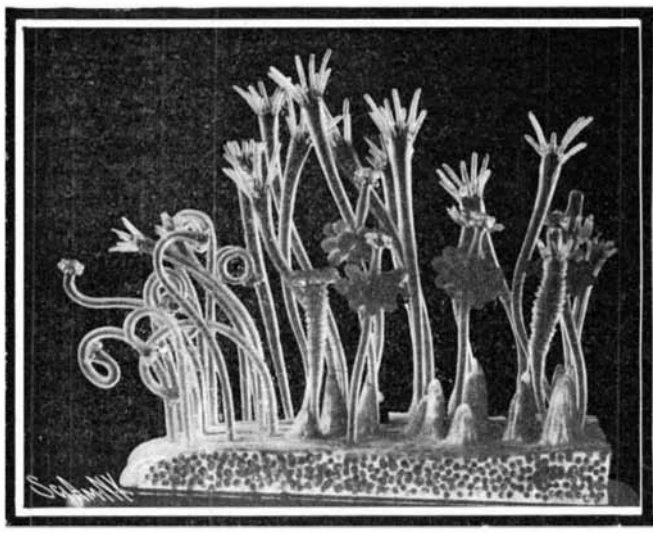
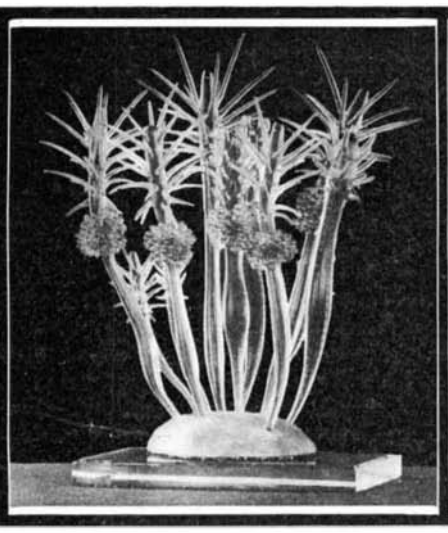
GLASS MODELS OF MICROSCOPIC FORMS OF LIFE—AN INTERESTING ART.

To the layman anything connected with the countless minute protoplasmic forms of animal life that exist in the sea and the waters of the land is a mystery. As the scientist becomes acquainted with them and informed concerning them by means of close study and microscopic research of a most exacting and painstaking kind, it seems an undertaking of considerable difficulty to place before the general public, in our museums, an accurate and at the same time comprehensible representation of these vastly interesting specimens of animal life. To show these animalculæ by means of drawings or even colored illustrations is at best unsatisfactory to the unscientific eye. To give a correct representation of these curious living forms, models are necessary which portray the intricate and sometimes even marvelously involved form of the animalcule. Such models must be made of some material capable of being worked with ease into any desired shape, a material that may be colored any desired tint and that will give a correct idea of the qualities and substance of the original. Many of these animalculæ are transparent or translucent. Especially is this true of marine forms. Hence the material of which the models are to be made must possess these properties. Of course the best available substance is glass. However, the skill and training necessary in the making of these glass models are so great that up to a short time ago it had not been accomplished in this country, though it has been done successfully in Europe, the few models of this kind to be found here having been made by Blascha in Germany.

