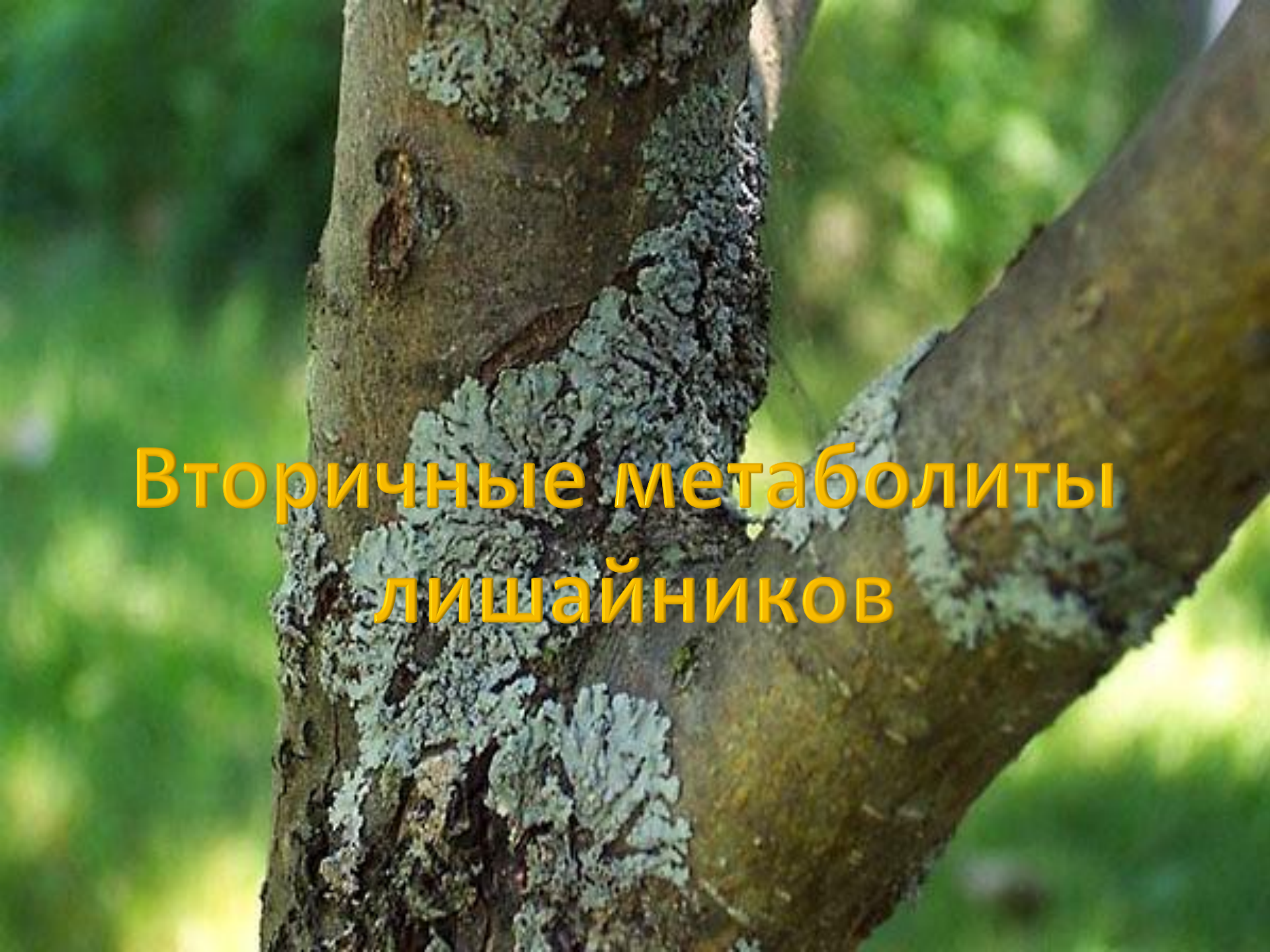


Вторичные метаболиты лишайников

Лишайники

Виды слоевищ (талломов)

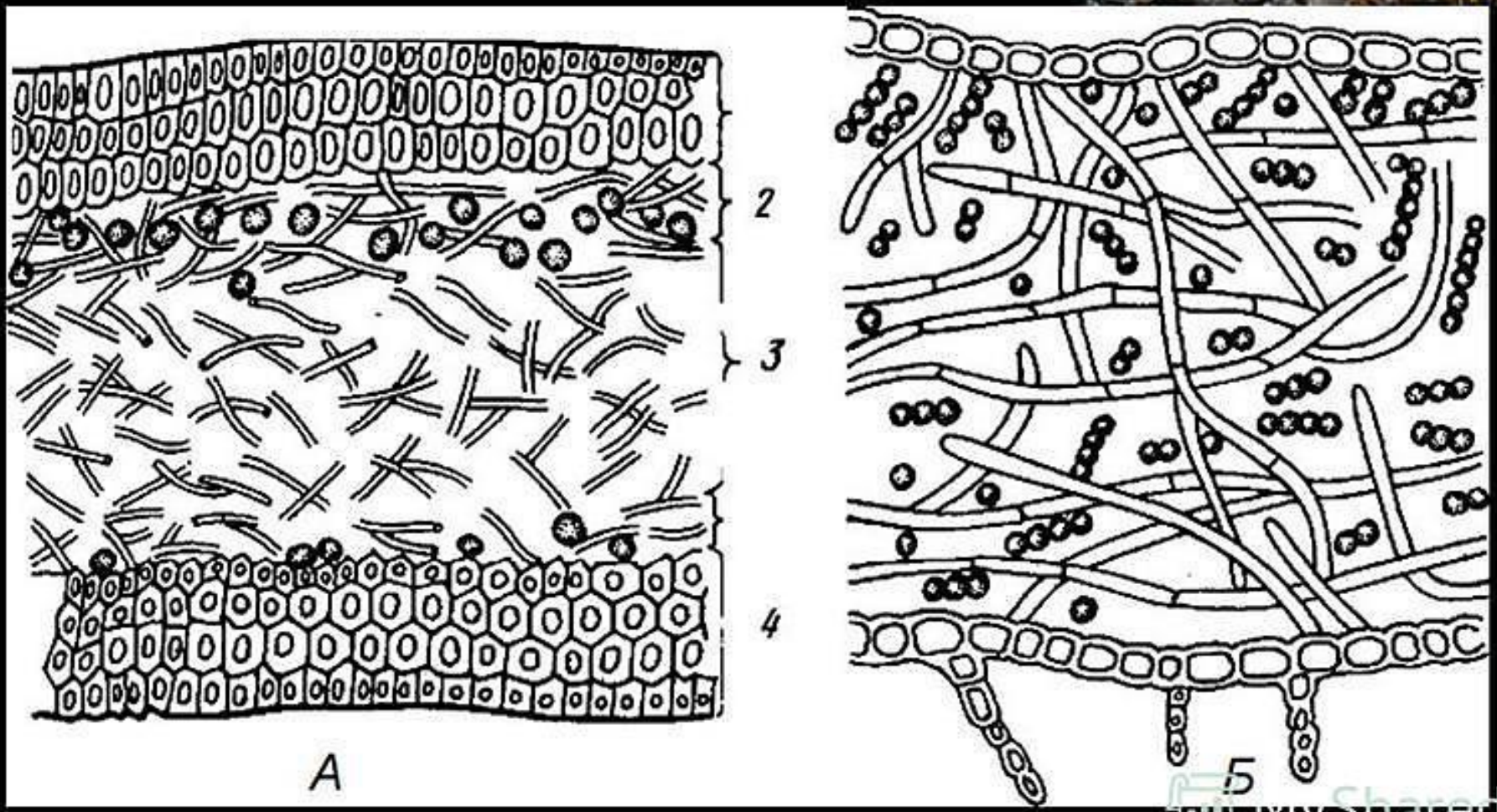
накипные (корковые)

