OMPHALINA

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Newsletter of FORAY NEWFOUNDLAND AND LABRADOR

Vol. V, No 7
Jul. 30, 2014

FORAY NEWFOUNDLAND AND LABRADOR

is an amateur, volunteer-run, community, not-for-profit organization with a mission to organize enjoyable and informative amateur mushroom forays in Newfoundland and Labrador and disseminate the knowledge gained.

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COVER

Have you already forgotten that white stuff of the past winter? The cover shows some of the first of it on Mount Ignoble, behind Humber Village, Oct 30, 2013. Along with an *Arrhenia obscurata*. Most of this issue is a discussion of that species, provided we have identified it correctly. If not, this issue discusses another species.

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CONTENT

This issue and all previous issues available for download from the Foray Newfoundland & Labrador website <nlmushrooms.ca>.

Message from the Editor

If your club's logo is an *Arrhenia* (a former *Omphalina*), and its newsletter is called OMPHALINA, you should have some knowledge of the omphalinoid group of mushrooms. It is an understudied group, filled with as much confusion as some of the other groups we have met recently. This issue will introduce you to four small, brown arrhenias with cap and central stem.

The lead article (as usual, after the Foray material), with a welcome cool cover picture during the hot summer, celebrates the arrival of *Arrhenia obscurata* into the exalted pensioner status already enjoyed for some years by the first 75% of the authors. The species was first described 65 years ago and this year swells the ranks of ever growing gray power.

Imagine that as the author of a mushroom book you came across an *A. obscurata*. The species is so uncommonly encountered that this may be the only time you will see it. You take your picture and put it in your book. That one picture will guide every reader to the appearance of this species. Now peruse the pictures in this issue to see the amazingly many faces of *A. obscurata*. A reader of your book may come across ten members of this species, not one resembling your picture. The poor soul will struggle and struggle, and be frustrated with her inability to identify her finds. One thing she will know for sure: none is an *Arrhenia obscurata*, because none looks like your picture!

Ah, but that is why you also add the invaluable microscopic morphology to your description. We all know that the microscope is the tool specifically devised for mushroom identification. Read on, and see how much spore size and some of the other good but small things helped your reader.

If you study a species closely, you will see that most have a breadth of morphologic appearance. One of the problems of texts is to illustrate ALL members of the species with but one picture and one description.

We tack on short descriptions of three other little brown arrhenias that we believe can be identified with reasonable certainty—at least some of the time.

Apart from names, the lifestyles of this group are far from known, and worthy of serious enquiry.

See you at the Foray!

andrus

PS

Speaking of Foray, if you are thinking of coming, please register now. Space is filling up and registrations close August 22 or when the limit is reached, whichever comes first.

Do not leave it to the last minute!

ERRATUM

Thanks to the two readers, who corrected an error in the last editorial. We wrote:

…we have known and collected *T. terreum* under the name *T. virgatum* in the past. The two have been shown to be genetically synonymous and *T. terreum* is the older name.

Actually, the species that has been synonymized with *Tricholoma terreum* is *T. myomyces* (as pointed out correctly in the article describing the latter). And we have not really "known" that species, having recorded it only once, in 2003. *T. virgatum* is a much commoner species in our province than *T. terreum* under either of its names. To balance off this error, here is a nice note from one of authors of the recent Nordic *Tricholoma* book:

What an amazing coverage of *Tricholoma* in just one newsletter!

Jacob Heilmann-Clausen

Ed comment: The secret is to get the right contributors.

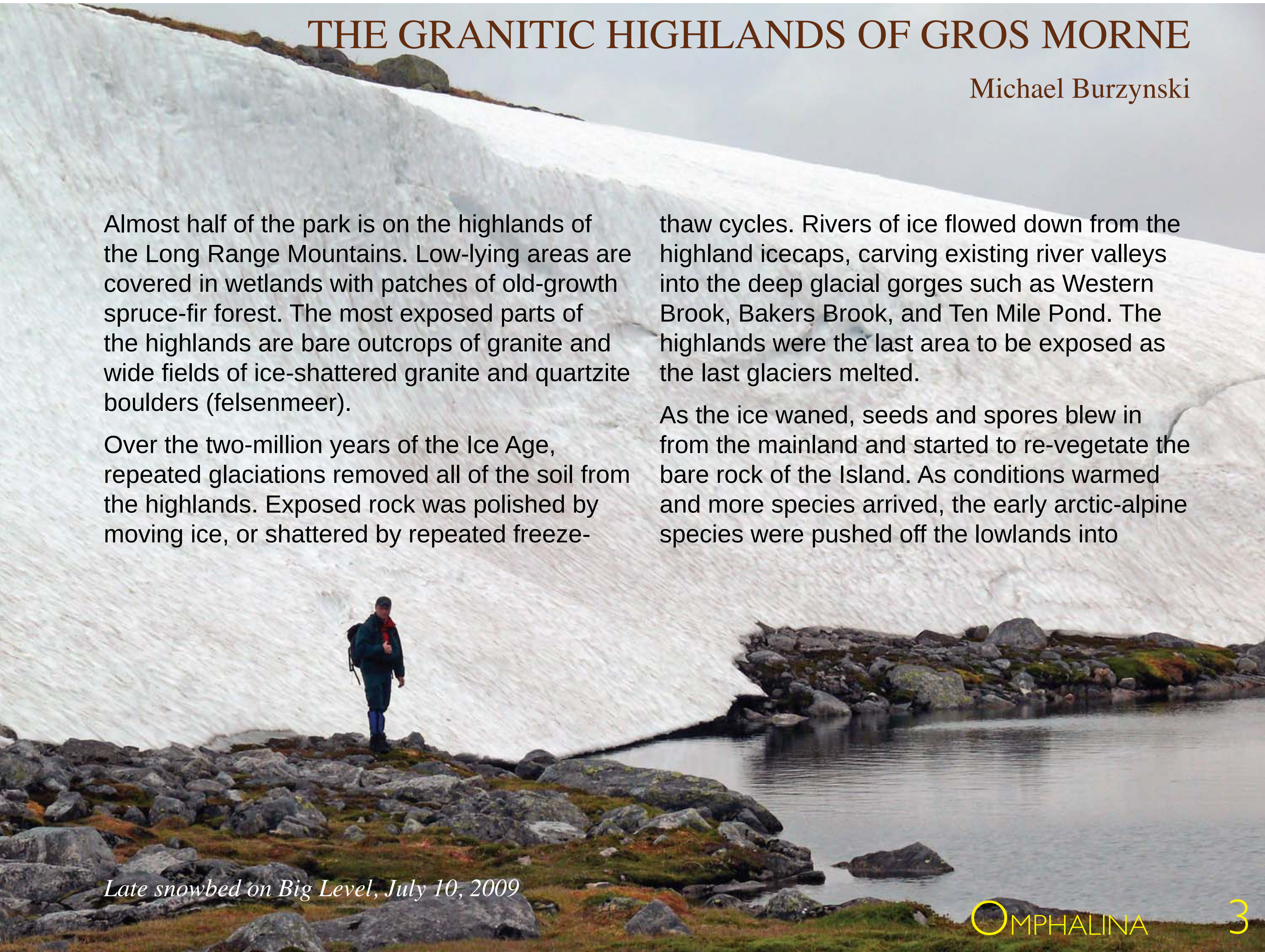
FORAY MATTERS…

1. **REGISTRATION FORM, INFORMATION, HOW TO GET THERE, etc.** Please see OMPHALINA V, No 4 (April issue), as well as other material stored on our website

   <nlmushrooms.ca>.

2. **MYCOBLITZ** For those able to make it, join us at Sir Richard Squires Memorial Provincial ark at 11:00 AM, Fri. Sep. 12, 2014. See April OMPHALINA for details.

3. **MORE DETAILED** discussion of last details regarding the Foray in the next issue.



THE GRANITIC HIGHLANDS OF GROS MORNE

Michael Burzynski

Almost half of the park is on the highlands of the Long Range Mountains. Low-lying areas are covered in wetlands with patches of old-growth spruce-fir forest. The most exposed parts of the highlands are bare outcrops of granite and wide fields of ice-shattered granite and quartzite boulders (felsenmeer).

Over the two-million years of the Ice Age, repeated glaciations removed all of the soil from the highlands. Exposed rock was polished by moving ice, or shattered by repeated freeze-thaw cycles. Rivers of ice flowed down from the highland icecaps, carving existing river valleys into the deep glacial gorges such as Western Brook, Bakers Brook, and Ten Mile Pond. The highlands were the last area to be exposed as the last glaciers melted.