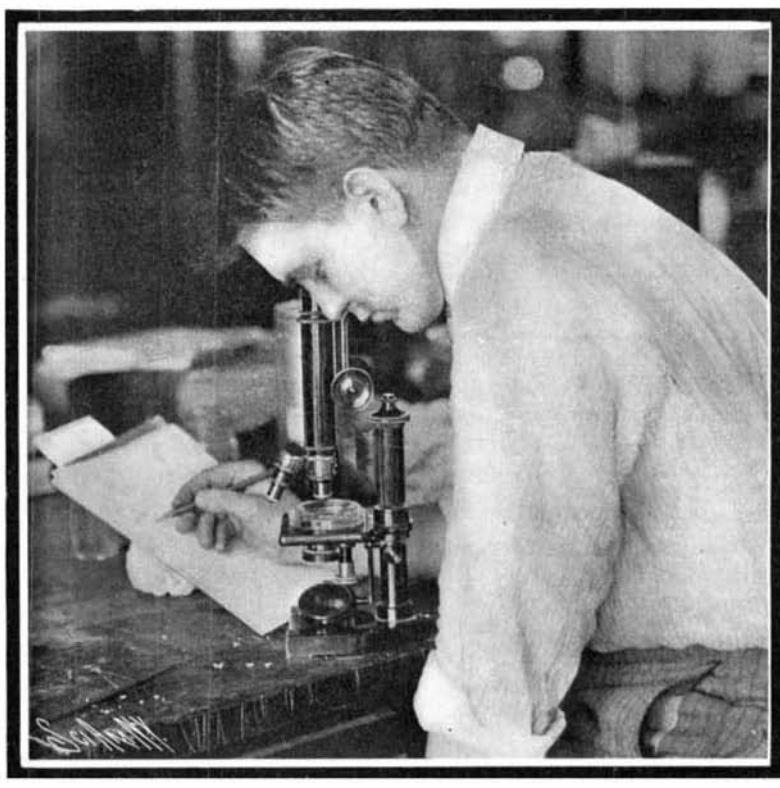


Hydroid Polyps.

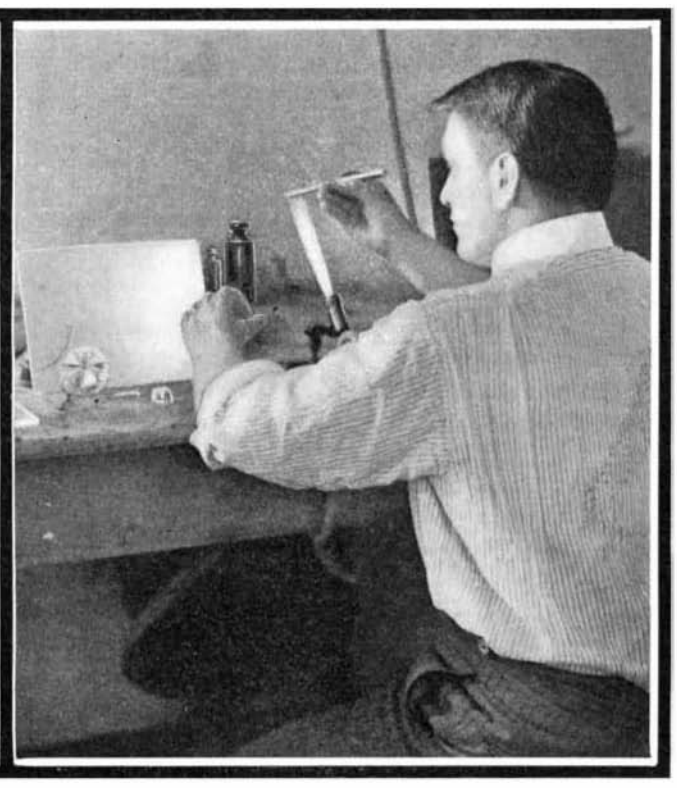


Hydroid Polyps.

