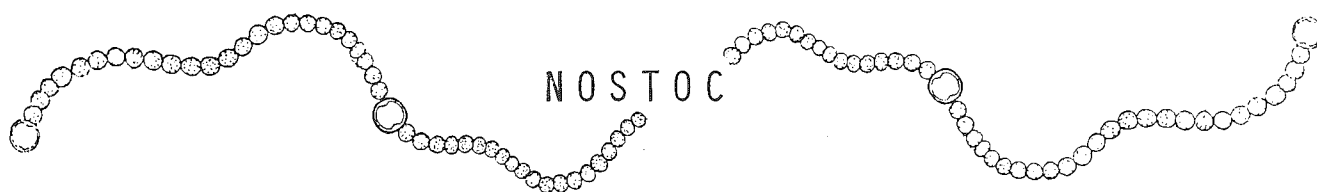


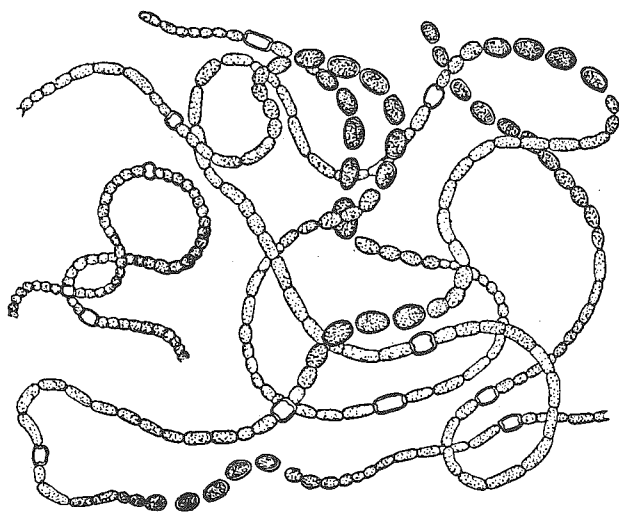
Volume 3 Number 1, October 1984

Geraldine C. Kaye, Editor



*Nostoc* is assumed to be a living fossil--ancient in lineage and primitive in organization--in the same sense as are the horseshoe crab and maidenhair tree. Paleontological studies have shown that *Nostoc* is very similar to the filaments of *Gunflintia minuta* found in deposits formed more than 2 billion years ago. Today, *Nostoc* is found as free-living colonies in lakes and seas, in nonessential associations with mosses, and in partnerships with numerous fungi forming lichens. Because it can carry on photosynthesis and can utilize (or fix) nitrogen directly from the atmosphere, *Nostoc* can grow in a variety of habitats, many of which are quite inhospitable to most plants.

In parts of the southern hemisphere and Polynesia, there lives a group of large-leaved herbaceous plants in the genus *Gunnera*, which are primary colonizers of newly cleared land. This is the only flowering plant group known to be symbiotically associated with a blue-green alga. Living within specialized cells of the stem are endosymbionts of the genus *Nostoc* (Silvester and McNamara, 1976). They serve a role analogous to that of the *Rhizobium* bacterium which forms root nodules with members of the Leguminaceae, furnishing the host with nitrogen in a form the plant can use. This association permits *Gunnera* to be a successful early colonizer.



Not only does *Nostoc* live symbiotically with *Gunnera*; it also associates with some cycads and bryophytes and with a fair number of fungi. With the latter it forms what we recognize as lichens. Finally, it may also form conspicuous free-living colonies.

Fig. 1. *Nostoc spongiaeforme* C. Agardh. Thick-walled cells are akinetes (dark cells) and heterocysts (clear cells).

