
Lichens
Dr.M.Gopi

- Lichen is derived from the Greek word ‘Leprous’ and refers to medicine used for treatment of skin diseases because of their appearance as peeling skin

- Schwendener –dual nature

OUTER SURFACE

Usually exhibits important features:

1- It may bear certain **epiphytes** such as:

a) Lichens (algae or cyanobacteria living among fungus filament) [grayish thalloid structure] as in Cinchona.

b) Liverworts [foliaceous, consists of very small stems to which small **leaves** are attached in one plane] as in Cascara.

c) Mosses [stem bearing spirally arranged **leaves** each possess a midrib and lamina of one cell thick].

Lichens

Liverwort

Mosses

Definition

Two separate plant

(Fungi - Mycobiont + Algae – Phycobiant)

Self supporting combination - Closely associated with each other - Single plant (intimate Association)

-Curious nature – Composite / Dual organisms

- Fungal hyphae + Algal cell often embedded

- 400 Genera; 16,000 species

- LICHENOLOGY; LICHENOLOGIST

Composition

Algal Partner - Cyanophyceae /simple Chlorophyceae

- Filamentous / Non filamentous

- Majority – Unicellular - 26 genera

Myxophyceae - 8 BGA, 17 Green Algae, 1 Yellow

Common BGA - *Nostoc, Stigonema, Rivularia* & *Gloeocapsa*

Chlorophyceae - 80 % Green Algae – Unicellular *Trebouxia* common

Fungal Partner - General Ascomycetes (Ascolichens)
Temperate Regions
Basidiomycetes (Basidiolichens)
Tropical Regions, 2 – 4 genera /400

Rarely associated with autotrophic Bacteria (Myxophyceae)

Classification

(i) Nature of Fungal elements
(ii) Kinds of the fructication - 2 groups

1. Ascolichens
2. Basidiolichens (Basidiomycetes)

Sub – Groups

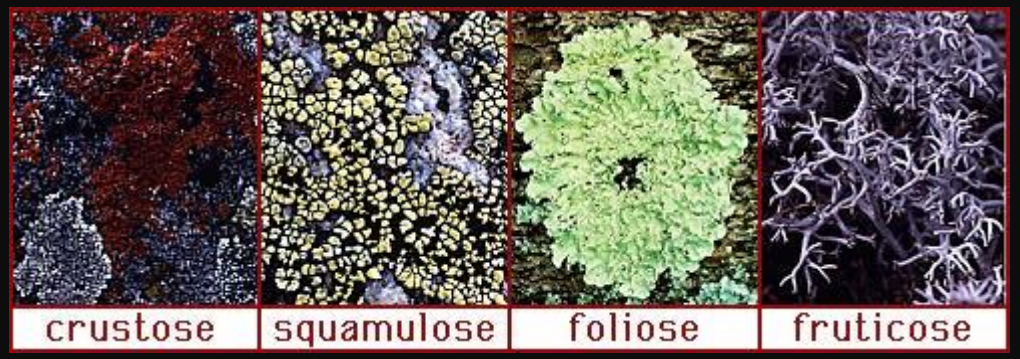
(i) Gymnocarpeae
Ascocarp – Apthecium type

(ii) Pyrenocarpeae
Ascocarp – Perithecium type

Nature

Controversy – Parasitism (Haustoria / Appressoria)/ Symbiotic Nature (Mutualism)
Helotism (Master – Fungal partner + Slave – Algal subordinate partner)

Algae – Prisoner / Beneficial Slavery / Consortium



Habitat - Wide variety – Walls, roofs of houses, leaves, tree bark, bare earth, even barren, rocky surfaces.

Xerophytic – Long periods of drought, sand dunes, deserts, starvation.

Substratum – Inorganic

Absorb – Rainwater

Low Temp. / High mountain / Cold region – Arctic / Tundras

Unfavourable for growth of other plants

3 categories – Saxicolous – Stone / Rock lovers, Cold substratum

Corticolous - Bark lovers, Tropics / subtropics, abundance of moisture, leaves epiphytes.

Terricolous - Terrestrial soil, direct sun, moderate / cold temp./ pure atmosphere, substratum moisture.

Unsuited growth – scanty precipitation, Hot & Dry summer.

Growth very slow

Growth forms

- **Foliose**
  - Thallus (lichen body) is leaf-like
  - May have rhizines

Distribution - most widely - globe, diverse habitats
Factors favouring world wide distribution

1. Symbiotic life
2. Vegetative propagation & Efficient means of dispersal
3. Resistance to extremes of temperature & moisture

Latitude, Altitude, tundra's ice land & fresh rocky surface.

Himalayas Eastern side, India, Peninsular India.

Thallus – Plant body, grey / greyish green, irregular, Yellow, Orange, Brown / Red.