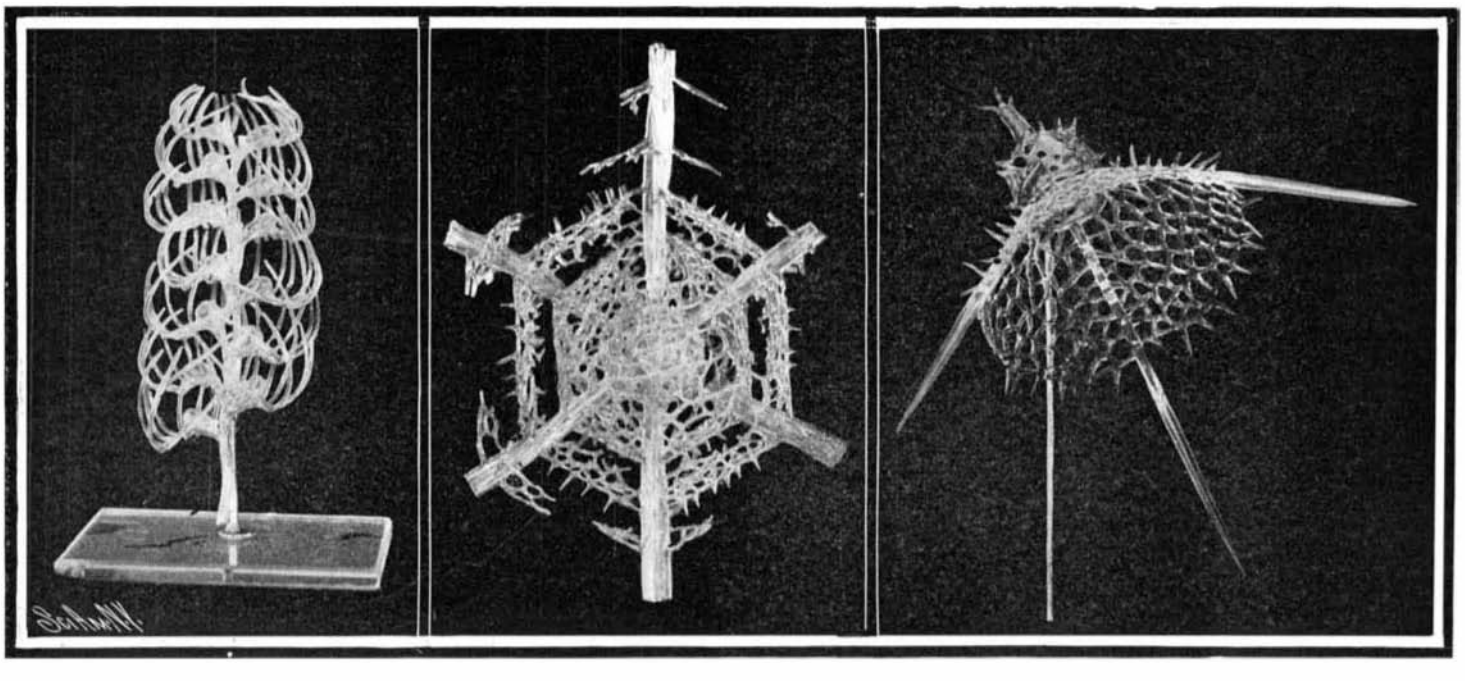
Hydroid, Natural Size.



Studying a Specimen Through the Microscope.



Fashioning a Glass Model.



Bryozoan, Bicellaria Bella.

Protozoan. Siliceous Skeleton of a Radiolarian.

Protozoan. Also a Radiolarian.

GLASS MODELS OF MICROSCOPIC FORMS OF LIFE—AN INTERESTING ART.

At the present time a considerable number of these beautiful representations of protoplasmic life are to be seen at the Museum of Natural History in New York, where they have been made by Mr. Mueller, a glass worker, under the direction of Dr. Dahlgren, of the Department of Preparation. Aside from the impossibility of distinguishing or even seeing many of these organisms with the naked eye, the glass models exhibit the form, structure, and color far better than the actual preserved specimen; for preserved specimens usually lose their natural shape and color in spite of and often through the action of the preserving medium.

When one of these models is to be made the animalcule is first microscopically examined, magnified from 10 to 700 or 800 diameters, and is then carefully studied, sketched or modeled in clay. The model is then painstakingly built up, piece by piece, the branches, tendrils or filaments being added one by one by means of the blowpipe, each member receiving its proper shape and formation by the most delicate manipulation of the blowpipe and other instruments of the glass-worker's art. The extreme delicacy and nicety of this work, the accuracy and patience necessary, need no comment. A glance at the accompanying photographs of the completed models is sufficient.

Many of the models on exhibition at the Museum of Natural History are of the class of Protozoa, too small to be seen with the naked eye, composed of a single cell, and such as are popularly known "to be found in a drop of water." One of our photographs shows a model of the siliceous skeleton of one of these, a radiolarian found at the depth of perhaps thousands of fathoms and entirely invisible to the naked eye. Although from a biological standpoint a simple structure, it is very complicated and marvelously wrought. This skeleton is invested in a protoplasmic capsule which forms the living portion of the organism.

