PRACTICAL LESSONS IN ELECTRO-THERAPEUTICS.

By Arthur Harries, M.D.,
and
H. Newman Lawrence, Member Institution Electrical Engineers.

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THE chemical reaction is shown by the following equations :—

$Zn + H_2SO_4 = ZnSO_4 + H_2$ (inner jar).

$H_2 + CuSO_4 = H_2SO_4 + Cu$ (outer jar).

The way in which this cell fulfils the conditions named is—(1) Its E.M.F. is low (equal to one volt); (2) it is very constant ; (3) internal resistance is rather high ; (4) its internal action when at rest is very small ; (5) it is clean ; and (6) gives off very little in the way of noxious fumes. There are many modifications of the Daniell cell, one of the chief of which is the Minotto, in which the copper element—in the form of a plate fitting loosely to the shape of the jar—is placed at the bottom, together with a few copper sulphate crystals. Piled upon it is sawdust or sand, till the jar is nearly filled. This absorbent medium is then saturated with dilute sulphuric acid, and the zinc element—which must also be of suitable shape—is placed on the top.

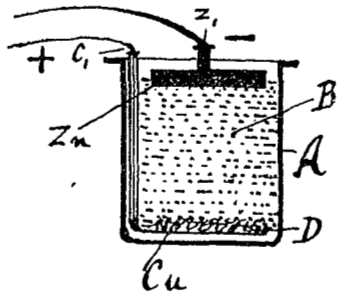

FIG. 9.—MINOTTO CELL.

Fig. 9 represents a Minotto cell in section. A is the containing jar, B the sawdust or other absorbent saturated with dilute sulphuric acid, *Cu* is the copper element covered with the sulphate of copper crystals D, *Zn* is the zinc element, c_1 is the positive pole, and z_1 the negative pole.

We have thus an arrangement which allows us to dispense with the inner jar, and which is fairly portable. The absorbent prevents the fluid spilling, while at the same time it does not interfere with its action as an excitant.

The internal resistance of the Minotto cell is very considerable.

B.—(II.) The bichromate cell, which was invented by Poggendorf, has for its elements zinc and carbon, and for excitant a solution of bichromate of potash and sulphuric or hydrochloric acid (the latter being the best). The single jar is generally of glass or porcelain and contains the solution into which the elements dip. As, however, the excitant will continue to act upon the zinc when the external circuit is open, these cells are usually supplied with some simple mechanism to enable the zinc to be raised out of the solution when the cell is not in use.

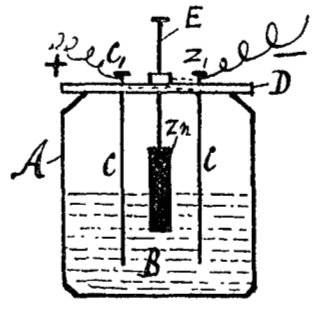

FIG. 10.—BICHROMATE CELL.

Fig. 10 is a diagrammatic sketch of a bichromate cell arranged in the form frequently adopted for working medical coils. A is the jar. B is the exciting solution. D is an insulating and close fitting lid or stopper. C is the carbon element in two plates. *Zn* is the zinc element attached to the movable rod or pin E, which is in metallic contact with the negative pole z_1; c_1 is the positive pole to which *both* carbon plates are attached. When the cell is not in use the zinc is raised out of the excitant by means of the rod E. In the drawing the zinc is shown only half immersed in the excitant, but when the full power of the cell is required it should be completely immersed.

Owing to the fact that the combinations of chromium are complicated and easily disturbed by conditions of temperature and saturation, it is difficult to state exactly what the chemical reaction is.

This cell has (1) the high E.M.F. of 2·0 volts ; (2) but is not constant ; (3) its internal resistance is low; but (4) there is great internal action when the cell is not at work ; so much is this the case that the zinc must always be removed when not in use ; (5) it is clean ; but (6) gives off slightly unpleasant fumes.

B.—(III.) The Grove cell has for its elements zinc and platinum, and for excitants nitric acid and dilute sulphuric acid.

There are two jars. The outer contains dilute sulphuric acid and the zinc element ; while the inner, which is porous, contains the platinum or platinum foil dipping into strong nitric acid.

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