1913.

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.

	Page
Surveys—	
Principal Work completed during the year ..	2
Triangulation	3
Standard Surveys	3
Settlement „	4
Native-land „	5
Tidal „	5
Inspections of „	6
Gold-mining „	6
Operations for Year 1913–14	6
Magnetic Observatory and Magnetic Survey ..	6
Conference of Surveyors-General, Melbourne, Australia	7
Departmental Changes	7
Obituary	8
Appendix I—	
Surveys—	
Auckland	10
Hawke's Bay	11
Taranaki	12
Wellington	14
Nelson	15
Marlborough	16
Westland	17
Canterbury	18
Otago	18
Southland	19
Appendix II—	
Chief Draughtsman, Head Office, Report of ..	21
Appendix III—	
New Secondary Triangulation, Report on ..	22
Appendix IV—	
Exploration Trip, direct route, Lake Wakatipu, to Milford Sound, Report on	28
Appendix V—	
Tidal Survey	31
Aprendix VI—	
Magnetic Observatory and Magnetic Survey ..	46
Appendix VII—	
Surveyors Board, Report of	54

	Page
Appendix VIII—	
Extracts from the Report of the Conference of Surveyors-General, &c., held in Melbourne, Australia, May, 1912	55
Tables—	
Table 1.—Summary of Field-work executed during the Year	63
Table 1A.—Return of Field-work for—	
Auckland Land District ..	64
Hawke's Bay „ ..	67
Taranaki „ ..	68
Wellington „ ..	70
Marlborough „ ..	71
Westland „ ..	71
Nelson „ ..	72
Canterbury „ ..	74
Otago „ ..	75
Southland „ ..	75
Table 2.—Surveyors employed and Work on hand	76
Table 3.—Plans placed on Crown Grants, &c., during the Year	76
Table 4.—Land Transfer Act, Work done during the Year under	76
Table 5.—Lithographs and Photographs printed and sold during the Year ..	77
Maps, Plans, &c.—	
New Secondary Triangulation ..	Facing p. 24
Sketch Plan, Lake Wakatipu to Milford Sound	„ 28
Tidal Diagram	„ 44
Magnetograms	„ 46
Seismograms (four sheets)	„ 48
Map showing Area covered by Triangulation, North Island	„ 60
Map showing Area covered by Triangulation, South Island	„ 60
Map showing state of Public Surveys, North Island	At end.
Map showing state of Public Surveys, South Island	„

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

SIR,— Department of Lands and Survey, Wellington, 14th July, 1913.

I have the honour to submit herewith the annual report on the survey operations of the Department for the twelve months ended the 31st March, 1913.

I have, &c.,

JAMES MACKENZIE,
Surveyor-General.

The Hon. W. F. Massey, Minister of Lands.

REPORT.

THE work for the past year has been, I am pleased to testify, a very favourable one indeed, and, taken as a whole, the area surveyed shows an excess over that of the previous year. Both the field and office staffs have worked in such a manner as to reflect great credit on themselves and to be productive of results which are extremely gratifying. Especially so is this the case when we consider the many disabilities at times under which some of their duties have to be carried out.

The number of surveyors employed were sixty-three staff, twelve temporary, and seventy-three contract, while apart from these there were, as usual, a number of cadets and surveyors' unlicensed assistants, all of whom were in full work during the year.

The total cost of the surveyors and their parties amounted to £113,661 6s., which is £24,131 in excess of that of the previous year. This is easily accounted for, in the first place, by the greater output consequent on the employment of additional surveyors, along with the difficulty in obtaining suitable hands for field parties, to meet the still great demand for settlement lands. There is also the coping with special and urgent survey work brought about by the acquisition of land under the Land for Settlements Act, which has to be attended to with special promptness so as to prevent loss of interest to the State. It must also be borne in mind that as settlement advances at its present rate the surveyors are driven back into more difficult country. This necessitates greater expense and brings about hardships that have to be endured and overcome—in fact, every year makes the life of the field surveyor on this account harder. This in many cases is intensified in the rough bush districts, where wet conditions so frequently prevail. Taking these facts into consideration, I think a perusal of the report will suffice to show that the staff has given a good account of itself for the season that has closed.

The following table gives a summary of the principal work completed during the year:—

TABLE A.

Class of Work.	Area.	Cost per Acre.	Total Cost.
	Acres.		£ s. d.
Triangulation, by staff surveyors	155,858	1.43d.	927 4 5
Topographical, by staff surveyors	50,657	2·13d.	450 0 2
Rural, by staff surveyors	337,521	2·00s.	33,600 14 6
Rural, by licensed surveyors	64,095	2·27s.	7,304 3 0
Rural, by licensed surveyors (costs not available)	8,299	..	..
Village and suburban, by staff surveyors	2,647	6·57s.	869 11 3
Village and suburban, by licensed surveyors	31	14·60s.	22 16 3
Town, by staff surveyors	294 (in 527 sections)	34·60s. per section	911 7 10
Town, by licensed surveyors	37 (in 112 sections)	24·21s. per section	135 12 0
Native Land Court, by staff surveyors	44,600	23·90d.	4,442 9 10
Native Land Court, by licensed surveyors	608,090	*16·70d.	42,336 8 1
Native Land Court, by licensed surveyors (costs not available)	927	..	..
Maori Land Board, by staff surveyors	15,792	22·86d.	1,504 1 3
Maori Land Board, by licensed surveyors	1,934	30·77d.	247 19 10
Gold-mining, by staff surveyors	206	4·04s.	41 13 6
Gold-mining, by licensed surveyors (costs not available)	1,706	..	..
Roads and railways, by staff surveyors	†221·84 miles	£24·29 per mile	5,387 16 9
Roads, by licensed surveyors	1·50 ,,	£16·25 per mile	24 7 6
Roads, by licensed surveyors (costs not available)	7·00 ,,	..	..

* The cost per acre is necessarily a low one when compared with the staff surveyors' work. This is due to subdivisional surveys of many blocks, where a large proportion of the outside boundaries of earlier surveys have been adopted without resurvey. † Includes 18 miles of railway.

Taking these prices in the aggregate, the cost is much the same as in previous years. In most of the classes (except rural, where the price of 1·82s. per acre last year reaches 2s. per acre this year) the cost per acre is rather lower than previously, and the rate per acre by staff surveyors compares favourably with that of contract surveyors. Accurate deductions, however, cannot always be reached with safety by a mere comparison of prices such as these. Often our most energetic surveyors at the end of a year of toil are so hampered with circumstances and conditions quite beyond their control that they find the cost of their work in the end comes out at a higher rate than other surveyors who have been fortunate in being on a block where the "going" was very much easier. With the exception, however, of a few individual cases which I have noted as being higher than usual, I am satisfied that the State has received good value for the work done by its surveyors.

Triangulation.

With the exception of the new secondary triangulation hereafter referred to, the work under this heading has been chiefly the extension of our triangulation to check settlement surveys in progress during the year.

The work on the new secondary triangulation has been pushed on actively, and many observations have been made by Mr. H. E. Girdlestone so as to allow a connection to be made between the Wairarapa and Okaiawa bases. A good many stations have still to be observed, however. A preliminary calculation by least squares has been made, and a provisional close of 2·723 links obtained in an approximate distance of 154 miles. This will probably be much improved when some eight of the triangles are reobserved. The area on hand between the bases is between two and three million acres.

Full particulars are given in the appendix of the provisional results of the calculation of the triangulation, and an example of the actual method of calculation adopted is given in detail.

Observations both for azimuth and latitude are now required at a number of points, so distributed as to eliminate as much as possible the errors due to the deflection of the plumb-line.

Mr. John Langmuir, Inspector of Surveys, has continued his work on the new base-line measurements during the year in his usual able, methodical, and scientific manner. The last base selected is situated on the Kaingaroa Plains. In regard to the accuracy of our base-line measurements I may say that, although the final results have not been worked out yet, as far as they are completed, however, I feel sure that the New Zealand work will stand comparison with that carried out in any part of the world. From particulars in Appendix III it will be seen that the probable errors vary from about 1 in 3,000,000 to 1 in 5,000,000, but this does not include final comparison with the standard bar only recently obtained from England by the Department. Mr. Langmuir has also had a party out selecting and erecting new signal-stations for extension purposes in the Auckland District after they had been examined and approved by himself. (For further particulars of this see Appendix III.)

Standard Surveys.

The necessity for this class of work arises primarily from the fact that very often the original surveys were not carried out with the accuracy that is necessary to ensure the definition of present-day titles. This, of course, is largely accentuated by the high value now placed on town and suburban holdings. Land that could probably have been purchased sixty or seventy years ago for a mere trifle has now reached as high as £1,200 per foot. It will thus be readily understood that surveys in connection with such land require to have values of length standardized to a scientific fineness in order to check and keep under proper control the different Land Transfer operations which come under the supervision of the Chief Surveyors in the district survey offices throughout the Dominion. The difficulties are increased by the fact that in our larger cities and towns where the money value of property is the highest most of the original survey marks are gone, and the surveyor has often greatly to depend on other evidences on which to reproduce the alignments of the city, originally surveyed perhaps three-quarters of a century ago. A standard survey is therefore really a great mathematical problem laid down in our streets with the greatest accuracy obtainable with scientific instruments, and is of such a character as to provide a thorough crucial test to every survey that connects with it. In the City of Auckland at the present time standard lines are being measured to the two-hundredth part of a link, whilst the same character of work is being carried out in the cities of Wellington, Nelson, and Dunedin. The local bodies in each centre are contributing to the cost of such work, they being chiefly interested in the delimitation of the streets, &c. The larger amount of this class of work has been carried out in the City of Auckland and suburbs under the supervision of Mr. John Langmuir, Inspector of Surveys, who

has associated with him Mr. H. M. Kensington, District Surveyor. The latter officer is now carrying on the major part of the field-work, as Mr. Langmuir has been giving his special attention to base-line measurements in connection with the new major triangulation of the North Island.

All the standard survey work of the City of Auckland has been completed, according to the boundaries as they existed at the commencement of the work. Since then, however, four new streets have been formed, and a standard and alignment survey made of these.

The field-work of the standard survey of the Borough of Parnell has been completed, and the plans, which are well forward, only wait the final determination of the alignments. In connection with this work fifty-three large scale offset plans of seventy streets have been drawn. This borough has now become merged in the City of Auckland.

Two valuable index plans of the Auckland standard survey have been drawn by Mr. Jarman, whose neat and careful draughtsmanship at the age of nearly fourscore years reflects the greatest credit to him. These have been photo-lithographed.

The field-work for the Auckland suburban standard survey has been completed along certain roads, necessitating a total chainage of 33½ miles and the insertion of 259 standard blocks.

Otahuhu standard survey: All preliminary offsets and ranging are now complete upon this work, in addition to which 92 chains of permanent offsets have been taken.

Mr. J. D. Climie, Inspector of Surveys, reports that the plans of the Hutt–Emerald Hill standard traverse were plotted and finished, and will be found of great use in checking future surveys.

Mr. W. T. Neill, District Surveyor, continues to make good progress with the standard survey of the City of Dunedin, 28 miles of streets having been traversed and marked during the year, but reports that the weather throughout has been very unfavourable for the work. Mr. Neill is carrying out this important duty with the care and precision that marks everything that passes through his hands. A remarkable feature of this work is the exceptional accuracy of the original survey of the City of Dunedin, executed nearly seventy years ago by the late Mr. Charles Kettle, the first Chief Surveyor of Otago.

Mr. C. Adnam Mountfort, District Surveyor, completed the observations necessary for the determination of true meridian at Ikitara and St. John Park, Wanganui, and has also been engaged upon, and brought to completion in the field, the standard survey of the Borough of Wanganui and the Town District of Gonville.

A standard survey of the City of Nelson has been urgently needed for a long time, and at the completion of the above-mentioned work Mr. Mountfort was transferred thence in the middle of November, at which time the work began. Up to the 31st March he reports that three-eighths of the field-work has been completed, and in conjunction with his operations he has thrown a revised minor triangulation over his work.

Further standard surveys are required all over the Dominion, and quite a dozen surveyors could be profitably employed on this class of work, but the pressure of settlement surveys for the present precludes this most necessary work being attended to.

Settlement Surveys.

The work coming under this head has during the year been pushed on with special vigour, and reaches a total area of completed surveys of 430,651 acres. These are comprised under the different heads as follow: Rural, 409,915 acres; village and suburban, 2,678 acres; Maori Land Board subdivisions, 17,726 acres; town allotments, 332 acres. These will be found, if desired, divided up into their respective districts by referring to the tables dealing with same, and also to the reports by the several Chief Surveyors.

A further area of 50,657 acres situated in the land districts respectively of Auckland, Nelson, Westland, and Canterbury has been topographically surveyed for the purpose of promptly throwing open for selection before final survey. Apart from this a large area has also been completed in the field, but owing to the plans not having been sent in this must come into the work of next year. It is needless to add that the great aim of the Department is to meet the keen demand always existing for suitable settlement land, and the areas quoted above show to what extent the Survey Department has endeavoured to satisfy the call for "more land." To further meet this still unsatisfied want I may state that for the coming year an area of ordinary settlement land reaching a total of 723,621 acres is in hand by staff and contract surveyors, a fair proportion of which has already been completed in the field. This area is spread over the following districts, viz.: Auckland, 220,404 acres; Hawke's Bay, 122,274 acres; Taranaki, 86,843 acres; Wellington,

56,279 acres; Nelson, 102,674 acres; Marlborough, 7,145 acres; Westland, 14,774 acres; Canterbury, 105,440 acres; Otago, 289 acres; Southland, 7,499 acres.

Apart from the above-mentioned areas there will, in the ordinary course of events, be the urgent surveys of land acquired from time to time by the Crown under the Land for Settlements Act. These surveys receive, as I have previously indicated, immediate attention by the Department, and as soon as the purchase arrangements are completed, surveyors are despatched to prepare them without loss of time for opening to the public, all such operations being treated as urgent.

Native-land Surveys.

The area of Native land surveyed during the year reached a total of 671,343 acres, in 2,755 subdivisions, which is a record for more than twenty years past. This total is made up of 653,617 acres, in 2,714 subdivisions, of Native Land Court surveys, and 17,726 acres, in 41 subdivisions, of Maori Land Board surveys.

The Native Land Court area comprises 44,600 acres, in 378 subdivisions, surveyed by the staff surveyors; 608,090 acres, in 2,314 subdivisions, by contract surveyors; and 927 acres, in 22 subdivisions, by licensed surveyors, who were paid by the applicants.

The Maori Land Board area comprises 15,792 acres, in 37 subdivisions, which was surveyed by the staff surveyors, and 1,934 acres, in 3 subdivisions, surveyed by contract surveyors.

An area of 614,997 acres represents surveys in hand and those waiting survey during the coming year. Out of this total the staff surveyors have allocated to them an area of 187,223 acres, and the contract surveyors 427,774 acres, confined almost exclusively to the districts of Auckland, Hawke's Bay, Taranaki, and Wellington.

The surveys of these lands all materially assist in furthering settlement, although nothing like to the same proportion as do our Crown lands, more particularly those specially acquired for the purpose.

Tidal Surveys.

On the 13th August, 1909, a communication was forwarded from the Lords Commissioners of the Admiralty to the Under-Secretary of State, Colonial Office, on the subject of supplementing the Admiralty Time-tables, which had hitherto been restricted to British and Irish ports, by the inclusion of information respecting certain standard Indian and colonial ports. The Secretary of State, on the 21st August, 1909, addressed His Excellency the Governor on the subject, and on the 21st October, 1909, the Secretary for Marine wrote to the Surveyor-General, and also pointed out the necessity of supplying these tidal predictions for publication in the New Zealand Nautical Almanac. The then Surveyor-General, on the 28th October, 1909, replied to the Secretary for Marine stating that the Department could undertake the work provided the necessary funds were forthcoming, and pointing out that the work of predicting the tides is of a highly technical and laborious nature, involving a large amount of calculation.

This Department had hitherto made no provision either for the harmonic analysis of tidal observations nor for the prediction of tides. As, however, Mr. C. E. Adams, M.Sc., F.R.A.S., Chief Computer, was conversant with the technicalities of the work, and had indeed made a special study of it and of the higher mathematics required, the whole conduct of the tidal survey was handed over to him. Two Computers—Mr. T. G. Gillespie and Mr. J. J. Hay—were appointed, and operations were actively put in hand. There were many initial difficulties to overcome, but these were successfully handled. A complete harmonic analysis of the Wellington and Auckland tides was made, and from the harmonic tidal constants thus derived the tides for these ports were predicted for the year 1912. These tide-tables are published by the Marine Department in the New Zealand Nautical Almanac and Time-tables, and by the Admiralty in the Admiralty Tide-tables. This is the only tidal survey in Australia and New Zealand. The accurate and successful manner in which this important work has been carried out reflects the greatest credit on the officer responsible and the staff employed. Details of the year's operations will be found in Appendix V.

I may mention here that, in addition to his other duties, Mr. C. E. Adams, in connection with his position as Government Astronomer, has spent quite half of his time at astronomical work. The British Antarctic Expedition was responsible for a large portion of his work for the year, the pendulum observations for the determination of gravity both at Christchurch and Wellington by Mr. C. S. Wright requiring much additional astronomical observations of the highest accuracy for this work. Mr. Wright conducted gravity observations at Potsdam before going to the Antarctic, and his observations in the Antarctic and in New Zealand will be checked again by further observations at the base station at Potsdam on his return to Europe.

Survey Inspections.

Although a greater number of survey inspections have possibly been made this year than last, it is very necessary that closer attention should be given to this essential element in our system. Pressure of settlement work has prevented more being undertaken, but something like a hundred inspections have been made, more or less, over the North and South Islands. These have been taken in hand chiefly by Inspectors J. D. Climie and W. J. Wheeler, whilst the district and senior staff surveyors have also largely assisted as occasion required.

In the great majority of cases the work inspected was of a very high order indeed. In some nine or ten instances, however, the surveys were found to be defective and call for further drastic action. As against this it is satisfactory to note that in the case of the better class of surveyor, fortunately still predominant, although the limit of error is fixed at 4 links to the mile for rural surveys, the average error for the Dominion as reported only amounts to 0·75 link per mile.

Gold-mining Survey.

The number of claims surveyed during the year was forty-one, representing an area of 1,912 acres. Of this area 206 acres, in four claims, situated in the Otago District, was surveyed by staff surveyors, at an average cost of 4·04s. per acre; whilst the balance of 1,706 acres, comprising 1,592 acres in thirty-four claims, in the Otago District, 68 acres in one claim in the Southland District, and 46 acres in two claims in the Auckland District, was surveyed by licensed surveyors and paid for by applicants.

Operations for 1913–14.

Taking into account those surveys that are actually in progress, those contemplated to be taken in hand, as well as those in prospect, there is every indication that the work of the Department for the coming year will, as usual, be a very busy one.

At the beginning of the new year the number of staff surveyors is seventy-nine, of which fourteen are temporary. In addition to these there are ninety-two contract surveyors, which makes a total of 171 surveyors. The work allocated to these is divided up as follows:—

——	Triangulation.	Settlement.	Roads.	Town.	Native Land.
	Square Miles.	Acres.	Miles.	Acres.	Acres.
Staff	4,577·40	696,497	308	12	187,223
Contract	..	27,124	32	2	427,774
	4,577·40	723,621	340	14	614,997

Apart from the foregoing, the cutting-up of estates acquired by the Government from time to time for closer settlement under the Land for Settlements Act will have to be undertaken. There is also the work in conection with the standard survey of the cities and towns that is still being carried on by surveyors specially appointed for the purpose.

The inspections of surveys during the year will have to be carried out with even more vigour than previously.

The Magnetic Observatory and Magnetic Survey.

The activities of the Observatory have been continued during the year in the direction of obtaining the diurnal magnetic curves, the registration of earthquakes, and other observations, and also particularly in the direction of serving as a magnetic base for the late Captain Scott's South Polar Expedition and in co-operating in the magnetic work of Dr. Mawson's Antarctic Expedition.

The equipment of the Observatory has been added to in several ways, notably by the provision of a set of delicate Eschenhagen-Toepfer magnetographs which have been erected at a substation in the Kowai Domain at Amberley for use in co-operation with the expeditions. The Observatory has also received from the British Antarctic Expedition the gift of a valuable set of storage batteries for use in the substation. Weber's apparatus for the determination of the induction coefficients of magnets has also been provided.

Mr. Wright, the physicist of the British Expedition, has emphatically pointed out the importance of the future work of the Observatory in carrying on magnetic observation at the most southerly permanent magnetic station on the globe, because it is to its work that magneticians of past and future expeditions look to enable their observations to be of the fullest and of permanent scientific value. At the same time Mr. Wright has pointed out that the Observatory is at present understaffed. He acknowledges gratefully the great assistance the Observatory has afforded to the expedition.

The detailed report of the Officer in Charge, Mr. H. F. Skey, B.Sc., appears in Appendix VI.

Conference of Surveyors-General at Melbourne.

At the invitation of the Government of the Commonwealth of Australia I attended, in company with Mr. C. E. Adams, M.Sc., F.R.A.S., Government Astronomer, a conference of Surveyors-General of the different States of Australia. This was held at Melbourne in May, 1912, and was called together for the purpose of discussing survey matters and associated subjects of great importance, with the idea of bringing about a reciprocity on same between the different States of the Commonwealth and the Dominion of New Zealand. The New Zealand representatives were well received and hospitably entertained in all the States visited. With the exception of West Australia, I visited the Land and Survey Offices of the different States in order to secure information as to their methods, &c., in vogue, and which might be of service to the Dominion. I have given extracts from the report of the proceedings of the conference which may be of interest to the profession in New Zealand. These will be found in Appendix VIII.

I might mention that the Surveyors-General of the Commonwealth of Australia expressed the wish of having a conference of Surveyors-General, to possibly combine with the Surveyors' Boards, in New Zealand during the summer of 1914. There has never been a conference of such bodies in this Dominion, whilst meetings have taken place in several of the States of the Commonwealth. There are still important remits to be considered from the conference held in London on the 31st May, 1911, at the Surveyors' Institution, Westminster, on the question of reciprocity throughout the Empire in the examination and authorization of surveyors, and I would strongly recommend that these be dealt with, along with other scientific subjects, at a conference proposed to be held in this Dominion about the time suggested, and that our Government be asked to grant facilities for such a gathering. The Empire's oversea dominions of Canada, South Africa, Australia, and New Zealand are all interested in this work, and it would be a compliment to this Dominion if the Australasian Section held its meeting in New Zealand.

Departmental Changes: Promotions, Transfers, etc.

The following changes consequent on my promotion from Chief Surveyor and Commissioner of Crown Lands, Wellington, to the position of Surveyor-General of this Dominion at the beginning of the year have taken place.

Mr. T. N. Brodrick, Chief Surveyor and Commissioner of Crown Lands for Canterbury, was promoted to succeed me at Wellington. Mr. C. R. Pollen, Chief Surveyor and Commissioner of Crown Lands for Hawke's Bay, was promoted to a similar position in Canterbury, while Mr. R. T. Sadd, in the same capacity, was appointed to take his place. Mr. F. A. Thompson, Chief Draughtsman at Napier, was promoted to be Chief Surveyor and Commissioner of Crown Lands at Nelson, while Mr. H. Mackay, Land Transfer Draughtsman at Wellington, was promoted to succeed him at Napier. Mr. John Cook, Land Transfer Draughtsman at New Plymouth, was promoted to the Wellington branch, his position being taken by Mr. F. J. Harrop, of the Napier office. Mr. R. S. Galbraith, Inspecting Surveyor, Auckland, was promoted to be Chief Draughtsman at Invercargill.

Other changes were as follow:—

Head Office: Mr. H. E. Girdlestone, who has been engaged on triangulation work, was returned to the staff of the Wellington District office consequent on the special need for settlement-survey work. Mr. K. M. Ballantyne, draughtsman and computer, resigned, and Mr. E. S. Wood, draughtsman, was transferred to Invercargill. During the absence on sick-leave of Mr. H. T. McCardell, Chief Draughtsman, for a period of three months during the year, his duties were efficiently carried out by Mr. H. A. R. Farquhar.

Auckland office: Three draughtsmen—viz., Messrs. R. Covil, J. Sims, and W. Scanlen—retired on superannuation. Five temporary draughtsmen were appointed—viz., J. R. Page, L. E. Martin, C. Acton, M. W. Haworth, and W. Moore; also one draughtswoman, Miss D. Warner. Messrs. W. S. Walker, F. A. Gainsford, and H. C. Hooper, temporary draughtsmen, resigned. The following draughting cadets were appointed—viz., A. C. Haase, H. M. Lawrey, A. D. Bines, L. B. Freeman, and B. Hutton.

Napier office: Mr. F. R. Burnley, assistant surveyor, was transferred to Auckland, and Mr. George Duncan, for many years in charge of the safe, retired from the service.

New Plymouth office: Mr. R. R. Richmond, temporary surveyor, was transferred to Canterbury.

Wellington District office: Mr. W. M. Gray, staff surveyor, was transferred to the Hawke's Bay District, as also Mr. Olsen, unlicensed surveyors' assistant. Mr. H. L. P. Dyett, staff surveyor, resigned to take up private practice. Mr. R. F. W. Mackenzie passed his surveyors' examination and was thence transferred to the field in the Auckland District. Messrs. L. W. B. Hall and N. A. Middlemas were transferred from the office staff to positions on the field staff in the Auckland District.

Nelson office: Mr. P. R. Wilkinson, temporary surveyor, was transferred to Auckland, Mr. S. Parkinson, surveyor and draughtsman in the office, taking his place in the field. Mr. E. A. Ingram, draughtsman, was transferred to Hokitika.

Blenheim office: Messrs. A. Hodgkinson, District Surveyor, and L. Hunt, temporary surveyor, were transferred temporarily for urgent work to the Auckland and Canterbury districts respectively.

Hokitika office: Mr. H. G. Bateman, temporary draughtsman and computer, resigned. Mr. J. R. Clements, draughtsman, was transferred to the Wellington District office. Mr. J. Fitzsimmons was appointed draughting cadet.

Christchurch office: Mr. A. G. Allom, District Surveyor, resigned in October. Mr. W. E. Taylor, temporary draughtsman, was transferred to the Napier office. Mr. R. T. Burgess, cadet, was transferred to the field staff of the Wellington District. Mr. H. W. Harris, draughting cadet, resigned.

Dunedin office: Mr. C. E. Pfeifer, draughtsman, was transferred to the Napier office.

Invercargill office: Mr. S. Robinson, Chief Draughtsman, was transferred to the Christchurch office. Mr. S. T. Seddon, survey cadet, was transferred to the Wellington District office.

Obituary.

During the year death has removed another small band of surveyors from among us, viz.,—

Francis Simpson, late Chief Surveyor and Commissioner of Crown Lands at New Plymouth. He was born at Lancaster, England, in the year 1846. At the age of seven he arrived with his parents at Auckland, where he was educated at the Wesley College and at the Church of England Grammar School. As a young man he served in the Maori war, and held a commission in the 2nd Waikato Regiment. In the year 1875 he joined the Survey Department at Gisborne as a District Surveyor, which appointment he held till 1892, at which time he was promoted to be Chief Draughtsman at the Napier office. In the year 1904 he was promoted to be Chief Surveyor and Commissioner of Crown Lands at New Plymouth, and filled this position with credit until his retirement on superannuation in 1911, after thirty-six years of faithful work in the service of the Department. Amongst other positions held by him in Taranaki were those of Chairman of the Mount Egmont Domain Board, member of the Board of School Commissioners, whilst he also was a member of the North Island Representation Commission for the adjustment of the electoral districts. Throughout Taranaki and other parts of the Dominion he was well known and held in high esteem. Owing to continued illness, his death, which took place on the 23rd April, 1912, at New Plymouth, was not unexpected.

Edward James Campion: This surveyor—a type of the older class—was one of the landmarks amongst the New Zealand profession. He entered the service of the Provincial Government of Wellington during the fifties, and executed a large number of surveys of all kinds. Subsequently he went into private practice as a licensed surveyor, and in later years was from time to time employed by the General Government as surveyor and draughtsman. Mr. Campion was well known, particularly in the Wellington District, and his happy and cheerful disposition gained for him a large circle of friends, especially amongst the earlier settlers in the country districts. His death was reported from Gisborne.

John Reay Mackay: This well-known Taranaki surveyor died at New Plymouth after being in failing health for a considerable time. He was a son of Mr. Joseph Mackay, formerly principal of the Wellington Boys' College. His sphere of work lay chiefly in the country districts between Hawera and New Plymouth, and was generally confined to private practice. In all his work he was recognized as a conscientious and painstaking surveyor. Throughout the Taranaki District, where his sterling qualities were so well known, his death will be felt by a large circle of friends both in the profession and out.

John Tiffin Stewart, M. Inst. C.E.: Since the end of our survey year this well-known and experienced engineer and surveyor passed away on the 19th of April, 1913, at the ripe age of eighty-five years. He was a native of Scotland, where he obtained his credentials as a civil engineer. During the fifties he joined the survey staff of the Wellington Provincial Government, and in the early sixties was a leading District Surveyor, conducting many important surveys particularly on the west coast of the province. Later on he became Provincial Engineer, and after the inception of the late Sir Julius Vogel's public-works policy in 1870 by the General Government Mr. Stewart was appointed District Engineer for the West Coast District of Wellington with his headquarters at Foxton. In his new capacity the construction of the present railway-line from Foxton to Palmerston North (then only a tramway-line) was one of the first important works which came under his supervision. This and other works carried out by him at this period have

clearly shown what value his undoubted ability has been to the Dominion. The engineering work, however, on the Wanganui River, which was carried out by him in an honorary capacity, is such as will always stand as a lasting monument to his professional skill and indefatigable energy. In this work he so successfully combated the wild forces of nature and so controlled and utilized the waterfalls and rapids of New Zealand's Rhine as to provide a safe waterway through reaches of unsurpassing beauty and grandeur. The engineering skill that he displayed here was such as to call forth high commendations from his professional *confrères* and others. The result is an immense gain to the Dominion annually of thousands of tourists from all quarters of the globe, who are enabled to visit these scenes of loveliness with safety that in earlier days were always fraught with danger. In 1889 Mr. Stewart retired into private life at Aramoho. His energy, however, and public spirit were such that even in his retirement it is said he crowded more work than some men show while still in harness. Notwithstanding his unassuming and retiring nature, all organizations in Wanganui for the advancement of art and science—viz., the astronomical, orchestral, arts and crafts, beautifying societies, as well as the Museum trustees—found in him a ready and financial supporter. To all of these he gave his time and talents ungrudgingly. From all parts of the community where he lived during his retirement, and elsewhere, come the many expressions of profound regret at his death, and which clearly voices the universal respect and honour in which he was so justly held and esteemed.

George Mackenzie: News is to hand that Mr. George Mackenzie, one of the oldest and most respected of our authorized surveyors, has joined the great majority. He was born in Kinross-shire, Scotland, in 1839. In the year 1857 he came out to Dunedin, and, studying first under the late Mr. Alex. Garvey, District Surveyor, Otago, and then under Mr. Mountfort, sen., he shortly afterwards qualified as a surveyor and followed that profession. In 1863 he was appointed Assistant Surveyor in the service of the Otago Provincial Government. Later on he was promoted to District Surveyor, and finally retired from the service in 1909. In his time Mr. Mackenzie conducted many very important surveys in Otago. During his long career as a pioneer and settler he had to face the difficulties associated with early settlement and the building-up of a new country. He was a man of the very highest integrity of character, and imbued at the same time with strong religious feelings. During his later years he was closely connected with evangelical and mission work. His death took place at Queenstown on the 1st June, 1913, at the ripe age of seventy-four years; and so passed away one universally esteemed and respected, and who in his every walk of life faithfully fulfilled his part to the last both as a man and a Christian.

Captain J. D. R. Hewitt, R.N.: This gentleman, who was another well-known figure in connection with the survey profession, passed away on the 10th July, 1913, at Palmerston North, in which town he had been resident for many years. After leaving the Royal Navy he joined the Provincial Government Survey staff in Wellington as Surveyor and Chief Computer about the year 1873, continuing afterwards in the service of the General Government. His special work was largely on the scientific side, and together with the late Mr. Henry Jackson, F.R.G.S., a former Chief Surveyor of the Wellington District, he took part in scientific and astronomical research work, and was one of the observers of the Transit of Venus in 1882. After retiring from the Service he followed farming pursuits successfully in the Fitzherbert district, where he took up a large area of forest country. In his day he was one of the ablest men from a scientific and mathematical standpoint that the Department had. In addition to this his sterling uprightness of character always commanded respect, and, whether in his capacity as a Royal Naval officer or Dominion surveyor and scientific computer, he served his country faithfully and well. As churchman and settler he also deservedly received the respect and esteem of his fellow-citizens, a large number of whom will regret the loss occasioned by his death.

Conclusion.

I have personally inspected and reported on all the district and sub offices in the Dominion with the exception of the Wellington and Blenheim offices and sub-offices of Hamilton and Wanganui. Survey matters were discussed with the officers in charge at various centres, and when opportunity offered I visited the staff surveyors in their respective camps. I also inspected Crown and land-for-settlement blocks in advance of their being offered for selection. My visit in dealing with the above extended from the Bay of Islands in the North to Foveaux Strait in the South, and included the east and west coast districts of both Islands.

I have to thank the survey officers of the Department—senior and junior alike—in both the head and district offices of the Dominion for their zealous, ready, and willing co-operation with me throughout the year that has closed.

James Mackenzie,
Surveyor-General.

APPENDICES.

APPENDIX I.—SURVEYS.

AUCKLAND.

Minor Triangulation.—The staff surveyors executed 40,750 acres, costing 0·8d. per acre, in Rotorua, Waitemata, and Kawhia Counties.

Topographical.—An area of 11,369 acres, costing 5·16d. per acre, for the Native Land Court, was surveyed by one of the staff surveyors. There is also an area of 23,555 acres of Crown land in the hands of staff surveyors (opened on scheme plans), the cost of which is carried forward to the completion of the survey.

Rural.—133,249 acres were surveyed during the year, comprising 115,442 acres, costing 1·45s. per acre, by the staff surveyors; 11,713 acres, costing 1·95s., by contract surveyors; and 6,094 by private surveyors, the cost of which is not available.

Village and Suburban.—2,352·2 acres in 111 subdivisions by the staff surveyors, costing 3·28s. per acre, and 1·3 acres in 4 subdivisions by private surveyors, costing 129·23s. per acre.

Town Section.—The staff surveyed 209·8 acres in 322 sections, costing 32·91s. per section, and private surveyors 5·5 acres in 8 sections, costing 70·88s. per section.

Native Land Surveys.—The total area surveyed under this heading is 442,948 acres, in 1,732 subdivisions. The staff surveyed 33,921 acres in 214 subdivisions, costing 19·61d. per acre, for the Native Land Court, and 3,292 acres in 12 subdivisions, costing 37·81d. per acre, for Maori Land Boards. Licensed surveyors accounted for 402,963 acres in 1,489 subdivisions, costing 16·77d. per acre, for the Native Land Court, 1,902 acres in 3 subdivisions, costing 28·98d. per acre, for Maori Land Boards, and 870 acres in 14 subdivisions for the Native Land Court, for which they were paid privately.

Gold-mining Surveys.—A private surveyor completed 2 claims, containing 46 acres, the cost of which is not available.

Roads, &c.—The staff executed 108·5 miles, at an average cost of £21·33 per mile.

Other Work.—Miscellaneous surveys, reports, repegging, inspections, engineering surveys, &c.

Inspections.—Thirty-six inspections of surveys have been made, and Mr. W. J. Wheeler, Inspecting Surveyor, reports that, with two exceptions, all the work tested was of a decidedly higher standard than surveys of former years.

Traverse Closures.—Taking 69 average closures by the staff surveyors, totalling 140·4 miles of chainage, a mean close of 0·54 of a link on meridian and 0·56 of a link on perpendicular per mile is obtained.

Contract Surveys.—Private surveyors have on hand 7,809 acres of Crown land, 300,010 acres of Native land, and 26 miles of roads, principally deviations.

Office-work.—Land Transfer Branch: 781 plans of 6,417 allotments, containing 197,716 acres, were passed, and 1,279 traverse sheets examined, 169 tracings prepared, and 35 plans compiled. Mr. A. B. Harding, of Land Transfer Office, indorsed 3,433 plans on certificates of title, &c., and made 25 tracings and plans.

Native Land Surveys Branch: 373 plans examined and approved, containing 375,522 acres in 1,271 subdivisions; 56 plans compiled and 219 tracings prepared; 1,285 Court orders indorsed on certificates of titles, &c.; 200 applications to Wellington for financial authority, and 374 authorities to survey issued; 11 Native Land Courts were attended, £1,120 16s. 6d. survey liens collected, and 212 charging-orders obtained, and 12,899 acres of land taken in lieu of survey costs; £21,338 6s. 3d. survey liens received.

Legislation (Roads, &c.) Branch: 261 plans of roads taken and closed (343 miles); 2,327 acres passed; 18 railways plans (71 miles, 852 acres); 45 plans proclaiming 3,225 acres for various purposes were examined and passed; 293 plans entered on all records, 24 plans compiled, and 221 tracings prepared.

Computing Branch: 191 plans, containing 211,964 acres of Crown land in 1,112 sections, were examined and passed; 3 mining plans and 2 residence-sites (mining) were examined and forwarded to Warden (these involved the examination of 518 traverse sheets and 78 connecting triangle sheets); 336 chain lengths surveyors' steel tapes were tested and certificates issued; 989 tracings for posters, selectors, surveyors, &c., were prepared. Applications for loans amounting to £22,410, on 19 blocks containing 66,745 acres, were prepared.

General: Fees collected, £339 19s. 3d.; 4,075 plans were indorsed on Crown grants, &c. The total number of plans passed by this office was 1,674; plans compiled, 115; tracings &c., made, 1,598; and 8,693 plans indorsed on titles, &c.

Proposed Operations, 1913–14.—Twenty-seven surveyors (twenty-one staff, and six temporary) have on hand 212,595 acres of Crown land, 100,187 acres of Native land (54,571 acres of which is for Maori Land Boards), and 157 miles of road surveys. In addition to the above the larger areas of Crown land and new purchases proposed to be surveyed for selection are as follows: Mangonui County, 11,800 acres, including 10,900 acres national endowment; Wha-

ngaroa County, 2,900 acres; Bay of Islands County, 49,000 acres, including 24,000 acres national endowment; Hokianga County, 17,000 acres, including 11,000 acres national endowment; Hobson County, 1,000 acres, national endowment; Whangarei County, 6,200 acres, including 3,800 acres national endowment; Otamatea County, 5,100 acres, including 3,200 acres national endowment; and 1,400 acres, balance Bickerstaffe Settlement; Rodney County, 1,100 acres; Waitemata, 6,600 acres, including 1,700 acres national endowment; Kawhia County, 21,000 acres; Awakino County, 8,000 acres; West Taupo, 30,000 acres; Waitomo County, 13,800 acres; Waikato County, 7,800 acres, including 6,400 acres national endowment; Ohinemuri County, 8,800 acres; Tauranga County, 8,000 acres, comprising 3,000 acres national endowment and 5,000 acres land for settlement; Matamata County, 20,300 acres, including 2,300 acres national endowment; Rotorua County, 10,000 acres; East Taupo, 4,600 acres, including 3,000 acres national endowment; Whakatane County, 3,000 acres; Opotiki County, 52,000 acres, including 20,000 national endowment.

Accounts.—Mr. David Smith, Accountant, reports that the number of vouchers which passed through the books for the year amounted to 3,061, for an expenditure of £85,498 19s. 5d. 2,404 vouchers, representing an expenditure of £49,545 12s. 6d., were paid from Imprest Account by 2,876 cheques; while 657 vouchers, for an expenditure of £35,953 6s. 11d., were sent to Wellington for payment direct from the Treasury. On Official Account 1,229 cheques were issued for an expenditure of £16,626 3s. 10d. Under the Public Works Fund advances amounting to £2,740 17s. 3d. were made to the settlers on improved-farm settlements, while £1,085 2s. 8d. was expended on the purchase of stock for the settlers.

Transfers, &c.—The field staff has been augmented by means of transfer and new appointments by eleven officers. Mr. R. S. Galbraith, Inspecting Surveyor, was promoted to be Chief Draughtsman at Invercargill. Five draughtsmen resigned and eight new appointments were made, being a net increase of three. Five draughting cadets were also appointed.

Conclusion.—The work passing through the office still shows an increase, and it is very difficult to keep the current work going and also satisfy the public on the present staff. The increased volume of work in field and office can only be met by additional draughtsmen, which are urgently required, and the question of the increased accommodation necessary is also brought under your consideration. I have to thank the officers, both field and office, for their unremitting efforts during the year, which has been an exceedingly arduous one.

H. M. Skeet,
Chief Surveyor.

HAWKE'S BAY.

Minor Triangulation.—An area of 56,823 acres of this class of work was executed during the year for the purpose of controlling sectional surveys. Owing to the stress of work surveying land for settlement, it has been impossible to execute any more of this class of work than was absolutely necessary, although the triangulation in this district is in a bad state, and requires a thorough revision to bring the triangulation in various parts of the district executed on different units of measurements into unison, and to agree with the Imperial standard.

Topographical Survey for Selection.—Although nothing has been returned under this heading, a good deal of preliminary topographical work was done on the Sherenden and Waihau Settlements in order to provide a scheme of roading and subdivision for approval before the execution of the final survey, the cost of which will be included in the sectional survey.

Rural.—The work executed during the year consisted principally of four blocks situated in the Survey Districts of Takapau, Patoka, Tutamoe, Runanga, Heruiwi, Porangahau, and Tautane, and comprised an area of 70,098 acres, at an average cost of 0·88 of a shilling per acre. Of this area, 57,035 acres was executed by contract surveyors, at an average cost of 0·82 of a shilling per acre; while the balance of 13,063 acres was executed by contract surveyors, at an average cost of 1·15s. per acre. Included in the 57,035 acres is an area of 50,683 acres representing the Pohokura Block, situated in the Runanga and Heruiwi Survey Districts, and surveyed by Mr. H. E. Walshe. This block lies in the Auckland Land District, and though surveyed by one of the Hawke's Bay staff on account of its being more easily worked from this district, it has to be returned in the table for the former district. This leaves the total portion for the Hawke's Bay District to stand at 19,415 acres, at an average cost of 1·73s. per acre. The 4,900 acres surveyed by Mr. J. Roddick is a subdivision of two small grazing-runs..

Town Surveys.—Only 2·31 acres was executed under this heading, in eight lots, at a cost of 103·52s. per acre.

Village and Suburban.—Ninety-five lots were laid off, containing 39·13 acres, at a cost of 77·98s. per acre.

Native Land Surveys.—The total area surveyed by the staff was 14,913·56 acres, at a cost of 20·53d. per acre, in 58 subdivisions, all in small lots with the exception of Tutaekuri No. 1, 12,500 acres (Maori Land Board subdivisions), in 25 lots, and Kohotea West, 1,598 acres, in 2 subdivisions (Native Land Court). The area surveyed by licensed surveyors was 28,879 acres, at a cost of 24d. per acre, and comprised 28,847 acres for Native Land Court and 32 acres for Maori Land Board.

Roads.—A length of 17·90 miles was surveyed under this class, nearly all in short lengths, to gives access to blocks being subdivided; average cost, £18·81 per mile.

Other Work.—Nearly half this amount was incurred in the Gisborne office as general departmental work; the balance consists of miscellaneous duties, such as minor surveys, inspections, reports, &c.

Field Inspections.—Nine field inspections were made by Messrs. T. Brook, Land Officer and Inspecting Surveyor, T. Cagney, and W. M. Atkinson, which were, with one exception, satisfactory. Several inspections were made by Mr. J. D. Climie, Inspector of Surveys, which were not altogether satisfactory, and demonstrate the necessity for every surveyor's work, whether staff or private, being inspected in a systematic manner at least once a year.

Work in Progress.—The following are the principal surveys in hand: Sherenden and Waihau Settlement, 26,740 acres, completed in field and plans in progress. Huiarua Block (national endowment): Area surveyed and returned 7,597 acres, comprising small grazing-run No. 98 of 2,697 acres, and the balance in four sections under renewable lease. This block was originally cut up into three small grazing-runs by Mr. Farnie in the year 1910, and no alteration has been made in the area of small grazing-run No. 98. Improved road-access is being surveyed through freehold about three miles in length, and arrangements being made for legalization. The Mangairoa Block, 18,000 acres, and Omahu No. 2, 2,500 acres (Native Land Court surveys), are completed in field, and the plan of Omahu is well on towards completion; also the Native Land Court survey of Wharekahika Block, 40,500 acres, nearly completed in field, is delayed for the hearing of an appellate case.

Proposed Operations, 1913–14.—Mr. E. H. Farnie, District Surveyor, has in hand the Kaiwaka Block (Crown lands), 14,483 acres. Mr. J. Roddick is to execute the survey of the northern portion of the Waipaoa Block, 12,000 acres, recently purchased from the Natives. Mr. H. E. Walshe, Tahoraite No. 2 Block, 1,000 acres, and supervision of unlicensed assistant's survey of Otawhao Block, 2,357 acres (well in hand), and later Omahaki and Timahanga Blocks, 33,000 acres. Mr. T. Cagney is to complete Mangawhariki Block, Native Land Court survey, 7,100 acres, and take in hand preliminary survey of Tahora Block, Crown lands, 49,000 acres. Mr. W. M. Atkinson: 6,000 acres Crown lands, Waikaremoana, and southern portion of Waipaoa Block of 12,000 acres mentioned above; also supervision of 8,568 acres Crown lands, being executed by an unlicensed assistant working under a permit issued by Mr. W. M. Gray; the latter is, I regret to say, laid up at the Wairoa Hospital with an attack of appendicitis, and will be incapacitated for several months. Private surveyors, under 48 authorities for survey, have in hand the subdivisions of 32,865 acres requisitioned for by the Native Land Court.

It was found necessary during last year to increase the staff by the employment of two more Assistant Surveyors and three unlicensed assistants in order to cope with the survey of the Sherenden and Waihau Settlements and other surveys; since the completion of the field-work of the above estates, one Assistant Surveyor and one unlicensed assistant have been transferred to Auckland.

Transfers.—I was transferred from Nelson to Hawke's Bay as from the 1st June, Mr. C. R. Pollen taking charge of Christchurch. Mr. F. A. Thompson, Chief Draughtsman, was promoted to the position of Commissioner of Crown Lands and Chief Surveyor at Nelson, and was succeeded by Mr. H. Mackay. Mr. E. H. Farnie was transferred from Gisborne to Napier in order that there should be a District Surveyor at Napier, and Mr. T. Cagney took his place at Gisborne. Mr. F. R. Burnley, Assistant Surveyor, was transferred to Auckland on the 25th February.

This last year has been characterized by greatly increased activity both in land settlement and survey work, and I have to commend the staff on the admirable way in which they have carried out their duties by using their best efforts to push on with the work so as to further the settlement of the land.

ROBT. T. SADD,
Chief Surveyor.

TARANAKI.

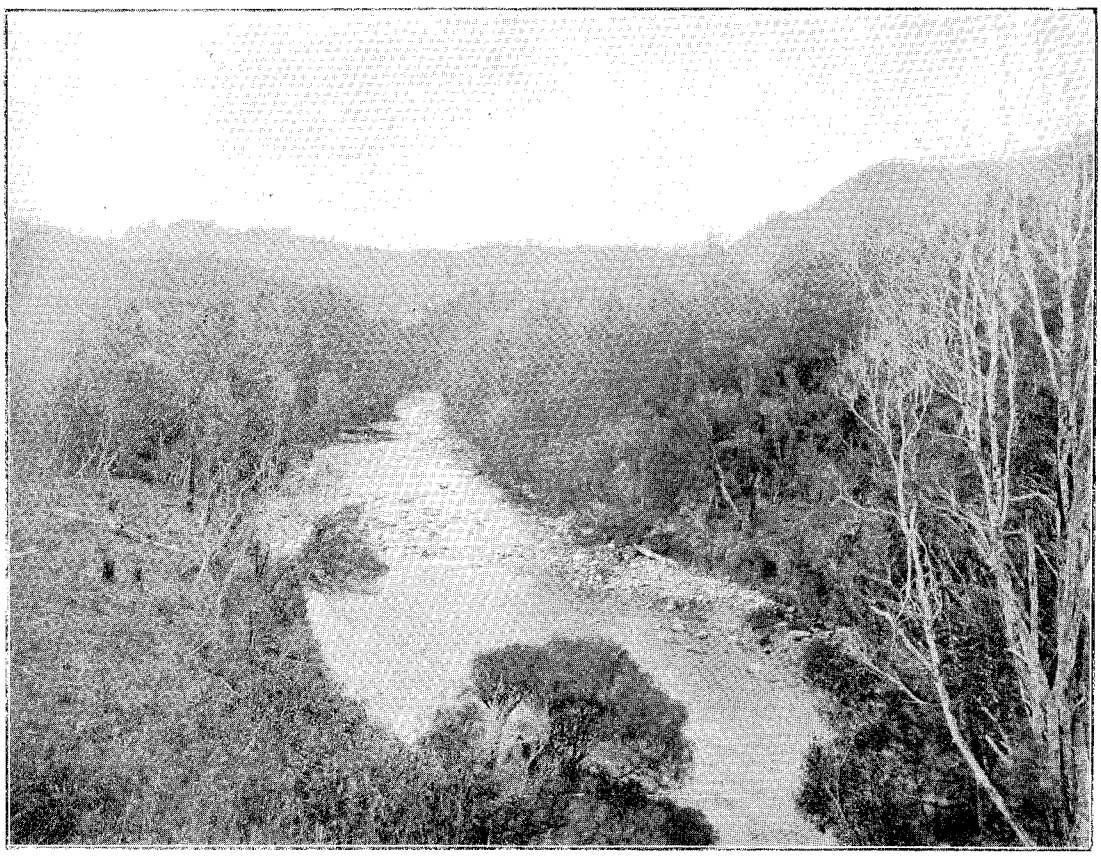
Minor Triangulation.—An area of 46,400 acres in the Mapara, Ohura, and Rangi Districts, &c., has been completed, at a cost of 1·63d. per acre, to control settlement surveys in hand.

