# VIVEKANANDA COLLEGE

# THAKURPUKUR

# KOLKATA-700063

## NAAC ACCREDITED 'A' GRADE

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| Topic: | PALEOBOTANY & PALYNOLOGY |
| Course Title: | PLANT DIVERSITY II |
| Paper: | BOT-G-CC-2-2-TH |
| Unit: | 3.1 |
| Semester: | II |
| Name of the Teacher: | Mrs. Rinku Halder Sahu |
| Name of the Department: | Botany (Morning) |

# *PALEOBOTANY*

## INTRODUCTION:

PALEOBOTANY (greek word Paleon = old and Botany = study of plants) is a branch of paleontology or paleobiology dealing with the recovery and identification of plant remains from geological contexts and their use for biological reconstruction of past environment (Paleogeography) and both the evolutionary history of plants with a bearing upon the evolution of life in general.

It includes the study of terrestrial plant fossils as well as the study of prehistoric marine photoautotrophs ---photosynthetic algae, seaweeds and kelp.

It is important in the reconstruction of the ecological system and climate i.e Paleoecology and Paleoclimatology. It is also useful for fundamental study of green plant development and evolution.

**FOSSIL**:

A fossil is the naturally preserved (in sedimentary rocks of different ages) remains or traces of animals and plants that lived in the geological past.

The term derived from the Latin word Fordere / Fossilis = to dig.

According to Arnold, the fossils are **"the relic of some former living things, plants or animals, embedded in or dug out of the superficial deposits in past geological periods."** Schopf (1975) defines fossil as any specimen that demonstrates physical evidence of occurrence of

ancient life.

## PALEONTOLOGY

It is the study of fossils and their age , method of formation and evolutionary significance.

## Nomenclature of Fossils:

The whole plant is not preserved, but only detached plant parts like stem, root, cone, leaf, etc. are preserved as fossils. These detached plant parts are being discovered in different times by different authors. Thus, these detached plant parts or organs are given a binomial (generic and specific name) by the same set of rules under the International Rules of Botanical Nomenclature which have been framed for living plants.

Each detached organ or fragment is given a different name. Each of these names acquires the status of a genus. The generic name in fossils is applicable for only a plant part like root, stem, leaf, cone or other organ, without indicating to what plant it belongs. Thus, the genus is termed **form genus or artificial genus** in contrast to natural genus for living plants.

A form genus cannot reliably be assigned to a single family, however, it may be assigned to an order or other higher taxonomic rank. For example, *Stigmaria* is a form genus of the order Lepidodendrales which cannot be assigned to any one of the three families: Lepidodendraceae, Sigillariaceae or Bothrodendraceae.

When the relationships among different organs like stem, root, leaf and reproductive structure are established and can be assigned to the same family, then the genera can be called **organ genera**.

For example, stem genus *Bucklandia*, leaf genus *Ptilophyllum*, male fructification *Weltrichia* and female fructification *Williamsonia* are genetically related and assigned to the same family Williamsoniaceae. Thus, all are considered to be organ genera. However, there is no provision in the International Rules of Botanical Nomenclature for the use of organ genera.

During reconstruction, the palaeobotanist should select the earliest (after 1820) validly published generic name applied to any one of its parts as per Rule of Priority. He or she will use any one of the form genera as the generic name for the whole organism. Say, for example, the validly published female fructification, Williamsonia has been used for naming the whole plant.

**Rules for naming form genera:**

A particular suffix is used for naming a form genus which signifies the organ it belongs to.

## The suffixes applied to different plant parts are:

| Suffix | Applied to organ | Examples |
|---|---|---|
| *Dendron* | Stem | *Lepidodendron, Lyginodendron.* |
| *Xylon* | Woody part | *Dadoxylon, Cordaixylon, Mesoxylon.* |
| *Phyllum* | Leaf | *Ptilophyllum, Nipaniophyllum, Brachyphyllum* |
| *Pteris* | Fern-like stem or frond | *Sphenopteris, Lyginopteris, Etapteris, Archaeopteris* |
| *Spermum* | Seed | *Corystospermum, Mitrospermum* |
| *Carpon* | Seed or seed like | *Lepidocarpon, Mazocarpon, Calamocarpon* |
| *Carpus* | seed | *Trigonocarpus, Cardiocarpus* |
| *Stoma* | seed | *Lagenostoma, Stamnostoma* |
| *Theca* | Microsporangia | *Codonotheca, Aulacotheca, Crossotheca* |
| *Strobus* | Cone | *Lepidostrobus, Androstrobus* |

## INDEX FOSSIL/ GUIDE FOSSIL/ INDICATOR FOSSIL :

The fossils that are used to define and identify a particular span of geologic time (or faunal stage ) or environment. It should have the following features-

1.have a narrow geological range

2. wide geographic distribution

3. rapid evolutionary trends

4. distinctive or easily recognizable abundantly.

*E.g Monograptus* is an index fossil of Lower Devonian, while *Myrepollenites* is a marker of Eocene. Foraminifera, pollen grains, spores etc. are also used as index fossils.