Habit - Powdery layer (Rock / Bark)

- Crust (substratum)
- Tiny shrub / leafy

Intermediate forms

General habit of growth form, attachment of substratum – 3 types

1. Crustose (Crustaceous) Lichens
2. Foliose (Foliaceous) Lichens
3. Fruticose Lichens

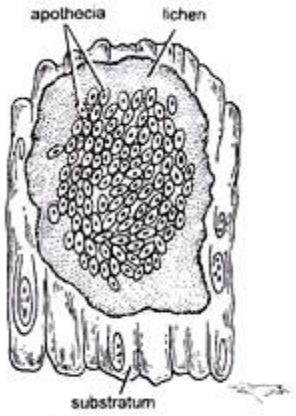


Fig. 2. Lichens : A crustose lichen

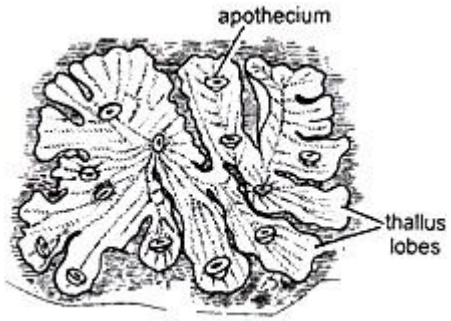


Fig. 3. Lichens : A foliose lichen

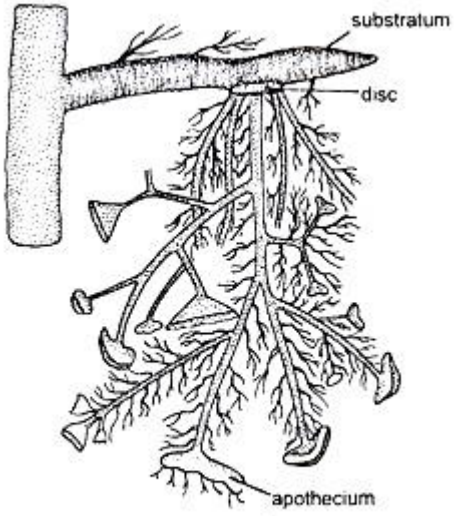


Fig. 4. Lichens : A fruticose lichen

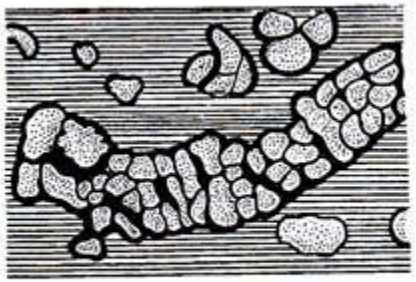


Fig. 5. A leprose lichen

Crustose	Foliose	Fruticose
		
		

1. Crustose (Crustaceous) Lichens – Thallus insignificant size, flat, thin layer / crust, partly buried in the substratum, attach to rock / bark (painted), Hexagonal areas – AREOLAE, Eg. *Graphic scripta* & *Haemtomma puniceum.*

2. Foliose (Foliaceous) Lichens – Striking, flat, broad, much lobed & leaf like.

Form – Crinkled & twisted leaves. Upper & lower surface, edges curled up white/ sooty.

Rhizinae – Rhizoid like outgrowth, lower surface

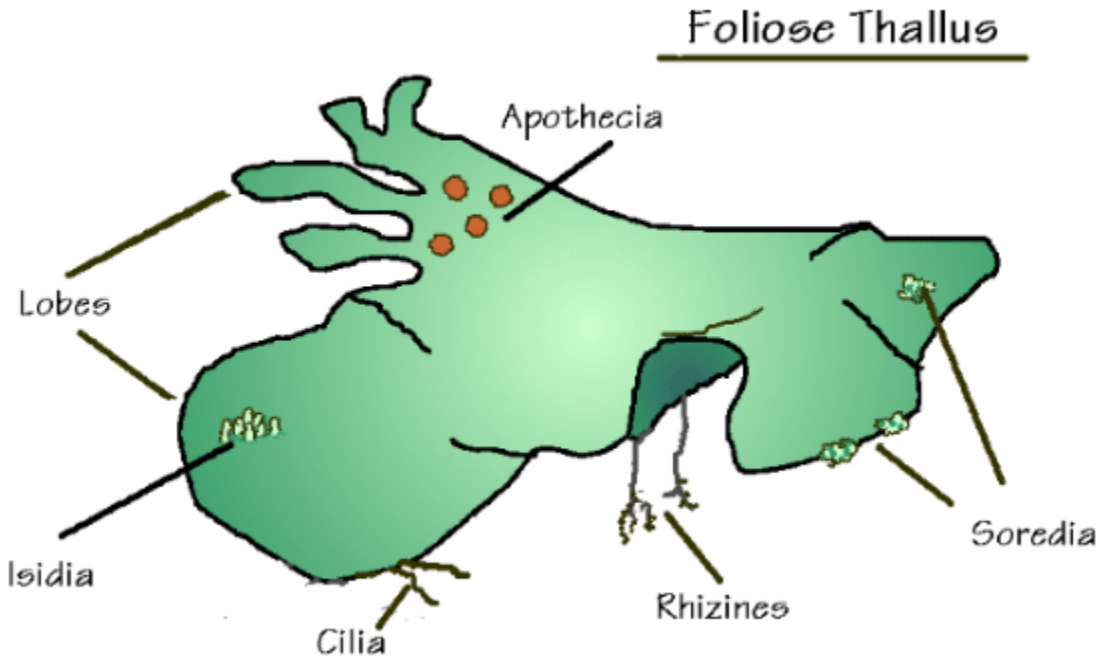
Single simple / branched hyphae, more.

Rhizine broadens flat disc – substratum (mucilage)

Anchorage & absorptive organs – dark/dark brown

Single rhizine / more – lower surface

Eg. Xanthoria, Physcia, Peltigera, parmelia, Cetraria and Chaudhuria.


Foliose Thallus
Apothecia
Lobes
Isidia
Cilia
Rhizines
Soredia

3. Fruticose – Conspicuous, complex, slender, freely branched, cylindrical (Ribbon / flat), thread / twig like tufts.

Cladonia – branches stiffly erect tiny bud.

