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The California Lichen Society seeks to promote the appreciation, conservation and study of lichens. The interests of the Society include the entire western part of the continent, although the focus is on California. Dues categories (in $US per year): Student and fixed income - $10, Regular - $20 ($25 for foreign members), Family - $25, Sponsor and Libraries - $35, Donor - $50, Benefactor - $100 and Life Membership - $500 (one time) payable to the California Lichen Society, PO Box 7775 #21135 , San Francisco, California 94120-7775. Members receive the Bulletin and notices of meetings, field trips, lectures and workshops.

The Bulletin of the California Lichen Society (ISSN 1093-9148) is edited by Tom Carlberg, tcarlberg7@yahoo.com. The Bulletin has a review committee including Larry St. Clair, Shirley Tucker, William Sanders, and Richard Moe, and is produced by Eric Peterson. The Bulletin welcomes manuscripts on technical topics in lichenology relating to western North America and on conservation of the lichens, as well as news of lichenologists and their activities. The best way to submit manuscripts is by e-mail attachments or on a CD in the format of a major word processor (DOC or RTF preferred). Submit a file without paragraph formatting; do include italics or underlining for scientific names. Figures may be submitted electronically or in hard copy. Figures submitted electronically should provide a resolution of 300 pixels-per-inch (600 minimum for line drawings in JPEG format); hard copy figures may be submitted as line drawings, unmounted black and white glossy photos or 35mm negatives or slides (B&W or color). Email submissions of figures are limited to 10 MB per email, but large files may be split across several emails or other arrangements can be made. Contact the Production Editor, Eric Peterson, at eric@theothersideofthenet.com for details of submitting illustrations or other large files. A review process is followed. Nomenclature follows Esslinger cumulative checklist on-line at http://www.ndsu.nodak.edu/instruct/esslinge/chcklst/chcklst7.htm. The editors may substitute abbreviations of author's names, as appropriate, from R.K. Brummitt and C.E. Powell, Authors of Plant Names, Royal Botanic Gardens, Kew, 1992. Instructions to authors will soon be available on the Society's web site (below). Style follows this issue. Electronic reprints in PDF format will be emailed to the lead author at no cost.

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The California Lichen Society is online at http://CaliforniaLichens.org and has email discussions through http://groups.yahoo.com/group/CaliforniaLichens.

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Front cover: *Pannaria rubiginosa* and captured spores (see paper on page 1). Photography by Mikki McGee.

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Spore-Printing Lichens

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Sexual spores of lichens are important to the lichen-fungus as well as to the person identifying lichens, or classifying them. The person identifying or classifying lichens wishes to have clear unobstructed or unobscured view of as many spores as possible. Their sizes and shapes and septation are used in distinguishing one species from the other. For the fungus, spores are arguably less important as propagules for starting new thalli than as a sexual means for maintaining sexual or genetic diversity in the thallus and the population.

Finding enough spores that are clearly visible to identify the lichen can be difficult. Tissues may be overlaying or underlying the free spores found, making them less clearly visible. And spores still in asci are possibly distorted by the pressures of the ascus.

Mycologists studying mushroom fungi make a regular practice of trying to get a collection of spores on a piece of paper by laying the mushroom on paper in a moist environment (covered by a dish) for an hour or so. The spores falling onto the paper are then examined for dry color, and examined microscopically for size and form. The paper on which the print is made often stays with the specimen for later examination. Ascus-bearing larger fungi (dime to dinner plate size) sometimes are treated the same as the more common basidiocarps.

The fresh smaller ascocarps of lichens may also produce deposits of spores which can serve some of the same processes, when collected on cover glasses. I use 12x12mm cover glasses routinely, and often easily collect more than enough spores to characterize the spores and the lichen, and they are free of any tissues that might obscure them.

The method is simple, but does not work for most of the material already long dead in herbaria. It may be used successfully on material that has not been forcibly air dried or frozen. Lichens fresh from the field are best. If there are several specimens, one is selected. If only one is available, then it may be subdivided to produce one fragment for spore printing, or the entire collection used, at the discretion of the worker. A single fruiting body may be spore printed successfully, if it is fresh and alive and undepleted on collection.

The lichen is placed in a petri dish, and soaked with distilled water. (Tap water is generally treated with chemicals that may harm the lichen, and bottled water often contains many more bacteria and protozoa than tap water.) When the lichen is well soaked, excess water is poured off, and a cover slip is laid over several fruiting bodies. If the specimen is quite small, a folded wad of wet paper towel may be enclosed in the dish to maintain moisture (Figure 1). It is common for water to seal the cover glass to the lichen - it holds the cover glass in place.

The asci, on discharge, forcibly shoot the spores some distance, and the spores being sticky attach to the cover glass. After an hour or so, I examine the cover glass in water on a slide, to look for spores. In the meantime, I may be preparing other parts of the same collection, or having coffee.

Water is the first choice of mounting media. The spores so examined may still show their halos well, if they have them. The halo, being of weak gelatin, once dried and shrunk may not re-expand later. If one wishes to preserve the halo for later examination, transferring the cover-glass after measurement to a preserving mountant such as Hantsch's fluid may serve. I also use formalin-alcohol-acetic acid (FAA) to kill, fix and preserve spores and other things for less distorted later viewing than with other methods. But the first measurement is always in water.

I photograph and measure the spores in water first, and later may mount the spores in other media for other treatments. If several cover glasses are used, one can treat each one differently - one for staining in iodine, or one to Hantsch's, eliminating oil droplets to see the septa more clearly. The treated spores are then photographed and measured again, to see and record the effect of the treatments. Some of the spores may detach from the cover slip and be found on the slide when the cover slip is lifted, making two preservations possible, as well.

Some spores, as of *Teloschistes*, *Xanthoria and Caloplaca*, are routinely heat treated to kill and dry them, for comparison to herbarium type material. This is easily done on the cover slip after the initial examination. For my work, I want to see them fresh, as well. It is interesting to see the fresh viable spores, as well as seeing the mummies the taxonomists love.

Hantsch's Fluid:

1 part(ml) glycerin with 2 parts water are mixed as stock solution. One drop of 95% alcohol is added to one drop of this stock for use, yielding two drops of 1,2,3 glycerin-water-alcohol, which on evaporation of the alcohol and water can make permanent ringed slides of one 24mm or two 12mm cover glasses. Preserved slides are placed in packets after ringing.

Formalin-Alcohol-Acetic Acid (FAA):

This is a standard preservative, which for fungi and lichens is usually mixed 10 parts 40% formalin, 50 parts 95% Alcohol, 5 parts glacial acetic acid; with 35 parts of water. (Total 100 parts.)

The glacial acetic acid can be adjusted too: from 2 parts to 6 parts, (2%-6% final acidity) to reduce shrinkage, or swelling from formalin and alcohol. Adjust by exchanging water for acid, or vice verse. (Email me for answers to questions.)

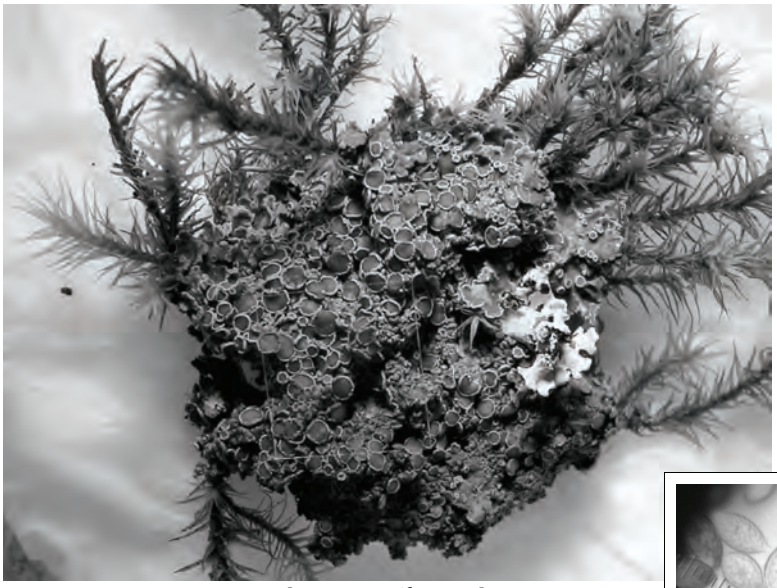

Figure 1. *Pannaria rubiginosa* (from the San Bruno Mountain field trip, reported elsewhere in this issue) prepared for spore printing. Note the paper toweling beneath the lichen. The edges of the cover slip are just visible. Printed in color on front cover.

