

drop, and the water now passes directly out of the apparatus by V into the sewer or elsewhere and no water will be delivered into the sterilizing chamber. Thus there is no danger of having unsterilized water flowing through the apparatus in case the current should fail. During the tests which were made at Marseilles, a quartz lamp of the Westinghouse-Cooper Hewitt type, with a current of 22 volts and 3 amperes was used, and the apparatus was run from August 19th until the end of September, working day and night without stopping. It gave an output of 60 cubic meters (78.5 cubic yards) per 24 hours, or $32\frac{3}{4}$ cubic yards per hour. During that time there were made eighteen bacteriologic tests of the incoming and outgoing water. Before entering the apparatus the (impure) water contained 30 to 300 germs per cubic centimeter (0.061 cubic inch) and 50 to 1,000 coli bacillus per liter (1.057 quarts). After sterilizing, on the average one germ per cubic centimeter and no coli bacillus in any case.

Following the foregoing synopsis of this recent art (photo therapeutics) it would be well to return to the rays themselves and consider them in more detail.

For a correct conception of the therapeutic value of these rays, it must be borne in mind that ultra violet rays are readily absorbed by most substances. Very few bodies are transparent to them. They even pass through air with difficulty, but they traverse without appreciable absorption quartz, Iceland spar, pure water and a variety of glass called Uviol, invented recently by Schott of Jena. Both the ultra violet and the visible rays are distinguished among themselves by their wave-lengths, which stand in an intimate though complex relation to their indices of refraction, or to the relative positions occupied by the different rays after refraction by a prism. The unit of measurement of wave-length is the micron, equal to $1/1,000$ millimeter, or $1/25,000$ inch. The Angstrom unit, equal to $1/1,000$ micron, is also employed.

Up to the present the mercury vapor arc has been employed as a source for these penetrations, several forms of

appreciable quantity of these substances requires several hours, but the sterilization is instantaneous. Bordier and Nogier and other physicists have proved that air exposed to the radiations of a quartz mercury vapor lamp acquires an odor resembling that of phosphorus, which was at first attributed to the production of ozone, but it is impossible to detect the least trace of ozone in this air, and the same odor is produced in nitrogen and other gases which contain no oxygen. In reality the odor is of physiological or subjective origin, and is due to the excitation of the olfactory nerves by the ionized and electrified air. If the gas is passed through a metal tube connected with the ground and thus deprived of its electrical charge, the odor disappears.

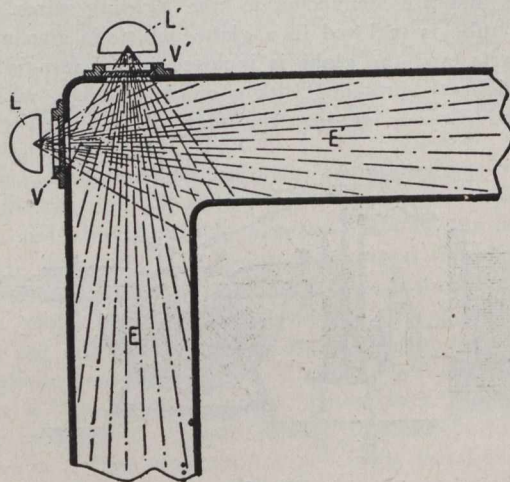


Fig. 5.

New researches by Courmont, Nogier, and Henri confirm the view that ozone and hydrogen dioxide play no part in the sterilization produced by these lamps, which is due to the direct action of the ultra violet rays. Water sterilized by this process retains its dissolved air, since it has not been heated. It remains fresh and its flavor is not changed in any way.

For municipal water service the sterilization may be effected in the water mains (Fig. 5). In order to avoid breakage of the lamps by the pressure and flow of the water they are placed outside the mains and their radiations are transmitted through windows or bull's eyes of quartz.

Some experiments are under way in the City of Toronto with the "hyper ultra violet rays." It was originally intended to generate this rays from iodine and mercury, but subsequent investigation and research showed a method of treating certain common inorganic gases with electric discharges in such a manner as to produce a volume of ultra violet rays 2,500 per cent. in excess of the mercury arc lamp. This lamp is almost devoid of luminosity under operation. Some account of the experiments and further information will be given regarding this lamp in a future issue.

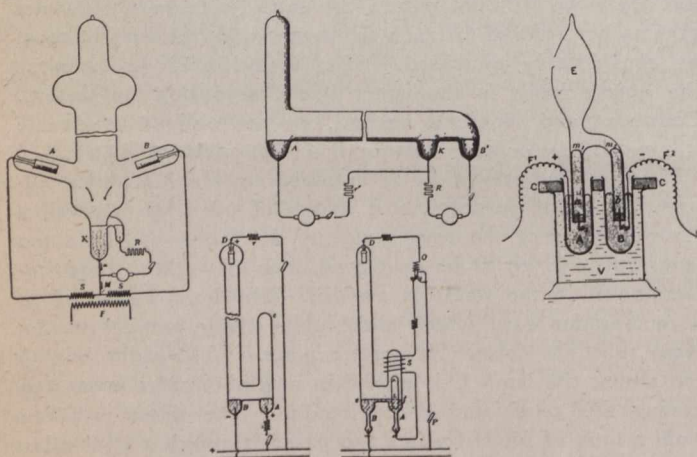


Fig. 4.

which are shown in Fig 4. All these lamps operate on the same principle, viz., metallic and carbon electrodes and a pool of mercury which is allowed to flow in a stream toward (generally the positive) electrode, thus completing the circuit and striking an arc.

The use of this lamp is attended with certain inconveniences, among which are the mechanical devices necessary to strike the arc, the high wattage and the uncertainty of maintenance. The bactericidal effect of the ray is due solely to the radiations themselves and not to any ozone or hydrogen dioxide that may be formed, for the production of an

SEWER SECTIONS.

Economical sewer sections have been the subject of study by Mr. Alberto Schreiner, assistant engineer in charge of design for the Bureau of Sewers, Borough of Queens, New York City. The experience in that office has led to the general conclusion that it is desirable, from the standpoint of low cost and ease of construction, to use vitrified pipe on all lines up to 24 in. in diameter. For sewers having diameters between 24 in. and 4 ft. plain concrete is believed to be the most economical type of construction but for diameters greater than 4 ft. it has been found that reinforced concrete may be used to best advantage.