spreads over the whole surface without any break.

Then read off the number of tenths of soap solution used.

From this number subtract 2, as that quantity is necessary to give a lather with 50 C.C. of the purest water. The soap solution which has been used indicates the hardness due to all ingredients which can act upon it; as a rule they are lime, magnesian salts, iron, and free carbonic acid.

It is usual to express this hardness by degrees of Clark's Scale. Though dependent upon various causes it is considered as so much calcium carbonate per gallon, one grain of calcium carbonate per gallon being one degree of Clark's Scale.

The calculation is as follows: Each tenth of the Soap Solution corresponds to .25 milligrammes of calcium carbonate. Multiply this co-efficient by the number of tenths of soap solution used and the result is the hardness of 50 C.C. Multiply by 20 for the amount per litre, and by .07 for grains per gallon, or degrees of Clark's Scale.

To obtain the PERMANENT HARDNESS.—Boil a known quantity briskly for half an hour, replacing the loss with distilled water from time to time; cork the vessel and allow it to cool. Then determine the hardness in 50 C.C. as before.

REMOVABLE HARDNESS. This is very easily calculated, for we have only to take the difference between the total hardness and the permanent hardness and express the result as removable hardness.

The permanent hardness is the most important, for it represents the most objectionable earthy salts, viz.: calcium sulphate and chloride, and the magnesium salts. The permanent hardness of good water should not exceed 3° or 4° of Clark's Scale.

The next step in our investigation is the Determination of Free or Saline Ammonia, and of Nitrogenous Organic matter.

AMMONIA in water is chiefly derived from organic substances, either vegetable or animal. In the detection and estimation of Ammonia, the very delicate test known as Nessler's Solution is of the greatest value.

NESSLER'S SOLUTION is thus prepared: Dissolve 50 grammes of Iodide of Potassium in 250 C.C. of distilled water; reserve a small quantity, warm the larger portion, and add a strong aqueous solution of corrosive sublimate until the precipitate ceases to disappear; then add the reserved solution of Iodide so as to just dissolve the red precipitate; filter, and add to the filtrate 200 grammes of solid potash dissolved in boiled water. Dilute to 1 litre, and add 5 C.C. of a saturated aqueous solution of mercury bi-chloride. Allow to subside; decant the clear liquid and keep in a dark place.

In addition to this liquid we require—

STANDARD SOLUTION OF AMMONIUM CHLORIDE, which is of the strength of .0315 grammes to 1 litre of water. Each C.C. represents .01 milligrammes of Ammonia. The mode of procedure is as follows: Place in a flask 250 C.C. of the water to be examined; distil off about 120 C.C.; measure this distillate carefully; test a little with Nessler's Solution in a test tube, and observe the colour; if not too dark, take 100 C.C. of the distillate and put it into a cylindrical glass vessel and place it upon a piece of white paper. Add to it 1½ C.C. of Nessler. Put into another similar cylinder as many C.C. of Ammonium Chloride as may be thought necessary, and fill up to 100 C.C. of pure distilled water, which has previously been proved to be free from Ammonia; drop in 1½ C.C. of Nessler. If the colours correspond, the process is finished, and the amount of Ammonium Chloride used is read off. If the colors are not the same, add a little more Ammonium Chloride, so long as no haze shows itself; if it does then a fresh glass must be taken and a new trial made. When the colours correspond, read off the C.C. of Ammonium Chloride used; allow for the portion of distillate not used, multiply by .01, and we have the number of milligrammes of free Ammonia in the 250 C.C. acted upon, multiply this amount by 4 and we have the number of milligrammes per litre.

EXAMPLE.—From 250 C.C. of water, 123 were distilled, 100 C.C. were taken for the experi-