In support of this presumption, we may offer the following contentions: First, the fact that, although in alkali regions, there are many evidences of the failure of concrete, yet there are many concrete structures in the same regions exposed under similar conditions which have given no signs of deterioration. Many have drawn the conclusion that if some concretes have survived the assaults of the alkali waters, then the failures of other concretes must have been due either to improper grading of the aggregate or to a careless mixing and molding of the concrete.

Further confirmation of the widely held opinion that good concrete will resist the action of alkali waters has been based upon the known facts regarding the action of the salts of sea-water upon concrete. The active salts in sea-water are the same as those in alkali waters, namely, the sulphates and chlorides of magnesium and sodium. While innumerable instances of failures of concrete in sea-water can be adduced, there are many piers and walls in salt water which have been in service for many years, and which are intact, showing no evidence of deterioration.

The scientific basis for the assumption rests upon the contention that in a well-proportioned, properly made concrete, the calcium content of the cement at the surface exposed to the air, combines with the CO_2 of the atmosphere to form calcium carbonate, a salt which is practically insoluble in the presence of alkali salts. While it may be contended that calcium carbonate is soluble in sodium chloride, the fact remains that the carbonate surface of concrete in salt water, when not removed by mechanical abrasion, will withstand the action of the sodium chloride of the sea-water. According to this theory, then, a dense non-porous skin of calcium carbonate is formed on the surface of good concrete; and upon the integrity of this surface depends the life of the concrete.

This is a brief statement of the indirect evidence bearing upon this phase of the subject. Inasmuch as the direct and indirect evidence combined lead to no definite conclusions, further investigations are needed.

The details of the plan to be adopted in an investigation are a matter for individual opinion, and I will take this opportunity of outlining a *modus operandi*. Locations in the western provinces in which it is evident that alkali salts are present in the ground water, should be designated. At these locations concrete blocks should be placed in the soil exposed to the action of the alkali waters. At each location the blocks should be of three kinds:—

First, blocks molded under the supervision of an engineer in the proportion of one part of cement to five or six parts of the combined aggregate obtainable in the district, the parts of the sand and gravel to be so proportioned as to give a concrete of a maximum density for the given cement content and the concrete to be placed with as small an amount of mixing water as will allow of being properly worked.

Secondly, a set of blocks should be made by a local contractor from the same aggregate in the proportion of 1:2:4 and of the consistency which is the common practice in the locality. These blocks should be fair samples of the concrete used in that district.

Thirdly, a set of blocks of a leaner mix and with the various blocks protected with different waterproofing coats should be exposed under the same conditions. Observations made at intervals of a year should be recorded, passed upon by a committee, and published.

The objects aimed at in this plan are to ascertain, first, whether a well-made concrete, proportioned from local aggregates in a manner which is commercially practicable for both large and small jobs, will resist the action of the alkali ground waters which are present; and second, whether the ordinary commercial concrete obtainable without engineering supervision, will withstand alkali salts.

Should these experiments show that one or both classes of concrete will deteriorate, then it may be necessary to recommend the use of a waterproofing coating, and the experiments with the third class of blocks will offer evidence upon which to base recommendations, as to the kind of waterproofing to be employed.

It may be pertinent at this time to revert to the fact that while the information from an investigation may not be available for several years, we are confronted with our immediate problem of the position which engineers should assume in the light of our present knowledge or lack of knowledge.

We have been forced to the conclusion that a porous concrete will disintegrate under the action of alkali salts. Engineers are familiar with the methods to be adopted in the attainment of a dense, non-porous concrete, and they know, too, that care in every operation of the making of the concrete is the price of success. Yet it is common knowledge that a large proportion of the concrete in the western provinces has been placed either with inadequate engineering supervision or with no supervision at all. The natural results of such a policy has been the widespread opinion held among contractors, foremen and laborers that concrete is a fool-proof material and that special care in the making of the concrete is not necessary. Reliable knowledge of the effect upon the density and compressive strength of concrete, of varying the proportions of cement, sand, gravel, the amount of water, the method and time of mixing, and the method of placing,—such knowledge is rare among foremen, workmen and even among subordinates employed by architects and engineers to supervise the work.

Under these conditions it is reasonable to suppose that much of the concrete placed in foundation work has been of a porous quality, and we may anticipate reports of failures when such concrete comes within the sphere of action of alkali waters.

The conservative position, then, for the engineer who is responsible for the placing of concrete in foundation and sub-soil work, should entail the examination of the soil and ground water for alkali salts; careful supervision of the proportioning and handling of the material to give a dense concrete, with a non-porous surface; and an adequate provision for the removal or drainage of the ground water.

In conclusion, we wish to apologize again for having been unable in the time and with the means at our disposal, to obtain more convincing evidence on this subject. We are painfully aware that we have offered in evidence only one series of facts which should have a place in a paper upon the durability of concrete in Western Canada, namely, the announcement of failures of concrete in the various provinces; and that the body of this paper has been built up from evidence dealing with conditions prevailing outside of the Dominion, which we have assumed as on a par with those which prevail in Western Canada. May we not offer this confession of our inability to obtain necessary information upon this important subject, as an argument in favor of an early beginning of a complete investigation into the action of the salts of alkali waters upon concrete?

The 14th convention of the American Concrete Institute will be held at the Hotel Traymore, Atlantic City, N.J., June 27th, 28th and 29th, 1918. This convention had been arranged for February, but owing to the unusual traffic conditions at that time, was deferred until the later date.