examination the questions are usually simple, direct and logical. The witness gives information of value, as far as the opinion of one man is of value, one secures some ideas on the question under discussion. Then comes the coss-examination. The witness at once feels he must be guarded. Half-a-dozen skilled examiners and trained men are watching for an opening. His examiner plys questions at time direct and clear, again involved and confusing should the witness become confused; with a wave of the hand he is dismissed, or, perhaps, to add to his confusion a sarcastic remark is made at his expense and for his benefit. The result of all this is that the expert witness does not give expert evidence. In direct examination they do not tell as much as they would like to; in cross-examination they tell just as little as they are allowed. The court is not enlightened, but wearied.

When a court, or a commission, or a board of arbitrators require expert advice, they and no one else should select the witnesses, and they and not the interested parties should provide for their examination. The witness's standing as a professional man and a citizen would then add weight to his utterances; his evidence would be clear, concise and of some value.

EDITORIAL NOTES.

If you are planning a trip to Toronto in June, why not arrange to take in one or both of the Conventions? The American Foundrymen meet June 9th to 12th at Exhibition Park. The Canadian Electrical Association meet in the Engineering Building, Toronto University, June 17th to 19th. At both these gatherings there will be papers and discussions that will be of interest to you no matter in which branch of engineering you specialize?

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In our correspondence page this week there is a short description of a covered highway bridge. As an example of good engineering design suitable for to-day this bridge is of little value. Yet we are sure many will be interested in a wooden structure that has done service for sixty-eight years. Not only is it interesting because of its age, but because of its unusual design. We would be pleased to receive articles descriptive of old bridges, foundations, and large masonry culverts. A knowledge of the life of these structures is of value to you as an engineer. Give of your experience, and your fellow-practitioner will reciprocate.

NOTES ON THE ACTION OF WATER ON GALVANIZED IRON.*

W. F. Monfort.

"Notes" bearing this caption are usually concerned with the danger to the water consumer from zinc dissolved from the coating. The case here presented is considered primarily from a different standpoint; namely, the action of a partially softened water upon the zinc coating of galvanized iron pipes as affecting their durability.

A new meter with a galvanized iron cup, subjected to unusual service during 24 days registered 128,266 cubic feet, or 961,995 gallons. Upon removing the meter cup at the end of this period, it was found to contain a soft, adherent, yellowish-white coating. This was loosened by gentle rubbing with a rubber coated glass rod and rinsing, without abrading the harder underlying layer. The weight of the materials removed dried was 2.5 grams. Its analysis gave these results:

Zinc Oxide	75.7 per cent.
Carbon Dioxide	8.1
Ferric Oxide and Alumina	4.45
Calcium Oxide	trace
Magnesia	trace
Silica and Insoluble	11.31
	100.00

The cleaned surface showed a hard, brittle, black layer about 1/100 of an inch in thickness, rich in sulphides and in carbon, overlying the cast-iron body of the cup, with only traces here and there of the original zinc coating, which had been almost entirely removed or converted in place into zinc oxide and basic carbonate. No pitting or tuberculation of the iron had taken place, although one short rust streak occurred where the iron seemed freshly exposed, perhaps by a scratch made by the attendant who removed the cup.

The water which effected this change was fairly uniform during the period, as shown by frequent examinations, yielding the following average results:—

Bicarbonate alkalinity	21.9 parts per million.
Neutral carbonates	33.8
Total alkalinity	55.7
Total hardness	112.5
Calcium	20.
Magnesium	15.
Chlorine	18.
Sulphate ions (SO_4)	95.2

The absence of free carbon dioxide and the presence of considerable quantities of bicarbonate and neutral carbonates may be considered as the important factors in affecting the zinc, in connection with the abundant supply of dissolved oxygen which the water carried at temperature ranging from 42 to 52 degrees Fahrenheit.

The questions raised by the facts presented are:—

First.—The danger of contamination by zinc in solution.

Second.—The value of the zinc coating as a protection for iron pipes.

As to the first, it may be said that despite the rapid flow through the meter of almost a million gallons of water, so large a portion of the zinc compounds remained in place, that there is small chance of serious pollution from the slight quantity of basic carbonate or oxide which could dissolve.

Furthermore, repeated tests of this water after exposure to zinc, and its oxide and basic carbon for a period of an hour, show only infinitesimal traces of zinc.

As to the second point, the continuous action of an excess of this water through twenty-four days was sufficient to remove almost the entire body of zinc or to convert it into the compounds above-mentioned. While the coating left had sufficed thus far to prevent tuberculation of the iron, it could not be relied upon to continue this protective action indefinitely. It is true the amount of water passing the meter was equivalent to about twelve to fifteen years' supply for the ordinary consumer; but the short time (24 days) in which the action occurred points to a much shorter life of the zinc surface than fifteen years.

It may be that the underlying thin layer of sulphides and carbon would retard the further action of oxidation of iron for a time. But in these very impurities in contact with the iron lies an element of danger, in that there may develop differences of potential which would result in local couples. Unquestionably the pasty adherent zinc compounds may be considered more effective than the thin subjacent layer as a protective coating to the iron beneath. It must be remembered, however, that the total zinc in the 2.5 grams of compounds (= 1.5 grams zinc) remaining in the cup represents but a very small portion of the original body on the surface; since it is equivalent to a film of 0.003 centimeters in thickness, or 0.00118 inch over the surface of the cup. The larger part of the original zinc coating had been removed during its temporary solution in the formation of the compounds, or forming in

*Paper read before the American Waterworks Association.