INTRODUCTION TO KINGDOM PLANTAE

Although traditionally, the term *plants* was used for a wide variety of organisms including the algae and fungi, modern botanists now confine the term to mosses, ferns, cone-bearing plants and flowering plants, as well as the various relatives of each of these groups. Members of the Plant Kingdom are more complex and varied in form than those of other kingdoms. Their tissues are more specialized for photosynthesis, conduction, support, anchorage and protection.

Plants share a number of common characteristics with green algae, which suggests that plants descended either from a remote common ancestor or perhaps several different, but related members of the green algae that successfully invaded terrestrial habitats. Like green algae, plants have chlorophyll *a* as their primary photosynthetic pigment and chlorophyll *b* and carotenoids as accessory pigments. The deposition of starch, the primary carbohydrate food reserve, within chloroplasts is a unique characteristic shared by plants and green algae. As in some genera of green algae, the principal component of plant cell walls is cellulose, and all plants form a **phragmoplast** and a cell plate during the process of cell division.

It appears that the ancestors of plants had a well-developed alternation of heteromorphic generations, since this type of life cycle is common among the living members of the Plant Kingdom. All plants are **oogamous** (i.e. exhibit sexual reproduction) and their zygotes are nutritionally dependent on the gametophyte generation.

Fossil records suggest that plants appeared on land more than 400 million years ago and by the time they became established on land, had developed several features that kept them from drying out, viz.:

Plant surfaces have a fatty cuticle that reduces water loss.

The gametangia and spore-producing structures (sporangia; singular: sporangium) of plants are surrounded by a sterile jacket of cells.

After fertilization, the plant zygote divides and develops into an **embry**o within the tissues that originally surround the egg. (Note that green algae lack embryos.)

Most modern textbooks group members of the Plant Kingdom into three main categories:

- Non-vascular plants (Mosses and their relatives)
- Seedless vascular plants (Ferns and their relatives)
- Seed plants (cone-bearing plants and flowering plants)

GENERAL BIOLOGY OF BRYOPHYTES (NON-VASCULAR PLANTS)

"Bryophyte" is a collective term for three distinct divisions of non-vascular plants, which include the *mosses* (Division Bryophyta), *hornworts* (Division Anthocerotophyta) and *liverworts* (Division Hepatophyta). There are about 23,000 different species of bryophytes, all of which lack true xylem or phloem. Although many mosses have water-conducting cells called **hydroids** and some have food-conducting cells called **leptoids** surrounding the hydroids, these cells do not conduct as efficiently as the vascular tissues in higher plants.

The habitats of bryophytes range in elevation from sea level near ocean beaches to more than 18,000 feet (5,486 meters) above sea level on mountains. They often occur as soft, green mats on damp banks, trees and logs; but some (e.g. *Grimmia* spp.) are able to withstand long periods of desiccation and are found on bare rocks in the scorching sun. Some bryophyte species are restricted to very specific habitats; e.g. on the antlers and bones of dead reindeer; in the dung of herbivorous animals (for some species) or dung of carnivorous animals (for other species); and also on large insect wing covers.

Body structure of liverworts (Division Hepatophyta)

The most common members of this group of bryophytes have flattened, lobed, somewhat leaf-like bodies called **thalli** (singular: **thallus**). The **thalloid** liverworts, however, constitute only 20% of the roughly 8,000 species of liverworts. The remaining 80% are "leafy" and superficially resemble mosses. *Marchantia* and *Frullania* species are examples of thalloid and "leafy" liverworts respectively. Growth in the liverworts is prostrate rather than upright and the plant body is anchored by unicellular **rhizoids**.

Body structure of hornworts (Division Anthocerotophyta)

Although the gametophytes of hornworts superficially resemble those of thalloid liverworts, there are many features that separate hornworts from other bryophytes:

- Hornworts usually have only one chloroplast in each cell (a few species have up to eight) and each chloroplast has pyrenoids similar to those found in green algae.
- They are often rosette-like in form.
- In contrast to the air-filled pores and cavities of thalloid liverworts, the thalli of hornworts have pores and cavities filled with mucilage. Cyanobacteria (nitrogen-fixing blue-green algae) often grow in the mucilage.

Hornworts are also anchored by rhizoids. The most common species belong to the genus *Anthoceros*.

Body structure of mosses (Division Bryophyta)

There are three distinct classes of mosses commonly called peat mosses (e.g. *Sphagnum* sp.), true mosses (e.g. *Polytrichum* sp.) and rock mosses, but in all these classes the gametophyte is the dominant plant body.

The stem of moss gametophytes may be erect or tufted as in *Brachymenium* sp. or prostrate as in Ectropothecium sp. They are anchored by filamentous multicellular rhizoids. Their leaves are never lobed or divided nor do they have a petiole.

Modes of Reproduction in Bryophytes

All bryophytes require an external source of water (either as rain or dew) in order to reproduce. Bryophytes reproduce both sexually and asexually.

Alternation of generations is a characteristic feature in their life cycle, with the gametophyte being the conspicuous and dominant generation. In all bryophytes, the sporophytes are permanently attached to the gametophytes, but vary in their dependence on them.

Asexual reproduction in liverworts (e.g. *Marchantia* sp.) is by means of **gemmae** (singular: **gemma**), which are produced in **gemmae cups** scattered all over the upper surface of the liverwort gametophyte. While in the cup, development of the gemma is inhibited by the presence of lunularic acid but, once out of the cap, each gemma is capable of growing into a new thallus. Sexual reproduction in *Marchantia* is achieved by means of sex cells that are produced by separate male and female gametophytes.

The gametophytes of some species of hornworts (e.g. *Anthoceros* sp.) are also unisexual, but others are bisexual. Asexual reproduction in hornworts is primarily by fragmentation.

ECONOMIC IMPORTANCE OF BRYOPHYTES

For Ecological Restoration

Some bryophytes and lichens are the first to colonize bare rocks after volcanic eruptions or other geological upheavals. They are, therefore, pioneers of succession and, by their gradual accumulation of minerals and organic matter, create conditions that favour the growth of other organisms.

As Biological Indicators

Some mosses grow only in calcium-rich soils whereas the presence of others indicates higher than usual soil acidity or salinity. Some mosses, when found growing in a dry area, are a good indication that the area receives running water during some part of the year.

As Packaging Material

Some mosses have been used for cushioning in the packing of dishes and other breakable objects, while some have been used for stuffing furniture.

For soil conditioning

1 kg of dry peat moss (e.g. Sphagnum sp.) is capable of absorbing up to 25 kg of water. Peat mosses are, therefore, very useful soil conditioners and have been used in nurseries and as components of potting mixtures.

As Preservative

Peat mosses have a natural acidity which inhibits fungal and bacterial growth. They have, therefore, been used in shipping live shellfish and other organisms.

In Medicine

The antiseptic and absorptive capacities of peat moss have made it a useful poultice material for application to wounds. This property of peat mosses was identified during World War I when a species of *Sphagnum* was used as a substitute for cotton bandages. It was observed that fewer infections developed in the wounds bandaged with *Sphagnum*.

For Plant Propagation

Sphagnum and other mosses have also been used in vegetative plant propagation, particularly for air layering.