MARINE AQUARIUM KEEPING

THE SCIENCE, ANIMALS, AND ART

STEPHEN SPOTTE

ILLUSTRATED WITH 23 DRAWINGS BY FRANCES McKITTRICK WATKINS
15 COLOR PLATES AND 65 PHOTOGRAPHS

Marine Aquarium Keeping

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FOR CAROL

Preface

As I write this sentence waves are breaking in frothy madness on the beach outside my window. The tail end of a winterstorm brings a brown and broken sea here to the edge of the land. Tomorrow its surface will be placid and the waves will break differently, although in the ancient structure of things such differences do not account for much. Ocean waves are still changeless in the gradually changing order of the universe.

Stability is the very essence of the sea. Its chemical composition hardly differs from day to day, year to year, century to century. Only the living things that drift and swim have diversified, mute testimony to the positive forces of stable environments.

The water is everything. Because sea water was the medium in which life evolved we are all, in a sense, self-contained oceans. Our blood has a composition reminiscent of the sea. All life, in fact, consists of variations on a single theme. You could almost say that nature took sea water, an old, original product, and repackaged it in different ways, some to be called fish, others trees, and still others men.

But if the sea is the stablest of environments, a marine aquarium is perhaps the most unstable. Without winds and surf, global currents, and the cleansing activities of uncountable microorganisms an aquarium is pathetically isolated and vulnerable. And as confinement alters the chemistry of the water the captive animals, unaccustomed to sudden changes throughout their long evolution, will weaken and die.

In the following pages I describe some of the commonly kept marine creatures and even explain how to exhibit them more attractively. Yet in the long run such matters are of minor importance. How well you control the inevitable changes taking place in the sea water will determine whether the aquarium succeeds or fails. The water, you see, is everything. It's as simple as that.

STEPHEN SPOTTE

Brooklyn, New York
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S. S.

The Science

Contents

Chapter One

Sea Water

1.1 COMPOSITION

Every substance in the universe is composed of *matter*. The paper on which these words are printed is matter. So are your eyes and the fingers you use to turn the pages. Matter is made up of smaller constituents known as *molecules*. These are composed of even smaller things called *elements*, which in turn are made of *atoms*. For our discussions an atom is the end of the line; there need be nothing smaller.

Some atoms have tiny electrical charges, either positive or negative. Electrically charged atoms are referred to as *ions*. Ions can combine to form molecules of compounds called *salts*. The formula below illustrates this principle in the symbolic language of chemists; Figure 1 shows it diagrammatically.

$$Na^+ + Cl^- \rightleftharpoons NaCl.$$

Sea water is composed mainly of salts, of which there are many kinds. Table salt, or plain sodium chloride, is the most common. Epsom salt (magnesium sulfate) and gypsum (calcium sulfate) are two more. The ionic composition of sea water is given in Table 1.

1.2 NATURAL SEA WATER

Although the elements and salts found in the sea are inorganic and therefore nonliving, it is wiser for us to consider sea water in its natural state as a

Table 1 Composition of Sea Water

Constituent	Concentration (ppm)
Chloride	18,980
Sodium	10,560
Sulfate	2,560
Magnesium	1,272
Calcium	400
Potassium	380
Bicarbonate	142
Bromide	65
Strontium	13
Boron	4.6
Fluoride	1.4
Rubidium	0.2
Aluminum	0.16–1.9
Lithium	0.1
Barium	0.05
Iodide	0.05
Silicate	0.04–8.6
Nitrogen	0.03–0.9
Zinc	0.005–0.014
Lead	0.004–0.005
Selenium	0.004
Arsenic	0.003–0.024
Copper	0.001–0.09
Tin	0.003
Iron	0.002–0.02
Cesium	$\sim$0.002
Manganese	0.001
Phosphorous	0.001–0.10
Thorium	$\leqslant$0.0005
Mercury	0.0003
Uranium	0.00015–0.0016
Cobalt	0.0001
Nickel	0.0001–0.0005
Radium	8×10^{-11}
Beryllium	. . .
Cadmium	. . .
Chromium	. . .
Titanium	Trace

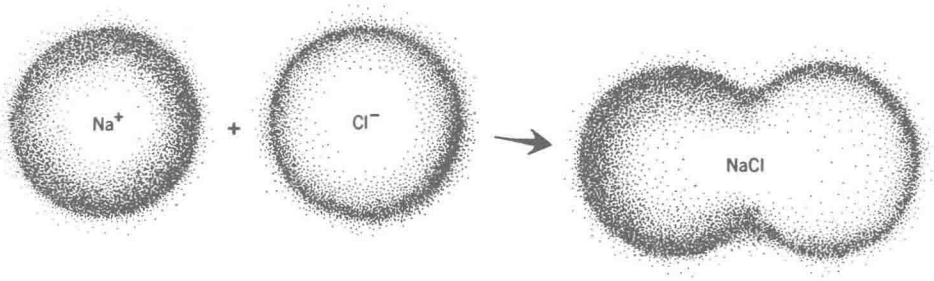

Figure 1 A sodium ion and a chloride ion combine to form a molecule of sodium chloride.

living substance. This makes it easier to understand why it must be treated in certain ways before use in the aquarium.

When you scoop up water from the surface of the ocean, you are seldom aware that it teems with life because most of the organisms are microscopic and invisible to the naked eye. Nevertheless, any sample of sea water, no matter how clear it looks, will contain thousands of simple one-celled animals and plants called *plankton* by oceanographers. Literally translated, this term means wanderer. A random sampling of planktonic organisms, as seen through a microscope, is shown in Figure 2.

The plankton immediately start altering the chemical composition of the newly collected water. The tiny animals prey on one another and on the plants, use up the oxygen, and give off carbon dioxide. Perhaps most important, they start to die, and their decaying remains poison the water, making it unfit to sustain other forms of life. In water taken at certain times of the year when plankton are most abundant, these changes may occur so rapidly that the water actually gives off an odor of decay after only a few hours in storage.

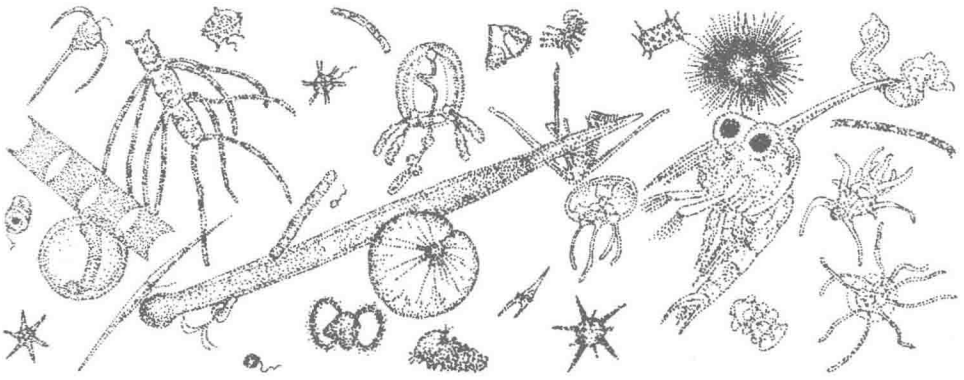

Figure 2 Plankton.