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

Paleontology

Muhittin Görmüş

Department of Geology

Lecture 8

ANKARA UNIVERSITY

http://members.cox.net/jdmount/paleont.html

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Topics

1. **Bryzoa**
   - General characteristics
   - Body organisations & related terms
   - Classification
   - Stratigraphical ranges
   - Examples (Recent)
   - Ancient examples
2. **Brachiopoda**
   - General characteristics
   - Body organisations & related terms
   - Classification
   - Stratigraphical ranges
     - Orthida
     - Strophomenida
     - Rhynchonellida
     - Spiriferida
     - Terebratulida


Bryzoa

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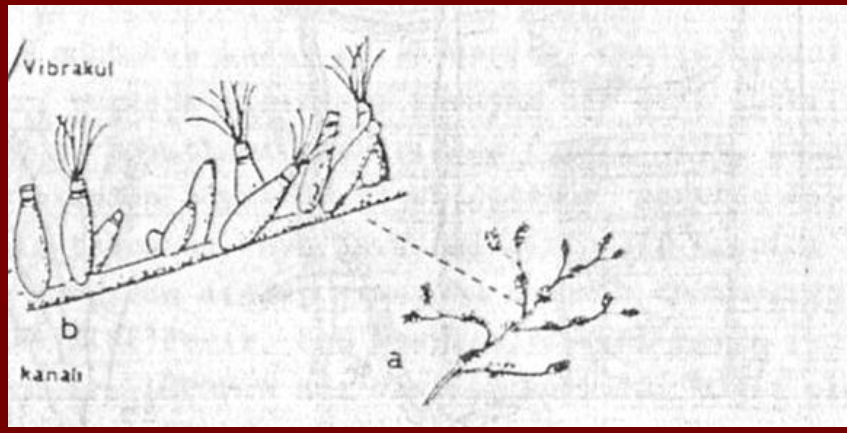
Bryzoa

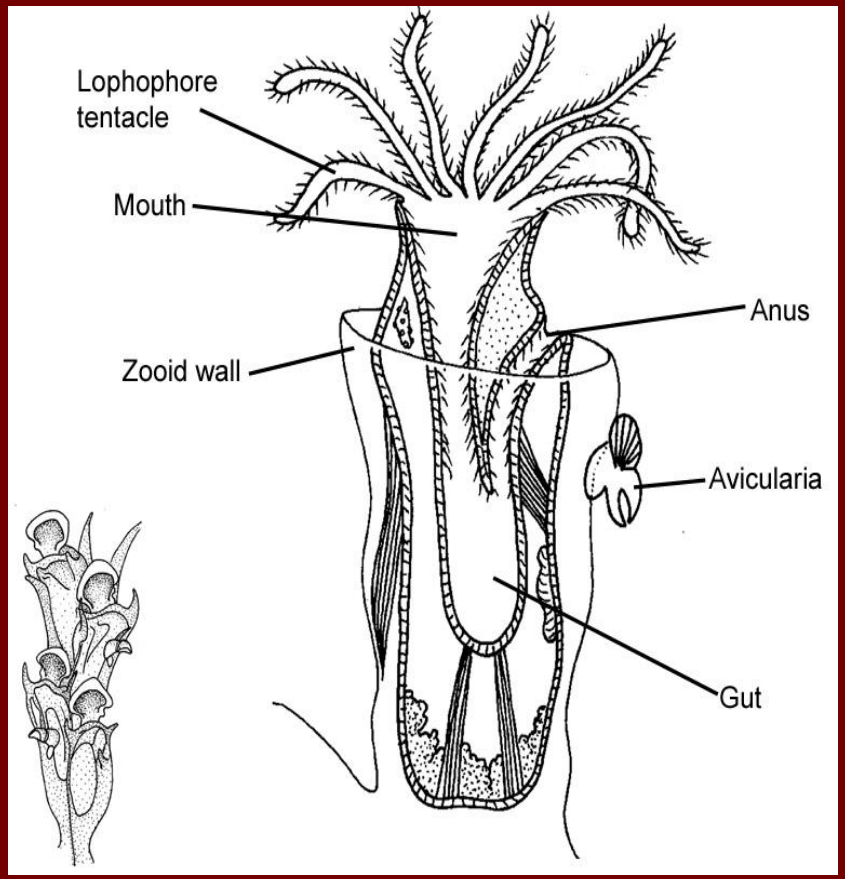
(Moss or lace animals)

General characteristics

(Greek.bryon = moss + zoon = animal)
Many bryozoans are gathered in small tuffed colonies attached to objects in shallow seawater. All species are colonial with the individuals being extremly small Bryzoa is a pulural word.

Some appear similar to hydroids or corals but their internal structure is more complex. Their form suggested the name moss animals.





http://www.marlin.ac.uk/taxonomydescriptions.php

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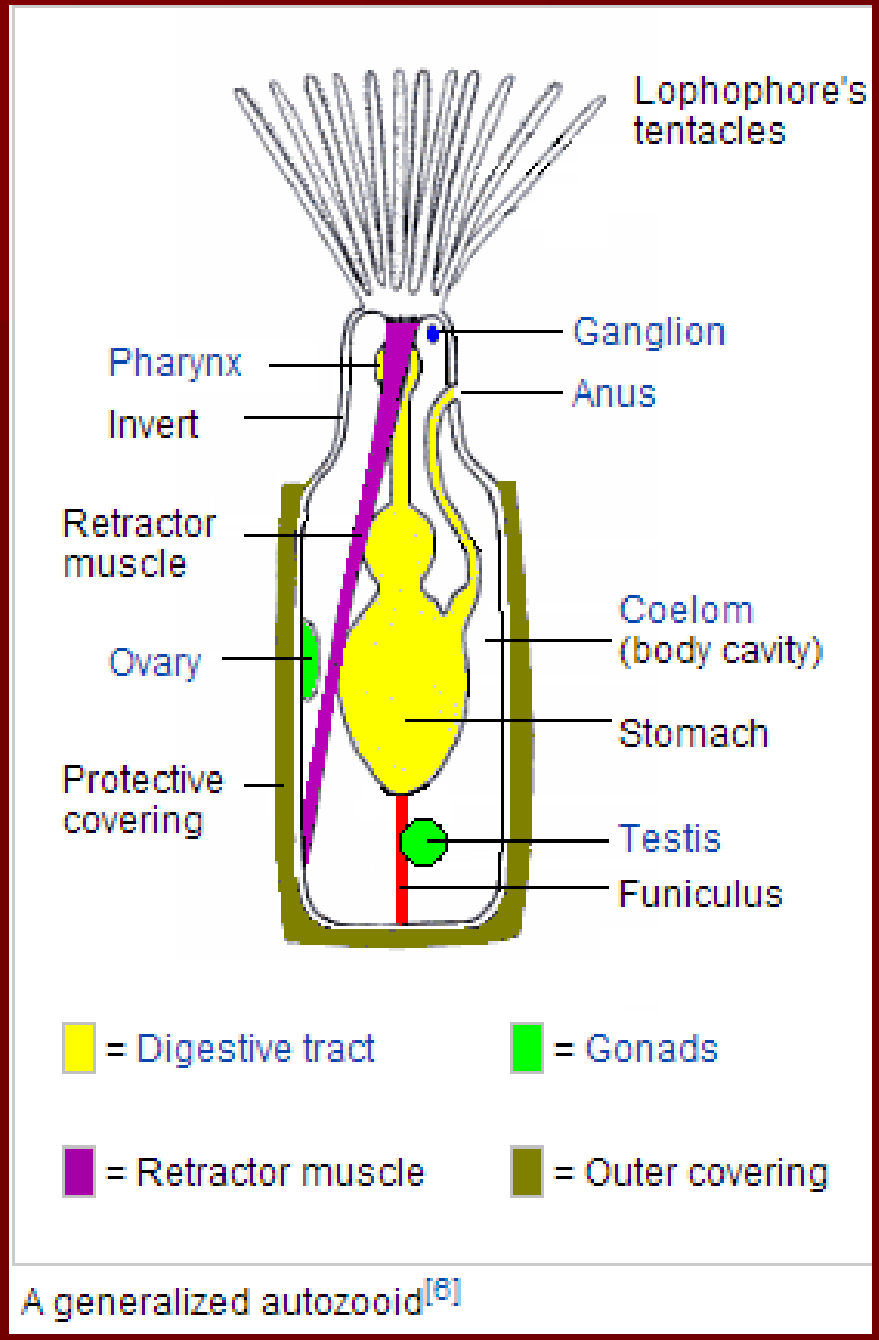
Bryzoa

(Moss or lace animals)

General characteristics



A generalized autozooid[6]

http://en.wikipedia.org/wiki/Bryozoa

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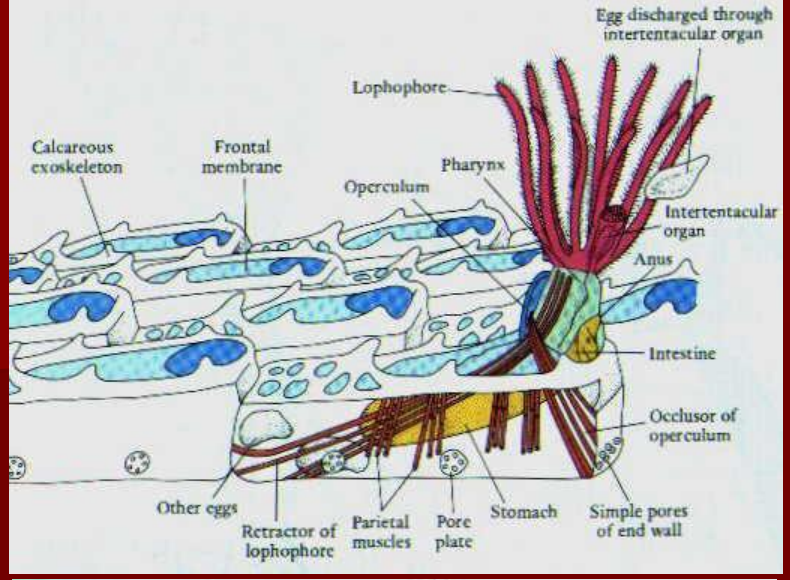
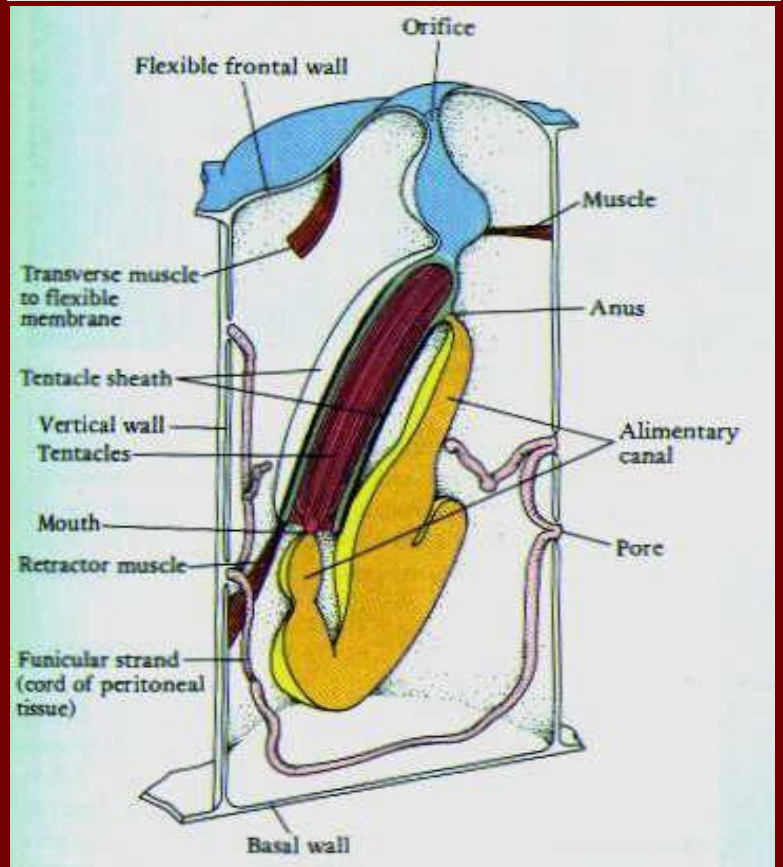
A lateral view, of a portion of a colony, of encrusting bryozoans.

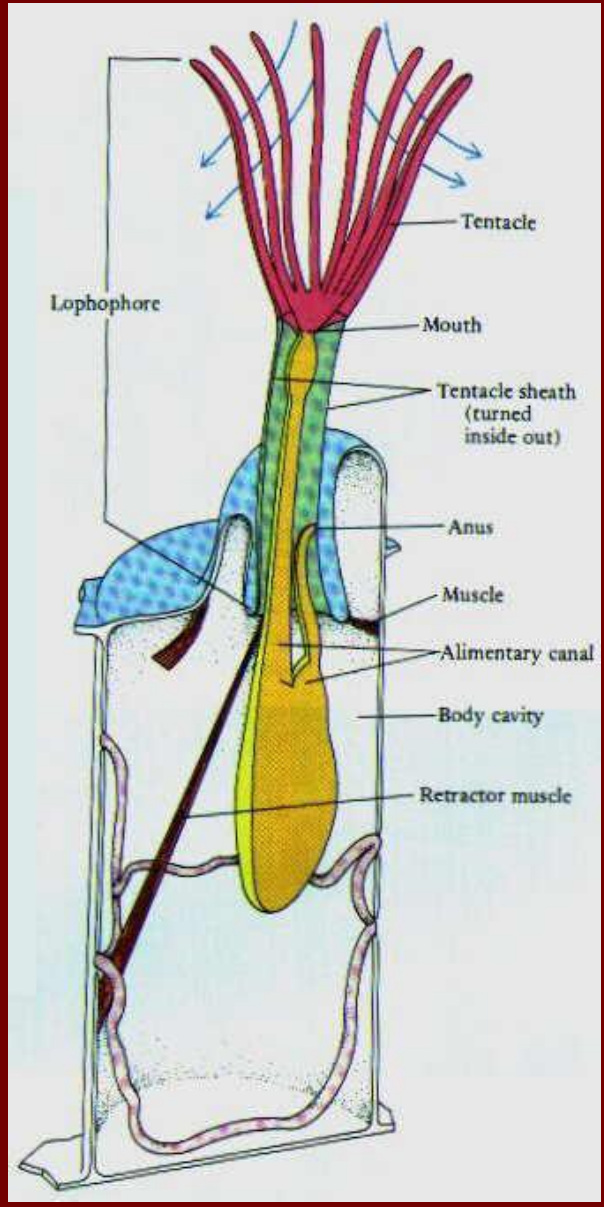
Bryzoa

(Moss or lace animals)

An individual of a colonial bryozoan with a retracted lophophore.







An individual of a colonial bryozoan with a protruded lophophore (the arrows indicate the flow of water).

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Bryzoa

(Moss or lace animals)

General characteristics

Characteristics:

1. Symmetry is bilateral. There occurs no segmentation. Triploblastic.
2. Colonial. The individuals are minutely small, each in its own housing (zooecium). Polymorphism in some.
3. Digestive canal complete(U-shaped). The mouth is surrounded by a retractile lophophore with ciliated tentacles. The anus opening outside the lophophores.
4. Coelom well developed into two parts. No circultory or respiratory organs present.
5. No nehpridia.
6. A nerve ganglia between mouth and anus.
7. The sexes are usually united and gonads are formed from peritoneum. The eggs are feritilized in the coelom or externally. The eggs are usually brooded in a modified zooecium (ooecium) among the tentacles, in the coelom or in a partition of reproductive individual. The larva is a trochopore. Colonies are formed by asexual budding.
8. Cambrian to Recent
9. Mainly marine, rarely freshwater

Modified from http://library.thinkquest.org/26153/marine/bryozoa.htm

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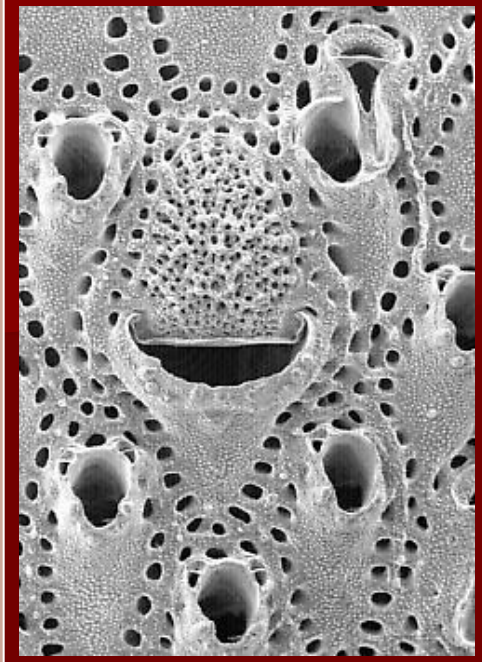
Zooid: Individuals of bryzoan colony: tube-shaped, or bowl-shaped, Carbonate or organic in composition

Bryzoa

(Moss or lace animals)

Terms



ZOOID

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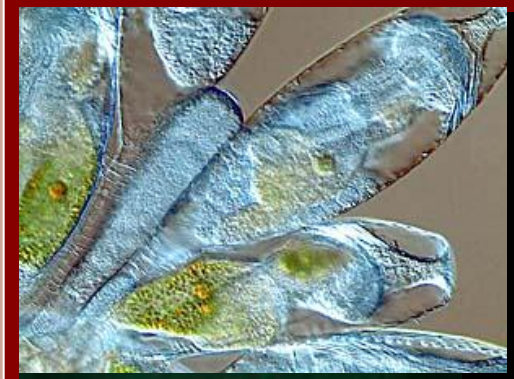
Zooid: It is similar to polyp of corals, but differs in having digestive channel, aperture and annal parts.

