Pre University Examination (2017-2018)

B.Sc.-II (CBZ)

Paper III- Pteridophytes, Gymnosperms and Paleobotany

Set A

Time: 3:00 Hours **Max. Marks: 33**

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1. Answer the following (not more than 20 marks) **½ mark each**

(a) Write name of two pteridophytes.

Answer: *Lycopodium, Selaginella, Marsilea* and *Equisetum.*

(b) How many cotyledons are present in the seed of *Ephedra*?

Answer: 2

(c) Whatcause sulphur like yellow dust in the Himalayas in pine forests in the month of April?

Answer: As the pollen cones mature, they discharge large quantities of pollen grains into the air and it appears as a yellow cloud of yellow of winged pollen grains in *Pinus*. This is called Sulphur Shower and occurs during spring. Pollen grains are released and carried by wind to the female cones.

(d) Define Protostele.

Answer: The most primitive form of stele, consisting of a solid core of xylem encased by phloem or of xylem interspersed with phloem. The roots of all vascular plants, as well as the stems of lycophytes, haveprotosteles.

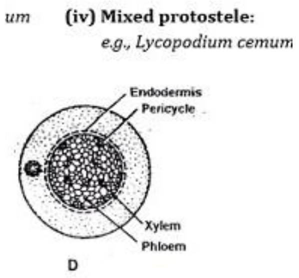
(e) Negatively geotropic roots are found in which genera?

Answer: Cycads.

(f) Which pteridophyte is used as gold indicator?

Answer: *Equisetum accumulates.*

(g) Draw a diagram of mixed protostele.



(h) Define apospory.

Answer: Apospory is the development of 2n gametophytes, without meiosis and spores, from vegetative, or non-reproductive, cells of the sporophyte.

(i) Which component of xylem is absent in *Ephedra.*

Answer: vessels**.**

(j) Which pteridophyte show secondary growth?

Answer: *Psilotum***.**

(k) Name the drug obtained by *Ephedra*.

Answer: Ephedrine.

(l) What is Eusporangiate development of sporangia?

Answer: Sporangia develop from more than one initial cell. Each sporangium contains an indefinite large number of spores.

(m) Write the name of gymnospermic plant whose female cone never develops.

Answer: *Cycas***.**

(n) Spike moss is the common name of which pteridophyte?

Answer: *Selaginella***.**

(o) Who discovered fossil genus *Williamsonia*?

Answer: William Crawford Williamson.

(p) Chilgoza, a dry fruit, is actually seed of which plant.

Answer: *Pinus.*

(q) A drug for the treatment of asthma is obtained from which plant?

Answer: *Ephedra.*

(r) What is petrification?

Answer: **Petrification** is the process of turning living organic material into stone. This process takes place when the molecules in an organism are replaced with the molecules of a mineral.

Unit I

2. Write short notes on following-

(i) Apogamy and Apospory. **1½ + 1½**

Answer: Apogamy: Development of sporophyte from the gametophytic tissue without involving fusion of gametes is known as apogamy. Such sporophytes grow vegetatively by budding from the gametophyte, hence they have the same level of ploidy as gametophytes. Apogamy first discovered by Farlow (1874) in *Pteris cretica*, and this term was introduced by de Bary in 1878. There are more than 50 sp of ferns in which apogamous sporophytes are known to occur naturally due to te absence of or nonfunctional nature of one or both sex organs, such apogamy is known as obligate apogamy.

When functional sex organs can be induced apogamous sporophyte, it called facultative apogamy.

Species of *Dryopteris, Adiantum, Diplazium, Pteris, Polystichum, Osmunda* and *Asplenium* are some examples of obligate apogamy. Lang (1896) was the first to induce apogamy successfully in many varieties of ferns. According to him 3 factors play an important role in the induction of apogamy: (1) ability of prothallial cell to become meristematic, (2) prevention of fertilization and (3) exposure of prothallus to direct illumination.

Factors:

1. Nutritional factor: maximum no. of apogamous sporophyte are obtained if the gametophytes are placed in 4 % sucrose solution.

2.Light quality: far red light (705nm) has been found to be the most effective in inducing apogamous sporophyte followed by blue (445nm) and wight light.

3. Hormones: presence of hormones like 2,4-D, GA_3, IAA, and tryptophan stimulate apogamous sporophyte at very low concentration (0.5 %) of carbohydrates.

Apospory: development of gametophyte directly from vegetative cell of the sporophyte without the formation of spores is known as apospory. Therefore, aposporous gametophytes have the same no. of chromosomes as sporophytes. Apospory first demonstrated by Druery (1884) in *Athyrium filix-femina*. Aposporous gametophytes have also been observed on the young leaves of *Osmunda regalis,* and *O. javanica.*

Factors:

1. Nutrition: complete absence of carbohydrate in growth medium induced development of aposporous gametophyte, 1 % carbohydrate induced callus like structure formed structure which was partly gametophytes and partly sporophytes (gametosporophytes), while 2 % carbohydrate induced only callus formed only sporophyte.

2. Light intensity: low light intensity favors development of aposporous gametophyte.

3. Age of sporophytic cells: young cells of shoot apex or leaf tip form gametophytes, whereas basal parts of shoot or leaf regenerate sporophytic tissue.

(ii) Economic importance of Pteridophytes.

Answer: pteridophytes have many economic importance like as follows:

(1) Food: Like other plants, pteridophytes constitute a good source of food to animals. Sporocarps of Marsilea, a water fern, yield starch that is cooked and eaten by certain tribal.

(2) Soil Binding: By their growth pteridophytes bind the soil even along hill slopes. The soil is protected from erosion.

(3) Scouring: Equisetum stems have been used in scouring (cleaning of utensils) and polishing of metals. Equisetum species are, therefore, also called scouring rushes.