Rural.—A total of 41,936 acres under this head has been completed, in 176 sections, at a cost of 3·59s. per acre, most of which is situated in very rough forest country, some 3,700 acres of it being scenic reserves with long rough boundaries enclosing small areas. An additional 45,693 acres has been completed in the field, and plans plotted sufficiently to allow of sale maps being issued shortly.

Village and Suburban.—76·75 acres, in 14 lots, was surveyed in Tahora and Whangamomona, at a cost of 34·55s. per acre, the roading, owing to the nature of the country, being very expensive.

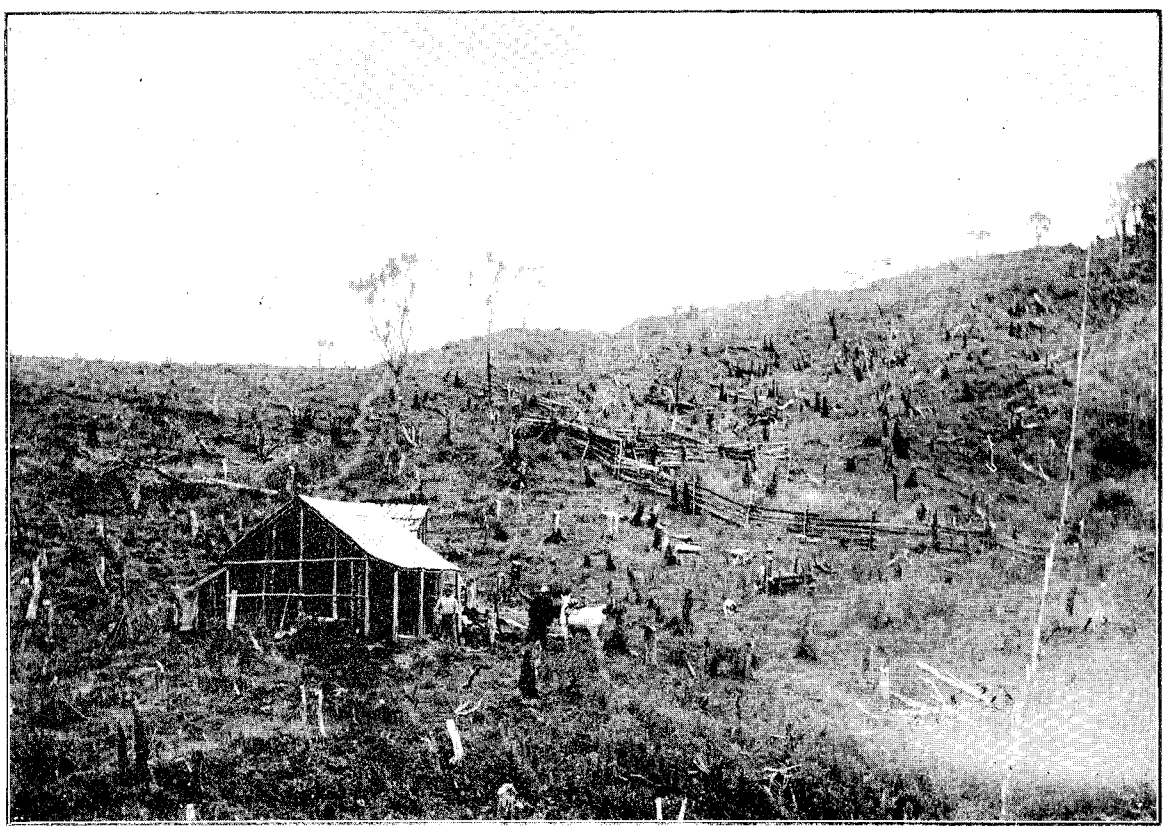
Town Section Surveys.—An area of 42·75 acres, comprising 82 lots in the Tahora and Whangamomona Townships, at a cost of 36·34s. per allotment, was surveyed.

Native Land Court Surveys.—The total area of Native land surveyed was 51,311 acres, into 96 subdivisions, at a total cost of £3,219 8s. 1d., or 15·05d. per acre. Of this amount, the staff surveyed 3,746 acres (2 subdivisions), costing £390 9s. 11d., or 25·01d. per acre, and private surveyors completed 47,565 acres (94 subdivisions), costing £2,828 18s. 2d., or 14·27d. per acre. The above areas were contained on 77 plans received for examination, 67 of which were approved. Of these plans, 33 were received on account of authorities issued during the year, and 44 were received for authorities issued prior to the 1st April, 1912. Seven plans received for examination prior to the 1st April, 1912, and 1 plan, compiled in the office, have also been approved during the year. Forty-two authorities were issued under the Native Land Act, 1909, for surveys covering 93 subdivisions of a total area of 53,724 acres, at an estimated cost of £3,340. Fifty-one subdivisions, of a total area of 26,040 acres, representing 51 autho-



[*H. E. Girdlestone, photo*

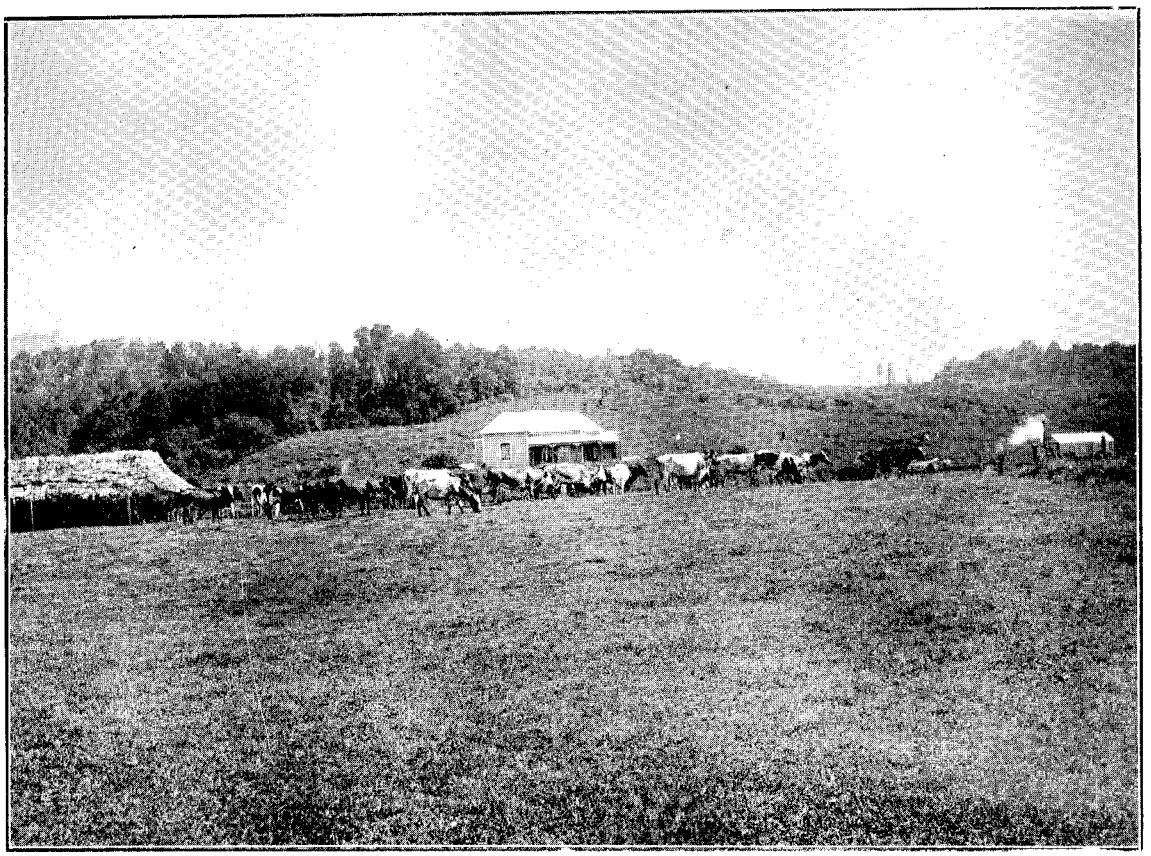
A Reach on the Manganui-a-te-ao Valley.



[*R. Leckie, photo*

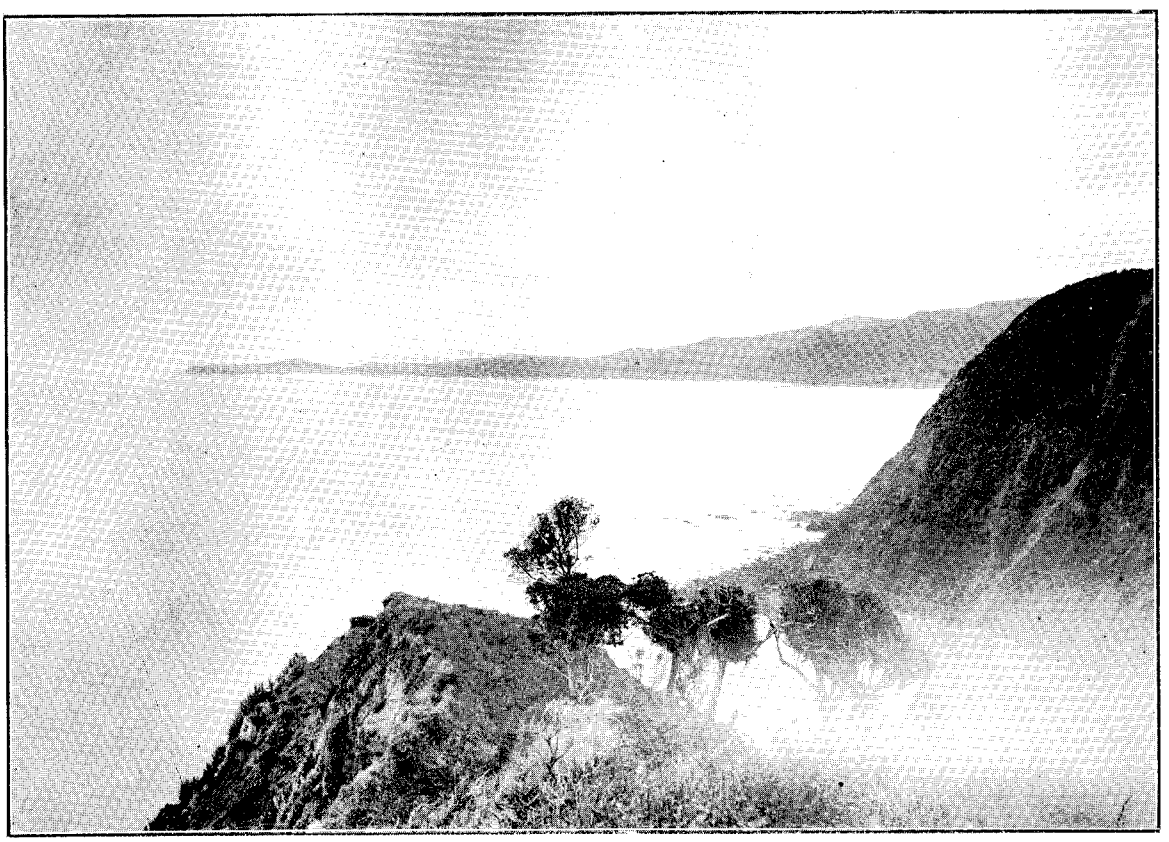
Settler's House, Wharerino (Second Year), South of the Marakopa River

To face p. 12.]



[*R. Leckie, photo.*

SETTLERS' HOMES ON TE KUITI—AWAKINO ROAD.



[*R. Leckie, photo.*

VIEW OF WEST COAST, NORTH ISLAND, FROM MOEATOA, LOOKING TOWARDS KAWHIA.

rities, are now under survey and will be completed at an early date; 6 requisitions, representing 40 subdivisions, of a total area of 52,071 acres, are now being dealt with, and authorities will issue shortly.

Maori Land Board Surveys.—Authority was issued to a private firm of surveyors for the subdivisional survey of one block, containing 6,316 acres, for leasing purposes, and was the only survey dealt with under this branch during the year. A scheme plan has been submitted and approved by the Board, and the field-work is now well in hand.

Roads.—In this class 8·68 miles were completed by the staff at a cost of £342 3s., or £39·42 per mile, most of it being done in very rough and precipitous country, as a specially urgent job in bad weather in winter.

Inspections.—Only two inspections of surveys have been made during the year, one of a Land Transfer survey inspected by Mr. T. G. Sole, and one of a Native survey close to Taumarunui, inspected by District Surveyor Mr. N. C. Kensington. Had time and opportunity allowed, I fully intended to myself inspect the contract surveys in upper Waitara and several important Native and Land Transfer surveys.

Other Work.—The expenditure under this head amounts to £143 9s., and includes inspections, preliminary scheme and inspection of a block of 6,000 acres of Crown lands intended for the Wanganui River Trust, and small miscellaneous surveys done by the office surveyor and Mr. Kensington.

Chainage Closures.—The mean of all closures returned by the staff, mostly in rough bush country, gave an average of 0·9 of a link per mile.

Office-work.—The total number of plans checked under all heads in the ordinary Survey Branch was 159, with 424 traverse sheets. These covered 391 sections of a total area of 78,918 acres, and 22 miles of roads and railways taken and closed. Of these, settlement surveys of Crown lands were represented by 14 plans, containing 177 subdivisions of a total area of 26,889 acres; 33 plans defining 22 miles of roads and railways taken and closed; 75 Native Land Court plans of 39,303 acres in 93 sections; 32 miscellaneous plans of 83 subdivisions, containing 5,206 acres; 4 office compilations of 7,516 acres in 15 sections; and 1 township plan of 4 acres in 22 sections. Four men sat for examination as authorized assistants, and three passed.

Land Transfer.—In this branch 132 plans, with 158 traverse sheets, were checked and approved, covering 383 sections and subdivisions of an area of 8,893 acres; in addition, 4 plans, comprising 30 subdivisions and containing 10,989 acres, previously checked by the other branch, were examined and approved for Land Transfer purposes. Land Transfer record maps are badly needed to replace our present system of bound tracings.

Titles.—The plans placed on instruments of title of all kinds were 1,922, and 425 copies of leases and licenses were prepared.

Compilations.—For photo-lithography 12 large drawings and tracings were prepared and 2 new 40-chain and 2 new 20-chain record maps were made, besides supplying the necessary tracings to the Head Office to compile a plan of the enlarged borough of New Plymouth. The old 2-mile map last printed from in 1906 was brought right up to the end of March, 1913, and sent on for publication, while the Head Office county maps of Waitomo and Ohura were examined and brought up to date. A special book of mounted lithos with index map of all the forest lands was prepared for the Forestry Commission, also special maps for the Railway Commission and other Commissions dealing with the enlargement of boroughs, &c.

Miscellaneous.—The usual demands made on the office staff were attended to, comprising the supplying of information to the general public, tracings for Rangers (including 87 corrected tracings from approved plans of improved-farm sections) and selectors; 35 complete sets of field data were supplied to staff and contract surveyors; plans for road and scenery Proclamations numbered 94. For the Valuer-General 150 tracings were made, while the total of tracings for selectors, Rangers, road, scenery, &c., numbered 377. All recording on block sheets already made on road, Crown grant, 40-chain record maps, reserve, index, and land-tenure and wall maps was kept well up to date, and the usual map-mounting attended to.

Native Land Court Work.—During the year 82 Court orders (in duplicate) have been indorsed with plans and forwarded, covering an area of 48,891 acres. A considerable amount of correspondence has been dealt with in this branch, chiefly with the Registrars of Native Land Courts, owners or lessees of Native blocks, or solicitors acting for clients interested. The sum of £2,341 11s. 11d. has been collected from the owners or lessees of Native lands in payment of survey charges, &c., where costs were previously advanced by the Crown. When considered necessary, an officer of this Department has attended sittings of the Native Land Court for purposes of obtaining charging-orders against Native blocks, collecting survey fees, &c. Nine tracings were made for Native Land Court purposes. Vouchers for payment to surveyors for surveys completed have been prepared, and all detail work necessary has been attended to.

Proposed Operations for 1913–14.—A staff of four permanent surveyors, with one cadet, one temporary assistant surveyor, and one contract surveyor are at present engaged upon settlement surveys along the eastern, north-eastern, and north-western boundaries of this land district, and it is now proposed to add thereto at least two other contract surveyors upon similar work. The total area to be covered by these operations amounts to 86,843 acres, of which an area of 45,693 acres is completed in the field, and litho tracings of most of this for the issue of sale maps have been prepared therefrom and sent to Wellington, thus leaving 41,150 acres of new country to be surveyed before the 31st March, 1914, situated in the Mapara, Aria, Tangitu, Waro, Mimi, Mahoe, and Omona Survey Districts.

Transfers.—Mr. John Cook was promoted in June to be Land Transfer Draughtsman in Wellington, and Mr. F. J. Harrop was promoted from Napier to fill his place here. Mr. R. R. Richmond, of the temporary field staff, was transferred to the Canterbury District in October.

In conclusion, I have to commend both the field and office staffs as a whole for the manner in which they have attended to their work. The field staff had the disadvantage of very wet weather in the early part of the year, and in some cases a difficulty in getting suitable hands for the field parties. The office staff could well stand being increased by an extra draughtsman, and for some time by two. It has not been possible to undertake the compilation of any new block sheets, and the Chief Draughtsman, Mr. H. J. Lowe, has found it difficult at times to meet all the demands from Government Departments, surveyors, and the public for tracings and information.

G. H. BULLARD,
Chief Surveyor.

WELLINGTON.

Triangulation.—The secondary triangulation upon which Mr. H. E. Girdlestone, under instructions from the Head Office, has been engaged for several seasons, and which embraces an area of some two million and a half acres, has been very nearly completed. Owing, however, to the exigency of settlement surveys this work had to be stopped at the end of August, when Mr. Girdlestone returned to the field staff of this office. Mr. R. P. Greville, Inspecting Surveyor, had occasion to visit the Hawke's Bay District, and he returns an area of 13,100 acres of minor triangulation consequent upon the inspection of a large block of land preparatory to its being thrown open for settlement. This area, coming as it does within the Land District of Hawke's Bay, appears in the return for that district.

Standard Surveys.—Mr. Mountfort has completed the field-work of the Wanganui standard survey, and received instructions for a rural standard traverse near Feilding not yet put in hand.

Topographical Survey for Selection.—No work coming under this head is returnable this year.

Rural.—An area of 16,814 acres is returned under this heading, of which some 10,000 acres are now in occupation, and the remainder is expected to be taken up within a few months. At the present time six staff surveyors have an area of 56,279 acres of unfinished work on hand, the greater part of which it is expected will be completed next season.

Town Surveys.—Only a few small sections under this heading have been done, and they were pegged off by the Inspecting Surveyor.

Native Land Court Surveys.—The cutting-out of subdivisions of Native land in the manner ordered by the Courts has occupied a number of private surveyors under instructions from the Department, and forms the larger proportion of this year's return. The work is different in character from the surveys of Crown lands, which are cut up into farms with the single purpose of their occupation and use. The subdivision of Native lands, on the contrary, is intended to satisfy the legal necessities of apportionment among a number of owners, without regard to the suitability of the resulting portions for occupation and use. Roading, for instance, is not attended to, and this, the most expensive item of Crown-land surveys, is thus absent from the cost of most Native surveys. One staff surveyor, however, has still a Native block of 14,850 acres on hand, which, owing to the necessities of the district, requires roading independently of the Court subdivisions. The total area of 122,038 acres completed includes an area of 117,545 acres by contract surveyors in a number of blocks which did not require complete survey, but merely subdivision of existing surveys. An area of 77,370 acres of Native land is in hand, the authorities having been already issued to various private surveyors. It should be mentioned under this head that the Native work returned by Mr. A. M. Roberts is a cadastral survey of small sections near Wanganui, for revision and amendment of titles, and is quite a different class of work to the Native Land Court work.

Roads.—There is nothing of importance under this heading, as, although all surveys of Crown lands necessitate great lengths of roads, these contribute to the total cost of settlement survey without appearing separately. Only 5½ miles of road were laid out separately from settlement work.

Other Work.—The main body of settlement survey is surrounded by a fringe of small surveys, reports, inspections, &c., undertaken usually in the winter recess, and which cannot be classified under the main headings. It includes, for instance, all the inspections which form the Inspecting Surveyor's principal occupation, also the cost of his duties as the principal office computer and examiner of plans.

Proposed Survey Operations.—One staff surveyor will, in two months' time, complete the roading of a Native block, and continue the subdivision of it for Native Land Court purposes; the remaining five surveyors will all be occupied with settlement surveys of the Crown lands they are engaged upon, totalling some 56,279 acres.

Office-work.—The staff has been somewhat short-handed during the year owing to illnesses and changes by transfer; the work, however, has been kept up very well. The "stock" works under these circumstances suffer first, sorely needed as many of them are, there are consequently fewer new maps made to replace disappearing records, only 5 having been done, with 30 block sheets. The output of district maps, however, has continued, and 9 of these have been sent for publication during the year. Of the 94 survey districts in this land district, however, only 27 have been drawn, and I look forward to the time when their completion will do away with much of the excessive hack tracing-work now necessary.

Examination of Plans.—There has been a general increase in the number of plans received for examination this year, the total under all heads being 591. Of these, 263 were received

in the Land Transfer Branch, 236 in the General Computing Branch (being a record), and 92 in the Statutory Plans Branch. A total of 528 plans were approved, being 222 in the Land Transfer Branch, 218 in the General, and 88 in the Statutory Plans Branches. The new plans in the General Branch covered 26,000 acres in 106 sections, and 144,776 acres of Native land in 658 subdivisions.

Land Transfer Branch.—In addition to the above plans, this branch dealt with 77 applications, 1,686 transfers, 224 leases, 155 mortgages, 42 Orders in Council, 76 Proclamations, 135 Native Land Court orders, 372 balance certificates, 64 caveats, 100 other dealings, and 4,505 plans were put on titles. An unpleasant feature of the year's work of this branch has been the unduly great waste of time and delay in examination caused by the plan-work and field-work of some two or three surveyors holding licenses under the Act, which has become much too serious to be dealt with leniently.

Native Land Court Work.—This work has continued to increase, 169 authorities having been issued for 597 subdivisions, totalling 118,354 acres, at an estimated cost of £9,259, of which the sum of £6,773 14s. 2d. has been paid on completed surveys. The liens repaid the Department on account of these and prior surveys amounted to £2,267 7s. 9d., the payment of which enabled 159 Court orders to be indorsed. Plans to the number of 183 passed through the branch, showing 829 subdivisions, containing 146,689 acres; 433 applications for charging-orders were made, and 143 notices of release issued.

General Drafting-work.—The staff of this branch has been kept busy and very fully occupied, owing to the larger number of plans passing through the office. This latter circumstance, combined with a shortage of staff referred to previously, made it necessary to confine the work chiefly to actual routine and attention to the daily income and outgo, relaxing work on the preparation of new standard records, replacing outworn maps and records, &c. The volume of work is of a kind requiring much and careful checking in details, this most essential part of the work constituting the principal difficulty in maintaining the output at a high level of quality and quantity. The officer in charge, Mr. Caldwell, is deserving of special mention in this respect, he being responsible for these characteristics. 1,502 tracings were made, 176 plans were reduced and recorded, 30 new block sheets were laid down, 53 tracings were made for photo-lithography, and 5 plans were compiled. In addition to the above, the Statutory Plans Branch made 12 tracings, 8 plans, and 1 new road-record map, and recorded 43 dedications, and amended 2 statutory local-body district maps, besides a large quantity of minor additions to records and amendments of plans.

Miscellaneous.—The general classes of work have been accompanied, as is invariable, by a cloud of small searches, minor works, amendments of plans, registers, plans of deeds-orders, attendances on public, correspondence, and other matters.

Changes of Staff.—In the field Messrs. W. M. Gray and H. L. P. Dyett left the district staff, Mr. Gray under temporary transfer to Hawke's Bay and Mr. Dyett retiring from the Department to private practice; Mr. Olsen, unlicensed assistant, also being transferred to Hawke's Bay. Owing to the exigencies of settlement survey, Mr. H. E. Girdlestone returned to the staff from triangulation work, and has been engaged in the South Wairarapa. Two cadets, Messrs. L. W. B. Hall and N. A. Middlemas, left the office and entered the field in another district, and Cadet Mr. R. F. Burgess joined the district field staff from Canterbury. In the office one draughtsman has been absent a great part of the year owing to serious illness, and there have been several changes among the cadets and officers. Mr. R. F. W. Mackenzie passed his authorized surveyor's examination and took the field in the Auckland District.

General Remarks.—Since my appointment to this office on the 1st June last the field surveyors have been chiefly occupied in continuing the work begun by them in the previous season. Much preliminary work in exploring large blocks of Crown and Native land has been done, and it will be the end of next season before the full results of their operations will be apparent. They are now busy on the straightforward subdivision of the blocks, and henceforward their progress will be more apparent.

I have much pleasure in reporting that I have found all the officers of this branch of your Department most obliging and willing to push forward the work allotted to them, and in this connection I desire especially to acknowledge the capable and energetic assistance I have received ever since I came here from Mr. Maurice C. Smith, the Chief Draughtsman.

T. N. Brodrick,
Chief Surveyor.

NELSON.

Triangulation.—The work under this heading completed during the year is 10,385 acres, of which 7,985 acres are on the north bank of the Motueka River and 2,400 acres in the Surrey Districts of Waitakere and Aorere.

Standard Survey.—The standard survey of the Township of Murchison, some 4½ miles, was completed during the year. The much-needed survey of the City of Nelson is in progress, and is well advanced. This is being carried out by Mr. C. A. Mountfort, acting under the control of the Head Office.

Topographical Survey for Selection.—Only a small area of 2,708 acres at the head of the Pokororo River was completed, at a cost of 1·35d. per acre.

Rural.—Under this head a total area of 60,365 acres, at an average cost of 2·68s. per acre, is returned, out of which the staff surveyors executed 33,626 acres, at an average cost of 2·66s.

per acre, while 26,739 acres were done by contract surveyors, at an average cost of 2·69s. per acre. Practically the whole of these areas were in heavy bush, and mostly on the west coast, where rough country and a wet climate obtain.

Town Selection Surveys.—This comprises the Winearls Settlement for workers' homes in Nelson, and the mining township of Hukawai, near Reefton, &c.

Native Land Court Surveys.—Contract surveyors did 7,578 acres, at a cost of 19·58d. per acre, but no area was surveyed by the staff surveyors.

Road Surveys.—A length of 28·15 miles was laid off, at a cost of £18·35 per mile.

Other Work.—By far the largest item—viz., £505 7s. 2d.—represents inspections, mostly of contract surveys on the west coast, and although this may seem a very large amount, the very unsatisfactory nature of the reports fully justified the expenditure.

Proposed Operations for 1913–14.—Next year the staff will be engaged on settlement surveys aggregating nearly 100,000 acres, and several large blocks of land should be opened for selection during the year—viz., the Howard Block, 20,000 acres; Waimea and Gowan Blocks, 10,000 acres each; Lamb Valley Block, 6,000 acres, &c. It is not anticipated that there will be much of any other class of survey.

Office-work.—The staff throughout the year has remained at the minimum strength, and it has only been possible to cope with absolutely necessary work in both the clerical and drafting branch.

Examination of Plans.—During the year 131 plans were examined and approved, in connection with which were 405 traverse sheets. Of these plans 79 were sectional surveys, 30 were road plans, and the remainder miscellaneous.

Land Transfer Branch.—In this branch 75 plans were approved, 176 applications and transfers were dealt with, and 221 certificates of title were made out in duplicate.

Native Land Court Surveys.—There is not much of this class of work in this district.

General Draughting Work.—During the year two draughtsmen, who were also surveyors, took the field, making the draughting staff so shorthanded that it has only been possible to keep up with difficulty the actually necessary current work.

Miscellaneous.—There was, of course, the usual volume of miscellaneous duties which cannot be tabulated, such as attendance on the public, correspondence, searches, &c.

Changes of Staff.—During the year Mr. P. R. Wilkinson, assistant surveyor, was transferred to Auckland, and Mr. S. Parkinson has taken his place here, and took the field in March.

In conclusion, I desire to thank all the officers, both field and office staff, for their active assistance and co-operation during the year.

F. A. Thompson,
Chief Surveyor.

MARLBOROUGH.

Triangulation.—With the exception of a little breaking-down work in connection with the Picton–Blenheim Railway survey, no work of this nature was carried out during the year.

Rural.—An area of 8,825 acres, in 23 sections, was completed under this head, practically the whole of which is situated in rough bush country, the cost of same being 2·21s. per acre, which, considering the nature of the country surveyed, must be taken as very satisfactory.

Town and Village Sections.—Very little work was done under these headings during the year.

Roads and Railways.—The principal work done during the year was the completion of the survey of the Picton–Blenheim Railway. This survey being in a very old-settled district, originally laid out by faulty magnetic traverses with comparatively few surveys of recent date in the vicinity, made it necessary to extend the verification work greatly beyond the limits first contemplated, and the work consequently has been more intricate and expensive than was originally anticipated. Mr. A. Hodgkinson, who carried out the survey, was, on completion of the field-work, temporarily transferred to the Auckland District, the plans of the railway survey being completed by the office staff. In conjunction with the above, some 8 miles of the Picton–Blenheim Road was surveyed by Mr. Hodgkinson. Except for an old magnetic traverse, made in the year 1864, this road, with numerous deviations, had never been properly surveyed. These two surveys will be of great value to surveyors, and can be used as a standard for future survey operations in the vicinity of the road and railway-line. Other work was mostly in the Sounds, and carried out by Mr. F. Stephenson Smith at schedule rates.

Native Land Court Surveys.—An area of 3,592 acres, covering 24 subdivisions, was surveyed during the year by private surveyors working on schedule rates.

Other Work.—The expenditure under this head is mainly in connection with revision surveys of old magnetic work in the Waitohi Valley.

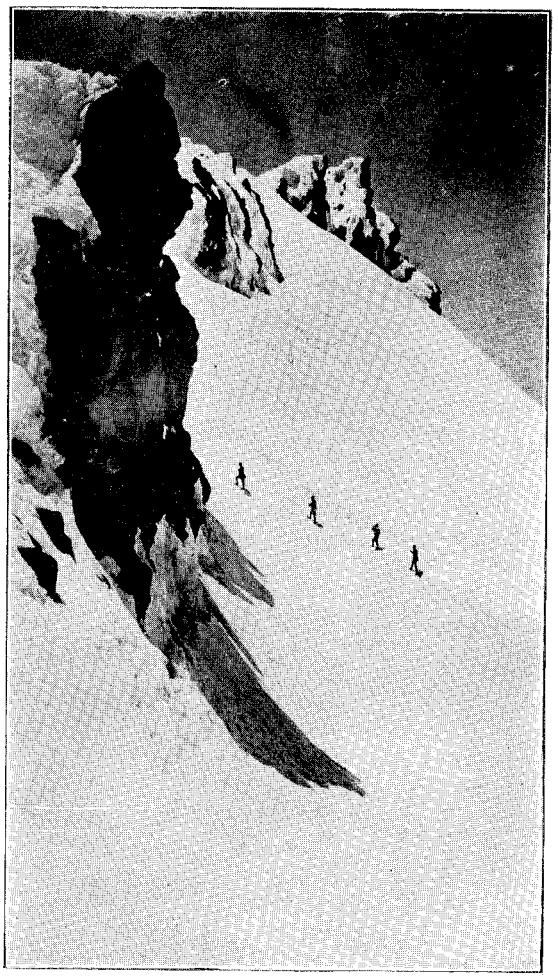
Inspections.—Three field-inspections of surveyors' work were made during the year, the results of which on the whole indicate generally satisfactory work.

Standard.—The previous standard for testing surveyors' tapes being in a very unsatisfactory position, permission was obtained from the Railway Department to lay down a 5-chain standard adjoining the Blenheim Railway-station. This has now been done, and I expect to have the final marking completed in the next few weeks.

Proposed Operations, 1913–14.—The settlement work for the coming year will be mainly in the Opouri Valley. A large portion of the milling-timber having been cut out, there will probably be an area of from 4,000 acres to 5,000 acres requiring subdivision. In the Sounds there is an area of about 1,300 acres that has been applied for; also a number of spotting surveys in various parts of the district.

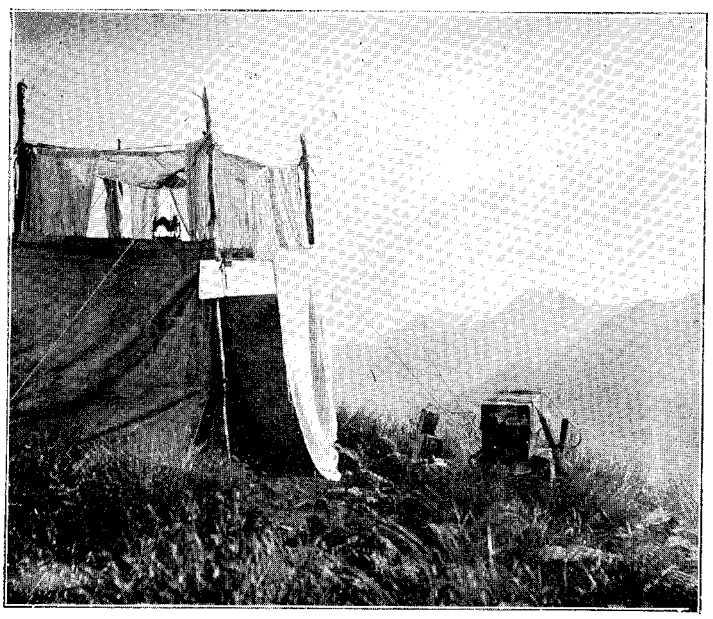
[*H. E. Girdlestone, photo.*

General View of the Spur leading up to Te Heu Heu Peak, the Route following from Waihohonu Hut.



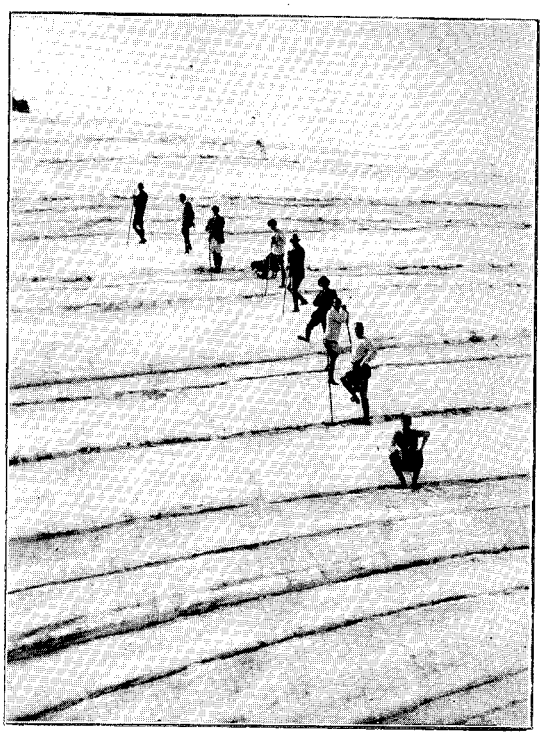
[*H. E. Girdlestone, photo.*

Rocks and Snow Slopes on the Summit of Mount Ruapehu.



[*H. E. Girdlestone, photo.*

Wind-screen erected to keep Sun and Wind off the Instrument-station, Mount Dundas. Height, 4,944 Feet. The Highest Trig. Station on the Tararuas.



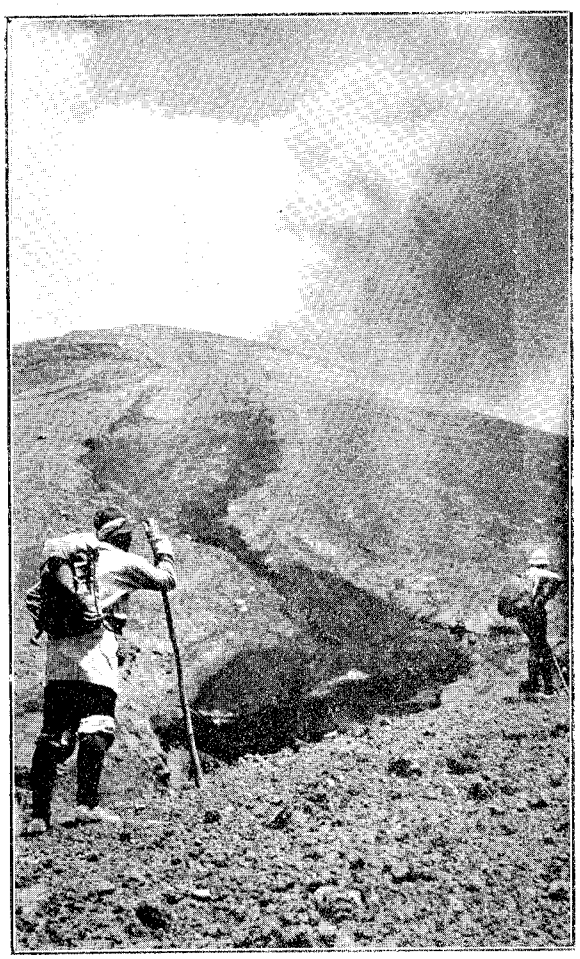
[*H. E. Girdlestone, photo.*

Peculiar Ice Formation in the Crater of Mount Egmont in the Middle of Summer.

To face p. 16.]

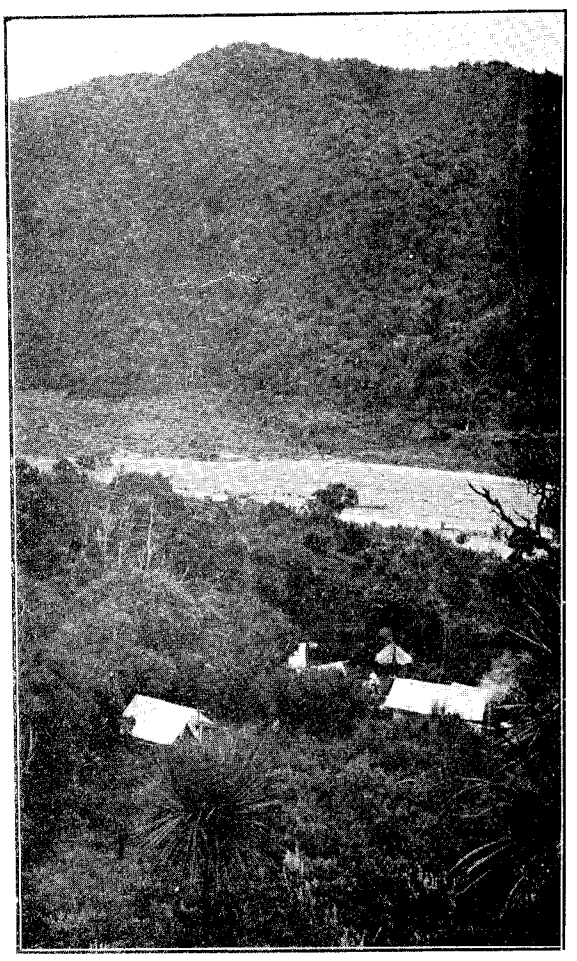
[*H. E. Girdlestone, photo.*

THE FIRST START.—PIONEER SETTLERS IN THE RUATITI BLOCK, WAIMARINO.



[*H. E. Girdlestone, photo.*

ASCENDING THE VOLCANO AT NGAURUHOE. THE ACTIVE CRATER HAS JUST SENT UP A VOLUME OF SMOKE.



[*H. E. Girdlestone, photo.*

SURVEY CAMP ON THE BANKS OF THE TURANGANUI RIVER, WAIRARAPA DISTRICT.

In the absence of our staff surveyors, who were, at the end of last September, temporarily transferred to other districts, Mr. F. Stephenson Smith has made several surveys for the Department, and has in hand at present about 600 acres in various districts.

Office-work: Examination of Plans, &c.—The total number of plans received in the ordinary Survey Branch was 63, with 85 traverse sheets, comprising 11 departmental plans with an area of 8,850 acres in 24 sections; 6 Native Land Court plans with 24 sections, and an area of 3,592 acres; 20 plans in triplicate (60 copies), covering 18 miles of the Picton–Blenheim Railway; 16 plans of 19 miles of road; 7 compiled plans, and 5 plans for Governor's approval. 349 tracings were prepared, 186 diagrams placed on Crown leases, &c., and 7 tracings made for photo-lithography.

Land Transfer.—In this branch 34 plans and 68 traverse sheets were received, covering an area of 17,256 acres, with 85 subdivisions; 442 diagrams were placed on certificates of title.

Changes of Staff.—The only changes made in the personnel of the staff was the resignation of Mr. H. P. Fougère, clerical cadet, his place being taken by Mr. C. E. Mountfort; and the transfer of Miss C. M. Watterson, who had been ten years in this office, to New Plymouth, Miss W. E. C. White, of that office, taking her place. Messrs. A. Hodgkinson and L. Hunt, the only staff surveyors in the district, were temporarily transferred for urgent work, the former to Auckland and the latter to Canterbury.

In conclusion, I beg to thank the staff for their active co-operation and assistance in the year's work.

W. H. Skinner,
Chief Surveyor.

WESTLAND.

Triangulation.—The total work under this heading comprises 1,500 acres by District Surveyor A. N. Harrop, at a cost of 15·4d. per acre.

Standard Survey.—A survey has been made under this heading of a portion of the Town of Cobden by District Surveyor A. N. Harrop.

Topographical Surveys.—Messrs Morison and Cunningham completed 2,400 acres under this heading at an average cost of 4·8d. per acre.

Gold-mining Surveys.—No work has been done by the staff under this heading.

Rural Surveys.—The total area surveyed under this heading for the year amounts to 9,622 acres, in 64 sections, at an average cost of 3·56s. per acre. Much of this has been isolated spotting surveys, nearly all in rough bush country and entailing a great deal of travelling.

Village and Suburban.—Under this heading Messrs. Morison and Cunningham have surveyed 125 acres, in 16 sections.

Town Surveys.—District Surveyor Harrop returns 23 sections under this heading, at an average cost of 30·0s. per section.

Roads.—Only 1 mile is returned under this heading, at a cost of £11.

Other Work.—This work chiefly consists of adjustments of scenic reserves and settlers' boundaries, inspections, defining boundaries of timber-areas, and clearing and repairing old trig. stations. I might here note that two of the field staff were absent in Canterbury three months, and another absent for nine months on extended leave.

Inspection Surveys.—District Surveyor W. Wilson has inspected the work of each surveyor, both staff and private, in this district, and the inspections generally disclose very satisfactory results. Unfortunately I have been unable to carry out my intention to make a personal inspection of every party, on account of pressure of work.

Office-work.—During the year the draughting staff has been occupied almost wholly with current work. The several resignations and changes having left the office again very short-handed, it has been impossible to work off many arrears. Ninety-three plans were received and examined, classified as follows: 26 Land Transfer, 19 statutory, 8 mining, and 40 relating to land-settlement. 732 copies of plans were placed on the deeds—namely, on Crown leases 508, and Land Transfer titles 224. Two 40-chain plans were compiled, and 28 tracings for photo-lithography were prepared, representing 157,000 acres of land for selection, 150,800 acres being pastoral runs and 6,200 acres of land for settlement. A litho was also prepared of Cobden Township and one of Waiwhero Survey District. 241 survey data tracings have been prepared for the field staff, and 497 miscellaneous tracings and numerous coloured lithos have been made. Plans have been compared with the office records for the District Land Registrar and others. The readjustment of the whole of the timber records has been completed, and the timber maps are now up to date. Various tracings and descriptions have been prepared for *Gazette* notices. Returns and plans have been forwarded giving the area of available land in Westland—revised area of the whole of Westland, and information for the Forestry Commission. The routine work of recording, cross-indexing, &c., is up to date, and many of the old plans have been repaired and remounted.

Proposed Operations, 1913–14.—There is on hand 14,774 acres of application surveys scattered all over Westland, which, having all my field hands at work again, I hope to see mostly finished during the coming season, besides current work in the shape of new applications. Further, I intend to have surveys of from 10,000 to 12,000 acres of lands for settlement made and offered if the disabilities under which we labour with regard to mining grants, &c., can be removed.

Changes of Staff.—During the year Mr. A. D. Macfarlane, Receiver of Land Revenue, was transferred to Invercargill, after an efficient service of twenty-three years on the local staff. Mr. H. G. Bateman, draughtsman and computer, resigned from the service to take up mission work in China. Mr. J. R. Clements, draughtsman, was transferred to the Wellington District Office. Mr. J. Fitzsimmons was appointed draughting cadet, and Mr. R. E. E. McLeod clerical cadet. Mr. S. Emmett resigned from the service.

In conclusion, I beg to thank the officers of both the field and office staff for their hearty co-operation and assistance in the work of the Department.

H. D. M. HASZARD,
Chief Surveyor.

CANTERBURY.

Rural.—Under this heading 77,339 acres are returned as completed, which comprise the following settlements: Sherwood Downs, Four Peaks, Bourndale, Avenel and Timaunga Extensions, Claremont, Waimate, Aylesbury, Strathmore, and part of Ashwick; also Mount Peel Exchange and Hanmer Plantation Extension and Exchange.

Topographical.—34,180 acres are returned under this heading, being portion of Sherwood Downs.

Roads.—The 4 miles returned under this heading form the road surveyed by Mr. C. H. Morison at Oxford.

Town and Gold-mining Surveys.—I have nothing to report under this heading.

Land Transfer.—In this branch 396 plans were examined and approved, 2,720 deeds and other instruments passed, and 4,495 certificates of titles were indorsed.

Other Work.—This comprises miscellaneous surveys.

Survey Inspections.—During the year 11 field inspections have been made, and in most cases the work has proved to be satisfactory.

Proposed Operations for the Year 1913–14.—This work will comprise the subdivision of Runs 145 and 145A (30,300 acres) in the Ashley and Oxford Survey Districts, the completion of inspection of roads and bridges in the Ashley, Oxford, Waikari, and Kowai Survey Districts, the survey of the road to give access to Crown lands in the Lees Valley, the survey of the Rangitata River Conservation Reserves (2,900 acres), the extension of the standard survey in the suburbs of Christchurch and Kaiapoi, the survey of any estates that may be acquired, as well as a number of miscellaneous surveys. There are also the surveys of Ashwick and Mount Nessing Settlements, Crown lands in the Oxford Survey District, and Greta Peak Runs, comprising 74,385 acres, which, though finished in the field, await the completion of plans.

Office-work.—The office staff has had a busy year preparing all the necessary data for the survey and notification of the respective settlements. Twenty-nine Public Works plans, 32 road-deviation plans, 28 land-for-settlement plans, and 7 other plans have been examined and approved, besides the usual tracing and descriptions. The tracings of Amuri County are in hand.

Transfers and Resignations.—Mr. T. N. Brodrick, Chief Surveyor and Commissioner of Crown Lands, was transferred to Wellington in June, and I succeeded him. Mr. A. G. Allom, District Surveyor, resigned in October last. Messrs. C. H. Morison and A. N. Harrop, District Surveyors, who were here temporarily, returned to Westland in June. Messrs. R. R. Richmond and Leslie Hunt were transferred here in October and November respectively, the former permanently and the latter temporarily, to assist at settlement and other surveys. Mr. G. A. Hathaway, unlicensed assistant, has also been assisting. Mr. E. Taylor, draughtsman, was transferred to Napier.

In conclusion, I beg to thank the staff for their co-operation and assistance.

C. R. POLLEN,
Chief Surveyor.

OTAGO.

Minor Triangulation.—No work has been done under this heading, but as mentioned in previous reports, there are several districts that should be revised when opportunity offers.

Rural and Suburban.—Two staff surveyors, Mr. D. I. Barron and Mr. S. T. Burton, have been engaged on this class of work, the first up to November, 1912, when he was transferred to the Auckland District, and the latter continuously for the past year. The services of Mr. N. Paterson, contract surveyor, were obtained in connection with the subdivision of the Otanomomo Settlement, recently acquired for selection. The total area returned for the year is 11,948 acres, particularized as follows: 8,350 acres surveyed and subdivided into 4 small grazing-runs; 1,818 acres divided into 23 allotments and forming the Otanomomo Settlement; 1,780 acres divided into 59 sections, and consisting of scenic reserves in heavy bush land, and ordinary application and settlement surveys very scattered and extending from Lake Hawea down to Roxburgh. The average cost per acre was 1·92s.

Standard Survey.—Mr. W. T. Neill, Inspecting Surveyor, continues to make good progress with the standard survey of the City of Dunedin, but has to report that the weather for the past year has been very unfavourable for his operations. Twenty-eight miles of streets were traversed and marked, and the work of offsetting for the final determination by the City Council of the permanent alignments will shortly be commenced.

Town Surveys.—Fifteen plans of new townships were examined and approved under the Land Act, 1908, and the Land Laws Amendment Act, 1912.

Mining Surveys.—Twenty-four mining surveys, comprising 1,798 acres, in 38 claims, were examined and approved. Three of these, in 4 claims comprising 206 acres, were made by our staff, at a cost of 4·04s. per acre, and the remaining twenty-one, in 34 claims comprising 1,592 acres, by private surveyors on the fee system or by private arrangements.

Roads and Railways.—Twenty-nine surveys and plans were examined and approved, all but two being the work of private surveyors.

Land Transfer.—One hundred and six plans, representing 9,740 acres, were examined and approved, and I have again to express satisfaction with the excellence of this class of work.

