B. SC. SEMESTER-II

BOTANY PAPER I
(PALAEOBOTANY, PTERIDOPHYTES, GYMNOSPERMS AND SOIL ANALYSIS)

UNIT-1: (PALAEOBOTANY)

1. Palaeobotany: Definition; fossil and Pseudo-fossil, Importance of fossils.

2. Types of fossils: Compression, Impression, Cast-Mold, Petrification and Amber.

3. Geological time scale: Definition, Outline and brief account of Eras

4. Fossil leaf: Glossopteris, Fructification: Scutum

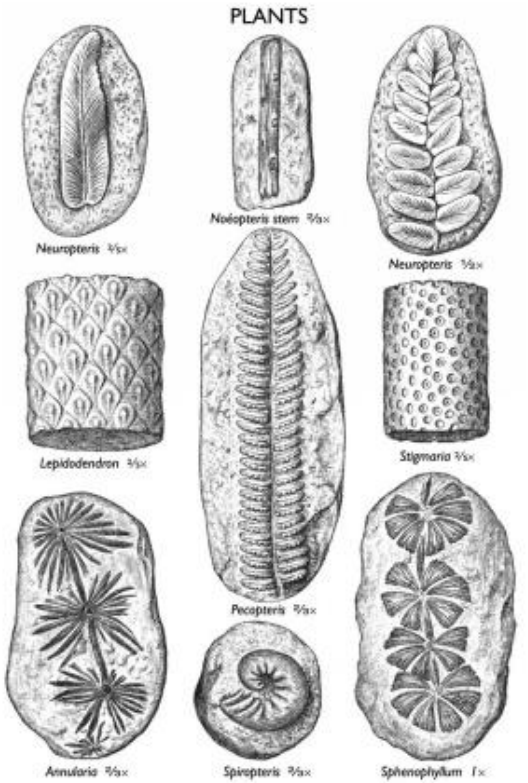
1. Palaeobotany: Fossils

- The term fossil is derived from the word '*fossilis'* or '*fodere'*, which means *'to dig out'*. Thus, fossil is some object occurring inearth's crust which requires to be dug out.

- According to Schop(1975), any specimen which demonstrates the physical evidence of occurrence of ancient life forms i.e., Holocene or older, may be defined as fossil".

- Steward (1983)on the other hand, has defined

- fossils as, "any evidence of prehistoric life forms".



Pseudo-fossil

- Pseudofossils are visual patterns in rocks that are produced by naturally occurring geologic processes rather than biologic processes.

- They can easily be mistaken for real fossils.

- Some pseudofossils, such as dendrites, are formed by naturally occurring fissures in the rock that get filled up by percolating minerals.

- Other types of pseudofossils are kidney ore (round shapes in iron ore) and moss agates, which look like moss or plant leaves.

- Concretions, round or oval-shaped nodules found in some sedimentary strata, were once thought to be dinosaur eggs, and are often mistaken for fossils as well.

Importance of fossils.

- They provide crucial information regarding the organism.
- It helps develop connecting links between different groups of organisms and study evolutionary relationships.
- Its discovery helped predict when the first fish would have ventured onto land.
- Fossils are key evidence that helps study evolution and the adaptation of different organisms to the environment.
- It provides the record of how organisms evolved and is represented as the tree of life.
- Fossils present at the bottom of the rock are simple while the ones which are present at the top are the most recent fossils.
- This succession revolves around evolution.
- The fossil record of certain mammals can be studied in a series of evolution by looking into their geological time scale.

Fossilization:-

- Fossilization is the processes by which a plant or animal becomes a fossil.

- This processes is extremely rare and only a small fraction of the plants and animals that have lived in the past 600 million years are preserved as fossils.

- Those plants and animals that do becomes fossils generally undergo, with some exception, several key steps.

First steps:-

- The soft tissue that exists during life decays leaving behind only the hard parts,(bone, shell, teeth).

Second steps:-

- Hard parts may be transported and broken. They represented remains incomplete living animal.

Third steps:-

- It is most important steps hard tissue become buried and altered.