(4) Nitrogen Fixation: Azolla (a water fern) has a symbiotic association with nitrogen fixing cyanobacterium Anabaena azollae. It is inoculated to paddy fields to function as biofertilizer.

(5) Medicines: An anthelmintic drug is obtained from rhizomes of Dryopteris (Male Shield Fern).

(6) Ornamentals: Ferns are grown as ornamental plants for their delicate and graceful leaves.

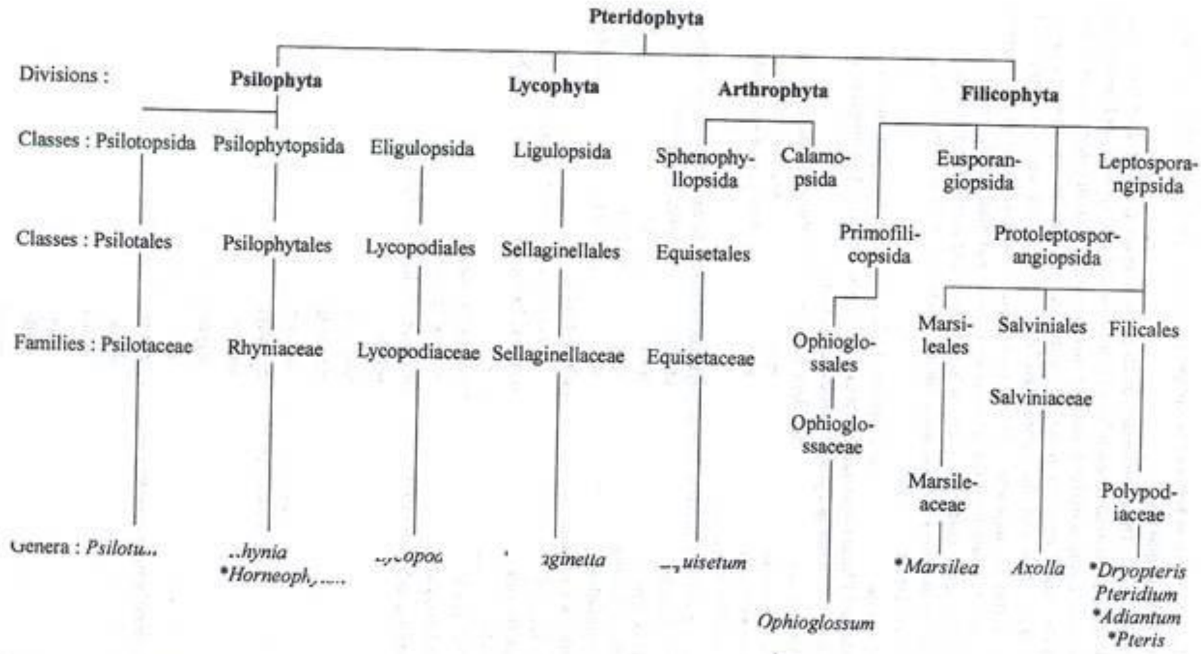
(7) Indusrial use- Club mosses are used as a dry industrial lubricant since it microscopic spore contain non-volatile oil.

(8) Forensic Investigation- Spores of mosses are use as finger print powder in forensic investigation. Also use as photography flash powder.

OR

Give a detailed account of classification of pteridophytes given by Smith. 6

Answer: According to Smith (1955) the classification of the pteridophytes is as follows:



The characteristic features of these divisions are as follows:

Psilophyta:

The sporophyte is differentiated into a rhizoid bearing subterranean rhizome and an aerial portion. The aerial portion is branched. The vascular system is of protostelic type. Leaf gaps are absent from vascular cylinder. The terminal sporangia are borne singly at the tips of short or long branches. The gametophyte is subterranean and colourless. They are homosporous. Antherozoids are multiciliate.

Lycophyta:

The sporophyte is differentiated into stem, roots, and leaves. The leaves are microphyllous, and with a single vein. The vascular strands or steles may be protostelic, siphonostelic, or polystelic. The leaf-gaps are always absent; sporophylls produce a single sporangium on the adaxial side near its base. The sporophylls are borne in strobili. They are homosporous or heterosporous. The antherozoids are biflagellate or multiciliate.

Arthrophyta:

The sporophyte is differentiated into stem, roots and leaves. The stem possesses distinct ridges and furrows. The foliage leaves are borne in transverse whorls upon stems and their branches. The vascular cylinder is protostelic or siphonostelic. The leaf-gaps are absent. The sporangia are produced upon a specialized structure, the sporangiophores present at the apex of the stem. The antherozoids are multiciliate. They are homosporous.

Filicophyta:

The sporophyte is differentiated into stem, leaves and roots. With the exception of protostelic forms, the other siphonostelic forms possess leaf-gaps in their vascular cylinders. The leaves are macrophyllous. The leaf bears many sporangia on either the margin or the abaxial face of the leaf lamina. They are homosporous. The antherozoids are multiciliate. The sex organs are found on the ventral surface of the heart-shaped prothallus (gametophyte).

Unit II

3. Write short notes on following-

(i) L.S. of strobilus of *Selaginella.* **3**

Answer: Study first the external features of strobilus under dissecting microscope, cut L.S., stain in safranin- fast-green combination, mount in glycerine and study. Also compare your preparations from the permanent slides of L.S. strobilus.

1. Spore-bearing organs are present on the apical part of the main axis as well as on the lateral branches. These are called sporangia

2. Sporangia are present in the axil of the leaf-like structures called sporophylls.

3. Each sporophyll has a ligule at its base and a stalked sporangium on the adaxial surface, and thus the sporangium is present in between the main axis and the ligule of the sporophyll.