листовые

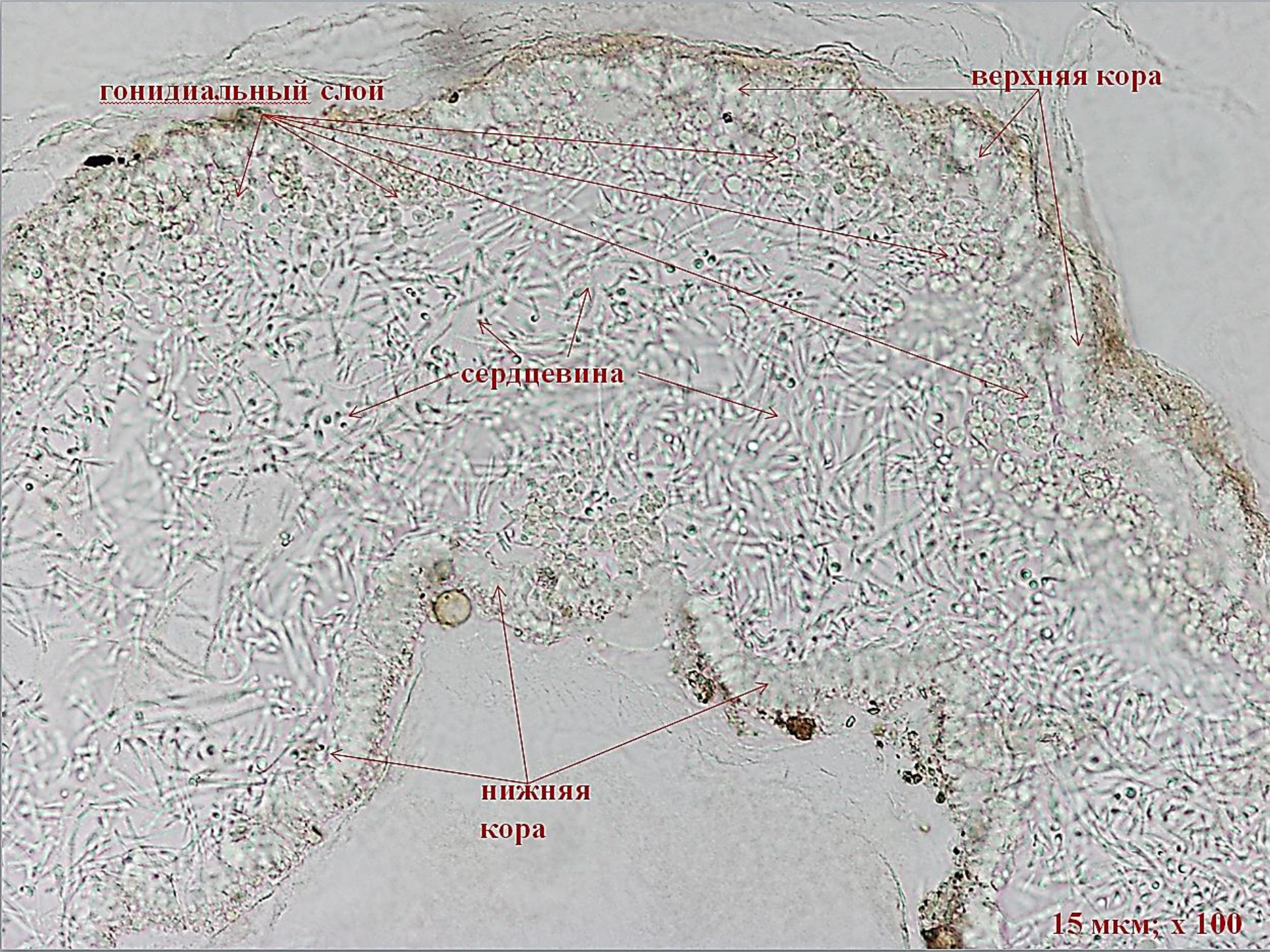
кустистые

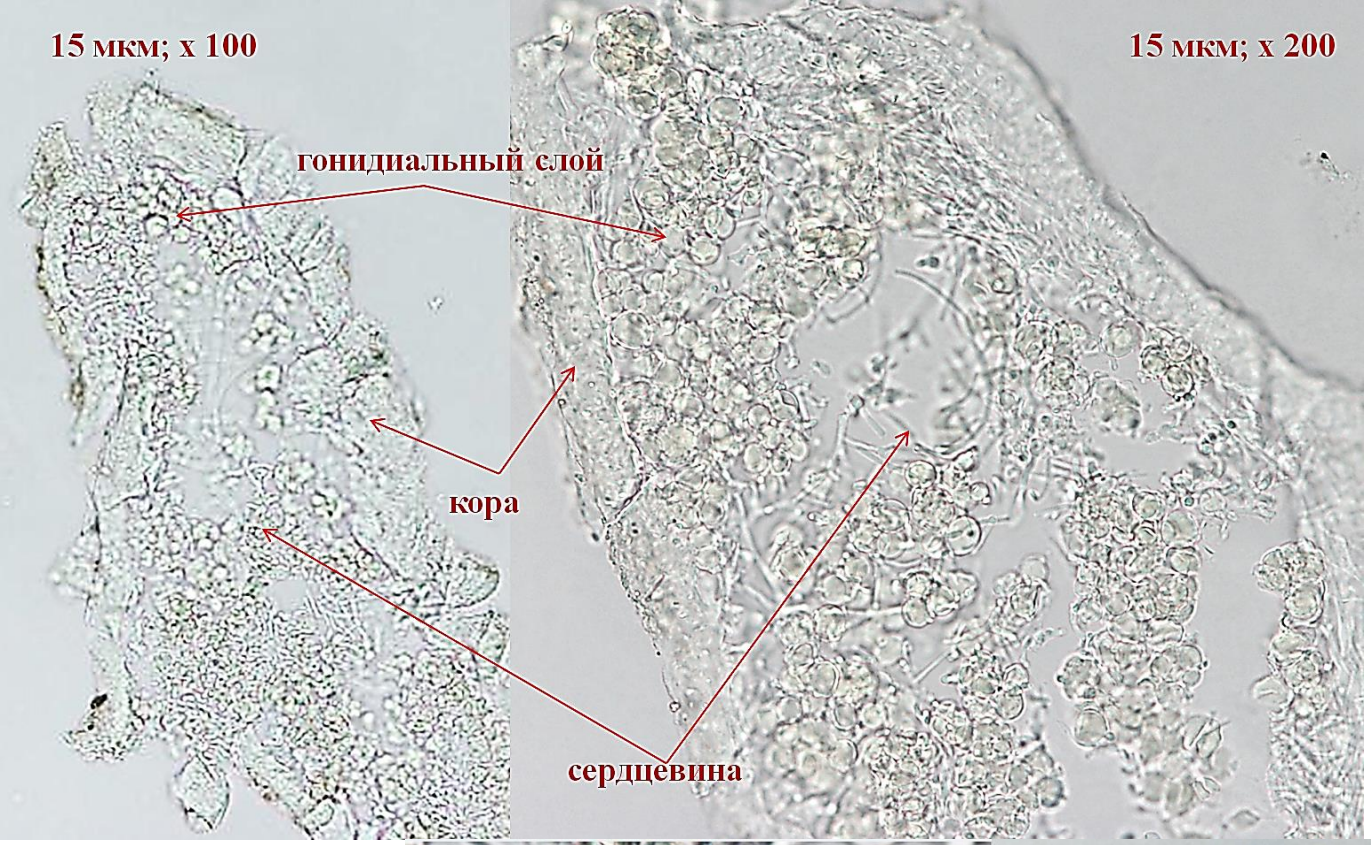
Пельтигера собачья
Peltigera canina

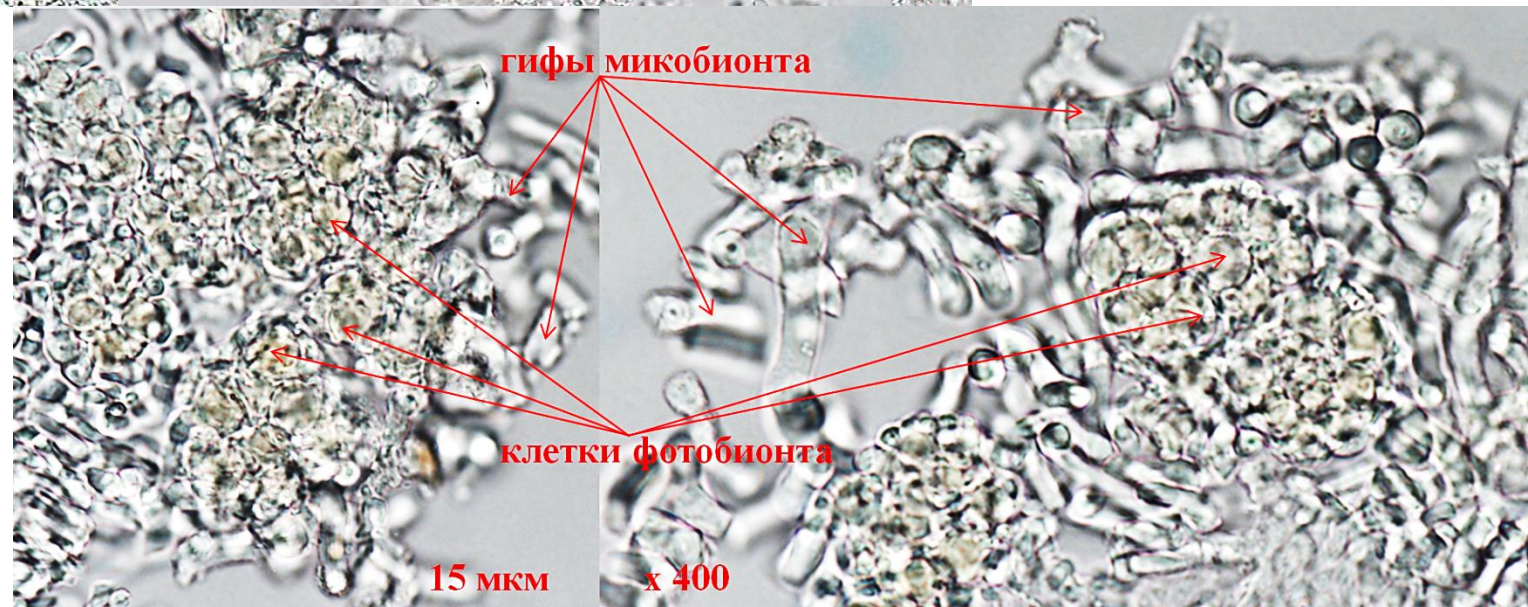
Collema

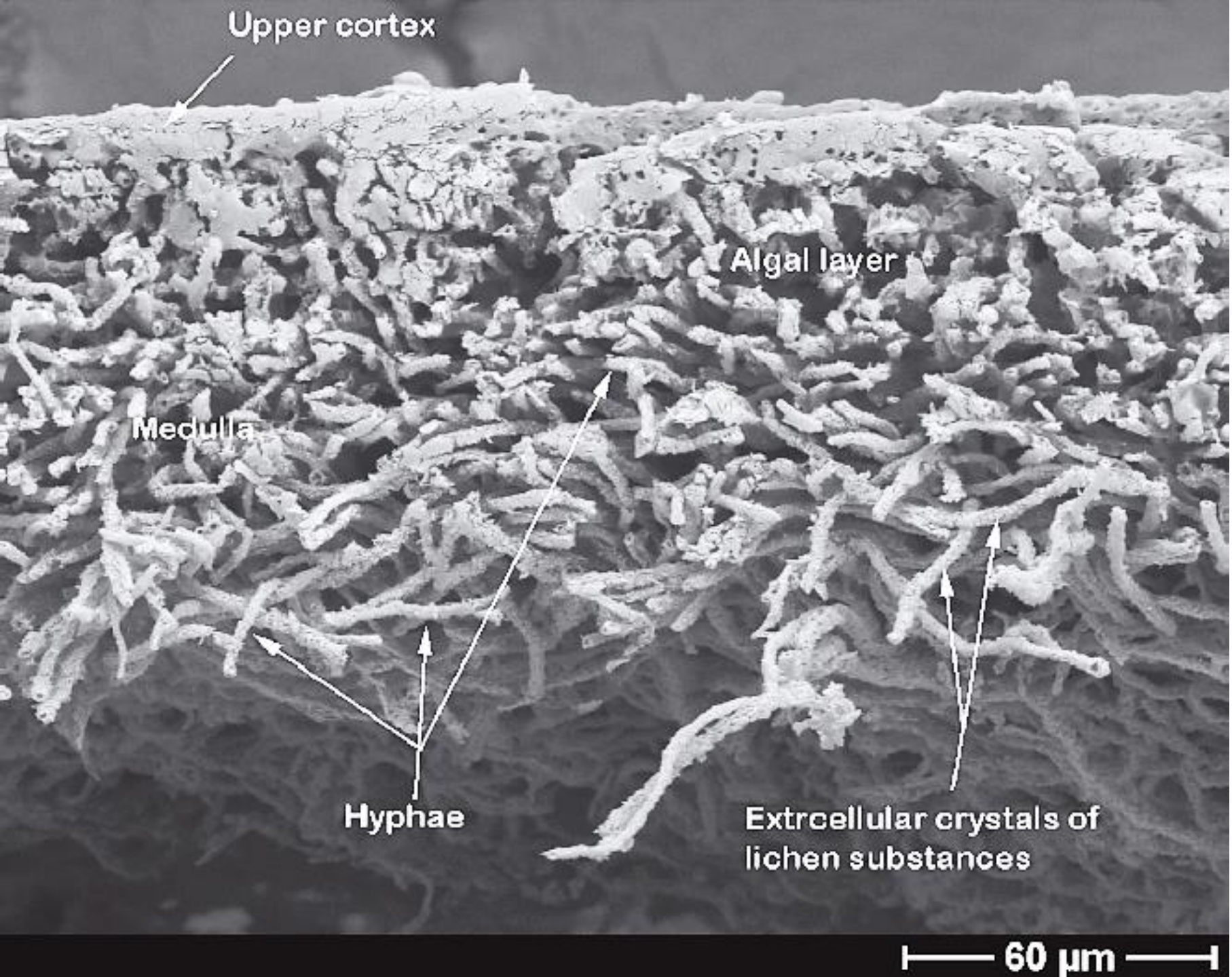


