Biyani's Think Tank

Concept based notes

Algae, Lichens and Bryophyta

[B.Sc. Part-I]

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Preface

I am glad to present this book, especially designed to serve the needs of the students. The book has been written keeping in mind the general weakness in understanding the fundamental concepts of the topics. The book is self-explanatory and adopts the “Teach Yourself” style. It is based on question-answer pattern. The language of book is quite easy and understandable based on scientific approach.

Any further improvement in the contents of the book by making corrections, omission and inclusion is keen to be achieved based on suggestions from the readers for which the author shall be obliged.

I acknowledge special thanks to Mr. Rajeev Biyani, *Chairman* & Dr. Sanjay Biyani, *Director* (*Acad.*) Biyani Group of Colleges, who are the backbones and main concept provider and also have been constant source of motivation throughout this Endeavour. They played an active role in coordinating the various stages of this Endeavour and spearheaded the publishing work.

I look forward to receiving valuable suggestions from professors of various educational institutions, other faculty members and students for improvement of the quality of the book. The reader may feel free to send in their comments and suggestions to the under mentioned address.

Author

Syllabus

UNIT-1

General characters, Classification (F.E.Fritsch and Smith). Diverse Habitat. Range of thallus structure, photosynthetic pigments and Food reserves. Reproduction (Vegetative, Asexual, Sexual), Evolution of sex in algae. Types of the life cycle: Economic importance (As food and fodder, in agriculture, pharmaceuticals and industries). Isolation and Culture of algae.

UNIT-II

Habitat, structure, reproduction and life cycle of following forms:
Chlorophyceae - *Volvox, Coleochaete, Chara.*
Xanthophyceae - *Vaucheria.*
Phaeophyceae - *Ectocarpus.*
Rhodophyceae - *Polysiphonia.*

UNIT-III

General characters, Origin, and evolution of Bryophyta. Classification (Eichler and Proskauer); Habitat, Range of thallus structure, Reproduction (Vegetative and Sexual); Alternation of generation; Evolution of sporophytes in Bryophytes; Economic importance: Habitat, structure ,reproduction and alternation of generation in following forms
Hepaticopida - *Riccia Marchantia. Porella*

UNIT-IV

Habitat, structure ,reproduction and alternation of generation in following forms
Anthocerotopsida- *Anthoceros.*
Bryopsida- *Sphagnum,Funaria*

Lichens-General character, Habitat, Structure, reproduction and economic importance of lichens, Importance of lichens as colonizers and indicators of environment.

Unit-I

Q.1 Multiple Choise Question:

a. Agar-Agar is obtained from
(a) Gelidium (b) Nostoc (c) Chlamydromonas (d) Ulothrix
Ans (a)

b. Which one of the following algae has the ability to fix the atmospheric nitrogen?
(a) Ulothrix (b) Nostoc (c) Spirogyra (d) Oedgonium
Ans (b)

c. The term 'algae' was coined by.
(a) Theophrastus (b) Fritsch (c) Engler (d) Linnaeous.
Ans (d)

d. 'Red rust of tea' is caused by parasitic
(a) Bacteria (b) Fungi (c) Algae (d) None of these
Ans (c)

e. Mark the Parasitic algae
(a) Cephaleuros (b) Ulva (c) Anabaena (d) All of these
Ans (a)

f. Water bloom is generally caused by
(a) Green algae (b) Blue green algae (c) Bacteria (d) Hydrilla
Ans (b)

g. Synzoospore is formed in
(a) Oedogonium (b) Ulothrix (c) Ectocarpus (d) Vaucheria
Ans (d)

h. The chief pigments of Blue green algae is –
(a) c-phycocyanin (b) c-phycoerythrin (c) Both (d) Allophycocyanin
Ans (d)

i. The phenoninon of 'red snow' is exhibited in polar regions by a chlamydomonas species.
(a) C.nivalis (b) C.coccifera (c) C. media (d) C. reticulata

Ans (a)

j. The plants of *volvox* are found in
(a) Fresh water ponds (b) Estuaries (c) Rivers (d) Hot water springs
Ans (a)

k. The plants of *chara* measure in length about
(a) 10-15cms (b) 20-30 cms (c) 30-50 cms (d) 50-60 cms
Ans (b)

l. The nucule of *chara* is capped by-
(a) Nodal cells (b) Inter nodal (c) Tube cells (d) Coronary cells
Ans (d)

m. The *vaucheria* plant shows the following habit-
(a) Filamentous (b) Siphonous (c) Coccoid (d) Dendroid
Ans (b)

n. The apical cell of *Ectocarpus* is
(a) Dome shaped (b) Capitates (c) Pointed (d) Lobed
Ans (c)

o. The pit-connections are present in polysiphonia in between.
(a) Axial cells (b) Axial and pericentral cells (c) Pericentral cells (d) All of these
Ans (d)

p. The carposporophytic phase of polysiphonia is represented by
(a) Carposporangium (b) Cystocarp (c) Carpogonial filament (d) All of these
Ans (b)

q. The term lichen was first used by
(a) Aristole (b) Dioscoredes (c) Theophrastus (d) All the these
Ans (c)

Q. 2 Fill in the blanks -

a. _________ grows within the thallus of Anthoceros as endophyte.

b. A thick walled vegetative cell rich in food material is called as ________

c. The chief Xanthophyll pigment of phaeophyceae is __________

d. The Chief algal source for obtaining iodine is ____________

e. Carrageen in is obtain from __________ and ___________

f. The carp osporangium of __________ produced single carpospores.

g. The sexual of reproduction in *Vaucheria* is ____________

h. The plants of *Ectocarpus* generally grow as ____________.

i. The posterior end of the *volvox* colony is identified by the presence of_________.

j. The *zygospore* of ________ give rise to a zoospore

Ans (a) Nostoc, (b) Akinete , (c) Fucoxanthin, (d) Laminarid, (e) Chondrus, Gigartinia. (f) polysiphonia (g) orgamous. (h) epiphyte. (i) phialpore (j) Volvox

Q.3 Answer the following in Short:

a. Name the algae which is parasitic.

Ans Cephaleuros virescens

b. Name any two algae which form 'bloom' in water.

Ans Nostoc, Anabaena

c. What is the function of Pyrenoids in algae?

Ans Synthesis and storage of starch

d. Which type of resource food material is found in Rhodophycene ?

Ans Floridian starch

e. How many divisions were recognized in algae by Smith?

Ans 7 divisions

f. Name the algae which is the source of Iodine?

Ans Laminaria

g. In which class of algae is mannitol reserve food?

Ans Phaeophyceae

h. The flagellated sporer are called as

Ans Zoospore

i. In which algae is reproduction by daughter colonies?
Ans Volvox

j. Which algae is fruiting body 'cysto carp' present?
Ans Polysiphonia

k. The algae found on snow or ice are called
Ans Cryophytes

l. Give the example of parasitic algae which causes 'Red rust of tea'.
Ans *Cephaleuros virescens*

m. Which algae is called "rolling alga".
Ans *Volvox*
n. Reticulate chloroplast is found in which alga?
Ans *Spirogyra*

Q.4 Write general characters of algae?
Ans

Algae — General characters

- ⇨ Study of algas 'Phycology' or 'Algology'
- ⇨ Algae are simple, thalloid, autotrophic non vascular plants.
- ⇨ Sex organs – unicelled
- ⇨ No embryo formation
- ⇨ They show distinct aslternation of generation
- ⇨ Plant body does not shown differentiation in various tissue systems.

Q.5 Give outline of FE Fritsch classification?
Ans Classification of Algae – (F.E. Fritsch)

A. F.E. Fritsch (1935) classified algae into 11 classes.

1. Class-Chlorophyceae (Isokantae) – Green algae
2. Class-Xanthophyceae (Heterokantae) Yellow green
3. Class-Chrysophyceae (Golden brown algae)
4. Class-Bacillariphyceae (Diatom) Yellow-golden brown
5. Class-Cryptophyceae
6. Class-Dinophyceae (paridinieae)
7. Class-Chloromonadineae.
8. Class-Englenineae
9. Class-Phaeophyceae (Brown algae)
10. Class-Rhodopohyceae (Red algae)

11. Class-Myxophyceae (cyanephyceae) (Blue green algae)

Q.6 Describe diverse habitat found in algae?

Ans

Diverse Habitat

- Fresh Water
- Marine water
- Terrestrial
- Specialized Habitats

A. Fresh Water –

- They occure in river, ponds, pool, lakes etc.
- Flooting form – Phytoplanktons – Diatoms
- Attach to bottom soil – Epibelic/benthos
- Attach to rocks or stones – lithophytic/epilithic
- On the surface of water forms water blooms → Blue green algae

B. Marine Forms – They occur in sea water

- Brown algae, Red algae, B.G.A.
- They occur as phytoplantons, bentos and lithophytes forms.
- e.g. giant algae – *macrocystis* (70 meters)
- simillest algae – *Nereocystic* (100 meters)

C. Terrestrial forms –

- They occur on damp soil.
- Acidic soil – *Fritschiella* algae
- Alkaline and calcareous soil – *Nostoc, Oscillatoria*
- Damp shady soil or on shally walls – *Vaucheria*

D. Speciliazed habitats –

1. **Cryophytes** – grow on snow or ice
   Yellow green – *Chlamydomonas yellowstonensis*
   Red – *Chlamydomonas nivalis*
   Black – *Scottella nivalis*
   Purple brown – Ancylomema nostenskioldis
2. **Thermophytes** – grow in hot water 70^{o}C (e.g. *Osillatoria brevis*)
3. **Epiphytes** – grow on other plant (algae, Angio yellow)
   (Oedogonium, Cladophora, Vaucheria)

4. **Endophytes** –grows inside other plants
   Anabaena – growing inside *Azolla* (form)
   Nostoc – inside the thallus of *Anthoceros* (liver wort)
   Anabaena, Nostoc, Oscillatoria – inside the (Coralloid roots of cycas).
5. **Epizoic** – grow on other
   Cladophora crispate grow on snail cell
   Charaium grow on the antennal of mosquito larval.
6. **Endozoic** – Grow inside animal
   Zoochlorella grow inside Hydra
   BGA grow inside respiratory tracts of animals.
7. **Symbiotic** grow in symbiotic relationship
   Lichens – Algae with fungi
8. **Parasites** – grow as parasite
   e.g. *Cephaleuros virescens* – parasite on the tea leaf causing 'red rust of tea'
   Cephaleuros coffeae – Parastie on coffee leaves

Thallus organization

Unicelluar form –	*Chlamydomonas, Chlorella,* ***chrococcus***
Multicelluar form –	Chara
Colonial –	*Volvox*
Palmalloid –	Vegetative cells surrounded by mucilaginous matrix e.g. *Tetraspora.*
Dendroid –	colony appear like a microscopic tree e.g. *Ecballocystis*
Filamentous-	*Cladophora, Ectocarpus Polysiphonia*
Siphonous –	*aseptate, coenocytic Vaucheria*
Parenchymatous	*Chara, Laminaria*

Q.7 List the different reserve food materials found in algal ?

Ans

Reserve food Material (RFM)

Chlorophyceae	-	Starch and oil;
Xanthophyceae	-	Chrysolamirarin (carbohydrate) and oils
Bacillariophyceae	-	Chrysolaminarin and oils.
Phaeophyceae	-	Laminarin (carbohydrate) Mannitol (alcohol) Oil
Rhodophyceae	-	Floridean Starch and Galactan SO_4 polymers

Cyanophyceae	-	Cyanophcean starch (glycogen) Cyanophycin(Protein)

Q.8 Write short notes on –

(a) Pigments in algae

Ans. Three major classes of photosynthetic pigments occur among the algae: chlorophylls, carotenoids (carotenes and xanthophylls) and phycobilins. The pigments are characteristic of certain algal groups as indicated below. Chlorophylls and carotenes are generally fat soluble molecules and can be extracted from thylakoid membranes with organic solvents such as acetone, methanol or DMSO. The phycobilins and peridinin, in contrast, are water soluble and can be extracted from algal tissues after the organic solvent extraction of chlorophyll in those tissues.

The rationale behind the extraction techniques is to disrupt cell integrity as much as possible, thereby removing pigment molecules from intrinsic membrane proteins. Freezing the tissue with liquid nitrogen, and grinding the still frozen tissue in with a mortar and pestle or blender, overcomes some of the problems of working with material that produces large amounts of viscous polysaccharides. "Freeze-thawing" tissue also breaks down cellular membranes, but may liberate more polysaccharides. Finely ground tissue can be then homogenized in organic solvent to further disrupt cellular membranes, and to liberate pigment molecules from the light harvesting pigment protein complex

Once the pigments are extracted into appropriate solvents they can be separated chromatographically by TLC or HPLC for spectral analysis and identification. Pigment concentrations in hydrocarbon solvents can be estimated; however, these formulas are predictive, and may overestimate some pigment concentrations (see Seely et al. 1972 for the development of equations). Uncoupling pigments from the pigment binding proteins can change the absorption patterns of the pigments, resulting in shifts in maxima from 10 to 50 nm, when compared with spectra measured for intact tissues.

Pigment composition of several algal groups (after Dring 1982):

DIVISION	COMMON NAME	MAJOR ACCESSORY PIGMENT
Chlorophyta	Green algae	chlorophyll b
Charophyta	Charophytes	chlorophyll b
Euglenophyta	Euglenoids	chlorophyll b
Phaeophyta	Brown algae	chlorophyll c1 + c2, fucoxanthin
Chrysophyta	Yellow-brown or golden-	chlorophyll c1 + c2,

	brown algae	fucoxanthin
Pyrrhophyta	Dinoflagellates	chlorophyll c2, peridinin
Cryptophyta	Cryptomonads	chlorophyll c2, phycobilins
Rhodophyta	Red algae	phycoerythrin, phycocyanin
Cyanophyta	Blue-green algae	phycocyanin, phycoerythrin

(b) Economic importance of algae.