- This totally three steps connectively called as processes of fossilization.

- Million years take place for fossils formation.

Theory of fossilization:-

There are many theory proposed by palaeobotanist tot explained the fossilization.
Out off two theory are given below:-

1) Replacement theory

2) Infiltration theory

Replacement theory:-

- In some cases , organic matter or minerals of an organisms can be replaced by different minerals substances. This replacement take place between molecules to molecules at microscopic level.
- Such molecules to molecule replacement called as replacement theory.
- Depending on the chemistry of pore waters within the sediment, a numbers of minerals replaced with the original matter or material.
- These transformation take place eerily or later stages of fossilization.
- The most common replacement minerals are :-
- Calcite
- Silica
- Pyrite and aragonite etc.
- Bone, shells and wood well preserved in this manner.

Infilterations theory:-

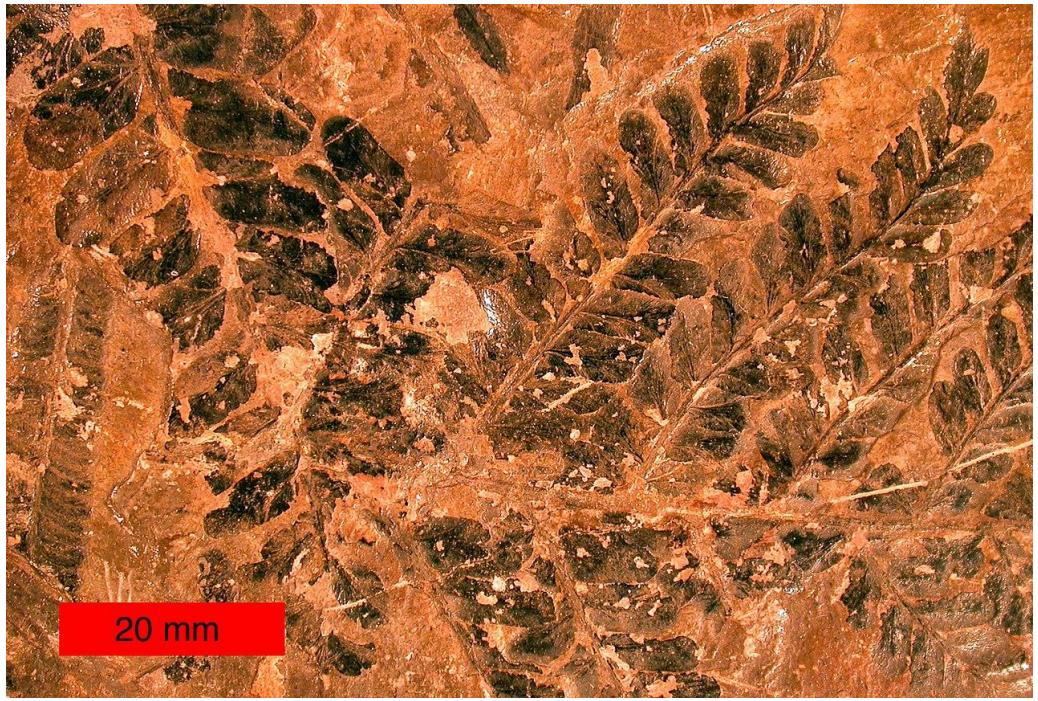
- In this theory, the infiltration of minerals substance occurs which is followed by interaction between the soluble minerals salts that exists in surrounding water and certain other compounds which are relapsed during plant cell walls partial integration
- That causes precipitation.
- This process releases free carbon that help in reducing sulfides contained in water.

2. Types of fossils:

Compression

- A compression fossil is a fossil preserved in sedimentary rock that has undergone physical compression.
- Compression fossils, such as those of fossil ferns, involve chemical reduction of the complex organic molecules composing the organism's tissues. In this case, the fossil consists of original material, albeit in a geochemically altered state.
- It is uncommon to find animals preserved as good compression fossils, it is very common to find plants preserved this way. The reason for this is that physical compression of the rock often causes distortion of the fossil. Since leaves are basically flat, the resulting distortion is minimal. Plant stems and other three-dimensional plant structures do not preserve as well under compression. The best fossils of leaves are found preserved in layers of sediment that had been compressed in a direction perpendicular to the plane of the deposited sediment.
- Typically, only the basic outline and surface features are preserved in compression fossils. Internal anatomy is not preserved.

