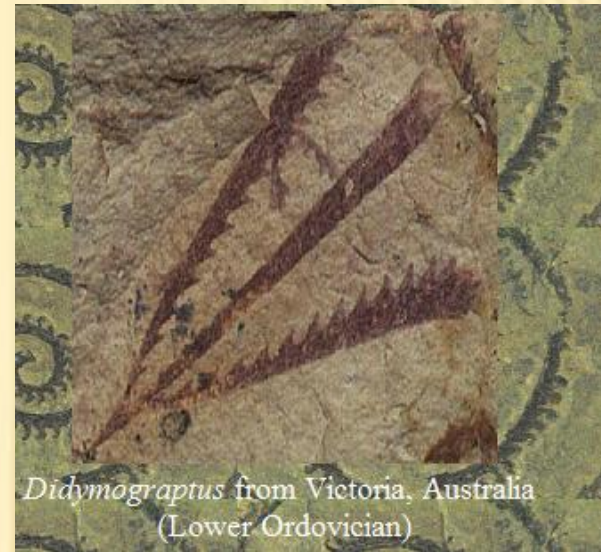




# Class Graptolithina



J.R. Barbour, photo



<http://www.earth.rochester.edu/ees207/Graptolites/caplangrap5.htm>

## *Didymograptus denticulatus* Berry

YPM 20252

Early Ordovician, Marathon Ls. *Didymograptus bifidus* zone, upper Marathon, 14.5 ft below Marathon top, section XVIII, bed of Alsate Creek, 3 mi W of Picnic Picnic Grounds & 0.1 S54W of Marathon, Brewster Co., Texas, USA. Collector: Berry, W.B.

<http://www.yale.edu/ympip/taxon/grap/20252.html>

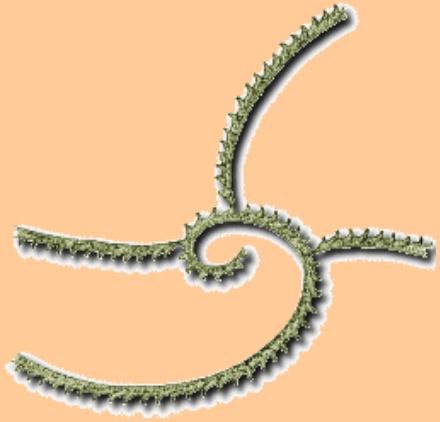
## *Tetragraptus approximatus* Nicholson