Bryzoa

(Moss or lace animals)

Terms



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Bryzoa

(Moss or lace animals)

Terms

ZOARIUM

A colony of bryozoans
collection of distinct, individual zooids that make up acompound or colonial organism.

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Bryzoa

(Moss or lace animals)

FIGURES OF COLONIES

Pictures from A[illegible]a (Suffolk Univ.), lecture notes.

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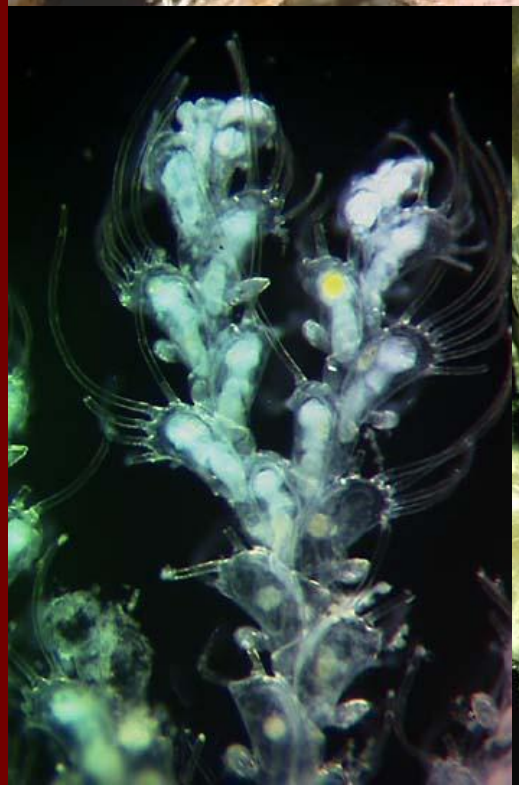
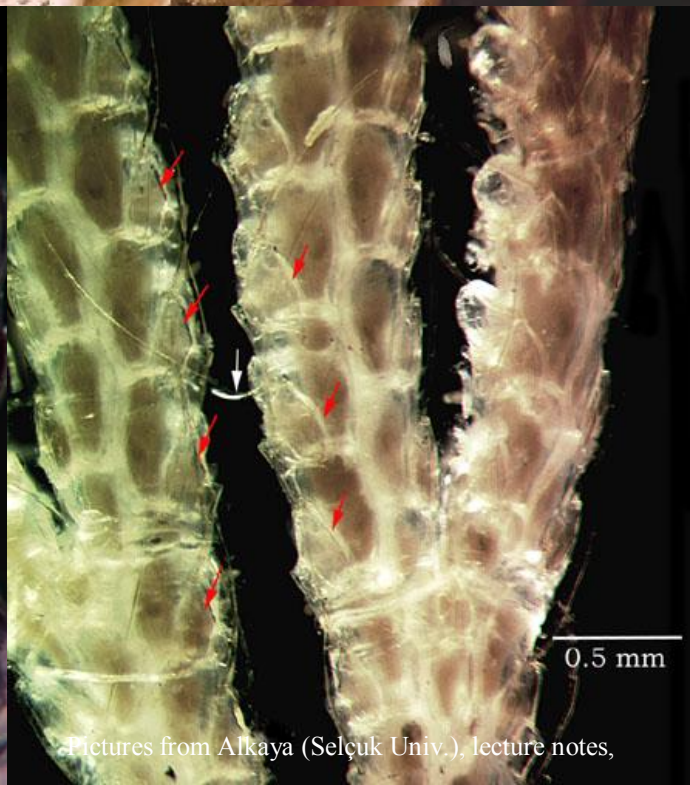
Bryzoa

(Moss or lace animals)

FIGURES OF COLONIES





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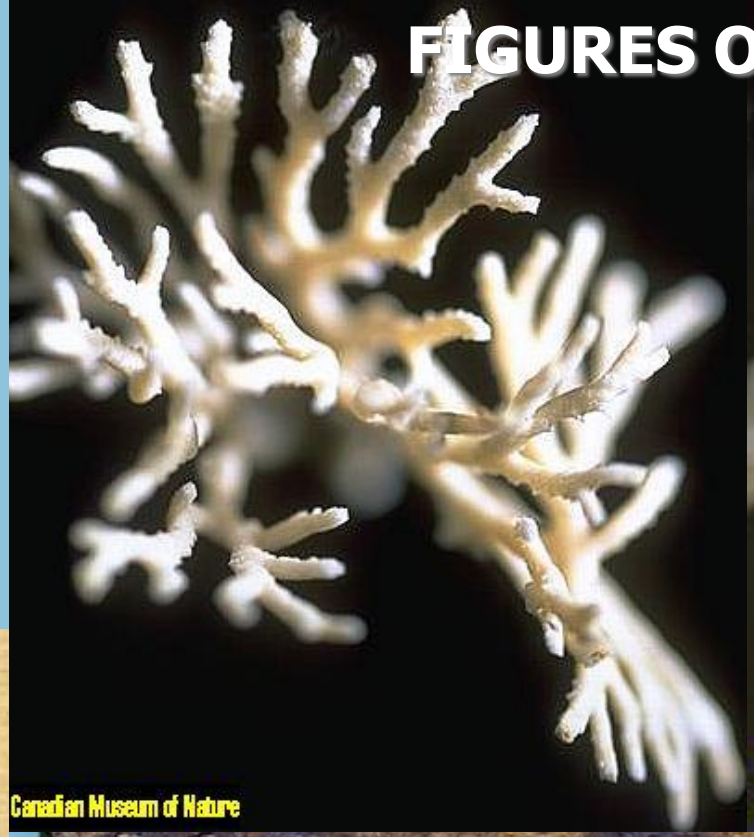
FIGURES OF COLONIES

Bryzoa
(Moss or lace animals)



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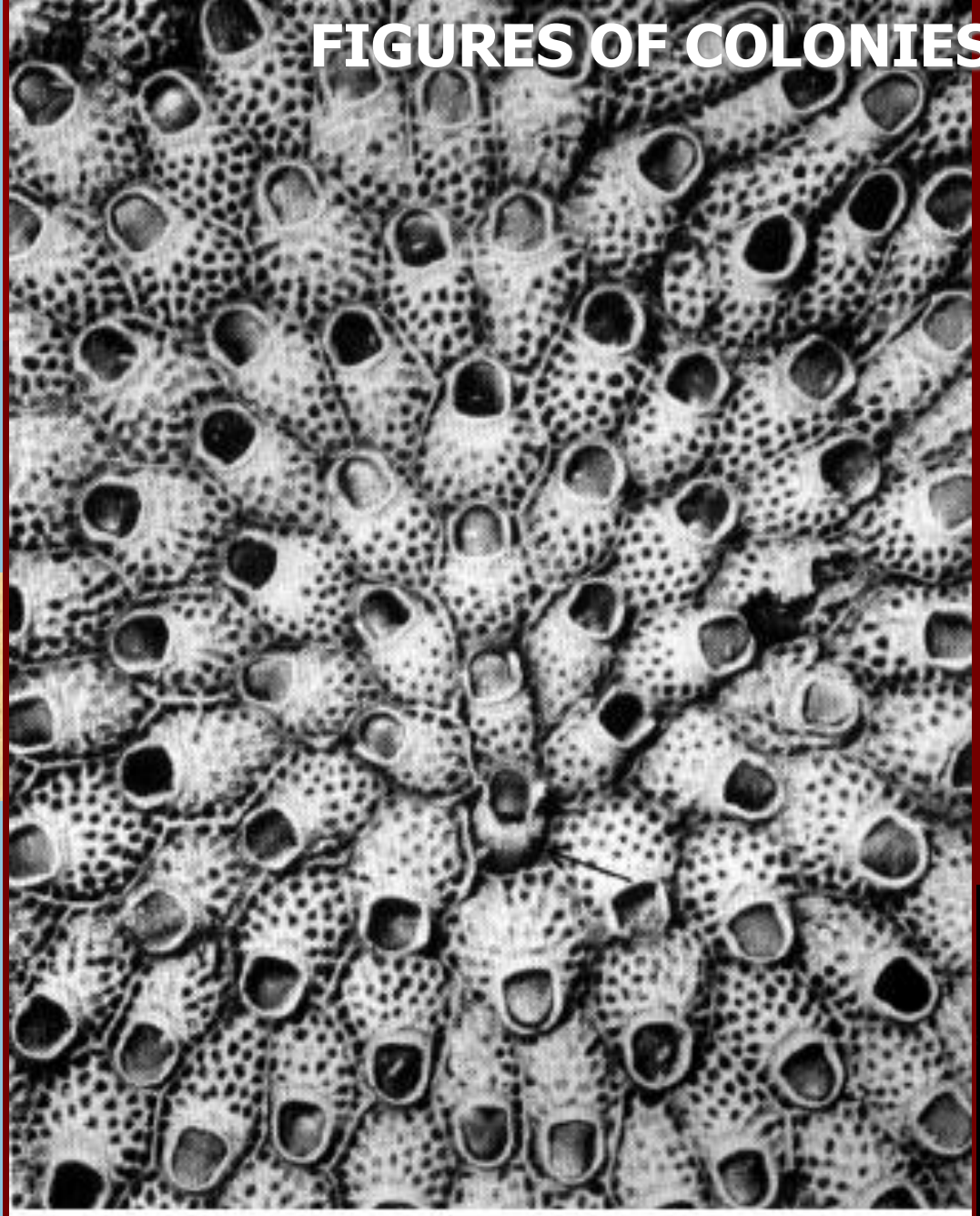
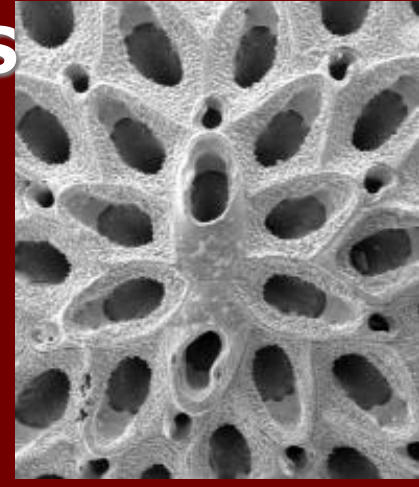
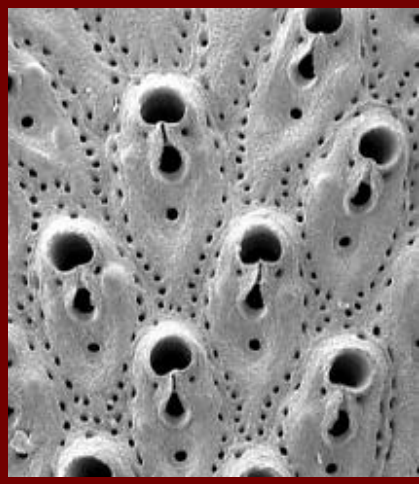
Bryzoa

(Moss or lace animals)

FIGURES OF COLONIES







Pictures from Alka[illegible] (Selçuk Univ.), lecture notes,

PHYLUM BRYZOA

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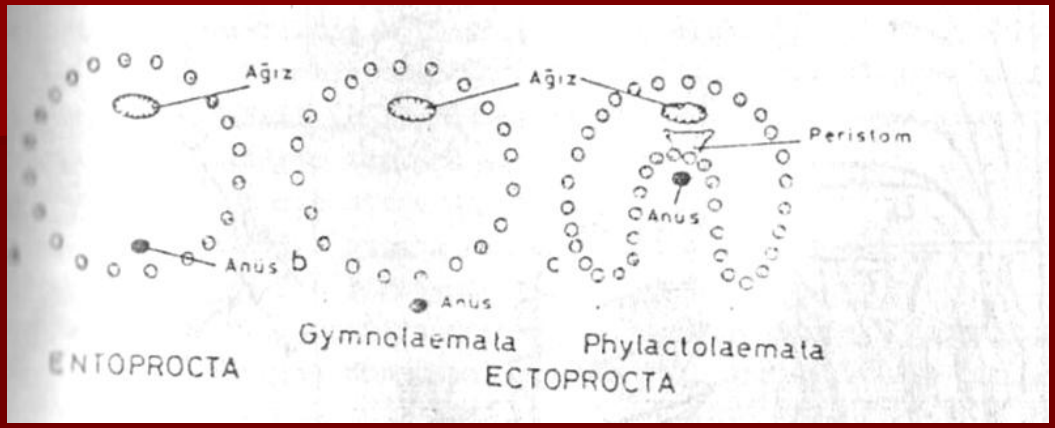
Classification



Subphylums

Entoprocta

Ectoprocta

Class	Phylactolaemata	Stenolaemata	Gymnolaemata	
Order	Plumatellida[44]	Cyclostomata	Ctenostomata	Cheilostomata
Environments	Freshwater	Marine	Mostly marine	

Fossils of about 15,000 bryozoan species have been found. The oldest species with a mineralized skeleton occurs in the uppermost Cambrian of Mexico (http://en.wikipedia.org/wiki/Bryozoa)

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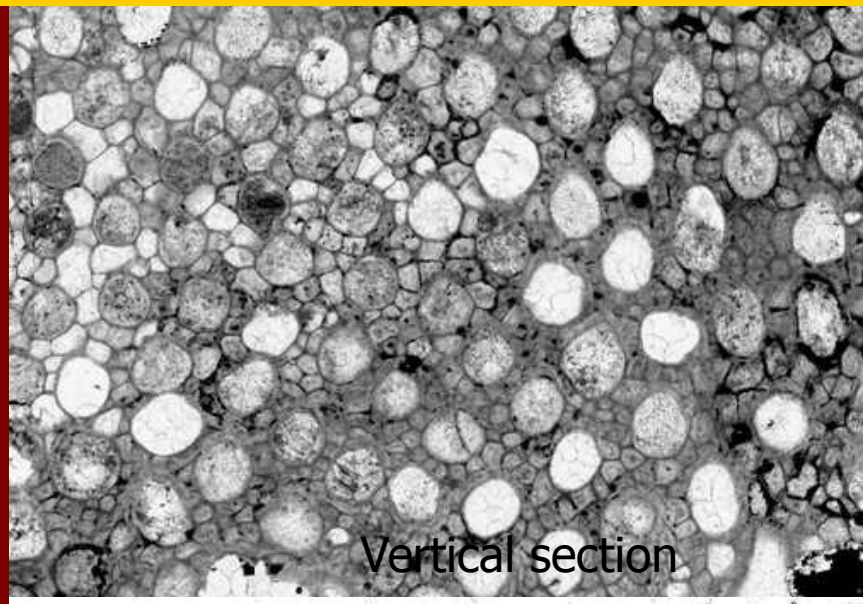
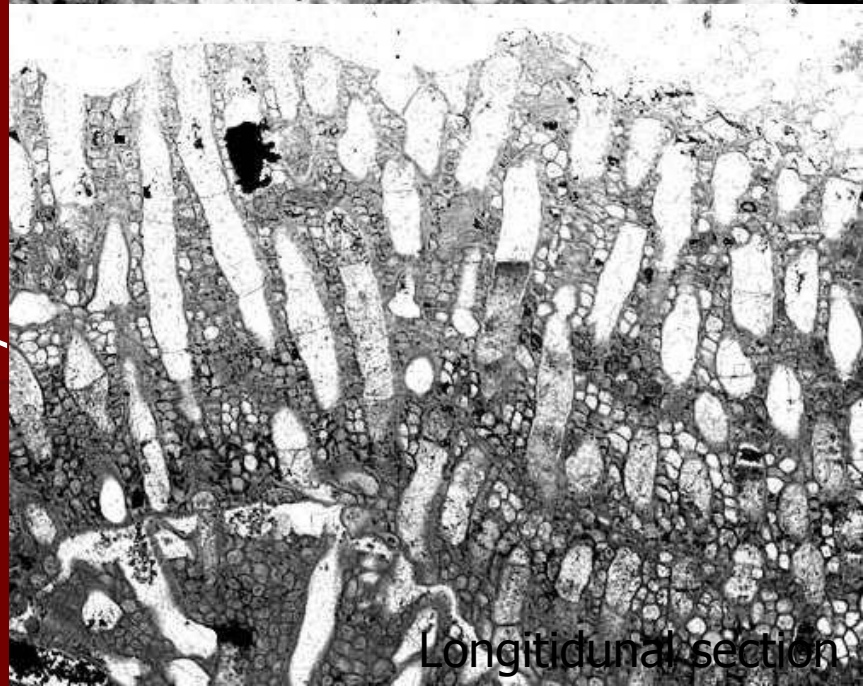
Fistulipora sp. (Silurian-Permian)

Bryzoa
(Moss or lace animals)

Cylindrical individuals



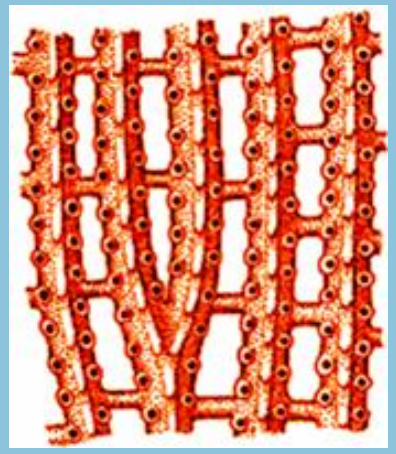


Pictures from Alkaya (Selçuk Univ.), lecture notes,

Fenestella sp. (Ordovician-Permian)

