Smithsonian Environmental Research Center

Newsletter

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Art Under the Microscope: In a Pig's Eyelash

by Sharyn Hedrick

A chandelier with finely cut crystals dangling like diamonds in mid-air presides over the lobby of a theater or grand hall, its pinpoint shafts of light reflecting, twinkling, sending ribbons of brilliant colors dancing across the room. One can't help but notice it. It's grand, it's beautiful, and it's big.

Now imagine looking into a microscope at a drop of water from the sea, and there on the small glass slide are geometric shapes of incredible complexity that under a microscope with black field optics, glitter, twinkle and shine just like the finely cut crystals in those chandeliers. *Diatoms*. (Figure 1). They appear in different colors due to refracted light. The variety of colors is dependent upon the amount of light refracted and the thickness of each diatom. Yet, these magnificent gems are only microns in size, so small that it would take hundreds to cover the head of a pin. One of nature's oldest life forms *and* art forms, their fossil records go back to the Lower Cretaceous period and perhaps even further.

Figure 1. A contemporary design of arranged diatoms by Klaus Kemp of Microlife Services, England.

Diatoms are one of those single celled organisms that don't quite fit into the plant or animal category. They are classified as Protistan, organisms that share qualities from both divisions, but lack tissue differentiation. Like plants, diatoms produce chlorophyll, which places them

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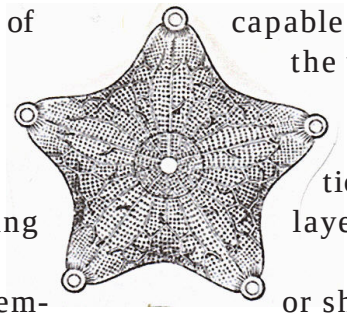
in the field of botany. But, some are capable of rudimentary movement, an animal characteristic. Diatoms are found in most bodies of water all over the world. Many are planktonic and live on the whim of tides and currents in moving water. Some are epiphytic and attach themselves to rocks, larger fronds of seaweed, even microscopic animals; and fossil diatoms are found in dolomite deposits such as the White Cliffs of Dover in England.



Although diatoms appear in a variety of shapes, there are only two basic forms in which they are classified: centric, which appear individually and in long necklace-like chains, and pennate, which are a diverse mix of geometric shapes, usually characterized by a raphe (the median groove in the valve) and bilaterally symmetrical ornamentation of the valves (the view of the diatom as it lies face up on a slide) (Figure 2). A few pennate species form long chains capable of sliding through the water like a carpenter's rule; others create star formations with layer upon layer of cells.

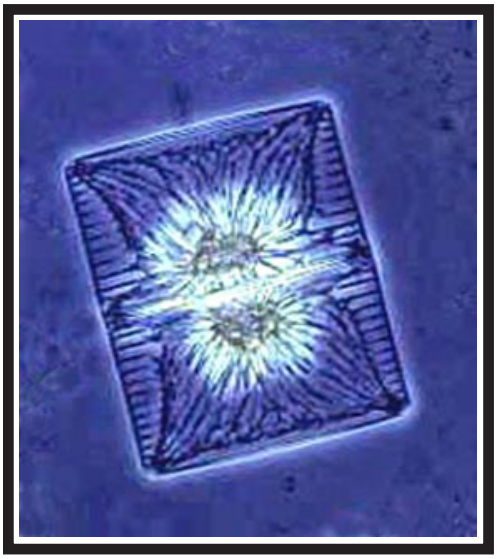


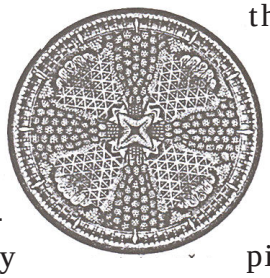
Figure 2. *Striatella unipunctata*. Photo by Sharyn Hedrick

Diatom frustules, or shells, are made of silica, and this is where the artistry begins. Silica is the hard mineral substance in silicon dioxide, and is used to manufacture glass. The alluvial deposits of silicate in diatoms allow for the creation of inflexible cell walls, which then, for reasons yet to be discovered, take on a variety of complex geometric shapes.

A Dutch spectacle maker introduced the first rudimentary microscope in the 1500s, but it was a century later when another Dutchman Antonie van Leeuwenhoek, a cloth maker by trade, actually recorded his observations of bacteria, yeasts, and protozoa. This was the beginning of studies into the microbial world, which eventually led to the intense study of diatoms.

Beginning in the mid-nineteenth century and continuing into the early 1900s, observing diatoms became extremely popular with amateur naturalists. Discovering the intricate beauty of diatoms became a favorite pastime for many Victorian hobbyists. They would spend hours leaning over a microscope, observing specimens and drawing images, some of which were quite elaborate. Enchanted by the diatoms' beauty, they would painstakingly clean the shells, and carefully mount them on permanent slides. Their primary tool for this arduous work was a brush made from the eyelashes of a pig. The pig's eyelash was oily and the minute shells would stick to the tip allowing them to move the individual diatoms into complex patterns creating spectacular designs. These avid hobbyists organized extravagant expeditions to collect mud, water samples

Figure 3. Pacini Compound Microscope c.1845.



