to 22.6. Thus we have in this series, concrete from the best to the worst practicable. We have a well graded aggregate and a poorly graded aggregate of various mixes; range in water ratio from 0.62 to 2.4 and a variation from 1 gr. of cement to 7.3 sq. ins. of surface area, to 1 gr. to 35.1 sq. ins., which gives a range in crushing strength from 3,800 lbs. per sq. in. to 300 lbs. per sq. in.

Complete records of the analysis of the cement and aggregate mixing water have been kept, while from a test hole at the site, a log of the ground water level with the corresponding chemical analysis of the water is being recorded in order to check the variation in concentrations with the water table. The weights of the various ingredients as well as the moisture content of the gravel were kept, of course, and it might be interesting to note that the best block (No, 1) weighed 147 lbs. per cu. ft., while No. 10, the poorest, only weighed 131 lbs. per cu. ft.

To be Photographed Periodically

Before placing in the ground, a photograph was taken of the blocks, and it is proposed that each time the blocks are dug up for inspection, photographs will be taken for comparison and record.

It is believed that from this preliminary series, we shall be able to obtain at least the danger zone of mixtures for this particular locality, and thus cut down the range for future experiments and indicate the value of the different factors in combating disintegration in this locality.

Series B—Blocks Nos. 11 to 19, 25 to 27 and 31 to 33 (15 blocks in all). This series was designed for the purpose of testing a few commercial water-proofing and alkali-proof products. Each compound was applied according to the manufacturer's specifications to each of the three blocks corresponding exactly to either blocks Nos. 11, 12 or 13, or Nos. 28, 29 or 30, in constituents, mix and consistency.

Four general types were used: An integral powder mixed with the cement; a compound mixed with the water; an alkali-proof paint applied on the surface; and tar applied to the surface.

Series C—Blocks Nos. 20 to 22. These blocks were made of the same aggregate and mix as Nos. 11, 12 and 13, but the consistency was made as wet as possible in order to see if the excess water decreases the resistance of a concrete to alkali just as it decreases its strength.

Series D—The purpose of this series is to check our assumption that the maximum disintegration takes place at a depth of 6 ft. These specimens were made 6 ins. by 6 ins. by 6 ft., and were placed upright so that one end is exposed to the air while the other is well under the ground water level. If we find that the 6-ft. level is not the worst, we will be able to change the position of the other blocks and make all future tests accordingly.

Series E—Blocks Nos. 34 to 36. In this series the pit-run gravel was first screened and divided at the No. 4 screen and then re-mixed. The mixtures by volume correspond to Nos. 28, 29 and 30. This series was designed to ascertain the economy, if any, of screening and remixing the gravels for concrete aggregate.

Series F—Blocks Nos. 37 to 39. The blocks in this series are of the same mix as Nos. 28, 29 and 30, but the mixing water was the alkali water taken from the ground where blocks are placed. At the time of making up all blocks of the series, small blocks for compression tests were made up for testing after 28 days in water in order to check, if possible, the alkali-resisting properties of concrete against its strength. With blocks Nos. 25 to 39, nine compression blocks of each mixture were also buried, to be tested three per year.

Observation of Buildings

This phase of the work consisted of an inspection of all known cases of disintegration in the city for the main purpose of defining the troublesome areas and gathering all the information and evidence possible. Added to that we have outlined a scheme for inspecting all buildings being erected in these areas and personally observing the concrete being put in, the mix, consistency, aggregate, etc.

Our inspection shows that the down-town section of about ten city blocks contain the greatest amount of affected concrete, and information gathered from a reliable source indicates that before the city was built this area was known as an "alkali slough." Accordingly, this section was selected for our tests and observations.

Various contractors and builders were interviewed, and some evidence obtained as to the probable mixes of the cases of failure, but little reliance can be placed upon the verbatim information generally, as was proven in many cases where we, ourselves, were able to check up. The following is a typical experience:—

1:5 or 1:9 Mix?

One owner informed us that he realized the danger of alkali, and in his new building, which he was then putting up, he was using a 1:5 mix. The contractor interviewed said he was using a 1:6. The foreman on the job said he was putting in a 1:7, and our personal observation showed that what was really going in was a 1:9. The same sort of vagueness seems to be prevalent generally and our own experiences have led us to accept nothing not seen personally.

On new buildings we take records of the conditions of the excavation, including an analysis of the ground water, a mechanical analysis of the aggregate, and data as to the mix and water used. On several buildings we got permission to put in a section of the wall of a very much stronger mix than was used for the rest of the work, and it is our desire to get a wall poured with about six different mixes, but up to the present time we have not succeeded.

On one old wall which was uncovered when extensions were being made, a very interesting thing was observed. Two distinct layers of disintegration were noted: The ordinary one at the 6-ft. level, and another at the ground level, suggesting that perhaps there had been disintegration by crystallization at the surface and direct chemical action at the 6-ft. level.

Laboratory Tests

Laboratory tests are being conducted as an aid to and for the purpose of throwing light on the results of the field tests, and not as primary tests themselves, as it is felt that conclusions drawn from laboratory tests are not always reliable when applied to field conditions.

For the present, the chemical work consists of a survey of ground waters, and analysis of the mixing waters and of the aggregate, etc. As we get results from our field tests, laboratory tests to clear up certain points will, no doubt, be necessary.

New Series This Summer

The above is a summary of the work done during the past summer, and while a great deal of actual labor has been done, we are, of course, unable to present any conclusions at present, although we hope that even by next summer we may be able to report at least some indications.

We intend extending the tests of the various series next summer and adding from time to time new series dealing with other phases such as admitting air to blocks at the 6-ft. level; application of "gunite" to the surface, etc. Concretes found immune to our local conditions will then be subjected to other concentrations of alkali in the hope that eventually we may be able to specify the mixtures for different conditions of alkali waters just as we do for other external forces.

Frank Barber, consulting engineer, Toronto, addressed the Toronto Branch of the Engineering Institute of Canada last Thursday evening on concrete bridges. He predicted that within a few years concrete will have replaced steel almost entirely for bridge construction. He stated that most of the bridges in Canada are too light for the traffic which they have to bear and in many cases are decidedly dangerous. "Beauty in architecture combined with utility is the ideal in bridge construction," declared Mr. Barber, "and the future of bridge building will depend a great deal upon the architect, with whom the engineer must co-operate more closely."