Ans. ***Economic importance of Algae*** *:* Since from olden days Algae species are intimately connected with human beings as a source food, medicine and other uses. Algae are taking an active role in human beings.

1. Primary Producers:

Algae are the main Oxygen producers in aquatic areas. They are also useful in decreasing water pollution by realizing Oxygen. 10% of photosynthesis is occurred by the algae in total photosynthesis quantity. With these activity algae forms 1.6-15.5 x 10 to the power of 11 tones of carbonic material like food.

2. Algae as food:

Algae species are used as food in several countries in several forms. Algae species have proteins, vitamins (A, B, C and E), lipids, and minerals. Laminaria species is the important edible seaweed in Japan and the food item 'Kombu' is prepared from it. 'Aonori' from Monostroma; 'Asakusa Nori' from Porphyra are prepared in different countries. Porphyra has 35% protein, 45% carbohydrates, Vitamins B and C and Niacin. Nostoc is used as food material in South America.

3. Algae as fodder for cattle:

Rhodymenia palmate is used as food for sheeps in Narvey. Laminaria saccharina, Pelvitia, Ascophyllum, etc. species are used as food for cattles.

4. Algae as fertilizers:

Blue-green algae are treated as bio-fertilizers from olden days. Nostoc, Oscillatoria, Scytonema, Spirulina, etc. are used as fertilizers to rice fields. All these algae are fixed the atmosphere Nitrogen in to ground. Cultivation of Spirulina is gaining importance as feed for fish, poultry and cattle.

5. Algae in Pisi culture:

Sea algae are used as food for fishes. So they play an important role in Pisi culture. Some green-algae, Diatoms, some blue-green algae are used as food material to fishes. These are also making the water clean, by realizing Oxygen.

6. Algae in reclamation of alkaline or Usar soils:

Our country has more number of alkaline soils or sterile soils. Blue-green algae like Nostoc, Oscillatoria, Scytonema, Spirulina are modified the soils in to fertile soils. Because they fixed Nitrogen in to soil. Nearly they fixed 400 K.g. of Nitrogen per year. Soil erosion is also reduced by these algae.

7. Algea in industry:

Iodine industry is mainly depended upon algae. Algae belonging to Phaeophyceae, like Laminaria, Ecklonia, Eisenia, etc. are used in the industry to prepare Iodine in industries. Phyllophora is used to prepare Iodine in Russia.

8. Alginates:

Alginates are the salts of alginic acid found in the cell wall of phaeophyceae. Alginates are extracted from Fucus, Laminaria, Macrocystis and Ecklonia. Alginates are used in the preparation of flame-proof fibrics, plastics, paints, gauze material in surgical dressing, soups, ice creams etc.

9. Agar-Agar:

Agar-agar is a jelly like substance of great economic value. It is obtained from certain red algae like Gelidium, Graciliaria, and Gigartina. Agar is used as a culture medium for growing callus in tissue culture.

10. Carragheen or Carragheenin:

It is extracted from cell walls of red algae like Chondrus and Gigartina. It is a polysaccharide esterfied with sulphate. It is used as emulsifier in pharmaceutical industry and also in textile, leather, cosmetics and brewing industries.

11. Diatomite:

Diatoms deposits at marine and fresh water areas. They are rich with silica. It is called as diatomite. It is used in the preparation of Dynamite in olden days. But now it is used in different industries like glass, metal polishing, paints, tooth pasts, soups, etc.

12. Funori:

It is a type of glue obtained from a red alga Gloipeltis furcata. It is used as an adhesive as well as sizing agent for paper and cloth. Chemically it is similar to agar-agar except that there is no sulphate ester group.

13. Minerals:

The brown sea weeds popularly called as kelps yield potash, soda, and iodine. Some sea weeds are rich source of iron, zinc, copper, manganese and boron. Bromine is extracted from red algae such as Polysiphonia and Rhodymenia.

14. Antibiotics and Medicines:
Antibiotic Chlorellin, obtained from Chlorella is effective against a number of pathogenic bacteria. Extracts from Cladophora, Lyngbya can kill pathogenic Pseudomonas and Mycobacterium. Laminaria is used as one of the modern tools for abortion. Seaweeds have beneficial effect on gall bladders, pancreas, kidneys, uterus and thyroid glands.

15. Role of Algae in Sewage Disposal: Some species like Chlamydomonas, Scenedesmus, Chlorella, Pondorhina, Euridina, etc are living in sewage water. They are mainly useful to clean the water by realizing Oxygen. They also modified the carbonate material in the water into N, P, K fertilizers.

16. Algae as research material: In biological research algae are useful because of their rapid growth, brief life span and easy mode of cultivation. Chlorella, Scenedesmus and Anacystis are used in investigations in photosynthesis. Blue-green algae are used in studies on nitrogen fixation. Researches in Genetics and Cytology are carried out on Acetabularia.

17. Algae in Space: Chlorella and Synechococcus are finding application in space ships and nuclear submarines as oxygen regenerating and food and water recycling organisms.

Harmful aspects of Algae : Some algae species like Microcystis, Lyngbya are develop water blooms in water areas. They secrete toxic materials into water. That they polluted the water. The algae, Cephaleuros virescence causes for red rust tea in tea plant. Some algae species are caused for some skin diseases. Dianophlagellate is caused for the death of fishes in water.

(c) Isolation and culture of algae .

Ans. Algal cultures are essential when conducting competition studies, bioassays, assessment of zooplankton food preferences, and determination of algal life histories. They are also necessary for molecular systematic work. Algal cultures may be "unialgal," which means they contain only one kind of alga, usually a clonal population (but which may contain bacteria, fungi, or protozoa), or cultures may be "axenic," meaning that they contain only one alga and no bacteria, fungi or protozoa. There are four major techniques for obtaining unialgal isolates: streaking, spraying, serial dilution, and single-cell isolations. Streaking and spraying are useful for single-celled, colonial, or filamentous algae that will grow on an agar surface; cultures of some flagellates, such as *Chlamydomonas* and *Cryptomonas* may also be obtained by these procedures. Many flagellates, however, as well as other types of algae must be isolated by single-organism isolations or serial-dilution techniques. We will practice spraying and single-organism isolations.

Spraying. In this technique, a stream of compressed air is used to disperse algal cells from a mixture onto the surface of a petri plate containing growth medium solidified with agar. Hold a petri plate about 18 inches from the touching tips of two Pasteur pipettes. One of these is attached to an airline via a hose, and mounted onto a ringstand. The other pipette is suspended tip-up into a container holding the algal mixture. The airflow from the first pipette creates a vacuum that draws a stream of algae-containing liquid up from the container through the second pipette. The airflow also sprays the suspended algae through the air, where they can be intercepted by the agar plate.

Single-cell/colony/filament isolations. The first step in this procedure is to prepare a number of "micropipettes" (very fine-tipped pipettes) from glass Pasteur pipettes. Hold a pipette in both hands; the tip end is held with a forceps so that the glass near the tip is within the flame of a bunsen burner (gas flame). The pipette is held in the flame only until the glass becomes slightly soft. This is determined by testing for flexibility by moving the tip with the forceps. Then the pipette is removed from the flame and pulled out straight. or at an angle so that there is a bend. If you pull the pipette while it is still in the flame, it will seal up, so don't do this. Always remove the pipette before pulling it. Use the forceps to break the tip. You can vary the diameter of the finely pulled tip by changing the speed of pulling; the diameter of a slowly-pulled tip will be greater than that of a rapidly-pulled tip. You would want a narrow diameter tip if you are trying to isolate very small algae, but a larger diameter tip is required for large cells. Try to match the diameter of the pipette tip to the size of the algal cells to be isolated.

Prepare a multiwell plate with sterilized media in each well. Place multiple drops of sterilized media or water onto the inside surface of a sterile petri plate. Attach a micropipette to a length of rubber tubing, attach a ethanol-sterilized mouthpiece to the the other end of the tubing, and put the mouthpiece in your mouth. Place a petri dish of algae on the stage of a dissecting microscope and locate the single cell/colony/filament to be isolated. Then find the tip of the micropipette and move it to the vicinity of the alga, then suck it up into the pipette tip, then stop the suction. Try to avoid sucking up any other algae. Now remove the pipette from the dish, then blow the liquid+alga into one of the drops of water on a petri plate). Break off and dispose of the portion of the micropipette tip that contained liquid; this has been contaminated. The micropipette can continue to be used until all of the pulled portion has been consumed. Now use the micropipette to transfer the isolated alga from the first drop into a series of fresh drops. This is a washing procedure that helps remove contaminants. After transfer through 5-10 drops, transfer the alga into a well of the multiwell plate holding liquid growth medium suitable for that particular species. Repeat the procedure. Usually several attempts are made because not all isolated algae will continue to grow, or some may be contaminated with other algal cells.

A particularly effective means of obtaining unialgal cultures is isolation of zoospores immediately after they have been released from parental cell walls, but before they stop swimming and attached to a surface. Recently-released zoospores are devoid of contaminants, unlike the surfaces of most algal cells. But catching zoospores requires a steady hand and experience.

Filaments can be grabbed with a slightly curved pipette tip and dragged through soft agar (less than 1%) to remove contaminants. It is best to begin with young branches or filament tips which have not yet been extensively epiphytized.

Antibiotics can be added to the growth medium to discourage growth of contaminating cyanobacteria and other bacteria. Addition of germanium dioxide will inhibit growth of diatoms.

Axenic cultures (beyond the scope of this course) can be obtained by treating isolated algae to an extensive washing procedure, and/or with one or more antibiotics. Resistant stages such as zygotes or akinetes can be treated with bleach to kill epiphytes, then planted on agar for germination. It is usually necessary to try several different concentrations of bleach and times of exposure to find a treatment that will kill epiphytes without harming the alga.

Place the tubes/dishes with isolated algae into the culture room and allow growth to occur for 3-4 weeks. Examine them with the dissecting scope for signs of growth or contamination.

Freshwater Growth Media used in this class:

1) BBM is Bold's basal medium, chemically defined; good for many green algae.

2) Soil-water is undefined and used for algae whose nutritional requirements are unknown, or which will not grow on simple inorganic media. The soil should be loam from a site where herbicides have not recently been used. Sometimes it is advisable to add a dried pea to the medium before autoclaving.

3) SD11 is a defined medium that is somewhat more complex than BBM; it contains a vitamin mixture. Good for many green algae.

4) DYIII is a defined medium to which vitamins are often added, used for culture of chrysophytes and cryptomonads as well as some dinoflagellates.

Unit-II

Q.1 Multiple Choice Questions

a. The group of plants referred to as 'amphibians of plant kingdoms'.
(a) Bryophytes (b) Mosses
(c) Liverworts (d) Hornworts

Ans (a)

b. In thallose bryophytes the rhizoids and scales are
(a) Both unicellular (b) Both multicellular
(c) Multi and unicellular respectively (d) Uni and multicellular respectively

Ans (d)

c. Gemmae are asexual reproductive bodies in.
(a) Liverworts only (b) Hornworts only
(c) Liverworts and mosses (d) All of these

Ans (d)

d. Gemma cup is formed in
(a) Marchantia (b) Lunularia
(c) None of these (d) Both of these

Ans (d)

e. The term 'Bryophyta' was given by
(a) Engler (b) Braun
(c) Schimper (d) Campbell

Ans (b)

f. Which of the following is an aquatic bryophyte?
(a) Anthoceros halli (b) Riccia discolor
(c) Sphagnum compactum (d) Riccia fluitans

Ans (d)

g. The oldest fossil bryophyte recorded is a sps of
(a) Ricciopsis (b) Hepaticites
(c) Marchantites (d) Muscites

Ans (b)

h. The bryophytes lack

(a) True roots (b)Vascular tissue

(c)Both of these (d)Both of these and embryo formation

Ans (c)

i. Spore mother cell in bryophyte is

(a) Haploid (b) Diploid

(c) Triploid (d) Tetraploid

Ans (b)

Q.2 Fill in the Blanks:

a. __________is a *colonial* alga.

b. The eight called stage during the development of a daughter colony in volvox is called as __________

c. The branching in *chara* is ___________.

d. The cell wall of Chara has impregnation of ________

e. The reserve food in *Vaucheria* is _______.

f. The cells of Eltocarpus are ________nucleate having a few _________ chloroplasts.

g. The cells of *Polysiphonia* lack _____________.

h. The thalli of __________ grow closely so as to form a rosette.

i. The gemmae of *Marchantia* are bilaterally symmetrical having ________ and _______cells.

Ans (a) Volvox (b) plaked. (c) $CaCO_3$

(d) oil (e) plaked. (f) Multi , Band shaped

(g) pyremoid (h) Riccia (i) rhizoidal , oil

Q.3 Answer the following in short:

a. What is the name of the male sex organ of Chara?

Ans Globule

b. In which alga is Plakea stage found?

Ans Volvox

c. Which type of sporangia is produced only on the saprophytic plants in Ectocorpus?

Ans Plurilocular sporangia

d. What are the different spores produced in the life cycle of *Polysiphonia*?

Ans Carpospore, tetraspore

e. Name one aquatic species of *Riccia* .
Ans *Riccia fluitans*

f. In which plant a gemma cup-present .
Ans *Marchantia*

g. The group of plants referred to as 'amphibians of plant kindom' is
Ans Bryophyta

h. The oldest fossil bryophyte recorded is
Ans Genus Hepaticites sp.

i. Give an example of siphoneous algae.
Ans *Volvox*

j. What kind of thallus is found in coleochaete?
Ans Discoid, prostrate and erect

k. Name any aquatic bryophyte?
Ans Riccia fluitans

l. Who gave the name of bryophyte?
Ans Braun (1864)

m. How many neck canal cells are found in archegonium of Marchantia?
Ans 4-6 cells

n. How many rows of leaves are found in Porella?
Ans 3 rows

Q.4 Give an illustrated account of the vegetative structure and method of reproduction in volvox?

