Water and Water Supply

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WATER
AND
WATER SUPPLY.

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PREFACE

TO

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The first edition of the abstract of these Lectures appeared in Van Nostrand's Engineering Magazine in 1875, and subsequently were incorporated in the Science Series, for the reason that at that time there was a demand for monographs on this special subject, the literature at that period being somewhat scanty.

The original Lectures were delivered at the School of Military Engineering, Chatham, England, in the autumn session of 1873, and were subsequently printed for private circulation, and attracted by their clearness and conciseness in detail, a very wide attention.
The principal point in view by Prof. Corfield was public health, and in this respect he did not enter into engineering matters to any great extent, not more so than the subject absolutely required, but he went very thoroughly over the whole ground, treating it in a practical, common-sense view. For these reasons, and from the fact that a very great many publications bearing upon this subject have appeared since these Lectures were printed, it has been deemed advisable, as the publishers desire to keep the different numbers of this Series available to the public, to reprint this particular one without change or addition, the fact being that comparatively little if any changes or additions could add to the permanent value of the matter presented in these pages. The Lecture form has been preserved throughout. Prof. Corfield's further Lectures on "Sewerage and Sewage Utilization" form No. 18 of this Series.

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WATER AND WATER SUPPLY.

It will be our purpose to discuss, in the first place, the sources and the kind of water that are required for large communities—the kind in the first place, the quantity in the next, the places to get it in the third, and then the ways to convey it to the community.

It is only one part of the fuel of a community that we have to consider. We shall then consider what are the wastes from a large community, and whether, although useless for the purpose for which the original fuel was supplied, they can be made useful for other purposes, and if so, how? Whether again there is any necessity of getting rid of them, and if so, how this can be
done most effectually, and most cheaply,
and without prejudice to other communities.

Now then as regards water. Water is required in a large community for a great variety of uses. These uses were divided by the Romans, and they have been divided ever since, into public and private uses. The public uses are such as for cleaning streets, extinguishing fires, for fountains, for public baths, and so on. The private uses are for drinking, washing, cooking, etc. Thus water you see at once from the mere examination of its uses comes to the community to be soiled. It comes in order that the community may be supplied with one of the necessities of life. It comes to wash communities, places, and habitations. It comes, I repeat, to be soiled. It is, therefore, generally, when soiled, useless for the purpose it was originally wanted for. It has either to be purified or got rid of. A community requires pure water for some purposes, and those are especially for drinking and cooking. Pure water
—I do not mean chemically pure, but we shall see directly what is meant hygienically by pure water—is not necessary for every purpose, such as for washing the streets, extinguishing fires, etc. However, practically speaking, only one kind of water can, as a rule, be supplied to a community, and so it becomes necessary for us to know where we can get this sufficient supply of water of a certain quality, viz., sufficiently good for drinking.

Now, roughly speaking, a drinking water should be, in the first place, transparent. In the second place, it should be transparent to white light; that is to say, it should be transparent and without color. It must be without taste and without smell, and it must deposit no sediment on standing, and have no particles suspended in it. Those are the rough qualities of water which anybody can examine for himself; the best way to look at it is to look through about a foot or 18 inches of it in a long glass cylinder, placed on a piece of white paper. It
must be aerated to be fit for drinking, and cool. Now, if the water you are examining does not fulfill these conditions, it must be rejected at once, or brought to satisfy them. We have to consider how these conditions are to be fulfilled, and we ought to satisfy them on a large scale. But a water may comply with all these conditions, and yet not be a safe water to drink. It may contain substances which you cannot tell in any of these ways, and, practically speaking, all waters do. Substances whether in solution or suspension may be hurtful, or they may be harmless; and now I want to tell you how, if you have a chemical analysis of a sample of water before you, you can tell whether that water is suitable for your purpose or not. That is a thing you do not generally find in engineering books. It is necessary for you to know it, because if a report is brought up upon a particular water, you ought to be able to know whether that will be a satisfactory water or not.

Natural waters contain dissolved (in
the first place especially) carbonic acid gas. They contain all the constituents of air in solution, but the gases are not in the proportion in which they are in atmospheric air. There is often a great quantity of carbonic acid gas, and oxygen, being more soluble than nitrogen, is generally in larger proportion than in atmospheric air. Now the carbonic acid gas is the one that I am going to speak of first. Water containing carbonic acid in solution has the property of holding in solution quantities of certain salts that it would not dissolve otherwise, or only in much smaller quantities, and the chief of these is carbonate of lime. Natural waters often contain, then, in the first place, salts of lime, especially the carbonate, dissolved in carbonic acid. They contain often the sulphates of lime, soda, magnesia, iron, and so on—in fact, different salts of these and other bases. Phosphates they all contain, and also chlorides and nitrates. All natural waters contain the latter in certain proportions—even rain water. Almost all
of them contain salts of ammonia. The question arises which of these may be allowed in water, and which may not, or which, at any rate, may not be allowed above a certain quantity, and what is the quantity? Beyond those simple characters for pure water which I gave you a few minutes ago, there is a property of natural waters which can be easily ascertained by any one, and which constitutes one of the best known differences between various specimens of water, and that is the quality of hardness. What does that mean? Hardness is tested in this way. Pure water dissolves soap, which is a combination of soda with some of the fatty acids. Pure water dissolves soap perfectly and forms a lather at once. Now water containing certain salts in solution, and notably salts of lime, magnesia, and iron, does not do so, because these salts form insoluble precipitates with the soap. That is what is meant by the water being hard. If a water, instead of lathering with soap immediately, takes a great deal of