- Compression fossils are formed most commonly in environments where fine sediment was deposited, such as in river deltas, lagoons, along rivers, and in ponds. The best rocks in which to find these fossils preserved are clay and shale, although volcanic ash may sometimes preserve plant fossils as well.



Impression

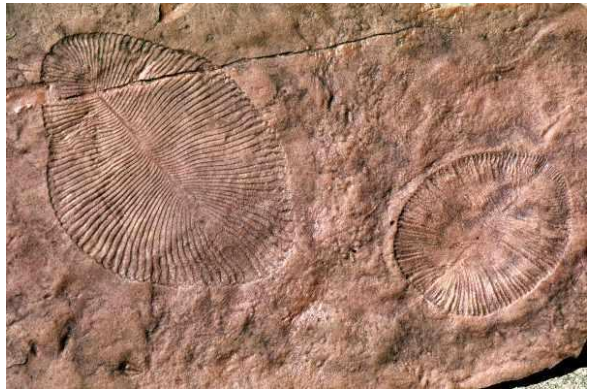
An imprint fossil, also known as an impression fossil or fossilized impression, is a fossil that doesn't contain organic material. They are a form of trace fossil – a fossil that leaves evidence of an organism's movements or activity. Examples of trace fossils include footprints, eggshells, nests and more.

Cast-Mold

- **Cast Fossils** A cast fossil forms when a mold is filled with sand or mud that hardens into the shape of the organism

- **Mold Fossils** Mold fossils form when sediments bury an organism and the sediments change into Rock

- The organism decays and leaves behind a cavity in the shape of the organism



Petrification

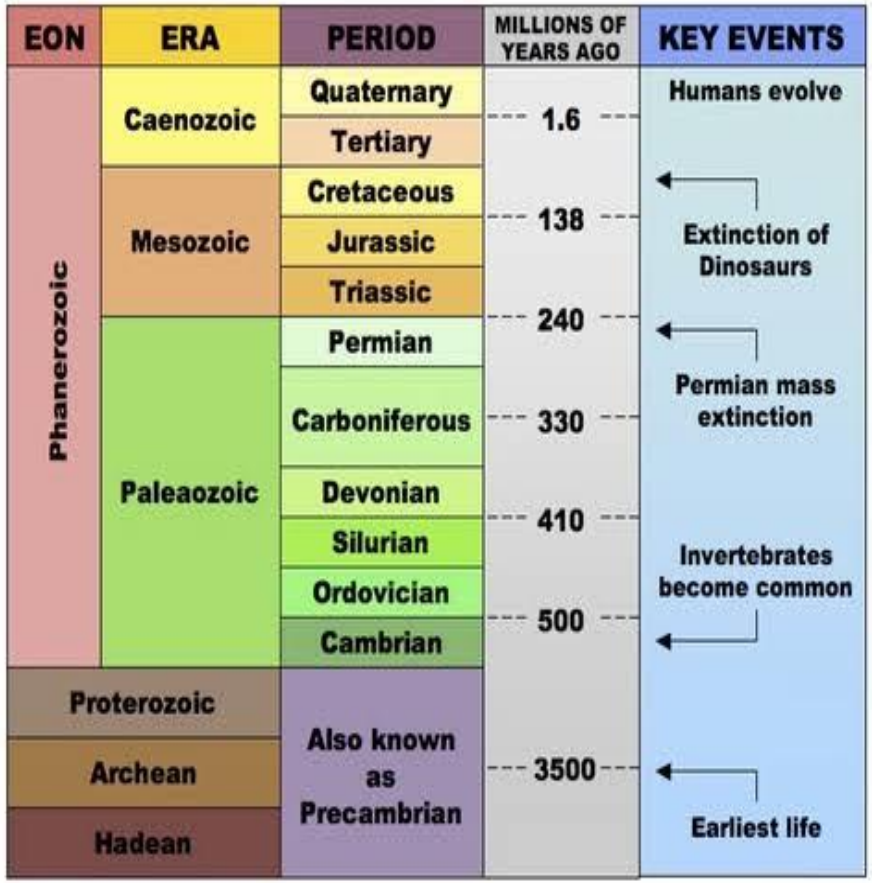
Petrified fossils form when minerals soak into the buried remains of an organism (usually plants or trees), and changes them into rock