The genus *Nostoc* was established by the Swiss botanist Jean Pierre Vaucher in 1803. Dozens of species have been

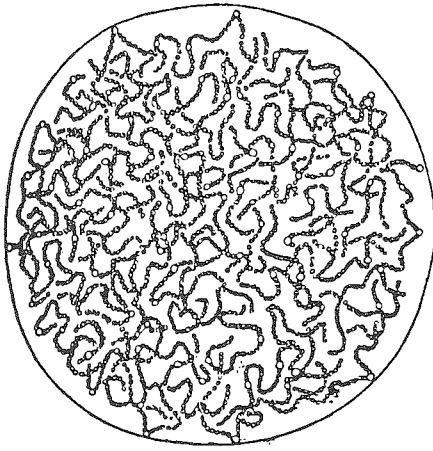


Fig. 2. *Nostoc planktonicum* W. Poretzky et Tschernow.

described worldwide, as reflected in the names on the accompanying illustrations. However, more recently Francis Drouet (1907-1982), an American phycologist, reduced most to synonymy and recognized only two species--*N. commune* and *N. spumigena*--claiming that the others were merely ecophenes, or morphological variants formed by a local environment. With strong affinities to bacteria--for instance, the chemistry of its cell wall and its lack of an organized nucleus--*Nostoc* is now classified as a photosynthetic cyanobacterium.

Along with its cousins *Anabaena* and *Cylindrospermum*, *Nostoc* is placed in the Nostocaceae, a family characterized by having unbranched filaments with akinetes and heterocysts scattered along the filament. Akinetes are resting spores incorporating the wall of the parent cell

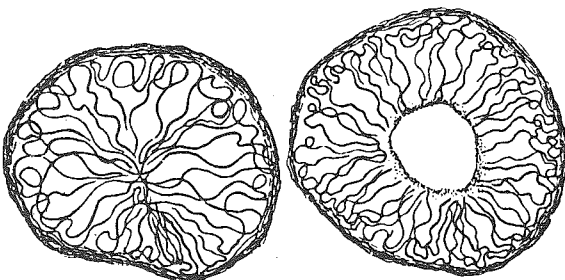


Fig. 3. *Nostoc pruniforme* C. Agardh.

which can withstand extended periods of unfavorable conditions. The hyaline, thick-walled heterocysts are specialized sites for fixation of atmospheric nitrogen

into a form easily incorporated into amino acids.

*Nostoc* as a free-living entity usually forms discrete colonies with hundreds of filaments. They are found in marine and fresh waters living as part of either the benthos or the plankton, and in terrestrial environments, where they flourish in moist alkaline soils. The widely distributed soil-inhabiting species *N. commune* Vauch. forms spherical gelatinous aggregates up to three centimeters across, which commonly break open to form flat-lobed expanses. An ecophene of *N. commune*, *N. amplissimum* Gard., forms thalli up to 10 centimeters across; they are called "mare's eggs". Some colonial species of *Nostoc* found growing on damp soil are used as food in the Orient, where they are considered a delicacy. *Nostoc* may also be

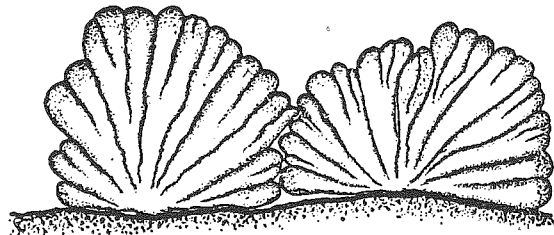


Fig. 4. *Nostoc Letestui* Fremy.

found in markets in Africa and South America. It contains up to 20 percent raw protein and can be an important dietary supplement.

*Nostoc* is one of a few blue-green algae which are planktonic. The planktonic species are adapted to remaining high in the water column, thus maximizing light reception. *Nostoc* has hollow, air-filled cylinders with conical ends, called pseudo-vacuoles, which develop within its cells. These gaseous vesicles in *Nostoc* are unique because their membranes are composed solely of protein. The vacuolar membranes in other plant cells contain a lipid-protein complex.

