SESSION II.

1912.

NEW ZEALAND.

DEPARTMENT OF LANDS AND SURVEY:

SURVEYS

(ANNUAL REPORT ON).

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

CONTENTS.

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

SIR,— Department of Lands and Survey, Wellington, 1st June, 1912.

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, 1912. In doing so I would draw attention to the fact that the Surveyor-General in charge of these operations for the year was Mr. John Strauchon, who relinquished such duties on being promoted to the position of Under-Secretary and Head of the Lands and Survey Department on the 1st April, 1912. The following report is therefore based upon the work carried out under his guidance.

I have, &c.,

JAMES MACKENZIE,
Surveyor-General.

The Hon. Thos. Mackenzie, Minister of Lands.

REPORT.

THE demands on the Department for the year ending the 31st March, 1912, have again been heavy, consequent on the still-increasing demand for land not only from within, but from many places outside the Dominion, as is testified by the great amount of inquiries in the correspondence department. Of the surveyors employed, 50 were staff, 11 temporary, and 105 contract, while, apart from these, there were a number of cadets and assistants employed.

WORK COMPLETED DURING THE YEAR.

The total cost of the surveyors and their parties amounts to £89,530. This, along with the costs per acre, compared with those of the preceding year, is somewhat in excess, which has been occasioned by the great amount of rainfall that prevailed. The summary below enumerates the principal work completed during the year:—

TABLE A.

Class of Work.	Area.	Cost per acre.	Total Cost.
	Acres.		£ s. d.
Triangulation, by staff	125,947	1·43d.	749 0 0
Triangulation, by licensed surveyors	10,800	0·33d.	15 0 0
Topographical, by staff	159,281	3·78d.	2,510 13 1
Rural, by staff	376,708	1·82s.	34,340 2 5
Rural, by licensed surveyors	53,761	2·28s.	6,131 4 0
Rural, by licensed surveyors (cost not available)	9,715	..	..
Village and suburban, by staff	1,759·37	11·06s.	973 8 2
Village and suburban, by licensed surveyors (cost not available)	84·5	..	..
Town, by staff	336·86 in 534 sections	38·90s. per section	1,038 14 9
Town, by licensed surveyors	5·25 in 57 sections	16·94s. per section	48 6 0
Native Land Court, by staff	64,987	14·70d.	3,981 6 0
Native Land Court, by licensed surveyors	257,882	16·96d.	18,227 2 9
Native Land Court, by licensed surveyors (cost not available)	76,407	..	..
Maori Land Board, by staff	21,777	27·18d.	2,467 1 5
Maori Land Board, by licensed surveyors	25,993	14·70d.	1,591 19 4
Maori Land Board, by licensed surveyors (cost not available)	5,403	..	..
Gold-mining, by licensed surveyors	596	4·64s.	138 7 5
Gold-mining, by licensed surveyors (cost not available)	1,570	..	..
Roads and railways, by staff	209·18 miles	£22·73 per mile	4,756 13 2
Roads and railways, by licensed surveyors	3·60 ,,	£21·41 per mile	77 1 9
Roads and railways, by licensed surveyors (cost not available)	4·25 ,,	..	..

TRIANGULATION.

The work returned for the year has been spread over an area of 136,542 acres. This has been confined to the following districts—viz., Auckland, 41,792 acres; Taranaki, 27,000 acres; Wellington, 48,900 acres; and Nelson, 18,850 acres.

Mr. H. E. Girdlestone has been engaged throughout the year on the extension of the secondary triangulation embracing the districts of Wellington, Wairarapa, Manawatu, Wanganui, and Taranaki. This work, which has been in hand for a number of years, was taken over from Mr. H. J. Lowe by Mr. Girdlestone in September, 1910. Good progress has been made, but, owing to the phenomenally wet weather that prevailed during the summer, observations were greatly retarded.

The very important work of laying down suitable base-lines has been continued by Mr. J. Langmuir, Inspector of Surveys. Those upon which he has been engaged are the Waitemata and Matamata bases, and his careful detailed report on same will be found in Appendix III.

These base-lines have been completed by him, and, as the figures speak for themselves in his report, nothing further need be said than that they reflect his great professional ability and painstaking accuracy.

The Kaingaroa Plains base-line is the next to be measured, and work on this has already been begun by Mr. Langmuir.

Standard Survey.

The standard survey of the City of Auckland is now almost completed. This work was started in the field and supervised by Mr. J. Langmuir, Inspector of Surveys, and by Mr. H. M. Kensington, District Surveyor, on the 20th March, 1907. After a period of six months Mr. Langmuir's duties in connection with the office-work, preparation of plans, &c., compelled him to relinquish the field-work, which was then carried on by Mr. H. M. Kensington and staff, but still under Mr. Langmuir's supervision.

There are forty-two plans in all, each of which has a covering-sheet attached. These have been copied in duplicate, one copy being for the Auckland City Council and one for the Auckland District Survey Office, making 149 finished plans. One hundred and forty traverse-sheets have been bound and deposited in the Auckland Survey Office. Owing to municipal works and other causes, fifty-three standard blocks had to be taken out and reinstated, which, besides the time and delay caused, always requires special care in refixing in their true position. To give some idea of what this entails I would mention that the blocks are frequently reinstated bodily—*i.e.*, surface box and all—the whole weighing from 5 cwt. to 7 cwt., illustrations of which will be found at end of report. The total length completed of street standard chainage is 65 miles, necessitating 923 standard blocks, of which 650 have been fitted with cast-iron covers, while the remainder are chiefly surface blocks level with the pavement. Besides these there are sixty iron spikes set partially in concrete. This very special work, requiring as it does such extra care and attention to details, has been carried out with such thoroughness and accuracy as to reflect the highest credit on the two officers mentioned.

Apart from the Auckland City standard survey referred to above, Mr. H. M. Kensington reports that the work during the year comprised computations in connection with the Parnell Borough standard survey, computations and plans in connection with the Rotorua standard survey, Auckland suburban standard survey, and the reinstating and fixing position of standard blocks in Auckland City and suburbs. There was also the precise levelling from high-water mark to the top of Mount Eden for the purpose of arriving at its true height relative to the new mean-tide level. This work was greatly interfered with by the bad weather that prevailed, and which has been the experience of nearly all the surveyors in the service in both Islands. Correspondence and the supplying of information in connection with the above works has also taken up a large amount of time.

Mr. J. D. Climie, Inspector of Surveys, reports that during the year the 10 miles of standard traverse, Hutt to Emerald Hill, was completed, including the connections to Mr. Mackenzie's old blocks. Forty concrete blocks were inserted. This work will be found very useful for Land Transfer surveys, and as soon as the new triangulation is available he can give the final co-ordinates for the standard blocks.

Mr. W. T. Neill, Inspecting Surveyor, who started the standard survey of the City of Dunedin last year, has made good progress with the work, as between 40 and 50 miles of streets have now been traversed and marked, despite the bad weather that has prevailed.

Mr. C. Adnam Mountfort reports, in connection with the Wanganui Borough standard survey, that the whole of the field-work has been completed, with the exception of Durie Hill and some check chaining which he hopes to finish at the beginning of the new year. The field-work was pushed on with as fast as possible, and this left no time for maps and computations to be made for this year's return.

District Surveyor Harrop made a start with the standard survey of the Borough of Greymouth, but as his services were required on the urgent settlement surveys of Canterbury, he was compelled to leave it in abeyance.

The standard survey of the Town of Blenheim has been extended into the suburban areas for a distance of about 2 miles. It is hoped that the Town of Invercargill and suburbs will be able to receive consideration shortly, in order to facilitate necessary work in connection with Land Transfer surveys.

Coastal Survey.

During the year, and for a period of three months from July, Lieutenant H. L. L. Pennell, R.N., in the "Terra Nova," R.Y.S., who had associated with him Lieutenants Renwick and Bruce,

visited the North Cape, Cape Maria van Diemen, and the Three Kings islands. During the period at their disposal they accomplished work of great importance to navigation, and the information thus obtained will be placed on the new chart of that locality to be issued by the Admiralty authorities.

Tidal Survey.

The report in connection with the tidal records, &c., will be found fully dealt with in Appendix V by Mr. C. E. Adams, M.Sc., F.R.A.S., Chief Computer, who is in charge of this work.

Settlement Survey.

Under settlement surveys a very large area has been completed during the year, which is represented by a total of 495,200 acres classed under the following heads: Rural, 440,184 acres; village and suburban, 1,843 acres; Maori Land Board subdivisions, 53,173 acres. On referring to Table I, these areas will be found divided up into their respective districts. Apart from the above-mentioned total, there is a still further area of 159,281 acres which has been topographically surveyed for the purpose of opening land for selection in the Districts of Auckland Hawke's Bay, Wellington, Westland, and Canterbury. At the close of the year the area of settlement surveys actually in hand and those proposed to be allotted give a total of 709,096 acres, of which 659,481 acres will be in the hands of the staff surveyors, and the balance of 49,615 acres in those of contract surveyors. This is exclusive of an area of 110 acres of town land.

The lands enumerated above, which also include the pastoral and small grazing-runs, are those upon which the selector will make his home, and from which the Dominion reaps so much of her prosperity. Such being the case, it demands and receives the most careful attention at the hands of the Department, in order that every detail may be considered prior to its ultimate disposal under the different tenures of the Land and other Acts through which they are offered to the public. One feature that calls for special attention is the cutting-up of those private estates acquired from time to time by the Crown under the Land for Settlements Act for the purpose of what is termed closer settlement. After taking into consideration the purchase-price paid, it follows that the scheme of survey has to be carefully gone into in order that the partition of the estate shall be into such areas as are most suitable to the particular locality, and that the settlement shall well repay the cost entailed. It also means that, in order to reap the greatest benefits from the disposal of these lands, the question of having the survey completed at such time as will be best for placing it on the market has also to be considered. This necessitates in some cases the drafting of certain surveyors from one district to another, and this considerably increases the cost, as these surveys are always urgent, and have to be pushed through in the shortest possible time in order save loss of interest on the capital invested. Owing to the shortage of surveyors at the present time, this throws certain work slightly in arrears, which condition, however, is met in part by the employment of private surveyors under contract.