Another photograph shows a model of a Bryozoan (*Bicellaria bella*), also an inhabitant of the deep sea. It is very minute but much more highly organized than the preceding type. While the individual organism is almost indistinguishable to the naked eye, it often forms colonies as large as a watermelon. One particular species of Bryozoa occurs in the immediate vicinity of New York, and Mr. Mueller is at present at work on a model of a specimen of this kind.

A third illustration shows a group of hydroid polyps magnified about twenty diameters, presenting a beautiful flower-like appearance with long contractile stems and waving tentacles attached in a circle about the mouths. They are bound together by, or rather arise from a network of tubes invested in a chitinous framework, which, with the tubes, is part of the organism. Some of these polyps are used to nourish the organism while others containing stinging cells protect it. Moreover, in case of danger the stems can contract till protected by the spines at their base. This organism is found spreading over dead shells usually such as are inhabited by a hermit crab and to

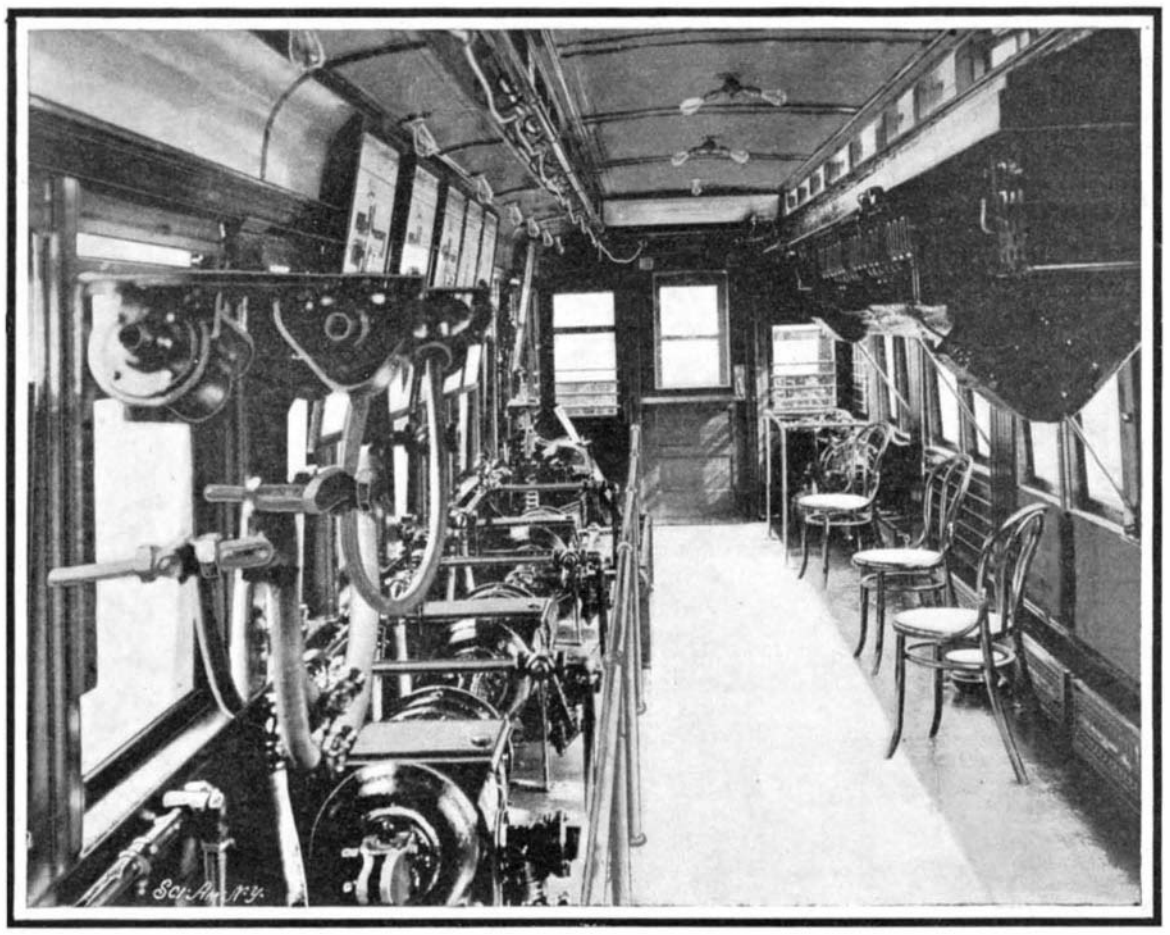
the unaided eye presents simply the appearance of a fine, almost colorless fuzz.

