Lichens

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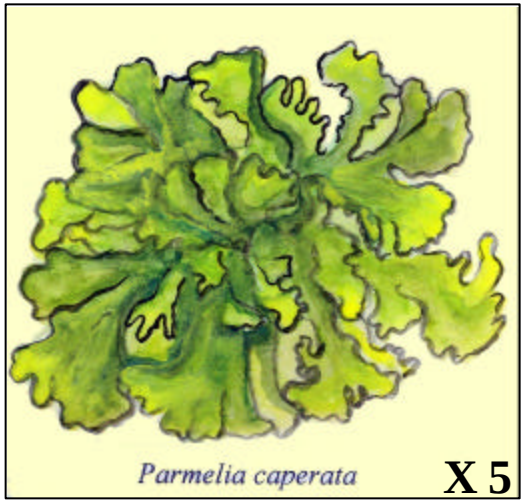
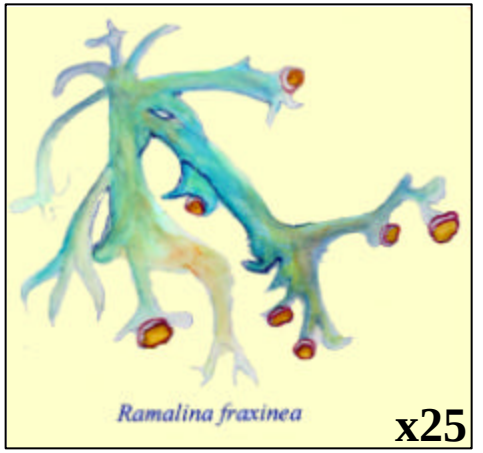
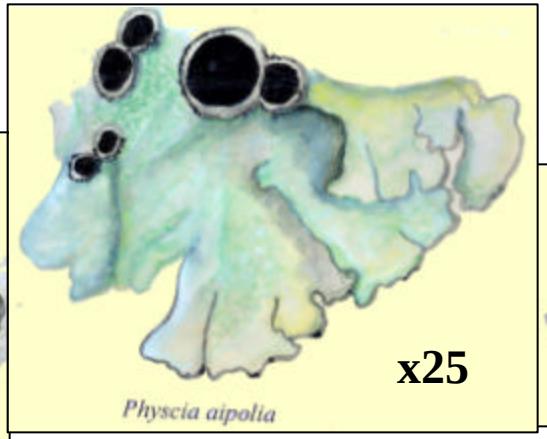
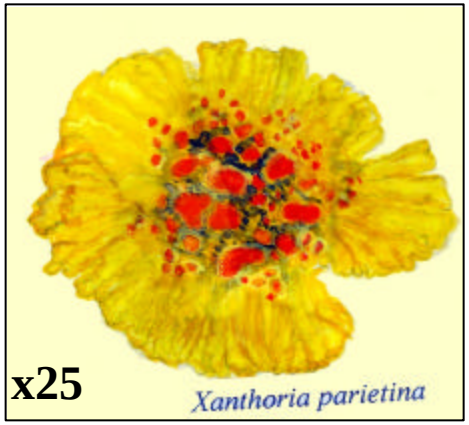
Have you come across these colourful Organisms? These are lichens

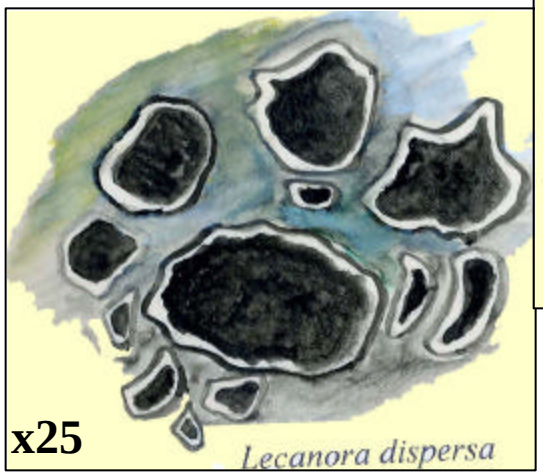
Want to Know more about them?











Drawings by Dr. P.Balaji

Lichens in Indian languages

Sanskrit- Sailaja, saileya, Silapushpam

Hindi- Charila, Pathar-ka - phul

Telugu- Rathipoovvu

Tamil- Marappasi, Kalpasi, maraottu

Malayalam- Kalpasi

Kannada- Kallu -huvvu

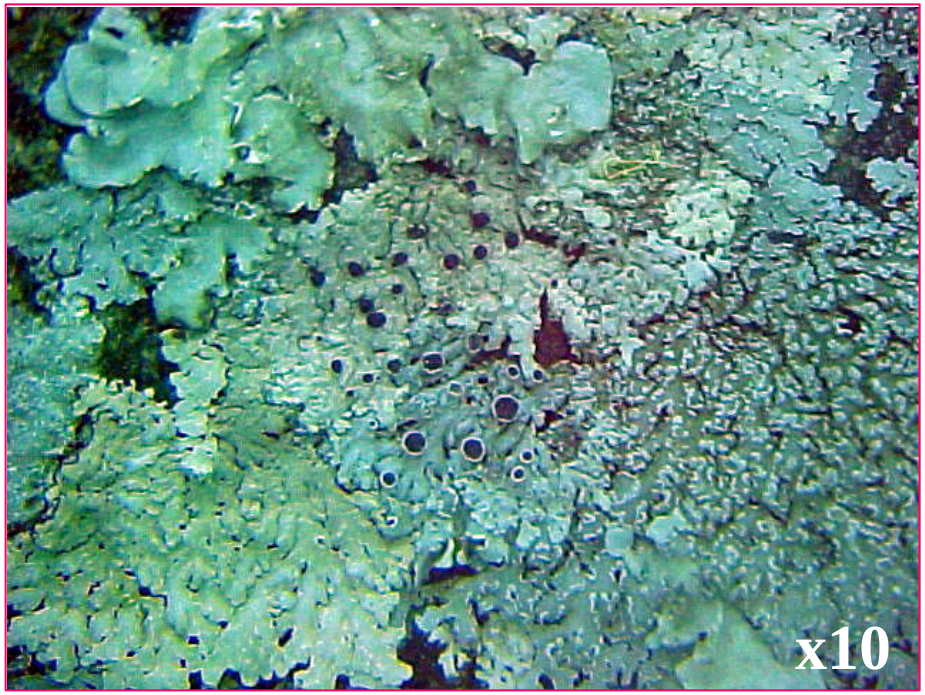
Punjabi- Chalchalira, charcharila, ausneh, hiunsew

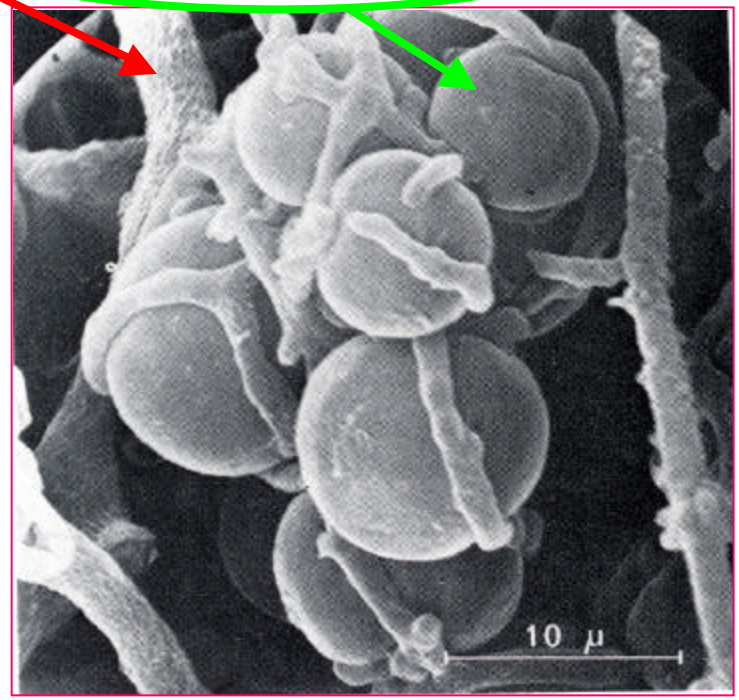
Marathi- Mota dagada phul, barik dagada phul.

All these names refer to the lichens…

What are Lichens?

Lichens are fungi that live in intimate symbiotic association with green algae or cyanobacteria.





The body of a lichen is known as a lichen thallus
The lichen thallus lack protective (=skin), conductive (= xylem or phloem in plants) and assimilatory (= roots) tissues.
The lichen thallus resembles neither fungal nor photosynthetic partner.