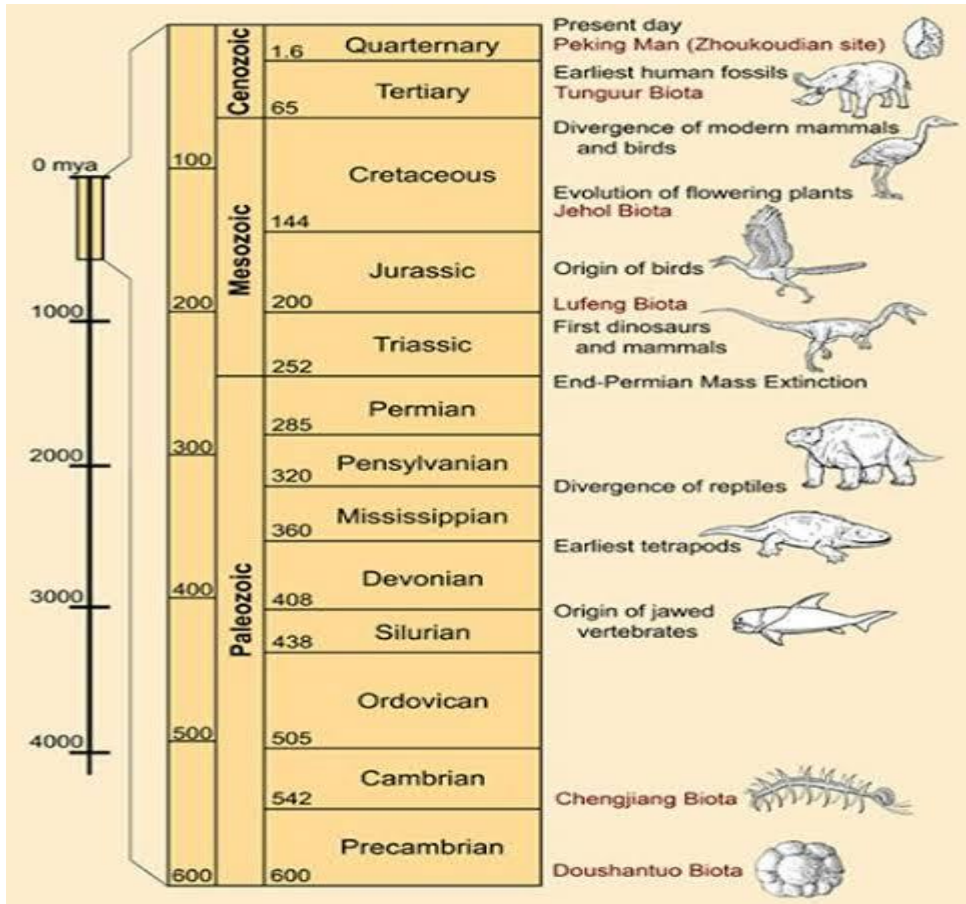
Amber.