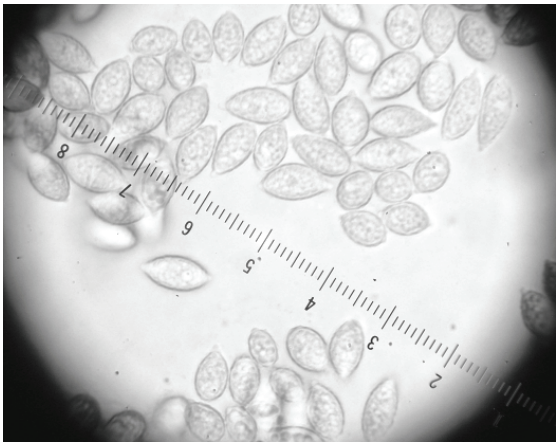

Figure 2. Spores captured using the methods in this article. Printed in color on front cover.

New Reports and Comments on California Lichens

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New additions to the California lichen flora are published continually, and some of these merit comments to stimulate searching and collecting in the state. Most are not in the most recent published checklist for the United States (Esslinger & Egan 1995), but all are in the online checklist by Esslinger (2008). I add these to my manuscript of the California catalogue (Tucker & Ryan, 2006) and eventually these additions will be inserted in the online version of the catalogue. Meanwhile, the following deserve attention from collectors.

***Byssoloma leucoblepharum* (Nyl.) Vainio.**

I found this crust once on bark in Mendocino County (*S. Tucker 35280*, Pygmy forest, Mitchell Creek Drive near Fort Bragg, SBBG). The apothecia are unmistakable because of the "byssoid" margin, like a fluffy halo of outward-extending colorless hyphae around the dark disk. There is a photograph of this crust in Brodo *et al* 2001 (p.192) showing the purplish-brown disk and pale margin, although the magnification is not great enough to show the fluffy margin. It is labeled as *B. meadii*, but that species has pale yellow disks and is in southeastern U. S. Another species, *B. marginatum*, has been found in *Sequoia sempervirens* treetops of Humboldt County by Williams & Sillett (2007). The minute apothecia of this species are pale greenish-gray and lack a byssoid margin.

An unusual lichen niche on the Pacific Northwest coast was mentioned by Williams & Sillett (2007) and more recently emphasized by Spribille et al. (2009). Unusual minute lichen crusts occur on stems of ericaceous evergreen shrubs such as species of *Vaccinium* and *Rhododendron*, close to ground level in rain forests. Collectors in northern CA could add new reports to the California lichen flora by searching this niche.

***Ptychographa xylographoides* Nyl.**

McCune (1997) described this taxon from Oregon; Williams & Sillett (2007) climbed to the tops of redwoods in Humboldt County and found an amazing flora of lichens, mosses and angiosperms growing there. They found 183 lichen species, 50 bryophytes, and 49 species of vascular plants. The article is well worth reading, as it not only describes the rope-climbing techniques used to access the treetops, but also discusses in detail the many and varied niches where lichens may grow – on live and dead foliage, large vs. small branches and twigs, bare wood, soil and plant debris lodged in branch crotches, and tree litter. *Ptychographa* is found on dead wood, especially in conifer forests, the same habitat as the similar *Xylographa*. McCune (1997) mentioned a means of field identification: *Ptychographa* resembles a *Graphis* or *Opegrapha* in having black lirellae (elongate apothecia) but has a middle ridge separating two parallel elongate hymenia. The spores are colorless unicells, like those of *Xylographa* but quite unlike the septate spores of either *Graphis* or *Opegrapha*.

Other lichens new to California found by Williams & Sillett (2007) include a new species of pin-lichen, *Calicium sequoiae* (Williams & Tibell 2008), three newly reported species of *Micarea* (determined by Brian Coppins), and the first state report of *Segestria leptalea*, a pyrenolichen with tiny orange perithecia on bark.

***Arthonia*.**

These inconspicuous crusts are common on bark, with at least 29 species reported from California, differing mainly in ascocarp appearance and spore type (Grube 2008 [2007]). The ascocarps may be circular dark spots ~ 1 mm in diameter, or lirellae, branched or dendroid, pruinose or not, depending on the species. The nearly globose asci are usually within one or two layers of the surface of the bark, and contain eight spores. With Grube's key available, it is worth collecting likely species of *Arthonia*. Probably the most common *Arthonia* is *A. pruinata*, a white pruinose crust common on live oak, *Quercus agrifolia*. Other species that are common in the Santa Barbara area are A. *lecanactidea, A. pinastri, A. sanguinea*, and *A. tetramera*. In north coastal counties, *Arthonia ilicina* occurs on alder.

Several species of *Arthonia* were found by Williams & Sillett (2007) in Humboldt County, but the species reported (*Arthonia arthonioides, A.*

leucopellaea, A. stellaris), most of which would be new to CA, are probably incorrect. The specimens respectively key to more likely species reported by Grube (2008 [2007]) in the recent Sonoran Lichen Flora as *Arthonia pinastri, A. glaucella*, and *A. pyrrhuliza*. I've found *A. pinastri* on pine, *Quercus agrifolia*, *Populus trichocarpa*, and sycamore in Santa Barbara County.

Grube (2008 [2007]) has sunk the genus *Arthothelium* (having muriform spores) in *Arthonia* (mostly septate spores). He does not consider spore type sufficient to separate these two genera. A common California *Arthonia* with muriform spores is *Arthonia beccariana*. The ascocarps are circular black superficial spots on twigs. The spores are 18-23 µm long. I have found *Arthonia beccariana* on cultivated *Aralia* and *Beaucarnea* (ponytail palm) in Santa Barbara County and on *Populus* sp. on the campus of the University of California, Santa Cruz. Another related species, *Arthothelium norvegicum* Coppins & Tønsberg, was discovered on *Vaccinium ovatum* twigs (Tønsberg & Williams 2006, citing C. Williams 313, Humboldt Co. collection; Williams & Sillett 2007). It has not been transferred officially to *Arthonia* so remains in *Arthothelium* for the time being. The spores are much larger than those of *Arthonia beccariana*.

***Candelaria pacifica* Westberg.**

Reference to recent issues of CALS Bulletins, summarized by Carlberg & Doell (2009), indicates that most collectors are not yet recognizing that our most common *Candelaria* on bark may be *C. pacifica*. *Candelaria concolor* has been widely accepted as the common species across the U. S., but Westberg & Nash (2002) recognized that *C. pacifica* is very common on the west coast. Most of my collections, from Amador and Solano County in central CA to those in Santa Barbara County, key to *C. pacifica* in Westberg's key (2002). *C. pacifica* is characterized by having soredia below the tips, no lower cortex, and by having 8-spored asci.

***Candelariella antennaria* Räs., *C. biatorina* M. Westb., & *C. lutella* (Vain.) Räs.**

Species of *Candelariella* on bark have bright gold-colored crustose thalli, often with apothecia but are generally small and overlooked. Westberg's key (2004) reveals that there are several species on bark that should be looked for in California. Among these, *Candelariella biatorina* (Westberg 2007a; Westberg & Nash 2008 [2007]) is easily identified by its biatorine apothecia (lacking a margin), as shown in a color photograph in Sonoran Flora, Vol. 3. It is found on conifer bark or wood. Two other species with lecanorine apothecia (having a margin) include *Candelariella antennaria* with yellow apothecia on a gray thallus and 8-spored asci, and *C. lutella* with yellow apothecia and thalli, and 24-32 spores per ascus. Three articles by Westberg (2007a, 2007b, 2007c) comprise a monograph of *Candelariella* for the western U. S. and Mexico.

***Coenogonium luteum* (Dicks.) Kalb & Lücking.**

This species was formerly called *Dimerella lutea*, and is easily recognized by the usually vivid green crust on bark and pale orange apothecia, less bright than a *Caloplaca*. The only recent published primary report for CA is by Judy Robertson (2002a) from Monterey County; I've found it in the pygmy forest in Monterey County, on Monterey cypress on the Monterey peninsula, and on madrone on the campus of University of California, Santa Cruz, on a CALS foray (Tucker *et al.* 2004). A second species, *Coenogonium pineti* (Ach.) Lücking & Lumbsch, has been reported only once in CA, near Larkspur in Marin County by Albert Herre in 1943; I have verified the specimen, now in the Field Museum herbarium in Chicago.

***Hypogymnia gracilis* McCune.**

This species was recognized and published by Bruce McCune (2002). He identified many specimens labeled *H. imshaugii* from the Santa Barbara Botanic Garden herbarium as *H. gracilis*, based on the white internal surface and small regular holes on the lower side. It is worth checking specimens of *H. imshaugii*, the most common *Hypogymnia* in California, for unrecognized collections of H. *gracilis*. Some records of *H. gracilis* include *D. Keil*, s.n., Los Osos, San Luis Obispo Co., Nov 1955, OBI; *T. Nash 29969*, Hastings Natural History Reserve, Monterey Co., ASU; *S. Tucker 37576*, trail to East Peak, Mt. Tamalpais, Marin Co., SBBG.