*Nostoc* is the phycobiont (algal partner) of a number of lichens. It is found dispersed throughout the thallus of the gelatinous lichens of the families Collemaaceae and Lichinaceae where it makes a greater contribution than the fungus to the thallus color, shape and consistency. It is also in a number of other prominent lichens, notably *Peltigera canina*, the dog lichen, and *Lobaria oregana*, the western lung lichen. When *L. oregana* is blown from its normal habitat in the upper reaches of Douglas fir, it becomes litter on the forest floor, re-

leasing the nitrogen to the soil. This lichen apparently makes a significant contribution to the soil nitrogen pool in the Pacific Northwest. Similarly, lichenized *Nostoc* has been found to be an important ecological component of the Colombian montane rain forests and is considered a principal agent of nitrogen fixation in the drier terrestrial habitats of arctic and subarctic environments. It is interesting to note that a survey of the balsam-fir forests of New Hampshire failed to reveal epiphytic lichens as a significant contributor to the total nitrogen pool there (Lang, Reiners, and Pike, 1980).

*Nostoc* also enters into a nonessential association with the gametophytes of a number of bryophytes. It may be found forming colonies in mucilage--containing cavities of *Blasia*, a liverwort, and *Anthoceros*, a hornwort. Another hornwort, *Dendroceros*, frequently contains a colony of *Nostoc* in its intercellular cavities. Finally, *Nostoc* has been found associated with the moss *Polytrichum commune* in the arctic tundra.

Widespread geographically and diverse ecologically, these primeval organisms combine simplicity and versatility to survive in an ever-changing world.

Barry L. Wulff  
Professor of Biology  
Eastern Connecticut State University

-----  
Lang, G.E., W.E. Reiners, and L.H. Pike. 1980. *Structure and biomass dynamics of epiphytic lichen communities of balsam-fir forests in New Hampshire*. Ecology 61(3): 541-500.

Silvester, W.B. and P.J. McNamara. 1976. *The infection process and ultrastructure of the Gunnera-Nostoc symbiosis*. New Phytologist 77: 135-141.  
-----

#### Librarian's Note

Not too surprisingly, there doesn't seem to be a "Field Guide to Blue-Green Algae" available. Here's what I've turned up in the Farlow collections for further reading (after you've exhausted the resources of your local library's encyclopedia and introductory phycology text).

Harold J. Humm & Susanne R. Wicks. *Introduction and guide to the marine blue-green algae*. New York: Wiley, 1980. 194p.

G.E. Fogg, W.D.P. Stewart, P. Fay, & A.E. Walsby. *The blue-green algae*. London, New York: Academic Press, 1973. 459p.

*The biology of blue-green algae*. N.G. Carr & B.A. Whitton, eds. Oxford: Blackwell, 1973. 676p.



#### Booksale

This year's sale by mail of natural history books was as much of a hit as the first one last year. You donated more books--210 items compared to 129--again covering a broad range of subjects. A series of minor disasters attended the efforts of our Secretary, Bob Edgar, to get the book lists out. The first delay was caused by the Postal Service which took a week to deliver a crucial item 60 miles. Next, a genuine computer "hacker" interfered with the computer listing and wiped out part of it. (We feel we've hit the big time!). A printers' strike further bogged down proceedings. Finally the lists were mailed, whereupon the postal people struck again by returning some of the foreign members' lists for repackaging. (As a result, these members had very little time to reply with their requests.) ...As a reward for surviving these trials, Bob and his daughter Gwendolyn got to do the major part of the packing and mailing of your orders. We're enormously grateful for your hard work--and stamina--Bob! Ready for another sale next year???

Meanwhile, we know that at least one FoF member takes his booksales seriously. At the sale deadline, this person was in the hospital for a major operation. In the recovery room, coming out of the anesthetic, his first words were, "Brent, would you please make sure my order gets in to the FoF booksale?" (P.S. He got the book!)

The books remaining unsold will be offered for sale to libraries of the Council on Botanical and Horticultural Libraries. Proceeds of both sales have been allocated to the Geneva Sayre Fund.

