

221.—ARTIFICIAL SEA WATER FOR AQUARIA.***By R. E. HOFFMANN.**

In former years hardly any salt-water aquaria were found in inland countries, because the expense and trouble of furnishing a constant supply of salt water were too great. Even the Berlin aquarium, with its abundant funds, was so far from the nearest sea-coast as to make the supply of natural sea-water uncertain, and it suffered from this condition of affairs. The people of Berlin wittily called this chronic condition of their aquarium its "sea-sickness." Although every new institution has to pass through a period of so-called "children's diseases," this peculiar "sickness" of the Berlin aquarium proved very obstinate, and even threatened the life of the young and tender child whose birth had been hailed with so much joy. The Vienna aquarium had to pass through similar experiences, and the stockholders were obliged to pay dearly for the experiment. As matters stood at the Berlin aquarium, the use of artificial sea-water seemed very desirable; but many a well-planned experiment based on scientific principles proved a failure; for, although the component parts of sea-water are well known, and any chemist can easily prepare it from a receipt, it seemed at first impossible, in a chemical way, to breathe the "breath of God" into our scientific sea-water, and to impart to it the secret of true vitality. At last, however, long after the institution had been opened, Dr. Hermes succeeded in solving the problem in a scientific manner, and proved in the most incontrovertible way that the maintenance of inland salt-water aquaria was no longer dependent on the nearness of the sea-coast. Dr. Hermes succeeded in satisfying every demand, as regards sea-water, within one week.

The very bold assertion of the director of the zoophyte aquaria in the zoological garden in Regent's Park, London, that artificial sea-water, even if a chemical analysis cannot discover the least difference between it and natural sea-water, is never beneficial to animals and plants, has been disproved by the success of the Berlin aquarium. Since we have succeeded in manufacturing artificial sea-water which possesses all the qualities necessary for the life of animals and plants, and which, by the use of suitable apparatus, can be kept fresh for years, nothing prevents inland towns from having sea-water aquaria, which, in many respects, are peculiarly interesting.

* *Ueber künstliches Seewasser für Aquarien.* From the *Deutsche Fischerei-Zeitung*, vol. vii, No. 30; Stettin, July 22, 1884. Translated from the German by HERMAN JACOBSON.

As sea-water aquaria have a great future in Germany and will rapidly increase in number if proper directions for their maintenance are given, I will describe the manufacture of the water in such a manner that any one can easily prepare it himself. To 50 liters (about 13 $\frac{1}{4}$ gallons) of pure hard well water take 1,325 grams (46 $\frac{1}{2}$ ounces) of common salt, 100 grams (about 3 $\frac{1}{2}$ ounces) of sulphate of magnesium, 150 grams (about 5 $\frac{1}{4}$ ounces) of chloride of magnesium (chlormagnesium), and 60 grams (about 2 ounces) of sulphate of potassium, all of which can be obtained at any drug store, but generally not entirely pure; and foreign admixtures and impurities may easily cause the death of all the animals. Each of these chemicals is dissolved in water by itself; afterward they may all be poured together and allowed to stand quietly for several hours, so that little stones and other impurities may settle to the bottom. All particles of dirt floating on the surface should be carefully removed by dipping. The mixture is then poured into another vessel and diluted with fresh water until the hydrometer indicates the proper degree of saltness. The quantities given above will produce about 50 liters (about 13 $\frac{1}{4}$ gallons) of sea-water.

This composition I have ascertained comes very near to that of natural sea-water, for, besides the component parts given above, it also contains small quantities of soda, iron, and potash. I obtain the chemicals for preparing my sea-water, which contains all the seven ingredients in their true proportions, from a friend of mine who is a chemist and am prepared to supply others. Most of the sea-water found in the market contains only the four first-mentioned salts, and is likewise suitable for filling the basin. One should be careful, however, not to put animals in such freshly manufactured sea-water, as this would almost beyond a doubt kill them. It is well known that sea-water is 0.027 gram heavier than fresh water; its weight is therefore 1.027. Everything in excess of this weight must be carefully corrected from time to time by pouring in fresh water as the water evaporates, while this is not the case with the salts. The solid ingredients of sea-water constitute about 3 $\frac{1}{2}$ per cent. of its weight, or one-half ounce to a pound of water. A hydrometer is indispensable for ascertaining the degree of saltness.

Newly manufactured sea-water should be placed in the open air in some cool place, and allowed to stand for some time. If one has any live salt-water algæ adhering to stones they should be added, because they impregnate the water with oxygen. After some weeks the algæ will spread all round them clouds of diminutive seeds, which adhere to the walls and quickly grow under the influence of light. By supplying oxygen they make the water, after it has been filtered several times, still more fitted to receive animals. Of sea-plants, the green ulvæ and the confervæ are particularly suitable for recently manufactured salt water.

In the beginning only a few hardy animals should be placed in the water, which will flourish and thrive in it; and after awhile an at-

tempt may be made with more tender animals, which, if placed in the water in the beginning, would probably have died. If no algæ can be obtained, the water should be allowed to stand longer. Any one who can afford to wait until a green cover of algæ spreads over the panes, will do well to defer placing the animals in the water till that time, and a little patience is very commendable during the entire process. Like wine, salt water, if properly treated, improves with age, as special apparatus continually supply it with oxygen by night, and keep it agitated. The water in the Hamburg aquarium has not been changed for fifteen years, and is still perfectly clear, transparent, and odorless, in short, of the very best quality; and all that has to be done is to make up for accidental losses or evaporation. The water of the salt-water aquarium is changed or filtered only when it begins to get turbid, or if some change is to be made in the arrangement of the aquarium. It will always be advisable, however, to keep at least a double supply of sea-water on hand, and place it in the cellar in well-corked bottles, as any sudden emergency will then be fully met.

I have never been able to obtain natural sea-water which was as clear as the artificial, through which one can see everything distinctly, even in the most remote corner of a large aquarium, which it would be very difficult to do in natural sea-water. I have brought up sea-water in a dipper, which, when poured into a glass, was as clear as crystal and had a brilliant blue color; but this is possible only on the high-seas, and when the water is brought up from a considerable depth. Fishermen take too little care and trouble in this respect; close to the shore they will dip up the water resembling a thick, yellow, and stinking juice, and ship it to other places. For this reason I use artificial sea-water prepared in the manner indicated above, and even without adding any plants, I succeed in keeping my animals alive.

It is self-evident that the principal point in constructing salt-water aquaria is the treatment of the water, which, after all, is the element which decides the well-being and sickness, life and death of the animals. Care should be taken to keep the water well supplied with oxygen, which is easily done by means of the aerating apparatus; and to see to it that the normal proportion between the salts and sea-water is always maintained, and as soon as anything appears to be wanting in this respect, it should be supplied. As soon as the water begins to get turbid, it should be filtered, and during an abnormal state of the weather it should be cooled. Only when these conditions are fulfilled, will it be possible to keep up a successful salt-water aquarium; only thus shall we be enabled to have in our rooms an exact representation of the bottom of the sea, with all its mysteries and wonders. I, therefore, repeat in conclusion, "The treatment of the water is the main thing."

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