

MUNICIPAL DEPARTMENT

THE INVESTIGATION OF PUBLIC WATER SUPPLIES.

By FRED DAVIS.

(Continued.)

From whatever source a public water supply is derived, it should be borne in mind that it will not remain constant in purity throughout a whole season, for there are fluctuations depending upon rainfall, temperature, season, vegetable and animal contamination, and communication with other morbid agents. These variations and probable degree of contamination of the public water supply should be investigated by the health officers, city physician, or other responsible and capable person, who should communicate his results to the people; and these investigations should extend to the surface wells and other sources of water, which the more ignorant and less fortunate classes are often compelled to use. It is a comparatively easy matter for one somewhat skilled in scientific manipulation to make a few qualitative tests that will enable him to determine with considerable accuracy whether or not a given water is badly polluted. For such examination I usually recommend two tests, one for chlorine and the other for decaying organic matter.

In most parts of the country away from the sea and salt wells the purest ground and surface waters do not contain more chlorine than suffices to give, with a solution of silver nitrate, a faint opalescence. In testing water with this reagent, its action on a sample of known purity near by should be determined, to use as a guide in comparing other water. And, whenever an experimental sample shows a decided milkiness with this reagent, then sewage contamination is to be suspected, in proportion to the amount of the precipitate; for sewage, dish water, cess-pool drainage, and other similar polluting agencies generally contain much chlorine. This test is also a valuable means of detecting drainage from a privy vault into a well. It may be made by first determining the degree of opacity produced in the water by this reagent, and then throwing about 50 lbs. of salt into the vault, together with several barrels of water. After a few days, again examine the well water with a silver solution, and, if there is a noticeable increase of chlorine, contamination is quite certain, because the salt, which contains this element, has probably washed from the vault into the well. This method of testing gives results which will frequently surprise those unfamiliar with the subject.

Decaying organic matter is never found in appreciable quantity in pure water. If to a glassful of such water a few drops of sulphuric acid and a few drops of a dilute solution of potassium permanganate be

added, a permanent pink color is produced; but, if the water contains decaying organic matter, then the pink color becomes fainter and finally disappears. In the hands of an expert this is an important test, but it cannot be relied on with a novice, since ferrous sulphate, hydrogen sulphid, and other reducing agents, sometimes present in water, produce similar results. But, when a water shows an excess of chlorine and bleaches potassium permanganate, it is certainly suspicious, and should be analyzed by an expert. My advice in all cases where persons seek counsel is to make the experiments given above, and, if the results are not satisfactory, to send the water to an experienced chemist, with necessary information regarding its source, and have a thorough analysis made.

The most extensive investigation of the quality of a water supply involves questions of a chemical, microscopical biological, and physiological character, together with an examination of the surroundings of the source of supply; and in all this much depends upon the judgment and experience of the analyst, for water analysis is certainly among the most delicate of all chemical operations, and its proper interpretation requires great experience. The chemical analysis should determine the present and past pollution of water, and distinguish between vegetable and animal matter; the microscope should reveal floating substances, like fragments of hair, excreta, and other filth derived from surface drainage or sewage, which show at once that the water containing them is loathsome and unfit for domestic use; the bacteriological investigation should be for the purpose of detecting infectious germs, but it is more frequently to determine the number of micro-organisms in a given volume of water; while the physiological test should be made in order to afford opportunity for studying the effect of the water on the lower mammals. Since bacteria are now believed to be the direct or indirect agents of all zymotic diseases, the determination of the conditions favorable for their development, as shown by the chemist, or of their actual existence in water, as shown by the bacteriologist, is the real aim of sanitary water analysis. Without discussing the relative importance of the chemical, microscopical, bacteriological, and physiological examinations, it is only necessary to say here that, whenever a chemical and microscopical analysis reveals an excess of filth or sewage in a water, its use should be discontinued without further investigation; for the time required for a thorough bacteriological analysis renders such too expensive for general use, to say nothing of the common failure to recognize the infectious germs. The most experienced water analysts look more to the chemical and microscopical results than to the bacteriological, because the chemical and microscopical methods of study are highly perfected, while the bacteriological methods are yet in a chaotic state so far as utility is concerned.

It is my opinion that the past history

and associations of many waters are often sufficient to condemn them, no matter how free they may seem to be from organic impurity; and it is not always necessary to make a laboratory investigation to condemn some of the polluted ones. Then, too, every analyst knows, or should know, the importance of having a thorough knowledge of the surroundings of the source of supply, before giving an opinion of the quality of a water for drinking; and I believe that no competent chemist will claim that a water high in chlorids and nitrates, although organically quite pure, is good, without a knowledge of the agencies which may pollute it. Inexperienced chemists are in error in sometimes relying wholly, in testing a water, upon the Wanklyn process, which determines the free and albuminoid ammonia, but gives no knowledge of its past history, or of the products of oxidation of its organic matter. Any analyst who finds a water contaminated beyond a reasonable limit of safety is justified in condemning it; but, because he may fail to find any of the immediate products of decomposition of organic matter, he would not, in my judgment, be warranted in pronouncing such water good, unless he knows that such products have never existed in it; for it frequently happens that a water having direct communication through the soil with cesspools and privies has but little organic matter in it. The same is true when lime is used to disinfect a privy-vault. In all such cases the amount of chlorids and nitrates in the water is excessively high, and generally the total solids and loss-on-ignition are also large. Still, this is not different from what we often find in good mineral waters; and a chemist who relies solely on his laboratory determinations might claim that such water is good and safely potable, while in fact it may be a most dangerous beverage and badly infested with disease germs. Thus it is that an opinion of the quality of a water should be given only after a careful consideration of the surroundings of the source of supply. More than this, I believe that no chemist should, and no experienced reputable chemist would, venture a decisive opinion as to the purity and wholesomeness of a water supply for a city or town without a personal inspection of the topography of the surrounding territory. It is unwise, it not impossible, to predicate an opinion upon the investigation and report of inexperienced men, or to determine the present and prospective soil pollution without a personal inspection of the entire drainage area.

England formerly led the world in the investigation of public water supplies, but in recent years Massachusetts has given us classic results in this as well as in the filtration of water; so in this country we are just beginning to realize that pure water, which was once the luxury of the few, is now the necessity and pleasure of the many. The benefits which have resulted from these and other investigations are attested by the healthful development and increased civilization of our race; for it is now admitted by all competent judges that the progress made by the inhabitants of manufacturing towns, in decency, cleanliness, self-respect, and morality, since the introduction of a pure public water supply, is as striking as the improvement in their health, which shows that pure water is a great moral as well as hygienic agent.