

APPENDIX III.—NEW SECONDARY TRIANGULATION.

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ACTIVE steps were taken, beginning in 1901, to revise some of the minor triangulation of the North Island, which has been of such immense value in the past in controlling settlement and all other surveys in the Dominion. Quite apart from the increasing value of land, it became necessary to keep somewhat in line with other countries, both inside and outside of our own Empire, and adopt more precise methods for our governing triangulation. To this end a start was made in observing the angles of the secondary triangles which had been schemed out to cover and tie in the minor triangulation in the Wellington and Taranaki Districts. The triangulation under revision is shown on the map attached to this report, and extends from the south of the Wellington District into the Taranaki District. The angles have been observed by Mr. H. J. Lowe and Mr. H. E. Girdlestone. The instrument used was a 10 in. Everest theodolite reading by three verniers to 10 seconds. Earlier observations by Mr. H. M. Skeet in the Taranaki District have also been used. These observations were made with a 10 in. Everest theodolite reading by verniers to 10 seconds. The triangulation emanates from the Wairarapa base and closes on the Okaiawa base. These are two of the bases that have been measured with high accuracy by Mr. J. Langmuir, Inspector of Surveys. Full particulars of the measurements of these bases are given in the Survey Reports for 1909–10 and following years. The provisional lengths await comparison of the measuring-bands with the 10-link standard bar. The approximate lengths and brief particulars of the bases are as under:—

Wairarapa base: Length, 64776·667 links = 8·1 miles; probable error, $\pm 0\cdot0219$, or 1 in 2,962,000; date measured, 25th March to 29th May, 1909 = 47 days = 5·2 days per mile.

Eltham–Okaiawa base: Length, 79605·123 links = 10·0 miles; probable error, $\pm 0\cdot0128$, or 1 in 5,142,000; date measured, 5th April to 24th June, 1910 = 46 days = 4·6 days per mile.

Waitemata base: Length, 41790·776 links = 5·2 miles; probable error, $\pm 0\cdot0077$, or 1 in 5,424,000; date measured, 27th June to 29th August, 1911 = 21 days = 4·0 days per mile.

Matamata base: Length, 54799·707 links = 6·8 miles; probable error, $\pm 0\cdot01005$, or 1 in 5,452,000; date measured, 2nd December, 1910, to 29th January, 1911 = 22 days = 3·2 days per mile.

Kaingaroa base: Length, about 11·5 miles. This has been completed on the ground, but the final results are not yet available.

These bases are shown on the map. The map also gives the proposed triangulation in the Auckland District, which it is intended to revise at an early date.

A provisional least-square calculation has been made through the sixty-one triangles connecting the Wairarapa and Okaiawa bases, using the provisional length of the Wairarapa base as the starting side and closing on the Okaiawa base.

In the report for 1911–12, page 27, an extract from the field-book and an abstract of the horizontal angles at a geodetic station were given. It is only necessary to add to that description that Chauvenet's criterion for the rejection of doubtful observations has been applied to all the observations given in the abstracts of the horizontal angles, with the result that out of a total of 1,118 separate observations only twenty-seven had to be rejected. In the adjustment there was one double quadrilateral containing ten triangles, and twelve polygons containing fifty-one triangles; the average error per triangle is $3\cdot13''$, and the probable error of an observed angle, as given by the expression $0\cdot6745\sqrt{\frac{\sum \Delta^2}{3N}}$ is $1\cdot52''$, while $m = \sqrt{\frac{\sum \Delta^2}{3N}} = 2\cdot25''$. The observations extend from 1896 to 1912.

The total area covered by the triangulation was 3,723 square miles, and the number of trig. stations was forty-four, and the average number of square miles per trig. station was 85. The lengths of the sides varied from 3 miles to 24, the average length being 12 miles. The distance between the bases is about 154 miles, and the calculated length of the Okaiawa base was 79602·40 links, while the measured length was 79605·123 links, giving a difference of $2\cdot723 = 0\cdot02$ links per mile = $0\cdot14$ in. per mile.

It is proposed to have the triangulation revised where the error exceeds $6''$ per triangle. This will involve the reobservation of eight triangles, and when this is done it is expected that the accordance between the calculated and measured lengths will be closer. As the average length of side is comparatively short and the observations are made in daylight, part at least of the triangle error is very probably due to phase, and in future observations steps will be taken to reduce the error from this cause as much as possible by specially designed signals and possibly by night observations.

The method of night observations should be given a systematic trial, as very frequently the conditions then are much more favourable than in the daytime. Experience elsewhere has shown that the method is not only more accurate than daylight observations, but it is also more economical, as the time occupied at any trig. station is materially reduced.

A modern theodolite of the design of the Repsold theodolite used in South Africa and now in use in Australia would certainly be of advantage for our higher-class work. The essential features are that the pivots are made of hardened steel, a watch-telescope is provided to check any slip or other movement of the instrument, and acts in the same way for a check on the horizontal circle as the bubble attached to the micrometers of the vertical circle does for the vertical circle. The conference of Surveyors-General held in Melbourne last year was most emphatic in its opinion that New Zealand's class of instruments was not consistent with the high character of our base-lines.