Lichens.....in the History

CAROLUS LINNAEUS
(later, **Carl von Linné**)
(May 23, 1707 - January 10, 1778) born at Råshult in the parish of Stenbrohult in Småland, Sweden.

Linnaeus grouped all lichen species under the genus *Lichen* and gave it to one of his last students Erik Acharius for further study

Linnaeus collected lichens from India.
Based on this lichen collection the following sp. was described in his work Species Plantarum.

"The father of lichenology"

ERIK ACHARIUS was born in the Swedish town of Gävle in 1757. At the age of 17 he came to Uppsala where he studied botany as one of Linnaeus' last students. After medical studies in Stockholm and Lund he served as a physician in southern Sweden. From 1789 he held a position as Provincial Medical Officer at Vadstena, where he died in 1819.

Acharius' scientific work was devoted to lichens. Linnaeus had grouped all lichen species in the same genus, *Lichen.* Acharius described many new species and arranged them in 40 distinct genera.
He created the first rational system for lichens and has been called the father of lichenology

Important works
Lichenographiæ suecicæ prodromus (1798);Methodus lichenum (1803);Lichenographia universalis (1810) &Synopsis methodica Lichenum (1814).

1868 – SIMON SCHWENDENER (Sweden) hypothesized that lichens are an association between fungi and algae

Identification or naming of lichens.....

You need to know the following:

1. Where it is growing?
2. How does it look like?
3. What is the colour?
4. What are the special structures you see?

Find out all these features of lichens using this TUTORIAL....

Identity of the mycobiont and photobiont

- **Lichen pronounced *lie'ken*, is derived from the Greek *? e???? ?* = tree moss**
  moss is a bryophyte but lichen is a fungi
- **There are about 13,500 lichen species reported world wide**
- **The scientific name of a lichen species is the name of the Fungal partner (mycobiont)**
- **Most mycobionts are Ascomycetes, although about twenty lichenized Basidiomycetes are known**
- **The photobiont (the alga or cyanobacterial partner which carryout photosynthesis within the lichen thallus) has a different scientific name**
- **In 90% of the lichens, the photobiont is a green alga of the genus *Trebouxia (Chlorococcales),* or *Trentepohlia (Chetophorales)***
- **Where cyanobacteria are involved, they are *Nostoc* or *Anabaena***
- **Algae and cyanobacteria grow faster when NOT part of a lichen**

Basic facts about the Lichen thallus

- Thallus is a vegetative body / Gametophyte (meaning which produces male & female sexual reproductive structures & cells
- Chromosome No: *n*
- Exhibit different growth forms
- Unique form that bears no resemblance to non-lichenized alga or fungus

- Slow-growing
  - most grow < 1mm/year - Crustose, maximum of 4 cm/year – Foliose & Fruticose
  - Growth favored by high humidity, cool temperature and low light

- Long-lived
  - Reach maturity at 4-8 years
  - Alpine-arctic lichens may be 1000-4500 years old
  - Longevity attributable to ability to withstand drought periods of several months
  - Able to absorb up 300% of its weight in water when available

Why lichens need to have different shapes and colours?

Thallus Structure - Adaptations to Abiotic & Biotic stresses

- **Colonize, and compete with other organisms like mosses and other plants for substrate, light, moisture and nutrients**
- **Maximize the photosynthetic surface of the thallus**
- **Protect its photosynthetic machinery from extremely bright light, UV radiation and desiccation during the day and from inundation during rains**
- **Withstand high wind-velocity in certain areas, and Disperse effectively diasporas**
- **Improve water retention ability for effective photosynthesis during the moisture-rich but dim early morning and late evening periods (especially in extreme environments).**

Where can you find lichens?

Use hand lens

Tree bark
Rock
Soil
Leaves

Logs
Fence post
Roof top
Glass
Insect
Tortoise Shell

Habitats of lichens.....

Corticolous- lichens growing on tree trunk/bark

Corticolous- lichens growing on twig

Use hand lens

Saxicolous- lichens growing on rock

Lichens growing on asbestos

Foliicolous -Lichens growing on leaf

Tools required for lichen collection in the field....

1. Hammer
2. Chisel
3. Butter paper cover
4. Knife
5. Writing pad
6. Tissue paper
7. 10x Hand lens with illumination
8. Camera preferably with digital imaging
9. Collection bag (Jola or Jolna bag)
10. Pencil

Field observation of lichen species using 10x hand lens

Use hand lens

Lichen specimen collection from bark

Tools required for lichen collection in the field....

Do’s & Dont’s prior to field trip & lichen collection	
Do’s	Dont’s/Never
Get field permit for collection from the land owner/Forest Department/local body	Never Enter the field without the field permit
Ensure all collection equipment in place in working condition	Never Enter the field without proper gear
Take a pocket size field note and a micro tip pencil	Never Enter the field without proper gear
Study / learn / understand the landscape / local people / flora / Fauna/ Hazards	Never Enter the field without proper knowledge
Ensure field logistics like boarding & lodging, Up & down journey tickets etc.	Never Enter the field without proper arrangements
Ensure field logistics like vehicle for local travel & field guides	Never Enter the field without proper arrangements
Keep your stomach light	Never over burden your stomach even with water
Take adequate rest & keep you healthy	
Ensure a pair of field dress (preferably dark greenish shades), & shoes are in usable condition	Never Enter the field without proper gear

Do’s & Don'ts during field trip & lichen collection

Do’s & Don'ts while drying the lichen collection

Tools required for lichen identification in the Lab....

Use a compound microscope

1. Plastic trays
2. Compound microscope
3. Dissection microscope
4. Small forceps
5. Glass rods
6. Needle
7. Razor blade or Ordinary blade
8. Glass slide and cover glass
9. KOH (in brown stopper bottle)
10. Sodium hypochloridep-phenylene diamine (in brown stopper bottle)
11. Identification keys (Books)

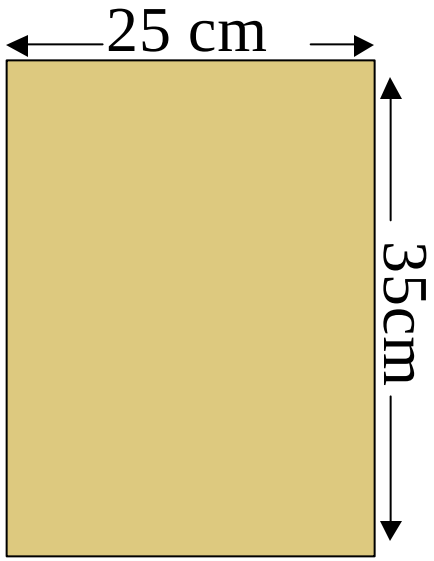
Observe the morphological characters of lichens using a Dissection microscope

Specimen preservation…..

Do’s	Don'ts
Wrap the specimen with tissue paper soon after collection	Don't collect the specimens in the polythene bags
Label them properly with field no., date and location and GPS data if possible	Don't collect the specimens without proper field numbers
At the resting room spread the samples and allow them to dry until their moisture content completely drained	Don't forget to spread out the specimens for drying
Prepare the herbarium folder as described in the next page and arranged them according to field number / families	Don’t store the material without proper herbarium folder and labelling

Preparation of a herbarium folder for lichens

1



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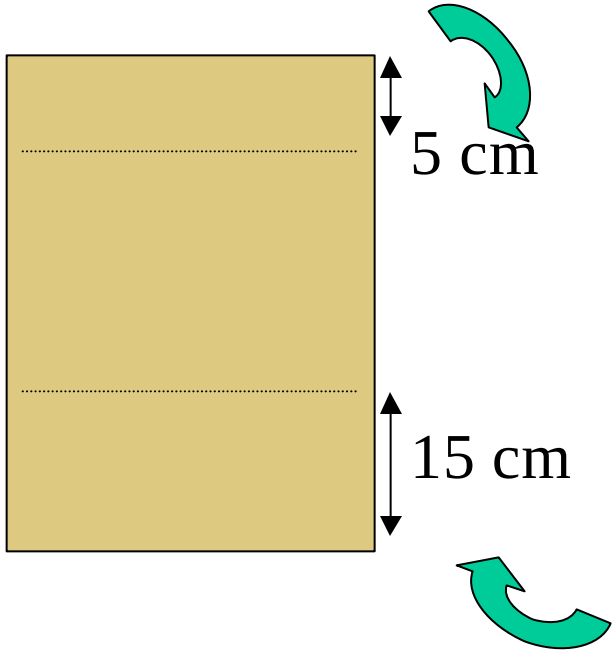

