

CHAPTER 2-4

BRYOPHYTA – TAKAKIOPSIDA



Figure 1. Hunting for *Takakia* in its typical damp, high elevation or foggy habitat. Photo with permission from <<http://www.botany.ubc.ca/bryophyte/LAB8.htm>>.

Phylum Bryophyta

Bryophyta, *sensu stricto* (in their narrowest sense), are the mosses. These comprise, roughly, 13,000 species worldwide (Crum 2001), but with many tropical taxa likely to be as yet undiscovered, the number could be much higher. Three classes have been recognized traditionally, the **Bryopsida**, **Andreaeopsida**, and **Sphagnopsida** (Crum 1991). However, as more evidence from genetic and biochemical relationships have become available, and the interesting genus *Takakia* has produced sporophytes in our presence, further division seems justified. Buck and Goffinet (2000) define six classes: **Takakiopsida**, **Sphagnopsida**, **Andreaeopsida**, **Andreaebryopsida**, **Polytrichopsida**, and **Bryopsida**. Recent cladistic analyses using morphological, developmental, anatomical, ultrastructural, and nucleotide sequencing data supports placement of these classes into a single phylum (Newton *et al.* 2000).

Class Takakiopsida

Takakia seems to be among the most primitive of mosses, possessing many characters similar to those of the liverworts, and is the only known genus of its class, having two species. Its **leaves in groups of fours**, often fused at the base (Figure 4, left), made it immediately stand out as unique. When it was first discovered high in the mountains of Japan, Sinske Hattori sent it to specialists around the world. The phycologists looked and decided it was not one of theirs, and eventually it produced multicellular archegonia, supporting their claim. The pteridologists concluded it was not a reduced fern, nor a lycopod or other vascular cryptogam. It seemed the more likely choices were mosses and liverworts. Although its 3-dimensional structure seemed a bit out of place, it seemed most like a liverwort, and there it stayed for several decades (Hattori & Mizutani 1958). But eventually, its **slime papillae**, its **leaves in 3 rows**, its **simple oil bodies** – not granular as in liverworts, its **archegonia** sometimes on a **pedestal**, and its archegonial **neck cells in 6 vertical rows** began to raise questions. Its chromosome number was 4 or 5, unlike the typical 10 in liverworts and even higher numbers in most mosses.

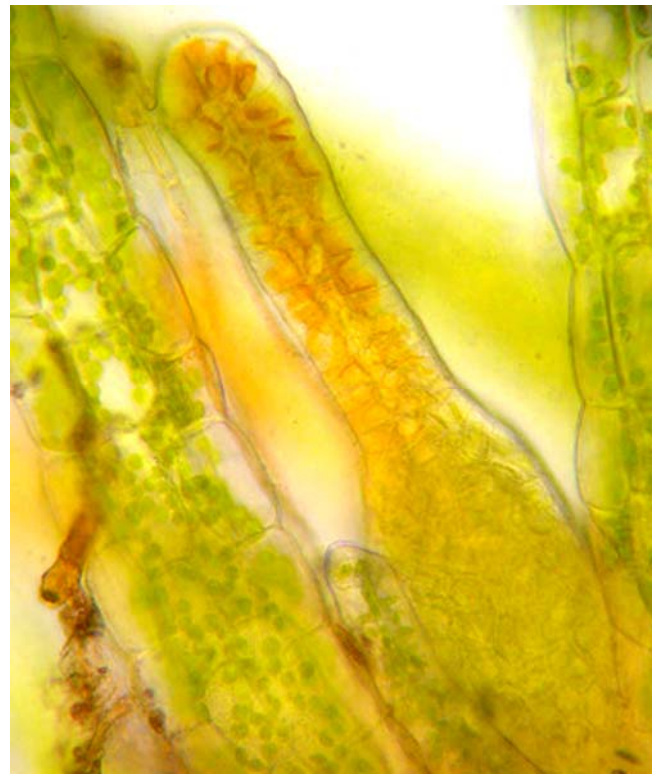


Figure 2. Archegonium of *Takakia lepidozoides*. Photo with permission from <www.botany.ubc.ca/bryophyte/LAB8.htm>.

Then, at one of its former collection sites, it produced capsules (Smith 1990; Smith & Davison 1993)! And there was the proof. Although not too distant from a liverwort capsule, it **dehisces spirally** in a single valve (Figure 4, right), and **no elaters** emerged. Indeed, aside from its **filamentous, divided leaves**, it had much in common with *Andreaea*, a moss. The spiral line of dehiscence splits and twists, creating a more efficient spore dispersal (Higuchi & Zhang 1998).



Figure 3. Slime papilla of *Takakia lepidozoioides*. Photo with permission from <http://www.botany.ubc.ca/bryophyte/LAB8.htm>.

In trying to resolve the phylogenetic position of *Takakia*, Schuster (1997) referred to it as "one of a handful of isolated and unique plants." It is like the Monocleales of the liverworts in its longitudinal suture of the capsule and its "feeble conducting strand" of the sporophyte. Its lobed leaves are like those in the Jungermanniales of the liverworts. The leafless horizontal stolons, slime papillae, massive secretions of mucilage, orange antheridia nestled among leaves of all three rows (Figure 4, middle), and absence of rhizoids are characters like those of the Calobryales among the liverworts. Its capsule with 3-4-5 layers and thickened epidermal cells with thin inner cells and its absence of stomata and air spaces resemble *Symphogyna* in the Metzgeriales, also a liverwort.

But it clearly has moss characters as well. The calyptra ruptures distally and is carried by the sporophyte on an elevated capsule. The capsule differentiates and sporogenesis occurs after the seta elongates. The sporophyte is persistent, and the capsule lacks elaters but has a "feeble" **columella** (mass of sterile tissue in center of capsule). Hence, as is often the case in the bryophytes, the gametophyte and the sporophyte tell different stories. In this case, the gametophyte is most like the Marchantiophyta, but the sporophyte is clearly more like members of the Bryophyta. Looking so much like a liverwort, yet also much like a moss, this apparently primitive plant seems an appropriate link between these two major groups.



Figure 4. *Takakia lepidozoioides*. **Left:** vegetative plant showing filamentous leaves. **Middle:** leafy plant with capsule. **Right:** dehiscing capsule showing spiral split and exposed spores. Note single suture that splits, hence a single valve. Photo permissions on left from www.botany.ubc.ca/bryophyte/LAB8.htm; photo in middle from website of the Hattori Botanical Laboratory; photo on right from Ken McFarland, Mosses website.

Summary

Bryophyta can be considered to have six classes: **Takakiopsida**, **Sphagnopsida**, **Andreaeopsida**, **Andreaebryopsida**, **Polytrichopsida**, and **Bryopsida**. **Gametophores** of Bryophyta, including Takakiopsida, produce **archegonia** and/or **antheridia** and the **embryo** develops within the archegonium.

In **Takakiopsida**, as in all Bryophyta, **sporophytes** remain **attached** to the gametophyte and produce **spores** by **meiosis**. Bryophyta, hence Takakiopsida, produce spores from the sporophyte only once. Takakiopsida have **capsules** that split spirally into valves.

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I appreciate the comments and suggestions of Karla Werner, who offered a beginner's perspective. Noris Salazar Allen offered constructive criticisms on the taxonomic descriptions and helped with the proof reading.

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