4. Sporophylls are loosely and spirally arranged, usually in four rows on the axis.

5. All the sporophylls and sporangia form a four- angled loose cone called strobilus or sporangiferous spike.

6. Length of the strobilus ranges from 1/4 to 1 or 2 inches in different species.

7. Sometimes the apical portion of strobilus grows into a vegetative structure as in S. *cuspidata*. It does not bear any type of spore.

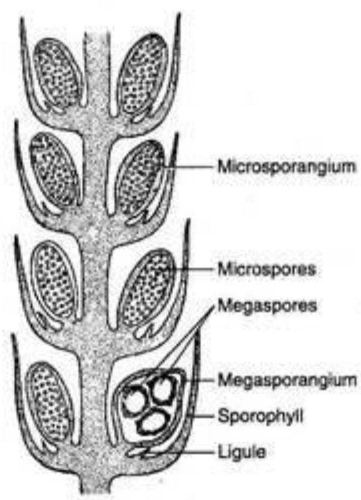


Fig. 7.51 : *Selaginella kraussiana* : L.S. of strobilus

8. Two types of sporangia are present in the strobilus, i.e., macrosporangia and microsporangia.

9. Sporophyll containing macrosporangium is known as macrosporophyll.

10. Each macrosporangium contains only four macrospores.

11. Sporophyll containing microsporangium is known as microsporophyll.

12. Each microsporangium contains numerous microspores.

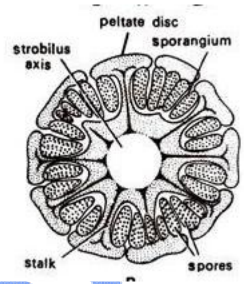
13. In majority of the cases, as in *S. kraussiana*, lowermost one or two sporophylls containmegasporangia and rest of the other upper ones contain microsporangia.

14. In some species all the sporophylls of one side of axis bear only microsporangia while that of the other side only macrosporangia, as in *S. oregana*, *S. inaequalifolia*, etc.

15. In *S. gracilis*, a strobilus bears either microsporangia or macrosporangia.

16. Both the types of sporangia are stalked structures surrounded by a sporangial wall, consisting of two outer jacket layers and an innermost layer of tapetum. Tapetum is very clear in young sporangia.

(ii) T.S. of Cone of *Equisetum*. **3**



Answer: Fertile aerial, unbranched shoots bear at their apices, the spore-bearing compact organs known as strobili (sing, strobilus) or cones. In some rare cases branched fertile axis is also present. Each cone or strobilus has a thick central axix known as strobilus axis or cone axis. On the strobilus axis are attached many umbrella like sporangiophores in whorl. Each sporangiophore is a stalked structure, the free end of which becomes flattened to form a peltate disc. The disc is a hexagonal structure and present at right angle to the stalk. On the undersurface of disc are present many sporangia, horizontally towards the axis of strobilus.

OR

Describe structure and development of prothallus of *Equisetum*. **6**

Answer: *Equisetum* is a homosporous pteridophyte. The haploid spores germinate to form gametophyte. The germination takes place immediately if the spores land on a suitable substratum. If the spores do not germinate immediately, their viability decrease significantly. The spores swell up by absorbing water and shed their exine. The first division of the spore results in two unequal cells: a small and a large cell. The smaller cell elongates and forms the first rhizoid. The larger cell divides irregularly to produce the prothallus. The prevailing environmental conditions determine the size and shape of the prothallus.

If a large number of spores are developed together within a limited space, then the prothalli formed are of thin filamentous type. But relatively thick and cushion-shaped prothalli are formed from sparsely germinating spores. Mature gametophytic plants may range in size from a few millimeters up to 3 centimeters (e.g., *E. debile*) in diameter.

They are dorsiventral and consist of a basal non-chlorophyllous cushion-like portion from which a number of erect chlorophyllous muticellular lobes develop upwards. Unicellular rhizoids are formed from the basal cells of cushion.The prothallus bears sex organs and reproduces by means of sexual method.

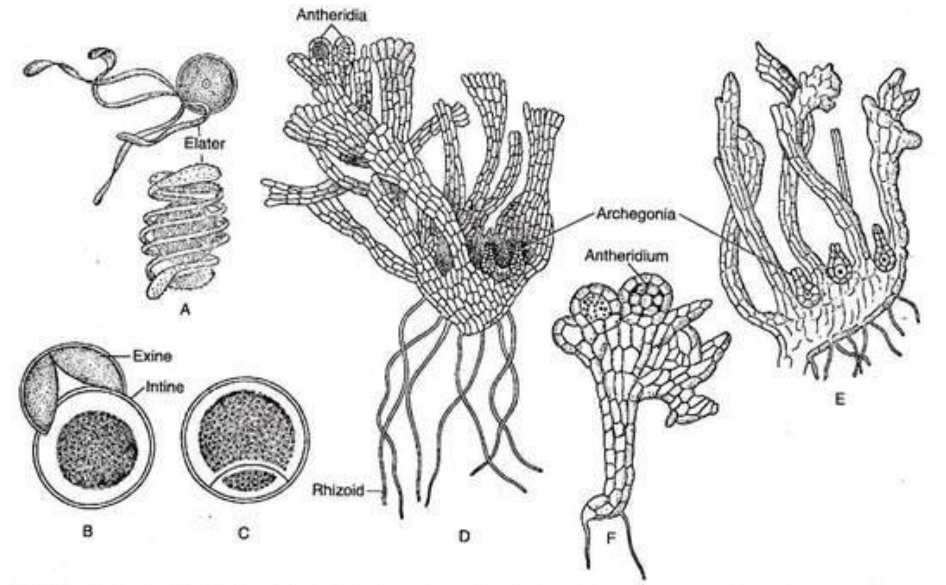


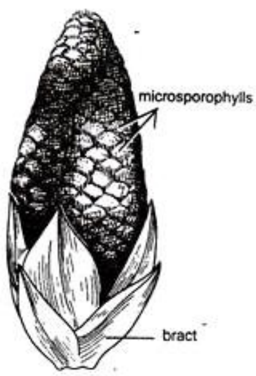
Fig. 7.87 : *Equisetum* : A. Spores with elaters, B–C. The stages of germination of spore, D. Monoecious gametophyte, E. Female gametophyte, F. Male gametophyte