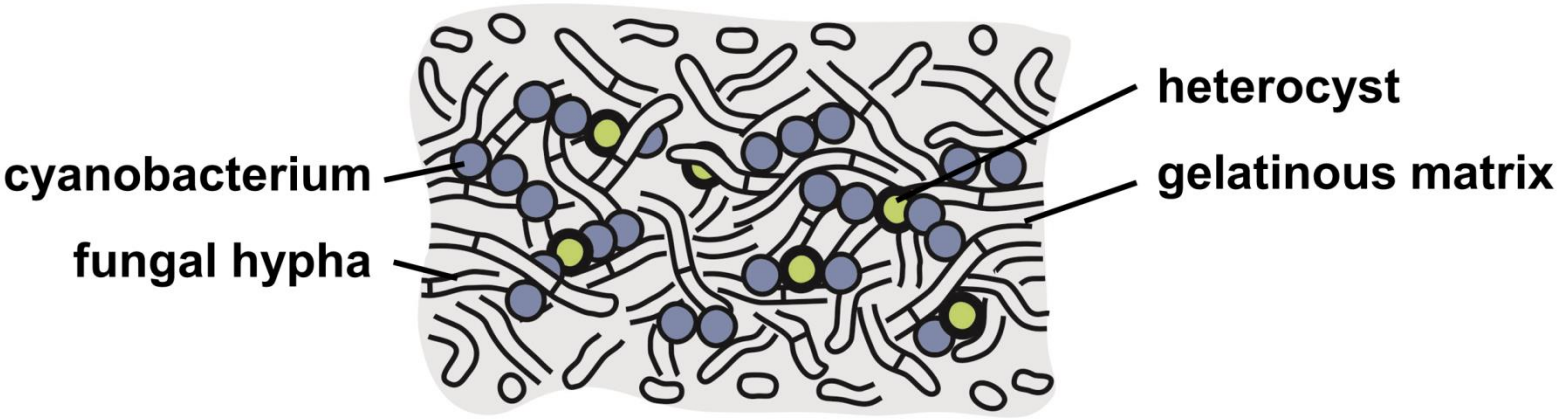
Usnea – pendant, tassel like, flattened disc, extensive and attractive growths rocks, foliage and branches of trees. No upper & lower surfaces.

Eg. Usnea, Cladonia, Ramalina

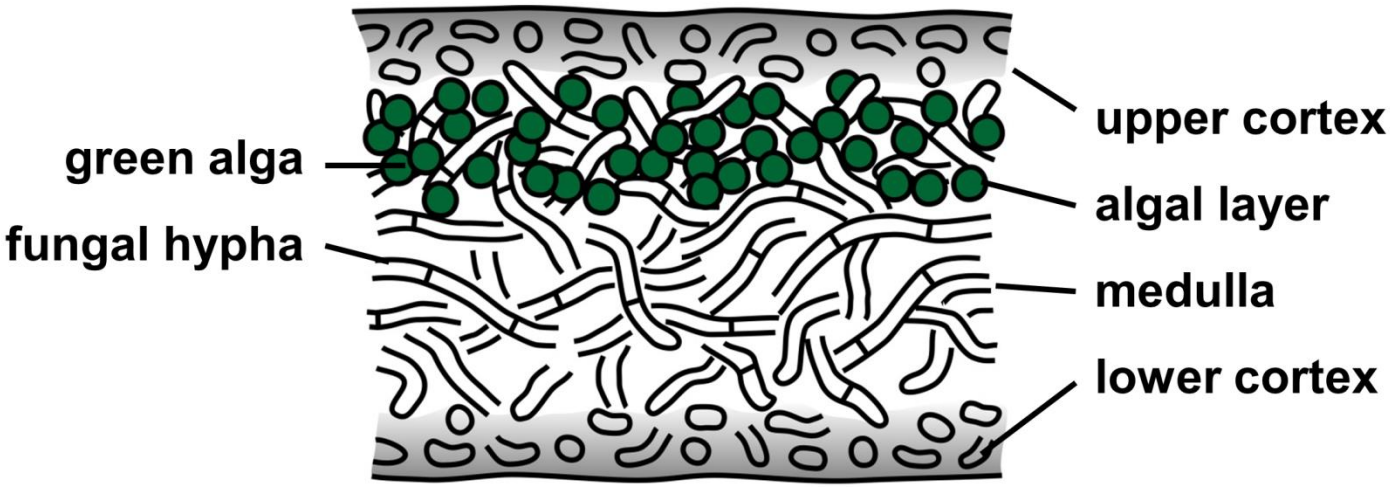
Structure - Internal

Homo(io)merous	Heteromerous
Gelatinous thallus	Most of the lichens
Collema & *Leoptogium*	Differentiation &
Simple, little differentiation	Layered structure
loosely interwoven mass	Algal unit restriction
Fungal hyphae	V.S. foliose
Algal cell - BGA, unbranched	Parmelia / Xanthoria
	/ 4 Distinct zone