Гетеромерные и гомеомерные лишайники

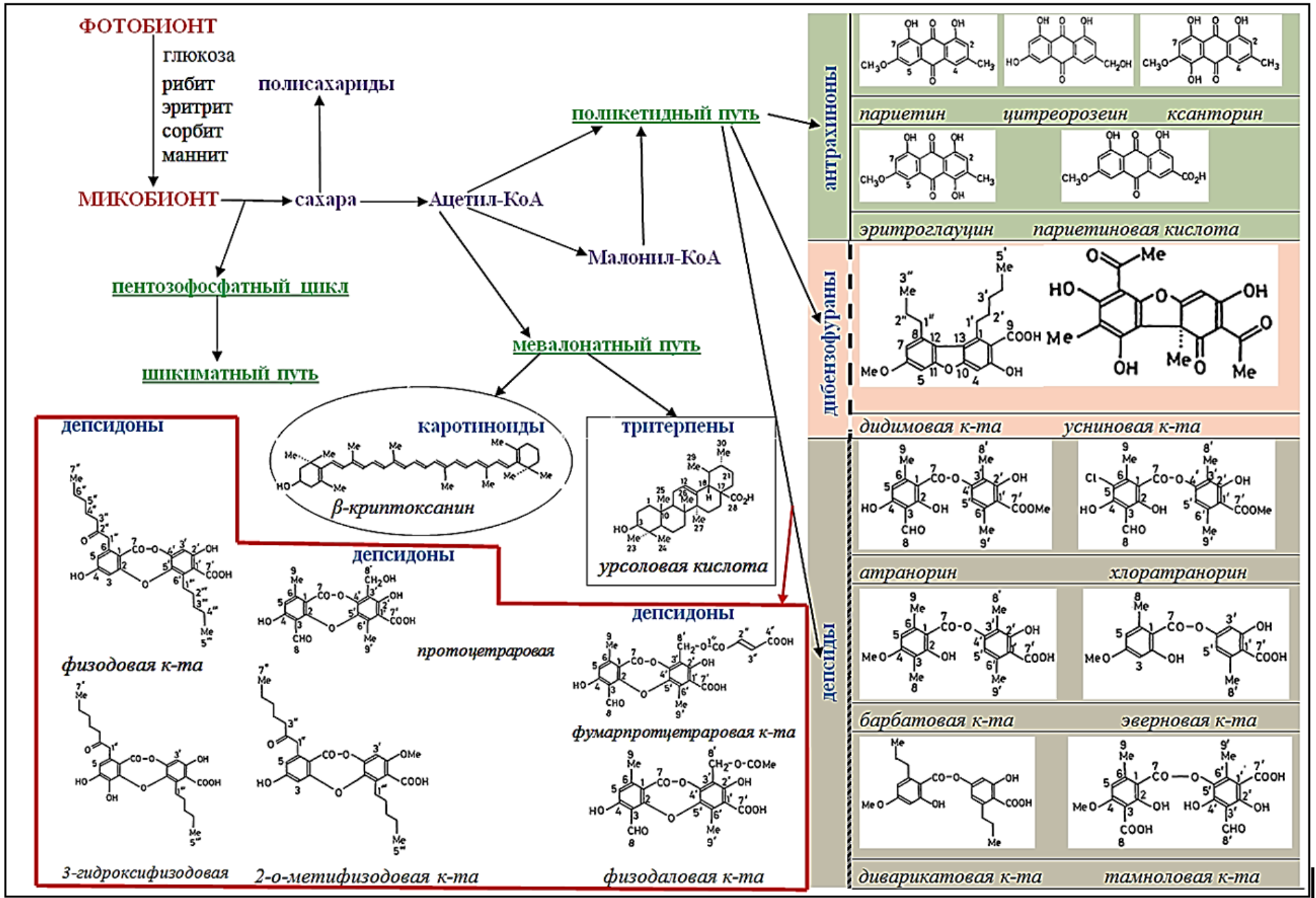

гонидиальный слой
верхняя кора
сердцевина
нижняя
кора
15 мкм; х 100


15 мкм; х 100
15 мкм; х 200
гонидиальный слой
кора
сердцевина