Unit III

4. Write short notes on following-

(i) Male and female cone of *Pinus*. **1½ + 1½**

Answer: Male cone: The male cones develop in clusters in the axil of scaly leaves on long shoot. They replace the dwarf shoots of the long shoot. Each male cone is ovoid in shape and ranges from 1.5 to 2.5 cm. in length. A male cone consists of a large number of microsporophylls arranged spirally on the cone axis.Each microsporophyll is small, membranous, brown-coloured structure. A microsporophyll is comparable with the stamen of the flower of angiosperms because it consists of a stalk (filament) with a terminal leafy expansion (anther), the tip of which is projected upwards and called apophysis. Two pouch-like microsporangia (pollen sacs) are present on the abaxial or undersurface of each microsporophyll. In each microsporangium are present many microspores (pollen grains). Each microspore or pollen grain is a rounded and yellow-coloured, light, uninucleate structure with two outer coverings, i.e., thick outer exine and thin inner intine. The exine protrudes out on two sides in the form of two balloon-shaped wings. Wings help in



floating and dispersal of pollen grains. Wings help in floating and dispersal of pollen grains. A few microsporophylls of lower side of cone are sterile. Sporangia are also not present on the adaxial surface of each microsporophyll of the male cone.

Female cone:

Observe the external features and longitudinal section of a young female cone and also study 1st year, 2nd year and 3rd year female cones. Female cone develops either solitary or in groups of 2 to 4. They also develop in the axil of scaly leaves on long shoots like male cones.

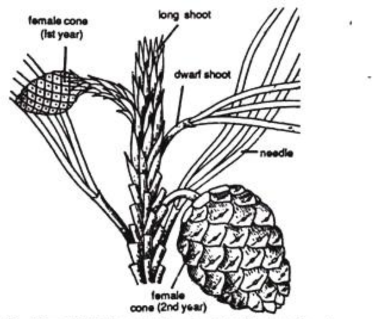


Fig. 43. Pinus. A fertile long shoot bearing 1st and 2nd year female cones.

Each female cone is an ovoid, structure when young but becomes elongated or cylindrical at maturity.

In the centre is present a cone axis. Many megasporophylls are arranged spirally on the cone axis. A few megasporophylls, present at the base and at the apex of strobilus, are

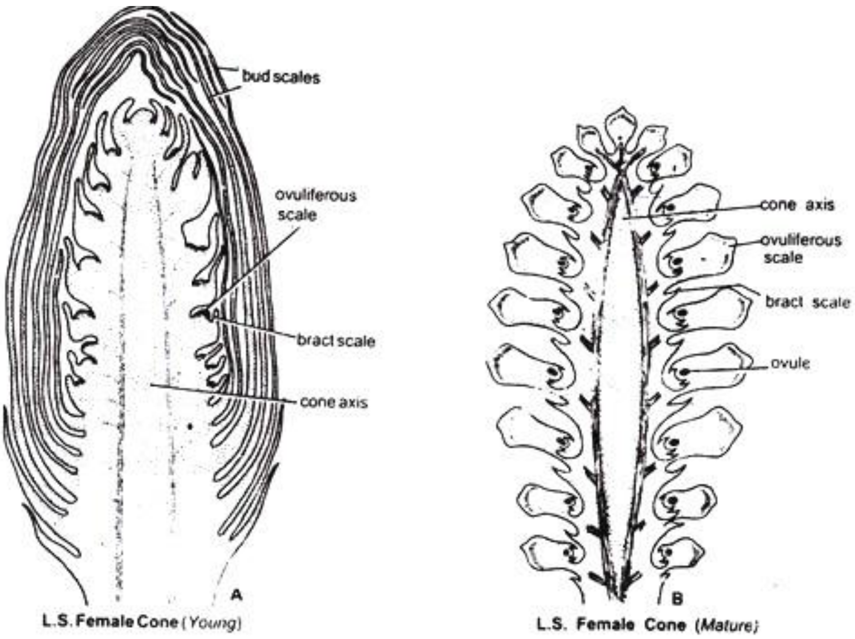


Fig. 44. Pinus. A, L.S. female cone (young); B, L.S. female cone (old).

sterile.Megasporophylls present in the middle of the strobilus are very large and they decrease in size towards the base and apex.

Each megasporophyll consists of two types of scales, known as bract scales and ovuliferous scales. Bract scales are thin, dry, membranous, brown- coloured structures having fringed upper part. These are also called carpellary scales. An ovuliferous scale is present on the upper surface of each bract scale. Each oruliferous scale is woody, bigger and stouter than bract scale and it is triangular in shape. A broad sterile structure, with pointed tip, is present at the apex of these scales. This is called apophysis. At the base of upper surface of each ovuliferous scale are present two sessile and naked ovules. Micropyle of each ovule faces towards the cone axis. Each ovule is orthotropous, and it remains surrounded by a single integument, consisting of an outer fleshy, a middle stony and an inner fleshy layer. It opens with a mouth opening called micropyle. Integument surrounds the megasporangium or nucellus. Just opposite the micropyle is present a pollen chamber. In the endosperm or female gametophyte are present 2 to 5 archegonia.