For many years past so great has the land-hunger been that it was found utterly impossible to make complete surveys dealing with certain areas. All that could be expected was a preliminary survey, while the matter of roading had to be left in abeyance. This entailed severe hardships in the matter of ingress and egress to the selector, although every effort was made to try and cope with these difficulties by roads and tracks as opportunity arose. It can still be said that the desire for land remains unsatisfied, but not to the extreme degree as heretofore. Under these circumstances, the Department has decided that no land shall be placed on the market until it has been fully surveyed. By this means it is hoped to mitigate as far as possible the difficulties of the settlers in the backblocks, and give them better facilities for financing their clearings and for grassing operations, as well as for the provision of better roads. I am also strongly of opinion that in future no remote blocks of dense bush land should be opened up for selection until at least one or more main roads have been formed (even as bridle-roads) to and through the block. This would save an immense amount of hardship and discomfort to the selectors, their wives and families.

Native-land Survey.

During the year the area surveyed was 452,249 acres in 2,135 subdivisions, comprising 399,276 acres of Native Land Court surveys, and 53,173 acres of Maori Land Board surveys.

Of the Native Land Court area, 64,987 acres in 284 subdivisions was surveyed by the staff; while 334,289 acres in 710 subdivisions was surveyed by contract surveyors, which includes an area of 76,407 acres in 409 subdivisions, the survey of which is paid for by the applicants.

Of the Maori Land Board area, 21,777 acres was surveyed by the staff, while 31,396 acres was surveyed by contract surveyors, which includes an area of 5,403 acres, the survey of which is paid for by the applicants.

The area of Native-land surveys contemplated to be put in hand and those actually in progress reaches a total of 813,121 acres. Of this area 204,082 acres is in the hands of the staff, while 609,039 acres is in that of contract surveyors.

The continual application of lessees of Native lands in the Auckland District for road-access through adjoining Native lands is a matter that will very shortly require to be considered and dealt with, in order to simplify the methods now in vogue and expedite the work required.

Inspections.

During the year, owing to the rush of subdividing areas for settlement lands in the Canterbury District, which necessitated the transference of surveyors from the Westland District, the inspections of surveys in these places were but few. In Taranaki and Nelson also there were not many inspections able to be made, as other more urgent work did not permit. Those, however, that were made proved to be satisfactory.

In the Auckland District Mr. W. J. Wheeler, Inspecting Surveyor, has made sixty inspections, and Mr. Galbraith, District Surveyor, seven inspections, all of which were very satisfactory.

Twenty-three inspections were made in the Hawke's Bay District by Messrs. Bullard, Brook, and Cagney, and although the results in some cases show a lack of thoroughness on the part of the surveyors, yet, taken as a whole, they were of a satisfactory character.

Although the inspections this year have not been as many as could be wished, owing to various causes militating against it, yet, these being exceptional, will no doubt not occur this year, and thus allow the work being carried on in the usual manner.

Gold-mining Survey.

Forty-two claims, representing 2,166 acres, were surveyed during the year by contract surveyors. Out of this area 596 acres, in seven claims, were completed, at a cost of 4·64s. per acre. The balance of 1,570 acres was paid for privately, and was distributed in the following districts—viz., Nelson, 394 acres, in six claims; Marlborough, 95 acres, in one claim; Otago, 883 acres, in twenty-three claims; Southland, 198 acres, in five claims.

Operations for 1912–13.

The field staff at the beginning of the new year comprises sixty-nine surveyors with eleven assistants, and the extent of work actually on hand with them and with the contract surveyors, as well as that actually in progress, will be found in the accompanying reports of the Chief Surveyors for the respective districts. The work may be summarized as follows: Minor and secondary triangulation, 4,899 square miles; settlement survey, 709,096 acres; Native-land survey, 813,121 acres; roads, 316 miles. The areas of 709,096 acres for settlement and that of 813,121 acres for Native land do not represent all new work, for the survey of more than a third of the former and a fair percentage of the latter is completed, but time has not permitted for plans of same to be sent in.

Apart from the above-mentioned work, there is also the carrying-on of the standard-survey work of the towns in both Islands, the customary inspection of surveys by the Inspecting Surveyors and others, the work of computing tide-tables, and also the necessary computations, &c., of the various triangles from the different bases in connection with the secondary triangulation now being carried on.

Surveyors Board.

For the report dealing with the Surveyors Board see Appendix IV.

Magnetic Observatory and Magnetic Survey.

Mr. H. F. Skey, B.Sc., the officer in charge of the Magnetic Observatory at Christchurch, who has been ably helped by his assistant, Mr. Thomas Maben, sends in his report for the year, and deals with the records obtained by the Milne seismograph No. 16, meteorological observations, and those of the Magnetic Survey. The latter calls for special attention, due to the valuable magnetic records obtained by Captain Scott's and Mawson's expeditions to the Antarctic. For report on the above see Appendix II.

Departmental Changes: Promotions, Transfers, Appointments, etc.

Consequent on the retirement on superannuation of the late Mr. E. C. Gold Smith, Commissioner of Crown Lands and Chief Surveyor for Auckland, Mr. H. M. Skeet was appointed from Southland to succeed him, while Mr. G. H. M. McClure, of Westland, took Mr. Skeet's place. Mr. H. D. M. Haszard, Chief Draughtsman at Christchurch, was promoted to Commissioner of Crown Lands and Chief Surveyor for Westland, while Mr. H. G. Price, Chief Draughtsman at Napier, was appointed to succeed him. Mr. F. A. Thompson, Chief Draughtsman at Hokitika, was promoted to succeed Mr. Price, while Mr. D. M. Calder, District Surveyor, Dunedin, was promoted to Mr. Thompson's place. Mr. G. H. Bullard, Inspecting Surveyor and Land Officer, Gisborne, was promoted to be Commissioner of Crown Lands and Chief Surveyor for Taranaki in the place of the late Mr. W. Armstrong. Mr. T. Brook, District Surveyor, was promoted to succeed Mr. Bullard at Gisborne. Owing to the retirement on superannuation of Mr. F. G. Smith, Commissioner of Crown Lands and Chief Surveyor for Marlborough, Mr. W. H. Skinner, Chief Draughtsman at New Plymouth, was promoted in his place, while Mr. H. J. Lowe, surveyor, Wellington, took the latter's position. Mr. W. F. Marsh, Chief Draughtsman at Blenheim, was transferred to Dunedin, his place being filled by Mr. A. D. Burns. Mr. H. T. McCardell, draughtsman, after a period of over thirty-eight year's service, two of which he has held as Acting Chief Draughtsman at the Head Office, was promoted to the position of Chief Draughtsman in the same office. Mr. R. W. S. Ballantyne, officer in charge of the Native Branch at Auckland, was transferred to Wellington, Mr. C. T. Brown of the Wellington District Office taking his place; and on the latter's appointment to the Presidency of the Ikaroa Maori Land Board his work was taken over by Mr. R. J. Knight. Mr. Hursthouse, Crown Lands Ranger, Westport, was transferred to Marlborough, and was succeeded by Mr. F. Ward. Mr. A. Meharry, Crown Lands Ranger for Westland, resigned, and his place has been taken by Mr. G. Anderson.

In the Auckland District Messrs. W. M. Atkinson and A. J. Mountfort, assistant surveyors, were transferred to Napier and Christchurch respectively. Mr. D. W. Gillies, District Surveyor, retired, as also Messrs. Covil and Scanlen, of the office staff. Mr. Macmorran, surveyor, was appointed to the engineering surveys, Hauraki Plains, while Mr. Hooper came from the field into the office. Mr. J. H. Lindsay was appointed to the field staff, and Mr. Goulding, surveyor, resigned. Mr. J. H. Boscawen, Chief Clerk, was appointed to the position of Inspector of Kauri-gum Reserves and Forest Areas. Mr. R. Leckie, clerk, was transferred to Christchurch, to succeed Mr. Bendely as Chief Clerk.

In the Hawke's Bay District Mr. D. Nelson, of Gisborne, was appointed assistant surveyor at Nelson. Mr. L. W. Ward, assistant surveyor, resigned.

In the Wellington District Mr. Greville, surveyor, joined the District Office staff as Inspecting Surveyor and Computer. Mr. Keddell, assistant surveyor, retired from the staff. Messrs. Randrup and Enting were transferred to Auckland, while Miss Gillanders, Computer, was transferred to Christchurch.

In the Nelson District Mr. N. Wright was tranfserred to Napier, Mr. P. Keenan taking his place as Record Clerk and Accountant. Cadet J. A. Montgomerie was promoted from the Reefton Office to be draughtsman at New Plymouth. Mr. W. D. Armit was appointed assistant surveyor, Miss S. M. Murrell as typiste, and Mr. H. Black as temporary draughtsman. Mr. Roebuck, draughtsman, resigned, and Mr. J. P. Black took his place. Mr. Henry Smith, Land Officer, is now in charge of the Land and Survey Office at Reefton.

In the Marlborough District Mr. W. Lindsay, draughtsman, resigned, the vacancy being filled by Mr. E. Pfankuch, of New Plymouth.

In the Canterbury District Mr. J. G. Bendely, Chief Clerk, was transferred to Auckland to succeed Mr. J. H. Boscawen, Mr. Henderson was appointed draughtsman, and Messrs. Newman and Freeman, draughtsmen, resigned.

Obituary.

During the past year death has been busy amongst the ranks of the surveyors, and it is with a feeling of regret that I have to record the passing-away of so many valued officers and ex-officers of the Department in the persons of Messrs. E. C. Gold Smith, Sidney Weetman, W. Armstrong, W. H. Pearson, and J. A. Montgomerie.

Mr. E. C. Gold Smith came to the Dominion in the year 1864, and joined the first Waikato survey under Mr. Lowe in 1867. About this time he enlisted in the Volunteers at Tauranga, and saw active service under Captain Skeet. He also served as sergeant in Major Fraser's expedition to Waimana. In 1870 he again took up surveying, and accepted an offer of the General Government on the Survey staff under Captain Heale. On 1st January, 1897, he was appointed Chief Surveyor and Commissioner of Crown Lands at Napier. In July, 1906, he was appointed to Christchurch, and in July, 1909, to Auckland. Consequent on failing health, he retired

about the end of the year 1911, after over forty years of faithful service to the Department. When we look back upon his early career the surveyors of to-day can perhaps best realize the hardships that had to be endured and obstacles to be overcome by those pioneers of early surveying, the strain of which may have helped to close a life earlier than otherwise would have been the case. The well-earned rest, however, to which he had hoped his retirement would have brought him, along with a share of renewed health and strength, was denied him, and he passed away on the 10th March, 1912.

Mr. Sidney Weetman, another old and faithful servant, who, though having retired on pension at the beginning of the year 1902, has not been forgotten. He entered the Provincial Government service of Southland as a surveyor in 1863, and rose in later years to the position of Chief Surveyor and Commissioner of Crown Lands. In this capacity he worked in the Districts of Taranaki, Marlborough, and Canterbury. His death occurred during the year after a protracted illness.