homoiomerous



heteromerous



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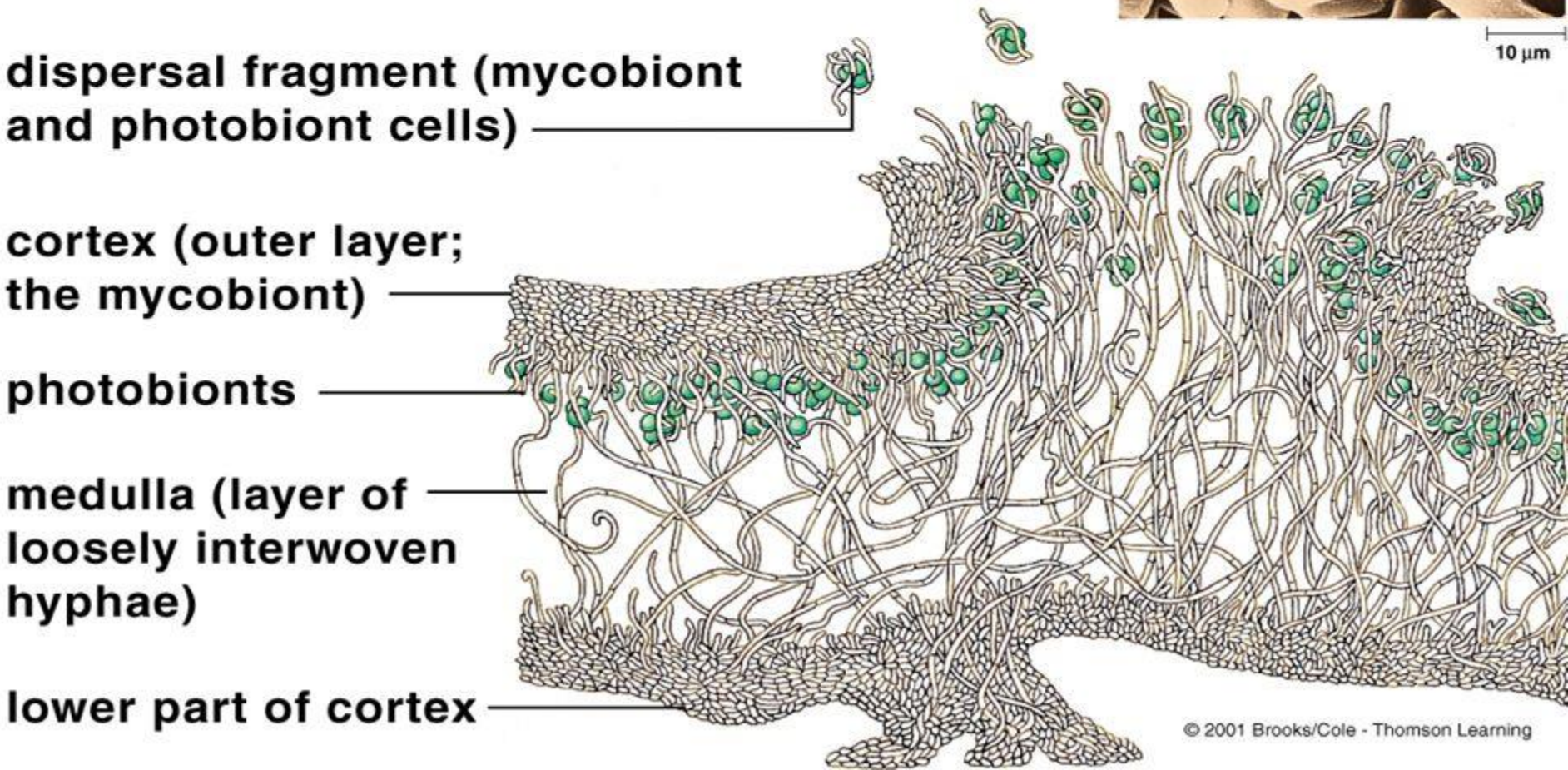
Lichen internal structure

An association of a fungus and a photosynthetic symbiont resulting in a stable vegetative body having a specific structure

Chlorophyta or Cyanobacteria

+

Ascomycota or Basidiomycota or Deuteromycota



(a) Upper cortex – Thick & protective, fungal hyphae – vertical, compact – Plectenchyma, Pseudoparenchyma, No intercellular space / Gelatinous materials, epidermis.

(b) Algal zone - BGA (*Peltigera canina*) – Filamentous BGA - *Nostoc*, *Rivularia*, (*Cystococcus*, *Gloeocapsa* - unicellular) / Green zone (*Zanthoria*) – unicellular – *Chlorella*, *Pleurococcus*, photosynthetic region, formerly – Gonidial layer – Misnomer, intermixed with fungal hyphae. Cell ÷ / Aplanospores – Algae, Haustoria – absorb – food – fungal hyphae.

(C) Medulla – Central core, less compact, thick walls – fungal hyphae, run in all directions.

(d) Lower cortex – Dorsely compacted hyphae, parallel / perpendicular to surface. Rhizinae – Subtratum – Anchorage. Hypothallus - lower cortex absent, rhizinae from medulla.

Vegetative structure 1. Breathing pores – foliose, upper cortex, interrupted at intervals, facing medulla, aeration, cone like elevation. 2. Cyphellae – aerating organ organised lower cortex, break, foliose lichens, Eg. *Sticta sylvatica*. Small cup like white spot – naked eye. Rounded cavity / concave circular depression white medulla exposed – microscopic. (Pseudocyphellae – definite border).