Cage-fan-shaped colony

Bryzoa
(Moss or lace animals)



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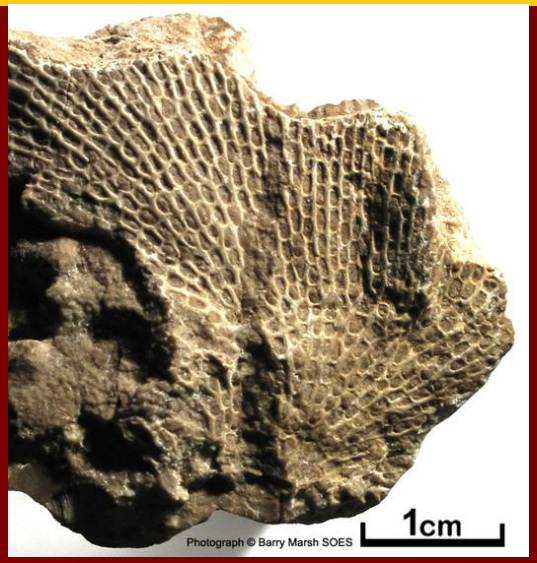
Fenestella sp. (Ordovician-Permian)

Bryzoa
(Moss or lace animals)



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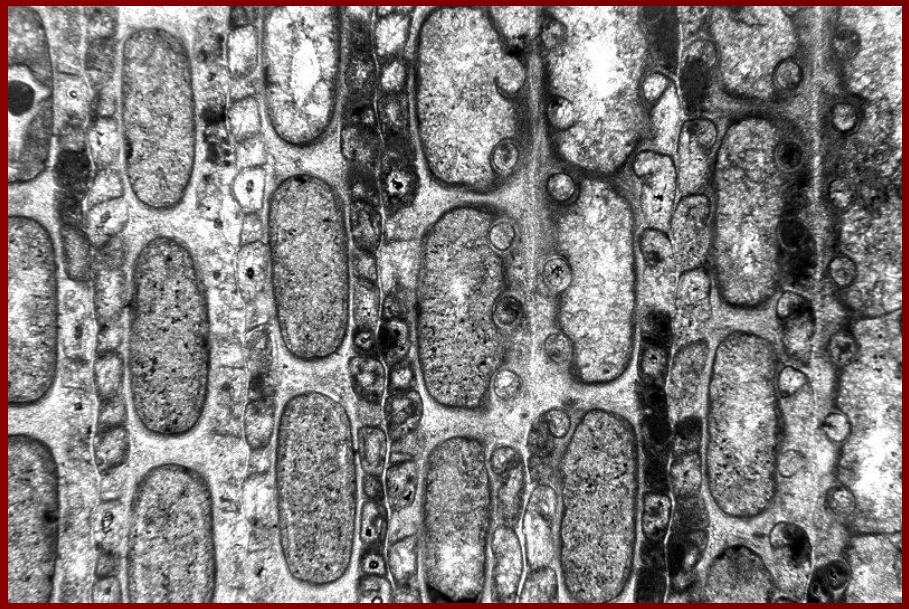
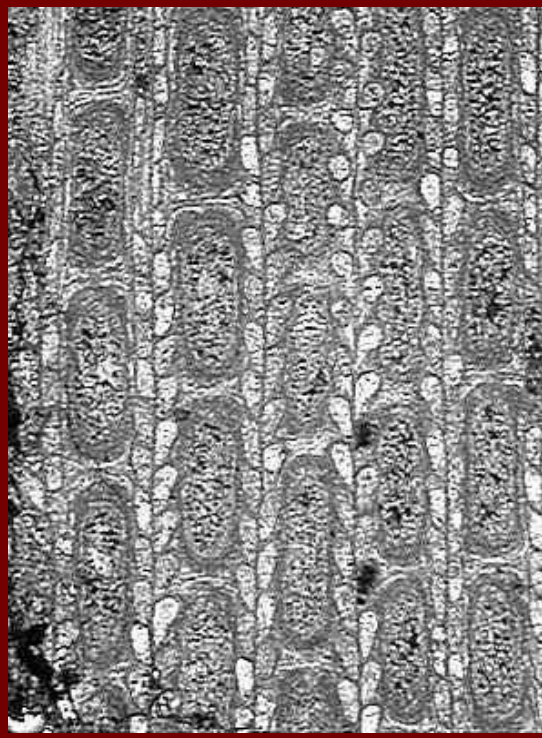
Fenestella sp. (Ordovician-Permian)

Bryzoa
(Moss or lace animals)



Longitidunal section



Tangential section

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Archimedes sp. (Carboniferous-Permian)

Bryzoa
(Moss or lace animals)

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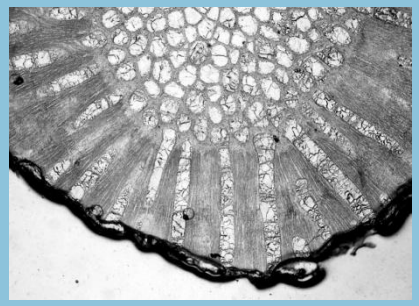
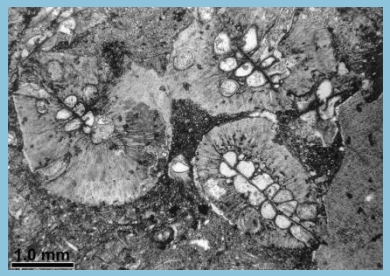
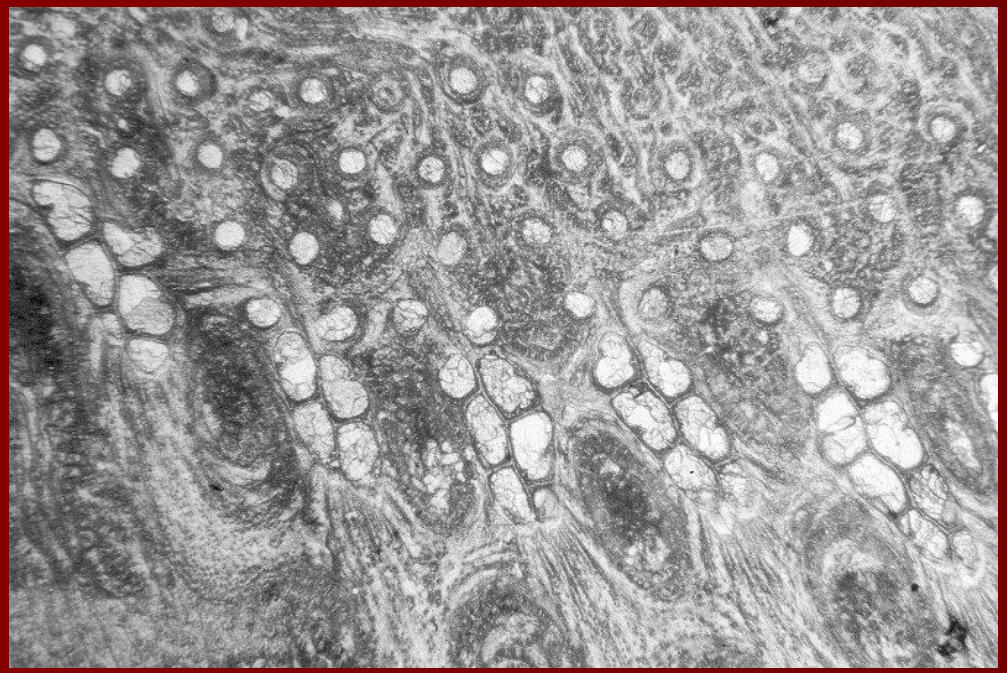
Bryozoa in thin sections

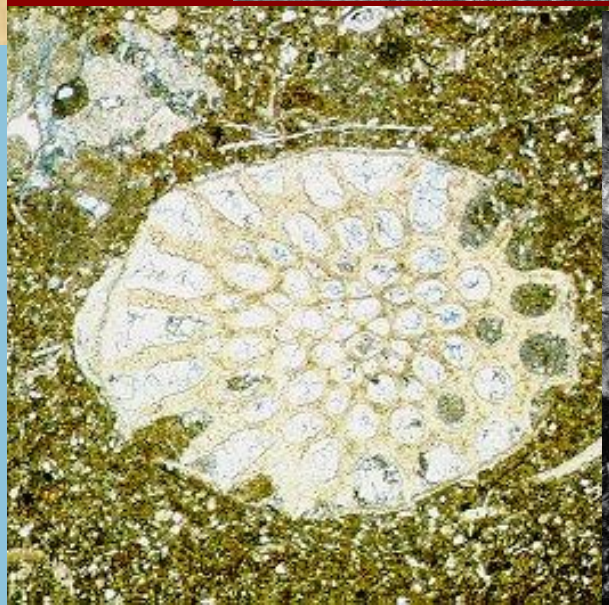


Bryzoa

(Moss or lace animals)







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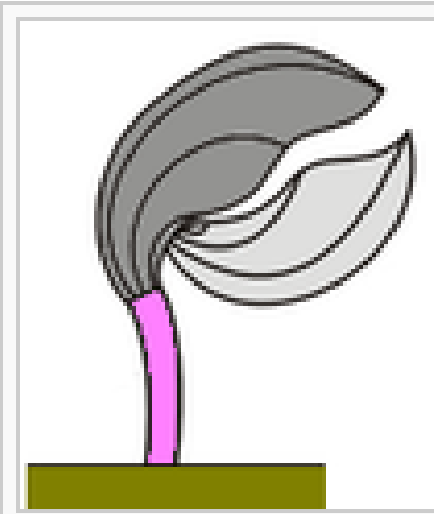
From Eldredge (1991)



An articulate brachiopod:

- Pedicle valve
- Brachial valve
- Pedicle
- Surface

http://en.wikipedia.org/wiki/Brachiopoda

Brachiopoda

http://paleo.cortland.edu/tutorial/Brachiopods/brachiopoda.htm

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Brachiopoda

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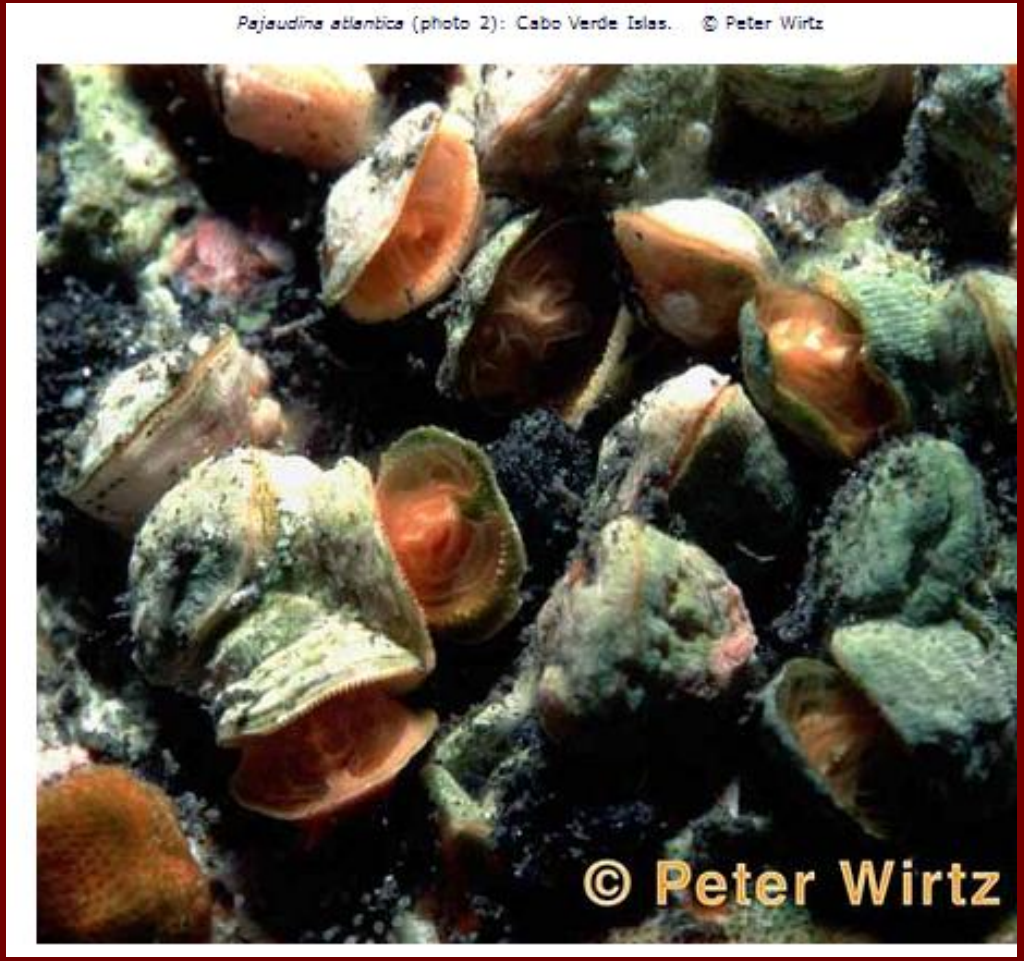
Brachiopoda

General characteristics

(Latin.brachio = arm + Greek.pod = foot)

Brachiopoda have a calcium carbonate shell. They bear a superficial relationship to bivalve molusks, but they are only distantly related. The shells of lamp shells consist of two plates (valves), one ventrally beneath the body and another dorsally above it. Most are attached by a short fleshy stalk (peduncle). The shape of the shells and this little stalk earned these animals their names. http://library.thinkquest.org/26153/marine/brachio.htm



http://paleopolis.rediris.es/BrachNet/CLASS/Bra_photos.htm

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Brachiopoda

General characteristics

Braciopods dominated the early seas when since animal life was first common.

Characteristcs:

1. Symmetry bilateral. No segmentation. Triploblastic.
2. External is covered with a shell, dorsal and ventral valves are unlike. The shell usually has a fleshy peduncle for attachment.
3. Mouth preceded by an extensive two armed lophophore. The digestive canal exists with or without an anus.
4. The coelom is well developed and filled with fluids. The circulatory system is open. The blood is colourless and with coelomocytes.
5. Excretion takes place by one or two nephridia serving also as reproductive ducts.
6. A nerve ring about gullet.
7. The sexes are usually seperate, each with paired gonads. Eggs and sperm are discharged into the seawater around it. A free swimming ciliated larva is born. No asexual reproduction takes place.
8. Cambrian to Recent
9. Marine, mainly shallow

http://library.thinkquest.org/26153/marine/brachio.htm

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Brachiopoda

Bilateral symetrical

General characteristics

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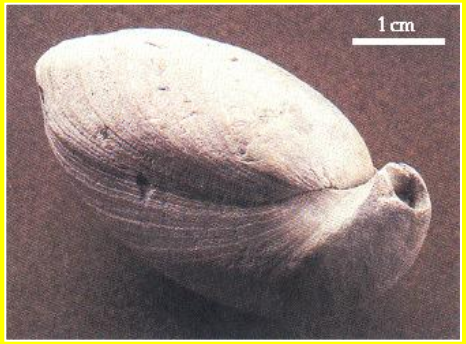
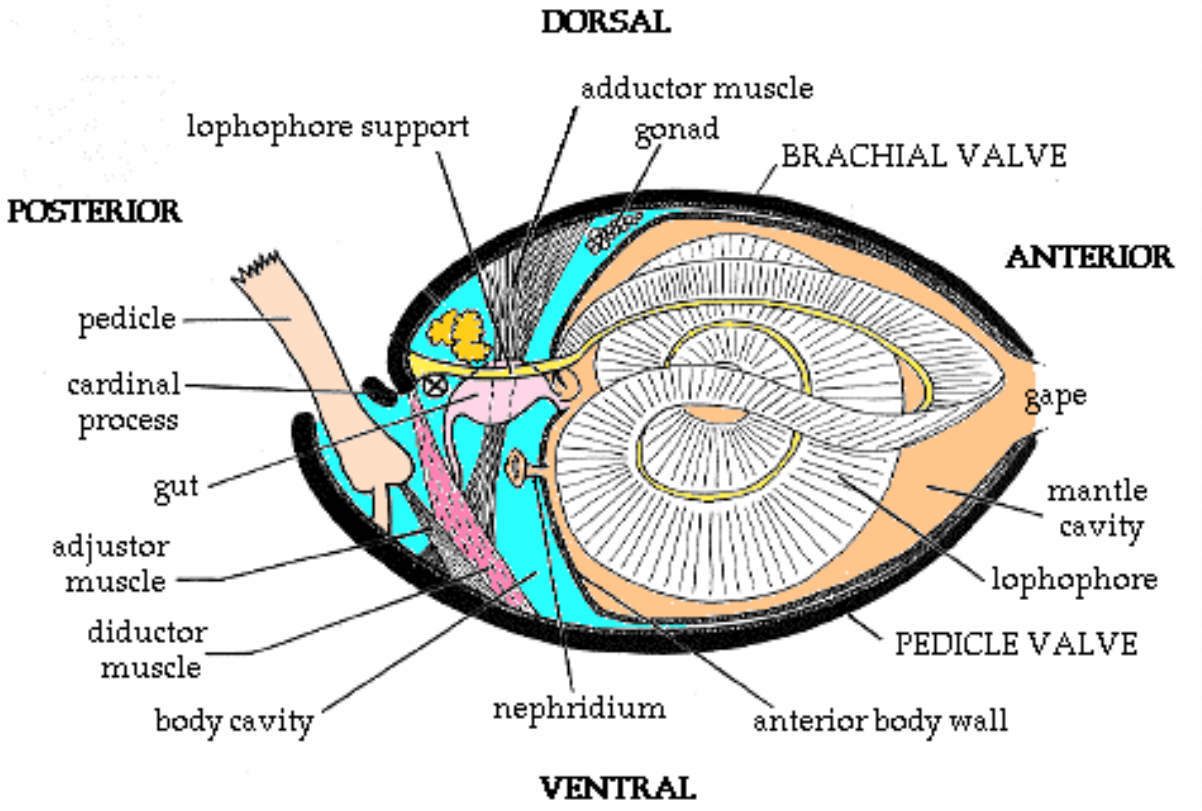


