AN ELECTRO-CHEMICAL APPARATUS FOR THE DISINFECTION AND CLEANSING OF CULTURES AND SLIDES FOR USE IN BACTERIOLOGICAL AND PATHOLOGICAL LABORATORIES.

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(With Plate II and 1 Text-figure.)

It is the custom in most laboratories where infected material is used during the progress of experimental work to have receptacles containing a disinfectant of some kind, placed so that the worker may drop any small piece of apparatus or culture into it which he has finished with, in order that such material should not be a source of danger to himself and to others in the laboratory. The disinfecting agent is more often than not some saponified tar-acid product, which, although lethal to naked bacteria may, or may not, destroy infection under the circumstances in which it is used. The fluid is also somewhat costly, apart from being uncertain in its action when resistant spores are being dealt with.

During an experimental enquiry[1] in relation to the sterilization of bacteria, the author made several tests with sodium and calcium hypochlorite which are well known to be powerful disinfectants even in very dilute solution. Instead, however, of adding the hypochlorite to

[1] Beattie, J. M. and Lewis, F. C. (1913). The utilisation of electricity in the continuous sterilization of milk. *Journ. Path. and Bact.* XVIII. July 1913, pp. 120–122.

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the fluid to be sterilized, it was decided to produce the disinfectant in the fluid by the aid of electricity.

When sodium chloride is dissolved in water, and a unidirectional electric current of suitable strength is allowed to flow through the solution, the salt is decomposed into sodium and chlorine, the water being electrolysed into hydrogen and oxygen. If metal electrodes are used, a chloride of the metal is produced. In the event, however, of the electrodes being of neutral material such as carbon, some of the chlorine is evolved free and under suitable conditions sodium hypochlorite is produced by the combination of the chlorine with sodium hydroxide. In order to ensure the formation of the hypochlorite, the temperature should not exceed 50° C. The temperature of the fluid can be regulated by directly varying the strength of the electric current used, or by modifying the internal resistance of the cell by altering the distance between the electrodes.

If a mechanical device be used to bring about more efficient mixing of the products of electrolysis or, when the direction of the current is reversed, say, every five seconds, a better result is obtained, *i.e.* the fluid is more toxic to bacteria. This result is also obtained by placing the anode beneath the cathode; thus allowing the liberated chlorine to travel upwards towards the cathode. All these modifications, by facilitating the production of the sodium hypochlorite, increase the disinfecting value of the fluid.

For the disinfection of culture tubes, slides, etc., I would suggest the adoption of the following method: a glass jar (*i.e.* museum jar type) should be three-quarters filled with a 10–20 % solution of common salt and an electric current passed through the fluid, using carbon electrodes.

The current for this purpose is best obtained from the ordinary lighting circuit and must be taken through a resistance of some kind, preferably the ordinary bench-light used for microscope illumination. For the experiments referred to here a 32 candle-power lamp was used, the jar was 10″ high and 7″ diameter, the carbon electrodes were 9″ high, 5″ wide and $\frac{1}{4}$″ thick.

In reality one of the cords of the ordinary lamp used for microscope illumination was cut, the copper wires at the severed points being bared for a distance of two inches. Each end of the wire was then tied separately to carbon plates (c' and c'') through a small hole previously bored into them. The exposed wire was thickly coated with varnish, paraffin wax, or sealing wax. It will thus be seen that, technically speaking, the electrodes of the disinfecting chamber were placed in series with a 32

candle-power carbon-filament lamp. Experiments made with the apparatus showed that opalescent emulsions of bacilli were rapidly disinfected. In the case of water sterilization could be readily accomplished by the addition of a minute percentage of sodium chloride, the other factors being so regulated that very shortly after electrolysis no alteration in taste or smell could be detected; the chemical tests for the presence of chlorine, etc. also yielding negative results.

Several experiments were made with spores of *B. anthracis*[1] and although the spores were undoubtedly very numerous, all attempts at cultivation after electrolysis showed the spores to have been destroyed.

