air conditions made on May 18, 19 and 20, Blue Hill Observatory and the United States Weather Bureau furnished the American contribution. The former institution sent up pilot balloons at the observatory and sounding balloons at Pittsfield, Mass., while the Weather Bureau made their usual kite flights at Mount Weather and sent up sounding balloons at Omaha, Nebr. After ascending to a height of about eleven kilometers and passing through air at a temperature of about —50° Centigrade, one of the four balloons sent up from Pittsfield descended in the Atlantic Ocean just east of Block Island, where it was recovered by the crew of a fishing schooner.

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SPECIAL ARTICLES

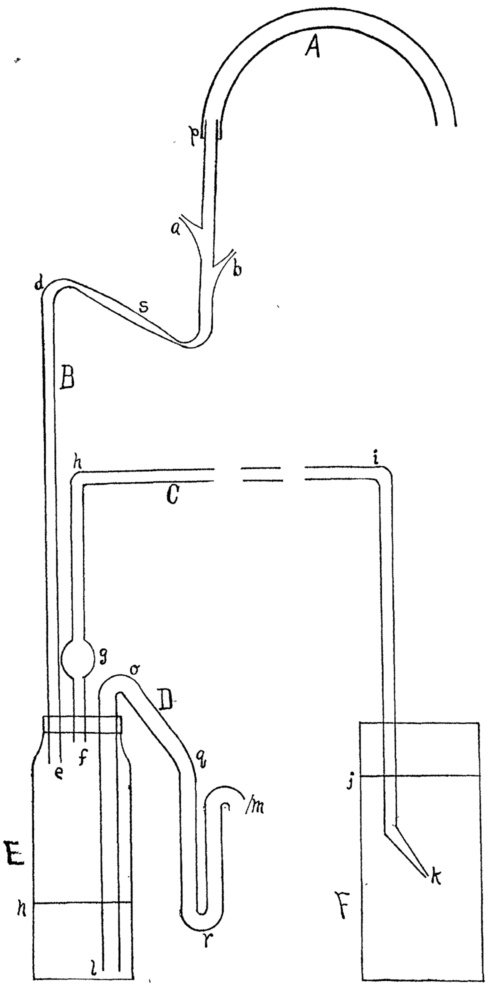
A SIMPLE AND ECONOMICAL AQUARIUM AERATOR

A SUCCESSFUL aquarium is a very rare object in undergraduate biological laboratories. The difficulties to be overcome in running an aquarium are generally thought to be so great that few are ever started; and if an animal happens to survive, it is usually considered an exceptional or an accidental case. There are, of course, good reasons for such a small number of aquaria. In the long run the various causes of non-success may generally be traced to two fundamental causes. These are insufficiency of food, and an insufficient supply of oxygen. In many cases the first of these defects is remedied by removing the second—an insufficient supply of oxygen. For when the food of an animal consists of living organisms, it is tolerably certain that there must be about the same amount of oxygen in the water for the food organisms to develop as is needed by the animal that feeds upon them. In other words, whenever the conditions are such that the food organisms can grow, the animal feeding upon them is also pretty certain to be able to live. Our chief concern seems to be therefore to establish a proper supply of oxygen to the water, and then knowing the food habits of the animal which we wish to put in the aquarium, we should not experience any great difficulty in keeping the animal alive.

There are many ways of aerating an aquarium, as might be expected, but there are always certain drawbacks, either in the simplicity of the apparatus, or in the economy of running it, or again in the irregularity of its action. The apparatus described below is the best which has yet come to my notice, as far as simplicity, economy and regularity of delivery of air are concerned. The apparatus is in use in the writer's laboratory and is giving perfect satisfaction on the three scores mentioned above, in addition to the important one of keeping the animals alive.

Before describing the apparatus it may be well to say that the aquarium should be stocked with water from the pond or stream from which the animal was taken, and not with "city water." The latter is often treated with chemicals to render it more fit for domestic use, as the precipitation of suspended clay by means of alum, etc. Water which has undergone this treatment is sometimes deleterious to animals, especially the lower forms.

Description of the Apparatus.—The tube A is of rubber and connects the aerator with the hydrant. Tube B is the "mixer." It conveys the water from A to the bottle E. As the water passes a and b, which are small open side branches in B, a quantity of air is sucked in and carried with the water into the bottle E. To obtain the maximum efficiency of the water as carrier of air, the tube B is drawn out to fine bore and bent at c and d in the form shown. The small bore causes all the water which passes down B to form drops filling the whole bore of B. Otherwise much of the water would run down the sides of the tube without pushing a quantity of air ahead of it. The tube C is of glass, or glass and rubber, as convenient, and carries the water brought down B into the aquarium through the opening k. The bulb g is for the purpose of preventing drops of water (which occasionally splash against f) from passing into the aquarium. The tube D is of glass and is what is known as a constant level siphon. Its purpose is to carry out the water which is collecting in the bottle. To work properly it should have the form shown in the sketch. (In the siphon it is essential to have the part at *m* of just the form shown in the cut. If *m* is lower than shown in the sketch, the part *r* to *m* will act as a small independent siphon, and the stream of bubbles into the aquarium



will in consequence be frequently interrupted.) The aquarium is represented by *F* and the surface of the water by *j*. In the bottle *E*, *n* represents the level of the water while running. The bottle *E* is fitted with an air-tight rubber stopper with three holes through which the tubes *A*, *B* and *C* pass.