The death of another hardworking, thoroughly conscientious, and valued officer has to be chronicled in the person of Mr. William Armstrong. In the year 1876 he entered the Provincial Government service, and at the beginning of 1880 joined the staff of the Otago District as surveyor. In December, 1883, he was transferred to the Gisborne district, and later on, in July, 1892, he joined the office staff at Napier. In 1899 he was promoted to be Chief Draughtsman and Receiver of Land Revenue at Blenheim. In April, 1909, he was appointed Chief Draughtsman at Dunedin, and received the well-earned promotion of Chief Surveyor and Commissioner of Crown Lands for Taranaki in May, 1911. In July of this year he was appointed on the Commission to deal with the electoral boundaries of the Dominion, and rendered valuable service. His death, which took place on the 26th January, 1912, was sudden and unexpected, and came as a great shock to all.

W. H. Pearson, an ex-officer of the Department, was for many years Commissioner of Crown Lands for Southland. He retired on pension on the 30th September, 1884, and his death has been reported at Napier during the year.

J. A. Montgomerie: This surveyor entered the Provincial Government service of Canterbury in August, 1867, as assistant and mining surveyor, which position he held till January, 1869. In 1871 he was appointed to the Public Works Department until March, 1874. In June, 1874, he joined the Nelson staff as assistant surveyor, and in 1877 was promoted to District Surveyor, a position he so creditably maintained till he was retired on superannuation, 31st March, 1909. His later years were spent in the private practice of his profession, and it was while thus enagaged that he met with a trap accident that caused his death during the year.

In this report, which is the first I have the privilege of submitting as Surveyor-General, I would like to here mention on behalf of my predecessor, Mr. John Strauchon, his desire to thank heartily all officers of the Department, both the indoor and field staff, for their ready help that has always been extended to him, and which, along with the amicable relations that have always existed, has assisted him so much in the exercise of his duties. In this connection I hope that the same spirit will still prevail and be extended to me so that I may look forward to and receive that hearty co-operation equally needed in my new position, and which so greatly assists to keep the Department up to its present high standard of efficiency.

Mr. H. T. McCardell, Chief Draughtsman at the Head Office, reports as under:—

One of the principal works of the year was the preparation of the maps for the Representation Commissioners in connection with the readjustment of the boundaries of the electoral districts of the Dominion. This work and the subsequent preparation and publication of the maps occupied the majority of the draughtsmen for several weeks. Seventy-six popular descriptions of proposed electorates were made, also seventy-six detailed descriptions defining in technical terms the boundaries of the electoral districts as finally determined by the Commissioners. 433 large-scale maps—one set for the Head Office, one set for the Chief Electoral Officer, and one set each for the Legislative Council and House of Representatives—were made, and lithographed maps on a scale of sixteen miles to an inch, showing the names and boundaries of the districts, were published for the information of the public. These important duties were of a highly technical nature and, being performed at a necessarily rapid speed, it is gratifying to the Department that no errors have been reported. In addition, about forty maps on a large scale were made for members of the House of Representatives.

The following plans were drawn for photo-lithography: The City of Wellington has advanced another stage, but, owing to the constant subdividing of properties, the compilation of this map

involves a large amount of searching, hence the delay in completion; the Town of Te Aroha (Auckland); additions to sheet 5, Auckland; map of Nelson Land District (completed); County of Pahiatua (nearly completed; when this county is finished the whole of the North Island can be obtained on a scale of one mile to an inch, every county being then published). All the plans in connection with the annual report, such as nurseries, base-lines, tidal results, &c., were also drawn.

Twenty-nine schedules for the Local Bills Committee of the House of Representatives were examined and certified to.

Maps of the following counties were published during the year: Manukau, Hobson, Piako (sheet 1), Thames, Opotiki (sheet 3); also the survey districts, on a scale of a mile to an inch, of Hope, Kakanui, Omona, Leeston, Halswell, Pigeon Bay, Highlay, Totoro, Reefton, Maruia, Tutaki, Hunua, Owatua, Nenthorn, and Wangapeka. The following towns: Timaru Borough (drawn in Christchurch office), Waikaka, East Winton, Tuatapere, Onehunga, Taupo, Whangarei, Cromwell, Ngaruawahia, and Glenorchy, also City of Nelson.

Land-tenure maps of the following counties were prepared for the Auckland, Hamilton, and Head Offices: Kaitieke, Waitemata, Hutt, Mangonui, Waimarino, Manukau, Piako, Matamata, Oroua, and Hobson.

Thirty registration districts (births, deaths, and marriages) were prepared for the Registrar-General on various scales.

During the year 175 towns (Government and private) were examined, reported on, and, when satisfactory and complying with the Act and regulations, recommended for the approval of His Excellency the Governor under section 16 of the Land Act, 1908. The distribution of these towns in land districts was as follows: Auckland, 86; Taranaki, 1; Hawke's Bay, 28; Wellington, 8; Nelson, 1; Marlborough, 1; Westland, 1; Canterbury, 27; Otago, 8; Southland, 14.

Among other duties performed by the draughtsmen there were 126 descriptions made; measuring-bands tested—two 10-chain, two 5-chain, one 1-chain; six licenses and six certificates of competency under the Surveyors' Institute and Board of Examiners Act, 1908, for September, 1911, and eight licenses and eight certificates under the same Act for March, 1912, were issued in duplicate, and twelve licenses, also in duplicate, were issued to surveyors under the Land Transfer Act, 1908. Twenty-three plans were drawn on deeds; 309 tracings made; 704 maps mounted. The last mentioned work occupies nearly the whole time of one officer, as it is found more advantageous and expeditious for this work to be done in the Head Office than forwarding to the Government Printer.

I have to thank all the officers for their co-operation and assistance given me during the year.

Mr. C. E. Adams, Chief Computer, reports as follows on the work of the year:—

Triangulation.—As will be seen from the appendix on Triangulation, further observations were carried out by Mr. H. E. Girdlestone, Assistant Surveyor, and the observations between the Wairarapa and Eltham bases are now nearly completed. The calculation of the triangulation has been put actively in hand, and the results of the Wairarapa base-net are given in the appendix, as well as a recalculation of the auxiliary triangle on this base-line.

Tidal Survey.—The Auckland tidal records have been harmonically analysed for the year beginning 1st December, 1908, and the Auckland tides have been predicted for the years 1912 and 1913, and the Wellington tides have been predicted for 1913. The tide-tables for these two ports have been published in the "British Admiralty Tide Tables" and in the "New Zealand Nautical Almanac." In the "New Zealand Nautical Almanac" an extensive table is given showing the tidal differences of many other ports, based on the predictions for Wellington and Auckland. It is satisfactory to note that, as in the case of the Wellington predictions, the Auckland predictions agree very closely with actuality. An illustration showing a portion of this test is given in the appendix. Messrs. T. G. Gillespie, J. J. Hay, and E. J. Williams have assisted in the calculations of the Tidal Survey and of the Triangulation in a satisfactory manner. An example of a new method of analysing tidal observations is given, and, so far as tests have been carried out, it appears to offer some advantages over the other methods now in use.

A new tide-gauge has been constructed, a brief description of which will be found in Appendix V. The excellent illustrations accompanying the description are the work of Mr. Harold Armstrong, of the Wellington District Office Staff, Lands and Survey Department.

APPENDICES.

APPENDIX I.—SURVEYS.

AUCKLAND.

Minor Triangulation.—30,992 acres by staff in Opotiki and East Taupo Counties, costing 1·79d. per acre; and 10,800 acres in Bay of Islands County, by private surveyor, costing 0·33d. per acre: a total of 41,792 acres, costing 1·41d. per acre.

Topographical Survey for Selection.—Under this heading is a total of 49,651 acres, costing 10·07d. per acre. Of this area, 29,127 acres is Crown land open for selection, the final surveys now being in hand, and 6,418 acres of Native land for the Maori Land Board, and 14,106 acres compass survey for the Native Land Court.

Rural.—The total area of rural surveys amounts to 142,089 acres: 108,185 acres, costing 1·42s. per acre, by the staff; and 25,507 acres, costing 2·29s., by private surveyors; and 8,397 acres, also by private surveyors, the cost of which is not available.

Village and Suburban.—1,376 acres in 178 sections, surveyed by staff, costing 10·96s. per acre; and 1 acre in 1 section, costing £10, by private surveyor; and 82 acres in 33 sections, by private surveyors, the cost of which is not available.

Town Section.—The staff surveyed 70 acres in 281 sections, costing 39·50s. per section; and a private surveyor 1 acre in 12 sections, the cost of which is not available.

Native-land Surveys.—The total area of Native land surveyed was 256,680 acres, into 1,196 subdivisions. The staff surveyed 33,478 acres (209 subdivisions), costing 18·13d. per acre, for the Native Land Court, and 18,980 acres (71 subdivisions), costing 28·52d. per acre, for the Maori Land Boards. Private surveyors completed 139,279 acres (738 subdivisions), costing 18·45d. per acre, for the Native Land Court, and 25,993 acres (52 subdivisions), costing 14·7d. per acre, for the Maori Land Boards; and also 38,950 acres (126 subdivisions) for the Native Land Court, the cost of which is not available. In connection with these surveys no delay takes place when once the authorities are to hand and the requisition of Maori Land Boards and Judges of Native Land Courts are submitted.

Gold-mining Surveys.—596 acres in seven claims was surveyed by private surveyors, costing 4·64s. per acre.

Roads, &c.—The staff surveyed 111 miles, at £26·37 per mile, and private surveyors ¾ mile, at £39·37 per mile; and 4¼ miles, the cost of which is not available. The continual application of lessees of land from Native owners for roads of access through the adjoining Native lands is a matter that may require consideration.

Other Work.—Miscellaneous surveys, side-pegging roads, reports explorations, reports inspections, &c.

Inspections.—Sixty-seven inspections of surveys have been made—sixty by Mr. Wheeler and seven by Mr. Galbraith—and all prove generally that the different surveys have been faithfully carried out.

Traverse Closures.—The staff surveyors' traverse closures, taking seventy-five average closures of 224 miles in length, show a mean close of 0·45 of a link on meridian, and the same error on perpendicular. Considering the class of country operated over, this is very satisfactory.

Contract Surveys.—Private surveyors have on hand 10,799 acres of Crown land, the cost of which has been deposited; also 3954 acres for settlement selection under authority from this office, and 482,167 acres of Native lands, requisitioned from time to time.

