water, being prevented from freezing by the injection of steam. Fig. 4 and 5 show work at this pier. A cofferdam of sand bags at the Mattagami was used, with indifferent success.

When possible, long spans were used to avoid foundations in midstream where clay was encountered in the river bed. For shore foundation pits, round logs were generally used to prevent caving in, as sawn lumber was expensive or unprocurable where such pits were dug ahead of the steel. Trestles of unsquared timber were erected at most of the openings where a bridge or culvert was required. They were constructed of the largest timber in the vicinity, irrespective of variety, even cottonwood being used. For the longer stringers, however, British Columbia fir was imported. These trestles were of the most temporary character, and in a few cases failed to withstand the impact of outgoing ice during the spring freshets. They served, however, to push the track ahead, so that steel and cement could be brought in for the permanent structures.

Concrete was almost universally employed for substructures. This was partly owing to the absence of a good quarrying stone, but more largely to the scarcity of skilled stone cutters and masons.

There will be about 240 steel bridges and viaducts, or a total length of 11 miles, and aggregating 61,000 tons. Of this amount, 52,000 tons have been erected or are under construction, leaving about 9,000 tons to be let. The greater part of this will be erected in 1912 and the balance in 1913. The maximum single span is 300 ft., and the Winnipeg River bridge, is an example of these 300 ft. truss spans. Steel viaducts are built with 40 ft. towers and 60 ft. intermediate spans. The viaduct over the Mistongo River (Abitibi region), is typical of these structures. All bridges are designed according to Dominion government specifications; engine loading, class "heavy," weight 180 tons, 49,400 lb. on each pair of drivers. Plate girder spans, both through and deck, are used up to a length of 100 ft. Bridge lettings are generally given early in the year and cover the required erection for the same year, depending on the concrete being completed and track reaching the bridge site. Upon these conditions the time of completion depends. For transportation, construction rates are given bridge companies over lines under construction, on a ton-mile basis. Bridge companies are furnished with drawings and weights of steel, so all can bid under the same conditions. All steel contracts are for a pound price erected, and a unit price for timber in floor.

TRACK AND TRACKLAYING.

The track is laid with 80 lb. rails of Am. Soc. C.E. section, 33 ft. long, with four bolt angle-bar joints. There are 3,000 ties per mile, 18 ties per rail on tangents and 20 on curves. By far the greater part of the ties cut for the line are of jack-pine; tamarack, hemlock, cedar and spruce are used in lesser quantities. Both single and double boom "pioneer cars" were used in tracklaying work. Tracklaying was sometimes carried on throughout the winter, the snow being in some cases shovelled or ploughed off the grade, or simply tramped down sufficiently not to impede the "tie-buckers." Finally snow packed about the ties was found to make a much firmer and more even skeleton track than that laid in the summer, but when this melted, a lot of repairing and shimming was required to render the line safe for material and surfacing trains.

Throughout Jan., 1912, tracklaying was continued west of the Nagagami River at the rate of one-third mile per day, with the thermometer often 40° below zero, and seldom above 5° below. Under favorable conditions, two miles of track a day was often laid for short periods, but temporary interruptions usually brought the average down below one mile a day.

TELEGRAPH.

The telegraph line is being built at the same time as the railway. It provides for an ultimate capacity of 12 wires, although only two wires are now being erected.

PROGRESS AND DELAYS.

It was hoped the entire railway would be completed in six years. Progress, however, on that portion to which access could be had only from either end, was continually interrupted by delay in getting out some large cut, failure of a temporary structure, development of sink holes, or other unforeseen cause. Throughout part of northern Ontario and Quebec, no supplies could be moved except in winter, by reason of the extensive prevalence of clay and muskegs, over which horses could not travel. In other localities, such as those served by Lakes Nipigon, Sturgeon and, to a less extent, Abitibi, contractors were dependent for transport on the season of open navigation. Frequently it was essential to have supplies conveyed part way by steamer and part by winter road.

