Lesson 2: Division of the Bryophytes

Purpose of the lesson: To study the life cycles and morphological features of Bryophytes. To learn how to make a morphological description and determine their systematic position**.**

Initial level questions.

1. Brief characterisation of the department of Bryophytes, classification.
2. Morpho-functional characteristics, life cycle of representatives of the Bryophytes division using Marchansia polymorpha as an example.
3. Morpho-functional characteristics, life cycle of representatives of Mossy species on the example of Cuckoo Flax.
4. Morpho-functional characteristic, life cycle of representatives of Bryophytes division using Sphagnum as an example.
5. Distinguishing features of the life cycle of representatives of Bryophytes from the life cycles of other higher spore plants.
6. Significance of Bryophytes in medicine and national economy.

Instructions for the work

Herbarium: sphagnum moss, cuckoo flax, barnacle moss, live mosses.

Micro preparations: cross-section of stem of cuckoo flax moss, Marchantia archegonium, Marchantia anteridium, Marchantia sporogonium, Cuckoo flax sporogonium.

Tables: cuckoo flax, sphagnum moss, Marchantia polymorpha.

Equipment: microscope, stereoscopic microscope, magnifying glasses, dissecting needles, blades, tweezers, covers and slides, filter paper, distilled water.

Methodology for the work

Task 1. Structure of generative and vegetative organs of representatives of the class of Hepaticopsida, using Marchantia polymorpha as an example.

Examine the herbarium of Marchantia polymorpha. Using the tables, study, sketch and mark the external structure of Marchantia polymorpha. Record its systematic position in the workbook.

Study under the microscope the prepared microscope slide "Marschantia anteridium". The antheridium is oval in shape and sits on a short stalk. The membrane consists of a single layer of cells. Spermatogenic tissue develops in the cavity of the antheridium. Each cell of this tissue forms two spermatozoa. Sketch the anteridium of Marchantia.

Examine under a microscope the prepared microslide "Archaegonias of Marchantia". The archaegonia are in groups between the rays of the gametophyte

peduncle, hanging on very short, thin stems. Under a microscope, examine the structure of the archaegonia. Archaegonians in the mature state have a neck, in the centre of which a canal (for sperm to pass through it into the interior of the archaegonium) is visible. Behind the neck is the main part of the archaegonium, the abdomen, in which the ovule is visible. Sketch the marchantia archaegonium.

Examine under a microscope the micrograph "Marchantia sporogonii". Find the suction cup (gaustoria), the stalk and the spore sac (sporangium). Find elateres and spores in the spore sac.

Sketch the life cycle of Marchantia polymorpha using Figure 1. Mark that the dominant phase is the gametophyte phase and not the sporophyte phase as in other higher plants.