Proposed Operations for the Year.—Under the direction of Mr. W. T. Neill, Inspecting Surveyor, the standard survey of the City of Dunedin will still be the particular work for the coming year. Since the commencement of the standardizing, the extent of the City of Dunedin has been very largely increased by the inclusion of the adjacent Boroughs of Roslyn and North-east Valley, and as it is almost certain that this additional area will be brought into the original scheme, there is every prospect that Mr. Neill's services will be necessary in this class of work for the next eighteen months or two years. Assistant Surveyor S. T. Burton has in hand 289 acres in the Teviot Survey District. Two pastoral runs, containing about 183,000 acres, mature in the year 1915, and it is probable that a subdivision into smaller areas for lease under similar or small-grazing-run systems will take place, necessitating the offering of the lands in February of 1914. Two estates in North Otago, aggregating 1,421 acres, have been purchased under the Land for Settlements Act. These will be subdivided, and it is hoped to offer them for selection in July of this year.

Office-work.—The following plans were examined and approved: 106 Land Transfer, 29 roads and railways plans, 24 mining surveys, 79 staff plans, being a total of 238. Thirty-five photo-lithographic tracings were made for sale posters, and maps for photo-lithography of Catlin, Teviot, Tarras, and Leaning Rock Districts were prepared for reduction and printing on the 80-chain scale. Twenty-four small plans of private subdivisions were drawn and lithographed here for the purpose of bringing the City of Dunedin and Suburbs maps up to date, and also the 4-mile map of Otago District. Twelve new plans were made for Land Office, and the Railway land plans affecting Conical Hills Settlement were compiled and drawn. Descriptions of all education reserves in Otago were revised, and all survey matter affecting Southland was collected and passed on to that district.

Diagrams were placed on 112 leases in duplicate and on 152 in triplicate; a total of 680 copies and 831 miscellaneous tracings for various purposes were prepared. In the Land Transfer branch diagrams were placed on 898 certificates in duplicate; a total of 1,796 copies and 1,150 deeds were examined. The preparaton of the City of Dunedin standard maps is being steadily advanced, and to preserve symmetry is being wholly undertaken by one draughtsman. In the lithograph department, 2,236 lithos were printed, 1,148 maps mounted, and 30 books bound or rebound.

I am pleased to be able to record my appreciation of the efficient manner in which the officers have carried out their duties, and of the improvement in draughtsmanship noticeable in the younger officers.

E. H. Wilmot,
Chief Surveyor.

SOUTHLAND.

Minor Triangulation.—No work of this nature has been done during the past year.

Rural.—A total area of 30,402 acres, in 173 sections, is returned under this heading. Of this total 26,736 acres was surveyed by the staff surveyors, at a cost of 3·62s. per acre, and includes about 15,000 acres situated in rough bush country necessitating a considerable amount of road-grading and exploration, and, being mostly worked-out sawmill areas, entailed unusually heavy line-cutting, as well as an area of 3,587 acres of undulating and hilly open land with patches of bush (Maori Hill Estate). Contract surveyors executed an area of 1,461 acres, at a cost of 1·27s. per acre, while the balance of 2,205 acres is sawmill areas by licensed surveyors, which were paid for by aplicants.

Village and Suburban.—Under this heading are shown 51·29 acres, in 28 sections, surveyed, at a cost of 32·67s. per acre, by Mr. H. M. Thompson in Alton District, and by Mr. N. L. Falkiner at Waikawa Village.

Town Section Surveys.—These comprise 19·34 acres, in 52 sections, surveyed, at a cost of 27·18s. per acre, by Mr. N. L. Falkiner in Invercargill City, Town of Gore, and Seaward Bush Township.

Native Land Court Surveys.—A subdivision of 11·7 acres into 45 sections of about a quarter-acre each, in the Aparima Native Reserve, Jacob River Hundred, adjoining Riverton, was made by Mr. H. R. Dundas, licensed surveyor.

Gold-mining Surveys.—One special claim, containing 68 acres, and surveyed by Messrs. Blaikie and Wilson, in the Hokonui Survey District, and paid for by applicant, appears under this head.

Roads and Water-races.—17·47 miles of roads to give access to Crown lands were surveyed by the staff surveyors during the year, at a cost of £21·42 per mile.

Other Work.—The amount shown under this heading includes inspection surveys, revision and street-alignment surveys, survey of 2,280 acres scenic reserves in Kingston District, exploration survey and trial grading of roads in connection with a large block of land in Mokoreta

District which proved too rough and inaccessible to warrant subdivision for settlement; inspection, supervision, and passing of Waikawa Jetty contract; reports and engineering surveys in conection with East Taieri drainage scheme; exploration and report on route from Wakatipu to Milford; miscellaneous small surveys and reports; re-establishing and repairing trig.-stations, &c.

Explorations.—Towards the end of December and the beginning of January last Mr. D. Macpherson, by permission, accompanied Mr. Grave, of Oamaru, and others in a very interesting trip over a new route from Wakatipu to Milford which had been located some two years ago by Mr. Grave and party. His full report on this, together with a sketch-map showing the route followed, was forwarded to you on the 4th March last.

Inspections.—Two Land Transfer subdivision surveys in Toetoes and Eyre Districts, comprising some 45,000 acres, were inspected by Mr. C. Otway, District Surveyor, during the year.

Traverse Closures.—Twenty-eight circuits, totalling 115 miles, returned by the staff, show an average closing-error of 0·29 link on the meridian and 0·31 link on the perpendicular per mile.

Proposed Operations.—Mr. C. Otway has just commenced the subdivision of 1,250 acres in Chatton District, which will probably finish in May. He will then proceed to Lillburn District and commence the subdivision of some 3,400 acres in Motu Bush. Mr. D. Macpherson has in hand some 3,500 acres in Alton and Aparima Districts, which he expects to finish about the end of December next. He will then undertake the subdivision of further areas in the same districts, provided they are released from sawmilling operations. Mr. N. L. Falkiner is now engaged on the subdivision of about 760 acres in the Hokonui District. When this is completed he will survey some small sections at Ocean Beach, Campbelltown Hundred, and afterwards proceed to cut up about 2,000 acres in Jacob River Hundred, together with any further area that may be found suitable in that locality. Mr. H. M. Thompson is at present subdividing about 2,000 acres in the Longwood Survey District, and when this is completed he will proceed to Lillburn District to explore some large blocks of Crown land there, with a view of having any suitable portions cut up for settlement.

General.—The unusually wet seasons during the past two years have been very unfavourable for field operations generally, but I am pleased to say that in spite of this the staff have returned a very satisfactory amount of work.

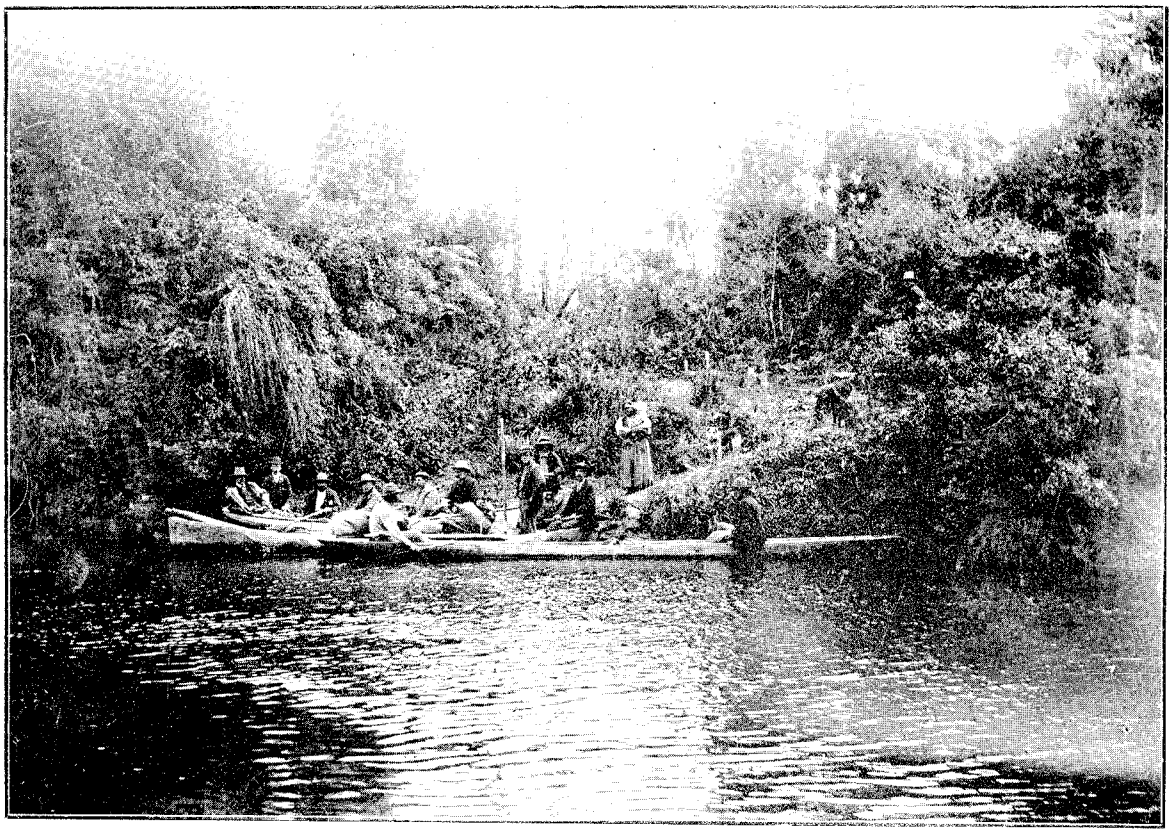
Office-work.—During the year the new lithographic map of Invercargill City referred to in my last annual report has been completed, and since its publication has been much in demand; six lithographic maps of survey districts have been thoroughly revised and brought up to date; the preparation of lithographs of the interior districts has been put in hand, one map containing four districts being almost completed. New Land Transfer record maps of the Town of Gore have been compiled, and several old maps brought up to date, but much remains to be done in compiling these records whenever opportunity offers. Eighty-six ordinary survey plans, representing an area of 19,327 acres, and 11 statutory plans, have been examined and passed; 17 lithographic tracings for sale plans, 389 miscellaneous tracings, and 455 working tracings were made; 144 Land Transfer plans were traced and maps of ridings revised for Valuation Department; 20 local bodies' schedules were prepared in duplicate, and 853 maps of various descriptions mounted. Two returns for Parliament were prepared, one in connection with the timber industry and one of Crown lands; also a return in triplicate for the Royal Forestry Commissioners. The work of compiling two large county index-maps has been gone on with whenever possible, and I am pleased to say that one is nearly completed. The time, however, of the draughting staff has been almost entirely taken up in coping with the current work and the renewing of old index, application, and other maps, so that the index work, though much needed, has had to be placed aside for a time.

Land Transfer.—141 plans, representing 20,339 acres, were examined and passed; 41 Proclamations, &c., coloured off on titles singly and 13 in duplicate; 1,350 diagrams placed on certificates of title; and 950 deeds and other instruments examined and passed. A considerable part of one draughtsman's time has been occupied in assisting the Land Transfer Draughtsman with this work.

Changes of Staff.—During the year there have been considerable changes in the staff. Mr. C. Robinson was transferred to Christchurch, and Mr. R. S. Galbraith succeeded him here as Chief Draughtsman. Mr. G. W. Palmer, Receiver of Land Revenue, was promoted to Christchurch, and Mr. A. D. McFarlane transferred from Westland to take his place. Mr. E. S. Wood, draughtsman, was transferred here from Head Office. Mr. E. D. Thompson, cadet in the Receiver's office, has been promoted to the Head Office; and three cadets, Messrs. G. A. Harvey, F. W. E. Mitchell, and T. H. Reid, have been appointed to the Lands Branch of this office.

In conclusion, I desire to record my appreciation of the efficient manner in which all the officers of both field and office staff have discharged their respective duties, and of their loyal co-operation and assistance during the past year.

G. H. M. McCLURE,
Chief Surveyor.



HAVELOCK'S LANDING, MAZARUNI RIVER. *H. Leckie, photo.*

SURVEY PARTY SWAGGING UP THE GOAK STREAM EN ROUTE TO MOUNT DUNDAS. *H. E. Gadelstone, photo.*

To face p. 20.

[*H. E. Girdlestone, photo.*

KAPAKAPANUI TRIG. SIGNAL. STILL IN GOOD REPAIR. BUILT BY THE LATE JAMES MITCHELL, DISTRICT SURVEYOR, IN 1873.

[*H. E. Girdlestone, photo.*

BIVOUAC TENT AT KAPAKAPANUI TRIG. AFTER A SNOWSTORM.

[*H. E. Girdlestone, photo.*

THE CRATER-LAKE, SUMMIT OF MOUNT RUAPEHU.

APPENDIX II.

REPORT ON DRAUGHTING-WORK AT HEAD OFFICE, WELLINGTON.

[By H. T. McCardell, Chief Draughtsman.]

The routine work of the office has been carried on very satisfactorily throughout the year.

The following plans were drawn for photo-lithography: Pahiatua County; Sheet 5, Auckland Provincial District, is being redrawn. The maps of Wanganui, Wanganui East, and Wellington are approaching completion, and should be published in the forthcoming year. A thermograph sheet was drawn for the Magnetic Observatory, Christchurch, and was printed in two colours. Plans of the base-lines at Matamata and Waitemata were prepared for the annual report, as was also a plan of the Warawara State Forest. A compilation of New Plymouth Borough is also in hand and very nearly completed.

Nineteen schedules for the Local Bills Committee of the House of Representatives were examined and certified to.

Fourteen new county maps were prepared and tenure coloured, also nine boroughs and four road districts.

Three hundred and sixty-four tracings were made, and no less than 1,001 plans were mounted. These comprise sale plans, county maps, tracings, townships, &c. This work absorbs nearly the whole of one officer's time throughout the year.

Among other duties performed by draughtsmen, there were 163 descriptions made; measuring-bands tested—two 10-chain, two 5-chain, and three 1-chain; seventeen licenses and seventeen certificates of competency, in duplicate, under the Surveyors' Institute and Board of Examiners Act, 1908, were prepared, and eighteen licenses in duplicate were prepared under the Land Transfer Act, 1908. Twenty-eight plans were drawn on deeds.

During the year 266 towns (Government and private) were examined, reported on, and when complying with the Act and regulations were recommended to His Excellency the Governor for approval under section 3 of the Land Laws Amendment Act, 1912. The distribution of these towns in land districts was as follows: Auckland, 176; Hawke's Bay, 23; Taranaki, 1; Wellington, 13; Nelson, 2; Marlborough, 2; Westland, 1; Canterbury, 22; Otago, 13; Southland, 13.

Thirty-eight plans were drawn on deeds. Twelve acclimatization districts for the Department of Internal Affairs, and ten registration districts were also compiled for the Registrar-General.

During the year I was absent on sick-leave for three months, and Mr. Farquhar fulfilled the duties. I have to thank all the officers for the assistance given me during the year.

APPENDIX III.—NEW SECONDARY TRIANGULATION.

[By C. E. ADAMS, M.Sc., F.R.A.S., Chief Computer.]

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, ± 0·0219, 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, ± 0·0128, 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, ± 0·0077, 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, ± 0·01005, 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 3·13″, and the probable error of an observed angle, as given by the expression $0{\cdot}6745\sqrt{\frac{\Sigma\Delta^2}{3N}}$ is 1·52″, while $m = \sqrt{\frac{\Sigma\Delta^2}{3N}} = 2{\cdot}25''$. 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 2·723 = 0·02 links per mile = 0·14 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.

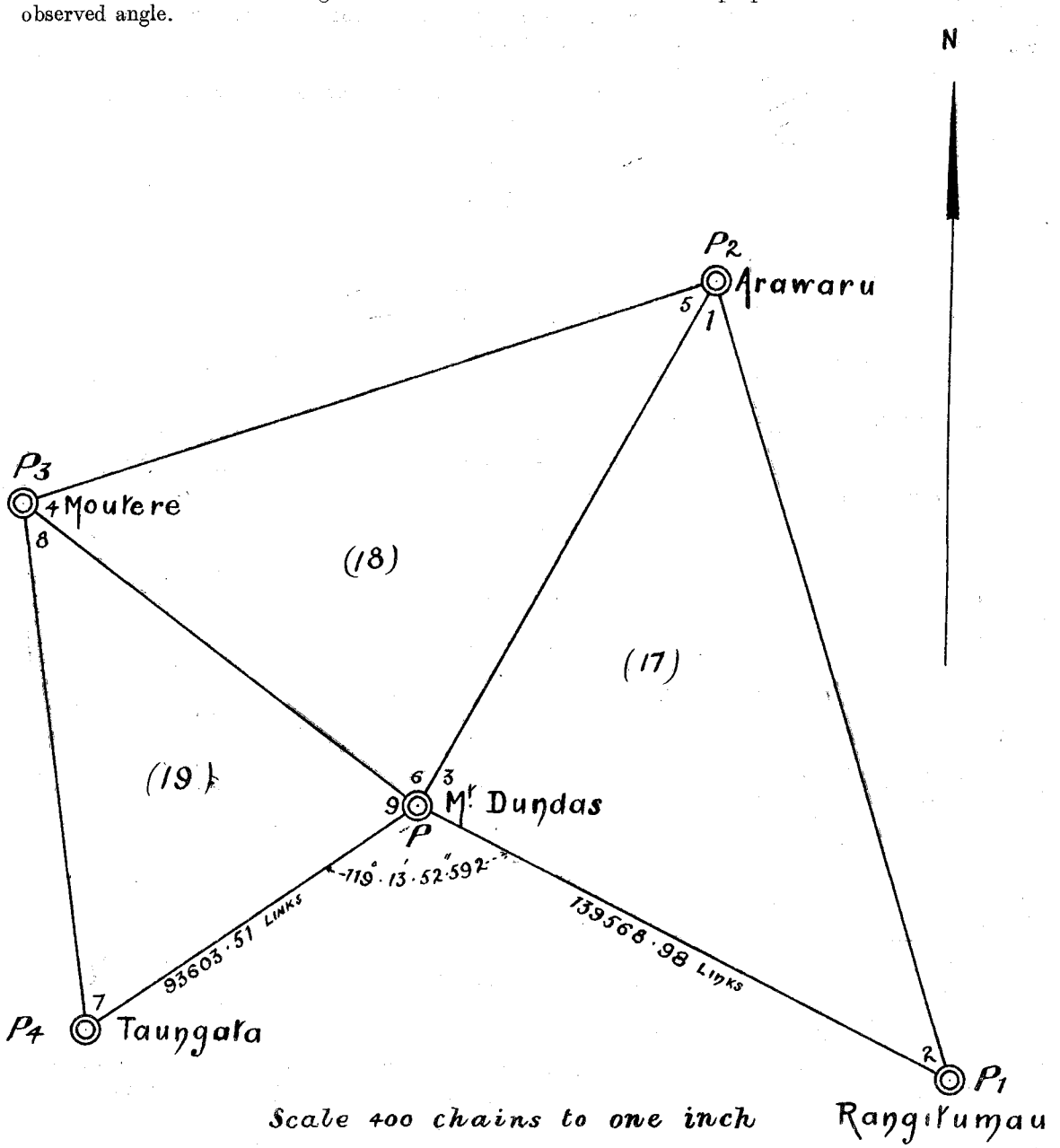
A modern theodolite of the design of the Repsold theodolite used in South Africa and now in use in Australia would certainly be of advantage for our higher-class work. The essential features are that the pivots are made of hardened steel, a watch-telescope is provided to check any slip or other movement 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.

Observations for azimuth are required at each base and at a number of intermediate stations. In order to eliminate as much as possible the effects of deflection of the plumb-line the fundamental azimuths on which the triangulation is to rest should be observed at all the trig. stations of a polygon at both bases.

Similar remarks apply to the observations for latitude. Former observations at Taranaki, Wellington, Nelson, and Marlborough have disclosed a number of discrepancies which point to large deflections of the plumb-line, and further observations are required to ascertain the extent of the deflections.

During the year Mr. H. E. Girdlestone has observed at the following geodetic stations: Ranganui, Pipipi, Maitaimoana, Tauakira, Aramaire, Tuku, Waverley, Kotawhiwhi, Omaranui, Momemome, Ikitara, and Mount Mitchell. Mr. E. J. Williams has assisted at the computations in a satisfactory manner, and now has a good working knowledge of the least-square adjustments of the triangulation.

An example is given here showing the adjustment of a polygon by the method of least squares. In the figure the sides PP_1, PP_4, and the included angle at P are to be adopted as correct both in angle and distance. The observed angles are first tabulated in order (for method of observing see "Report on the Survey Operations" for the year 1911–12), with number of complete sets of observations, and observers initial given opposite each angle. The "spherical excess" (ϵ_1) is then calculated as follows: ϵ_1 = double area in square chains × E : E being a geodetic latitude factor based on Clarke's 1880 Spheroid, and given in Tables of Geodetic Factors, Trans. A.A.A.S., 1904, p. 93. The summation error of each triangle is then found and distributed in the proportion of one-third to each observed angle.



The next schedule shows the application of the adjustment. Column (1) contains the number of angle, (2) the observed angles corrected for one-third triangle error, (3) the centre spherical angles, (4) the correction to (2) for spherical excess, (5) the angles of the first computation, equal to (2) + (4), (10) and (11) contain the sines and value of 1″ of (5), and with these sines the three triangles are solved.

and the length of PP_4 obtained by calculation from PP_1. Comparison of this value with the true value gives ϵ, while ϵ_0 is obtained from (3). Column (8) contains the cotangents of (5), (9) gives a_1 b_1.c_1, &c., and $\Sigma\ (a^2 + b^2 + c^2)$; from this column $h = c_1 + c_2 + c_3$ and $2k = \frac{1}{3}\ \Sigma\ (a^2 + b^2 + c^2)$ are obtained.

The equations for P and Q are now formed and solved. With these values of P and Q the corrections to the observed angles are calculated, and the values entered in column (6) and applied to the angles in (5), giving the final plane angles as shown in (7).

At this stage the work is checked by calculating PP_4 from PP_1, using the sines of the final plane angles in (7), and, as shown on the schedule, the calculated value of PP_4 agrees with the true value, thus proving the correctness of the work.

The triangles are solved using the sines in (13) and the results given in (15). The cotangents of (5) in (8) are taken from "Tafeln für Maschinenrechnen," by Dr. F. G. Gauss, published at Halle, A.S., by Von Eugen Strien, and checked by Chambers's tables. The natural sines of (5) in (11) are taken from tables of "Natural Sines and Cosines," by C. L. H. Max Jurisch, published at Cape Town, S.A., by Herrman Michaelis, and checked by Chambers's tables, the value of 1″ being entered in (10). The natural sines of (7) in (13) are again taken from tables by C. L. H. Max Jurisch, the first and second of each triangle being checked by adding algebraically (12), the third being checked by Chambers's tables. The work being thus checked at every point reduces the risk of numerical slips to a minimum.

In solving the triangles the usual practice is to start from the longest base-line and divide that length by the sine of the opposite angle, entering the value obtained underneath the three sines of each triangle in (13). This value is in turn multiplied by the sines opposite the required sides and the results entered in column (15), and so on for each triangle.

The notation used is as follows:—

Let l^1 = length of PP_4, calculated from PP_1, using the angles from column (5);
let l = true length of PP_4:
then $\epsilon = \frac{l - l^1}{l}$ radians,

ϵ_0 = sum of angles at P (from (3)) − 360°,
a_1 = cot angle 1, column (5),
β_1 = cot angle 2, column (5),
$a_1 = 2\ a_1 + \beta_1$,
$b_1 = -a_1 - 2\ \beta_1$,
$c_1 = -\ a_1 + \beta_1$,
$2k = \frac{1}{3}\ \Sigma\ (a^2 + b^2 + c^2)$,
$h = c_1 + c_2 + c_3$,
i = the number of triangles.

The equations for P and Q are—

$$h\ P + 2i\ Q + \epsilon_0 = 0$$
$$2k\ P + h\ Q + \epsilon = 0$$

The corrections to the angles are—

Angle 1 = $a_1\ P - Q$
Angle 2 = $b_1\ P - Q$
Angle 3 = $c_1\ P + 2Q$, &c.

The final plane angles are therefore equal to column (5) + column (6).

Observed Angles.

No.	Angle.	Observers.	No.	Angle.	Observers.
1	45° 58′ 28·96″	8 G.	6	81° 42′ 12·77″	6 G.
2	46 16 12·70	4 G.	7	62 42 11·58	10 G.
3	87 45 16·11	6 G.	8	45 59 13·71	9 G, 4 L.
4	55 29 28·71	7 G, 4 L.	9	71 18 40·00	6 G.
5	42 48 17·81	6 G, 2 L.			

	(17)	⅓ Δ Error.
45° 58′	28·96″	+ 1·413″
46 16	12·70	+ 1·413
87 45	16·11	+ 1·413
179 59	57·77	
Sph. ex.	2·009	
	− 4·239	

	(18)	⅓ Δ Error.
55° 29′	28·71″	+ 0·786″
42 48	17·81	+ 0·786
81 42	12·77	+ 0·787
179 59	59·29	
Sph. ex.	1·649	
	− 2·359	

	(19)	⅓ Δ Error.
62° 42′	11·58″	− 1·412″
45 59	13·71	− 1·412
71 18	40·00	− 1·413
180 00	05·29	
Sph. ex.	1·053	
	+ 4·237	

NOTES.—8 G refers to number of complete sets of observations by Mr. H. E. Girdlestone; 7 G, 4 L refers to combined number of complete sets of observations by Mr. H. E. Girdlestone and Mr. H. J. Lowe, the mean being obtained as follows:—

Mean of Mr. Girdlestone's sets = 55° 29′ 29·16″ × 7 = 204·12″
Mean of Mr. Lowe's sets = 55 29 27·91 × 4 = 111·64
11) 315·76
55.29.28.71

NORTH ISLAND
(TE IKA-A-MAUI)

NEW ZEALAND

Showing Progress of New Secondary Triangulation for the Dominion.

JAMES MACKENZIE
Minister of Lands

Scale of English Miles
30 5 0 10 20 30 40 50 60 70 80 90

Reference
Cities (thus ●)
Boroughs
Towns
Railways
Roads
Boundaries of Land Districts
Projection - Rectangular Tangential

Observed sides of triangles shown in continuous red lines - thus
Lines projected or to be revised shown as broken red lines - ,,
New base-lines measured - ,,
Signals erected - ,,

WAITEMATA BASE
MATAMATA BASE
KAINGAROA BASE
OKAIAWA-ELTHAM BASE
WAIRARAPA BASE

RAOUL or SUNDAY I.
Denham Bay

MACAULEY I.

CURTIS I.

L'ESPERANCE RK

KERMADEC ISLANDS

COOK ISLANDS

T A S M A N S E A

Bay of Plenty
Hawke Bay
North Taranaki Bight
South Taranaki Bight
Golden Bay
Tasman Bay
D'Urville I.
Karamea Bight
Cloudy Bay
Palliser Bay
Mahia Peninsula

M I D D L E I S L A N D

COOK STRAIT

SOUTH PACIFIC OCEAN
TE MOANA-NUI-A-KIWA

172° 173° 174° 175° East Longitude 176° 177° 178°
34 35 36 37 38 39 40 South Latitude

BY AUTHORITY: JOHN MACKAY, GOVERNMENT PRINTER.

Least-square Calculation of Polygon.

1. No. of Angle.	2. Observed Spherical Angles.*			3. Centre Spherical Angles.			4. ⅓ Correction Spherical Excess.	5. Corrected Plane Angles.	6. Least-square Correction.	7. Final Plane Angles.			8. Cot.	9. a, b, c.	10. Value $\cdot 1''$.	11. Natural Sines of Column 5.	12. 6×10.	13. Natural Sines of Column 7.	14. Sides.	15. Links.
	°	′	″	°	′	″	″	″	″	°	′	″								
1	45	58	30·373	119	13	52·592	− 0·670	29·703	+ 1·034	45	58	30·737	+ 0·967	$a_1 = + 2{\cdot}891$	33·7	0·7190356	+ 35	0·7190391	P P$_1$	139568·98
2	46	16	14·113				− 0·670	13·443	− 0·218	46	16	13·225	+ 0·957	$b_1 = - 2{\cdot}881$	33·5	0·7226102	− 7	0·7226095	P P$_2$	140262·01
3	87	45	17·523	87	45	17·523	− 0·669	16·854	− 0·816	87	45	16·038		$c_1 = - 0{\cdot}010$				0·9992321	P$_1$ P$_2$	193955·80
	180	00	02·009					00·000		180	00	00·000						194104·85		
4	55	29	29·496				− 0·550	28·946	+ 0·940	55	29	29·886	+ 0·688	$a_2 = + 2{\cdot}456$	27·5	0·8240409	+ 26	0·8240435	P P$_2$	140262·01
5	42	48	18·596				− 0·550	18·046	− 0·211	42	48	17·835	+ 1·080	$b_2 = - 2{\cdot}848$	35·5	0·6795054	− 7	0·6795047	P P$_3$	115659·79
6	81	42	13·557	81	42	13·557	− 0·549	13·008	− 0·729	81	42	12·279		$c_2 = + 0{\cdot}392$				0·9895344	P$_2$ P$_3$	168430·53
	180	00	01·649					00·000		180	00	00·000						170211·90		
7	62	42	10·168				− 0·351	09·817	+ 0·840	62	42	10·657	+ 0·516	$a_3 = + 1{\cdot}998$	22·3	0·8886391	+ 19	0·8886410	P P$_3$	115659·79
8	45	59	12·298				− 0·351	11·947	− 0·124	45	59	11·823	+ 0·966	$b_3 = - 2{\cdot}448$	33·7	0·7191779	− 4	0·7191775	P P$_4$	93603·51
9	71	18	38·587	71	18	38·587	− 0·351	38·236	− 0·716	71	18	37·520		$c_3 = + 0{\cdot}450$				0·9472686	P$_3$ P$_4$	123290·38
	180	00	01·053	360	00	02·259		00·000		180	00	00·000						130153·56		

$\epsilon_0 = + 2{\cdot}259''$

$\Sigma (a^2 + b^2 + c^2) = 41{\cdot}142.$

Sin 1 sin 4 sin 7 from column 9 = $\cdot 5265317_{,7}$
Sin 2 sin 5 sin 8 from column 9 = $\cdot 3531290_{,1}$

$$\frac{139568{\cdot}98 \times \cdot 3531290_{,1}}{\cdot 5265317_{,7}} = 93604{\cdot}71$$

93604·71
93603·51

$- 1{\cdot}20 = 0{\cdot}10$ links per mile.

$$\therefore \epsilon = \frac{- 1{\cdot}20}{93603{\cdot}51} = - \cdot 00001282 \text{ radians;}$$

$$\therefore \epsilon = - \cdot 00001282 \times 206265 = - 2{\cdot}644''$$

$h = c_1 + c_2 + c_3 = + 0{\cdot}832$
$2k = \frac{1}{3}\Sigma (a_2 + b_2 + c_2) = + 13{\cdot}714$
$i = + 3$
$\epsilon_0 = + 2{\cdot}259$
$\epsilon = - 2{\cdot}644$

$$\therefore \quad \cdot 832\,P + 6\,Q + 2{\cdot}259 = 0$$
$$13{\cdot}714\,P + \cdot 832\,Q - 2{\cdot}644 = 0$$

$\therefore P = + 0{\cdot}217 \qquad Q = - 0{\cdot}407$

* Corrected for ⅓ triangle errors.

Electrical Measurement of Temperature of Steel and Invar Measuring-bands.

In conjunction with Professor T. H. Laby, experiments are being carried out at Victoria College on the electrical measurement of temperature of steel and invar measuring-bands. Two concrete blocks have been put in 4 chains apart; one block is 2 ft. square on the bottom, 10 in. square on top, and 2 ft. 6 in. high, while the other is 3 ft. square on the bottom, 10 in. square on top, and 6 ft. high; the difference in size being necessary owing to the slope of the ground. These blocks carry the marks with which the bands are compared. High-power microscopes are mounted over the marks. The bands are supported at every chain on large wheels 3 in. in diameter mounted on ball-bearings and insulated. The bands are anchored to a straining-post at one end, and are strained by weights at the other end. An electric current from a small accumulator is sent through the steel band, and returns by a piece of insulated flexible copper wire, and passes through a sensitive galvanometer and a resistance-box. The variation of the temperature of the steel band alters its resistance, and by measuring the resistance the true temperature of the band is obtained. Preliminary experiments seem to show that the results will be of high accuracy, and that a portable and convenient field outfit can be designed for use on base measurements and on standard surveys.

Standard Bar and Comparator.

This apparatus was obtained from the Cambridge Scientific Instrument Company, England, and will be the final standard of length for the measurements of the bases of the triangulation. The copies of the certificates of examination give a good description of the apparatus and show its high accuracy.

National Physical Laboratory, Teddington, England.—Copy of Certificate of Examination of a 10-link Scale.

For Lands and Survey Department, Wellington, New Zealand.

Description: H form section. Total length, 207 cms.; width, 3 cms.; depth, 3 cms. Four pairs of brass supports fit into the groove of the bar and act as holders for thermometers.

Marked: On front—Standard Bar No. 1, Lands and Survey Department, Wellington, New Zealand, Made by the Société Genevoise, Geneva, for the Cambridge Scientific Instrument Company, Limited. On back—Acier Nickel 43% Coulée 2432. 162. No. 9407.

Graduations: The graduations are on the neutral plane of the bar, and are marked and numbered at each $\frac{1}{10}$ link throughout. The ends are engraved A and B, left and right respectively. At end A a space from $\frac{1}{20}$ of a link to the left of the zero mark to the 0·1-link mark is divided to 0·001 of a link. At end B a space from 9·9-link mark to $\frac{1}{20}$ of a link to the right of the 10-link mark is divided to 0·001 of a link. The spaces for 0·02 of a link on either side of each link-graduation are also divided to 0·001 of a link.

The scale, symmetrically supported on two rollers 118 cms. apart, has been compared with the Laboratory standards, and the lengths at 0° Centigrade between the various link-graduations have been found to be as given below:—

Graduations.	Actual Lengths at 0° C. Links.
0 — 1 ..	$1{\cdot}00001_3$
0 — 2 ..	$2{\cdot}00004_1$
0 — 3 ..	$3{\cdot}00003_4$
0 — 4 ..	$3{\cdot}99999_7$
0 — 5 ..	$5{\cdot}00002_3$
0 — 6 ..	$6{\cdot}00002_3$
0 — 7 ..	$7{\cdot}00001_6$
0 — 8 ..	$7{\cdot}99996_5$
0 — 9 ..	$8{\cdot}99991_9$
0 — 10 ..	$9{\cdot}99992_4$

The above results may be relied on as accurate, for the shorter lengths to within about 3 units, and for the longer lengths to within about 5 units in the last (dropped) decimal place.

The coefficient of linear dilatation of this scale has been determined between the temperatures 0° C. and 31° C, and the length of the scale at other temperatures than 0° C. has been found to be given by the following formula:—

$$Lt = Lo\,(1 + 0{\cdot}00000714\ t + 0{\cdot}000{,}000{,}000{,}39\ t^2)$$

the temperature being expressed in the hydrogen scale.

(Signed) R. T. Glazebrook, Director.

September 25th, 1912.
Ref. M 105, 46.

National Physical Observatory, Teddington, England.—Copy of Certificate of Examination of a 10-link Comparator.

For the Lands and Survey Department, Wellington, New Zealand.

Description: This instrument consists of a firm base carried on three levelling-screws. A nickel-steel shaft, somewhat longer than 10 links, is supported on four hardened-steel rollers, which are connected to the base, and which allow free longitudinal movement of the shaft. Two microscopes, placed any distance apart from 6 cms. to 208 cms., can be gripped in the shaft. The position of the microscope shaft is controlled by a micrometer-screw, suitably mounted on the base, two springs keeping the shaft and the end of the micrometer-screw in contact with the two ends of a connecting-rod.

Makers: The Cambridge Scientific Instrument Co., Ltd.

Marked: The Cambridge Scientific Instrument Co., Ltd., Cambridge, England, No. 14338 NP 9406.

This instrument has been examined at the Laboratory, and its workmanship has been found to be satisfactory.

The coefficient of expansion of the nickel-steel shaft has been determined, and its mean value between the temperature 1° C. and 30° C. has been found to be $0{\cdot}000{,}004_0$ per 1° Centigrade.

CALIBRATION OF THE MICROMETER.

The micrometer-screw, as mounted in the comparator, has been calibrated, one of the microscopes belonging to the comparator being set to known distances on one of the Laboratory line standards. During this calibration the micrometer was screwed against the pressure of the springs designed to keep the end of the movable shaft in contact with the end of the screw.

(*a.*) *On the Millimetre Scale.*—The pitch of the screw is approximately 0·5 mm. and the drum is divided into 250 parts: hence one division represents 0·002 mm.

Table 1 gives the corrections to be applied to the readings to annul the progressive error of the screw.

TABLE 1.

Reading of Drum on the Millimetre Scale.	Correction to the Reading.
	Millimetres.
0·0000 ..	$0{\cdot}000_0$
1·0000 ..	$-0{\cdot}000_4$
2·0000 ..	$-0{\cdot}001_2$
3·0000 ..	$-0{\cdot}002_4$
4·0000 ..	$-0{\cdot}004_0$
5·0000 ..	$-0{\cdot}004_6$
6·0000 ..	$-0{\cdot}005_8$
7·0000 ..	$-0{\cdot}007_4$
8·0000 ..	$-0{\cdot}009_6$
9·0000 ..	$-0{\cdot}010_4$
10·0000 ..	$-0{\cdot}010_8$

The micrometer-screw has also a periodic error, which has been found to repeat in each successive revolution of the drum.

Table 2 gives the necessary corrections to the readings.

TABLE 2.

Reading on the Drum on the Millimetre Scale.	Approximate Value of Reading.	Correction.
Divisions.	Millimetres.	Millimetres.
0 ..	0·00 ..	$0{\cdot}000_0$
20 ..	0·04 ..	$+0{\cdot}000_7$
40 ..	0·08 ..	$+0{\cdot}000_9$
60 ..	0·12 ..	$+0{\cdot}000_7$
80 ..	0·16 ..	$0{\cdot}000_0$
100 ..	0·20 ..	$-0{\cdot}001_4$
120 ..	0·24 ..	$-0{\cdot}002_9$
140 ..	0·28 ..	$-0{\cdot}004_1$
160 ..	0·32 ..	$-0{\cdot}004_6$
180 ..	0·36 ..	$-0{\cdot}004_2$
200 ..	0·40 ..	$-0{\cdot}003_3$
220 ..	0·44 ..	$-0{\cdot}002_0$
240 ..	0·48 ..	$-0{\cdot}000_5$
250 ..	0·50 ..	$0{\cdot}000_0$

To obtain the correct value from any reading on this scale it is necessary to add, algebraically, to the reading the corrections of Tables 1 and 2. For example, the reading 4 mm. + 100 divisions becomes $(4{\cdot}200 - 0{\cdot}004 - 0{\cdot}001_4) = 4{\cdot}1946$ mm. when corrected.

(*b.*) *On the Link Scale.*—This scale is inclined to the axis of the micrometer-screw at about 60°. One division of the drum read on this scale represents 0·00001 of a link.

The progressive error of the screw is corrected by applying the corrections of Table 3 to the readings taken in this scale.

TABLE 3.

Reading of Drum on the Link Scale.	Correction to the Reading.
	Links.
0·000 ..	$0{\cdot}00000_0$
0·005 ..	$-0{\cdot}00000_3$
0·010 ..	$-0{\cdot}00000_7$
0·015 ..	$-0{\cdot}00001_4$
0·020 ..	$-0{\cdot}00002_1$
0·025 ..	$-0{\cdot}00002_5$
0·030 ..	$-0{\cdot}00003_0$
0·035 ..	$-0{\cdot}00003_9$
0·040 ..	$-0{\cdot}00005_0$
0·045 ..	$-0{\cdot}00005_4$
0·050 ..	$-0{\cdot}00005_6$

Since more than a revolution of the screw is required to give 0·0025 link, the periodic error does not quite repeat on this scale, and in Table 4 are given the values of corrections to be applied to readings at various points of the scale.

TABLE 4.

Reading on Drum on Link Scale.	Corrections to Readings from				
	0 to ·01.	·01 to ·02.	·02 to ·03.	·03 to ·04.	·04 to ·05.
Division.	Links.	Links.	Links.	Links.	Links.
0	$\cdot 00000_0$	$\cdot 00000_0$	$\cdot 00000_0$	$\cdot 00000_0$	$\cdot 00000_0$
20	$+ \cdot 00000_3$	$+ \cdot 00000_2$	$+ \cdot 00000_1$	$+ \cdot 00000_1$	$\cdot 00000_0$
40	$+ \cdot 00000_4$	$+ \cdot 00000_2$	$+ \cdot 00000_1$	$\cdot 00000_0$	$- \cdot 00000_1$
60	$+ \cdot 00000_3$	$\cdot 00000_0$	$- \cdot 00000_2$	$- \cdot 00000_4$	$- \cdot 00000_6$
80	$- \cdot 00000_1$	$- \cdot 00000_5$	$- \cdot 00000_8$	$- \cdot 00001_1$	$- \cdot 00001_3$
100	$- \cdot 00000_9$	$- \cdot 00001_3$	$- \cdot 00001_6$	$- \cdot 00001_8$	$- \cdot 00002_0$
120	$- \cdot 00001_6$	$- \cdot 00001_8$	$- \cdot 00002_2$	$- \cdot 00002_5$	$- \cdot 00002_6$
140	$- \cdot 00002_2$	$- \cdot 00002_4$	$- \cdot 00002_6$	$- \cdot 00002_7$	$- \cdot 00002_7$
160	$- \cdot 00002_4$	$- \cdot 00002_4$	$- \cdot 00002_5$	$- \cdot 00002_5$	$- \cdot 00002_4$
180	$- \cdot 00002_2$	$- \cdot 00002_1$	$- \cdot 00002_1$	$- \cdot 00002_0$	$- \cdot 00001_9$
200	$- \cdot 00001_6$	$- \cdot 00001_5$	$- \cdot 00001_5$	$- \cdot 00001_4$	$- \cdot 00001_2$
220	$- \cdot 00001_0$	$- \cdot 00000_9$	$- \cdot 00000_7$	$- \cdot 00000_6$	$- \cdot 00000_5$
240	$- \cdot 00000_3$	$- \cdot 00000_2$	$- \cdot 00000_2$	$- \cdot 00000_1$	$- \cdot 00000_1$
250	$\cdot 00000_0$	$\cdot 00000_0$	$\cdot 00000_0$	$\cdot 00000_0$	$\cdot 00000_0$

In the case of a large number of readings being taken, it is sufficient, as a rule, to correct the mean reading from Table 1 or Table 3 only. It is only necessary to correct the individual readings from Table 2 or Table 4 when the highest accuracy is required.

September 25th, 1912. (Signed) R. T. GLAZEBROOK, Director.

Ref. M. 105, 62.

Mr. John Langmuir, Inspector of Surveys, reports that under the heading of secondary triangulation his work for the year has been only of a preparatory nature—viz., in the visiting of positions in the proposed scheme of triangulation, and with the erection of large permanent signals at twenty-one of the stations. In this connection the following islands lying off the east coast of the Auckland District were visited—viz., one of the Mokohinau Group, Great Barrier, Cuvier, Great Mercury, Red Mercury, and Flat Island of the Aldermen Group. Signals have since been erected on these islands. At the Great Barrier Island it was discovered that many of the old minor trig. stations were much in need of attention, while in some cases the tubes were entirely missing. A contract has been let to effect the necessary repairs. Apart from this, the country some 96 miles north of Auckland has been travelled over, and proposed stations visited to ensure that they are reciprocally visible from one another. The area covered by this triangulation—of which so far the positions of stations have been examined and part of the signals built—will be nearly three million acres of land and water.

The work of laying down suitable base-lines—reference to which has been made in previous yearly reports—has been continued on the last base chosen, viz., that on the Kaingaroa Plains. Up to the 31st March the total chainage completed at this base was 11·94 miles, of which 2·74 miles was done last year. To ensure accuracy as far as possible this mileage was gone over four times, which means that a total distance of 47·76 miles was chained.

It is desirable that another base be measured in North Auckland if a suitable one can be obtained. The most likely country will, I think, be about the Kerikeri, Bay of Islands, or Waimate North. This base should be the last required in the North Island.

APPENDIX IV.

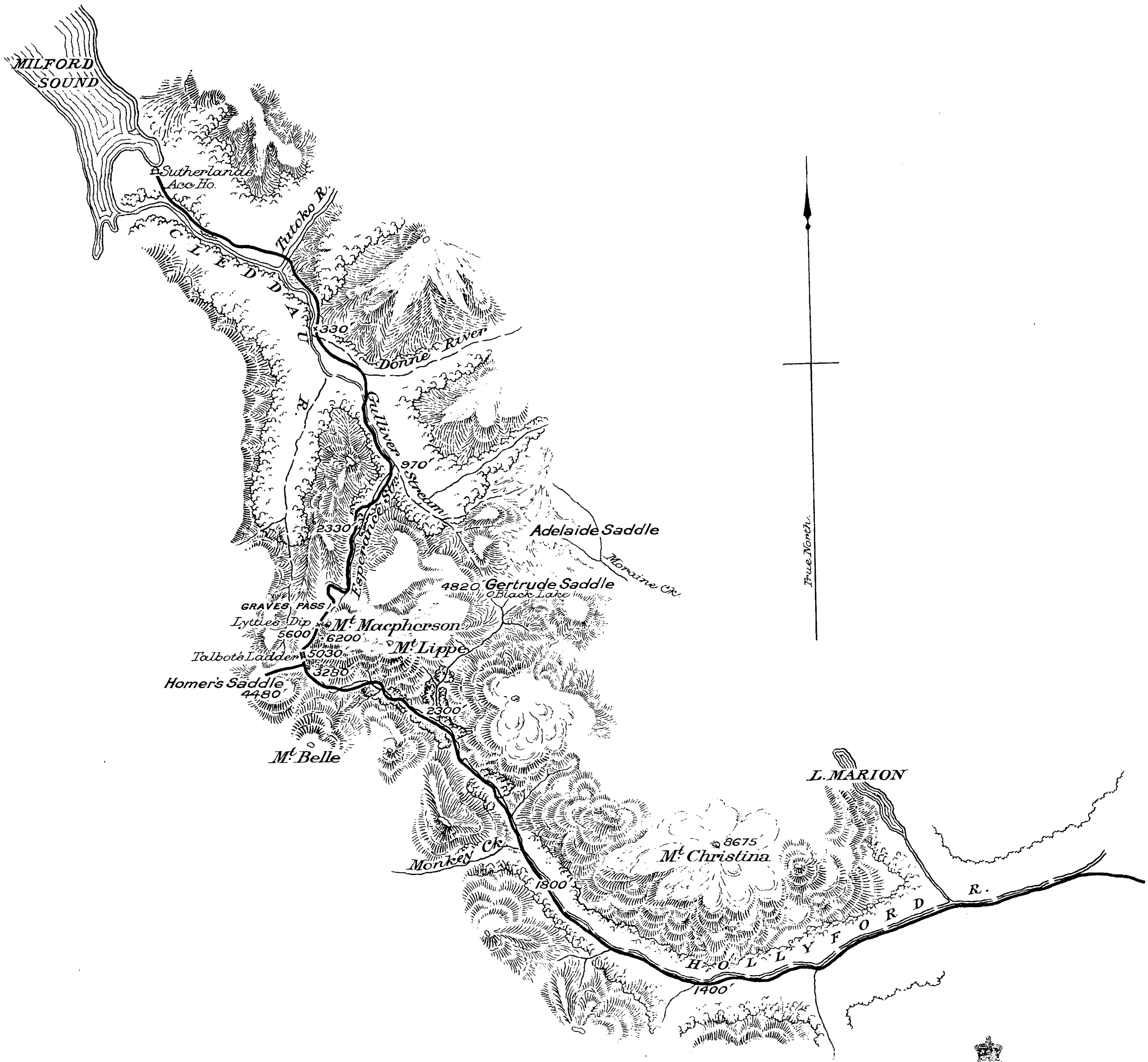
REPORT ON EXPLORATION TRIP, DIRECT ROUTE, LAKE WAKATIPU TO MILFORD SOUND.

[By D. MACPHERSON, District Surveyor.]

THE plan accompanying this report is not intended for an accurate presentment of the route, such as could be obtained from a prismatic and chain traverse, but is simply a sketch, from prismatic bearings of main direction of the valleys, &c.

As there is a well-known pack-track from Elfin Bay, on Lake Wakatipu, up the Greenstone River to Lake Howden, at its source, a distance of about twenty-five miles, I will confine my report to the country to the west of this.

Leaving Lake Howden on the morning of the 28th December, 1912, accompanied by Guide Lippe, of the Hermitage staff, Mount Cook, and under the able guidance of Messrs. Grave and Talbot, we set out with a 47 lb. swag and an ice-axe each. Rain had just commenced as we started, which made the bush wet, and obscured the view of surrounding mountains. Leaving the Hollyford track after less than half a mile, we struck westward and downwards towards the Hollyford River; the going was fairly good, and the fall about 1,000 ft. The river is here a chain and a half or more in width, with a rapid flow of from 2 ft. to 4 ft. of water, its course being fairly direct. We kept up the southern side of the Hollyford River right up to Monkey Creek. The route lay through flat bush at first, till after the outlet from Lake Marion is passed, when a high bluff obstructs the passage; this can be negotiated close to the river, then a succession of rather steep sidelings is met, and we were glad to avail ourselves of the first strip of flat ground to pitch camp.



Sketch Plan of Part of Wakatipu to Milford Route.

Surveyed by D. Macpherson, Dist. Surveyor

4 · 2 · 1913

Scale : 1 Mile = 1 Inch

Heights in Red figures are Barometric.

NZ LANDS AND SURVEY

JAMES MACKENZIE.
Surveyor General

Drawn by H. E. Taylor, April 1913.