A fourth photograph represents a model, natural size, of another hydroid. The original of this model is a deep purple in color and exhibits in a striking way the peculiar flower-like beauty so characteristic of organisms belonging to this class. The last two photographs are of models of organisms similar to one or the other of those described above and the similarity is easily seen.

For courtesies extended in furnishing the information contained in the foregoing account, we are indebted to Dr. Dahlgren, of the American Museum of Natural History.

THE NEW YORK SUBWAY INSTRUCTION CAR.

That the man in charge of a train to run in New York's Subway may be entirely competent to fulfill his responsible position, the Interborough Rapid Transit Company is using an instruction car, where the prospective motorman may be taught something of the construction and operation of the apparatus he is to handle. In this instruction car, the applicant is shown the use and mode of operation of every piece of mechanism that will come under his charge, is taught how to handle it and what to do in almost every emergency that can arise.



INTERIOR OF THE CAR USED FOR THE INSTRUCTION OF NEW YORK SUBWAY MOTORMEN.

The school car is similar to the regular service cars to be run in the Subway, with the Sprague-General Electric multiple unit system of control. The apparatus is uncovered for demonstration purposes wherever possible—master and air-brake controllers, contacters, reverser, pump governor, switch-board, and the like. Portions of the apparatus underneath the car have, where possible, been placed inside of it to facilitate the explanation of their operation. In the case of the motors, motor resistance, and air pumps this, of course, was thought to be neither feasible nor necessary.

In addition to the regular equipment the car contains a complete air-brake outfit for a six-car train, operated from the brake controller which is used to make the men familiar in all details with this complicated mechanism. It contains, moreover, a defective triple valve, the presence of which the men must detect after a certain amount of teaching. To facilitate the instruction there are additional parts, such as the auxiliary reservoir and the brake cylinder, with portions of the metal cut away to permit the instructor to explain their operation fully. A triple valve similarly cut away, and connected in tandem with another operating triple valve, fully demonstrates the working of this complicated piece of mechanism. To supplement all this a series of colored drawings show the details and operating positions of every important piece of apparatus. A section of contact rail with the rail shoe is used to teach the men what to do in case of trouble there. An automatic car coupler and drawbar is installed for a similar purpose. A complete set of controller and air-brake couplings is employed to demonstrate their use in operation or emergency.

The safeguards in the system used are manifold, and so complete that only a rather inventive mind can conceive any situation which the prospective motorman has not been taught to meet. Should the motorman release the controller handle while it is in a running position, not only would the current be immediately shut off but the emergency brakes would at once be set and the train brought to a stop. Should he attempt to reverse his motors while running, the same thing would happen. The controller is automatically governed and no matter how fast the handle is turned, the motors are started at a certain fixed speed. Should the contacters adhere or fuse, the current is automatically shut off. Should the motorman not see or ignore a signal to stop, the brake is automatically tripped and the train brought to a standstill. The train may be run from any motor car, or any motor car may be cut out and used as a trailer. The wiring insulation is as nearly perfect as it can be made, and the steel cars are fireproof.

The prospective motorman is thoroughly drilled in the school car by a competent instructor not only in use of the mechanism but also how to act in cases of emergency. This personal teaching is supplemented by an excellent book of instructions containing about 150 questions and answers of a practical nature, with cuts and explanations of all the apparatus. This the motorman is expected to study closely and thoroughly. From time to time his knowledge of its contents is tested in examinations. Should he be of an inquiring turn of mind he is further allowed the privilege and opportunity of entering the shops and studying the entire system in detail, as much as he desires.

