

**WATER SUPPLY
CONSIDERED MAINLY
FROM A CHEMICAL AND
SANITARY STANDPOINT**

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Water supply considered mainly from a chemical and sanitary standpoint by Wm. Ripley
Nichols

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WM. RIPLEY NICHOLS

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WATER SUPPLY

UNIV. OF
CALIFORNIA

CONSIDERED MAINLY FROM A

CHEMICAL AND SANITARY STANDPOINT.

BY

WM. RIPLEY NICHOLS,

PROFESSOR AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

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P R E F A C E.

THE following pages contain, somewhat amplified, the substance of a course of "Lectures on Water Supply" which the author has been in the habit of delivering before certain classes at the Institute of Technology. It is primarily as an aid to engineering and other students at this and similar institutions that the book is printed. It is hoped, however, that the book will be found of service to young engineers, to persons in charge of water works, to water committees, and to others who are interested in the matter of water supply.

The aim is not to present a complete treatise on water supply for the civil engineer, nor a treatise on water analysis for the chemist, nor a treatise on mycology for the botanist, and certainly not a treatise on sanitary science for the physician, but, rather, to occupy a territory which encroaches on the fields of these and other professions and which belongs exclusively to no one alone—ground, in fact, with which all who are professionally interested in water supply must be more or less familiar.

The metric system of weights and measures is used, as well as the English; tables for the conversion of one system into the other will be found at the end of the volume. In the nomenclature of chemical substances, the old and more familiar terms are generally—although not exclusively employed—such as carbonate of soda and not sodic carbonate, sulphate of lime rather than sulphate of calcium.

The author has quoted freely from other works on the subject, and from his own earlier reports, now mostly out of print.

He would acknowledge especial indebtedness to the Reports of the Rivers Pollution Commission, and to Fischer's chemische Technologie des Wassers, and regrets that Wolffhügels Wasserversorgung did not come to hand until the manuscript was in the hands of the printer.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
Boston, Mass., *May*, 1883.

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INTRODUCTORY CHAPTER.

SOLUTION.

No water which occurs in nature is pure in the strict chemical sense of the term, but all natural waters, however free from suspended particles of foreign matter which are visible to the eye, invariably contain *in solution* more or less of substances which, in their ordinary condition, are solids or gases. It is therefore important, in the beginning, to understand some of the many things which might be said of solution in general.

Solution of Solid Substances.

If some pure salt be put into water, after a time the salt disappears from sight, and becomes incorporated with the water, so that it is no longer possible to distinguish it by the eye, or to remove it by ever so fine a filter. As far as we can make it out, the change that has taken place is as follows: The ultimate particles of the salt (the molecules of the chemist) are no longer held together in a solid mass by that mutual attraction which we call cohesion, but have become separated from each other and distributed among the particles (molecules) of the water so as to form a homogeneous mixture. As far as we can perceive, it is, indeed, simply a mixture—a mixture of particles of salt with particles of water—we can discover no chemical change, we can trace no chemical action between the dissimilar substances, salt and water. This is an example of what is usually called *physical solution*. The solution differs, of course, essentially from the water. The transparency is not noticeably impaired,* but if

* This would not be true if, instead of common salt, we had taken a strongly colored substance like the permanganate of potash. In such a case the strong color of the solution would perceptibly diminish its transparency; otherwise the phenomena would be as above.