By Authority. John Mackay. Government Printer

G. H. M. McClure Chief Surveyor Southland
H. I. McCardell Chief Draughtsman Head Office Wellington

1500.5.13.278

Next morning being fine, the bush soon dried, and walking was more pleasant. We passed a large creek, with fine falls, coming in from the left. From this point the going was sometimes on sideling, with small flats, and short stretches along boulders at side of river, until the first elbow was reached, just above a rather rapid fall in river-bed. From here a magnificent view is obtained of the towering Mount Christina, with its snowfields and overhanging glaciers, the summit being apparently in close proximity to the river, but over 7,000 ft. above. The Hollyford is very much like the Clinton Valley in general description, but the distance to be traversed is less, and the mountains on the northern face are far more magnificent, with their additional height and overhanging glaciers, from which avalanches are frequently precipitated over the cliffs below. The going for some stretches above this is indescribably slow—the bush becomes more mixed with ribbonwood, with high ferns, which are best walked *on* from top to top. Here and there are patches of huge stones between which the bush has grown. The sidelings, however, are not steep, and now and again the walking is good.

We camped the next night half a mile or so below Monkey Creek. In the morning we were soon out of the bush and on to a well-grassed flat about 50 or 60 chains in length, containing about 100 acres, and infested with rabbits. There were signs of hares also, but we did not see any. Bird-life in this valley is very scarce; we saw no wekas or other ground birds, only paradise and blue duck, and keas. Above this is a short patch of stunted bush, low mountain totara, veronica, and box, with birch. Another open patch of similar extent is then reached, over which alpine flowers grow in profusion. At the head of this is some open birch bush rising more rapidly over a terminal moraine, above which the valley flattens out at the forks. Immediately in front Mount Lippe rises in a sheer angular cliff for 2,000 ft. or more, above which is a fine glacier and snow-capped summit of considerable extent. Here we had an incessant twenty-four hours genuine West Coast downpour, which started the avalanches going, often in quick succession.

On the following afternoon we made an excursion to the Gertrude Saddle, 4,820 ft., a fairly easy climb; one can go on either side of the creek at first, but should afterwards cross to the north side. When at Black Lake, a narrow basin of about 100 yards diameter, the easier way is to climb round rocks close to the north of the lake to snowfield, which leads by an easy ascent to the saddle. Here a most glorious panorama opens out—the most beautiful I have seen from any pass. You look down the Cleddau Valley to Milford Sound, about two-thirds of which can be seen, with Stirling Fall, Mounts Pembroke, Tutoko, and Underwood—which last is a fine mountain from this side. Just to the north-west, and apparently within a few hundred yards, is the Adelaide Saddle, at the headwaters of Moraine Creek. The cliff between is vertical, but it might be possible to traverse a route over the mountain. The Gertrude is the saddle where Quill is supposed to have lost his life in attempting the descent on the other side.

On the following morning—1st January, 1913—Lippe got us out at 2 a.m., when we had breakfast and made an early start for Homer Saddle, which we reached without difficulty. From the head of the Hollyford Valley to Homer Saddle is a rise of 1,200 ft. The climb to Homer Saddle is straight up on loose good-holding rocky fan. Homer Saddle is 4,480 ft. The outlook on the other side is rather circumscribed; the descent appears to be sheer, looking from the saddle. Here we saw Quill's cairn, with stump of a stick on which is cut his name, "W. Quill," still legible though the wood is nearly rotten.

It has been found quite impossible to climb down the western face of Homer Saddle, as the cliff falls away almost sheer, for what I would judge to be 1,500 ft. to 2,000 ft., to where a steep snow-grass slope leads down to the head of the Cleddau River. As the rock slope is not quite perpendicular, and is very even, there would be nothing but the cost and necessary time to prevent a zigzag sideling from being blasted out of the face, at any grade that might be required. Of course, on a similar basis a tunnel could be run through from foot to foot, which would eventually make a pack-track possible; it would, however, have to be from 600 to 700 yards in length, with substantial fall towards the Cleddau River. Both these alternatives would, to my mind, rob the route of its most attractive part. From Homer Saddle the route runs northward up the very steep rocky spur to an elevation of 5,030 ft.

During this ascent, which we named "Talbot Ladder," we were coupled together by rope. The rock is fairly good holding, but the climbing is necessarily slow, as only one can move at a time. The distance up this was estimated at about 15 chains, and for safety it would be necessary to let in iron pipes, which could be connected by steel ropes. Footholds or steps should also be cut out of the rock or the snow-grass. A very fine view is obtained during this climb of the glacier towards Mount Lippe, which seems very close below.

On arrival at the easier slope we unroped, and proceeded in a northerly direction round the western face for about 200 yards, first over loose rocky slopes, and then up a steep snow slope. At rocks on this we had lunch and left our swags, afterwards climbing a snow-covered mountain, 6,200 ft., which we named Mount Macpherson. From it a most beautiful view is obtained. To the south-west rise numberless snow-clad peaks, among which is what we took to be Mount Balloon; on the west, Mitre Peak and Mount Sheerdown; then, northwards, Mounts Pembroke, Tutoko, Underwood, and countless other peaks of similar altitude, culminating in what we took to be Mount Aspiring; in the nearer north-east Mount Lippe with its glaciers, and eastward the magnificent pile of Mount Christina, with Mount Belle in the south-east. The valleys of the Hollyford and Cleddau Rivers, with those of their tributaries, lie spread out below us like a map, while the hollow of the Adelaide Saddle is visible, falling towards Moraine Creek, but the Gertrude Saddle is hidden behind a shoulder of Mount Lippe.

An easy downhill walk brought us again to our swags, and we proceeded in a northerly direction across the snow for a hundred yards or so, then over some shingle-slopes below a bluff, and on to snowfields which, except for a few crevasses, extend unbroken for about half a mile, where another spur is crossed at Lyttle Dip, 5,600 ft. Here there is a hole in the rock just large enough to allow one to crawl through with a swag, when a yawning abyss is encountered. A few yards, however, brings one to a natural shelf which leads to the right, down the cliff, to another snowfield of about a quarter of a mile in extent. Along this the grade is practically

level and the going good. This brings us to Grave Pass, on another spur, the crest of which has to be traversed for 4 or 5 chains until the pass is reached. From this a fine view of the Esperance Valley is obtained, towards which the route now leads, by a narrow snow-grass shelf leading to the right, and then doubling to the left and downwards. After this a series of shelves are negotiated leading up towards the crown of the ridge again and to the left, within a few hundred feet of it. I think that the shelf to the left, close up under the cliff, is the better here; we took the lower one, which leads along the brow of a 2,000 ft. precipice, and is in places rather close and bare to be pleasant climbing. After pursuing a downward grade on wider shelves, a gutter is reached, down which a straight course may be maintained with safe climbing. Ropes are not needed now, and a faster pace can be indulged in, the route being in the direction of the waterway, with one sharp double to the left, to get down off a rounded spur. Near the bottom a cliff has to be avoided by a slight detour to the right. From here on we found our way down in the dark to small bush to the right of the creek, and below the falls, 2,330 ft., our camping-ground, which was not reached till 10 p.m. By the time the billy was boiled we did not feel like pitching camp, so just turned into our sleeping-bags.

I may mention that the snowfields referred to slope down to the edge of what appears to be a perpendicular cliff of great height, overhanging and running parallel to the Cleddau Valley. It is possible that a practicable route may be found below some of these snowfields, close to the brow of the cliff, where two high bluffs appear to bar the way, but might be negotiated. However, I think that even if so it would not be so safe or enjoyable a route, as avalanche snow might be encountered, and I believe that the snow walking is really the safer, when once one gets used to the first feeling of insecurity. The route we traversed is evidently over safe snow —that is, free from avalanches—as it is near a rock wall on upper side. The cost of formation would also be nil, and the snow walking and opportunities for glissading would, I have no doubt, be appreciated by a large number of tourists.

Leaving camp fairly late on the morning of the 2nd January, 1913, our way lay for half a mile or less down the bed of the Esperance River until the fall became too great and the boulders too large to negotiate, when we took once more to the bush. Here we made our way towards the rocky wall to our right, where we struck a watercourse, which led us in the right direction as it joined the Esperance River just as it debouches from its narrow gorge. Soon the Esperance joins the Gulliver River (970 ft.), whence a good view of the Gertrude and Adelaide saddles may be obtained. They certainly look no more promising from below than from on top—though an adjacent saddle to the north of the Adelaide, and also leading into Moraine Creek, appears as though it might be climbable. From here on the walking is good and the fall ever getting less. We made a mistake in bearing to the right, which immediately took us beside the Donne River, here running in a deep gorge, and at a much lower level. We struck the Cleddau River about a quarter of a mile below its junction with the Gulliver River. From here to Milford the going was much the easiest walking on the route, cattle-tracks and open bush being everywhere found, excepting about 10 chains of bluff round the Cleddau River. I must mention the view of Mount Tutoko which we obtained from the shingle-beach, about a quarter of a mile above the junction of the Tutoko and Cleddau Rivers, which is probably unsurpassed as a view of a single mountain anywhere in New Zealand. The Tutoko carries more water than the Cleddau River, is about 2 chains wide, and, being over 3 ft. deep and very swift, we found it bad enough to ford. We thought that the better route for a track would be along the southern side of the Cleddau River all the way, which could be more easily forded near Sutherlands.

From the Tutoko River to Sutherlands, Milford, is about two miles of easy walking, and we reached our destination in good time. On this latter track there is a small portion of 4 chains or so that should be reconstructed, as in its present state it is an awkward scramble on what is otherwise an easy and pleasant walk. Two men could vastly improve it in a week's work.

With regard to the practicability or otherwise of this as a tourist route, I might as well at once confess myself an absolute new chum at this sort of climbing, so the fact of my having come over it with a 50 lb. to 30 lb. swag without slip or misadventure of any kind makes it apparent that the average man, if in good company, could do the same thing. If a track up the valleys similar to that from Lake Howden to Glade House were made, and the worst places over the pass improved by narrow side cuttings, steps, or footholds, as required by local conditions, with iron bars or pipes let in, with wire rope attached at the most dangerous places, huts built at the head of the Hollyford and Esperance Valleys, I should say that with competent guides (who would be necessary) about half the people who now go over McKinnon Pass could with safety and pleasure, accomplish the return journey by this route. From the hut on Hollyford an interesting side journey to the Gertrude Saddle could be made; and, for the more ambitious, the trip to the summit of Mount Macpherson, while going over the pass, would be amply rewarded. Mount Lippe has not yet been climbed, but would be easy of access, while I believe a route from Homer to Gertrude Saddle over the mountain would be practicable, and possibly from Gertrude to Adelaide Saddle.

My remarks on the snow slopes *en route* are based on Guide Lippe's experience and advice.

The distance from Lake Howden to camp at forks of the Hollyford River is about twelve miles, thence to camp near head of the Esperance River about six miles or a little less; of this about 15 chains up Talbot Saddle, and, say, 40 chains from Grave Pass down towards the Esperance River, would be dangerous. Thence to Milford, about eight miles, or a total of about twenty-six miles, or much the same distance as from Lake Howden to Glade House. My distances are only estimates from point to point, as any measurements under the conditions were out of the question.

Messrs. Grave and Talbot deserve every credit for their persistence in finding this route over the mountain, as several attempts were unsuccessful. Their route up Talbot Ladder and along snowfields was first suggested after examination of photographs taken from the other side of the Cleddau Valley. I saw some places that they had climbed down that I am sure I could not be induced to tackle. The most wonderful part of the route, I think, is from Grave Pass down, which, viewed from below, seems impracticable.

My thanks are due to them, and to Guide Lippe, for their comradeship throughout, and for their ready assistance in the most dangerous places.

APPENDIX V.

TIDAL SURVEY.

[By C. E. Adams, M.Sc., F.R.A.S.]

Harmonic Analysis.

The harmonic tidal constants for the ports of Wellington and Auckland have been obtained by harmonic analysis from the hourly ordinates measured from the self-registering tide-gauges. In each case the period of observation was one year; Wellington for the year 1909, and Auckland for the year beginning 1908, December, 1.

Harmonic Tidal Constants.

—		Wellington.	Auckland.	—		Wellington.	Auckland.
Latitude ...		41° 17′ S.	36° 50′ S.	...		...	...
Longitude ...		174° 46′ E.	174° 49′ E.	...		...	...
A_0		37·931 ft.	9·237 ft.	...		...	...
S_1	H	0·005	0·006	Q	H	0·036 ft.	0·008 ft.
	κ	151·36	50·35		κ	26·35	56·64
S_2	H	0·112	0·583	L	H	0·093	0·221
	κ	332·98	264·36		κ	141·99	209·57
S_4	H	0·005	0·018	N	H	0·431	0·797
	κ	181·34	340·80		κ	95·47	173·55
S_6	H	0·005	0·002	ν	H	0·125	0·236
	κ	298·67	27·47		κ	107·37	152·81
M_1	H	0·007	0·011	μ	H	0·082	0·126
	κ	30·85	143·63		κ	81·28	178·00
M_2	H	1·594	3·814	R	H	0·024	0·024
	κ	133·65	203·73		κ	169·69	237·40
M_3	H	0·022	0·052	T	H	0·056	0·058
	κ	184·01	202·32		κ	317·20	102·91
M_4	H	0·030	0·113	MS	H	0·039	0·169
	κ	275·89	126·80		κ	137·58	194·56
M_6	H	0·013	0·026	2SM	H	0·039	0·064
	κ	76·55	282·96		κ	19·73	304·96
O	H	0·110	0·059	Mm	H	0·116	0·127
	κ	33·66	148·79		κ	260·23	291·98
K_1	H	0 078	0·233	Mf	H	0·048	0·072
	κ	77·59	168.93		κ	172·03	204·75
K_2	H	0·042	0·145	MSf	H	0·161	0·075
	κ	312·25	255·18		κ	60·87	122·80
P	H	0·023	0·068	Sa	H	0·049	0·091
	κ	53·04	166·21		κ	201·65	62·55
J	H	0·007	0·017	Ssa	H	0·073	0·028
	κ	143·21	196·39		κ	165·59	56·77

Values of H are in English feet, κ in degrees.

Prediction.

From the harmonic tidal constants the tides for Wellington and Auckland have been predicted, using the method described in the Tidal Survey Reports for 1910–11 and 1911–12. The tide-tables for these two ports for the year 1914 are given here. They are supplied to the British Admiralty and published in the Admiralty Tide-tables, and to the Marine Department and published in the New Zealand Nautical Almanac and Tide-tables.

The time used in the tide-tables is New Zealand civil mean time for the meridian 11 h. 30 m. east of Greenwich; 0 h is midnight, 12 h is noon; all hours less than 12 are in the forenoon (a.m.), all greater are in the afternoon (p.m.), and when diminished by 12 give the times after noon—for instance, 14 h. 11 m. is 2 h. 11 m. p.m.

Wellington Tide-tables for 1914.

The heights, in feet and tenths, are measured from a point 36·131 ft. above the city datum, and approximately 1·8 ft. below mean sea-level.

WELLINGTON TIDE-TABLES FOR 1914—*continued.*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					January, 1914.								
1	Thursday	2	4	0·5	8	7	3·2	14	11	0·5	20	31	3·2
2	Friday	2	53	0·5	8	56	3·4	15	4	0·5	21	23	3·1
3	Saturday	3	40	0·5	9	44	3·1	15	53	0·4	22	9	3·2
4	Sunday	4	25	0·5	10	28	3·1	16	38	0·4	22	52	3·1
5	Monday	5	4	0·5	11	12	3·2	17	20	0·4	23	33	3·1
6	Tuesday	5	44	0·5	11	49	3·2	18	0	0·4	..		..
7	Wednesday	0	14	3·0	6	20	0·5	12	29	3·3	18	41	0·4
8	Thursday	0	57	3·1	6	59	0·6	13	13	3·4	19	26	0·5
9	Friday	1	41	3·2	7	41	0·6	14	1	3·5	20	13	0·5
10	Saturday	2	27	3·2	8	31	0·6	14	46	3·7	21	2	0·6
11	Sunday	3	13	3·3	9	15	0·6	15	36	3·7	21	50	0·6
12	Monday	4	5	3·3	10	5	0·6	16	28	3·8	22	43	0·6
13	Tuesday	4	57	3·4	11	3	0·6	17	22	3·8	23	40	0·5
14	Wednesday	5	53	3·4	12	1	0·4	18	20	3·7	..		..
15	Thursday	0	32	0·3	6	50	3·4	12	59	0·3	19	16	3·7
16	Friday	1	31	0·2	7	44	3·5	13	57	0·1	20	13	3·7
17	Saturday	2	24	0·1	8	41	3·6	14	54	0·0	21	7	3·7
18	Sunday	3	20	−0·1	9	34	3·7	15	50	−0·2	22	0	3·7
19	Monday	4	11	−0·2	10	27	3·7	16	44	−0·3	22	55	3·6
20	Tuesday	5	2	−0·3	11	19	3·7	17	36	−0·4	23	46	3·5
21	Wednesday	5	53	−0·3	12	10	3·7	18	28	−0·4	..		..
22	Thursday	0	37	3·5	6	43	−0·2	13	3	3·7	19	23	−0·3
23	Friday	1	29	3·4	7	36	−0·1	13	55	3·7	20	17	−0·1
24	Saturday	2	22	3·3	8	26	0·1	14	46	3·6	21	10	..
25	Sunday	3	14	3·2	9	16	0·2	15	38	3·6	22	1	0·2
26	Monday	4	5	3·2	10	10	0·4	16	32	3·5	22	58	0·4
27	Tuesday	5	3	3·0	11	7	0·5	17	31	3·4	23	57	0·5
28	Wednesday	6	0	3·0	12	2	0·6	18	26	3·3	..		..
29	Thursday	0	52	0·6	6	51	3·0	12	55	0·7	19	16	3·2
30	Friday	1	41	0·7	7	37	3·0	13	44	0·7	20	5	3·2
31	Saturday	2	23	0·7	8	26	3·0	14	31	0·6	20	54	3·1
					February, 1914.								
1	Sunday	3	7	0·7	9	8	3·1	15	20	0·6	21	38	3·1
2	Monday	3	48	0·6	9	51	3·2	16	4	0·5	22	17	3·1
3	Tuesday	4	24	0·6	10	29	3·3	16	44	0·4	22	55	3·1
4	Wednesday	4	59	0·5	11	10	3·4	17	21	0·4	23	34	3·1
5	Thursday	5	37	0·4	11	52	3·5	18	4	0·3	..		..
6	Friday	0	14	3·1	6	18	0·4	12	35	3·6	18	47	0·3
7	Saturday	1	1	3·2	7	0	0·3	13	22	3·6	19	35	0·3
8	Sunday	1	48	3·2	7	47	0·3	14	11	3·7	20	23	0·3
9	Monday	2	37	3·3	8	37	0·3	15	3	3·7	21	18	0·3
10	Tuesday	3	31	3·3	9	35	0·3	15	58	3·7	22	16	0·2
11	Wednesday	4	29	3·3	10	37	0·2	16	58	3·6	23	13	0·1
12	Thursday	5	30	3·3	11	40	0·1	17	58	3·7	..		..
13	Friday	0	12	0·1	6	28	3·5	12	42	0·1	18	58	3·8
14	Saturday	1	8	0·1	7	26	3·7	13	41	−0·1	19	54	3·8
15	Sunday	2	2	−0·1	8	23	3·8	14	38	−0·1	20	50	3·7
16	Monday	3	2	−0·2	9	17	3·8	15	36	−0·4	21	46	3·7
17	Tuesday	3	53	−0·3	10	10	3·9	16	28	−0·5	22	38	3·6
18	Wednesday	4	43	−0·4	11	2	3·8	17	21	−0·5	23	29	3·5
19	Thursday	5	33	−0·4	11	53	3·8	18	13	−0·5	..		..
20	Friday	0	20	3·4	6	22	−0·3	12	44	3·7	19	6	−0·3
21	Saturday	1	11	3·2	7	11	−0·1	13	36	3·6	19	59	−0·2
22	Sunday	2	4	3·1	8	7	0·1	14	27	3·4	20	53	0·1
23	Monday	2	54	3·0	8	59	0·2	15	19	3·3	21	47	0·3
24	Tuesday	3	46	2·9	9	51	0·4	16	13	3·1	22	44	0·5
25	Wednesday	4	39	2·8	10	46	0·6	17	10	3·1	23	38	0·6
26	Thursday	5	35	2·8	11	41	0·7	18	2	3·0	..		..
27	Friday	0	28	0·8	6	24	2·8	12	34	0·8	18	53	3·0
28	Saturday	1	15	0·8	7	11	2·9	13	21	0·8	19	44	3·0

WELLINGTON TIDE-TABLES FOR 1914—*continued.*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					March, 1914.								
1	Sunday	1	56	0·9	7	56	3·0	14	4	0·7	20	26	3·0
2	Monday	2	32	0·9	8	35	3·1	14	44	0·7	21	5	3·0
3	Tuesday	3	5	0·8	9	14	3·2	15	23	0·6	21	43	3·0
4	Wednesday	3	42	0·6	9	56	3·4	16	6	0·4	22	21	3·0
5	Thursday	4	19	0·5	10	33	3·5	16	46	0·3	22	58	3·1
6	Friday	4	55	0·3	11	14	3·5	17	26	0·2	23	38	3·2
7	Saturday	5	36	0·2	11	58	3·6	18	8	0·1	..		..
8	Sunday	0	22	3·2	6	25	0·1	12	47	3·6	18	59	0·1
9	Monday	1	11	3·2	7	16	0·1	13	40	3·6	19	52	0·0
10	Tuesday	2	7	3·3	8	13	0·0	14	33	3·6	20	47	0·0
11	Wednesday	3	3	3·4	9	12	0·0	15	34	3·7	21	46	0·1
12	Thursday	4	2	3·4	10	14	0·0	16	34	3·7	22	47	0·0
13	Friday	5	4	3·5	11	19	−0·1	17	35	3·7	23	48	0·0
14	Saturday	6	6	3·7	12	20	−0·1	18	35	3·8	..		..
15	Sunday	0	45	−0·1	7	5	3·9	13	20	−0·2	19	35	3·8
16	Monday	1	43	−0·2	8	2	4·0	14	19	−0·4	20	32	3·8
17	Tuesday	2	38	−0·3	9	0	4·1	15	15	−0·4	21	26	3·7
18	Wednesday	3	31	−0·3	9	52	4·0	16	10	−0·5	22	19	3·7
19	Thursday	4	24	−0·3	10	45	4·0	17	2	−0·5	23	9	3·5
20	Friday	5	13	−0·3	11	33	3·8	17	53	−0·4	23	58	3·3
21	Saturday	6	2	−0·2	12	25	3·6	18	46	−0·3	..		..
22	Sunday	0	48	3·1	6	53	−0·1	13	15	3·4	19	38	−0·1
23	Monday	1	40	3·0	7	45	0·1	14	7	3·2	20	33	0·1
24	Tuesday	2	35	2·8	8	39	0·3	15	2	3·1	21	23	0·4
25	Wednesday	3	26	2·8	9	33	0·5	15	54	3·0	22	15	0·6
26	Thursday	4	16	2·7	10	31	0·7	16	47	2·9	23	9	0·8
27	Friday	5	9	2·8	11	25	0·9	17	41	2·8	23	55	0·9
28	Saturday	5	59	2·9	12	13	0·9	18	29	2·9	..		..
29	Sunday	0	39	1·0	6	42	3·0	12	58	1·0	19	11	2·9
30	Monday	1	16	1·1	7	21	3·1	13	35	0·9	19	50	2·9
31	Tuesday	1	46	1·0	7	57	3·3	14	11	0·8	20	24	3·0
					April, 1914.								
1	Wednesday	2	20	0·9	8	37	3·4	14	49	0·7	21	1	3·0
2	Thursday	3	1	0·6	9	18	3·4	15	34	0·5	21	40	3·1
3	Friday	3	43	0·5	9	58	3·6	16	14	0·3	22	21	3·2
4	Saturday	4	26	0·2	10	44	3·6	16	56	0·1	23	4	3·2
5	Sunday	5	10	−0·1	11	29	3·6	17	43	0·0	23	52	3·2
6	Monday	6	2	−0·1	12	19	3·6	18	34	−0·1	..		..
7	Tuesday	0	46	3·3	6	56	−0·2	13	14	3·6	19	24	−0·1
8	Wednesday	1	40	3·3	7	50	−0·2	14	12	3·6	20	19	−0·1
9	Thursday	2	38	3·4	8	49	−0·1	15	8	3·6	21	19	−0·1
10	Friday	3	37	3·5	9	53	−0·1	16	8	3·7	22	22	0·0
11	Saturday	4	39	3·7	10	58	−0·2	17	11	3·7	23	22	−0·1
12	Sunday	5	41	3·9	12	0	−0·2	18	13	3·8	..		..
13	Monday	0	22	−0·1	6	41	4·0	13	0	−0·3	19	11	3·8
14	Tuesday	1	18	−0·2	7	39	4·1	13	58	−0·3	20	6	3·8
15	Wednesday	2	11	−0·3	8	34	4·1	14	53	−0·4	21	0	3·7
16	Thursday	3	4	−0·3	9	27	4·1	15	47	−0·4	21	52	3·6
17	Friday	3	58	−0·3	10	20	4·0	16	43	−0·4	22	44	3·5
18	Saturday	4	50	−0·3	11	10	3·8	17	32	−0·4	23	33	3·3
19	Sunday	5	39	−0·2	11	59	3·6	18	21	−0·2	..		..
20	Monday	0	26	3·1	6	32	0·0	12	52	3·3	19	15	0·0
21	Tuesday	1	16	2·9	7	26	0·1	13	43	3·1	20	5	0·2
22	Wednesday	2	5	2·8	8	17	0·3	14	37	3·0	20	56	0·5
23	Thursday	2	59	2·8	9	11	0·5	15	28	2·9	21	47	0·7
24	Friday	3	46	2·9	10	4	0·8	16	17	2·9	22	34	0·9
25	Saturday	4	33	2·9	10	53	0·9	17	9	2·9	23	20	1·1

WELLINGTON TIDE-TABLES FOR 1914—*continued.*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					April—continued.								
26	Sunday	5	19	3·0	11	37	1·0	17	53	2·9	..		..
27	Monday	0	0	1·2	6	3	3·2	12	17	1·0	18	33	2·9
28	Tuesday	0	34	1·2	6	43	3·3	12	55	1·0	19	8	3·0
29	Wednesday	1	8	1·1	7	20	3·4	13	35	0·9	19	46	3·0
30	Thursday	1	47	0·9	8	0	3·5	14	19	0·7	20	26	3·1
					May, 1914.								
1	Friday..	2	26	0·7	8	47	3·6	15	1	0·5	21	10	3·2
2	Saturday	3	10	0·4	9	31	3·6	15	46	0·3	21	56	3·2
3	Sunday	3	58	0·2	10	19	3·6	16	33	0·1	22	41	3·2
4	Monday	4	47	0·0	11	6	3·6	17	17	0·0	23	30	3·3
5	Tuesday	5	36	−0·1	11	59	3·6	18	9	−0·1	..		..
6	Wednesday	0	25	3·4	6	35	−0·2	12	55	3·6	19	3	−0·1
7	Thursday	1	21	3·5	7	35	−0·2	13	52	3·6	19	59	−0·1
8	Friday..	2	18	3·6	8	36	−0·2	14	49	3·6	20	56	−0·1
9	Saturday	3	16	3·8	9	34	−0·1	15	46	3·7	21	56	0·0
10	Sunday	4	15	3·9	10	36	−0·1	16	49	3·8	22	56	0·0
11	Monday	5	16	4·1	11	37	−0·1	17	48	3·8	23	56	0·0
12	Tuesday	6	16	4·1	12	37	−0·1	18	46	3·8	..		..
13	Wednesday	0	52	0·0	7	13	4·2	13	34	−0·2	19	41	3·8
14	Thursday	1	47	0·0	8	9	4·1	14	31	−0·2	20	35	3·7
15	Friday..	2	41	0·0	9	4	4·1	15	26	−0·2	21	26	3·5
16	Saturday	3	33	−0·1	9	54	3·9	16	19	−0·2	22	18	3·4
17	Sunday	4	25	−0·1	10	46	3·7	17	10	−0·1	23	9	3·2
18	Monday	5	16	0·0	11	39	3·5	17	58	0·0	..		..
19	Tuesday	0	1	3·1	6	8	0·1	12	30	3·3	18	46	0·2
20	Wednesday	0	49	3·0	6	59	0·2	13	18	3·1	19	34	0·4
21	Thursday	1	37	3·0	7	50	0·4	14	10	3·0	20	21	0·5
22	Friday..	2	25	3·0	8	41	0·5	14	56	2·9	21	5	0·8
23	Saturday	3	10	3·1	9	29	0·8	15	43	2·9	21	52	1·0
24	Sunday	3	52	3·2	10	18	0·9	16	25	2·9	22	34	1·1
25	Monday	4	35	3·3	10	59	1·0	17	7	3·0	23	14	1·2
26	Tuesday	5	19	3·4	11	41	1·0	17	50	3·1	23	52	1·2
27	Wednesday	6	5	3·5	12	22	1·0	18	34	3·1	..		..
28	Thursday	0	31	1·0	6	50	3·6	13	6	0·9	19	15	3·2
29	Friday..	1	16	0·9	7	35	3·6	13	49	0·7	19	58	3·2
30	Saturday	2	1	0·6	8	19	3·6	14	37	0·5	20	46	3·2
31	Sunday	2	50	0·4	9	9	3·6	15	25	0·3	21	36	3·3
					June, 1914.								
1	Monday	3	42	0·2	10	2	3·6	16	14	0·1	22	26	3·3
2	Tuesday	4	34	0·0	10	53	3·6	17	4	−0·1	23	16	3·4
3	Wednesday	5	26	−0·1	11	43	3·6	17	54	−0·1	..		..
4	Thursday	0	9	3·5	6	22	−0·2	12	38	3·6	18	46	−0·2
5	Friday..	1	4	3·6	7	19	−0·2	13	34	3·6	19	40	−0·1
6	Saturday	1	58	3·7	8	17	−0·2	14	30	3·6	20	37	−0·1
7	Sunday	2	55	3·9	9	16	−0·1	15	25	3·7	21	34	0·0
8	Monday	3	53	4·0	10	14	−0·1	16	23	3·7	22	31	0·1
9	Tuesday	4	51	4·1	11	12	0·0	17	20	3·7	23	25	0·2
10	Wednesday	5	50	4·1	12	10	−0·1	18	19	3·6	..		..
11	Thursday	0	20	0·2	6	46	4·0	13	8	−0·1	19	13	3·6
12	Friday..	1	16	0·2	7	41	3·9	14	5	0·1	20	8	3·5
13	Saturday	2	14	0·1	8	35	3·8	14	59	0·1	21	2	3·4
14	Sunday	3	10	0·1	9	31	3·7	15	52	0·1	21	55	3·3
15	Monday	4	2	0·1	10	22	3·5	16	41	0·1	22	43	3·2
16	Tuesday	4	51	0·1	11	11	3·3	17	28	0·2	23	29	3·2
17	Wednesday	5	40	0·2	11	58	3·1	18	11	0·3	..		..
18	Thursday	0	17	3·2	6	28	0·3	12	45	3·1	18	55	0·4
19	Friday..	1	1	3·2	7	16	0·4	13	31	3·0	19	37	0·6
20	Saturday	1	44	3·2	8	1	0·6	14	14	3·0	20	18	0·8

WELLINGTON TIDE-TABLES FOR 1914—*continued.*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					June—continued.								
21	Sunday	2	27	3·3	8	46	0·7	14	56	3·0	20	58	0·9
22	Monday	3	10	3·4	9	28	0·8	15	38	3·0	21	38	1·0
23	Tuesday	3	52	3·5	10	12	0·9	16	22	3·1	22	20	1·1
24	Wednesday	4	39	3·5	10	58	0·9	17	8	3·1	23	8	1·0
25	Thursday	5	27	3·6	11	48	0·9	17	58	3·2	23	59	0·9
26	Friday..	6	19	3·6	12	36	0·8	18	49	3·2	..		..
27	Saturday	0	52	0·7	7	11	3·6	13	26	0·6	19	39	3·3
28	Sunday	1	44	0·5	8	3	3·6	14	16	0·4	20	29	3·4
29	Monday	2	36	0·3	8	55	3·6	15	7	0·3	21	21	3·4
30	Tuesday	3	32	0·1	9	46	3·6	15	58	0·1	22	12	3·5
					July, 1914.								
1	Wednesday	4	28	0·0	10	41	3·6	16	52	−0·2	23	6	3·6
2	Thursday	5	21	−0·1	11	34	3·6	17	42	−0·2	23	57	3·7
3	Friday..	6	14	−0·3	12	26	3·6	18	31	−0·2	..		..
4	Saturday	0	50	3·8	7	8	−0·3	13	19	3·5	19	22	−0·1
5	Sunday	1	44	3·8	8	3	−0·2	14	11	3·5	20	16	−0·1
6	Monday	2	39	3·9	8	57	−0·1	15	4	3·5	21	9	0·0
7	Tuesday	3	31	3·8	9	53	0·0	15	59	3·4	22	4	0·2
8	Wednesday	4	27	3·8	10	52	0·1	16	55	3·4	23	1	0·3
9	Thursday	5	24	3·8	11	49	0·2	17	52	3·4	..		..
10	Friday..	0	1	0·3	6	19	3·8	12	44	0·3	18	49	3·4
11	Saturday	0	56	0·4	7	19	3·7	13	40	0·3	19	43	3·3
12	Sunday	1	51	0·3	8	14	3·6	14	35	0·3	20	35	3·3
13	Monday	2	45	0·3	9	5	3·4	15	24	0·3	21	25	3·3
14	Tuesday	3	35	0·3	9	53	3·3	16	9	0·4	22	11	3·2
15	Wednesday	4	25	0·3	10	41	3·2	16	53	0·4	22	56	3·3
16	Thursday	5	11	0·3	11	23	3·1	17	33	0·4	23	38	3·3
17	Friday..	5	53	0·3	12	7	3·1	18	11	0·5	..		..
18	Saturday	0	19	3·3	6	35	0·4	12	49	3·0	18	50	0·5
19	Sunday	1	1	3·4	7	16	0·5	13	28	3·0	19	29	0·6
20	Monday	1	45	3·4	7	58	0·6	14	11	3·1	20	10	0·7
21	Tuesday	2	29	3·5	8	44	0·6	14	55	3·1	20	54	0·6
22	Wednesday	3	17	3·6	9	31	0·7	15	44	3·1	21	43	0·7
23	Thursday	4	6	3·6	10	22	0·7	16	33	3·2	22	38	0·7
24	Friday..	4	57	3·6	11	14	0·6	17	28	3·3	23	32	0·6
25	Saturday	5	52	3·6	12	8	0·5	18	21	3·3	..		..
26	Sunday	0	31	0·5	6	49	3·6	13	2	0·4	19	18	3·4
27	Monday	1	29	0·3	7	46	3·6	13	58	0·2	20	14	3·5
28	Tuesday	2	28	0·1	8	41	3·6	14	51	0·1	21	7	3·6
29	Wednesday	3	22	−0·1	9	34	3·6	15	42	−0·1	22	0	3·7
30	Thursday	4	17	−0·2	10	26	3·6	16	34	−0·2	22	50	3·8
31	Friday..	5	8	−0·3	11	17	3·5	17	23	−0·2	23	41	3·8
					August, 1914.								
1	Saturday	5	59	−0·4	12	7	3·5	18	12	−0·3	..		..
2	Sunday	0	31	3·8	6	52	−0·4	13	0	3·4	19	3	−0·2
3	Monday	1	25	3·7	7	46	−0·3	13	52	3·3	19	54	−0·1
4	Tuesday	2	17	3·7	8	38	−0·1	14	47	3·3	20	46	0·0
5	Wednesday	3	11	3·6	9	34	0·0	15	38	3·2	21	41	0·2
6	Thursday	4	5	3·5	10	31	0·2	16	35	3·1	22	40	0·4
7	Friday..	5	5	3·4	11	29	0·4	17	33	3·1	23	38	0·4
8	Saturday	6	2	3·4	12	22	0·5	18	27	3·1	..		..

WELLINGTON TIDE-TABLES FOR 1914—*continued.*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					August—continued.								
9	Sunday	0	35	0·5	6	58	3·3	13	18	0·5	19	19	3·1
10	Monday	1	29	0·5	7	49	3·3	14	7	0·6	20	9	3·1
11	Tuesday	2	19	0·5	8	40	3·2	14	54	0·6	20	56	3·2
12	Wednesday	3	8	0·5	9	23	3·1	15	35	0·5	21	39	3·2
13	Thursday	3	55	0·4	10	5	3·1	16	14	0·5	22	20	3·3
14	Friday..	4	35	0·4	10	44	3·1	16	50	0·5	23	0	3·3
15	Saturday	5	15	0·4	11	25	3·0	17	28	0·4	23	38	3·4
16	Sunday	5	52	0·3	12	2	3·0	18	7	0·4	..		..
17	Monday	0	18	3·5	6	33	0·3	12	43	3·0	18	45	0·4
18	Tuesday	1	5	3·5	7	18	0·3	13	30	3·1	19	32	0·4
19	Wednesday	1	51	3·5	8	5	0·3	14	16	3·1	20	21	0·4
20	Thursday	2	40	3·5	8	55	0·4	15	5	3·2	21	14	0·4
21	Friday..	3	32	3·6	9	49	0·4	16	0	3·2	22	11	0·4
22	Saturday	4	31	3·5	10	47	0·3	17	1	3·3	23	14	0·3
23	Sunday	5	32	3·6	11	47	0·3	18	1	3·4	..		..
24	Monday	0	14	0·2	6	31	3·6	12	40	0·2	18	59	3·6
25	Tuesday	1	13	0·0	7	27	3·7	13	36	0·1	19	55	3·7
26	Wednesday	2	11	−0·1	8	23	3·7	14	30	−0·1	20	50	3·8
27	Thursday	3	6	−0·3	9	15	3·7	15	23	−0·2	21	41	3·9
28	Friday..	4	1	−0·4	10	8	3·6	16	14	−0·1	22	32	3·9
29	Saturday	4	53	−0·5	11	1	3·5	17	5	−0·4	23	25	3·9
30	Sunday	5	44	−0·5	11	52	3·4	17	55	−0·4	..		..
31	Monday	0	16	3·8	6	36	−0·5	12	42	3·3	18	44	−0·3
					September, 1914.								
1	Tuesday	1	8	3·7	7	28	−0·3	13	32	3·1	19	37	−0·1
2	Wednesday	1	59	3·5	8	21	−0·1	14	25	3·0	20	30	..
3	Thursday	2	53	3·4	9	17	0·1	15	18	3·0	21	25	0·2
4	Friday	3	48	3·2	10	10	0·3	16	11	2·9	22	21	0·4
5	Saturday	4	45	3·1	11	6	0·5	17	8	2·9	23	22	0·5
6	Sunday	5	41	3·1	12	5	0·6	18	4	2·9	..		..
7	Monday	0	18	0·6	6	36	3·0	12	55	0·7	18	56	3·0
8	Tuesday	1	10	0·7	7	26	3·0	13	39	0·7	19	39	3·1
9	Wednesday	1	58	0·6	8	10	3·0	14	19	0·8	20	22	3·1
10	Thursday	2	39	0·6	8	53	3·0	14	55	0·7	21	2	3·2
11	Friday	3	17	0·5	9	30	3·0	15	31	0·6	21	40	3·3
12	Saturday	3	55	0·5	10	6	3·0	16	4	0·5	22	19	3·4
13	Sunday	4	32	0·4	10	43	3·0	16	43	0·4	23	0	3·4
14	Monday	5	12	0·3	11	20	3·0	17	22	0·3	23	39	3·5
15	Tuesday	5	54	0·2	12	3	3·1	18	5	0·2	..		..
16	Wednesday	0	26	3·5	6	38	0·1	12	53	3·1	18	54	0·1
17	Thursday	1	19	3·5	7	29	0·2	13	43	3·2	19	49	0·1
18	Friday	2	12	3·5	8	25	0·1	14	38	3·3	20	48	0·1
19	Saturday	3	8	3·5	9	22	0·2	15	34	3·4	21	49	0·1
20	Sunday	4	7	3·6	10	18	0·2	16	34	3·5	22	51	0·1
21	Monday	5	8	3·6	11	17	0·1	17	35	3·6	23	54	0·0
22	Tuesday	6	8	3·7	12	16	0·0	18	35	3·8	..		..
23	Wednesday	0	53	−0·1	7	4	3·8	13	13	−0·1	19	31	3·9
24	Thursday	1	50	−0·3	7	59	3·8	14	7	−0·2	20	28	4·0
25	Friday	2	47	−0·4	8	56	3·7	15	2	−0·3	21	24	4·0
26	Saturday	3	42	−0·5	9	49	3·6	15	55	−0·4	22	16	4·0
27	Sunday	4	36	−0·5	10	39	3·5	16	46	−0·4	23	7	3·9
28	Monday	5	26	−0·5	11	32	3·4	17	35	−0·4	23	56	3·7
29	Tuesday	6	17	−0·4	12	23	3·2	18	26	−0·3	..		..
30	Wednesday	0	49	3·5	7	10	−0·3	13	14	3·2	19	18	−0·1
					October, 1914.								
1	Thursday	1	40	3·2	8	4	−0·1	14	5	2·9	20	13	0·1
2	Friday	2	34	3·2	8	56	0·2	15	2	2·9	21	11	0·3
3	Saturday	3	31	3·1	9	52	0·4	15	55	2·9	22	10	0·5

WELLINGTON TIDE-TABLES FOR 1914—*continued*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					October, 1914.—continued.								
4	Sunday	4	26	3·0	10	48	0·6	16	47	2·9	23	4	0·7
5	Monday	5	20	3·0	11	38	0·9	17	36	3·0	23	53	0·8
6	Tuesday	6	10	2·9	12	22	1·0	18	23	3·0	..	..	..
7	Wednesday	0	39	0·9	6	54	2·9	13	3	1·0	19	7	3·2
8	Thursday	1	20	0·9	7	38	2·9	13	38	1·0	19	48	3·3
9	Friday	2	1	0·8	8	15	2·9	14	11	0·9	20	23	3·3
10	Saturday	2	39	0·7	8	49	3·0	14	46	0·8	21	1	3·4
11	Sunday	3	17	0·6	9	25	3·0	15	23	0·6	21	42	3·4
12	Monday	3	56	0·4	10	4	3·0	16	5	0·4	22	26	3·5
13	Tuesday	4	36	0·3	10	48	3·1	16	47	0·2	23	11	3·5
14	Wednesday	5	18	0·1	11	34	3·1	17	34	0·1	..	..	..
15	Thursday	0	2	3·5	6	6	0·0	12	22	3·2	18	28	0·0
16	Friday	0	53	3·5	7	1	0·0	13	17	3·3	19	25	−0·1
17	Saturday	1	44	3·6	7	55	0·0	14	11	3·4	20	23	−0·1
18	Sunday	2	41	3·6	8	50	0·0	15	10	3·6	21	24	0·0
19	Monday	3	38	3·6	9	49	0·0	16	9	3·7	22	27	0·0
20	Tuesday	4	41	3·7	10	50	0·0	17	10	3·9	23	31	−0·1
21	Wednesday	5	40	3·8	11	50	0·0	18	10	4·1	..	..	..
22	Thursday	0	29	−0·2	6	40	3·8	12	47	−0·1	19	10	4·1
23	Friday	1	29	−0·3	7	38	3·8	13	43	−0·2	20	5	4·2
24	Saturday	2	23	−0·4	8	32	3·8	14	36	−0·3	20	59	4·1
25	Sunday	3	20	−0·4	9	26	3·7	15	31	−0·3	21	51	4·0
26	Monday	4	14	−0·4	10	17	3·5	16	23	−0·3	22	44	3·9
27	Tuesday	5	7	−0·4	11	10	3·4	17	14	−0·3	23	36	3·7
28	Wednesday	5	59	−0·4	12	1	3·2	18	7	−0·2	..	..	..
29	Thursday	0	28	3·4	6	53	−0·2	12	55	3·1	19	4	0·1
30	Friday	1	22	3·2	7	44	0·1	13	47	3·0	19	56	0·2
31	Saturday	2	18	3·1	8	34	0·3	14	38	2·9	20	53	0·4
					November, 1914.								
1	Sunday	3	8	2·9	9	26	0·5	15	30	2·8	21	49	0·5
2	Monday	3	58	2·8	10	19	0·5	16	17	2·8	22	38	0·5
3	Tuesday	4	48	2·7	11	2	0·7	17	5	2·8	23	27	0·6
4	Wednesday	5	37	2·7	11	45	0·8	17	50	2·9	..	..	..
5	Thursday	0	10	0·7	6	18	2·7	12	22	0·9	18	32	3·1
6	Friday	0	47	0·8	6	58	2·8	12	55	1·0	19	11	3·2
7	Saturday	1	23	0·9	7	36	2·9	13	30	1·0	19	46	3·4
8	Sunday	2	2	0·9	8	12	3·0	14	9	0·9	20	26	3·5
9	Monday	2	40	0·8	8	50	3·2	14	50	0·8	21	10	3·7
10	Tuesday	3	23	0·7	9	34	3·3	15	39	0·6	21	55	3·8
11	Wednesday	4	11	0·6	10	18	3·4	16	28	0·4	22	44	3·8
12	Thursday	4	56	0·4	11	5	3·5	17	16	0·2	23	35	3·7
13	Friday	5	44	0·2	11	58	3·5	18	11	0·1	..	..	..
14	Saturday	0	29	3·7	6	35	0·0	12	55	3·6	19	5	0·1
15	Sunday	1	24	3·6	7	29	0·0	13	52	3·6	20	4	−0·1
16	Monday	2	21	3·7	8	26	−0·1	14	47	3·7	21	5	−0·2
17	Tuesday	3	19	3·5	9	25	−0·2	15	45	3·7	22	6	−0·3
18	Wednesday	4	16	3·6	10	23	−0·2	16	44	3·8	23	7	−0·3
19	Thursday	5	14	3·5	11	22	−0·3	17	44	3·9	..	..	..
20	Friday	0	7	−0·4	6	13	3·6	12	19	−0·2	18	42	4·1
21	Saturday	1	4	−0·3	7	12	3·7	13	15	−0·2	19	39	4·1
22	Sunday	2	2	−0·3	8	7	3·7	14	12	−0·1	20	35	4·1
23	Monday	3	0	−0·2	9	0	3·7	15	7	−0·1	21	28	4·1
24	Tuesday	3	52	−0·1	9	53	3·7	16	2	0·0	22	22	4·0
25	Wednesday	4	46	0·0	10	48	3·6	16	57	0·1	23	16	3·9
26	Thursday	5	37	0·1	11	38	3·5	17	49	0·2	..	..	..
27	Friday	0	8	3·7	6	27	0·3	12	32	3·4	18	40	0·3
28	Saturday	1	1	3·5	7	17	0·4	13	21	3·3	19	32	0·4
29	Sunday	1	52	3·2	8	5	0·6	14	8	3·2	20	24	0·5
30	Monday	2	41	3·0	8	52	0·7	14	53	3·1	21	12	0·6

WELLINGTON TIDE-TABLES FOR 1914—*continued.*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					December, 1914.								
1	Tuesday	3	29	2·9	9	35	0·8	15	40	3·1	21	59	0·7
2	Wednesday	4	13	2·8	10	17	0·9	16	22	3·0	22	46	0·8
3	Thursday	4	52	2·7	10	59	1·0	17	4	3·1	23	27	0·8
4	Friday	5	35	2·7	11	38	1·0	17	50	3·2	..		..
5	Saturday	0	8	0·9	6	18	2·8	12	17	1·0	18	33	3·3
6	Sunday	0	49	0·9	6	57	2·9	12	55	0·9	19	16	3·4
7	Monday	1	32	0·8	7	41	3·0	13	40	0·8	19	59	3·5
8	Tuesday	2	15	0·7	8	24	3·2	14	28	0·7	20	48	3·6
9	Wednesday	2	59	0·6	9	13	3·3	15	19	0·6	21	37	3·7
10	Thursday	3	48	0·5	10	1	3·5	16	10	0·4	22	26	3·7
11	Friday	4	35	0·4	10	51	3·6	17	2	0·2	23	16	3·8
12	Saturday	5	23	0·2	11	42	3·7	17	57	0·1	..		..
13	Sunday	0	9	3·7	6	15	0·1	12	34	3·8	18	50	0·0
14	Monday	1	4	3·7	7	9	0·0	13	31	3·8	17	47	—0·2
15	Tuesday	1	59	3·6	8	4	—0·1	14	26	3·9	20	44	—0·2
16	Wednesday	2	53	3·6	8	59	—0·2	15	21	3·9	21	40	—0·3
17	Thursday	3	50	3·7	9	56	—0·2	16	19	3·9	22	40	—0·3
18	Friday	4	49	3·5	10	54	—0·2	17	18	3·9	23	40	—0·3
19	Saturday	5	48	3·5	11	52	—0·2	18	16	3·9	..		..
20	Sunday	0	38	—0·2	6	47	3·5	12	50	—0·1	19	13	3·9
21	Monday	1	35	—0·2	7	40	3·5	13	49	0·0	20	9	3·9
22	Tuesday	2	35	—0·1	8	35	3·5	14	46	0·0	21	7	3·9
23	Wednesday	3	29	0·0	9	30	3·6	15	42	0·1	22	2	3·8
24	Thursday	4	22	0·2	10	23	3·6	16	37	0·2	22	52	3·7
25	Friday	5	12	0·3	11	14	3·6	17	28	0·3	23	43	3·6
26	Saturday	5	56	0·4	12	3	3·5	18	18	0·4	..		..
27	Sunday	0	31	3·4	6	41	0·6	12	49	3·4	19	5	0·5
28	Monday	1	18	3·3	7	23	0·6	13	34	3·4	19	50	0·6
29	Tuesday	2	3	3·1	8	7	0·8	14	17	3·3	20	33	0·6
30	Wednesday	2	46	3·0	8	49	0·8	14	59	3·3	21	17	0·7
31	Thursday	3	22	2·8	9	27	0·9	15	40	3·2	21	58	0·8

AUCKLAND TIDE-TABLES FOR 1914.

