should be a fair average of the contents of the package from which it is taken. At least one barrel in every ten should be sampled. (2) Cement in barrels should be sampled through a hole made in the centre of one of the staves, midway between the heads, or in the head, by means of an auger or sampling iron similar to that used by sugar inspectors. If in bags, it should be taken from surface to centre. (3) All samples should be passed through a sieve having twenty meshes per linear inch in order to break up lumps and remove foreign material. For determining the characteristics of a carload of cement the individual samples may be mixed and the average tested; where time will permit, however, each sample will be tested separately.

Not less than 94 per cent. of the cement tested shall pass through a No. 100 standard sieve. The standard sieve shall be circular, about 20 cm. (7.87 ins.) in diameter, 6 cm. (2.36 ins.) high, and provided with a pan 5 cm. (1.97 ins.) deep and a cover. The wire cloth in the sieve to be woven (not twilled) from brass wire having a diameter of 0.0045 ins. This cloth to be mounted in the frame without distortion; the mesh should be regular in spacing, and for a No. 100 sieve shall contain not less than 96 nor more than 100 meshes per linear inch. The cement to be thus tested shall be thoroughly dried at a temperature of 100 C. (212 degrees Fahr.) before sieving.

Set.-(1) Initial set shall not occur in less than thirty (30) minutes. (2) Final set shall not occur in less than one hour nor more than ten hours. (3) The time of setting shall be determined by means of the Vicat needle apparatus, as recommended by the committee of the American Society of Civil Engineers upon uniform tests of cement in conjunction with the committee of the International Association for Testing Materials. (4) Using a paste composed of neat cement and water, of normal consistency, the initial set is said to have commenced when the needle ceases to pass a point 5 mm. (0.20-in.) above the upper service of the glass plate in the Vicat apparatus, and is said to have terminated the moment the needle does not sink visibly into the mass. (5) The paste is of normal consistency when the cylinder of the Vicat apparatus penetrates to a point in the mass 10 mm. (0.39-in.) below the top of the ring. (6) The amount of water required to make a paste of normal consistency varies with different cements, but will be found to be approximately 20 per cent. of the weight of the cement. It should have a temperature of 70 degrees Fahrenheit.

Soundness.—(I) A pat of neat cement $2\frac{1}{2}$ to 3 inches in diameter, $\frac{1}{2}$ -inch thick at centre, tapering to a thin edge, and allowed to take its final set in moist air, must withstand indefinite exposure in water or air at any ordinary temperature without checking, distortion or softening. (2) A pat of neat cement, as above, placed in water, which shall be slowly raised to the boiling point and then maintained in that condition for three hours and allowed to cool gradually, shall not show any signs of checking, distortion or softening. The same result should follow exposure to steam not under pressure for three hours. This test may or may not be cause for rejection, at the option of the engineer in charge.

Tensile Strength .- (1) The briquette used in testing shall be formed in moulds of the size and form now in customary use and recommended by the American Society of Civil Engineers, the stress to be applied at a uniform rate of 600 pounds per minute until fractured. (2) All briquettes of neat cement are to be made from paste of normal consistency in the following manner: The moulds shall be filled with the paste as soon as it is thoroughly mixed and tempered, the material pressed in firmly with the fingers and smoothed off with a trowel without ramming; the material should be heaped up on the upper surface of the mould, and in smoothing off the trowel should be drawn over the mould in such a manner as to exert a moderate pressure upon the excess material. The mould should then be turned over and the operation repeated upon the other side. (3) Briquettes for twenty-four-hour tests shall be allowed to set twenty-four hours in moist air. (4) Briquettes for seven and twenty-eight day tests shall be allowed to set one day in moist air and remainder of period in water. (5) All briquettes are to remain in the water until they are placed in the testing machine, except in the case of twenty-four-hour tests. (6) Neat twenty-four-hour tests shall not show less than 125 pounds per square inch. Neat seven-day tests shall not show less than 400 pounds per square inch. Neat twenty-eightday tests shall not show less than 500 pounds per square inch, and should show at least 10 per cent. increase above the sevenday test.

The specific gravity, determined upon dried cement which has passed through a No. 100 sieve, shall not be less than 3.10 nor more than 3.30. The specific gravity can be conveniently and accurately determined by the use of Le Chatelier's apparatus, as recommended by the committee on uniform tests of cements. Chemical analyses should show not more than 5 per cent. of magnesia, nor more than 1.75 per cent. of sulphuric anhydride. If in the tests of any given brand of cement any sudden, irregular or wide variation from its normal action is found, it should be withheld from use until more extended tests shall have demonstrated its reliability.

Natural Cement.

Natural cement is a product formed of calcinated limestone containing clay and carbonate of magnesia reduced to a fine powder. Cement should be packed in well-made wooden barrels lined with paper, or in strong jute or paper sacks. Each package shall be plainly marked with the brand and name of the manufacturer, and the net weights shall be exact and uniform. One barrel shall contain not less than 300 pounds of cement. (West of the Alleghany Mountains this may be 265 pounds.) Three paper sacks of cement shall be equivalent in weight to one barrel. All cement shall be delivered in sound packages, undamaged by moisture or other causes. Cement must be stored until used in a perfectly dry place in such manner as will ensure it from all damage. All cement failing to meet the requirements of the specifications may be rejected, and all rejected cement, whether damaged or rejected for other causes, shall be removed at once from the company's property. All cement shall be subject to the following tests:

Test Sampling .- (1) The selection of the sample for testing, the number of packages sampled, and the quantity taken from each package, must be left to the discretion of the engineer, but each sample should be a fair average of the contents of the package from which it is taken. At least one barrel in every ten should be sampled. (2) Cement in barrels should be sampled through a hole made in the centre of the staves, midway between the heads, or in the head, by means of an auger or sampling iron similar to that used by sugar inspectors. If in bags, it should be taken from surface to centre. (3) All samples should be passed through a sieve having twenty meshes per linear inch in order to break up lumps and remove foreign material. For determining the characteristics of a carload of cement the individual samples may be mixed and the average tested; where time will permit, however, each sample shall be tested separately.

Fineness.—Not less than 80 per cent. of the cement tested shall pass through a No. 100 standard sieve. The standard sieve shall be circular, about 20 cm. (7.87 ins.) in diameter, 6 cm. (2.36 ins.) high, and provided with a pan 5 cm. (1.97 ins.) deep and a cover. The wire cloth in the sieve to be woven (not twilled) from brass wire having a diameter of 0.0045 ins. This cloth to be mounted in the frame without distortion; the mesh should be regular in spacing and for a No. 100 sieve shall contain not less than 96 nor more than 100 meshes per linear inch. The cement to be thus tested shall be thoroughly dried at a temperature of 100 C. (212 degrees Fahr.) before sieving.

Set .- Initial set shall not occur in less than twenty (20) minutes. (2) Final set shall not occur in less than forty-five (45) minutes nor more than four (4) hours. (3) The time of setting shall be determined by means of the Vicat needle apparatus, as recommended by the Committee of the American Society of Civil Engineers upon uniform tests of cement in conjunction with the Committee of the International Association for Testing Material. (4) Using a paste composed of neat cement and water, of normal consistency, the initial set is said to have commenced when the needle ceases to pass a point 5 mm. (0.20 ins.) above the upper surface of the glass plate in the Vicat apparatus, and is said to have terminated the moment the needle does not sink visibly into the mass. (5) The paste is of normal consistency when the cylinder of the Vicat apparatus penetrates to a point in the mass 10 mm. (0.39 ins.) below the top of the ring. (6) The amount of water required to make a paste of normal consistency varies with different cements,