(ii) *Pinus* needle. **3**

Answer: The typical needle-shaped leaf is found in all species of the Pinaceae family and it is the arrangement of these needles in bundles or fascicles that is the most characteristic feature of the genus *Pinus*. Actually pines have three kinds of leaves. The first appear after the seed germinates and are called cotyledons or "seed leaves." These are small soft needle-shaped leaves and their number varies from 3 or more (*P. contorta, banksiana* and *sylvestris*) to eighteen or more (*P. lambertiana, sabiniana* and *maximartinezii*). As soon as the emerge, they are capable of respiration and photosynthesis. Shortly after the cotyledons come the juvenile leaves which are shaped like the cotyledons and are solitary and arranged in a spiral. These are usually shed in several weeks after the adult leaves, which have basal sheath and fascicular arrangement characteristic of the genus pinus, make their appearance.

The outer layer of the adult leaf is the waxy cuticle which protects the leaf from drying. In the cuticle are minute openings known as stomata and these permit the movement of carbon dioxide into and oxygen from the leaf. In most haploxylon pines the stomata are on the ventral (lower) surfaces and the diploxylon pines have stomata on both ventral and dorsal surfaces. These stomata often form fine white streaks running along the length of the leaf. The internal structure of the leaf is complex and includes a photosynthesizing parenchyma

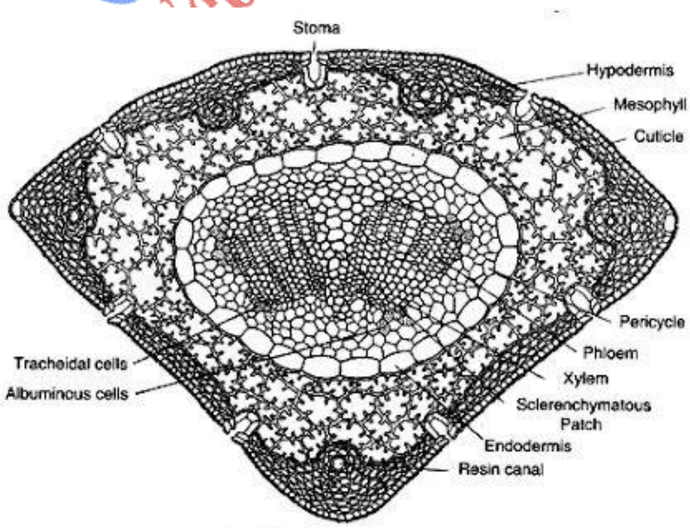


Fig. 8.36. T.S. of *Pinus* needle.

("chlorenchyma" or mesophyll) and resin canals which may be located just beneath the cuticle (often in the haploxlon pines) or varyingly deeper within the needle (often in the diploxylon pines). Centrally there are fibrovascular bundles, which form the basis of classification of the genus pinus into the subgenera Strobus (the"soft" or "white" pines) with one (haploxylon) fibrovascular bundle and Pinus (the "hard" or "yellow" pines) with two (diploxylon) fibrovascular bundles. The resin canals connect with the stomata are involved in gas exchange and the fibrovascular bundles connect ultimately with the xylem involved with the transport of nutrients, sugars and water between the top of the tree and the roots.

OR

Describe economic importance of Gymnosperms. What is difference between gymnosperms and angiosperms? 6

Answer: Economic Importance of Gymnosperms:

1. Ornamental value:

A number of gymnosperms are grown as ornamental plants, e.g., *Cycas, Araucaria, Thuja* etc.

2. Food Value:

i. 'Sago' starch obtained from pith and cortex of stem of *C. revolute, C. rumphi* etc.

ii. 'Seed starch' obtained from seeds of *Cycas rumphii, Dioon edule* etc. It is prepared into flour and cooked before eating.

iii. Seeds of *Pinus gerardiana* (chilgoza) are edible.

iv. 'Kaffir bread' prepared from the stem pith of *Encephalartos*.

v. Young leaves of *Cycas* cooked as vegetables.

3. Medicinal value:

i. Ephedrine (alkaloid) extracted from *Ephedra* used in treating asthma, cough, cold, bronchitis etc.

ii. Tincture of *Ephedra* is a cardiac stimulant.

iii. The juice extracted from young leaves of *Cycas revoluta* is used for curing blood vomiting and flatulence.

4. Industrial Use:

i. Gum-*Cycas* gum used as adhesive, antidote for snake bites and using malignant ulcers.

ii. Tannins – Tannins extracted from bark of *Araucaria, Pinus, Sequoia* etc. used in leather industry.

iii. Canada balsam – It is turpentine obtained from *Abies balsamea* and used as a mounting medium in biological preparations.

iv. Amber (fossil resin) – obtained from *Pinus succinifera*. Wood of *Pinus* is used for doors, poles, beams, railway wagon flooring etc.

v. Plywood prepared from *Podocarpus*.

vi. Papers like newsprints, writing and printing papers are being prepared from the wood pulp of *Pinus*, *Picea*,*Abeis*, *Gnetum* etc.

vii. The leaves of cycads are used for preparing baskets, mats, hats, brooms etc.

viii. The fibres obtained from the leaves of *Cycas* and *Macrozamia* are used for stuffing pillows and making mattresses.

5. Source of oils:

i. Oils extracted from seeds of *C. revoluta*, *Macrozamia reidlei*, *Pinus cembra* and *Cephalotaxus drupacea* are used as edible oils.

ii. Red cedar wood oil extracted from the heart wood of *Juniperus virginiana* is used for cleaning microscopic preparations and for oil immersion lenses.

iii. Oils obtained from *Cedrus deodara*, *Ciyptomeria japonica* and *Cupressus serm-perivirens* are used in preparations of perfumes.