Office-work.—Plans examined: 209 plans of 1,578 Crown sections, total area 156,398 acres; 12 mining plans, totalling 936 acres; 11 residence-sites (for Warden), 16 sections; 405 Native Land Court plans of 1,200 subdivisions, totalling 365,890 acres; 620 Land Transfer plans, area 196,322 acres in 5,210 allotments; 275 plans taking and closing roads, totalling 545 miles; 24 plans taking 231 acres of land for railway purposes; and 49 plans proclaiming 40,383 acres reserves for various purposes: the total number of plans of all classes checked being 1,605. There were 1,880 tracings, &c., made for posters, surveyors, selectors, and others. Six Native Land Courts were attended, and £220 9s. 1d. on 24 blocks collected at the Courts. The total amount for survey liens collected during the year, £6,896 15s. 11d. Forty-six charging orders were obtained for £1,175 7s. 3d. 130 applications for financial authority were forwarded to Head Office, and 349 authorities issued, 219 being upon guarantees from the interested parties, the total area covered by the authorities being 500,800 acres in 963 subdivisions, 388,161 acres of Native lands being intrusted to contract surveyors, and 62,634 to staff surveyors. Maori Land Board surveys comprising 2,540 acres were given to contract surveyors, and 47,465 to staff surveyors. Three candidates were examined for surveyors' unlicensed assistants. 333 chain lengths of surveyors' steel tapes were tested and certificates issued. There were applications to Head Office for Government loans of a total amount of £37,757 over 94,931 acres. 4,784 plans were indorsed on certificates of titles, leases, and Native Land Court orders, &c. 3,072 plans were indorsed by Mr. A. B. Harding, of the Land Transfer Office. Fees collected, £291 19s. The Land Transfer Branch is gradually reducing the arrears, and, with an increase of staff, hope to have all plans checked to date, and record maps started this year. With regard to the general records of the office, I hope, with the assistance of further officers, to shortly bring them to a more complete state.

Proposed Operations, 1912–13.—Twenty surveyors (fourteen staff and six temporary), have on hand 169,880 acres of Crown land, 146,445 acres of Native land (64,524 acres of which is for Maori Land

Boards), and 171 miles of road-surveys. In addition to the above total, the larger areas of Crown land and new purchases proposed to be surveyed for selection are situated as follows: Mangonui County, 9,550 acres, including 8,600 acres national endowment; Bay of Islands County, 5,700 acres, including 3,900 acres national endowment; Hokianga County, 7,600 acres, including 6,000 acres national endowment; Hobson County, 7,050 acres, including 1,150 acres national endowment; Waitemata County, 4,870 acres, including 3,270 acres national endowment; Kawhia County, 5,000 acres; Awakino County, 5,400 acres national endowment; Waitomo County, 11,145 acres; Raglan County, 45,000 acres, Tauranga County, 2,500 acres national endowment; West Taupo County, 6,900 acres; Rotorua County, 6,300 acres, including 2,300 acres national endowment; East Taupo, 48,500 acres national endowment; Whakatane County, 3,000 acres national endowment; and Opotiki County, 7,000 acres national endowment.

Accounts.—The amount of work thrown on the Accountant's branch has increased very much. The number of vouchers which passed through the books totalled 3,179, being an increase of 945 over the previous year. These vouchers represented an expenditure of £78,985 9s. 5d., made up as follows: Paid from credit notes on Chief Postmaster, £4,934 18s. 11d.; paid from imprest, £13,442 3s. 8d.; paid on certificates through Post Office, £22,459 18s. 6d.; direct payments, £38,148 8s. 4d. During the year 1,713 cheques were issued on the Imprest Account, and on the Official Account 971 cheques were issued, representing an amount of £14,367 0s. 7d. Under the Native Land Settlement Account £14,551 2s. 10d. was paid for survey of Native lands, and £6,211 17s. 10d. was collected for survey liens. The amount of credits received during the year was £13,254 17s.

Transfers, &c.—Many changes have taken place during the last year. Mr. Gold Smith, the Chief Surveyor and Commissioner of Crown Lands, a very old servant of the Department, in his long career had gone through many hardships during his strenuous field life, and no doubt the early strain necessitated his retirement on account of ill health on the 31st December last. Unfortunately, he did not live long to enjoy the well-earned rest, as he was suddenly taken ill, and died on the 10th March. Mr. Sidney Weetman, formerly Chief Surveyor and Commissioner of Crown Lands, Canterbury, another old Auckland officer, living in this city, also died during the year, after a long illness; and Mr. Gillies, District Surveyor, also retired on account of ill health. Mr. A. J. Mountfort was transferred to Canterbury, Mr. W. M. Atkinson to Hawke's Bay, and Mr. MacMorran to the engineering surveys, Hauraki Plains. Mr. Hooper has been transferred from the field to the office; Mr. Goulding resigned; and Mr. Clayton's services were dispensed with. Mr. J. H. Lindsay has been appointed to the field staff. Mr. R. Ballantyne, in charge of the Native branch, was transferred to Wellington, Mr. C. T. Brown taking his place; and on Mr. Brown's appointment to the Presidency of the Ikaroa Maori Land Board Mr. R. J. Knight took charge of this work. Two old officers in Messrs. Covil and Scanlen retired. Two other draughtsmen resigned, and one was transferred; and eleven draughtsmen and cadets, by new appointment or transfer from other districts, were added to the office staff, making a net increase of five.

Conclusion.—Work in all branches shows a great increase. All officers have done their utmost to keep the additional work up to date, and I have to express my thanks for their efforts and attention to their various duties. The work of the office is increasing so fast that additional space and officers are required, both in the interest of the Department and public.

H. M. SKEET,
Chief Surveyor.

HAWKE'S BAY.

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

Topographical Survey for Selection.—Included under this head is an item of 42,000 acres, costing £157 2s., or at the rate of 0·9d. per acre, executed by Mr. Farnie for purposes of partition of Wharekahika Block, included in which is cost of attendance at Native Land Court, as also a provisional survey of 12,070 acres, costing £98 15s. 7d., or at the rate of 0·16s. per acre, made by Mr. Brook, which includes road-location and scheme for nineteen sections in Manawaangiangi Settlement, near Porangahau. The final sectionizing of the above block, which has been purchased by the Crown from the Natives, was let by contract, and the plans are expected in shortly.

Rural.—An area of 10,457 acres of pastoral Crown land, situated in the districts of Motu, Ngatapa, Koranga, and Maungaharuru, was surveyed by three staff surveyors into twenty-two lots, at a total cost of £1,215 12s., or an average of 2·42s. per acre.

Town Section Surveys.—A total area of 9½ acres has been cut up into twenty-two lots—namely, twenty-two sites for workers' dwellings at Awatotō and four sections at Clyde. The total cost was £52 19s. 1d., or an average of 48·14s. per lot.

Native-land Surveys.—The total area surveyed by the staff was 28,153 acres. Of this area 2,797 acres were surveyed at the request of the Maori Land Boards into ten divisions, at a total cost of £211 9s., or at the rate of 18·09d. per acre, comprising the blocks of Tongoio South, Taumata-o manu, and Waihua 1B. The balance, 25,356 acres, was surveyed by requisition of the Native Land Court, in order to complete partitions into fifty divisions, at a total cost of £706 7s. 2d., or at the rate of 6·68d. per acre.

In addition, surveys of 57,505 acres were executed during the year by private surveyors at the requisition of the Court, the Government in most cases advancing the cost of survey, making a grand total of 85,658 acres.

Village and Suburban.—An area of 6½ acres was surveyed into two lots in Motu Village, at a total cost of £10, or at the rate of 31·4s. per acre.

Roads.—2½ miles were surveyed, at a total cost of £49 5s. 2d., or an average of £19·7 per mile.

Other Work.—This includes miscellaneous surveys, inspections, reports, and road-explorations.

Traverse Closures.—The staff surveyors' closures, twenty-four in number, comprise 120 miles of traverse, being 0·45 on meridian and 0·53 on perpendicular per mile.

Inspections.—Twenty-three field inspections were made by Messrs. Bullard, Brook, and Cagney. The results indicate in general satisfactory work, but in some cases call for more thoroughness on the part of surveyors, and emphasize the necessity of consistent attention to independent field checks.

Work in Progress.—The field-work of the following surveys has been completed by the staff, and plans are now well in hand—viz., Whitiatara Block (Crown land), 1,281 acres; and road-access to Manawaangiangi, 7 miles (to be formed during the winter). Also surveyed by contract 12,070 acres, the Manawaangiangi Settlement, unavoidably delayed through the surveyor's illness and rough weather.

The field-work of the following surveys is approaching completion—viz., Pohokura (Crown land), 50,160 acres; Tutaekuri No. 1 (Maori Land Board), 12,500 acres; and 15 miles of roads in Wharekahika Block.

The above surveys make up a total of 63,500 acres of Crown land, 12,500 acres of Maori Land Board surveys, and 22 miles of roads (past season's work) to be plotted during recess and returned next year.

Proposed Operations, 1912–13.—Mr. Farnie to complete Mangairoa Block, 18,000 acres (Native Land Court), and proceed with survey of Tangakaka Block. Mr. Roddick to complete Huiarua Block, 7,750 acres, and proceed with survey of Crown lands in Tahora Block, 48,000 acres. Mr. Walshe, after completing Pohokura Block, to report on Timahanga and Omahaki Blocks, 26,000 acres, with view to subdivision. Mr. Cagney, after completing Tutaekuri Block, to proceed with survey of Omahu No. 2 Block, taken over from Mr. Brook. Mr. Atkinson to complete the survey of Crown lands in Kaiwaka Block, 14,000 acres, sundry small surveys, inspections, and the more urgent town standard surveys in Hastings and Napier. Private surveyors, under thirty-eight authorities for survey, have in hand the subdivision of 29,425 acres requisitioned for by the Native Land Court. Other requisitions are coming in.

Office-work.—During the year 507 plans were examined and approved, representing an area of 227,531 acres. These divided up into their several classes are as follows: Land transfer, 239 plans, 69,429 acres; Native Land Court, 127 plans, 116,275 acres; statutory, 107 plans, 1,436 acres; Crown lands, 30 plans, 39,568 acres; reserves, 4 plans, 823 acres. In addition to these 719 instruments of title, such as transfers, leases, mortgages, &c., have been examined and reported on, 3,358 copies of plans indorsed on titles, and 143 authorities to survey issued upon requisition of the Native Land Court. There is a marked increase in the number of plans received, and in the general office-work.

