ELECTROLYSIS FROM STRAY ELECTRIC CURRENTS.

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(Continued from page 521 of last week's issue).

A number of investigations have been made to determine the effect of electrolysis on iron or steel embedded in concrete, and these have shown that where the iron is an anode —that is, where current passes from the iron to the concrete —this effect is to corrode the iron and form rust which occupies more space than the iron, causing expansion which finally cracks the concrete. The most recent and most complete investigation of this kind is one made at the Bureau of Standards, Washington, and described in a paper by E. B. Rosa, Burton McCollum and O. S. Peters, presented before the National Association of Cement Users in Pittsburgh, December, 1912. These recent experiments have shown that an extremely small current, flowing from an iron rod to a surrounding block of concrete, will produce enough corrosion to crack the concrete in the course of one or two years. These investigations have also shown that the presence of even a fraction of 1 per cent. of salt or of other chlorides may increase the action of electrolysis on iron embedded in concrete over 100 fold. They have also shown that, where the iron is a cathode—that is, where current passes from concrete to the iron—a softening of the concrete is produced in the immediate neighborhood of the iron which eventually destroys the bond between the concrete and the iron. The introduction in recent years, of buildings constructed entirely of reinforced concrete, has raised the question of the possible damage to such buildings from electrolysis of the reinforcing steel. Where reinforced concrete structures are located near railway power stations which have a grounded negative bus-bar, there may be a considerable potential

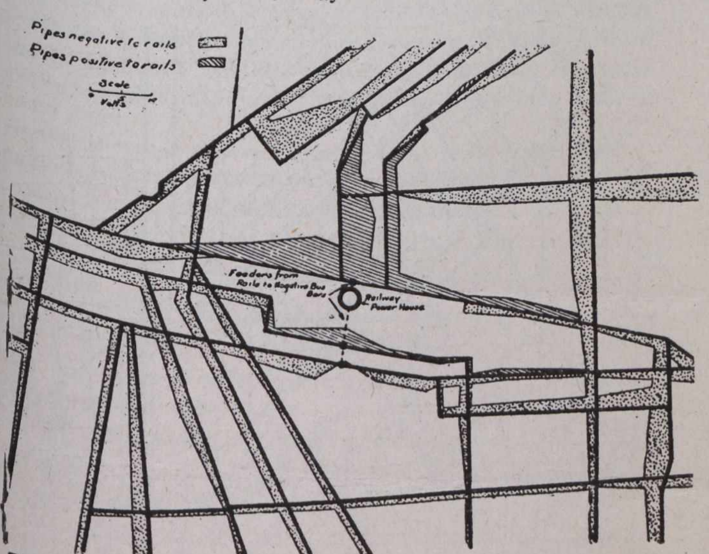

Fig. 3.—Typical Potential Survey of City, Showing Electric Railway Tracks and Potentials of Underground Pipes to Trolley Rails.

gradient through the ground upon which the concrete building stands, and in such cases it is possible that currents may flow through such a reinforced concrete building. These currents, although very small in magnitude, may cause a great deal of damage because the successive elements of steel and concrete form a series circuit, and damage will result at every point where current flows from steel to concrete or from concrete to steel. The most likely means of entrance or exit of stray electric currents, into or out of such buildings, is by underground gas or water pipes, or by foundations of concrete or of steel. In the light of these recent investigations it would, therefore, seem a wise precaution in such buildings to install insulating joints in every pipe which connects to the building from ground. In the paper above referred to it is also suggested that granite blocks might be interposed between the building footings and soil so as to prevent stray currents from flowing into and out of the building through the footings.

Electrolysis Surveys.—The diagram illustrated in Fig. 2 shows that voltage drop in the rail produces stray current through ground and through underground pipes, and pro-

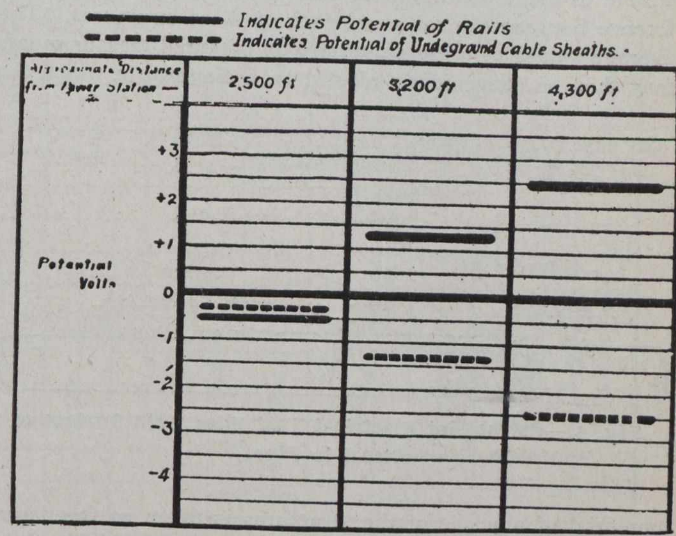

Fig. 4.—Diagram Showing Route of Potentials with Pipes Taken as the Datum or Zero Potential.

duces potential differences between pipe and rails, making the pipe appear positive in potential where current leaves the pipe, and negative in potential where current flows to the pipe. The first step in an electrolysis survey of a town is, therefore, to measure potential differences between pipes and rails, at a number of points throughout every street on which there are electric railways. Where the main itself is not exposed, connections to the pipes for these voltmeter measurements may be obtained by means of service pipe or drip connections. Such connections are generally satisfactory because the voltmeter itself has a high resistance and, therefore, takes only a very small current. Readings are taken at each point every 10 seconds for 10 or 20 minutes, depending upon the car schedules, and the maximum, minimum and average results of the readings recorded. A convenient instrument for these potential readings, which can also be used for the drop measurements described below, is a Weston, Model 1, combination millivoltmeter and voltmeter, with its zero in the centre of the scale, and having ranges of 5, 50 and 500 millivolts and of 5 and 50 volts. These instruments are made with very high resistances, so as to be particularly applicable to electrolysis testing.

After such potential measurements have been made throughout the principal streets of a town, they are then conveniently plotted on a skeleton map of the town, in which the trolley lines are shown. The potentials of the pipes referred to the rails are laid off normal to the lines representing the railway tracks to some convenient scale, usually 1 inch = 10 volts. The ends of these potential lines are then connected, and the included areas are colored red where the pipes are positive in potential to the rails, and blue where the pipes are negative in potential. In Fig. 3 is shown a typical potential survey map, in which the negative areas are