YPM 20276

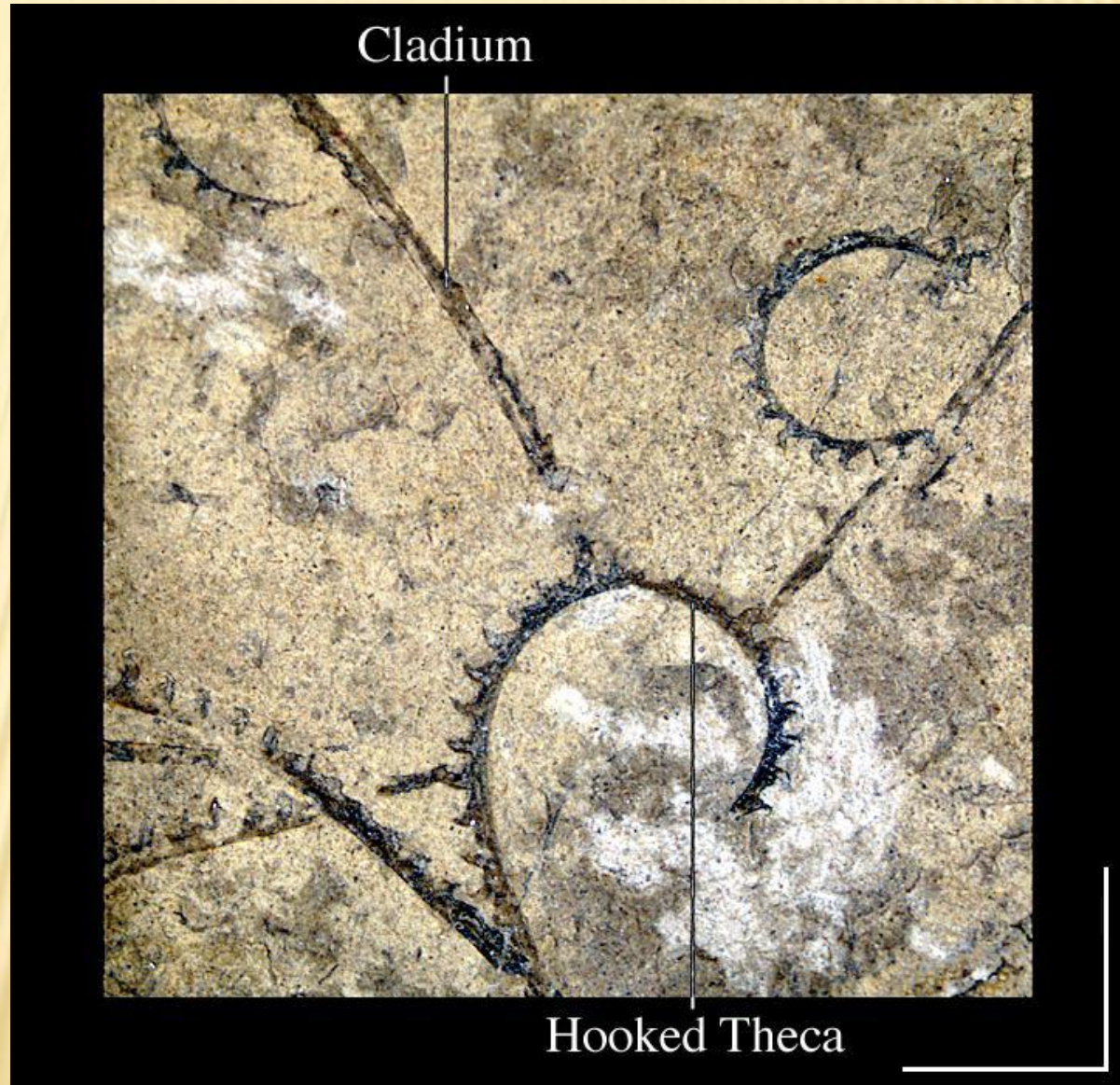
Early Ordovician, Marathon Ls, Monument Spring Dolomite Mbr. *Tetragraptus aproximatus* zone, 37-39 ft above isoclinal fold zone in section I beginning on NW limb of a large isoclinal fold, section bearing S65E, 4 mi SW of Marathon, Brewster Co., Texas, USA. Collector: Berry, W.B.



