

A large, dense bush of flowering azaleas in shades of purple and pink, set against a background of green foliage. The flowers are in full bloom, creating a vibrant display of color. The text "Erikoidní mykorrhiza" is overlaid on the image in a black serif font.

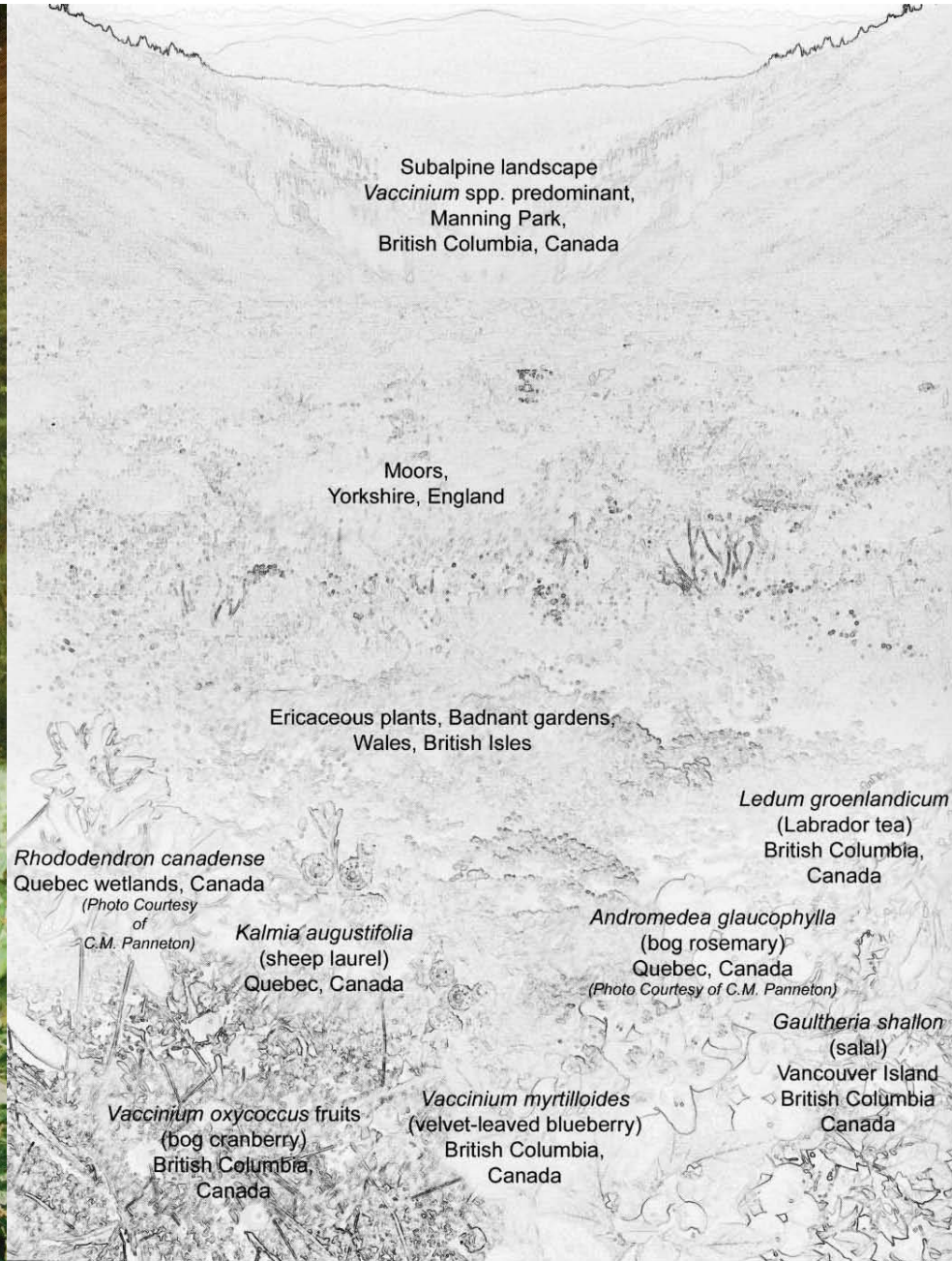
Erikoidní mykorrhiza

Erikoidní mykorhiza

- je vedle AM a OM třetím nejdůležitějším typem endomykorhizy na Zemi
- charakteristická pro stanoviště s vysokými C/N a C/P poměry v půdě
- většina zástupců řádu Ericales
- ca 140 miliónů let stará symbióza