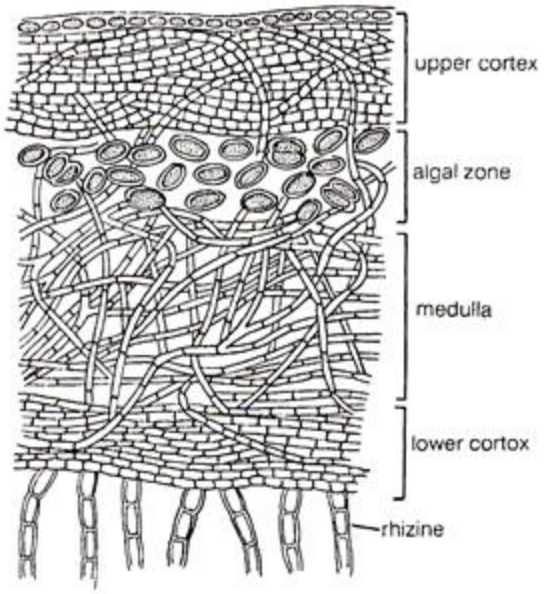


Fig. 6. *Lichens* : Transverse section of heteromerous (foliose) lichen thallus

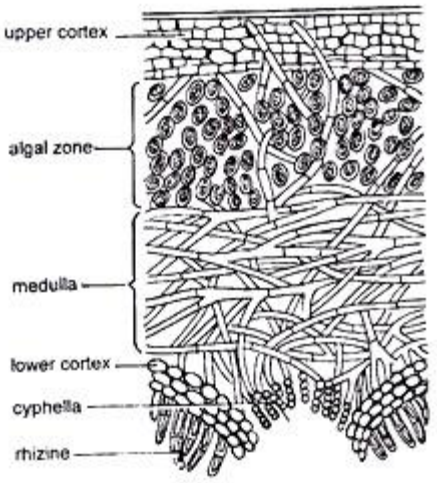


Fig. 8. Lichens : Cyphellae. Vertical section of thallus

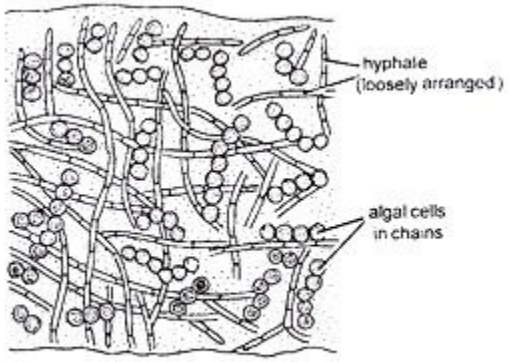


Fig. 7. Lichens : Transverse section of homoiomerous lichen

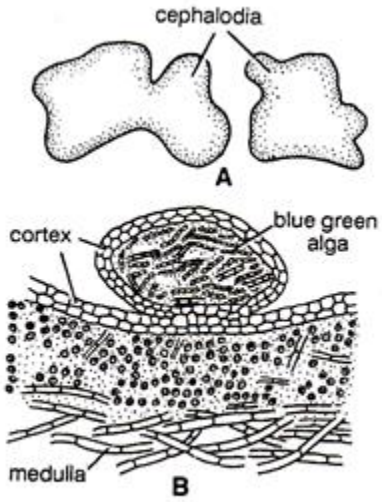


Fig. 9 (A–B). Lichens : Cephalodia. (A) Surface view of Cephalodia, (B) Vertical section of thallus passing through Cephalodium

3. Cephalodia – small, hard, dark coloured, gall like – *Peltigera aphthosa*. Fungal hyphae – same, Algal cell differ, BGA, thallus bright green kind.

4. ISIDIA – small out growth, upper side outer cortical layer, same algal cell, increase the photosynthetic area. Vary in form – *Parmelia sexualilis* – Rod, *Umblicacia postulata* – Coralloid, *Usnea comosa* – Cigar, *Peltigera praetexta* – coral bud, *Collema crispum* - Scale.

5. Soredia - small bud like outgrowth, Greyish powder – surface, 1 - ∞ algal cells by hyphae, develop only in upper cortex, pustule like areas – Soralia / Sorelia, *Physcia*, *Parmelia* – small, white pustules, each devlop new thalli, soredial dust – greyish powder on the tree