Ans. *Volvox* is a genus of chlorophytes, a type of green algae. It forms spherical colonies of up to 50,000 cells. They live in a variety of freshwater habitats, and were first reported by Antonie van Leeuwenhoek in 1700. *Volvox* developed its colonial lifestyle 200 million years ago.

Description *Volvox* is a genus of chlorophytes, a type of green algae. It forms spherica colonies of up to 50,000 cells. They live in a variety of freshwater habitats,andwere first reported by Antonie van Leeuwenhoek in 1700. *Volvox* developed its colonial lifestyle 200 million years ago.

Habitats

Volvox is a freshwater alga and is found in ponds and ditches, even in shallow puddles. According to Charles Joseph Chamberlain, "The most favorable place to look for it is in the deeper ponds, lagoons, and ditches which receive an abundance of rain water. It has been said that where you find *Lemna*, you are likely to find *Volvox*; and it is true that such water is favorable, but the shading is unfavorable. Look where you find *Sphagnum*, *Vaucheria*, *Alisma*, *Equisetum fluviatile*, *Utricularia*, *Typha*, and *Chara*. Dr. Nieuwland reports that *Pandorina*, *Eudorina* and *Gonium* are commonly found in summer as constituents of the green scum on wallows in fields where pigs are kept. The flagellate, *Euglena*, is often

***Volvox* colony**: 1) *Chlamydomonas*-like cell, 2) Daughter colony, 3) Cytoplasmic bridges, 4) Intercellular gel, 5) Reproductive cell, 6) Somatic cell.

Volvox is the most developed in a series of genera that form spherical colonies. Each mature *Volvox* colony is composed of numerous flagellate cells similar to *Chlamydomonas*, up to 50,000 in total, and embedded in the surface of a hollow sphere or coenobium containing an extracellular matrix made of a gelatinous glycoprotein. The cells swim in a coordinated fashion, with distinct anterior and posterior poles. The cells have eyespots, more developed near the anterior, which enable the colony to swim towards light. The individual algae in some species are interconnected by thin strands of cytoplasm, called protoplasmates. They are known to demonstrate some individuality and working for the good of their colony, acting like one multicellular organism. The flagellates on its outside resemble Euglena.

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Reproduction

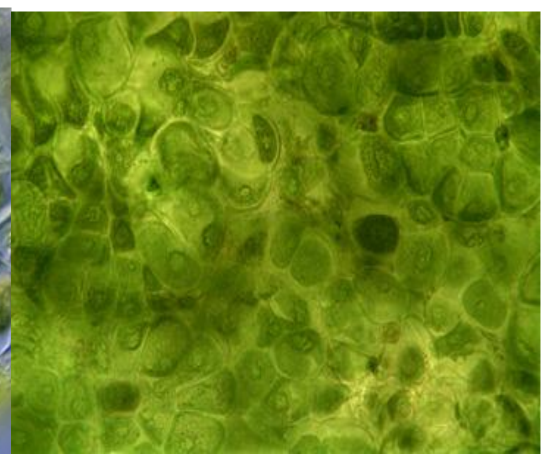
An asexual colony includes both somatic (vegetative) cells, which do not reproduce, and *gonidia* near the posterior, which produce new colonies through repeated division. The daughter colonies are initially held within the parent coenobium and have their flagella directed inwards. Later, the parent disintegrates and the daughters invert. In sexual reproduction two types of gametes are produced. *Volvox* species can be monoecious or dioecious. Male colonies release numerous microgametes, or sperm, while in female colonies single cells enlarge to become oogametes, or eggs.

Q.5 Describe vegetative structure of *Coleochaete?*

Ans The thallus morphology of *Coleochaete* varies greatly. The genus may be prostrate and flat with radial symmetry, or may have more upright, branched filament systems. Other specimens have a combination of prostrate and upright portions. There may be a single layer of cells, or many. Species with a flat, tissue-like morphology are found more often in shallow waters than filamentous species, indicating that they have a competitive advantage in this environment.

Seta cells have extensions of the cell wall and cytoplasm. These sheathed hair cells may be as much as 100 times longer than the cell itself and help to protect the cells from herbivory. The hairs frequently break off at the edge of the sheath near the base of the hair cell, and are occasionally coiled. The seta cells differ from the other cells in that they have layered cell walls and C-shaped chloroplasts. Most cells have a single, parietal, plate-like chloroplast with at least one large pyrenoid. The thylakoids are arranged in grana, which makes them more plant-like than those of other green algae. Most or all species only grow vegetatively from the tips or edges of the thallus since they possess terminal or marginal meristems.

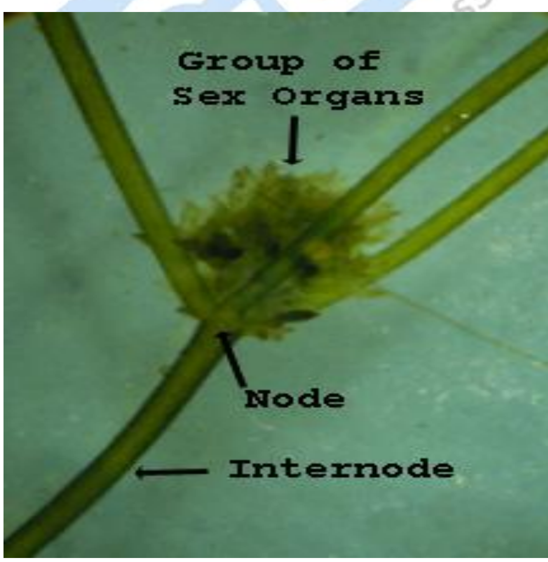
The variations in *Coleochaete* morphology may represent the evolution of the thallus morphology of land plants, as it is known that the genus is closely related to embryophytes.



Structure of Coleochacte

Q.6 Describe the vegetative and reproductive characters of *chara* with the help of neat diagrams?

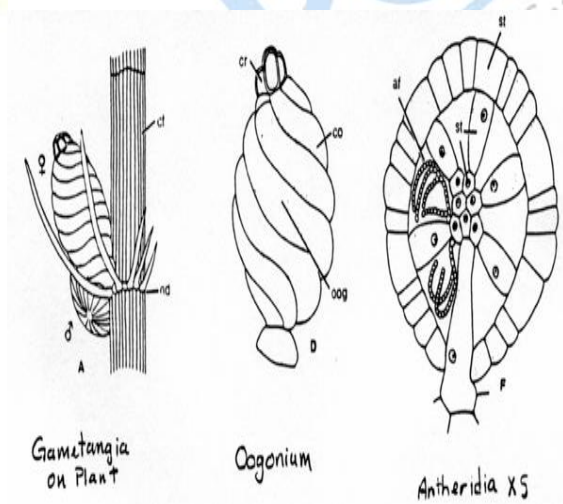
Ans. Vegetative Structure . *Chara* is a genus of green algae in the family Characeae *Chara* species are multicellular and superficially resemble land plants because of stem-like and leaf-like structures. The branching system is complex with branches derived from apical cells which cut off segments at the base to form nodal and internodal cells alternately. They are typically anchored to the littoral substrate by means of branching underground rhizoids. *Chara* plants are rough to the touch because of deposited calcium salts on the cell wall. The metabolic processes associated with this deposition often give *Chara* plants a distinctive and unpleasant smell of hydrogen sulfide



Morphology The plant body is a gametophyte. It consists of a main axis (differentiated into nodes and internodes), dimorphic branches (long brach of unlimited growth and short branches of limited growth), rhizoids (multicellular with oblique septa) and stipulodes (needle shaped structures at the base of secondary laterals.

Occurrence Species are found in fresh water, particularly in limestone areas throughout the northern temperate zone. They prefer less oxygenated and hard water and are not found in the waters where mosquito larvae are present. Chara grow submerged attached to the muddy bottom of the pools and ponds of clear water. They are covered with calcium carbonate deposits.

Reproduction :*Chara* reproduces vegetatively and sexually. Vegetative reproduction takes place by tubers, amylum stars and secondary protonema. The fructifications for sexual reproduction are globule or antheridium (male) and nucule or archegonium (female).



Q.7 Write short notes on:

(a) Reproductive structure in vaucheria

Ans. **Life History Of Vaucheria**

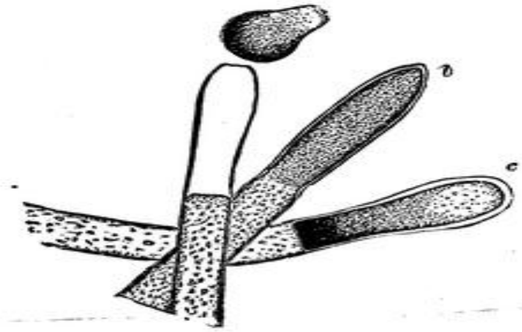


FIG. 1.—GROWTH OF GONIDIA.

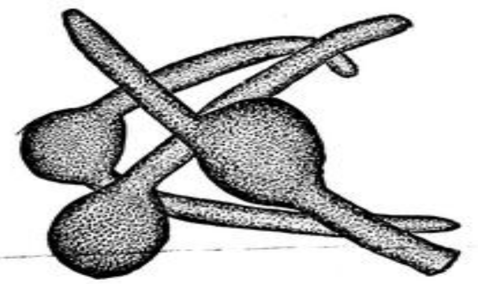


FIG. 2.—GONIDIA GERMINATING.

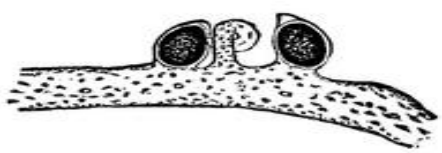


FIG. 3.—ANTHERIDIUM AND OOSPORES.
V. SESSILIS.

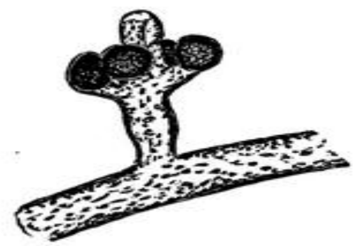
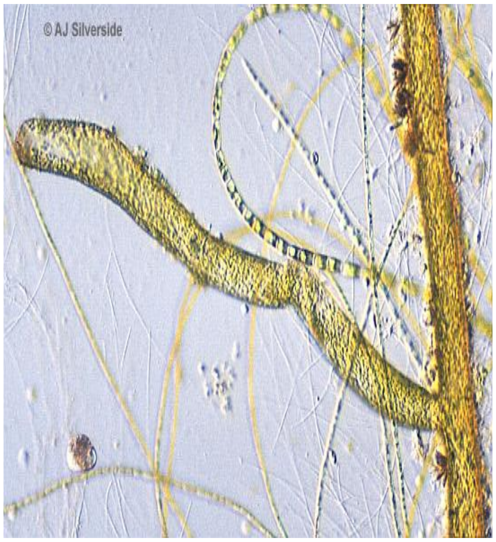


FIG. 4.—ANTHERIDIUM AND OOSPORES.
V. RACEMOSA.

Growth of the alga, vaucheria, under the microscope.
Vaucheria has two or three rather doubtful marine species assigned to it by Harvey, but the fresh water forms are by far the more numerous, and it is to some of these I would call your attention for a few moments this evening. The plant grows in densely interwoven tufts, these being of a vivid green color, while the plant is in the actively vegetative condition, changing to a duller tint as it advances to maturity. Its habitat (with the exceptions above noted) is in freshwater - usually in ditches or slowly running streams. I have found it at pretty much all seasons of the year, in the stretch of boggy ground in the Presidio, bordering the road to Fort Point. The filaments attain a length of several inches when fully developed, and are of an average diameter of 1/250 (0.004) inch. They branch but sparingly, or not at all, and are characterized by consisting of a single long tube or cell, not divided by septa, as in the case of the great majority of the filamentous algae. These tubular filaments are composed of a nearly transparent cellulose wall, including an inner layer thickly studded with bright green granules of chlorophyl.



This inner layer is ordinarily not noticeable, but it retracts from the outer envelope when subjected to the action of certain reagents, or when immersed in a fluid differing in density from water, and it then becomes distinctly visible, as may be seen in the engraving (Fig. 1). The plant grows rapidly and is endowed with much vitality, for it resists changes of temperature to a remarkable degree. Vaucheria affords a choice hunting ground to the microscopist, for its tangled masses are the home of numberless infusoria, rotifers, and the minuter crustacea, while the filaments more advanced in age are usually thickly incrusted with diatoms. Here, too, is a favorite haunt of the beautiful zoophytes, Hydra vividis and H. vulgaris, whose delicate tentacles may be seen gracefully waving in nearly every gathering.

