APPENDIX I.

EXTRACT FROM REPORT BY W. T. NEILL, CHIEF INSPECTOR OF SURVEYS.

TRIANGULATION.

THE field-work of the major triangulation of the Dominion is at present held in abeyance, and, as a systematic reduction of the observations and the computation of the work cannot be commenced by the office staff until further data are available, no progress has been made with this work except the examination of the horizontal circles of the two 8 in. micrometer theodolites by Troughton and Simms, which were used on this triangulation. This was effected by a harmonic analysis of the readings of the graduated limb by the two opposite microscopes at each 10° division, and has for its object the determination of (1) the eccentricity (E), (2) the point on the graduated circle of the line of no eccentricity (ϵ), (3) the angular distance between the opposite microscopes (180° + C), (4) the mean uncertainty of any one residual.

If the centre of rotation of the vertical axis does not coincide with the centre of the graduated limb, the differences of the readings of the opposite microscopes at each division of the limb will range, by a regular periodic law, from a vanishing nothing to a maximum between the points on the limb indicated by the line of no eccentricity and 90° on each side of it.

The variable periodic quantity represented by the difference of the readings of opposite microscopes can be expressed by the formula

$$\mu = E \sin (Z + \epsilon)$$

and as the microscopes may not be exactly 180° apart a constant C added to the above formula gives

$$\mu = E \sin (Z + \epsilon) + C$$
$$= C + A \cos Z + B \sin Z$$

if $A = E \sin \epsilon$, $B = E \cos \epsilon$, where Z is an angle found by dividing the circumference of the graduated limb by the number of observations, which is 36 in this case.

Four readings of the graduated limb at 90° apart will suffice to determine the three unknown quantities C, E, and ϵ in the above formula; but in order to determine the eccentricity with greater accuracy, and to eliminate errors in reading and accidental errors of graduation, the circle readings at each 10° division are used.

Each reading of a pair of opposite microscopes furnishes an equation of condition as above, and from these 18 equations the most probable value of the eccentricity is deduced by the method of least squares.

The results for theodolite No. 218 are—$E = 1{\cdot}53''$; $\epsilon = 0° \; 05'$; $C = -17''$. The angular distance between the microscopes is therefore 179° 59′ 43″. The sum of the squares of the 36 residuals is found to be 530·28″. The mean uncertainty of each is therefore $\pm \sqrt{\frac{530{\cdot}28}{35}} = \pm 3{\cdot}89''$, and mean error of reading of one microscope $= \pm 3{\cdot}89'' / \sqrt{2} = \pm 2{\cdot}75''$.

For theodolite No. 219 the results are—$E = 3{\cdot}53''$; $\epsilon = 103° \; 12'$; $C = -23''$. The angular distance between the microscopes is therefore 179° 59′ 37″. The sum of the squares of the residuals is found to be 166·84″. The mean uncertainty of each is therefore $\pm \sqrt{\frac{166{\cdot}84}{35}} = \pm 2{\cdot}18''$, and mean error of reading of one microscope $= \pm 2{\cdot}18'' / \sqrt{2} = \pm 1{\cdot}54''$.

TIDAL SURVEY.

During the first part of the year Messrs. Gillespie and Williams prepared the tide-tables for 1920 at the ports of Auckland and Wellington. The method of computing the predictions was that which was introduced by Dr. Adams, a brief description of which is given in the annual report for 1910–11, and a more detailed account in Appendix No. 7, Part II, U.S. Coast and Geodetic Report, 1894, under the title of a "Manual of Tides" (Chapter V, page 183), by Rollin A. Harris. The heights and times of high and low water were checked at intervals of a lunation by the formula given by Sir G. H. Darwin in the Admiralty Manual of Scientific Inquiry, page 89, and the diurnal inequality was examined to see that it followed the same rule as shown on the tide-gauge records. The diurnal inequality is a portion of the lunar tide which depends, at a given port, wholly upon the declination of the moon, the effect being a difference in height of the alternate tides when the declination of the moon is north or south of the Equator.

A simple explanation of this phenomenon is afforded by the equilibrium theory of the tides worked out by Newton. This theory is not entirely satisfactory, and in some respects it is inaccurate; nevertheless it furnishes a guide for the discussion of tidal observations, and its usefulness in explaining some of the peculiarities of the tides is generally recognized.

Referring to Fig. 1: E and M are the positions of the sun and new moon with respect to the Equator AB on 21st December, 1911. The shaded portion represents the form of the ocean due to the combined attractions of the disturbing bodies. At a port P in the Northern Hemisphere it is apparent that there is a difference in the height of the tide at P, and twelve hours later at P^1, and that in both hemispheres the difference increases with the latitude, but at ports on the Equator the successive tides are equal. When the new moon is on the meridian of a given place the tide under the moon occurs in the daytime, whilst the tide opposite the moon is the night tide. This