***Menegazzia subsimilis* (H. Magn.) R. Sant.**

This species resembles the more common *M. terebrata* of the north-coastal flora except that it has stalked soralia. Looking through specimens labeled *M. terebrata* in herbaria will probably turn up one or two of *M. subsimilis* that had not been recognized. Williams & Sillett (2007) found *M. subsimilis*, a new report for California, in the tops of *Sequoia* trees in Humboldt County.

Pseudocyphellaria perpetua (Miadlikowska et

al. 2002) was also found by Williams & Sillett (2007). It is a foliose macrolichen, resembling *P. crocata* except that *P. perpetua* has a yellow medulla (versus white in *P. crocata*), and mostly marginal soralia (laminal as well as marginal in *P. crocata*).

Punctelia.

Five species of the foliose lichen *Punctelia* can be found in California, with *P. perreticulata* being the most common on bark (Egan & Aptroot 2004). Most species have white dots or pores (pseudocyphellae) on the upper surface. Reports of *P. subrudecta* in CA are misidentifications of *P. perreticulata*. The photograph in Brodo *et al*. (2001, p. 609), while labeled as *P. subrudecta*, is *P. perreticulata*. On rock one finds *Punctelia stictica*, common on boulders on Mt. Tamalpais in Marin County, and *P. punctilla*, on the Channel Islands and mainland of Santa Barbara County, at the Santa Barbara Botanic Garden. *Punctelia borreri* and *P. ulophylla* also have been reported in the state.

LITERATURE CITED

Brodo, I.M., S.D. Sharnoff, & S. Sharnoff. 2001. Lichens of North America. Yale University Press, New Haven.

Carlberg, T. & J. Doell. 2009. California lichens by county compiled from field trip reports in the Bulletin of the California Lichen Society. Bulletin of the California Lichen Society 15 (2): 30-42.

Egan, R.S., & A. Aptroot. 2004. *Punctelia*, pp. 431-436, *in* T. H. Nash III, B. D. Ryan, P. Diederich, C. Gries, & F. Bungartz (eds.), Lichen flora of the Greater Sonoran Desert region, Vol. 2. Lichens Unlimited, Arizona State University, Tempe.

Esslinger, T.L. 2008. A cumulative checklist for the lichen-forming, lichenicolous, and allied fungi of the continental United States and Canada. North Dakota State University, http://www.ndsu.nodak.edu/instruct/esslinge/chcklst/chcklst7.htm (posted 18 January, 2008), Fargo, N.D.

Esslinger, T.L, & R.S. Egan. 1995. A sixth checklist of the lichen-forming, lichenicolous, and allied fungi of the continental United States and Canada. The Bryologist 98: 467-549.

Grube, M. 2008 (2007). *Arthonia*, pp.39-61, *in* T. H. Nash III, C. Gries, & F. Bungartz (eds.), Lichen flora of the Greater Sonoran Desert region, Vol. 3. Lichens Unlimited, Arizona State University, Tempe.

McCune, B. 1997. *Ptychographa*, a lichen genus new to North America. The Bryologist 100: 239-240.

McCune, B. 2002. *Hypogymnia*, pp. 228-238, *in* T. H. Nash III, B. D. Ryan, C. Gries, & F. Bungartz (eds.), Lichen flora of the Greater Sonoran Desert region, Vol. 1. Lichens Unlimited, Arizona State University, Tempe.

Miadlikowska, J., B. McCune, & F. Lutzoni. 2002, *Pseudocyphellaria perpetua*, a new lichen from western North America. The Bryologist 105: 1-10.

Robertson, J. 2002a. Pygmy Forest field trip, Mendocino County, March 16, 2002, and list of macrolichens of the Pygmy Forest. Bulletin of the California Lichen Society 9 (1): 8-12.

Spribille, T., C.R. Björk, S. Ekman, J.A. Elix, T. Goward, C. Printzen, T. Tønsberg, & T. Wheeler. 2009. Contributions to an epiphytic lichen flora of northwest North America: 1. Eight new species from British Columbia inland rain forests. The Bryologist 112(1): 109-137.

Tucker, S.C., J. Robertson, & S. Altermann. 2004. Lichen foray on the campus of University of California, Santa Cruz, May 15-16, 2004. Bulletin of the California Lichen Society 11(2): 48-53.

Tucker, S.C. & B.D. Ryan. 2006. Revised catalogue of lichens, lichenicolous and allied fungi in California. Constancea 84 (University of California, Berkeley) Online (http://ucjeps.berkeley.edu/constancea/84/)

Westberg, M. 2004. *Candelariella*, pp. 46-53, *in* T. H. Nash III, B. D. Ryan, P. Diederich, C. Gries, & F. Bungartz (eds.), Lichen flora of the Greater Sonoran Desert region, Vol. 2. Lichens Unlimited, Arizona State University, Tempe.

Westberg, M. 2007a. *Candelariella* (Candelariaceae) in western United States and northern Mexico: the species with biatorine apothecia. The Bryologist 110(3): 365-374.

Westberg, M. 2007b. *Candelariella* (Candelariaceae) in western United States and northern Mexico: the polysporous species. The Bryologist 110 (3): 375-390.

Westberg, M. 2007c. *Candelariella* (Candelariaceae) in western United States and northern Mexico: the eight-spored, lecanorine species. The Bryologist 110(3): 391-419.

Westberg, M., & T.H. Nash. 2002. *Candelaria*, pp. 116-118, *in* T. H. Nash III, B. D. Ryan, C. Gries, & F. Bungartz (eds.), Lichen flora of the Greater

Sonoran Desert region, Vol. 1. Lichens Unlimited, Arizona State University, Tempe.

Westberg, M., & T.H. Nash. 2008 (2007). *Candelariella*, pp. 378-380, *in* T. H. Nash III, C. Gries, & F. Bungartz (eds.), Lichen flora of the Greater Sonoran Desert region, Vol. 3. Lichens Unlimited, Arizona State University, Tempe.

Williams, C.B., & S. Sillett. 2007. Epiphyte communities on redwood (*Sequoia sempervirens*) in northwestern California. The Bryologist 110 (3): 420-452.

Williams, C.B., & L. Tibell. 2008. *Calicium sequoiae*, a new lichen species from northwestern California, U. S. A. The Lichenologist 40:185-194.

Basic Lichenology 2: Reproduction

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Lichens are incredibly diverse organisms, with a documented catalogue of over 4400 species in North America (Tucker & Ryan 2006) and more being discovered all the time. They are diverse in a variety of characters, such as thallus type, substrate preference and pollution tolerance. One set of characters that holds great variety involves modes of reproduction. Structure and anatomy of lichen reproductive organs are also key toward lichen identification.

Lichens can reproduce vegetatively or sexually, and often do both. Vegetative means can involve specialized organs such as soredia or isidia, or simply through thallus fragmentation. Sexual reproduction typically involves the fungal partner only, and the variety of fruiting bodies or ascomata (sing. ascoma) is mind-boggling. Not only that, but their internal anatomy such as tissue arrangement, spore sacs (known as asci) and the spores themselves vary quite a bit across species and higher orders of taxonomy like genus, family, etc. Overall, lichens of all types can have any of these structures, and often in combination. Reproductive traits are usually species specific, thus their usefulness in identification.

Vegetative Reproduction

Soredia are minute dispersal packets consisting of a few algal cells wrapped by fungal threads, and often appear as pale granules. Their placement on the lichen thallus varies, and depending on species, they can appear on the thallus surface, on lobe tips, margins or in patches of broken cortex known as soralia. In some loop lichens (*Hypotrachyna*), the thallus can form pustules that break open to release soredia; these are known as schizidia. Finally, the soredia of some crustose lichens can even comprise the entire thallus. These latter lichens, such as those in the genus *Lepraria*, are known as dust lichens.

Isidia are small, finger-like extensions of the thallus, which break off and disperse in the wind. They have a cortex, medulla and algal layer, and can be globular, cylindrical or branched. Many rock shield lichens (*Xanthoparmelia*) use isidia to propagate themselves. Both soredia and isidia are best seen with a hand lens, but soralia can be seen with the naked eye.

Fragmentation is often employed by lichens that are brittle and tend to break apart when dry, like many reindeer lichens (*Cladonia* spp. formerly known as *Cladina*). One unusual microfoliose lichen found in the tropics and eastern North America that uses fragmentation exclusively is *Flakea papillata*. Its minute lobes are dichotomously branched and very thin, and thus flake off (hence the name). Lacking any reproductive organs, this species was not known to be a lichen until the 1990s and went by the name "The Thing" as bryologists and lichenologists struggled to classify it (Perlmutter 2006). Only recent molecular analysis has placed *F. papillata* into a lichen family (Muggia et al. 2009).

