1924.

NEW ZEALAND.

# DEPARTMENT OF LANDS AND SURVEY.

# SURVEYS

(ANNUAL REPORT ON).

*Presented to both Houses of the General Assembly by Command of His Excellency.*

## CONTENTS.



The SURVEYOR-GENERAL to the Hon. MINISTER OF LANDS.

SIR,— Wellington, 4th July, 1924.

I have the honour to present herewith the report on survey operations for the year ended 31st March, 1924.

I have, &c.,

W. T. NEILL,

Hon. A. D. McLeod, Minister of Lands. Surveyor-General.

# REPORT.

THE demands on the Department for the year ended 31st March, 1924, have again been heavy, the total acreage surveyed having increased by 289,792 acres as compared with last year's returns. Of the fifty-four surveyors employed, thirty-five were staff and nineteen contract; while apart from these a number of cadets and assistants were employed.

The Poverty Bay Land District, containing 1,580,000 acres, and portion of the Auckland Land District containing 942 acres, embracing the Opotiki County and portions of Whakatane and Wairoa Counties, has been declared a separate land district, and appears in the appended tables as the "Gisborne Land District."

The attached Tables A, B, and 1 to 5 inclusive, give a concise summary of the amount of work completed during the year under review. Full details are contained in the reports supplied by the Chief Surveyor, which are filed as departmental records.

Under the heading of "Rural Surveys," in Table B, an area of 266,308 acres is shown as completed work, as compared with 344,635 acres for last year, a decrease of 78,327 acres; and under the heading of "Native Land Surveys" the area of completed work is shown as 345,500 acres, an increase of 101,457 acres as compared with last year's return.

The average cost per acre of both rural and Native-land surveys shows an advance of 1d. per acre on the last year's rates, which were 1s. 6d. and 1s. 8d. respectively, the figures for the year under report being 1s. 7d. and 1s. 9d. The work, however, is being done at a reasonable price.

TABLE A.

| Class of Work. | Area, &c. | Average Cost. | Total Cost. |
|---|---|---|---|
| | | | £ s. d. |
| Topographical, by staff surveyors .. .. | 71,516 acres | 3·3d. | 979 14 9 |
| Triangulation, by staff surveyors .. .. | 128,443 ,, | 1·0d. | 553 2 4 |
| ,, by licensed surveyors .. .. | 99,750 ,, | 1·5d. | 623 8 9 |
| Rural, by staff surveyors .. .. .. | 264,437 ,, | 1·6s. | 21,426 0 9 |
| ,, by licensed surveyors .. .. | 1,871 ,, | 2·6s. | 244 13 9 |
| Village and suburban, by staff surveyors .. | 723 ,, | 15·6s. | 562 10 8 |
| Town, by staff surveyors .. .. .. | 155 sections | £3·33 | 516 11 6 |
| ,, by licensed surveyors .. .. | 11 ,, | £3·63 | 39 19 0 |
| Native Land Court, by staff surveyors .. | 91,364 acres | 1·24s. | 5,693 11 7 |
| ,, by licensed surveyors .. | 254,136 ,, | 1·82s. | 23,166 9 0 |
| Roads by staff surveyors .. .. .. | 181·3 miles | £37·5 | 6,796 7 4 |
| ,, by licensed surveyors .. .. | 10·9 ,, | £25·1 | 273 11 4 |

TABLE B.

| Land District. | Rural Surveys. | Native-land Surveys. |
|---|---|---|
| | Acres. | Acres. |
| North Auckland .. .. .. | 31,169 | 9,400 |
| Auckland .. .. .. .. | 131,763 | 164,827 |
| Gisborne .. .. .. .. | 15,052 | 17,699 |
| Hawke's Bay .. .. .. | 1,156 | 101,934 |
| Taranaki .. .. .. .. | 1,399 | 5,734 |
| Wellington .. .. .. .. | 70,000 | 42,448 |
| Marlborough .. .. .. .. | 620 | 2,709 |
| Nelson .. .. .. .. | 9,341 | .. |
| Westland .. .. .. .. | 726 | .. |
| Canterbury .. .. .. .. | 2,365 | 248 |
| Otago .. .. .. .. | 2,717 | 501 |
| Southland .. .. .. .. | .. | .. |
| Totals .. .. .. | 266,308 | 345,500 |

### Minor Triangulation.

An area of 228,193 acres, at an average cost of 1·24d. per acre, was completed during the year to control settlement surveys in Auckland, Hawke's Bay, Nelson, and Otago Districts.

### Settlement Surveys.

The settlement surveys comprise Crown lands, land for settlement, and land for discharged soldiers. The bulk appears in Table A under the head of "Rural," the acreage shown being 266,308 acres, while the remainder includes village and suburban and town lands, totalling 817 acres.

### Native-land Surveys.

An area of 345,500 acres was completed by staff and contract surveyors during the year.

Table A shows that areas of 91,364 acres and 254,136 acres were surveyed by staff surveyors and contract surveyors respectively. The area surveyed in each land district is shown in Table B.

### Geodetic Triangulation.

Two field parties have been engaged on this survey during the year; one was employed on the erection of signals at the selected trig. stations within the Gisborne Land District, while the other party undertook the observational work commencing from the stations marking the terminals of the Kaingaroa Plains base-line. Good progress has been made with the survey, although the season was generally unfavourable on account of rain and high winds. The state of the survey is shown on the index map appended hereto.

### Standard Surveys.

The standard work executed during the year comprised the capping of standard blocks in the Boroughs of Inglewood, Levin, and Palmerston North, the reinstatement of blocks in the City of Auckland and surrounding suburbs, the levels of which had been altered by street improvements. The total cost of this work is paid by the local bodies.

The precise survey of Gisborne and suburbs has been completed during the year, forty-eight miles of traverse-lines having been laid down at a cost of £89 per mile, including the levelling operations to determine the height of each block above the mean sea-level.

Portions of the field-work of the extension of the Auckland City survey at Point Chevalier, the New Plymouth survey, and the Invercargill survey have been completed. In connection with these works the local bodies contribute two-fifths of the cost of the surveys.

One staff surveyor has been engaged on a standard survey of the Te Aroha Township, which is still in progress. Sixteen miles of roads standard traverse were completed in the Leeston Survey District, Canterbury, and the field-work of the Clutha District, Otago, is in progress.

The average closing-error per mile in the precise survey is 0·08 link per mile, which shows that the high degree of accuracy necessary in standard measurements is being maintained.