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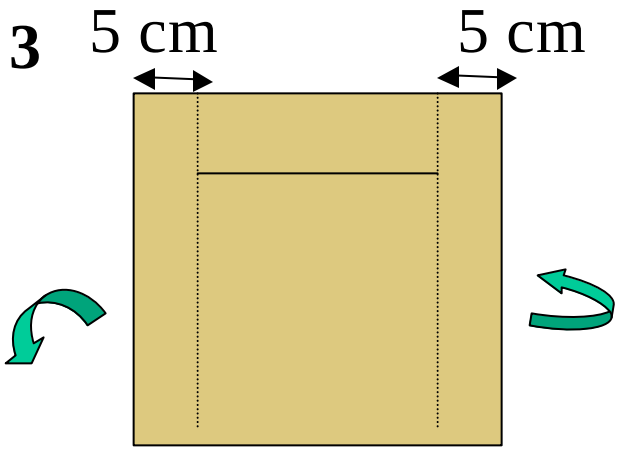

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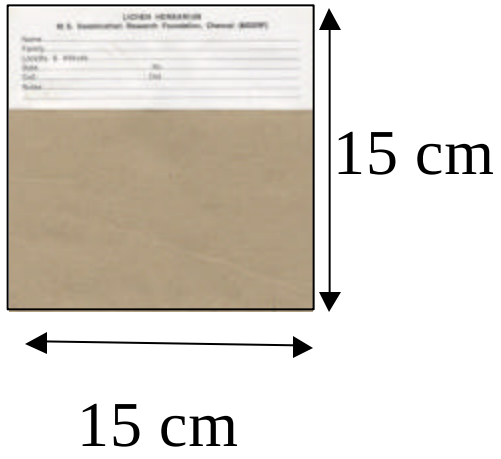
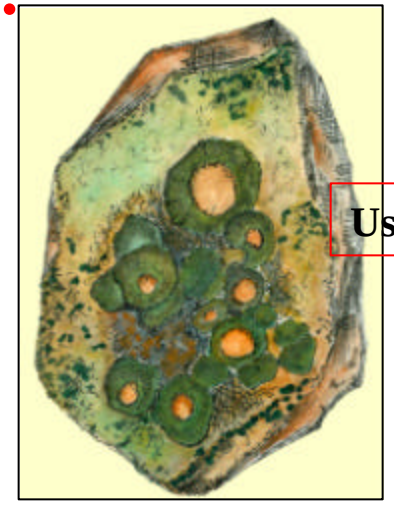


Habit and growth forms of lichens....

Crustose – crust like

Leaf like- lobes broad



Use hand lens

Thallus squamulose

Fruticose – Strap shaped

Fruticose – Cylindrical shaped

Lichen with two fold characters

Basidiolichen

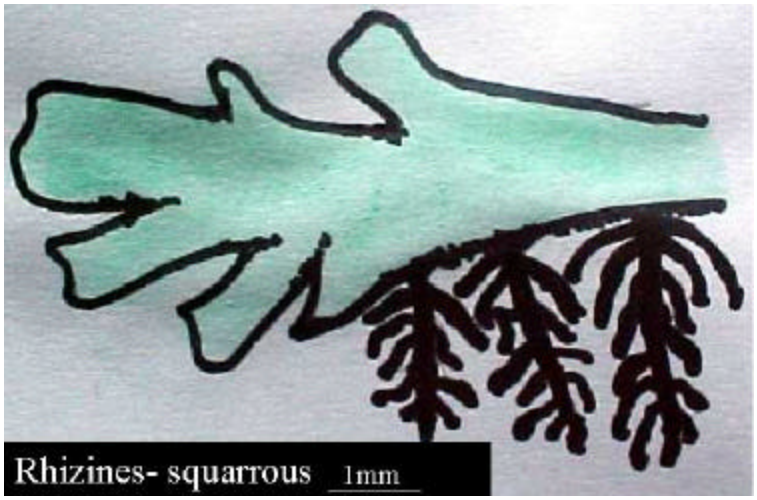
Structural features of lichens….

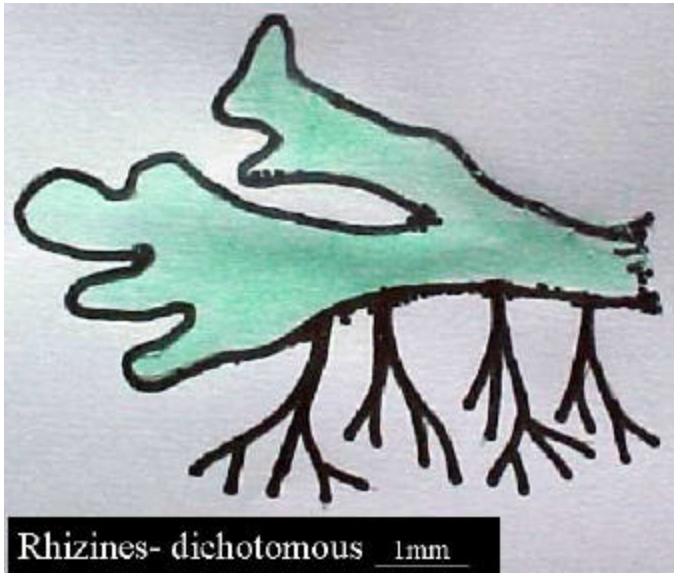
Use a compound microscope

Types of Rhizines

Rhizine – ‘root’ like

Composed of mycobiont





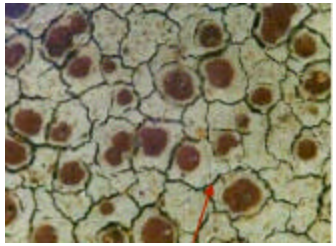
Upper surface Characteristics – Specific to each growth form….

a. Crustose

Prothallus

Smooth

Verrucose



Areolate

b. Foliose

Maculate

Pruinose

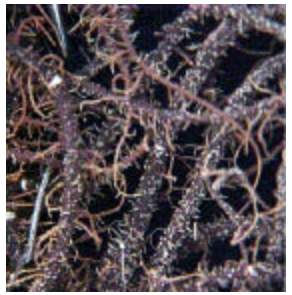
Nervulose

Pseudocyphellate

c. Fruticose

Smooth

Cracked



Papillae/tuberculate

d. Colour of the thallus

Yellow

Black

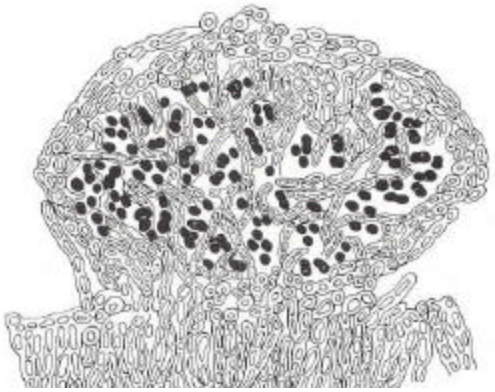
Brown

Orange

Structural features of lichens…

Thallus with black cephalodia

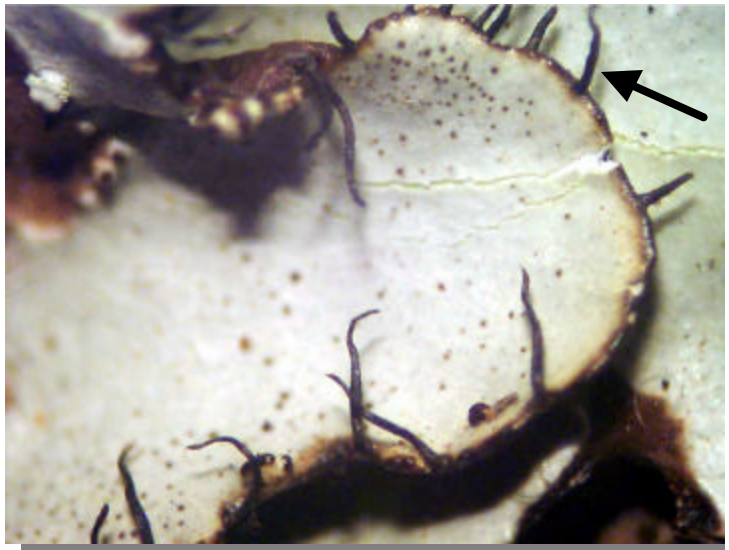
***Lobaria amplissima* (Scop.) Forssell**