Asci, Spores and the Fungal Sexual Life Cycle

While the vegetative propagules serve to reproduce the lichen as a whole organism, it does not leave the opportunity for genetic material to mix and produce offspring that are genetically different. In lichens only the fungal partner reproduces sexually (the photobiont cells merely divide), and the way fungi "do it" is distinct from that of plants and animals, earning their placement in a separate Kingdom. In a word, fungal sex is weird.

For starters, the thallus is haploid, meaning that only one set of chromosomes exist in any given cell nucleus. We animals are diploid, with two sets of chromosomes per nucleus, and only our eggs and sperm are haploid. Plants are also diploid, but they involve an alternation of generations with haploid stages of their life cycle growing as multicellular organisms, largely hidden in cones, flowers or freely growing on the soil as in mosses and liverworts. From our animal viewpoint, fungi can be seen as backwards in their lifecycle. But it gets even stranger.

The life cycle begins with a spore (haploid, or *n*), which germinates into a hypha. This hypha splits and grows, captures an alga or cyanobacterium, and the combination of partners triggers the fungus to produce a lichen thallus. When two adjacent thalli meet, they may merge. Because of this merging, the

concept of the individual is not really applicable to lichens, for a single thallus can represent one individual or an entire colony all merged into one form. That's why we call "individual" lichens "thalli". When a thallus matures, ascomata develop and this is where the fungal sex happens.

In fungi there is no male and female, but rather type "a" and type "b". Another strange thing with fungi is that their cells are multinucleated, resulting from the breakdown of cell walls. In the base of a developing ascoma, a hypha from one of the types develops into a multinucleated ascogonium, while that of the other type into an antheridium, containing an equal number of nuclei as the former. These two microscopic organs merge and share nuclei, which do not themselves merge, but instead lie side by side in a stage known as dikaryon (literally "two nuts", or *n* + *n*). The dikaryotic stage is a character that both sac and mushroom fungi share and have probably evolved from a common ancestor.

From the dikaryotic ascogonium, ascogenous hyphae develop, each composed of cells containing nuclei from the two parents. The nuclei then merge, becoming fertilized like egg and sperm. The resulting diploid (*2n*) structure becomes the ascus, or sac, from which the Ascomycota or sac fungi get their name. Inside the ascus meiosis occurs, mixing the genetic material from the parent nuclei and producing four daughter cells (*n*). These cells undergo one mitotic division, resulting in the set of eight ascospores typical of lichens. Together the spores and the ascus develop analogous to offspring inside a womb until the spores are ejected from the ascus to be carried by the wind.

Anatomy of the Ascoma

Ascomata come in two major types: apothecia (open cups) and perithecia (closed cups). Within these two types is a dazzling array of forms. To understand their variety we must describe their anatomy.

A typical ascoma, say that of a rim lichen (*Lecanora*; Figure 1), has five tissues. These are the eiphymenium, hymenium, hypothecium, exciple and thalline rim. The uppermost tissue of the cup is the epihymenium, which is made up of the tips of short fungal threads known as paraphyses, and tips of asci. These tips are often swollen and in the case of paraphyses sometimes branched. Often there are granules in this tissue that give the disk its color, and sometimes granules also lie on top, giving the disk a frosted look. The outer granules are known as pruina; such a disk is described as pruinose.

Under the eiphymenium lies the hymenium. An important tissue, this is where the spores are produced. They develop in the asci, which are supported in an upright position by the paraphyses. This is so that when spores are dispersed from the asci tips, they leave the ascoma. More on asci and spore diversity below. These organs take root in the hypothecium, a dense fungal tissue made up of highly branched hyphae, including ascogenous hyphae.

Surrounding these tissues is the exciple, which functions as the outer wall. When exposed, it usually appears as a thin rim the same color as the disk, such as in many button lichens (*Buellia*). The exciple can surround the disk like a cup, or just the base of it, or just the sides and not extending below. In perithecia the exciple completely surrounds the ascoma, leaving only a hole for spore release. And surrounding the exciple is a thalline rim, composed of cortical, medullary and photobiont tissues. The thalline rim, as the name implies, is the same color as the thallus.

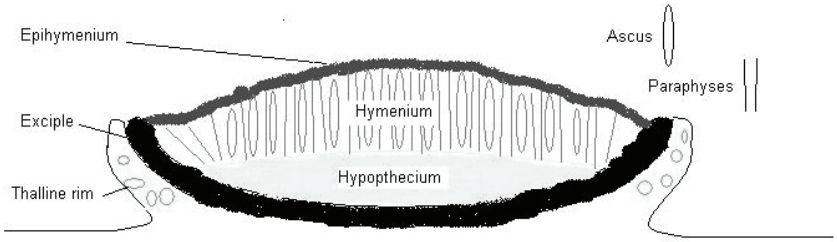


Figure 1.

Types of Ascomata

As noted above there are a plethora of ascomatal types, which vary in the composition and arrangement of tissues just described. Many of these are family specific, and can be readily observed in the field. Following is a tour of fruiting body diversity.

Arthonioid apothecia are the simplest forms of apothecia (Figure 2A), with a poorly developed exciple and no thalline rim. Superficially they are often very small, and can

vary from dot-like to star-like, but often are irregular in shape. These are typical of the Family Arthoniaceae, also known as dot, comma or asterisk lichens. These lichens are crustose with very simple thalli, and are considered a basal lichen branch (Martin Grube, pers. comm.).

Lecanorine apothecia (Figure 2B & 2C) are the quintessential apothecia, with all tissues present and fully developed. They are the ascomata found on rim lichens (f. Lecanoraceae), shield lichens (f. Parmeliaceae) and others within the Order Lecanoromycetes.

Lirellae are elongated apothecia (Figure 2D), often branched to starlike. Lirellae are diagnostic of the crustose script lichens (f. Graphidaceae), also known as graphids.

Lecideine apothecia (Figure 2E) lack thalline rims, but have prominent excipular rims. The rims are the same color as the disk, and are usually black (*i.e.*, carbonized). In shape they are typically flat, but in more mature apothecia of some species, the exciple is overgrown by the hymenial tissues and appear convex. Button lichens (genus *Buellia*) and rock tripes (*Lasallia* and *Umbilicaria*) are typical in bearing these apothecia as well as many crustose taxa that are often difficult to identify. These latter crusts bear the name "Little Black Dots", not unlike the "Damn Yellow Composites" of the sunflower family (Asteraceae) that frustrate our botanist friends.

Biatorine apothecia (Figure 2F) are similar to lecideine ones, but are paler in color with the exciple noncarbonized. They are typical of crusts in the genera *Bacidia* and *Biatora*.

Maezedia are a specialized type of ascoma with tissues so reduced that only a mass of loose spores are seen. Maezedia are usually stalked and are diagnostic of the minute "stubble lichens" (*e.g. Calicium, Chaenothecopsis*), which are themselves indicative of healthy environments.

In **thelotremoid** or "double-walled" apothecia the thalline wall is separated from the exciple and is termed a columella (Figure 2G). These are characteristic of the largely tropical family Thelotremataceae, known as barnacle or volcano lichens. (Note: thelotremoid lichens have just been recognized to lie within the Graphidaceae through molecular analysis, but the taxonomic change has not yet been made [Papong *et al.* 2009].)

Pertusarioid apothecia – The thalline margin is thick and wart-like, covering the apothecium with only a pore (ostiole) for spore release (Figure 2H). Warts can contain one to several apothecia, each distinguished by its ostiole. The crustose Wart Lichens (f. Pertusariaceae: *Pertusaria*) are characterized by pertusarioid apothecia.

Perithecia – These are a type of ascoma largely buried in the thallus in which the exciple has nearly fully enveloped the inner tissues, leaving only an ostiole for spore release (Figures 2I & 2J). While found in separate evolutionary lines of sac fungi, it appears that this ascoma type has evolved from the open condition of apothecia (Liu & Hall 2004). Perithecia usually appear as convex black fruiting bodies with an ostiole at the apex, although there are deviations in this body plan. They may be separate or grouped; the groupings may be in thalline tissue in a structure called the pseudostroma (as in *Trypethelium*), or the perithecia may be fused to form one exipular mass with several ostioles. This latter condition is known as compound perithecia and is characteristic of *Mycoporum*. Most perithecial lichens are crustose and represent several families; but some, such as stipplescales (*Dermatocarpon*), are squamulose.