- Amber is organic, like petrified wood or dinosaur bones, but, unlike those substances, it retains its chemical composition over time, and that is why some experts resist calling it a fossil resin.
- Amber preserves organisms three-dimensionally and with great fidelity, including arthropods, fungi, bryophytes, lichens, as well as minute inclusions of seed plants, such as leaves, flowers, catkins and pollen

3. Geological time scale: Definition Outline and brief account of Eras

- The geological time scale is a record of the life forms and geological events in earths history.
- Scientists developed the time scale by studying rock layers and fossil world wide.
- The largest section are called eons.
- Eons divided into eras.
- Eras divided into periods.
- Periods divided into epochs.,i.e epoch is a smallest scale on he geological time scale.
- The geological time scale described the below figure


EON
ERA
PERIOD
MILLIONS OF YEARS AGO
KEY EVENTS
Phanerozoic
Caenozoic
Quaternary
Tertiary
1.6
Humans evolve
Mesozoic
Cretaceous
Jurassic
Triassic
138
Extinction of Dinosaurs
240
Paleaozoic
Permian
Carboniferous
330
Permian mass extinction
Devonian
410
Silurian
Ordovician
Invertebrates become common
500
Cambrian
Proterozoic
Archean
Hadean
Also known as Precambrian
3500
Earliest life


0 mya
1000
2000
3000
4000
100
200
300
400
500
600
Cenozoic
Mesozoic
Paleozoic
1.6
Quarternary
65
Tertiary
Cretaceous
144
Jurassic
200
Triassic
252
Permian
285
Pensylvanian
320
Mississippian
360
Devonian
408
Silurian
438
Ordovican
505
Cambrian
542
Precambrian
600
Present day
Peking Man (Zhoukoudian site)
Earliest human fossils
Tunguur Biota
Divergence of modern mammals and birds
Evolution of flowering plants
Jehol Biota
Origin of birds
Lufeng Biota
First dinosaurs and mammals
End-Permian Mass Extinction
Divergence of reptiles
Earliest tetrapods
Origin of jawed vertebrates
Chengjiang Biota
Doushantuo Biota

4. **Fossil leaf: *Glossopteris*, Fructification: Scutum**

- Glossopteridales included an extinct group of seed plants.
- They were originated during the Permian period on the Gondwana Continent.
- They became the dominant vegetation in the Permian period.
- They extinct completely by the end of the Triassic period.
- The order name derived from the genus *glossopteris.*
- *Glossopteris* is the best known member of Glossopteridales.
- *Glossopteris* is a leaf.
- The name *Glossopteris* means tongue – fern.
- The name was used to describe fossil leaves from India and Australia that were spatulate and tongue- shaped. (glossa = tongue)
- About 70 species of *Glossopteris* have been recognized from India alone.

Important genera of Glossopteridales

- **Leaves** : *Glossopteris , Gangamopteris*
- **Stem and Root** : Vertebraria
- **Male Fructifications** : Glossotheca
- **Female Fructifications** – two types :
- **Cupular Fructifications** : Pterigospermum
- **Multi- ovulate Fructifications** : Scutum