### Topographical Survey.

Of the area shown under this heading in Table 2, 19,200 acres have been done by plane table and contoured, the balance being sketched topography for selection purposes.

Four parties, as compared with one for the previous season, are now exclusively engaged on the topographical survey proper. Of these three are engaged in surveying the thermal-springs area in the vicinity of Rotorua, where field operations were commenced last January. This survey will also include all the settled pumice lands adjoining the Rotorua area, and the completed maps will be of great assistance to the Chemists in connection with a soil-survey contemplated by the Agricultural Department.

The fourth party is engaged in the Waimea and Motueka Survey Districts, on which the officers of the Cawthron Institute are conducting a soil-survey and experimenting in afforestation. An area of 30 square miles, costing 6·37d. per acre, has been completed.

### Inspections.

About twenty inspections of surveys under the Land Transfer Act have been made during the year. In most cases the work has been found satisfactory; several cases, however, show that sufficient care has not been taken to ensure the accuracy required by the Survey Regulations. It is necessary that the number of inspections should be increased in order to ensure that an adequate check is being maintained on the field operations of the staff and surveyors in private practice or on contract surveys.

### Tidal Survey.

The work for the past year comprised two fresh analyses for each of the ports of Auckland and Wellington, and one each for Bluff and Westport. The constants derived therefrom, combined with previous determined values of the constants of these ports and the mean values of the constants for Lyttelton and Dunedin, are contained in Table C below.

TABLE C.

*Mean Values of the Harmonic Constants for Use in preparing the Tide-tables.*

| Tide Symbol. | Auckland. $A_0$ = 5·74 ft. | | Bluff. $A_0$ = 5·27 ft. | | Dunedin. $A_0$ = 3·23 ft. | | Lyttelton. $A_0$ = 3·20 ft. | | Wellington. $A_0$ = 2·93 ft. | | Westport. $A_0$ = 4·77 ft. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | H. | K. | H. | K. | H. | K. | H. | K. | H. | K. | H. | K. |
| *Short Period.* | Ft. | ° | Ft. | ° | Ft. | ° | Ft. | ° | Ft. | ° | Ft. | ° |
| S1 | 0·011 | 11·61 | 0·010 | 100·05 | 0·015 | 14·41 | 0·035 | 31·91 | 0·002 | 327·99 | 0·011 | 78·04 |
| S2 | 0·577 | 267·73 | 0·502 | 49·79 | 0·245 | 129·50 | 0·179 | 143·04 | 0·101 | 330·48 | 0·959 | 332·22 |
| S4 | 0·017 | 329·51 | 0·009 | 223·42 | 0·007 | 318·52 | 0·009 | 202·78 | 0·004 | 225·46 | 0·007 | 32·75 |
| S6 | 0·003 | 59·53 | 0·006 | 170·17 | 0·003 | 115·92 | 0·015 | 344·95 | 0·004 | 307·40 | 0·006 | 331·21 |
| M1 | 0·009 | 111·11 | 0·011 | 127·33 | 0·010 | 108·52 | 0·010 | 99·40 | 0·005 | 23·12 | 0·012 | 143·08 |
| M2 | 3·815 | 206·15 | 2·858 | 35·68 | 2·485 | 122·39 | 2·879 | 125·63 | 1·608 | 139·02 | 3·747 | 304·43 |
| M3 | 0·036 | 194·31 | 0·011 | 272·74 | 0·016 | 262·98 | 0·016 | 112·80 | 0·019 | 172·05 | 0·021 | 208·15 |
| M4 | 0·101 | 124·01 | 0·088 | 226·45 | 0·261 | 177·75 | 0·016 | 80·19 | 0·041 | 250·90 | 0·057 | 53·90 |
| M6 | 0·025 | 316·01 | 0·086 | 79·53 | 0·072 | 357·87 | 0·022 | 68·96 | 0·012 | 99·73 | 0·026 | 36·82 |
| O1 | 0·051 | 146·07 | 0·113 | 72·91 | 0·088 | 72·39 | 0·088 | 61·46 | 0·103 | 36·51 | 0·093 | 45·98 |
| K1 | 0·235 | 168·40 | 0·058 | 115·68 | 0·074 | 90·24 | 0·148 | 82·58 | 0·082 | 85·35 | 0·073 | 184·39 |
| K2 | 0·140 | 256·42 | 0·134 | 46·77 | 0·091 | 122·50 | 0·054 | 102·88 | 0·046 | 7·69 | 0·276 | 328·04 |
| P1 | 0·076 | 162·90 | 0·023 | 105·44 | 0·023 | 94·68 | 0·051 | 112·04 | 0·032 | 79·01 | 0·022 | 133·91 |
| J1 | 0·020 | 180·76 | 0·006 | 198·96 | 0·004 | 78·86 | 0·007 | 146·39 | 0·009 | 173·01 | 0·013 | 219·25 |
| Q1 | 0·009 | 75·19 | 0·031 | 47·70 | 0·028 | 76·62 | 0·021 | 43·38 | 0·037 | 20·69 | 0·037 | 33·03 |
| L2 | 0·109 | 211·10 | 0·109 | 32·44 | 0·155 | 102·59 | 0·088 | 148·45 | 0·028 | 149·18 | 0·097 | 285·41 |
| N2 | 0·802 | 178·79 | 0·654 | 16·50 | 0·537 | 104·34 | 0·663 | 95·31 | 0·402 | 104·71 | 0·770 | 289·02 |
| V2 | 0·192 | 218·23 | 0·153 | 53·35 | 0·099 | 114·97 | 0·148 | 122·05 | 0·124 | 126·10 | 0·194 | 320·40 |
| U2 | 0·103 | 180·78 | 0·065 | 7·93 | 0·029 | 46·38 | 0·091 | 59·29 | 0·065 | 89·62 | 0·134 | 283·83 |
| T2 | 0·056 | 294·90 | 0·020 | 89·11 | 0·017 | 231·08 | 0·030 | 219·85 | 0·029 | 274·37 | 0·053 | 9·08 |
| (MS)4 | 0·180 | 187·66 | 0·081 | 2·78 | 0·108 | 140·91 | 0·102 | 123·98 | 0·035 | 134·93 | 0·105 | 294·78 |
| (2SM)2 | 0·065 | 300·51 | 0·045 | 121·63 | 0·046 | 8·44 | 0·066 | 25·99 | 0·032 | 355·14 | 0·076 | 199·89 |
| R2 | 0·016 | 210·66 | 0·014 | 111·90 | 0·014 | 198·62 | 0·013 | 150·12 | 0·010 | 116·63 | 0·035 | 178·80 |
| *Long Period.* | | | | | | | | | | | | |
| Mm | 0·049 | 176·42 | 0·043 | 1·94 | 0·056 | 69·33 | 0·048 | 137·29 | 0·030 | 197·55 | 0·051 | 199·18 |
| Mf | 0·038 | 203·39 | 0·067 | 235·36 | 0·068 | 184·30 | 0·063 | 183·39 | 0·029 | 187·39 | 0·055 | 7·87 |
| MSf | 0·035 | 175·40 | 0·063 | 326·77 | 0·089 | 137·64 | 0·129 | 156·38 | 0·042 | 98·83 | 0·069 | 98·39 |
| Sa | 0·195 | 18·15 | 0·089 | 16·98 | 0·135 | 267·26 | 0·097 | 246·56 | 0·092 | 343·71 | 0·113 | 81·51 |
| Ssa | 0·077 | 151·87 | 0·115 | 82·05 | 0·073 | 104·27 | 0·085 | 139·91 | 0·078 | 133·80 | 0·116 | 111·03 |

