PUBLIC HEALTH ENGINEERING

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EPIDEMIC OF INTESTINAL DISORDERS IN CHARLESTON, W. VA., OCCURRING SIMULTANEOUSLY WITH UNPRECEDENTED WATER SUPPLY CONDITIONS

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THE great drought of 1930 caused public water supply conditions in Charleston, W. Va., from August to December, 1930, which probably have never been duplicated in a public drinking water supply for intensity of pollution. A widespread epidemic of intestinal disorders similar to those caused by mild food infection or a strong cathartic occurred in the city during the latter part of October and early November in which it was estimated that between 8,000 and 10,000 persons in Charleston were affected.

Throughout the entire period of 4 months—August to December, 1930—in which the acute and offensive taste and odor conditions existed in the water supply and a high pollution thereof continued due to a river reversing its flow, the filtration plant operation was above reproach, and daily independent bacteriological tests by three different water testing laboratories showed that the U. S. Treasury Standards for a bacteriologically safe drinking water had been met.

Charleston is furnished its public water supply of approximately 7 m.g.d. by a private water company, the source being the Elk River. This river with a 1,550 sq. mi. drainage area and a normal flow of 100 to 500 m.g.d. joins the canalized and navigable Kanawha River 1¼ miles below the water supply intake. Previous low water flow in the Elk over a period of 50 years was 19 sec. ft. Below the water intake are many sewers and a garbage incinerator which, due to laxity on the city's part during 1929 and until July 24, 1930, was discharging weekly 200 tons of household garbage and wholesale produce to the river. The State Water Commission, which has authority over stream pollution, ordered this grossly insanitary practice of discharging garbage into the stream stopped on July 24, 1930, and the city complied immediately.

Early in August the Elk River flow fell below the city's needs to the extent of 2 or 3 m.g.d., and then the Kanawha River, carrying the excessively high organic content from garbage putrefaction, with practically zero dissolved oxygen, and so polluted with sewage as to give a bacteria count of 50,000 to 100,000 per c.c. and *B. Coli* in 1/1,000 c.c., flowed upstream to the water intake. A heavy growth of algae developed in this filthy pool into which only a few million gallons of fresh water entered daily and a woody, mouldy, disagreeable taste developed with which strenuous water purification methods could not cope.

The following purification measures,

in addition to the regular sedimentation, filtration and final chlorination processes, were tried: prechlorination to reduce the heavy pollution load, using copper sulphate in the river basin to kill algae; aeration to attempt to replace the dissolved oxygen; and activated carbon fed into the inlet to the sedimentation basin to absorb the disagreeable flavors. Permanganate, ammonia, super-chlorination and dechlorination treatments also were tried in an effort to get rid of tastes and odors. All these measures were ineffective in removing entirely the taste and odor which came and went in varying intensity.

The prechlorination dosage finally reached a peak of 20 lbs. per m.g. The daily operation throughout August, September, October and November was under the watchful eyes of capable sanitary engineers. Every effort was made to see that no unsafe water passed into the city mains. Bacteriological tests indicate that, measured by the present accepted U. S. Treasury Standards for bacteria content, the water was safe.

Microscopical tests during August and September revealed abundant growths of blue-green algae of several different types capable of causing the objectionable odor. Cycles of algae growth were followed by development of crustacea, daphnia and other allied water flea organisms being present in such great numbers that a glassful of the raw river water appeared to be actively vibrating from the infinite number of organisms present.

So intense and disagreeable was the taste, particularly in the latter part of October and in early November, that, naturally, the general public refused to use the water for drinking purposes.

The State Health Department, relying upon the standardized bacteriological tests as a criterion for safe water, urged the general public to use the purified public supply rather than that from unknown wells and springs, or bottled waters which were being widely dispensed throughout the city for beverage purposes. The concentration of bacterial pollution of the lower Elk River pool, made up of both Kanawha River and Elk River waters, increased proportionally as the weeks went on because the Elk River practically dried up. Prechlorination had become the normal operation now in order to put out a safe water, a residual chlorine being held throughout the sedimentation basin, the filters and clear well.