Erikoidní mykorrhiza (ErM)

- taxony hostitelských rostlin
- taxony mykorrhizních hub
 - základní biologická charakteristika
- mykorrhizní struktury
 - smyčky a klubička v epidermis jemných kořenů
- (fungování EKM)



Hostitelské rostliny

- řád Ericales, čeled' Ericaceae (Empetraceae, a Epacridaceae řazeny pod Ericaceae)
 - rody *Calluna*, *Erica*, *Rhododendron*, *Vaccinium*, *Ledum*
 - blueberries and cranberries
 - jemné kořeny (hair roots), rhizodermis bez rhizinů, velmi redukovaný kortex (často jednovrstevný, sekundárně netloustnou)
 - erikoidní + monotropoidní (mykoheterotrofní *Monotropa hypopitis*) + arbutoidní mykorhizy (rody *Arbutus*, *Arctostaphylos*) hostitelé

Hostitelské rostliny

- rašeliniště, vrchoviště, subalpinská a alpinská flóra
- Epacridaceae: rašeliniště a (kyselé) písčité pláně

Mykorrhizní houby

- poměrně malý počet druhů
- odd. Ascomycota, řád Helotiales
 - voskovička vřesovcová (*Rhizoscyphus ericae*)
 - *Meliniomyces* sp.
 - *Oidiodendron* sp. (anamorfní rod)
- saprotrofové, snadno kultivovatelní
- produkce lytických enzymů
- kolonizují i rhizoidy jätrovek