Reproduction In Vaucheria

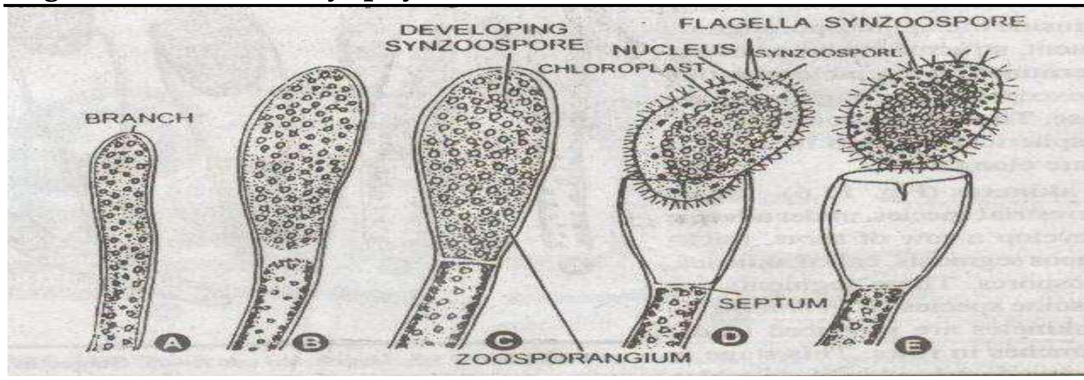
After the plant has attained a certain stage in its growth, if it be attentively watched, a marked change will be observed near the ends of the filaments. The chlorophyl appears to assume a darker hue, and the granules become more densely crowded. This appearance increases until the extremity of the tube appears almost swollen. Soon the densely congregated granules at the extreme end will be seen to separate from the endochrome of the filament, a clear space sometimes, but not always, marking the point of division. Here a septum or membrane appears, thus forming a cell whose length is about three or four times its width, and whose walls completely inclose the dark green mass of crowded granules (Fig. 1, b). These contents are now gradually forming themselves into the spore or "gonidium," as Carpenter calls it, in distinction from the true sexual spores, which he terms "oospores." At the extreme end of the filament (which is obtusely conical in shape) the chlorophyl grains retract from the old cellulose wall, leaving a very evident clear space. In a less noticeable degree, this is also the case in the other parts of the circumference of the cell, and, apparently, the granular contents have secreted a separate envelope entirely distinct from the parent filament.

The grand climax is now rapidly approaching. The contents of the cell near its base are now so densely clustered as to appear nearly black (Fig. 1, c), while the upper half is of a much lighter hue and the separate granules are there easily distinguished, and, if very closely watched, show an almost imperceptible motion. The old cellulose wall shows signs of great tension, its conical extremity rounding out under the slowly increasing pressure from within. Suddenly it gives way at the apex. At the same instant, the inclosed gonidium (for it is now seen to be fully formed) acquires a rotary motion, at first slow, but gradually increasing until it has gained considerable velocity. Its upper portion is slowly twisted through the opening in the apex of the parent wall, the granular contents of the lower end flowing into the extruded portion in a manner reminding one of the flow of protoplasm in a living amoeba. The old cell wall seems to offer considerable resistance to the escape of the gonidium, for the latter, which displays remarkable elasticity, is pinched nearly in two while forcing its way through, assuming an hour glass shape when about half out.

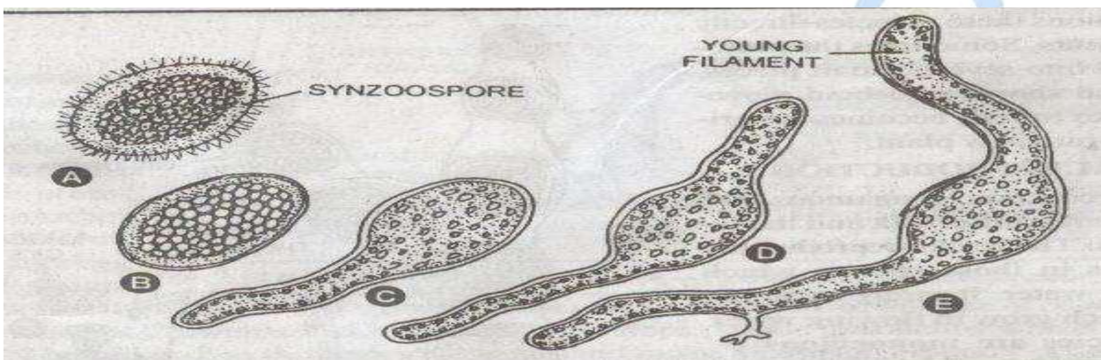
The rapid rotation of the spore continues during the process of emerging, and after about a minute it has fully freed itself (Fig 1, a). It immediately assumes the form of an ellipse or oval, and darts off with great speed, revolving on its major axis as it does so. Its contents are nearly all massed in the posterior half, the comparatively clear portion invariably pointing in advance. When it meets an obstacle, it partially flattens itself against it, then turns aside and spins off in a new direction. This erratic motion is continued for usually seven or eight minutes. The longest duration I have yet observed was a little over nine and one-half minutes. Hassall records a case where it continued for nineteen minutes. The time, however, varies greatly, as in some cases the motion ceases almost as soon as the spore is liberated, while in open water, unretarded by the cover glass or other obstacles, its movements have been seen to continue for over two hours.

Q.8 Write short note on synzoospores?

Ans. **Synzoosopres**: Multiflagellate & multinucleate, produced in club shaped sporangium. During development of zoosporangium, tip portion of side branch starts swelling and becomes club shaped dense cytoplasm along with large number of nuclei and chromatophores flow into the swelling followed by appreence of septum. Central vacuole reduces, zoosporangium turns into dark green in color Nuclei exchange their position from chromatophores the protoplasm starts ontracting from cell wall and changes into zoospore. Zoospores are liberated and are called synzoospore or compound zoosopre.



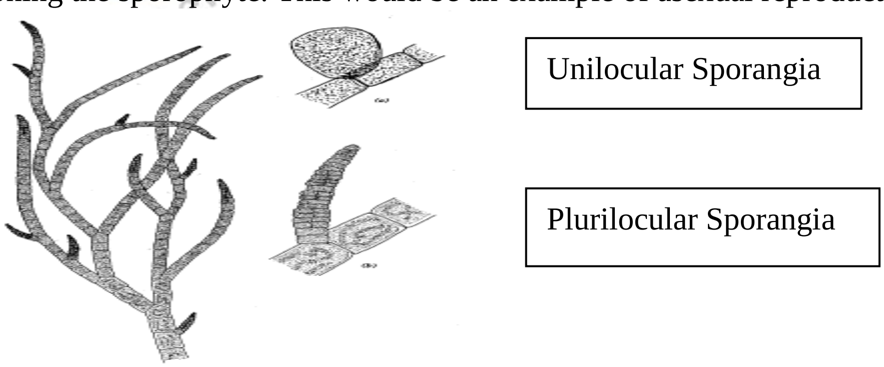
Development & liberation of synzoospores



Germination of synzoospores and zygote formation

Q.9 Write short notes on Plurilocular Sporangia and unilocular?

Ans **Plurilocular sporangia** : The sporophyte of *Ectocarpus* can also produce plurilocular sporangia that are morphologically indestinguishable from those of the gametophyte and contain cells produced by mitosis. But the motile cells that swim away from these plurilocular sporangia are, of course, diploid zoospores rather than gametes. They swim away, settle down on a marine surface, and grow by mitosis into a new sporophyte, thus cloning the sporophyte. This would be an example of asexual reproduction.

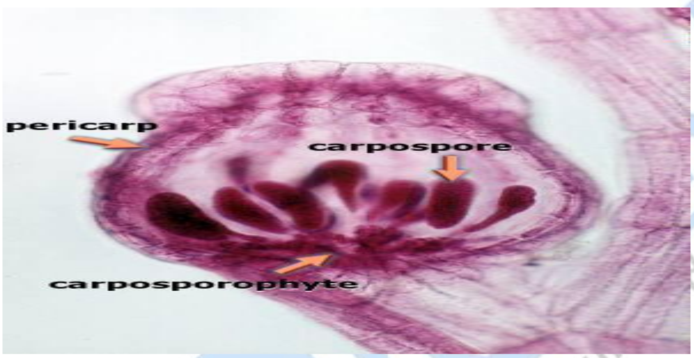


A branch of *Ectocarpus siliculosus* bearing immature plurilocular sporangia. *(a)* A unilocular sporangium. *(b)* A mature plurilocular sporangium. The conical plurilocular sporangia are 50-60 *um* in length, the unilocular sporangia are about 30-60 *um* in diameter. Cells of the main axis measure 40-60 *um* in diameter .

unilocular sporangia: The third kind of *Ectocarpus* thallus is, again indestinguishable macroscopically, looking just like more brown fuzz. Microscopically it is different. This filament is made of cells that are diploid rather than haploid. This thallus produces unilocular sporangia with diploid cells undergoing meiosis to produce unicellular haploid zoospores. This thallus is therefore called the sporophyte. The meiotically-produced zoospores swim away, settle down on a marine surface, and grow by mitosis into gametophytes...about half of the zoospores will make gametophytes of one mating type, the rest will be the opposite mating type.

Q.10 Draw a label diagram of Polysiphonia cystocarp?

Ans.



***Polysiphonia* cystocarp**

Q.11 Describe Polysiphonia with diagrams.

Ans *Polysiphonia* is a red alga, filamentous and usually well branched some plants reaching a length of about 30 cm. They are attached by rhizoids or haptera to a rocky surface or other alga. The thallus (tissue) consists of fine branched filaments each with a central axial filament supporting pericentral cells. The number of these pericentral cells, 4–24, is used in identification. *Polysiphonia elongata* shows a central axial cell with 4 periaxial cells with cortical cells growing over the outside on the older fronds. Its cuticle contains bromine

Features used in identification include the number of pericentral cells, the cortication of main branches, constriction of young branches at their base, whether the branching dichotomous or spiral, and the width and length of thalli.

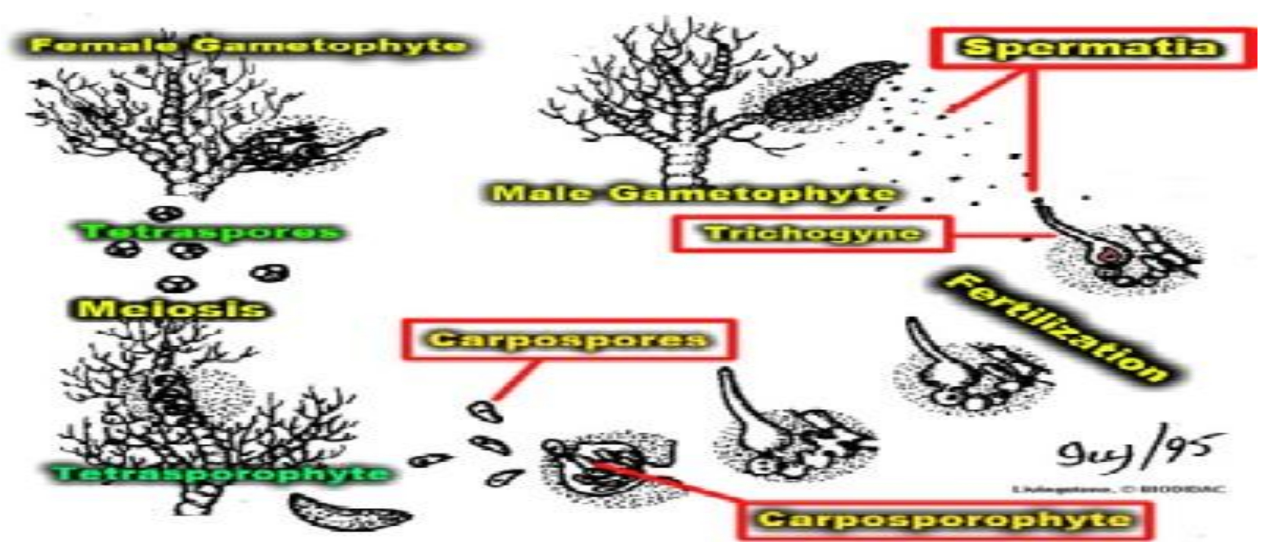
Distribution and ecology

Species have been recorded from Europe, Australia and New Zealand, North America and South America, islands in the Pacific Ocean, South Africa, southwest Asia, Japan, Greenland and Antarctica.

The species are entirely marine, found growing on rock, other algae, mussels or limpets and artificial substrata etc from mid-littoral to at least 27 m depth. Many species are abundant in rock pools. *Polysiphonia lanosa* is commonly found growing on *Ascophyllum nodosum*.

Life cycle

The life-cycle of the red algae has three stages (triphasic). In *Polysiphonia* it consists of a sequence of a gametangial, carposporangial and tetrasporangial phases. Male (haploid) plants (the male gametophytes) produce spermatia and the female plants (the female gametophytes) produce the carpogonium (the haploid carpogonium) which remains attached to the parent female plant. After fertilization the diploid nucleus migrates and fuses with an auxiliary cell. A complex series of fusions and developments follow as the diploid zygote develops to become the carposporophyte, this is a separate phase of the life-cycle and is entirely parasitic on the female, it is surrounded by the haploid pericarp of the parent female plant. The diploid carpospores produced in the carposporangium when released are non-motile, they settle and grow to form filamentous diploid plants similar to the gametophyte. This diploid plant is the tetrasporophyte which when adult produced spores in fours after meiosis. These spores settle and grow to become the male and female plants thus completing the cycle.



Life Cycle of Polysiphonia

Unit III

Q.1 Fill in the blanks:

a. The photosynthetic filaments in the liver worts may be _______or _______.
b. The psendoelaters are found in the capsule of ____________ .
c. The fertilization in bryophytes is ________.
d. The number of ventral canal cells in bryophytes is always _____.
e. In <u>Riccia fluitans</u> thallus there are no ________and ______.
f. The sex organs in Riccia are born in ______order and lie in _____
g. The cluster of 'leaves' surrounding the antheridia in moss is called as ______.

Ans (a) branched , unbranced (b) Anthoceros
(c) zooidogamous (d) one
(e) rhizoids , scales (f) acropetal , median furrow
(g) perichatium

Q.2 Answer the following in short:

a. What is the significance of scales in bryophytes?
Ans Protection of growing points.

b. What is the function of elaters in the capsule of *Marchantia*?
Ans Dispersal of spores

c. Name the class to which *Riccia* belongs?
Ans Hepaticopsida

Q.3 Explain evolution of sporophyte in Bryophytes?"