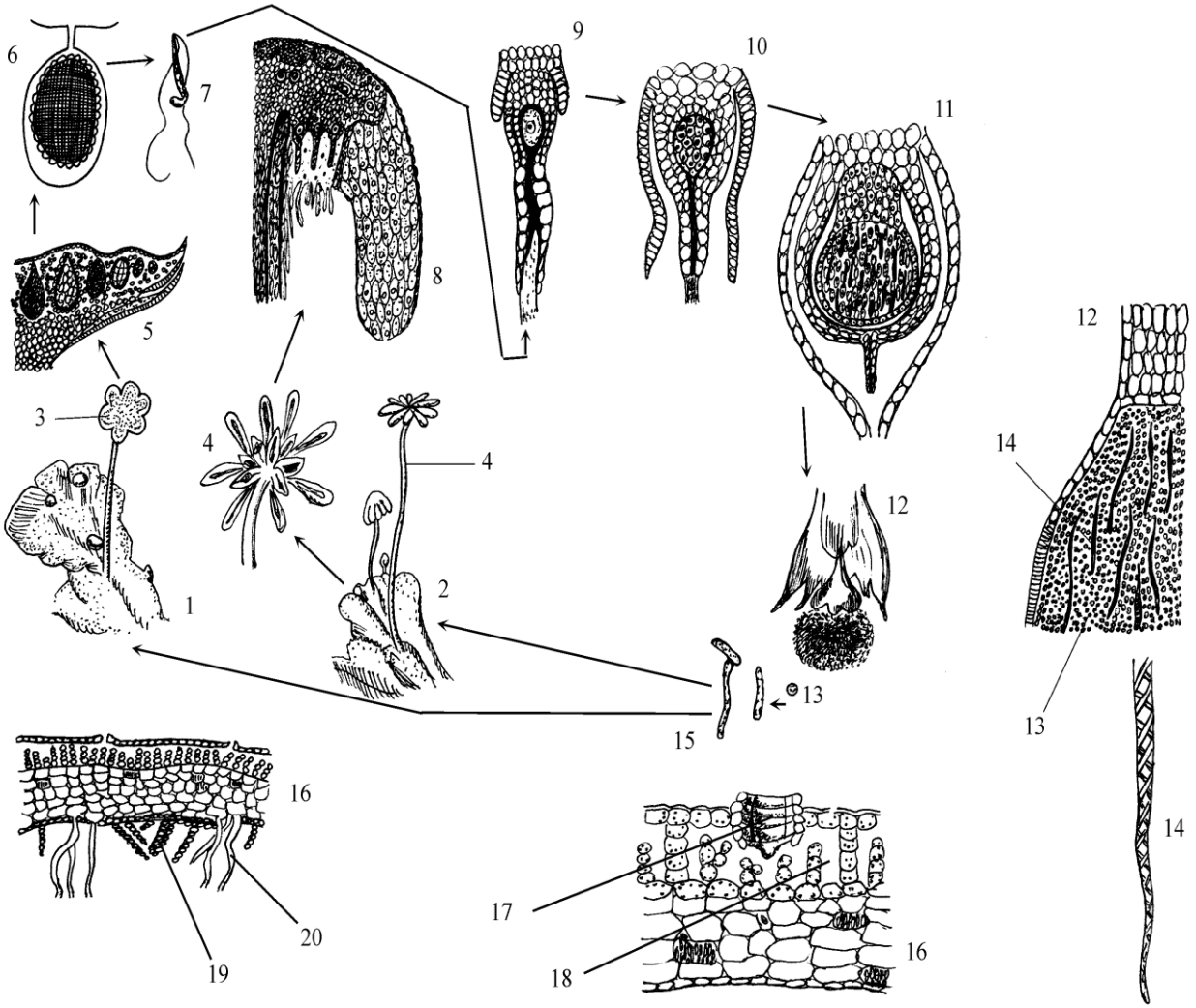

Figure 1. Life cycle of Marchansia (Orig.).
1 - male gametophyte, 2 - female gametophyte, 3 - male base, 4 - female base, 5 - transverse section of male base, 6 - anteridium, 7 - spermatozoon, 8 - section through female base, 9 - archaegonium, 10 - embryo inside archaegonium 11 - young sporophyte (sporogonium), 12 - opened sporogonium, 13 - spores, 14 -

elateria, 15 - spore germination, 16 - transverse section through thallus, 17 - stomata, 18 - air cavity, 19 - simple rhizoids, 20 - reed rhizoids.

Task 2. Structure of vegetative and generative organs of representatives of the class Green mosses, order Brias mosses, using Cuckoo flax (Polytrichum commune) as an example.

Examine the herbaria of Cuckoo flax. Draw attention to the fact that sporogonies are not formed in every gametophyte plant. Plants with sporogoniums have green "leaves" on their crowns, plants without sporogoniums sometimes have green and sometimes brown leaves. Plants with brown leaves on top are male gametophytes and those with green leaves are female.

Archaegonias and anteridia in Brium mosses are not located on special organs, as in Marchantia, but between the upper leaflets. The archaegoniums differ little in structure from the archaegoniums of Marchantia. The anteridia differ much more.

Examine the microslide "Cuckoo flax anteridia". On the upper part of the gametophyte find brown leaflets, at the base of which are elongated dark purple anteridia filled with spermatogenous tissue. On the other side of the antheridium are always light-coloured leaflets, which do not bear antheridia at the base. These are the paraphyses and have a protective function.

Examine the prepared microslide "Cross-section of the stem of the moss Cuckoo Flax" under low magnification of the microscope. Two main parts can be distinguished in the stem: the bark, the peripheral part, and the conductive, the central part. Under high magnification, the bark part is composed of covering tissue, parenchyma and mechanical tissue, while the conductive part consists of tissues resembling phloem and xylem.

Sketch the preparation and identify all the tissues.

Examine the permanent microslide of Cuckoo Flax Sporogonium. The sporogonium is the foot, the lower part, attached to the apex of the stem of the female gametophyte. From the foot, a long, slender stalk emerges, on top of which is the sporangium (spore sac). The structure of the sporangium is rather complex. The base of the sporangium, where it is attached to the stalk, is called the apophysis. The sporangium itself is cylindrical and consists of a capsule (urnose), the spore sac itself and a lid (operculum). Under the cap is a thin, filmy membrane, the epiphragm. At its border with the capsule there is a special device for dispersing spores, the peristome. Inside the capsule there is a column to which the spore sac is attached. The entire sporogonium is often covered by a cap (calyptra) formed from the sprawling tissues of the archaegonium. It subsequently flaps off (Figure 2).