Transfers.—Mr. H. G. Price, Chief Draughtsman, was at the beginning of January promoted to Christchurch, and Mr. F. A. Thompson was promoted from Hokitika to succeed him in Napier. Mr. G. H. Bullard, Inspecting Surveyor and Land Officer at Gisborne, was promoted to be Commissioner of Crown Lands and Chief Surveyor at New Plymouth, and Mr. Thomas Brook, District Surveyor at Napier, was promoted to succeed him at Gisborne. Mr. W. M. Atkinson, assistant surveyor, was transferred from the Auckland District at the beginning of March.

At the end of July, 1911, Mr. L. W. Ward, assistant surveyor, resigned from the staff in order to take up private practice.

I desire to thank the staff for their active and intelligent co-operation and assistance.

C. R. POLLEN,
Chief Surveyor.

TARANAKI.

Minor Triangulation.—An area of 27,000 acres has been completed, mostly in the Mapara District, to control settlement surveys in hand.

Rural.—A total of 37,193 acres under this head has been completed in 147 sections, most of which is situated in very rough forest country.

Another 57,000 acres would have been completed and ready for disposal but for the exceptionally wet season and delay occasioned by the alteration of Stratford – Te Koura Railway.

Town Section Surveys.—An area of 13 acres, comprising sixteen lots, in the Matiere Township was surveyed.

Native Land Court Surveys.—During the past year the work in this branch has considerably increased. Sixty-one authorities under the Native Land Act, 1909, were issued to private authorized surveyors and one to a staff surveyor, covering 178 subdivisions, of a total area of 46,733 acres, at an estimated cost of £3,448. Of these the survey of 111 subdivisions, of a total area of 6,426 acres, representing twenty-two authorities, have been completed, forty plans received, and thirty-four approved. Fifty-three subdivisions, of a total area of 33,003 acres, representing thirty-two authorities, are now under survey and nearing completion; nine requisitions, representing forty-six subdivisions, of a total area of 46,548 acres, have been recently received, and are now being dealt with. Of authorities issued prior to 1st April, 1911, under the Act of 1909, thirty-four plans of forty-eight subdivisions, of a total area of 42,992 acres, have been received and approved during the year. Of authorities issued prior to 1st April, 1910, under the Act of 1894, six plans of eighteen subdivisions, of a total area of 12,347 acres, have been received and approved during the year, completing all authorities then existing under the old Act.

Roads, &c.—In this class 4·28 miles were completed by the staff, at a cost of £60 6s. 6d., or £14·09 per mile. The contractors for Native Land Court surveys, however, completed 28·5 miles of road, at an average cost of £20·11 per mile.

Inspections.—Only a few inspections have been carried out over survey-work in progress, but I am of opinion that more would have been advisable had time and opportunity permitted.

Other Work.—The expenditure under this head amounts to £225 3s. 6d., including inspections, corrections to old Native surveys, small miscellaneous surveys, reports, explorations, &c.

Chainage Closures.—The mean of all closures returned by the staff, comprised in 83 miles of traverses in rough bush country, gave an average of 0·87 of a link per mile.

Office-work: Examination of Plans.—The total number of plans checked under all heads in the ordinary Survey Branch was 152, with 270 traverse sheets: these covered 252 sections, of a total area of 97,540 acres, and 28 miles 6 chains of roads and railways taken, and 5 miles 10 chains closed. Settlement surveys of Crown lands were represented by 7 plans, containing 10 subdivisions, of a total area of 1,135 acres; 30 plans defining 33 miles 16 chains of road and railways taken and closed; 81 Native Land Court plans of 74,402 acres in 167 sections; 19 miscellaneous plans of 28 subdivisions, containing 2,633 acres; 10 office compilations of 14,797 acres and 22 sections; and 1 township plan of 4 acres in 12 sections.

Land Transfer.—128 plans with 195 traverse sheets were checked and approved, covering 776 sections and subdivisions of an area of 11,407 acres.

Titles.—The plans placed on instruments of title of all kinds were 2,006, and 273 copies of leases and licenses were prepared.

Compilation.—For photo-lithography 12 drawings and tracings were prepared, and 9 new block-sheets and other record maps were made, besides special plans for the purpose of adding Fitzroy, the Hurworth Riding District, and St. Aubyn Town District to the Borough of New Plymouth. The return under the head of block-sheets is smaller than the previous years, and is getting into arrears owing to the want of draughtsmen to keep them up.

Miscellaneous.—The usual demands made on the office staff were attended to, comprising the supplying of information to the general public; tracings for Rangers (mostly improved-farm sections) and selectors; data for staff and contract surveyors, Public Works and Railway Departments; plans for Maori Land Boards and road proclamations; information for local bodies and other Departments, &c. For the Valuer-General 142 tracings were prepared, and 211 for selectors, for Rangers, and for gazetting. All recording on block-sheets already made, road and Crown-grant record, reserve, index, land-tenure, and other maps has been kept well up to date.

Native Land Court Work.—During the year 7 plans have been compiled and approved for Native Land Court purposes, covering an area of 10,637 acres; 111 Court orders (in duplicate) were indorsed and forwarded, covering an area of 88,629 acres. The sum of £867 8s. 1d. has been collected from the owners and lessees of Native lands in payment for surveys, &c. The correspondence, greatly owing to the fact that we have no resident Registrar or Judge, has resulted in over 920 letters being received and 1,500 sent out in this branch of the office. Other work of a routine nature has been carried out in the usual manner.

Proposed Operations for 1912–13.—A staff of four permanent surveyors with one cadet and two temporary surveyors are at present engaged upon settlement work along the eastern and north-eastern boundaries of this district, and also upon the Mokau and Wanganui River scenic reserves. The total area to be covered by these operations amounts to 98,634 acres, of which 57,000 acres is almost completed in the field, leaving about 41,000 acres of new country, situated in the Mapara, Pahi, Rangi, Tangitu, Mahoe, Taurakawa, Omara, Momohaki, Taumatamahoe, Waro, and Mimi Survey Districts; while (in addition to the Native Land Court surveys) contracts are let for 2,482 acres in 50- and 25-acre lots for landless Natives in Upper Waitara Survey District; survey of scenic reserves on Mokau and Wanganui Rivers (four contracts) and Wanganui River Trust lands, covering 5,000 acres.

Transfers.—The late Mr. William Armstrong was appointed Commissioner of Crown Lands and Chief Surveyor here on the 1st April, 1911, and died on the 26th January, 1912, and I was promoted from Gisborne to succeed him in February. Mr. W. H. Skinner, Chief Draughtsman, was promoted to be Commissioner of Crown Lands and Chief Surveyor at Blenheim in September, 1911, and Mr. H. J. Lowe was promoted from Wellington to succeed him.

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

G. H. BULLARD,
Chief Surveyor.

WELLINGTON.

Surveys.—The close of this departmental year also marks the end of my personal connection with this district in various capacities which has extended over a period of forty years. I now leave it with a staff of six surveyors and an area of 40,000 acres for survey, which is all that remains of the several million acres surveyed during the above period under various Chief Surveyors. The total areas surveyed under all heads was 140,544 acres, and 26¾ miles of roads.

Triangulation.—The areas under this heading are two only—the trigs governing the South Waimarino surveys of 40,000 acres above mentioned, and the chain of triangles governing the standard survey by Mr. Climie up the Hutt Valley to the Upper Hutt Township.

Standard Surveys.—Mr. Climie's Hutt Valley work of 10 miles in length is the only finished work of this class, but Mr. Mountfort has been engaged throughout the year on the standard survey of Wanganui Borough, revising and extending it. Suburban extensions of the Wellington City standard through all the adjoining boroughs are much to be desired, and should be undertaken while the subdivisional ground marks are still available.

Topographical Survey for Selection.—As it has been decided not to bring land into the market until fully surveyed, in order to avoid the difficulties encountered by earlier selectors in financing their clearings, and grassing operations, and in roading blocks, there is no new area returned, although some 5,000 acres might have been utilized in this way.

Rural.—The bulk of this area comprises selection surveys completed, but there are also some 2,000 acres of finished survey which will be ready for market when certain legal difficulties have been removed. Some 6,300 acres are complete in the field but not yet completely mapped.

Town Section Survey.—This comprises merely a small extension of existing surveys, and no new towns have been laid out.

Native Land Court.—This class has provided the largest area of finished work this year, but has been almost wholly done by private surveyors, under contract, 1,580 acres only out of the total 58,116 being done by staff. There are, however, two areas, one of 4,087 acres, of which the field-work is completed, and another of 14,850 acres, in hand by a staff surveyor. The total area of this class now actually in hand by staff and private surveyors is 81,217 acres.

Roads.—No important work has been done under this head this season, but the total of 26¾ miles includes 10 miles of standard survey along the Hutt Valley Main Road, and 14 miles traverse of an existing coach-road hitherto undefined by survey, near Alfredton.

Other Work.—This includes the usual small surveys and reports which cannot be included or classified under the other principal heads.

Proposed Survey Operations.—The principal work remaining in the district is the South Waimarino Block, where three surveyors with two assistant parties are at work. In addition to this, Native surveys of 18,937 acres are in hand by the staff, and a total of 62,280 acres has been let to private surveyors.

Office-work.—A beginning has been made during the year with the work of replacing old records —*i.e.*, working-plans which were becoming obliterated by use, some twenty-seven plans having been made. The work of publishing survey district lithographs, much wanted, has also been begun in a systematic manner, and one district has been completed. It is hoped to keep up a steady output till the district has been covered by these handy maps. The north-west part of the district is now under revision, and the county map thereof will shortly be ready for reprinting up to date. All the public county index maps have been carefully revised, and nine new ones made. The general map of the district has also been revised and republished.

Examination of Plans.—The number of new plans received was 244, and 248 were approved, being 152 in the general computing branch and 96 in the statutory plans branch. These two branches have a total of 69 plans on hand, 40 in the general and 29 in the statutory branch. The new plans in the general computing branch covered 32,341 acres of Crown sections, 73,460 acres Native lands, 278 acres town sections, and 667 acres for Maori Land Board.

Land Transfer.—In this branch 233 plans were received and 217 approved, while 53 applications, 1,910 transfers, 158 leases, 138 mortgages, 108 Orders in Council, 91 Proclamations, 445 balance certificates, 48 caveats, 54 other dealings were put through, and 4,724 plans were put on titles.

Native Land Court Work.—This work is increasing under the influence of the new Act and the ease of obtaining surveys, new authorities for a total area of 58,116 acres in 405 subdivisions having been surveyed, at a cost of £4,903 2s. 5d. The number of Court orders completed as a result of these surveys is, however, disproportionately small, owing to the liens due for survey not being satisfied, 80 only being sent forward. Crown liens to an amount of £2,430 16s. 4d. were received, and 168 acres were cut off, in lieu of 15 liens, amounting to £366 11s. 6d. 53 surveys are outstanding, of 225 partitions, containing 62,280 acres.