The tide-tables for the year 1925 of the six New Zealand ports for which predictions are published were received in Wellington on the 6th December, 1922, from the Director, National Physical Laboratory, Teddington, where the tidal predictions have been prepared satisfactorily since 1921. The removal of the tide-predicting machine from the National Physical Laboratory to India left the firm of Messrs. Edward Roberts and Sons the sole source of supply of harmonic predictions within the Empire, with the exception of India, until an alternative source of supply was developed at the Tidal Institute University of Liverpool, due to funds generously provided by Sir A. A. Booth and Mr. C. Booth in the first place, with Professor Proudman as honorary director. The primary object of the Institute is "to prosecute continuously scientific research into all aspects of knowledge of the tides"; another object of the Institute is to carry out research work for other bodies in connection with the analysis of tidal observations.

A communication was received from the Hydrographer to the Admiralty, dated 8th December, stating that tidal predictions for the six New Zealand ports have been ordered from the Tidal Institute for delivery by the 1st June, 1924, at a cost of £15 per port, and that full arrangements for the permanency of the work of the Tidal Institute have been made. The work is carried out under the direction of competent officials, and the Admiralty is represented on the governing committee.

The report by Mr. E. J. Williams, Tide-computer, appended hereto, contains further details of the tidal work.

## MAGNETIC OBSERVATORY.

During the year under report the work of the Magnetic Observatory at Christchurch and the substation at Amberley has been efficiently carried on by the Director, Mr. H. F. Skey, B.Sc. His report is published as an appendix hereto.

The magnetographs have continued in regular operation throughout the year, and the base values of the curves were determined by absolute observations of declination, dip, and horizontal force, usually taken once a month. The results of the absolute observations have appeared in the monthly reports of the Director.

The mean annual values of the magnetic elements as far as they are available are given in Table D following:—

TABLE D.

*Mean Annual Values of the Magnetic Elements at Christchurch Observatory.*

| Date. | Declination E. of N. | Annual Change. | Horizontal Force. | Annual Change. | Vertical Force. | Annual Change. | Inclination South. | Annual Change. | Hourly Values Published in Annual Report. |
|---|---|---|---|---|---|---|---|---|---|
| | ° ′ | ′ | C.G.S. Unit. | γ | C.G.S. Unit. | γ | ° ′ | | |
| 1902 .. | 16 15·1 | +3·2 | 0·22694 | −25 | 0·55277 | + 9 | 67 40·8 | +1·50 | 1912–13 |
| 1903 .. | 16 18·3 | +3·5 | 0·22669 | −25 | 0·55286 | +21 | 67 42·3 | +1·80 | 1912–13 |
| 1904 .. | 16 21·8 | +3·6 | 0·22644 | −16 | 0·55307 | +41 | 67 44·1 | +1·70 | 1912–13 |
| 1905 .. | 16 25·4 | +2·4 | 0·22628 | −23 | 0·55348 | +28 | 67 45·8 | +1·80 | 1919–20 |
| 1906 .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1907 .. | 16 31·1 | .. | .. | .. | .. | .. | .. | .. | .. |
| 1908 .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1909 .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1910 .. | 16 37·6 | +1·4 | 0·22515 | −27 | 0·55485 | +12 | 67 54·8 | +1·40 | 1920–21 |
| 1911 .. | 16 39·0 | +2·5 | 0·22494 | −23 | 0·55497 | − 9 | 67 56·2 | +1·00 | .. |
| 1912 .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1913 .. | 16 44·0 | +0·8 | 0·22449 | −35 | 0·55478 | −13 | 67 58·2 | +1·60 | 1913–14 |
| 1914 .. | 16 44·8 | +2·2 | 0·22414 | −27 | 0·55465 | + 7 | 67 59·8 | +1·67 | 1914–15 |
| 1915 .. | 16 47·0 | +2·8 | 0·22387 | −32 | .. | .. | .. | .. | *Sept., 1918 |
| 1916 .. | 16 49·8 | +3·2 | 0·22355 | −27 | .. | .. | .. | .. | *Sept., 1918 |
| 1917 .. | 16 53·0 | +2·7 | 0·22328 | −24 | 0·55486 | +30 | 68 04·8 | +1·90 | *Mar., 1921 |
| 1918 .. | 16 55·7 | +2·9 | 0·22304 | −24 | 0·55516 | − 9 | 68 06·7 | +1·10 | 1918–19 |
| 1919 .. | 16 58·6 | +3·1 | 0·22280 | −19 | 0·55507 | +18 | 68 07·8 | +1·40 | 1919–20 |
| 1920 .. | 17 01·7 | +2·9 | 0·22261 | −20 | 0·55525 | +03 | 68 09·2 | +1·10 | †1920–21 |
| 1921 .. | 17 04·6 | +3·7 | 0·22241 | −24 | 0·55528 | −21 | 68 10·3 | +0·90 | †1921–22 |
| 1922 .. | 17 08·3 | +3·4 | 0·22217 | −08 | 0·55507 | +19 | 68 11·2 | +0·80 | †1922–23 |
| 1923 .. | 17 11·7 | .. | 0·22209 | .. | 0·55526 | .. | 68 12·0 | .. | †1923–24 |

* Mean hourly values published in *New Zealand Journal of Science and Technology.* † Special publication.

