Example (selected integers 2 and 9)

Distance 150 feet ÷ 2 = 75
Distance 150 feet ÷ 9 = 16⅔ } Gradient pair.

Difference 7 giving subtense 7 feet.

The gradient pair is 75 and 16⅔; set up and send out rodman in direction of required line; move index to 75 on gradient limb and take reading which assume to be 10.42 feet, unclamp and set index at 16⅔ and take second reading, which should be 3.42 feet, if the rod is exactly 150 feet from instrument; but as this is most important in ordinary work, it will be found necessary to move the rodman nearer or further until the subtense representing distance required is read on rod. Where distance to be set out is a constant one, a table of subtenses, with integers and resultant gradient pairs, can be easily prepared beforehand. The greater the subtense the more accurate the setting out will be.

Regarding the accuracy of telemeter levels, the writer's experience is that the checking in is not usually so close as with an ordinary level, but that there is a certain amount of give and take, which limits the difference to within 1 foot in any distance of consequence, such as 75 to 100 miles. The rodman is a most important factor in obtaining satisfactory results, and should be selected with careful judgment. A rod-level should always be attached to the rod in the field, as a truly vertical position at right angles to the line of sight is absolutely necessary, or, in other words, a plumb-line suspended at the side of rod should strike the centre from top to bottom. This rule, however, does not apply to the face of rod, which must always be slanted over either to the right or left, so that the vertical hair in diaphragm will intersect the centre of rod-face throughout its length. The reason for that is, that when the telescope is tilted up or down, by being moved around the gradient limb to the pair numbers selected, the diaphragm (in common with the telescope) leans over to one side or the other, so that the cross-hairs are only truly vertical and horizontal respectively when the index is at zero on the gradient limb, and the instrument leveled up.

A valuable property of the telemeter not generally known is, that distance can always be measured by using any pair, whether the instrument has been levelled up at zero or not. For example, assume a 16-foot rod to be 1,000 feet from the instrument and a level reading of 8 feet is obtained as foresight. The instrument man cannot get the distance (by tilting either up or down) at the corresponding pair number of 100, for in the first case he strikes 2 feet above the top, and in the alternative case 2 feet below the foot of rod. However, after booking his level reading, he can depress or raise the line of sight by using the levelling screws, and then, having the whole rod to work upon, can obtain the distance by moving index to the pair number. Gradient pairs which do not include a level (or zero) reading can also be calculated from by this method, but the result will only be approximate, and such readings should only be used for intermediate sights.

The telemeter gives very satisfactory results in the strongest winds, and will stand a good deal of travelling in rigs, extremes of temperature, etc., without getting out of adjustment. It is not designed for particularly accurate work in cities, etc., but for preliminary and even final location, contour work and exploration, it is a very decided success.

CHICOUTIMI.

Its New Dam—Its Waterworks and Electric Light—Its Pulp Works—Its City Improvements.

BY CHAS. BAILLAIRGE, C.E., QUEBEC.

On the occasion of my second visit to Chicoutimi, at the request of the municipal council, to report on its waterworks, etc., a few words, now that these works are more advanced, will not be uninstructive to readers of The Canadian Engineer. I had about two years ago to describe to you—with a diagram of the occurrence—how the destruction of the Chicoutimi dam was brought about, by the pressure of the water impounded causing a tiny leakage around the foot of the dam at its western end, which then abutted against a cliff of clayey and sandy material, while the eastern end thereof closed in upon a solid promontory of rock. This tiny leakage was not long, however, in wearing away a passage for itself, increasing soon to the dimensions of a drain, then to those of a sewer, a culvert, and soon to the size of a veritable tunnel, the roof of which fell in, when 100 feet in width of the cliff, several hundred feet of it in length, and its height 60 to 70 feet, was in a very few hours washed away—some 300,000 cubic yards of it—into the Chicoutimi river (the outlet of great lake Kinogami), and thence into the Saguenay of which the waters were rendered undrinkable for a whole week after the occurrence.

The dam has now been rebuilt with sluice gates as before to let off the freshets as required, while the 100 ft. extension of it westward to meet the new line of cliff, has been constructed as a core-wall, some 4 ft. thick at top, 7 to 8 ft. at base, and over 30 ft. in height, of hydraulic cement, rubble or mosaic work; and this core is now flanked on each side by earthwork to a slope of 1½ or 2 to 1; while on the up-stream side the foot of the embankment is protected by heavy stone-filled crib-work, extending up stream so far as to preclude all danger of future rupture; or substantially on the lines prediated by the writer in his description of the occurrence at the time.

The total length of the dam is say 300 feet—head above Racine street, level 270 feet, or more than 300 feet above the waters of the Saguenay river. The depth of the water impounded is 30 feet; the penstock, 13 ft. in diameter, with inlet splayed to 14-ft., and mouth of recess thereof, in dam wall, extended with flanks or sides further splayed to a size of say 20 ft.; while the shutting off of the water from the penstock, as may be required, is to be accomplished by the closing of three sluice gates, working vertically in frames of the stoutest timbering, lined with steel rubbing surfaces.

The general features of the power plant have been designed by Wallace C. Johnson, of Montreal, a member of our Canadian Society of Civil Engineers, and a Mr. DeGeer, a Swede, is on the ground as resident engineer, charged with seeing that Mr. Johnson's ideas are faithfully interpreted and carefully carried out.

The penstock, which, as already stated, is not less than 13 feet in diameter, is 800 ft. in length, and while starting at the fountain head, where the pressure is that due to a height of 17 ft. of water over roof of flume, with a thickness of steel plate of but ¼ to 5-16 of an inch, increases with the pressure of a fall of some 70 ft. towards the power house, to nearly an inch in thickness, where it enters it. It is built in rings, in sections of four sheets, each of some 10 ft. by 5 or 6 ft., the whole thoroughly double riveted. This tube is a splendid piece of work, prepared ready for putting together in Pittsburg, whence it has been sent with a Mr. McDermot, of that city, to superintend its erection on the premises, and a Mr. Wilson in charge of the aerial or cable railway erected by that gentleman to move the sections to destination, and save the expense and delay of transportation over the very rough and rocky bottom of the locality. Throughout the 800 feet between the dam and power house, this gigantic tube or water tunnel is supported at 10 ft centres on stone pedestals or pillar blocks of substantial build, with iron cradles to each, shaped to curve of tube, and each of a length of about 10 ft. or one-quarter the circumference of pipe. Nor need this be wondered at, when we find on calculation that each foot in length of such a conduit, with its contained water, comes to close upon 9,000 pounds, while its total length reaches three and a half million pounds or 3,529 tons.

Emile Cote, of Quebec, is contractor for all the masonry, including dam, power house and pulp mills, while Berlinguet and Lemay have been entrusted with the architectural features of the installation. Mr. Winsler, a Norwegian engineer, is the designer of the pulp work machinery, and will be retained by the company as managing engineer of the power works and pulp mills.

There are two mills: the first or smaller built some few years ago on the opposite side of the Chicoutimi river, and