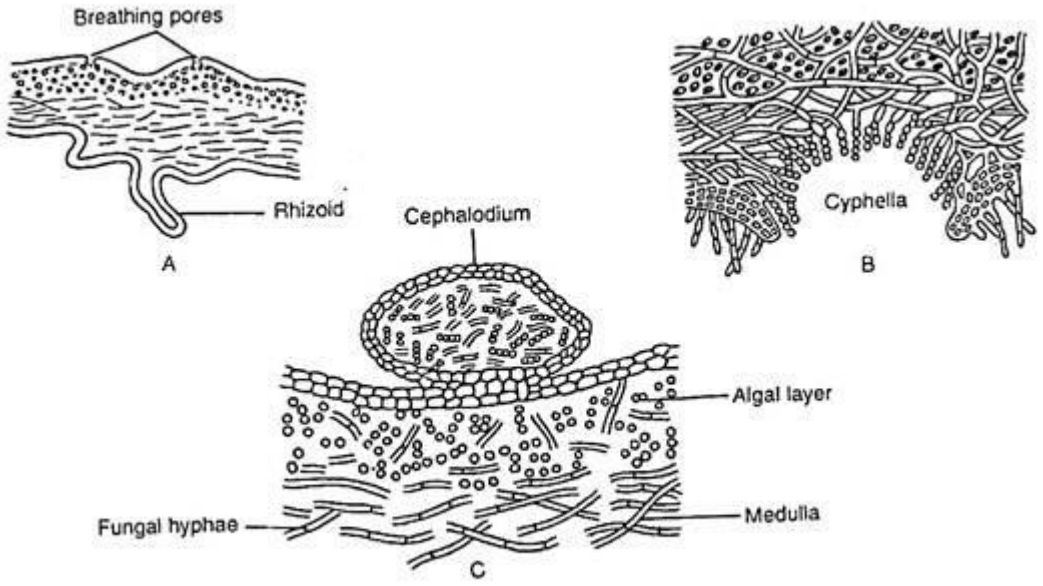
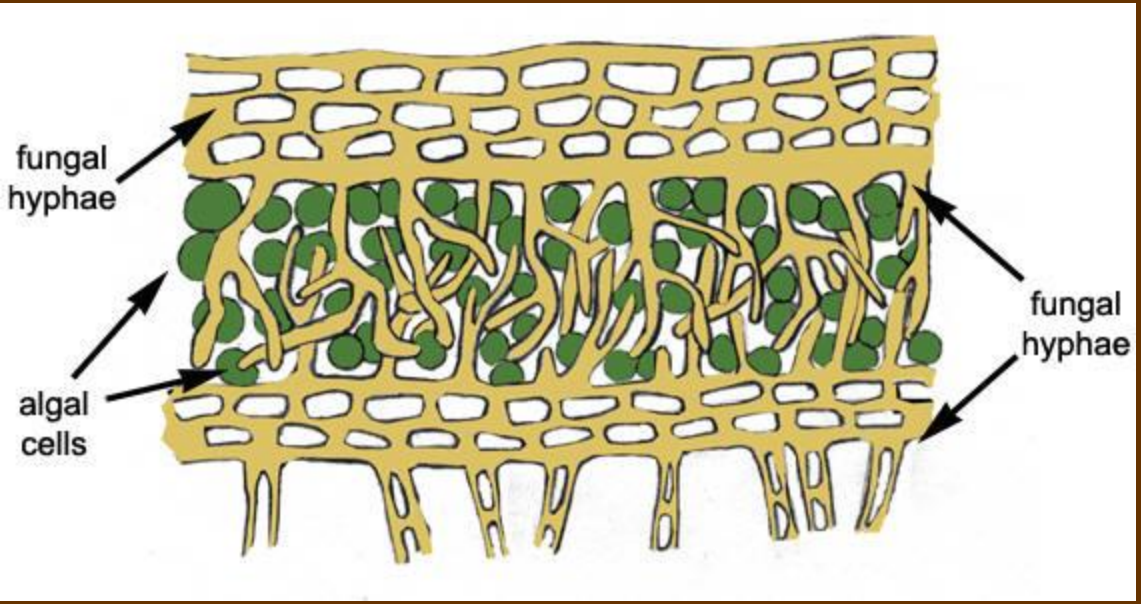


Fig. 4.114 : Specialised structures associated with lichen thallus : A. Breathing pores, B. Cyphella, C. Cephalodium

Nutrition : Body - fungal partner, neither parasite nor a saprophyte, symbiosis. Algae synthesize food. Diffusion – fungal hyphae absorb food & dead bodies of algae.



Reproduction – Asexually as well as sexually

1. Asexual Reproduction – vegetative methods and sporulation. Both partner reproduce independently, Algae – simple fission, Fungi – fructification.

(a) Vegetative methods : Asexual Reproduction -

(i) Fragmentation : breaking up - segments, ageing and accidental severing, basal part / posterior part – ageing – apical growth. Fructicose – wind – other trees.

Propagation

(ii) Soredia & (iv) Isidia.

(b) Sporulation - fungal partner only, small, non-motile, asexual – Pycnidiospores, conical, flask cavity – Pycnidia, upper surface, sunken, small pore – Ostiole.

2. Sexual Reproduction – fungal partner

a) ♂spermogonium - Pycnidium like spermogonia, flask receptacle upper surface, small pore – ostiole, Male cell : Spermatia – non motile, large no. cell wall, set free slimy mass oozes out through ostiole.

b) ♀Carpogonium - Spl. Cellular filament, 2 portions : 1. lower coiled – Ascogonium : multicellular, uninuleate, rarely multinucleate, medullary region.

2. Upper portion (Fungal hyphae / Algal layer) – Trichogyne : Multicellular, elongated, septa one hole centre project out side gelatinous CW.

Coiled ascogonium - sunken, long multicellular trichogyne, terminal cell project outside, absence of supporting & auxiliary cells. Antheridia from flask shaped, ♂ cell cw.

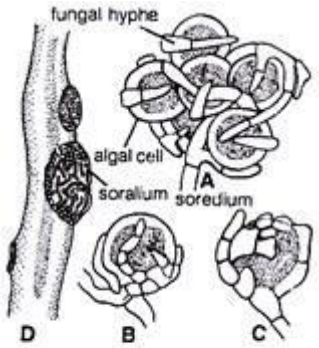


Fig. 10 (A–D). Lichens : Soredia. (A) Single soredium, (B–C) Stages in the formation of sorocium, (D) Soredia on thallus.

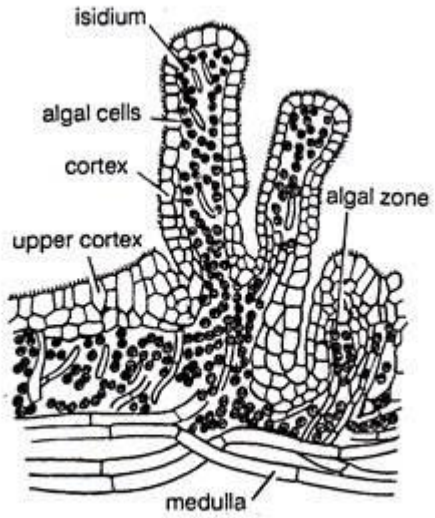


Fig. 11. Lichens : Isidia. Vertical section of thallus passing through isidia

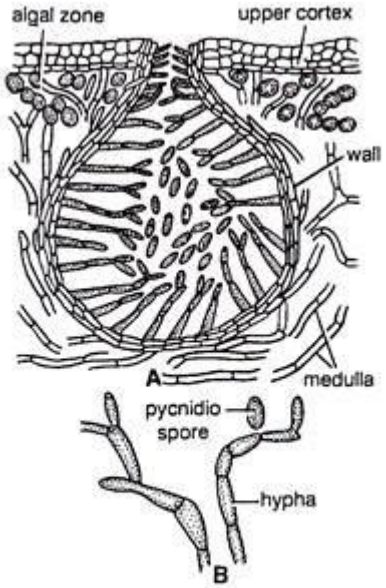


Fig. 12 (A–B). Lichens : Pycnidium. (A) Vertical section of thallus passing through pycnidium, (B) Pycnidial hyphae bearing pycnidiospores