Whether the intestinal disorders in the city during the latter part of October and in early November can be attributed to the water is still a mystery; but it is a fact that widespread disorders were noted wherever the water supply mains went. After careful epidemiological studies had been made by state and federal public health agencies, it was recommended that the intake be moved to the Kanawha River to a less sewage polluted zone. The water company is now spending $100,000 to install such an emergency intake.

On November 10 Dr. W. T. Henshaw, Commissioner of the State Department of Health, following a report to him by Dr. David Littlejohn, his epidemiologist, and E. S. Tisdale, state sanitary engineer, that several thousand cases of an acute intestinal ailment existed in Charleston, communicated with Surgeon General Hugh S. Cumming of the U. S. Public Health Service, stating the unusual conditions and asking assistance to determine if possible the real cause of the trouble. The Service immediately complied and Surgeon M. V. Veldee and Sanitary Engineer R. E. Tarbett arrived in Charleston on Armistice Day. They spent 3 days reviewing carefully the findings of the State Health Department, going over the bacteriological records, and making independent epidemiological studies. Their report describes the type of ailment from which Charleston people suffered:

A house-to-house canvas of a fair group of families living in two widely separated sections of the city reveals that from 10 to 15 per cent of the population was ill during the first week of November with an acute gastrointestinal ailment. This illness was characterized by a sudden onset, pain in the region of the stomach, usually nausea or vomiting or both, and followed by diarrhea of varying severity. Those ill had essentially no fever and the illness was very largely confined to persons over 10 years of age. The duration of illness varied with severity—usually from less than 1 day to upwards of 4 days.

In addition an interview was had with a representative group of the local physicians. The symptoms observed by them among their patients correspond with those recorded above.

The character of the onset and the ensuing symptoms do not suggest a disease caused by a bacterial infection but rather a poisoning by some substance which acts as a gastrointestinal irritant. In fact, the symptoms are similar to those produced by a strong cathartic.

In the case of the local source of water supply, the quiescent condition of the pool has allowed anaerobic decomposition (fermentation in the absence of oxygen) to take place in the accumulated sludge, with the absorption of the products of decomposition by the overlying water to an extent not possible in a flowing stream. It is entirely possible that such products might not be removed by the known processes of water purification.

In so far as we are aware the circumstances surrounding the public water supply of Charleston at the present time are entirely unprecedented in this country. In view of this fact we do not feel that the occurrence of an outbreak such as has taken place in Charleston within the past few weeks could have been reasonably predicted, particularly since the bacteriological records continued to indicate a drinking water of safe quality.

DEDUCTIONS FROM UNUSUAL CONDITIONS AT CHARLESTON, W. VA.

It is of note that the Charleston malady affecting several thousand people was experienced during unusual drought conditions. Actual septic conditions similar to those found in a septic tank prevailed in Elk River near the water works intake due to decomposing garbage, and sludge from the sedimentation basin, lying on the river bottom. Violent ebullition of bubbles took place when this river bottom sludge was disturbed. River traffic—stern wheel paddle-boat variety—was quite active in this stretch of river.

Whether products of anaerobic decomposition of nitrogenous or carbonaceous matter could be sufficiently concentrated in the water to produce a condition simulating food poisoning in those drinking the water has not been shown. Laboratory tests did show that the odoriferous compounds were quite readily removed by boiling and there appeared to be a large amount of oily substances in the water.

It is of interest to note that *Public Health Reports* of November 21, 1930, give an account of R. R. Spencer's studies of a persistent type of mild dysentery-like epidemic occurring in the national parks during the drought months of the year. His description of the malady (short duration, nausea, sharp pain in abdomen and diarrhea) is similar to the trouble which occurred in Charleston when drought conditions were at their height.

Neither the U. S. Public Health Service nor the State Health Department has stated definitely that the bacteriologically safe water supply was responsible for the epidemic, but it is certain that most unusual conditions have existed with reference to intensity of raw water pollution. The recommendations which both federal and state services have made were to the effect that

1. Boiling the water would drive off the substances responsible for the objectionable tastes and odors.

2. A temporary intake should be sought in the Kanawha River in a zone of less pollution since the water plant was operating under too great a sewage load.

3. A new water works intake be provided so that 1930 drought conditions could not be duplicated.