Brachiopoda

Terms & General views



Modified from Clarkson (1986)

A section through a brachiopod.

http://paleo.cortland.edu/tutorial/Brachiopods/brachmorph.htm

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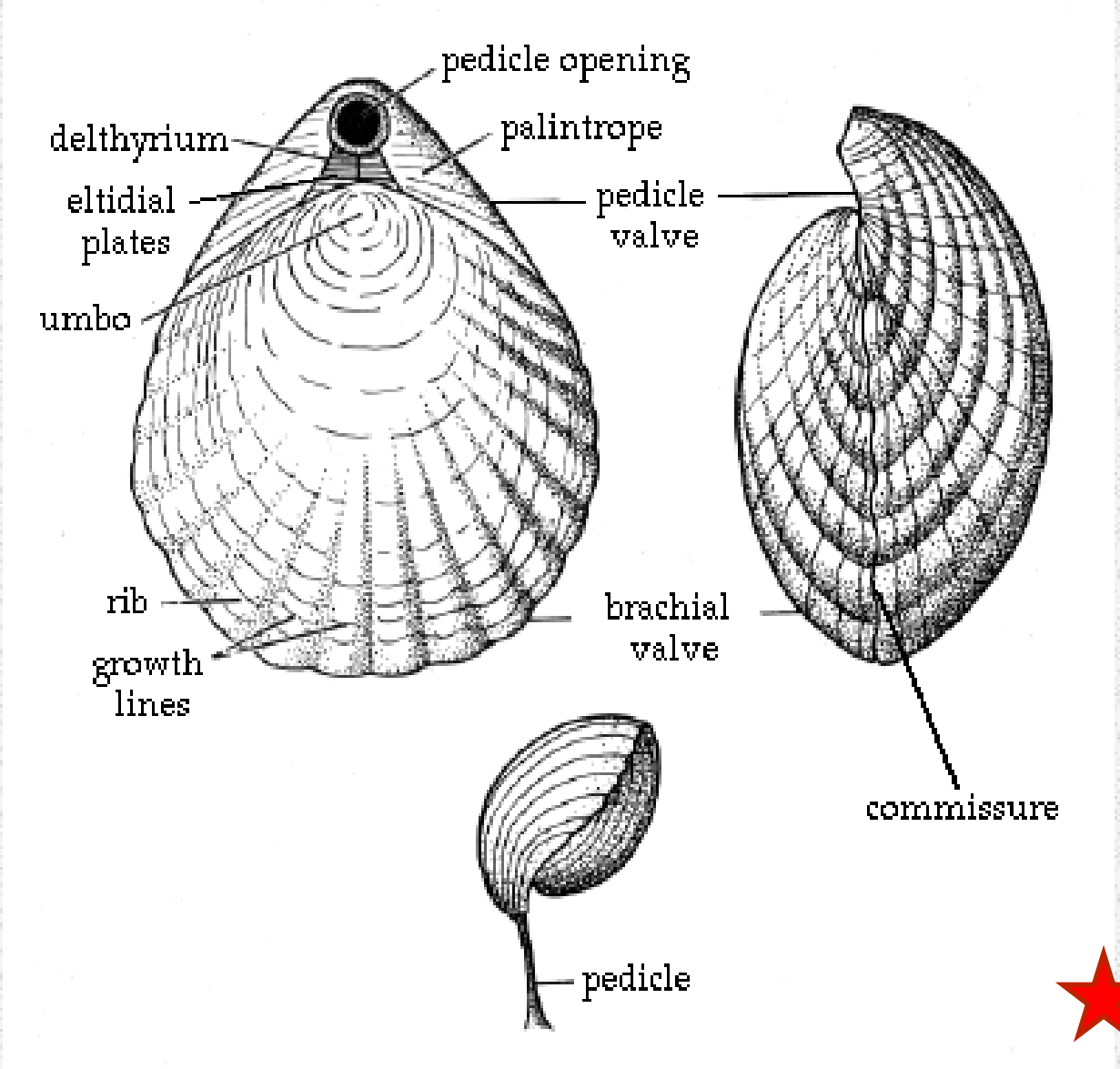
Brachiopoda

Terms & General views

Figure 2 - Brachiopod External Morphology



http://paleo.cortland.edu/tutorial/Brachiopods/brachmorph.htm

From Clarkson (1986)

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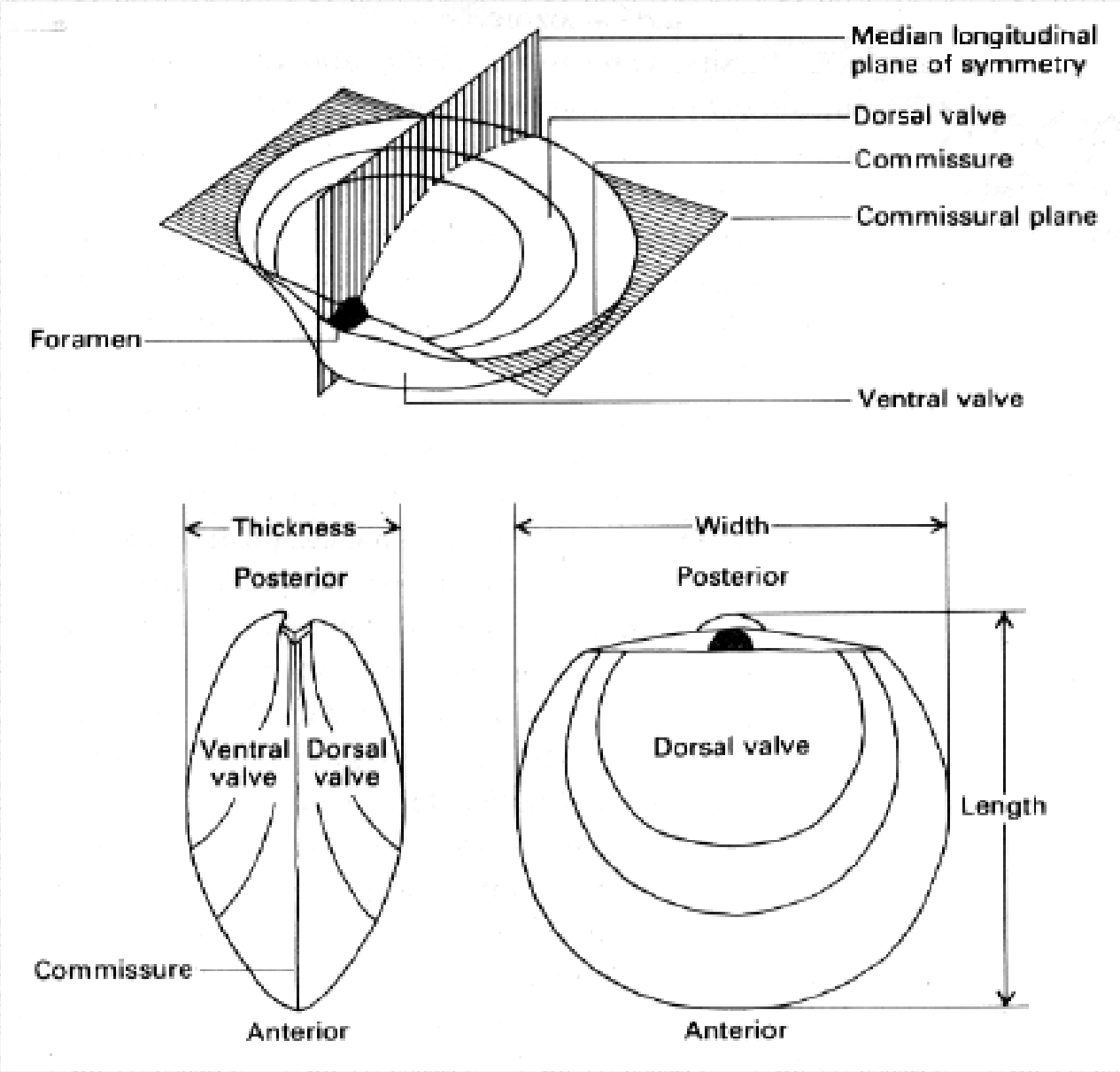
Brachiopoda

Terms & General views

Figure 3 - Brachiopod Symmetry



From Boardman et al (1987)

http://paleo.cortland.edu/tutorial/Brachiopods/brachmorph.htm

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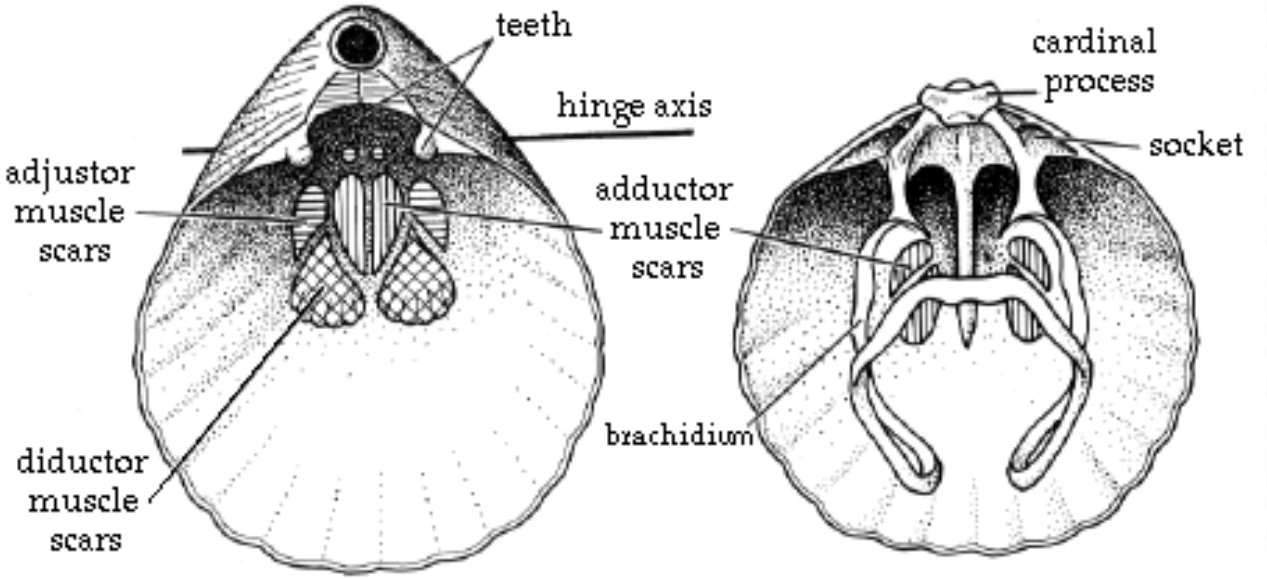
Brachiopoda

Terms & General views

Figure 4 - **Brachiopod Internal Shell Morphology**



From Clarkson (1986)

http://paleo.cortland.edu/tutorial/Brachiopods/brachmorph.htm

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Brachiopoda

Terms

Valve positions

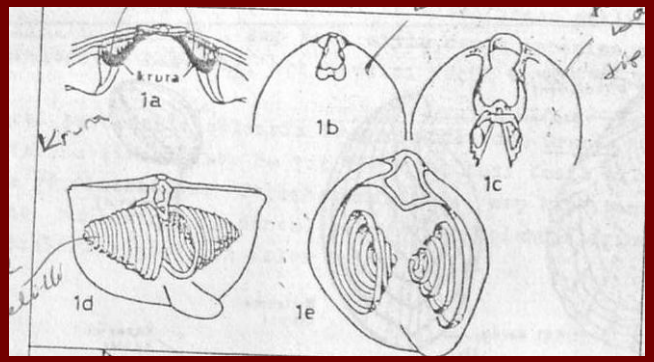
Convex to concave

Resipunal

Biconvex

Concava-convex

Askew biconvex



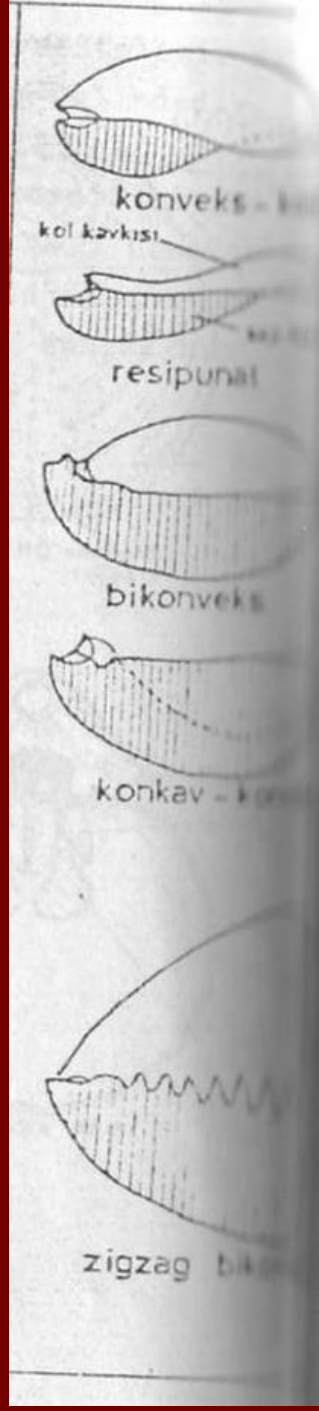
Brachidium types

Krura

Curved

Tranversal

Spiral



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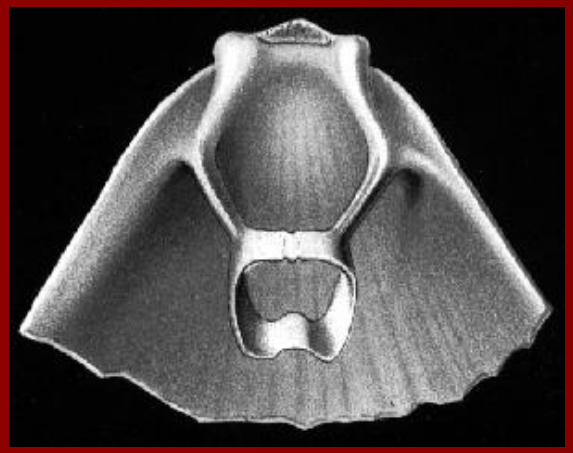
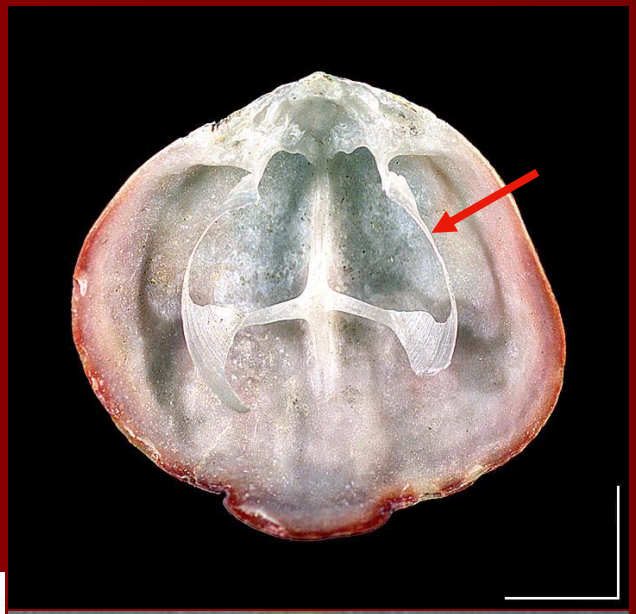
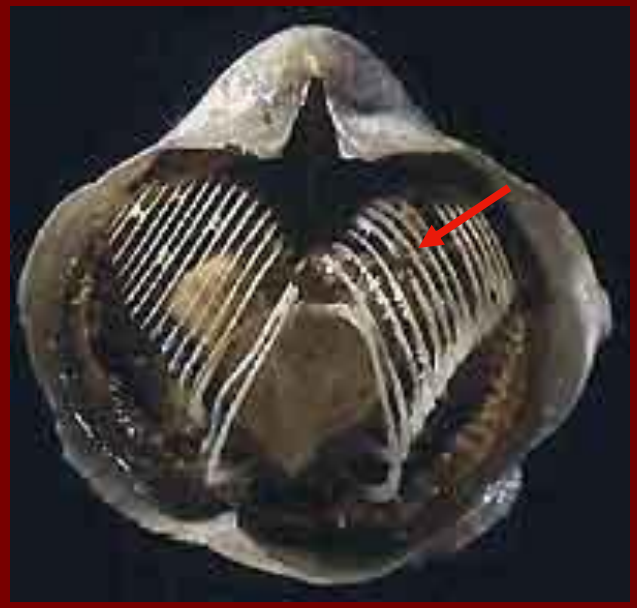
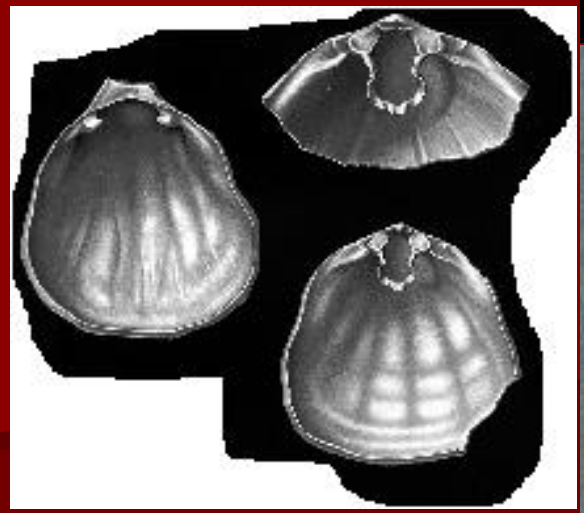
Brachiopoda