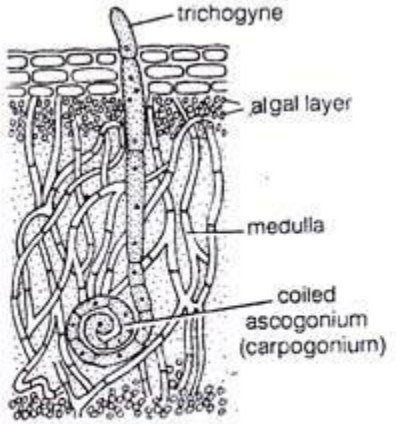


Fig. 13. Lichens : Carpogonium. Vertical section of thallus passing through Carpogonium

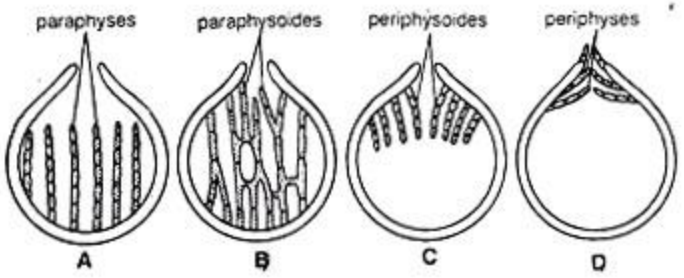


Fig. 15 (A–D). Lichens : Types of hamathecia

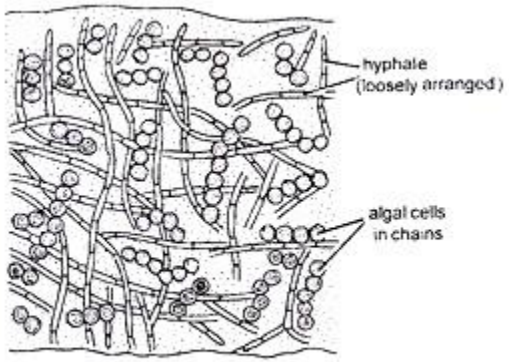


Fig. 7. Lichens : Transverse section of homoiomerous lichen

(C) Fertilization : spermatia – functional

(d) Post Plasmogamy changes – carpogonium

(i) Gradual withering – trichogyne (ii) development of ascogneous hyphae (iii) formation of Asci spore – spore fruit / fructification – Apothecium, Perithecium.

1. Apothecium – Ascomycete fungus, rounded cup shaped / plate / elobrate form, vary in colour – reddish brown, yellow – black, Lecidea, Cladonia and Gyrophora - fungal elements only no algae – LECIDEINE type. Parmelia, Physcia & Lecanora – highly developed both fungal and algal apothecial margin – LECANORINE type.

a) Structure of Apothecia – 2 parts DISC + MARGIN

(i) Disc – Fertile portion, soft, bright colour, hard, black.

V. S. Apothecia – Disc closely packed like palisade sac like asci + paraphyses.

Hymenium / hymenial layer / thecium - Fertile layer – stout, club shaped asci between paraphyses, do not project out side. Asci – 8 ascospores. Smooth projecting ends of paraphses – Epithecium.

