BIOLOGY

Crystal Wonderland

Glassworker's Skill Models Three-Dimensional Pictures Of Fantastic Creatures That Live in a Drop of Water

See Front Cover

By DR. FRANK THONE

ROMANCERS of the Verne-Wells school, as well as older-fashioned tellers of fairy-tales, have always delighted in occasional excursions into the world of the very small, showing us through the eyes of a Hop-o'-my-Thumb or a Gulliver the astonishing aspect of things when their scale of size is changed. It is a real adventure, undoubtedly, to see a wine-cask no bigger than a wine-glass, or in another imaginary land to drive a mouse as you would a horse.

But not even Wells, most modern of these literary discoverers of wonderlands, has ever taken us on as exciting a voyage as he could if he only would. Imagination would not be necessary at all; one would only need to take for granted eyes gifted with microscopic vision, and then dive into the first inch of water in the nearest brook or garden pond. In those clear or greenish depths is a world of plants and animals more fantastic, more fascinating, often more ferocious, than you will find in the jungles of the Amazon or the Niger or the Irrawaddy. Here you will find animals rooted like plants; plants that snatch their prey like animals. You will see Edens of Adamless Eves: strange little female animals that have no males among them, yet spawn forth countless swarms of young. You will see other little animals that have no sex at all, swirling down the currents like living stars or jewels in their unimaginable delicacy of lacy structure.

Easy Way For You

You can see all these things through a microscope, as scientists and laymen have been seeing them for many years. But the way into this Lilliputia of the waters is being made even more easy for you, through the amazing artistry in glass of a worker at the American Museum of Natural History in New York. This man, Herman O. Mueller, has been hailed as "the most skillful glassblower in the world." He was once glassblower for Tiffany's as was also his father before him, but the wisdom of the American Museum's administrative officers brought about his capture from the services of a few wealthy patrons and dedicated his unique talents to the more democratic service of the museum-visiting public.

Some recollection of his apprenticeship in this jewelry profession lingers in Mr. Mueller's models of individual specimens of the deep-sea protozoa known as radiolarians. These tiny animals, only one cell in size, belie the adjective "primitive" often applied to them; they are highly complex in spite of their unicellular structure, and in their complexity they attain a beauty of design that not even the sophisticated artists of Renaissance Venice ever dreamed of. They are veritable swimming jewels, and would undoubtedly dictate fashions in gold and platinum if jewelry designers knew about them—and had the skill to imitate their intricate patterns.

Mr. Mueller, at least, can reproduce these patterns, and in a medium which most craftsmen find much harder to handle than the precious metals. But in his hands, glass, the brittle and refractory, becomes plastic and obedient. He has only two principal tools: flame, as manipulated with the blowpipe, and his own breath. With these, and a few odd sticks and rods, he treats glass as though it were wax, cutting and trimming it, bending and moulding it, drawing out points to threadlike fineness or blowing up globose bubbles, welding together pieces of diverse colors to give the soft green of plants, the brilliant patterns of some of the little animalcules whose bodies he renders faithfully in all details but enlarged thousands of times so that our not-so-very-sharp eyes can see and study them.

In doing this work he uses as models preferably the living things whose portraits he is moulding in glass. He has them individually under the microscope, and looks at them from time to time as he manipulates his glass. Sometimes, however, he cannot get the fresh material and must work from the drawings in scientific monographs, as a portrait painter must sometimes work from photographs of a person long since dead. This was the case with the radiolarians, which live in the depths of the ocean, and some of them in remote parts of the world.

These radiolarians are sometimes known as "wheel animalcules," because most of them build many-pointed spiky skeletons out of silica. They are not really wheels, however, but spheres. But the foreshortened view one gets of them from one side makes them look like many-spoked little wheels, and as they go rolling over and over in the gentle currents of water, the wheel-resemblance becomes even more striking. Glass is a most appropriate medium in in which to portray radiolarians, for the transparent silica of which their skeletons are built is one of the chemical constituents of glass; moreover, the living protoplasm that clothes it is itself almost glass-transparent.

Groups Are Masterpieces

Not all the radiolarians are little globular wheels; at least one species that has been modeled by Mr. Mueller has bilateral rather than spherical symmetry, and it is a beauty, too, as its picture on the front cover attests. But most of the tiny animals fit the name.

In spite of the unbelievable beauty of his individual radiolarian models, Mr. Mueller's real masterpieces are the "habitat groups", in which plants and animals appear bearing the same complex relationships to each other that they do in nature. On a group of this sort, often containing models of hundreds of plants and animals, Mr. Mueller will spend literally years of work, just as some of the old Italian masters spent years on a big battle painting.

A notable group in the American Museum, which has been attracting a great deal of attention lately, is called the Rotifer Group, because of the prominence it gives these curious little animals. It is an exact representation of a half-inch patch of pond bottom, with its aquatic plants growing in place and a population of rotifers and other animals engaged in the intense and endlesss game of eating and trying to escape being eaten. Seen still, as though caught by a lightning flash, this hundred-diameter enlargement of a

watery microcosm is tense with drama.

Zigzag through it run the stems of a bladderwort. This is a very common plant, with species all over the world. Above water it bears attractive little yellow flowers on the stems rising a few inches over the surface. Very innocent and attractive it seems—but below water it shows itself for the hungry harpy it really is: an avid and remorseless plant of prey. Scattered on branches of its zigzag underwater stem system are little hollow green globes, with mouth-like openings at the side, guarded with fine green bristles.

These are the plant's traps, with which it catches its prey. They are apparently its stomachs also, for digesting the prey afterwards, for whatever gets into one of those traps never comes out again, but eventually turns into meat for the blatterwort.