Sketch the sporogony of Cuckoo flax and mark all its parts.

Sketch the life cycle of Cuckoo flax. Compare it with the life cycle of Marchantia. Find the similarities and differences.

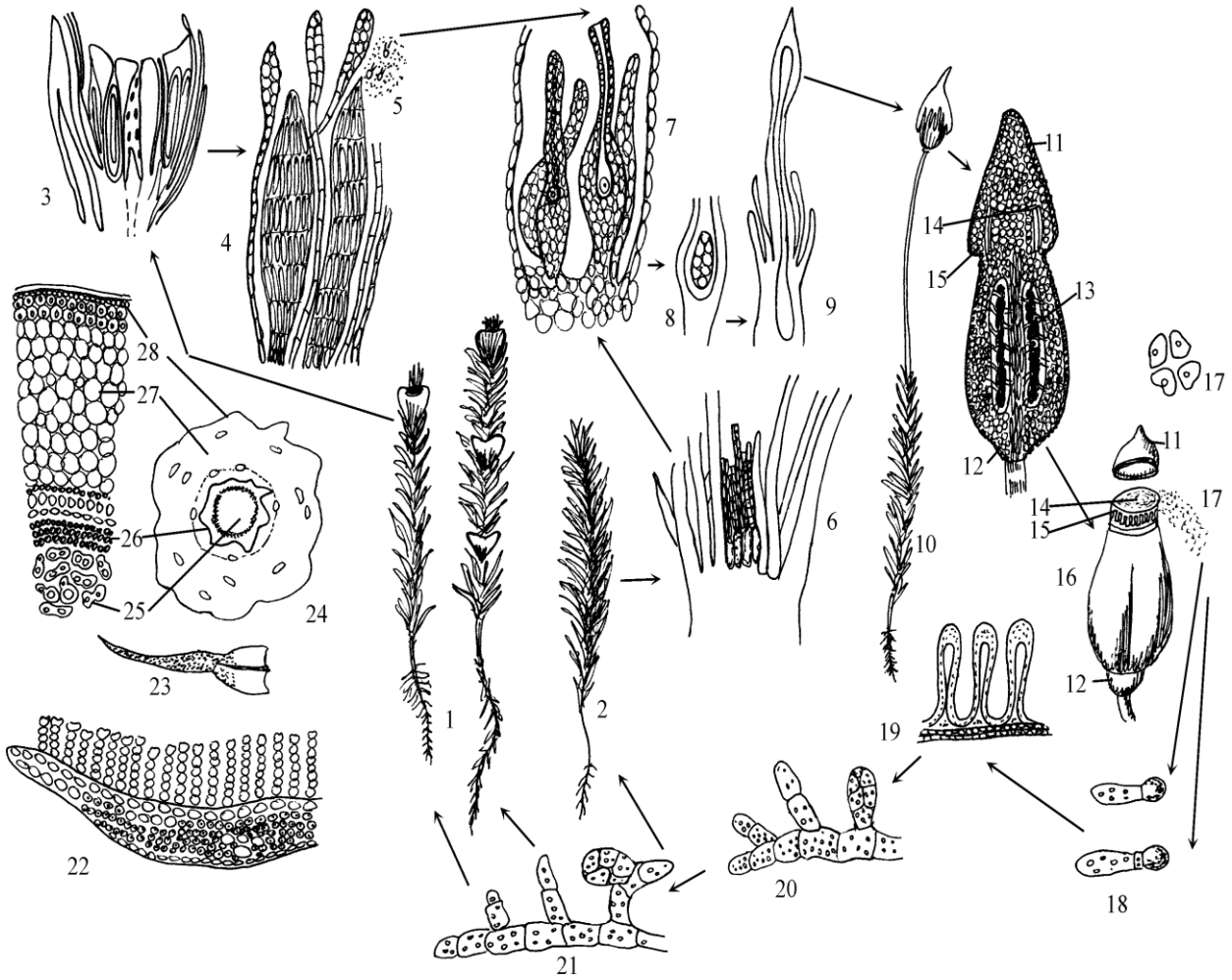

Figure 2: Life cycle of the moss Cuckoo flax (Orig.).
1 - male gametophyte, 2 - female gametophyte, 3 - apex of male gametophyte, 4 - anteridia, 5 - spermatozoa, 6 - apex of female gametophyte, 7 - archaegonia, 8 - embryo formed from zygote in archaegonia, 9 - developing sporogon, 10 - female gametophyte with mature sporogon (sporophyte) 11 - lid, 12 - apophysis, 13 - spore sac, 14 - epiphragm, 15 - peristome, 16 - spore dispersal, 17 - spores, 18 - germinating spores, 19-21 - protonema development, 22-23 - leaf structure, 24 - stem transverse section, 25 - hydroids, 26 - leptoids, 27 - bark, 28 - epidermis.