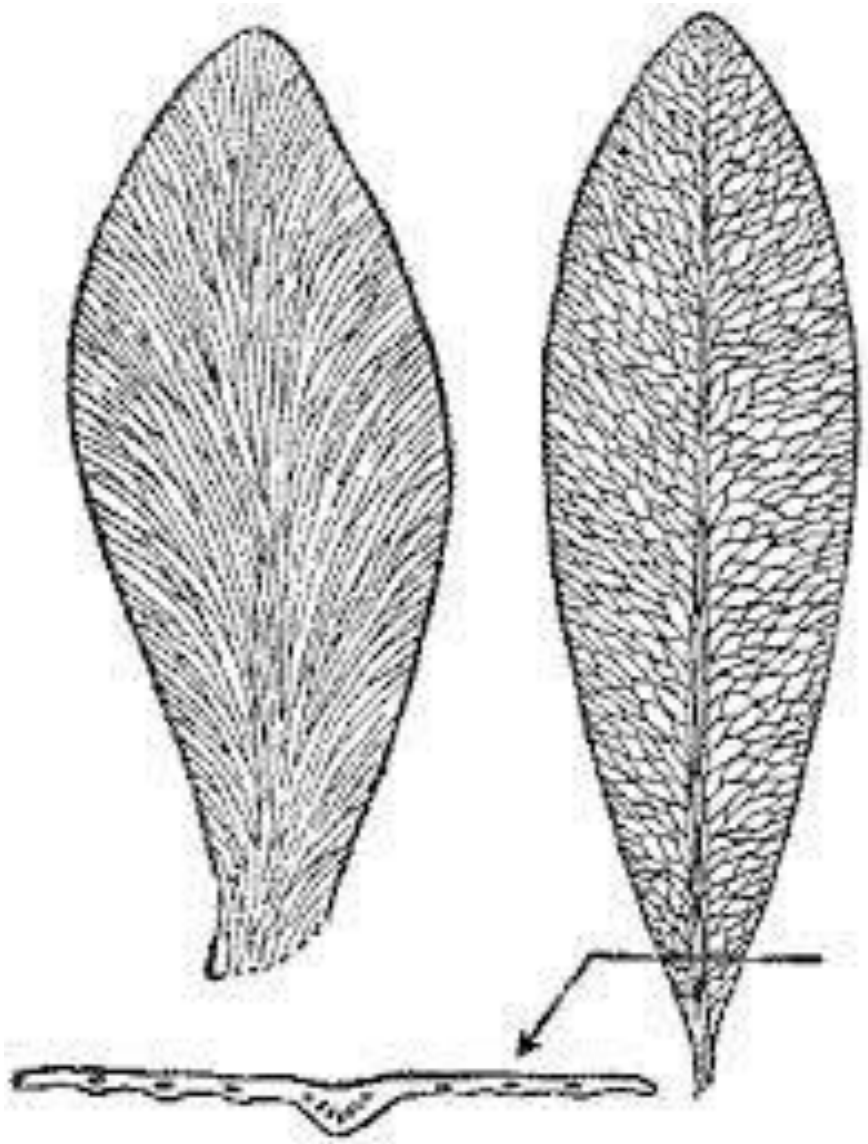
Morphology of leaf

- The leaves described under name Glossopteris were present in spiral or whorls probably on short shoot.

- For many years species of Glossopteris leaves were identified on the basis of external form and venation pattern.

- The important features of the leaf is presence of a single prominent midrib from which numerous fine veins pass out to the margin forming a network of dichotomous branching.

- Glossopteris leaves are simple, entire, sessile or very shortly petiolate, linear, lanceolate to spathulate ovate and with a very strong midrib, many species of such leaf fossils are known from the Indian lower Gondwana, viz, *G. indica*, *communis*, *angustifolia*, *decipens*, *longicaulis*, *ampla*, *retifera*, *browiana*,



Internal Structure of Leaf.

- Detailed anatomically studies of the leaves have been made by Pant (1958). Leaves are dersiventrally flattened and hypostomatic.
- The stomata are sunken and irregularly distributed between the veins.
- They are of the haplocheilic type. In some species a hypodermis may be present below the epidermis.
- The mesophyll is differentiated into palisade and spongy parenchyma. The vein of the midrib has scalariformly thickened tracheids. Leaf genera are distinguished on the basis of venation.
- Leaves with midrib
- *Glassopterts*: Form a distinct midrib, Secondary veins arise at different angles, forming mesh of varied size.
- *Rhabdotaenia*: Midrib traverses 2/3 portion of leaf Secondary veins originate at acute angle which dichotomise without getting anastomose.
- *Gangamopteris*: Median sub-parallel vein gives rise to secondary veins at acute angles forming meshes due to interconnections.