Pycnidia and Conidia

Resembling small perithecia are pycnidia, flask-shaped reproductive bodies that produce asexual spores called conidia. Like ascomata, pycnidia serve to reproduce only the fungal partner of the lichen. Conidia are produced by the budding of specialized hyphae inside a pycnidium and can appear in large numbers. Appearing as tiny black dots, pycnidia can be produced on lichens bearing apothecia or perithecia, and in the latter they are distinguished in the field by their smaller size. Internally, pycnidia are distinguished by lacking ascomatal tissues, and the conidia are generally smaller than spores, one cell each and colorless, and far more numerous.

Asci and Ascospores

Both the asci and the spores they contain vary from species to species, and can even distinguish genera or goups of higher taxonomic order. Asci can vary in size, shape and details of their tips, where the spores eject from. In arthonioid genera such as *Arthonia* and *Arthothelium*, these are balloon-shaped, whereas those of other genera may be either club-shaped or cylindrical. Asci may contain one or several layers of walls, which function in spore release. The tips of asci are typically thickened, and this thickened part is termed the tholus. Parts of the tholus and the ascal walls variously stain blue with iodine, which is important in keying of many lichens, especially crusts. As the ascus and the spores inside mature, pressure builds inside, until the tip breaks,

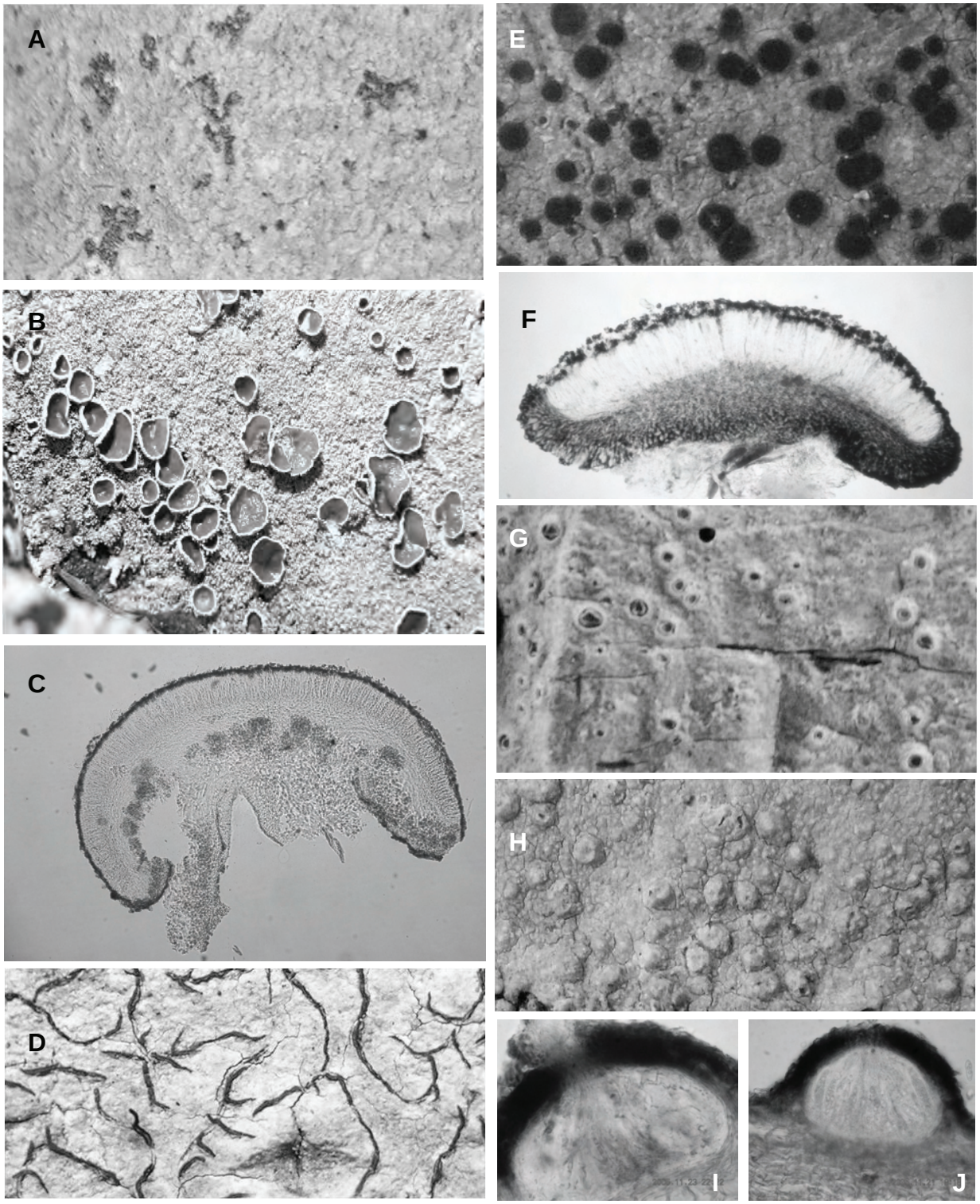


Figure 2. Ascomata. A) Arthonioid apothecia. B) Lecanorine apothecia. C) Lecanorine in cross-section. D) Lirellae. E) Lecidine apothecia. F) Biatorine apothecia. G) Thelotremoid apothecia. H) Pertusarioid apothecia. I and J) Perithecia. Photography by Gary B. Perlmutter (A, B, D, E, G, and H) and Mikki McGee (C, F, I, and J). Figure printed in color on back cover.

shooting the spores to be dispersed by wind currents.

Ascospores vary by size, shape, color, number of cells (Figure 3), and how many are produced per ascus. These traits are most useful in identifying crustose lichens. Colors are usually either clear (as in *Lecanora*) or some shade of brown at maturity (*Buellia, Pyrenula*); colors typically develop as the spore matures. Sizes range from a few microns (1/1,000 mm; "μm") to over 200 μm and barely visible under a dissecting scope. Conversely, the smallest spores can be found in the largest numbers (over 100) per ascus (*Acarospora*), whereas the largest are typically solitary in the ascus (in some *Pertusaria*). Spores can also range from globose through various grades of elliptical to thin and needlelike (*Bacidia*). And their septation varies. Simple spores are just one cell each (as in *Lecanora*). Transversely septate spores are composed of cells in a single line, produced by lateral divisions, and can range from merely two in species of Buellia to many as in some species of Bacidia. Following transverse septation is longitudinal septation; spores with many cells are termed muriform or submuriform, the latter when one longitudinal septation is incomplete.

In summary, lichen reproduction is fascinating and the variety of modes and structures lichen species use to propagate themselves will keep many of us glued in wonder to our handlenses and microscopes for years to come. As I like to say, the beauty lies in the details. For pictures of this great variety I recommend Chapter 3 of Brodo *et al.* (2001).

LITERATURE CITED

Brodo, I.M., S.D. Sharnoff and S. Sharnoff. 2001. Lichens of North America. Yale University Press, new Haven, CT. 795 pp.

Liu, Y.J. and B.D. Hall. 2004. Body plan evolution of ascomycetes, as inferred from an RNA polymerase II phylogeny. PNAS 101(13): 4507-4512.

Muggia, L., C. Gueidan, G.B. Perlmutter, O.E. Eriksson, M. Grube. 2009.. Molecular data confirm the position of *Flakea papillata* in the Verrucariaceae. Bryologist, 112(3):538-543.

Papong, K., R. Lücking, A. Thammathaworn, K. Boonpragob. 2009. Four new taxa of *Chroodiscus* (thelotremoid Graphidaceae) from southeast Asia. Bryologist 112(1): 152-163.

Perlmutter, G.B. 2006. *Flakea papillata* in North America. Bryologist 109(4): 566-569.

Tucker, S.C. and B.D. Ryan. 2006. Revised catalogue of lichens, lichenicoles and allied fungi in Califorina. Constancea 84 (http://ucjeps.berkeley.edu/constancea/84/). Accessed on 11 March 2009.

