distilling the water, when characteristic odors are frequently given off.

The evidence derived from an examination of the physical characters is very unreliable, we must, therefore, proceed to an examination of the dissolved solids, which gives us the most valuable evidence. The examination is divided into the Qualitative and Quantitative:

I. QUALITATIVE. The most useful tests are the following:—

SUBSTANCES SOUGHT FOR	RE-AGENTS TO BE USED, AND EFFECTS.
Reaction	Litmus and turmeric papers: usual red or brown reactions.
Lime	Oxalate of ammonium: white precipitate.
Chlorine	Nitrate of Silver and Dilute Nitric Acid: white precipitate becoming lead color.
Nitrous Acid	Iodide of Potassium and Starch in Solution: a blue color.
Ammonia	Nessler's Solution: a yellow color or yellow brown precipitate.
Nitric Acid	Sol. of Sulphate of Iron and pure Sulphuric Acid: olive colored zone.
Oxidisable Matter including Organic Matter	Permanganate of Potassium: red color disappears.

II. QUANTITATIVE:

1. DETERMINATION OF CHLORINE.—Prepare a solution of Nitrate of Silver, by dissolving 17 grammes in one litre of water.

Take 100 C.C. of the water to be examined, place it in a white porcelain dish; add enough solution of yellow chromate of potash to make it just yellow. Then add the nitrate of silver solution from a burette, and stir. A red color is produced, which disappears as long as any chlorine is present. Stop when the least red tint is permanent, then read off the number of C.C. of silver nitrate used; each of these represents 3.55 milligrammes of chlorine. Multiply by 10 to give the amount per litre, and this again by .07 for grains per gallon. Chlorine in water is very suspicious of the presence of the liquid excreta of men or animals. If in addition we find nitric and nitrous acids, ammonia and phosphoric acid, the evidence is very strong. Chlorine, however, may be due to strata containing chloride of sodium or calcium. In this case the water is alkaline from sodium carbonate. In some cases the chlorine is due to impregnation from sea water. It is then large in quantity; there is also magnesia and little evidence of organic matter.

2. HARDNESS.—This is estimated by Clarke's soap test, and by it we determine—

1. TOTAL HARDNESS, representing the aggregate earthy salts and free carbonic acid.
2. THE REMOVABLE HARDNESS, or that which disappears on boiling.
3. THE PERMANENT HARDNESS, which is unaffected by boiling.

By the soap test can also be determined the amount of certain constituents, such as lime, magnesia, sulphuric acid, and free carbonic acid.

APPARATUS REQUIRED FOR THE SOAP TEST.—Measure of 50 or 100 C.C. Burette divided into 10ths of a cubic centimetre, two or more stoppered bottles to hold about four ounces. We also require the following solutions:

1. STANDARD SOLUTION OF BARIUM NITRATE. Dissolve .26 grammes of pure barium nitrate in 1 litre of water or 18.2 grains to 1 gallon. A concentrated solution of ten times this strength may be made and diluted with nine parts of water when used.

2. SOLUTION OF SOAP. Dissolve a piece of soft potash soap, of the British Pharmacopœia, in equal parts of water and alcohol; filter, and then graduate as follows:

Put 50 C.C. of the Standard Solution of barium nitrate into the shaking bottle, and add to it slowly the soap solution from the finely-graduated burette. After each addition shake vigorously and place the bottle on its side. Continue this until you have a thin beady lather over the whole surface, permanent for five minutes. Read off the amount of soap solution used; if exactly 2.2 C.C. have been taken the solution is correct; if less, the soap solution must be diluted with spirit and water. The amount of dilution can be ascertained by a simple rule. Suppose 1.8 C.C. have been used and the whole of the unused solution measures 200 C.C. then

$$\text{As } 1.8 : 2.2 :: 250 : x$$
$$x = 244.4 \text{ C.C.}$$

The 200 c.c. must then be diluted with equal parts of spirit and water to 244.4 C.C.

With these solutions, and having all glasses, burette, etc., perfectly clean—for the least quantity of acid would destroy the accuracy of the process—we can proceed as follows:

1. To determine the total hardness of the water. Take 50 C.C. of the water in a stoppered bottle, and add the soap solution from the burette, shaking strongly after each addition until a lather permanent for five minutes