As the ice waned, seeds and spores blew in from the mainland and started to re-vegetate the bare rock of the Island. As conditions warmed and more species arrived, the early arctic-alpine species were pushed off the lowlands into

Late snowbed on Big Level, July 10, 2009


Lichen-covered felsenmeer on Big Level

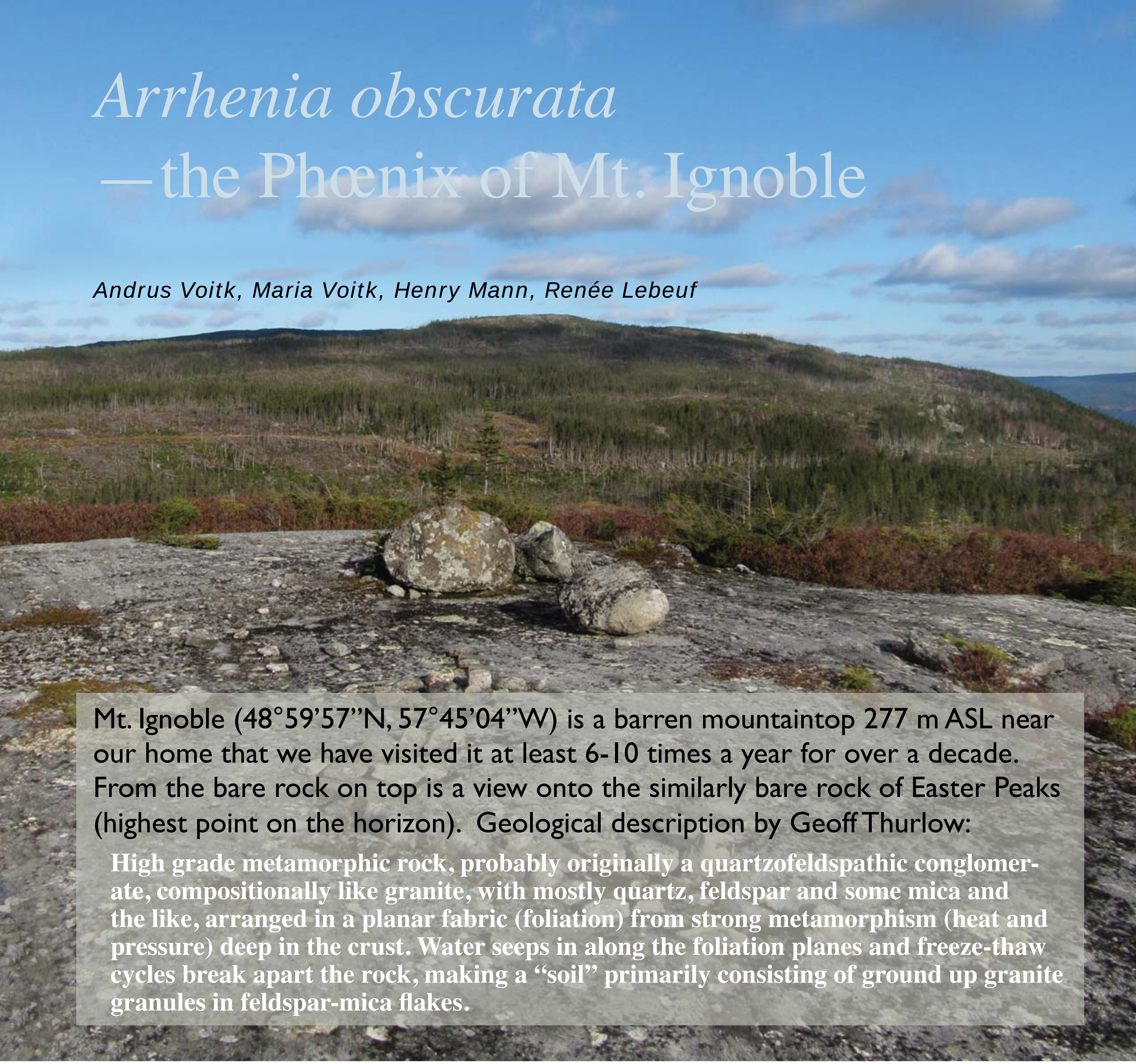

Rock ptarmigan on Gros Morne Mountain

restricted corners of harsh habitat—habitat where they could survive, but the more temperate, and faster growing, trees and shrubs could not. To this day, plants typical of the high arctic live on the exposed hilltops of Gros Morne, and in the late-melting snowbeds farther inland.

The late snowbeds are a particularly unusual habitat. They form on north-facing slopes where snow builds up in winter but melts slowly in summer. Caribou favour these snowbeds when they are raising their young, since the cool air keeps large parasitic botflies and warble flies from parasitizing and weakening the calves. As the snowbeds gradually melt back during the summer, they provide constant moisture enriched with caribou droppings to specialized arctic plants that are adapted to growing, flowering, and setting seed in only a few weeks. Most of these plants can survive nowhere else in the park.

Winds are strong on the highlands; low clouds create fog-like conditions, and the temperature can be much lower than on the lowlands. If you venture up to look for plants and fungi, be prepared with a windbreaker or raincoat, water, sunscreen, and a fleece. You will be rewarded with tremendous views of the park, and a visit to an ancient refuge of arctic plants and animals only a few hours hike from sea level.


Summit of Killdevil Hill, 2010



Arrhenia obscurata —the Phœnix of Mt. Ignoble

Andrus Voitk, Maria Voitk, Henry Mann, Renée Lebeuf

Mt. Ignoble (48°59'57"N, 57°45'04"W) is a barren mountaintop 277 m ASL near our home that we have visited it at least 6-10 times a year for over a decade. From the bare rock on top is a view onto the similarly bare rock of Easter Peaks (highest point on the horizon). Geological description by Geoff Thurlow:

> **High grade metamorphic rock, probably originally a quartzofeldspathic conglomerate, compositionally like granite, with mostly quartz, feldspar and some mica and the like, arranged in a planar fabric (foliation) from strong metamorphism (heat and pressure) deep in the crust. Water seeps in along the foliation planes and freeze-thaw cycles break apart the rock, making a "soil" primarily consisting of ground up granite granules in feldspar-mica flakes.**

In 2011 we found some very small brown omphalinoid mushrooms in this "soil". Did the mushrooms just move there recently? Unlikely. Once noticed, we have been able to locate some on each subsequent visit in season, suggesting that they have always been there, but it just took us over 10 years to notice them. Why? Well, the mushrooms are obscure: dark and tiny, blending inconspicuously into their surroundings—surroundings that are unlikely places to look for mushrooms in the first place. We set out to study them more closely.

Weekly visits were made to the site from the beginning of March (snow at that altitude lasts well into May, but the barren mountaintop is blown bare by March) to the first week of December, 2013 (when snow returned). Two weeks were not surveyed, when we were away. Note was taken of the number of mushrooms, their size, growth, habitat, duration, other macroorganisms, weather and any other notable event. At least one fruiting body was photographed and at least one collected (if there) at each visit and a microscopic examination done.

The cap measured 3-14 mm. in diameter. It was approximately the same as stem length. Its shape varied from bowl-shaped to flat, but almost always retained an inturned margin.

The margin was even, but became crenulate (sinuate or wavy) with time. At the same time the cap became radially ribbed with raised regions above the gills and lower areas between.

There navel varied from several mm in depth to a shallow central depression, to bowl shape with no depression.

The cap was translucently striate (the darker radial stripes over the gills show through) when moist.

Hygrophanous and translucent, the cap became opaque and lighter in colour when it dried, often flecked with brown pigment.

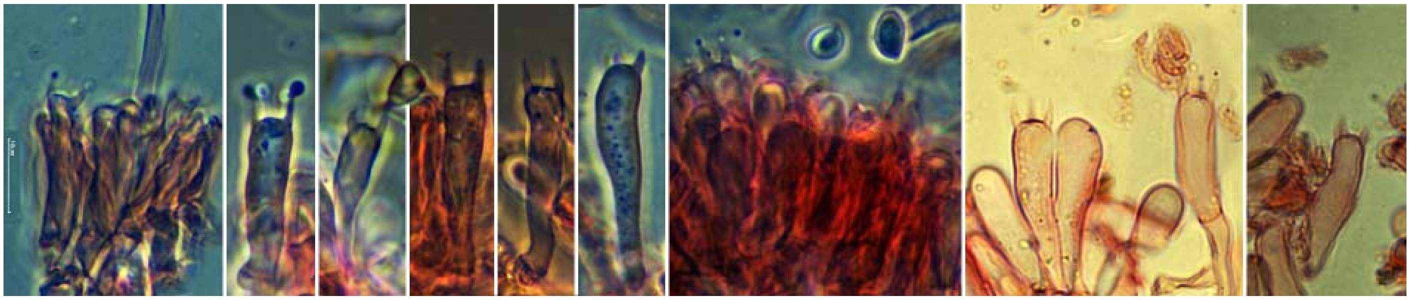
Cap texture was initially coarsely granular, becoming minutely pruinose, and finally merely of a pebbly or finely bumpy texture. The projections seemed to be end hyphae, not cystidia.

