A more satisfactory explanation of this cause of corrosion will doubtless be found in the following extracts of letters to the writer, from Prof. Allerton S. Cushman, author of two recent papers on the subject of "Corrosion of Iron," of which you are no doubt familiar. At Dr. Cushman's request, we furnished him with the data of these cases of oil tank corrosion, in which he was much interested, and he has kindly given his opinion, with permission to use same in this paper.

Washington, D.C., October 1st, 1907.

"I have read your letter with care, and I can only say that I am not surprised that the bottom of the oil tanks, in which you are interested, pitted as rapidly as they did. According to the modern theories of corrosion, the electrolysis is not caused so much by outside electrical currents or differences of potential as it is by local difference of potential set up within the metal itself, owing to concentration changes in the distribution of impurities.

"In your tanks, which undoubtedly contained at the bottom a layer of water, in which electrolytes of various kinds were dissolved, you had the ideal conditions for pitting to take place. In my opinion, a fairly liberal application of bichromate would protect the bottoms of such tanks as those in which you are interested."

He also states under date of October 1st, 1908:—

"Since the date of the letters you mention, however, my studies have taught me that the concentration changes in the distribution of the impurities in the iron is only one of the controlling factors in stimulating corrosion. The physical condition of the surface is also important, the slightest indentation, scratch or cut in the surface appears to become positive to the surrounding area, and thus forms a nucleus for a future pit hole. It is probable that in the best practice hereafter attention will have to be paid not only to the method of manufacture of the steel as affecting its chemical constitution, but also to the condition of finish of the surface which is going into use."

Referring to the surface abrasion as a contributing cause for corrosion, it has been noticed by the writer there were many corroded rivet heads on the floors of all three tanks, some partially, but many entirely eaten away. Dr. Cushman's remark as to indentation, scratches, etc., forming a nucleus for future pittings and holes may apply to rivet heads, as well as other parts of a tank bottom, as there is no lack of opportunity for surface abrasion at such points, either in the process of rivetting, men walking over them, or other causes.

Remedies.

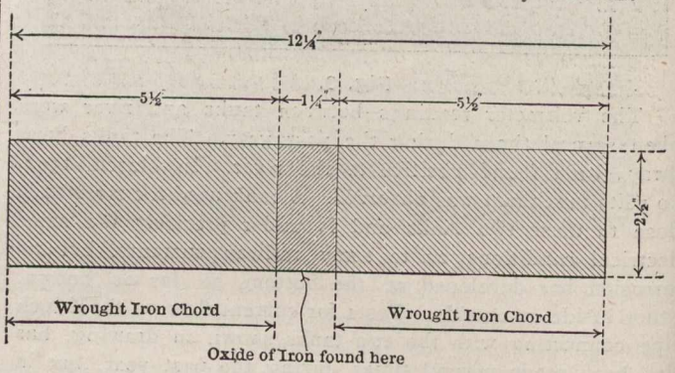
The use of bichromate solution as a protective measure for corrosion of iron has been strongly recommended by Dr. Cushman in his papers and letters, and to myself at a personal interview. His opinions are, it is well known, based upon the results of carefully conducted experiments and we believe worthy of the most favorable consideration. If this method is applied to oil tanks, we think it should be sent into the tanks from the same intakes as the oil, as in such case the remedy would be distributed where most damage occurs, as indicated by the shaded parts of drawing. Fig. 1.

In one instance, as a protection from corrosion, it was proposed by the manager of an oil works to place a layer of concrete upon the floor of tanks. We expressed doubts of this method being effective protection, in view of former experiments by the writer on corrosion of iron in concrete.

Owing to the well known absorption qualities of concrete, water containing electrolytes would naturally pass through it to the iron bottom, probably causing the concrete to crack at points where electrolytic action takes place. Attempts have been made by some to prevent the absorption properties of concrete by incorporating with it certain waterproof materials, but we have no data to present at this time of the efficiency or otherwise of concrete so treated.

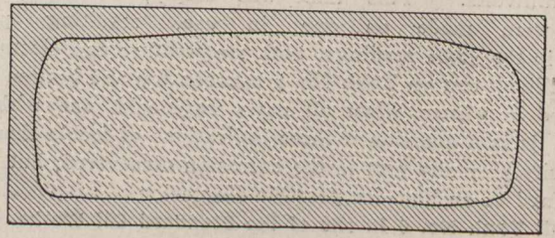
Corrosion of Other Structures.

Referring to the Rochester steel conduit, Mr. Richard H Gaines has given an interesting account of the corrosion of this water main in a paper before this society at the Albany meeting, April 30th, 1908, printed in the transactions. We have carefully read this account, and we are inclined to believe with those who took part in the discussion that the author's conclusions should not be accepted as final, where he states, page 87 (2), "The corrosion of the Rochester steel conduit was caused by electrolysis, the current for which resulted from chemical processes between water solution in the soil and the metal." While this may be true at some portions of the pipe, we notice that after a long account giving analysis of soils, and of composition of metal, character of coatings, etc., not one statement is made of the methods of measurements by the "electrician from the municipal laboratory," upon whose brief report that "no measurable current could be found with the millivoltmeter from outside sources," it is concluded by Mr. Gaines that no stray currents, past or present, should be considered as a cause for corrosion on this main. Under these circumstances, we do not think this a fair conclusion. Laboratory electricians are not always well equipped either with experience or instruments in locating or tracing stray currents. There are no details of the measurements, or if 24-hour readings were made, the latter to determine if the electrical conditions were the same during the entire 24 hours. It often occurs that the sources of power upon railway lines are changed, operating from a sub-station during the day, and from another part of the city or country at night, from a central station, when totally different results are obtained as to current flow on pipes. It is quite unusual to find pipes as badly corroded as this main is reported, where such corrosion is entirely due to "chemical processes."



Cross section with dimensions of two wrought iron bridge chords, before being damaged by electrolysis. Point St. Bridge, Providence, R.I.

Another point has been noticed in underground electrolysis in an interesting paper before this society, April 30th, 1908, by Prof. Burgess, also at the Albany meeting, entitled "Corrosion of Iron from the Electro-Chemical Standpoint," printed in the transactions. In this paper corrosion of underground structures by straying railway currents is referred to, in which the author seems to question certain testimony that had been given by experts to the effect that a flow of current through the earth had resulted in the deposition of a coat of iron upon pebbles in the earth. I do not know who gave this testimony, but am sure he was correct, as such finds are not unusual.



SECTION OF ONE OF THE WRO'T IRON CHORD MEMBERS OF POINT STREET BRIDGE

Original section of Chord before being affected with electrolysis.

Section of Chord after being affected with electrolysis.

Area of original section 12.375 Sqr. Inches. Area of present section 8.41 Sq'r. Inches. Percent of loss of section 32 Per cent. Area worked out with planimeter.

I have here two pebbles of a number found so coated,