## TYPES OF FOSSIL ( KINDS OF PRESERVATION ) :

## 1.BODY FOSSIL:

Body fossils are remains of living and direct evidence of past life. In this type hard tissues are preserved for e.g shell, bones, carapace.

It is of two types—***microfossils & megafossils***

### a. Microfossils:

Microscopic organisms like bacteria, spores and pollen grains, fungal and algal spores, foraminifera, diatoms, epidermal and wood fragments of plants etc. preserved in the sedimentary deposits are referred to as microfossils. Microfossils are visible only after maceration of sediments.

### b. Megafossils:

Large parts of plants like leaf, stem, root, flower, seed, etc. and animal remains as a whole organism or in parts, preserved in the sedimentary deposits are called megafossils. These are visible to naked eyes and are the better source of morphological as well as anatomical studies.

## 2.TRACE FOSSIL/ICHNOFOSSIL:

Fossil shows the activities of the organisms. An animal makes a footprint when it steps into the sand. Over time the foot print is buried in a layer of sediment. The sediment becomes solid rock. So, it is the direc t evidence for the existence of past life.

***E.g:*** These also include animal tracks preserved in rocks, burrows of invertebrates, coprolites (fossil excretes), gastroliths (polished stones in the abdomen of dinosaurs), gnawed bones, etc.

## 3.SUBFOSSIL:

It is a part of a dead organism that is partially rather than fully fossilized. So , mainly it is preserved, not fossilized.

Partial fossilization may be present because not enough time has elapsed since the animal died for full fossilization or because the conditions in which the remains where deposited were not optimal for fossilization.

***Eg:*** Coal is a compressed fossil, while peat, an early stage of Coalification is referred to as sub-fossil.

## 4.CHEMICAL FOSSIL:

When some organisms decompose they leave a characteristic chemical signature.These organic compounds are preserved in sediments or in parts of fossilised structures without undergoing any or minimal change. These include amino acids, hydrocarbons, fatty acids, lipids, carbohydrates and the derivatives of other organic compounds. Such chemical traces provide indirect evidence for the existence of past life.

***Eg:*** The chemical composition of Pre-Cambrian rocks is an important criterion to establish the biogenicity of putative unicellular or multicellular organisms present in Pre- Cambrian rocks. The existence of insoluble kerogen is used as proof of biogenicity. Similarly, the occurrence of pristane and phytane, degradable products of chlorophyll molecule, may be used as proof of photosynthesis.

## 5.PSEUDOFOSSIL:

watery solution 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.

## 6.PETRIFIED FOSSIL:/ MINERALIZED PLANT:

The fossil is formed accordingly------

- ➢ 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.
- ➢ minerals such as pyrites, iron, silicates, carbonates, sulphate etc get deposited and impregnated inside the cells and tissue of the plant.
- ➢ These types of fossils are suitable for the study of structural details.
- ➢ petrified plant organs roughly spherical in shape and are known as coal balls.

## 7.MOLD & CAST:

When hard parts of an organism are buried in the sediment such as sand, silt, or clay, it completely dissolves over time, leaving behind a hollow area of organism shape called MOLD.

Water with dissolved minerals and sediments fill the mold’s empty space or cavity. The cavity or incrustation with mineral sediments that are left in

the mold makes a CAST. This is suitable for study of the morphology of plants.

***E.g:*** *Stigmarian* root system is an example of mold, while the pith cast of a *Catamites* stem is a common example of incrustation. In these types, only external forms are preserved, while internal cellular details are not preserved.

## 8.CARBON FILMS:

All living things contain an element that is carbon. When organisms die and are buried in the sediment, the materials make the organism break down and eventually only carbon remains. The thin layers of carbon left behind can show an organism's delicate parts like leaves or plants.

## 9.AMBER:

The fossilised resin of extinct coniferous trees, *Pinus succinifera* in in particular, is called Amber.This kind of fossil is preserved to their original state.

***E.g:*** Organism such as insect is trapped in a tree's sticky resin and die. It hardens into amber. Some organisms like wooly mammoths die in a very cold region. its body is frozen in ice which preserves organism, even it’s hair.

## 10.COMPRESSION:

Most of the organic remains of the plant remain in fossil state. The plant or plant parts get buried and the sediments go on accumulating over the plant. Thus the growing pressure of sedimentary rocks removes the air and the watery contents of the fragment out and causes the plant tissue to compress . it shows the original outline of plants but the original thickness of plant material can’t be determined. The buried part become flat due to compression of the sediments.

## 11.COMPACTION OR MUMMIFIED PLANT:

Plant parts get compressed by vertical pressure against one another to form such kinds of fossils.Coal or coal balls are the important sources of plant fossils. Here coals are irregular or sub spherical mass of Ca or $MgCO_3$.

## 12.IMPRESSION:

These fossils are just impressions 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

## 13.Derived Fossils:

The fossilised organisms that hold in a stratum younger or older than the fossil themselves are called derived fossils. These are results of tectonic movement of earth or other geological upheaval.