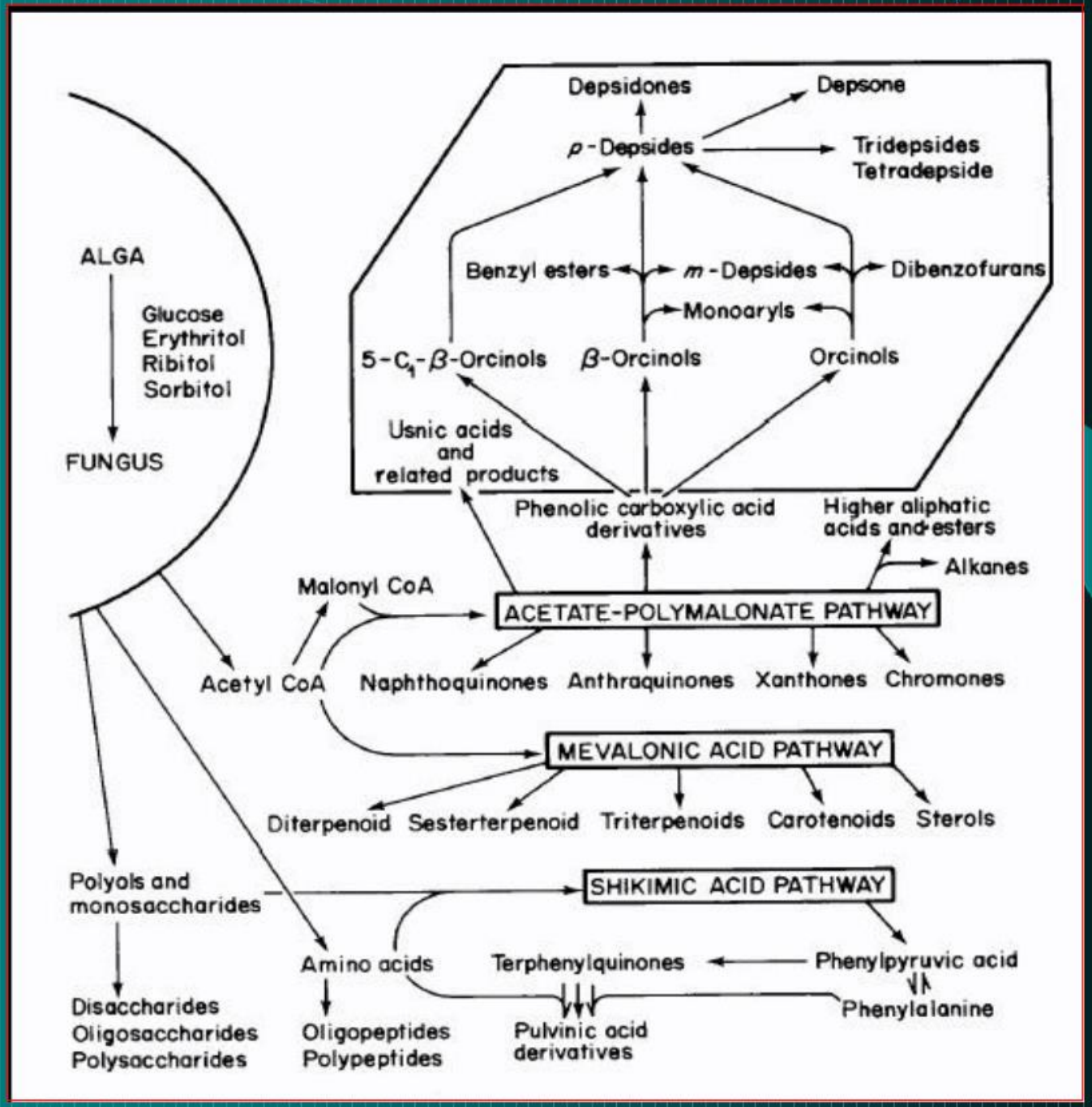

гифы микобионта
клетки фотобионта
15 мкм
х 400


Upper cortex
Algal layer
Medulla
Hyphae
Extrcellular crystals of
lichen substances
60 µm

Пути биосинтеза вторичных метаболитов лишайников



Secondary Metabolite Production in Lichens : The Important Pathways



Biochemical pathways of lichens

Polyketide Pathway

- Dibenzofurans
- Depsidones
- Depsides
- Depsones
- Xanthones
- Chromones
- Usnic acid
- Anthraquinones