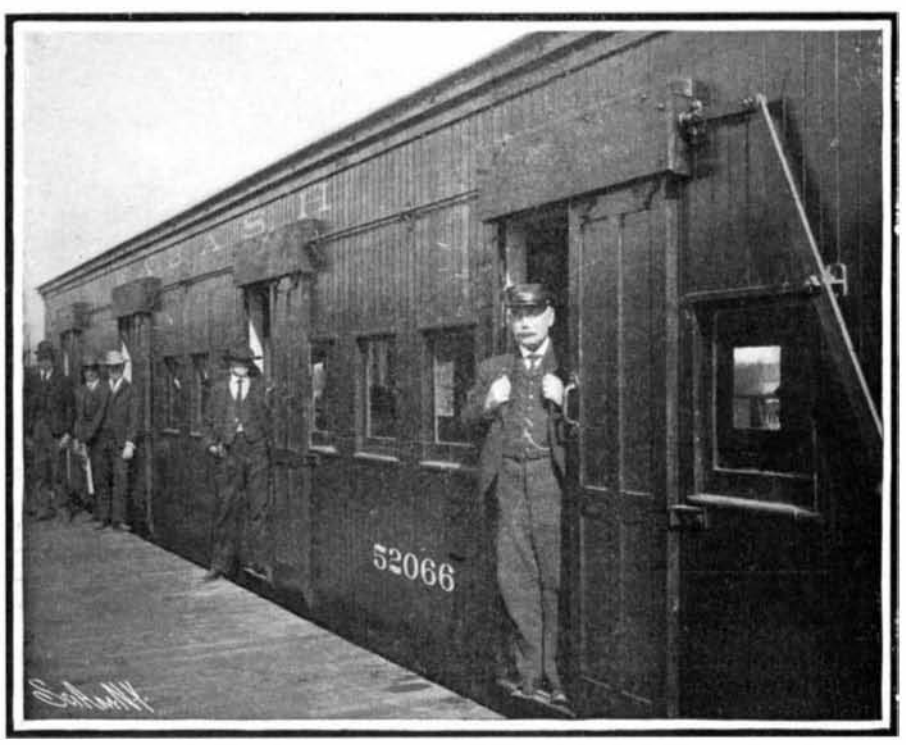
SIDE-DOOR COACHES FOR WORLD'S FAIR SERVICE.

BY CHARLES ALMA BYERS.

The use of side-door coaches for quick service on railroads is rapidly growing into popularity. The advantages pointed out some time ago by the SCIENTIFIC AMERICAN of side doors for passenger coaches over end doors have been fully realized. Actual experiments have clearly shown the theory that a train of coaches thus constructed can handle a crowd of passengers much more quickly to be absolutely practical. The first real test of this theory was made by the Illinois Central Railroad at the Chicago Exposition in 1893. That experiment proved satisfactory in every way, and as a consequence the Wabash Company has followed suit by using coaches of such construction for its shuttle trains between the Union Station and the World's Fair grounds at St. Louis. The construction of the Wabash's side-door coaches, however, differs slightly from that of those used by the Illinois Central. This difference is noticeable mainly on the interior. Instead of an aisle on each side, there is only one through the center, as in the ordinary coach. This is probably an improvement so far as affording more space for seats is concerned, but the plan undoubtedly detracts from the real object of the side doors—that is, of allowing the cars to be the most quickly filled and emptied. Another difference is that the Wabash's coaches have only four doors on each side, or eight in all, while those used by the Illinois Central had ten to the side, or a total of twenty. This is also a feature in which the Illinois Central surpassed in the matter of constructing a coach so as to be more quickly filled and emptied. Nevertheless, the time which is required for filling or emptying a Wabash coach of passengers is remarkably short as compared with the ordinarily constructed car.

The length of the Wabash coach is 50 feet and its seating capacity 92. Straps, however, are provided for standing passengers, as in a street car, and if neces-

Interior of the Side-Door Car.



View Showing Side Doors and the Lever by Which They Are Opened.

SIDE-DOOR COACHES FOR WORLD'S FAIR SERVICE.