#### The Geneva Sayre Fund to Support Visiting Scholars

At the time of Dr. Geneva Sayre's seventieth birthday a number of her friends and associates established a permanent endowment fund which according to Dr. Sayre's wishes is to be used from time to time to support visiting scholars at the Farlow Reference Library and Herbarium. The goal was to raise \$10,000 and then to use the interest to support a Geneva Sayre Scholar.

The Friends of the Farlow Executive Committee has decided that this is an appropriate and highly practical project for FoF participation. We are happy to announce through optional designation of FoF dues and the proceeds from this year's booksale, we have now reached our goal. It will therefore be possible to select a Sayre Scholar within the next year.

We are delighted to honor Dr. Sayre in this way. Over the last 12 or more years she has been the driving influence in the rehabilitation of the Bryophyte Collection at the Farlow. The Farlow will continue to benefit from the work of the Sayre Scholars made possible by this fund.

Donald H. Pfister  
Director, Farlow Herbarium

#### Membership

Individual dues notices were mailed in July. As of 14 September, 105 renewals for 1984-85 have reached us. If you haven't sent yours yet, we hope you'll do so soon. (We wish we could

say that the scrambled sentence on the renewal form was really a test...many of you patiently pointed it out...we have to note it's the price of our entrance into the computer age!)

We asked you to indicate fields of interest and add your comments. We feel we know some of you a little better as a result. The subject tally (with some people indicating several subjects) was: *Bryology*, 20; *Lichenology*, 14; *Mycology*, 75; *Phycology*, 5; *Other*, 8; *Unknown*, 3. We can also report at least 3 mycophilatelists, scattered from Kenya to Michigan!

One resourceful member sent us a Matching Gift form through which his employer will contribute an equal sum. We're eligible for this program as a nonprofit organization. We hope others will check to see if their employers have such a program.

#### Brent Mishler Goes South

We've lost our ace Farlow bartender, Brent Mishler, to Duke University in Durham, N.C. Brent completed his Ph.D. in Bryology last spring, with his dissertation "Systematic Studies in the Genus *Tortula* Hedw. (Musci: Pottiaceae)". He has been appointed Assistant Professor of Botany at Duke University. We wish him and Carol great success in their educational endeavors in the Research Triangle.

#### New Exhibit

Our Fall exhibit in the Farlow entry hall will be mushroom photographs by Marilyn Wood, photographer, naturalist and FoF member. Ms. Wood has had several exhibits in New England recently including last Spring's "Mainly Mushrooms" at New England Wild Flower Society.

*We're sad to have to report the first loss of a member by death. Mrs. Elizabeth Leach was a long-time member of the Boston Mycological Club and occasional visitor to the Farlow. We remember fondly the time she got lost in the basement and had to be rescued. She had limitless enthusiasm for things mycological, going on foreign forays when she could. She will be much missed at Boston area gatherings.*

## NEW PUBLICATIONS

Index to the Moss Herbarium of William Starling Sullivant (1803-1973), by Geneva Sayre.

This is the newest in the well received series of Farlow indexes (W.S. Sullivant, the "Noble Fellow", was featured in our first Newsletter, in October 1982.)

The Index covers the main Sullivant herbarium of approximately 10,800 specimens, including specimens from W.P. Schimper, Richard Spruce, J.D. Hooker, J.F.C. Montagne, C.F. Schwaegrichen, and Carl Mueller. It also includes Sullivant's exsiccata *Musci Alleghanienses*. Not covered in the Index are other exsiccata sets and several special collections, comprising another 8000 specimens and some Sullivant bibliographic types.

The Index is arranged alphabetically by species, with references to sheet number and genus. The publication is 8½ x 11", 117 pages, unbound. Price is \$5 plus 50¢ postage.