Unit IV

4. Write short notes on following-

(i) Reconstructed plant *Lepidodendron*. **3**

Answer: Like other ancient lycopods, Lepidodendron was also tree like in habit (Fig.55). In general appearance it was not unlike that of present day *Lycopodium*. But in size the genus enormously exceeded the herbaceous *Lycopodium*. The petrified trunks were sometimes as long as 100 feet. Judging from this it may be safely assumed that the plant reached a height of over 120 feet.The stem was erect and did not branch up to some distance from the ground. The branching of the stem was typically dichotomous. The ultimate dichotomies produced the leaves. The branches and the foliage formed a sort of crown at the apex of the stem.

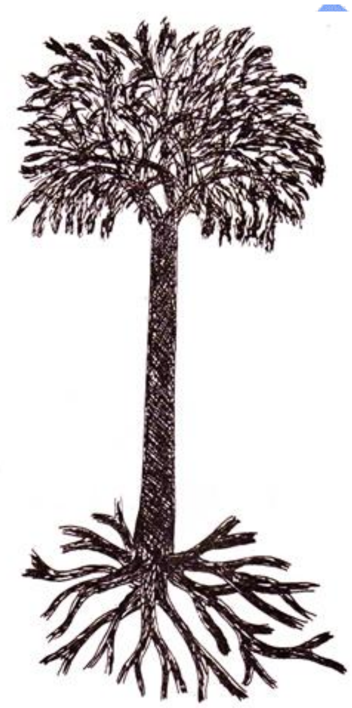


Fig. 55. Lepidodendron: Reconstruction of L. Obovatum

The leaves which clad the young stems and branches were acicular or linear in shape having a length of 5-9 inches. The arrangement of the leaves was spiral or very rarely they showed a whorled arrangement. The leaves were ligulate.

Each leaf had a single vein with the stomata situated in two bands on the ventral surface. The leaves were deciduous. Upon abscission a flat rhomboidal scar persisted on the stem resembling a small cushion. The base of the stem had a stigmarian type of root system.

1. Stem: In majority of the species, secondary growth is characteristic. But some species seem to lack a cambium. A transverse section of the trunk, of *L. vasculare* shows three regions, stele, cortex and a periderm.

In the primary structure there was an epidermis but soon i.e. even before the initiation of secondary growth in the vasculature, it was replaced by the periderm.

The periderm was produced by a phellogen which produced phelloderm towards the interior and phellem towards the exterior. The outline of the bark was wavy due to the presence of leaf bases (Fig. 56).

It consisted of four regions viz.:

(1) Outer cortex consisting of alternating bands of sclerotic and parenchymatous cells,

(2) A middle cortex having a homogenous mass of parenchyma cells. Interspersed with the parenchyma cells were the leaf traces,

(3) Secretory zone consisting of glandular cells which were filled with a dark coloured substance. They probably secreted the waxy material which covered the surface of the stem,

(4) An inner cortex having parenchyma cells.

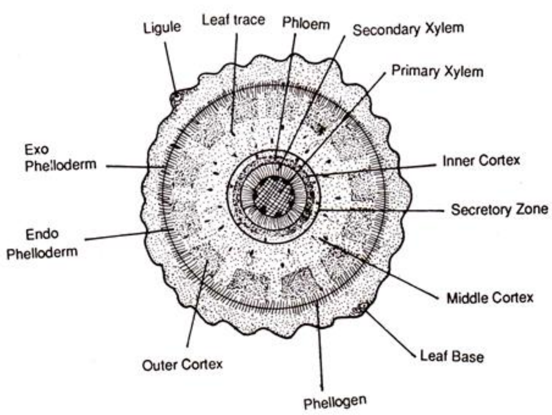


Fig. 56. *Lepidodendron* : T.S. of Stem of *L. vasculare*

The central region of the stem was occupied by the stele which was either protostelic or siphonostelic. The protoxylem was exarch and polyarch. In many species (*L. vasculare*) there was a secondary growth initiated by the cambium.

This produced secondary xylem to the interior and secondary phloem to the exterior. The cambial activity was not uniform; as a result there was a tendency for the formation of an eccentric vascular ring. The secondary xylem had radial rows of tracheitis separated by xylem rays which were uniseriate.

2. Leaf: Anatomically the leaves showed a single vascular bundle flanked on either side by parichnos cavities. These are believed to be aerating organs.

Reproduction in Lepidodendron:

The strobili of *Lepidodendron* are given the name *Lepidostrobus*. In general structure they had a central axis bearing spirally arranged or whorled sporophylls. The sporophylls were ligulate and somewhat peltate bearing a single, sessile, elongate sporangium on their adaxial face.It is quite possible that some sporangia were trabeculate, the trabeculae being concerned with nutrition. The strobili were heterosporous with the megasporophylls aggregated towards the base.

(ii) Fossil plant *Rhynia*. **3**

Answer: The plants of *Rhynia* were herbaceous. *R. major* was 50 cm. in height and 1.5 to 6 mm in diameter whereas *R. gwynne-vaughani* was only about 20 cm. in height and 1 to 3 mm in diameter.

The plant body was differentiated into a subterranean rhizome with an abruptly turned upright photosynthetic aerial shoots. Roots were absent but at places rhizome was provided with tufts of unicellular rhizoids.The aerial shoots were cylindrical and leafless with a tapering dichotomously branched system.

In *R. major* the aerial shoots were smooth but in case of *R. gwynne-vaughani* many adventitious branches were present on the aerial shoots as well as rhizome. These branches perhaps help in vegetative propagation.

The tip of the aerial branch usually bears a solitary terminal sporangium which was about 12 mm in length and about 4 mm in diameter.