Pictures from Alkaya (Selçuk Univ.), lecture notes,

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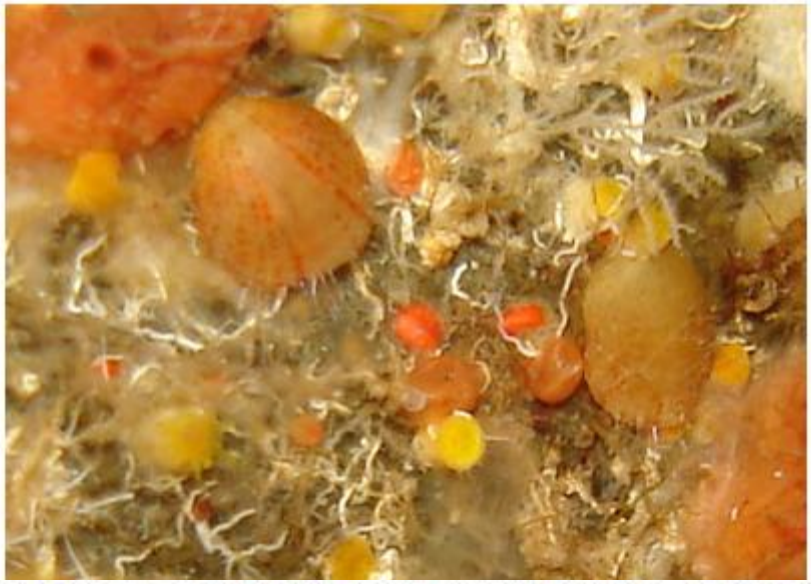
Brachiopoda

Terms

Kraussina mercatori: in cave, 6 m depth - Cabo Verde Islas. © Peter Wirtz



Pajaudina atlantica: in cave, 8 m depth - El Hierro, Canary islands. © Peter Wirtz

http://paleopolis.rediris.es/BrachNet/CLASS/Bra_photos.htm

PEDUNCLE : A short fleshy stalk

PEDUNCLE VALVE: Larger valve, having peduncle

BRACHIAL VALVE: Smaller valve, bearing brachidium

LOPHOPHORE: It is an apparatus for feeding & respiration.

BRACHIDIUM : Supporting apparatus to Lophophore

POSTERIOR: Frontal side

ANTERIOR : Back side

HINGE AXIS: Axis between valves

DELTHYRIUM: Triangular part in front of foramen.

FOROMEN: Opening of peduncle

ARTICULATA

INARTICULATA

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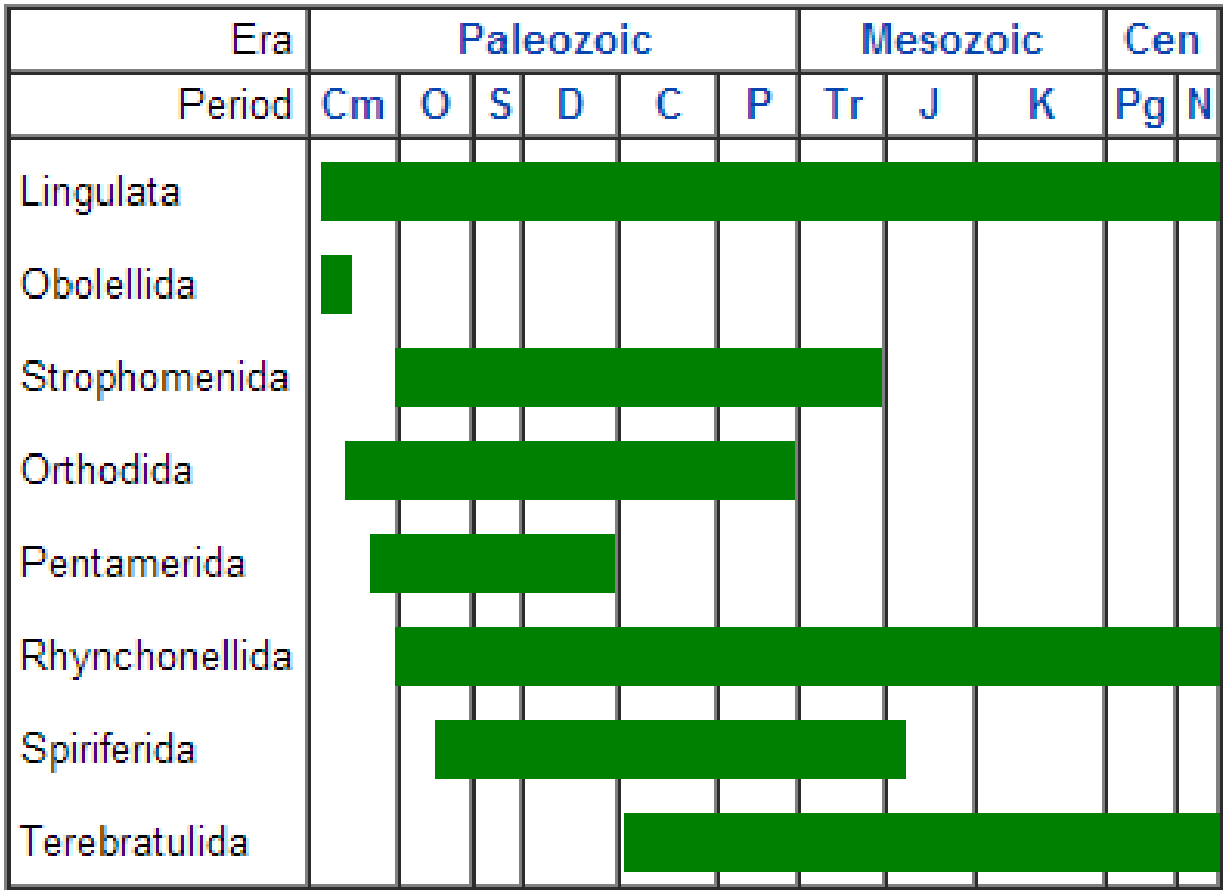
Brachiopoda

Stratigraphical Ranges

Timeline of major fossil brachiopod groups[27]



http://en.wikipedia.org/wiki/Brachiopoda

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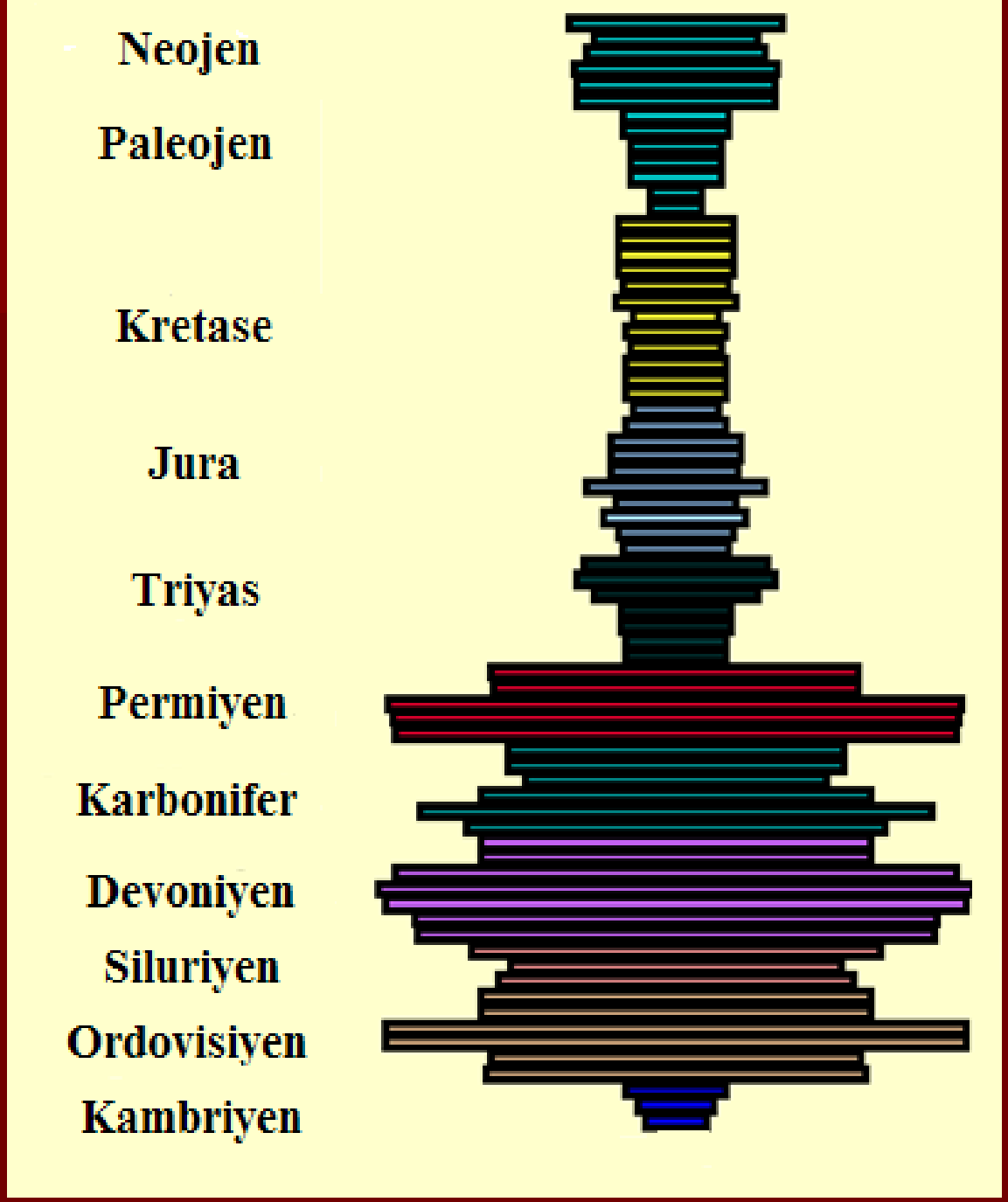
Brachiopoda

Stratigraphical Aboundances



Drawing from Alkaya (Selçuk Univ.), lecture notes,

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Brachiopoda

CLASSIFICATION

--- In the "traditional" classification, the Articulata have toothed hinges between the valves, while the hinges of the Inarticulata are held together only by muscles.

--- A classification devised in the 1990s, based on the materials of which the shells are based, united the Craniida and the "articulate" brachiopods in the Calciata, which have calcite shells. The Lingulida and Discinida, combined in the Lingulata, have shells made of chitin and calcium phosphate.

--- A three-part scheme, also from the 1990s, places the Craniida in a separate group of its own, the Craniformea. The Lingulida and Discinida are grouped asLinguliformea, and the Rhynchonellida and Terebratulida as Rhynchonelliformea.

Three high-level classifications of brachiopods[4][6]

"Traditional" classification[4][6]	Inarticulata			Articulata	
"Calciata" approach[6]	Lingulata		Calciata		
Three-part approach[21][22]	Linguliformea		Craniformea	Rhynchonelliformea	
Orders	Lingulida[4]	Discinida[4]	Craniida[4]	Terebratulida[4]	Rhynchonellida[4]

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Brachiopoda

CLASSIFICATION

Phylum **Brachiopoda** (Cambrian-Recent)

- Class **Inarticulata** (Cambrian-Recent)
- Class **Articulata** (Cambrian-Recent)
  - Order **Orthida** (Cambrian-Permian)
  - Order **Strophomenida** (Ordovician-Jurassic)
  - Order **Pentamerida** (Cambrian-Devonian)
  - Order **Rhynchonellida** (Ordovician-Recent)
  - Order **Spiriferida** (Ordovician-Jurassic)
  - Order **Terebratulida** (Devonian-Recent)

http://paleo.cortland.edu/tutorial/Brachiopods/brachclass.htm

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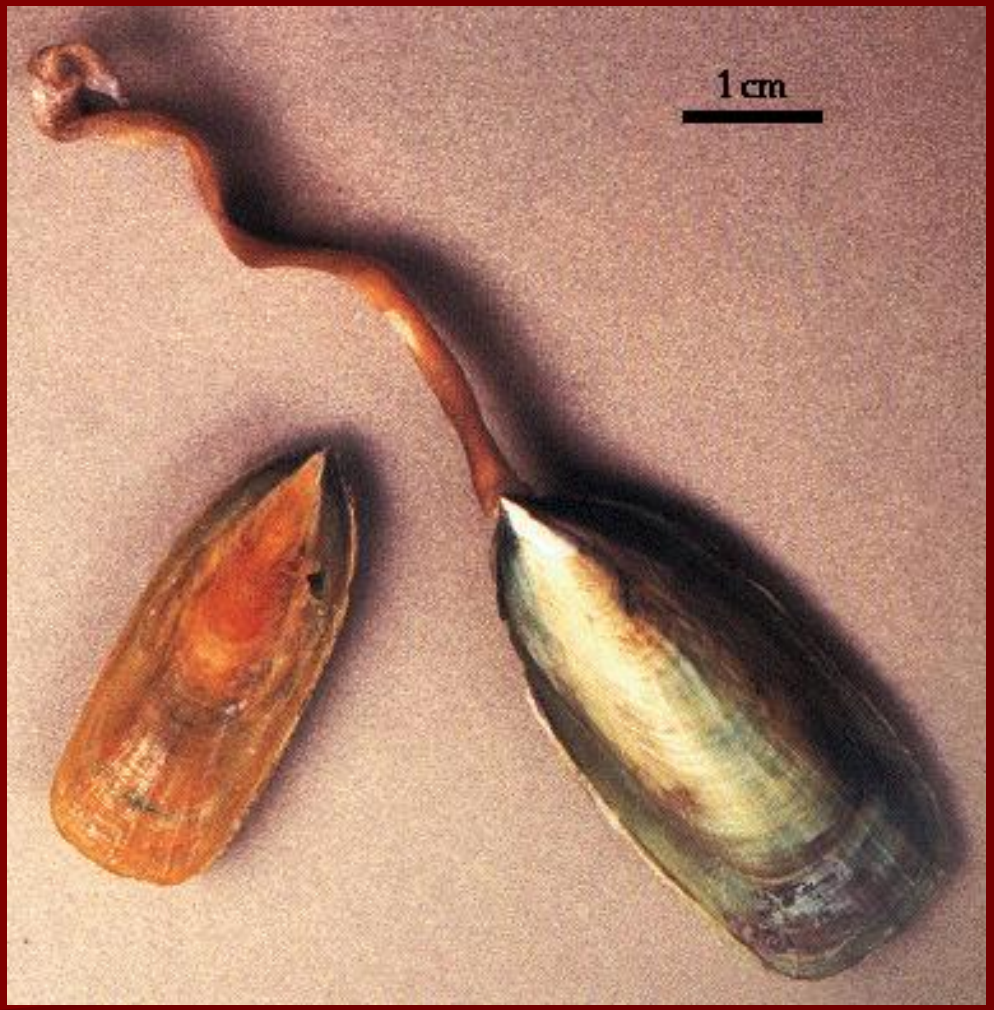
Lingula sp. Siluriyen-Güncel

Brachiopoda



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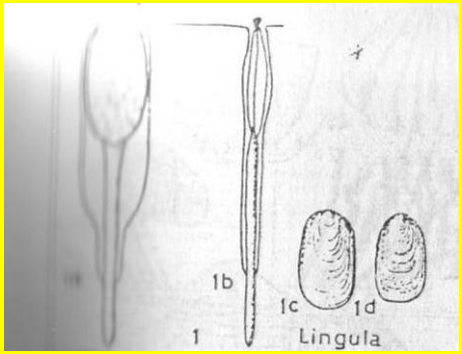
Brachiopoda



Lingula adamsi Dall, 1873

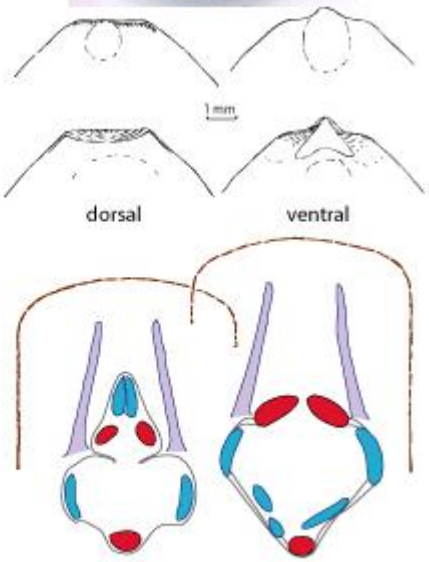
Lingula tumidula : Adams, 1863 ; Davidson, 1871 (non *L. tumidula* Reeve, 1841).
Lingula adamsi : Dall, 1873 ; Dall, 1921; Davidson, 1888 ; Emig, 1979 ; Emig & Hammond, 1981.
Lingula shantungensis : Hatai, 1937, 1940.

