(c) That no absorption takes place after 31 days' immersion.

Quantity of Water Required to be Added to Cement to Produce Complete Hardening.

According to the formula laid down by Le Châtelier,* $3CaO\ SiO_2 + water = CaO\ SiO_2\ 2\frac{1}{2}\ H_2O + 2Ca\ (Oh)_2$ 35.4 per cent. of water would be required to be added to cement for complete hardening, and the hardened cement, therefore, would contain 26.2 per cent. of water in a combined state. From the figures the writers now give, this is found to be by no means the case. Possibly the re-action is not so complete, as Le Châtelier works it out by theory, and, although more water is combined by using an excess in gauging, yet the test becomes less and the strength is impaired, for Dr. Michaelis† found that, by sealing up some very finely ground cement with 150 per cent. of water for four weeks and then drying it over sulphuric acid, a loss on ignition was shown which equalled 27.5 per cent. of water absorbed. The results of the writers' experiments are as follows:

Experiment A.—Neat-cement test pieces gauged with 20 per cent. water, after 14 days' immersion in water, gave free moisture = 11.75 per cent., combined = 9.7 per cent.,; after 28 days' immersion they gave free moisture = 12.14 per cent.; combined = 10.9 per cent.

Experiment B.—Mortar briquettes, with 3 sand to 1 cement, gauged with 10 per cent. of water, after 24 hours were immersed in water and kept there for 7, 14 and 28 days:

	Free water at 105° cent. Percentage.	Combined water. Percentage.
At 7 days	9.44	9.20
" 14 "	8.49	10.58
" 28 "	8.68	10.29

Experiment C.—Neat cement test pieces were gauged with 20 per cent. of water, and, after 24 hours under damp flannel, were immersed in fresh water for periods up to 18 months.

	Free water at 105° cent. Percentage.	Combined water. Percentage.
After 3 days	8.0	6.4
" 7 "	8.9	7.9
" 28 "	9.0	12.38
" 3 months	9.25	13.05
" 6 "	9.55	12.95
" 12 "	9.40	12.90
" 18 "	9.82	12.20

Experiment D.—Other test pieces, made of different cement, were also tried, 20 per cent. of water being used for gauging, with the following results.

	Free water. Percentage.	Combined water Percentage.
After 24 hours	8.5	3.3
" 48 "	7.45	11.5
" 72 "	7.10	7.7

Experiment E.—Frozen Test Pieces.—The cement was gauged with 20 per cent. of water, and, after 24 hours under damp flannel, was placed in cold storage at 15° Fahr. (17° of frost) for 6 days. The free water = 10.29 per cent.; combined water = 5.92 per cent. There was no active hardening of the cement.

Conclusions from the foregoing Experiments.—That from the quantity of water absorbed by cement and cement concrete the writers are unable to determine precisely its ultimate effect upon the hardening of the concrete. It depends entirely upon physical conditions, such as the porosity of the concrete. When an excess of water is added, there seems to be a loss due to evaporation during the few hours after gauging; then, although immersed in water, the percentage of uncombined water remains constant, while the percentage of combined water increases until it attains a maximum of approximately 12 per cent. This occurs also with gauged cement exposed to open air, the only difference being that the quantity of free moisture gradually diminishes, owing to evaporation. In the case of sand and cement mortar, more water is absorbed in proportion to the quantity of cement used; this, most probably, is due to the greater porosity of the mass. The same result, it will be noted, occurs in the case of cement compressed into moulds, less water being absorbed in the same period when the mass is denser in bulk; so that, in the case of fireproof floors and reinforced work, the denser the concrete, and with no more than the maximum quantity of water used to obtain a perfect gauging, the more fireproof will be the mass, and less subject to dilation through the expansion of unnecessary water. In the case of the test pieces subjected to hard frost, the process of hardening has been stayed, and, although the proportion of water used was the same as in Experiment C, yet in the same period of time 20 per cent. less of the water had gone into combination, preventing the cement from attaining its normal strength.

* Annales des Mines, 1887.

† Thonindustrie-Zeitung, 1899.

RAILWAY ORDERS.

(Continued from Page 432.)

Junction, P.Q., and the M.C.R.R. at P.C. ½ mile w. Charing Cross Station, between Lots 18 and 19, Con. 10, Raleigh, Ont.

8167 to 8171—September 23—Granting leave to the Manitoba Government Telephone System, to place its wires across the tracks of the C.N.R. and C.P.R. at various points in the Province of Manitoba.

8172—September 24—Authorizing the Corporation of the City of Toronto, Ont., to lay and thereafter maintain a section of high level intercepting sewer on the Don Esplanade, across the land and under the track of the G.T.R. in said city.

8173—September 24—Authorizing the Corporation of the town of Walkerville, Ont., to lay sewer under track of the G.T.R., Walkerville, Ont.

8174—September 25—Authorizing the C.P.R. to construct, maintain, and operate a line connecting the Pembina branch of its line with main line of the G.T.P. in the City of Winnipeg, Man.

8175—September 24—Amending Order of the Board No. 8087, dated September 15th, 1909, authorizing the Mt. McKay & Kakabeka Falls Railway to cross the track of the C.N.R. at Yonge Street, Fort William, Ont., by striking out the words " Applicant Company's " in the 3rd and 4th line of par. 3 and substitute the words " The Canadian Northern Railway Company's "; and the words " the Applicant Company's " in line 5 of said paragraph and substitute the words " the Canadian Northern Railway Company."

8176—September 24—Granting leave to the C.N.R. Company to cross with its line the tracks of the C.P.R., Wetaskiwin branch, at Camrose, Alta.