Ans. Plant scientists recognize two kinds of land plants, namely, bryophytes, or nonvascular land plants and tracheophytes,or vascular land plants. Bryophytes are small, herbaceous plants that grow closely packed together in mats or cushions on rocks, soil, or as epiphytes on the trunks and leaves of forest trees. Bryophytes are distinguished from tracheophytes by two important characters. First, in all bryophytes the ecologically persistent, photosynthetic phase of the life cycle is the haploid, gametophyte generation rather than the diploid sporophyte; bryophyte sporophytes are very short-lived, are attached to and nutritionally dependent on their gametophytes and consist of only an unbranched stalk, or seta, and a single, terminal sporangium. Second, bryophytes never form xylem tissue, the special lignin- containing, water-conducting tissue that is found in the sporophytes of all vascular plants. At one time, bryophytes were placed in a single phylum, intermediate in position between algae and vascular plants. Modern studies of cell ultrastructure and molecular biology, however,confirm that bryophytes comprise three separate evolutionary lineages, which are today recognized as mosses (phylum Bryophyta), liverworts (phylum Marchantiophyta) and hornworts (phylum Anthocerotophyta). Following a detailed analysis of land plant relationships, Kenrick and Crane (1998) proposed that the three groups of bryophytes represent a grade or structural level in plant evolution, identified by their "monosporangiate" life cycle. Within this the geologically oldest group, sharing a fossil record with the oldest vascular plants in the Devonian era.

Of the three phyla of bryophytes, greatest species diversity is found in the mosses, with up to 15,000 species recognized. A moss begins its life cycle when haploid spores, which are produced in the sporophyte capsule, land on a moist substrate and begin to germinate. From the one-celled spore, a highly branched system of filaments, called the protonema, develops. Cell specialization occurs within the protonema to form a horizontal system of reddish-brown, anchoring filaments, called caulonemal filaments and upright, green filaments, called chloronemal filaments. Each protonema, which superficially resembles a filamentous alga, can spread over several centimeters to form a fuzzy green film over its substrate. As the protonema grows, some cells of the caulonemal filaments specialize to form leafy buds that will ultimately form the adult gametophyte shoots. Numerous shoots typically develop from each protonema so that, in fact, a single spore can give rise to a whole clump of moss plants. Each leafy shoot continues to grow apically, producing leaves in spiral arrangement on an elongating stem. In many mosses the stem is differentiated into a central strand of thin-walled water-conducting cells, called hydroids, surrounded by a parenchymatous cortex and a thick-walled epidermis. The leaves taper from a broad base to a pointed apex and have lamina that are only one-cell layer thick. A hydroid-containing midvein often extends from the stem into the leaf. Near the base of the shoot, reddish-brown, multicellular rhizoids emerge from the stem to anchor the moss to its substrate. Water and mineral nutrients required for the moss to grow are absorbed, not by the rhizoids,but rather by the thin leaves of the plant as rain water washes through the moss cushion.

As is typical of bryophytes, mosses produce large, multicellular sex organs for reproduction. Many bryophytes are unisexual, or sexually dioicous. In mosses male sex organs, called antheridia, are produced in clusters at the tips of shoots or branches on the male plants and female sex organs, the archegonia, are produced in similar fashion on female plants. Numerous motile sperm are produced by mitosis inside the brightly colored, club-shaped antheridia while a single egg develops in the base of each vase-shaped archegonium. As the sperm mature, the antheridium swells and bursts open. Drops of rain water falling into the cluster of open antheridia splash the sperm to near-by females. Beating their two whiplash flagellae, the sperm are able to move short distances in the water film that covers the plants to the open necks of the archegonia. Slimey mucilage secretions in the archegonial neck help pull the sperm downward to the egg. The closely packed arrangement of the individual moss plants greatly facilitates fertilization. Rain forest bryophytes that hang in long festoons from the trees rely on torrential winds with the rain to transport their sperm from tree to tree, while the small pygmy mosses of exposed, ephemeral habitats depend on the drops of morning dew to move their sperm.Regardless of where they grow, all bryophytes require water for sperm dispersal and subsequent fertilization. Embryonic growth of the sporophyte begins within the archegonium soon after fertilization. At its base, or foot, the growing embryo forms a nutrient transfer zone, or placenta, with the gametophyte. Both organic nutrients and water move from the gametophyte into the sporophyte as it continues to grow. In mosses the sporophyte stalk, or seta, tears the archegonial enclosure early in development, leaving only the foot and the very base of the seta embedded in the gametophyte. The upper part of the archegonium remains over the tip of the sporophyte as a cap-like calyptra. Sporophyte growth ends with the formation of a sporangium or capsule at the tip of the seta. Within the capsule, water-resistant spores are formed by meiosis. As the mature capsule swells, the calyptra falls away. This allows the capsule to dry and break open at its tip. Special membranous structures, called peristome teeth, that are folded down into the spore mass,now bend outward, flinging the spores into the drying winds. Moss spores can travel great distances on the winds, even moving between continents on the jet streams. Their walls are highly protective, allowing some spores to remain viable for up to 40 years. Of course, if the spore lands in a suitable, moist habitat, germination will begin the cycle all over again.

Liverworts and hornworts are like mosses in the fundamental features of their life cycle, but differ greatly in organization of their mature gametophytes and sporophytes. Liverwort gametophytes can be either leafy shoots or flattened thalli. In the leafy forms, the leaves are arranged on the stem in one ventral and two lateral rows or ranks, rather than in spirals like the mosses. The leaves are one cell layer thick throughout, never have a midvein and are usually divided into two or more parts called lobes. The ventral leaves, which actually lie against the substrate, are usually much smaller than the lateral leaves and are hidden by the stem. Anchoring rhizoids, which arise near the ventral leaves, are colorless and unicellular. The flattened ribbon-like to leaf-like thallus of the thallose liverworts can be either simple or structurally differentiated into a system of dorsal air chambers and ventral storage tissues. In the latter type, the dorsal epidermis of the thallus is punctuated with scattered pores that open into the air chambers. Liverworts synthesize a vast array of volatile oils, which they store in unique organelles called oil bodies. These compounds impart an often spicy aroma to the plants and seem to discourage animals from feeding on them. Many of these compounds have potential as antimicrobial or anticancer pharmecuticals.

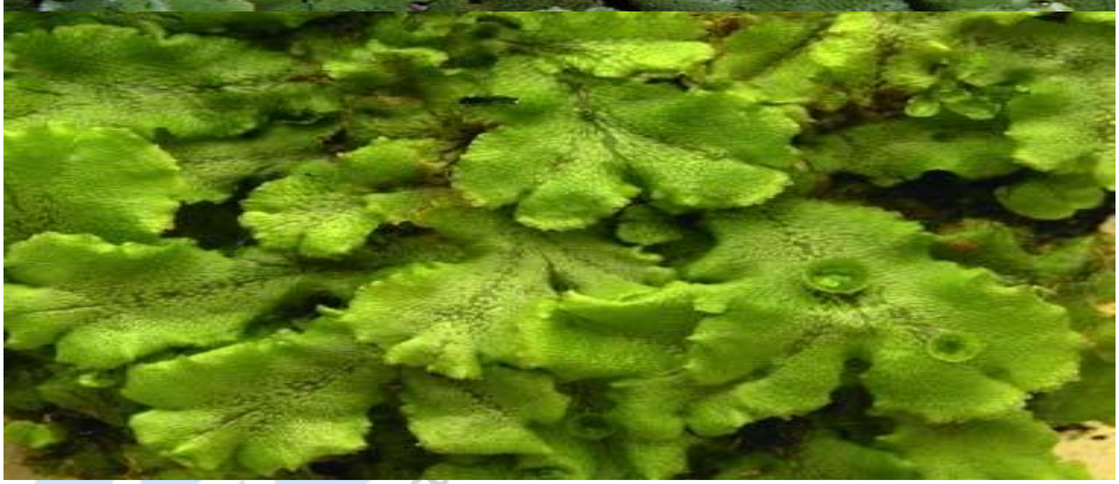
Liverwort sporophytes develop completely enclosed within gametophyte tissues until their capsules are ready to open. The seta, which is initially very short,consists of small, thin-walled, hyaline cells. Just prior to capsule opening, the seta cells lengthen, thereby increasing the length of the seta upto 20 times its original dimensions. This rapid elongation pushes the darkly pigmented capsule and upper part of the whitish seta out of the gametophytic tissues. With drying, the capsule opens by splitting into four segments, or valves. The spores are dispersed into the winds by the twisting motions of numerous intermixed sterile cells, called elaters. In contrast to mosses, which disperse their spores over several days, liverworts disperse the entire spore mass of a single capsule in just a few minutes.

Hornworts resemble some liverworts in having simple, unspecialized thalloid gametophytes, but they differ in many other characters. For example, colonies of the symbiotic cyanobacterium *Nostoc* fill small cavities that are scattered throughout the ventral part of the hornwort thallus. When the thallus is viewed from above, these colonies appear as scattered blue-green dots. The cyanobacterium converts nitrogen gas from the air into ammonium, which the hornwort requires in its metabolism and the hornwort secretes carbohydrate- containing mucilage which supports the growth of the cyanobacterium.Hornworts also differ from all other land plants in having only one large, algal-like chloroplast in each thallus cell. Hornworts get their name from their long, horn-shaped sporophytes. As in other bryophytes, the sporophyte is anchored in the gametophyte by a foot through which nutrient transfer from gametophyte to sporophyte occurs. The rest of the sporophyte, however, is actually an elongate sporangium in which meiosis and spore development take place. At the base of the sporangium, just above the foot, is a mitotically active meristem,which adds new cells to the spore-producing zone throughout the life span of the sporophyte. In fact, the sporangium can be releasing spores at its apex, at the same time that new spores are being produced by meiosis at its base. Spore release in hornworts takes place gradually over a long period of time, and the spores are mostly dispersed by water movements rather than by wind

Mosses, liverworts and hornworts are found throughout the world in a variety of habitats. They flourish particularly well in moist, humid forests like the fog forests of the Pacific northwest or the montane rain forests of the southern hemisphere. Their ecological roles are many.They provide seed beds for the larger plants of the community, they capture and recycle nutrients that are washed with rainwater from the canopy and they bind the soil to keep it from eroding. In the northern hemisphere peatlands, wetlands often dominated by the moss *Sphagnum*, are particularly important bryophyte communities. This moss has exceptional water-holding capacity, and when dried and compressed, forms a coal-like fuel. Throughout northern Europe, Asia and North America, peat has been harvested for centuries for both fuel consumption and horticultural uses and today peat lands are managed as a sustainable resource.

Q. 4 Describe vegetive structure of Marchantia.

Ans *Marchantia* referred to as hepatics or liverworts. Like other bryophytes, they have a gametophyte-dominant life cycle, in which cells of the plant carry only a single set of genetic information.It is estimated that there are 6000 to 8000 species of liverworts, though when neotropical regions are better studied this number may approach 10,000. Some of the more familiar species grow as a flattened leafless thallus, but most species are leafy with a form very much like a flattened moss. Leafy species can be distinguished from the apparently similar mosses on the basis of a number of features, including their single-celled rhizoids. Leafy liverworts also differ from most (but not all) mosses in that their leaves never have a costa (present in many mosses) and may bear marginal cilia (very rare in mosses). Other differences are not universal for all mosses and liverworts, but the occurrence of leaves arranged in three ranks, the presence of deep lobes or segmented leaves, or a lack of clearly differentiated stem and leaves all point to the plant being a liverwort.



Liverworts are typically small, usually from 2–20 mm wide with individual plants less than 10 cm long, and are therefore often overlooked. However, certain species may cover large patches of ground, rocks, trees or any other reasonably firm substrate on which they occur. They are distributed globally in almost every available habitat, most often in humid locations although there are desert and arctic species as well. Some species can be a nuisance in shady green-houses or a weed in gardens.

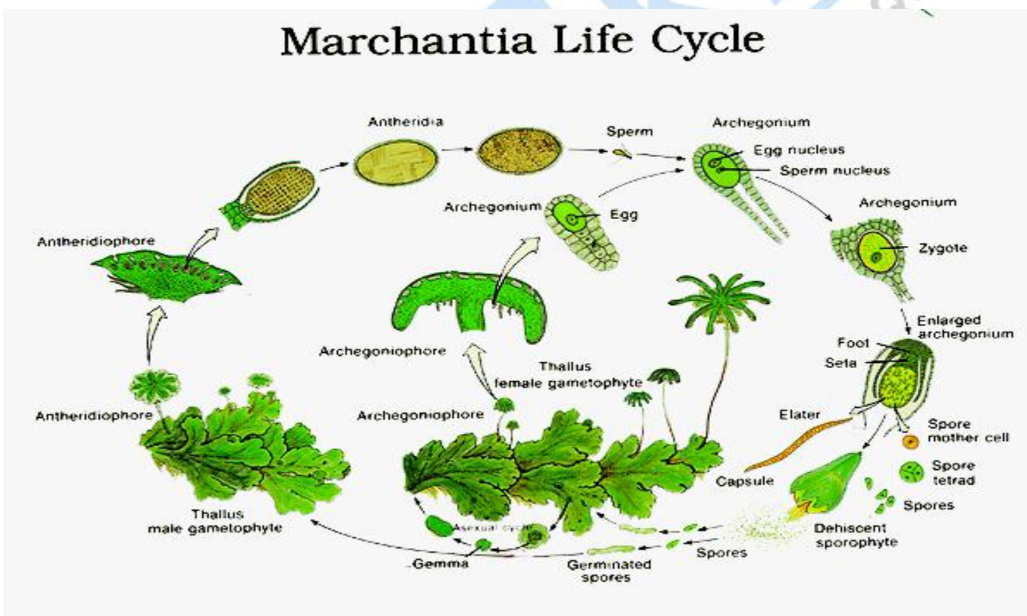
Most liverworts are small, usually from 2–20 millimetres (0.08–0.8 in) wide with individual plants less than 10 centimetreslong so they are often overlooked. The most familiar liverworts consist of a prostrate, flattened, ribbon-like or branching structure called a thallus (plant body); these liverworts are termed thallose liverworts. However, most liverworts produce flattened stems with overlapping scales or leaves in two or more ranks, the middle rank is often conspicuously different from the outer ran.

