

harmless or hurtful to the human system. Where this is not done, the conclusions are of doubtful value, and the opinion is formed more from the general condition and character of the water than from the special reactions and behaviour of its organic constituents. For this reason, a new and very simple process for determining the nature of organic impurities in water may be perhaps not unwelcome. The only really dangerous contamination of waters of wells and reservoirs—which in this connection come more especially into consideration than the running waters—when they are not otherwise exposed to specific pollution from manufacturing establishments, is their pollution with privy and sewage material. In both there is present such decomposing animal and vegetable refuse as, on one hand, which constitutes the very nidus for the growth and thriving of germs of infectious diseases, and, on the other, is liable to produce organic poisonous compounds in the form of organic alkaloids or acids belonging to the aromatic and fatty series, or both combined.

"The presence of the former, of germs of infectious and infective diseases, can be ascertained by the microscope only, either by examining the deposits directly formed in the water, or by examining microbic cultures made on the well-known organic media, with the deposit retained by the filtration of the water through cotton filters.

"The organic alkaloids, when present even in considerable quantity, cannot be detected either by odor or taste or in visible state as crystalline or amorphous matter, or directly by chemical reactions. The aromatic and fatty compounds and acids may be perceived by smell or taste, but are generally present in such small quantity only that they escape detection without resorting to other means.

"I have used for these latter purposes, in my analyses of well and other waters in this city and from other places for a number of years, the following process, which is the same in substance with the one employed for the detection of organic poisons in organic material and tissues, and which, indeed, gives the most satisfactory results:

"Two to four quarts of the water to be tested will generally suffice. One half is rendered alkaline by adding a small quantity of soda or potassa, the other acidulated by a little sulphuric acid. Both samples, well corked, are digested for an hour or two at a temperature not exceeding one hundred to one hundred and ten degrees Fahrenheit. After cooling, the fluids are shaken thoroughly and repeatedly with a proper amount of pure ether. After complete separation of the liquid from the ether, which then has dissolved from the water almost all of the liberated alkaloids, volatile, aromatic or fatty compounds, if such had been present in the sample, the ethereal solution is removed from its surface. It is filtered

into a small flask, and the ether carefully distilled off at a temperature not quite reaching its boiling point. The residue is preserved for further examination. One half of the ethereal solution may also be distilled mixed, or another mixed ethereal extract be prepared from one or two quarts of the water if it is deemed necessary.

"The residue in the flask is left exposed to the air until the last traces of ether have evaporated. It is then dried over calcium chloride, when it will be found to be either of an essential oily nature or transformed into a crystalline or amorphous mass, or to consist of a mixture of the three.

"Now in any case where there existed a privy or sewage contamination of the water, this will be rendered at once perceptible in the residue by its odor, which, in the concentrated form of volatile and aromatic compounds, is very characteristic of its source and cannot be mistaken.

"The residue in most cases is of a mixed nature, and by proper manipulations one may succeed in separating the crystallizable and amorphous substances from the oily or volatile ones for further microscopical and chemical investigation, and occasionally may get one or the other characteristic reaction. If, however, a few quarts of water only have been handled, the quantity of the residue is too small in general to permit of the determination of the chemical nature of the alkaloids, acids, or volatile compounds present. This must be left to further investigations by handling large quantities of such contaminated waters, which, on account of my at present limited laboratory facilities, I have not been enabled to carry out.

"Yet successful experiments have been made occasionally during the last seven years, for the purpose of examining the action of these substances upon the animal system by injecting watery or alcoholic solutions of the same into the blood of warm-blooded animals, as mice, birds, and rabbits. It was found that some of these compounds act as most virulent poisons. A few cases may be mentioned here. In one case the ethereal extract was from a well-water in the eastern part of this city, near the streets not provided with sewers. The well was located on premises occupied by a family of nine persons, of whom eight at the time had been suffering for weeks from a severe attack of malarial fever, which, in two of the cases, had assumed a typhoid character. A few drops of watery solution of the mixed extract injected into a rabbit weighing two pounds and eleven ounces, killed the animal within half an hour. In another case, where a rabbit of about the same weight was killed within two hours and a mouse in eleven minutes, the extract was from the water of a well on a farm situated not far from a barn in which cows and horses were kept, and a heap of manure. On the farm at the time was a local epidemic of typhoid-fever, with two deaths—a fact which led