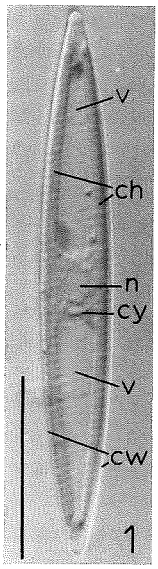
Newsletter of the FRIENDS OF THE FARLOW

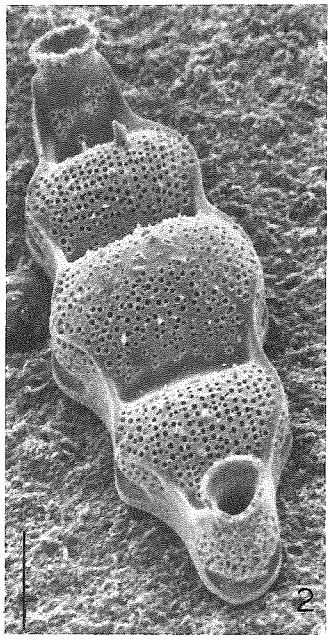
Volume 1 Number 2, April 1983

DIATOM COLLECTIONS AT THE FARLOW

Cryptogams are a heterogeneous lot--mosses, fungi, lichens and algae. However, this montage is not mysterious when we consider its origin. Linnaeus founded the Cryptogamia to logically contrast with plants that flowered. The cryptogams were united not by the characters they shared but by those they lacked--their sex organs were either absent or well-hidden. This cryptogamic variety endures in the Farlow. We can easily imagine examining the pressed and dried seaweeds elegantly displayed on paper or the mosses, lichens and fungi carefully tucked into packets attached to herbarium sheets. But cryptogamic variety exceeds the macroscopic and familiar. The Farlow also houses collections of microorganisms. What do these collections look like? A sketch of the collection of one of these unfamiliar groups--the diatoms--reflects the nature of these organisms and the views of diatomists who have studied them.

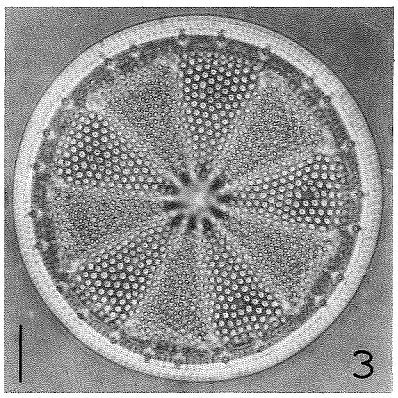
Diatoms are unicellular, photosynthetic organisms which are ubiquitous in aquatic environments. In the light microscope their larger organelles are apparent (Fig. 1): a nucleus (n) embedded in a cytoplasmic matrix (cy), chloroplasts (ch), which are golden-brown because pigments other than chlorophylls predominate, vacuoles (v) and a cell wall (cw, indicated by the outline of the cell and the evenly spaced, faint lines traversing the cell). Cell walls in nature are usually multilayered fabrics woven from fibers of polysaccharides, such as cellulose. The fibers form a cellular skeleton while the "holes" in the weave permit the necessary exchange of materials between the cell and its environment. In contrast, the diatom cell wall is made of glass, an unwoven matrix of inorganic crystals which holds matter like a glass bottle. It's a good skeleton, but it's impermeable! A cell attempting to live in a homogeneous glass box is destined to suffocate, starve and toxify itself. This problem in diatoms has been solved by the evolution of a variety of patterns of holes, slits and tubes, as well as other wall structures, which facilitate not only exchange but attachment, movement and reinforcement for a wall riddled with holes (Fig. 2). These patterns of wall ornamentation have held the focus of diatomists for a century and a half--patterns with symmetry worthy of a Steuben label (Fig. 3). As a result, the illustrated diatom is almost always only the cell wall. The other organelles have been comparatively neglected except with respect to the ecological and