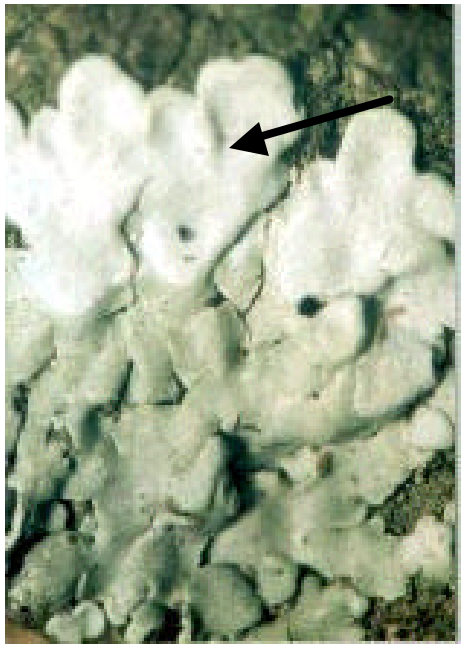
V.S. through cephalodium

Use a compound microscope

Use hand lens



Cilia on thallus margin



Pruina on actively growing portions of the thallus–

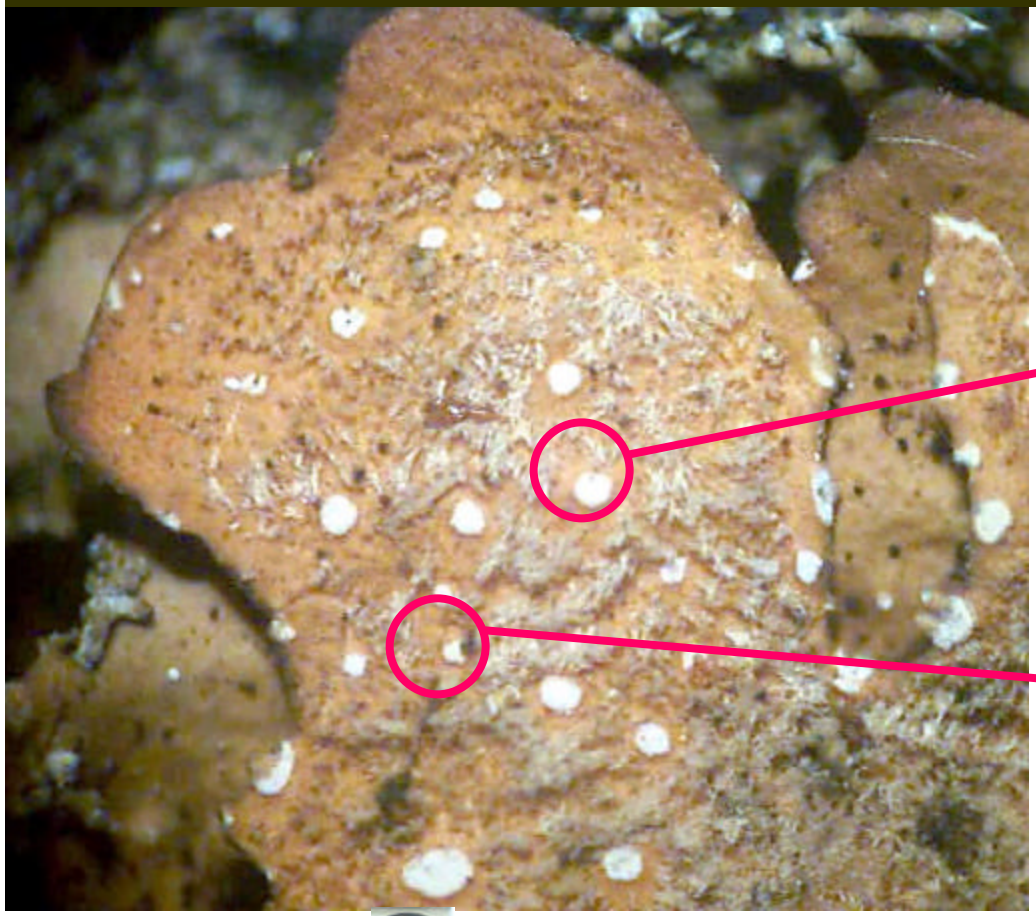
Calcium oxalate crystals

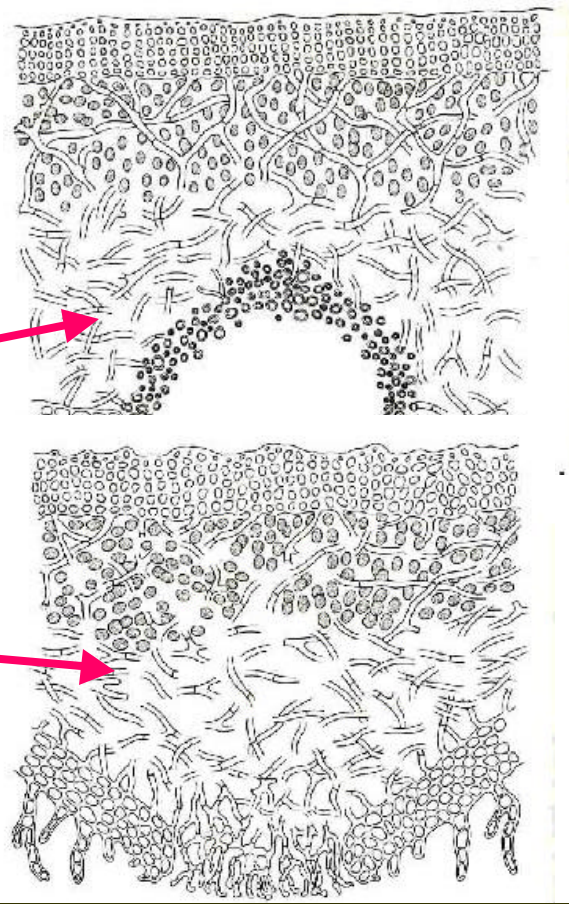
Structural features of lichens…..

Use a compound microscope

Cyphella

(cup-shaped white depression of non-gelatinized hyphae) in lower cortex of *Sticta*





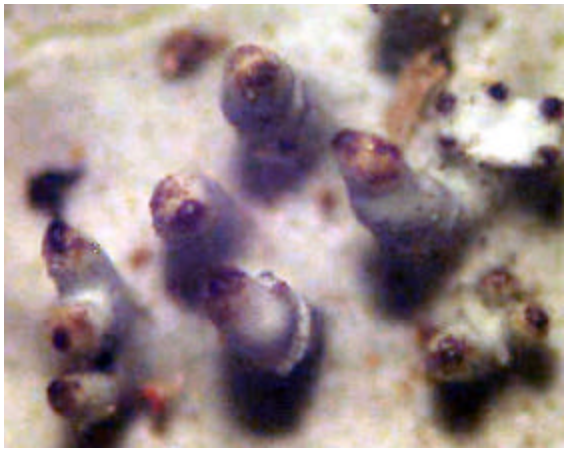
Use hand lens

Pseudocyphella

(small pore forming white dot) in lower cortex of *Pseudocyphellaria* and *Sticta* spp.

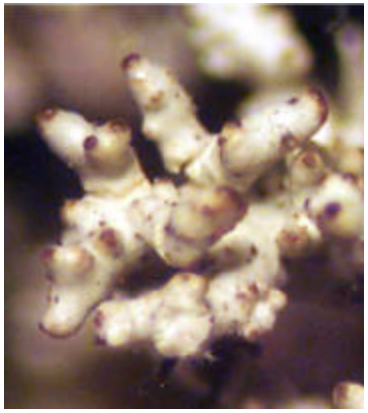
Structural features of lichens
Vegetative reproduction

