

his part would be of vastly more practical value than a location of the trouble by some sanitary commission after an epidemic was well under way.

The greatest responsibility borne by the inspector, however, would be during periods when gangs of laborers were employed at construction work within the limits of the watershed. Should the workmen be many and the time of their remaining be two weeks or more, nothing short of incineration of all camp waste and night-soil should be demanded, and the utmost care should be taken that sanitary instructions were carried out to the letter. A Woodruff pit, which can be constructed in a few hours, would be suitable for a temporary camp; while, if something more permanent were demanded, a well-constructed incinerating furnace should be built.

When meadow lands are flooded, the extraction of food for plankton growth must of necessity take place, and we are forced to choose between stripping the proposed bottom or else depending upon the employment of some means of killing or removing the organisms that are likely to develop.

As to what could be done to rid a water of the odors due to algal and other growths, the outlook was not very hopeful previous to the appearance of the "copper sulphate process" proposed by Moore and Kellernan in 1904 (Bulletins 64 and 76, U.S. Bureau of Plant Industry).

The method of applying this chemical is simple enough, and its use is very efficacious. Bought in bulk, it can be had at about five cents per pound, and its distribution is readily secured by filling it into perforated buckets, or even bags, and towing the same by row-boat or launch over the reservoir surface.

Decided objection was raised against such a process of "disinfecting" a public water supply, and the opposition was especially marked in England, but the use of it is still with us and is likely to stay, for the reason that the "dose" is minute and is only occasionally required, that it is reliable in results, and that experiment has shown that it is not followed by the evil consequences predicted.

It must be remembered that it is not added to the water continually but is used only at stated and widely separated intervals, namely, at those times when the "crop" of minute organisms has become so well grown as to produce objectionable effect upon the water.

Perhaps one reason why the "coppering" of reservoirs has led to so much criticism is because of the dead fish that are to be seen after the chemical has been applied. When considering this effect upon fish life, one should bear in mind that the "dose" has of necessity to be applied uniformly over the surface of the water, and each acre of such surface presumably receives the same amount, irrespective of the depth of water that the acre covers. As a result, the shallow parts of the lake receive temporarily a greater quantity of the sulphate, per cubic foot of water, than do those which are deeper; again, the entire quantity of chemical intended for the whole body of the lake is delivered to a few inches of its surface layer; therefore, until diffusion has taken place, fish which chance to swim into such water receive a very concentrated dose and are likely to be affected by it. Distribution is complete by the time the water reaches the public mains, and, moreover, the minute dose used has been more or less completely disposed of through its action upon the organisms for whose destruction it has been employed.

In a paper before the Section on Hygiene of the Eighth International Congress of Applied Chemistry, 1912, Kellernan presented the following data:

**Quantity of Copper Sulphate Required to Kill Various Forms of Odor-producing Organisms.**

Copper Sulphate Required, Expressed as Parts per Million Parts of Water.

Anabaena . . . . .	.09	Kirchneriella . . . . .	5. to 10.
Asterionella . . . . .	.1	Leptomitus . . . . .	.4
Beggiatoa . . . . .	5.	Microspora . . . . .	.4
Chara . . . . .	.2 to 5.	Navicula . . . . .	.07
Cladophora . . . . .	1.	Oscillatoria . . . . .	.1 to .4
Cladotrix . . . . .	.2	Peridinium . . . . .	.2
Clathrocystis . . . . .	.1	Scenedesmus . . . . .	5. to 10.
Cœlosphærium . . . . .	.3	Spirogyra . . . . .	.05 to .3
Conferva . . . . .	.4 to 2.	Ulothrix . . . . .	.2
Euglena . . . . .	1.	Uroglena . . . . .	.05
Fragilaria . . . . .	.25	Volvox . . . . .	.25
Hydrodictyon . . . . .	.1	Zygnema . . . . .	.7

He adds a list of twelve genera of algæ that in his experience are causing trouble in reservoirs and ponds:

**Number of Observed Cases.**

Anabaena . . . . .	27	Conferva . . . . .	56
Asterionella . . . . .	9	Crenothrix . . . . .	13
Beggiatoa . . . . .	20	Fragilaria . . . . .	19
Chara . . . . .	26	Navicula . . . . .	21
Cladophora . . . . .	17	Oscillatoria . . . . .	49
Clathrocystis . . . . .	23	Spirogyra . . . . .	43

Jackson claims that blue-green algæ will die if the water be "coppered" one part to five million. His dose for Mellosira or Synedra is one to two million, and he claims that the former gives no odor of growth, but only that of decay. He finds that coppering runs out certain forms of organisms and substitutes others by a sort of selective action, but those thus substituted are not likely to be odor-producers; and he further notes that, while "bottom" or decomposition odors are easily shaken out by aëration, "top" odors, viz., those of growth, have to be removed by filtering out the organism, or killing them by copper sulphate, or both. In his opinion, filtration of either type is effective for removal of odors of growth, but he believes that aëration would be worse than useless for living plankton, for the reason that the agitation would tend to mechanically release the oil causing the taste, which oil is not very easily oxidized.

Naturally the cost of treatment with sulphate of copper will depend in part upon the amount of the chemical that is to be used, which in turn is determined by the kind of organism that it is intended to kill; but it may be said that a mixed growth of Mellosira and Asterionella was removed from the Troy reservoir at an expenditure of 14.9 cents per million parts of water treated, labor included. The dose was one part of copper sulphate to 3,500,000 parts of water by weight.

In the article by Kellernan above quoted there are figures given indicating the safe limit for treating water with copper sulphate when certain fish are to be protected.

Copper Sulphate, Expressed as Parts, per Million Parts of Water.

Black bass . . . . .	2.1	Pickerel . . . . .	.4
Carp . . . . .	.3	Suckers . . . . .	.3
Catfish . . . . .	.4	Sunfish . . . . .	1.2
Goldfish . . . . .	.5	Trout . . . . .	.14
Perch . . . . .	.75		

It must be noted that these figures assume a thorough mixing of the sulphate solution with the whole body of water. They would not hold for the unequal distribution and resulting local concentrations already mentioned.

In some reservoirs which have been formed by the extensive flooding of swamp bottoms there may develop objectionable growths of crenothrix, a general term denoting an aquatic plant which at times gives much trouble because of its tendency to develop in the street mains and