Unstopper the bottles only when ready to put the water in and stopper them immediately afterward.

In collecting a sample from a pump, use the pump for at least three minutes just before sampling, taking care that the waste water is carried to a distance so that it will not wash back into the well or cistern. Collect the water directly into the bottle.

In collecting a sample from a bucket, draw up three or four buckets of water and allow the water to waste, using care that the waste water does not wash back into the well. Pour from the bucket directly into the bottle. In collecting samples from a faucet, allow the water to run at least three minutes, then collect the sample directly into the bottle. In collecting samples from a reservoir, lake or river, hold the bottle by the bottom and plunge its mouth downward into the water to a depth of about six inches; then turn it horizontally, and as it fills move the bottle mouth forward and then upward. In other words, do not let the washings from the hand enter the bottle. The samples should be packed in ice and shipped to the laboratory as soon as possible.

Equal care should be exercised in collecting chemical samples as in collecting water for bacteriological examination.

The chemical determinations that in general constitute a sanitary chemical analysis are: the amount and character of suspended matter, oxygen consumed, oxygen dissolved, nitrogen as albuminoid ammonia, nitrogen as free ammonia, nitrogen as nitrites, nitrogen as nitrates, and chlorine. The results are expressed in parts of the substance determined in a million parts of water.

The object of these determinations is to find out whether organic material from sewage has gained entrance to the source from which the supply of water is drawn. Organic matter of this kind is readily acted upon by bacteria, and during the decomposition, compounds are formed which can be identified and determined with accuracy by chemical methods. The decomposition products of nitrogen containing organic matter are the ones that can be determined most accurately. Nitrogen in albumin-like compounds (or that which is liberated by alkaline potassium permanganate), indicates the presence or absence of the undecomposed animal or vegetable matter containing proteins. Any abnormal amount of these compounds shows the water is polluted.

Nitrogen as free ammonia in any considerable quantity shows that bacterial action on the protein compounds has been carried a step farther, and that ammonia compounds of urea are present. Nitrogen as nitrites yields the information that the bacterial process has gone a step farther, and that oxidation of the nitrogen is taking place. Nitrogen as nitrates shows that the organic material has been completely transformed to a mineral salt which is relatively stable. On the Atlantic coast the chlorine determination is of great value as an indicator of contamination by animal excrement, for every district has a normal value for chlorine. Any excess over this normal amount shows that the water is receiving drainage which probably contains urine. The determination is of little value in the middle west on account of the salt beds underlying the country.

The oxygen consumed tells us how much oxygen is necessary to completely oxidize any undecomposed organic matter.

It may be stated that it is only by comparison with the every-day results that the contamination of water may be determined. The quality of water has generally been judged by the degree of sparkle, of turbidity, of temperature, and since the introduction of soap, of hardness. These standards have their value, but they are considered by sanitarians to be superficial criteria for determining wholesomeness. Water may be hard, warm, flat and turbid and yet be safe to drink; it may also be soft, cold, clear and sparkling and still carry infection.

Wholesomeness depends upon comparative absence of salts and organic matter, deleterious to health. Injurious salts, while inducing disturbances of a more or less discomforting nature, even causing permanent injury if long continued, do not create such serious consequences as polluting organic matter, especially if this takes the form of pathogenic micro-organisms.

Analytical determinations which relate to the general attractiveness of water are those of taste, odor, color, turbidity and sediment. As these quantities increase the water becomes less attractive for drinking purposes until finally a point is reached where people refuse to drink it. For this, however, a personal element enters. Some people drink a water with relish, while others condemn it. Habit and association have much to do with this.

When it comes to using water for other purposes than for drinking, other attributes have to be considered. Hardness makes a water troublesome to wash with and to use in boilers; iron makes trouble in the laundry; chlorine corrodes pipes and makes work for plumbers; presence of carbonates and sulphates of lime and magnesium affects the paper maker, the brewer, the tanner, the dyer, and the bleacher.

The inconveniences of the use of hard waters are perhaps more important than the money loss involved. In using hard waters for washing the hands and for bathing, the calcium and magnesium stearates are precipitated by the soap and give rise to unsightly scums in the wash bowl and bath tub. They tend to fill the pores of the skin, preventing a thorough cleansing. They also prevent the formation of a good lather in shaving. For culinary operations such as in making tea, hard waters are less satisfactory than soft waters, as they increase the color but decrease the aroma.

The point at which a water becomes objectionably hard has never been exactly defined. The ordinary person washing his hands considers the water soft if the soap will quickly produce suds without curdling. A hardness of 10 parts per million is practically unnoticeable, a hardness of 20 to 30 parts per million being required to produce curdling. Waters which have a hardness below 25 parts per million seldom cause much inconvenience, but when the hardness rises above 50 the water may well be called hard and above 100, very hard. In Kansas a hardness of over 300, which is excessive hardness, is often found. Experiment shows that the hardness of water has a substantial effect on the use of soap. Tests made by G. C. Whipple, in 1903, showed that one pound of the average soap softens 167 gallons of water having a hardness of 20 parts per million. This is equivalent to about three tons of soap per million gallons. It was also found that for every increase of one part per million of hardness the cost of soap increased about $10 for each million gallons of water completely softened. Number of gallons per capita per day completely softened has been estimated by different authorities all the way from 1 to 10. It will certainly be a conservative estimate to assume that one gallon per capita per day is thus softened. On this basis the depreciation of water on account of its hardness may be expressed by the formula $D = H/10$ where D is depreciation in dollars per million gallons, and H the hardness of the water in parts per million. Applying this formula