In colour it was a dark mushroom, almost black brown, but varied to a mixture of light browns and tan. Radial lines over the gills were darkest, with lighter areas between. Colour lightened as it dried. Note presence of some red tones, especially the far right photo. The mushroom colour is darker in real life than shown on the photos. Narrow spot metering, fixed on the mushroom, causes the camera to compensate for the darkness to bring out a wider range of colours than seen with the naked eye.

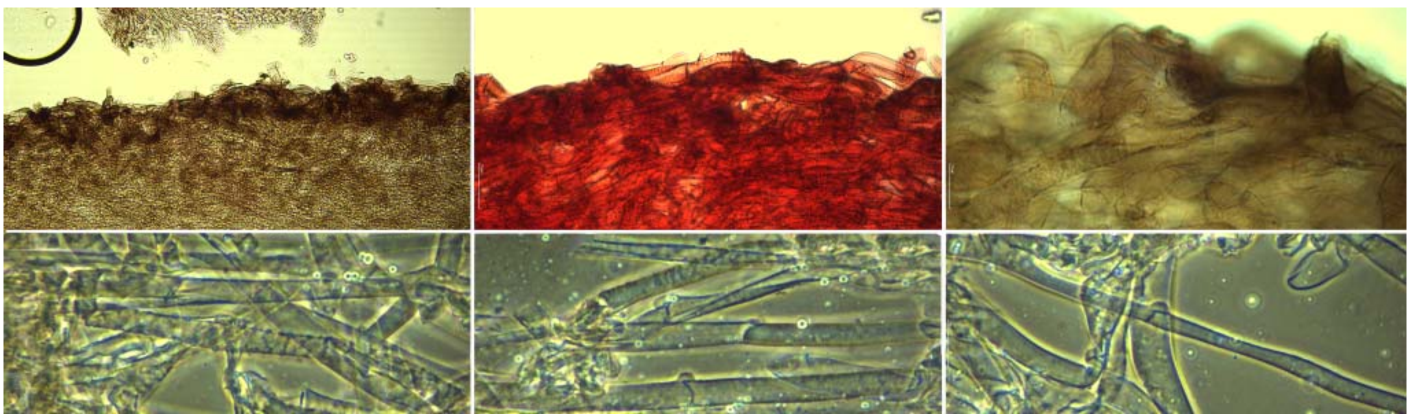
The gills were distant, arcuate and moderately to deeply decurrent. Occasionally they forked near the cap edge. Cross-veining was very rare, seen minimally in old specimens only. Gills were lighter in colour than the cap or stem, with an edge that was usually somewhat darker. There was rarely more than one level of lamellulae.

The stem was 4-15 mm x 0.6-2 mm, minutely pruinose, becoming smooth with age, with a few whitish wisps of mycelia at its base. Old stems showed longitudinal fibrous striations. It was dark in colour, like the cap.

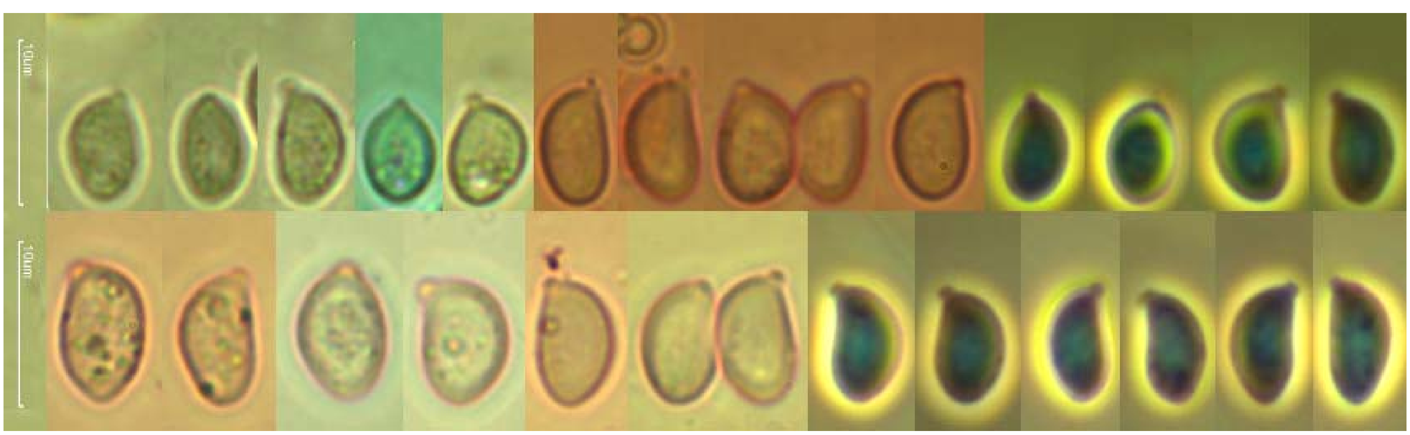
Average stem length was equal to or only slightly longer than cap diameter for most mature mushrooms.



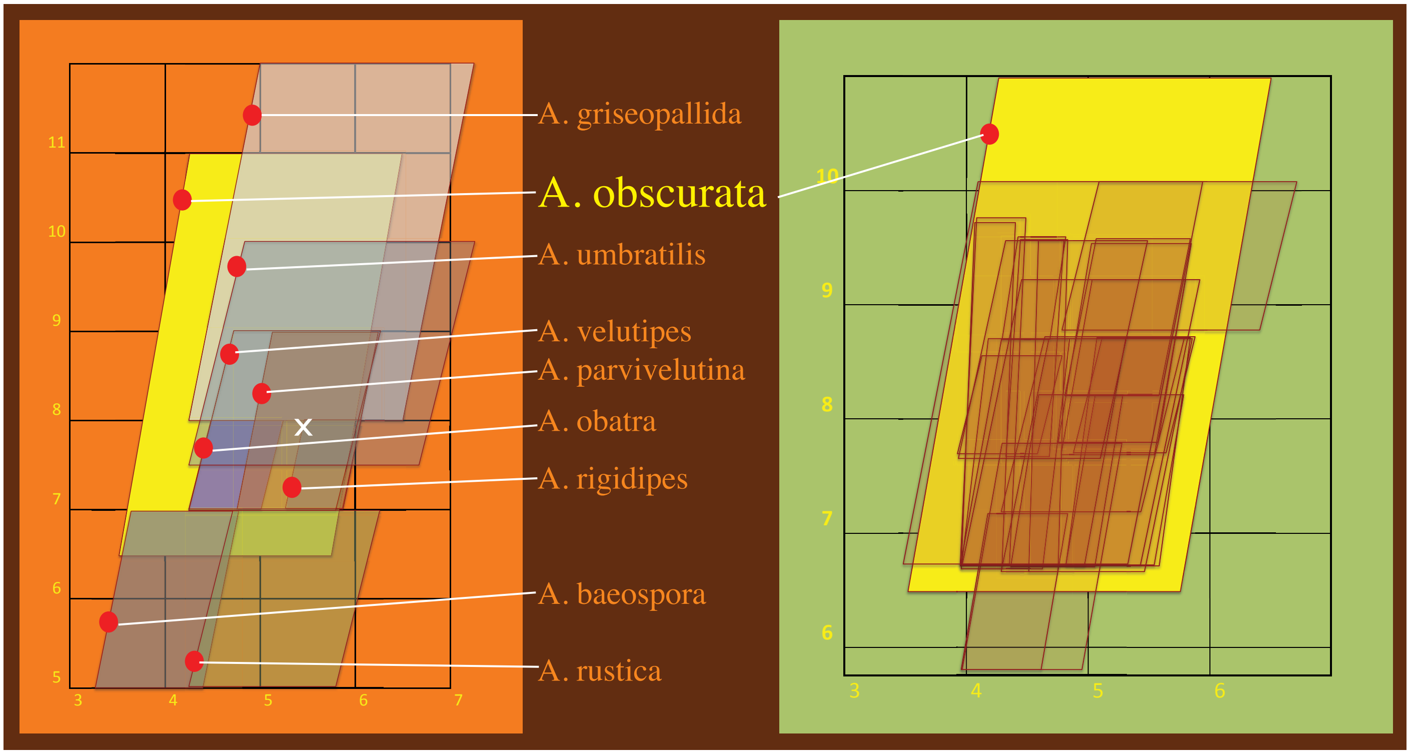
The basidia (club-like reproductive cells on the gill surface), illustrated here from two fruiting bodies, were about 30 x 6 µm and had a basal clamp connection. In fact, clamp connections were prominent throughout all tissues. Most basidia had four sterigmata (prong-like projections or prongs, on which spores are formed), with 20-25% bisporigerous (2-pronged). Because sometimes all prongs cannot be seen despite attempts to focus at several depths, it is easy to overestimate the proportion of bisporigerous basidia. Several basidia are shown, some with spores in various stages of development. Two views show full-sized spores for comparison. There were no cystidia (club-like larger and often sharp projections from tissues) on the gill faces, edges, cap or stem.