An account of the earthquake of the 25th December, 1922 (with map); a list of the earthquakes recorded at Christchurch by Milne seismograph No. 16; a discussion of the magnetic observations; Vector diagrams for the seasons; monthly and annual curves of declination and horizontal force, and tables of hourly values of the declination and horizontal force for 1923, are contained in Volume I of the Records of the Survey, a supplementary report to be published this year for the first time.

## PROPOSED OPERATIONS FOR THE YEAR 1924–25.

*Geodetic Triangulation.*—The field-work of this survey will be conducted by Mr. H. M. Ross, surveyor. The observations will be continued by means of an 8 in. geodetic theodolite at the stations of the scheme on which signals have been erected.

*Standard Surveys.*—The proposed work for the year includes the extension of survey in progress at Auckland, Te Aroha, New Plymouth, and Invercargill by Messrs. Kensington, King, Haase, and Otway respectively. The commencement of the work at Whangarei, Hamilton, Blenheim, Christchurch, Dannevirke, and Dunedin is contemplated as soon as trained surveyors are available.

*Settlement Surveys.*—The work may be summarized as follows: 67 square miles of minor triangulation, 248,650 acres rural survey, 145,509 acres Native-land survey, 208 miles road survey, and 144 acres of town survey. The amount of work in each land district is shown in Table 4 below.

*Topographical Survey.*—Three parties will continue operations in the vicinity of Rotorua and survey the thermal region and the settled pumice area adjoining, and one party will continue the survey of the area in Nelson district over which the officers of the Cawthron Institute are conducting a soil survey.

*Miscellaneous.*—In addition to the above-mentioned works, there is the customary examination and checking of plans, the inspection of surveys, the work of computing the harmonic constant for the tidal predictions, measuring the curves of the magnetograph records, the preparation of various tables, and the drawing and compilation of the maps for publication.

## GENERAL.

*Proclamation of Roads, &c.*—During the year under review twenty-three applications for the proclamation of road-lines laid off by the Native Land Court under sections 48, 49, 50, and 52 of the Native Land Amendment Act, 1913, were dealt with. Statutory notices of intention to proclaim the roads, together with plans showing the location of same, were forwarded to the local bodies of the districts affected, in terms of section 15 of the Native Land Amendment Act, 1914, to enable such local bodies to forward any objections or representations they might wish to make prior to the issue of the *Gazette* notices.

Under the Land for Settlements Act a number of unused and unformed road-lines intersecting estates acquired under the Act were closed, in terms of section 80 thereof, to enable the areas to be incorporated in the new subdivisions surveyed for closer settlement.

Under the Land Transfer Act 218 warrants for the issue of certificates of title were examined and certified in terms of section 13 of the Act.

In addition, several cases of overlaps and defective surveys arising out of land transactions carried forward from the early days were investigated and reported upon.

*Publication of Maps.*—For some years past the demands of the public and the Government Departments for maps has not been fully met, on account of the yearly volume of work produced by the draughtsman being too great for the Printing Department to cope with. A number of maps was therefore printed by a private firm in Auckland during the year, and it is proposed to print several survey-district maps next year privately, until such time as the staff of the Printing Department can

be strengthened to satisfactorily keep pace with the map-production of the draughtsman in the Department.

Further particulars of the draughting-work are contained in the report by Mr. H. E. Walshe, Chief Draughtsman, appended hereto.

*Explorations in Fiordland.*—Representations were made by the Otago Expansion League and the Tourist Department for the need of further explorations in Fiordland, particularly in the quadrilateral between Sutherland Sound, the Arthur River, Milford Sound, and the Tasman Sea, in which sulphur springs and several beautiful valleys have been reported to exist. The Government having approved of the work being undertaken, Mr. T. W. Preston was detailed to spend a season examining this country and to survey the Tutoko and Cleddau Rivers with a view of locating a feasible return track from Milford Sound to Lake Wakatipu. An interesting report (and a map of the country) by Mr. Preston will be published in Volume I of the Records.

Further surveys are required of the valleys at the heads of several of the Sounds, particularly the country between Caswell and George Sounds, which is visited by sportsmen on deer-hunting expeditions, who have reported that the topography is misleading.

*Scientific Expedition to the Chatham Islands.*—The Otago Institute, in co-operation with the Philosophical Institute of Canterbury, organized a scientific expedition to the Chatham Islands last January, and invited officers of the Department to assist in determining more accurate values of the latitiude and longitude of the wireless station on the island, and a reobservation of the magnetic elements at the stations of the original survey occupied in 1907. Messrs. H. F. Skey, B.Sc., Director of the Magnetic Observatory, and H. E. Walshe, surveyor, of the Head Office staff, were detailed to undertake this work. The Government Astronomer, Dr. C. E. Adams, kindly supplied a chronograph in connection with the longitude-determination. Captain Hooper, Nautical Adviser, Marine Department, also assisted the expedition by supplying two chronometers.

Messrs. Skey and Walshe arrived at the island on the 1st February, and during the following five weeks took complete observations for declination, horizontal force, and dip at eight of the stations formerly observed and at one new station. Observations were taken for latitude and longitude at a pier near the wireless station. For these a 7 in. Troughton and Simms micrometer transit was used in the meridian and also on the colatitude circle. Wireless time-signals from Hector Observatory (ordinary) and Bordeaux (rhythmic) were picked up clearly. The resulting position shows that the island on our maps is placed nearly three miles out of position, the new determination placing it 13 seconds of time nearer New Zealand. Cloudy skies greatly interfered with the time observations, no perfectly clear night being experienced. A full report by the observers will be published later in the Records of the Survey.

*Publication of Professional Paper No. 1.*—A second edition of Professional Paper No. 1, "Directions for testing Traverse Bearing by Observations on Circumpolar Stars with a 5 in. Theodolite," by Thomas Humphries, F.R.A.S., together with the paper "On the Determination of Time, Latitude, and Azimuth with an 8 in. Theodolite," by C. W. Adams, have been prepared for publication as one volume with the above title, and is in the press.

*Records of the Survey of New Zealand.*—The activities of the scientific work of the Department, in connection with precise triangulation and levelling, tidal survey, magnetic and seismological work, topographical and standard surveys, &c., are extending to such an extent that a detailed account of them is becoming too voluminous for this report. A detailed account of the above-mentioned operations for the year are, with your approval, published separately under the above title.