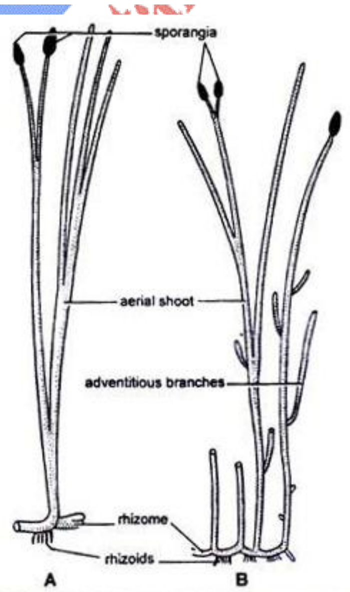


Fig. 1 (A–B). *Rhynia*. External features. A. *R. major*, B. *R. gwynne-vaughani*

Internal Structure of *Rhynia*:

Transverse section (T.S.) of Aerial shoot and Rhizome:

Anatomically, the aerial shoots and rhizome are almost similar. T. S. of aerial shoot can be differentiated into three parts: epidermis, cortex and stele.

(a) Epidermis: It was the outer-most surrounding layer. It was one cell thick and covered by thin cuticle. In aerial shoots it was interrupted at certain places by stomata but stomata (Fig. 2 B) were absent in rhizome.

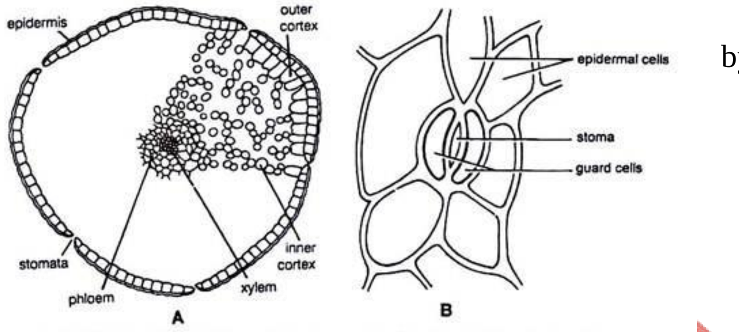


Fig. 2 (A–B). Rhynia. Internal Structure : A. T. S. of aerial shoot, B. a stoma

(b) Cortex: Epidermis was followed by cortex. It is differentiated into outer cortex and inner cortex. The outer cortex was only 1-4 cells thick, thin walled and without intercellular spaces. The inner cortex had large intercellular spaces and its cells had chloroplast. It is thought that this was the chief photosynthetic region of the plant. The endodermis and pericycle layers were absent.

Stele: The centre of the aerial shoot/rhizome was occupied by stele. The stele was a protostele (haplostele). The xylem was made up of annular tracheids and there were no sieve plates in phloem.

Reproductive Structures of *Rhynia*:

The sporangia were borne singly on the apices of some aerial branches, each sporangium being oval or slightly cylindrical structure with a little greater diameter than that of aerial branch on which it is developed. They were 12 mm long and 4 mm in breadth in R. major and 4 mm long and 1 mm broad in *R. gwynne-vaughani*.

A longitudinal section (L.S.) of sporangium shows that it had a five cells thick wall. The outermost layer was 1 cell thick cuticularized epidermis. It was followed by 3 cells thick middle layers of thin walled cells.The inner-most layer was 1 cell thick tapetum. The wall was surrounding a spacious sporangial cavity which was without columella and contained large number of spores. The spores were of same size and measured upto 60 µ in diameter.

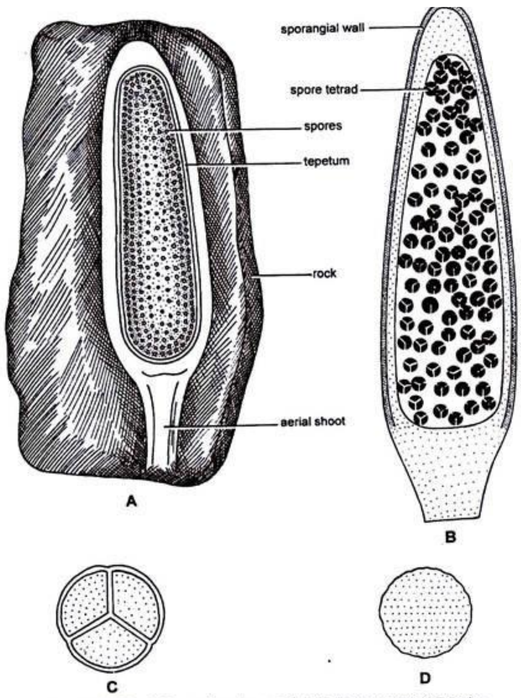


Fig. 3 (A–D) *Rhynia*. Sporangia and spores A. L. S. of sporangium of *R. major*, B. LS. of sporangium of *R. gwynne-vaughani*, C. Sporetetrad, D. Spore

It means that *Rhynia* was homosporous. In many specimens the sporangium contained tetrahedral tetrads of spores (Fig. 3 B, C) which suggest that they were formed by reduction division and the plant bearing them represented the sporophytic generation.There was no special mechanism of sporangium dehiscence. The liberation of spores seems to have taken place by disintegration of the sporangial wall. Nothing definite about the gametophyte of *Rhynia* is known.

OR

Describe fossilization and its types. 6

Answer: Fossilization is the process that preserves evidence of life in earth's rock record. This evidence of past life is called a fossil. The word "fossil" is derived from the Latin *fossilis*, something dug up. During the Middle Ages, the term "fossil" was used for any sample recovered from the earth, including rocks and minerals.[1] Today, the use of "fossil" is limited to the record of ancient life. Fossilization can preserve actual remnants of an organism, or evidence of their presence in an ecosystem

1. Petrified Fossils: The word petrifaction means turning into stones. The fossils form when minerals replace all or the parts of the organisms. Water is full of dissolved minerals. It seeps through the layer of sediments to reach the dead organism. When water evaporates only the hardened, materials are left behind. There is molecule by molecule replacement of plant parts by minerals such as iron, pyrites, silicates, carbonates, sulphates etc. These minerals get deposited and impregnated inside the cells and the tissues of the plant. This type of fossil can be studied by preparing the sections and are most suitable for the study of structural details (Fig. 1D). Petrified plant organs roughly spherical in shape are known as coal balls.

