

APPENDIX III.—SECONDARY TRIANGULATION.

MEASUREMENT OF THE MATAMATA BASE-LINE, AUCKLAND DISTRICT.

[By J. LANGMUIR, Inspector of Surveys.]

Geographical Position of Base.—The north end is in latitude $37^{\circ} 46'$ S. and longitude $175^{\circ} 45'$ E. (approximately). The line selected starts from the new trigonometrical station, Waharoa, situated about half a mile west of the township and railway-station of the same name, on the Auckland to Rotorua Railway. Running on a bearing of about $163^{\circ} 50'$, it passes through the Matamata Settlement, which at the time of the measurement was mostly in English grass or under crop. As the country was fairly closely subdivided, sixty-four fences and hedges had to be crossed four times during the course of the measurements. The southern terminal is the new trigonometrical station, Manga-where, on Section 16, Mangawhero Settlement.

Thanks are due to all the settlers through whose farms the line runs for the assistance given by freely consenting to the line being taken through, though in several instances it involved the damage incident to passing through standing crops. Messrs. Johnston, of Waharoa, and Wilson, of Manga-where, were especially considerate in allowing the erection, without question, of the terminal marks and signals on their respective properties.

Selection of Base.—This base was provisionally selected by Mr. R. T. Goulding, who, working under my direction, examined all the country from Frankton Junction to Morrinsville, across to Waihou, and up the Thames Valley to Matamata. This examination included the positions recommended by the late Mr. Cussen, "along the railway from Hamilton to Morrinsville, and from Ruakura Junction eastwards." On both of these proposed sites there is far too much swamp land to allow of proper measurements being made. Owing to curvature and the configuration of the ground along the line I had some trouble in finally deciding on the position to be adopted, as from either end only a portion of the 27-ft. signals, as now erected, at the other end can be seen under the best conditions. From the top of the 7-ft.-high concrete mound at the southern end perhaps five-eighths of the signal at the northern end can be seen in the early mornings for from one to two hours after daybreak. From the ground at the northern end about one-third of the signal at the southern end can be seen during the same early hours, disappearing altogether before 8 a.m., as refraction lessens and the air becomes unsteady owing to the rising heat. The position of the line and the height of the necessary mound at the south end were finally decided upon after experimenting with sun-flashes from a point about 15 ft. above the ground at the northern end, viewed from a temporary staging 9 ft. high at the southern end.

MARKING.

The terminal marks at the northern end of the base are the same as those depicted in Fig. 5 of the report on the measurement of the Wairarapa base. For a representation of the marks at the southern end see Fig. 3 of this report. Signals of a height of 27 ft. from the ground to the tops of the finials were erected in totara timber at both ends. The principal ranging of the line was done with an 8-in. transit theodolite, great care being taken when fixing the positions of the intermediate marks, of which those numbered II, III, IV, V, VI, and VIII are galvanized trig. tubes set in concrete. Tubes II, III, V, and VIII are on the sides of roads, where they are sunk 4 in., and covered with jarrah blocks, 1 ft. square, thus forming standard points for the future control of ordinary surveys (See Fig. 4). Points I and VII are marked by 2 ft. by 3 in. totara pegs countersunk 1 ft. in the ground, where they will be well clear of all cultivation. These intermediate marks break the line up into eight sections, seven of which consist of nearly level country, Section I being the only one on which there are any steep grades, the highest inclination being $23\frac{1}{4}^{\circ}$.

Standard of Length.—The standard of length for the measurement of this line is, for the present, the Imperial standard steel tape No. 3, with its balance No. 3 deposited in the District Survey Office, Auckland.

Field Measurements.—The measurements in the field were all executed with the same apparatus as figured and described in the reports on the measurements of the Wairarapa and Eltham to Okaiawa base-lines. The importance of the shelter-tent for the comparator was again recognized in the satisfactory results of the tape comparisons. Four measurements of the line with four separate tapes were made, the results of which are all shown in Table No. 1. The measurements were started on the 2nd December, 1910, and completed on the 27th January, 1911, a portion of this interval being taken up by the Christmas and New Year holidays, there being also some delay by wet and stormy weather. The air-temperatures during the measurements ranged from 49° Fahr. to 86° Fahr. The least probable error in any section is in Section 4, where it amounts to ± 0.0004 , or 1 in 6,551,945. The greatest error in any section is in Section 5, where it amounts to ± 0.0043 , or 1 in 1,271,825. The probable error of the whole line is ± 0.010051 , or 1 in 5,452,225.

Fig. No. 1 shows the base net of triangles. Trig. 147, Mangakawa Station, is the present centre of the polygon in the so-called "major triangulation," but as a station on Tapui gave very much better conditions I had this hill cut out and a new station built. This work was rather expensive, owing to the heavy nature of the bush, but fully warranted by the infinitely better triangles obtained.

Fig. No. 2 gives a plan and section of the base.

Fig. No. 3 shows a cross section and plan of the station marks at the southern end of the base.

Fig. No. 4 shows the nature of some of the intermediate marks on the line.

A plan on a scale of 10 chains to an inch is also attached to this report. This plan gives all the intermediate distances along the line, also three connections to the settlement surveys.