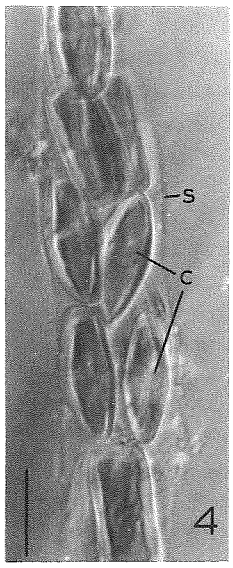




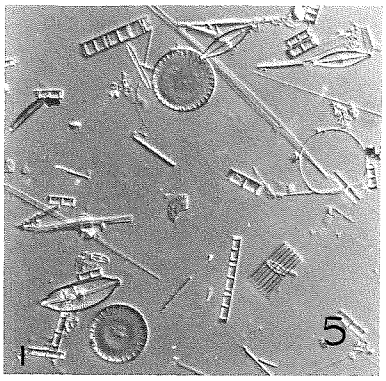
physiological aspects of photosynthesis. Imagine for a moment the trophic importance to man of grasses (rice, wheat, corn and rye) and to other grazing mammals of the earth's grasslands (prairies, savannahs and pampas). Diatoms fulfill a similar and commensurate role in aquatic ecosystems. They can appropriately be called "the grass of the waters." But so much for the diatoms themselves; what about the collections?

Early nineteenth century, permanent collections of diatoms are primarily dried specimens resembling small seaweeds or masses of entangled threads, which are glued to paper or wrapped in small paper envelopes. But how can the specimens resemble seaweeds or filaments if diatoms are unicellular? There are two explanations: one involves identity, the other, mimicry. Some specimens look like seaweeds because they are seaweeds (or less commonly, filamentous freshwater algae). Individually or in clusters diatoms attach to the larger algae by mucilaginous pads or stalks. To the diatom collector this permits nearly one-stop shopping. Seaweeds typically host a variety of kinds of diatoms, and consequently, a list of many species names is often associated with the specimens. These diatoms were microscopically examined using temporary mounts made by rehydrating pieces of the larger algae. Other specimens in these early collections resemble seaweeds, because the diatoms are colonial and themselves form large filaments mimicking the larger algae. Diatoms use mucilage not only to attach to bottom substrates but also to each other. A cell may encapsule itself with mucilage and then divide forming a daughter cell; each cell may then secrete more mucilage and divide again, repeatedly, such that the result is a densely aggregate colony of cells within a mucilaginous sheath, the whole having the form of a filament (Fig. 4, a small part of one filament; cells [c], mucilage sheath [s]). Because a colony descends from one or several related cells, filaments contain predominantly a single kind of diatom. Colony formation in diatoms can result in colonies ranging from a few cells to tens of thousands of cells--the larger ones are readily visible to the human eye. Also, mucilage coverings are useful in buffering osmotic changes in the environment, such as those characteristic of nearshore marine and estuarine environments. These habitats were a focus of the early collectors of the larger algae, who also collected the diatoms. Not surprisingly then, colonial diatoms predominate in the early herbaria collections. Diatoms which do not form colonies and exist as motile unicells are underrepresented in early herbaria, because their study developed in the domain of zoologists, who obviously considered them animals (They moved!). Although collections of paper-mounted specimens of diatoms became increasingly representative of the real diversity of diatoms through the mid- to late-1800's, they were increasingly replaced by permanent collections in another form.



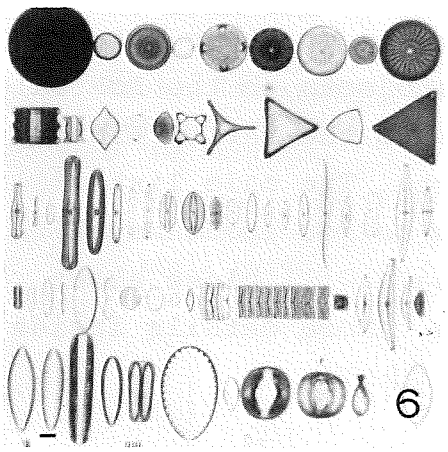


When diatoms die, their organic parts decay like those of most organisms. However, their walls do not. The walls are also highly resistant to dissolution in many environments. Consequently, they fossilize well. When diatom growth has been luxurious, great fossil deposits can arise. The discovery of such deposits in Europe, Africa and America between 1835 and 1840 marked the beginning of diatom