# *Crytograptus* sp. Silurian

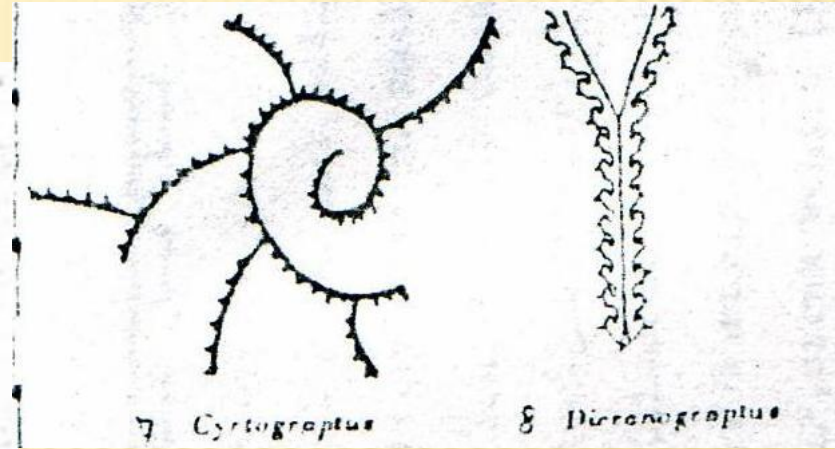
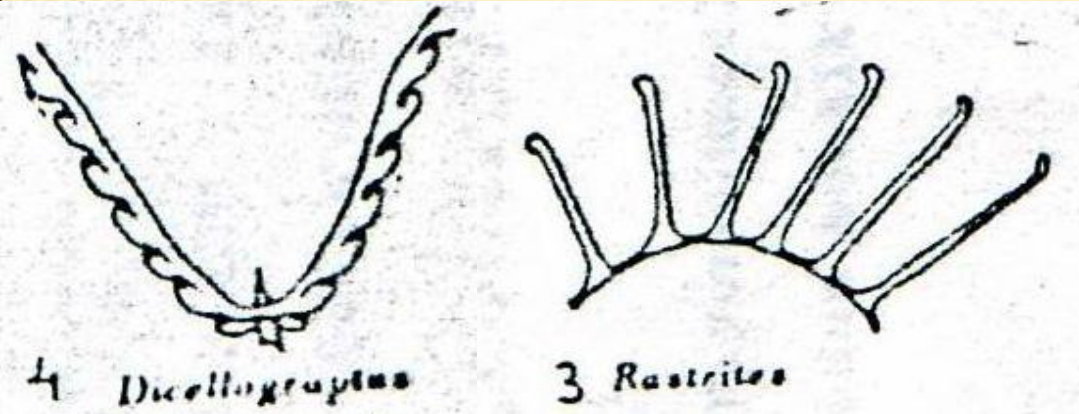