Use a compound microscope



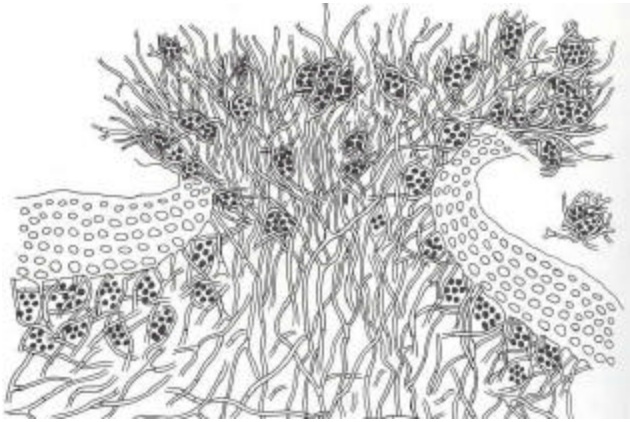
Isidia on upper surface

Soredia on upper surface



Isidia (coral-like outgrowths) of *Parmotrema*

C.S. of **Isidia**

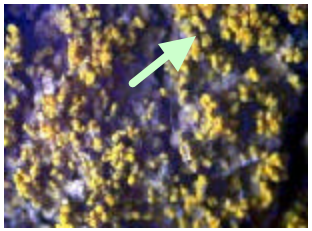


C.S. of **Soredia**

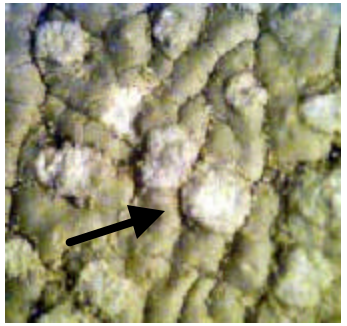
Asexual reproduction in lichens…

- Fragmentation of thallus when dry and brittle

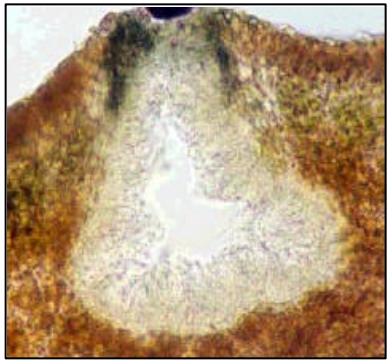
- Detachment of isidia



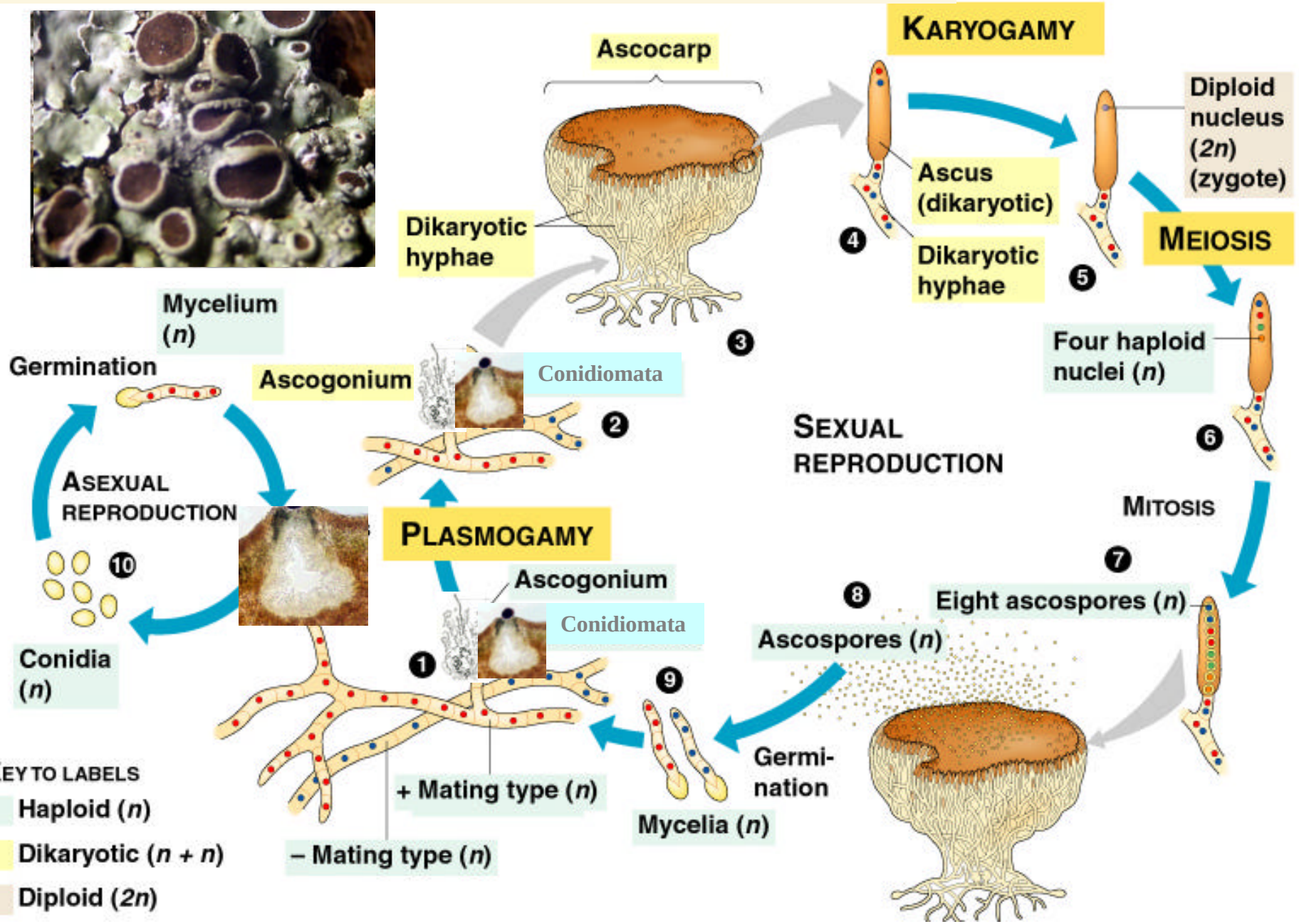
- Loose dusty masses of **soredia**



- **Pycnidia**



Lichenised Ascomycete life cycle



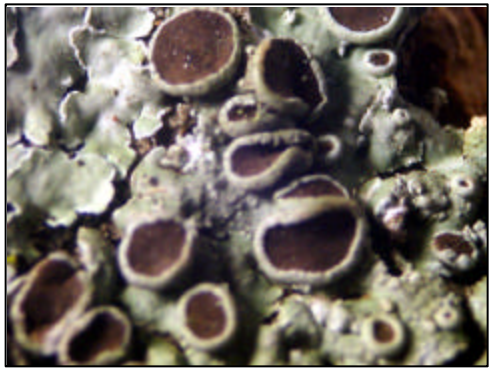
Sexual Reproduction in Lichens

Use hand lens

Only the fungal partner undergoes sexual reproduction

In the **ascomycetous** (i.e. most) lichens, **ascospores** are formed in sacs called **asci**, mixed with **paraphyses** to form a **hymenium.**

Asci can be arranged on an open or convex or concave disk, when it is called an **APOTHECIUM** (round button like or letter like) or in an immersed, urn-shaped **PERITHECIUM.**