*Desiderata.*—There is a pressing need for a suitable site to compare the tapes used by the staff and private surveyors with the Imperial standard band, and to erect and house the comparator and standard bar in a locality where it is unlikely that it will be disturbed by the extension of existing buildings or the erection of new ones. The importance of the preservation of the standard of length, on which all title-deeds in the country depend, is so great that expenditure for this purpose of erecting the necessary building should be authorized before any other scientific work is undertaken by the Government.

*Magnetic Survey.*—A repeat survey of the magnetic work is also desirable, and should be undertaken at an early date. The results of the magnetic work are now in demand by aviators, mariners, and surveyors. Formerly the variations of the compass or the declination was the only magnetic element n constant practical use. Now a knowledge of the dip of the needle or its inclination to the horizontal plane is required by the aviator.

*Seismological Observations.*—The recent advances in seismological science necessitate more modern instruments in this country, particularly the class of seismographs which are in use for recording earthquakes at short distances from the observatory.

*Staff.*—Full details of the personnel of the staff, both field and office, are given in the report by the Under-Secretary for Lands. In conclusion, I am pleased to bring under your notice and to place on record the appreciation by the various Chief Surveyors of the manner in which their officers have carried out their duties during the year, and I desire to convey my thanks to the whole of the Survey staff for their good work.

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**Table 1.**—Return of Field-work executed by Head Office Staff from 1st April, 1923, to 31st March, 1924.

| Land District. | Standard Surveys. | | | | Geodetic Triangulation. | | | | Other Work. |
|---|---|---|---|---|---|---|---|---|---|
| | Completed. | | In Progress. | | Completed. | | In Progress. | | |
| | Miles. | Cost. | Miles. | Cost. | Square Miles. | Cost. | Square Miles. | Cost. | Cost |
| | | £ s. d. | | £ s. d. | | £ s. d. | | £ s. d. | £ s. d. |
| North Auckland .. | .. | .. | 14 | 677 12 1 | .. | .. | .. | .. | 669 6 0 |
| Auckland .. | .. | .. | .. | .. | } .. | .. | 7,200 | 2,422 10 1 | .. |
| Gisborne .. | 48 | 4,287 7 0 | .. | .. | | | | | |
| Taranaki .. | .. | .. | .. | 210 11 11 | .. | .. | .. | .. | .. |

**Table 2.** — Return of Field-work executed by the Staff and Contract Surveyors on Lands administered by Lands and Survey Department, from 1st April, 1923, to 31st March, 1924.

| District. | Minor Triangulations. | | | Topographical Survey. | | | Rural. | | | Village and Suburban. | | | | Town Section Survey. | | | | Roads, Railways, and Water-races. | | | Other Work. | Total Cost of Completed Work from 1st April, 1923, to 31st March, 1924. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Acres. | Cost per Acre. | Total Cost. | Acres. | Cost per Acre. | Total Cost. | Acres. | Cost per Acre. | Total Cost. | Acres. | No. of Sections. | Cost per Acre. | Total Cost. | Acres. | No. of Sections. | Cost of Sections. | Total Cost. | Miles. | Cost per Mile. | Total Cost. | Cost. | |
| | | d. | £ s. d. | | d. | £ s. d. | | s. | £ s. d. | | | s. | £ s. d. | | | £ | £ s. d. | | £ | £ s. d. | £ s. d. | £ s. d. |
| N. Auckland .. | .. | .. | .. | 7,251 | 9·72 | 293 19 10 | 31,125 | 2·55 | 3,973 12 5 | 138 | 21 | 13·66 | 94 0 0 | 25 | 77 | 1·68 | 129 19 2 | 30·4 | 23·53 | 715 3 11 | 611 7 6 | 5,818 2 10 |
| Auckland .. | 118,891 | 0·48 | 239 4 3 | 42,000 | 0·75 | 125 5 7 | 131,763 | 1·81 | 11,931 11 9 | 312 | 32 | 9·64 | 150 11 2 | 2 | 2 | 4·33 | 8 13 4 | 58·6 | 35·20 | 2,071 6 6 | 894 8 3 | 15,421 0 10 |
| Gisborne .. | .. | .. | .. | .. | .. | .. | 15,052 | 2·02 | 1,519 13 4 | .. | .. | .. | .. | 2 | 11 | 3·63 | 39 19 0 | .. | .. | .. | 1,464 17 2 | 3,024 9 6 |
| Hawke's Bay | 99,750 | 1·50 | 623 8 9 | .. | .. | .. | 1,156 | 0·85 | 46 5 0 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 669 13 9 |
| Taranaki .. | .. | .. | .. | .. | .. | .. | 1,399 | 4·26 | 298 2 6 | 39 | 2 | 5·15 | 10 0 0 | .. | .. | .. | .. | 21·6 | 63·23 | 1,300 14 10 | 103 4 9 | 1,712 2 1 |
| Wellington .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 45 | 3 | 5·60 | 12 15 0 | 33 | 43 | 3·99 | 171 10 10 | 2·3 | 36·80 | 84 16 3 | 657 1 11 | 926 4 0 |
| Marlborough .. | .. | .. | .. | 3,065 | 3·95 | 50 9 4 | 620 | 3·41 | 105 18 5 | .. | .. | .. | .. | .. | .. | .. | .. | 33·0 | 38·09 | 1,256 16 4 | 160 14 8 | 1,573 18 9 |
| Nelson .. | 6,552 | 2·60 | 73 10 0 | 19,200 | 6·37 | 510 0 0 | 9,341 | 1·24 | 580 17 4 | 31 | 2 | 19·76 | 30 12 0 | 23 | 19 | 3·96 | 75 6 1 | 4·3 | 26·20 | 112 3 5 | 75 4 5 | 1,457 13 3 |
| Westland .. | .. | .. | .. | .. | .. | .. | 726 | 7·10 | 258 1 1 | 64 | 9 | 29·17 | 93 7 2 | 1 | 1 | 11·34 | 11 6 9 | 2·0 | 18·00 | 36 0 0 | 264 11 6 | 663 6 6 |
| Canterbury .. | .. | .. | .. | .. | .. | .. | 2,365 | 1·43 | 169 9 7 | 2 | 2 | 400·00 | 36 0 0 | 2 | 4 | 3·75 | 15 0 0 | 5·8 | 22·27 | 127 5 10 | 1,025 2 7 | 1,372 18 0 |
| Otago .. | 3,000 | 19·23 | 240 8 1 | .. | .. | .. | 2,717 | 7·07 | 961 3 1 | 92 | 33 | 29·30 | 135 5 4 | 6 | 9 | 11·64 | 104 15 4 | 4·0 | 42·25 | 169 0 0 | 410 6 0 | 2,020 17 10 |
| Southland .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 5·5 | 10·00 | 54 19 6 | .. | 54 19 6 |
| Totals .. | 228,193 | 1·24 | 1,176 11 1 | 71,516 | 3·28 | 979 14 9 | 196,264 | 2·02 | 19,844 14 6 | 723 | 104 | 15·56 | 562 10 8 | 94 | 166 | 3·35 | 556 10 6 | 167·5 | 35·39 | 5,928 6 7 | 5,666 18 9 | 34,715 6 10 |