Reproductions

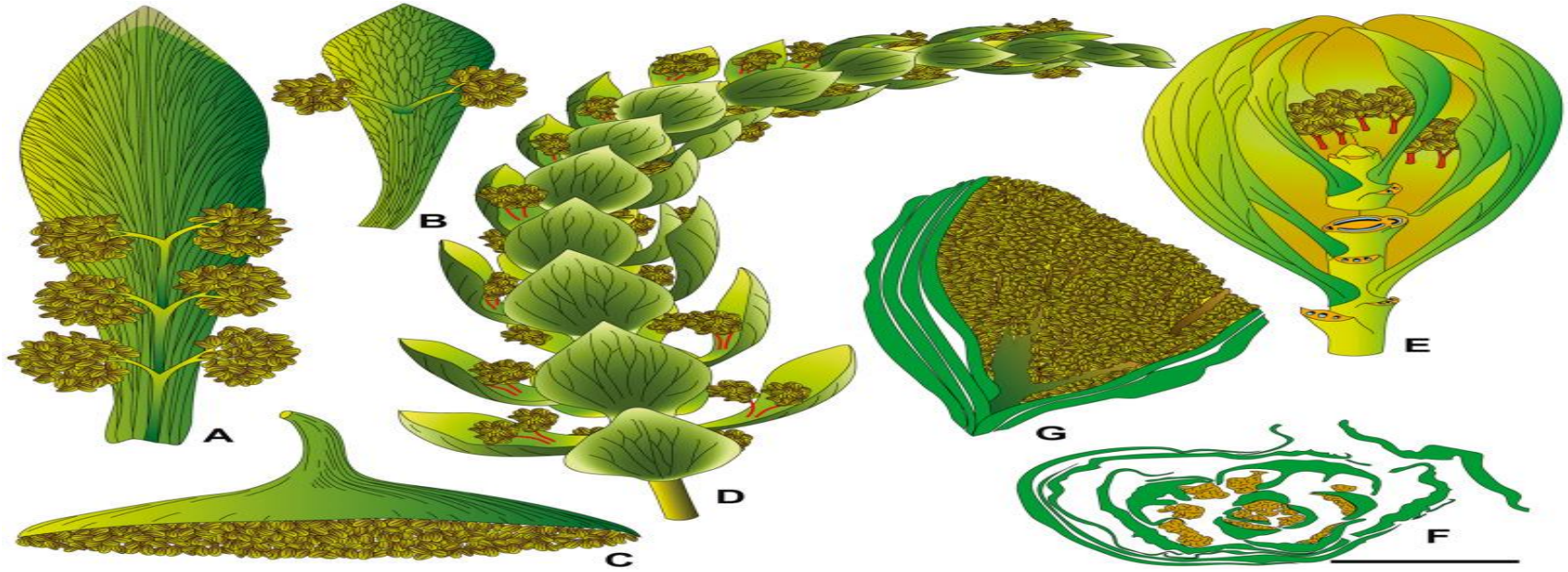
- The Glassopteris plant reproduces by means of male and female fructifications as these fructifications have been found detached from the vegetative plant body in a number of cases, hence it is difficult to designate whether the Glossopteris plant was monoceious or dioceious.

- The fructifications associated with Glassopteris are male, female and occasionally bisexual also. All the fructifications are borne on the leaf some however may be axillary.

- In a few instances the fructifications are found in organic connection with the Glossopteris leaves