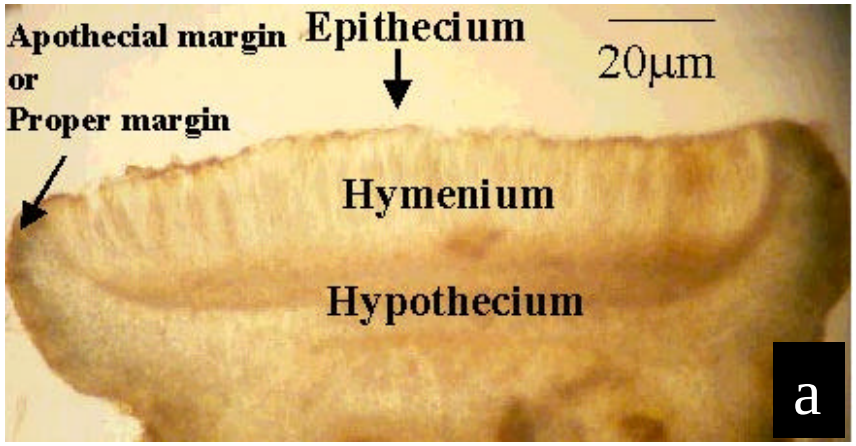


Apothecium-round button like

Apothecium-letter like

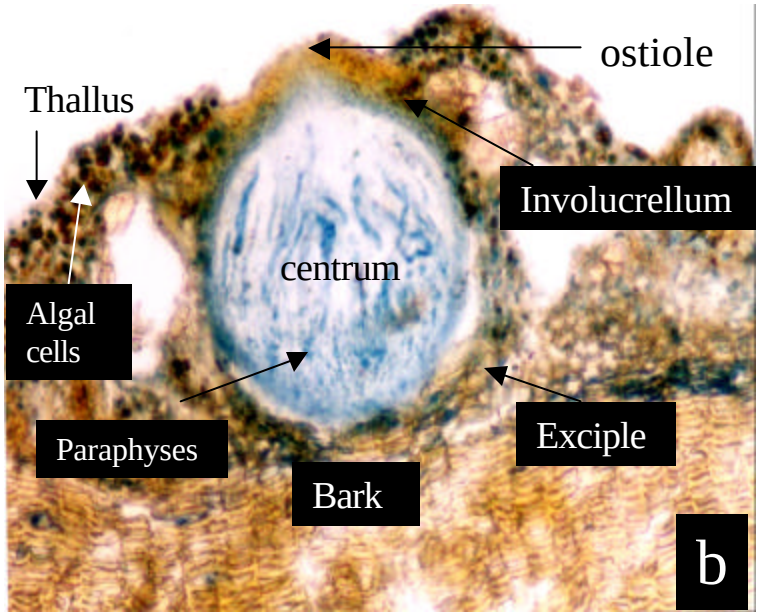
Perithecium-flask shaped

Lichen ascomatal types in cross section

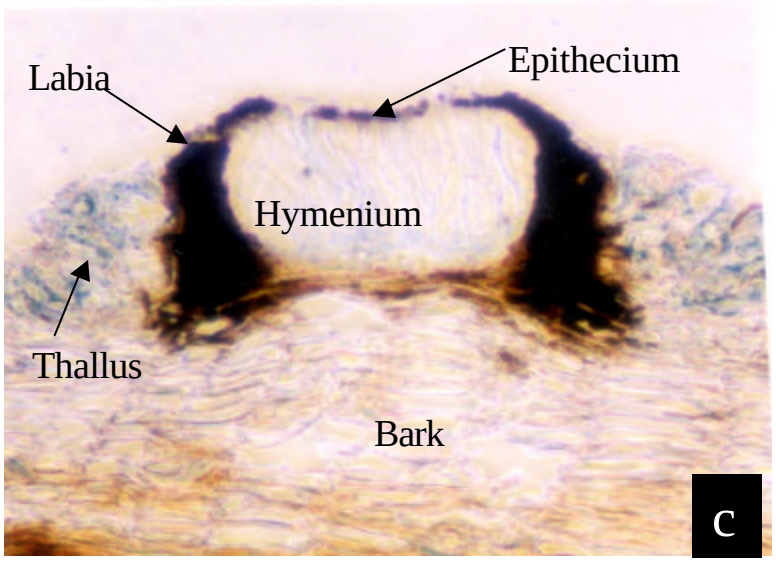


a. Ascomata – Apothecia – Cup shaped

Use a compound microscope



b. Ascomata – Perithecia – Flask shaped

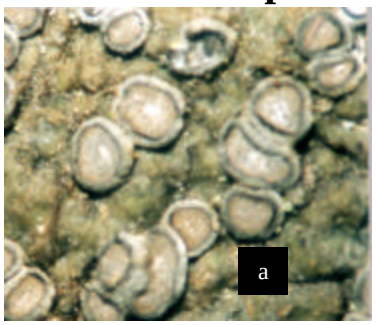


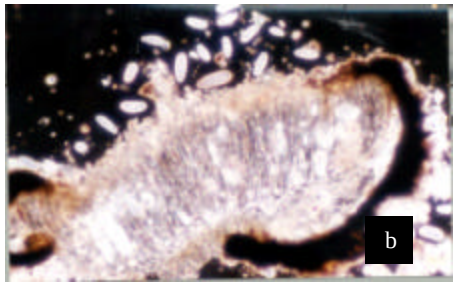
c. Ascomata – Apothecia – lirellate - script shaped

Microscopical characters of fruiting bodies to identify lichen species…

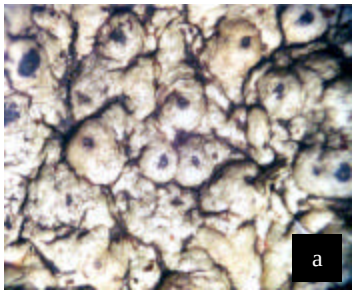
Use a compound microscope

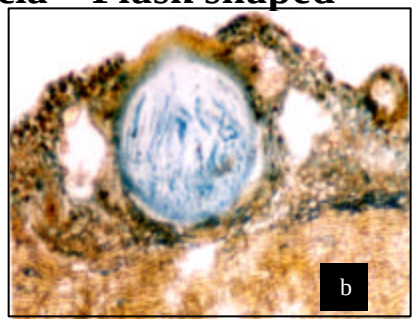
Ascomata – Apothecia – Cup shaped

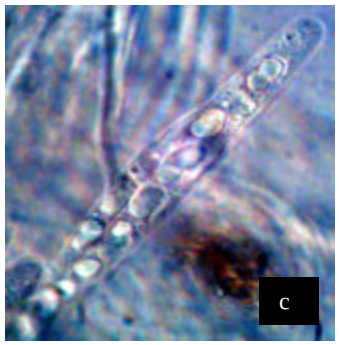


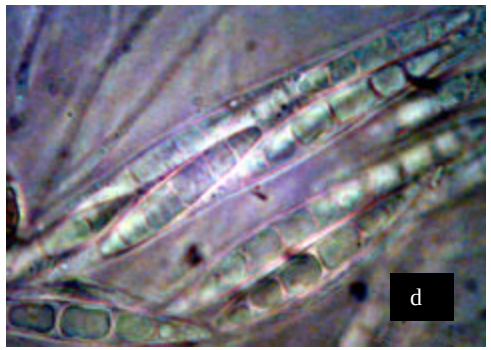


Ascomata – Perithecia – Flask shaped

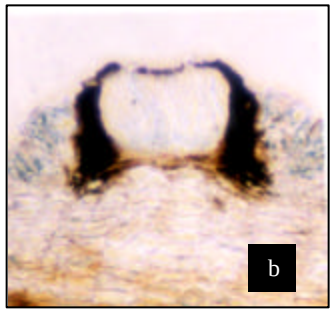


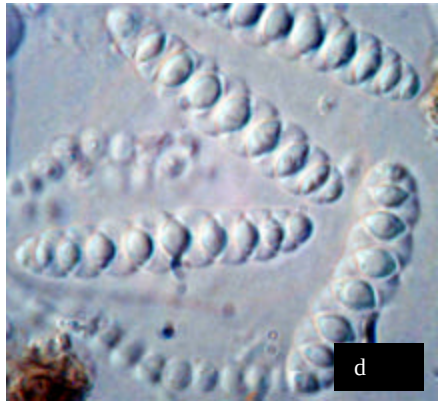






Ascomata – Apothecia – lirellate - script shaped

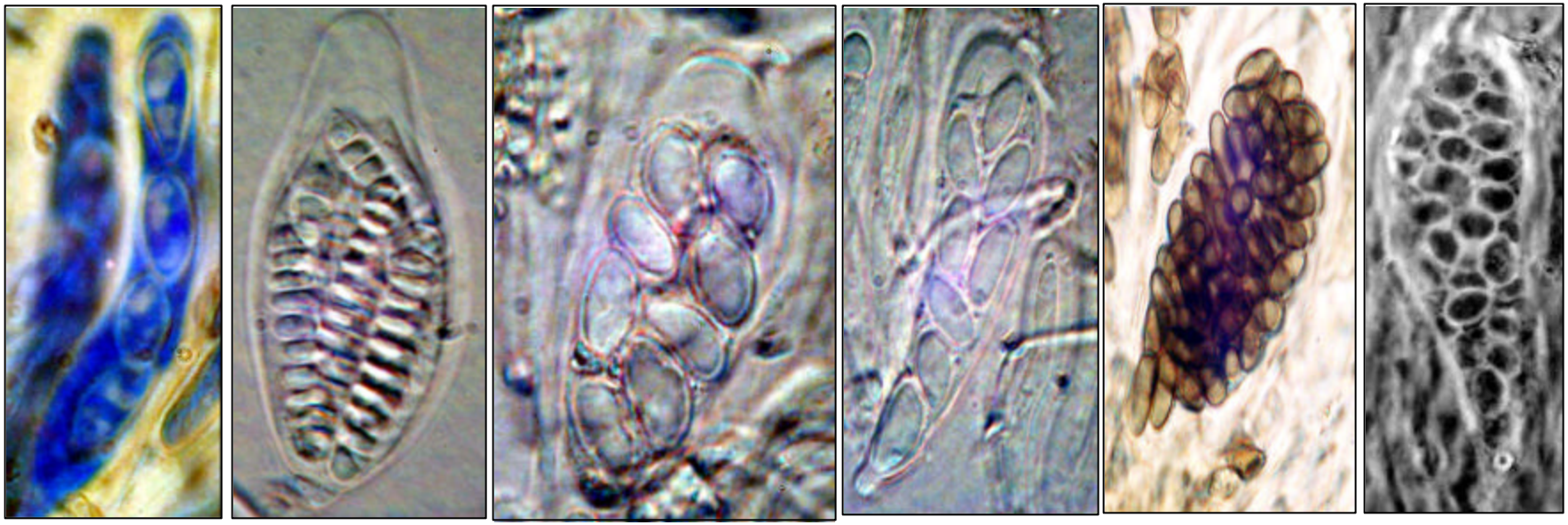




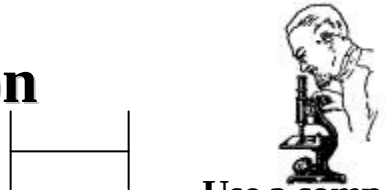
a.Thallus with Ascomata (fruiting body); b. c.s. of ascomata; c.ascus with ascospores & d. Ascospores

