DISCUSSION ON "ELECTROLYTIC CORROSION OF IRON BY DIRECT CURRENT IN STREET SOIL" (GANZ), BOSTON, MASS., JUNE 25, 1912.

Carl Hering: It seems to me that the tests made by Professor Ganz are very valuable, and we are fortunate to have had the benefit of his experience. But I think that to speak of voltage as Professor Ganz does in this paper, is somewhat misleading. The voltage for the electrolytic corrosion of iron is negative. Therefore it should be possible that with no external voltage at all there might be some corrosion. There are always two voltages, one at each electrode, and we generally refer to their sum, as it is difficult to separate them. The result described was perhaps due largely to "over-voltage" at the copper electrode which he used. In my opinion there is also an important mechanical effect in underground electrolysis in the form of the rate of diffusion of the liquid which does the electrolyzing. If that liquid cannot circulate rapidly there will be much less electrolysis than if it can, and it therefore seems to me that this effect of the circulation of the liquid through the soil is an important factor in determining whether the corrosion will be bad or not; it must also have a very decided effect on the voltage. Professor Ganz says nothing about the inside of the pipe and whether the results there are the same or not.

Edward B. Rosa: Regarding the excessive loss of weight by corrosion, it does not seem to me that it is necessary to assume that it is due to the removal of metal by mechanical means. At the Bureau of Standards we have made some similar experiments, and under some conditions the excess above the calculated value is considerable. It is well known that if iron pipes are embedded in cinders or in certain soils, the corrosion may be very greatly accelerated. I have known of one case where a line was laid through cinders and the pipe was destroyed within a year without the application of any outside current whatever. If the current puts the surface in a different condition from the surface of the pipe exposed as a blank experiment, the local action of self-corrosion may be thereby accelerated. These experiments are of great importance, and I think they emphasize the need of making laboratory experiments under as nearly as possible practical conditions.

Irving Langmuir: The corrosion of the pipe and the consequent loss in weight, in excess of that calculated by Faraday's law, must be due to oxidation. The iron in the ferric condition reacts with the iron itself to produce iron in the ferrous condition, thus causing a greater corrosion of the pipe. Some experiments made at Stevens Institute several years ago threw some light on the pitting. We placed two iron plates in the soil and passed a current between them for several days. At the end of that time we opened the circuit and found that there was a potential difference between the plates, in the same direction as the original current, thus tending to maintain the current.

Therefore, if the current leaves a pipe at one place with a little higher current density than at another, there will be a voltage set up at that place which will make the current concentrate at that point. The explanation of this is difficult to find. There are one or two other cases where a similar phenomenon is noticed. For example, the same effect may be observed with hydrochloric acid alone. If a current of very low density be passed between two platinum electrodes in a dilute solution of hydrochloric acid through which hydrogen is bubbling, it is found, upon opening the circuit, that there is a difference of potential between the electrodes in the same direction as that which originally produced the current. This effect, however, persists only a short time.

C. H. Sharp: The idea that I desire to express about the excess of corrosion over and above the theoretical amount, is that the action of the current accelerates the normal or so-called "chemical" oxidation of the iron. Consequently the ordinary oxidation goes on more rapidly when the current is flowing than when it is not. One interesting thing is Professor Ganz's suggestion as to the reason for the greater durability of cast iron pipes than wrought iron and steel pipes, explaining the fact on a rational basis. He did not say anything about scale or about surface conditions or anything like that, but he showed that the higher resistivity of cast iron alone would result in greater durability.

Albert F. Ganz: Dr. Hering has said that the voltage which I have measured in my experiments is somewhat misleading, because there are always two voltages, one at each electrode. This is, of course, true, but I was measuring the total applied voltage between the electrodes as we do when we make the usual potential survey. Regarding the insides of the pipes, I wish to say that in my experiments only the outside surfaces of the pipes were in contact with the soil, so that the inside surfaces were not affected by corrosion. Referring to Dr. Rosa's remarks, I wish to say that the large excess of corrosion over that calculated from Faraday's law, amounting to several hundred per cent in some cases, was undoubtedly due to the effects of scale on the surface of the pipes, because in the last series of experiments where this scale was removed by turning down the pipes before the test was begun, the excess of corrosion over that computed from Faraday's law was only from 3 to 23 per cent, and this excess of corrosion is probably due to the accelerated natural corrosion set up by the electrolytic action.