LETTERS TO THE EDITOR.

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On a Form of Artificial Submarine Cable.

IN order to illustrate the effect which capacity has on the sending of arbitrary electrical disturbances along a conductor, Mr. C. F. Varley, about the year 1860, devised an artificial submarine cable equivalent in its action to a real cable long enough to reach from England to Australia. For obvious reasons such a device would be a most instructive piece of lecture-table apparatus.

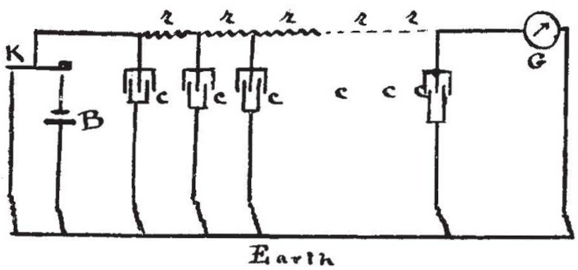
The so-called "K.R. Law" of Lord Kelvin states that the time-lag in signalling over a cable is proportional to the capacity of the dielectric sheathing per unit length, to the resistance (also per unit length), and to the square of the length.

Thus in order that the time-lag of an artificial cable shall be great, both the resistance and capacity must be great. The first of these two conditions is, of course, easily fulfilled, but if the ordinary tin-foil type of condenser is used as the capacity, both the bulk and cost of the apparatus is very considerable.

For this reason very few artificial cables have been made after Varley's plan. I have recently made an artificial cable, giving about six seconds time-lag, which is entirely free from the disadvantages just mentioned, and for this reason I trust that it may commend itself to teachers of physics as a piece of demonstration apparatus.

In an actual cable the capacity is distributed uniformly along the length of the line, but in an artificial cable of great equivalent length the capacity must be distributed non-uniformly in some such way as that shown in the accompanying figure.

In it B is the battery, K a double key so connected as to put the cable either to the ungrounded pole of the battery or to



earth, *r r* are a number of high resistances which play the part of the conducting core of the cable, and *c c* are the capacities which play the part of the insulating sheath of the cable. G is the galvanometer, one side of which is connected to earth, and forms the receiving end of the apparatus.

This is substantially the arrangement which Varley used, the only difference between his artificial cable and mine being that I have substituted light, easily made electrolytic capacities for the bulky, expensive commercial capacities used by him.

As is well known, the polarisation capacity of platinum electrodes in dilute sulphuric acid is very great. Unlike true dielectric capacity, it is not independent of the charging potential, its value increasing with the charging potential and reaching a value as high as 500 micro-farads per square inch of electrode surface.

Even though the capacity of such a cell is not a fixed quantity we may make use of its great value in constructing an artificial cable, though, of course, we are then obliged to use a battery at the sending end having an E.M.F. less than the maximum polarisation of the electrolytic cell.

The capacities I used were made by fusing platinum wire into the ends of little cells made of glass tubing. These were filled with water and a piece of platinum foil was corked into each so as to dip a few millimetres into the water.

I made thirty-six such cells and mounted them on a board in which holes were drilled to allow the platinum wires to project through so that they might dip into a trough filled with mercury which was connected to earth. These thirty-six cells were divided into twelve sets of three cells in parallel, and each of the twelve sets were connected in the positions *c c* of the figure. The resistances *r r* aggregated about a million ohms.

The advantage of mounting the cells on the board as described is that the action of the cable when the platinum wires are in the mercury (and hence the capacities in, as shown in the figure) can be rapidly compared with the action when the capacities are out. In the latter case the apparatus represents an overhead line of resistance equal to that of the cable.

With the apparatus as described the galvanometer responds as soon as the key is closed in case the capacities are out, but if they are in there is a time-lag of about six seconds.

A. TROWBRIDGE.

Physical Laboratory of the University of Wisconsin, U.S.A.

Electro-Chemistry.

MY attention has lately been directed to your review of my book on "Practical Electro-chemistry" (April 18, p. 582). I desire to thank you for noticing a modest effort at length. Your reviewer is in error in supposing that the series system of copper refining is now of any commercial importance. The process was founded on a delusion and is dead. The working up of anode sludge, mentioned by your reviewer, is a purely chemical question and does not fall within the scope of the book. I note with interest that a method has been devised for refining tin, but I do not anticipate its general adoption; gold and silver being absent from crude tin it is hardly to be expected that the anode sludge obtained in the process of refining will be worth exploitation. The electrolysis of chlorides to produce chlorates is an important branch of electro-chemical industry, and omissions of details in my book, quite fairly remarked by your reviewer, are due less to indolence on my part than to the impossibility of obtaining authentic information. Manufacturers, even in the United States, where a liberal spirit prevails, are chary of allowing entry to their works. A somewhat persevering inquiry at Niagara convinced me of this reluctance. But in spite of this difficulty I am well assured that the competent chemist, equipped with a sound knowledge of the principles of electrolysis, need not fear to engage in the practice of this the latest and most promising of industries.

BERTRAM BLOUNT.

Westminster.

WITH reference to Mr. Blount's letter—if the "series system" of copper refining was "founded on a delusion" it appears to have been a fairly successful delusion. If Mr. Blount consults "The Mineral Industry" for 1899 he will see that the Baltimore Copper Smelting and Rolling Co., which uses this system, turned out between 60 and 70 million pounds of refined copper in 1898. The Nichols Chemical Co., N.Y., whose daily output of refined copper amounts to 60 tons, also employs this method (or did in November 1899).

Mr. Blount further states that gold and silver are absent from tin and therefore "it is not to be expected that the *anode sludge* obtained in the process will be worth exploitation." Mr. Blount is probably thinking of Cornish tin, but Mr. Claus's process has been devised for purifying South American tin, some of which contains considerable quantities of gold and silver, *e g.* an *anode sludge* analysed for Mr. Claus contained 698 ozs. silver and ½ oz. gold per ton (1 ton of *anode sludge* would be obtained from about 10 tons of crude metal). In another analysis the crude anode gave 7 ozs. silver and 1 oz. gold per ton.

I am still of the opinion that Mr. Blount would have considerably added to the value of his book had he described in detail the working up of a "typical" anode sludge. The successful treatment of the sludge is extremely important to the practical electro-chemist, and if a description of it is outside the scope of a book devoted to electro-chemistry, I fail to see in what book it should be described.

In the third place I did not accuse Mr. Blount of being "indolent"; if he were so he would not sit down and write a book of nearly 400 pages. An author must of necessity use his own judgment, as to what he will include and what he will reject, in writing a book. It does not, however, follow that the reviewer will agree with him.

F. MOLLWO PERKIN.

Specimens of "Aecidium berberidis."

THERE is a barberry bush near where I live which usually bears on its leaves a number of cluster cups (*Aecidium berberidis*). They are just appearing.

Perhaps some of your readers might care for a few specimens. If so, and if they would communicate with me, I should be pleased to send them a supply.

J. LEWTON BRAIN.

Swanton Morley, Dereham, May 20.