Liverworts can most reliably be distinguished from the apparently similar mosses by their single-celled rhizoids.Other differences are not universal for all mosses and all liverworts;but the lack of clearly differentiated stem and leaves in thallose species, or in leafy species the presence of deeply lobed or segmented leaves and the presence of leaves arranged in three ranks, all point to the plant being a liverwort. In addition, 90% of liverworts contain oil bodies in at least some of their cells, and these cellular structures are absent from most other bryophytes and from all vascular plants.The overall physical similarity of some mosses and leafy liverworts means that confirmation of the identification of some groups can be performed with certainty only with the aid of microscopy or an experienced bryologist.

Liverworts have a gametophyte-dominant life cycle, with the sporophyte dependent on the gametophyte.Cells in a typical liverwort plant each contain only a single set of genetic information, so the plant's cells are haploid for the majority of its life cycle. This contrasts sharply with the pattern exhibited by nearly all animals and by most other plants. In the more familiar seed plants, the haploid generation is represented only by the tiny pollen and the ovule, while the diploid generation is the familiar tree or other plant. Another unusual feature of the liverwort life cycle is that sporophytes (i.e. the diploid body) are very short-lived, withering away not long after releasing spores. Even in other bryophytes, the sporophyte is persistent and disperses spores over an extended period.

Q. 5 Describe life cycle of Marchantia.

Ans



The life of a liverwort starts from the germination of a haploid spore to produce a protonema, which is either a mass of thread-like filaments or else a flattened thallus. The protonema is a transitory stage in the life of a liverwort, from which will grow the mature gametophore ("gamete-bearer") plant that produces the sex organs. The male organs are known as antheridia (singular: antheridium) and produce the sperm cells. Clusters of antheridia are enclosed by a protective layer of cells called the perigonium (plural: perigonia). As in other land plants, the female organs are known as archegonia (singular: archegonium) and are protected by the thin surrounding perichaetum (plural: perichaeta).Each archegonium has a slender hollow tube, the "neck", down which the sperm swim to reach the egg cell.

Liverwort species may be either dioicous or monoicous. In dioicious liverworts, female and male sex organs are borne on different and separate gametophyte plants. In monoicious liverworts, the two kinds of reproductive structures are borne on different branches of the same plant.In either case, the sperm must move from the antheridia where they are produced to the archegonium where the eggs are held. The sperm of liverworts is biflagellate, i.e. they have two tail-like flagellae that enable them to swim short distances,provided that at least a thin film of water is present. Their journey may be assisted by the splashing of raindrops. In 2008, Japanese researchers discovered that some liverworts are able to fire sperm-containing water up to 15 cm in the air, enabling them to fertilize female plants growing more than a metre from the nearest male. When sperm reach the archegonia, fertilisation occurs, leading to the production of a diploid sporophyte. After fertilisation, the immature sporophyte within the archegonium develops three distinct regions: (1) a foot, which both anchors the sporophyte in place and receives nutrients from its "mother" plant, (2) a spherical or ellipsoidal capsule, inside which the spores will be produced for dispersing to new locations, and (3) a seta (stalk) which lies between the other two regions and connects them.When the sporophyte has developed all three regions, the seta elongates, pushing its way out of the archegonium and rupturing it. While the foot remains anchored within the parent plant, the capsule is forced out by the seta and is extended away from the plant and into the air. Within the capsule, cells divide to produce both elater cells and spore-producing cells. The elaters are spring-like, and will push open the wall of the capsule to scatter themselves when the capsule bursts. The spore-producing cells will undergo meiosis to form haploid spores to disperse, upon which point the life cycle can start again.

Unit IV

Q.1 Multiple Choise Questions:

a. The Lichens are
(a) Fast growing, short lived
(b) Fast growing, long lived
(c) Slow growing, short lived
(d) Slow growing, long lived
Ans (d)

b. 'Reindeer' moss is
(a) Cladonia sp.
(b) Cetraria sp
(c) Usnea sp.
(d) Parmelia sp.
Ans (a)

c. 'Iceland' moss is
(a) Usnea sp.
(b) Cetraria sp.
(c) Parmelia sp.
(d) Lecanora sp.
Ans

d. Lichen growing on rocks are called as.
(a) Corticoles
(b) Lignicoles
(c) Terricoles
(d) Saxicoles
Ans (d)

e. The following lichen is used as food in tundras.
(a) Caladonia
(b) Parmelia
(c) Evernia
(d) All of these
Ans (a)

f. Which of the following is a poisonous lichen?
(a) Lethoria Vulpina
(b) Lecanora esculentia
(c) Usnea Parbata
(d) All of these
Ans (a)

g. Urcein dye is obtained from the lichen
(a) Lasallia
(b) Cladonia
(c) Ramalin
(d) Lecanora
Ans (d)

h. Lichens are composite structures consisting of algae and.
(a) Mosses
(b) Protozoa
(c) Fungi
(d) Bacteria
Ans (c)

Q.2 Fill in the blanks:

a. Each cell of *Anthoceros* thallus has _____ chloroplast and a ______.

b. The seta of *Anthoceros* saprophyte acts as _______ meristem.

c. The endothecium in *Anthoceros* forms is called as columella.

d. At maturity the Pseudoelaters of Anthoceros are dead celled helping in dehiscence of the capsule.

e. The rhizoids of *Funaria* possess _______ septae.

f. The stalk of antheridia of *Funaria* is multi celled and

g. The peristome of *Funaria* is made up of _____ quter and *sixteen* inner teeth.

h. A mature stomata of moss capsule has _______ guard cells.

i. The archegonium of Funaria contains ______, neck canal cells.

j. Morrison called lichen as ______.

k. Lichen growing on tree bark are called as ______

l. The algal component of lichens is called as ________.

m. The sterile lichens producing no spores are placed in _______

n. Fruticose lichens are also called as ______.

o. The cup like structure in the upright branches of fruticose lichens is called as _______.

p. Lichens commonly multiply by forming prop gules like isidia and ______.

q. The lichen _______ yields litmus.

r. The linchens are the ______ of vegetation in the ecological succession on a rocky surface.

s. Usnic acid is present in the lichens like _____and ______.

t. Common name of ________ is peat moss.

u. The talli of *Anthocerosthalli* _______ dissected

Ans	(a) single , pyrenoids	(b) intercalary	(c) columella
	(d)	(e) oblique	(f) biseriate
	(g) sixteen	(h) annular	(i) 6 to many
	(j) mucofungus	(k) corticoles	(l) phycobiont
	(m) duterolichens	(n) shrubby	(o) scyphus
	(p) soredia	(q) Roccella montagnei	(r) pioneer
	(s) Cladonia , Usnea	(t) Sphagnum	(u) pinnately

Q.3 Answer the following in short:

a. Name a bryophyte in which the basal part of capsule is meristematic

Ans *Anthoceros*

b. What are the important features of the rhizoids of Bryopsida?

Ans Absorption of minerals and water.

c. Give the botanical name of Reindeer's moss.

Ans *Cladonia rangifera*

d. The fungal components of lichens generally belong of which class?

Ans Basidiomycetes.

e. What are crustose lichens?

Ans Thin, flat thallus adhered to the substratum and provides a crust like appearance

f. From which algae is Agar-agar obtained?
Ans *Gelidium, Gracilaria*

g. The Lichens growing on the bark of trees are called
Ans *Parmelia, Usnea*

h. Lichen found in polar region is
Ans *Cladonia rangiferina*

i. Which plant is called 'Horne wort'?
Ans *Anthoceros*

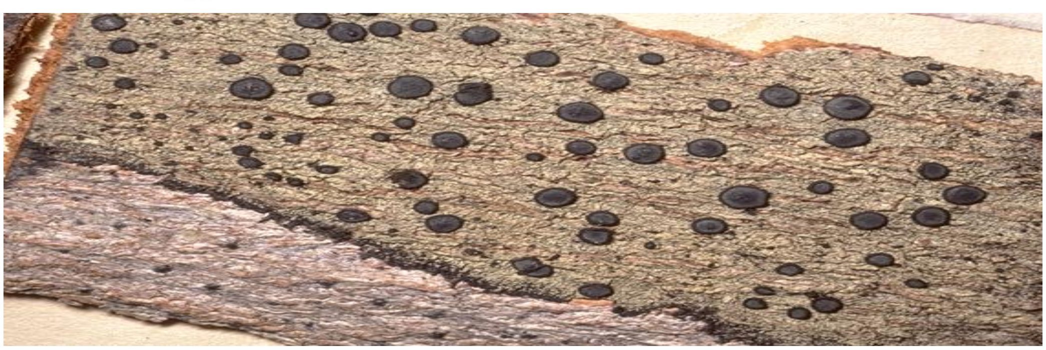
j. Which plant is 'peat moss'?
Ans *Sphagnum*

k. Which lichen in used in formation of litmus paper?
Ans *Roccella montagnei*

l. Thin and flat lichens occurring as crust on rock and bark are called as-
Ans Crustose

Q.4 What are lichen? Describe various type of lichens and their mode of reproduction.

Lichen Structure: Structurally, lichens are among the most bizarre of all forms of life. That's because every lichen species is actually composed of two, possibly even three, distinct species of organisms. One species is a kind of fungus. Usually the other species is an alga, but sometimes it can be a photosynthesizing bacterium known as a cyanobacterium. Sometimes all three organisms are found in one lichen.



The drawing at the right gives an idea of what fungal hyphae wrapping around alga cells might look like at the microscopic level. Since all three kinds of organism are profoundly different from one another, what lichens do is almost like merging a shrub with a dog to produce something that looks and lives unlike either shrub or dog.

In this amazing association the fungus benefits from the algae because fungi, having no chlorophyll, can't photosynthesize their own food. A lichen's fungal part is thus "fed" by its

photosynthesizing algal part. The algae benefit from the association because the fungus is better able to find, soak up, and retain water and nutrients than the algae. Also, the fungus gives the resulting lichen shape, and provides the reproductive structures. This kind of relationship between two or more organisms, where *both organisms benefit*, is known as mutualism.

The main body of a lichen is called a thallus. At the left you see the British Soldier Lichen, *Cladonia cristatella*. It's only about ¼-inch high (6 mm). In this common lichen the red spore-producing reproductive structures are clearly visible. The lichen's name, *Cladonia cristatella*, is actually the name of the fungus.

The alga species in the lichen is known as *Trebouxia erici*. However, it's customary to name a lichen after its fungal part, so the whole lichen is known as *Cladonia cristatella*. British Soldiers are usually found on decaying wood, soil, mossy logs, tree bases, and stumps. They help break down old wood and put nutrients back into the soil where they can be used by plants. Lichens also take nitrogen from the air and put it into the soil so plants can use it.

Lichens are very sensitive to air pollution, so if your town has dirty air your backyard may not have many lichens to study. Moreover, unless you know what you're looking for, you can be staring right at a healthy lichen and not even know it. On the other hand, the picture at the right is a scanning of a lichen-covered twig fallen from a big Pecan tree above.

Kinds of lichen:

Traditionally three broad categories of lichen have been recognized: crustose (crusty), foliose (leafy),and; fruticose (shrubby). Nowadays sometimes other forms are recognized.

For example, very simple lichens for which fruiting bodies have never been observed, looking like no more than powdery patches, are known as leprose lichens.

Sometimes crustose lichens develop blister-like "squamules," where part of the plant body, or thallus, lifts off the substrate on which the lichens grow. Such lichens can be squamulose lichens.

However, for our introductory, backyard needs, we can stick with the traditional three lichen categories. Click on the following links to see some examples of each kind:

LICHEN ECOLOGY:

Ecologically, lichens are important because they often occupy niches that, at least sometime during the season, are so dry, or hot, or sterile, that nothing else will grow there. For example, often the only plant growing on a bare rock will be a crustose lichen.

That crustose lichen will be patiently collecting around and beneath itself tiny amounts of moisture, and mineral and organic fragments. When freezing temperatures come, the lichen's collected water will expand as it forms ice and maybe this expanding action will pry off a few more mineral particles from the rock below the lichen, thus making more soil. The water itself is a bit acidic, plus humic acids from the organic matter collected by the lichen will also be acidic, so these acids will likewise eat away at the stone.

Over a period of perhaps many years, even centuries, the lichen gathers an extremely thin and fragile hint of a soil around it. As the lichen grows the soil-producing processes speeds up and takes place over an ever-larger area.. Eventually other more complex plants, perhaps a foliose or fruticose lichen, or mosses or ferns, or even some form of flowering plant, may take root in the modest soil and replace the crustose lichen.

Thus crustose lichens on bare rock often begin a *succession* of communities, as described on one of our ecology pages. And when your heel dislodges a patch of lichen from a rock, you may be undoing the patient work of centuries...

Certain lichens live on leaves, sometimes as parasites. These special leaf-living lichens are known as foliicolous lichens (*not* foliose). You might enjoy downloading a free, well-illustrated field guide to foliicolous lichens, in PDF format, presented by the Field Museum of Chicago.