Class  
Graptolithina



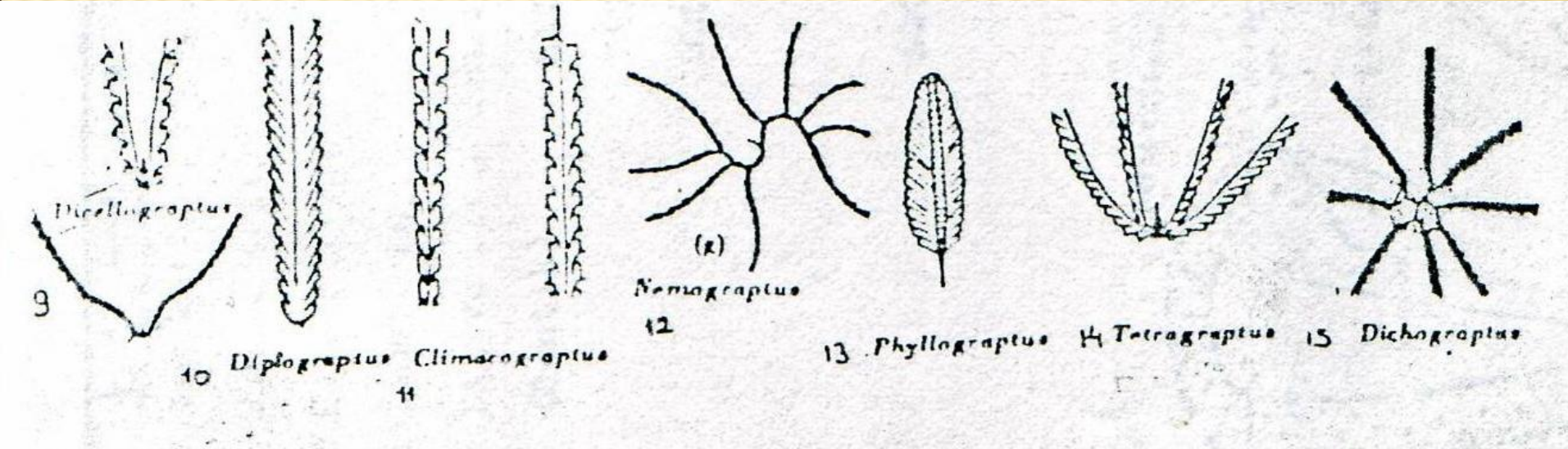


# Class Graptolithina

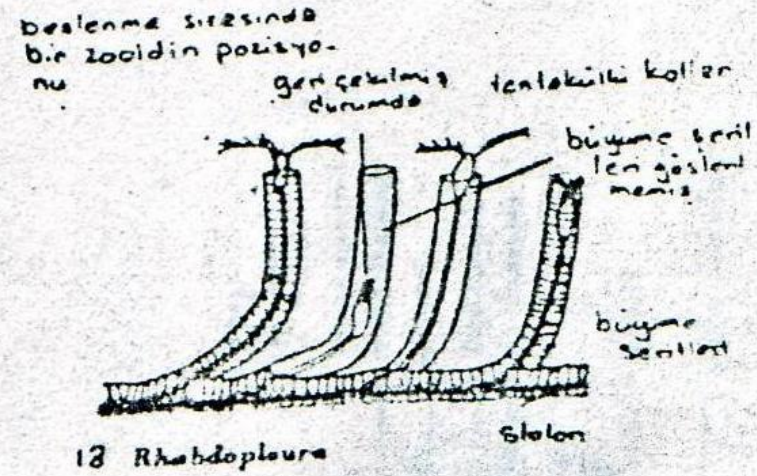
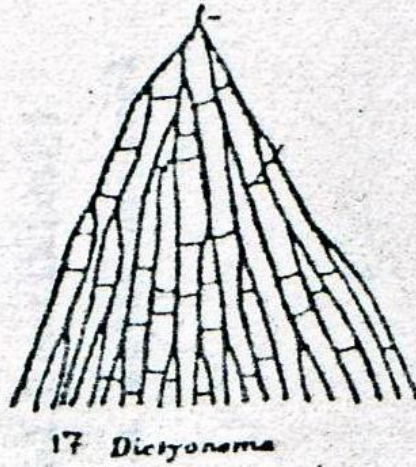
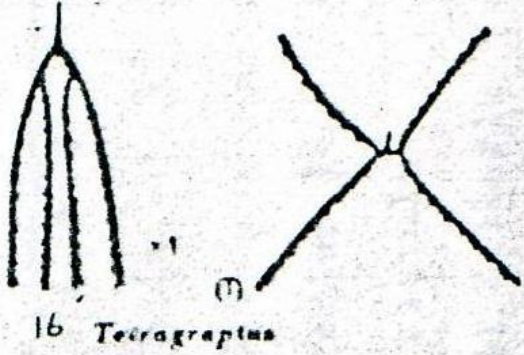


Ord.      A.Silüryen

M. Sil.      M. Ord.



# Class Graptolithina



K. Carlson, photo

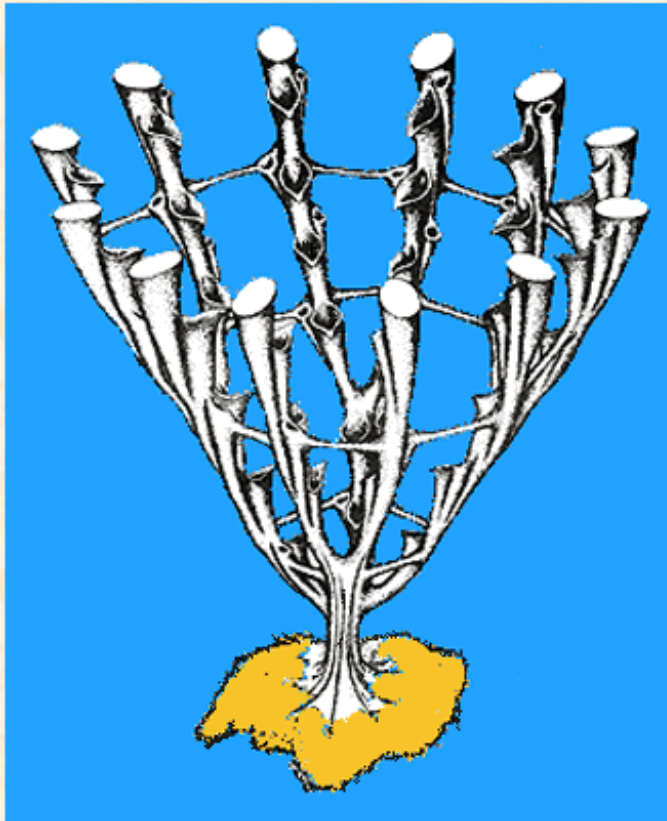
*Dictyonema* sp. (Late Cambrian- Early Carb. )