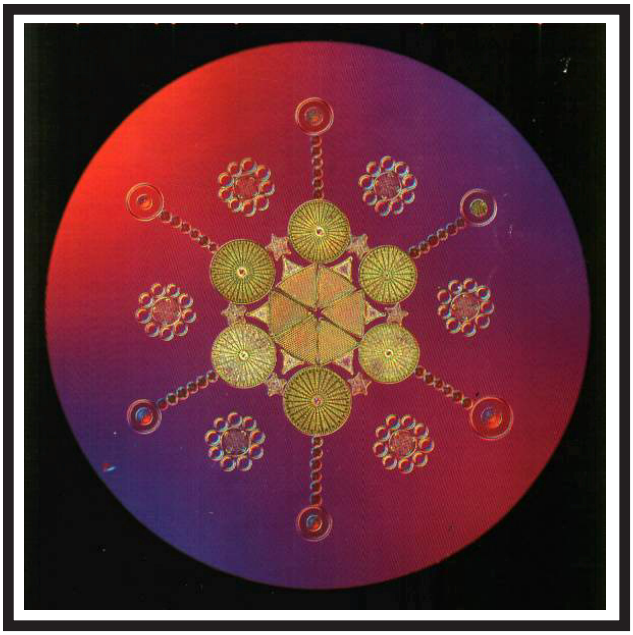
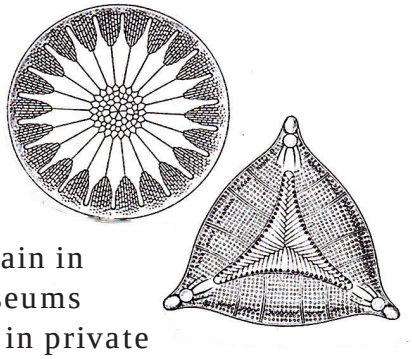


Figure 4. Arranged slide by Johannes Möller from Klaus Kemp collection.

and diatomaceous earth from the most remote parts of the world to add to their collections. It was not uncommon to go to a dinner party and retire to the drawing room for the evening's entertainment of viewing these elegant slides. The host would produce his brass microscope (Figure 3) and his collection of small leather cases lined in velvet or silk that cradled the intricate round slides. One of the most prodigious pioneers of this new art form was a German by the name of Johannes Diedrich Möller. He and his cohorts sold and traded their prized arranged slides all over the world (Figure 4).

Arranging diatoms on a small slide took a steady hand and many hours of dedicated concentration. Mistakes could rarely be corrected. The diatoms were not glued down. They remained in place from the pressure of the cover slip and the resin holding the cover slip to the slide. Unfortunately the resin used to create these permanent slides frequently deteriorated with age and only a few of these arranged slides remain in museums and in private collections today (Figure 5). Creating arranged slides is almost a lost art. There are only a few avid microscopists that continue the art today, such as Klaus Kemp of Microlife Services in England (Figure 6).



As the hobbyists concentrated on arranging diatoms in flower-like designs, professional naturalists were busy identifying and naming the diatoms, and drawing their images. A German physician turned naturalist, and former student of Möller's, by the name of Ernst Heinrich Haeckel is one of the most well known of these professional naturalists. His book, *Art Forms in Nature*, was pub-