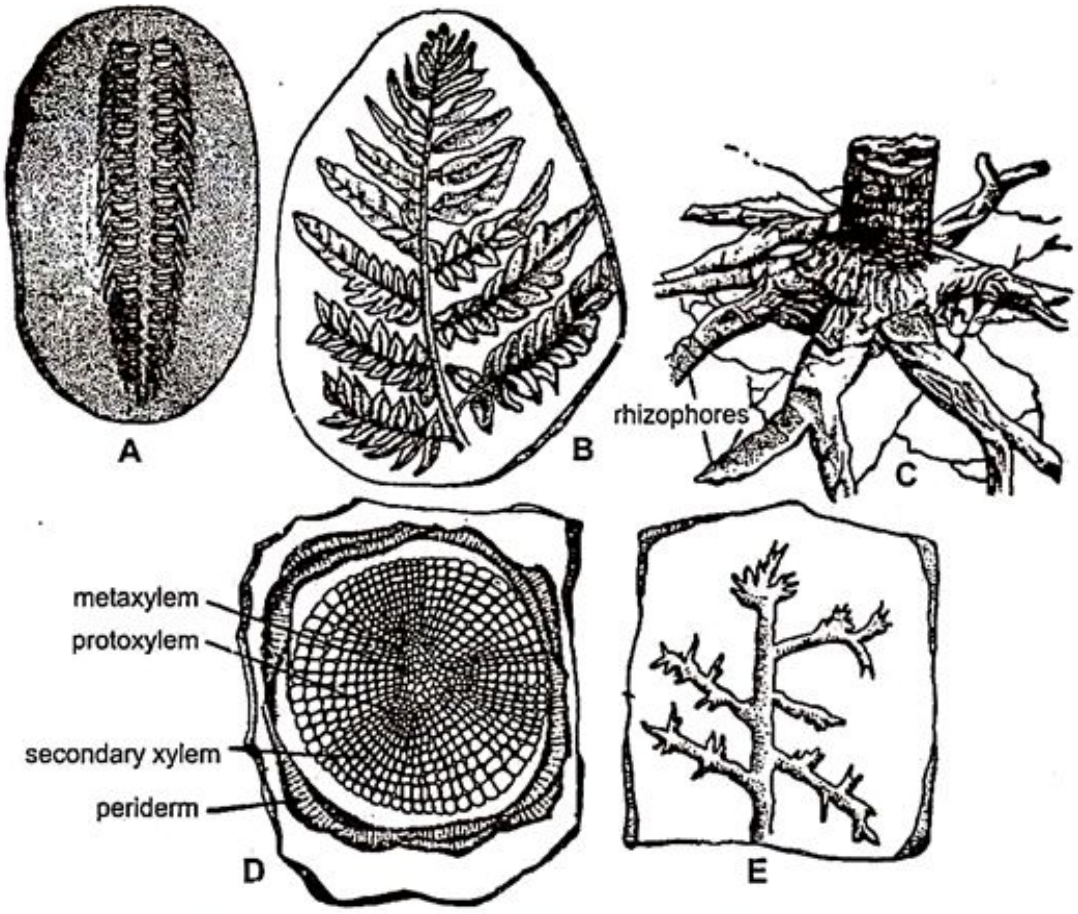


**Fig. 1 (A – E) various types of fossils (A) Compression; (B) Impression; (c) Cast; (D) Petrification (E) Pseudofossil.**

## Coal Balls:

The petrified spherical balls containing plant parts are commonly termed coal balls (Fig. 1.88). These spherical balls are formed as a result of infiltration of plant debris in swamps by carbonates of calcium or magnesium, thus restricting the conversion of the debris into coal. Coal balls occur in localised regions and they range in few centimeters to several meters and weigh from a few to several pounds. Coal balls are specifically significant in palaeobotanical studies.

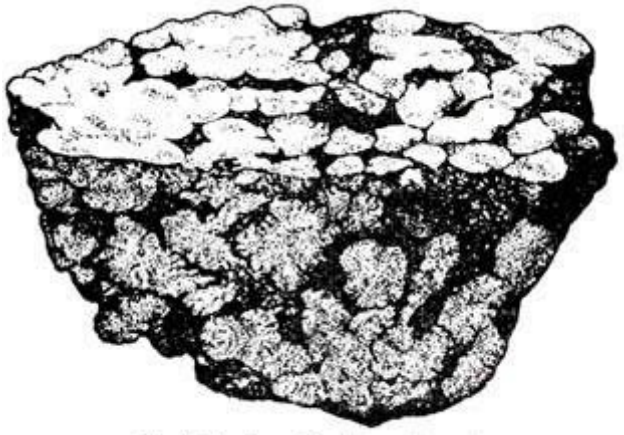

Fig. 1.88: A coal ball (sectioned)

## Paper Coal:

It consists of thin dead leaves, dispersed in an organic matrix. The inner tissues of leaves are destroyed, thus the paper coal consists of layer after layer of cuticles, often with decomposed stems. The carbonaceous limestone horizon at Tovarkovo, in Toula in Russia, is an example of paper coal.