## Table 3.—Return of Field-work executed by Staff and Contract Surveyors on Lands administered by other Departments from 1st April, 1923, to 31st March, 1924.

| District. | Rural. | | | Native-land Survey. | | | | Roads, Railways, and Water-races. | | | Other Work. | Total Cost of Completed Work from 1st April, 1923, to 31st March, 1924. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Acres. | Cost per Acre. | Total Cost. | Acres. | Number of Sections or Divisions. | Cost per Acre. | Total Cost. | Miles. | Cost per Mile. | Total Cost. | Cost. | |
| | | s. | £ s. d. | | | s. | £ s. d. | | £ | £ s. d. | £ s. d. | £ s. d. |
| N. Auckland | 44 | 5·91 | 13 0 0 | 9,400 | 121 | 2·76 | 1,295 18 6 | 7·1 | 27·7 | 193 14 6 | .. | 1,502 13 0 |
| Auckland .. | .. | .. | .. | 164,827 | 1,138 | 1·69 | 13,961 5 0 | ... | .. | .. | .. | 13,961 5 0 |
| Gisborne .. | .. | .. | .. | 17,699 | 104 | 1·75 | 1,547 14 8 | 4·0 | 32·6 | 130 10 0 | .. | 1,678 4 8 |
| Hawke's Bay .. | .. | .. | .. | 101,934 | 110 | 1·12 | 5,685 10 0 | .. | .. | .. | .. | 5,685 10 0 |
| Taranaki .. | .. | .. | .. | 5,734 | 90 | 2·56 | 734 0 0 | .. | .. | .. | .. | 734 0 0 |
| Wellington .. | 70,000 | 0·52 | 1,813 0 0 | 42,448 | 260 | 2·40 | 5,179 16 11 | 13·6 | 60·1 | 817 7 7 | .. | 7,810 4 6 |
| Marlborough | .. | .. | .. | 2,709 | 22 | 1·89 | 255 18 0 | .. | .. | .. | 30 14 6 | 286 12 6 |
| Nelson .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Westland .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Canterbury .. | .. | .. | .. | 248 | 17 | 9·25 | 114 12 0 | .. | .. | .. | .. | 114 12 0 |
| Otago .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Southland .. | .. | .. | .. | 501 | 4 | 3·40 | 85 5 6 | .. | .. | .. | .. | 85 5 6 |
| Totals .. | 70,044 | 0·52 | 1,826 0 0 | 345,500 | 1,866 | 1·67 | 28,860 0 7 | 24·7 | 46·2 | 1,141 12 1 | 30 14 6 | 31,858 7 2 |

## Table 4.—Return showing Surveyors employed and the Work on Hand on 1st April, 1924.

| Chief Surveyor. | Surveyors employed. | | District. | Work on Hand. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Staff. | Contract. | | Trig. | Topo. | Settlement. | Native Blocks, &c. | Roads, &c. | Towns. | Standard Traverse. |
| | | | | Sq. Miles. | Sq. Miles. | Acres. | Acres. | Miles. | Acres. | Miles. |
| H. J. Lowe .. | 5 | .. | N. Auckland | .. | .. | 37,063 | .. | 14 | 24 | .. |
| W. F. Marsh .. | 13 | .. | Auckland .. | .. | 1,100 | 71,398 | 18,187 | 121 | .. | 6 |
| V. I. Blake .. | 1 | 2 | Gisborne .. | .. | .. | 7,636 | 97,855 | 4 | .. | .. |
| J. D. Thomson .. | 2 | 1 | Hawke's Bay | 62 | .. | 38,700 | .. | .. | .. | .. |
| J. Cook .. | 2 | 4 | Taranaki .. | .. | .. | 8,500 | 4,867 | 27 | .. | .. |
| T. Brook .. | 2 | 10 | Wellington .. | .. | .. | .. | 24,169 | 6 | .. | .. |
| J. Stevenson .. | 1 | .. | Marlborough | .. | .. | .. | 100 | .. | .. | 6 |
| N. C. Kensington | 2 | .. | Nelson .. | 5 | 16 | 184 | .. | .. | 81 | .. |
| W. T. Morpeth .. | 2 | .. | Westland .. | .. | 70 | 451 | 13 | 16 | 35 | .. |
| G. H. Bullard .. | 1 | .. | Canterbury .. | .. | .. | .. | .. | 19 | 3 | 22 |
| R. S. Galbraith | 3 | .. | Otago .. | .. | .. | 64,718 | .. | 1 | 1 | 14 |
| K. M. Graham | 1 | 2 | Southland .. | .. | .. | 20,000 | 318 | .. | .. | 10 |
| Totals .. | 35 | 19 | .. | 67 | 1,186 | 248,650 | 145,509 | 208 | 144 | 58 |