Other indexes in the herbarium series include:

Moss herbarium of Edwin Bartram  
140 pp. -- \$5.00

Jacob W. Bailey diatom collection  
155 pp. -- \$6.00

Microscopic slide collection of Boston Society of Natural History  
166 pp. -- \$6.00

Moss herbarium of Max Fleischer  
191 pp. -- \$7.50

Hepatic herbarium of V.F. Schiffner  
52 pp. -- \$3.00

Moss herbarium of V.F. Schiffner  
61 pp. -- \$3.50

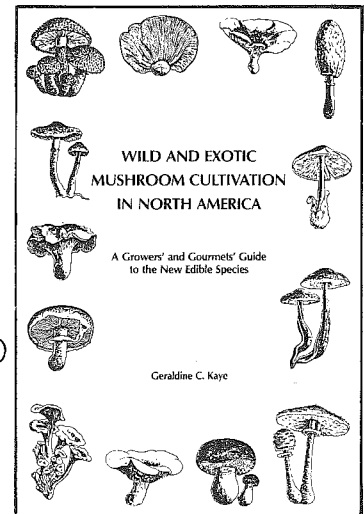
Hepatic herbarium of W.S. Sullivant  
25 pp. -- \$2.00

Moss herbarium of Thomas Taylor  
37 pp. -- \$2.00

To order any of the above items, send your check to Farlow Herbarium, 20 Divinity Ave., Cambridge, MA 02138, U.S.A. FoF members deduct your 10% publication discount; then add 50¢ per item for postage.

Wild & Exotic Mushroom Cultivation in North America...

...A Growers' and Gourmets' Guide to the New Edible Species, by Geraldine C. Kaye. The 32-page bibliography and directory is designed as a resource for both growers of nontraditional species and those who are interested in buying their produce. Included are sources of spawn and equipment; commercial growers and suppliers of alternative mushrooms; mycological organizations; book-sellers; and a list of common and equivalent names. (Reviews have been enthusiastic!) Cost is \$4 plus 50¢ postage.

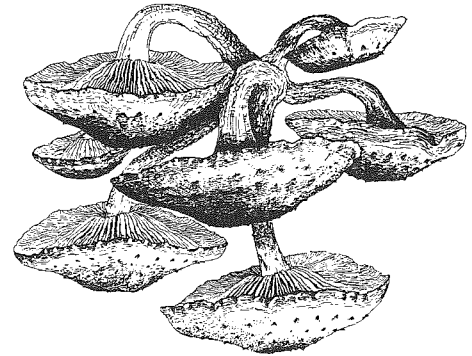


Greeting Cards and Note Paper

We are repeating an offer we tried out on a small scale last year. We have available cards with the *Pholiota* design, pictured on the mailing panel. They are printed on 4½" x 6" folded tan stock, with matching envelopes. The artist, Joseph Bridgman (1845-1915), did most of the water-color illustrations in W.G. Farlow's posthumous work *Icones Farlowianae*.

The price for plain notecards is 3 for \$1; for cards inscribed "Season's Greetings and Best Wishes for a Happy New Year", 50¢ each. The 10% FoF discount applies of course. (Please add 50¢ for postage.)

## FRIENDS of the FARLOW



### THIRD ANNUAL MEETING

Our 1984 Annual Meeting will be held Saturday, November 10, at the Harvard University Herbaria, 22 Divinity Avenue, Cambridge, MA. The planned schedule for the day is as follows (coffee and tea will be available through the day): Library open hours...10 a.m. - 2 p.m. Annual business meeting...3 p.m. Margaret Lewis, "The Intricacies of *Tricholoma*"... 3:15 p.m. Ronald H. Petersen, "The Coralloid Fungi of New Zealand"...4 p.m. Reception in the Library...5 p.m.

Margaret Lewis of the Boston Mycological Club is a friend of the Farlow from 'way back--the 1940's. Her studies of *Tricholoma* started here. Ronald Peterson is Professor of Botany at University of Tennessee, Knoxville, and a well-known figure at mycological forays. He has published extensively on the clavarioid fungi and on mycological history.

### LIBRARY SATURDAY OPENINGS

FoF will again sponsor open hours at the Library one Saturday per month. This year's dates are October 6, November 10, December 1, January 5, February 2 (Groundhog Day), March 7, April 13, and May 4. The time is 10 a.m. to 2 p.m. Enter through the green door between the Herbaria Building and the Farlow.