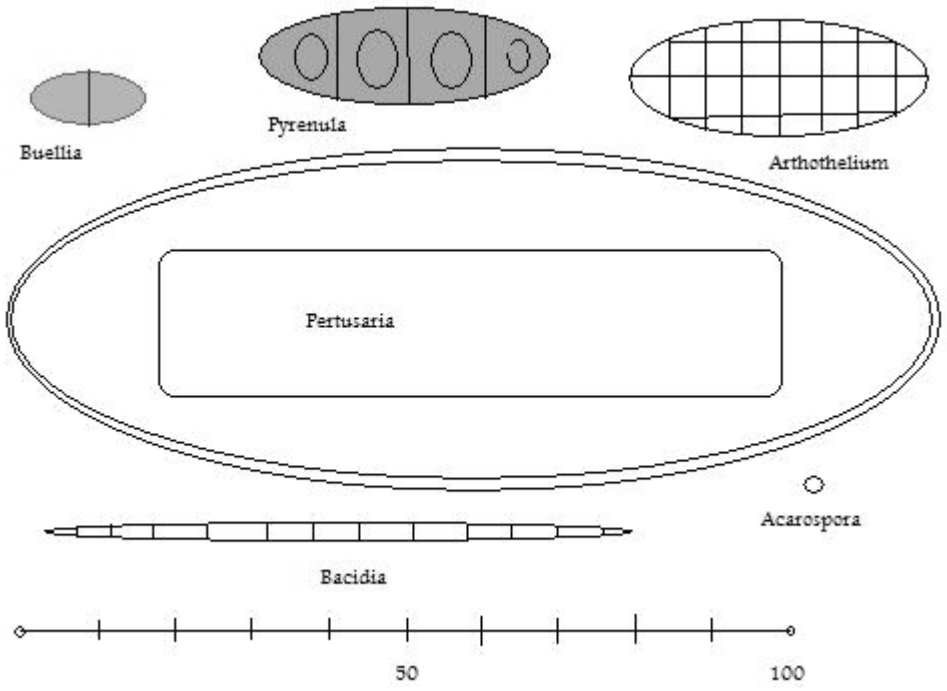


Figure 3. Variation in Ascospores. Scale in micrometers.

Ronald "Ron" Robertson

Ron Robertson passed away peacefully at home after a three-year battle with cancer, on 27 January 2009. He was sixty-three.

Ron taught biology in the Sonoma Valley School system for thirty one years, until his retirement in 2006. He was born in Earlimart, California, to Wanda Massey, a single mother who immigrated to the California Central Valley from Tupelo, Oklahoma, after the Great Dust Bowl. He met his future wife, Judy Robertson, in the sixth grade at the John S. Park Elementary School in Las Vegas, Nevada, where he took his first solitary hike through the Charleston mountain range at age 11. He returned with a nascent love for the plants, animals, and topography of the Great Basin ecosystem. In his senior year of high school, he supported himself by working the night shift as a dishwasher in several casinos. He graduated at the top of his class, and was awarded an engineering scholarship to the Colorado School of Mines in Golden, Colorado. He later attended the University of California at Berkeley on the GI bill, after serving in the United States Marine Corps, and graduated with a degree in Biology. He was an avid naturalist and lepidopterist who worked with the California Academy of Sciences, and tirelessly conducted research on noctuid moths. Five moth species, and one species of moss, have been named after him, and his collections can be found in herbariums at UC Davis, UC Berkeley, and Sonoma State University. He was a member of the California Lichen Society, the British Lichen Society, and the Lepidopterist Society. He leaves behind his beloved wife of 37 years, Judy Robertson, one sister, and two daughters, Lisa and Kelly, who learned from him the appropriate way to catch a sheep moth in the high altitude Sierra Nevada; to identify tiger beetles below sea level in the Mojave basin; the correct way to hold a King snake; and the careful way to handle Darkling beetles; and how to identify a Mourning Cloak butterfly in mid flight. He believed in hard work in the face of obstacles, the enduring power of the written word, and the ecological mystery of the American Southwest, where he ultimately found the greatest peace.

Under the Lens

FIELD TRIP REPORT
SAN BRUNO MOUNTAIN
DECEMBER 13, 2008

On Saturday, December 13, 2008, ten individuals from CALS and the CNPS Yerba Buena chapter gathered at the park entrance parking lot of San Bruno State Park, south of San Francisco, despite dire predictions of rain, for a lichen walk, ostensibly led by Cheryl Beyer. J. R. Blair, , Lee Gallagher, Jan Hintermeister, Bill Hill, Ken Howard, Daniel Kushner, Bill Lupfer, Mikki McGee and Henry Schott all attended.

San Bruno Mountain State Park is a 2,266 acre natural reserve at the northern end of the Santa Cruz Range, with day-use facilities, hiking trails, and beautiful views of the city and the bay.

After a brief introduction to lichens, the group drove up to the top of the San Bruno, parked, and spent several hours walking along the Summit Trail. Mikki McGee and Bill Hill provided interesting lichen tidbits and identifications along the way.

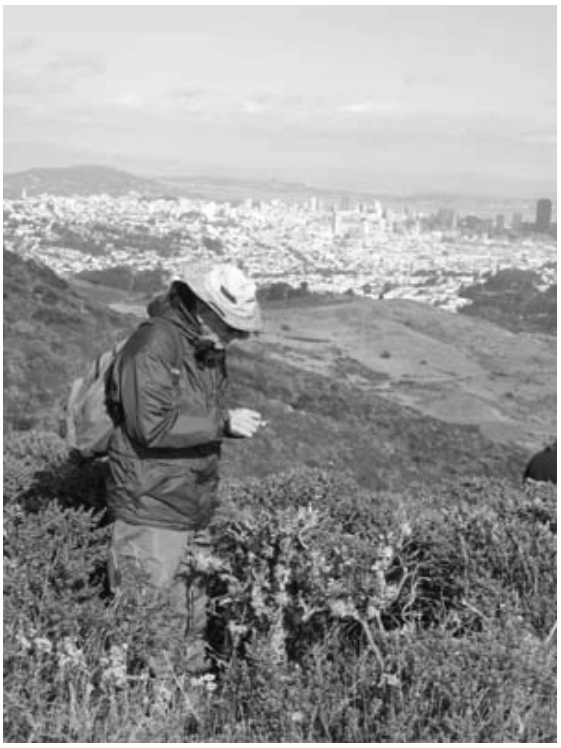


Figure 1. Bill Lupfer on San Bruno Mountain with San Francisco in the background.

There were several highlights to the trip: 1) the blue lichen, *Pannaria rubiginosa*, on the shrub *Baccharis pilularis* and nestled in a bed of the moss *Orthotrichum lyellii* along with *Heterodermia leucomelos*; and 2) *Abrothallus welwitschii* on *Sticta limbata* - both lichens found by Mikki (see http://www.nhm.uio.no/botanisk/lav/RLL /PDF/McGee_10-2.pdf).

Besides lichens and mosses, there was a small patch on soil of the liverwort, *Cephaloziella divaricata* var. *divaricata*. Schofield (2002) reports that this is an extremely hairlike plant with leaves barely as wide as the stem, and its small size may result in considerable difficulty in recognizing patches of this plant as a liverwort.

The sunny, windless weather lasted until about 2 pm, just long enough for the participants to have the parking lot within view. The predicted rain was seen approaching the ridge, and the trip ended abruptly in a gust of wind.

Reported by Cheryl Beyer and Mikki McGee.

LICHEN SURVEYS AT CLAREMONT CANYON

CALS has entered into an informal cooperative partnership with the Claremont Canyon Conservancy in Berkeley, to conduct an inventory of lichens in the Canyon. The Conservancy is a stewardship organization dedicated to the preservation and restoration of Claremont Canyon's natural landscape. One of their primary goals is to promote fire safety throughout the canyon and in adjacent residential neighborhoods, a vital concern in an area that has experienced fourteen wildfires in the 20th century. Both the 1991 Oakland hills fire and the 1923 Berkeley fire burned a portion of Claremont Canyon.

CALS became acquainted with the Claremont Canyon Conservancy when the 2nd edition of the *Mini guide to some common California lichens* was published. University Press Book Store in Berkeley traditionally hosts an invitational event whenever they add a new subject to their field guide section, and the Mini guide is their first book on lichens. Bill McClung, co-owner of the bookstore, and Martin Holden, both members of the Board of Directors of the Conservancy, invited members of CALS and interested members of the Conservancy to a

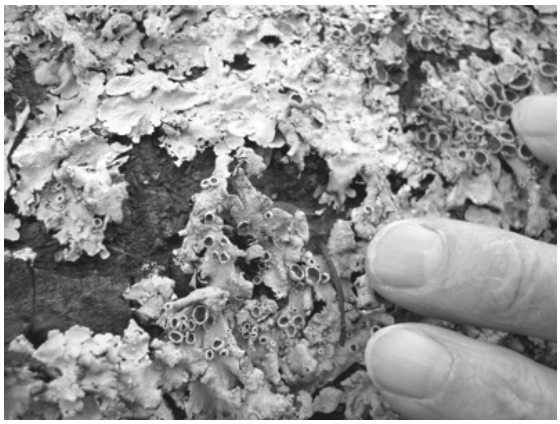


Figure 2: Undetermined lichen at the Claremont Canyon Conservancy. Photography by Bill McClung.

conversational gathering with light refreshments at the bookstore to talk about lichens and other related matters. About a dozen people appeared for this event.