These traps are not mere passive lobster-pots, either, into which the prey swims and is unable to swim out again. They are as positive as steel-traps in their action. When a swimming or creeping animalcule touches certain bristles at the mouth of one of them, it suddenly snaps open. Inside, the globe has been empty, and seemingly under some tension; for the water immediately swirls into the opening, sweeping the luckless beastie with it. And that is the end of *him.*

All this, carefully studied out by botanists, is faithfully reproduced in Mr. Mueller's huge-scale models. One of the traps shows through its transparent wall the remains of an unlucky rotifer that has been engulfed.

Each of these traps in the model is basically a large bubble of glass. Over this the artist has fused on a network of green glass threads, to represent the network of veins seen on the natural plant. The bristles are slender glass rods and threads, and the attaching stem is a bit of glass tubing. The main stem is made of larger tubing, cut into lengths and fused together at zigzag angles, faithfully copied from life. Within the outer stem-wall is a second tube, on which has been fused three network layers of green threads, to represent the three layers of green cells found in the natural plant.

Beads For Chlorophyl

Lying athwart the bladderwort stem at one point is a large desmid, a single-celled primitive plant shaped like a half-moon. To make this, Mr. Mueller first moulded two glass cornucopias. Into these he fitted masses of green glass beads lightly fused together over glass cores, to represent the chlorophyl masses of the desmid itself.

Along one side are stems of a leafy waterplant, its spiky leaves reminding one a little of Christmas-tree twigs. Each of these leaves was made by first fusing a green "midrib" along the side of a glass cylinder, and then diagonally slicing out a piece of the glass.

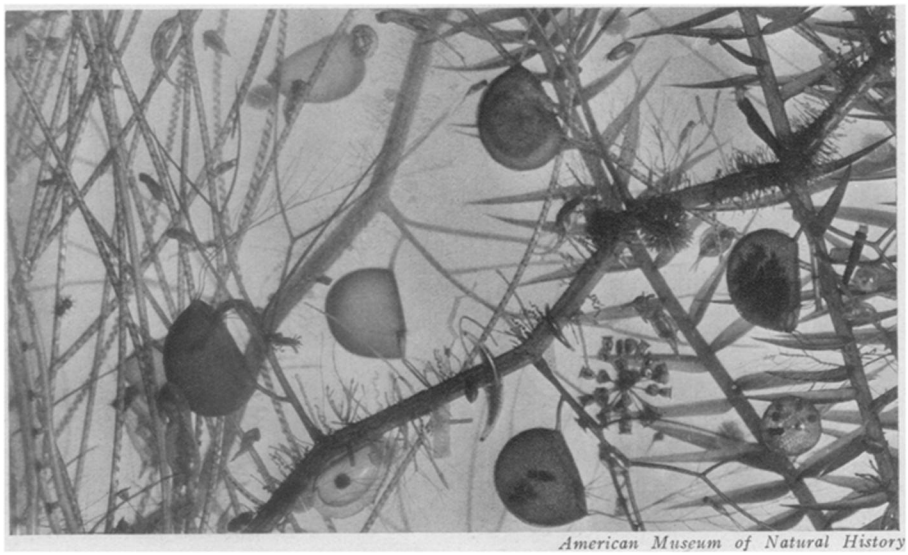
Running through the group are numerous threads of the freshwater alga known as "water silk", or more learnedly as *Spirogyra.* It earns the second name by the beautiful bands of green that spin spirals around all of its cells. These are its chloroplasts, its food-making bodies. *Spirogyra* is alone among plants in having spiral chlorophyl bodies.

Of the various animals shown in the group, the most numerous and prominent are the rotifers. These are small, mostly transparent creatures, more or less replated to worms though they suggest very little of a worm-like nature to the casual observer.

The world is full of rotifers, that is, all the moist parts of it are. You can hardly put a drop of water picked up at random under a microscope without finding some of them in it. They are certain to attract attention, too, because they seem literally to have wheels in their heads. That is how they got their name, which is Latin for "wheel-bearers". They do not really have rotating wheel-like organs, but instead have two circles of exceedingly fine whip-like processes, whose incessant undulating lashings create the illusion of rotation. These "wheels" of flagellae are the animal's swimming oars, and when it is anchored by its other end to something solid they draw the water to it, bearing the "unconsidered trifles" that rotifers feed on.

In Mr. Mueller's group there is one cluster of anchored "colonial" rotifers, growing from a common stem-point like a loose bouquet of fantastic flowers. There are some other rotifers that have anchored themselves to the back of a *Daphnia,* or water-flea, and are stealing a ride—subaquatic hitch-hikers. And there is one large rotifer that is engaged in a most interesting way of getting its food. It is creeping along one of the threads of *Spirogyra,* and each cell it comes to it punctures, sucking out the living contents as a weasel sucks eggs!

So realistically has all this been done that one forgets it is all imitation, all glass. And that, perhaps, is the highest tribute to the consummate skill of Herman Mueller and of the patient old father who helped him.



American Museum of Natural History

IN THE LITTLE JUNGLE OF THE POND

Magnified a hundred times, a fraction of an inch of the vegetation of a pond bottom has been modeled in glass for the American Museum of Natural History. The zigzag stems are those of the carnivorous water plant known as the bladderwort; a number of its hemispherical animal-catching traps are also shown. The straight bamboo-like stems belong to Elodea, and the slender threads, like vines in a jungle, are of the alga Spirogyra. Other algae are shown rooting like epiphytes on the bladderwort stems. The crescent is that of another alga, a desmid. Animals are mostly rotifers—notably the colony of stalked ones near one of the bladderwort traps. A rotating Volvox colony is also shown, in the lower right hand corner.

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