Failure to foresee and make provision for what should be required months, or even a year ahead, meant serious loss. Uncertainty regarding the duration of the seasons had to be allowed for also. In 1907 there was a 2 ft. depth of snow in the Kenogami district on June 1, and the ice in Lake Nipigon did not break up until June 16; whereas on another occasion snow had disappeared from long stretches of the tote roads (running east from Cochrane and Matheson) before the end of March. Navigation could not generally be relied on after about Oct. 20 on many of the waterways traversed. Toward the close of one of the busiest seasons on Lake Nipigon, both steamboats operating on this route went aground within a fortnight of each other, in consequence of which large quantities of essential supplies were not delivered until late in the winter. During the excessively dry summers of 1909 and 1910, disastrous forest fires swept over the country. These did enormous damage along the line north of the height of land, burning up contractors' camps, warehouses and plant, and putting a stop to the work in many localities.

Scarcity of labor, and time lost in replacing men who quit, was an ever present cause of delay. By far the greater part of the grading was sublet to "station men," who frequently "jumped" if they found themselves going behind with their work. Prices, however, were high, and in most cases, covered the extra cost of pushing the work in the face of unfavorable conditions.

The undertaking has now progressed to such a point that it is reasonably certain trains will be running across the whole eastern division sometime in 1914. The track is already laid 355 miles eastward from Winnipeg and 750 miles westward from Moncton, except for a short distance in southern Quebec, and the yet unbridged St. Lawrence.

Another stretch of track extends east and west of Cochrane, covering 330 miles of the clay belt. This leaves a gap of 150 miles in northern Quebec and another of 240 miles in northern Ontario. Across the former, contractors were putting in supplies last winter, but except for the most easterly 10 miles, which is partly constructed, no grading has yet been done. Throughout the latter, however, only a small amount of excavation and some temporary trestles remain to be completed, on which work is being rushed, so as not to delay the "pioneers" of the tracklaying gangs working from either end. These are expected to meet not later than the end of the present year, giving through connection by way of the T. & N. O. Ry. between the cities of eastern Canada and the wheat fields of the West.

Across New Brunswick, east and west of Quebec city, for about 100 miles out of Cochrane, and between Winnipeg and Superior Junction, train filling, surfacing and ballasting are finished steel bridges are in place; water tanks, stations and section houses built, or under construction; telegraph line strung, and the line practically ready for operation. Division yards are located at an average of 120 miles apart, and the grading and the work on engine houses and other necessary structures for these are well advanced, at all except three of the yards. Sidings are provided about seven miles apart, with a water tank at every third siding.

While the whole country west of the settled part of Quebec was a wilderness six years ago, thriving towns have since grown up at La Tuque, Cochrane, Hearst and Graham. All of these are actual or prospective junction points with other railways and all in the midst of vast pulp-producing forests. La Tuque has the enormous undeveloped water powers of the St. Maurice River behind it, and Cochrane and Hearst are destined to be the market towns for the future farms of the clay belt.

PROGRESS REPORTS ON CONSTRUCTION.

In order to keep check on the rate of progress of the work D. MacPherson, the Assistant to the Chairman introduced percentage forms of reports, being modifications and extensions of somewhat similar forms in use on the C.P.R. The form shown in fig. 3 is returned monthly to the Assistant to the Chairman by the division engineers, through the district engineers, and it is then graphically plotted on a diagram, a portion of which is shown in fig. 4. This shows not only the percentage done during the month on grading, ballasting, and all other items of construction, but also shows the percentage done to date under each of these headings and the percentage done of the whole work in each main contract. This form of report has been found invaluable as an aid in answering requests for information from the government and for compiling the annual reports.

THE COMMISSIONERS OF THE TRANSCONTINENTAL RAILWAY.

Contract No..... District..... Contractor.....

Percentage Report of Work Done, Month Ending ....., 191....

Division No..... from Mile..... to Mile.....

Class of work.	Percentage done in month.	Percentage done to date.	Cost of work done during month	Cost of work done to date.	Approximate estimate of total cost of work.	Brief description of work done.
Grading						
Tracklaying						

Fig. 3. Headings of Monthly Progress Report.

The form of progress report on construction is a sheet 14 in. wide and 17 in. high, divided into seven vertical columns, with headings as follows: 1, class of work; 2, percentage done in month; 3, percentage done to date; 4, cost of work done during month; 5, cost of work done to date; 6, approximate estimate of total