

TOPOGRAPHICAL SURVEYS.

The whole of the work under this heading was confined to the Auckland District.

SETTLEMENT SURVEYS.

The returns show a decrease on the previous year of approximately 20 per cent. The areas are shown in Table I under their appropriate headings for each land district.

NATIVE SURVEYS.

This work is carried out partly by the staff and partly by contract surveyors and was principally in the Auckland and North Auckland Land Districts. Apart from the area shown in the return, other work was done by private surveyors, the cost of which was paid direct by the owners.

GEODETIC SURVEYS.

Work under this heading was resumed in the latter part of the year and ten stations were occupied and observations taken. Of the resulting twenty-seven triangles, twenty-two closed to within 1 sec. and five to between 1 sec. and 1.4 sec. All observations were taken on lamps with the Wild Primary Triangulation Theodolite No. 77.

HAWKE'S BAY RE-ESTABLISHMENT SURVEYS.

Further progress was made with the controlling rural standard work in the Hawke's Bay District, a distance of 172 miles being completed during the year by staff surveyors at an average cost of £26.84 per mile, which represents an increase of nearly 40 per cent. on the cost of the work for previous years. This increase is chiefly accounted for owing to a very wet season, more tortuous roads, and interruption of these surveys. Only one surveyor has been engaged for full time on this work, and with the work in hand and proposed work (approximately 77 miles) the work in this district, as far as rural standard surveys are concerned, should be completed during the coming year. With regard to borough standard surveys the field work and plans have now been completed, the work done comprises the standard survey of streets (in the boroughs of Napier, Hastings, and Wairoa) of a total length of approximately 120 miles at a cost of £50 per mile.

STANDARD SURVEYS.

With the exception of the standard survey work in the Hawke's Bay District and the maintenance of existing standards no work was carried out under this heading during the year.

FIELD INSPECTIONS.

During the year forty-eight investigational and inspection surveys were made and the results show that while the field work is generally very satisfactory, pegging in many cases does not come up to the standard required by the regulations.

STANDARD OF ACCURACY.

The general high standard of accuracy as indicated by traverse closures has been more than maintained, and the fact that the majority of the staff has been trained on the more precise work of rural standard surveys is reflected in the returns of traverse closures, comparatively few circuits exceeding 1 in 25,000 in closing error. The error allowed by regulation 1 in 4,000 (rural) and 1 in 8,000 (town) would appear to be too generous, especially where circuits contain modern work only.

The Propagation of Errors in the Rural Standard Traverses.—It has been customary in the Department and in the survey regulations to state the accuracy of a closed circuit as the ratio between the lengths of the closing line and that of the whole circuit, generally expressed in the form of links per mile. It is well known that a higher ratio may be obtained more often on larger circuits than on smaller, and therefore the accuracy of closure does not depend directly upon the circuit length.

When drawing up the specifications for the rural standard traverses in Hawke's Bay the limits allowed for the closing line in links in any circuit were based on the formula—

$$.5 \times d^{\frac{2}{3}} \text{ where } d \text{ is the length of the circuit in miles.}$$

The use of the function " $d^{\frac{1}{2}}$ " recommended in some text-books was discarded as requiring too large an initial constant for small circuits if due regard for large circuits of ten miles or more was to be made. The choice of the index $\frac{2}{3}$ was made for ease in computing as well as lying between the values $\frac{1}{2}$ and 1 (the direct length), but was not the subject of any special investigation.

It may be noted that the surveys were not necessarily precise, but were made for the purpose of throwing over the district as quickly as possible a reasonably accurate close control with permanently marked stations.

On the completion of the second and third order triangulations, the adjustment of this network of standard traverses was taken up and the question of weighting each section between junction points and triangulation points arose. At first the weights used were inversely as the square root of the lengths, thus reverting to the text-book index $\frac{1}{2}$. This, however, was found to place too great a correction upon the shorter lines, exceeding in some instances the errors which might reasonably be expected to occur in them. Further solutions were made with the weights of sections inversely as the length, and this method spread the adjustment corrections much more evenly, but was considered as going to the other extreme, and a more reasonable solution would lie between these two methods.