Diagnose - (Emig, 1982)

Coquille : Forme rectangulaire, à bord frontal droit légèrement convexe sans pointe médiane : stries d'accroissement bien marquées, surface externe rugueuse avec des stries équidistantes concentriques plus ou moins profondes. De profil, la valve dorsale est plus aplatie que la valve ventrale.
* Coloration beige à brun foncé, distalement rouge-brun à brun-noir.
* Régions umbonales aplaties : valve dorsale à bord postérieur rectiligne, valve ventrale avec un petit bec central.

Disposition des muscles et canaux : L'arrangement des muscles est de forme élargie : sur la face dorsale, le muscle adducteur postérieur se situe juste sous la ligne des muscles obliques ; sur la face ventrale, les trois muscles obliques internes sont regroupés près du muscle adducteur postérieur.
Les deux canaux antérieurs principaux sont bien séparés, rectilignes et subparallèles.
Aucune pigmentation palléale n'est observée.

Pédoncule de couleur chair.



http://paleopolis.rediris.es/BrachNet/CLASS/LINGULIDAE/Lingula.html

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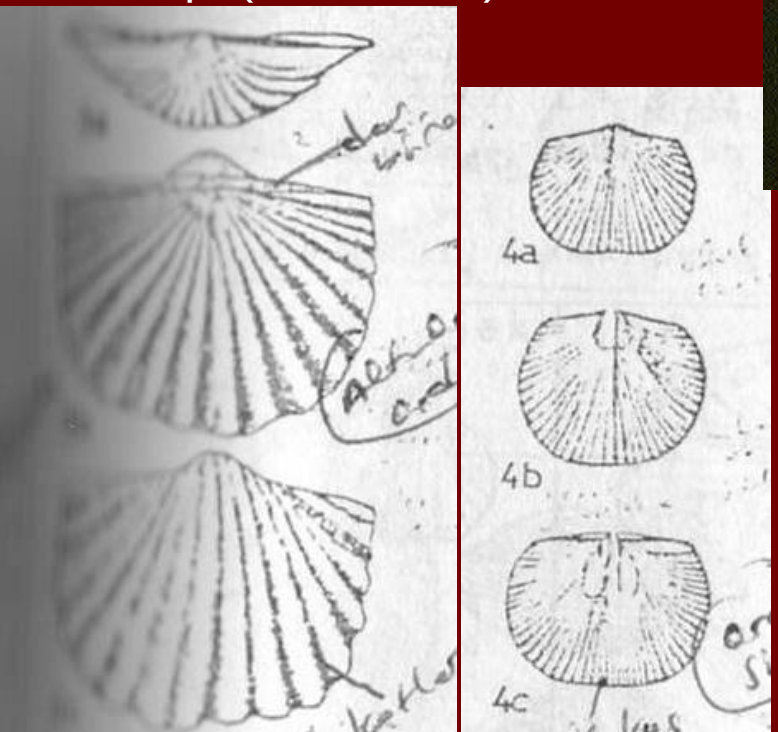
Phylum **Brachiopoda** (Cambrian-Recent)
- Class **Inarticulata** (Cambrian-Recent)
- Class **Articulata** (Cambrian-Recent)
  - Order **Orthida** (Cambrian-Permian)
  - Order **Strophomenida** (Ordovician-Jurassic)
  - Order **Pentamerida** (Cambrian-Devonian)
  - Order **Rhynchonellida** (Ordovician-Recent)
  - Order **Spiriferida** (Ordovician-Jurassic)
  - Order **Terebratulida** (Devonian-Recent)

Orthis sp. (Ordovician)



Dalmanella sp. (Ord.-Sil.)

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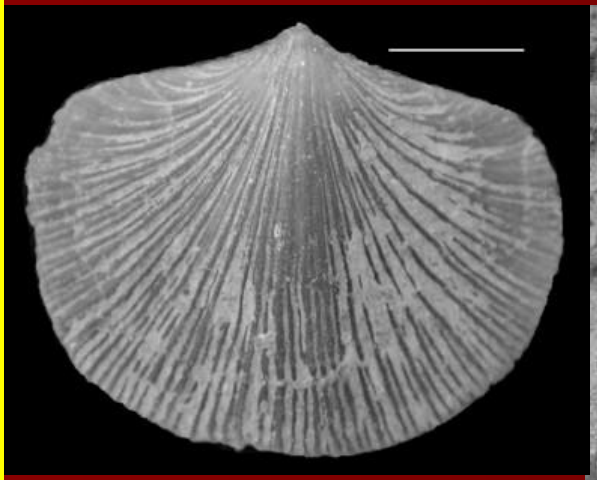
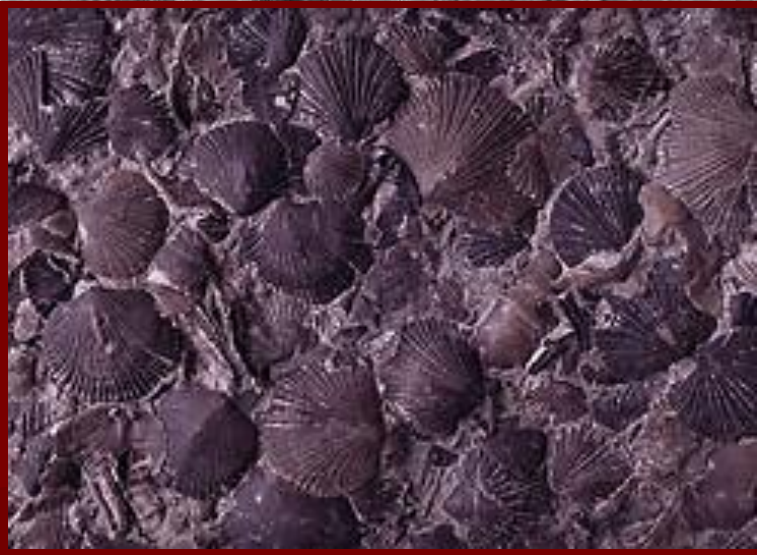
Dalmanella sp. (Ordovician-Silurian)



Brachiopoda



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Phylum **Brachiopoda** (Cambrian-Recent)
- Class **Inarticulata** (Cambrian-Recent)
- Class **Articulata** (Cambrian-Recent)
  - Order **Orthida** (Cambrian-Permian)
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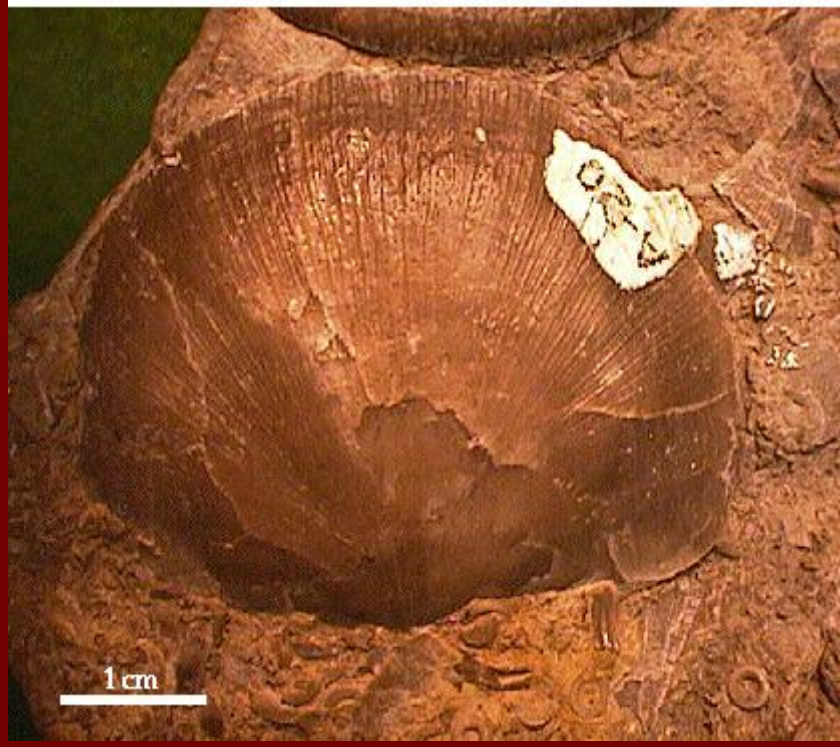
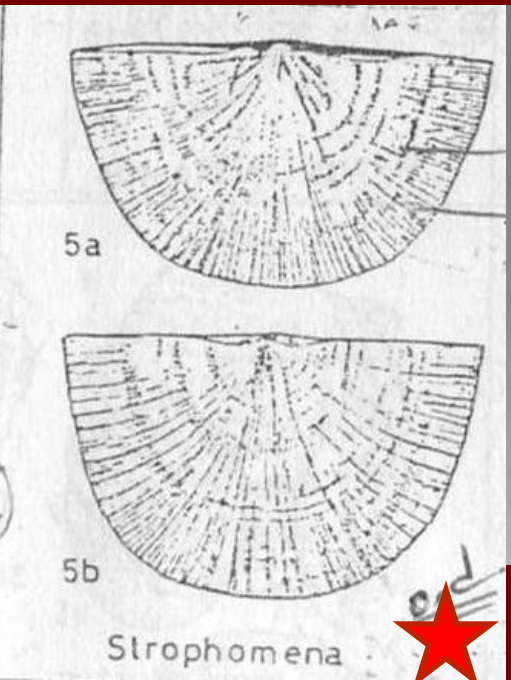
  - Order **Pentamerida** (Cambrian-Devonian)
  - Order **Rhynchonellida** (Ordovician-Recent)
  - Order **Spiriferida** (Ordovician-Jurassic)
  - Order **Terebratulida** (Devonian-Recent)



Strophomena sp.
Ordovician

Leptaena sp.
Ord.-Dev.



STROPHOMENIDA

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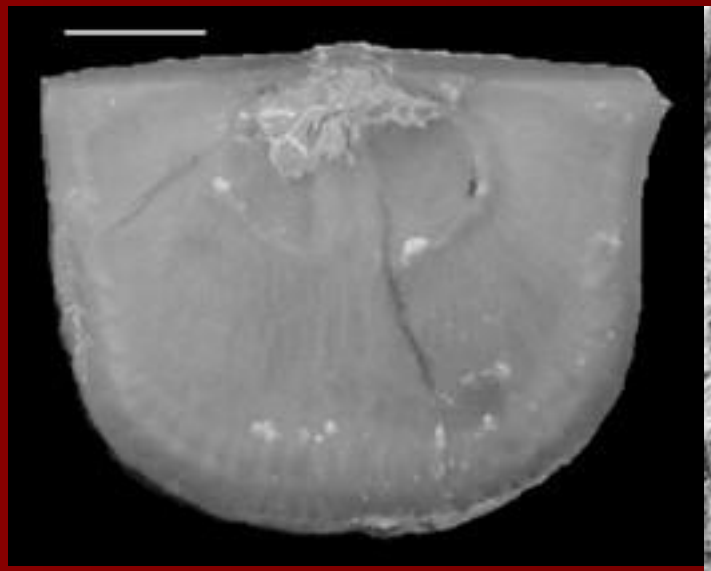
Strophomena Ordovician-Silurian

Brachiopoda



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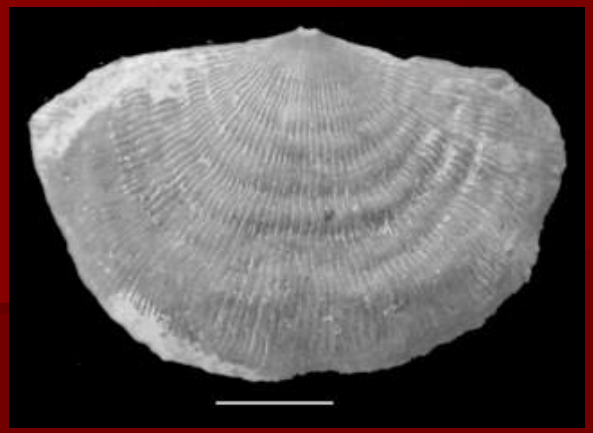
Lepteana sp. Ordovician-Devonian

Brachiopoda



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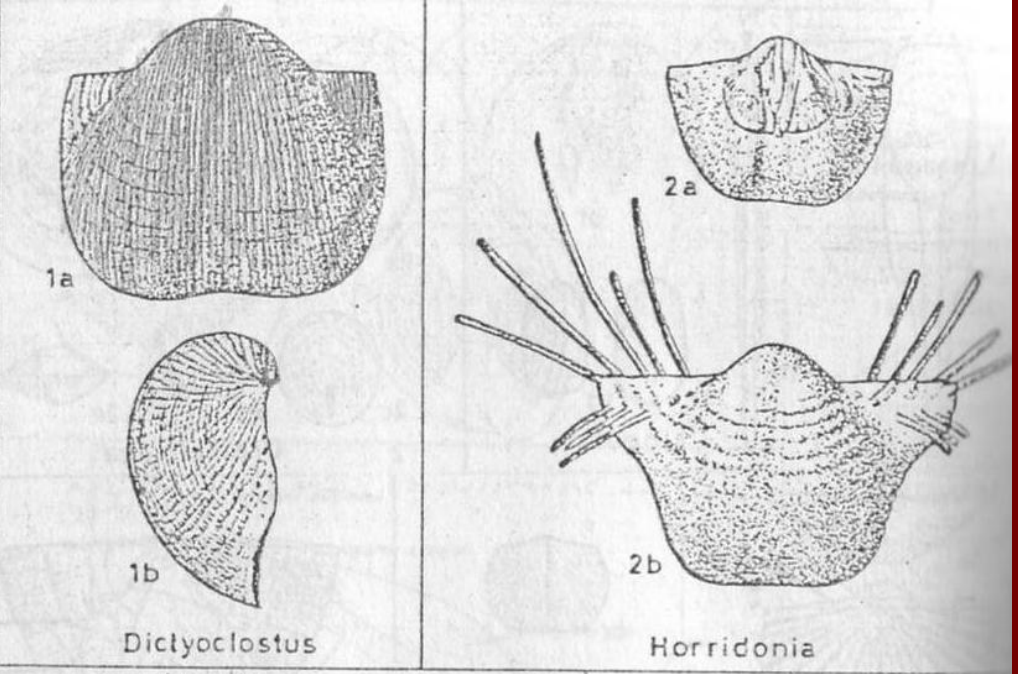

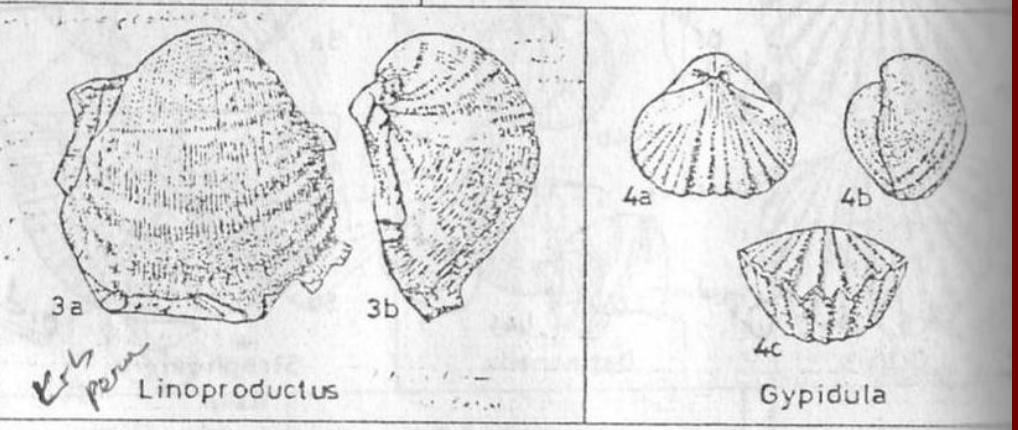

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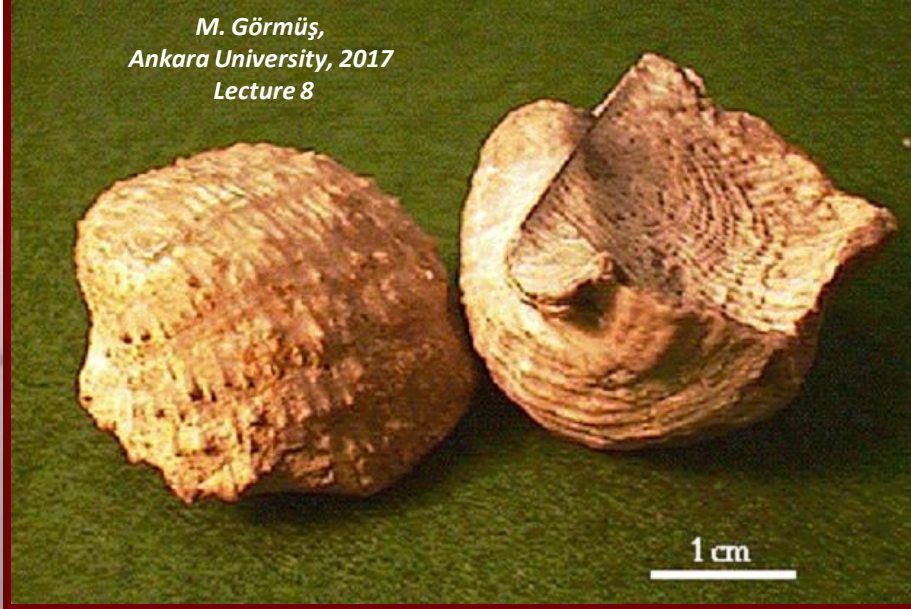