Lichen reproduction:

Lichens reproduce in two main ways:

- The fungus part produces reproductive structures that further produce spores. If a spore lands and germinates, and the resulting hypha finds the right species of alga in the neighborhood, the hypha will grow through the algal cells and a new lichen will start developing.

- By asexual (vegetative) techniques. One asexual strategy is that of *fragmentation*, which simply involves a piece of a lichen breaking off and this fragment then grows into a new lichen. Lichens also produce on their surfaces microscopic, dust-like particles composed of one or several algal cells closely enveloped by fungus hyphae. These are known as *soredia*. Each soredium can pro
- duce a new plant. Lichen fragments and soredia can be transported great distances by wind and water.

Q. 5 Describe the life cycle of Anthocerose.

Ans *Anthourose* is commonly called as hornwort.

Hornwort sporophytes lack setae. Each tapering "horn-like" sporophyte, that grows out from a bulbous foot embedded in the thallus is entirely spore capsule. To see the foot you need to dissect the hornwort. The immature sporophyte is green and so, like the immature moss sporophyte, photosynthesizes.

A liverwort or moss capsule comes to a definite stop in its development, with the spores having all matured together. The capsule then opens in some way to release the spores. In the hornwort genus *Notothylas* the sporophyte also has a determinate period of growth. By contrast in the other hornwort genera the sporophyte is continually growing from near the base. In theory such a sporophyte could grow indefinitely, though the death of the aging thallus or changes in environmental conditions eventually put a stop to sporophyte growth. Technically the near-basal area in which there is continual cell addition is an example of a meristem. Meristems are found in all plants for all plant growth is via meristematic tissue of some sort. The apical cell, mentioned in the introductory life cycle page is an example of a meristematic cell.

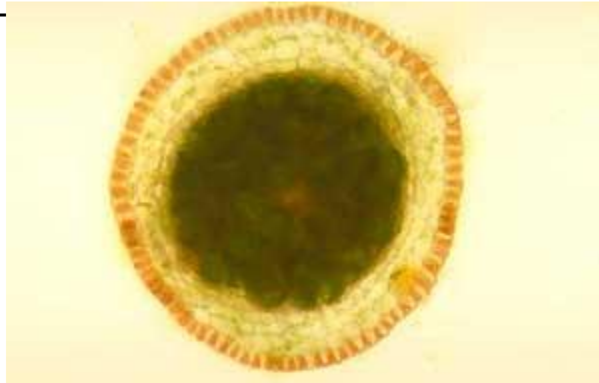
The meristematic tissue near the base of a hornwort sporophyte is composed of a number of cells. By the production of new cells the meristem is constantly causing the sporophyte to extend upward. This means that the oldest part of the sporophyte is at the apex with regions progressively younger as you go down the sporophyte. When the sporophyte is still very short it is enclosed within a protective sheath (an involucre) but the sporophyte grows through it, leaving a cylindrical remnant around the sporophyte's base. This photo of a species of *Megaceros* shows some involucral remnants quite well.

Phaeoceros, maturing sporophytes

Given that the oldest cells in the sporophyte are near the apex it is in the apical region that the first spores mature. Then the spores a little lower mature and so on. In this photo the majority of sporophytes are brown in the upper region and green below. The spores in the brown areas are approaching maturity but in the green areas spore development is at various earlier stages.

As the spores mature the sporophyte walls change from green to brown, though mature spores may be green to brown, the colour depends on genus. When spores near the apex are mature the sporophyte develops slits there. Generally there are two slits but in some species there is only one and there are also species in which four slits develop. As the sporophyte dries the slits open and the spores can be released. As lower areas of the sporophyte mature the slits extend downward.

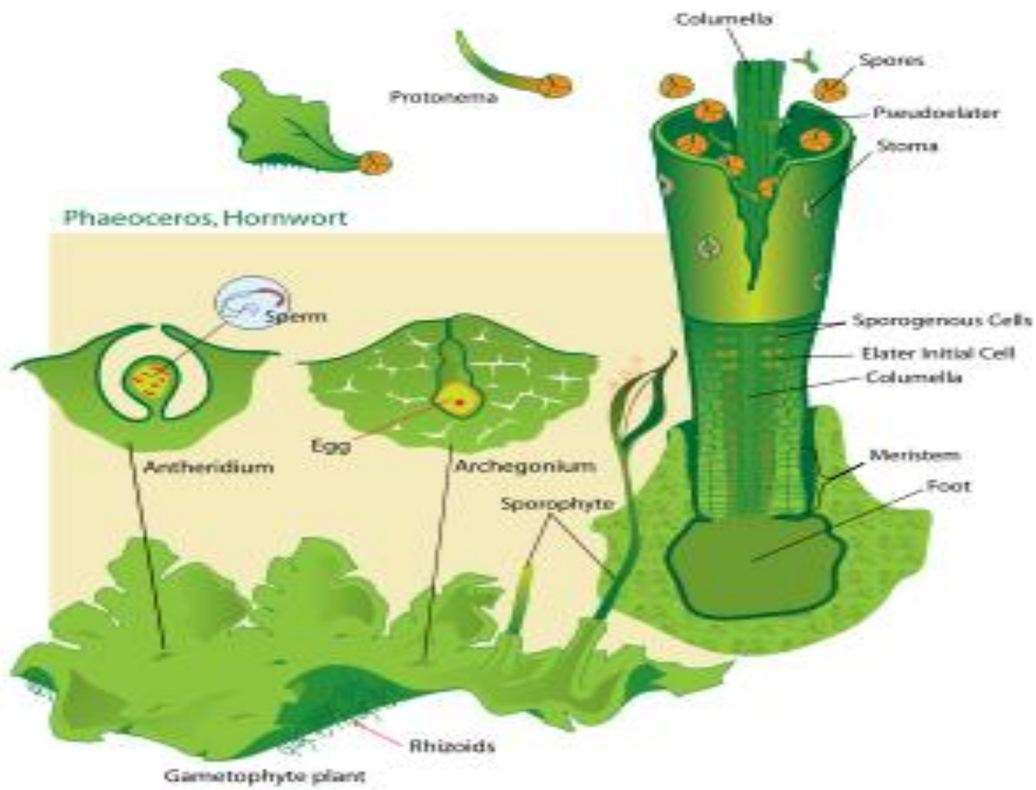
In many hornworts the slits stop a little before the sporophyte apex so that the sporophyte segments are united at their apices. In a mature sporophyte you will also find pseudo-elaters. These are tiny, filamentous structures that superficially resemble the spiralled elaters that are a feature of the capsules in many liverwort species. However, elaters and pseudo-elaters have different origins The pseudo-elaters are not spiralled in the genera *Anthoceros*, *Folioceros*, *Phaeoceros*, always spiralled in *Megaceros* and *Dendroceros* and have rudimentary spiral thickenings in *Notothylas*.



Cross section of *Megaceros* sporophyte

This photo shows a cross section through the lower, still green region of a hornwort sporophyte. The yellow-green cells forming a ring around the centre are the sporogenous cells that will give rise to spores as well as the pseudo-elaters. Between the sporogenous cells and the sporophyte surface are the chlorophyllous, photosynthesizing cells. The photo (right) is of a cross-section of the upper part of a hornwort spore capsule that has started to turn brown. You can see that the outermost cells now have a brownish tinge. Where the previous photo showed sporogenous cells there is now a mass of dark green cells – a mix of mature spores and pseudo-elaters. Here are some spores and pseudo-elaters.

Along the hornwort sporophyte's central axis there is a column of sterile tissue called a columella. This is thought to be a conducting system that helps supply nutrients to the developing spores. When you look at a group of open sporophytes it's easy to see the capsule segments but amongst them you'll find the columellas, thinner and wiry in appearance. If you use a handlens to look closely at mature sporophytes such as the ones shown in this earlier photograph you will be able to see columellas amongst the split capsules. The columellas are markedly thinner than the sporophyte segments. On the left is an enlargement of part of that previous photo and the arrow points to a columella.



Q .6 What are the economic importance of lichens?

Ans Food

Lichens are eaten by many different cultures across the world. Although some lichens are only eaten in times of famine, others are a staple food or even a delicacy. Two obstacles are often encountered when eating lichens: lichen polysaccharides are generally indigestible to humans, and lichens usually contain mildly toxic secondary compounds that should be removed before eating. Very few lichens are poisonous, but those high in vulpinic acid or usnic acid are toxic. Most poisonous lichens are yellow.

In the past Iceland moss (*Cetraria islandica*) was an important human food in northern Europe, and was cooked as a bread, porridge, pudding, soup, or salad. Wila (*Bryoria fremontii*) was an important food in parts of North America, where it was usually pitcooked. Northern peoples in North America and Siberia traditionally eat the partially digested reindeer lichen (*Cladina* spp.) after they remove it from the rumen of caribou or reindeer that have been killed. Rock tripe (*Umbilicaria* spp. and *Lasalia* spp.) is a lichen that has frequently been used as an emergency food in North America, and one species, *Umbilicaria esculenta*, is used in a variety of traditional Korean and Japanese foods

Other Uses

Many lichens produce secondary compounds, including pigments that reduce harmful amounts of sunlight and powerful toxins that reduce herbivory or kill bacteria. These compounds are very useful for lichen identification, and have had economic importance as dyes such as cudbear or primitive antibiotics.

There are reports dating almost 2000 years of lichens being used to extract purple and red colors. Of great historical and commercial significance are lichens belonging to the family Roccellaceae, commonly called orchella weed or orchil. Orcein and other lichen dyes have largely been replaced by synthetic versions. The pH indicator litmus is a dye extracted from the lichen genus *Rocella tinctoria* by boiling

Extracts from many *Usnea* species were used to treat wounds in Russia in the mid-twentieth century.

The substance olivetol is found to be naturally present in certain species of lichens. This is a property it shares with the cannabis plant, which internally produces the related substance olivetolic acid (before using it to biosynthesise tetrahydrocannabinol (THC)).

Lichen is used in model railroading and other modeling hobbies as a material for making trees and shrubs.

B.Sc. (Part I) Examination, 2014

(Faculty of Science)

[Also common with subsidiary Paper of B.Sc. (Hons.)Part I]

(Three – Year Scheme of 10+2+3 Pattern)

BOTANY

First Paper

Algae, Lichens and Bryophyta

Time allowed : Three Hour *Maximum Marks : 33*

All questions are compulsory.

1. Answer the following in short :-
   (i) A colony with a definite shape, size and arrangement of cells is known as
   (ii) Name the main photosynthetic pigments found in Cyanophyceae.
   (iii) Usually there are two- at the base of every short lateral.
   (iv) What is the role of diploid zoospores in Ectocarpus ?
   (v) When does meiosis occur in Polysiphonia ?.
   (vi) Agar-Agar is obtained from –and – algae.
   (vii) Fritsch divided algae into ____ classes.
   (viii) What is the protein percentage in Spirulina ?
   (ix) In Liverworts, the scales are -----and ------colour.
   (x) Pseudoelaters are found in the capsule of ------
   (xi) The main plant body of bryophytes is always ------
   (xii) Write the name of aquatic species of Riccia.
   (xiii) The mycobiont in Lichens generally belongs to class -----and -----
   (xiv) "Reindeer moss", lichen, belongs to the genus--------
   (xv) Operculum is separated from rest of the capsule by --------
   (xvi) Who is the father of Indian Bryology ?
   (xvii) Lichens growing on rocks are called ----------
   (xviii) Each cell of Anthoceros thallus has --------chloroplast and a --------

2. Give an account of the habit, habitat and various thallus organizations in algae.

Or

Write an essay on economic importance of algae.

3. Describe the methods of reproduction in Ectocarpus.

Or (अथवा)

Describe the thallus structure and asexual reproduction in Polysiphonia.

4. Writes short notes on following :-
   (i) Alternation of generations in bryophytes
   (ii) Classification of bryophytes.

Or

Describe the structure of Riccia thallus with suitable diagrams.

5. Discuss the development and structure of mature sporophyte of Sphagnum.

Or

What are lichens ? Describe the reproduction in lichens.

****

B.Sc. (Part I) Examination, 2011

(Faculty of Science)

[Also common with subsidiary Paper of B.Sc. (Hons.)Part I]

(Three – Year Scheme of 10+2+3 Pattern)

BOTANY

First Paper

Algae, Lichens and Bryophyta

Year – 2011

Time allowed : Three Hour *Maximum Marks : 33*

All question are compulsory

1. Answer the following in short:

(i) Name the alga which is parasitic.
(ii) Name any two algae which form 'bloom' in water.
(iii) What is the function of pyrenoids in algae?
(iv) Which type of reserve food materials is found in Rhodophyceae?
(v) How may divisions were recognized in algae by Smith?
(vi) Name the alga which is the source of Iodine.
(vii) What is the name of the male sex organ of Chara?
(viii) In which alga is Plakeastage found?
(ix) Which type of sporangia is produced only on the sporophytic plants in Ectrocarpus?
(x) What are the different spores produced in the life cycle of Ploysiphonia?
(xi) What is dominant phase of the life cycle in bryophyetes?
(xii) What is the significance of scales in bryophytes?
(xiii) What is the function of elaters in the capsule of Marachantia?
(xiv) Name the class to which Riccia belongs.
(xv) Name a bryophyte in which the basal part of capsule is meristematic.
(xvi) Name one aquatic species of Riccia.
(xvii) What are the important feature of the rhizoids of bryopsida?
(xviii) Give the botanical name of Reindeer's moss.
(xix) The fungtal components of lichens generally belong of which class?
(xx) What are crustose lichens?

2. Discuss the range of thallus organization in algae.

or

Write short notes on:

(i) Economic importance of algae.
(ii) Isolation and culture of algae.