Mevalonate Pathway

- Steroids
- Diterpenes
- Triterpenes

Shikimic acid pathway

- Pulvinic acid
- Terphenylquinones

Primary metabolites

Carbohydrates

Polysaccharide cell wall compounds
eg. lichenan, isolichenan

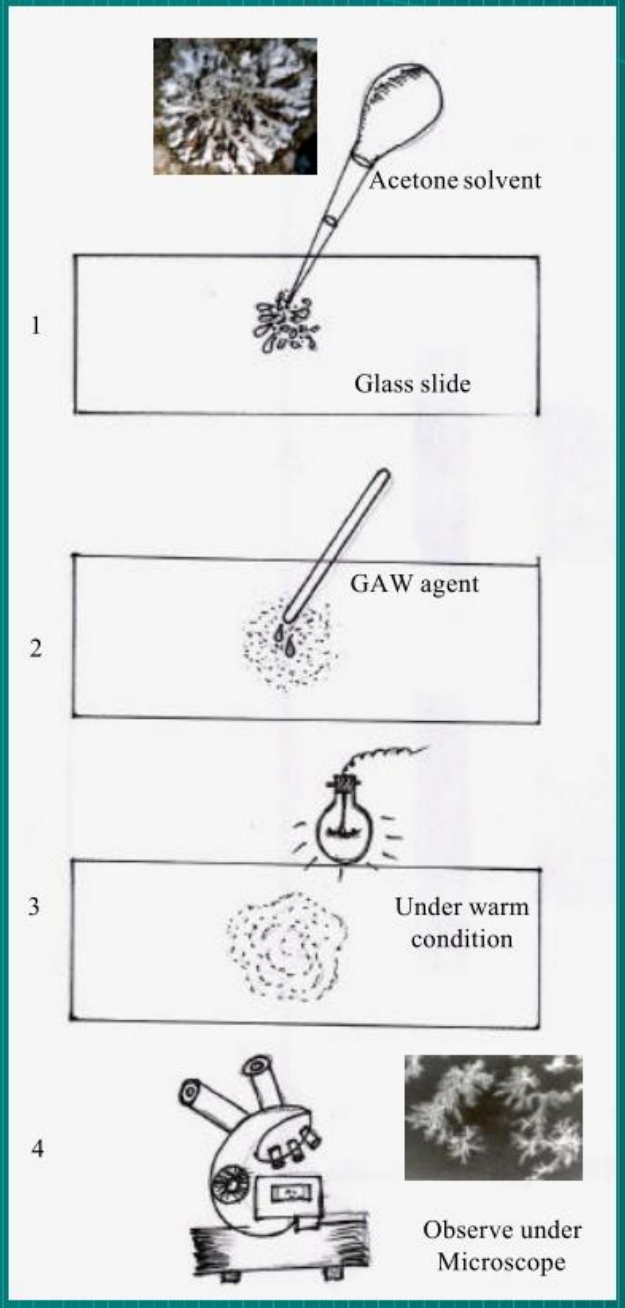
Proteins and Amino acids

Hydroproteins
Oligopeptides
Polypeptides

Fatty acids

Aliphatic acids
Lactonecarboxylic acid
Cycloaliphatic compounds

Microcrystal Test



1. Place a small fragment of the lichen thallus over a slide. Add few drops of acetone-leave to evaporate-remove the thallus fragments

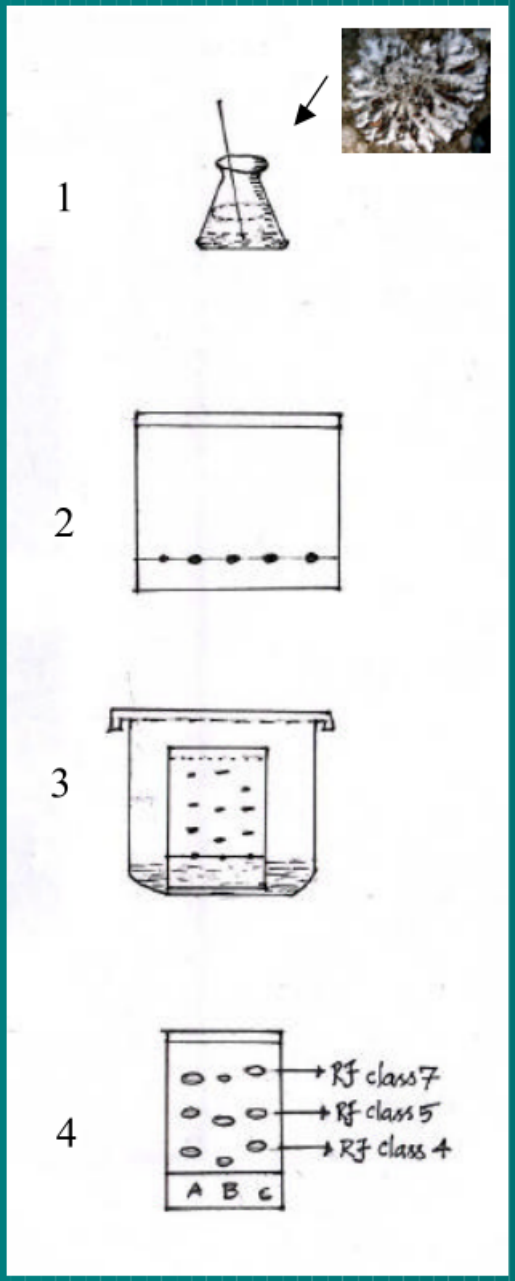
2. Add few drops of crystalization agent like GAW * to the residue

3. Keep the slide on a warm place

4. Place the cover slip and observe it under the compound microscope for crystal formation. Compare the crystal types with published literature for identification.

Acronym	Solvent mixer	Proportion
GAW*	Glycerol: ethanol:water	1:1:1
GE	Glycerol: acetic acid	1:3
An	aniline: glycerol: ethanol	1:2:2
$_{o}$T	o-toluidine: glycerol: ethanol	1:2:2
Py	pyridine: glycerol: water	1:3:3
Q	quinoline: ethanol: glycerol	1:2:2

Thin Layer Chromatography (TLC)



1. Extraction of secondary metabolite from the lichen thalli (minimal quantity) using acetone (50 ml) in a Conical flask/glass vial.