The hyphae (long cells) of the pileipellis (pilei=of the pileus or cap, pellis=skin) run parallel to the cap surface, forming a cutis (skin). The upper pictures show interlaced, winding hyphae, roughly parallel to the surface, with some ends extruding, probably creating the granular surface. The lower pictures show some hyphae with crosswise stripes—the incrusted brown pigment. Also note the clamp connections (bumps like swollen knee caps at cell junctions), abundant in all tissues.



Spores of two mushrooms (upper: ammonia, Congo red, Meltzer's; lower: Congo red & Meltzer's). Spores were hyaline with a prominent lateral apiculus, and mature spores contained granules and vacuoles or droplets. Size range for individual mushrooms was narrow, but the range between mushrooms varied widely. Size for 24 mushrooms: 6.5-10 x 3.5-6 µm, with an average Q (length divided by width, an indicator of shape) 1.7 (range, 1.4-2.0). Spores from a fresh sporeprint tended to be more uniform in shape, more elliptical than pip shaped, and tended to be in the upper half of the expressed range.



The left image shows parallelograms for reported spore size range of nine macroscopically similar little brown arrhenias.[1] The spore size range of *A. obscurata* (yellow panel) is the most central and largest of the depicted species, overlapping all the others (4 totally, 2 over 70% and two 20-35%). This means that any specimen of any of these species could have spores in the size range of *A. obscurata*, and the vast majority will. Thus, spore size outside this range may exclude *A. obscurata*, but a match does not help distinguish it from several others. A few have other microscopic features that help identify them, but the majority cannot be distinguished from each other microscopically.

Let us say, for example, that you found a fruiting body of *Arrhenia parvivelutina*, with spores closely scattered around the middle of its reported range (the white X). That spore size is within the range of *A. obscurata*, *A. umbratilis*, *A. velutipes* and *A. rigidipes*. A little longer spores would bring in *A . griseopallida* and a little thinner, *A. obatra*. Good luck!

The right image shows the spore size ranges for 23 of our individual collections of the putative *A. obscurata*, with the same yellow panel of reported ranges in the background. A minimum of 10-30 spores were measured each time. Note that:

1. Only 2 mushrooms had spores of or minimally above10 µm. This is significant, in that many authorities state that one way to recognize this species is that over 50% of spores are over 10 µm long. Not so on Mt. Ignoble—provided our identification is correct.
2. Only one mushroom had spores that covered most of the reported range for the species.
3. The range for most mushrooms was very narrow. The ranges for several single collections differed so much from each other that they could be suspected to be different species.
4. The range for the majority of individual collections fit entirely within reported ranges for other species, and if a single collection, could be mistaken for any of these.
5. About 15 collections were required before it became apparent that all clustered within the wide range of *A. obscurata*, and did not represent a variety of different species.

With this much variation in spore size, is it possible that our collections are, indeed, of several species?

Theoretically, yes, but our combined many hundred years of observing life on this earth argue strongly that it is unlikely to find another, let alone several, species elbowing each other for a chance to grow on and out of bare rock during frost and snow. However, we are not too old to learn, so please do not hesitate to let us know if you think we err.

Note: the parallelogram is a quick way to represent the spore size range, but is not as accurate as a mathematically calculated or computer-generated scatter diagram, based on a large number of measurements.

This view is from Easter Peaks, along the same axis as on the title banner, but the opposite direction. And a bit later in the year. The barren Mt. Ignoble is indicated by the arrow, with Marble Mountain ski runs and the Humber River behind it.

The general habitat of this mushroom was impressive: bare rock! Not areas of turf nearby, or gouged out depressions with soil and trees or other vascular plants, but bare rock. As the photo shows, at 277 m ASL, Mt Ignoble is not above the normal timberline. However, its top has suffered some stochastic event removing the trees, and erosion has removed the soil in places, to lay part of the rock bare. The bare rock was covered with a plethora of lichenized ascomycetes. In more fertile cracks, moss grew, followed by heath plants such as *Empetrum hermaphroditum*, *E. eamsei* and *Vaccinia* spp. Associated with these were *Lichenomphalia umbellifera* and *Clavaria argillacea*. Among them small conifers and birch gained a toehold, at least for a while. Around these we have collected *Inocybe lacera* (with birch) and small *Lactarius hibbardae* (with conifer), and occasional unidentified *Mycena* spp. Heath with *Kalmia* and stunted *Picea* among *Cladonia rangiferina* and other reindeer lichens made up the part of the mountaintop covered with thin soil, and on the slopes leading to the top there was a mixed boreal forest of *Abies*, *Betula* and *Picea.* People, dogs, snowshoe hare, squirrel, voles, various birds and moose and caribou visited the area. The first basidiolichen (*Lichenomphalia umbellifera*) was seen May 27, the first saprobe (an unidentified *Mycena*) July 31, and the first mycorrhizal mushroom (*Inocybe lacera*) Aug 5. On one occasion we collected *Microglossum atropurpureum* in one of the cracks on bare rock. Examination of this crack showed it to have been filled with caribou droppings.

Easter Peaks is 2 Km due NE from Mt. Ignoble and 100 m higher in altitude. It has similar topography, with bare areas of similar rock to that of Mt. Ignoble. To test our suspicion that this mushroom actively seeks out such habitat, we explored Easter Peaks. The same mushroom grew there, in the exactly the same microhabitat.

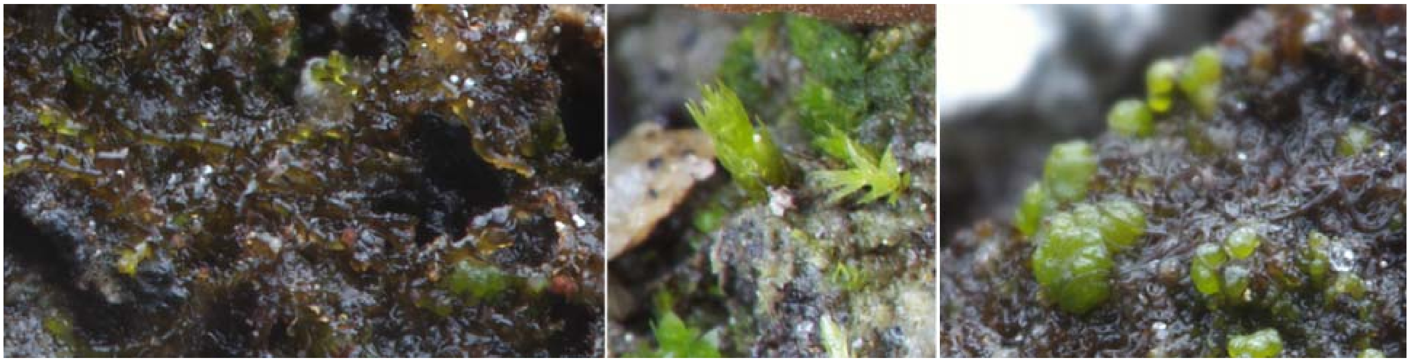
The forest between the two peaks was clearcut a few years ago by Corner Brook Pulp and Paper Company.

The most striking thing about this mushroom was not what it looks like, but the substrate on which it chose to fruit. In this choice it was very consistent. Its favourite place was between cracks of foliation plates that have undergone minimal separation, a place where "soil" from crumbling of granite had not yet accumulated. These places had no evident organic nutrients, but water could be assumed to be present in the thin space between opposing foliation plate surfaces due to capillary action. Here the mushroom stood out as the only large macroorganism.

An alternate habitat was pioneer soil filling small crevasses in the rock face. The soil consisted of visible grains of granite and quartz, mixed with finer feldspar-mica silt. This gravel-sand contained some organic matter. Because our mushroom was the largest multicellular organism there, the soil probably did not contain enough organic matter to sustain a large saprobe. In these furrows a small number of lichens could be seen, and very small beginnings of moss. A botrydinal mat was always found. Mushrooms were not found in older furrows overgrown with low moss, or those with established vascular plants.

