

APPENDIX III.—SECONDARY TRIANGULATION.

MEASUREMENT OF THE WAIRARAPA BASE-LINE.

[By J. LANGMUIR, Inspecting Surveyor.]

HAVING been detailed to measure the first base-line in connection with the proposed scheme of secondary triangulation of the Dominion, I have been requested by Mr. T. Humphries, who was the Surveyor-General when the work was done, to write a description of the apparatus used and methods followed in the work.

A considerable amount of literature on the subject of base-measurements has appeared during the last few years, dealing with refined work in various parts of the world, notably the United States of America, South Africa, Rhodesia, Egypt, &c. It might have been expected that before this a standard design of apparatus would have been evolved, suitable for any country and type of measurement required, but such does not appear to be the case; and in submitting this description of methods and apparatus used I do not assume any superiority over similar apparatus used in other places, but simply claim that it has sufficiently satisfied expectations in the results attained.

Before proceeding to details, it is desirable to give a general description of the position and topographical features of the line, with the climatic difficulties of the locality. The latter were very marked, the high and frequent winds being the most disturbing element, and no doubt have had more or less influence on some of the sectional results. The Wairarapa district is generally acknowledged to be the most windy in New Zealand, and, although the work was carried out in what has been considered the most favourable season of the year, still the locality amply maintained its character in this respect, and much time was lost in waiting for suitable weather.

GEOGRAPHICAL POSITION OF BASE.

The south end of the base is Trig. Station Bidwill, the position of which is approximately S. lat. $41^{\circ}12'30''$ and E. long. $175^{\circ}24'$.

SELECTION OF BASE.

The base was selected by Mr. H. J. Lowe, District Surveyor, in December, 1908, and was finally examined, and approved by the Surveyor-General, on the 20th January, 1909.

In deciding on the position, the following requirements were considered to be essential:—

- (1.) That this, the first base, should be as near the south end of the triangulation as possible.
- (2.) That it should be so placed as to render extension from it as simple and perfect as possible.
As regards this requirement, it is rarely that such natural conditions exist as have in this case lent themselves for the almost perfect geometrical figures of expansion from the base, forming an ideal base net (see Fig. No. 1).
- (3.) That it should avoid if possible all obstacles of any nature whatever that would interfere with direct measurements.

Acknowledgment should be made here to the ready courtesy with which Mr. Lowe was met by those settlers through whose properties the line runs, and their prompt consent to the insertion of the necessary marks on the line, clearing the same, and permission to camp where suitable. Especial thanks were due to the late Mr. J. Williams, Kaiwairai, for the privilege of camping near his homestead, and other appreciated favours.

The line selected starts from a point about three-quarters of a mile south-west along the railway-line from the Woodside Station on the Wellington-to-Napier Railway-line, and, running on a bearing of about $176^{\circ}46'$, intersects in parts closely occupied country; forty-one barb-wire fences being crossed during the course of the measurements. (See Fig. No. 2.) The longitudinal section of the base also shown in Fig. No. 2 generally indicates its profile, but it may further be mentioned that sections 1, 2, and 3 are of a very shingly nature, there being in many places little or no soil overlying the loose stones, which increased the difficulties of setting up both theodolite and measuring-tripod. Sections 4 and 5 are mostly free from shingle, and are good measuring-country. Section 6 is a surface-dry swamp, but the subsoil to a depth of 6 ft. in places consists of soft peat, through which, down to the solid, heavy stakes of sawn timber, 5 in. by 4 in., were driven, to provide stable supports for both theodolite and tripod legs. Sections 7 and 8 are good measuring-ground, but section 9 is for the greater part irregular, with steep rising and falling grades, in some cases approaching to 15° of inclination; and owing to the prevalence of wind it was found absolutely necessary to closely follow the undulations of the country with the measurements. Great care was, however, taken in observing the vertical angles: where these were large eight readings were taken with the instrument in direct and reversed positions, particular attention being paid to the bubble-readings.

It should be explained here that the reason for introducing this section into the line at all was the great desirability of having the base directly connected to "Bidwill," one of the main stations of the triangulation, and for the extension of the latter eastwards. A quite satisfactory base in itself could have been obtained near the one chosen, and about 50 chains shorter, but the improvement in the facilities of expansion attached to the longer base was considered to be of such importance as to outweigh any difficulties inherent to the measurement of section 9.

It is very satisfactory, therefore, to be in a position to say that, judging from the residuals alone of the four measures of section 9, the results of the measurements of this section will be quite as good as those of the measurement of the more level portions of the line. (See Table of Measurements No. 1.)