

## Spore Germination and Thallus Development in Porella

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### AN ABSTRACT

Since no extensive account of spore germination in the leafy liverworts exists, this study was undertaken as preliminary to a comprehensive publication on the life history of *Porella*. Living plants of this genus were secured from the vicinity of Corvallis, Oregon, at regular intervals during the winter and spring of 1937. Judging from the large spores which may attain a diameter of nearly 90 microns, the species under consideration is *Porella navicularis* (Lehm. et Lindenb.) Lindb. When planted, the green, echinulate spores sink to the bottom of the modified Beyerinck's nutrient solution which serves as the growing medium. Even if submerged in several millimeters of nutrient solution, the spores germinate readily when the containing culture dish was placed in diffuse light in a moderately heated room. Tips of *Porella* plants with adhering or imprisoned germinating spores were embedded in paraffin and sectioned at five to seven microns.

According to Herzog,<sup>4</sup> *Porella* (Madotheca), *Pellia*, *Conocephalus* (Fegatella), *Androcryphia*, and *Dendroceros* have multicellular spores at the time they are shed from the sporangium. Goebel<sup>3</sup> discusses spore germination in all of these genera briefly and mentions that *Porella* and *Frullania* germinate much like *Pellia*, but states specifically that the spore of *Porella* undergoes cell division after its dispersal. This is true of *Porella navicularis* since a one-celled spore was found in a dehiscent capsule. Whether the spore was a product of the capsule in which it was found or whether it originated in another capsule, could not be ascertained. In either case, the fact remains that this ungerminated spore was found in a capsule which had shed most of its spores. In this investigation all closed capsules have been found to contain uninucleate spores.

The manner of spore germination can be illustrated by a spore which was accidentally caught in an archegonial involucre surrounding the base of a mature sporophyte. Serial paraffin sections revealed that this spore had germinated to form approximately 16 cells, all within the spore wall. Judging from its location and prominence, the first wall divided the one-celled spore into a two-celled gametophyte. Subsequent walls usually form at right angles to the preceding one. In some instances, however, walls form which are radial with respect to the whole thallus. Such cells appear triangular in section and resemble to some extent the pyramidal apical cell of an adult plant. However, these triangular cells are not visibly different from the other cells of the thallus.

As early as 1862, Hofmeister<sup>5</sup> described spore germination in *Radula complanata*. The sequence of wall formation closely resembles that of *Porella* except that the young thallus appears to be a plate of cells and not a sphere.

During early thallus development, the spore wall has retained its outward appearance. Although the cells of the gametophyte have increased in number, they occupy a space essentially that of a mature spore.

Median sections of a spore or of a young gametophyte show a wall of two layers. The third layer of the spore wall as described by Goebel<sup>2</sup> was not distinguishable in the mature spore. Continued cell development of the thallus finally exerts enough pressure to rupture the spore coats. Parts of the thallus, which commonly are the apical end and the primary rhizoid, protrude from the spore wall. The number of rhizoids in *Porella* sporelings varies from none to two, when young rhizoids contain numerous plastids which disappear with age.

When a thallus consists of approximately 50 cells, a definite apical region with a distinct apical cell has been differentiated. In those thalli with a single rhizoid the apical cell may be diametrically opposite the rhizoid or inclined at an angle of 90 degrees from the rhizoid. This apical region is the source of all "leaves" and branches. Differentiation of a ventral leaf or amphigastrium was observed to take place before the lateral (dorsal) leaves made their appearance. When apparent, the lateral leaves are not yet differentiated into lower and upper lobes. This differentiation occurs later. Goebel<sup>2</sup> has figured a young thallus of *Porella* which is older and already has several sets of leaves. No other illustrations of *Porella* in the process of spore germination have been found in the literature.

Once the apical cell has given rise to additional cells which in turn differentiate into axis, leaves, and branches, the pattern of the plant is established. It can perpetuate itself by means of apical growth indefinitely.

It is noteworthy that in *Porella navicularis* as well as in most of the leafy liverworts in which germination studies have been made by Goebel<sup>3</sup> (*Lejeunea*, *Polyotus*, *Frullania*, etc.), no filament is formed in spore germination. Campbell<sup>1</sup> also points out that in *Porella* the formation of a filament in early thallus development is completely suppressed. The development of a spherical thallus may be to the advantage of such plants as *Porella* since, as Goebel<sup>3</sup> suggests, a compact group of cells probably can withstand alternate wetting and drying better than a filament of cells.

#### LITERATURE CITED

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