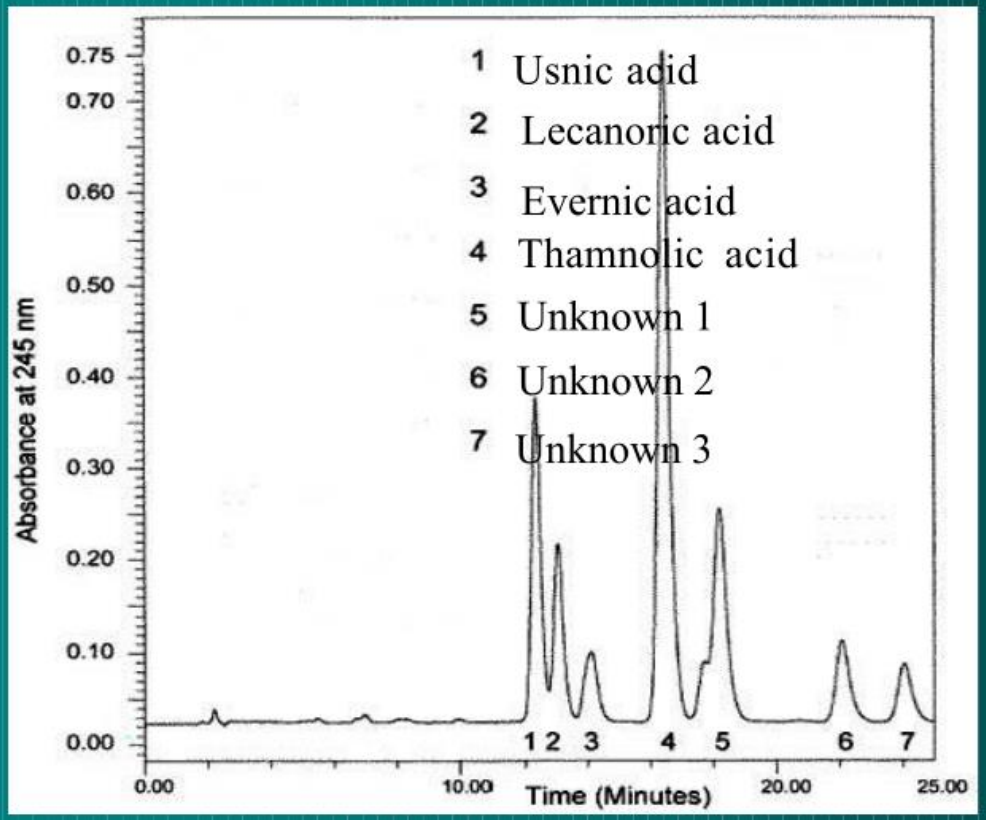
2. Using capillary tube load few drops of extract in acetone, and let the solvent of the extract evaporated (mark a loading line on the plate, 2cm from one edge of the plate).

3. Run the chromatogram in a suitable solvent system* in a TLC tank (use separate tanks for different solvent systems) until the solvent covers 90% of the plate.

4. Take the chromatogram out of the tank and evaporate the solvent. View the chromatogram and mark any coloured spots.

5.Note down the colour and Rf value of the spot. Compare with the standard and identify the compound.

Isolation of lichen compounds using High Performance Liquid Chromatography (HPLC)



Isolate warm Methanol Extract using Clean and dried lichen fragments.

Add standards (Benzoic acid and Anthracene internal solvent controls) and inject extract

Identify Compounds with retention index values (RI) calculated using standard Retention time (RT) values. Samples are collected using an automated fraction collector and absorption peaks graphically represented.

For HPLC a spectrophotometric detector operating at 254 nm with a flow rate of 1 ml/min is used.

Two solvent systems can be used: 1% aqueous orthophosphoric acid and methanol in the ratio 7:3 (A) and methanol (B).

Ecological functions of Lichen Secondary metabolites (Rundel, 1978)

Ecological function	Compound
Light-Screening (to protect photobiont from excess light)	Usnic acid, Parietin
Anti-herbivore defense	Pulvinic acid derivatives
Anti microbial	Usnic acid
Allelopathic (including antibiotic)	Psoromic, Lecanoric, Usnic and Gyrophoric acids

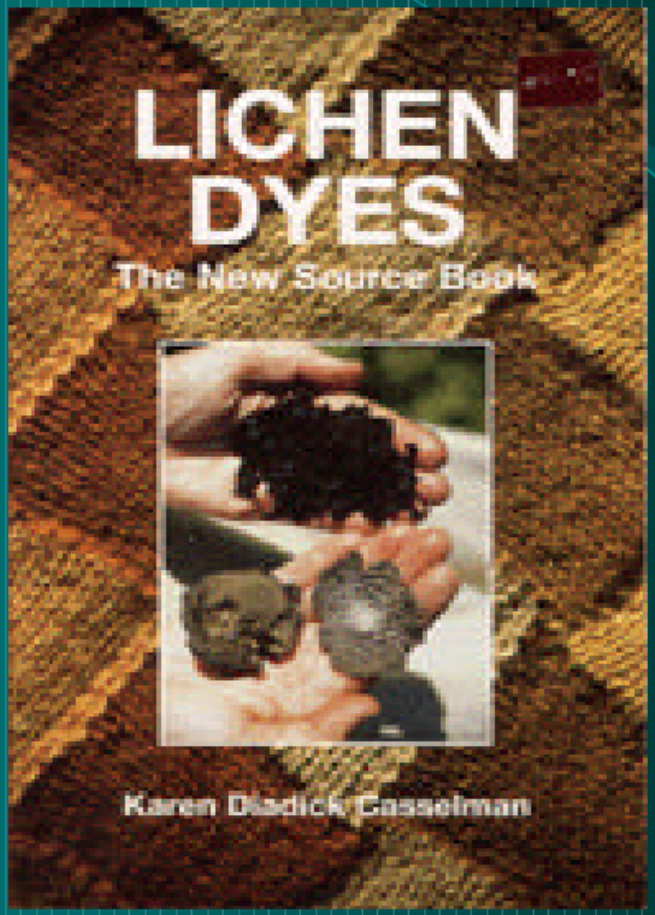
Economic importance of lichen secondary compounds

Dyes

Litmus

Perfumes

Medicines



http://www.dyeman.com/bbook4.GIF

«Лекарственные» лишайники

Цетрария исландская

Пармелия блуждающая

Эверния сливовая

Гипогимния вздутая

Lichen acids were the source of important dyes for cotton and wool in medieval Europe.

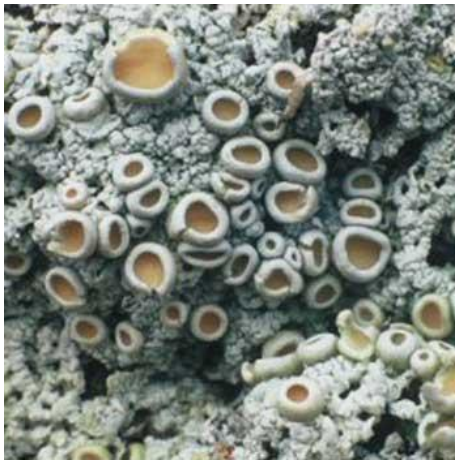
Two purple and red dyes, orchil and cudbear, were obtained from the lichens *Roccella* and *Ochrolechia*.

Lichen dyes were dissolved in human urine, and the yarns were immersed in this mixture.