2. Molds and Casts:A mold forms when hard parts of an organism are buried in the sediment such as sand, silt or clay. The hard part completely dissolves overtime, leaving behind a hollow area of organism shape. A cast forms as a result of the mold. Water with dissolved minerals and sediments fills the mold's empty space or cavity. The cavity is known as incrustation and the mineral sediments that are left in the mold make a cast (Fig. 1C). A cast is opposite to its mold. These fossils are suitable for the study of the morphology of fossil plants.

3. Carbon Films: All living things contain an element carbon. When an organism dies and is buried in sediment, the materials that make the organism break down and eventually only the carbon remains. The thin layer of carbon left behind can show an organism's delicate parts like leaves or plant e.g. fern fossil 300 million years old.

4. Trace Fossils: These fossils show the activities of the organisms. An animal makes a foot print when it steps in sand. Overtime the foot print is buried in layers of sediment. Then the sediment becomes solid rock.

5. Preserved Remains: Some organisms are preserved in or close to their original states. These fossils are called preserved remains e.g., an organism such as an insect is trapped in a tree's sticky resin and dies. More resin covers it sealing the insect inside. It hardens into amber. Some organisms such as a wooly mammoth dies in a very cold region. Its body is frozen in ice which preserves organism even its hair.

6. Compression: This type of fossil is common in the sedimentary deposits of rocks. It is a sort of impression where most of the organic remains of the plant remain in the fossil state. The plant or plant part gets buried and the sediments go on accumulating over the plant. The growing pressure of the sedimentary rocks removes the air and the watery contents of the fragment out and causes the plant tissue to compress. The compression shows the original outline of the plant or plant parts but the original thickness of the plant material cannot be determined. The buried part becomes flat due to compression or overlying pressure of the sediments (Fig. 1 A).

7. Impression: These fossils are just impression of plants or plant parts on sediments. These fossils are useful in studying the external features of various plant parts and venation pattern of leaves (Fig. 1B).

8. Pseudofossils: Sometimes watery solutions of various minerals speed through the sediments and it takes the shape of some plant part or animal. Their study shows that they are neither plants nor animals. Such fossils are called pseudofossils (Fig. 1E).

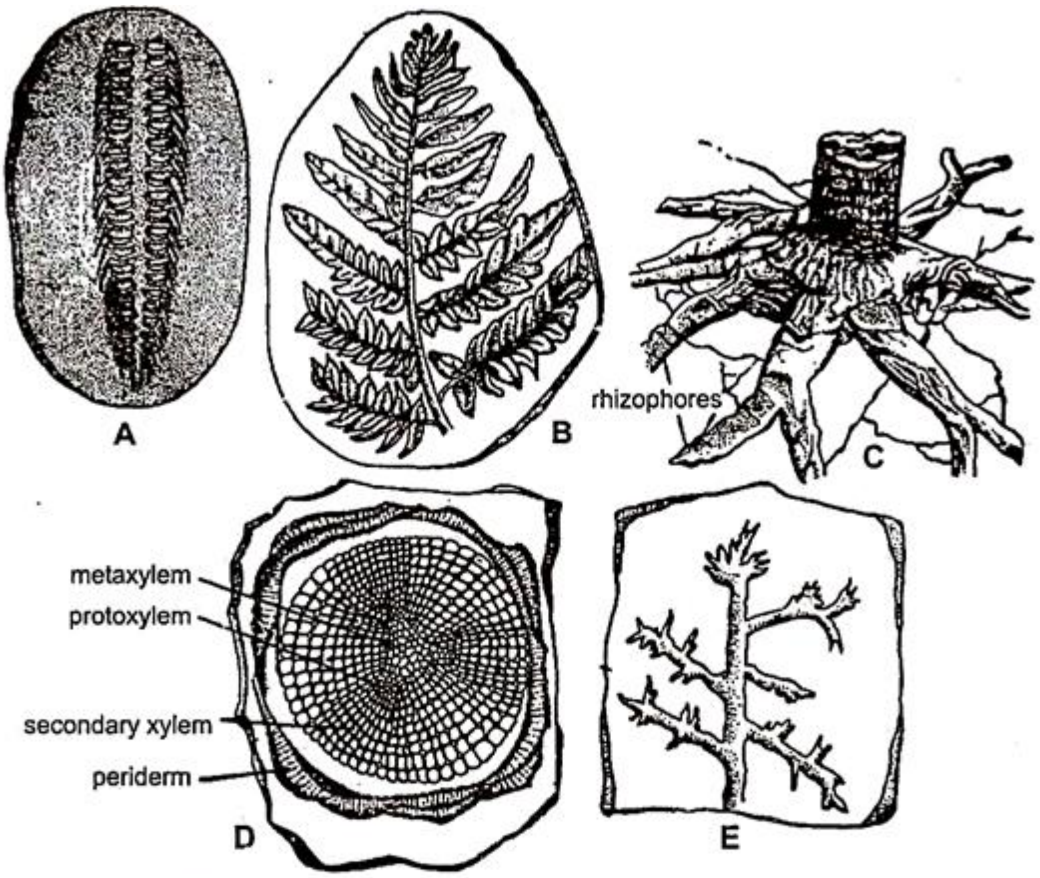


Fig. 1 (A – E) various types of fossils (A) Compression; (B) Impression; (c) Cast; (D) Petrification (E) Pseudofossil.