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VI.—On manufactured sea-water for the aquarium

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VI.—*On Manufactured Sea-Water for the Aquarium.*

By P. H. Gosse, A.L.S.

The inconvenience, delay and expense attendant upon the procuring of sea-water, from the coast or from the ocean, I had long ago felt to be a great difficulty in the way of a general adoption of the Marine Aquarium. Even in London it is an awkward and precarious matter; how much more in inland towns and country places, where it must always prove not only a hindrance, but to the many an insuperable objection. The thought had occurred to me, that, as the constituents of sea-water are known, it might be practicable to manufacture it; since all that seemed necessary was to bring together the salts in proper proportion, and add pure water till the solution was of the proper specific gravity. Several scientific friends to whom I mentioned my thoughts, expressed their doubts of the possibility of the manufacture; and one or two went so far as to say that it had been tried, but that it had been found not to answer; that though it looked like sea-water, tasted, smelt, like the right thing, yet it would not support animal life. Still, I could not help saying, with the lawyers, "If not, why not?"

Experientia docet. I determined to try the matter for myself.

I took Schweitzer's analysis; but as I found that there was some slight difference between his and Laurent's, I concluded that a very minute accuracy was not indispensable. Schweitzer gives the following analysis of 1000 grains of sea-water taken off Brighton:—

Water	964·744
Chloride of sodium . . .	27·059
Chloride of magnesium . .	3·666
Chloride of potassium . .	0·765
Bromide of magnesium . .	0·029
Sulphate of magnesia . .	2·295
Sulphate of lime	1·407
Carbonate of lime . . .	0·033
	999·998

The bromide of magnesium and the carbonate of lime I thought I might neglect, from the minuteness of their quantities; as also because the former was not found at all by M. Laurent in the water of the Mediterranean; and the latter might be found in sufficient abundance in the fragments of shell, coral, and calcareous algæ, thrown in to make the bottom of the aquarium. The sulphate of lime (plaster of Paris) also I ventured to eliminate, on account of its extreme insolubility, and because

M. Laurent finds it in excessively minute quantity. The component salts were then reduced to four, which I used in the following quantities :—

Common table salt	$3\frac{1}{2}$ ounces.	
Epsom salts	$\frac{1}{4}$ „	
Chloride of magnesium . .	200 grains	} Troy.
Chloride of potassium . . .	40 „	}

To these salts, thrown into a jar, a little less than four quarts of water (New River) were added, so that the solution was of that density that a specific gravity bubble 1026 would just sink in it.

The cost of the substances was—sulph. mag. 1*d.*; chloride mag. 3*d.*; chlor. pot. $1\frac{1}{4}d.$; salt, nil;—total, $5\frac{1}{4}d.$ per gallon. Of course if a larger quantity were made the cost of the materials would be diminished, so that we may set down 5*d.* per gallon as the maximum cost of sea-water thus made. The trouble is nothing, and no professional skill is requisite.

My manufacture was made on the 21st of April. The following day I poured off about half of the quantity made (filtering it through a sponge in a glass funnel) into a confectioner's show-glass. I put in a bottom of small shore-pebbles, well washed in fresh water, and one or two fragments of stone with fronds of green sea-weed (*Ulva latissima*) growing thereon. I would not at once venture upon the admission of animals, as I wished the water to be first somewhat impregnated with the scattered spores of the *Ulva*; and I thought that if any subtle elements were thrown off from growing vegetables, the water should have the advantage of it, before the entrance of animal life. This too is the order of nature; plants first; then animals.

A coating of the green spores was soon deposited on the sides of the glass, and bubbles of oxygen were copiously thrown off every day under the excitement of the sun's light. After a week therefore I ventured to put in animals as follows :—

2 *Actinia mesembryanthemum.*	*Coryne ramosa.*
7 *Serpula triquetra.*	*Crisia eburnea.*
3 *Balanus balanoides.*	—— *aculeata.*
2 *Sabella* —— ?	*Cellepora pumicosa.*
2 *Sabellaria* (*alveolata* ?)	*Cellularia ciliata.*
2 *Spio vulgaris.*	*Bowerbankia imbricata.*
1 *Cynthia* (*quadrangularis* ?)	*Pedicellina Belgica.*

These throve and flourished from day to day, manifesting the highest health and vigour; the plants (including one or two Red Weeds that were introduced with the animals) looked well, and the water continued brilliantly crystalline. Within the succeeding month specimens of *Actinia mesembryanthemum*, *A. angui-*

coma and *A. clavata*, a *Trochus umbilicatus*, and a *Littorina littorea* were at different times added.

Six weeks have now elapsed since the introduction of the animals. I have just carefully searched over the jar, as well as I could do it without disturbing the contents. I find every one of the species and specimens mentioned above, all in high health; with the exception of some of the Polyzoa, viz. *Crisia aculeata*, *Cellepora punicosa*, *Cellularia ciliata*, and *Pedicellina Belgica*. These I cannot find, and I therefore conclude that they have died out; though if I chose to disturb the stones and weeds, I might possibly detect them. These trifling defalcations do in no wise interfere with the conclusion, that the experiment of manufacturing sea-water for the Aquarium has been perfectly successful.

P. H. Gosse.

58 Huntingdon Street, Barnsbury Park,
June 9, 1854.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

March 23, 1854.—Colonel Sabine, R.A., Treas. and V.P., in the Chair.

"Note on an indication of depth of Primæval Seas, afforded by the remains of colour in Fossil Testacea." By Edward Forbes, F.R.S., Pres. G.S. &c.

When engaged in the investigation of the bathymetrical distribution of existing mollusks, the author found that not only did the colour of their shells cease to be strongly marked at considerable depths, but also that well-defined patterns were, with very few and slight exceptions, presented only by testacea inhabiting the littoral, circumlittoral and median zones. In the Mediterranean only one in eighteen of the shells taken from below 100 fathoms exhibited any markings of colour, and even the few that did so, were questionable inhabitants of those depths. Between 35 and 55 fathoms, the proportion of marked to plain shells was rather less than one in three, and between the sea-margin and 2 fathoms the striped or mottled species exceeded one-half of the total number.

In our own seas the author observes that testacea taken from below 100 fathoms, even when they were individuals of species vividly striped or banded in shallower zones, are quite white or colourless. Between 60 and 80 fathoms, striping and banding are rarely presented by our shells, especially in the northern provinces; and from 50 fathoms shallow-wards, colours and patterns are well marked.

The relation of these arrangements of colour to the degrees of light penetrating the different zones of depth, is a subject well worthy of minute inquiry, and has not yet been investigated by natural philosophers.