micropaleontology. These discoveries stimulated great interest in diatoms, but the interest was necessarily focused on the cell walls. The number of fossil species described grew explosively from this time. Fossil diatoms are useful as indicators of the earth's aquatic environmental conditions thousands to millions of years ago, as long as they can be related to their living descendants and relatives, which presumably live in similar conditions. This paleoecological use of diatoms requires a common classification for living and fossil forms, which, by default, must be based on the cell wall. Organelles left inside the cell of living diatoms interfere with critically seeing the wall, so living specimens are oxidized with heat or acids until only the wall remains. Living diatoms are converted to fossil equivalents! Coincident with the discovery of fossil diatoms, advances in microscopical optics (the invention of the achromatic microscope) and mounting techniques (the introduction of Canada balsam as a non-drying medium for making permanent slides) riveted attention on the details of the wall. The result of these discoveries in the 1830's was that paper gave way to balsam and glass as the form of the permanent archival record. Slides could be repeatedly examined and readily exchanged. Most of the diatom collections in the Farlow are preserved on microscope slides--more than 20,000 of them, with each slide typically containing hundreds to thousands of individuals (cell walls!) of many different species. More diatoms are usually collected than can be mounted on a single slide, so the remainder is stored in vials and used to make replicate slides as needed. Practically all of the Farlow slides are replicates from vials housed in other herbaria and gathered by exchange among European and American collectors between 1840 and 1940.

Most slides consist of a randomly dispersed sample of many diatoms (Fig. 5). More rarely, slides bear a single, select diatom or several diatoms arranged in some pattern, many of which are just ornamental. However, others display systematically arranged diatoms selected as "typical" of their respective species. A portion of a large preparation of diatom "types" made by the master German mounter, Johann Möller, is illustrated in Figure 6. Few can look at Möller's meticulously prepared slides and not be struck by their beauty and by the skill of their maker. Couple to this their rarity, and they should be the most prized possessions. But diatom systematics and ecology are basically studies of variability. And as neither the reified average American nor Miss America reflects the variety of Americans, so no single diatom, either middle-of-the-road or by any criterion select, contributes much to fields where variability is intrinsically the subject. To the practicing scientist, they are of little value compared to the commoner slides with thousands of diatoms in disarray. It is in the vast numbers of these slides of strewn diatoms that the richness of the Farlow collection resides.



Robert K. Edgar

(All figures are light microscope photographs, except Fig. 2, which was taken using a scanning electron microscope. A 25-micron magnification bar is drawn in the lower left of each figure.)

AN INTRODUCTION TO THE FARLOW LIBRARY

Through the years since W. G. Farlow bequeathed his wonderful book collection to Harvard, the caretakers of the Library have tried to maintain its excellence by acquiring the major new publications in cryptogamic botany as they are issued. In spite of the fluctuating fortunes of the Farlow's history, this has been done amazingly well. Today the Library contains some 60,000 items--books, bound journals, cataloged pamphlets and reprints, manuscripts and letters, portraits and watercolors. We currently receive from all over the world about 110 journals concerned with algae, fungi, lichens and bryophytes. Some of the 1400 total journal titles go back to the 18th century, and are the only copies in North America. A number of items in the book collection are just as rare.

We continue to fulfill our obligation to keep up with the important current publications in the systematics of non-vascular plants and fungi. We are most concerned with monographs giving systematic classifications of plant groups and other items containing the first published descriptions of new species. We also obtain floras (lists of plants observed in particular geographic areas), general cryptogamic textbooks, works on history and biography related to cryptogamic botany, and representative popular publications and journals. We do not attempt to provide comprehensive coverage of two large special areas, medical mycology and plant pathology, nor of advanced ecology, physiology, or genetics literature; these subjects are best covered in institutions where related research is currently going on. We have a good collection of the standard reference works in our fields, special dictionaries, and abstracts and indexes, all necessary for fullest use of the literature. Conversely, the Farlow's holdings are widely known through the 1979 publication of our card catalog by the G. K. Hall Co. Many special libraries have copies and can readily ascertain if we have a desired item. We frequently receive requests for photocopies or microfilm copies of scarce items.

The original and central role of the Library is the documentation connected with the Herbarium--its reference specimens and research activities. It also, however, serves a University-wide clientele of faculty, staff and students in biological studies. In addition, it is used by scientists from the Boston area, across the country, and around the world. Recent visitors have included two phycologists from Egypt and one from Australia; mycologists from Quebec City, Japan, China, the Philippines, and England; and a bryologist from China. An amateur botanist is tracing the life of pioneer lichenologist Edward Tuckerman through his letters and books, many of which are found here. A high school science teacher is doing an independent literature project on lichens and air pollution. And Bob Edgar, our Secretary, is here on sabbatical making heavy use of the Library in his studies on Darwin and diatoms.

