ingredient in tooth paste and mouth washes. It is a hemostatic and antiphlogistic. It reduces inflammation and overcomes bleeding gums. Moreover, it does not introduce into the mouth foreign ions, for both calcium and chloride ions are found in normal saliva.

Now that dental investigators are agreed that tooth pastes and mouth washes must be mildly acidic in reaction, calcium chloride may easily be incorporated with marked beneficial results. In fact, dentists should insist that their patients be supplied with dentifrices and mouth washes containing this important salt. Tooth pastes and mouth washes containing the proper amount of calcium chloride have been found noticeably efficacious in overcoming bleeding gums.

The fact that science has proven that mouth preparations must be mildly acidic is rather coincidental in this connection, for calcium chloride cannot be incorporated in alkaline preparations. Being an acid salt—a combination of a strong acid and a weak base—alkalies, particularly soaps, decompose it and destroy its action.

THE USE OF PRECIPITATED COPPER FOR STERILIZING PURPOSES.*

BY GRETCHEN SPRECHER.

It has been known for some time that copper and its salts acted as efficient agents in destroying bacteria, algae, and related minute organisms found in water. Copper sulphate in high dilution (1–500,000 to 1–4,000,000) has proven very efficient in ridding water supplies of annoying accumulations of filamentous algae. As applied in Stowe Lake, Golden Gate Park, San Francisco, enough copper sulphate to make 1–1,000,000, was placed in gunny sacs which were tied to boats and rowed about the Lake until all of the copper salt had gone into solution. As if by magic the filamentous algae disappeared, which until then required the constant labors of a number of men to rake out and dispose of the growth. According to a report by the Bureau of Chemistry this method has proven efficient in ridding city water supplies of algal growths.

In the experiments herein recorded, precipitated copper was used. This material is prepared by passing a current of hydrogen over finely powdered copper oxide, reducing the oxide to metallic copper which is nearly black in color and consists of very minute particles of irregular form. There are on an average 1,840,000 particles of copper per gram. The particles average 25 microns in diameter. Naturally, this reduction in size results in an enormous increase in surface exposure per unit mass of the metallic copper. Considering each particle as a sphere it was estimated that one gram of the copper represented a surface exposure of approximately 3.60 square meters.

Metallic copper when placed in water and in the presence of electrolytes, gives up colloidal copper particles to the water, and it is these colloidal particles of metallic copper which are effective as destroyers of the microörganisms which may occur in such waters. The rate of colloidal diffusion into a liquid as water, in the presence of a given quantity of electrolyte, is directly proportional in the surface exposure of the copper present. It therefore follows that precipitated copper with its enormous surface exposure will yield a maximum amount of colloidal

* Scientific Section, A. Ph. A., Cleveland meeting, 1922.

copper particles within a minimum period of time, and its germ-destroying power is far greater than that of copper in any other form. However, as suggested, the rate of the colloidal diffusion of metallic copper within a given liquid also depends on the amount of electrolyte present. All waters, excepting pure distilled water, contain some electrolyte, and usually enough to yield a sufficient amount of copper for sterilizing purposes. No doubt the efficiency of the copper could be increased and regulated through the addition of some cheap and harmless electrolyte, should the water to be sterilized not contain enough of such substance.

The experimental part of the work was carried out as follows. To 50 cc of average samples of tap water was added 0.1 gram of precipitated copper, making a dilution of 1–500. The mixture was shaken by tapping the container against the palm of the hand (mechanical agitators would be an advantage), and plate cultures made at different periods of time, using the clear supernatant liquid from the top. The controls showed that the tap water in question contained 300 bacteria per cc. The same water exposed to the precipitated copper in the above dilution was free from living bacteria after an exposure of 2 minutes. The test was repeated a number of times and in each instance the results were the same. A few colonies appeared in some of the test plates, but most of these were traceable to accidental contaminations due to the imperfection of the method employed. The results however warrant the conclusion that precipitated copper in the presence of electrolytes is a very efficient destroyer of microörganisms. Incidentally it may be noted that copper has been used with success in the treatment of abscesses, ulcerations, in tuberculosis of the skin, in eye infections, and it is believed to be the active ingredient of some of the secret cancer pastes. According to an article in the *Lancet*, "Brass Paste," which is a combination of copper sulphate, zinc sulphate and picric acid, is very effective in lupus or skin tuberculosis and to reduce tubercular glands. It is suggested that the effects produced are due to colloidal copper.

The manner in which colloidal copper produces its effects is probably as follows. Such solid particles as may appear in a liquid containing the colloidal copper, adsorb said copper particles, and the amount (per unit mass) so adsorbed is proportional to the surface exposure and the electric conductivity of the particle in suspension. Thus a very minute particle will adsorb proportionally more copper than a larger particle possessing the same or like electric conductivity. It thus follows that a microbe may adsorb enough copper to destroy life, whereas a larger organism, as crustacean, fish, lily, etc., cannot possibly adsorb enough copper to do serious harm or to produce appreciable effects of any kind. Just how the adsorbed copper produces death of the cell plants is not determined.

The above brief experiments suggest the possible use of precipitated copper for the purpose of sterilizing drinking water supplies. This might be done by making filtering material consisting of precipitated copper suspended in some inert material as sand, through which the water may percolate. Perhaps copper sponge might be used through which the water would flow readily, thus doing away with the need of a suspending material. Water will not pass through pure precipitated copper as the smallness and the proximity of the particles holds the water by capillarity and will not permit it to flow excepting under considerable pressure.

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