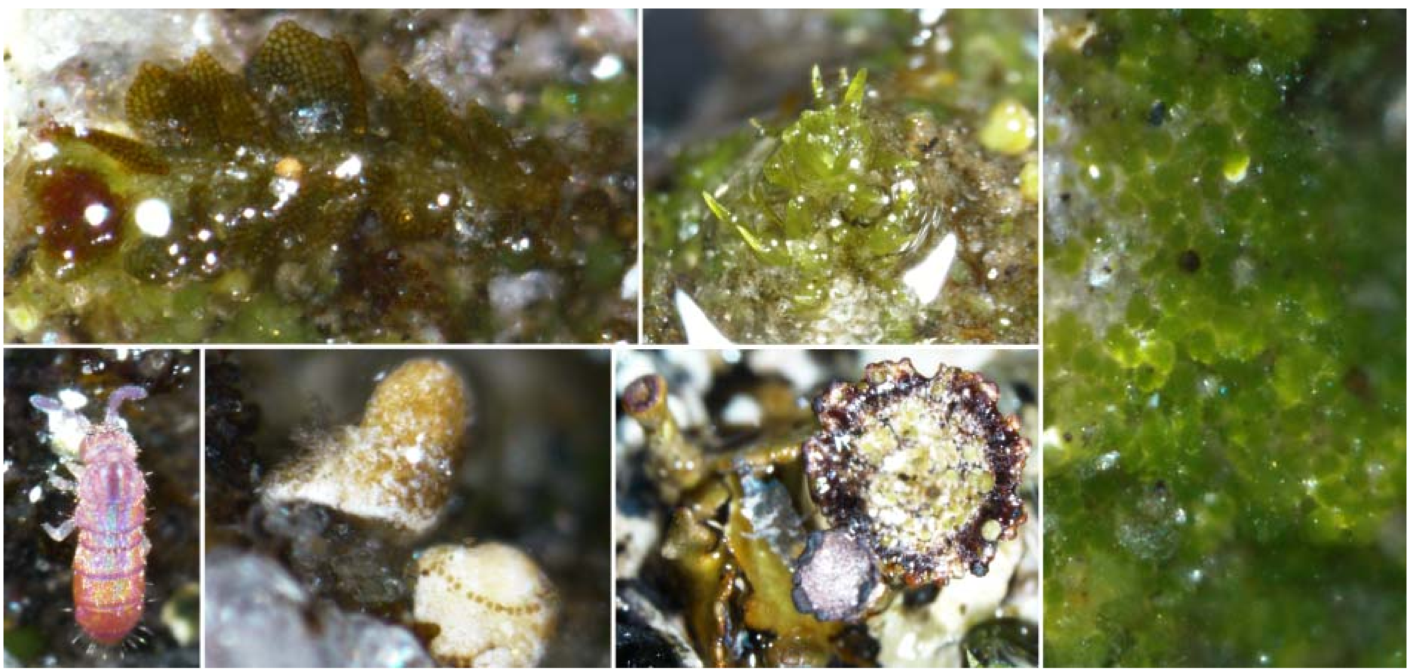
Botrydinal mat covering the "soil" around the mushrooms. Not always so prominent, but with magnification algal globules could always be found.

Strands to the right in upper picture look like a leafy liverwort, and in the lower some moss is evident. See next page for magnified views of these.



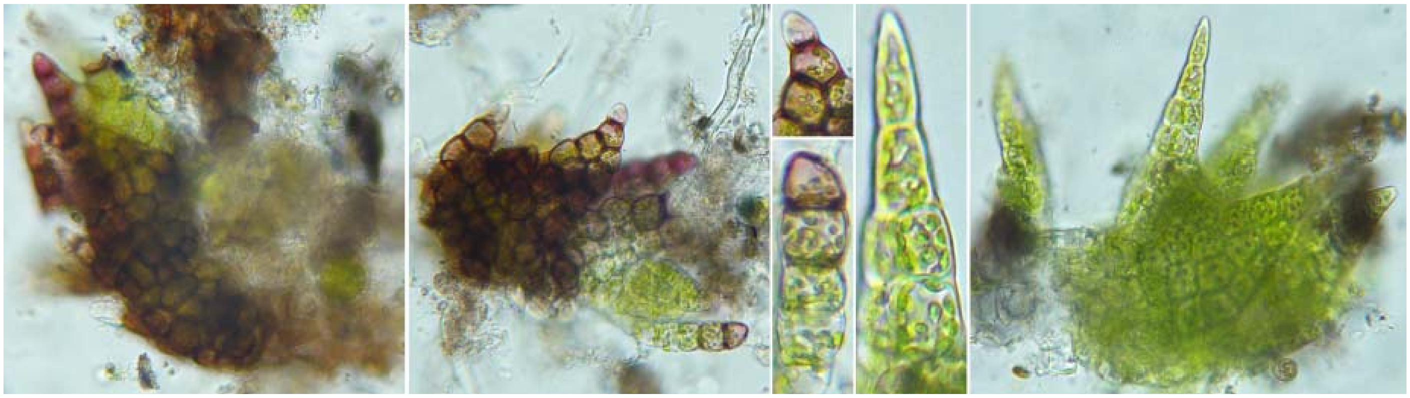
Although there were no large vascular plants inhabiting the furrows where these mushrooms grew, there were other organisms containing chloroplasts (small organelles with chlorophyll, allowing the organism to use the sun's energy to convert atmospheric CO_2 into sugars—photosynthesis). The photo shows enlarged details from the photos on the previous page. The organisms, left to right, are a leafy liverwort, beginning small mosses, and algae in globules (*Botrydina*).

Liverworts of this size were not commonly seen, but microscopically small buds and branches were not unusual. Small moss buds and a few sprigs were not unusual, if very carefully sought. However, of interest is that arrhenias were not found in furrows where there was more mature moss, or moss that had covered the soil. Algal globules were always found on soil around mushrooms, although in certain sites they were sparse and not obvious. Note on this picture the network of strands going to and over the algal globules. We may guess, but have not confirmed them to be mycelial or to be directly connected to the algal globules.

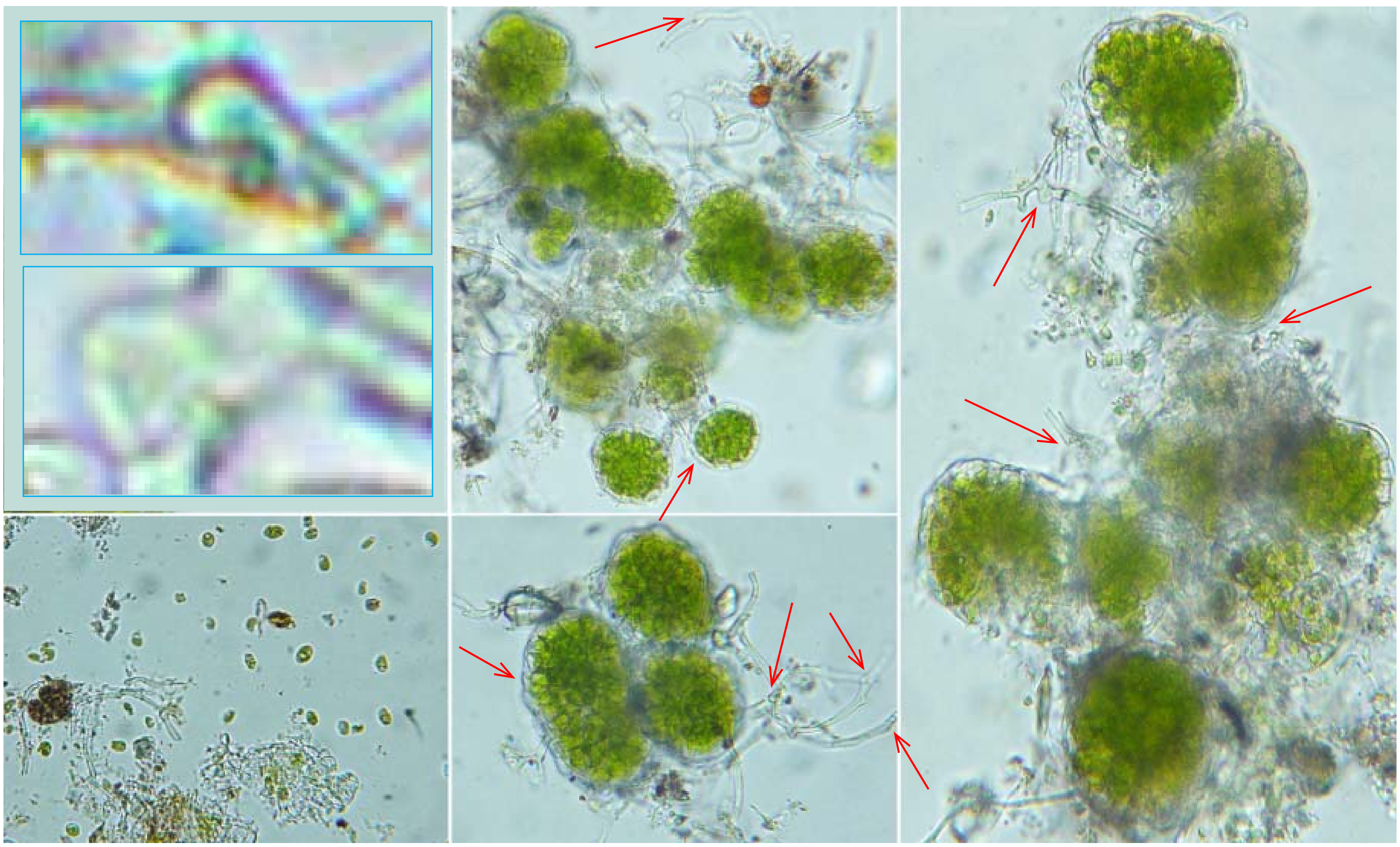


The soil from one collection was placed in a covered moist glass container on a cool windowsill to encourage growth, and examined with a dissecting microscope after 2 weeks. Upper two left photos show a leafy liverwort and young moss beginning to sprout. Below from the left are one of three peacefully grazing purple hypogasturids (more can be read about them in the latest Osprey[2]), some early lichens, one wearing what looks like a necklace of blue-green algae, and some tiny cup-forming lichens, likely *Cladonia* species. On the right is a mat of algal globules, the commonest visible green organism at the time.