Mykorhizní houby

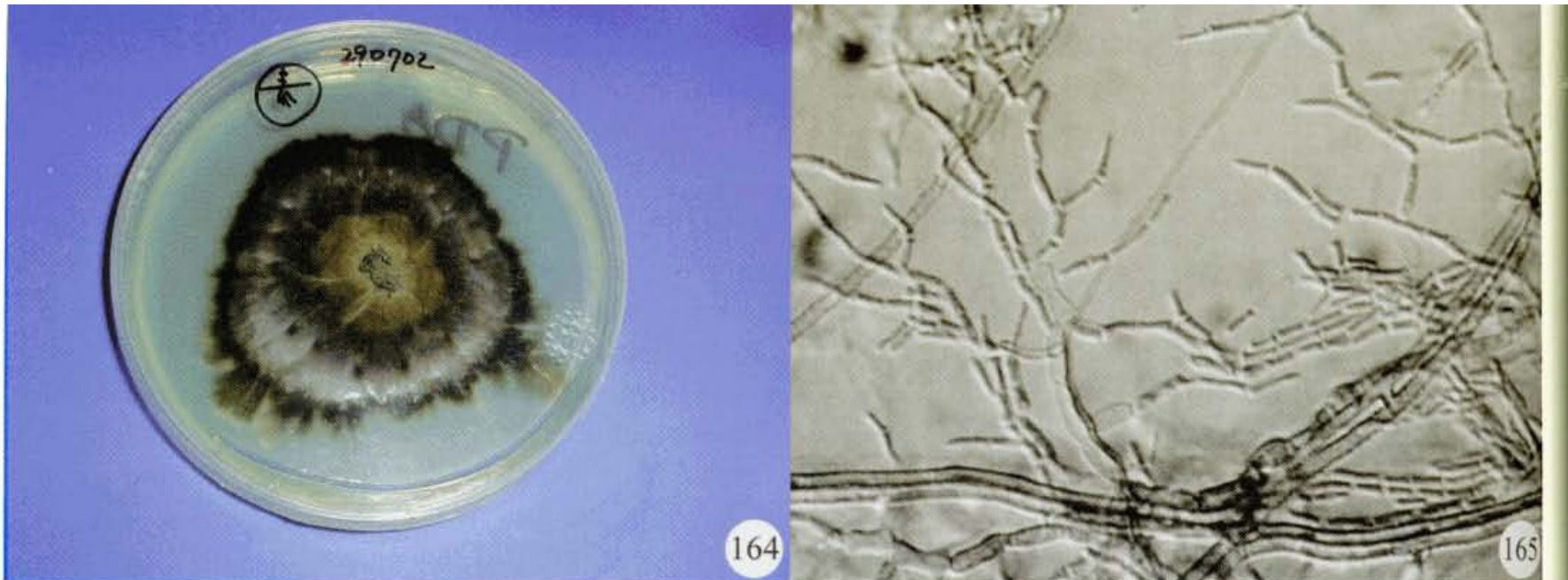


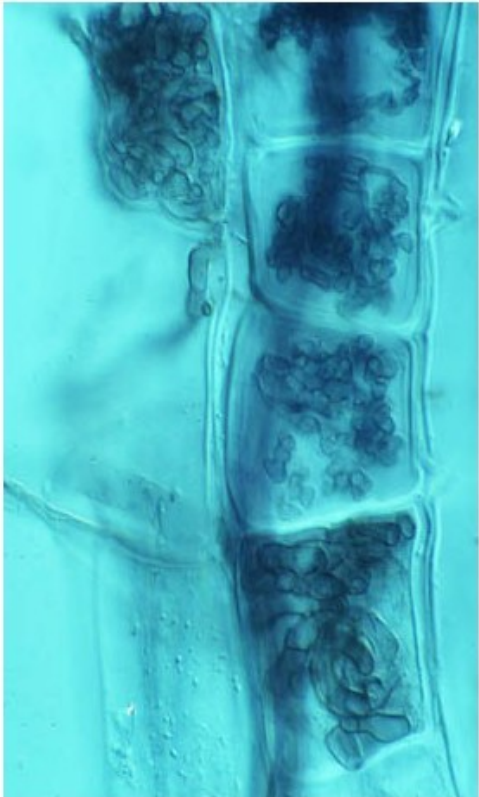
Figure 164. Culture of *Hymenoscyphus ericae*.

Figure 165. Arthroconidia (asexual propagules) of *Scytalidium vaccinii* (the anamorph state of *Hymenoscyphus ericae*). Photo from Hambleton and Currah. *Can. J. Bot.* 75: 1570–1581 (1997).

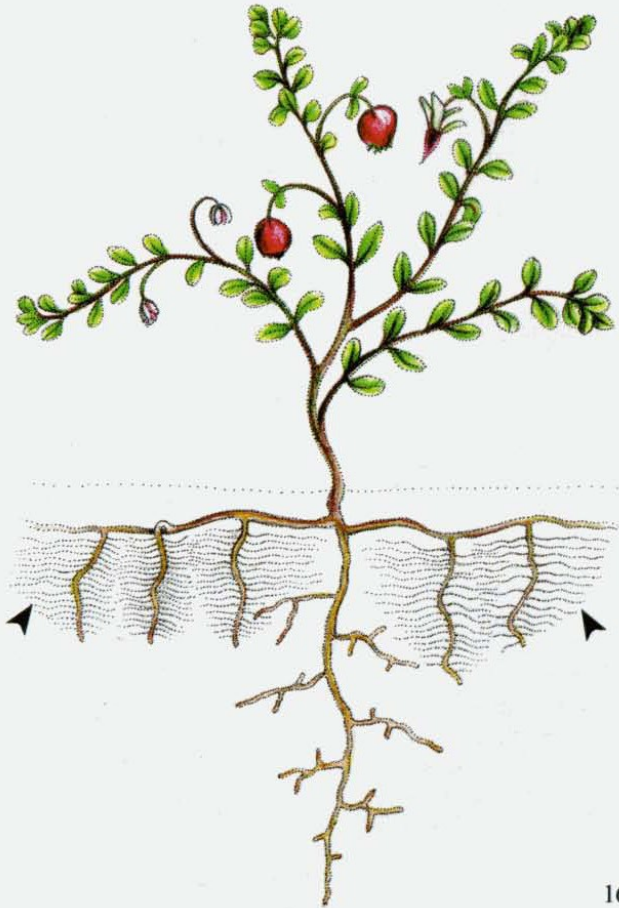
Figure 161. Diagrammatic representation of an ericoid species with numerous hair roots (arrowheads).

Figure 162. Diagram of a transverse section of a hair root showing enlarged epidermal cells (E) with a thickened outer tangential wall, one layer of cortex (C), an endodermis (En), a few xylem tracheary elements (X), and a few phloem cells (P).

