rubbish. No water must be allowed to stand in any ditch or culvert, but must be carried to its proper outlet. A patrolman's instructions should include a positive order to traverse his entire section immediately after each rain to see that all ditches and culverts are working properly, and that water is not being held back in any place; also to look through each culvert at least once a week.

Weeds on any part of the road allowance should be cut and burned before going to seed. On the earth shoulders, they may be kept far from the seed stage with a log drag, which will at the same time keep the shoulder smooth. Broken guard rails should be immediately repaired. Approaches to bridges and other embankments should be watched in order that any shifting of earth may be promptly arrested. Damage to bridges or other property on the section, repair of which does not lie within the patrolman's field, should be immediately reported to his superior officer.

For purposes of patrol work, a man with a single horse and wagon, and heating kettle, is generally employed. For social reasons it might be preferable to have two men with a wagon, and to double the length of the section patrolled. This would double the amount of work done per outfit, and reduce the cost to somewhat less than twice that of a single man. In the wagon are carried the necessary tools for the work, a quantity of stone chips for repairing the bituminous surface, and a supply of fuel for the heating kettle. The outfit can start from headquarters in the morning fully equipped with tools and materials for any repair or maintenance work which will be encountered during the day, and lost time, usually spent in going for supplies for a particular job, is eliminated. In efficiency the patrol system has already proved its worth, and the organization of such a sustem, suited in detail to local conditions, will result in better kept roads at less cost.

In conclusion, macadam roads form the greater percentage of the heavily travelled roads in this country; they represent an expenditure of millions of dollars, and it is our duty, as engineers and roadbuilders, to see that this investment is preserved to as great an extent as possible.

RAILWAY EARNINGS.

The following are the weekly railway earnings during the first three weeks of June:—

Canadian Pacific Railway.

	1916.	1915.	
June 7	$2,674,000	$1,585,000	+ $1,089,000
June 14	2,629,000	1,623,000	+ 1,006,000
June 21	2,631,000	1,619,000	+ 1,012,000

Grand Trunk Railway.

June 7	$1,107,091	$ 959,977	+ $ 148,114
June 14	1,113,418	949,313	+ 164,105
June 21	1,152,440	989,072	+ 163,368

Canadian Northern Railway.

June 7	$ 629,700	$ 409,400	+ $ 220,300
June 14	880,400	403,500	+ 476,900
June 21	744,300	413,800	+ 330,500

The Canadian Northern Railway's statement of earnings and expenses for May is as below:—

	1916.	1915.	Increase.
Gross earnings	$3,088,900	$1,721,400	+ $1,367,500
Expenses	2,361,700	1,362,800	+ 998,900
Net earnings	727,200	358,600	+ 368,600
Mileage in operation	9,039	7,271	+ 1,768

LIFE OF CONCRETE STRUCTURES.

By Bertram Blount, F.C.S.

At the International Engineering Congress held towards the end of last year in San Francisco, Mr. Bertram Blount, of Westminster, contributed a paper dealing, from the standpoint of an analytical chemist, with the probable and presumptive life of concrete structures embodying modern cements.

The chief possible causes of destruction of concrete, as stated by the author, are bad cement, bad aggregate, bad proportions, bad mixing, bad workmanship, bad design, external violence and chemical action.

With regard to this category, Mr. Blount is qualified to speak with special authority on the subject of cement, concerning which he remarks: "It may be confidently said that, given careful manufacture, rigid inspection and thorough testing to a searching specification, modern cement can be obtained free from all inherent vice, and that structures of which it forms part will not be brought to a premature end by internal treachery."

Bad aggregate is characterized as a fruitful source of trouble. The one property which is indispensable is that aggregate must be chemically stable under the conditions in which it is to be used. Therefore, in general, rocks containing pyrites should be avoided, but it would be pedantic to reject a granite or a hard limestone on the ground that specks of pyrites are present. Substances containing sulphates or sulphides, capable of oxidation under working conditions, are so dangerous that their use should not be tolerated, and the need of this restriction can be the better realized when it is remembered that 1 per cent. of SO_3, calculated on the aggregate, may mean 5 per cent. or more on the cement. Perhaps, of all the materials used as aggregates, the most dangerous is coke breeze. The danger lies in the fact that some samples contain an abundance of sulphates, and, on account of the porous nature of the breeze, these are readily extracted and do their deadly work on the cement. Aggregate may be mechanically as well as chemically bad; such obvious defects as softness, cracks, and excessive smoothness need no more than mention, but how far a "dirty" aggregate carries it our condemnation is a more difficult matter to decide. While clayey matter round the coarser lumps will prevent a proper bond, the effect of a small amount of clayey matter in the sand is not necessarily harmful. The author does not refer to the special need for scientific grading of aggregate and sand, this being a most important factor which too frequently receives inadequate attention.

Four other conditions prejudicial to the endurance of concrete, *viz.*; bad proportions, bad mixing, bad workmanship, and bad design, are matters for the engineer and the contractor rather than for the analytical chemist and are passed over with little comment by the author. All these defects can be obviated if the designer and the contractor are qualified by technical knowledge and above all, by practical experience for the performance of their respective duties.

After referring to the possible effects of wind, wave and earthquake, Mr. Blount quotes the results of laboratory tests illustrating the resistance of concrete to high temperatures, and discussing chemical action as the result of immersion in sea water, he emphasizes the need for impermeability. In fact, he says, the one indispensable condition for a long life of work exposed to the sea is the denseness and imperviousness of the concrete, and this is