To test the accuracy of the stadia levels, a run of regular levels were made on the first portion of the line, a profile of which is given. It was found that the variations between the stadia calculations and the level were very little when the stadia observations were calculated by the regular methods.

This surveying with stadia means much work in camp in reducing and calculating the sights, but in a country where there is not much bush it is a rapid and satisfactory method. The regular party can be divided into two stadia parties for running the preliminary line. For exploration lines in new country it is an excellent method. The map-plans and profiles well illustrates the methods employed.

Station	Def. Angle	Bearing of Tangent	Points taken	Azimuths	Distance (Stadia reading)	Distance corrected	Vertical Angles	Compt. Diff. of Elevations	Elevations	Remarks
1	31°30	N.E. 31.30		31°30	.71	65	—14.55	—17.7	17.7	Mean Sea Level
2		S.W. 31.30	Tan	211°30	3.20	319	+2.15	+125	30.2	
			Tan	31°30	3.06	305	+2.30	+13.	43.2	
			Tan	211°30	2.70	269	2.05	+9.8	53.0	
			Left	142.	1.13	109	+2.15	+4.3	47.5	
3			Right	312.30	1.10	109	+1.10	+2.2	45.4	
			Tan	31.30	2.30	229	—.50	—3.3	56.8	
			Left	97.	1.82	181	+1.10	3.6	59.9	
			Right	291.	.83	82	+30	.8	57.1	
			Right	328.	1.10	109	+1.00	+1.18	58.1	
4	46°30′	S.E. 15.	Tan	165.	2.70	368	+2.05	+9.7	66.2	
			Tan	345.	3.03	302	—.45	—4.	70.	

One locating engineer, in particular, on the National Transcontinental Railway, several years ago, when the writer was working on the line, employed the stadia for most of his preliminary lines, and for all of his exploration lines. He divided his party into two units, one in charge of the transitman and the other in charge of the leveller. As a stadia party only requires about one-half the number of men to carry on the work satisfactorily that a transit party needs, he was in this way enabled to cover twice the area of ground than if he employed the transit alone.

At that time, in the wilds of Northwestern Ontario nothing comparatively was known of the country north of the Canadian Pacific Railway. There was no map of that wide range of country from Winnipeg east to Lake Nipigon. The country around Lake Nipigon was partly mapped. East of Lake Nipigon to Lake Abitibi was little known nor further east. The railway explorers sent in by the Grand Trunk Pacific in 1904-05-06, entered a dense wilderness, and were under great disadvantages. On entering this wilderness these hardy engineers were like a ship in mid-ocean without beacon, buoys or landmarks, and like the sailors on board ship, were forced to take astronomical observations for latitude, longitude and azimuth to find their bearings and make a start mapping the country by means of exploratory surveys. It was on these surveys that the value of the stadia was first prominently brought into play in Canadian railway surveying. The country west of Lake Nipigon was covered by lakes large and small. One could scarcely go a mile without striking a small lake. The larger lakes had to be traversed in order to map it. Here the stadia was used entirely. Very rapid work in the traversing of lakes was accomplished with the stadia. In this way was the country mapped and made possible for the final location.

WATER WASTE INVESTIGATION.

Water waste in our Canadian cities is a familiar subject, but we have not heard so much about waste in the smaller towns. W. D. Gerber, consulting engineer, of Chicago, presented a paper on this subject before the Illinois Water Supply Association, an abstract of which we publish herewith.

The curtailment of water waste is particularly desirable in places which secure their water supplies from deep or artesian wells. The continual draft on the wells has lowered the ground water level to such an extent that serious problems are presented in getting the water to the surface. With a less severe demand on such wells we may reasonably expect their life to be materially lengthened.

Those towns which draw their supply from rivers or other surface waters must, of course, treat such water to render it suitable for domestic purposes. These treatment plants, besides the treatment tanks and filters, usually have connected therewith large clear water reservoirs for the storage of a considerable quantity of the treated water. The capacity of the treatment plant, including the reservoir, is usually designed upon the consumption, and the consumption is usually taken as a factor of the total daily displacement of the pump plungers. If a large percentage of the pumpage is waste, we can readily see that the works will be designed too large for the immediate needs of the community, and with a consequent expenditure of funds that in many cities can be ill afforded.

In the design, then, of new equipment, and, subsequently, if the station is to be operated on an efficient and economical basis, and the supply conserved, all unnecessary pumping should be eliminated.

The causes of this unnecessary pumping or water waste can usually be grouped under five heads: Pump slip, underground leakage, defective plumbing, carelessness, or wilful waste and surreptitious connections.

With pumps of the direct acting or non-flywheel type, there is frequent complaint that the pumps pound, and several arrangements have been supplied to produce more of a cushion at the end of the stroke. This cushioning has the effect of shortening the stroke and, of course, thus reducing the volume of pumpage. The pump counter, however, goes on counting the number of revolutions, and the daily report card shows so many revolutions at full capacity as the volume of water pumped.

Pump slip is not, properly speaking, a water waste, but is rather a waste of pumping effort, and should be kept as low as is practical. Just where this practical limit is we do not know exactly, but undoubtedly the same limit would not apply to all cities or to all types of pumps. About all we can say is that the practical limit is the point where the value of the water gained through close-fitting plunger and valves would be less than the value of the additional power required to overcome the added friction due to the tight packing. However, an allowable slip of 3 to 5 per cent. does not seem to be out of line with good operation and practice.

The detection of underground leakage is a very different matter than that of discovering and measuring pump slip. The distribution mains are covered up and we can only guess at what has taken place by a detail study of the pumping chart. The demand or consumption for a few hours after midnight, say, from 12 to 4 o'clock, is frequently indicative of the tightness of the system. At this time of the day the consumption is, or should be, at its minimum, while if the relative demand is high it is an indication that something is wrong.

There is always some leakage from the mains that cannot be checked, and it is usual to allow a loss of 2,000 gals.