in sea water. These were connected in series, with 0.1 am pere continuously flowing through them. Block 3, Fig. 3 was also immersed in sea water, but no current was sent through it. This was for the purpose of comparison after the blocks were broken open.

These tests were commenced on February 1, 1906, and ended March 2, 1906. The results of importance upon this first group of blocks were found in the gradual disruption of the concrete, as shown by the cracks as time went on, and the appearance of electrolysis and loss in weight of the iron tubes of both No. 2 and No. 4 when the tests were concluded. Block 4 is not shown, it being quite similar to the others. During the test these cracks were noted as follows: On the 17th day a small crack down one side of block 2 was observed. On the 27th day this crack in No. 2 had a maximum width of ⅛-inch and extended clear down one side, across the bottom and nearly to the top of the other side. Two cracks also appeared in No. 4. This disintegration of the concrete was a genuine surprise. The report furnished by the laboratory on this first set of experiments concludes as follows:

After the conclusion of this test, which extended over thirty days time, the blocks were removed, and after allowing

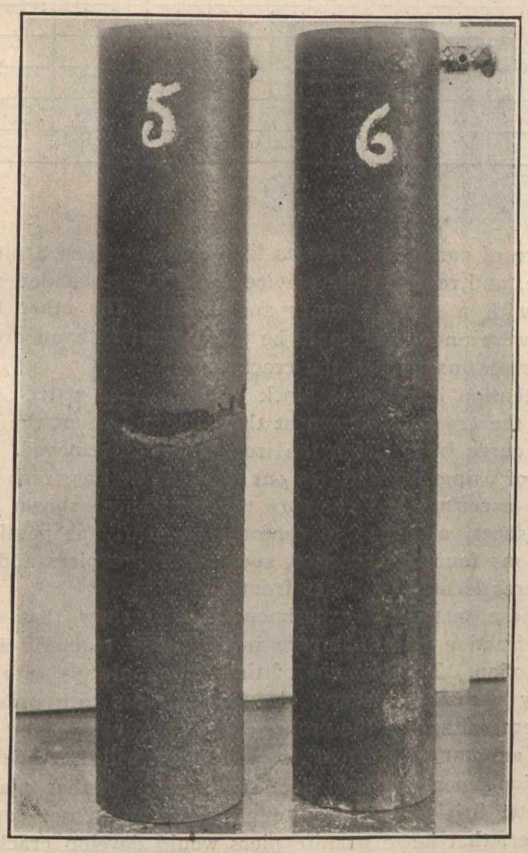

Fig. 3.

them to dry they were broken open. It was found to be quite easy to break open blocks Nos. 2 and 4 which had already become cracked. Block No. 3 which had not been subjected to electrolysis, was broken with the greatest difficulty. Blocks No. 2 and 4 showed on their interior strong evidences of electrolytic action in the form of what was apparently a deposit of iron rust extending from the pipe toward the outside of the block. Along certain lines which acted like lines of cleavage, the cement was found to be softened so that it could readily be cut or scraped with a knife. This softening was such that the point of a blade of a pocket knife could be inserted into it far enough so that the knife was supported in an upright position. The pipes inclosed in Nos. 2 and 4 were found to be considerably corroded. A portion of the scale on the corroded parts of these pipes was removed and the pipes were weighed. The pipe in block No. 3 was as bright as a new pipe. The concrete showed no evidences of a deposit of iron rust. An idea may be formed of the condition of the concrete blocks from the photographs given herewith.

Weighing of the pipes had been made before casting them in the blocks. Weighings made at the conclusion of the experiment, together with these initial weighings, are given in the following table:

	No. 2 Fresh Water.	No. 4 Salt Water.
Initial....	3 pound 12.50 ounce.	3 pound 7.5 ounce.
Final.....	3 pound 10.95 ounce.	3 pound 6.4 ounce.
Loss...	1.55 ounce.	1.1 ounce.

As has been said above, the scale was not entirely cleaned off from pipes Nos. 2 and 4 before the final weighing was made, so that the loss in weight does not represent the entire amount of the electrolysis which had occurred.

The results of these experiments seemed so important that it was thought best before drawing conclusions to have the tests repeated, and, therefore, another set of experiments similar to the first was made to see how the data would compare.

Second Set of Experiments.—In this case two blocks of concrete were prepared, numbered 5 and 6. These were made the same as the others, except the Rosendale cement was used, called in the trade "Brooklyn Bridge Brand." The object of using a different cement was to see if there was any change in the results that could be attributed to the use of a different brand of cement. In these tests more careful and more frequent measurements were employed than in the first set of experiments. They were commenced on April 12, 1906. Two readings were made every twenty-four hours through the entire thirty days, and the appearance of the blocks was closely watched. The source of current, as in first test, was from a storage battery, and the pressure was increased or decreased according to the resistance, in order to maintain a constant current of 0.1 ampere.

The variation of resistance in both blocks during the test of thirty days is important. The figures showing ohms are given as relative, as they may not quite accurately represent the true values. They were obtained by simply dividing the volts by the 0.1 ampere. It was found in the preliminary trials that resistance measurements by the usual methods, such as the Wheatstone Bridge, were not accurate, owing to strong polarizing effects. For this reason the resistances as shown by these curves, while not considered absolutely accurate in every case, are sufficiently so for our purpose of examination and study.

The curves on Fig. 5 represent the sudden fall or practical breakdown of concrete as insulation in 48 hours. The measurements in this test were made by the Wheatstone Bridge, using alternating current and a telephone receiver. They are considered fairly accurate.

Quoting from the report on the second series of tests, the following notes are of interest:

Second Day of Test.—Water appeared around the pipe of No. 5, having soaked through the concrete.

Sixth Day of Test.— Cracks were observed in both samples of concrete, those in No. 5 being the most prominent. A small amount of water was found standing in the bottom of pipe No. 5. None in pipe No. 6.

Seventh Day of Test.—The cracks in the concrete are increasing in the case of both samples.

Ninth Day of Test.—A yellow, frothy substance appeared at several points at the top of the concrete, close to the iron pipe of sample No. 6. Later this turned rust color.

Eleventh Day of Test.—Same rust colored deposit observed around pipe of sample No. 5. The cracks of both samples have increased in prominence.

Eighteenth Day of Test.—The cracks have assumed such proportions that it appears as though the concrete might easily fall apart, being ⅛ to 3-16 of an inch in many places. There is considerable rust colored, frothy deposit on top of sample No. 5, especially near the pipe.

It appears from these observations that before the ninth day the process of electrolysis had arrived at quite an advanced stage on both blocks and before the rise in resistance took place, which afterwards in fresh water reached 300 to 400 ohms, requiring some 30 to 40 volts to maintain the 0.1 ampere. We should not, therefore, conclude that because such high readings are not found in practice, it is a sign