Photographed at 400 x magnification; same scale kept for all pictures in this composite.



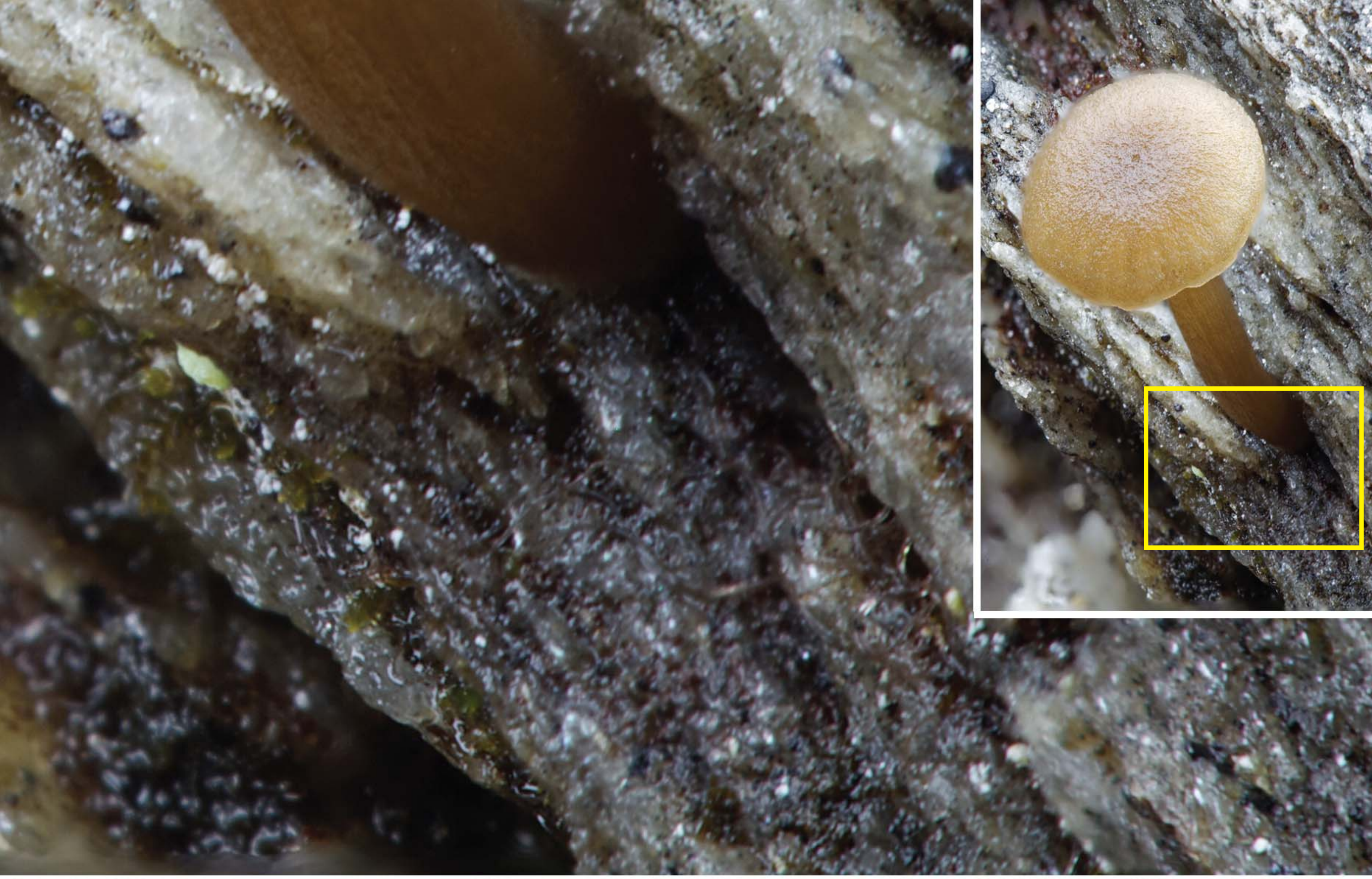
Photomicrographs (original magnification 400 x) showed again the liverworts (four photos on the right) and moss (two on the left). Note the different cellular structure. Note also the visible chloroplasts (small green granules) in the cells of these plants. We consistently found a few long hyaline (clear and uncoloured) cells, presumed to be hyphae, in the vicinity of liverworts, but none around moss.



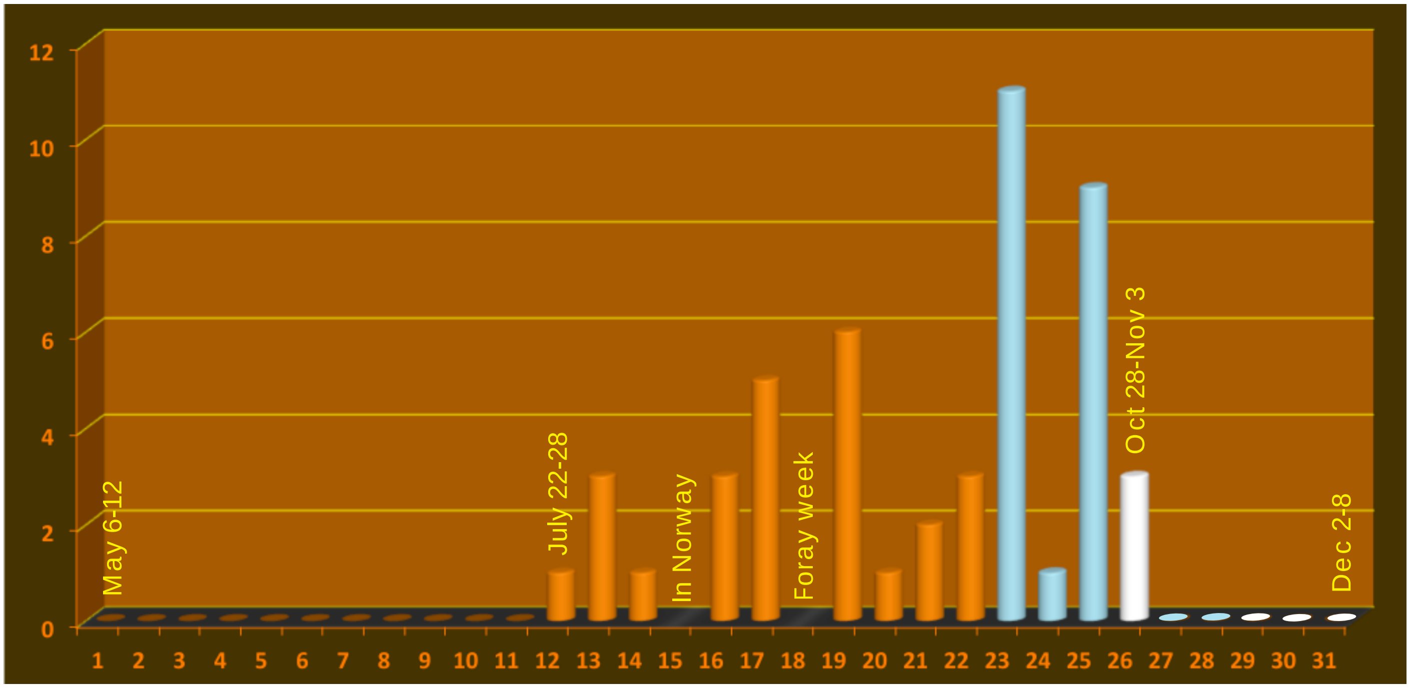
The algal globules consisted of spherical conglomerates of algal cell, surrounded by flat hyaline cells. Note the profusion of long hyaline strands traveling to, from and around the globules, in intimate contact with them, and seemingly extending from the flat cells that make up the walls of the globules. Arrows point to what seem to be clamp connections, two enlarged in the left upper panel.

As opposed to the organized but free cells of moss and liverwort, the algal cells seem compressed and chloroplasts cannot be discerned within each alga. However, if the preparation is compressed to crush the cells (lower left photo), the hyaline strands are attached to empty cell walls, and chloroplasts are released.