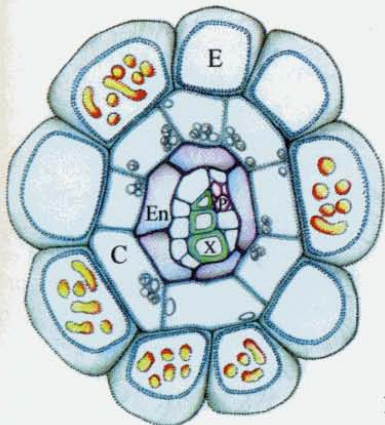
Figure 163. Diagram of epidermal cells showing entry of fungal hyphae through the thickened wall (arrowhead), hyphal complexes (HC), and a narrow hypha (double arrowhead) connecting adjacent epidermal cells.



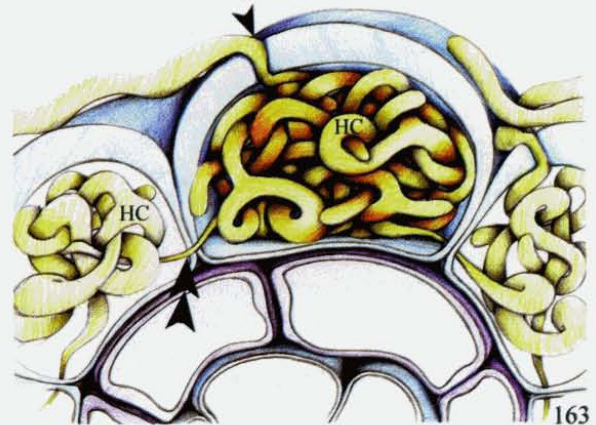
LS of a fine root of *Leucopogon juniperinum*. The fungus forms coils in each colonised cell from a single penetration point on the outer surface. (Photo of A. Ashford)



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Mykorhizní struktury

- Smyčky a klubíčka hyf
 - převážně v epidermis
 - někdy každá buňka samostatná infekční jednotka
 - velmi krátká životnost klubíček (několik týdnů), poté kolaps podobný „stravování“ klubíček hyf u orchideoidní mykorhizy
 - přitom neuvažována trofická (mykoheterotrofní) role tohoto procesu!
- ERM

Figure 166. Dark septate fungal endophytes (arrowheads) in cleared roots of *Gaultheria shallon*.

Figure 167. Microsclerotia (arrowheads) of dark septate fungal endophytes in cleared roots of *Vaccinium* sp.