The heights, in feet and tenths, are measured from a point 4·737 ft. above the dock-sill, and approximately 4·5 ft. below mean sea-level.

					January, 1914.								
1	Thursday	4	0	0·9	10	34	8·1	16	13	0·8	22	50	8·5
2	Friday	4	46	0·9	11	8	7·8	17	0	1·2	23	30	8·2
3	Saturday	5	30	1·1	11	47	7·6	17	44	1·5	..		..
4	Sunday	0	9	7·9	6	16	1·2	12	26	7·4	18	29	1·8
5	Monday	0	48	7·7	7	2	1·4	13	10	7·2	19	21	1·9
6	Tuesday	1	29	7·5	7	50	1·5	13	55	7·2	20	14	2·0
7	Wednesday	2	16	7·3	8	42	1·4	14	46	7·2	21	5	1·9
8	Thursday	3	11	7·3	9	29	1·2	15	43	7·5	21	56	1·7
9	Friday	4	7	7·5	10	20	0·9	16	38	7·8	22	48	1·4
10	Saturday	5	2	7·7	11	13	0·7	17	35	8·2	23	39	1·0
11	Sunday	6	0	8·1	12	2	0·4	18	30	8·6	..		..
12	Monday	0	29	0·7	6	56	8·4	12	48	0·0	19	21	9·0
13	Tuesday	1	19	0·2	7	47	8·7	13	35	—0·2	20	12	9·3
14	Wednesday	2	6	—0·1	8	38	8·9	14	24	—0·3	20	58	9·5
15	Thursday	2	52	—0·2	9	26	9·0	15	10	—0·3	21	46	9·5
16	Friday	3	41	—0·2	10	16	9·0	15	58	—0·1	22	32	9·5
17	Saturday	4	32	0·0	11	1	8·9	16	53	0·3	23	17	9·2

AUCKLAND TIDE-TABLES FOR 1914—*continued.*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					January—continued.								
18	Sunday	5	26	0·2	11	51	8·7	17	48	0·6	..		..
19	Monday	0	7	8·9	6	25	0·4	12	41	8·4	18	49	0·9
20	Tuesday	0	58	8·5	7	25	0·6	13	38	8·1	19	51	1·1
21	Wednesday	1	56	8·1	8	26	0·7	14	42	7·9	20	55	1·2
22	Thursday	2	59	7·8	9	28	0·7	15	49	7·9	21	57	1·1
23	Friday..	4	10	7·7	10	25	0·6	16	58	8·1	22	53	1·0
24	Saturday	5	19	7·7	11	19	0·5	17	59	8·3	23	47	0·8
25	Sunday	6	19	7·9	12	8	0·4	18	55	8·5	..		..
26	Monday	0	39	0·6	7	10	8·1	12	56	0·3	19	41	8·7
27	Tuesday	1	25	0·3	7	56	8·2	13	44	0·3	20	26	8·8
28	Wednesday	2	10	0·3	8	43	8·2	14	26	0·4	21	5	8·7
29	Thursday	2	49	0·3	9	23	8·1	15	6	0·6	21	43	8·6
30	Friday..	3	29	0·5	10	0	8·0	15	44	0·9	22	20	8·4
31	Saturday	4	9	0·7	10	37	7·9	16	20	1·2	22	55	8·2
					February, 1914.								
1	Sunday	4	44	1·0	11	13	7·7	16	56	1·6	23	29	7·9
2	Monday	5	25	1·3	11	49	7·6	17	38	1·9	..		..
3	Tuesday	0	5	7·7	6	10	1·5	12	26	7·5	18	23	2·1
4	Wednesday	0	43	7·6	6	55	1·6	13	8	7·5	19	14	2·2
5	Thursday	1	29	7·5	7	49	1·6	14	1	7·5	20	18	2·1
6	Friday..	2	21	7·4	8	45	1·5	14	58	7·6	21	18	1·8
7	Saturday	3	26	7·5	9	44	1·2	16	2	7·9	22	19	1·4
8	Sunday	4	30	7·7	10	39	0·8	17	2	8·3	23	13	0·9
9	Monday	5	30	8·1	11	32	0·3	18	1	8·7	..		..
10	Tuesday	0	3	0·4	6	30	8·5	12	23	−0·1	18	55	9·2
11	Wednesday	0	55	−0·2	7	25	8·9	13	14	−0·4	19	44	9·6
12	Thursday	1	43	−0·6	8	16	9·2	14	1	−0·7	20	34	9·8
13	Friday..	2	29	−0·8	9	3	9·4	14	48	−0·6	21	21	9·9
14	Saturday	3	20	−0·7	9	53	9·5	15	37	−0·4	22	8	9·8
15	Sunday	4	8	−0·5	10	40	9·3	16	29	0·0	22	58	9·5
16	Monday	5	1	−0·1	11	31	9·1	17	25	0·5	23	47	9·1
17	Tuesday	6	0	0·3	12	23	8·7	18	29	0·9	..		..
18	Wednesday	0	37	8·6	7	2	0·7	13	19	8·4	19	32	1·3
19	Thursday	1	37	8·0	8	5	0·9	14	19	8·0	20	38	1·4
20	Friday	2	40	7·7	9	9	1·0	15	26	7·9	21	44	1·4
21	Saturday	3	51	7·5	10	9	1·0	16	35	8·0	22	41	1·1
22	Sunday	4	59	7·6	11	2	0·8	17	37	8·2	23	32	0·8
23	Monday	5	59	7·7	11	53	0·6	18	34	8·5	..		..
24	Tuesday	0	20	0·5	6	55	7·9	12	41	0·5	19	22	8·6
25	Wednesday	1	9	0·4	7	41	8·1	13	23	0·4	20	5	8·6
26	Thursday	1	47	0·3	8	20	8·1	13	58	0·5	20	40	8·6
27	Friday..	2	25	0·3	8	53	8·1	14	35	0·7	21	13	8·5
28	Saturday	2	58	0·4	9	29	8·0	15	9	1·0	21	46	8·3
					March, 1914.								
1	Sunday	3	32	0·7	10	4	8·0	15	40	1·3	22	19	8·1
2	Monday	4	4	1·0	10	35	7·9	16	16	1·6	22	55	8·0
3	Tuesday	4	40	1·3	11	16	7·9	16	52	1·9	23	33	7·9
4	Wednesday	5	15	1·5	11	53	7·8	17	36	2·2	..		..
5	Thursday	0	13	7·7	6	6	1·7	12	34	7·7	18	35	2·3
6	Friday..	0	55	7·5	7	8	1·8	13	23	7·7	19	42	2·2
7	Saturday	1	44	7·4	8	10	1·6	14	21	7·8	20	48	1·9
8	Sunday	2	50	7·5	9	10	1·3	15	25	8·0	21	48	1·4
9	Monday	3	56	7·7	10	9	0·9	16	31	8·4	22	46	0·7
10	Tuesday	5	5	8·1	11	6	0·3	17	32	8·8	23	40	0·1
11	Wednesday	6	5	8·6	11	59	−0·2	18	26	9·3	..		..
12	Thursday	0	32	−0·5	7	0	9·0	12	50	−0·5	19	20	9·7
13	Friday..	1	20	−0·9	7	52	9·4	13	40	−0·8	20	10	10.0
14	Saturday	2	8	−1·1	8	42	9·7	14	28	−0·8	20	58	10·0

AUCKLAND TIDE-TABLES FOR 1914—*continued.*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					March—continued.								
15	Sunday	2	54	−1·0	9	31	9·8	15	16	−0·5	21	45	9·9
16	Monday	3	44	−0·7	10	19	9·6	16	7	−0·1	22	33	9·5
17	Tuesday	4	37	−0·3	11	10	9·3	17	5	0·4	23	25	9·0
18	Wednesday	5	33	0·2	12	2	8·9	18	7	0·9	..	..	..
19	Thursday	0	18	8·5	6	38	0·7	12	58	8·4	19	10	1·1
20	Friday..	1	16	7·9	7	46	1·0	14	1	8·1	20	24	1·4
21	Saturday	2	20	7·5	8	52	1·1	15	8	7·9	21	29	1·3
22	Sunday	3	32	7·4	9	52	1·1	16	16	8·0	22	22	1·1
23	Monday	4	38	7·4	10	40	0·9	17	11	8·1	23	9	0·8
24	Tuesday	5	37	7·6	11	29	0·9	18	6	8·2	23	58	0·5
25	Wednesday	6	27	7·7	12	16	0·7	18	51	8·4	..	..	..
26	Thursday	0	40	0·3	7	12	8·0	12	57	0·6	19	34	8·5
27	Friday..	1	17	0·3	7	52	8·1	13	32	0·7	20	6	8·5
28	Saturday	1	53	0·3	8	27	8·2	14	6	0·9	20	40	8·4
29	Sunday	2	25	0·5	9	1	8·2	14	38	1·1	21	15	8·3
30	Monday	2	55	0·7	9	33	8·1	15	5	1·4	21	47	8·2
31	Tuesday	3	24	1·0	10	9	8·1	15	40	1·7	22	23	8·0
					April, 1914.								
1	Wednesday	3	57	1·2	10	47	8·1	16	16	1·9	23	1	7·9
2	Thursday	4	37	1·5	11	25	8·1	17	2	2·1	23	46	7·8
3	Friday..	5	32	1·7	12	16	8·0	17	59	2·3	..	..	..
4	Saturday	0	34	7·6	6	36	1·7	12	58	8·0	19	10	2·1
5	Sunday	1	26	7·5	7	43	1·6	13	55	8·0	20	22	1·8
6	Monday	2	30	7·5	8	47	1·3	14	59	8·1	21	26	1·2
7	Tuesday	3	35	7·8	9	47	0·8	16	2	8·4	22	23	0·6
8	Wednesday	4	41	8·1	10	43	0·3	17	1	8·8	23	17	−0·1
9	Thursday	5	39	8·6	11	37	−0·1	17	59	9·3	..	..	..
10	Friday..	0	8	−0·6	6	34	9·1	12	27	−0·5	18	52	9·6
11	Saturday	0	56	−1·0	7	26	9·5	13	16	−0·7	19	43	9·9
12	Sunday	1	44	−1·1	8	17	9·7	14	6	−0·6	20	34	9·9
13	Monday	2	32	−1·0	9	9	9·8	14	54	−0·3	21	25	9·8
14	Tuesday	3	21	−0·6	10	1	9·8	15	47	0·1	22	14	9·6
15	Wednesday	4	13	0·0	10	48	9·6	16	44	0·7	23	6	9·1
16	Thursday	5	10	0·5	11	40	9·1	17	44	1·1	..	..	..
17	Friday..	0	0	8·5	6	13	0·9	12	35	8·7	18	50	1·3
18	Saturday	0	55	8·0	7	19	1·2	13	31	8·3	19	59	1·4
19	Sunday	1	56	7·6	8	26	1·3	14	34	8·0	21	2	1·3
20	Monday	2	59	7·4	9	24	1·3	15	38	7·9	21	54	1·0
21	Tuesday	4	7	7·4	10	16	1·1	16	40	8·0	22	41	0·8
22	Wednesday	5	7	7·5	11	2	1·0	17	28	8·0	23	23	0·6
23	Thursday	5	56	7·7	11	43	0·9	18	17	8·1	..	..	..
24	Friday..	0	7	0·5	6	41	7·9	12	22	0·9	18	56	8·2
25	Saturday	0	46	0·4	7	16	8·0	12	59	1·0	19	31	8·3
26	Sunday	1	20	0·5	7	53	8·2	13	35	1·1	20	7	8·3
27	Monday	1	53	0·6	8	29	8·3	14	11	1·2	20	43	8·3
28	Tuesday	2	26	0·7	9	7	8·4	14	43	1·4	21	21	8·2
29	Wednesday	3	0	0·9	9	45	8·4	15	19	1·6	22	2	8·1
30	Thursday	3	36	1·1	10	23	8·4	16	1	1·8	22	37	8·1
					May, 1914.								
1	Friday	4	17	1·4	11	4	8·3	16	51	1·9	23	28	7·9
2	Saturday	5	11	1·6	11	50	8·3	17	46	2·0	..	..	..
3	Sunday	0	13	7·8	6	10	1·7	12	38	8·3	18	51	1·9
4	Monday	1	6	7·7	7	15	1·6	13	30	8·3	19	57	1·6
5	Tuesday	2	5	7·8	8	20	1·4	14	29	8·4	21	2	1·1
6	Wednesday	3	10	7·9	9	22	1·0	15	33	8·5	21	58	0·5
7	Thursday	4	14	8·2	10	19	0·5	16	35	8·8	22	51	0·0
8	Friday	5	13	8·6	11	13	0·1	17	32	9·0	23	44	−0·5
9	Saturday	6	11	8·9	12	5	−0·2	18	28	9·3	..	..	..

AUCKLAND TIDE-TABLES FOR 1914—*continued.*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					May—continued.								
10	Sunday	0	35	−0·7	7	5	9·3	12	56	−0·4	19	21	9·5
11	Monday	1	21	−0·9	7	57	9·6	13	47	−0·3	20	13	9·5
12	Tuesday	2	10	−0·7	8	49	9·7	14	35	−0·1	21	5	9·4
13	Wednesday	3	1	−0·4	9	41	9·6	15	28	0·2	21	56	9·2
14	Thursday	3	52	0·0	10	28	9·4	16	23	0·6	22	47	8·9
15	Friday	4	47	0·6	11	22	9·2	17	22	1·0	23	38	8·5
16	Saturday	5	46	1·0	12	12	8·8	18	27	1·2	..		..
17	Sunday	0	30	8·1	6	50	1·3	13	3	8·5	19	28	1·3
18	Monday	1	27	7·7	7	50	1·5	13	59	8·1	20	24	1·3
19	Tuesday	2	23	7·4	8	46	1·5	14	53	7·9	21	19	1·2
20	Wednesday	3	21	7·3	9	36	1·5	15	50	7·7	22	6	1·0
21	Thursday	4	15	7·3	10	24	1·4	16	41	7·7	22	47	0·8
22	Friday	5	8	7·5	11	4	1·2	17	31	7·8	23	28	0·7
23	Saturday	5	50	7·6	11	46	1·1	18	13	7·9	..		..
24	Sunday	0	5	0·5	6	40	7·9	12	27	0·9	18	56	8·0
25	Monday	0	44	0·5	7	22	8·1	13	7	1·0	19	37	8·1
26	Tuesday	1	26	0·5	8	0	8·2	13	43	1·0	20	17	8·2
27	Wednesday	1	59	0·6	8	39	8·5	14	21	1·1	20	59	8·3
28	Thursday	2	38	0·7	9	22	8·6	15	2	1·2	21	44	8·3
29	Friday	3	16	0·9	10	5	8·7	15	46	1·4	22	28	8·3
30	Saturday	4	4	1·1	10	49	8·7	16	37	1·5	23	14	8·2
31	Sunday	4	51	1·3	11	32	8·7	17	35	1·6	..		..
					June, 1914.								
1	Monday	0	0	8·1	5	53	1·4	12	17	8·6	18	34	1·5
2	Tuesday	0	51	8·0	6	54	1·5	13	10	8·5	19	35	1·3
3	Wednesday	1	45	8·0	7	59	1·3	14	5	8·4	20	37	0·9
4	Thursday	2	47	8·0	8	58	1·1	15	5	8·4	21	34	0·6
5	Friday	3	48	8·1	9	59	0·8	16	9	8·5	22	28	0·2
6	Saturday	4	51	8·4	10	52	0·4	17	8	8·6	23	20	−0·1
7	Sunday	5	51	8·7	11	46	0·2	18	8	8·8	..		..
8	Monday	0	12	−0·4	6	47	9·1	12	39	0·1	19	4	8·9
9	Tuesday	1	4	−0·4	7	41	9·3	13	29	0·0	19	59	9·1
10	Wednesday	1	53	−0·3	8	32	9·5	14	21	0·0	20	49	9·0
11	Thursday	2	42	−0·1	9	22	9·5	15	11	0·3	21	41	8·9
12	Friday	3	31	0·2	10	11	9·3	16	2	0·6	22	29	8·7
13	Saturday	4	22	0·6	10	59	9·1	16	57	0·8	23	16	8·4
14	Sunday	5	16	1·0	11	43	8·8	17	51	1·1	..		..
15	Monday	0	4	8·2	6	11	1·4	12	29	8·5	18	46	1·3
16	Tuesday	0	54	7·8	7	8	1·7	13	15	8·1	19	40	1·4
17	Wednesday	1	41	7·4	8	1	1·7	14	5	7·7	20	29	1·3
18	Thursday	2	33	7·2	8	52	1·7	14	56	7·5	21	17	1·2
19	Friday	3	24	7·1	9	38	1·7	15	47	7·4	22	2	1·1
20	Saturday	4	19	7·3	10	23	1·6	16	40	7·5	22	45	0·9
21	Sunday	5	10	7·5	11	7	1·4	17	31	7·6	23	28	0·7
22	Monday	6	0	7·8	11	53	1·2	18	20	7·8	..		..
23	Tuesday	0	12	0·5	6	46	8·2	12	38	1·1	19	10	8·1
24	Wednesday	0	55	0·5	7	32	8·5	13	22	0·9	19	53	8·3
25	Thursday	1	39	0·5	8	16	8·9	14	0	0·9	20	40	8·5
26	Friday	2	20	0·5	9	1	9·1	14	46	0·8	21	25	8·6
27	Saturday	3	2	0·5	9	44	9·2	15	32	0·9	22	10	8·7
28	Sunday	3	49	0·7	10	28	9·2	16	22	0·8	22	56	8·6
29	Monday	4	40	0·9	11	13	9·1	17	14	0·9	23	43	8·5
30	Tuesday	5	38	1·1	12	0	8·9	18	10	1·0	..		..
					July, 1914.								
1	Wednesday	0	30	8·4	6	32	1·2	12	48	8·6	19	10	0·9
2	Thursday	1	25	8·1	7	38	1·3	13	43	8·4	20	13	0·8
3	Friday	2	24	8·0	8	39	1·2	14	43	8·2	21	11	0·7
4	Saturday	3	29	8·0	9	39	1·1	15	47	8·1	22	9	0·5

AUCKLAND TIDE-TABLES FOR 1914—*continued.*

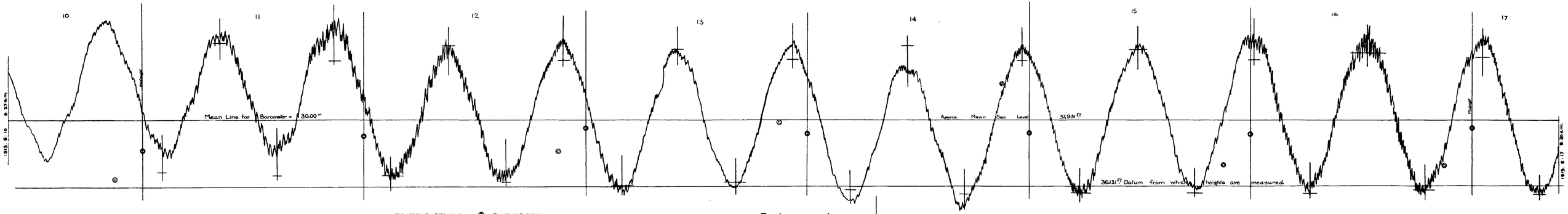
Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
						July—continued.							
5	Sunday	4	32	8·2	10	35	0·9	16	54	8·2	23	4	0·4
6	Monday	5	35	8·5	11	31	0·7	17	56	8·4	23	59	0·2
7	Tuesday	6	36	8·8	12	23	0·5	18	56	8·6	..	..	..
8	Wednesday	0	49	0·1	7	31	9·1	13	16	0·3	19	49	8·7
9	Thursday	1	38	0·0	8	20	9·3	14	5	0·2	20	37	8·7
10	Friday	2	24	0·1	9	7	9·3	14	54	0·2	21	24	8·7
11	Saturday	3	10	0·3	9	50	9·2	15	38	0·2	22	6	8·5
12	Sunday	3	56	0·6	10	31	8·9	16	28	0·6	22	51	8·3
13	Monday	4	43	1·0	11	13	8·6	17	14	0·9	23	32	8·0
14	Tuesday	5	29	1·3	11	54	8·2	18	1	1·1	..	..	..
15	Wednesday	0	13	7·7	6	17	1·6	12	32	7·9	18	46	1·3
16	Thursday	0	55	7·4	7	7	1·9	13	17	7·6	19	35	1·5
17	Friday	1	40	7·2	7	58	2·1	14	2	7·3	20	26	1·5
18	Saturday	2	31	7·2	8	51	2·0	14	54	7·2	21	15	1·4
19	Sunday	3	25	7·3	9	41	1·9	15	47	7·3	22	4	1·3
20	Monday	4	22	7·6	10	32	1·7	16	48	7·5	22	54	1·0
21	Tuesday	5	19	7·9	11	28	1·4	17	45	7·8	23	41	0·8
22	Wednesday	6	13	8·4	12	11	0·9	18	39	8·2	..	..	..
23	Thursday	0	29	0·4	7	3	8·7	13	0	0·5	19	29	8·5
24	Friday	1	15	0·2	7	49	9·2	13	44	0·3	20	16	8·8
25	Saturday	2	0	0·0	8	37	9·4	14	30	0·1	21	3	9·0
26	Sunday	2	45	0·0	9	22	9·1	15	14	0·0	21	51	9·5
27	Monday	3	29	0·1	10	6	9·6	16	3	0·1	22	34	9·0
28	Tuesday	4	22	0·3	10	50	9·4	16	53	0·2	23	22	8·9
29	Wednesday	5	14	0·7	11	40	9·1	17	48	0·4	..	..	..
30	Thursday	0	13	8·6	6	14	1·0	12	27	8·7	18	49	0·7
31	Friday	1	7	8·4	7	15	1·3	13	22	8·3	19	49	0·9
						August, 1914.							
1	Saturday	2	3	8·1	8	19	1·4	14	24	7·9	20	55	0·9
2	Sunday	3	12	8·0	9	26	1·3	15	32	7·8	21	54	0·8
3	Monday	4	20	8·1	10	25	1·1	16	41	7·8	22	49	0·7
4	Tuesday	5	23	8·3	11	19	0·9	17	45	7·9	23	42	0·5
5	Wednesday	6	23	8·6	12	14	0·6	18	43	8·2	..	..	..
6	Thursday	0	35	0·3	7	18	8·9	13	4	0·3	19	36	8·4
7	Friday	1	22	0·2	8	2	9·0	13	49	0·1	20	20	8·5
8	Saturday	2	6	0·2	8	44	9·0	14	32	0·1	21	4	8·5
9	Sunday	2	47	0·3	9	28	8·9	15	11	0·2	21	45	8·4
10	Monday	3	28	0·6	10	4	8·7	15	53	0·3	22	21	8·2
11	Tuesday	4	7	1·0	10	42	8·5	16	34	0·8	22	59	7·9
12	Wednesday	4	45	1·4	11	17	8·1	17	11	1·1	23	35	7·7
13	Thursday	5	26	1·8	11	54	7·8	17	54	1·4	..	..	..
14	Friday	0	15	7·5	6	13	2·1	12	31	7·5	18	37	1·6
15	Saturday	0	55	7·4	7	4	2·3	13	13	7·3	19	33	1·7
16	Sunday	1	43	7·3	8	2	2·3	14	6	7·2	20	27	1·7
17	Monday	2	38	7·4	9	1	2·1	15	5	7·2	21	27	1·4
18	Tuesday	3	41	7·6	9	59	1·7	16	8	7·4	22	19	1·1
19	Wednesday	4	41	8·0	10	53	1·2	17	8	7·7	23	13	0·7
20	Thursday	5	37	8·4	11	44	0·7	18	9	8·2	..	..	..
21	Friday	0	3	0·2	6	30	8·9	12	35	0·2	19	2	8·6
22	Saturday	0	52	−0·1	7	23	9·4	13	22	−0·4	19	52	9·1
23	Sunday	1	39	−0·4	8	9	9·7	14	8	−0·6	20	40	9·4
24	Monday	2	25	−0·5	8	57	9·9	14	55	−0·7	21	27	9·5
25	Tuesday	3	13	−0·3	9	43	9·8	15	40	−0·5	22	17	9·4
26	Wednesday	4	0	0·0	10	31	9·6	16	30	−0·2	23	2	9·2
27	Thursday	4	53	0·4	11	19	9·2	17	26	0·2	23	54	8·9
28	Friday	5	53	0·9	12	10	8·7	18	25	0·6	..	..	..
29	Saturday	0	48	8·5	6	58	1·3	13	4	8·3	19	30	0·9
30	Sunday	1	47	8·2	8	4	1·4	14	5	7·8	20	35	1·1
31	Monday	2	52	8·0	9	7	1·4	15	16	7·6	21	40	1·0

AUCKLAND TIDE-TABLES FOR 1914—*continued.*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					September, 1914.								
1	Tuesday	4	2	8·0	10	12	1·1	16	27	7·5	22	37	0·8
2	Wednesday	5	9	8·2	11	8	0·8	17	32	7·7	23	29	0·6
3	Thursday	6	7	8·4	11	59	0·4	18	26	8·0	..		..
4	Friday..	0	19	0·4	6	55	8·6	12	42	0·2	19	17	8·2
5	Saturday	1	2	0·3	7	41	8·7	13	27	0·1	20	1	8·3
6	Sunday	1	43	0·3	8	19	8·7	14	7	0·0	20	41	8·3
7	Monday	2	22	0·5	8	58	8·7	14	43	0·2	21	18	8·2
8	Tuesday	2	57	0·8	9	34	8·4	15	17	0·5	21	51	8·1
9	Wednesday	3	30	1·2	10	7	8·2	15	52	0·8	22	28	8·0
10	Thursday	4	4	1·5	10	44	8·0	16	25	1·1	23	4	7·8
11	Friday..	4	38	1·9	11	19	7·7	17	2	1·4	23	40	7·7
12	Saturday	5	23	2·1	11	56	7·5	17	50	1·7	..		..
13	Sunday	0	20	7·5	6	18	2·3	12	38	7·3	18	47	1·8
14	Monday	1	7	7·5	7	19	2·3	13	29	7·2	19	47	1·7
15	Tuesday	2	0	7·5	8	25	2·0	14	30	7·1	20	49	1·5
16	Wednesday	3	0	7·7	9	27	1·6	15	34	7·3	21	49	1·1
17	Thursday	4	5	8·1	10	23	0·9	16	39	7·7	22	44	0·5
18	Friday..	5	5	8·5	11	17	0·3	17	38	8·2	23	36	0·0
19	Saturday	5	59	9·0	12	7	−0·3	18	34	8·8	..		..
20	Sunday	0	26	−0·4	6	52	9·4	12	57	−0·8	19	25	9·2
21	Monday	1	14	−0·7	7	42	9·8	13	42	−1·0	20	16	9·5
22	Tuesday	2	3	−0·7	8	30	9·9	14	30	−1·1	21	4	9·7
23	Wednesday	2	50	−0·6	9	19	9·9	15	16	−0·8	21	52	9·6
24	Thursday	3	39	−0·2	10	8	9·6	16	7	−0·4	22	43	9·4
25	Friday..	4	33	0·3	10	59	9·2	17	2	0·1	23	36	9·1
26	Saturday	5	34	0·8	11	52	8·7	18	4	0·5	..		..
27	Sunday	0	30	8·7	6	38	1·1	12	47	8·1	19	13	0·9
28	Monday	1	29	8·2	7	50	1·3	13	50	7·7	20	22	1·0
29	Tuesday	2	32	8·0	8	59	1·1	14	59	7·4	21	24	0·9
30	Wednesday	3	38	8·0	9	54	1·0	16	10	7·3	22	17	0·8
					October, 1914.								
1	Thursday	4	41	8·0	10	49	0·6	17	10	7·5	23	7	0·6
2	Friday..	5	38	8·2	11	36	0·3	18	1	7·7	23	55	0·5
3	Saturday	6	31	8·3	12	19	0·1	18	50	7·9	..		..
4	Sunday	0	38	0·4	7	13	8·4	13	2	0·1	19	37	8·1
5	Monday	1	19	0·5	7	53	8·4	13	39	0·2	20	13	8·2
6	Tuesday	1	53	0·7	8	29	8·4	14	15	0·4	20	49	8·2
7	Wednesday	2	31	1·0	9	8	8·3	14	47	0·6	21	23	8·1
8	Thursday	2	58	1·3	9	35	8·1	15	15	0·8	21	58	8·0
9	Friday..	3	30	1·6	10	13	7·9	15	45	0·9	22	34	7·9
10	Saturday	4	7	1·8	10	49	7·7	16	25	1·4	23	12	7·9
11	Sunday	4	48	2·0	11	29	7·5	17	11	1·6	23	53	7·8
12	Monday	5	40	2·1	12	12	7·4	18	10	1·7	..		..
13	Tuesday	0	34	7·6	6	46	2·0	13	4	7·2	19	14	1·6
14	Wednesday	1	30	7·7	7	56	1·8	14	4	7·2	20	19	1·3
15	Thursday	2	31	7·8	9	0	1·3	15	4	7·4	21	19	1·0
16	Friday..	3	31	8·1	9	55	0·7	16	8	7·8	22	16	0·5
17	Saturday	4	32	8·5	10	49	0·1	17	11	8·2	23	10	0·0
18	Sunday	5	28	8·9	11	40	−0·5	18	5	8·8	..		..
19	Monday	0	1	−0·4	6	23	9·3	12	31	−0·9	18	58	9·3
20	Tuesday	0	50	−0·6	7	16	9·6	13	18	−1·1	19	50	9·6
21	Wednesday	1	41	−0·7	8	7	9·7	14	6	−1·1	20	43	9·8
22	Thursday	2	29	−0·5	8	58	9·7	14	54	−0·8	21	34	9·7
23	Friday..	3	19	−0·2	9	49	9·6	15	46	−0·4	22	23	9·5
24	Saturday	4	16	−0·2	10	41	9·1	16	42	−0·1	23	16	9·2

AUCKLAND TIDE-TABLES FOR 1914—*continued.*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					October—continued.								
25	Sunday	5	16	0·6	11	35	8·6	17	43	0·5	..	..	..
26	Monday	0	10	8·8	6	22	0·9	12	29	8·1	18	49	0·8
27	Tuesday	1	7	8·4	7	30	1·0	13	29	7·7	19	55	0·9
28	Wednesday	2	6	8·1	8	35	0·9	14	31	7·3	20	59	0·9
29	Thursday	3	8	7·8	9	31	0·7	15	36	7·2	21	51	0·8
30	Friday..	4	13	7·8	10	19	0·5	16	41	7·4	22	40	0·8
31	Saturday	5	7	7·9	11	4	0·4	17	35	7·6	23	23	0·8
					November, 1914.								
1	Sunday	5	56	8·0	11	47	0·3	18	22	7·8	..	..	..
2	Monday	0	5	0·8	6	42	8·0	12	30	0·2	19	4	7·8
3	Tuesday	0	47	0·7	7	19	8·0	13	7	0·2	19	41	7·8
4	Wednesday	1	23	0·8	7	56	8·0	13	41	0·4	20	19	8·0
5	Thursday	2	1	0·9	8	34	7·9	14	16	0·6	20	55	8·1
6	Friday..	2	32	1·3	9	10	7·9	14	47	0·8	21	32	8·1
7	Saturday	3	5	1·5	9	50	7·8	15	18	1·1	22	9	8·1
8	Sunday	3	42	1·7	10	26	7·7	16	1	1·3	22	47	8·1
9	Monday	4	31	1·8	11	9	7·6	16	51	1·5	23	31	8·1
10	Tuesday	5	25	1·8	11	55	7·6	17	40	1·5	..	..	..
11	Wednesday	0	14	8·0	6	22	1·8	12	43	7·5	18	37	1·5
12	Thursday	1	4	8·0	7	26	1·5	13	34	7·5	19	45	1·3
13	Friday..	1	57	8·1	8	32	1·0	14	35	7·6	20	51	0·9
14	Saturday	2	58	8·1	9	29	0·5	15	39	7·8	21	49	0·5
15	Sunday	4	0	8·4	10	20	0·0	16	40	8·2	22	44	0·1
16	Monday	4	58	8·7	11	13	−0·5	17	40	8·6	23	37	−0·2
17	Tuesday	5	56	8·9	12	4	−0·8	18	34	9·0	..	..	..
18	Wednesday	0	25	−0·4	6	53	9·2	12	56	−1·0	19	31	9·3
19	Thursday	1	21	−0·5	7	47	9·3	13	44	−0·9	20	22	9·5
20	Friday..	2	12	−0·4	8	40	9·3	14	35	−0·7	21	13	9·6
21	Saturday	3	4	−0·2	9	34	9·2	15	27	−0·4	22	6	9·5
22	Sunday	3	57	0·2	10	25	9·0	16	21	0·1	22	56	9·3
23	Monday	4	56	0·5	11	17	8·6	17	19	0·5	23	48	8·9
24	Tuesday	5	59	0·7	12	8	8·2	18	23	0·8	..	..	..
25	Wednesday	0	40	8·6	7	1	0·9	13	4	7·8	19	25	1·0
26	Thursday	1	33	8·1	7	57	0·8	14	1	7·5	20	23	1·1
27	Friday..	2	29	7·8	8	53	0·8	14	57	7·2	21	17	1·1
28	Saturday	3	23	7·6	9	42	0·7	15	56	7·2	22	7	1·1
29	Sunday	4	21	7·5	10	30	0·6	16	52	7·3	22	52	1·1
30	Monday	5	14	7·6	11	12	0·5	17	41	7·5	23	35	1·1
					December, 1914.								
1	Tuesday	6	0	7·6	11	52	0·5	18	27	7·6	..	..	..
2	Wednesday	0	14	1·0	6	45	7·7	12	32	0·5	19	10	7·9
3	Thursday	0	55	1·1	7	25	7·8	13	13	0·6	19	47	8·1
4	Friday..	1	33	1·1	8	5	7·9	13	49	0·7	20	27	8·3
5	Saturday	2	11	1·2	8	46	8·0	14	24	0·8	21	7	8·4
6	Sunday	2	49	1·2	9	30	8·0	15	2	0·9	21	48	8·5
7	Monday	3	28	1·3	10	11	8·0	15	42	1·0	22	28	8·5
8	Tuesday	4	13	1·4	10	55	7·9	16	23	1·1	23	11	8·5
9	Wednesday	5	2	1·4	11	39	7·9	17	21	1·3	23	53	8·4
10	Thursday	5	57	1·3	12	25	7·8	18	19	1·3	..	..	..
11	Friday..	0	42	8·3	6	59	1·1	13	14	7·8	19	23	1·2
12	Saturday	1	34	8·1	7	59	0·8	14	9	7·7	20	26	1·0
13	Sunday	2	29	8·1	8	58	0·5	15	10	7·8	21	27	0·8
14	Monday	3	32	8·2	9	58	0·1	16	16	8·1	22	22	0·4
15	Tuesday	4	35	8·3	10	51	−0·2	17	17	8·4	23	17	0·2
16	Wednesday	5	35	8·5	11	44	−0·4	18	19	8·8	..	..	..
17	Thursday	0	11	0·0	6	35	8·7	12	37	−0·5	19	15	9·1
18	Friday..	1	5	−0·2	7	32	8·9	13	27	−0·6	20	8	9·4
19	Saturday	1	57	−0·2	8	26	9·0	14	17	−0·5	20	59	9·5



— Note Velocity of Wind shown: ◎ South plotted below mean line. North above. —
— Scale — 1 inch = 250 miles per 24 hours —

— Predictions shown —
— Barometer shown ○ — Scale-full size. —

— Wellington, 1913, May 10-17 —

— Scales: — Horizontal — 1 inch = 3.98 Hours —
— Vertical — 1 inch = 0.97 Feet — } For Tide curve. —

AUCKLAND TIDE-TABLES FOR 1914—*continued.*

Date.	Day.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.	H.	m.	Ft.
					December—continued.								
20	Sunday	2	47	−0·1	9	19	9·0	15	8	−0·2	21	48	9·5
21	Monday	3	38	0·1	10	6	8·9	16	0	0·1	22	35	9·4
22	Tuesday	4	32	0·3	10	54	8·6	16	55	0·5	23	22	9·0
23	Wednesday	5	28	0·5	11	43	8·3	17	50	0·8	..		..
24	Thursday	0	10	8·6	6	21	0·7	12	32	7·9	18	45	1·1
25	Friday..	0	58	8·0	7	17	0·9	13	20	7·5	19	43	1·3
26	Saturday	1	46	7·7	8	10	0·9	14	13	7·2	20	36	1·4
27	Sunday	2	38	7·4	8	59	0·9	15	8	7·1	21	23	1·5
28	Monday	3	30	7·2	9	48	1·0	16	3	7·1	22	10	0·9
29	Tuesday	4	23	7·2	10	35	1·5	16	56	7·3	22	56	1·4
30	Wednesday	5	19	7·3	11	16	0·8	17	47	7·6	23	41	1·4
31	Thursday	6	10	7·5	11	58	0·8	18	35	7·9	..		..

The work of the year has comprised the predictions of the tides for 1914 both for Wellington and Auckland, also the examination of the tidal records of Melbourne, Dunedin, Port Chalmers, Bluff, and Lyttelton. The harmonic analysis of the tides of Dunedin is in hand, as well as the predictions for 1915 for Wellington.

Inspections were made of the tide-gauges at Wellington, Bluff, Dunedin, and Port Chalmers, and suggestions given to the officers in charge of the gauges as to the necessary checks to be applied periodically to the gauges to keep them as accurate as possible. After careful examination of these records advice was given as to the necessary precautions to be taken to make the records sufficiently reliable for use in making harmonic analyses from.

A new tide-predicting machine has been designed, and all the necessary calculations made for it; difficulties in construction, however, have to be overcome and have delayed the machine. These are not serious, so the machine may be expected to be in working-order soon. If the machine works as well as it is anticipated, a very considerable saving in time will be effected in the tidal predictions. This is urgently wanted, as under present arrangements and with a limited staff there is very little time available for the analysis of the tides of the other ports.

For the very large amount of arithmetical work the various calculating-machines in use have been of the greatest assistance. For the additions the Mercedes adding-machine has been used regularly; this machine has one set of keys numbered from 0 to 9, and can add columns of figures nine digits wide; it is compact and easily portable, and is well made and reliable in its action. The Rapid Computer, a small adding-machine, has also been used. For the multiplications, &c., the Brunsviga calculating-machine, with printing attachment, and the Millionaire calculating-machine have been used. For plotting the numerous curves required the very fine Coradi co-ordinatograph is employed; by this machine rectangular co-ordinates can be readily plotted to 1/1000 of an inch. For checking harmonic analysis the harmonic analyser, designed by Dr. O. Mader has been used on curves plotted by the co-ordinatograph. The analyser is well made, and works on a base of 24 in. For a description of it see *Elektrotechnische Zeitschrift*, 1909, Nos. 34, 35.

CHECKS OF PREDICTIONS.

As in former years, checks are constantly applied to the predicted times and heights of high and low water. The figure shows a portion of the record made by the tide-gauge described and illustrated in the Tidal Survey Report for 1911–12. This gauge is at present working in the N shed of the Wellington Harbour Board, on Jervois Quay.

On the figure the predicted high and low waters, as determined by the Tidal Survey, are plotted, and it will be seen how closely the predictions agree with actuality. A check of this kind proves the accuracy of the predictions and gives confidence in the results of the Tidal Survey. As will be seen from the figure, the predicted heights vary slightly from the actual heights; this is due to the winds and barometric pressure, which have a marked influence on the height of the tide. The wind-velocity for the preceding twenty-four hours, measured at 9 a.m. each day, is shown plotted at twelve hours earlier—*i.e.*, at 9 p.m.—and gives a general indication of its effect on the heights; while the height of the barometer is also shown for each day on the diagram.

The predictions are for average conditions, and the heights accordingly require slight corrections for the wind and barometric pressure for any given day. The times of high and low water are not altered by the barometric conditions or by the winds, and, as will be seen from the figure, the predicted times agree very closely with actuality.

General.—Messrs. T. G. Gillespie and J. J. Hay have assisted in the calculations of the tidal survey in a satisfactory manner, and they are now conversant with the details of the calculations both for the harmonic analysis of the tidal records and for the prediction of the tides. Their work has been of a technical nature, involving great care to guard against errors, and has been carried out accurately.

APPENDIX VI.

THE MAGNETIC OBSERVATORY AND THE MAGNETIC SURVEY.

THROUGHOUT the year the Magnetic Observatory has been maintained in continuous operation, and the usual routine work of obtaining magnetic, seismological, and meteorological records has been duly performed. The prearranged term-hour observations in connection with the Antarctic expeditions have been made as in the previous year. Copies of the records and observations obtained during term-hours are now being made for transmission to the authorities of the expeditions.

Towards the end of 1912 the new set of Eschenhagen-Toepfer magnetographs arrived, and these were installed in an above-ground magnetograph house at Amberley, thirty-four miles north of Christchurch, so as to be beyond the disturbing influences of the electric-tramway currents. It was thus found possible to observe all the later term-hours with these instruments, and magnetograms of declination, horizontal force, and vertical force were obtained for all these term-hours, including those occurring in daylight-hours.

It is proposed to improve the installation of these magnetographs somewhat, chiefly with regard to temperature insulation, and providing an electric recording-light and time-marking arrangement, and then to keep them in continuous operation, and obtain undisturbed records from them.

Our thanks are due to Dr. Atkinson and Mr. Wright, of the scientific staff of Captain Scott's Expedition, for securing to the Observatory the gift of the valuable storage battery used by Dr. Simpson and Mr. Wright in the Antarctic in conjunction with their magnetographs. The only condition attached to the gift is that I persuade the Government to install and use them in the Amberley substation.

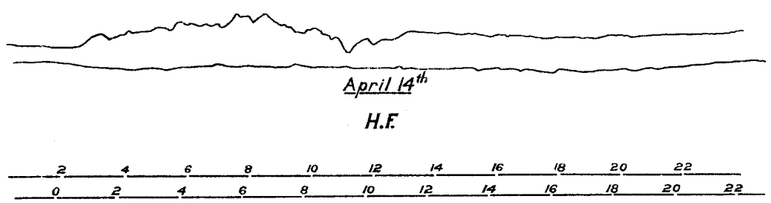
During the year, on the occasion of the several visits of the "Terra Nova" to Lyttelton, facilities were given to Lieutenant Pennell, R.N., and other officers of the "Terra Nova," for the standardization of their dip and total force circles, and the necessary information as to the simultaneous observatory values has been made out and given to Lieutenant Pennell.

The "Terra Nova" went south to the relief of Captain Scott's shore party early in the summer, and returned unexpectedly early in February with the news of the gallant and successful attempt made by Captain Scott, Dr. Wilson, Captain Oates, Lieutenant Bowers, and Petty-officer Evans to reach the South Pole over the difficult route by which Sir Ernest Shackleton had previously arrived within a hundred miles of the pole. Deep sympathy and sadness were, however, aroused by the news of the death of these brave men on their journey back from the pole. They died nobly, after undergoing incredible hardships, through the protracted continuance of a terrible blizzard. Magnetic science already owes a deep debt of gratitude to Captain Scott, a debt which will be increased many fold when the magnetic results of his last and glorious expedition have been published.

Upon the return of the "Terra Nova," Mr. Wright, physicist to the expedition, with other officers, lost no time in resorting to the Observatory to complete their necessary labours there in the comparison of instruments, &c. Mr. Wright was enabled to again swing the gravity pendulums of the expedition under conditions considerably improved, and direct telegraphic communication was made, by the courtesy of the Department of Telegraphs, with the Government Astronomical Observatory in Wellington for the transmission of time-signals here. In addition, and to guard against the possibility of bad weather preventing star-observations in Wellington, star transits for time were observed at the Magnetic Observatory with a smaller instrument. The ship and the shore magnetic instruments of the expedition were again compared with the Observatory standard by Lieutenant Pennell, R.N., Dr. Levick, and Mr. Wright, and letters since received here evince the satisfaction with which these gentlemen regard their work at the Observatory, and the great usefulness of the Observatory to the expedition.

Mention must also be made of the very successful magnetic work of the Antarctic Expedition (Australian) by and under the direction of Mr. Eric N. Webb. The weather experienced by the expedition was generally more severe than that experienced at Captain Scott's base; but, despite the conditions, I think that the magnetic results will be equally good, and the simultaneous operations of magnetographs on either side of the magnetic pole may be expected to yield very valuable scientific results. Dr. Mawson reports auroræ of unexampled brilliancy. During his enforced sojourn in the Antarctic this winter Dr. Mawson intends to continue the registration by the magnetographs, and now that his wireless telegraph is working so well, it is expected that he will arrange by telegraph for simultaneous open-scale runs at all observatories during some of the longer-continued aurora.

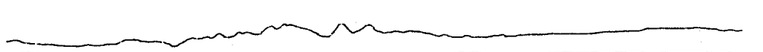
April 15th 1912 G.M.C.T.



April 14th

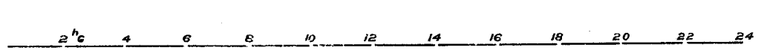
H.F.

April 15th 1912 Gr



April 14th

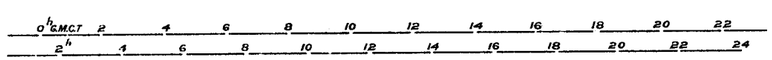
D



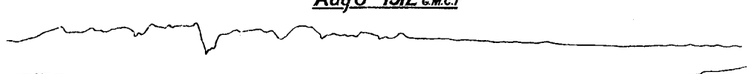
May 12th 1912

May 13th

H.F.

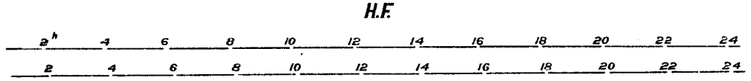


Aug 6th 1912 G.M.C.T

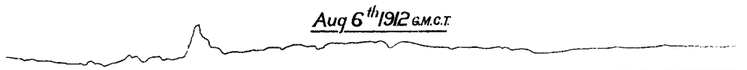


Aug 5th

H.F.

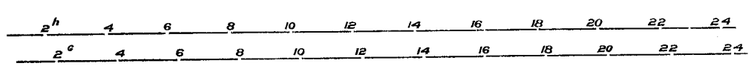


Aug 6th 1912 G.M.C.T.

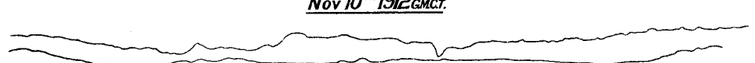


Aug 5th

D

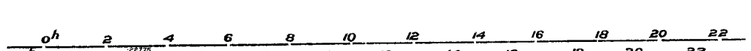


Nov 10th 1912 G.M.C.T.

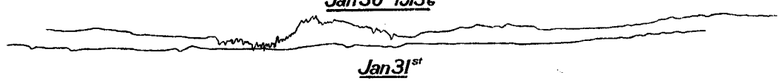


Nov 9th

H.F.

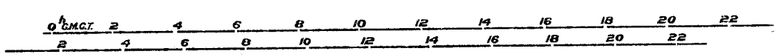


Jan 30th 1913 G

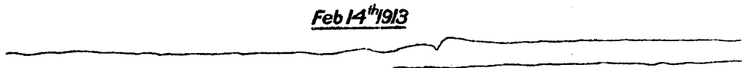


Jan 31st

H.F.

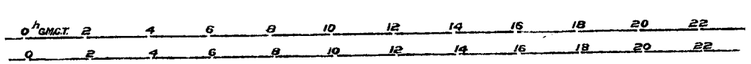


Feb 14th 1913

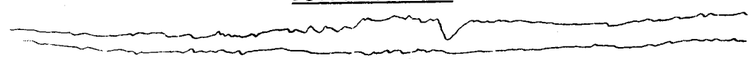


Feb 13th

V.F.

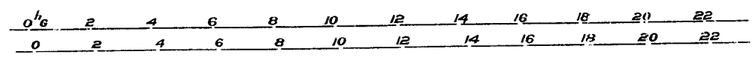


Feb 14th 1913 G.M.C.T

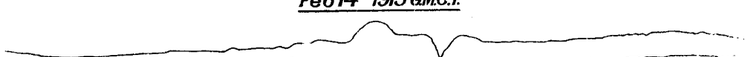


Feb 13th

H.F

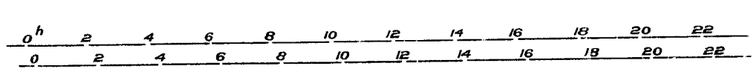


Feb 14th 1913 G.M.C.T.

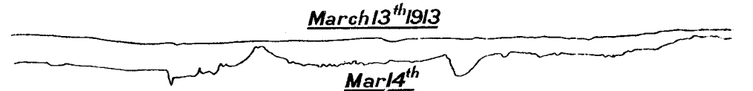


Feb 13th

D

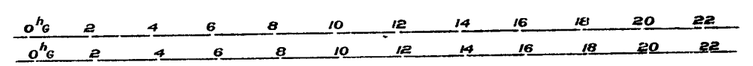


March 13th 1913



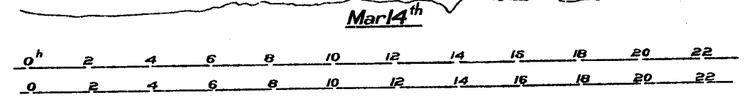
Mar 14th

H.F.



March 13th 1913 G.M.C.T.

Mar 14th



1700. 6. 13. 518.

April 15th 1912 G.M.C.T.

April 14th

H.F.

2 4 6 8 10 12 14 16 18 20 22

0 2 4 6 8 10 12 14 16 18 20 22

April 15th 1912 Gr

April 14th

D

2h 4 6 8 10 12 14 16 18 20 22 24

0h 2 4 6 8 10 12 14 16 18 20 22

May 12th 1912

May 13th

H.F.