3. Describe reproduction of Vaucheria with the help of suitable diagrams.

or

Write short notes on:
(i) Thallus structure o Volvox.
(ii) Thallus structure of Polysiphonia.

4. Give General characters of Bryophyta.

or

With the help of labeled diagrams describe the external and internal structure of the thallus of Marchantie.

5. Describe structure and asexual reproduction in lichens.

or

Draw the diagrams of:
(i) L.S. of sporophyte of Anthoceros
(ii) L.S. of sporophyte of Funaria.

B.Sc. (Part I) Examination, 2010

(Faculty of Science)

[Also common with subsidiary Paper of B.Sc. (Hons.)Part I]

(Three – Year Scheme of 10+2+3 Pattern)

BOTANY

First Paper

Algae, Lichens and Bryophyta

Year – 2011

Time allowed : Three Hour ***Maximum Marks : 33***

All question are compulsory

1. Answer the following in short:
   (i) From which algae is Agar-agar obtained?
   (ii) The term 'algae' was coined by –
   (iii) Which class of algae is called heterokontae?
   (iv) Which type of chlorophyll is found in Rhodophyta?
   (v) Which cell of volvox forms daughters colony?
   (vi) In algae zygote undergoes which division?
   (vii) In unfavourable conditions, thick walled protoplasm forms a spore called:
   (viii) Which species of Coleochaete is cushion form?
   (ix) What is the name of female sex organ of Chara?
   (x) In which algae is trimorphic diplodiplohaplontic life cycle present?
   (xi) In which plant are gemma cups present?
   (xii) The group of plants referred to as amphibians of plant kindom is:
   (xiii) Which pigment forms violet colour in the scales of Riccia?
   (xiv) The plant which has both the sex organs is called as:
   (xv) By which scientist have the Bryophyta been placed in Embryophyta Asiphonogama?
   (xvi) In which cell does meiosis occur in bryophyte?
   (xvii) In Lichens conidia are produced in a cup like structure called as:
   (xviii) What is the name of male sex organ is Lichens?
   (xix) The Lichenses growing on the bark of trees are called.
   (xx) The Lichen found in polar region is

2. Describe the important pigments, reserve food and type of sexual reproduction in different classes of algae.

or

Describe evaluation of sex in algae.

3. Describe sexual reproduction in Chara with diagrams.

or

Write short notes on:
   (i) Carposporophyte of Polysiphonia
   (ii) What is isomorphic alternation of generation ? Describe life cycle of Ectopcrpus.

4. Describe classification of bryophyte.

or

Draw diagrams of:

(i) V.S. of Riccia thallus with sporogonium '

(ii) L.S. of sporogonium of sphagnum.

5. Write note on economic importance of Lichens.

or

Write notes on the following:

(i) Development of Archegonium of Funaria

(ii) Mature sporogonium of Poella.

B.Sc. (Part I) Examination, 2009

(Faculty of Science)

[Also common with subsidiary Paper of B.Sc. (Hons.)Part I]

(Three – Year Scheme of 10+2+3 Pattern)

BOTANY

First Paper

Algae, Lichens and Bryophyta

Year – 2009

Time allowed : Three Hour *Maximum Marks : 33*

All question are compulsory

1. Answer the following in short:
   (i) In which calss of algae is mannitol reserve food?
   (ii) The flagellated spores are called as.
   (iii) In which alga is reproduction by daughter colonies?
   (iv) Which alga is reproduction by daughter colonies?
   (v) In which alga is fruiting body "Cystocarp' present.
   (vi) The algae found on snow or ice are called:
   (vii) Give the example of parasitic alga which causes 'red rust or tea.
   (viii) Which alga is called 'rolling alga".
   (ix) Reticulate chloroplast is found in which alga?
   (x) The unicellular female sex organ which is not covered by sterile jacket is known as:
   (xi) Which plant group is embryophyte without vascular tissues?
   (xii) Which plant is called as "Hornewort"?
   (xiii) In which plant group is dependent sporophyte produced?
   (xiv) Which species of Riccia is aquatic?
   (xv) The oldest fossil bryophyte recorded is:
   (xvi) Which plant is "peat moss".
   (xvii) Lichens growing on rocks are called as:
   (xviii) The fungal component of lichens is:
   (xix) Which lichen is used in formation of litmus paper?
   (xx) The thin and flat lichens occurring as crust on rock and bark are called as:

2. Describe classification of algae according to smith.

or

Describe types of life cycle in algae.

3. Describe sexual reproduction of voucheria.

Describe asexual reproduction of volvox.

4. Describe the range of thallus structure in bryophyte.

or

Draw diagram of:

(i) V.S. of Marchantia archegoniophore

(ii) L.S. of Anthoceros sporophyte.

5. Give the types of lichens and their structure with diagrams.

or

Write notes on the following:

(i) Protonema of Funaria

(ii) Sporophyte of Riccia

B.Sc. (Part I) Examination, 2008

(Faculty of Science)

[Also common with subsidiary Paper of B.Sc. (Hons.)Part I]

(Three – Year Scheme of 10+2+3 Pattern)

BOTANY

First Paper

Algae, Lichens and Bryophyta

Year – 2008

Time allowed : Three Hour ***Maximum Marks : 33***

All question are compulsory

1. Answer the following in short:

(i) Given an example of symphonious algae.
(ii) Give the name of algae which gives agar.
(iii) What is the function of phycobilins?
(iv) What is the structure of paranoids?
(v) Name a culture medium which is used for algae.
(vi) In which algae is gongrosira stage found?
(vii) What kind of thallus is found is Coleochaete?
(viii) Write name of female sex organ of Polysimphonia.
(ix) What type of life cycle is met in Chara?
(x) What is clump formation? In What algae is it found?
(xi) Name any aquatic bryophyte.
(xii) Who gave the name bryophyte?
(xiii) How many neck canal cells found in archegonium of Marchantia?
(xiv) How many rows of leaves are found in Prella?
(xv) Who is known as father of Lichenology?
(xvi) In which conditions does dehiscence of capsule take place Anthoceros?
(xvii) What is the function of retort cells?
(xviii) How many peristomial teeth are found in Funaria capsule?

2. Describe origin and development of sexual reproduction in Algae.

or

Write an essay on economic importance of Algae.

3. Describe sexual reproduction only by diagrams in Chara and Ectocarpus.

or

Describe the alternation of generation in Polysiphonia.

4. Give comparative account of saprophyte of Riccia and Marchantia.

or

Write notes on:

(i) Alternation of generation in Bryophyta

(ii) Structure of sporangium in Porella.

5. Give in brief the types and methods of reproduction in Lichens.

or

Draw diagrams:

(i) T.S.thallus of Anthoceros

(ii) L.S. Sporophyte of Sphagnum

(iii) L.S. Archegonial head of Funaria.

Key Terms

Algae Glossary

algal bloom	An abundant growth of microscopic algae producing visible colonies in nature
algin	A sodium salt of mannuronic acid (CHO); found in brown algae
anal pore	A site in certain protozoa for elimination of waste
anamorph	Ascomycete fungi that have lost the ability to reproduce sexually; the asexual stage of a fungus
arthroconidia	An asexual fungal spore formed by fragmentation of a septate hypha
ascospore	A sexual fungal spore produced in an ascus, formed by the ascomycetes
ascus	A saclike structure containing ascospores; found in the ascomycetes
asexual spore	A reproductive cell produced by mitosis and cell division (eukaryotes) or binary fission (actinomycetes)
basidiospore	A sexual fungal spore produced in a basidium, characteristic of the basidiomycetes
basidium	A pedestal that produces basidiospores; found in the basidiomycetes
blade	A flat leaf like structure of multicellular algae
coenocytic hypha	A fungal filament that is not divided into uninucleate cell-like units because it lacks septa.
conidiophores	An aerial hypha bearing conidiophores
conidium	An asexual spore produced in a chain from a conidiophores
gamete	A male or female reproductive cell
sporangiophore	an aerial hypha supporting a sporangium
sporangiospore	an asexual fungal spore formed within a sporangium
zoospore	an asexual algal spore; has two flagella
zygospore	a sexual fungal spore characteristic of the zygomycetes
zygote	a diploid cell produced by the fusion of two haploid gametes

Lichens Glossary

apothecia - the most common sexual reproduction structure of the lichen’s fungal partner, it is cup-shape**chlorolichen** - a lichen that has a green alga for its photobiont.d or disc-shaped and produces spores.
cephalodia - little pockets of cyanobacteria that form on top of a chlorolichen, normally black in color.

cilia - little hairs on the margin of a lichen; for example, black hairs on the margins of a foliose lichen.

hyphae (hypha) - the filamentous strands of fungal cells that make up the thallus of a lichen; they encapsulate the algal cells
isidia - a vegetative means of propagation for lichens; normally found on the top-side or outer cortex of the lichen; both fungal and algal cells are combined in a column-like structure that can break off and establish elsewhere.

lobe - a flattened branch, generally found on foliose lichens. **mycobiont** - the fungal partner of a lichen.

photobiont - the photosynthetic partner of a lichen.

mycobiont - the fungal partner of a lichen.

Bryophytes Glossary

baxial: *of the side or surface of an organ*, facing away from the axis. cf. **adaxial**.

acumen: a slender, tapering point. Adj. **acuminate**.

adaxial: *of the side or surface of an organ*, facing towards the axis. cf. **abaxial**.

amphigastria (sing. **amphigastrium**)**:** leaves that grow in a row on the lower side of a stem and which are usually smaller and have a different shape to other leaves.

amphithecium: the outer embryonic tissue of an embryonic capsule surrounding the central **endothecium**; gives rise to all tissues from the epidermis to the outer spore sac; also produces the spore sac in *Sphagnum*.

androecium (pl. **androecia**): the 'male gametoecium' consisting of antheridia, paraphyses and surrounding bracts. See also **perigonium**.

anisomorphic: describing related structures that exhibit more than one distinct type of size or shape.

antherozoid: a motile male gamete; in mosses propelled by two flagellae.

apical cell: a single cell at the apex of a shoot, leaf or other organ that divides repeatedly to produce new leaves, stems or other organs.

archegonium (pl. **archegonia**)**:** the female gametangium; a multicellular, flask-shaped structure consisting of a stalk, a swollen base (venter) containing the egg and a neck through which the antherozoid swims to fertilise the egg.

ascending: sloping or curved upwards.

auricle: a small bulge or ear-like lobe at the basal margin of a leaf, e.g. in *Papillaria* and *Calyptothecium*; adj. **auriculate**.

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axis: the main stem; the conceptual line around which leaves, branches and other organs develop.

basal membrane: a delicate or robust membrane at the base of the endostome, often bearing segments and cilia (= **basement membrane**).

bract: one of the specialised leaves surrounding and protecting archegonia and/or antheridia.

bryophyte: a non-vascular, green plant with a gametophyte generation that is free-living and a comparatively ephemeral sporophytel; a collective name for mosses, liverworts and hornworts.

bulbil: a small deciduous, bulb-shaped, axillary, vegetative propagule or rhizoidal gemma; often with rudimentary leaves.

bulbiform: bulb-shaped.

caducous: falling readily or early.

calyptra (pl. **calyptrae**)**:** a membranous or hairy hood or covering that protects the maturing sporophyte; derived largely from the archegonial venter.

capitulum (pl. **capitula**)**:** a head-like mass of crowded branches at the apex of the stem, e.g. in *Sphagnum*.

capsule: the terminal, spore-producing part of a moss sporophyte.

carinate: folded along the middle, like the keel of a boat; V-shaped in cross-section.

cilia (sing. **cilium**)**:** a delicate, hair-like or thread-like structure, usually one cell thick and unbranched; in peristomes, a structure that occurs singly or in groups alternating with the segments of the inner endostome; hair-like appendages fringing leaves or calyptrae. adj. **ciliate**.

clone: population of genetically identical plants produced vegetatively from a single propagule or spore.

collenchymatous: cells with walls that are thickened at the corners, e.g. exothecial cells or cortical cells of stems seen in cross section.

columella: the sterile, central tissues of a moss capsule.

cortex: the outermost layer or layers of cells in a stem, often differentiated from the central cylinder. adj. **corticate**, **cortical**.

cuticle: a non-cellular coating on the outer surface of cells in contact with the environment, often variously roughened or ornamented.

cygneous: curved downards in the upper part like the neck of a swan, e.g. setae of *Campylopus*.

cylinder: the central strand in stem. adj. **cylindrical**.

dimorphic: of two distinct forms, e.g. leaves, male and female plants.

diploid: a cell, individual or generation with two sets of chromosomes (*2n*); the typical chromosome level of the sporophyte generation.

distal: away from the base or point of attachment; the converse of **proximal**.

divergent: spreading in opposite directions.

dorsiventral: flattened with distinct upper and lower surfaces.

embryo: the developing sporophyte phase normally generated from a zygote; in mosses it usually consists of a foot, seta and capsule.

endothecium: in most mosses, the inner embryonic tissue of a capsule which gives rise to all tissues interior to the outer spore sac. In *Sphagnum* it also produces the columella.

epidermis: the outer layer of cells at the surface of an organ, e.g. **exothecium**.

epiphyte: a plant that grows on the surface of another plant.

eukaryote: any cell or organism composed of cells that possess a membrane-bound nucleus, several chromosomes, cellular organelles and accomplishes cell division by mitosis and meiosis. adj. **eukaryotic**.

flagellum (pl. **flagella**)**:** a slender, tapering branch; also the organs of locomotion in an antherozoid; adj. **flagellate**.

flexuose: slightly bent, wavy or twisted.

foliose: leafy or leaflike; covered with leaves.

foot: the basal organ of attachment and absorbtion for the bryophyte sporophyte, embedded in the gametophyte.

fusiform: narrow and tapering at each end, spindle-shaped.

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