General Drafting-work.—The staff upon this work as been kept busy throughout the year, and a large quantity of data has been prepared for surveys of Native and other lands as well as the routine work of recording approved plans. 783 tracings were made for office purposes, 190 for data, 34 for photo-lithography, 113 for Surveyor-General's records, 219 for Valuer-General's records, 122 for selectors, 122 plans were recorded, 10 new record maps were made, 272 plans were placed on miscellaneous titles, 16 plans were drawn and 25 tracings for local bodies, as well as much miscellaneous drafting-work.

Changes of Staff.—In the field Mr. Keddell retired from the staff, and Mr. Greville left the field and was made Inspecting Surveyor and Computer. Mr. Lowe, Computer, was promoted to Chief Draughtsman in Taranaki, and Mr. C. T. H. Brown was transferred to the Auckland Office, Mr. R. W. S. Ballantyne taking his place. Mr. Randrup and Mr. Enting also were transferred to Auckland. Messrs. Girdlestone and Mountfort, District Surveyors, have still been attached to the Head Office staff throughout the year.

Consequent on the promotion of Mr. James Mackenzie to the position of Surveyor-General of the Dominion from the 1st April, 1912, and up to which time he was in charge of this office, I can only voice the pleasure he has in acknowledging the able assistance received from both indoor and outdoor officers as well as private authorized surveyors during the year, and to place on record his appreciation of the loyal, zealous, and ever-ready help that he has received during his administration of Lands and Surveys in the Wellington Land District.

M. C. SMITH,
Acting Chief Surveyor.

NELSON.

Minor Triangulation.—The only work of this description executed was an extension of the trig. work in the Maruia Valley, containing an area of 18,850 acres, which was necessary to control the sectional surveys in the Warwick, Rappahannock, and Glenroy Blocks. This work was executed by Mr. James Stevenson.

Standard Survey.—During the year the field-work of the standard survey of part of Westport and Murchison was completed, but the plans have not yet been returned. The revision of

the standard survey of the City of Nelson is badly needed, and I understand Mr. Mountfort's services will be available in August to put this very necessary work in hand. Press of settlement work still prevents any standard surveys of the main roads being undertaken to control Land Transfer surveys, which are increasing year by year.

Rural.—The staff surveyors have completed 46,830 acres, at an average cost of 2·34s. per acre, and the contract surveyors 25,896 acres, at 2·39s. per acre. As the contract surveyors only made fair pay out of their contracts, and the work executed by the staff is practically the same price, the above figures are quite satisfactory. Additional contracts of 5,000 acres and 10,000 acres have recently been completed in the field, and another 5,300 acres will be finished in a few weeks.

Mr. J. A. Montgomerie, who undertook the surveys of selections by contract in the Inangahua County, met with a trap accident during the year, which resulted in his death. He was universally liked and respected by all those with whom he came in contact, and I very much regret his untimely end; his work and plans were very satisfactory. The work in this district is now being executed by Mr. T. Learmont, and a number of the surveys of selections in the Buller County by Mr. Snodgrass by contract. Although I have every confidence in these surveyors, it would be much more satisfactory if inspections of their work had been made, but I have not so far been able to spare the services of a staff surveyor for this work, and it is out of the question to make inspections myself. I hope that Mr. D'Arcy Irvine will soon be able to undertake some of these inspections when he has recovered his strength from his very serious accident; failing his services, it will be necessary to get Mr. James Stevenson, who is now stationed in the Buller County, to make some of these inspections.

Inspections.—Mr. J. D. Climie, Inspector of Surveys, made four inspections of some Land Transfer surveys executed in this district by the private surveyors, and, with the exception of the Taitapu Block, they proved to be fairly satisfactory. Staff surveyors also made six inspections, embracing work done by both staff and contract surveyors, which also proved satisfactory, except for some errors disclosed in the survey of D'Urville Island.

Native Land Court.—During the year the subdivision of D'Urville Island (40,469 acres) into the original eleven blocks and also some further partitions have been executed by contract at a cost of 4·79d. per acre. There still remain some 5,864 acres for further partition, and a contract has been let for this work, which is almost completed in the field.

Native Reserve Survey.—Mr. D'Arcy Irvine, staff surveyor, commenced the survey of the Okiwi Native Reserve (3,345 acres), but unfortunately met with a very severe accident owing to a tree falling on him. He has been in the hospital on and off for nearly five months; he is now convalescent, and will probably be able to undertake light work at an early date. Mr. D. Nelson, assistant surveyor, completed Mr. Irvine's work in a most satisfactory manner.

Other Work.—This work consists chiefly of inspections, reports, and miscellaneous small surveys and services which do not come under any of the headings of Table 1.

Roads.—Apart from the roads embraced in the area returned as rural, some eight miles and a half have been laid off in heavy bush by the staff surveyors at the very reasonable cost of £21·82 per mile.

Mining Surveys.—No surveys of this description were made by the staff, but six mining surveys, comprising 394 acres, were executed by contract surveyors, who were paid by fees deposited in the Warden's Court.

Land Transfer Work.—The Land Transfer Draughtsman reports that 78 plans, containing 5,597 acres, were examined and approved, and that 34 others were examined and returned for correction; 148 deeds were passed, and 196 certificates of title were made out in duplicate.

Proposed Operations, 1912–13.—An area of 77,000 acres is in the hands of the staff surveyors, of which about 12,000 acres are completed in the field. There are still fifty applications unallotted, with a total area of 25,453 acres. The blocks to be dealt with during the coming year are the Brighton Block, 9,584 acres, in the hands of Mr. James Stevenson and his authorized assistant Mr. Patton; the Howard Block, some 20,000 acres, in progress by Mr. Fairhall and authorized assistant Mr. Hemphill; the Waimea Block, allotted to Mr. J. D. Thomson, District Surveyor; the Gowan Block, 4,000 acres, allotted to Mr. Maitland, District Surveyor. There are also 4,000 acres to subdivide in the Mokihinui Valley, 4,000 acres of cut-out timber lands in the Oparara district, and 8,600 acres in the Matiri-Owen Block. In addition, Mr. James Stevenson has instructions to remeasure the triangulation base near Westport to bring it in terms of the Imperial standard, and to revise the triangulation between Westport and Brighton to control the surveys of selections, approximately 6,000 acres, between Westport and Charleston (in the hands of Mr. D. Nelson) and the Brighton Block survey. Most of this triangulation was executed in 1878 and badly needs revision.

Office-work.—During the year the Computer, Mr. J. F. Frith, has examined 64 plans with an area of 90,106 acres in 167 sections, 6 mining plans, 3 township plans, 5 plans minor and subsidiary triangulation, 23 plans of roads, and 16 railway-land plans, and checked 338 traverse reduction sheets. Photo-lithographic tracings were executed as follows: Completion of tracings of the Waimea County, also of the Borough of Nelson; plan of mining claims in the vicinity of Reefton, and also plans of the Survey Districts of Reefton, Maruia, Tutaki, and Wangapeka. All the triangulation for which satisfactory observations have been taken has now been recomputed on the polygon system in terms of the Imperial standard, and tracings made showing the amended values to take the place of the old trig. maps, and as opportunity offers new plans will be made. The subsidiary trig. work is being recomputed with a view of preparing separate maps.

Changes of Staff, &c.—Mr. N. Wright was transferred to Napier, and Mr. Keenan took his place as Record Clerk and Accountant, and Miss S. M. Murrell was appointed as typiste. Mr. Roebuck, draughtsman, left for an appointment in Western Australia, Mr. J. P. Black was taken on in his place, and Mr. H. Black was appointed temporary draughtsman. Mr. R. E. Harris has

been employed for three months in the Grey County by the Valuer-General, and Mr. A. J. Whitehorn is Acting Crown Lands Ranger in his place. Mr. Hursthouse, Crown Lands Ranger, Westport, was transferred to Marlborough, Mr. F. Ward from that place taking up his duties. Mr. D. Nelson, from Gisborne, passed his examination and was appointed assistant surveyor, and Mr. W. D. Armit, a cadet trained in the Nelson District, passed the Surveyors' Examination at the last sitting at the first attempt, and is now appointed assistant surveyor in this district. Cadet J. A. Montgomerie has been transferred from the local office at Reefton to a draughtsman's position at New Plymouth, and the Reefton Lands and Survey Office is now placed under the charge of Mr. Henry Smith, Land Officer. Mr. D. Thomson, Land Officer at Westport, is to be transferred to Auckland as draughtsman on the 30th April, and Miss S. Montgomerie is taking up his duties at Westport as assistant under Mr. James Stevenson, staff surveyor, who is appointed Land Officer at Westport.

In conclusion, I wish to place on record my appreciation of the manner in which the staff, both office and field, have rendered me their willing co-operation and assistance.

ROBT. T. SADD,
Chief Surveyor.

MARLBOROUGH.

Triangulation.—The only work of this nature carried out during the year has been a little breaking down to enable the sectional work in progress to be brought under check.

Rural.—A total of 6,039 acres under this head has been completed in twenty-five sections, all of which is situated in rough bush country. The excessive rainfall of last season in the northern half of this district caused great loss of time to the survey parties engaged, and accounts in a great measure for the comparatively high cost per acre shown in schedule against rural and suburban lands. In Native Land Court work, surveys of eighteen subdivisions in various localities, comprising 1,719 acres, have been completed, partly by the staff, and partly by private surveyors, at schedule rates.

Town Section Survey.—This comprises the survey of education reserves and Crown sections in the Town of Picton.

Roads.—In this class 18 miles were completed, principally in the Sounds County, in rough bush country, at a cost of £531 9s. 6d., or £29·53 per mile. An intricate railway and road survey, Picton–Blenheim, is now nearing completion, having occupied Mr. Hodgkinson, of the field staff, for the greater part of the year.

Other Work.—The expenditure under this head amounts to £190 16s. 8d., made up by the cost of surveys, readjustment of boundaries between the Crown and Native lands, Gore Survey District, scenery-reserve survey, compass traverse of summit of Mount Duppa Range (land district boundary), &c.

Standard Survey.—The standard survey of the Town of Blenheim was extended for a distance of about two miles into the suburban areas. Inspecting Surveyor Climie carried out an inspection covering the whole of the Town of Picton standard work, completed at various times and by different surveyors. The result of Mr. Climie's inspection was, on the whole, satisfactory, and certain recommendations made by him with regard to the standard marks are now being attended to.