The mere description of the apparatus may not be sufficient to give a clear understanding of its action. Its mode of working may be briefly described as follows: Suppose the apparatus, as described, is connected up properly, as shown in the sketch, and the bottle is empty of water. Now on opening the tap, a little of the water comes down *A* and *B* and runs into *E*, carrying with it a certain quantity of air. Water and air collect in *E* until there is enough pressure to force the water into *D* so that it begins to flow out at *m*. The water will have reached a point a little below before the siphon begins to work. At first the siphon takes out the water faster than it is delivered into *E*, but finally there is reached a stage where the siphon draws out in a steady stream just as much water as is brought in by *B*, and in the same interval of time. This point is at *n*, and this is the permanent level of the water in the bottle as long as the apparatus is run. At the moment the level of the water reaches *n*, the tube *C* delivers air into the aquarium through *k* in a constant stream.

There must be more water in *B* below *d* than there is in *C* from *j* to *k*; otherwise the air could not be forced out at *k*. For this reason the greater the distance *d* to *e*, the more air will be carried into the bottle. (The ratio is not constant, however. Various factors seem to operate, as shown by experiment.) The distance *f* to *h* should be at least twice the vertical distance *j* to *k*, to prevent possible flooding of *F*. The siphon should be of a bore at least twice as great as that of *B* to guard perfectly against flooding.

It will be obvious that the vertical distance *j* to *k* can never be greater than the vertical distance *l* to *m*. Also that vertical distance *j* to *k* equals approximately vertical distance *n* to *m*.

The cut is a sketch of the writer's most efficient aerator. The cut is not drawn to scale. A number of different designs of siphons and mixers were tried, but those sketched gave the best results. One centimeter of water carries into the bottle (and therefore into the aquarium) from four to seven times the quantity of air (the quantity depending on the length of the tube *B* and also on the flow of the water—the slower the flow the more efficient). This apparatus is therefore four to seven times as efficient as the ordinary air-displacement type of aerator, of which Dr. Pratt, of Haverford College, was so kind as to show me a working model last summer. But this apparatus does not use displaced air, since the siphon keeps the water at a constant level, and there is therefore no air to be displaced by water.

Another advantage which is of great importance is in the constancy of delivery of air. A constant stream of air bubbles without a second's intermission can be sent into an aquarium for weeks with this aerator with no attention whatever, providing the hydrant works well. With the air-displacement type this is of course impossible, since every time the bottle is filled with water, the current of air must be interrupted until the bottle is emptied.

Aside from the simplicity of the apparatus, and its constancy of working, its economy in the use of water will at once commend itself to all directors of laboratories who have limited funds at their disposal for running expenses. This aerator will deliver a constant stream of air, using only from 50 to 100 cubic feet of water per month. At the rate of 28 cents for 500 cubic feet of city water (the rate in Knoxville, an average rate), the monthly cost of operation would be only from 3 to 5 cents.

The writer's apparatus can be exactly duplicated by referring to the following measurements: *p* to *a*, 3 cm.; *p* to *b*, 6 cm.; *p* to *c*, 12 cm.; *c* to *d*, 6 cm.; *d* to *e*, 145 cm.; *f* to *g*, 10 cm.; *f* to *h*, 32 cm.; *j* to *k*, 16 cm.; *r* to *m*, 13 cm.; *l* to *o*, 38 cm.; *l* to *m*, vertical, 25 cm.; *h* to *i*, 5 meters; bore of *a*, 1 mm.; of *b*, 1 mm.; of *c*, 1.5 mm.; of *d*, 1.5 mm.; of *s*, 5 mm.; of *B*, 5 mm.; of *C*, 5 mm.; of *D*, 8 mm.; of *k*, 2 mm.; depth of water in *E* while running, 7 cm.; height of *E*, 38 cm.; contents of *E*, 8,000 c.c.; height of *F*, 24 cm.; contents of *F*, 7.5 liters.

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ARGYROSOMUS JOHANNÆ, A NEW SPECIES OF CISCO FROM LAKE MICHIGAN

HEAD 4.1 in length to base of caudal; depth 3.8; eye 6.5 in head; depth of caudal peduncle 3.1; snout 3.4; maxillary 2.6; mandible 2.0; height of dorsal fin 1.5; distance from snout to dorsal 1.9 in length; gillrakers 10 + 19; longest 1.0 in eye. D. 10 A. 12; scales 9–80–8.

Body deep, not greatly compressed, back strongly arched, rising rapidly for one half the distance from snout to dorsal, then more gradually. Caudal peduncle high, not greatly compressed. Head small, sharply wedge-shaped, its height at occiput 1.9 in height of body. Eye small. Lower jaw even with upper; maxillary reaching nearly to center of eye. Gillrakers coarse and widely set. Lateral line straight. Scales large and thick, non-deciduous.

Color (in formalin): lips and head pale; body dark above but not nearly to lateral line; quite pale below. Dorsally some indication of stripes, longitudinally. Dorsal and caudal fins with black edges, other fins pale.

Type: No. 372*d*, of the collections of the Wisconsin Geological and Natural History Survey, a male specimen 269 mm. in length, taken in about 25 fathoms some eighteen miles out from Racine, Wisconsin. Nos. 372, *a*, *b*, *c* and *e*, also Nos. 538, *a*, *b*, *c* and *e*, all from the same locality, may be considered as co-types. The specific name has been chosen as a slight token of gratitude for my great indebtedness to my life-companion.

The table on p. 958 gives the principal measurements of the specimens here included.

Early in July, 1906, the writer made collections of the fishes of Lake Michigan for the Wisconsin Geological and Natural History Survey. On a trip made with Captain C. Hyttel, of Racine, to his gillnets, set some eighteen or twenty miles out from that city, he had a good opportunity to observe and secure specimens of Coregonidæ. These did not, however, fall easily into groups conforming to the then known species. So the specimens were placed into lots according to their most marked external characteristics, and sent