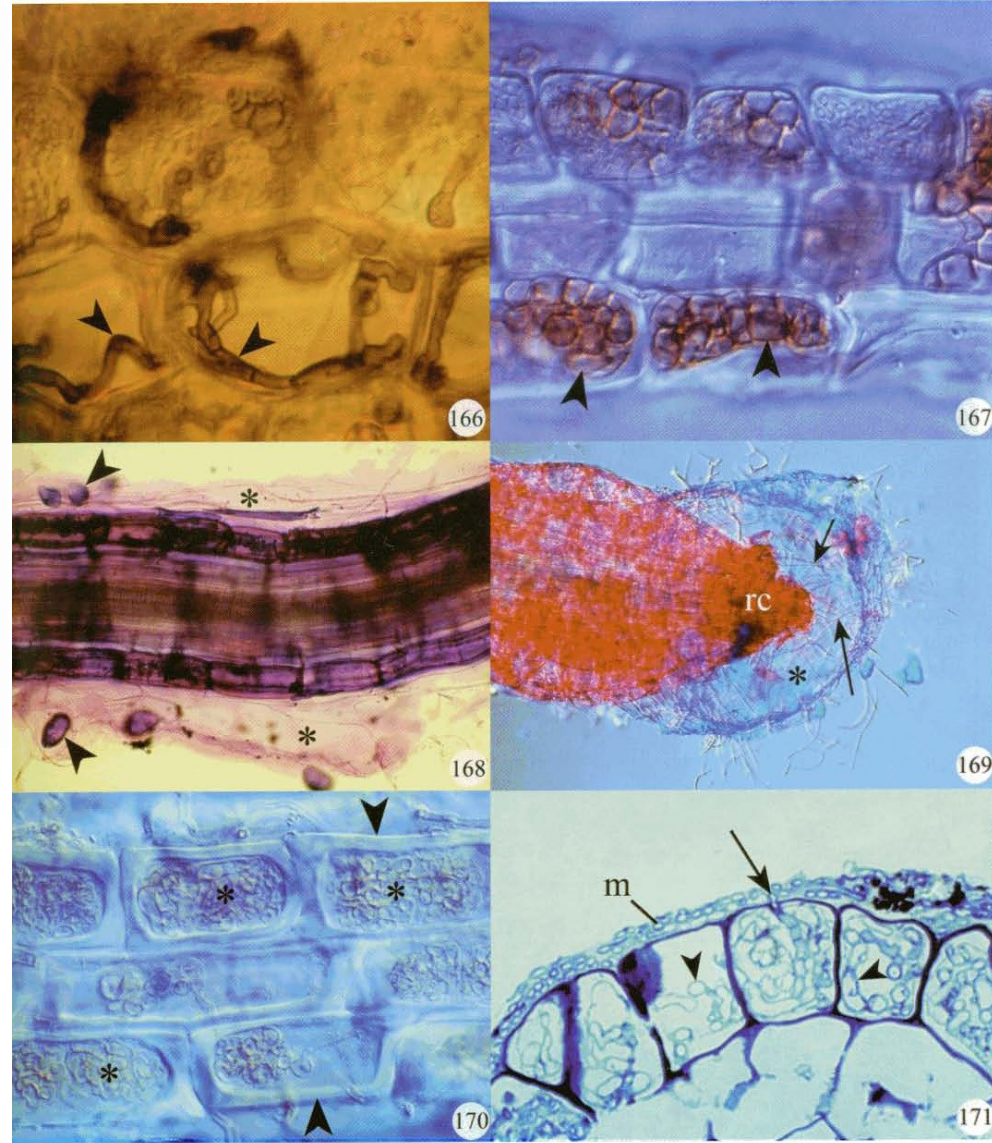
Figure 168. Hair root of *Gaultheria shallon* stained with toluidine blue O showing the mucilage sheath (*) and trapped sloughed root cap cells (arrowheads).

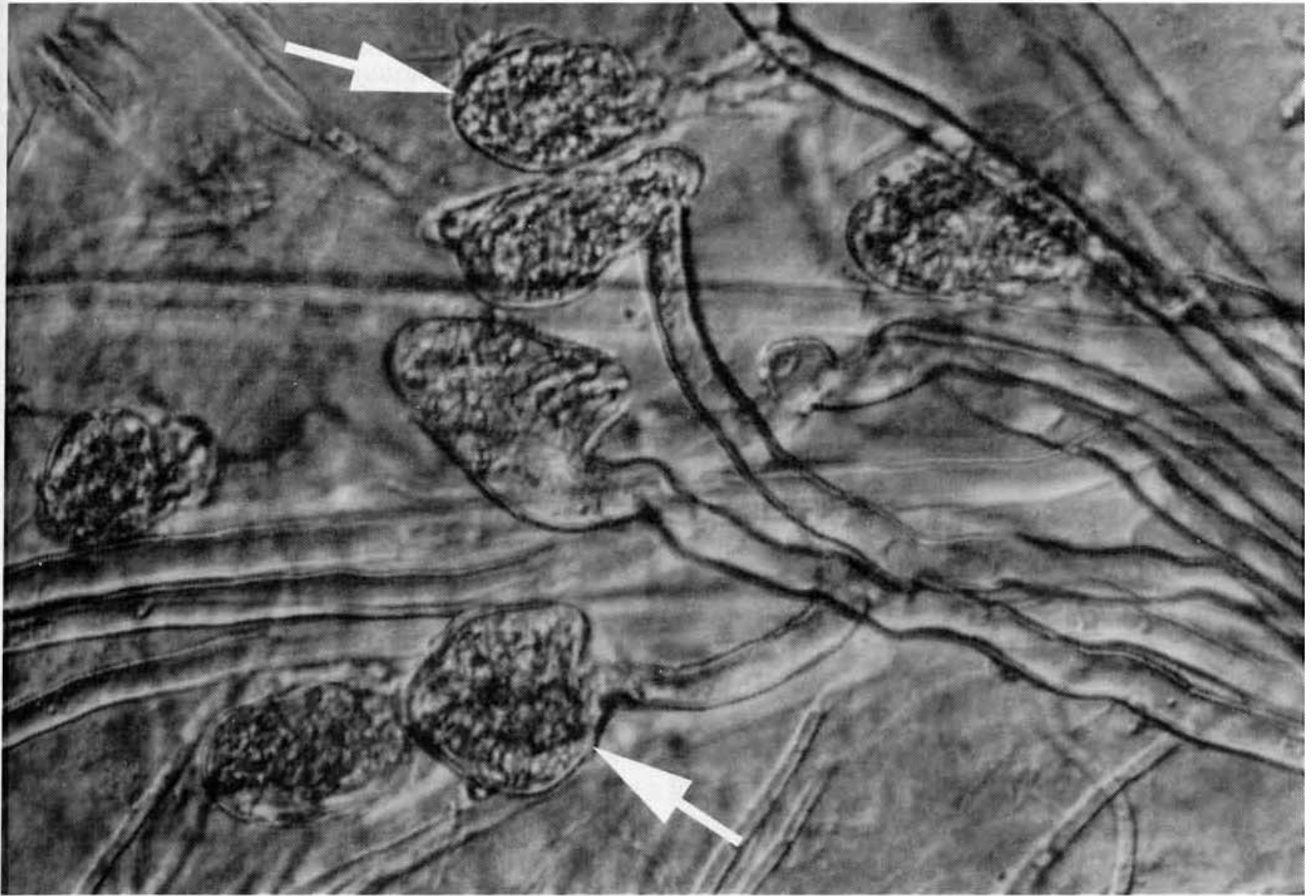
Figure 169. PAS-stained root tip of *Gaultheria shallon* counterstained with alcian blue showing root cap (rc), mucigel (*) and fungal hyphae of *Hymenoscyphus ericae* (arrows).