Proposed Operations, 1912–13.—The settlement-work of the coming year will lie mainly, if not wholly, in the Heringa and Wakamarina Survey Districts, where an area of 7,000 acres is nearing completion by Mr. Hunt, and 400 acres by Mr. Hodgkinson in Pine Valley. There will also be the usual miscellaneous work required, such as the pegging of isolated spotting surveys, &c., and the completion of the Picton–Blenheim road and railway survey. This latter, owing to the original faulty work—magnetic bush traverse—and the almost utter lack of reliable survey data, has given great trouble to the surveyor engaged, and the ground covered has of necessity been extended greatly beyond the limits first contemplated.

Office-work.—The number of new plans received during the year was 52, consisting of 11 departmental plans—settlement survey—with an area of 6,039 acres; 8 Native Land Court, containing 1,720 acres; 16 Land Transfer plans, of 558 acres; 11 plans defining eighteen miles of roads; and 6 office compilations; 289 tracings were prepared, 766 diagrams were placed on certificates of title, Crown leases, &c.; and 8 photo-lithographic tracings were prepared.

Changes of Staff.—The retirement on superannuaiton of Mr. Frank S. Smith, Commissioner of Crown Lands and Chief Surveyor, after many years of faithful service, led to my transfer from New Plymouth to fill his position. Mr. W. F. Marsh, Chief Draughtsman, was transferred in May to Dunedin on promotion, his place being filled by Mr. A. D. Burns, of the local staff. In December Mr. W. Lindsay, Draughtsman, resigned, the vacancy being filled by Mr. E. Pfankuch, from the New Plymouth staff.

In conclusion, I beg to record my appreciation of the manner in which the whole staff has worked, and for their active assistance and co-operation during the year, and of the valuable assistance I have received from Mr. Burns.

W. H. SKINNER,
Chief Surveyor.

WESTLAND.

Triangulation.—I have no work to report under this heading for the year.

Standard Survey.—Mr. District Surveyor Harrop made a start with the standard survey of the Borough of Greymouth, but was called away to assist in Canterbury surveys before much was accomplished. This work will be resumed as opportunity offers.

Topographical Survey.—Messrs. Morison and Harrop completed 7,000 acres under this heading at an average cost of 2·58d. per acre.

Rural Surveys.—The total area surveyed under this heading for the year amounts to 17,016 acres, in ninety-four sections, at an average cost of 2·86s. per acre. Much of this has been isolated spotting-surveys, practically all in bush country, and entailing a great deal of travelling.

Village and Suburban.—District Surveyor Harrop surveyed 307 acres in Cobden and Blaketown. These include large reserves and small suburban sections.

Town Surveys.—District Surveyor Wilson returns eight sections under this heading laid off in Hokitika and Greymouth, at a cost of £37 4s. 1d. Surveys of isolated sections in these localities are always costly on account of deficiencies in old work.

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

Roads.—Only 3¾ miles are returned under this heading, at an average cost of £18 per mile.

Other Work.—The return shows a total of £508 12s. 10d. under this heading, the chief items being an engineering survey and estimates for the Runanga water-supply scheme, and inspection surveys by Mr. District Surveyor Wilson.

Inspection Surveys.—Owing to the exigencies of settlement surveys, and the absence of the staff surveyors in Canterbury, not much has been done during the year under this heading, but the few inspections which have been made disclose generally satisfactory results.

Office-work.—In the early part of the year the draughting staff was considerably reduced by transfers of experienced men to other districts, leaving the office very short-handed. This, however, was remedied later by the appointment of new men, which now enables the current work to be coped with, and a certain amount of arrears to be worked off. During the year 108 plans were received and examined, classified as follow: 35 Land Transfer, 20 statutory, 2 mining, and 51 relating to land settlement. 1,017 copies of plans were placed on the deeds—namely, on Crown leases 587 copies, and on Land Transfer titles 430 copies. Numerous plans were also compared with office records for the District Land Registrar. 24 tracings have been prepared for photo-lithography, representing 164,000 acres of land which has been thrown open for selection, 160,500 acres as pastoral runs, and 3,500 acres as settlements lands; 5 tracings from compilations have also been prepared, completing the southernmost portion of Westland and the balance of that class of work in this district; 187 tracings of survey data have been forwarded to the field staff, and 5 compilation maps completed. Numerous tracings and descriptions have been prepared for *Gazette* notice. Electoral maps were prepared for the Grey and Westland Returning Officers. The customary routine work of cross-indexing, recording, &c., has been kept well up to date, and, in addition, a considerable number of plans and posters were mounted and renewed.

Proposed Operations, 1912–13.—There are in hand at present 12,132 acres of application surveys scattered from the north to the far south of Westland, and with current applications being dealt with at each Board meeting I anticipate a very busy year. For the best five months of the year I have had only one staff surveyor available, the others being absent on urgent surveys in Canterbury, with the consequence that arrears are piling up, and settlers are becoming rather restive in the matter of titles to their holdings, as the want of these titles hampers them in any financial arrangements. I hope it may be found practicable to return Messrs. Harrop and Morison to this district as soon as possible, and also to provide another surveyor to take the place of Mr. Wilson, who has gone to England on extended leave, and thus enable me to push on with the urgent surveys required.

Changes in Staff.—There has been a very considerable change in the *personnel* of the staff during the year. In January I succeeded Mr. G. H. M. McClure, who was transferred to Invercargill as Commissioner of Crown Lands and Chief Surveyor, and Mr. D. M. Calder, of the Dunedin Office, succeeded Mr. F. A. Thompson as Chief Draughtsman. Mr. A. Meharry, Crown Lands Ranger, resigned in February, and his place has been taken by Mr. G. Anderson. There have also been several changes in the draughting staff.

In conclusion, I would tender the customary tribute to the officers of both the field and office staff for their hearty co-operation in the work of the Department.

H. D. M. Haszard,
Chief Surveyor.

CANTERBURY.

Rural.—The total area surveyed under this heading for the year amounts to 82,078 acres, subdivided into 213 sections, of which 21,240 acres, comprising the Mount Peel grazing-runs, is national-endowment land, while the remainder represents the new settlements of Douglas, Scargill, Smithfield, Four Peaks, Sherwood Downs, Avenel, Timaunga, and Valverde. Much of it is good agricultural land, though a large proportion of Mount Peel, Four Peaks, and Sherwood Downs is pastoral country. The Valverde Settlement of 2,312 acres was surveyed by a contract surveyor, the remainder by the staff surveyors. Out of the above-mentioned total of 82,078 acres there was an area of 37,900 acres the plans of which were not completed, and, owing to this, an area of 44,178 acres only is able to be returned in Table I.

Topographical.—Under this heading 46,570 acres are returned, being Pastoral Run 241 and Mount Peel grazing-runs. There is also a further area of 34,182 acres, the plans of which are not yet completed, comprising Run 178, Acheron, and three of the largest sections in Sherwood Downs.

Roads.—The seventeen miles returned under this heading consist of five miles of the Summit Road from Evan's Pass to Godley Head, near Lyttelton, executed by Mr. Allom; and twelve miles of the Glynn Wye Roads, by Mr. Morison.

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

Land Transfer.—Work in this branch of the Department has continued to increase during the year, 458 plans having been checked and passed. I append hereto a schedule compiled by

the Land Transfer Draughtsman, Mr. Leversedge, showing a complete list of the nature of the dealings carried out during the year. The large arrears of work at the beginning of the financial year have been overtaken, and the work on hand reduced to a reasonable compass, and should this favourable condition continue I hope in time to be able to commence the renovation of the record maps without increasing the present staff, which is a very much needed work.

Other Work.—This comprises miscellaneous surveys executed by Messrs. Allom, Cunningham, Gray, and Wilson, the particulars of which are given on Table 1 attached.

Survey Inspection.—Owing to the pressure of settlement surveys only two inspections have been made during the year.

Proposed Operations for the Year, 1912–13.—During the present year the undermentioned lands will be prepared for settlement: Bourndale Settlement, 1,580 acres; Claremont Settlement, 2,440 acres; Waimate Settlement, 1,600 acres; Aylesbury Settlement, 1,000 acres; Avenal Settlement, 521 acres; Timaunga Settlement, 3,459 acres; and others that may be acquired; also the subdivision of the Greta small grazing-runs, the surveying of the Ashley Valley Road, and the Oxford bush-workers' subdivisions, the completion of the Mount Peel exchanges, and other miscellaneous surveys that may be required.

Transfers and Resignations.—Mr. Haszard, Chief Draughtsman, was promoted to be Commissioner of Crown Lands and Chief Surveyor for Westland in January, and Mr. Price, Chief Draughtsman, Napier, succeeded him there. Mr. Mountfort, District Surveyor, Auckland, was transferred to the district in August. Mr. Morison, District Surveyor, Mr. Harrop, District Surveyor, and Mr. Cunningham, assistant surveyor, were temporarily transferred here from Westland in November and December, and the two former still remain. Miss Gillanders, computer, was transferred from Wellington in October, and Mr. Henderson, draughtsman, was appointed to this office during the year. Messrs. Newman and Freeman, draughtsmen, resigned to take up appointments outside the Department.

Office-work.—The Chief Draughtsman, Mr. Price, reports that the office staff has had a strenuous year preparing all the necessary data for the respective settlements, besides the preparation of the plans and tracings for photo-lithography and the schedules and descriptions for notification. Fifty-seven Public Works plans, forty road-deviation plans, twelve land-for-settlement plans, and twenty-five other plans have been checked and recorded, besides the usual tracings for local bodies, surveyors, and *Gazette* notices. The plan of the Timaru Borough was completed, and lithos published, making a most useful map. Owing to the pressure of general work and the limited staff, the plan of the Amuri County for photo-lithography has not been completed. However, I hope to have this done when an opportunity occurs.

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

T. N. Brodrick,
Chief Surveyor.

OTAGO.

Minor Triangulation.—No work was done under this heading, but there are several districts that should be revised when opportunity offers.

Rural.—Two staff surveyors, Messrs. Barron and Burton, were engaged continuously on this work, and two, Messrs. Calder and Neill, for a combined period of three months. They have been seriously handicapped in their work by the very wet and windy season. Especially is this the case with Mr. Burton, whose work has been mostly in the southern districts. The total area returned for the year is 51,122 acres, at a cost of 1·03s. per acre, and particularized as follows: 24,817 acres divided into small runs and accurately surveyed; 12,432 acres divided into 81 allotments, being the Conical Hills and Elderslie No. 2 Settlement recently acquired by the Crown; 13,873 acres, more than half of which was rough bush land, divided into 62 sections.