0h G.M.C.T. 2 4 6 8 10 12 14 16 18 20 22

2h 4 6 8 10 12 14 16 18 20 22 24

Aug 6th 1912 G.M.C.T.

Aug 5th

H.F.

2h 4 6 8 10 12 14 16 18 20 22 24

2 4 6 8 10 12 14 16 18 20 22 24

1500. 6. 13. 5/18.

Aug 6th 1912 G.M.C.T.

Aug 5th

D

2h 4 6 8 10 12 14 16 18 20 22 24

2c 4 6 8 10 12 14 16 18 20 22 24

Nov 10th 1912 G.M.C.T.

Nov 9th

H.F.

0h 2 4 6 8 10 12 14 16 18 20 22

0h 2 4 6 8 10 12 14 16 18 20 22

Jan 30th 1913 G

Jan 31st

H.F.

0h G.M.C.T. 2 4 6 8 10 12 14 16 18 20 22

2 4 6 8 10 12 14 16 18 20 22

Feb 14th 1913

Feb 13th

V.F.

0h G.M.C.T. 2 4 6 8 10 12 14 16 18 20 22

0 2 4 6 8 10 12 14 16 18 20 22

Feb 14th 1913 G.M.C.T.

Feb 13th

H.F

0h G 2 4 6 8 10 12 14 16 18 20 22

0 2 4 6 8 10 12 14 16 18 20 22

Feb 14th 1913 G.M.C.T.

Feb 13th

D

0h 2 4 6 8 10 12 14 16 18 20 22

0 2 4 6 8 10 12 14 16 18 20 22

March 13th 1913

Mar 14th

H.F.

0h G 2 4 6 8 10 12 14 16 18 20 22

0h G 2 4 6 8 10 12 14 16 18 20 22

March 13th 1913 G.M.C.T.

Mar 14th

0h 2 4 6 8 10 12 14 16 18 20 22

0 2 4 6 8 10 12 14 16 18 20 22

The Adie Magnetographs.—These have been kept in continuous operation, and all the daily magnetograms developed. A large portion of these have also been measured at hourly intervals for declination, horizontal force, and vertical force. In addition, the measurement of the curves for the previous two years, 1910 and 1911, was completed, and the mean annual values derived from the international " quiet " days have been found to be as follows :—

Year.	Declination. (East of North.)	Horizontal Force. C.g.s.	Inclination.	Vertical Force. C.g.s.
1910 (January–December) ..	16° 37·6′ E.	0·22511	67° 54·8′ S.	0·55474
1911 ,, ..	16° 39·0′ E.	0·22494	67° 56·2′ S.	0·55497
Increment	+ 1·4′	− 0·00017	+ 1·4′	+ 0·00023

The above have been forwarded to Kew, for publication in their list of values for observatories.

The necessary absolute magnetic observations for standardizing the magnetic curves have been duly made, and computed throughout the year.

Twelve of the principal magnetograms obtained are published herewith, reduced to three-eighths of the originals.

For purposes of comparison it is noted that on the reproduced curves the ordinates have the following values :—

Declination curves .. .. + 1 mm. = − 3·0′.
Horizontal force curves .. .. .. + 1 mm. = − 0·00014 c.g.s. unit.
Vertical force curves .. .. .. + 1 mm. = − 0·00012 c.g.s. unit.

It has been found that the constancy of base-line of the magnetographs has much improved of late years upon that of the early years of the running of these magnetographs. This is usually experienced in new observatories, a steady state being gradually attained.

A table of monthly means of hourly values from all days for the years 1902, 1903, 1904 is published herewith. It will be useful for comparing the mean diurnal variation at Christchurch with that at other observatories, especially with respect to seasonal differences.

The Milne Seismograph No. 16.—This instrument has been kept continuously recording, and all the daily seismograms have been developed and records measured. Records were obtained of thirty-one earthquakes, a smaller number than in previous years. This may partly be explained, however, by the fact that night-tremors due to local and instrumental effects have been more pronounced, and the tendency of these is to mask the effects of some of the smaller and far-distant shocks. The boom period of the instrument has been approximately 15 seconds through the year, as recommended. At first, after the removal and replacement of the boom during the installation of the new recorder, difficulty was experienced in keeping the period high, but now that the condition of the instrument has become more stable, it is intended to bring the period up to 20 seconds, to bring the recording into line with that of the Sydney seismograph-station, which now runs with the period at 20 seconds.

A table of times, &c., of earthquakes recorded here is appended, and it will be noticed that several of the records are those of mega-seisms of more or less violence occurring in the Dominion.

The seismograms of ten of the principal earthquakes are published herewith.

Meteorological Observations.—The usual daily observations of air-pressure, temperature, humidity, cloud, and wind have been made at 9·30 a.m. and at 5 p.m. throughout the year. The recording barograph and thermograph have been kept in continuous operation. Daily epitomes of meteorological observations have been published daily in the newspapers, and monthly returns have been forwarded for the information of the Weather Forecast Department.

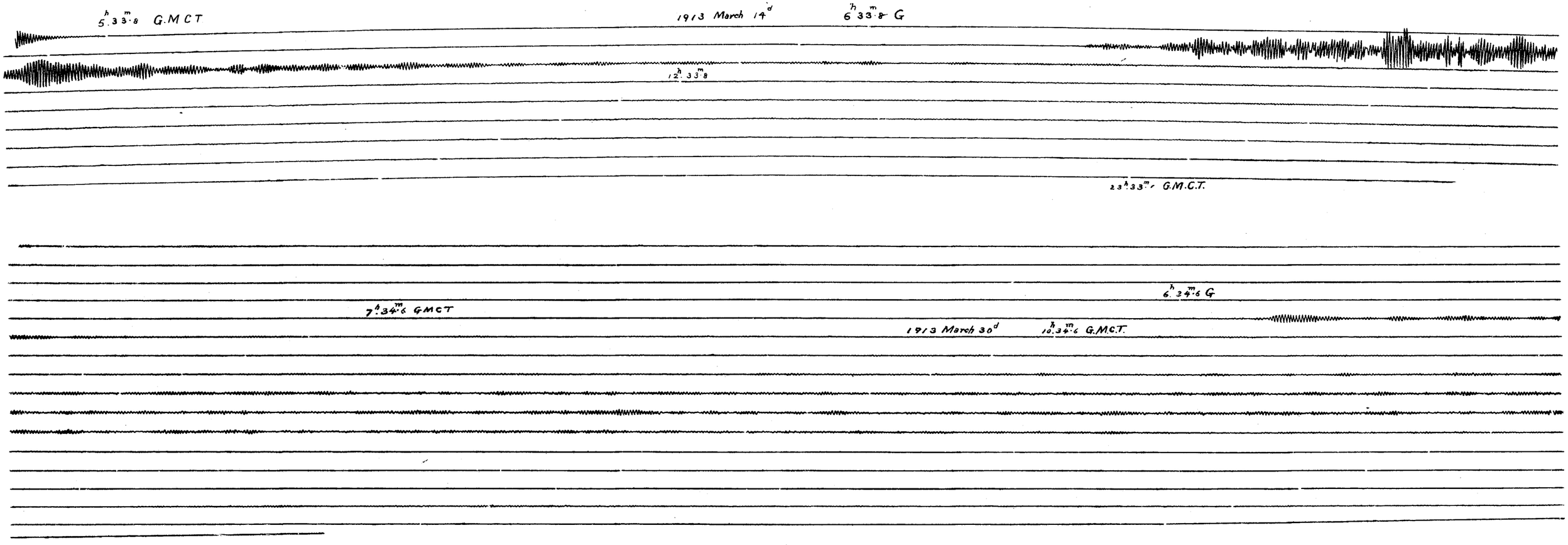
In conclusion, I have to acknowledge the services of my assistant, Mr. T. Maben, throughout the year. I have also to return thanks to the various scientific institutions and observatories which have contributed publications and observations to this Observatory.

I have, &c.,
HENRY F. SKEY, B.Sc.,
Officer in Charge.

EARTHQUAKE RECORDS of MILNE SEISMOGRAPH No. 16, AT CHRISTCHURCH, WITH NEW TYPE OF RECORDER.

Latitude, 43° 31′ 48″ S.; longitude, 172° 37′ 13″ E.; time employed, Greenwich civil time. Amplitude = half-range in millimetres.

Date.	Commencement.	Maxima.	Maximum Amplitude.	Duration.	Natural Boom Period.	Remarks.
1912.	H. M.	H. M.	Millimetres.	H. M.	Seconds.	
April 14	22 47·5	22 57·5	9·9	1 18·0	15	
„ 15	16 20·0	16 26·3	2·0	..	..	
		16 27·4	1·7	..	..	End obscured by N.T.
„ 20	1 47·2	2 06·5	1·5	2 0·3	..	
May 15	0 11·3	0 13·3	1·9	..	..	
		0 15·8	2·2	..	..	
		0 19·5	2·2	1 00·0	..	
„ 17	13 58·1	13 59·0	0·6	..	..	
		14 03·0	0·9	..	..	Duration obscured by N.T.
		14 06·0	0·5	..	..	
„ 23	2 44·7	3 22·7	0·4	1 39·0	..	Mean period of long waves, 40 secs., 30 secs., and 20 secs. successively.
„ 26	6 38·8	6 40·8	6·0	0 55·3	..	Origin, North Island, New Zealand. L.W. commence, 6 h. 39 m.
June 6	17 39·2	17 45·0	0·4	..	..	Duration obscured by N.T.
July 7	9 44·8	9 47·8	0·2	..	..	
		9 54·0	0·2	..	..	
		9 58·2	0·2	0 28·0	..	Waves 24 secs. period.
19	21 36·0	21 55·4	2·4	..	..	
		22 10·0	0·8	1 50·2	15	Excellent record.
„ 25	23 15·3	23 33·8	1·1	..	..	
		24 02·5	0·5	2 02·0	..	
„ 26	2 33·6	3 00·8	1·8	..	..	
		3 29·0	1·0	2 20·0	..	
„ 26	7 57·4	8 13·1	2·4	..	..	
		8 15·9	1·2	..	..	
		8 18·0	1·3	..	..	
		8 24·3	0·8	..	..	
		8 29·0	0·5	1 29·0	15	
Aug. 6	23 15·5	23 33·5	2·0	..	..	Duration obscured by N.T.
		23 33·9	1·1	..	..	
		24 02·7	0·5	2 +	..	
„ 7	2 37·5	2 58·7	2·0	..	..	
		3 26·5	1·0	2 00·0	..	
„ 9	1 57·5	3 04·5	1·4	..	..	Succession of tremors, with maxima increasing and decreasing gradually.
		3 10·5	1·8	..	..	
		3 16·0	1·1	..	..	
		3 20·2	1·0	3 00·0	..	
„ 16	23 18·4	23 20·2	0·4	0 09·6	..	
„ 17	19 30·7	19 40·0	1·1	..	..	
		19 51·0	..	..	..	End obscured by N.T.
„ 18	8 17·0	8 20·0	0·2	0 32·0	..	
Sept. 1	5 23·0	5 35·0	0·5	1 32·0	..	
„ 29	21 09·8	21 29·8	3·1	..	..	
		21 34·1	3·7	..	..	
		21 42·6	2·9	..	..	
		21 45·1	2·5	..	..	
		21 48·8	2·0	3 16·0	15	
Oct. 16	4 05·1	4 06·8	1·0	..	..	Duration uncertain.
		4 10·3	0·4	..	..	
„ 17	10 08·0	10 16·8	1·0	..	..	
„ 20	9 39·5	9 44·4	2·0	..	..	
		9 47·9	1·7	..	..	End obscured by N.T.
Nov. 13	0 44·0	0 49·3	0·2	..	..	
		0 53·5	0·5	1 11·0	..	
Dec. 6	..	11 01·6	1·0	..	..	Duration uncertain.
1913.						
Jan. 24	4 35·6	4 35·7	1·6	0 06·1	..	Felt at Christchurch; origin, near Masterton, North Island, N.Z.
Feb. 22	1 09·1	1 09·7	4·0	0 52·0	..	Origin, near Westport, N.Z.
Mar. 10	..	14 10·5	0·8	..	14	Duration obscured by N.T.
[„] 14	8 56·8	9 06·0	4·0	..	..	
		9 11·4	3·5	..	..	
		9 22·5	7·0	..	..	
		9 28·6	5·0	..	..	
		9 32·2	5·5	..	..	
		9 38·6	5·0	2 28·0	..	
„ 30	8 43·0	8 48·0	1·5	..	..	End obscured by N.T.



RECORDS BY MILNE SEISMOGRAPH No. 16, AT CHRISTCHURCH.

In 19h 39m 9 G.M.C.T. 18 Apl. 1912

20d 0h 33m 5 G. hG

2h G

1912 July 19d 19 29·0 G.M.C.T.

21-29-0

h m
22 29·0

20h 31m 0 G.

1912 July 25d 21h 31m 0 G

h m
1 31·0 G.M.C.T.

1912 July 26d 6h 31m.0 G

8h. 31m.0

9h. 31m.0

1912 Aug 9d 0·34·5 G.C.T.

4. 34·5 G. C. T.

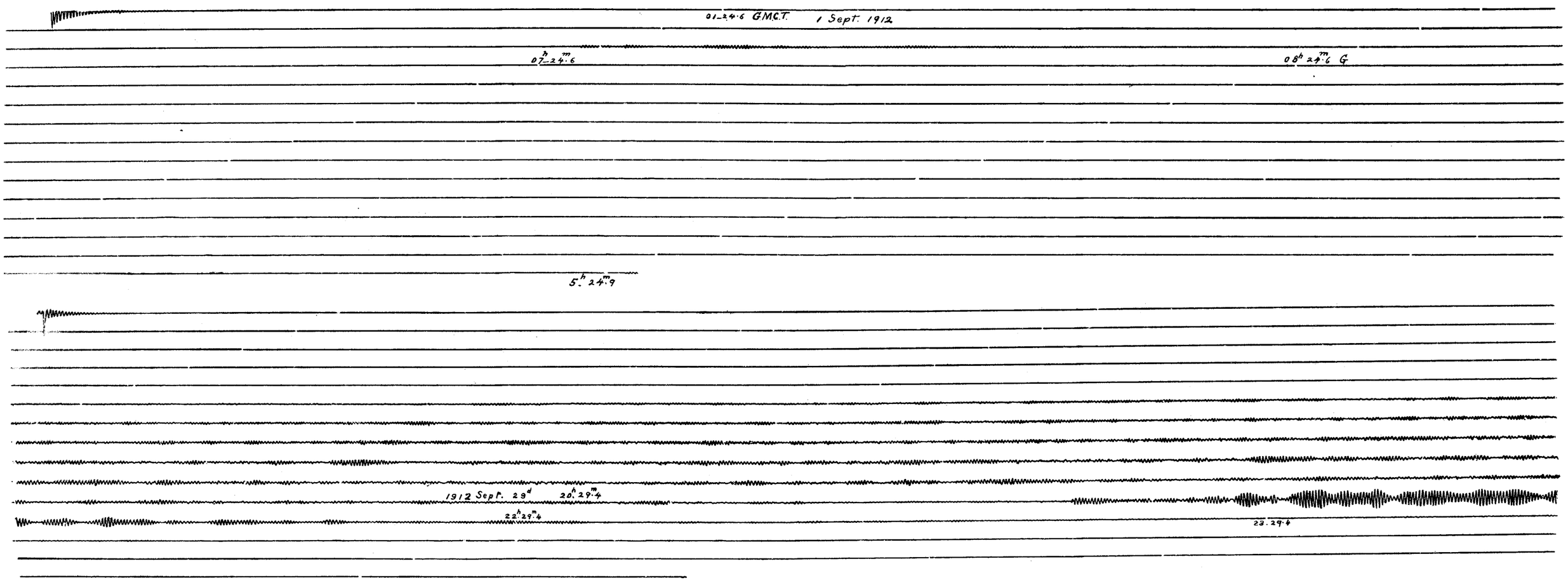
14d 22h 05m·5

23h G.

15h G.M.C.T.

1912: Aug 15d 16h G

Records by Milne Seismograph No. 16, at Christchurch.



Records by Milne Seismograph No. 16, at Christchurch.

1500.8.13.416.

Table of Hourly Means for Months—1902.

Month.	0h.	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	Mean.
Declination (east of north) : 16° + . . .′																									
	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
January	15·0	16·9	17·7	17·5	16·6	16·0	15·6	15·5	15·0	14·7	14·6	14·2	14·1	14·0	13·8	13·7	13·7	13·7	13·0	12·3	11·5	11·3	11·9	13·3	14·4
February	15·1	16·7	17·9	17·6	16·5	15·6	14·9	14·8	14·3	14·2	13·7	13·5	13·6	13·4	13·6	13·6	13·5	13·5	13·2	12·1	10·8	10·5	11·9	13·3	14·0
March	14·8	16·9	18·3	18·5	17·5	16·0	15·0	15·0	14·8	14·4	14·1	14·0	13·9	14·0	13·9	14·2	14·0	13·9	13·9	12·9	11·4	10·1	10·1	11·5	14·2
April	13·6	16·0	17·3	17·3	16·3	15·3	14·6	14·5	14·1	13·7	13·5	13·2	13·2	13·5	13·7	13·8	13·9	14·0	14·0	13·7	13·0	12·0	11·2	11·7	14·0
May	14·0	15·8	16·9	16·9	16·6	15·6	15·3	15·1	14·9	14·6	14·5	14·4	14·2	14·3	14·4	14·6	14·7	15·0	14·8	14·7	14·4	14·0	13·3	13·3	14·8
June	14·1	15·1	16·1	16·4	16·1	15·1	14·8	14·7	14·5	14·4	14·2	14·3	14·3	14·3	14·5	14·4	14·8	14·9	14·8	14·8	14·7	14·4	13·9	13·9	14·7
July	14·1	15·4	16·7	17·2	17·1	16·0	15·4	15·2	15·0	14·6	14·6	14·4	14·5	14·6	14·8	15·1	15·2	15·2	15·1	15·1	14·9	15·1	14·1	13·7	15·1
August	14·4	15·9	17·1	17·6	17·6	16·9	16·1	15·9	15·7	15·4	15·5	15·4	15·4	15·4	15·5	15·6	15·7	15·8	15·6	15·8	15·5	14·8	13·9	13·8	15·7
September	15·8	17·5	18·7	18·9	18·4	17·7	17·0	16·8	16·6	16·1	16·0	15·9	15·8	15·9	16·1	16·2	16·4	16·3	16·2	15·9	14·9	13·7	13·2	14·0	16·3
October	17·2	19·2	20·2	20·0	18·9	17·8	16·8	16·5	16·3	16·0	15·5	15·2	15·4	15·4	15·4	15·6	15·6	15·6	15·3	14·5	13·1	12·8	13·0	15·0	16·1
November	16·7	18·5	19·8	19·6	19·3	18·3	17·0	16·2	15·8	15·7	15·3	15·0	14·9	15·1	15·1	15·3	15·2	15·2	14·6	13·5	11·9	11·3	11·9	14·5	15·7
December	17·2	19·9	20·9	21·0	20·5	19·2	18·0	17·0	16·5	16·2	16·1	16·0	15·8	15·9	15·8	15·8	15·8	15·5	14·8	13·2	12·1	11·9	13·2	15·4	16·4
Means . .	15·2	17·0	18·1	18·2	17·6	16·6	15·9	15·6	15·3	15·0	14·8	14·6	14·6	14·7	14·7	14·8	14·9	14·9	14·6	14·0	13·2	12·7	12·6	13·6	15·1
Horizontal Force : 0·22 . . . C.G.S.																									
January	706	708	713	718	721	724	724	724	724	725	725	724	723	721	721	720	720	722	723	721	720	713	708	705	719
February	685	693	701	706	710	711	712	710	710	709	709	708	708	708	707	707	707	708	707	705	698	688	680	680	703
March	677	685	692	700	705	708	707	709	708	710	708	708	708	708	708	707	708	708	709	708	702	693	681	675	701
April	678	683	689	694	697	697	697	699	699	697	697	699	697	698	698	698	699	699	700	701	699	693	687	681	695
May	694	690	691	695	699	703	703	703	703	703	703	703	703	703	703	703	704	705	706	707	707	706	703	698	702
June	696	692	691	692	696	700	701	700	699	698	698	698	697	698	698	699	699	700	701	702	703	705	704	701	698
July	693	685	685	688	695	699	700	699	698	697	696	697	698	698	698	699	699	699	701	702	703	705	707	707	701	698
August	685	681	680	683	688	692	693	694	693	691	692	691	691	691	692	692	692	693	695	696	698	699	697	692	691
September	676	677	683	688	692	694	694	694	693	693	691	692	689	693	692	692	693	695	696	698	697	692	685	679	690
October	672	681	688	694	697	695	693	691	690	690	689	688	689	689	690	690	691	693	694	693	688	679	670	667	687
November	653	665	675	683	687	685	682	678	679	679	678	678	677	677	677	677	678	678	680	680	672	662	652	650	674
December	651	662	673	683	687	688	683	680	678	678	678	677	676	675	674	673	673	676	677	674	667	655	647	646	672
Means . .	680	683	688	694	697	700	699	698	698	697	697	697	696	696	696	696	697	698	699	699	696	691	685	681	694

TABLE OF HOURLY MEANS FOR MONTHS—1902—*continued*.

Month.	0h.	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	Mean.
Vertical Force : 0·55 . . . C.G.S.																									
	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
January	293	294	294	295	296	296	296	297	297	297	296	296	297	296	296	296	296	296	296	296	296	296	296	294	296
February	269	268	269	269	270	270	271	271	270	271	270	270	270	270	270	270	269	270	270	270	271	271	271	269	270
March	280	279	279	279	279	275	281	282	282	282	282	283	283	282	281	281	281	281	281	281	282	282	283	281	281
April	265	265	265	265	265	266	266	267	266	266	266	266	266	266	265	266	265	265	265	265	266	266	266	265	266
May	282	282	282	283	283	284	283	284	284	284	284	283	283	283	283	283	282	282	282	282	282	282	282	282	283
June	286	286	287	287	287	287	287	287	287	287	288	288	287	287	287	287	287	287	287	287	287	286	286	286	287
July	275	276	277	277	277	278	278	278	277	277	277	277	277	274	277	277	276	275	276	273	276	275	275	275	276
August	271	271	271	272	272	272	272	272	272	272	272	272	272	271	271	271	271	271	271	271	271	270	268	271	271
September	286	287	287	287	288	288	289	289	289	289	289	289	289	289	288	288	288	288	288	288	288	288	287	286	288
October	289	291	291	292	293	294	295	295	295	295	295	294	294	294	294	293	293	293	293	293	293	293	294	293	293
November	259	259	259	259	260	261	261	262	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261	260	261
December	251	251	250	251	252	253	254	254	254	254	254	254	254	254	253	254	253	254	254	254	254	254	254	252	253
Means ..	275	276	276	276	277	277	278	278	278	278	278	278	278	277	277	277	277	277	277	277	277	277	277	276	277

TABLE OF HOURLY MEANS FOR MONTHS—1903.

Month.	0h.	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	Mean.
Declination (east of north) : 16° . . . ′																									
	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
January	17·1	19·1	20·1	20·5	19·8	19·2	18·6	18·1	17·6	17·3	17·1	16·9	16·7	16·4	16·3	16·3	16·0	16·0	15·5	14·5	13·6	13·0	13·6	15·2	16·9
February	16·9	18·9	20·4	20·6	19·8	19·0	18·2	17·5	17·0	16·7	16·4	16·1	16·1	16·2	16·1	16·2	16·1	16·3	15·8	14·9	14·6	13·1	13·8	15·2	16·7
March	18·0	20·1	21·1	21·2	20·2	18·7	17·9	17·8	17·5	17·2	17·0	16·8	16·6	16·8	16·7	16·8	16·9	16·8	16·7	16·0	15·0	13·8	13·9	15·6	17·3
April	17·6	20·1	21·4	21·5	20·5	19·4	18·6	18·0	17·8	17·4	17·0	17·0	16·8	16·8	17·1	17·5	17·6	17·5	17·5	17·3	16·5	15·5	14·7	15·4	17·8
May	17·8	19·3	20·1	20·2	19·6	18·6	18·4	18·1	17·9	17·5	17·1	16·8	17·1	17·3	17·5	17·8	17·8	17·9	17·7	17·5	17·3	16·9	16·6	16·8	17·9
June	17·7	19·0	19·9	19·9	19·6	19·9	17·7	18·0	17·6	17·3	17·3	17·2	17·1	17·1	17·5	17·6	17·9	17·8	18·0	17·9	18·2	18·0	17·4	17·3	18·0
July	17·5	18·8	20·4	20·7	20·2	18·8	18·4	18·2	18·0	17·9	17·4	17·3	17·6	17·6	17·6	18·3	18·3	18·5	18·6	18·4	18·5	18·2	17·4	16·9	18·3
August	17·8	19·5	21·0	21·5	21·2	19·8	19·3	19·1	18·5	18·0	17·9	17·7	17·4	17·6	17·8	18·4	18·7	18·9	18·9	18·8	18·5	17·8	16·9	16·7	18·7
September	18·2	20·2	21·5	22·1	21·6	20·7	19·7	18·9	18·8	18·4	18·0	17·7	17·9	18·2	18·6	18·8	19·3	19·3	19·1	19·0	18·0	16·7	16·0	16·4	18·9
October	20·1	22·2	23·6	23·8	23·0	21·6	20·8	20·1	19·2	18·3	18·5	17·5	19·5	16·8	18·1	16·5	17·4	18·9	19·4	18·3	17·6	16·4	16·6	17·8	19·3
November	19·8	22·4	23·9	23·9	23·4	22·5	21·2	19·9	19·6	19·1	18·2	18·2	18·3	18·2	18·2	18·4	18·4	18·2	17·4	16·0	15·2	14·5	15·1	17·2	19·0
December	20·6	23·4	25·2	26·1	25·6	24·6	23·2	21·6	21·2	21·0	20·2	19·7	19·7	19·8	19·7	19·7	19·9	20·0	19·4	18·1	16·5	15·5	15·7	17·7	20·6
Means ..	18·3	20·2	21·5	21·9	21·2	20·2	19·3	18·8	18·4	18·0	17·7	17·4	17·6	17·4	17·6	17·7	17·9	18·0	17·8	17·2	16·6	15·8	15·6	16·5	18·3

TABLE OF HOURLY MEANS FOR MONTHS—1903—*continued.*

Month.	0h.	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	Mean.
Horizontal Force 0·22 . . . C.G.S.																									
	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
January	666	671	675	682	688	691	691	691	688	688	687	687	687	687	686	686	685	685	684	683	680	674	669	665	682
February	656	664	670	676	680	683	682	681	681	682	682	680	681	680	679	679	679	680	681	678	671	662	654	652	675
March	654	662	670	676	677	679	679	680	681	681	681	680	680	681	680	680	681	681	682	678	677	670	661	656	675
April	647	651	658	664	666	667	669	671	671	672	672	669	671	670	670	670	671	672	673	674	672	666	657	648	666
May	667	669	670	672	674	677	678	678	678	679	679	680	679	680	680	680	681	682	683	683	684	683	680	669	678
June	677	675	673	674	679	683	681	682	679	682	681	681	688	682	682	681	682	683	685	685	681	687	685	681	681
July	670	664	664	667	671	675	676	675	675	675	675	673	674	675	675	675	676	677	677	679	681	684	683	676	675
August	667	663	664	665	668	675	676	677	675	674	672	672	674	675	673	674	674	676	677	678	681	682	678	673	673
September	654	652	657	664	669	672	671	672	670	669	669	674	674	671	671	671	671	673	674	674	674	670	664	657	668
October	643	649	652	664	667	664	664	669	664	659	661	660	663	664	665	665	663	665	665	662	658	650	640	643	659
November	617	630	638	645	652	648	645	643	644	643	644	643	645	646	643	642	642	643	646	642	634	623	615	611	638
December	627	639	650	664	672	672	669	666	660	660	659	659	656	657	656	656	658	658	660	657	650	641	631	624	654
Means ..	654	657	662	668	672	674	673	674	672	672	672	671	673	672	672	672	672	673	674	673	670	666	660	655	669
Vertical Force : 0·55 . . . C.G.S.																									
January	286	286	286	287	287	288	285	288	288	288	288	288	288	288	287	287	287	287	287	289	287	287	286	286	287
February	287	286	286	287	288	288	288	288	288	288	288	288	288	288	287	287	287	287	287	287	288	288	287	287	287
March	274	274	274	274	275	276	276	276	276	276	276	276	276	276	276	275	275	275	275	275	276	276	276	275	275
April	274	273	273	273	274	275	275	275	275	275	275	275	275	275	275	275	275	274	274	275	275	275	275	274	275
May	300	300	301	301	302	302	302	302	302	302	302	302	302	302	302	301	301	301	301	301	301	301	301	300	301
June	291	291	292	293	293	293	293	294	294	293	294	293	293	293	293	292	292	293	292	293	292	292	292	291	293
July	276	276	277	277	278	278	278	278	278	278	278	278	278	278	277	277	277	277	277	277	276	276	276	276	277
August	293	294	294	295	295	295	296	296	296	296	296	296	296	295	295	295	295	295	295	295	294	294	294	294	295
September	292	292	293	293	293	294	294	294	294	295	294	294	294	294	294	293	293	293	293	293	293	293	293	293	293
October	288	287	287	288	289	290	291	291	291	290	289	287	291	290	290	290	285	290	290	287	289	290	289	289	288
November	282	281	282	284	283	283	284	284	285	284	284	284	283	283	282	282	282	283	282	283	284	284	284	282	283
December	276	276	276	276	277	280	281	282	282	282	281	281	281	281	281	280	280	280	280	280	280	280	281	279	280
Means ..	285	285	285	286	286	287	287	287	287	287	287	287	287	287	287	286	286	286	286	286	286	286	286	285	286

Table of Hourly Means for Months—1904.

Month.	0h.	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	Mean.
Declination (east of north) : 16° + . . .′																									
	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
January	21·7	24·2	25·0	24·9	24·1	23·3	22·8	22·2	21·7	21·2	20·8	20·4	20·2	20·4	20·2	20·0	20·5	20·1	19·3	18·2	16·8	16·3	17·3	19·4	20·9
February	21·5	23·9	25·3	25·4	24·4	23·2	22·3	21·5	21·5	21·1	20·5	20·4	20·4	20·2	20·2	20·3	20·4	20·3	20·1	18·7	17·2	16·1	16·5	18·9	20·8
March	21·3	23·6	24·9	25·0	24·4	22·9	22·3	22·0	21·4	20·8	20·7	20·6	20·5	20·5	20·5	20·6	20·5	20·6	20·5	19·9	18·7	17·4	16·7	18·8	21·0
April	22·2	24·4	25·6	25·7	24·8	23·8	23·0	22·3	22·2	21·5	21·0	20·9	20·6	21·0	20·9	21·5	21·8	21·7	21·6	21·2	20·9	20·0	19·6	20·3	22·0
May	20·3	22·0	23·3	23·3	22·6	21·6	20·8	20·5	19·7	19·1	19·4	19·1	19·0	18·8	18·9	19·8	20·1	20·4	20·4	20·2	19·9	19·7	19·2	19·3	20·3
June	20·5	21·8	22·7	23·2	22·8	21·7	21·1	21·0	20·9	20·7	20·0	19·6	19·4	19·9	20·1	20·4	20·7	20·8	20·7	20·8	20·8	20·5	19·9	19·8	20·8
July	20·7	22·1	23·4	23·9	23·5	22·5	21·6	21·7	21·6	21·3	20·8	20·6	20·5	20·6	20·9	21·2	21·5	21·6	21·5	21·3	21·4	21·3	20·5	20·1	21·5
August	20·9	22·8	24·3	25·1	25·1	24·2	23·2	23·0	22·7	22·6	22·2	22·2	21·4	21·4	21·7	21·8	22·2	22·0	22·1	22·1	21·6	20·7	19·6	19·4	22·2
September	21·2	23·6	25·3	26·2	25·9	25·0	23·8	23·2	22·7	22·4	21·9	21·7	21·6	21·5	21·9	22·3	22·6	22·5	22·4	22·1	21·1	19·6	18·5	19·0	22·4
October	23·5	26·0	27·7	27·8	26·8	25·6	24·3	23·4	23·1	22·8	22·5	22·1	21·9	21·8	22·0	22·0	22·3	22·6	22·0	20·6	18·8	17·8	18·2	20·5	22·7
November	24·0	26·9	29·0	29·0	28·1	26·9	25·4	24·2	23·7	23·1	22·4	22·4	22·1	22·0	21·9	22·4	22·8	22·7	22·0	20·1	18·2	17·0	17·9	20·6	23·1
December	24·4	27·2	28·9	29·6	28·9	27·6	26·0	24·8	24·0	23·9	23·4	23·1	22·9	22·8	22·9	23·0	23·1	22·5	21·6	20·0	18·3	17·4	18·4	20·9	23·6
Means ..	21·8	24·0	25·4	25·8	25·1	24·0	23·0	22·5	22·1	21·7	21·3	21·1	20·9	20·9	21·0	21·3	21·5	21·5	21·2	20·4	19·5	18·6	18·5	19·7	21·8
Horizontal Force : 0·22 . . . C.G.S.																									
January	623	634	645	655	658	663	660	658	657	655	657	656	654	654	653	654	653	655	653	650	642	630	626	619	648
February	624	632	642	650	657	657	657	654	654	654	656	655	656	657	653	652	652	652	653	652	642	633	623	618	647
March	634	638	644	651	657	659	657	657	659	658	659	657	658	658	658	657	658	657	658	657	653	646	638	635	653
April	613	615	620	627	633	634	636	638	638	637	637	639	638	637	640	639	639	642	645	644	640	633	625	616	634
May	626	626	630	632	635	639	639	640	633	635	638	637	637	637	640	639	640	642	643	644	645	642	637	624	637
June	643	639	638	642	648	653	653	653	653	652	652	650	649	650	651	651	653	653	654	655	656	658	656	651	651
July	641	636	635	640	646	651	651	651	650	650	650	650	649	649	650	650	650	650	653	656	657	659	656	650	649
August	637	631	632	638	643	648	651	650	649	650	650	651	650	650	652	651	651	653	653	654	656	656	651	643	648
September	629	628	630	635	642	645	647	648	649	648	648	649	650	649	650	649	650	652	652	654	655	651	646	636	646
October	615	622	634	645	652	650	649	647	647	645	647	644	644	646	644	645	646	648	650	647	640	630	620	614	640
November	608	618	637	649	655	657	652	650	647	644	645	644	644	643	642	642	643	643	645	644	636	623	609	603	638
December	615	627	641	654	664	662	658	653	652	651	650	648	648	648	646	645	645	647	648	646	636	623	612	606	643
Means ..	626	629	636	643	649	651	651	650	649	648	649	648	648	648	648	648	648	649	651	650	646	640	633	626	644

TABLE OF HOURLY MEANS FOR MONTHS—1904—*continued.*

Month.	0h.	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	Mean.
										Vertical Force : 0·55 . . . C.G.S.															
	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
January	271	270	269	270	271	273	274	275	275	275	274	274	273	273	273	273	273	272	272	273	273	272	272	272	273
February	296	295	296	296	297	298	300	300	300	300	300	299	299	299	298	298	298	298	298	299	299	300	299	297	298
March	293	292	294	295	295	297	296	297	297	297	297	297	296	296	296	296	295	296	296	296	297	296	297	295	296
April	289	289	289	290	291	292	292	292	292	292	292	292	291	291	290	291	290	290	290	290	291	291	291	290	291
May	304	303	304	305	305	305	306	306	306	306	306	306	306	306	305	305	305	304	305	305	305	305	305	304	305
June	308	308	308	309	309	309	309	310	310	310	310	310	310	309	309	309	309	309	309	309	309	308	308	308	309
July	313	313	313	313	314	314	314	314	315	315	315	315	315	314	314	314	314	314	314	314	313	313	313	313	314
August	316	315	316	316	316	317	317	318	318	318	318	318	318	318	317	317	317	316	316	317	316	316	317	315	317
September	325	325	325	325	325	326	326	327	327	327	327	327	326	326	326	326	325	326	326	326	326	326	325	325	326
October	313	313	312	313	314	316	316	316	316	316	316	316	316	316	315	315	315	315	315	315	316	316	316	314	315
November	322	321	321	322	322	323	324	324	324	324	324	324	323	323	322	322	322	322	323	323	324	325	324	323	323
December	322	320	319	319	321	323	324	325	325	324	324	325	324	324	324	324	324	324	324	324	324	325	324	322	323
Means ..	306	305	305	306	307	308	308	309	309	309	309	308	308	308	307	307	307	307	307	308	308	308	308	306	307

APPENDIX VII.

REPORT OF THE SURVEYORS BOARD.

THE Board for 1913 consists of Mr. James Mackenzie, Surveyor-General *ex officio;* Mr. Thomas Humphries, Lower Hutt, President of the Institute of Surveyors, Wellington, and Mr. E. H. Wilmot, Chief Surveyor, Dunedin, nominated by the Hon. the Minister of Lands; Mr. H. Sladden, Vice-President of the Institute of Surveyors, Wellington, and Mr. J. W. Harrison, Vice-President of the Institute of Surveyors, Auckland, nominated by the Council of the Institute of Surveyors. At the first meeting of the Board in 1913 Mr. James Mackenzie was elected Chairman.

The Board, acting in conjunction with the six Australian Surveyors Boards, conducted examinations of candidates for surveyors' licenses in September, 1912, and March, 1913.

At the September examination thirty-five candidates sat. Of these Mr. Frederick Norman Thompson, Public Works Department, passed the examination with credit, obtaining over 80 per cent. of the maximum marks; Mr. John Asher Parry, Auckland, and Mr. Ronald Francis Wilson Mackenzie, Lands and Survey Department, passed the whole examination; while Mr. Percy Russell Wilkinson, Lands and Survey Department; Mr. Gordon Pearson Parkinson, Christchurch; Mr. Archibald Wilson Craig, Lands and Survey Department; Mr. Harry Lawrence Fendall, Auckland; Mr. William Roderick Hayes, Auckland; Mr. Philip Corliss Gannaway, Lands and Survey Department, Auckland; Mr. Louis Pieters Swarbrick, Hamilton; Mr. John McKinlay, Dunedin; Mr. Tristram James Havelock Speedy, Auckland; Mr. George Moore Ross Jackson, Lands and Survey Department; Mr. Joseph Charles Simmonds, B.Sc., Auckland; Mr. Charles Kirkpatrick Grierson, Auckland; Mr. Frank Rupert Burnley, Lands and Survey Department; and Mr. Roy McEwan, Napier, completed the examination, having passed in some of the subjects at a former examination.

At the March examination seventeen candidates sat. Of these, Mr. Frederick William Watson and Mr. George Pirrit, Lands and Survey Department, passed the whole examination; while Mr. John Edward Anderson, Public Works Department, Mr. Henry John Gould, Dunedin, and Mr. Felix Herbert Waters, Lands and Survey Department, completed the examination, having passed in some of the subjects at a former examination.

The papers for the September examination were set by the New South Wales Board, while those for the March examination were set by the Queensland Board, and the papers for the forthcoming examination in September will be set by this Board.

The Board has been engaged on the revision of the Examination Regulations, and it is hoped to have the new regulations gazetted and issued soon.

The Board extended the time of sitting for examination from March to September, 1912, for those candidates who had commenced service before 1908. The resolutions passed at the Conference of the Director of Commonwealth Lands and Surveys, the Surveyor-General and the Government Astronomer of New Zealand, and the Surveyors-General of the States of the Commonwealth of Australia, which met at Parliament House, Melbourne, on Monday, 20th May, 1912, were discussed by the Board. The Chairman gave a résumé of the proceedings at the Conference, and said he could not help feeling that the representatives from New Zealand had been the means of contributing towards the good results accruing from the deliberations. He intimated that as a result of the Conference the Prime Minister of the Commonwealth stated that he would provide the sum of £6,000 on the 1912–13 estimates towards the cost of the geodetic survey of Australia.

The list of licensed surveyors as at 1st January, 1913, containing 473 names, was published in the *New Zealand Gazette* on the 30th January, 1913, and copies of the list are obtainable from the Board. A new feature of the list this year is that members of the Surveyors' Institute are indicated on it.

The Board records with regret the deaths of the following surveyors reported during the year: Francis Simpson, New Plymouth; Edwin James Campion, Gisborne; John Reay Mackay, Stratford.

Since September, 1902, no less than 147 candidates have entered for the examination, and of this total 132 have passed.

Mr. A. C. Turnbull, Chief Accountant, Lands and Survey Department, was appointed Auditor of the Board's accounts.

Printed lists of licensed surveyors and examination regulations and Acts were received from most of the States of the Commonwealth of Australia.

During the year two recess committee meetings and nine Board meetings were held.

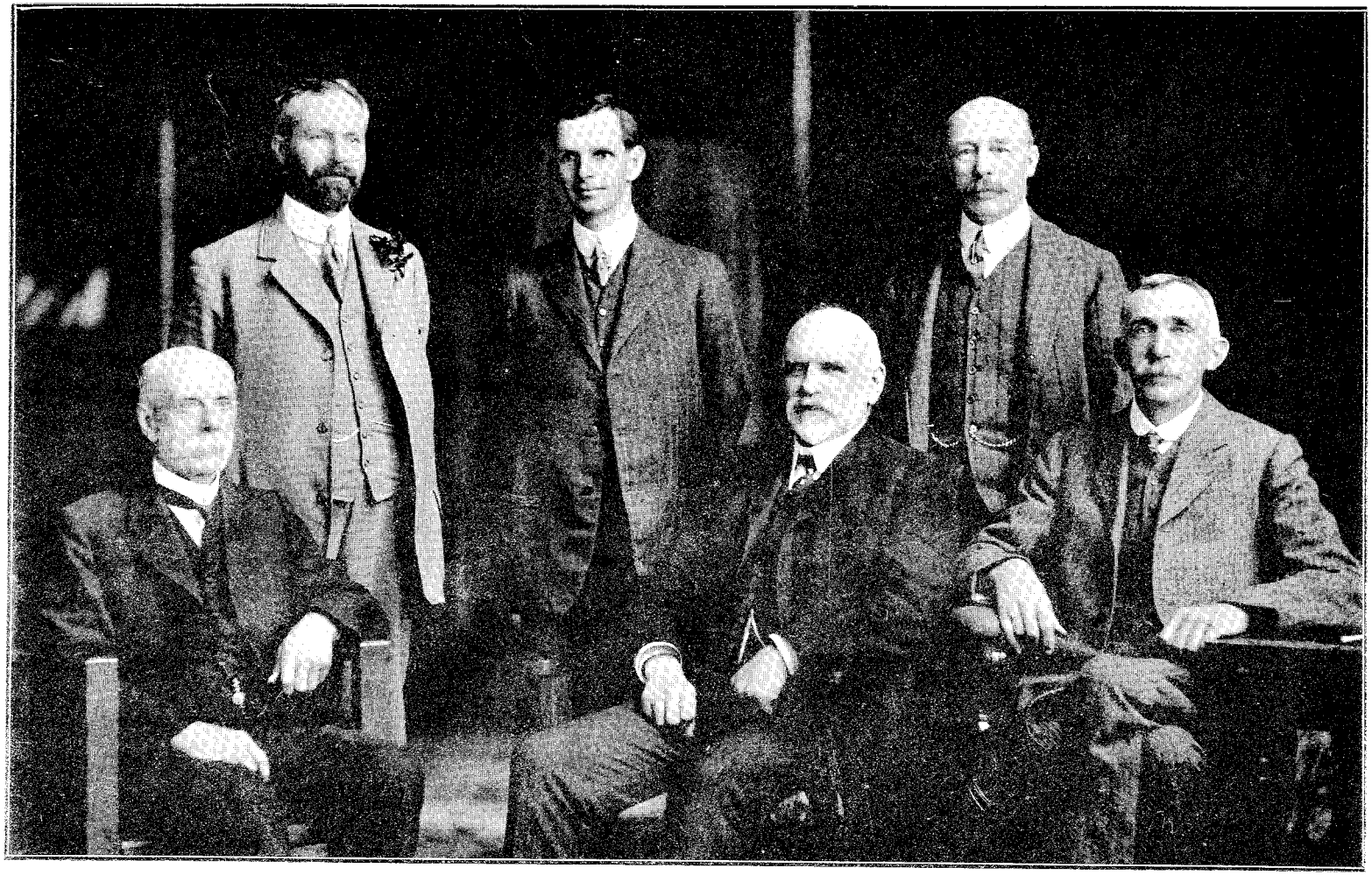
JAMES MACKENZIE, Chairman.
C. E. ADAMS, Secretary.

Wellington, 31st March, 1913.

C. E. Adams, M.Sc., F.R.A.S.,
Government Astronomer,
Secretary.

H. Sladden,
Vice-President, N.Z. Institute of
Surveyors, Wellington.

T. N. Brodrick,
Chief Surveyor, Wellington.



T. Humphries,
President, N.Z. Institute of Surveyors,
Wellington.

James Mackenzie,
Surveyor-General, Chairman

J. W. Harrison,
Vice-President, N.Z. Institute of Surveyors,
Auckland.

The Surveyors' Board of Examiners, 1912–13.

Note.—On the present Board Mr. E. H. Wilmot, Chief Surveyor, Dunedin, takes the place of Mr. T. N. Brodrick, Wellington.

E. M. Smith,
Surveyor-General, South Australia.

James Mackenzie,
Surveyor-General, New Zealand.

C. Seddon,
Clerk.

H. E. Finney,
Secretary.

C. E. Adams,
Government Astronomer,
New Zealand.

Charles Robert Scrivener,
Director of Commonwealth
Lands and Survey.

Allan A. Spowers,
Surveyor-General,
Queensland.

Frederick Poate,
Surveyor-General,
New South Wales.

E. A. Counsel,
Surveyor-General and
Secretary for Lands,
Tasmania.

J. M. Reed, Chairman
Surveyor-General,
Victoria.

The Conference of Surveyors-General in Session at Parliament House, Melbourne, 25th May, 1912.

APPENDIX VIII.

EXTRACTS FROM THE REPORT OF THE CONFERENCE OF THE DIRECTOR OF COMMONWEALTH LANDS AND SURVEYS, THE SURVEYOR-GENERAL AND THE GOVERNMENT ASTRONOMER OF NEW ZEALAND, AND THE SURVEYORS-GENERAL OF THE STATES OF THE COMMONWEALTH OF AUSTRALIA.

THE Conference met at Parliament House, Melbourne, at 11·30 a.m., on Monday, 20th May, 1912, and the following representatives were present:—

Commonwealth of Australia	..	Charles Robert Scrivener, Esquire, Director of Commonwealth Lands and Surveys.
Dominion of New Zealand	..	James Mackenzie, Esquire, Surveyor-General.
		Charles Edward Adams, Esquire, M.Sc., F.R.A.S., Government Astronomer.
State of New South Wales	..	Frederick Poate, Esquire, Surveyor-General.
,, Victoria ..	..	Joseph Martin Reed, Esquire, I.S.O., Surveyor-General.
,, Queensland ..	..	Allan Alfred Spowers, Esquire, Surveyor-General.
,, South Australia	..	Edwin Mitchell Smith, Esquire, Surveyor-General.
,, Tasmania ..	..	Edward Albert Counsel, Esquire, Surveyor-General and Secretary for Lands.

The Surveyor-General of Victoria having been elected Chairman, the Conference was formally opened by the Honourable King O'Malley, Minister of State for Home Affairs, who said, "I cannot tell you how pleased I am to welcome you on behalf of the Commonwealth Government—you who have so much to do with the ultimate progress and prosperity of Australia, and who have met here for the purpose of discussing matters of great importance to the Commonwealth, and of peculiar interest to the Lands and Survey Branch of my Department. I give a special welcome to the representatives of the Dominion of New Zealand, Mr. Mackenzie, the Surveyor-General, and Mr. Adams, the Astronomer, who have come so far to take part in this Conference. I am very pleased indeed to have a Conference between the Surveyors-General of the States and of the Dominion of New Zealand, and the Director of Commonwealth Lands and Surveys, with the object of advising me as to the best method to be adopted to secure the fullest measure of reciprocity and those harmonious relations between the States, the Dominion, and the Commonwealth upon matters of common interest which we all desire. I have much pleasure in declaring this Conference open."

The Chairman acknowledged the kindly welcome extended by the Minister, and expressed the hope that the deliberations of the Conference would prove in every way satisfactory.

REPORT.

To the Hon. the Minister of State for Home Affairs.

SIR,— Melbourne, 25th May, 1912.

In response to your invitation, the Surveyors-General of all the States except Western Australia, the Surveyor-General and the Government Astronomer of New Zealand met in conference with the Director of Commonwealth Lands and Surveys at the Federal Parliament House on Monday, the 20th May, 1912.

After the election of the Surveyor-General of Victoria as Chairman, the members of the Conference having been cordially welcomed by the Minister for Home Affairs, entered upon their duties.

Each subject submitted has received our earnest consideration, and we hope and believe that the resolutions, all unanimously adopted (a copy of which accompanies this report), will, if carried into effect, prove of distinct benefit both to the Commonwealth as a whole and to the States individually.

Regarding the geodetic survey, though this will entail expenditure by the Commonwealth, experience extending over the last twenty years shows that the cost of the primary work is about one-fifteenth of a penny per acre, and we are convinced that any outlay involved in the carrying-out of this survey is amply justified.

The proposed contribution by the Commonwealth towards the preparation of an international map of the world is a recognition of Australia's obligation to take part in a matter of world-wide interest.

The cordial relations that have existed between the members of this Conference, and the results attained, are evidence of the advantages that accrue from the association of representatives of the Commonwealth, the Dominion, and the States; and the interchange of views between those whose experience covers so wide a range must be advantageous, and in the interests of all concerned.

We respectfully recommend for your favourable consideration these resolutions, with the assurance that they have been exhaustively discussed, and that, in framing them, this Conference desires only to assist in the advancement of the interests of Australia.