Suborder: Productidina

Phylum **Brachiopoda** (Cambrian-Recent)
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- Class **Articulata** (Cambrian-Recent)
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Dictyoclostus sp. Early Carboniferous

Brachiopoda

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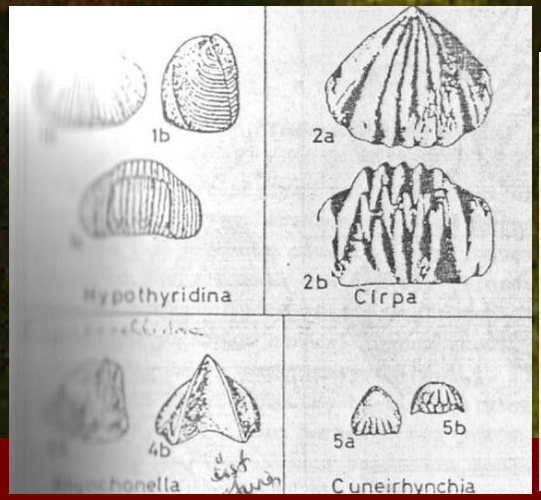
RHYNCHONELLIDA
Rhynchonella sp. (LateJurassic)

1 cm



Phylum **Brachiopoda** (Cambrian-Recent)
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  - Order **Rhynchonellida** (Ordovician-Recent)
  - Order **Spiriferida** (Ordovician-Jurassic)
  - Order **Terebratulida** (Devonian-Recent)

http://paleo.cortland.edu/tutorial/Brachiopods/Brachiopod%20Images/rhynchonellid.GIF

Hypothridina sp. Devonian

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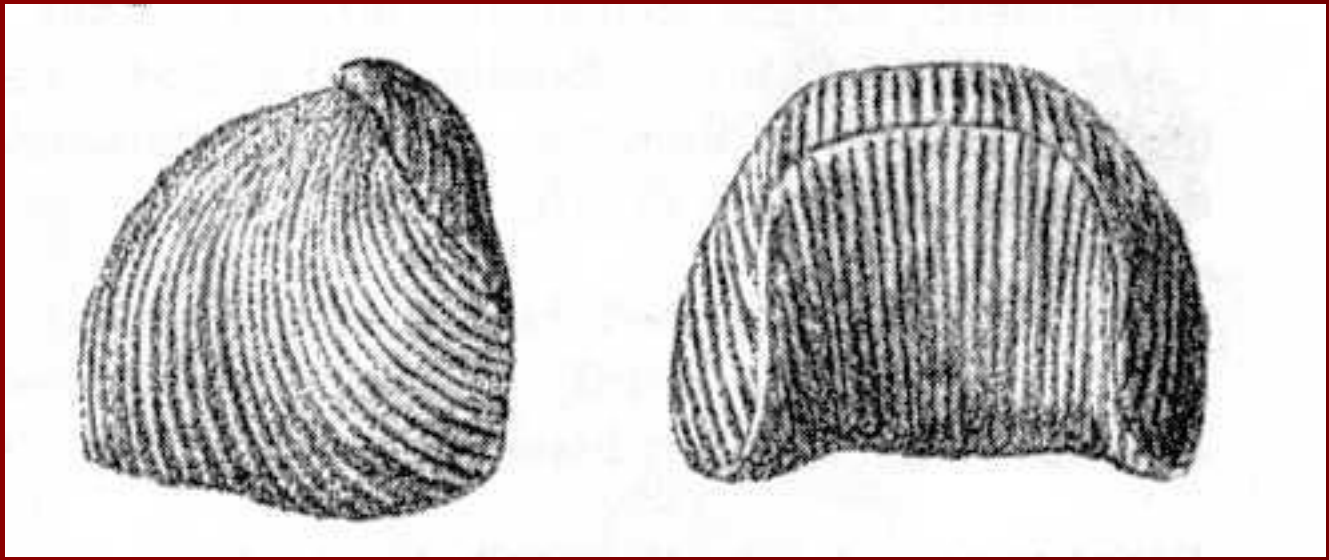

Cirpa sp. Early Jurassic

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Phylum **Brachiopoda** (Cambrian-Recent)
- Class **Inarticulata** (Cambrian-Recent)
- Class **Articulata** (Cambrian-Recent)
  - Order **Orthida** (Cambrian-Permian)
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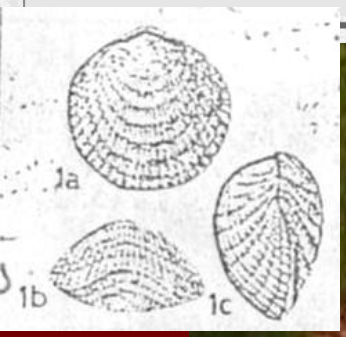

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1 cm

Alt ordo: Atrypidina
Atrypa (Alt Sil.-Üst Dev.)

http://paleo.cortland.edu/tutorial/Brachiopods/Brachiopod%20Images/rhynchonellid.GIF

Atrypa sp. Silurian-Devonian

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Suborder: Spiriferidina
Euryspirifer (Dev.)
Cyrtospirifer (Dev.-Carb.)
Spirifer (Carb.)
Spiriferina (Trias- Early Juras.)

Phylum **Brachiopoda** (Cambrian-Recent)
- Class **Inarticulata** (Cambrian-Recent)
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http://paleo.cortland.edu/tutorial/Brachiopods/Brachiopod%20Images/rhynchonellid.GIF

Cyrtospirifer sp. Devonian-Carboniferous

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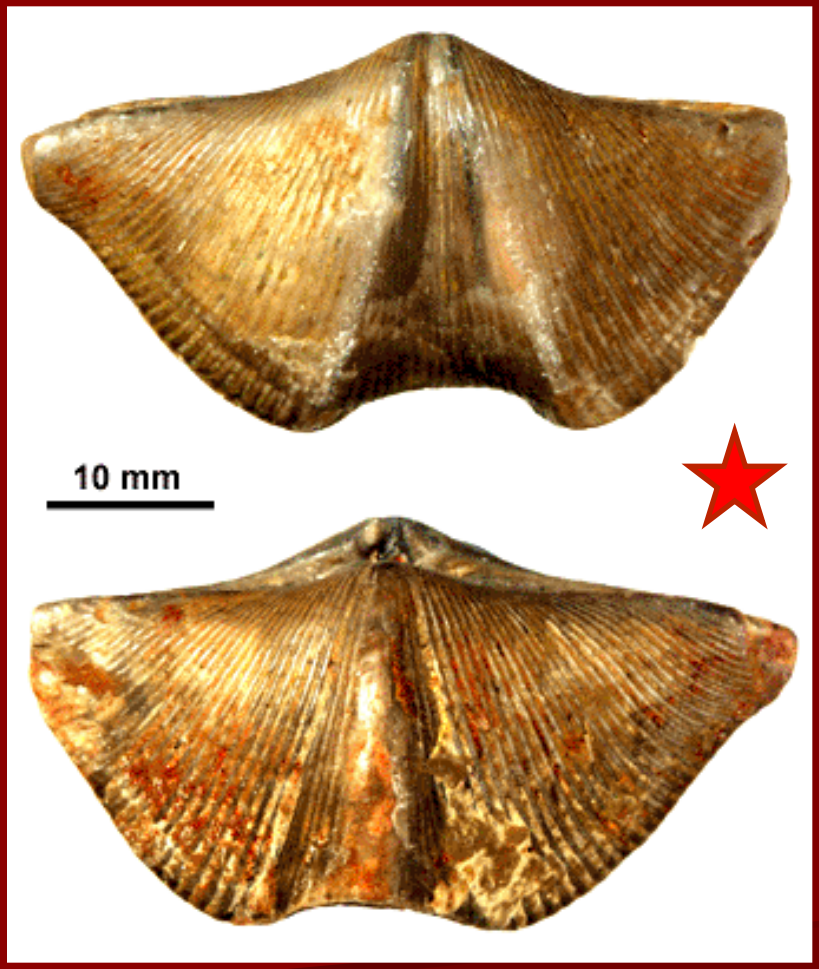

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Cyrtospirifer sp. Devonian-Carboniferous

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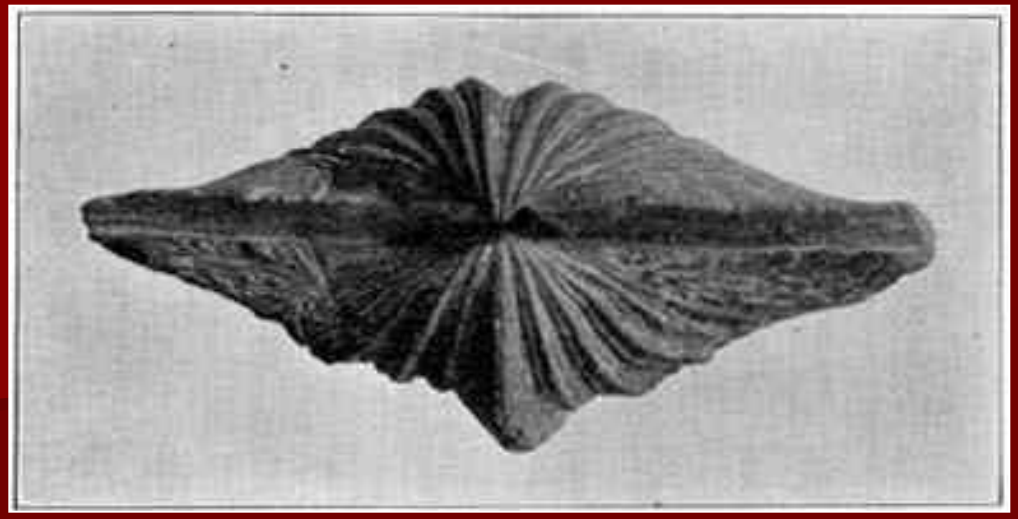

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Spiriferina sp. Triassic-Early Jurassic

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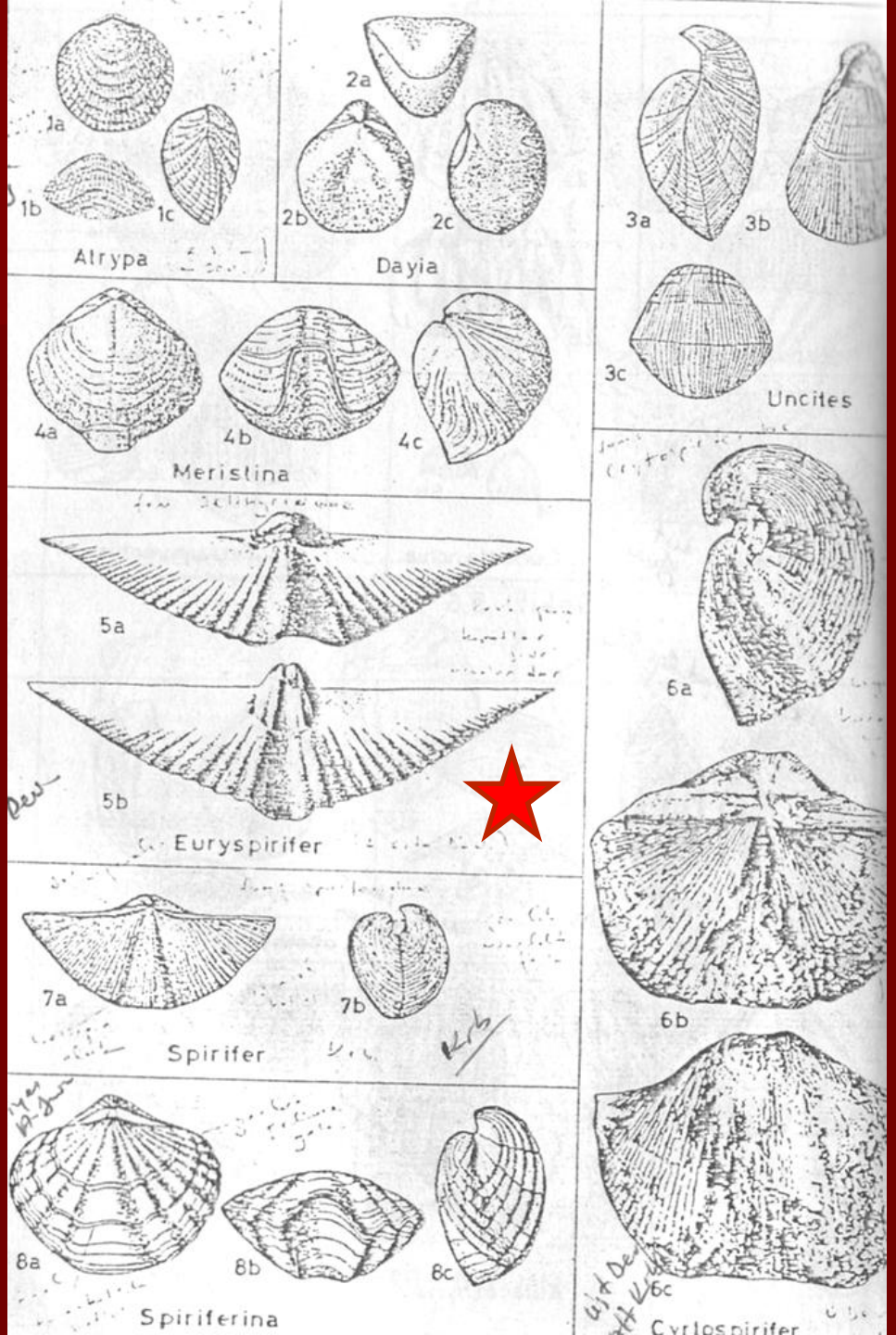
Brachiopoda



Terebratula sp. (Miocene-Pliocene)

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Phylum **Brachiopoda** (Cambrian-Recent)
- Class **Inarticulata** (Cambrian-Recent)
- Class **Articulata** (Cambrian-Recent)
  - Order **Orthida** (Cambrian-Permian)
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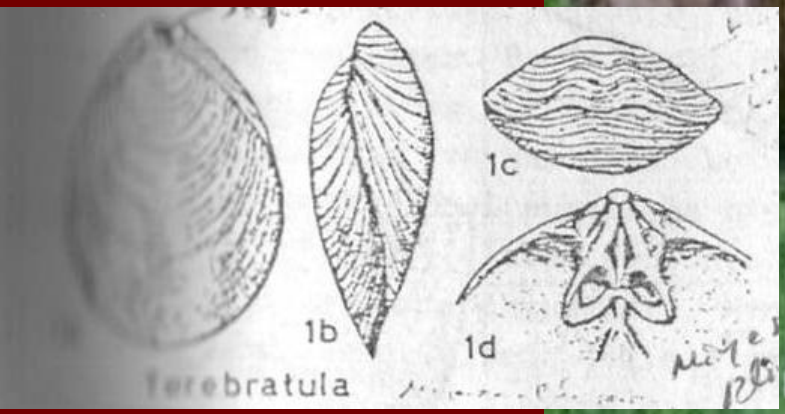
  - Order **Spiriferida** (Ordovician-Jurassic)
  - Order **Terebratulida** (Devonian-Recent)



1 cm

http://paleo.cortland.edu/tutorial/Brachiopods/Brachiopod%20Images/rhynchonellid.GIF

Terebratula sp. Miocene-Pliocene

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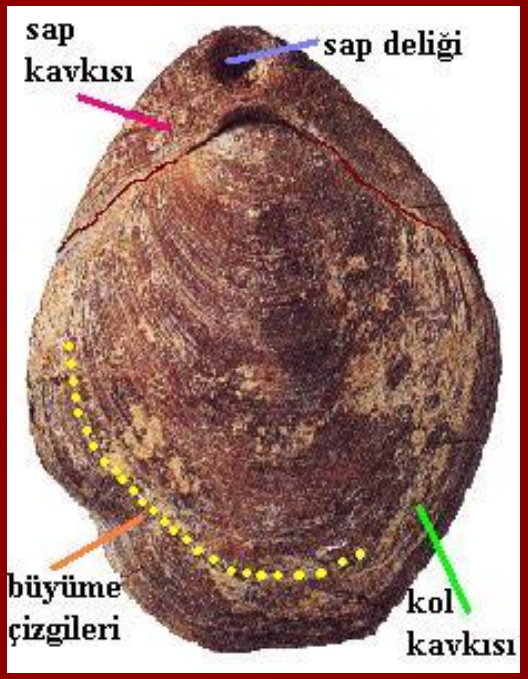