Out of this gathering grew the idea for CALS to do an inventory of the lichens found on the Conservancy lands: 500 acres consisting of various parcels belonging to the University of California, the East Bay Regional Park District, the East Bay Municipal Utility District, AT&T, the Pacific Foundation, the City of Oakland, and some properties held privately.

The Claremont Canyon Conservancy helps hold all of these various owners together in a group dedicated to being stewards of Claremont Canyon "not only for the safety of our family and homes, but to ensure the survival of the Canyon as a source of natural beauty and discovery for the broader community". Toward this end, fire control, eradication of invasive plants and the encouragement of native plants and animal habitats are important factors in the conservancy's ongoing program.

The first event was a lichen outing in late January. Bill Hill, Cheryl Beyer, Irene Winston, Janet Doell, Patti Patterson and Tom Carlberg attended from CALS, and more than a dozen interested members of the Conservancy came. Four locations were visited that day.

Large portions of the Canyon are of a dry nature, and those parts dominated by eucalyptus trees or annual grasses are largely devoid of lichens. As a result of this condition, subsequent trips have been made to sample as many different habitat and vegetation types as possible. The terrain is an interesting combination of grasslands, north coastal scrub, oak-bay woodland, some redwoods, and eucalyptus, at various elevations.

The CALS lichen survey of the Claremont Canyon Conservancy lands is currently in full swing, and barring unforeseen circumstances CALS should have a report ready for the Conservancy at the time of their Annual Meeting in November.

Reported by Janet Doell.

Figure 3. Martin and Walker Holden checking out lichens at Redwood Creek Place. Photography by Bill McClung.

News and Notes

CALS Research/Educational Grants Program

CALS offers small grants to support research or education pertaining to lichens in California. No geographical constraints are placed on grantees or their associated institutions. The Research/ Educational Grants committee administers the grants program, with grants awarded to an individual only once during the duration of a project.

Grant Applicants should submit a proposal containing the following information:

1. Title of the project, applicant's name, address, phone number, email address. Date submitted.
2. Estimated time frame for project.
3. Description of the project: outline the objectives, hypotheses where appropriate, and methods of data collection and analysis. Highlight aspects of the work that you believe are particularly important and creative. Discuss how the project will advance knowledge of California lichens.
4. Description of the final product: We ask you to submit and article to the CALS Bulletin, based on dissertation, thesis, or other work.
5. Budget: summarize intended use of funds. If you received or expect to receive grants or other material support, show how these fit into the overall budget.

The following list gives examples of the kinds of things for which grant funds may be used if appropriate to the objectives of the project:

- Expendable supplies
- Transportation
- Equipment rental or purchase of inexpensive equipment
- Laboratory services
- Salaries
- Living expenses
- Supplies

CALS does not approve grants for outright purchase of high-end items such as computers, software, machinery, or for clothing.

6. Academic status: state whether you are a graduate student or an undergraduate student. CALS grants are available to non-students conducting research on California lichens. CALS grants are available to individuals only and will not be issued to institutions.
7. Support: one letter of support from a sponsor, such as an academic supervisor, major professor, or colleague should accompany your application. The letter can be enclosed with the application, or mailed separately to the CALS Grants Committee Chair.
8. Your signature, as the person performing the project and the one responsible for dispersing the funds.

The proposal should be brief and concise.

The research/education grants committee brings its recommendations for funding to the CALS Board of Directors, and will notify applicants as soon as possible of approval or denial.

Review:

Members of the education committee review grant proposals once a year based on: completeness, technical quality, consistency with CALS goals, intended use of funds, and likelihood of completion. Grant proposals received by October 1, 2009, will be considered for the current grant cycle.

Grant Amounts:

CALS offers 2 grants: $500 and $750 each year.

Obligations of Recipients:

1. Acknowledge the California Lichen Society in any reports, publications, or other products resulting from the work supported by CALS.
2. Submit a short article to the CALS Bulletin.
3. Submit any relevant rare lichen data to California Natural Diversity Data Base using NDDB's field survey forms.

How to submit an application:

Please email submissions or questions to the committee chairperson by October 1, 2009.

This year the committee chairperson is Erin Martin, her email is shastalichens@gmail.com. Alternatively you can mail a hard copy to Erin Martin, Pacific University – Department of Biology, 2043 College Way UC A121, Forest Grove, OR 97116.

Items for Sale

CALS Mini Guide to some Common California Lichens. 2nd Edition – $12.00
Mailing cost – $2.00

Mini Guide to some Southern California Lichens – $10.00
Mailing cost – $2.00

Posters. 21 photos of California Lichens – $5.00
Mailing cost – $2.00

Lichen note cards by Kristin Jacob, Each – $2.50
Packet of 4 cards, 2 of each design – $9.00
Mailing cost – $1.00

Hand lens – $5.00
Mailing cost – $1.00

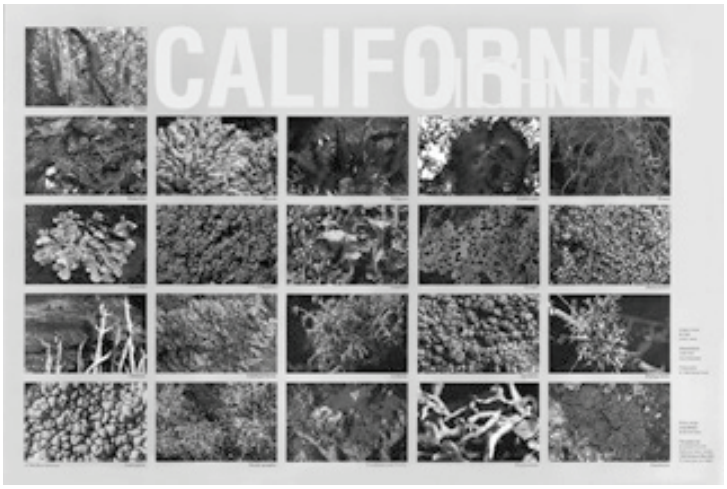
To order, please contact Janet Doell at 510-236-0489 or jkdoell@sbcglobal.net, or send a check made out to the California Lichen Society to Janet Doell at 1200 Brickyard Way #302, Point Richmond, CA 94801.

Also:

Cladonia fimbriata postcards, artwork by Ryan Griswold. 10 for $5.00 + 1.00 shipping and handing. These postcards can be ordered by mailing a request to the CALS address.

Lichen note card by Kristin Jacob (1 of 2 designs). Actual cards are in color.

CALS Mini Guide.



Poster.


Cladonia fimbriata postcard. Actual cards are in color.

Upcoming Events

5-Day Crustose Workshop Through Jepson Herbarium Proposed For March, 2010

The Jepson Herbarium Public Workshop program, operating out of the UC Berkeley campus, provides educational opportunities for interested amateur and professional botanists through a weekend workshop series. The Jepson Herbarium has offered lichen workshops in the past, and currently is considering its offerings for the 2010 year to include a 5-day crustose workshop with Dr. Irwin Brodo in early 2010, depending on interest shown by the lichen community in attending such a workshop.

Dr. Brodo is an emeritus scientist at the Canadian Museum of Nature, in Ottawa, Ontario, Canada. He is a world authority on the identification and biology of lichens, and was honored in 1994 with an Acharius Medal presented to him by the International Association for outstanding contributions to lichenology. Dr. Brodo's list of publications includes 75 research papers, 8 popular articles, 22 reviews and 6 editorials. One of Irwin Brodo's great achievements was the publication of the 795 page book, ***Lichens of North America*** which is filled with high quality photographs of lichens taken by Sylvia and Stephen Sharnoff.

This workshop would be held at the McLaughlin Reserve in Napa and Lake Counties, northwest of Davis, California (http://nrs.ucop.edu /McLaughlin.htm). Meals and dorm style lodging would be included. The cost would be around $600. I am trying to gage whether there would be enough interest to offer this class. If you think you would take it, please let me know.

Cecile Shohet
Public Education, Coordinator
Jepson Herbarium, UC Berkeley
1001 Valley Life Sciences Bldg
Berkeley, CA 94720-24655
phone (510) 643-7008
email cshohet@berkeley.edu

Collections will be made from bark, wood, rocks and soil, and they will then be identified in the laboratory. Updated keys to genera of crustose lichens from *Lichens of North America* will be used, as well as other modern keys from the world literature. Techniques for sectioning, staining, and interpreting the tissues of crustose lichen fruiting bodies will be introduced, with special attention being devoted to staining various ascus types with iodine. Techniques for testing lichens with para-phenylenediamine, hypochlorite solution (bleach), potassium hydroxide, nitric acid, and iodine will be discussed and used regularly for identications.