Sub Hymenium – Dense mass of sterile hyphae below the thecium

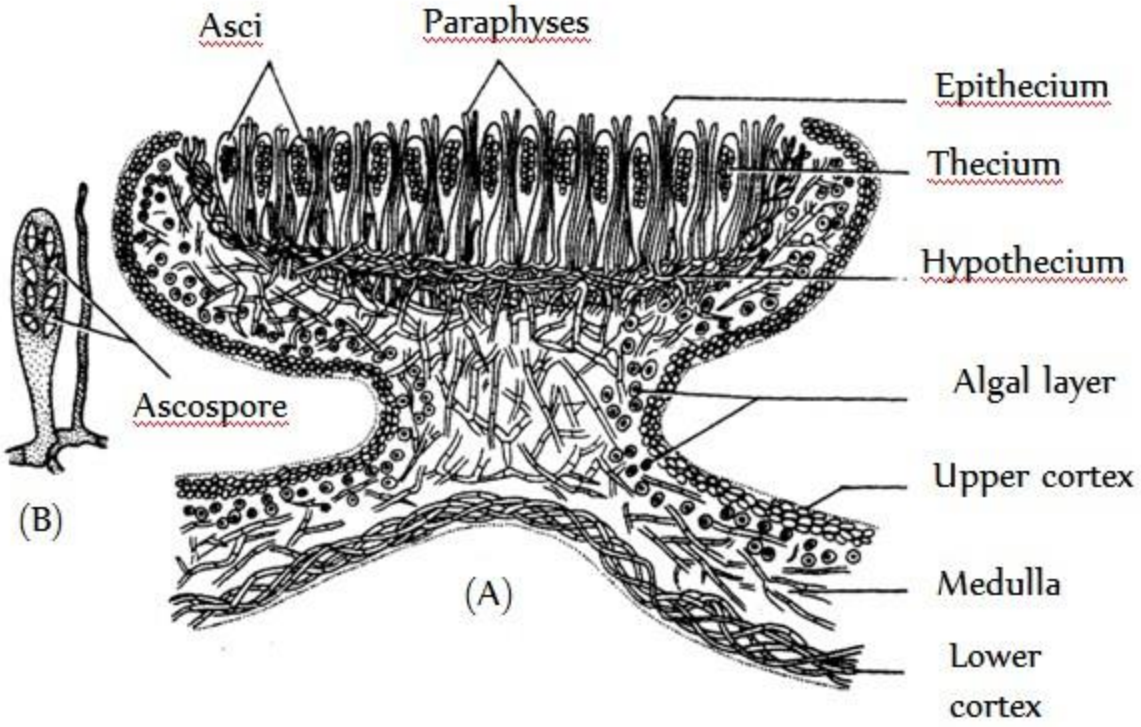


Fig : V.S. of lichen thallus through apothecia, (A) Lecanorine type, (B) Lecideine type

(ii) Margins of the apothecium – surrounding the disc – proper margin

Lecideine type – proper margin

Lecanorine type – Xanthoria & Physcia (fungal + Algal elements) proper margin + thalline margin second layer like thallus.

(b) Development of Ascospores – Young ascus mother cell – single 2n nucleus – union of 2 haploid nucleus. 3 divisions 8 N (1 meiosis, 2 mitosis) = 8 Ascospores, cytoplasm gelatinous absorb water and burst at the tips – liberation of spores, before liberation 2 celled to many cell stage, wind dispersal – suitable substratum – germinate. Fungal hyphae contact algal component.

2. Perithecia – second sub group PYRENOCARPEAE

Ascus – Perithecium type, much smaller in size, dot, millimeter dia. V. S. flask shaped. Surrounded by dark coloured wall, paraphysis few / absent, upper side small pore – ostiole. Parthenogenetic development also reported.

Special features of Lichens : Pollution indicator, lowest growing plant 1mm to 10 mm in radius / yr.

Dual, composite organisms, Thallus – fungus and algae synthesis food, crustose, foliose, fruticose, internally 4 regions upper cortex, algal zone, medulla, lower cortex. Asexual rep – asexual spores. Sexual only by fungal partner. Carpogonium coiled, multicellular filament – trichogyne septa. Antheridia spermatia – non motile, fructification, ascus haploid spores – germination, lichen acid no other plant.

Lichen

1. Flourish temperate and cold regions
2. Grow freely exposed to air & light dislike smoky atmosphere of town
3. Barren substratum drought starvation
4. Epiphytes / terrestrial / autophytes
5. Coloured by organic acids
6. Thallus tough, leathery in texture, soft as a rubber sponge

Fungi

1. Thrive, tropical, subtropical, warm
2. Moist, shady, dark green, places prefer town
3. Dead organic matter / living, moist area
4. Parasites / saprophytes
5. Colourless
6. Filamentous, delicate in texture immersed in substratum many slimy and gelatinous

Ecological Importance : Soil farmers, pioneer plants to grow on barren area, crustaceous forms first to appear, foliaceous, fruticose type, live happily under drought and apparent starvation like blotting paper. Organic acid - disintegration of rocks. Soil fertile – successors – mosses – flowering plants.

Economic Importance : Beauty, variety & abundance

1. Sources of food : fruticose lichen Cladonia rangiferina (Rein deer moss) & tundra lichens food for Rein deer, musk, ox, wild animals of the arctic tundra zone, few species for food. Rocky lichen delicacy in China and Japan. Parmelia southern India. Cetraria islandica (Ice land moss), Lecanora esculenta edible species – little nutritive value.

2. Traditional use : preparation of dyes – fabrics, paints eg. ORCHIL blue dye - woolens. Litmas – acid base indicator – Rocella montaignei – brown and yellow dye.

3. Medicinal uses : Jaundice, fevers, diarrhoea, epilepsy, skin diseases – Peltigera camana, Lobaria pulmonaria, Everina – yellow substance USNIC ACID – USNEA cladonea – antibiotic for various infections, preparation of ointments for wounds and burns, mucilagenous substances – Centraria islandica (Ice Land Moss) laxative.

4. Sweet scented thalli – manufacture of dhup, hawan samagris and other perfumeries. Oak moss fixative for perfumes Southern Europe.

5. Acid used for identification 6. formation of soil

USNEA – fruticose lichens, cylindrical to ribbon like much branched thallus, grows erect / pendent, holdfast, grey green, single main stalk / many. Stalk arise from base and fork repeteadly main stalk and branches covered with conspicuous branchlets like bristles / fibrils. C.S. of central medulla loosely arranged hyphae, many interspaces, surrounded by algal layer phycobiont green algae – Protococcus. Thallus rep – veg. by fragmentation. U. Comosa bear cigar shaped soredia, whitish soralia. Apothecium large, plate like, terminal in position, Thalline margin fringed with bristle like out growths – simple / branched. Disc – fawn in colour, 1 cm in dia. Ascus – 8 ascospores colourless and simple.

Systematic Position

Division	:	Mycota
Sub – Division	:	Eumycotina
Class	:	Lichens
Sub – Class	:	Ascolichens
Series	:	Gymnocarpeae
Order	:	Parmeliales
Family	:	Usneaceae
Genus	:	USNEA