*Dictyonema retiforme* Hall

YPM 34922

<http://www.yale.edu/ypmip/taxon/grap/34922.html>

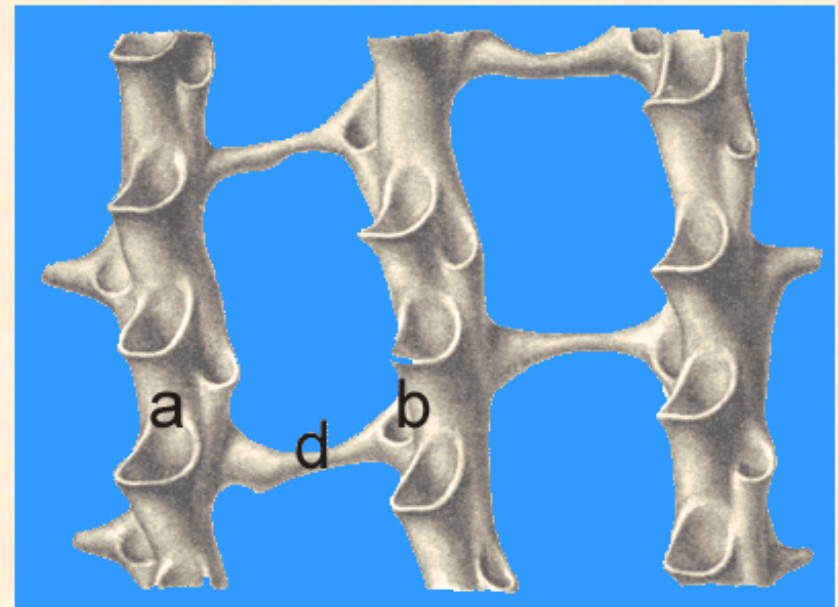
No Locality Data Available.

Diagrammatic illustrations of *Dictyonema* (Dendroidea)compiled by [Piotr Mierzejewski](#)General view of colony of *Dictyonema*

Based on Baldwin, Rickards &amp; Palmer (1977). Modified.

Visit also:

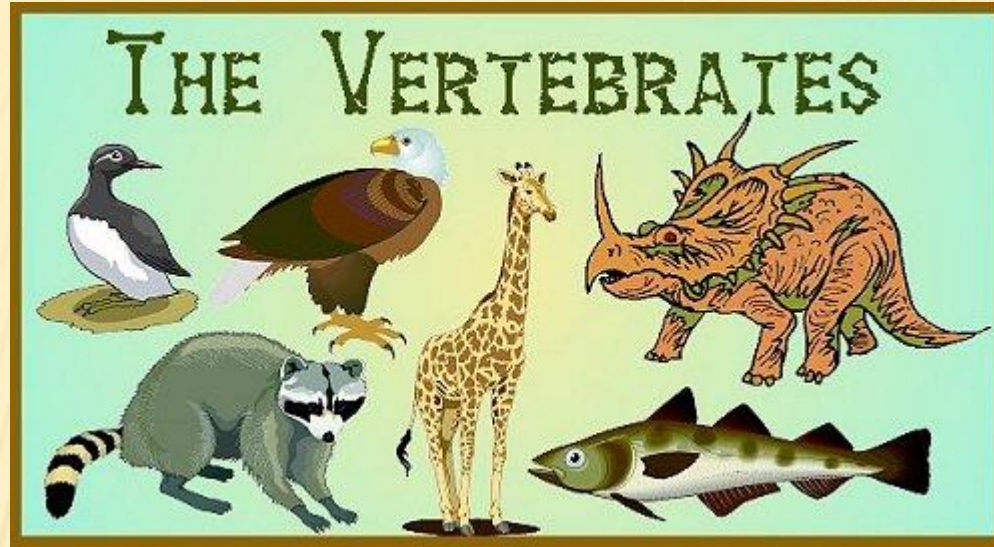
[Dendroids from the Xinghangian stage \(Early Ordovician\) of the Xiushui Drainage Basin, Jiangxi province](#)  
[On the anisograptid affiliation of \*Dictyonema\*...](#)  
[Cortical bandage-like structures in \*Dictyonema\*](#)

*Dictyonema flabelliforme*

Arrangement of autothecae (a), bithecae (b) and dissepiments (d).