These globules are similar to the botrydinal granules Oberwinkler described for some basidiolichens.[3] Algae are contained within a globular sac of hyphae, with hyphal cells also between the algae. As algae multiply, they become more compressed. The globules enlarge, but seemingly not at the same speed. This is where the exchange with the photobiont takes place: water and minerals for sugars. The connecting hyphae transport the exchange materials in the required direction. Not unlike ectomycorrhizal exchange, except that the photobiont is noticeably smaller!



Rock around the base of the stem of the mushroom in the insert. Lower photo same as upper, with yellow lines and green dots drawn in to help locate putative mycelial thread and algal globules in upper photo. If these are hyphae, this is a high-risk way to live. On bare rock, they are exposed to sun and wind, ever at risk for drying out and thereby cutting off the source of food to the fungus, and, probably, the source of water and minerals for the algae. Perhaps this is why fruiting bodies on rock tended to last half as long as those on "soil".



The bars indicate the number of new fruiting bodies found each week. Snow persisted in the surrounding woods until mid May, but the mountaintop was blown bare by March. The first three months with no fruiting bodies are not shown on the graph. The first *Arrhenia* was collected July 24.

From the first fruiting body on July 24, at least one mushroom was found every week, ranging as high as 11 (average 4), until week 26 (cover photo). Most grew singly, although up to 4 of varying size and maturity could be found within the same small crack.

Light blue bars indicate frost, at least at night, during that week. The white bars indicate snowfall in the week, even if subsequently melted. At almost 300 m ASL, temperatures are colder than at ground level, about 30 m ASL. Week 27 had 5 consecutive days of sub-zero weather with no snow cover and week 28 had three.

Note the apparent increase in fruiting with the arrival of cold and snow, which ceased abruptly with the onset of persistent cold.

Photos one week apart. In temperate weather mushrooms on soil lived for over three weeks. Some smaller mushrooms did not survive to the following week, but those that had managed to grow over 4 cm cap diameter usually survived. Growth varied (presumably related to not drying) from 0 to 60%. Even if they had not attained full size, most mushrooms dried by the third week. If left undisturbed, they were the same a further week later. We did not see dried mushrooms revive in wet weather, but frozen ones seemed to do so. Compared to those on "soil," fruiting bodies growing on "bare rock" rarely survived longer than one week.

Mushroom 13.11.07.av01, in one of the more species diverse furrows, soil depth 9 mm. The microscopic pictures of soil organisms come from this furrow, as do the algal granules submitted for DNA analysis.

A seeming increased fruiting late in the season suggests an ability to manage cold. Transient periods of night frost, with above zero temperatures in the day, began on week 23. The above mushroom was first seen on week 25, when its cap diameter was 3 mm. On week 26, snow fell for several days, then melted. This mushroom looked healthy and its cap had increased to 4 mm in diameter. Week 27 had five consecutive days of sub-zero temperature, without snow. The ground was frozen and all small organisms growing on it. The left photo shows the same mushroom at that time: frozen and shrivelled, its cap shrunken to under 2 mm in diameter. This was followed by two days of thaw and light drizzle. 48 hrs later the same mushroom (right photo) had recovered and was of normal appearance, cap again of 4 mm diameter. It produced a sporeprint, suggesting that sporulation was functional.

This fruiting body grew during night frosts and snowfall, shrivelled up in response to several days of consecutive unrelenting frost, but with the appearance of thaw and moisture, seemed to recover fully.

Several days of frost without snow halted further fruiting in 2013. In 2012 snow fell with the first frost, providing cover during cold and moisture during thaws. Three fruiting bodies are shown on the right, recovered during thaws, November 11 and 17. This is the only time we have seen the cap straighten out so that even the inrolled margin flares out. They sporulated well, suggesting they are able to withstand short freeze-thaw cycles. The mushroom on the left is reminiscent of a *Cuphpohyllus*. Maybe cryotherapy brings out family traits, because phylogenetically *Arrhenia* arises from a sister branch to *Cuphophyllus.*

Discussion

These have been our observations over three years, brought into focus by a concentrated season of more formal observation in 2013. It was a joy to pursue and record the appearance and behaviour of these beautiful mushrooms. However, that enjoyment pales in comparison to the pleasure of the speculation these observations permitted. To compensate for over a dozen pages of boring pictures, we shall discuss our speculations in three pages of solid but exciting text unsullied by pictures, under the headings, Identification, Range, Season and Lifestyle.

Identification

Once we exclude arrhenias with a cap over 2 cm wide, those that grow on wood or *Sphagnum*, those with a primitive lateral or no stem, the colourful ones and the non-translucent opaque ones, those with cystidia, those with consistent bisporigerous basidia and characteristic spore shapes, and those without clamps (*Lichenomphalia*), the macroscopic and microscopic descriptions for about half a dozen little brown *Arrhenia* species are virtually interchangeable. If you go on an excursion through the mountains and find a single sample of our mushroom, any pretense at its confident identification based on macroscopic and microscopic morphology seems risible. Look over all the pictures again to get an idea of the wide range of variation in the macroscopic appearance of any part of it you wish to consider. The section on microscopy made the same point for its microscopic appearance.

If we cannot tell them apart by looks, we need some other character for identification.

The most arresting aspect of this beautiful mushroom is its rigid adherence to a very inhospitable microhabitat. Like many beauties, it is a master of the grand entrance: after all, it is very difficult to be more dramatic than to spring forth from solid rock! Surely this attention-getting behaviour would be a strong identifying feature? Yet, one of the things that made us hesitant about the identification was the lack of emphasis authorities gave to what to us was the most noteworthy aspect of this organism. The experts were underwhelmed and blasé.

The most current description of the omphalinoid mushrooms can be found in Steen Elborne's treatment of the group in the 2012 edition of Funga Nordica.[1] Both macro- and microscopic descriptions of our find fit best with Elborne's description of *Arrhenia obscurata*. However, Elborne did not mention—let alone stress—saxicoly for this mushroom, while describing two others specifically as denizens of pioneer soil. (Neither of these other two fit with the description of our species.) *Arrhenia obscurata* was described as growing "between low moss or on naked sandy to loamy soil from lowland to arctic, spring and autumn." This is presumably based on Kuyper's description, "common in The Netherlands", fruiting "between mosses on dry to moist, sandy to loamy soil" April-June and Sept.-Feb.[4]

Even more uncharacteristic (to us) is the description by Reid, first to give the species a valid taxonomic description, who stated that his selected type collection came from a "burnt patch of soil amongst *Sphagnum*",[5] i.e. an area with a goodly supply of carbonaceous organic matter able to support other multicellular organisms. Kühner, who first described this species (but illegitimately), said that the mushroom is found on bare ground or among moss, sometimes on rock (parfois sur les rochers).[6] He did not elaborate, so depending on how one interprets those impassive words, this can be said to fit with our observations, at least at times. Descriptions by authorities like Lange, Clémençon, Lamoure and others, use the same understated and laconic language without stressing our mushroom's most startling microhabitat. Watling virtually dismissed it in Greenland with the terse, "appears to be a common rather northerly agaric on base-poor soils."[7]

A little more comfort for our identification is provided by Gminder, who states that *Arrhenia obscurata* is one of a group of pioneer mushrooms which grows on virgin soil (Rohböden), but adds that the species also can be found in nourishment-poor rather sandy soil.[8] To a soul, a very phlegmatic group, these mycologists: it is difficult to correlate words like "sandy and loamy soil" with the dramatic setting we observed.

Apart from Gminder, the only description that struck a chord was by Peck.[9] Bigelow[10] believes that Peck's *Agaricus (Omphalia) montanus* may be the first description of this species. As with most of Peck's laconic descriptions, at first glance it seems hopeless to guess what organism he described. If we include the title, treat single-letter abbreviations and numerals as full words, and each side of a hyphenated word as separate, then Peck accords this new species a total of 37 words! However, for us only eight were enough: "Thin soil covering rocks. Summit of Mt.

Marcy." These eight words, more than any number in most other treatments of what is purported to be this same entity, convinced us that they described the organism we observed. Peck's name for it was illegitimate, because *Agaricus montanus* had been used previously for the beautiful mushroom we now know as *Psilocybe montana*. Too bad, because from our limited experience, montanus is more appropriate to this organism than to the *Psilocybe* species.

Back to identification—if this is a species limited to barren rock in a arctoalpine setting, its daramatic lifestyle should serve to identify it, provided the other findings fit. If this species is ubiquitous, and may be found on sand dunes, loam, burns in Sphagnum, and many other places, usually in moss, then the identification becomes difficult to hopeless. Questions:

1. Is it possible that several species are included in these descriptions? (Our guess is yes.)
2. Is it possible that it behaves differently on the mountaintop than in the valley? (Our guess is no.)

Range

Is it possible that the same species fruits not only in arcto-alpine regions, but also in lowlands? Most organisms tend to specialize for one major climatic setting and tend to be intolerant of major differences. Therefore, the possibility of the taxon containing more than one species is real. On the other hand, perhaps the species is unable to compete in a biodiverse environment, and its only requirement is pioneer soil, devoid of sufficient nutritional content to support competing species. In that case it is conceivable that it can thrive in submarine Dutch littoral sand bars equally well as on arcto-alpine rocks. But Reid's carbonaceous *Sphagnum*?

