

ceeds simultaneously with the minor triangulation. To accomplish these objects it is essential that all the lines of survey should have a definite relation in angular bearing to a known fixed line, and have the same unit measure of length.

The only known fixed line of any place is the true or astronomical meridian of that place. It is independent of any local reference-marks, for, should they get lost or displaced, the line can be redetermined by observation, as in the first instance. It is convenient in practice to refer all the surveys of a considerable area, east and west, to the meridian of some conspicuous natural point. New Zealand, from its lying so much north and south, and covering only twelve degrees of longitude, might conveniently have had all the sectional surveys referred to seven or eight meridians if trigonometrical survey could have in all cases preceded settlement; but this was impossible for many reasons. In 1876, when the surveys were brought under the control of one department, the colony was divided into twenty-eight meridional circuits. The meridians of twelve of these had already been observed under the Provincial Survey Departments. The astronomical observations to determine the remaining sixteen were entered on, and extensions of standard bearings made from each throughout their respective circuits where necessary.

All surveys are now conducted on the bearings of the circuit within which they are situate. The unit measure of length is the standard brass yard at the head office. From it a standard chain length has been laid down there at a temperature of 62° Fahr. At all the survey offices of the colony similar standards have been laid down, and compared with the one at the head office.

On the uniform basis of true meridian and standard length the trigonometrical survey proceeds in the districts where it is immediately required. As the different series of triangles close on each other from independent bases, they become a check and verification the one of the other. During the year an area of 4,699,191 acres has been triangulated, principally in the Land Districts of Auckland, Wellington, Marlborough, Nelson, Westland, Canterbury, and Otago. 8-inch and 6-inch theodolites have been used in the observation of the major triangles, and 5-inch in the minor.

The excellent results obtained by the surveyors engaged in triangulation and topography are convincing testimony of the skill and care exercised by them in its execution. In the various triangulations detailed in Chief Surveyors' reports it will be seen that only in a few cases does the error of closure on base of verification or on side of an adjacent triangulation exceed 2 links to the mile; generally the closure is well within that limit. Thus, Mr. C. Cussen, in a series of triangles extending over 282,000 acres of the Patetere country, began on a side of the Auckland major triangulation and closed on another side with the very satisfactory results of only $\cdot 53$ of a link per mile of discrepancy in length of common side, of 8" in bearing, and of 4 feet in height of station.

From the base in Wairau Plain, Marlborough, Mr. A. D. Wilson extended major triangles across Cook Strait to a close on side Kaukau-Mana. Length of side by Wellington triangulation, 84,185·3 links; length of side by Marlborough triangulation, 84,183·2 links, a difference of 2·1 links, or $\cdot 2$ of a link per mile. Without much further trouble it may be possible, with better-conditioned triangles than those already observed, to have observations from other points across the Strait, as the triangulation is extended down the coast of the Middle Island. Mr. Wilson, in the selection of stations, is to keep this in view; for it will be satisfactory to have a further verification of a work on which the relative geographical positions of the two Islands on the future maps of the colony will depend. In the Marlborough Sounds Mr. R. F. Goulter, a young surveyor, took up the survey and trigonometrical connection of the settlements in the numerous small bays. The closures of his minor triangulation, the first work of this class he has undertaken, are very creditable to him.

In Westland Mr. G. J. Roberts, who for the last three years has been engaged in a trigonometrical and topographical survey of that district, recently completed the observation of a Ray-trace, or chain of triangles, across the dividing range, connecting the triangulations of Westland and Canterbury. This was a very arduous work, conducted, as it necessarily was, for a considerable distance over glaciers and