To detail a further experiment, an old plate culture, thickly coated with *B. anthracis* and other sporing organisms, was placed in the apparatus. Within a few minutes the agar was colourless and films of

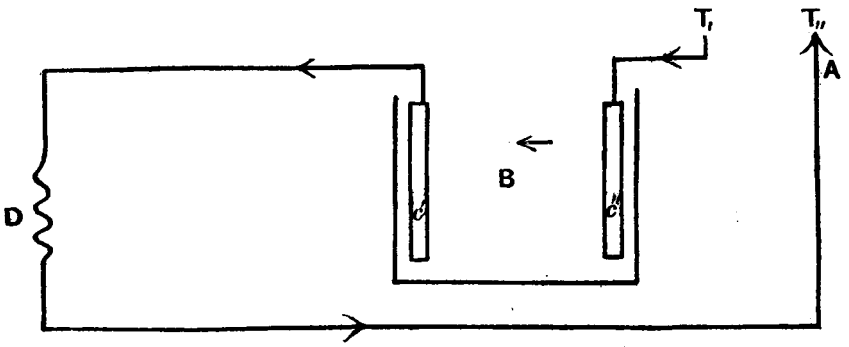
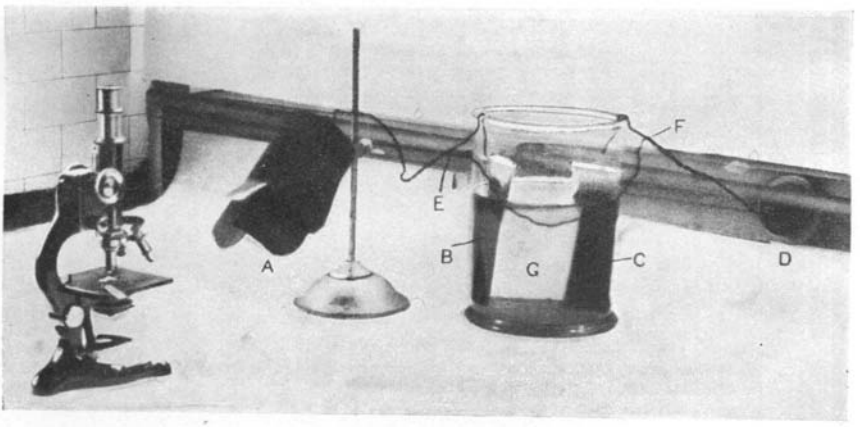


Fig. 1. Diagram showing the electrical connections where T' and T'' are terminals of an ordinary lighting circuit; B is a glass jar, c' and c'' are carbon electrodes; D is a resistance (electric globe). The arrows indicate the direction of the current.

the growth were floating in the fluid. The growth obtained by spreading a $\frac{1}{4}$ square inch of the floating film over the surface of an agar tube after the expiration of $\frac{3}{4}$ of an hour was very feeble, and at the end of $1\frac{1}{2}$ hours—the time at which the next culture was made—the floating films were sterile and most of the agar dissolved.

The lethal value of the fluid is increased by an increased candle-power lamp and also, of course, by the prolonged passage of the current, while, substantially speaking, so long as salt remains undissociated the fluid can be regenerated no matter what material, within reason, is placed in it for disinfection.

[1] Glynn, E. E. and Lewis, F. C. (1912). Detection of anthrax spores in industrial material. *Journ. Hygiene*, XII. 2, June, 1912, pp. 227–244.



The apparatus in use:

A, microscope lamp.
B, *C*, carbon electrodes.
E, *F*, bifurcation of wire.
G, jar of salt solution.

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In conclusion I wish to draw attention to the advantages of this system of disinfection.

1. The bactericidal power of the solution obtained is maintained for several days even when the passage of the current is discontinued.

2. The bactericidal power of the fluid can be easily regenerated. The current need not be used except as and when required for laboratory purposes. The method, therefore, is economical.

3. While using electricity for microscope purposes useful disinfecting work is also being accomplished.

4. The apparatus is simple in arrangement and can be used on any bench where suitable current is available. The use of the apparatus materially assists the cleaning of culture tubes etc.

5. The apparatus can be used with confidence as to the efficiency of the disinfection.

In connection with this communication my best thanks are due to Professor J. M. Beattie for his criticisms and suggestions, and to Professor Ernest Glynn in whose laboratory the work was commenced.