## Table 5.—Principal Classes of Office-work done from 1st April, 1923, to 31st March, 1924.

| District. | Plans placed on Instruments of Title. | | | | Deeds and other Instruments passed. | Plans examined and passed. | | | | Maps drawn for Lithography. | | Lithographs, &c., sold. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Crown. | | Native. | Land Transfer. | | Crown. | Native. | Land Transfer. | Other Departments. | Standard Publications. | Sale Plans. | |
| | Leases, &c. | Freehold. | | | | | | | | | | £ s. d. |
| North Auckland .. | 612 | 954 | 548 | 10,064 | 5,625 | 83 | 43 | 594 | 116 | 5 | 48 | 108 1 5 |
| Auckland .. | 700 | 394 | 432 | | | 218 | 186 | 921 | .. | 6 | 24 | 152 10 2 |
| Gisborne .. | 4 | .. | 371 | 616 | 413 | 9 | 52 | 66 | 17 | .. | 5 | 30 15 3 |
| Hawke's Bay .. | 51 | 54 | 434 | 957 | 713 | 17 | 40 | 96 | 23 | 1 | 6 | 15 16 6 |
| Taranaki .. | 107 | 122 | 381 | 1,281 | 1,913 | 12 | 75 | 145 | 24 | .. | 15 | 52 10 4 |
| Wellington .. | 342 | 184 | 572 | 4,862 | 4,818 | 28 | 68 | 439 | 99 | 2 | 13 | 64 17 9 |
| Marlborough .. | 90 | 16 | 70 | 281 | 68 | 14 | 14 | 48 | 32 | 1 | 2 | 44 9 11 |
| Nelson .. .. | 357 | .. | .. | 477 | 232 | 52 | .. | 102 | 6 | 3 | 8 | 34 1 6 |
| Westland .. | 234 | .. | .. | 300 | .. | 69 | .. | .. | .. | .. | .. | 61 13 9 |
| Canterbury .. | 300 | 92 | 78 | 4,392 | 2,199 | 29 | 8 | 370 | 22 | .. | 6 | 57 10 0 |
| Otago .. .. | 399 | 298 | 8 | 1,710 | 403 | 65 | 3 | 75 | 4 | 20 | 17 | 80 5 0 |
| Southland .. | 176 | 118 | .. | 953 | 547 | 20 | 2 | 78 | 14 | 2 | 5 | 70 19 2 |
| Head Office .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 14 | .. | 267 16 6 |
| Totals .. | 3,372 | 2,232 | 2,894 | 25,893 | 16,931 | 616 | 491 | 2,934 | 357 | 54 | 149 | 1,041 7 3 |

# APPENDIX I.

## HEAD OFFICE, DRAUGHTING BRANCH.

REPORT BY H. E. WALSHE, CHIEF DRAUGHTSMAN.

*Map-publication.*—During the year 103 maps, not including sale poster maps, were printed, at a cost of £938. Of these, fourteen were large-scale town maps, twenty 40-chain survey-district maps, sixty one-mile maps, and the balance small-scale general maps of the Dominion. The publication of our principal standard maps, those on a scale of one mile to an inch, is falling into arrears, and unless the printing of these is pushed ahead more rapidly it will be impossible to keep these maps in print. There are about eight hundred of these maps, which cover the whole of the Dominion on that scale, so that, allowing for an average of seven years before revising and reprinting, giving a range of from four to twelve years, at least 112 of these should be reprinted yearly. As stated above, of this class only sixty or practically half of the minimum required, were printed this year.

The cash sales of maps amounted to £869 4s. 3d., showing a steady though small increase over previous years. This is satisfactory, as it shows the growing demand for the standard maps only, no new map of general interest being published during the year. Other Departments were supplied with maps to the value of £455, this being about the usual amount for a year in which no extra-ordinary demands, such as for census, or electoral maps, have arisen.

Several large wall-maps, illustrating the products, climatic conditions, sport, scenic wonders, and various statistical information of the Dominion, were drawn and sent forward for exhibition at the British Empire Exhibition.

*Town Plans.*—The number of these plans received during the year, three hundred, is still increasing, and calls for considerable work in examining and recording them. The use of the photostat has enabled the time occupied in making our records to be considerably cut down, and the approved plans are now returned much more quickly. There is still much public agitation directed against the requirements of the Department, which shows that modern town-planning legislation is urgently required.

*Draughtsmen's and Computers' Examination.*—This examination was held in December, when thirteen candidates for the Draughtsmen's examination and two candidates for the Computers' examination presented themselves. Of these, Mr. N. P. Brinsden obtained a first-grade certificate and Mr. C. T. Brown a second-grade certificate in draughting, and Messrs. H. R. Holt and S. W. Hodgson a second-grade certificate each in computing.

This examination has now been in force for the past seven years, but has not achieved the object for which it was instituted. It was primarily intended as an incentive to the staff to improve themselves through the practice in and study of the best examples of their craft. This it has failed to do except with a comparatively small proportion, most of the staff viewing it with disfavour or suspicion. The preparation of the papers and the subsequent examination of the answers has proved a considerable task to those officers who undertook the work in their own time. Steps will be taken during the present year to simplify the requirements, while still keeping the high standard previously required.

*Standard of Length.*—The comparison of surveyors' bands with the standard band is regularly carried out, there being about 107 chains compared this year. This work is carried out under difficulties, there being no accommodation for housing the comparator. This accounts for the delay in a few cases in returning surveyors' bands, as the condition of the ground may prohibit the use of the official standard.

## HEAD OFFICE, COMPUTING BRANCH.

REPORT BY E. J. WILLIAMS, TIDE-COMPUTER.

*Tidal Operations.*—The operations for the year under report comprised the reduction by harmonic analysis of the hourly heights of the self-registering tide-gauge diagrams of the following standard ports—Wellington, for 1922 and 1923; Auckland, for 1921 and 1922; Bluff and Westport, for 1922. The values of H and K derived from these analyses have been combined with the "harmonic constants" published last year, and the mean value accepted as giving the best result. These values will be used in preparing the tide-tables for the year 1927, and are tabulated in Table C.

A diagram graduated to scale for time and height has been drawn, proved, and a supply printed for use with the automatic tide-gauge installed during the year at Gisborne.

During the coming year the diagrams from the new self-registering tide-gauges installed at Lyttelton and Dunedin—which have been in operation continuously for over twelve months—will be available for reduction by harmonic analysis.

During the year a six-figure Monroe calculating-machine was added to the equipment of the computing division for testing as to its suitability for certain portions of the tidal computations. The machine has proved to be reliable and rapid in action, and will shortly be replaced by an eight-figure machine, that type, owing to its greater keyboard capacity, being far more suitable for the work of the division.

# APPENDIX II.

## SURVEYORS' BOARD.

A PRINCIPAL event during the year was the completion and gazetting of new regulations for conduct of surveys, issued under the amendments to the Surveyors' Institute and Board of Examiners Act, under which the Board cannot issue regulations for scientific and fundamental surveys, but for land-transfer and ordinary surveys only.

Draft regulations for the conduct of examinations were also forwarded to Australia for the consideration of the reciprocating Boards.