After Bulman (1932). Modified.

Species of *Dictyonema* in Graptolite Net[Dictyonema altayense](#) Sennikov, 1976[Dictyonema apertum](#) Sherrard, 1956[Dictyonema crassibasale](#) Gurley[Dictyonema flabelliforme polonicum](#) Tomczyk, 1962[Dictyonema goepperti](#) Prantl, 1951[Dictyonema kozlowskii](#) Boucek, 1957[Dictyonema pragense](#) Kraft, 1984[Dictyonema rectithecale](#) Kozlowski, 1949



The word *vertebrate* derives from the Latin word *vertebratus* (**Pliny**), meaning *joint of the spine*. It is closely related to the word *vertebra*, which refers to any of the bones or segments of the spinal column

<http://en.wikipedia.org/wiki/Vertebrate>

- \* Fish
- \* Amphibians
- \* Reptiles
- \* Birds
- \* Mammals



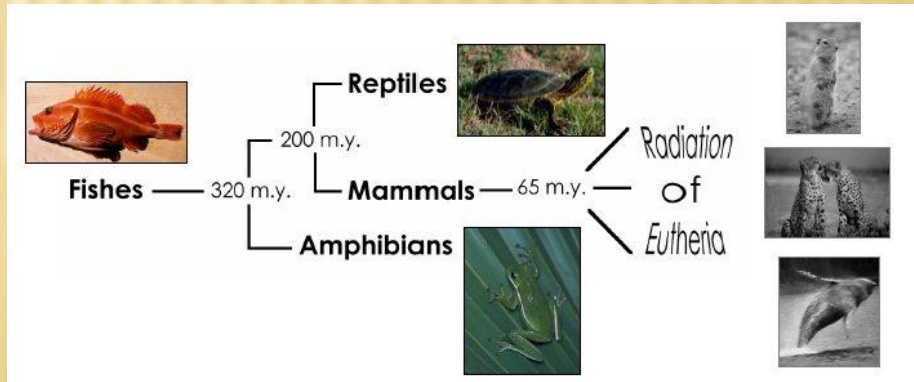
[http://en.wikipedia.org/wiki/File:Naturkundemuseum\\_Berlin\\_-\\_Dinosaurierhalle.jpg](http://en.wikipedia.org/wiki/File:Naturkundemuseum_Berlin_-_Dinosaurierhalle.jpg)



Because bone is resistant to decay, the fossil record of vertebrates is extensive and has been studied for over 200 years. A very brief summary:

- The first known vertebrate fossils, found at the Chengjiang locality in China, early Cambrian
- Today there are approximately 50,000 species of vertebrates which account for about 3 % of all known species on our planet (<http://animals.about.com/cs/zoology/g/vertebrata.htm>)
- Vertebrates appear to have radiated in the late Ordovician, about 450 million years ago. However, most Ordovician fossil vertebrates are rare and fragmentary,
- The Silurian is sometimes called the "Age of Fishes."
- By the late Devonian, 360 million years ago, bony fish were diversifying.
- The late Devonian also marked the first tetrapods
- By about 330 million years ago, in the Mississippian, several groups of land-dwelling amphibians had appeared.
- Crocodiles appeared in Triassic
- Dinosaurs were widespread during Mesozoic
- Miocene-Pliocene are most important ages for Turkiye.

Modified from <http://www.ucmp.berkeley.edu/vertebrates/vertfr.html>



*Hipparion* sp. (Horse teeth)

*Gazella* sp.

*Ovis* sp. (sheep horn)

*Ichtiterium* sp. (pig)

*Mastadon* sp.

*Tragoceras* sp.



**They are important for Late Miocene to Pliocene in Türkiye**