Task 3. Study Green Mosses, Sphagnum mosses with the example of Sphagnum.

Study the herbaria of sphagnum. Note the similarities and differences with bryophyte mosses.

Study the anatomical structure of the leaves of the sphagnum moss. To do this, place a leaf (not to be confused with a twig) of sphagnum moss in a drop of water on a slide. Cover with a coverslip.

Examine the prepared temporary preparation under a microscope. The entire leaf has a single layer of cells. Some cells are attached to each other only by their ends. They are very narrow, elongated in one direction, green in colour from the chloroplasts located in them. These cells form a relatively regular network of the

assimilation part of the leaf. The cells of this network are colourless. Each cell is filled with one large cell devoid of contents. In the middle of this cell a through large pore is visible. Spiral thickenings can be seen across the cell, preventing the cell membranes from contracting. These are water-bearing cells that make sphagnum hygroscopic. When dry, they are filled with air, which is why dried peat moss has a white colour (Figure 3).

Sketch the structure of a sphagnum leaf and mark: chlorophyll-bearing cells, hyaline cells - large, dead, colourless.

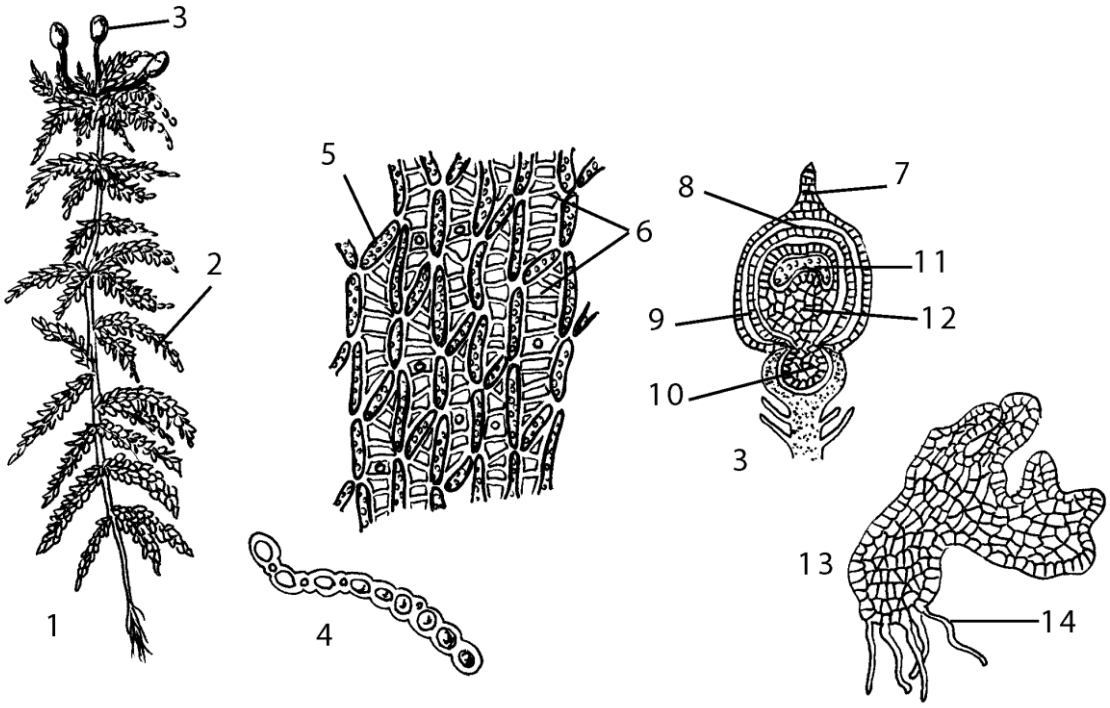

Figure 3. Peculiarities of gametophyte and sporophyte structure of Sphagnum mosses by the example of Sphagnum (Orig.).

1 - gametophyte, 2 - gametophyte branch with leaves, 3 - sporogonium (it emerges above gametophyte on the apical branch), 4 - leaf section, 5 - leaf chlorophyll-bearing cells at high magnification, 6 - water bearing (hyaline) cells of leaf at high magnification, 7 - operculum, 8 - capsule, 9 - urnose, 10 - apophysis, 11 - sporangium (spore sac), 12 - column, 13 - protonema, 14 - rhizoids of protonema.