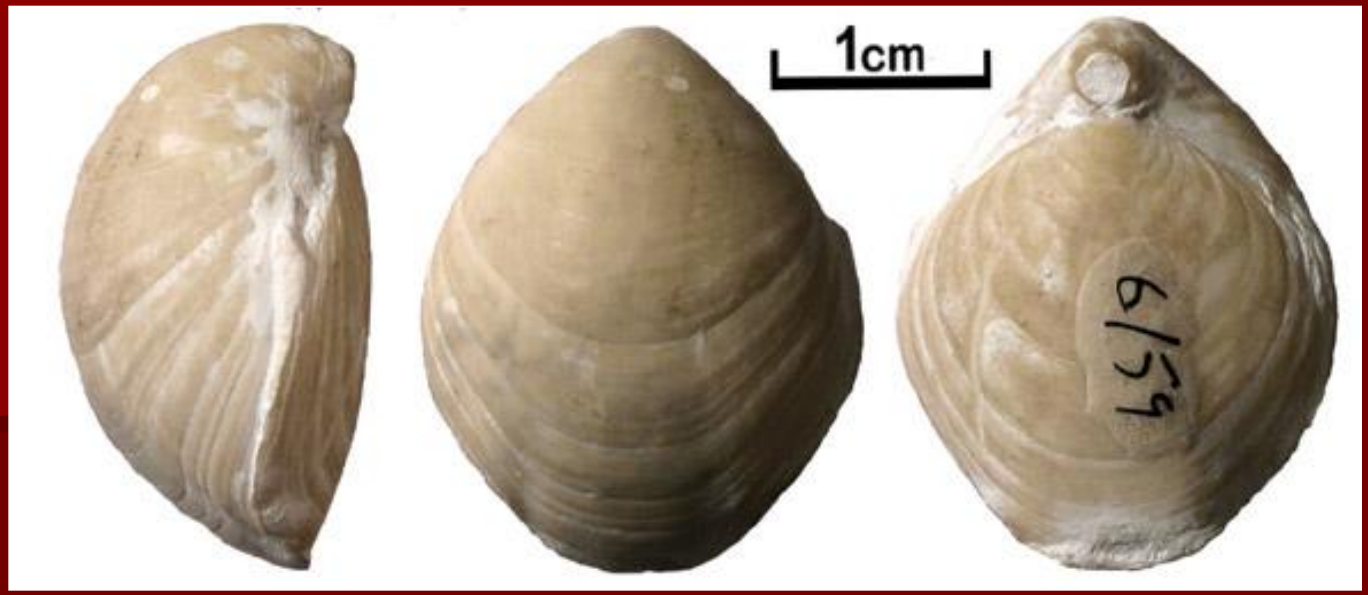

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Lobothyris sp. Early-Middle Jurassic

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Limestones with rich brachiopods

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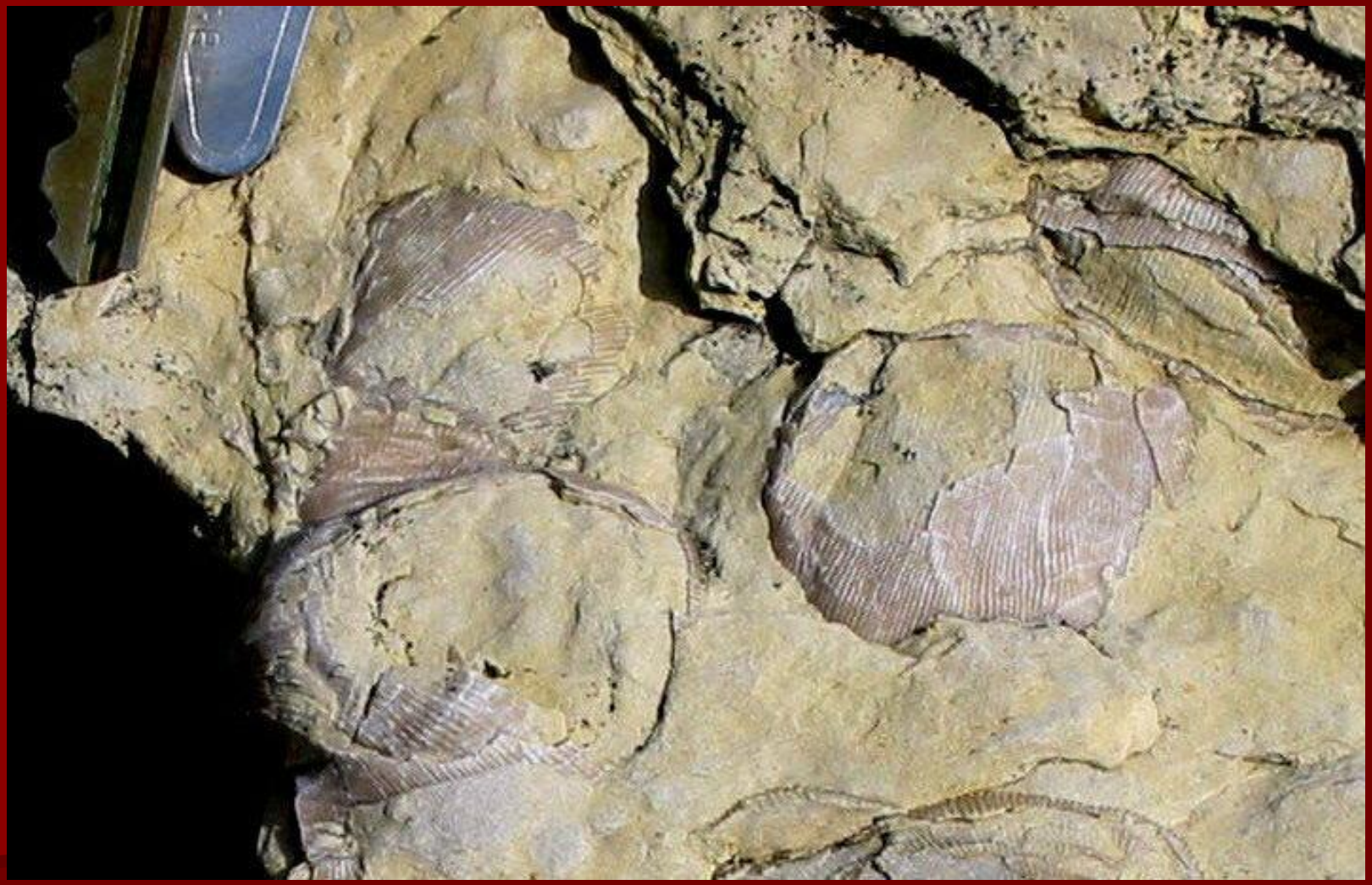
Pictures from Alkaya (Selçuk Univ.), lecture notes,

Limestone with rich brachiopods



Linoproductus

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Limestone with rich brachiopods

Aulacothyris anatolica

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Limestone with rich brachiopods

Tetrarhynchia tetrahedra

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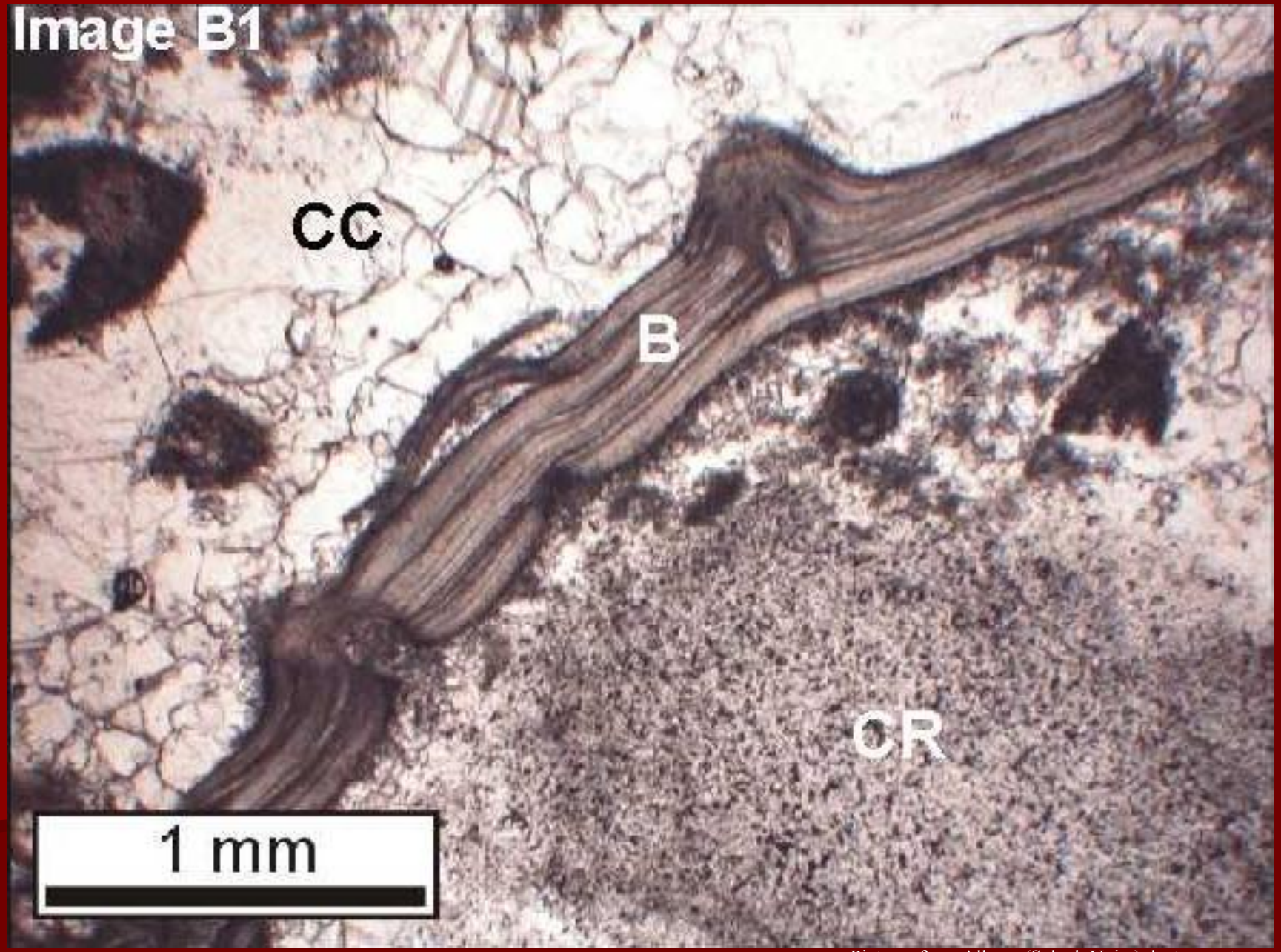
Brachiopods within thin sections



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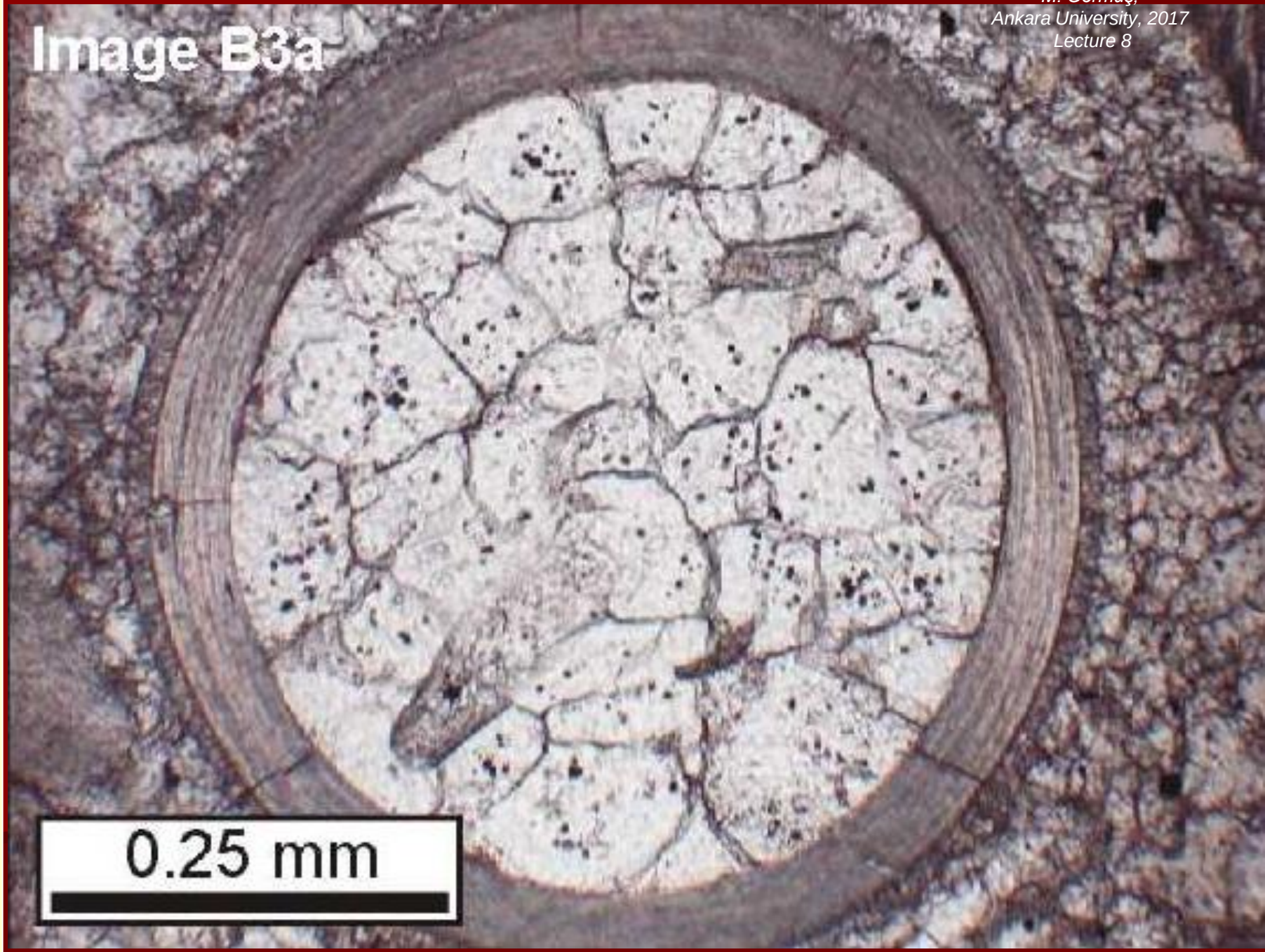
Brachiopods within thin sections



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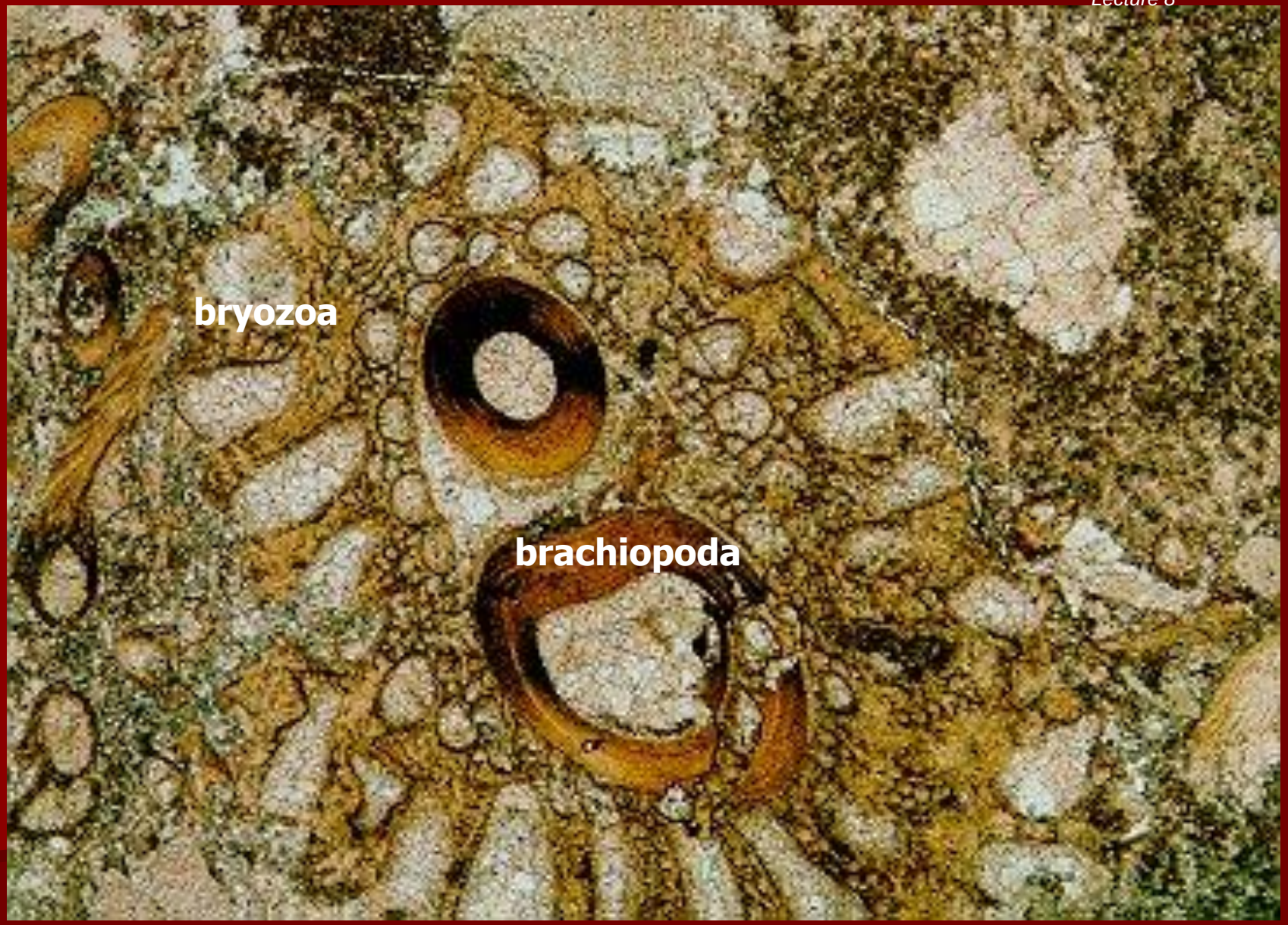
Brachiopods within thin sections



Pictures from Alkaya (Selçuk Univ.), lecture notes,

Homework 8

Please get a stratigraphical range chart of the genera of Bryzoa and Brachiopoıda phylums mentioned in the Lecture 8.