Figure 170. Cleared root of *Gaultheria shallon* showing thickened epidermal cell walls (arrowheads) and intracellular fungal coils (*).

Figure 171. Transverse section of *Gaultheria shallon* hair root showing a mantle-like structure (m), a hypha penetrating the epidermis (arrow), and hyphal coils (arrowheads).

Cultured seedlings of *Gaultheria shallon* inoculated with *Hymenoscyphus ericae* used for Figures 168, 169 were provided by Dr. Shannon Berch.





Swollen rhizoid tips of the liverwort, *Calypogeia muellerana*, colonized by the ericoid fungus *Hymenoscyphus ericae*.
From Duckett and Read. *New Phytol.* **129**: 439–447 (1995).

Box 14: Ericoid mycorrhizal fungi access various sources of nitrogen

Ericoid mycorrhizal fungi assist a broad spectrum of plants in the large order Ericales in the acquisition of nitrogen. Plant habitat varies considerably but most soils are characterized as being low in nutrients, particularly available nitrogen (Read 1996). Many fungi, including ericoid mycorrhizal fungi, are able to assimilate both ammonium and nitrate obtained from the soil solution (Read 1996). However, other important sources of nitrogen have been documented. *In vitro* experiments have shown that a number of amino acids (Bajwa and Read 1986), peptides and proteins (Bajwa and Read 1985; Bajwa et al. 1985) can be utilized by ericoid fungi as sources of nitrogen. *Hymenoscyphus ericae*, the most common fungal endophyte in the Ericales, produces an extracellular proteinase with a very low pH optimum (pH 2.2). Similar low pH levels may be encountered by this fungus in association with the fine hair roots of ericoid species that occur in the litter layer of acidic heathlands (Leake and Read 1989). Plant, fungal, and animal proteins therefore become potential sources of nitrogen for ericoid fungi and their plant hosts. Nitrogen from proteins that are complexed with polyphenolic compounds can also be accessed by these fungi (Bending and Read 1996); in addition, soluble phenolics and lignin can be degraded by *Hymenoscyphus ericae* (Bending and Read 1997).

Of particular interest, ericoid mycorrhizal fungi are able to use the polymer, chitin, as their sole source of nitrogen (Leake and Read 1990). An important source of chitin for these fungi would be the large biomass of hyphal walls of necrotic mycorrhizal and other fungi as well as insect remains in these soils.

There is convincing experimental evidence that species in the Ericaceae show increased growth when colonized with ericoid mycorrhizal fungi (see Read 1978, 1996); there is less evidence for this in the Epacridaceae (Bell and Pate 1996).