Examinations were held as usual in September, 1923, and March, 1924. At the former forty-two candidates sat and seven passed; at the latter thirty-one sat and eight passed.

The Board has taken action during the year to obtain the amendment of the Matriculation Examination to render it more suitable to the needs of survey candidates.

Mr. Preston Chambers, a member of the Board for a number of years, resigned at the end of the year for business reasons, and Mr. A. H. Bogle, on the nomination of the Institute, was appointed in his place. Otherwise the personnel of the Board remains as formerly.

The business of the Board has noticeably increased in the last two years.

W. T. NEILL, Chairman.
M. CROMPTON-SMITH, Secretary.

# APPENDIX III.

## MAGNETIC OBSERVATORY, CHRISTCHURCH.

ANNUAL REPORT OF THE DIRECTOR (HENRY F. SKEY, B.Sc.).

DURING the year 1923 the work of the Observatory—magnetic, seismological, and meteorological—was continued as previously. The resulting mean values of the magnetic elements for Christchurch, determined from the hourly measurement of the magnetograms, are as follows:—

| | Mean Value, 1923. | Change since 1922. | Change from 1921 to 1922. |
|---|---|---|---|
| Magnetic declination (east) .. .. | 17° 11·7′ | +3·4′ | +3·7′ |
| Magnetic horizontal force .. .. | 0·22209 | −08γ | −24γ |
| Magnetic inclination (south) .. .. | 68° 12·0′ | +0·8′ | +0·9′ |
| Northerly component .. .. .. | 0·21217 | −13γ | −30γ |
| Easterly component .. .. .. | 0·06566 | +19γ | +16γ |
| Vertical component .. .. .. | 0·55526 | +19γ | −21γ |
| Total magnetic force .. .. .. | 0·59803 | +01γ | −14γ |

These values are from measurements of the Eschenhagen magnetograms, standardized by observations at Christchurch Observatory Absolute house, as previously, observations of inclination being made during the night—that is, at times when there is no tramway disturbance.

Temperature-variation compensating-magnets are in use on both the vertical- and horizontal-force Eschenhagen variometers, and such comparison as has been possible with the Adie curves here has shown that temperature effects are negligible, as the housing-chamber at Amberley is sufficiently insulated with sawdust to keep the temperature-range inside well within the degree centigrade.

The usual diurnal vector diagram in the horizontal plane, and this year in the two principal vertical planes (the latter of exceptional interest), and monthly and seasonal diurnal curves for D, H, and V are included in Volume I, Records of the Survey.

Milne seismograph No. 16 has been kept in operation, A list of records and the usual meteorological observations at 9.30 a.m., N.Z.S.T., noon, and 5 p.m., have been made, as in previous years; these together with a few notes on peculiarities of the 24-hourly wave in the diurnal variation of D and of H for 1922 are included in Volume I, Records of the Survey.

Acknowledgment is made of the receipt from numerous institutions throughout the world of their various publications. Acknowledgment is also due to my assistant, Mr. H. F. Baird, B.Sc., for valuable services during the year.

*Approximate Cost of Paper.*—Preparation, not given; printing (775 copies, including maps), £33.

By Authority: W. A. G. SKINNER, Government Printer, Wellington.—1924.

*Price 1s.*]

# NORTH ISLAND

# NEW ZEALAND

## SHOWING PROGRESS OF GEODETIC TRIANGULATION.

*Scale: 35 miles to an inch.*

Reference

| | | |
|---|---|---|
| Cities | thus | AUCKLAND |
| Provincial Centres | .. | NAPIER |
| Boroughs | .. | FEILDING |
| Town Districts | .. | MANAIA |
| Small Centres | .. | Tokomaru |
| Railways | .. | |
| Coach Routes | .. | |
| Boundaries of Land Districts | .. | |

TASMAN SEA

*REFERENCE.*

*Bases measured 1909-1913 shown thus :*

*A Waitemata.* *C Kaingaroa.*

*B Matamata.* *D Eltham-Okaiawa.*

*E Wairarapa.*

*Area covered by triangles, with signals erected, the observations at which are in progress, shown thus :*

W. T. NEILL.
SURVEYOR GENERAL
1924

BY AUTHORITY W. A. G. SKINNER, GOVERNMENT PRINTER, WELLINGTON.

1713-L.81/24

W. T. NEILL
SURVEYOR-GENERAL
1924

# NORTH ISLAND

# NEW ZEALAND

## SHOWING

## STATE OF TOPOGRAPHICAL SURVEY.

*Scale: 35 miles to an inch.*

Reference

| | | |
|---|---|---|
| Cities | thus | AUCKLAND |
| Provincial Centres | .. | NAPIER |
| Boroughs | .. | FEILDING |
| Town Districts | .. | MANAIA |
| Small Centres | .. | Tokomaru |
| Railways | .. | |
| Coach Routes | .. | |
| Boundaries of Land Districts | .. | |

TASMAN SEA

*REFERENCE.*

*Area surveyed and mapped by Topo. Section, Defence Department, shown thus* - - -

*Areas under survey by L. & S. Dept. shown thus :*

*Areas surveyed and mapped by L. & S. Dept.*

SOUTH ISLAND

PACIFIC OCEAN

172 173 174 175 East Longitude 176 177 178

34 35 36 37 38 39 40 41 South Latitude

W. T. NEILL
SURVEYOR GENERAL
1924

# SOUTH ISLAND

# NEW ZEALAND

SHOWING

## STATE OF TOPOGRAPHICAL SURVEY.

*Scale: 35 miles to an inch.*

Reference

| | | |
|---|---|---|
| Cities | thus | NELSON |
| Provincial Centres | .. | HOKITIKA |
| Boroughs | .. | TEMUKA |
| Town Districts | .. | CLINTON |
| Small Centres | .. | Lyell |
| Railways | .. | |
| Coach Routes | .. | |
| Boundaries of Land Districts | .. | |

TASMAN SEA

SOUTH PACIFIC OCEAN

Karamea Bight

Golden Bay

Tasman Bay

Pegasus Bay

Banks Peninsula

Canterbury Bight

Otago Peninsula

Stewart Island

Foveaux Strait

South Latitude

East Longitude

REFERENCE.

*Area surveyed and mapped by Topo. Section, Defence Department, shown thus*

*Areas under survey by L. & S. Dept. shown thus :*

*Areas surveyed and mapped by L. & S. Dept.*

By Authority: W. A. G. Skinner, Government Printer, Wellington.