and called a first location. These plans and profiles were plotted in the field, and tracings, with reports, sent to headquarters monthly. These reports were carefully gone over by the chief and assistant chief engineers, necessary changes suggested, and instructions issued accordingly. Whenever the head of a party completed what he considered the best possible first location, the engineer in charge was changed and another man given a chance to improve the line by making his best attempt at a revised location. The original head of a party, or a third man, was given a chance to still further revise for a final location. In this way it was found that a healthy rivalry was established and good results obtained. Revision of location is, however, never considered as finished until construction work is well under way; and it is often found, after the line is cleared, that slight changes will effect a very considerable saving. An equation table giving definite values for savings in distance, curvature, rise and fall, etc., was furnished all parties in the field, so that when the estimated cost of construction of any two or more lines was had, the better one to adopt from all points of view could be at once determined.

Maximum Curves.—The maximum curve used is 6° (Rad. 955 ft.) and is only used sparingly where the topographical conditions prohibit an easier radius with reasonable cost. All curves of 1° (Rad. 5,730 ft.) and sharper are connected to their tangents with easy spirals.

The maximum grades decided upon are, so far as the writer is aware, the easiest on any transcontinental line in America, being on tangents of 0.4% = 21.1 feet per mile adverse to the major or eastbound traffic, and 0.6% = 31.68 feet per mile against the comparatively minor westbound traffic. These maximum grades are used sparingly and only for the purpose of avoiding heavy work. On curves, the grades are reduced 0.04 ft. per degree in the index of the curve, so that, on the maximum curve of 6°, the maximum eastbound grade would be 0.4 minus 6 × 0.04 = 0.16% or 8.44 ft. per mile.

All curves of 1° and over are spiralled at both ends. Vertical curves are used at all intersections of grades. The width of embankments at sub-grade is 16 ft. for banks 16 ft. or less in height; the width of embankments for greater heights, 18 ft. Earth excavations are 22 ft. wide at sub-grade; rock excavations, 20 ft. wide at sub-grade. Slopes of earth embankments are 1½ to 1; rock, 1 to 1. Slopes of excavations are: earth, 1½ to 1; loose rock, 1 to 1; solid rock, ¼ to 1. The depth of ballast is 18 in. between rail base and sub-grade, or 11 in. below the under side of tie 7 in. thick.

The whole line between Moncton and Winnipeg, with the slight exception of short approaches to the Quebec Bridge on 1% grades, was definitely located with the above-mentioned very easy maximum grade; but at one point in New Brunswick, at mileage 146 from Moncton, it was found that, by the insertion of about 12½ miles of 1.1% grade adverse to eastbound traffic, a saving would be made of 17.2 miles in distance, nearly two million dollars in construction, and one and a quarter million dollars in capitalized operating value.

At another point in Quebec, near mileage 286 from Moncton, a similar grade about 10 miles long adverse to westbound traffic was found to effect a saving of 18.8 miles in distance, about half a million in construction, and over three-quarters of a million dollars in capitalized operating value. These possible temporary grades were adopted with the corresponding saving in distance and cost. If the future traffic of the road justifies the expense, these two short lengths of standard grade can be built at any time.

The proviso for directness of alignment proved a very wise precaution; as, in the Province of New Brunswick especially, the people inhabiting the fertile, well settled St. John River Valley very naturally desired to secure the advantage which would accrue to their section of country by the construction of a transcontinental railway. The fact that this would unnecessarily lengthen the line by 29 miles, a most important factor on a through route, did not appeal to them as strongly as to the inhabitants of the more western provinces anxious to secure the best possible outlets for the rapidly increasing volume of freight from the great wheat field of the west. Fortunately, our engineers were able to prove that the direct line would not only be much shorter and effect a great saving in operation, but also that the total cost of construction would be very considerably less. An additional factor in favor of the direct line was the opening up of new territory not hitherto possessing railway facilities; whereas, the St. John Valley is already served by the Canadian Pacific, and to some extent by the Intercolonial Railway.

The surveys being well advanced for some distance east of Winnipeg and west of Quebec, tenders were called, closing on the 12th March, 1906, for 150 miles of line from the north side of the St. Lawrence at Cap Rouge, westward, and for a steel viaduct 3,000 ft. long, 150 ft. high, across the Cap Rouge Valley; also for 245 miles from near Winnipeg to Peninsula Crossing, near the proposed junction with the Fort William branch of the Grand Trunk Pacific Railway. This branch line had been under construction for some time; and the intention was, as soon as it and the portion of the main line between the junction and Winnipeg were completed, to start operating between Fort William, Winnipeg and the west, thus giving another outlet to the Great Lakes from the western wheat fields.

The summer of 1906 was a busy one in railroad construction all over the continent of North America, the result being that good men were almost impossible to obtain, so that progress was not as fast as was anticipated on the two first main contracts let. The financial depression in 1907 proved, in some ways, a blessing in disguise to railway contractors; as only roads which were strong financially were able to proceed with any new construction; also, men were more plentiful. From time to time as the final location was completed on different sections, new contracts were let until, on October 29, 1908, the last contracts were let on Districts "D" and "E". In the summer of 1908, 21,000 men were at work on the various contracts between Moncton and Winnipeg.

The originally estimated distance of 1,900 miles between these points had been reduced gradually by repeated revisions of location at various points to a distance of 1,804.8 miles. This distance is 261 miles less than the shortest distance over any other combined railway between Moncton and Winnipeg. The distance between Winnipeg and Quebec City over the Transcontinental Railway, will be 1,351 miles, which is 215 miles shorter than the shortest existing line, and the grades are so much more favorable that engines of equal capacity could haul nearly twice the load on the former line than they could on the latter.

Transportation of grain by water has always been much cheaper than by rail, but the latter has been slowly and surely cheapening until at the present time, when the easy gradients and tremendously powerful locomotives of modern lines will make a combination of land difficult to excel, or peradventure, to equal on water.

The distance from Winnipeg to Quebec, via rail to Fort William, and lake, canal and St. Lawrence River to