We have, &c.,

J. M. REED,
JAMES MACKENZIE,
FRED. POATE,
ALLAN A. SPOWERS,
E. A. COUNSEL,
E. M. SMITH,
C. E. ADAMS,
CHARLES ROBT. SCRIVENER.

RESOLUTIONS.

Subjects of Agenda Paper.	Resolutions agreed upon.
1. Geodetic survey of Australia.	1. That a geodetic survey of Australia should be undertaken. 2. That, in order to give effect to the foregoing resolution, this Conference respectfully recommends that such survey be undertaken by the Commonwealth Government, and submits in support thereof the following reasons:— (*a.*) That the time has arrived when the Commonwealth should take its place in the scientific investigations of the world, not the least important of which are the determination of the figure of the earth, its density, and other cognate matters. (*b.*) That work of this character, involving the highest form of survey, should be effected under the supreme authority of Australia, as it is essential that it should be carried out with the greatest degree of accuracy on a uniform basis and a definite plan, the individual parts being co-ordinated and eventually forming one homogeneous whole. (*c.*) That the system which has hitherto prevailed by which the individual States carried out this work with instruments of varying character has resulted in divergent standards of accuracy, rendering the work, to a great extent, unsatisfactory, and, though much of it is of high grade, portions of it are impossible of reconciliation and co-ordination with a continental scheme. (*d.*) That the disirablene s of this work being undertaken by the Commonwealth Government is evidenced by the fact that the geodetic survey of the United States is carried out under the direct control of the Federal Government, and that the South African geodetic survey is also under one central control. (*e.*) That such survey is absolutely necessary for the production of accurate maps, will be of high value in connection with cadastral and geological surveys, and form a basis for topographical work for defence and other purposes. It will, moreover, provide a standard of accuracy for surveys of every description throughout the Commonwealth. (*f.*) That it will afford an invaluable base to which settlement surveys already effected can be connected, providing data for re-establishing boundaries, which, with increasing density of settlement, becomes a matter of great importance. Further, as regards the sparsely occupied areas of Australia, such a survey, if carried out in advance of settlement, will be of the greatest utility and assistance in effecting the settlement surveys which can, at any future time, be reproduced with a minimum error, and at a relatively low cost, preventing litigation, consequent upon other methods. 3. That the geodetic survey referred to in the resolutions submitted by the Committee shall embrace the geodetic and major triangulation only. 4. That, in view of the precision with which the base lines of New Zealand have been measured, it is desirable that the New Zealand survey should be brought into line with the geodetic surveys of the world by the use of instruments capable of carrying out the angular work with an equal degree of accuracy, and so that the present trigonometrical survey may be strengthened by a series of main triangles.
2. Revision of the map of Australia, now in course of preparation, with regard principally to the nomenclature.	1. (*a.*) That the proofs of the Commonwealth map of Australia be referred to the respective Surveyors-General for revision, inviting them to confer with the local Geographical Society and marine authorities. Map when revised to be adopted for present use. (*b.*) That, later, the map be referred to the Admiralty and the Royal Geographical Society of England for suggestions. (*c.*) That final review of the map be made by the Committee of the Surveyors-General of the States and the Director of Commonwealth Lands and Surveys.

RESOLUTIONS—*continued.*

Subjects of Agenda Paper.	Resolutions agreed upon.
3. Discussion on the participation of Australia and New Zealand in the production of a map of the world on a scale of 1 in 1,000,000.	1. That the preparation of the portion of the map of the world, embracing the Commonwealth of Australia and the Dominion of New Zealand on a scale of 1 in 1,000,000, is a work that should be undertaken by the Commonwealth and the Dominion of New Zealand. As New Zealand is in a position to do its own portion, this Conference recommends that the work, as regards Australia, should be carried out under the direction of the Commonwealth Government, the respective States being asked to provide all available information.
4. Issue of licenses by the Commonwealth Government and reciprocity between the several States, the Dominion of New Zealand, and the Commonwealth.	1. That this Conference is of opinion that, as soon as the Commonwealth Government gives necessary authority for the creation of a Board of Examiners for Surveyors operating in Commonwealth territory, such Board should be admitted to the reciprocal arrangement now existing between the various States and the Dominion of New Zealand, and recommends that this resolution be referred for the consideration of the reciprocating Boards.
5. Commonwealth Lands Titles Office.	1. That the Surveyors-General would, as far as possible, furnish the Director of Commonwealth Lands and Surveys with information regarding "lands titles" methods in their respective States, and no further action was considered necessary.
6. On the desirableness of uniformity in the declarations made by surveyors on plans of survey under the various Lands Acts and Torrens Act.	1. This Conference recommends (as regards surveys under the Real Property Acts) for the favourable consideration of the Surveyors Boards of the States the form of certificate under the Real Property Acts as expressed in the Authorized Surveyors Declaration for Land Transfer Surveys in New Zealand, viz. :— "I. of , licensed surveyor, do solemnly and sincerely declare that this plan has been made from surveys executed by me (or under my own personal supervision, inspection, and field check), and that both plan and survey are correct, and have been made in accordance with the regulations of the Surveyors Board, dated . "And I make this solemn declaration conscientiously believing the same to be true, and by virtue of the provisions of . "Declared at , &c." No resolution was adopted regarding the form of certificate under the various Lands Acts.
7. The carrying-out of surveys by the several States for the Commonwealth Government.	1. That the procedure to be adopted in connection with such surveys as may be effected by the States for the Commonwealth should be as follows :— (*a.*) That, in order to avoid delay, the Director of Commonwealth Lands and Surveys and the Surveyors-General of the States be authorized to communicate directly with one another in connection with such surveys. (*b.*) That full particulars as to the required surveys should be supplied to the Surveyor-General of the State in which the survey is desired, with a request that the survey should be made. (*c.*) That the Surveyor-General should supply necessary detailed information for the use of the surveyor, and issue requisite instructions. (*d.*) That the surveyor should carry out the survey in accordance with State regulations and supply certified plan and field notes in duplicate. (*e.*) That the State officials should examine the plan, and the Surveyor-General (or other authorized officer) certify in the usual manner, both as to plans and accounts, and then transmit one plan with one copy of field notes to the Director, retaining the other plan and copy of field notes for State record purposes. (*f.*) That the Commonwealth should pay all costs, both field and office.
8. The spelling of names of Australian places.	1. That, in the opinion of this Conference, it is desirable that, as far as practicable, the system of orthography adopted by the Royal Geographical Society, the Colonial and Foreign Service, the Admiralty, and War Office for native names should be adopted, as well as a uniform method of spelling Australian place-names.

DISCUSSION.

Geodetic Survey of Australia.

Mr. Mackenzie.—In New Zealand it was looked upon as a necessity to have a trigonometrical survey. Mr. J. T. Thomson started the work in the early fifties, and when he became Surveyor-General of New Zealand, in 1876, it was vigorously pushed forward well in advance of settlement. I regard it as impossible to carry out survey work satisfactorily without a trigonometrical survey, and our successive Dominion Governments have always approved of it without question as being the first essential in all settlement operations. It has never been claimed for the New Zealand triangulation that it possesses the high scientific status of the geodetic surveys of other countries, but it has always been practical, and was also sufficiently accurate to govern all classes of detail surveys. The outstanding difference between our Dominion work and that of the Australian States, excepting perhaps South Australia, is that we bring it into everyday use, our reconnaissance and trigonometrical surveys being the real forerunners of settlement, whilst in Australia, though the surveys are often highly scientific, there has been much less practical application, neither have these surveys been a factor in the settlement problem. I cannot help thinking that had New Zealand's way of keeping the practical uses of triangulation more to the front been adopted, Australian legislators would have looked upon the work more kindly, and any resolutions we pass should voice this side of the question.

Mr. Spowers.—At the present time there is no trigonometrical vote in Queensland, and only a very small area is covered by the major triangulation, which was carried out about 1890. In addition to other reasons, we are greatly in need of this survey to assist us in the correct compilation of our maps: much time is now lost and expense incurred in endeavouring to make accurate maps from information that is faulty or altogether wanting. We are in the unenviable position of being about the only civilized nation that has not an accurate trigonometrical survey. The work is rightly one for the Commonwealth Government to undertake.

Mr. Mackenzie.—There is no doubt as to the necessity for it.

The Chairman.—Victoria is covered to a great extent by triangulation carried out under the direction of Mr. Ellery, but unfortunately settlement preceded that survey and little use has been made of it. Geodetic lines have also been run to afford a check on settlement surveys.

Mr. Smith.—In South Australia the trigonometrical survey was commenced in 1839, and was continued until 1892. It, to a great extent, preceded settlement, and has been found extremely useful in determining the positions of run-boundaries, and as a check upon settlement surveys.

Mr. Counsel.—Triangulation was in Tasmania commenced in 1833, and continued for some years. The major triangulation extended over the greater part of the State. Doubts were expressed as to the accuracy of the survey, which was never connected with the cadastral or block surveys, and it has never been made use of except in the compilation of maps, though some expense has been incurred in establishing new and re-establishing old stations. Much accuracy is claimed for the work.

Mr. Poate.—In New South Wales a geodetic survey has been carried out more or less intermittently since 1867. Last year a 10 in. Repsold theodolite was purchased, and an observer has recently been appointed to continue the survey. Settlement preceded the triangulation, and, as the latter advanced, the ordinary surveys for alienation purposes were connected to it, one result of which was that accurate maps could be produced. I have had a short history of the geodetic survey of New South Wales compiled, which may interest members.

The Chairman.—Victoria carried out an extensive and accurate triangulation, but the demand for land for settlement was so great that all the surveyors available were required to meet the demand, and settlement surveys were pushed on without being connected with the triangulation. The trigonometrical survey has been of immense value in the compilation of maps and in correcting errors. With regard to the question of a geodetic survey of Australia, there cannot, I think, be two opinions as to the desirableness of it from the scientific standpoint; and, further, it will permit of an accurate determination of the coast-line, and so aid navigation.

Mr. Spowers.—It would be useful in connection with defence.

The Chairman.—Yes.

Mr. Spowers.—In all the States topographical information is insufficient.

The Chairman.—We need, I think, a trigonometrical survey of the whole Continent; it would be of great value in the future.

Mr. Scrivener.—The information afforded by such a survey would be available to all the States and would be utilized in their minor work.

The Chairman.—The Commonwealth would carry out the major triangulation principally.

Mr. Spowers.—If the Commonwealth conducts the primary, would it not be better also to do the breaking-down?

Mr. Scrivener.—It would be cheaper not to reoccupy stations, but observe both primary and secondary stations at the same time.

Mr. Spowers.—That is, if the stations were ready for observation.

Mr. Poate.—Would the States do the breaking-down?

Mr. Spowers.—Some would and some would not.

Mr. Poate.—Would it be done with sufficient accuracy by the States?

Mr. Smith.—It is absolutely necessary that the Commonwealth Government should undertake a trigonometrical survey of the Northern Territory, if only to control surveys for settlement purposes.

Mr. Counsel suggested that it would be well, perhaps, that the Commonwealth should only carry out the major triangulation within the States, though he would like to see the whole of the work undertaken by the central authority.

Mr. POATE.—The geodetic survey of Australia would be undertaken by one body, and that body should undoubtedly be the Federal Government, in order that one standard of accuracy should be applied to the whole of the work, and that it should be similar in character to the great geodetic surveys of the world. It should be conducted on similar lines to those adopted in the United States coast survey, and, taking the coast-line first, should be gradually extended inland.

Mr. MACKENZIE urged that after the major triangulation was done, if only in sections, the minor must follow for settlement purposes.

Mr. COUNSEL then moved, and Mr. POATE seconded, the following motion, which was unanimously agreed to: "That, in the opinion of this Conference, it is desirable that a geodetic survey of Australia should be undertaken." It was then determined, "That a committee, comprising Messrs. Poate, Spowers, Mackenzie, and Scrivener, should draft resolutions based upon and giving effect to resolution No. 1."

The Conference proceeded with the discussion on the draft resolutions drawn up by the committee (in support of the motion that a geodetic survey should be undertaken).

The following resolutions were fully discussed, revised, and, on the motion of Mr. POATE, seconded by Mr. SPOWERS, unanimously adopted:—

"That, in order to give effect to the foregoing resolution, this Conference respectfully recommends that such survey be undertaken by the Commonwealth Government, and submits in support thereof the following reasons:—

"(*a.*) That the time has arrived when the Commonwealth should take its place in the scientific investigations of the world, not the least important of which are the determination of the figure of the earth, its density, and other cognate matters.

"(*b.*) That work of this character, involving the highest form of survey, should be effected under the supreme authority of Australia, as it is essential that it should be carried out with the greatest degree of accuracy on a uniform basis and a definite plan, the individual parts being co-ordinated and eventually forming one homogeneous whole.

"(*c.*) That the system which has hitherto prevailed by which the individual States carried out this work with instruments of varying character has resulted in divergent standards of accuracy, rendering the work, to a great extent, unsatisfactory, and, though much of it is of high grade, portions of it are impossible of reconciliation and co-ordination with a continental scheme.

"(*d.*) That the desirableness of this work being undertaken by the Commonwealth Government is evidenced by the fact that the geodetic survey of the United States is carried out under the direct control of the Federal Government, and that the South African geodetic survey is also under one central control.

"(*e.*) That such survey is absolutely necessary for the production of accurate maps, will be of high value in connection with cadastral and geological surveys, and form a basis for topographical work for defence and other purposes. It will, moreover, provide a standard of accuracy for surveys of every description throughout the Commonwealth.

"(*f.*) That it will afford an invaluable base to which settlement surveys already effected can be connected, providing data for re-establishing boundaries, which, with increasing density of settlement, becomes a matter of great importance. Further, as regards the sparsely occupied areas of Australia, such a survey, if carried out in advance of settlement, will be of the greatest utility and assistance in effecting the settlement surveys, which can at any future time be reproduced with a minimum error and at a relatively low cost, preventing litigation consequent upon other methods."

It was moved by Mr. COUNSEL, seconded by Mr. MACKENZIE, and carried unanimously, "That the geodetic survey referred to in the resolutions submitted by the committee shall embrace the geodetic and major triangulation only."

Later, a discussion took place regarding the quality of the angular measurements in the trigonometrical surveys of the States of Australasia and the Dominion of New Zealand, when it appeared that in some of the States and in New Zealand the instruments used were not of the character necessary to attain the precise results demanded in geodetic work, though the triangulation effected in every case is unquestionably of great value in preventing the accumulation of large errors in surveys for alienation purposes and in the production of accurate maps.

TRIANGULATION IN NEW ZEALAND.

[By JAMES MACKENZIE, Esq., Surveyor-General of the Dominion of New Zealand.]

IN order to realize the position of triangulation in New Zealand it is necessary to explain that the Dominion was originally subdivided into six provincial districts (afterwards increased to ten), and each carried out its surveys in its own way, under the control of its own Government. These provinces were abolished in 1876, but provincial land districts still remain, the land and survey matters therein being controlled by a combined Commissioner of Crown Lands and Chief Surveyor. There was no attempt at triangulation in the original provinces, except in Otago, Canterbury, Wellington, and Taranaki, and the Native surveys of the North Island.

The great pioneer of accurate survey methods in New Zealand under the Provincial Government was the late Mr. J. T. Thomson, F.R.G.S., then Chief Surveyor of the Province of Otago, who became in 1876 first Surveyor-General of New Zealand, after the establishment of Responsible Government. It was in 1856 that he established a rapid system of reconnaissance survey and a minor triangulation. In this he was ably assisted first by Mr. Alexander Garvey, and later by Mr. James McKerrow, F.R.A.S., who afterwards succeeded Mr. Thomson in the Surveyor-Generalship of the Dominion. Briefly, the process was to observe latitudes at stations about 60 miles apart on the same meridian, and to use the base so obtained for fixing the positions of all prominent mountains and other important features. Regarding Mr. McKerrow's surveys, the country did not lend itself to Mr. Thomson's system of astronomical bases. Mr. McKerrow selected three mountain-peaks, 60 or 70 miles apart, at which the latitude was determined, as also very carefully the times at each place, and by means of chronometers conveyed from point to point the longitude of these base points was ascertained; and, following on this, by ordinary triangulation methods, the topography of the country was filled in.

It may be mentioned that on subsequent close trig. and topographical surveys taking place, the remarkable accuracy of these early reconnaissance surveys, costing as they did only a few shillings per square mile, has been fully demonstrated. The process was extremely rapid, as no stations were built, and was suited to the mountainous nature of the country, while a very fair degree of accuracy was attained. By these means a sufficiently accurate survey of Otago was effected, and used for the first disposal of the early pastoral runs, besides being utilized for many purposes of early settlement, leaving closer detail surveys to follow, as well as the marking-out of electoral, road, registration, and other districts. Information was also afforded of the heights of mountains, passes, lakes, and of distances between geodesical stations.

Minor triangulation followed on this, and was used to check and control all section surveys. The limit of error in traverses then adopted (following Indian practice) was 8 links to the mile, and, as it was desirable that the error on the ground should never exceed 10 links in these early surveys, the minor trig. stations were established at an average distance of $2\frac{1}{2}$ miles apart. Although the permissible error was 8 links to the mile, most of the work when checked showed errors ranging from half a link to 6 links per mile. The maximum error allowed by regulation has since been reduced to 4 links in rural surveys, and 1 link in town surveys; but in actual practice the error rarely exceeds 2 links per mile in rural surveys.

The Province of Otago was divided into meridional circuits of about 120 miles in longitude and 90 miles in latitude; in each circuit the true meridian was observed at the initial station, and a system of standard bearings was extended wherever required, stations being established at intervals of about 12 miles. Each meridional circuit was divided into survey districts, 12 miles square, with sides parallel perpendicular to the initial meridian. Thus each survey district had a geodesical station within it, and a number of carefuly observed standard bearings, so that in the event of settlement surveys being carried out a minor triangulation could at once be put in hand, using the geodesical stations as the initial, and the standard bearings for the true, meridian.

Each survey district was thus complete in itself, and either had its own base-line or extended the triangulation from an adjacent district. In this way very great flexibility was obtained, and no more triangulation need be carried out than that required for the settlement surveys in hand or anticipated. Triangulation with an accuracy in advance of the original Otago methods was carried out gradually throughout the Dominion after the abolition of the provinces in 1876, when Mr. Thomson took complete control as Surveyor-General of the Dominion, Mr. McKerrow being Assistant Surveyor-General. Long before this date, however, Captain T. Heale, Inspector of Native Surveys under the General Government, and Mr. H. Jackson, F.R.G.S., Chief Surveyor of the Wellington Province, had started in the Provinces of Auckland and Wellington a secondary system of triangulation, Captain Heale's work extending over a large area in the North Island, principally in connection with Native-lands surveys, whilst Mr. Thomas Humphries, Chief Surveyor of the Taranaki Province in the North Island, also made a beginning with a triangulation on sound lines, this triangulation governing his detail surveys. The main object of the triangulation has been practical utility rather than a strictly scientific work, and thus nearly every survey in Otago since 1856 may be said to be founded upon or connected with traingulation, and since 1876 the same statement applies to the whole Dominion.

The minor triangulation has always been the forerunner of settlement work, and has formed part and parcel of it, and has generally been accompanied by topography on a scale of 40 chains to 1 in.

These early trig. surveys met all settlement wants, and the topographical plans have given the fullest details regarding the character of the country, altitudes, soils, road routes, and all matters relating to the opening-up of land for settlement.

Since 1876 in many of the more settled districts the triangulation has been revised from time to time, and as the topography becomes better known it has been possible to increase the lengths of the sides of the triangles.

The Dominion may now be said to be entering upon a more scientific triangulation, and in the North Island four bases have been measured. In measuring the bases the greatest accuracy was aimed at, and they will be available for use when the time comes to run a series of primary triangles over the whole Dominion.

Up to the present four bases have been measured by Mr. John Langmuir, one of the senior Inspecting Surveyors. The standards of length used were the ten 1-chain steel bands certified to by the Standards Department, Board of Trade, London, in 1903. Invar bands in 5-chain lengths, supported at 50-link intervals, were used, and the details are fully given in the Survey Reports for 1909–10 and the following years.

The approximate lengths of the bases are as follows:—

"Wairarapa" base—length, 64776·6668 links.
Probable error ±0·0219, 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, 79605·1228 links.
Probable error ± 0·0128, or 1 in 5,142,000; date measured, 5th April to 24th June, 1910 = 46 days = 4·6 days per mile.

"Waitemata" base—length, 41790·7756 links.
Probable error ± 0·0077, or 1 in 5,424,000; date measured, 27th June to 29th August, 1911 = 21 days = 4·0 days per mile.

"Matamata" base—length, 54799·7068 links.
Probable error ±0·01005, or 1 in 5,452,000; date measured, 2nd December, 1910, to 29th January, 1911 = 22 days = 3·2 days per mile.

In 1901 a secondary triangulation was commenced in the Wellington and Taranaki Districts, with a view of bringing into harmony all the different nets of minor triangles which had spread inland from the coastal chain from time to time in advance of the settlement work. A scheme of triangles with sides varying from 6 to 24 miles was drawn out to cover the whole of the minor work, using wherever possible the old minor trigs for the secondary points. The whole of the scheming-out of the triangles, erection of signals, and observation-work was done by one field party, which included the surveyor in charge and four men. The instrument used was a 10 in. Everest, graduated to 10 seconds and read by verniers, the best in the Department at that time.*

Owing to the urgency of settlement work in other parts, the revision of the triangulation was dropped in 1902, and not taken up again until 1909. The same instrument was again used, and the work proceeded at intervals during the next three years. The connection between the two bases is now almost complete.

The computations are being carried out by the Chief Computer, using the latest methods, and of the twenty-eight triangles calculated the value of "m"†, using General Ferrero's formula, comes out at 1·55"; the average error per triangle is 2·25"; the area covered is 2,630 square miles, and there is, on the average, one trig. station in 119 square miles.

Considering the unsuitability of the New Zealand atmosphere for observation-work, and the class of instrument used, the results are considered satisfactory, and the work should fully serve the purpose intended.

The smoke, from bush-fires during the summer, and the haze caused by the sun on the moisture-laden country during the winter, prevented the signals showing out distinctly even on comparatively short lines. Numbers of trigs. were situated on the high backbone ranges, which were very rarely clear from mist. In many cases over a month elapsed before the observations at a station were completed.

When the primary work is undertaken, the observations will have to be taken at night in order to get over the vagaries of the atmosphere. Signals 25 miles distant can very rarely be seen during the day in New Zealand.

The maps accompanying this report show that practically the whole Dominion is covered by a minor triangulation, while the secondary triangulation in progress in the Wellington and Taranaki Districts is also shown.

I would like to point out that observations were made at a large number of stations for latitude and azimuth in 1883, 1884, 1885, by Mr. C. W. Adams, then Geodesical Surveyor, using a zenith telescope; also, prior to this, observations were made by Mr. J. W. A. Marchant. These stations, as well as a number of the others, where observations for latitude and azimuth were carried out in the earlier years by other officers of the Department, are shown on the map. Longitude has been determined on a number of occasions, at first by absolute methods or by the transportation of chronometers, later by telegraphic signals. The more recent determination for longitude by telegraphic signals are those between Wellington and Sydney, by Mr. C. W. Adams and the late Mr. H. C. Russell, Government Astronomer of New South Wales, in 1883; and between Wellington (*via* Doubtless Bay) and Norfolk Island, by Dr. O. Koltz, in 1903, thence from Norfolk Island to Australia and Canada by the Pacific cable.

---

* New 8 in. micrometer transit theodolites have now been obtained for future triangulation.

† $m = \sqrt{\frac{\Sigma\Delta^2}{3N}}$ where Δ = error of triangle. N = number of triangles.

In conclusion, I should like to place on record here, without making invidious distinctions, that the names in the past standing out prominently in connection with the advancement and control of the Dominion's geodesical minor triangulations, and accurate system of surveys generally, from their initiation up to the present day are—John Turnbull Thomson, F.R.G.S., Alexander Garvey, James McKerrow, F.R.A.S., Captain Theophilus Heale, Henry Jackson, F.R.G.S., Stephenson Percy Smith, F.R.G.S., John William Allman Marchant, Thomas Humphries, Charles William Adams, John Strauchon, Gerhard Mueller, John Holland Baker, John Samuel Browning, John Hay, Eric Charles Gold Smith, George John Roberts, William Arthur, and many others; whilst among the many who have been employed from first to last the following might be mentioned as probably the principal observers: Messrs. Alexander Dundas, James Mitchell, John Aitken Connell, Anthony Dixon Wilson, Henry James Lowe, Morgan Carkeek, John Annabell, James Arthur Thorpe, Thomas Noel Brodrick, Harry May Skeet, Llewellyn Smith, Horace Baker, Lawrence Cussen, John Langmuir, Thomas Maben, James Daniel Climie, James Baber, jun., Hubert Earle Girdlestone. Many of these are not now with us, and not a few have joined the "great majority," but it is only fitting that in the brief outline of New Zealand surveys the men who had so much to do with the building of the structure should not be forgotten.

Table 1.—Summary of Field-work executed by the Staff and Contract Surveyors from 1st April, 1912, to 31st March, 1913.

District.	Minor Triangulations.		Topographical Survey for Selection as "Unsurveyed Land."		Rural.		Village and Suburban.			Town Section Survey.			Native-land Survey.			Gold-mining Survey.			Roads, Railways, and Water-races.		Other Work.	Total Cost of Surveyor and Party from 1st April, 1912, to 31st March, 1913.
	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	No. of Sections.	Cost per Acre.	Acres.	No. of Sections.	Cost of Sections.	Acres.	No. of Secs. or Divs.	Cost per Acre.	Acres.	No. of Sections.	Cost per Acre.	Miles.	Cost per Mile.	Cost.	
		d.		d.		s.			s.			s.			d.			s.		£	£ s. d.	£ s. d.
Auckland ..	40,750	0·80	11,369	5·16	127,155·00	1·50	2,353·50	115	3·35	215·30	330	33·83	*436,884·00 †5,194 00	1703 15	16·99 34·58	..	..	..	108·52	21·33	2,602 0 6	52,813 11 1
Hawke's Bay	56,823	1·23	..	..	19,415·16	1·73	39·13	95	77·98	2·31	8	103·52	*31,260·56 †12,532·00	248 26	24·22 19·22	..	..	..	17·90	18·81	838 12 7	7,147 16 0
Taranaki ..	46,400	1·63	..	..	41,936·00	3·59	76·75	14	34·55	42·75	82	36·34	*51,311·00	96	15·05	..	..	..	8·68	39·42	143 9 0	9,464 17 1
Wellington	..	..	..	..	16,814·50	3·51	..	..	..	8·50	4	77·50	*122,038·00	555	16·72	..	..	..	5·50	38·45	1,121 15 6	15,072 13 9
Nelson ..	10,385	2·05	2,708	1·35	60,365·00	2·68	..	..	..	36·20	137	24·54	*7,578 00	18	19·51	..	..	..	28·15	18·35	903 6 4	14,508 17 1
Marlborough	..	..	..	..	8,825·00	2·21	33·00	2	10·30	1·00	3	63·00	*3,592·00	24	20·12	..	..	..	29·75	38·74	177 3 0	1,348 11 6
Westland ..	1,500	15·40	2,400	4·80	9,622·00	3·56	125·00	16	17·92	6·00	23	30·00	..	..	..	..	..	..	1·00	11·00	557 10 11	2,576 14 11
Canterbury	..	..	34,180	1·00	77,339 00	0·75	..	..	..	..	..	..	*14·50	3	206·90	..	..	..	5·75	20·65	400 5 6	3,593 15 2
Otago ..	..	..	..	..	11,948·00	1·92	..	..	..	..	..	..	..	..	..	206	4	4·04	0·62	54·16	231 1 2	3,022 3 5
Southland ..	..	..	..	..	28,197 00	3·49	51·29	28	32·67	19·34	52	27·18	*11·70	45	759·00	..	..	..	17·47	21·42	1,000 19 7	4,112 6 0
Means and totals	‡155,858	1·43	50,657	2·13	401,616·66	2·85	2,678·67	270	6·66	331·40	639	32·77	670,415·76	2733	17·37	206	4	4·04	223·34	24·23	7,976 4 1	113,661 6 0
Licensed surveyors (paid by applicants)					8,299·00	..	..	..	..	1·00	3	..	927·00	22	..	1,706	37	..	7·00	..	..	..
Totals					409,915·66	..	..	..	..	332·40	642	..	671,342·76	2755	..	1,912	41	..	230·34	..	..	..

* Native Land Court. † Maori Land Board. ‡ 6,22½ acres of this is secondary triangulation.

Table 1a.—Return of Field-work executed by the Staff and Contract Surveyors from 1st April, 1912, to 31st March, 1913.

Auckland Land District.

Surveyor and District.	Minor Triangulations and Connecting Triangles.		Topographical Survey for Selection as Unsurveyed Land.		Rural.		Village and Suburban.			Town Section Survey.			Native Land Survey.			Gold-mining Survey.			Roads, Railways, and Water-races.		Other Work.	Total Cost of Surveyor and Party from 1st April, 1912, to 31st March, 1913.
	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	No. of Sections.	Cost per Acre.	Acres.	No. of Sections.	Cost of Sections.	Acres.	No. of Sections or Divisions.	Cost per Acre.	Acres.	No. of Sections.	Cost per Acre.	Miles.	Cost per Mile.	Cost.	
Staff Surveyors.		d.		d.		s.			s.			s.			d.					£	£ s. d.	£ s. d.
W. J. Wheeler, Auckland(*a*)	..	..	..	..	..	..	..	..	..	120·00	101	39·38	..	..	..	..	..	..	..	..	685 7 5	972 14 0
H. F. Edgecumbe, Pakaumanu(*b*)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·50	15·12	24 16 3	1,070 4 9
A. Wilson, Wharepapa, &c.(*c*)	..	..	..	..	24,987	1·32	..	..	..	..	..	..	*118	10	66·61	..	..	..	..	..	4 2 0	2,120 3 11
A. A. Seaton, Hokianga, &c.(*d*)	..	..	..	..	..	..	..	..	..	..	..	..	*266	2	40·80	..	..	..	1·25	42·82	229 0 11	1,099 16 7
V. I. Blake, Rotoma, &c.(*e*)	15,000	0·83	..	..	14,276	1·27	148·0	11	17·69	40·00	156	29·81	..	..	..	..	..	..	..	..	3 13 0	1,106 17 0
A. H. Vickerman, Waitemata, &c.(*f*)	20,000	0·34	..	..	3,485	1·39	2,108·0	82	2·13	..	..	..	*250	2	48·00	..	..	..	28·75	17·02	336 15 6	1,018 4 5
T. W. Hughes, Rotorua, &c.(*g*)	..	..	..	..	50	2·96	..	..	..	..	..	..	*17,212 †157	19 1	8·10 24·23	..	..	..	20·60	8·00	38 17 6	891 2 6
T. Carroll, Tuhua, &c.(*h*)	..	..	..	..	568	2·00	..	..	..	..	..	..	..	..	..	..	..	..	1·40	32·14	137 6 10	1,111 7 8
A. Hodgkinson, Tuhua, &c.(*i*)	..	..	..	..	..	..	..	..	..	..	..	..	†1,932	2	11·98	..	..	..	5·50	8·73	..	519 4 5
H. T. Mitchell, Rotorua, &c.(*j*)	..	..	..	..	..	..	86.0	5	2·56	..	..	..	*730 †59	70 1	75·75 65·13	..	..	..	9·00	28·66	251 6 8	1,086 17 4
D. I. Barron, Puhipuhi(*k*)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	23 12 3
P. S. Sherratt, Kaihu, &c.(*l*)	..	..	..	..	7,119	4·33	..	..	..	..	..	..	..	..	..	..	..	..	4·75	21·97	64 14 2	641 3 6
H. R. Atkinson, Waoku, &c.(*m*)	..	..	11,369	5·16	..	..	..	..	..	..	..	..	†616	7	130·19	..	..	..	7·00	37·54	15 0 0	654 5 8
C. B. Turner, Kawakawa(*n*)	..	..	..	..	2,385	3·89	..	..	..	2·50	3	94·86	..	..	..	..	..	..	1·75	21·13	174 19 3	529 2 6
W. B. de L. Willis, Whangarei, &c.(*o*)	..	..	..	..	72	13·16	..	..	..	..	..	..	..	..	..	..	..	..	2·10	25·55	208 0 8	599 0 4
R. F. W. Mackenzie, Rotorua, &c.(*p*)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	387 10 0
G. M. R. Jackson, Urutawa, &c.(*q*)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3·50	49·23	2 3 10	446 16 1
F. R. Burnley, Mangonui, &c.(*r*)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	69 7 3
A. W. Craig, Rotoma, &c.(*s*)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	384 11 0
P. W. G. Barlow, Waimana, &c.(*t*)	..	..	..	..	218	6·31	3·6	11	21·66	..	..	..	*1,700	48	35·54	..	..	..	1·50	18·72	15 10 10	1,084 10 7
A. D. Newton, Whareorino, &c.(*u*)	..	..	..	..	5,400	2·97	..	..	..	..	..	..	*5,522 †528	13 1	22·32 25·52	..	..	..	2·00	21·50	104 5 6	1,559 8 1
H. E. Walshe, Runanga, &c.(*v*)	..	..	..	..	50,683	0·56	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1,429 0 6
J. B. Thompson, Piako, &c.(*w*)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·25	10·48	..	2 12 6
O. N. Campbell, Waimana, &c.(*x*)	..	..	..	..	110	3·82	..	..	..	..	..	..	..	..	..	..	..	..	3·12	25·54	..	100 13 6
R. G. MacMorran, Waihou, &c.(*y*)	..	..	..	..	126	3·61	..	..	..	..	..	..	*137	6	26·28	..	..	..	0·70	10.00	23 0 0	100 5 0
P. C. Gannaway, Thames(*z*)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	342 11 0
Temporary Staff.																						
P. R. Wilkinson, Opotiki(*aa*)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	484 2 0
W. M. Atkinson, Whangarei, &c.(*bb*)	..	..	..	..	1,599	2·88	6·6	2	48·18	32·30	35	18·51	*293	5	52·75	..	..	..	3·55	12·17	44 3 8	3 7 6
C. Kenny, Whakatane, &c.(*cc*)	..	..	..	..	..	..	..	..	..	..	..	..	*7,654	38	30·49	..	..	..	9·50	38·42	45 5 7	805 10 8
G. H. Purchas, Hapuakohe, &c.(*dd*)	..	..	..	..	234	5·59	..	..	..	15·00	27	38·46	..	..	..	..	..	..	..	..	82 5 11	854 2 5
J. H. Lindsay, Coromandel, &c.(*ee*)	..	..	..	..	4,130	4·01	..	..	..	..	..	..	*39	1	92·31	..	..	..	..	..	5 0 0	1,096 0 0
J. K. Ledger, Kawhia(*ff*)	5,750	2·32	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1·80	27·51	106 5 0	438 11 6
T. J. Mountain, Coromandel, &c (*gg*)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	121 14 10
——, Tutamoe(*hh*)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	90 11 3

Contract Surveyors.		d.		d.		s.			s.			s.			d.				£	£ s. d.	£ s. d.
E. F. Adams, Ohinemuri, &c.(*a*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*688	29	75·20	..	..	..	..	..	215 11 8
E. W. Buckeridge, Kawhia(*b*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*1,961	19	23·66	..	..	..	..	..	193 7 2
Y. Booker, Kawhia(*c*)	..	..	..	..	..	..	..	..	..	..	..	..	*14,120	69	22·88	..	..	..	..	..	1,346 3 9
J. B. Birkmyre, Whakatane, &c.(*d*)	..	..	..	..	..	..	..	..	..	..	..	..	*55	3	99·70	..	..	..	..	..	22 17 2
F. E. Byrne, Utakura(*e*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*59	2	44·50	..	..	..	..	..	10 18 10
P. Chambers, Punakitere(*f*) ..	..	..	..	..	242	4·13	1·3	4	129·23	..	..	..	*20,063	38	10·77	..	..	..	..	..	958 17 11
A. W. Cheal, Punui, &c.(*g*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*29,806	115	15·00	..	..	..	..	..	1,863 18 1
O. M. Creagh, Whangaparoa(*h*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*33,041	13	6·51	..	..	..	..	..	896 18 3
J. Dawson, Maungakawa, &c.(*i*) ..	..	..	..	..	700	1·90	..	..	..	..	..	..	..	..	..	..	..	..	..	..	66 13 4
J. W. Davis, Tarawera, &c.(*j*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*17,991	37	18·52	..	..	..	..	..	1,388 15 11
G. H. Davis, Mangaorongo, &c.(*k*)	..	..	..	..	..	..	..	..	..	..	..	..	*4,226	30	17·47	..	..	..	..	..	307 14 5
R. S. Finch, Russell, &c.(*l*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*6,752 †1,902	25 3	24·26 28·97	..	..	..	..	..	912 2 7
P. C. Frasi, Otanake, &c.(*m*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*5,122	48	35·24	..	..	..	..	..	752 1 7
R. E. Fry, Kaipara, &c.(*n*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*2,938	5	17·32	..	..	..	..	..	211 19 10
Foster and Miller, Motatau, &c.(*o*)	..	..	..	..	..	..	..	..	..	..	..	..	*30,847	98	18·02	..	..	..	..	..	2,316 13 10
R. T. Goulding, Orahiri, &c.(*p*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*2,150	9	13·05	..	..	..	..	..	116 17 0
D. W. Gillies, Orahiri, &c.(*q*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*2,851	10	10·44	..	..	..	..	..	124 0 10
E. H. Hardy, Otanake(*r*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*426	14	12·66	..	..	..	..	..	22 9 5
M. F. Haszard, Hapuakohe(*s*) ..	..	..	..	..	5,318	2·06	..	..	..	..	..	..	*14,341	29	9·75	..	..	..	..	..	1,131 13 4
F. J. Hosking, Kaihu, &c.(*t*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*3,482	11	24·10	..	..	..	..	..	349 13 4
H. K. Hovell, Whangaparaoa(*u*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*8,757	3	6·84	..	..	..	..	..	249 11 9
H. P. Hanify, Rotorua(*v*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*1,058	10	47·64	..	..	..	..	..	210 0 0
Hunt and Sandford, Punakitere(*w*)	..	..	..	..	35	5·00	..	..	..	..	..	..	*6,705	95	36·28	..	..	..	..	..	1,022 7 10
H. Hammond, Mangamuka, &c.(*x*)	..	..	..	..	482	3·02	..	..	..	..	..	..	*10,249	18	14·65	..	..	..	..	..	698 3 3
G. A. Jackson, Otamatea(*y*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*3,620	24	16·70	..	..	..	..	..	251 17 9
R. C. Jordan, Pakaumanu(*z*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*5,361	21	19·31	..	..	..	..	..	431 7 7
J. A. Johnston, Tuhua, &c.(*aa*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*4,859	19	15·16	..	..	..	..	..	307 1 0
T. W. Kenny, Waihou, &c.(*bb*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*4,095	26	24·06	..	..	..	..	..	410 9 2
A. F. Matthews, Tokatoka(*cc*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*2,353	3	34·36	..	..	..	..	..	336 18 6
T. J. Mountain, Orere(*dd*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*15,699	24	16·53	..	..	..	..	..	1,081 8 7
G. A. Martin, Russell(*ee*)..	..	..	..	..	120	4·67	..	..	..	..	..	..	*10,758	10	11·22	..	..	..	..	..	530 19 0
R. M. McIver, Pirongia(*ff*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*5,527	37	17·26	..	..	..	..	..	397 10 2
C. C. Otway, Whangaroa, &c.(*gg*) ..	..	..	..	..	4,023	1·45	..	..	..	..	..	..	*9,915	44	18·02	..	..	..	..	..	1,036 8 11
S. Orbell, Wharepapa(*hh*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*3,064	17	16·89	..	..	..	..	..	215 13 9
J. A. Parry, Mangaorongo ..	..	..	..	..	..	..	..	..	..	..	..	..	*95	1	30·52	..	..	..	..	..	12 1 7
C. W. Reardon, Maketu, &c.(*ii*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*8,622	48	18·04	..	..	..	..	..	648 0 0
J. Reilly, Haratauna(*jj*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*260	2	46·75	..	..	..	..	..	50 13 0
F. A. Stevens, Maketu(*kk*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*220	14	84·49	..	..	..	..	..	77 9 1
S. B. Sims, Tapapa(*ll*) ..	..	..	..	..	..	..	..	..	..	5·50	8	70·87	*10,727	57	21·54	..	..	..	..	..	991 4 5
W. C. Spencer, Piako, &c.(*mm*) ..	..	..	..	..	105	2·86	..	..	..	..	..	..	*867	5	28·70	..	..	..	..	..	118 13 5
D. Stubbing, Cambridge(*nn*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*6,749	37	23·56	..	..	..	..	..	662 8 7
A. B. Stubbing, Maketu(*oo*) ..	..	..	..	..	..	..	..	..	..	..	..	..	*928	2	27·82	..	..	..	..	..	107 12 0
Sladden and Palmer, Awakino(*pp*)	..	..	..	..	..	..	..	..	..	..	..	..	*88	7	84·90	..	..	..	..	..	31 2 8
Thomson and Farrer, Cambridge(*qq*)	..	..	..	..	..	..	..	..	..	..	..	..	*32,698	84	13·70	..	..	..	..	..	1,866 16 5
P. Ward, Maungataniwha, &c.(*rr*)..	..	..	..	..	..	..	..	..	..	..	..	..	*28,276	205	23·82	..	..	..	..	..	2,805 16 3
H. M. Wilson, Hukatere, &c.(*ss*) ..	..	..	..	..	688	1·78	..	..	..	..	..	..	*30,494	72	13·74	..	..	..	..	..	1,807 5 8
Means and totals ..	40,750	0·80	11,369	5·16	127,155	1·50	2,353·5	115	3·35	215·30	330	33·83	442,078	1,718	17·20	..	..	..	108·52	21·33	2,602 0 6	52,813 11 1
Licensed surveyors (paid for by applicants)	..	..	..	..	6,094	..	..	..	..	..	..	..	*870	14	..	46	2	..	..	..	..	..
Totals	..	..	..	..	133,249	..	..	..	..	..	..	..	442,948	1,732	..	46	2	..	..	..	..	..

Note.—For references see next page.

* Native Land Court. † Maori Land Board.

Table 1a.—Return of Field-work executed by the Staff and Contract Surveyors from 1st April, 1912, to 31st March, 1913—*continued.*

Auckland Land District—continued.

References to Page 64.

(*a*) "Other work" is chiefly inspections. £105 1s. 3d. carried forward.
(*b*) "Other work" is inspection. 11,000 acres Crown land in hand. £1,155 10s. 8d. carried forward. Scheme plan, 11,000 acres forwarded; cost carried forward.
(*c*) Rough bush land; 24,800 acres almost complete. £2,614 17s. 11d. carried forward. Includes two parties.
(*d*) "Other work" is principally resurveys. £1,631 13s. 6d. carried forward.
(*e*) Moturiki Town and Suburbs and bush land. £714 15s. carried forward.
(*f*) Broken to undulating scrub and bush. Road survey includes 13 miles engineering. "Other work" is inspections, redefining boundaries, &c. £196 7s. 7d. carried forward
(*g*) Open bush land. £624 13s. 5d. carried forward.
(*h*) Rough bush country. "Other work" is reports, &c. £1,796 15s. 11d. carried forward. Scheme plan 4,500 acres Crown land forwarded; cost carried forward.
(*i*) Easy open country. Joined Auckland Staff, September. £374 14s. 5d. carried forward.
(*j*) "Other work" is principally Maori Land Board work, reports, &c. £1,428 11s. 4d. carried forward.
(*k*) Just commenced on Crown land at Puhipuhi. £23 12s. 3d. carried forward.
(*l*) Bush land. "Other work" is scattered surveys of creamery-sites, &c. £300 19s. carried forward. 5,000 acres in hand.
(*m*) Rough bush; topographical survey for Native Land Court. Maori Land Board surveys include reports, road-grading, &c. £202 2s. 6d. carried forward.
(*n*) "Other work" is mostly office-work, &c. £59 18s. 11d. carried forward.
(*o*) "Other work" is small scattered surveys. £289 18s. 11d. carried forward.
(*p*) About 5,000 acres on hand. Joined Staff, October. £387 10s. carried forward. Scheme plan 2,355 acres forwarded, Crown land; cost carried forward.
(*q*) Joined field staff, October. £140 7s. carried forward.
(*r*) Joined field staff, March. £69 7s. 3d. carried forward.
(*s*) Joined field staff, November. £384 11s. carried forward.
(*t*) Rough country. 20,000 acres Crown land on hand. £1,676 15s. 11d. carried forward.
(*u*) Rough bush land; two parties. "Other work" is survey scenic reserve, &c. £981 8s. 7d. carried forward. 12,000 acres in hand.
(*v*) This work was carried out by one of the Hawke's Bay staff because it was more easily worked from that district.
(*w*) Balance of cost of party as Drainage Engineer. £68 2s. carried forward.
(*x*) Balance of expenditure charged against Rangitaiki Drainage.
(*y*) Balance of expenditure charged against Hauraki Plains and engineering works. £32 10s. carried forward.
(*z*) Attached to Drainage Engineer. £342 11s. carried forward.
(*aa*) 5,900 acres on hand. Joined staff, October. £484 2s. carried forward. Scheme plan 5,900 acres Crown land forwarded; cost carried forward.
(*bb*) Transferred to Napier (assistant completed plans). "Other work" is resurveying.
(*cc*) Open country. £264 14s. carried forward.
(*dd*) Level and undulating. £854 2s. 5d. carried forward. Hauraki pastoral-lease surveys and roads in hand.
(*ee*) Rough bush land. £797 6s. carried forward. Hauraki pastoral-lease surveys and roads in hand.
(*ff*) "Other work" is exploring, grading, &c. Joined field staff September. £227 6s. carried forward. In hand, 5,000 acres.
(*gg*) 2,365 acres Hauraki pastoral leases on hand. Joined staff February. £121 14s. 10d. carried forward.
(*hh*) Work by J. C. Olsen, unlicensed surveyor's assistant. Commenced March.

References to Page 65.

(*a*) Mostly swamp.
(*b*) Rough bush.
(*c*) Mostly undulating bush and scrub.
(*d*) Open.
(*e*) Bush.
(*f*) Rough bush.
(*g*) Surveys comprise all classes of country.
(*h*) Very rough bush.
(*i*) Open and scrub.
(*j*) Mostly open and scrub.
(*k*) All classes of country.
(*l*) Mostly rough bush.
(*m*) Undulating bush and scrub.
(*n*) Mostly scrub.
(*o*) Surveys comprise all classes of country.
(*p*) Mostly bush.
(*q*) Mostly scrub.
(*r*) Open.
(*s*) Mostly open and swamp.
(*t*) Mostly bush.
(*u*) Rough bush.
(*v*) Rough bush.
(*w*) All classes of country.
(*x*) All classes of country.
(*y*) Mostly undulating scrub land.
(*z*) Mostly rough bush.
(*aa*) Bush and open.
(*bb*) Mostly swamp and open.
(*cc*) Rough bush.
(*dd*) Very rough bush. Work performed prior to his joining the staff in February.
(*ee*) Mostly rough bush.
(*ff*) All classes of country.
(*gg*) Undulating bush and open.
(*hh*) Bush and open.
(*ii*) Bush and swamp.
(*jj*) Bush.
(*kk*) Open and scrub.
(*ll*) Mostly bush.
(*mm*) Rough bush.
(*nn*) Mostly open, undulating and level.
(*oo*) Mostly open.
(*pp*) Bush.
(*qq*) Surveys comprise all classes of country.
(*rr*) Surveys comprise all classes of country.
(*ss*) Surveys comprise all classes of country.

Table 1a.—Return of Field-work executed by the Staff and Contract Surveyors from 1st April, 1912, to 31st March, 1913—*continued.*

Hawke's Bay Land District.