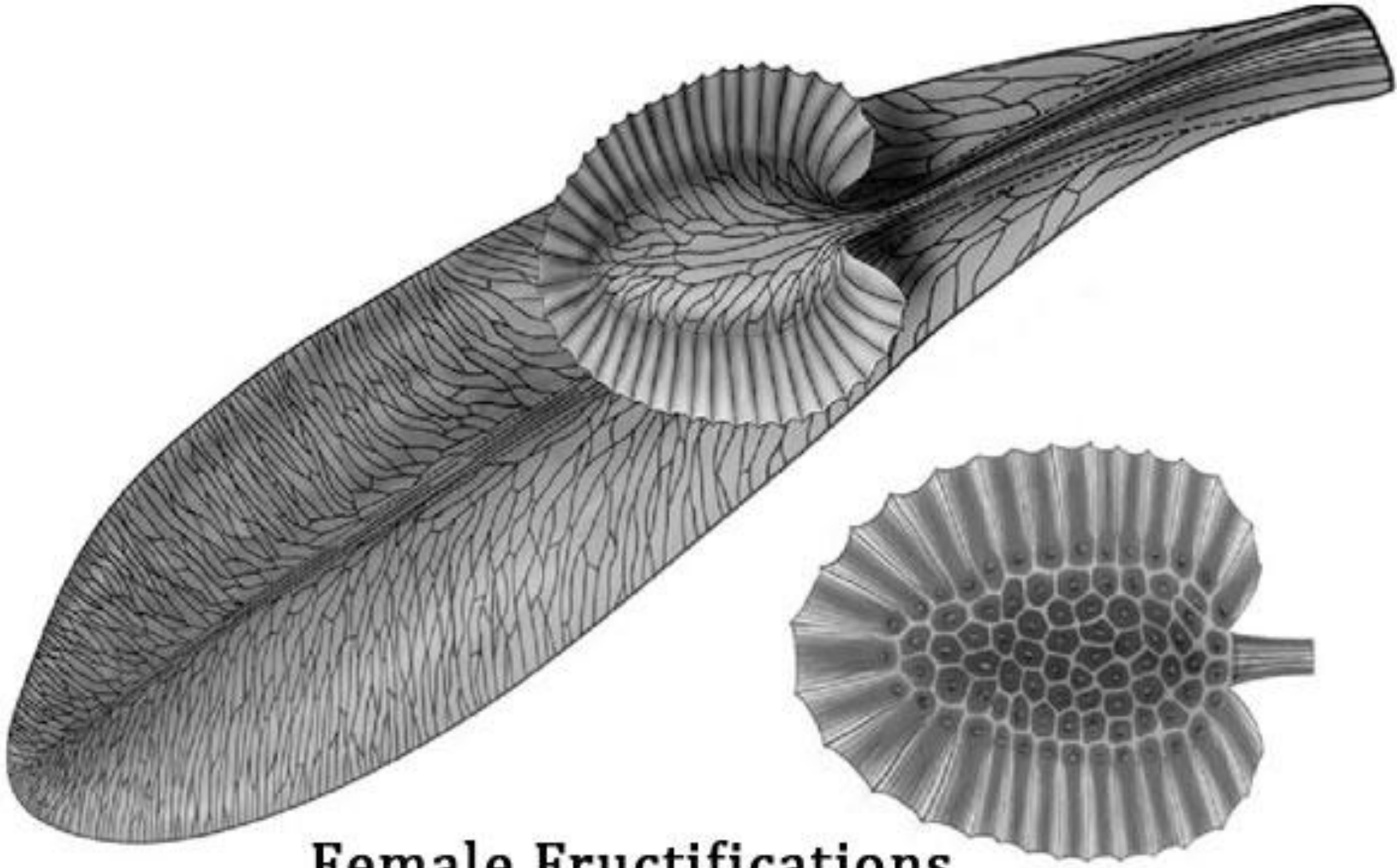
Male Fructifications

- A number of male fructifications have been identified and are given the names *Eretmonia* and Glossotheca
- Both fructification bear microsporangia *Eretmonia* consists of a petiolate lamina and has a triangular outline.
- The upper part of the lamina bears two branches which intern bear two whorls of microsporangia.
- The microsporangia are Purace shapedand open out due to longliudinal splitting the pollen are striated soul has two sacks According to Pant (1987) Pollination was probably anemophilus.



Female Fructifientions

- A large number of female fuctificatious have been included in the *Glossopteris*
- Some of them are attached to the *Glossopteris* leaf while some are attached to the modified leaf or bract.
- In addition to this some seeds not found in organic connection but found in asociation of the Glossopteris leaves are also included.
- The reproductive structure is lanceolate to ovate and attached by a pedicel to a lower part of a leaf midrib. The structure is bisexual, the lower sac representing seeds while the upper ones are pollen sac. The Fructifications go under the name Scutum has been found also in India.
- It is a cupulate structure with two bilaterally concave symmetrical-(upper and lower) valves and a wing like expansion along the line where the two valves join. It seems that the valves of the cupule closed after fertilization.. Small sac-like (1 to 2 mm in diameter) structures occur in the concavity of both the halves.



Female Fructifications


a
b
c
d
e
f
g

THE END