In addition to routine operations, there are several projects going on in the library itself. During the past two summers the librarian, Gerry Kaye, and student assistants have been doing the first complete book inventory ever; this should be completed during the coming summer. Also, a student assistant has been indexing the Roland Thaxter correspondence, a rich source of insight into the workings of early 20th Century science. Mrs. Kaye has for several years been compiling short biographical records of cryptogamic botanists. She has recently obtained a Bryant Library Fellowship to set up a computer storage system for these biographies which will allow her to interfile entries, print out a complete list or a list selected by special subject or geographic area, and perhaps eventually publish a biographical dictionary of cryptogamists.

WHAT'S NEW WITH FRIENDS of the FARLOW

We're in business! FoF has officers and bylaws, as presented at the November 6th inaugural meeting and ratified by the Advisory Board. The officers are: President, Moselio Schaechter; Vice-President, Barry L. Wulff; Secretary, Robert K. Edgar; Treasurer, Harvey I. Pofcher.

Dr. Schaechter is Professor and Chairman of the Department of Molecular Biology at Tufts University Medical School. His interests in the Farlow are primarily mycological as reflected in his editing the Boston Mycological Club Bulletin and teaching the course in mushroom identification for the New England Wildflower Society.

Dr. Wulff is an Associate Professor of Biology at Eastern Connecticut State College, where he teaches a broad range of botanical courses. His research interests involve the ecology of marine algae and fungal systematics.

Mr. Pofcher is an amateur botanist and Massachusetts business consultant whose interests in cryptogams and the Farlow are long-standing.

Dr. Edgar is a Professor of Biology at Southeastern Massachusetts University, where he teaches courses in population and evolutionary biology. His research focuses on diatom systematics and ecology and the history of American diatom studies.

Members have received copies of the bylaws, directories of Advisory Board members and general membership, and preliminary plans for FoF projects. The President's progress report on these first activities follows.

Here is some of what's happened since we got started:

Library Saturdays: Since January, FoF has sponsored the opening of the Farlow Library one Saturday a month (usually the first Saturday), 10 am to 2 pm. Attendance has not been overwhelming, perhaps because word has not gotten around. We aim to correct that and hope that all of you will make a note and, should you be in this area, will avail yourselves of this opportunity. Spring dates are April 9, May 7, and June 4th.

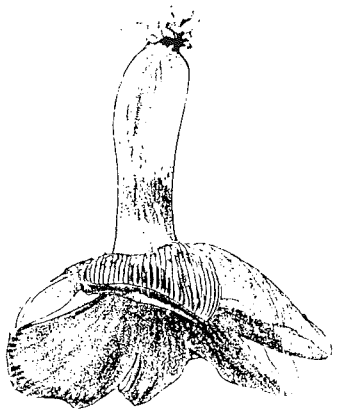
Book Sale: We are in the process of putting together our first FoF Book Sale. This is what we have in mind: You are hereby solicited to contribute any suitable books on Cryptogamic Botany or any Natural History subject. Mail them (right away!) to the Farlow and they will be included in the sale. About the middle of May we will send FoF members a list of the books available, stating prices and condition. You will have a month to respond. Should more than one of you ask for the same book, we will draw lots on the closing date specified on the list. Books that are not sold at that point will then be offered for sale to the general public. Please note that the value of the donated books is a tax-deductible contribution.

Memorial Book Fund: An FoF book fund has been set up in the Farlow Library as an appropriate memorial to deceased friends or relatives. The name of the honoree and of the donor will be inscribed on an FoF book plate. This is also tax-deductible.

Photocopy Service: Full members may obtain at cost reasonable numbers of photocopies of Farlow literature. Several members have been enthusiastically taking advantage of this perquisite, and testing the librarian's detective abilities to the limit into the bargain.

Our yearly get-together is planned for November. Following our tradition of long standing--started last year--we will have a dinner, which will be preceded by a cocktail party, and, we hope, some presentations of Farlowiana.

Elio Schaechter



FRIENDS of the FARLOW
Farlow Library and Herbarium
20 Divinity Avenue
Cambridge, MA 02138, U.S.A.

SPECIAL SATURDAYS!

9 April

7 May

4 June

FRIENDS of the FARLOW are sponsoring open hours at the Farlow Library, 10 a.m. to 2 p.m., one Saturday a month. Come in and take advantage of these weekend hours.

Need directions? Call:
(617) 495-2369

COMING UP...

A BOOK SALE BY MAIL

FRIENDS of the FARLOW will hold a mail sale of Natural History books. Donate your spare books on cryptogams or other natural history subjects to the FoF sale. Send them to the Farlow Library by May 1st. The sale list will be mailed to you about May 15th, and the sale will close about June 15th. More details inside.