Chicago to Montreal, (via Canada Atlantic), grain, per 100 lbs.	8c.	827	.21
INLAND WATER RATES.			
Duluth to Cleveland, iron ore, 80c. per ton..		875	.09
Chicago to New York, grain, via Erie Canal, 9c. per 100		1330	.15
Chicago to Montreal, grain, 12c. per 100.....		1175	.23
Duluth to Quebec, grain, 12c. per 100		1580	.17
OCEAN RATES.			
Montreal to Antwerp, grain, 1s. 3d. per qr...		1250	.044
Antwerp to Montreal, steel rails, 7s.3d. per ton		3250	.053
Montreal to Liverpool, grain, 1s. 3d. per qr...		2900	.046

The rates in the foregoing table are all important commercial examples, and cannot fail to convey to the mind of the engineer exactly what has been accomplished up-to-date. In putting forward these rates, no effort was made to search for isolated cases of unusually low rates, but rather to furnish an idea of what the regular every day freight rates actually are. To what extent these rates can be bettered by engineering improvements is the interesting point. The foregoing rates per ton per mile are not of course the average rates which apply on miscellaneous articles, but are the low long haul rates which obtain to-day in the handling of grain, coal, iron, etc., and which constitute the greatest part of our tonnage. These splendid results from an economical point of view are what you are invited to consider.

Let us analyze the details of the water carriage of iron ore from Duluth to Cleveland, Ohio. The particulars of a standard ore carrying lake steamer are as follows: Length 416 ft., keel over all 436 ft., 50 ft. beam, 28 ft. depth moulded, carrying capacity 6,500 gross tons of iron ore, consumption of coal on round trip of 875 miles, going up light and returning with ore, 180 tons, approximate value of boat, $280,000. The engines of this boat are of the vertical type with three inverted cylinders, diameter of cylinders being 22 in., 35 in. and 58 in. by 42 in. stroke, indicating 1,300-h.p., which propel the boat 11 miles per hour. Cost per day for wages about $70. This steamer can be loaded from the ore pockets in 50 minutes, and unloaded by mechanical means in six or seven hours. You will observe that this ore business is done at .09 of a cent per ton mile at present, when rates are supposed to be very remunerative. And it is a well-known fact that these vessels have made profitable returns on a 60c. rate, which is .06 of a cent per ton per mile, or in round numbers less than 1-10 of the average rate of freight per ton per mile that is earned by the railways of this continent. It may be interesting to you to know, because it confirms these figures, that the Dominion Coal Company find by their large experience in the transport of coal, of say about 1,000,000 tons per annum, from Sydney to Montreal, that the actual cost of transportation owning or chartering their own vessels is 55c. per ton for the distance of 780 miles or say about .06 of a cent per ton per mile.

The history of the competition between the Erie Canal and the railways paralleling it is most instructive in connection with this question of cost of carriage per ton per mile. The present old fashioned canal boats have a capacity of 240 tons, and the grain rate this summer from Buffalo to New York by canal was 2.6c. per bushel, or .23c. per ton per mile, and while it is a fact that the parallel roads were charging nearly four cents per bushel, or say .35c. per ton per mile for the same haul, the canal is now more or less out of business, and many of the boats laid up. This state of affairs has been brought about by the railways, which on more than one occasion during the last few years, made a cut on the grain rate from Buffalo to New York, to 2.5c. per bushel, which so disturbed the canal traffic as to leave the railways the masters of the situation. The tax-payers of the State of New York have now decided to spend $110,000,000 in enlarging the Erie Canal, giving it a depth of 12 ft. so that 1,000-ton barges can be used, and the rates reduced to .06 of a cent per ton per mile, or less than ¾ of a cent per bushel, Buffalo to New York. The New York State Canal Committee, after a careful enquiry into this matter, reported that there was no probability of the railways ever being able to carry freight at .1 of a cent per ton per mile, which would be a guarantee of the continued and uninterrupted value and usefulness of the canal to the State. I think you will agree that the estimate these commissioners made was a pretty safe one, and that the figures have a most important significance with reference to the whole question of the relative cost of land and water transportation.

The exhibit given in the table of rates on the Atlantic shows still lower rates per ton per mile, but it is generally conceded by shipping men that these rates are more or less unprofitable and are about rock bottom. While shipping men are not holding out hopes of any substantial reduction in rates in the near future, railway men on the other hand appear to be alive to the possibility of further economies.

The present comparatively low railway freight rates have come from many causes, larger locomotives, larger cars, and the practice of making up train loads to the full capacity of each locomotive, and also to that most important work of improving the grades and curvature. This last question is one to which all railway officers are now fully aroused. It is with them the most important question of the hour. Nearly every railway company in good standing financially is making marked progress in this respect. The railway president of to-day, who has mapped out a plan of improvement for his road that will result in a reduction of controlling grades of say from one per cent. to four-tenths of one per cent., has, so to speak, a "level head." Such a change will reduce the cost of hauling freight per ton per mile very largely, and he will be able to give to the community served by his road lower rates, and at the same time place the railway in a better position to give its shareholders fair returns on their investments.

A very brief examination of the subject of engine loads upon varying gradients affords the most convincing proof of the value of easy grades. A. M. Wellington, in his work on the economic theory of railway location, gives the following figures to show what is a working load of a locomotive upon various grades. For instance he sets forth in his tables that an 18 by 24 freight engine could haul the following load of net tons on varying grades as under:

Load Rating for 18-in. by 24-in. Locomotive, in Net Tons, Including Weight of Cars.

Incline of Grade.	Total load in net tons, Mr. Wellington's Table. Tons.	Total load in net tons, C.P.R. Ratings. Tons.
Level	2,183	
1/10 of 1 per cent.....	1,733	1,500
2/10 " 1 "	1,433	1,400
3/10 " 1 "	1,219	1,300
4/10 " 1 "	1,058	1,200
5/10 " 1 "	933	1,100
6/10 " 1 "	883	1,000
7/10 " 1 "	751	900
8/10 " 1 "	682	800
9/10 " 1 "	625	700
One per cent.	578	607

I have examined the working ratings and loads for locomotives, as adopted by the Canadian Pacific Railway, after they had arrived at the same by making an exhaustive investigation of the subject by aid of a dynamo-meter car, and find that they work out approximately as shown. This is an interesting and satisfactory comparison.

In explanation of the discrepancies in the above table, it must be remembered that a level piece of road free from the complications of curvature is very rare, and Mr. Wellington's figures giving the load for a level piece of road as 2,183 tons were no doubt arrived at after making a test on an ideal piece of level tangent which is hard to find in actual practice. The question also of speed has to be considered very carefully in making a comparison of this nature.

With regard to possible further reductions in rail rates in the future, I have analyzed the results of some of the most economically operated railroads on this continent, as shown in Poor's Manual. The public of this country are paying on an average, as before stated, about .70 of a cent per ton per mile for their freight rates by rail, but at the same time a large amount of mineral and grain traffic is handled, as