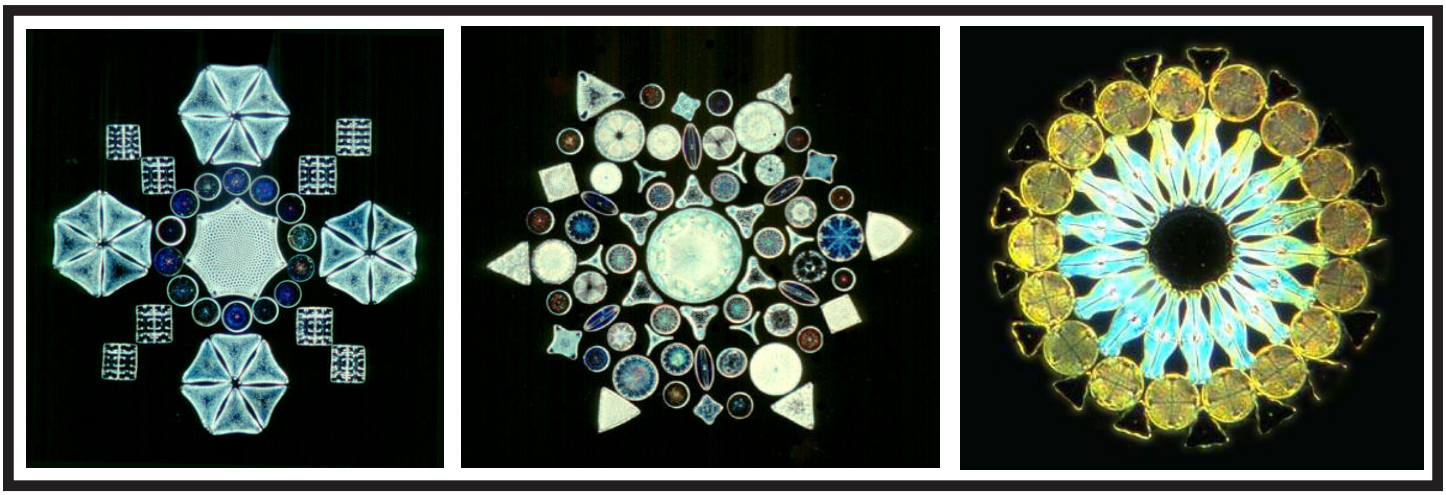


Figure 5. Left and center: Arranged slides from the historical collection of The Philadelphia Academy of Natural Sciences Museums. Photographed by Jan Rines, URI. Right: a contemporary design by Klaus Kemp of Microlife Services, England.

lished in 1904, and covers more than just diatoms. The attention to detail he gives to the diatom frustules is exquisitely portrayed (see line drawings scattered throughout this article). The book was most recently republished in 1998 by Prestel-Verlag, and is well worth viewing.

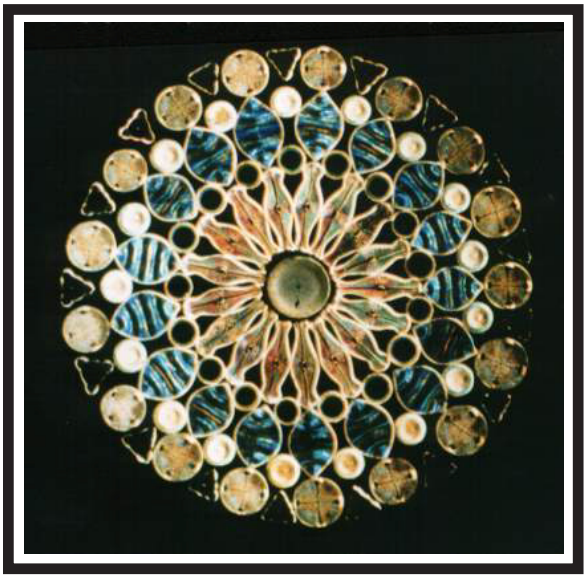


Figure 6. Slide by Klaus Kemp of Microlife Services, England.

In America, Reverend Francis Wolle also studied diatoms and in 1890 wrote *Diatomaceae of North America*. In it are the plates of his beautifully hand drawn diatoms. This taxonomic key is still used today as a means of diatom identification, although the book has not been republished in many, many years.

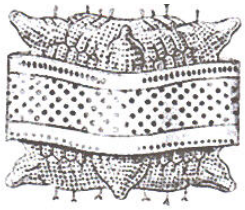
What is the attraction of these microscopic, chlorophyll-producing, pseudoplants? Granted it is not everyone's cup of tea to sit for tedious hours hunched over a microscope looking at minute examples of diatoms. But for those of us who do, the lure lies in the diatom's faultless structure, the basic pattern of symmetry, and the mystery of their highly structured designs. It is also the challenge of each sample, of finding a particularly unusual species or a familiar species in exceptional condition, which then may be drawn in detail or photographed.

With today's powerful microscopes, digital cameras, and photo enhancing programs, capturing the beauty of a diatom is much easier and, via the Internet, can reach a much wider audience. There is, however, something unique about a pen and ink rendering of a diatom. The attention to detail by a steady hand holding a pen can never truly be replaced. It's an art form that should be treasured. Ernst Haeckel said it best in 1860 when writing to a friend, "…life is anything but tedious owing to nature's inexhaustible richness which, time and again, produces ever new, beautiful and fascinating forms that provide new material to speculate and ponder over, to draw and describe." Diatoms definitely fit into this category.

There are many websites available exemplifying the exquisiteness of diatoms. Many of these sites concentrate on the diatom as an art form, such as Klaus Kemp's webpage at www.diatoms.co.uk. If you are interested in a multitude of natural photos of diatoms in full color, please visit the SERC website. Go to Research, then Coastal Ecosystems and Phytoplankton photos, or go directly to the webpage www.serc.si.edu/algae/phyto_index.htm.

After viewing these specimens, I can almost guarantee that you will never look at a pond or river, a lake or the ocean quite the same way again. •

Sharyn Hedrick is a phytoplankton taxonomist and head technician in the Phytoplankton Lab. She has been studying diatoms for nearly 20 years, including 17 years on the Chesapeake Bay. She says one of the "perks" of her job is identifying, photographing, and drawing diatoms.



Scattered figures of diatom pen and ink drawings by Ernst Haeckel.

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