of .046 per ton per mile. In a word, any analysis of freight rates on the inland waters of Canada would be misleading which failed to recognize, and to separate for special treatment, this overwhelming movement of ore and coal under the conditions indicated.

Special care was taken during the year to ascertain with accuracy the rates which were charged on waterborne wheat. The facts in that regard were carefully tabulated. They yielded the following results:—

Fort William to Buffalo, per ton per mile, .103 cent; per bushel, 2.863 cent.

Fort William to Georgian Bay, per ton per mile, .163 cent; per bushel, 2.629 cent.

Fort William to other Canadian ports, per ton per mile, .115 cent; per bushel, 2.384 cent.

Fort William to Montreal, per ton mile, .160 cent; per bushel, 5.774 cent.

The lowest rate prevailed in May, and the highest in December.

There was not any wheat actually brought down from Fort William to Montreal in December; and the rates are for November. The largest volume of wheat moved between Fort William and Montreal occurred in October, when the average rates were .184 per ton mile and 6.149 cents per bushel. For the same month the rates from Fort William to Buffalo were .084 per ton per mile, and 2.259 cents per bushel. The maximum rate of the season between Fort William and Montreal was in effect in November, and was 8 cents per bushel.

To measure the conditions which influenced the movement of Canadian wheat to Montreal or Buffalo, it is necessary to know the freight rate on wheat from Buffalo to the Atlantic seaboard during 1912. It was officially ascertained from the Buffalo chamber of commerce, under date of 14th February, 1913, that these rates per bushel were: May to end of September, on lake wheat for export, 4⅛ cents; in October 5⅛ cents; after fifteenth November, six cents.

Thus, the all water rate from Fort William to Montreal in May was 5.444 cents per bushel, and the combined water and rail rate from Fort William to the American seaboard (say New York) was 7.219 cents. In November, the water rate from Fort William to Montreal was 7.129 cents per bushel, and the combined water and rail rate from Fort William to the United States seaboard, via Buffalo, was 8.616 cents. The apparent difference in favor of Montreal was 1.765 cents per bushel in May, and 1.487 cents in November, so far as the rates of freight were concerned.

There remains to be presented the facts with respect to traffic by way of Fort William and Georgian Bay ports. The average rate for the season was 2.629 cents per bushel. It was officially ascertained that the rail rates from Georgian Bay to Montreal were as follows:—

	Per Bushel.
Canadian Pacific Railway	6 cents.
Grand Trunk Railway, January 1st to June 30th	5 cents.
Grand Trunk Railway, July 1st to September 30th	4 cents.
Grand Trunk Railway, October 1st to December 31st	5 cents.

Speaking broadly, it might be assumed that the combined water and rail rate is adjusted to practically equal the all-water rate.

Among the causes which operate to divert a large percentage of Canadian wheat from Canadian to United States channels despite the lower transportation cost are:—The availability of ocean tonnage at New York, the consideration of time in making delivery at foreign ports, and the rates of marine insurance. It is obvious that these causes must have continued to operate effectively in 1912.

The question is frequently, and quite naturally, asked: How do freight rates by water compare with freight rates by rail? This question will never be fully and satisfactorily answered until carriers by water are required to report in precisely the way railways are asked to do.

This year, for the first time, accurate information has been obtained with regard to the average rate per ton per mile on the waterborne traffic of the Great Lakes. That rate, so far as Canadian business was concerned, was found to be .194 cent. It is pointed out, however, that this rate does not take cognizance of the special conditions under which traffic on the inland waters of Canada is conducted, and that the contribution of government should be taken into the reckoning. There is pertinency in such a contention. It would seem, at all events, to be proper to include the interest charge on the capital cost of the canals and the annual outlay by government for up-keep. The facts in that regard are definitely known. This plan omits all expenditures for harbors, lighthouses, dredging, buoying, etc., which might be included; but, whether they should be included or not, the matter is ruled out for the time being by reason of the fact that the sum of such expenditures is not definitely known.

HARDENING ARMOR PLATE BY WELDING.

Sheffield steel experts are awaiting with considerable interest further information concerning tests, which, it is stated, have been applied with some success to armor plates manufactured by a new process which, the inventor claims, renders them capable of resisting projectiles of the highest power.

The inventor is William Henry Worrall, of Sheffield. He states that the new armor plate does not at all rely upon any new ingredient for its increased resisting power, but that this is obtained as the result of a different process of hardening, largely secured by the welding or bonding of four or six sheets of metal into one plate, instead of molding the plate as a whole in one ingot. The main object is to effect a thorough homogeneous hardness. This, it is said, will permit of ironclads being as efficiently protected with much thinner and lighter plates than is at present the case.

Several experts express some doubt as to whether the welding of a number of plates contributes to greater homogeneity. They all agree that experiments conducted on somewhat similar lines have not hitherto been attended with success. Dr. J. O. Arnold, F.R.S., professor of metallurgy at Sheffield University, said:

"Practical experience in armor plate manufacture is that you must have the face sufficiently hard and with sufficient depth of hardness to smash up a shell. No reliable estimate can be formed of the value of a plate until it has been drastically tested by the admiralty, under standard conditions. So far as I know there is only one plate of this so-called bonded process of manufacture which has been so tested, and that was a failure. There is a new system of manufacturing armor plates, at present in the experimental stage, which consists of welding a face of high-speed steel on to the relative soft backing of the plate. This has been done with some measure of success, but the ultimate value of the plate can only be determined by an admiralty test. I see it is claimed that Mr. Worrall's plate has withstood a fourteen-inch shell. If that is so, it must have been an admiralty test, because I do not think any private firms are equipped with such a gun.