WATER STERILIZATION BY ULTRA-VIOLET RAYS.

A PAPER which is being presented by M. von Recklinghausen at the 31st annual convention of the American Institute of Electrical Engineers in Detroit on June 26th, is based upon the sterilization of water by ultra-violet rays of the mercury-vapor quartz lamp. It refers to the historical development of mercury lamp water sterilizers and the development of pistol lamps for large sterilizing units. The sterilization of water is a field that has developed for the application of electricity during the past five years. The experimental work has been done chiefly in France and with it M. von Recklinghausen has been prominently identified. His paper deals particularly with the work done by him in collaboration with Messrs. Henri and Helbonner at the physiological laboratory of the Sorbonne University. A considerable portion of it is devoted to a study of the economical use of ultra-violet rays for this purpose and the best temperature to be employed in the luminous part of the lamp. The measurement of ultra-violet power, based on physical, chemical and bacteriological reactions is explained and these reactions are compared.

It is found best to choose as a unit some value of the particular effect of the rays which concerns the work in hand, and of the four different methods of examining the power of the ultra-violet spectrum the bactericidal or abiotic action is found well suited in the sterilization of water. However, in choosing a unit of bactericidal reaction it was found that cultures of microbes vary so much with age and other conditions that it was impossible to get sufficiently constant results upon which to base a unit reaction. It has been necessary, therefore, to determine the sensibility of the reactive material; i.e., the germ culture on hand, by exposing samples of it to the light of a lamp which has been standardized. This has led to the creation of a laboratory standard lamp to be operated so that it will always produce the same amount of ultra-violet rays. The experimental method of procedure consisted in taking a drop of the culture, exposing it at a definite distance from the lamp, counting the seconds necessary to render them motionless and comparing the

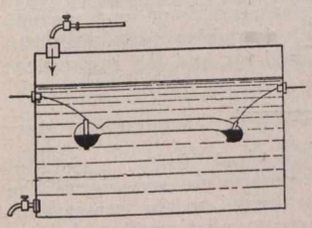

Fig. 1.

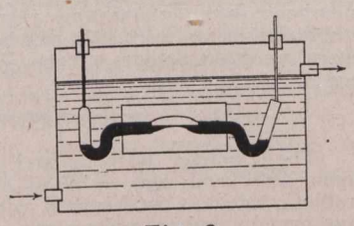

Fig. 2.

figures thus obtained with figures obtained under the standard lamp.

As for the sterilizing apparatus itself, the most efficient way for the mercury lamp to react upon the water seems to be to submerge the lamp entirely in the water. Direct contact, however, of the water with the heated lamp influences the luminous and ultra-violet efficiency of the quartz lamp to an enormous degree. This has led to a means of protecting the lamp from direct contact with the water by fusing over the former a wide quartz jacket. This system has been adopted with modern apparatus. Difficulties arose in the manufacture of such jacketed lamps, however, resulting in the construction of what are known as pistol lamps. Another method is to let the water circulate in such a way around the lamp that it will not come into contact with it, receiving, nevertheless, all the rays emitted by it. Again, where it is more a question of convenience and less a question of efficiency the simplest method is to place the lamp above the water as close as possible to its surface, but reflectors placed above such lamps have a low efficiency in the reflection of ultra-violet rays.

Water bacteria are killed in as short a time as 1/20th of a second at a distance of 1 to 2 centimeters from the powerful ultra-violet ray lamps. Water being practically as transparent to the rays as air itself, if a germ floats in the water it will be annihilated by getting into the illuminated zone, the condition for this being that no suspended matter is contained in the water which would form a shield for the germ.

Water for this sterilization has, therefore, in most cases to be filtered before being submitted to the steriliz-

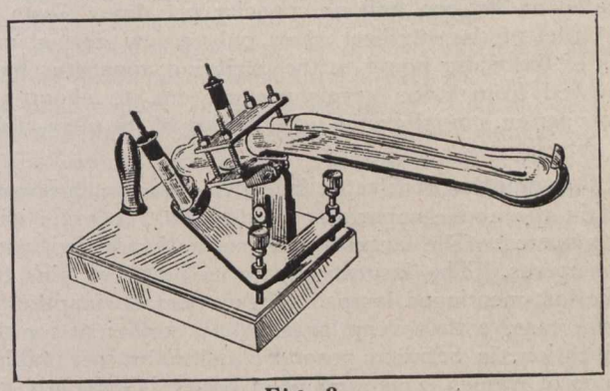

Fig. 3.

ing action of the rays. However, even very good filters will allow some microscopic matter to pass. It is much more effective, as shown by experiments, to stir up such water while it is going through the illuminated zone so as to turn over and over any particles which otherwise might allow microbes to pass by under cover. Baffle arrangements are built in for this purpose of stirring up the water. For the same reason, also, it is best to pass the water through several illuminating zones, which can easily be done by leading the water several times towards the same source of light, or by passing it successively under several sources of light.

Typical Installations.—The largest unit ever built was set up about two years ago in the city of Luneville, France, to sterilize the city water supply. It consists of a flume into the sides of which ten 500-volt pistol lamp equipments are inserted. These equipments consist of metal boxes for the starting of the lamps (the latest types of them contain also the rheostats). The boxes are equipped on the inside with a stuffing box arrangement holding the quartz protective tube which protrudes into the water. The lamps are lit in the starting boxes and then their luminous parts are inserted into the protective tubes, so that the light emitted from the lamp enters the water.

The raw water fed into this plant comes from the Meurthe River and contains sometimes as high as 60,000 germs per cu. cm. It is clarified by a series of roughing filters and one filter. After this it is physically in fairly good condition, being very poor in suspended matter, but having from time to time fairly deep color (up to 45 U.S. standard) in solution. The germ contents are sometimes as high as 1,000 per cu. cm. in this water. It is then passed through the sterilizing unit described above, coming under the influence of the light from one to two minutes altogether, according to the number of lamps running. This number (sometimes only 4) depends on the