Ascus types…including its shape, size & no. of spores present

Use a compound microscope



Spores types…inclusing its shape, size & septation

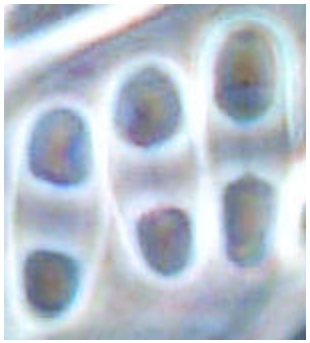


Use a compound microscope

10?m

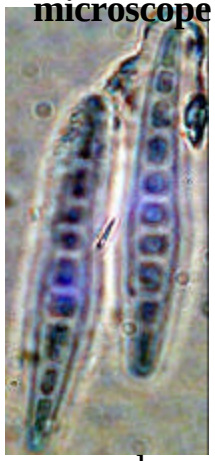
Simple

Transversely single septate Pigmented



Transversely single septate Hyaline Bacillar

Transversely many septate Hyaline Slipper shaped



Transversely many septate Hyaline Fusiform

Polari bi locular

Transversely many septate Hyaline Needle shaped

Multi (plane) Septate muriform

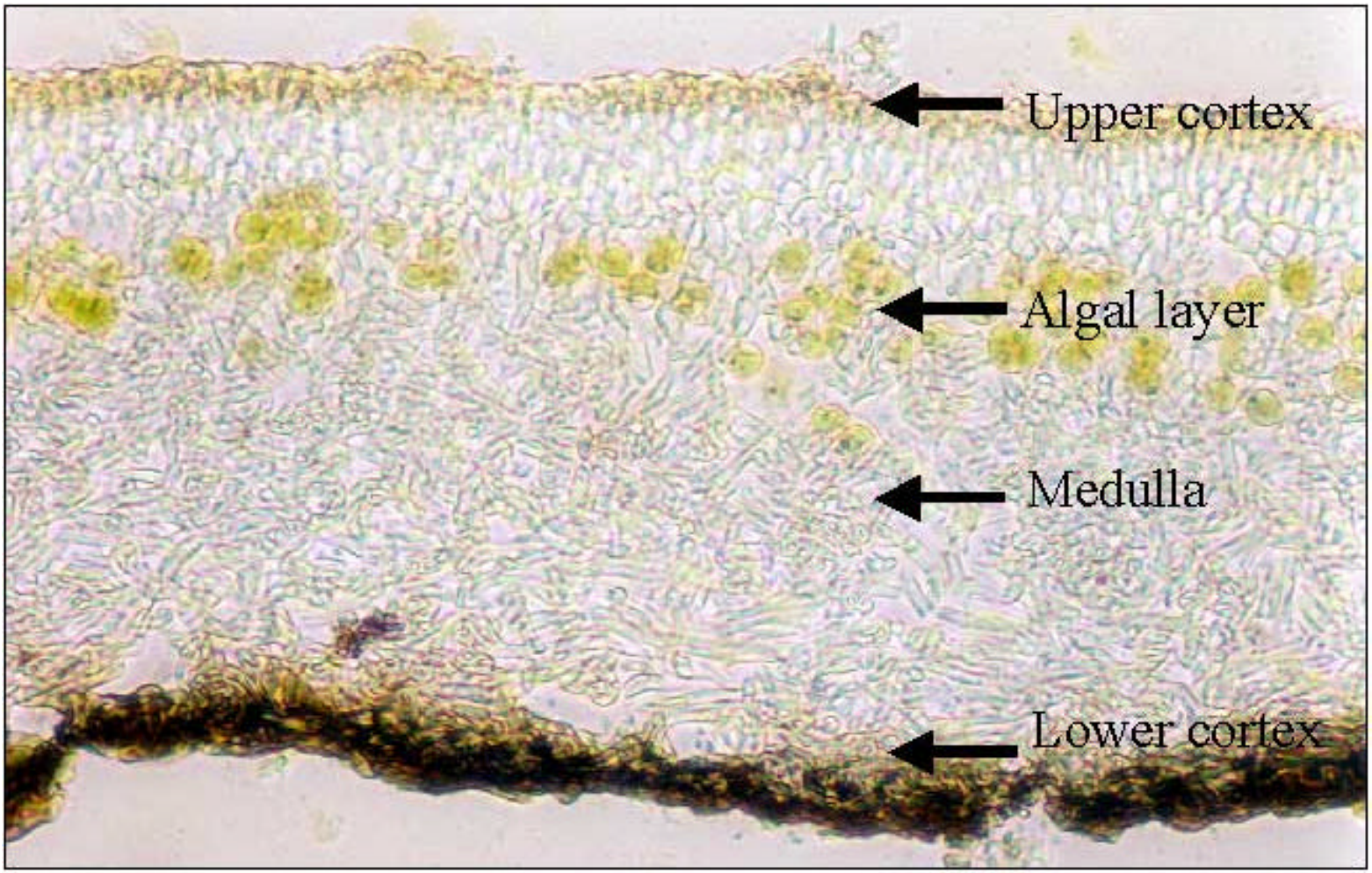
Internal morphology of lichens

Use a compound microscope

Cross-section of thallus of *Parmelia* (foliose lichen)

Heteromerous

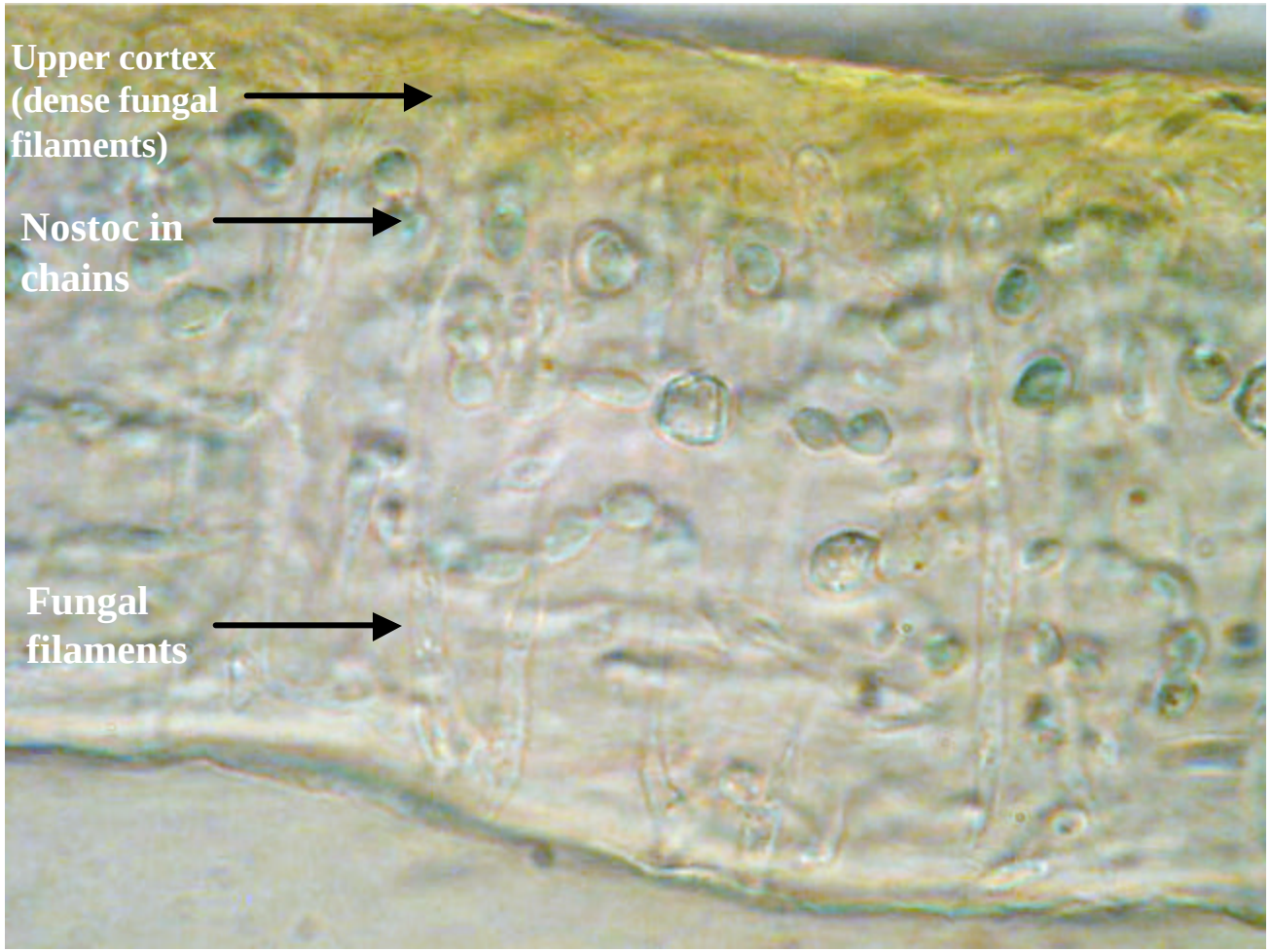
50 ?