President's Message

I hope that all of you have enjoyed the summer so far, have had the opportunity to embark on many outdoor adventures in California, and have had the chance to experience all the joy that lichens bring not only in summer, but also in any season. It is with great sadness that I report the passing of one of our dedicated members, Ron Robertson. Ron and his wife Judy, were both devoted to the study of lichens in California, and had hoped to compile a flora of Marin County. Ron was in attendance at the IAL conference last summer, still enthusiastically searching for lichens, and sharing his knowledge with others. Ron was a great advocate for lichens in this state and thankfully Judy continues their work after his passing. I also feel that Ron would be proud that membership in a group he helped to start is still strong and growing each year.

On that note, I want to express sincere thanks to all CALS members for renewing your memberships, and also welcome the many new members who recently joined CALS. With your support we will continue to promote lichen education, awareness and conservation in the state of California. Even in these difficult economic times our membership numbers are still strong!

California is facing a staggering budget deficit, which could possibly affect the status of natural areas in California. Recently, as you may have heard by way of the CALS yahoo group, the legislators in California were considering a proposal to close many of our state parks. CALS board members took action by writing letters to our senators and congressmen to oppose the closure of state parks because these areas offer unique habitats for lichens and hold undoubtedly many undescribed lichen species. It is now more important than ever for members of CALS to educate people about the importance of lichens and conduct excursions to inventory lichen species currently found in state parks. If you have any interest in leading a trip to a state park in your area please contact me and I can help you obtain collection permits and put together announcements of the trip. You don't have to be a lichen expert to lead a trip in your area!

Members of CALS are currently involved in many activities. Several members are working with the Claremont Canyon Conservancy to inventory lichens in this area. You can read about their efforts in this issue of the Bulletin. Bi-monthly lichen identification workshops continue at the College of Marin. Long time member Mikki McGee has been helping other members hone their skills in microscopy at the workshops, which are held the second and fourth Friday of each month. You are welcome to bring your own specimens or work with those of others. These workshops are geared to help members with lichen identification and refine our skills in microscopy. I want to extend many thanks to Mikki McGee, Patti Patterson, and Bill Hill who plan, direct, and attend each of these workshops. Their participation in CALS is invaluable.

The CALS Conservation Committee has also been hard at work. The IAL meeting generated some meaningful discussions related to lichen conservation in California and worldwide. The work done by the Conservation Committee seems well respected by many lichenologists throughout the globe. In January, the committee also finalized rankings on 4 more species, bringing the total of finalized species to 6. In March, the Committee's website (http://calscc.crustose.net) was revised and now provides a PDF report with our finalized listings.

Last year, CALS provided two educational grants to support research on California lichens. The

CALS Education Committee is now accepting proposals for the 2009 educational grants cycle. Details and guidelines for these grants are provided in this bulletin. Please pass this information along to anyone you know who is currently conducting research or would like to begin a research project on lichens in California. Proposals are due on Oct. 1, 2009.

In closing, the CALS board would like to encourage our members to become active in the Society. There are many ways to contribute to CALS including leading workshops and field trips, participation in committees or as an officer, or writing something for the Bulletin, which publishes articles related to general lichenology, scientific studies, reports from fieldtrips and workshops, and welcomes all submissions. Please feel free to submit any items to Tom Carlberg (tcarlberg7@yahoo.com). CALS is currently in need of an activity coordinator, who would recruit and help other members with the logistics of leading fieldtrips or workshops in the areas where they live. California is such a large state, and current board members feel that the Society could benefit from having someone who would stimulate lichen-related activities throughout the state. Michelle Caisse, our Vice President, and Cheryl Beyer, our Treasurer are near completion of their terms as officers. We ask our membership for nominations for the positions of Vice President and Treasurer of CALS. If you know of anyone who would be a good candidate for these positions, or are yourself willing to serve in this capacity, please contact me so that we can discuss the responsibilities of these positions. We are also currently looking for someone to help maintain our website. This person would be involved in updating the website with the input of other CALS members.

In closing, thank you for your continued support. With your help we continue to promote the mission of CALS: to increase awareness, education, and appreciation of lichens throughout California.

Happy lichenizing!

Erin Martin
shastalichens@gmail.com

The Bulletin of the California Lichen Society

Vol. 16, No. 1 Summer 2009

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B) Lecanorine apothecia. Photography by Gary B. Perlmutter.

C) Lecanorine in cross-section. Photography by Mikki McGee.

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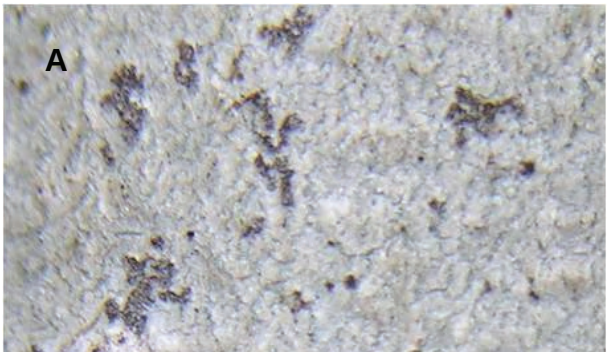
G) Thelotremoid apothecia. Photography by Gary B. Perlmutter.

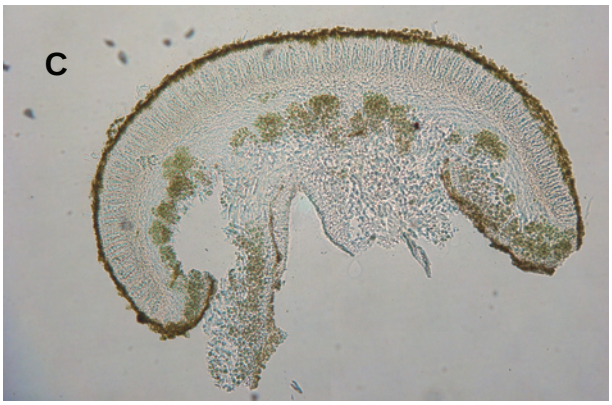
H) Pertusarioid apothecia. Photography by Gary B. Perlmutter.

I) Perithecia. Photography by Mikki McGee.

J) Perithecia. Photography by Mikki McGee.


A


B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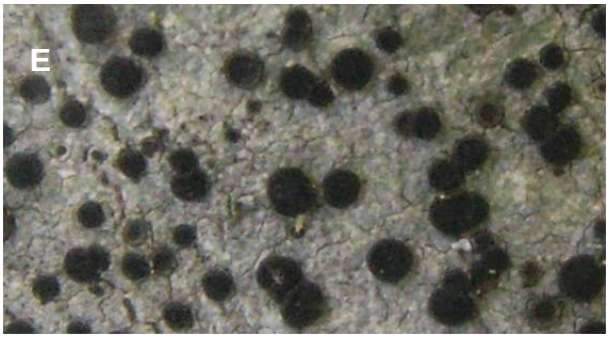
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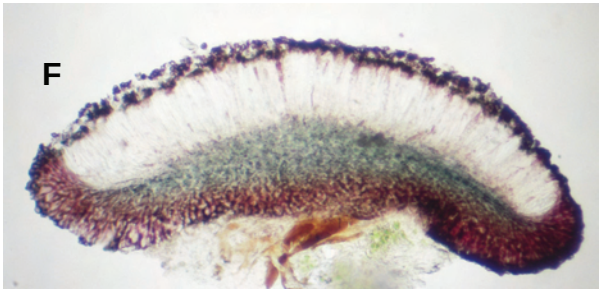
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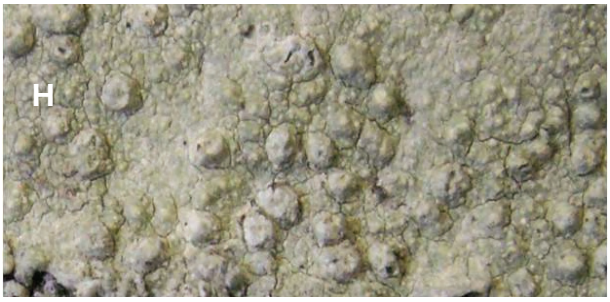
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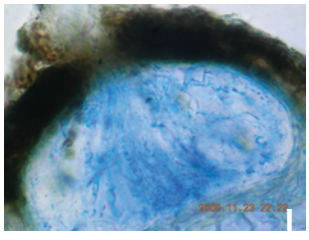
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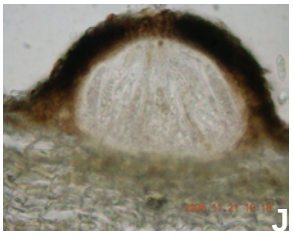
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