Ammonia salts in the urine functioned as mordants to make the dyes permanent

«Красильные» лишайники

Roccella tinctoria



Ochrolechia tartarea

Parmelia omphalodes

Evernia mesomorpha

Parmelia sulcata

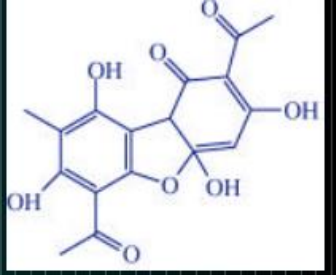
Xanthoparmelia camtschadalis

"Oakmoss lichen"
(*Evernia prunastri*)

This species is harvested commercially in south-central Europe, and then sent to France where it is used in the manufacture of fine perfumes.

The lichen acts as a fixative for other scents, and also adds a subtle herbal fragrance of its own.

Usnea spp.

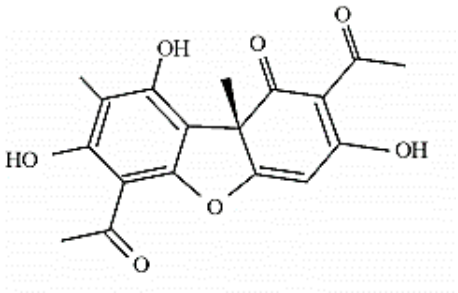


Antifungal, Antibacterial properties

Наиболее распространенные лишайники Гомельщины и их главные вторичные метаболиты

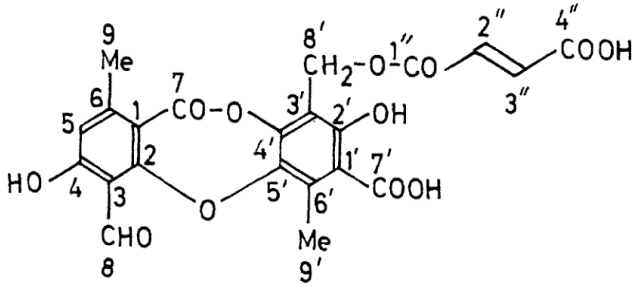
Cladonia arbuscula

Усниновая, фумарпротоцетраровая и урсоловая кислоты



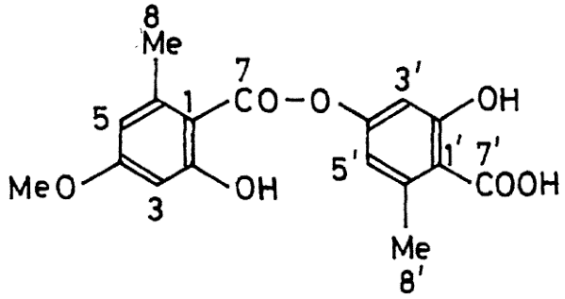
Cladonia cornuta

Фумарпротоцетраровая кислота



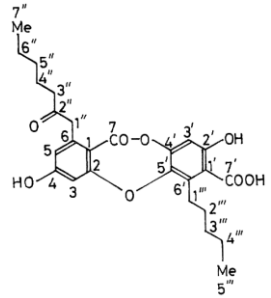
Evernia prunastri

Атранорин, усниновая, **эверновая** и салазиновая кислоты

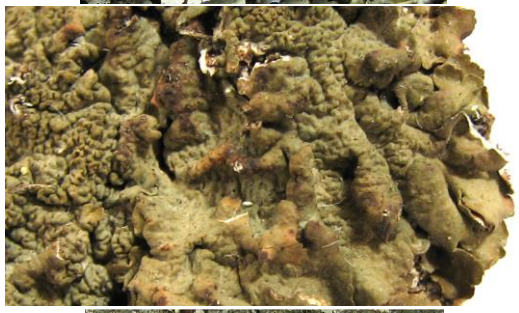


Hypogymnia physodes

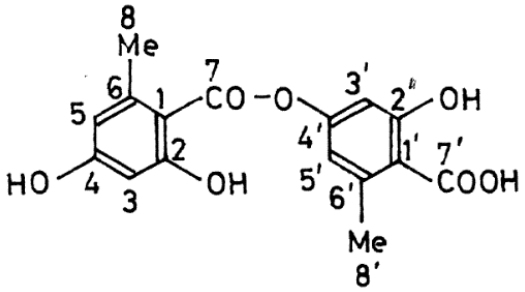
Атранорин, **физодовая** и физодаловая кислоты



Melanelixia glabra

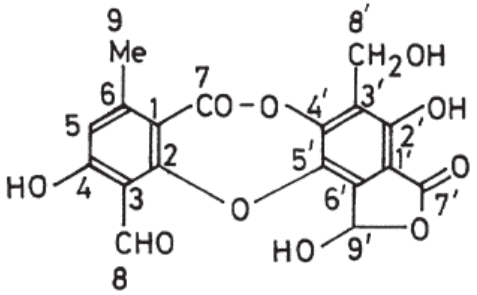


Леканоровая кислота



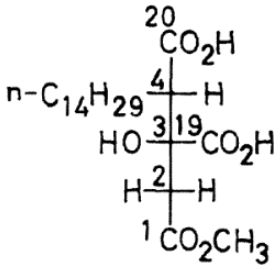
Parmelia sulcata.

Атранорин и **салазиновая** кислота



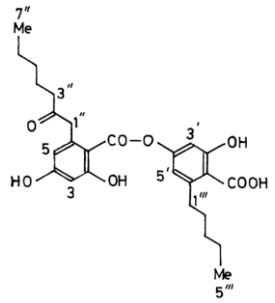
Platismatia glauca

Атранорин и **каператовая** кислота



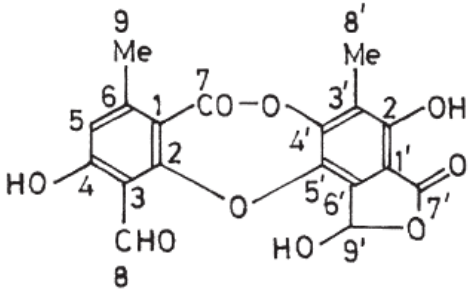
Pseudevernia furfuracea

Атранорин, физодовая и **оливеторовая** кислоты



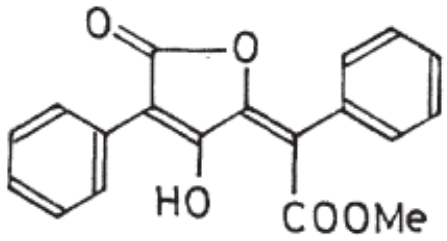
Usnea hirta

Усниновая и **норстриктовая** кислоты



Vulpicida pinastri

Усниновая, пинастриновая и **вульпиновая** кислоты



Xanthoria parietina

Париетин