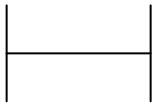


Internal morphology of lichens

Use a compound microscope

Cross-section of thallus of *Collema* (Gelatinous lichen) - Homiomerous

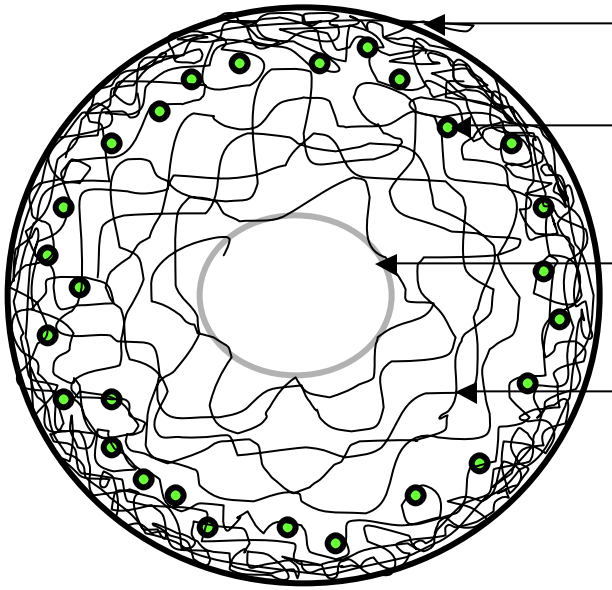




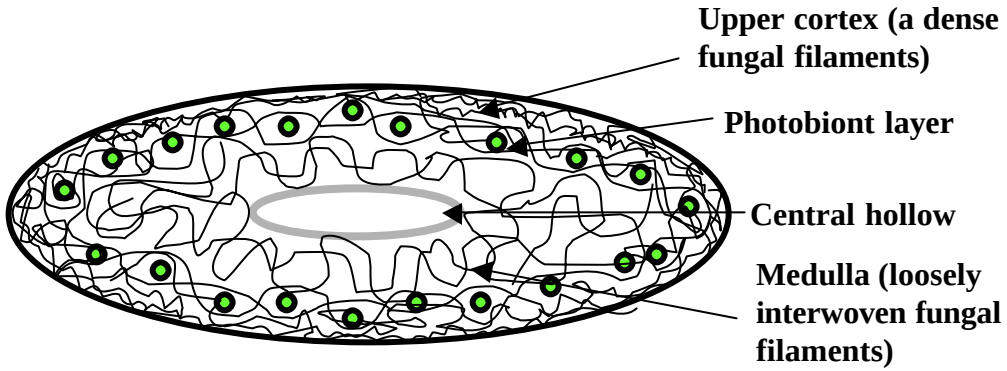
50 ?

Internal morphology of lichens....

Use a compound microscope

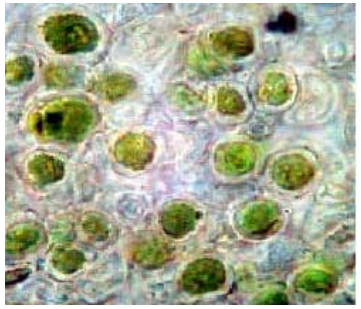


C.S. of Fruticose-cylindrical shaped thallus



C.S. of Fruticose-strap shaped thallus

The Photosynthetic partner….



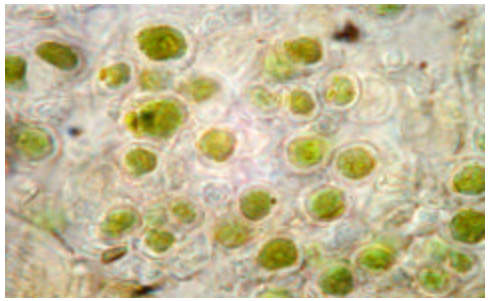
Use a compound microscope

The Photosynthetic partner either green algae or Cyanobacteria (prokaryotes - blue-green algae).

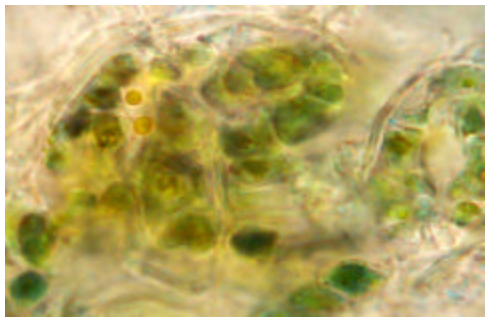
- **In 70% of lichens the alga is a sp. of *Trebouxia*.**
- **Photobiont can be free living since they are autotropic**
- **Some lichens have both Cyanobacteria and green alga as partners in same thallus.**

Photobionts of Lichens

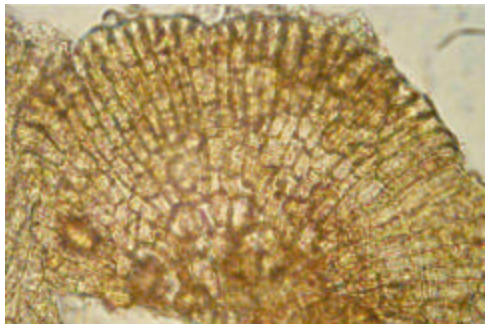
Use a compound microscope



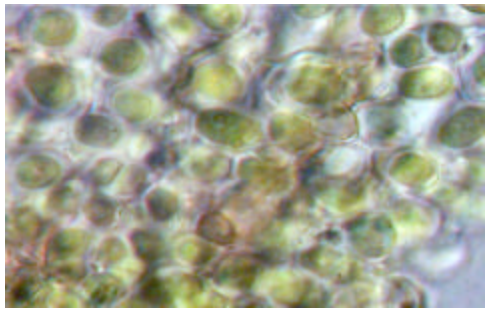
***Trebouxia* – Chlorococcales**



***Trentepohlia* – Chetophorales**



***Phycopeltis* – Chetophorales**



***Nostoc* – Nostocales**

Lichen Secondary Compounds

Lichens produce a variety of extra-cellular secondary metabolites in either an amorphous form or as crystals.

These compounds occur only in lichens and are known as lichen substances.

More than 700 such compounds have now been isolated from nearly 5000 lichen species.

These compounds are very important in lichen systematics

Identification of Compounds…

Lichen Spot tests Procedure

1. Apply the reagent solutions* to the lichen's cortex or medulla (or both) using a small glass needle. Keep a separate needle for each reagent.

2. Observe the colour

3. Wait at least half a minute before concluding that the test is negative.

4. If it is positive mention it as Thallus/medulla K/C/KC/P+ & the colour obtained

Lichen Spot tests and Reagent preparations

Test Reagent*

K test10% water solution of potassium hydroxide

C Test a solution of commercial bleach

P Test a saturated alcohol solution (95% ethanol) of *p*-phenylenediamine (1,4-diamiobenzene) or (Steiner's solution) 1 g of *p*-phenylenediamine, 10g of sodium sulphite, and 5 ml liquid detergent to 100ml distilled water

Suggested reading…..

Text Books

Hale, M.E. (1983) *The biology of lichens* (3rd ed.). Edward Arnold. pp 1-190.

Hawksworth, DL & Hill, DJ 1984: The Lichen-Forming Fungi. - Blackie, Glasgow and London. 158 pp

Galun, M. (ed.) (1988) CRC Handbook of Lichenology. Volume I. - CRC Press, Inc., Boca Raton. 297 pp.

Galun, M. (ed.) (1988) CRC Handbook of Lichenology. Volume II. - CRC Press Inc., Boca Raton. 181 pp.

Galun, M. (ed.) (1988) CRC Handbook of Lichenology. Volume III. - CRC Press, Inc., Boca Raton. 147 pp.

Indian Lichen identification keys & Field Guides

Awasthi, D. D. (1988) A key to the macro lichens of India and Nepal. *Journ. Hattori Bot. Lab.* 65: 207-302.

Awasthi, D. D. (1991) A key to the micro lichens of India, Nepal, and Sri Lanka. *Biblioth. Lichenol.* 40: 1-336

Singh, K.P. and Sinha G.P. (1994) Lichen flora of Nagaland. Bishen Singh Mahendra Pal Singh, Dehra Dun. Pp1-498.

Upreti, D.K. and Sanjeeva, N. (2004) A field guide to the common lichens of Corbett Tiger Reserve. Bishen Singh Mahendra Pal Singh, Dehra Dun. Pp 1-41.

Location of Indian Lichen laboratories…

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Kerala Forest Research Institute,
Peechi, Trissur,
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Lucknow 226 001
Uttar Pradesh, India

Dr K.P. Singh &
Dr G.P. Sinha
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