Season

Some observers report two fruitings during the year. Climate makes this unlikely in most arctoalpine situations. But if it really also lives in regions with little or inconsistent frost and snow, like The Netherlands where double fruiting was reported, this is theoretically possible.

We did not observe double fruitings. But why did it not fruit before the end of July? If it were a saprobe, presumably it could fruit any time that the temperature and moisture were right—but there is not enough organic matter to sustain a saprobe. *Microglossum atropurpureum*, the only saprobe we have seen in the same microhabitat in 14 years, was facilitated by a special situation: a caribou dropped some concentrated heavenly organic manna into a small furrow like a gift from the gods.

If ours were a mycorrhizal mushroom, associated with a tree, as are the *Inocybe* and *Lactarius* from the same area, then the tree's cycle determines when enough food can be given the fungus to produce fruiting bodies. However, the absence of obvious mycorrhizal hosts suggests that ours is not mycorrhizal. A basidiolichen might fruit all season long. The first *Lichenomphalia umbellifera* fruitbody, a well-known algal associate, was seen on Mt. Ignoble on May 27, just a few weeks after the snow disappeared. Why did our *Arrhenia obscurata* not fruit until the end of July?

The answer is probably related to its choice of microhabitat. Whereas *Lichenomphalia, Inocybe* and *Lactarius* live in turf, where their mycelium can probably overwinter, it is quite likely that our fungus lives so exposed and in such shallow and superficial cracks and crevasses, that it freezes completely in the winter, killing the mycelium. There is no soil in its preferred cracks between foliation plates. Where fruiting bodies appeared on crumbled granite "soil", its measured depth was seldom over 1 cm. The fungus probably reappears as the result of new mycelial growth from sporulation into its substrate of choice. Once things thaw out and warm up, it takes several months for spores to develop into mycelia capable of producing fruiting bodies. The ability to survive early frost and ephemeral snow in the fall (in fact producing more sporocarps at that time) may be part of its strategy to drop a lot of spores with the falling and melting snow right into the same areas that it likes, to be ready to grow the next year.

Drought may also contribute to the late onset of fruiting. We have 30% more rain and more cloudy days in Aug-Oct than May-Jul. In an unprotected setting exposed to constant sun and wind, this may be sufficient to prevent viable fruiting bodies in the earlier, sunnier and drier quarter.

Lifestyle

How does *Arrhenia obscurata* produce such substantial beauty from its self-imposed austerity? As mentioned, the life of a traditional saprobe or mycorrhiza are unlikely. Among potential smaller partners we found moss, liverwort and alga. Many arrhenias are reputed to be moss associates. Two observations argue against our mushroom's being one of those. If it were a moss partner, then one might expect to find it preferentially among moss. Our mushroom preferred bare "soil" and avoided furrows where low moss had established itself. Secondly, the microscope did not reveal any hyphae associated with moss.

Liverworts might be a little more likely, because at least we saw a few hyphae near them. However, these were very few in number, and macroscopic liverworts were relatively uncommon around these mushrooms.

Several reasons argue that this mushroom might be a closet basidiolichen, i.e. an undeclared algal partner:

1. With their bare soil and botrydinal globules these mushrooms reminded us of *Multiclavula vernalis*, another basidiolichen denizen of pioneer soil.
2. Based on what we have seen, algal globules were the one consistent potential partner around these mushrooms—even on bare rock!
3. Macroscopic connecting threads could be seen between mushrooms and algae.
4. Microscopically the algae were all inside hyphal containers, connected by copious hyphae.
5. No other basidiolichen was seen in the vicinity to account for these mycelial algae farms. (*Lichenomphalia umbellifera* grew on the mountain, but not in these thin cracks and furrows.)
6. Sherlock Holmes states that if you discard explanations that do not fit, what is left—no matter how unlikely—is the solution: here, only algae are left.
7. Throughout their evolution, fungi have turned to the lichenized lifestyle whenever it suited them, with no respect to any classification we may impose upon them, so when it comes to omphalinoids, surely *Lichenomphalia* does not hold the patent to the use of algae?
8. The hyphae going to and from the granules, possibly even some surrounding them, seem to have clamp connections; better magnification and resolution is required to confirm this with absolute certainty.
9. And the most overwhelming reason: it goes against conventional wisdom.

One of us was privileged to pen a few words on basidiolichens for an upcoming lichen issue of FUNGI.[11] That article also makes a comparison with the first mushroom—an omphalinoid very similar to ours—to appear on Surtsey, an island off the coast of Iceland that arose from the sea due to volcanic activity. The island is a protected nature reserve, set aside exclusively to document the successive stages of colonization of pioneer soil. The story of that mushroom seems so parallel to our observations—even to a later discovery of green granules at its base—that we suspect that the first mushroom identified on Surtsey must be the same species.

Although we have studied our mushroom enough to almost fill this journal issue, we actually know very little about it. Even its identity is not certain. We can speculate, advance our theories with chest thumping and brave posturing, but really, we have more questions than answers. Greg Thorn made a brave attempt to extract DNA from the hyphae around the algal granules, but unfortunately these were reluctant to reveal their secrets.

Stay tuned as we learn more of this saxifragous Phoenix, arising anew each summer from cracks in the rock of Mt. Ignoble.

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ARRHENIA GRISEOPALLIDA

Andrus & Maria Voitk

As mentioned when discussing the putative *Arrhenia obscurata*, identification of small, brown arrhenias is difficult. However, a few have distinctive characters, not shared by others, which allows them to be separated from the group. One such species is *Arrhenia griseopallida*. Overall, it is a larger mushroom (cap diameter 3-25 mm, stem height 10-30 mm), whose stem length is nearly twice the cap diameter. The cap, as illustrated in the title banner, is distinctly scaly, not quite as scaly as *Arrhenia sphagnicola*, our logo, but reminiscent of it. The colour is darker and drabber, with gray rather than reddish tones.

Should any doubt remain, its distinct identification character is microscopic. Whereas most of the basidia of the other two species had four spores, all basidia of these had two, and the spores were big, 11.6-14.5 × 6.7-7.7 µm. Two-spored basidia and big spores easily keyed it out to *Arrhenia griseopallida*. However, before you jubilate that finally you have a reliable character, you should be aware that four-spored forms have also been reported. Of course.

The mushrooms illustrated were collected July 20, 2011, near a gravelly path to the lower or steep section of the Main River. The substrate was perhaps a bit more like disturbed soil than pioneer soil, and did have more moss, with some grass and other vascular plants as well, and even some small seedling conifers not too far away, only a few metres from the forest edge. That said, the soil was not rich, and one could make a case for newly "created" pioneer soil.

Arrhenia peltigerina

Andrus Voitk

Photo: Roger Smith

Omphalinoid fungi live in areas of poor soil. From this one might suspect that either they have developed special coping mechanisms to extract nutrition form this substrate, or they have developed partnerships, whether mutualistic or parasitic, with other organisms living in these habitats. Some (*Lichenomphalia*) have known algal associations, and other may as well. Some have associations with liverworts or mosses, some with lichens.

Among the latter is *Arrhenia peltigerina*. As the name suggests, it grows with the lichen *Peltigera*, which allows for relatively secure identification among this group of similar, small, brown mushrooms. The exact nature of this relationship is unclear: is it a parasite on the lichenized ascomycete, does it use its algae directly or indirectly, is there some other mutualistic relationship, or is it a saprobe specialized to dead thalli of *Peltigera*?

In size it is intermediate between *A. obscurata* and *A. griseopallida*: cap diameter 4-20 mm, stem length 8-30 mm; the stem again is usually twice cap width. The cap is smooth with a minute pebbly texture, without burr-like scales, like *A. griseopallida*. It is more translucent and the colour is lighter than the latter.

The illustrated specimen was collected from Change Island's Squidjigger trail on September 5, 2013. The lichen was identified by Michele Piercy-Normore as *P. degenii*. Whether *A. peltigerina* associates with all *Peltigera* spp., or only some, is unknown.

Photo: Michael Burzynski

ARRHENIA EPICHYSIUM

Andrus Voitk

Arrhenia epichysium (above) is uncommon in NL: the mushroom illustrated is the only one I have seen in over ten years of collecting. For a little brown mushroom in a group of little brown mushrooms, it is easy to recognize because of its substrate—the only *Arrhenia* to grow on rotted wood. The odds of a misidentification of an omphalinoid on this substrate is extremely slim. *Lichenomphalia umbellifera* (left) may be found on rotten wood, but it has a more crenulate or scalloped cap edge, wider gill spacing, ranges from white to yellowish tan, and if the log is bare of moss, the granular algal mat is readily seen.

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