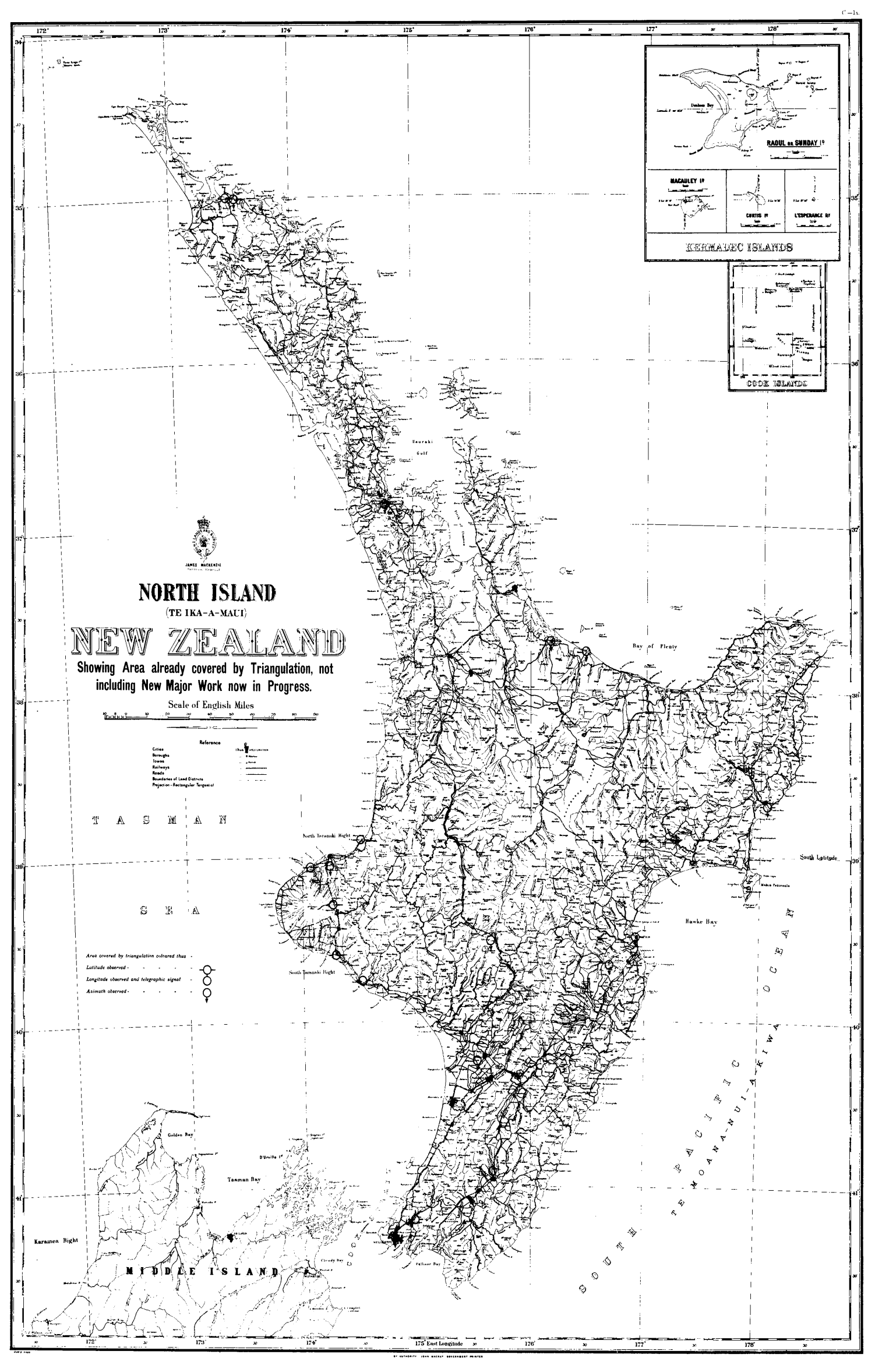
Surveyor and District.	Minor Triangulations.		Rural.		Village and Suburban.			Town Section Survey.			Native Land Survey.			Roads, Railways, and Water-races.		Other Work.	Total Cost of Surveyor and Party from 1st April, 1912, to 31st March, 1913.	Remarks.
	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	No. of Sections.	Cost per Acre.	Acres.	No. of Sections.	Cost of Sections.	Acres.	No. of Sections or Divisions.	Cost per Acre.	Miles.	Cost per Mile.	Cost.		
Staff Surveyors.		d.		s.			s.			s.			d.		£	£ s. d.	£ s. d.	
T. Brook, Takapau	..	..	1,390·00	3·25	..	..	..	..	..	..	..	..	..	7.00	11·71	475 8 10	783 12 2	£308 3s. 4d. was brought forward from last year.
R. P. Greville, Porangahau, &c. ..	13,100	0·75	..	..	..	..	..	..	..	..	..	..	..	..	..	42 0 0	42 0 0	Manawaangiangi Block.
J. Roddick, Tutamoe, &c. ..	..	..	4,900·00	2·58	6·73	14	103·47	..	..	..	*4·10	2	307·31	4·00	36·18	..	792 13 3	£135 7s. 2d. carried forward to 7¾ miles of road.
					14·01	56	64·28				*35·64	2	78·78					
											*53·25	2	54·67					
											*42·38	3	113·26					
											*11·42	2	246·93					
											*21·21	3	153·51					
											*20·56	3	124·55					
E. H. Farnie, Matakaoa, &c. ..	37,500	1·37	..	..	..	..	..	..	..	..	*95·00	2	56·26	6·25	13·76	2 0 0	890 10 0	£1,425 5s. 6d. is carried forward for execution of plans, Native Land Court surveys, and Kaiwaka Block, which are incomplete.
											*184·00	6	48·00					
T. Cagney, Turanganui, &c. ..	..	..	..	..	5·00	21	106·28	..	..	..	*1,598·00	2	10·06	..	..	27 3 4	284 16 6	£633 5s. 1d. brought forward against Omahu No. 2 Block, Waihau Settlement, plans incomplete.
											*79·00	2	71·39					
											*246·00	2	32·73					
											*23·00	2	†233·00					
H. E. Walshe, Ruataniwha, &c. ..	..	..	15·93	19·25	..	..	..	..	..	..	‡12,500·00	25	18·91	0·15	64·20	..	253 10 7	Mr. Walshe also surveyed the Pohokura Block of 50,683 acres in the Auckland Land District, at a cost of £1,429 0s. 6d. (See table for that district.) £951 2s. 2d. is carried forward against various works awaiting completion of field-work and plans.
W. M. Gray, Waiau	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	17 4 3	17 4 3	"Other work" comprises compass traverse and erecting tripods. £421 13s. 3d. to be carried forward to next year. Waihau Settlement and Waiau Block, of which plans and field-work Waiau incomplete.
F. R. Burnley, Patoka	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Completed 9,265 acres Waihau Settlement at a cost of £314 5s. 6d., but this has been carried forward to Mr. T. Cagney for completion of plans. Mr. Burnley was transferred to Auckland in February.
Temporary Staff.																		
W. M. Atkinson, Porangahau, &c.	§6,223	1·37	45·73	22·67	3·24	2	108·02	1·10	2	212·20	..	..	..	0·50	29·00	274 16 2	445 1 10	Triangulation is set down as secondary. £209 16s. 10d. to be carried forward to next year
					10·15	2	56·51	1·21	6	67.30								
Contract Surveyors.																		
Kennedy Bros., Woodville ..	..	..	993·50	2·04	..	..	..	..	..	..	..	..	..	..	..	..	101 15 0	Ahuatauranga, Block VIII, Woodville Survey District.
H. Baker, Porangahau, &c. ..	..	..	12,070·00	1·08	..	..	..	..	..	..	..	..	..	..	..	..	654 6 2	Manawaangiangi Block.
Licensed Surveyors	..	..	..	..	..	..	..	..	..	..	*28,847·00	215	24·00	..	..	..	2,863 18 9	
											‡32·00	1	24·00	..	..	..	18 7 0	
Means and totals ..	56,823	1·23	19,415·16	1·73	39·13	95	77·98	2·31	8	103·52	43,792·56	274	22·78	17·90	18·81	838 12 7	7,147 16 0	

* Native Land Court. † A charge of £11 3s. 4½d. per subdivision was made in this case. Maori Land Board. § Secondary triangulation.

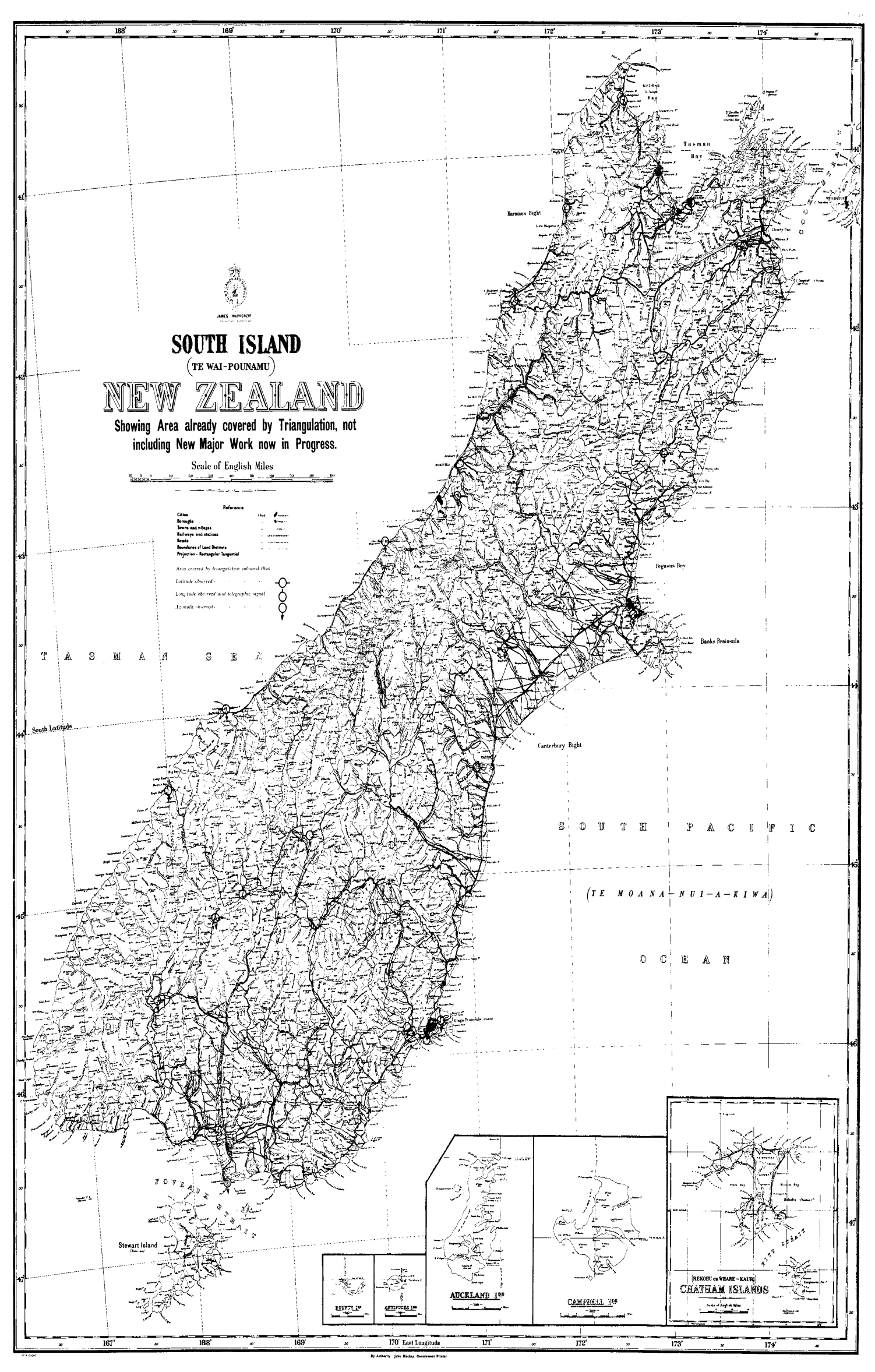
Table 1a.—Return of Field-work executed by the Staff and Contract Surveyors from 1st April, 1912, to 31st March, 1913—*continued.*

Taranaki Land District.

Surveyor and District.	Minor Triangulations.		Rural.		Village and Suburban.			Town Section Survey.			Native Land Survey.			Roads, Railways, and Water-races.		Other Work.	Total Cost of Surveyor and Party from 1st April, 1912, to 31st March, 1913.	Remarks.
	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	No. of Sections.	Cost per Acre.	Acres.	No. of Sections.	Cost of Sections.	Acres.	No. of Sections or Divisions.	Cost per Acre.	Miles.	Cost per Mile.	Cost.		
Staff Surveyors.		d.		s			s.			s.			d.		£	£ s. d.	£ s. d.	
W. Laing, Omara, Kapara, &c. ..	..	..	19,114	2·36	..	..	..	..	..	..	..	..	..	..	..	..	818 17 5	Rough and broken bush country, difficult of access. £650 14s. 8d. to be carried forward against incompleted sectional surveys in the Mokau-Mohakatino Block, and £30 against minor trig. work, all in the Mimi and Waro Survey Districts.
D. M. Wilson, Pouatu, Mahoe, &c.	..	..	..	..	35·25	9	55·66	36·75	60	40·00	..	..	..	8·25	39·93	..	973 9 7	£3,826 5s. 4d. carried forward against Tariki Estate, Whakaihuwaka North, and Taumatamahoe Blocks of 21,000 acres, of which 17,500 acres is completed in the field and plans well in hand. This large amount includes £2,869 19s. 4d. for surveys executed in previous years. The roads were located in very rough precipitous country, and done in the middle of winter, to provide the required access from the railway at Whangamomona, &c., to Crown lands about to be opened for selection.
N. C. Kensington, Ohura, Rangi, &c.	30,000	1·38	12,163	3·44	..	..	..	..	..	..	*46	1	46·95	0·13	30·77	89 13 4	971 9 1	"Other work" consists of preliminary-survey scheme and supervision of the Wanganui River Trust contract (5,649 acres), and inspection of Native surveys for purposes of progress payments, also ordinary field inspections. Rough bush country. £726 13s. 2d. carried forward against unfinished surveys in Whatitokarua, Tapuiwahine, and miscellaneous sectional surveys.
T. G. Sole, Mahoe, Paritutu, &c. ..	..	..	..	..	41·50	5	16·76	6·00	22	26·36	..	..	..	..	..	45 11 8	109 7 4	The town and suburban sections were situated in bush country. "Other work" consists of pegging out sections in New Plymouth for lease, &c.; access to Education Reserve No. 16, of XII, Hawera Survey District; replacing standards; cemetery-site, Pukearuhe; survey of island in Waitara River; and extensions of standard work in New Plymouth.
A. F. Waters, Mapara	12,200	1·95	..	..	..	..	..	..	..	..	..	..	..	..	..	..	846 7 4	£1,313 8s. 8d. to be carried forward against surveys of Mapara-Haupehi Block, minor trig., and road through Native blocks. £25 18s. of this sum will be charged to Crown land in the Pahi Survey District, about to be let by contract.



BY AUTHORITY: JOHN MACKAY, GOVERNMENT PRINTER



By Authority: John Mackay, Government Printer.

		d.		s.			s.			s.			d.		£	£ s. d.	£ s. d.	
Temporary Staff.																		
R. R. Richmond, Heao ..	..	..	333	17·18	..	..	..	..	..	..	*3,700	1	24·74	0·30	29·00	..	386 17 1	£44 15s. 4d. carried forward against scenic reserves on right bank of Wanganui River, Maraekowhai and Whitianga Blocks. Mr. Richmond reported Native opposition during survey of Maraekowhai A Block. Mr. Richmond was transferred to Canterbury at end of October.
J. P. Larkin, Mokau, Tainui, &c. ..	4,200	2·47	1,612	16·45	..	..	..	..	..	..	..	..	..	..	..	8 4 0	973 0 0	"Other work" consists of two small miscellaneous surveys. The 1,612 acres comprises scenic reserves on the right bank of the Mokau River involving 56 miles of traverse on rough and precipitous bush country. £730 2s. 11d. carried forward against surveys in Blocks VI and X, Aria Survey District, Waro Block, and other miscellaneous surveys. The Waro Block has been explored, roads located, and scheme of subdivision made.
Contract Surveyors.																		
Sladden and Palmer, Mokau, Tainui, &c.	..	..	1,773	2·74	..	..	..	..	..	..	..	..	..	..	..	..	242 17 3	Scenery reserves in Mokau-Mohakatino Block. Rough and precipitous bush country.
W. C. Wall, Ohura, Heao, &c. ..	..	..	4,600	3·70	..	..	..	..	..	..	*2,007	5	10·48	..	..	..	938 6 8	Scenery reserves on right bank of Wanganui River, also River Trust survey. Rough bush country.
S. Orbell, Ngatimaru, Upper Waitara, &c.	..	..	2,341	3·96	..	..	..	..	..	..	..	..	..	..	..	..	463 0 0	This survey was done for the purpose of providing holdings for the landless Natives at Purangi. The sections, considering the nature of the country, which is rough bush, were small, but the scheme had to conform to the Act.
C. F. Dowsett, Paritutu, Waitara..	..	..	..	..	..	..	..	..	..	..	*60	5	108·00	..	..	..	26 19 5	Open country.
J. A. Johnston, Aria, Totoro ..	..	..	..	..	..	..	..	..	..	..	*6,835	13	18·39	..	..	..	523 18 1	Rough bush country.
E. W. H. Thompson, Aria, Ohura..	..	..	..	..	..	..	..	..	..	..	*2,689	9	15·70	..	..	..	176 0 5	Hilly, open, and bush country.
Muir and Bogle, Totoro, Mapara, &c.	..	..	..	..	..	..	..	..	..	..	*10,964	12	14·72	..	..	..	672 15 7	Rough bush country.
E. W. M. Lysons, Tangitu, Mapara, &c.	..	..	..	..	..	..	..	..	..	..	*18,254	29	13·03	..	..	..	991 5 8	Rough bush country.
A. W. Cheal, Aria, Totoro, &c. ..	..	..	..	..	..	..	..	..	..	..	*6,147	16	10·85	..	..	..	277 18 6	Rough bush country.
R. C. Jordan, Piopiotea West ..	..	..	..	..	..	..	..	..	..	..	*389	3	25·40	..	..	..	41 3 9	Open country.
E. H. Hardy, Mapara	..	..	..	..	..	..	..	..	..	..	*220	2	34·03	..	..	..	31 3 11	Open country.
Means and totals ..	46,400	1·63	41,936	3·59	76·75	14	34·55	42·75	82	36·34	*51,311	96	15·05	8·68	39·42	143 9 0	9,464 17 1	

* Native Land Court.

Table 1a.—Return of Field-work executed by the Staff and Contract Surveyors from 1st April, 1912, to 31st March, 1913—*continued.*

Wellington Land District.

Surveyor and District.	Secondary Triangulation.		Topographical Survey for Selection as Unsurveyed Land.		Rural.		Town Section Survey.			Native Land Survey.			Roads, Railways, and Water-races.		Other Work.	Total Cost of Surveyor and Party from 1st April, 1912, to 31st March, 1913.	Remarks.
	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	No. of Sections.	Cost of Sections.	Acres.	No. of Sections or Divisions.	Cost per Acre.	Miles.	Cost per Mile.	Cost.		
Staff Surveyors.						s.			s.			d.		£	£ s. d.	£ s. d.	
R. P. Greville, Wellington					549·0	2·35	8·50	4	77·50				0·50	23·00	412 16 6	545 7 6	Inspecting surveyor.
J. R. Strachan, Puketoi, Mangahao					4,811·5	2·71									119 8 3	808 14 2	£325 8s. 4d. carried forward on behalf of settlement bush lands; 4,450 acres in hand.
J. Stevenson, Rarete, Makotuku					107·0	1·83				*4,087	20	42·00	5·00	40·00	51 10 0	1,006 12 0	Has 14,850 acres Native survey in hand. £1,134 9s. 9d. carried forward. Cadet assisting.
A. M. Roberts, Whirinaki					993·0	2·27				*406	61	†133·00			144 11 10	1,319 6 0	Has part of 40,000 acres bush settlement in hand, and 600 acres Native finished. £2,201 15s. 5d. carried forward.
H. E. Girdlestone, Haurangi and general																965 4 5	Has 2,500,000 acres of secondary triangulation in hand, on which £2,030 4s. 7d. is carried forward. Has also 10,000 acres of settlement survey in hand, of which 6,246 acres, with 5½ miles of road, are completed in the field, and on which £453 13s. is carried forward.
W. Stewart, Whirinaki					5,475·0	‡5·46									156 3 10	1,499 16 0	Bush surveys. Has 5,000 acres in hand. Carries forward £1,282 7s. 9d.
W. M. Gray, Ngamatea, &c.					4,292·0	2·60									119 17 6	291 6 11	Transferred to Hawke's Bay District in October.
H. L. P. Dyett, Whirinaki															21 7 5	336 3 9	Retired from Department, 21st September.
V. Blake, Whirinaki															96 0 2	674 5 9	Has 7,000 acres bush-settlement land in hand. £859 12s. 3d. carried forward.
Contract Surveyors.																	
J. Annabell, Ikitara, &c.										*3,837	19	16·72				267 8 0	These surveys are nearly all in rough forest country, and in almost all cases are subdivisional surveys where a large proportion of the boundaries consists of earlier surveys adopted without resurvey. The cost of each block, therefore, as given is practically only for the completion of the survey, and owing to the varying proportion of adopted work in each survey no comparative cost per acre can be correctly obtained. In most cases the totals are made up of a number of different blocks for each surveyor.
W. O. Beere, Ohinewairua										*72	4	126·00				37 16 0	
M. Carkeek, Waitohu										*362	24	92·37				139 6 10	
J. W. Davis, Mount Robinson, &c.										*10,187	30	14·64				621 8 6	
Davis and Porteous, Waitohu, &c.										*31,208	97	14·79				1,922 16 6	
Dix and Marchant, Maungakaretu, &c.										*24,026	62	12·70				1,271 19 1	
P. R. Earle, Ohinewairua										*1,103	5	15·58				71 12 7	
H. P. Hanify, Kaitieke										*380	11	69·16				109 10 8	
G. A. M. Luff, Mikimiki, &c.										*563	2	12·28				28 17 0	
Muir and Bogle, Ohinewairua, Wangaehu, &c.										*4,043	29	22·49				378 17 7	
Middleton and Smith, Pencarrow, &c.										*9,040	63	25·50				960 11 8	
L. H. Reynolds, Wainuioru										*348	20	69·93				101 8 0	
C. W. Reardon, Nukumaru										*500	6	21·77				45 7 0	
J. A. Syverston, Waipawa, &c.										*2,154	22	23·44				210 7 8	
Seaton, Sladden, and Pavitt, Kaiwaka, &c.					587·0	2·10				*22,148	42	10·91				1,068 5 3	
W. C. Wall, Owatua, Hunua, &c.										*6,101	9	7·81				198 13 7	
T. Ward, Mount Robinson, &c.										*1,473	29	31·21				191 11 4	
Means and totals					16,814·5	3·51	8·50	4	77·50	*122,038	555	16·72	5·50	38·45	1,121 15 6	15,072 13 9	

Native Land Court. † See general report, cadastral revision survey. ‡ Cost includes other work which is inseparable, chiefly preliminary explorations and reconnaissance survey of the Waimarino Block.

Table 1a.—Return of Field-work executed by the Staff and Contract Surveyors from 1st April, 1912, to 31st March, 1913—*continued*.

Surveyor and District.	Minor Triangulations.		Topographical Survey for Selection as Unsurveyed Land.		Rural.		Village and Suburban.			Town Section Survey.			Native Land Survey.			Roads, Railways, and Water-races.		Other Work.	Total Cost of Surveyor and Party from 1st April, 1912, to 31st March, 1913.	Remarks.
	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	No. of Sections.	Cost per Acre.	Acres.	No. of Sections.	Cost of Sections.	Acres.	No. of Sections or Divisions.	Cost per Acre.	Miles.	Cost per Mile.	Cost.		
Marlborough Land District.																				
Staff Surveyors.						s.			s.			s.			d.		£	£ s. d.	£ s. d.	
A. Hodgkinson, Pine Valley, Heringa, &c.	..	..	..	..	1,351	1·78	..	..	..	0·5	1	63·0	..	..	..	27·75	40·19	136 1 0	542 12 1	Rural surveys in rough forest-clad country. "Roads and Railways" include survey of 18 miles of Picton–Blenheim Railway. This survey being in a very old-settled district with comparatively few recent surveys, and, the original surveys being magnetic only, the cost was much higher than originally anticipated. "Other work" includes revision of old magnetic surveys in the Waitohi Valley.
Office staff (various districts) ..	..	..	..	..	112	1·43	..	..	..	0·5	2	63·0	..	..	..	0·50	26·00	25 0 0	52 6 0	"Other work" comprised inspection surveys.
Temporary Staff.																				
L. Hunt, Heringa, Wakamarina ..	..	..	..	..	7,362	2·31	3	1	17·47	..	..	..	..	..	..	..	..	16 2 0	413 14 0	Rural surveys in heavy bush and rough country. "Other work" was measurement of timber in the Ronga Valley.
Contract Surveyors.																				
F. Stephenson Smith (various districts) / A. P. Seymour (various districts .. / Middleton and Smith (various districts)	..	..	..	..	..	..	30	1	9·61	..	..	..	*3,592	24	20·12	1·50	16·25	..	339 19 5	Surveys at schedule rates.
Means and totals ..	..	..	..	..	8,825	2·21	33	2	10·30	1·0	3	63·0	*3,592	24	20·12	29·75	38·74	177 3 0	1,348 11 6	
Licensed surveyors (paid by applicants)	..	..	..	..	..	..	..	..	..	1·0	3	..	*57	8	..	7·00	..	..	..	
Totals	..	..	..	..	..	..	..	..	..	2·0	6	..	3,649	32	..	36·75	..	..	..	

* Native Land Court.

Westland Land District.																				
Staff Surveyors.		d.		d.		s.			s.			s.					£	£ s. d.	£ s. d.	
W. Wilson, Punakaiki, &c. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	269 12 9	269 12 9	Finished work. Includes £196 17s. 6d., salary, &c., extended leave. £145 9s. 10d. carried forward.
C. H. Morison, Toaroha, Kopara, Haupiri, &c.	..	..	1,800	4·0	3,912	3·15	13	7	49·23	..	..	..	..	..	..	1	11·0	29 3 6	718 3 4	Nine months' work (absent in Canterbury three months).
A. N. Harrop, Mahinapua, Kanieri, &c.	1,500	15·4	..	..	3,230	3·80	..	..	..	6	23	30·0	..	..	..	..	..	228 14 8	973 13 4	Nine months' work (absent in Canterbury three months). Balance from last year, £529 5s. 3d. Carried forward to next year, £300 18s. 7d.
J. Cunningham, Poerua, Mount Bonar, Hohonu, &c.	..	..	600	7·2	2,480	3·93	112	9	14·28	..	..	..	..	..	..	..	..	30 0 0	615 5 6	Carried forward, £286 4s. 4d.
Means and totals ..	1,500	15·4	2,400	4·8	9,622	3·56	125	16	17·92	6	23	30·0	..	..	..	1	11·0	557 10 11	2,576 14 11	

Table 1a.—Return of Field-work executed by the Staff and Contract Surveyors from 1st April, 1912, to 31st March, 1913—*continued.*

Nelson Land District.

Surveyor and District.	Minor Triangulations.		Topographical Survey for Selection as Unsurveyed Land.		Rural.		Town Section Survey.			Native Land Survey.			Roads, Railways, and Water-races.		Other Work.	Total Cost of Surveyor and Party from 1st April, 1912, to 31st March, 1913.	Remarks.
	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	No. of Sections.	Cost of Sections.	Acres.	No. of Sections or Divisions.	Cost per Acre.	Miles.	Cost per Mile.	Cost.		
Staff Surveyors.		d.		d.		s.			s.			d.		£	£ s. d.	£ s. d.	
J. D. Thomson, Hope, Gordon, &c. ..	..	..	..	..	9,161	2·22	..	..	..	..	..	..	1·00	22·00	49 18 2	1,337 0 7	"Rural" is applications and Crown land. Rough broken country in heavy bush. "Other work" is inspections, &c. £248 5s. carried forward to next year. Cadet assisting with second party.
H. Maitland, Aorere, Rotoroa, &c. ..	..	..	..	..	2,100	6·00	..	..	..	..	..	..	4·50	26·97	..	937 4 8	Isolated applications and roads in rough broken country in heavy bush. £589 8s. 8d. carried forward to next year against the Gowan Block of 10,000 acres; nearly half completed in the field.
J. L. D'Arcy Irvine, Waimea, &c. ..	..	..	..	..	..	..	3·5	28	34·57	..	..	..	..	..	585 12 2	865 12 10	"Town survey" is workers' homes, City of Nelson. "Other work" is inspection surveys, £430 1s. 2d.; office work, £64; absent owing to serious accident, £79 11s., &c. £231 12s. 8d. carried forward to next year.
S. L. Fairhall, Howard, Tutaki, &c. ..	..	..	..	..	..	..	..	..	..	..	..	..	12·30	5·50	71 7 8	1,588 4 6	Road surveys consist mostly of repegging; no plans required. "Other work" is standard survey of Murchison, 4½ miles. £2,220 7s. 5d. carried forward to next year, representing some 24,000 acres practically complete in the field, &c. A second party assisting under an unlicensed assistant.
D. Nelson, Waitakere, Aorere, &c. ..	2,400	4·50	..	..	2,577	2·90	..	..	..	..	..	..	1·40	19·25	7 16 6	854 12 0	Rough broken country in heavy bush. £554 12s. 2d. carried forward to next year, representing rural surveys in Waitakere, Lewis, and Matiri Survey Districts, &c.
W. D. Armit, Totaranui	..	..	..	..	..	..	..	..	..	..	..	..	6·20	27·00	35 10 0	760 9 0	Tortuous road surveys in heavy bush intersecting small sections. "Other work" is prospecting for roads, repairing trig. stations, &c. £557 11s. carried forward to next year, representing 20 miles of road survey, &c.
——, Motueka, Mount Arthur, &c.	7,985	1·32	2,708	1·35	3,388	2·60	..	..	..	..	..	..	1·75	31·14	15 2 8	695 11 0	Applications, &c., in high broken country in heavy bush. £1,428 15s. carried forward to next year, representing some 10,000 acres, complete in the field. This work carried out by Mr. J. H. Buttress, authorized assistant.
——, Totaranui, Oparara ..	..	..	..	..	1,159	3·57	..	..	..	..	..	..	..	..	9 5 6	642 5 3	Rough broken country in heavy bush. £426 2s. 1d. carried forward to next year, representing 1,553 acres of rural land and 40,000 acres of triangulation nearly complete in field. This work carried out by Mr. F. H. Waters, authorized assistant.
Temporary Staff.																	
S. S. Springall, Otumahana, Waitakere	..	..	..	..	4,791	3·60	1·2	5	50·00	..	..	..	1·00	57·00	73 13 8	830 18 4	Applications, &c., in rough broken country in heavy bush, on west coast. "Other work" consists of remeasuring the Karamea base and some alignment surveys in Westport. £320 4s. 9d. carried forward to next year.

		d.		d.		s.			s.			d.		£	£	s.	d.	£	s.	d.	
J. Stevenson, Burnett, Matakitaki, &c.	..	..	..	..	8,330	1·85	..	..	..	..	..	..	..	..	55	0	0	1,590	4	5	Tae Warwick Block broken country in heavy bush. £1,623 6s. 11d. carried forward to next year, representing part of the Brighton Block and triangulation on west coast, 150,000 acres of which is completed in the field. A second party assisting under an authorized assistant.
P. R. Wilkinson, Matakitaki ..	..	..	..	..	2,120	1·71	..	..	..	..	..	..	..	..	..			25	2	2	Part of Rappahannock Block; broken country, heavy bush. Left the field in April. Subsequently transferred to Auckland.
S. Parkinson, Rotoroa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..			48	5	1	Took the field in the middle of March. Assisting Mr. Maitland on the Gowan Block.
Contract Surveyors.																					
T. Learmont, Reefton, Maimai, &c. ..	..	..	..	..	3,791	3·00	31·5	104	20·60	..	..	..	..	..	..			676	5	6	Applications, &c., in Inangahua County; very steep and broken country in heavy bush on west coast. "Town survey" is mining township of Hukawai.
J. Snodgrass, Steeples, Ngakawau, &c.	..	..	..	..	1,847	2·95	..	..	..	..	..	..	..	..	..			272	11	0	Applications in the Buller County. Very steep and broken country in heavy bush on the west coast.
J. Cumine, Burnett	..	..	..	..	4,701	2·75	..	..	..	..	..	..	..	..	..			646	7	9	Maruia South Block. Crown land in Maruia Valley. Very steep country in heavy bush on the west coast.
Davis and Porteous, Otumahana, Kongahu	..	..	..	..	9,951	2·66	..	..	..	..	..	..	..	..	..			1,326	16	0	Kongahu Block. Rough broken country in heavy bush on the west coast.
Middleton and Smith, Otumahana ..	..	..	..	..	5,392	2·50	..	..	..	*5,864	9	13·03	..	..	..			992	8	9	Rural is Blue Duck Block, which is rough broken country on the west coast. Native is part of D'Urville Island (subdivision only).
C. M. Hoult, Kaiteriteri	..	..	..	..	1,057	2·25	..	..	..	..	..	..	..	..	..			118	18	3	Applications in heavy bush on the Takaka Hills.
Ledger and Hoult, Wangamoa ..	..	..	..	..	..	..	..	..	..	*1,714	9	42·00	..	..	..			300	0	0	Wangarae Native Reserve. Very high broken country in heavy bush.
Means and totals	10,385	2·05	2,708	1·35	60,365	2·68	36·2	137	24·54	*7,578	18	19·58	28·15	18·35	903	6	4	14,508	17	1	

* Native Land Court.

Table 1a.—Return of Field-work executed by the Staff and Contract Surveyors from 1st April, 1912, to 31st March, 1913—*continued.*

Canterbury Land District.

District.	Minor Triangulations.		Typographical Survey for Selection as "Unsurveyed Land."		Rural.		Village and Suburban.			Town Section Survey.			Native-land Survey.			Roads, Railways, and Water-races.		Other Work.	Total Cost of Surveyor and Party from 1st April, 1912, to 31st March, 1913.	Remarks
	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	Cost per Acre.	Acres.	No. of Sections.	Cost per Acre.	Acres.	No. of Sections.	Cost of Sections.	Acres.	No. of Secs. or Divs.	Cost per Acre.	Miles.	Cost per Mile.	Cost.		
Staff Surveyors.				d.		s.									d.		£	£ s. d.	£ s. d.	
A. G. Allom, Waimate	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	100 6 0	100 6 0	£16 7s. 4d. was carried forward from last year against Waimate Settlement survey. This survey was commenced by Mr. Allom, and on his being granted extended leave was finished by Mr. Drury, and an amount of £63 1s. 2d. (including the £16 17s. 4d.) is included in Mr. Drury's total cost of rural surveys, as it was found impossible to allocate the area done by Mr. Allom.
A. J. Mountfort, Opuha, Waimate, Corwar (and assistant)	..	..	34,180	1·0	38,673	0·46	..	..	..	..	..	..	..	..	..	..	..	10 0 0	966 16 3	£727 19s. 11d. was carried forward from last year, and is included in the total cost of topographical and rural surveys. £606 10s. 11d. is carried forward against work in hand, and includes cost of Mr. Hathaway and party, £169 13s., Greta Peaks runs survey.
E. de C. Drury, Waimate, Mount Peel, Nimrod (and assistant)	..	..	..	..	7,403	1·47	..	..	..	..	..	..	*14·5	3	206·9	..	..	30 15 5	1,228 0 6	£63 1s. 2d., expenses incurred by Mr. Allom on Waimate Settlement survey is included in the cost of rural surveys, as the work was taken over and completed by Mr. Drury. £653 13s. 8d. is carried forward against work in hand, and includes cost of Mr. Hathaway and party (£206 14s. 3d.) on survey of Mount Nessing Settlement.
A. N. Harrop, Four Peaks, Pareora	..	..	..	..	17,695	0·64	..	..	..	..	..	..	..	..	..	..	..	23 10 0	263 15 8	£327 12s. 8d was carried forward from last year, and is included in the total cost of rural surveys. Mr. Harrop returned to Westland in June.
C. H. Morison, Rolleston, Oxford ..	..	..	..	..	1,008	1·66	..	..	..	..	..	..	..	..	..	4·0	21·42	77 16 4	247 9 2	Mr. Morison returned to Westland in June.
Temporary Staff.																				
L. Hunt, Opuha, Oxford ..	..	..	..	..	11,160	0·36	..	..	..	..	..	..	..	..	..	1·75	18·89	..	492 7 5	£256 12s. 10d. carried forward against work in hand. Temporarily transferred from Marlborough District.
R. R. Richmond, Hinds, Ashley, Oxford, &c.	..	..	..	..	1,400	0·86	..	..	..	..	..	..	..	..	..	..	..	157 17 9	295 0 2	£76 15s. 3d. carried forward against work in hand.
Means and totals ..	..	..	34,180	1·0	77,339	0·75	..	..	..	..	..	..	*14·5	3	206·9	5·75	20·65	460 5 6	3,593 15 2	

* Native Land Court.

Table 1a.—Return of Field-work executed by the Staff and Contract Surveyors from 1st April, 1913, to 31st March, 1913—*continued.*

Surveyor and District.	Rural.		Village and Suburban.			Town Section Survey.			Native Land Survey.			Gold-mining Survey.			Roads, Railways, and Water-races.		Other Work.	Total Cost of Surveyor and Party from 1st April, 1912, to 31st March, 1913.	Remarks.
	Acres.	Cost per Acre.	Acres.	No. of Sections.	Cost per Acre.	Acres.	No. of Sections.	Cost per Acre.	Acres.	No. of Sections or Divisions.	Cost per Acre.	Acres.	No. of Sections.	Cost per Acre.	Miles.	Cost per Mile.	Cost.		
		s.												s.		£	£ s. d.	£ s. d.	
Otago Land District.																			
Staff Surveyors.																			
W. T. Neill, City of Dunedin ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1,358 7 6	Standard survey, City of Dunedin. Total cost to 31st March, 1913, £3,078 9s. 4d.
D. I. Barron, Leaning Rock, Teviot, &c.	8,646	1·64	..	..	..	..	..	..	..	..	..	..	..	..	..	..	79 0 9	791 1 9	About 8,350 acres consisted of open country cut into four small grazing-runs. The balance of 296 acres represents scattered application surveys in the Clutha Valley. Mr. Barron was transferred to Auckland in November.
S. T. Burton, Woodland, Rimu, &c.	1,484	4·70	..	..	..	..	..	..	..	..	..	206	4	4·04	0·62	54·16	152 0 5	785 10 2	£208 17s. 3d. is carried forward to next year. This work was partly heavy bush scenic reserves in Southern Otago and partly application and settlement surveys very scattered in the Otago Central District.
Contract Surveyor.																			
N. Paterson, Clutha	1,818	0·95	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	87 4 0	Otanomomo Settlement. All level open land, 5 miles from Balclutha.
Means and totals ..	11,948	1·92	..	..	..	..	..	..	..	..	..	206	4	4·04	0·62	54·16	231 1 2	3,022 3 5	
Licensed surveyors (paid for by applicants)	..	..	..	..	..	..	..	..	..	..	..	1,592	34	..	..	..	..	..	
Totals	..	..	..	..	..	..	..	..	..	..	..	1,798	38	..	..	..	..	..	
Southland Land District.																			
Staff Surveyors.																			
C. Otway, Longwood, Jacob River, Oteramika, &c.	5,162	4·30	..	..	..	..	..	..	..	..	..	..	..	..	1·75	12·40	381 14 8	827 6 0	£685 8s. 7d. brought forward from last year. Mostly rough bush country. Cadet assisting from 1st January.
D. Macpherson, Aparima, Waiau ..	10,120	3·85	..	..	..	..	..	..	..	..	..	..	..	..	2·30	16·13	50 10 11	1,011 12 5	£1,041 18s. brought forward from last year. £16 18s. carried forward to next year. Bush and hilly open country. Cadet assisting up to 12th January.
N. L. Falkiner, Campbelltown, Invercargill, &c.	8,575	2·09	3·72	9	61·88	19·34	52	27·18	..	..	..	..	..	..	7·82	32·00	469 9 6	1,207 19 10	£494 13s. 5d. brought forward from last year. £5 carried forward to next year. Bush country—open, hilly, and swampy.
H. M. Thompson, Longwood and Alton	2,879	6·12	47·57	19	30·38	..	..	..	..	..	..	..	..	..	5·60	11·60	82 14 6	919 3 9	£338 8s. 10d. brought forward from last year. £155 16s. 8d. carried forward to next year. Chiefly heavy rough bush country.
Contract Surveyors.																			
H. R. Dundas, Jacob River and Aparima	46	6·39	..	..	..	..	..	..	*11·7	45	759·0	..	..	..	..	..	..	51 14 0	Contracts.
Blaikie and Wilson, Hokonui ..	1,415	1·10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8 2 0	86 2 0	Contracts.
L. Webb, Invercargill	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8 8 0	8 8 0	Alignment survey, part Georgetown, Borough of Invercargill.
Means and totals ..	28,197	3·49	51·29	28	32·67	19·34	52	27·18	*11·7	45	759·0	..	..	..	17·47	21·42	1,000 19 7	4,112 6 0	
Licensed surveyors (paid for by applicants)	2,205	..	..	..	..	..	..	..	..	..	..	68	1	..	..	..	..	..	
Totals	30,402	..	..	..	..	..	..	..	..	..	..	68	1	..	..	..	..	..	

* Native Land Court.

Table 2.—Return showing Surveyors employed and the Work on Hand on 1st April, 1913.

Chief Surveyors.	Surveyors employed.			Work on Hand.					
	Staff.	Temporary.	Contract.	Land District.	Trig.	Settlement.	Town.	Native Land Survey.	Roads.
					Sq. Mls. standard	Acres. and inspection	Acres. other works.	Acres. surveys.	Miles.
Head Office ..	4	..	..	Engaged on					
..	4	..	..	"					
H. M. Skeet ..	21	6	..	Auckland ..	10·60	212,595	..	100,187	157·25
R. T. Sadd ..	5	1	..	Hawke's Bay	312·93	*122,274	..	72,186	44·75
G. H. Bullard ..	4	1	..	Taranaki ..	48·00	76,619	10	..	21·00
T. N. Brodrick ..	6	1	..	Wellington ..	3,919·37	54,450	..	14,850	30·00
F. A. Thompson ..	7	3	..	Nelson ..	277·00	96,024	..	..	39·00
W. H. Skinner ..	1	1	..	Marlborough	..	6,533	2	..	4·00
H. D. M. Haszard	4	..	..	Westland ..	9 50	14,774	..	..	9·00
C. R. Pollen ..	3	1	..	Canterbury ..	..	105,440	..	..	3·00
E. H. Wilmot ..	2	..	..	Otago ..	..	289	..	..	..
G. H. M. McClure	4	..	..	Southland ..	..	7,499	..	..	0·50
Total staff surveyors	65	14	..	..	4,577·40	696,497	12	187,223	308·50
	..	..	53	Auckland ..	..	7,809	..	300,010	26·25
	..	..	10	Hawke's Bay	..	..	..	32,865	..
	..	..	11	Taranaki ..	..	10,224	..	32,356	6·00
Contract surveyors	..	..	13	Wellington ..	..	1,829	..	62,520	..
	..	..	3	Nelson ..	..	6,650	..	..	..
	..	..	1	Marlborough	..	612	2	..	..
	..	..	1	Southland ..	..	..	..	23	..
Total contract surveyors	..	..	92	..	..	27,124	2	427,774	32·25
Total staff and contract surveyors	65	14	92	..	4,577·40	723,621	14	614,997	340·75

* 49,000 acres of this will be a preliminary survey.

Table 3.—Plans placed on Crown Grants and other Instruments of Title from the Crown from 1st April, 1912, to 31st March, 1913.

Land District.	Number.					Cost.		
	Singly.	In Duplicate.	In Triplicate.	In Quadruplicate	Total Copies.	£	s.	d.
Auckland	..	23	1,319	18	4,075	270	0	0
Hawke's Bay ..	..	314	117	6	1,003	62	13	9
Taranaki	10	96	220	10	902	81	5	5
Wellington	12	24	525	..	1,635	81	15	0
Nelson	..	..	41	..	123	20	6	8
Marlborough ..	7	18	32	..	139	11	8	6
Westland	..	152	68	..	508	63	10	0
Canterbury	29	..	..	..	29	2	3	6
Otago	..	112	152	..	680	95	0	0
Southland	32	44	292	..	996	53	16	4
Totals	90	783	2,766	34	10,090	741	19	2

Table 4.—Work done under the Land Transfer Act, etc., from 1st April, 1912, to 31st March, 1913.

Land District.	Number of Plans passed.	Deeds and other Instruments passed.	Number of Plans placed on Certificates of Title.					Miscellaneous Plans, &c.	Cost.		
			Singly.	In Duplicate.	In Triplicate.	In Quadruplicate.	Total Copies.		£	s.	d.
Auckland ..	781	3,649	39	3,394	..	..	6,827	50	593	17	0
Hawke's Bay ..	141	714	1	639	..	..	1,279	..	283	8	1
Taranaki ..	132	1,020	10	502	2	..	1,020	..	183	9	4
Wellington ..	222	2,931	4,505	..	..	..	4,505	..	1,650	4	0
Nelson ..	75	176	..	221	..	..	442	..	155	15	5
Marlborough ..	32	..	5	154	43	..	442	..	82	10	9
Westland ..	26	..	..	49	42	..	224	..	71	7	8
Canterbury ..	396	2,720	22	2,184	35	..	4,495	45	1,673	16	2
Otago ..	106	1,150	..	898	..	..	1,796	..	389	6	4
Southland ..	141	950	16	664	2	..	1,350	..	388	6	6
Totals ..	2,052	13,310	4,598	8,705	124	..	22,380	95	5,472	1	3

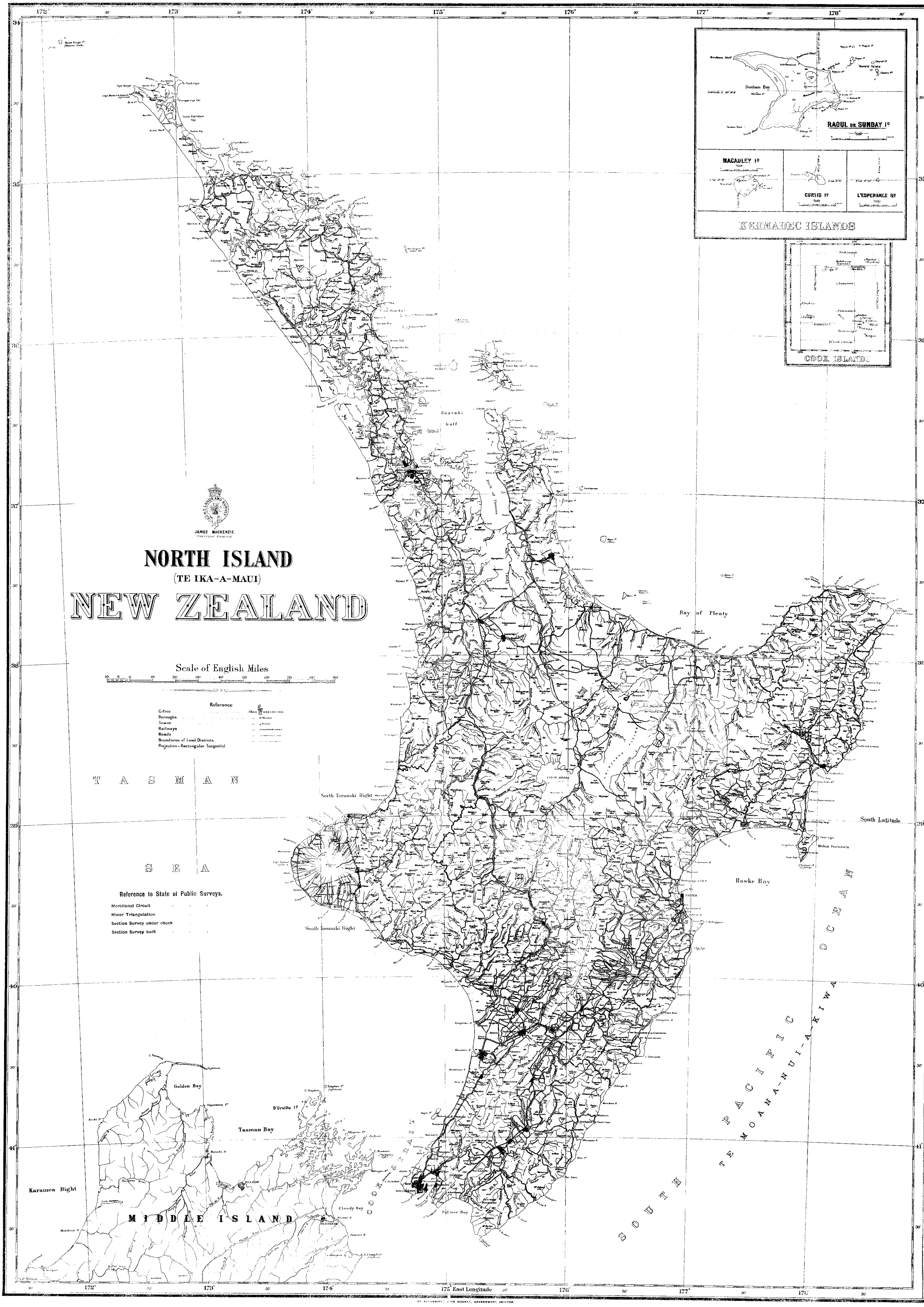
Table 5.—Lithographs and Photographs printed and sold, from 1st April, 1912, to 31st March, 1913.

Land District.	Number of Lithographs printed.	Number of Photographs printed.	Amount of Fees received from Sale of Maps, Lithographs, &c.
			£ s. d.
Auckland	2,000	..	339 19 3
Hawke's Bay	..	..	..
Taranaki	..	..	68 11 8
Wellington	..	..	24 3 0
Nelson	..	..	15 0 0
Marlborough	..	..	34 15 4
Westland	..	..	16 16 0
Canterbury	..	..	62 18 6
Otago	2,236	..	93 18 6
Southland	..	..	61 2 4
Totals	4,236	..	717 4 7

Approximate Cost of Paper.—Preparation, not given; printing (1,500 copies, including maps, plans, and illustrations), £170.

By Authority: John Mackay, Government Printer, Wellington.—1913.

Price 2s. 9d.



BY AUTHORITY: JOHN MACKAY, GOVERNMENT PRINTER.

JAMES MACKENZIE.
Surveyor General

SOUTH ISLAND
(TE WAI-POUNAMU)
NEW ZEALAND

Scale of English Miles
10 5 0 10 20 30 40 50 60 70 80 90

Reference
Cities ..... thus
Boroughs .....
Towns and villages .....
Railways and stations .....
Roads .....
Boundaries of Land Districts .....
Projection – Rectangular Tangential

Meridional Circuit
Minor Triangulation
Section Survey under check
Section Survey built

Golden (To Taitapu) Bay
Tasman Bay
Karamea Bight
Cloudy Bay
Pegasus Bay
Banks Peninsula
Canterbury Bight
Otago Peninsula (Otakou)
Stewart Island (Rakiura)
T A S M A N S E A
S O U T H P A C I F I C O C E A N
(TE MOANA-NUI-A-KIWA)
FOVEAUX STRAIT
COOK STRAIT
SOUTH ISLAND
NORTH ISLAND
South Latitude
East Longitude

BOUNTY Is^DS
ANTIPODES Is^DS
AUCKLAND Is^DS
CAMPBELL Is^DS
(REKOHU OR WHARE-KAURI)
CHATHAM ISLANDS
Scale of English Miles

By Authority: John Mackay, Government Printer.