Town Surveys.—Mr. W. T. Neill, considering the exceptional bad season, has made good progress with the standard survey of the city, and up to date some fifty miles of streets have been traversed and marked. It was my intention to have had Mr. Burton assisting in this work last year, but his services were required in connection with settlement and other surveys. During the coming year, however, he may be able to help with it. Nine plans of new towns were examined and approved by the Governor under section 16 of the Land Act, 1908.

Mining Surveys.—Seventeen surveys representing 23 sections and comprising 883 acres were examined and approved. These were all made by private surveyors on the fee system or by private arrangement.

Roads and Railways.—Thirteen surveys were received and approved, all of them having been made by private surveyors.

Land Transfer Surveys.—116 plans, representing an area of 17,150 acres, were examined, recorded, and approved, the work being uniformly very good.

Proposed Operations for the Year.—The standard survey will occupy the pride of place, under the direction of Mr. Neill, with, if possible, Mr. Burton. Mr. D. I. Barron has completed the surveys of Moutere and Lower Wanaka runs, and is engaged upon various application and spotting surveys, which will engage his attention probably until the surveyors are called in for the winter recess. On resumption of field-work his services will probably, if the policy of acquiring land for settlements be pushed on, be available for survey of any estate acquired, or for the subdivisions of areas of Crown lands for settlement in Central Otago.

Office-work.—The following plans were examined, approved, and recorded—viz., 116 Land Transfer, 13 roads and railway, 17 mining, and 61 staff—a total of 207.

Plans for photo-lithography: 52 tracings for sale posters were prepared, also 80-chain maps of Kakanui, Warepa, Waipahi, and Nenthorn Survey Districts, and the Town of Cromwell, Hull, and Glenorchy; 23 plans of private townships and subdivisions were reduced and lithographed in this office for addition to the large map of Dunedin and suburbs; 10 maps were made for Land Office purposes, also new county maps of Bruce and Waitaki, and 10 large compilations for the Stock Department.

Diagrams were placed on 303 Crown titles in duplicate, and on 762 in triplicate—a total of 2,892.

In the Land Transfer Branch diagrams were drawn on 997 certificates of title in duplicate, on 1 in triplicate, and 14 single, a total of 2,011; and 1,298 deeds and other instruments were examined.

A revision of the Valuation Departments' maps was completed, and 823 miscellaneous tracings and compilations have been made for various purposes.

During the year 65 working-plans of the subdivisions in Morven Hills, Kawarau, Northburn, and Linnburn runs have been made by the office staff, but are not included in the list of plans passed and recorded, as they await final examination by the surveyors who were engaged on the work.

The acquisition by the Crown of Conical Hills and Elderslie No. 2 Settlements entailed a great deal of extra office-work in construction of the plans and calculations.

A start has been made with the plans of the Dunedin City standard work, and one draughtsman has been detailed to carry it through. In the lithographic department 3,350 lithos were printed, 1,095 maps mounted, and 29 books repaired and rebound.

It will be seen that the year has been a busy one, and I am pleased to be able to express my appreciation of the willing and efficient way in which the various officers have discharged their duties.

E. H. WILMOT.
Chief Surveyor.

SOUTHLAND.

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

Rural.—28,017 acres, in 112 sections, are returned under this head, 15,000 acres of which were situated in rough bush country, the roading of which necessitated much exploration and grading. Mostly old worked-out sawmill areas, 6,000 acres in Terepa Estate, the balance consisting of open scrub country, and 1,318 acres of sawmill areas paid for by applicants.

Village and Suburban.—49 acres, in thirteen sections, were surveyed by Mr. Thompson in the Alton District.

Town Section Survey.—The surveys under this head comprised 24 acres, in forty-seven sections, surveyed by Mr. Drury, in Towns of Gore and Tuatapere Extension No. 2.

Gold-mining Surveys.—These consisted of 198 acres, in five sections, surveyed by private surveyors, and paid for by applicants.

Roads and Water-races.—These comprise 21½ miles of roads to give access to Crown lands, and 2½ miles of water-races traversed through the same.

Other Work.—The amount expended under this heading represents revision surveys, school-sites, coal leases, inspections and reports, work in connection with the Taieri drainage scheme, preparation of plans and specifications for Waikawa Jetty, street alignment surveys, &c.

Chainage Closures.—The mean of seventeen closures returned by the staff and comprised in 93 miles of traverse gives an average of 0·44 of a link per mile.

Proposed Operations.—Mr. Otway has in hand 3,000 acres in Longwood and Jacobs River Hundreds, the whole of which it is expected will be completed by the end of June. There is an additional area of about 2,500 acres in Jacobs River Hundred, consisting of worked-out sawmill areas, which I propose to have cut up whilst Mr. Otway is in the locality. Mr. Macpherson expects to complete his block of 9,000 acres in Aparima and Jacobs River Hundreds about the end of October. There will, however, be a further area of cut-out sawmill areas in Aparima Hundred of about 1,000 acres, which I will get him to survey before he leaves the neighbourhood. Mr. Thompson has in hand 3,000 acres of settlement surveys in Longwood District, and some spotting surveys which will occupy him till about July. It is probable, however, that with further exploration a good deal more land will be found suitable for settlement, in which case the amount of his work in that district will be increased. Mr. Falkiner has 15,000 acres in Mokoreta District in hand. It has, however, been decided to discontinue the survey of all but 1,000 acres of this block for the present. On the completion of the 1,000 acres he will take up the subdivision of 6,500 acres in Campbelltown and Oteramika Hundreds left untouched by Mr. Drury, who has been transferred to Canterbury. There is a considerable area of bush land in Lillburn and Monowai Districts which may be found suitable for settlement, but this can only be ascertained by a preliminary exploration, which at present is quite impossible, as I have not a surveyor available. Owing to the very large number of subdivisional and town surveys in progress in the Town of Invercargill and suburbs, it is imperative that the standard survey should be extended at once, in order to facilitate field and office check in Land Transfer plans, but unless another surveyor is added to my staff it will be impossible to do this very necessary work.

Office-work.—During the year 53 ordinary survey plans, representing 16,640 acres, were examined and passed; 36 photo-lithographic tracings for sale plans were made; the new topographical map of the Dominion mentioned in last year's report was completed and sent forward for publication. Three original lithographic drawings were compiled, and maps of 3 survey districts revised and brought up to date. The work of renewing some of our old application maps is being done as opportunity offers, 3 new maps having been drawn, and a new map of Wallace County is nearly completed. 376 miscellaneous and 389 working tracings were made, and 101 Land Transfer plans traced for Valuation Office. 24 local bodies' schedules in duplicate were prepared, and a list of educational endowments made. 8 road-closing tracings in triplicate were drawn, a map for Defence Department prepared, and 380 maps and plans were mounted. The amalgamation of the suburban boroughs with that of Invercargill proper has lessened the usefulness of the present lithograph of Town of Invercargill, and a new drawing for lithography has therefore been put in hand, and considerable progress has been made with it. This map will be thoroughly up to date, and when published will be found to be most useful for general purposes.

Land Transfer.—115 plans, representing 47,195 acres, were examined and passed. The work in this branch has increased so much as to necessitate one of the draughting staff giving a large amount of his time to assist the Land Transfer Draughtsman in placing diagrams on certificates.

Changes of Staff.—At the beginning of December last Mr. Skeet, Commissioner of Crown Lands and Chief Surveyor, was promoted to the Auckland Land District, and I was transferred from Westland to succeed him.

My thanks are due to all the officers, both in the field and the indoor staff, for their able assistance in the year's work.

G. H. M. MCCLURE,
Chief Surveyor.

APPENDIX II.

THE MAGNETIC OBSERVATORY AND THE MAGNETIC SURVEY.

DURING the year the Magnetic Observatory has been maintained in thorough working, and all the usual magnetic seismological and meteorological records have been obtained. Besides routine work, a large amount of magnetic work has been done in connection with the work of the National Antarctic Expedition led by Captain Scott, and the later Australian Antarctic Expedition led by Dr. Mawson. This work has consisted principally in the obtaining of the necessary quick-run magnetograms during the prescribed term-hours, and is still being continued. The operation of the Christchurch electric tramways has inevitably sometimes interfered with these delicate observations, and thus reduced the value of some of the records obtained, but such interference has still left a great deal of valuable record obtained during the night-hours when the tramways were not working and the artificial electric "earth current" due to current returning outside the rails did not exist.

Unless by some miracle the Christchurch Tramway Board decide to run their cars with an alternating current, and replace their present tram motors with alternating-current motors upon the completion of the Lake Coleridge electrical-supply scheme, the only absolute remedy for the tramway disturbances experienced by the Observatory will be to shift the Magnetic Observatory some thirty miles away from Christchurch; and it would be quite possible to shift the present buildings this distance to a new site selected at some ten miles distance from a railway (in view of their possible electrification) at a minimum of expense.

The question of shifting the Observatory has been considered before, but, in addition to my own opinion, the opinion of leading authorities in magnetic science, such as Dr. Chree, F.R.S., agreed that it was desirable to complete eleven years' observations at Christchurch (a "sun-spot period") before shifting the Observatory, seeing that so many years' records had already been obtained free from disturbance. The time has now arrived when it is desirable to select a fresh site.

On those occasions when the term-hours fell mostly within the hours of tramway-running the undisturbed curve of magnetic declination has been obtained by half-minute eye readings of a Kew magnetometer set up at Amberley—a place outside the range of the disturbing currents. Eye readings were also made there over a period of five hours at the time of the solar eclipse of 1911, in order to co-operate with investigations made at other observing-stations during the eclipse.

The Adie Magnetographs.—These have been kept in thorough working-order throughout the year, and the necessary absolute observations for the determination of base-line values were made. The records have been developed and annotated to date, and the measurement of these curves is approaching completion. Some minor alterations and improvements were made in the dark-room of the magnetograph-house. It is highly desirable that a portable field set of Eschenhagen self-recorders should be obtained for the Observatory, to enable a comparison to be made between diurnal variations at Christchurch and any selected situation, and for other purposes.

The magnetograms of the principal magnetic storms of the year are reproduced herewith on a scale of three-eighths of the originals. The values of ordinates on the reproductions are—

Declination curve	.. .. ..	+ 1 mm. =	− 3·0′ of arc.
Horizontal-force curve	.. .. ..	+ 1 mm. =	− 0·00014 c.g.s.
Vertical-force curve	.. .. ..	+ 1 mm. =	− 0·00011 c.g.s. unit.

Milne Seismograph No. 16.—With this instrument records of sixty-nine earthquakes were obtained during the year. The new recording-apparatus has worked successfully. A *résumé* of the observations obtained with this seismograph and with No. 20, stationed at Wellington, in charge of Mr. G. Hogben, M.A., has been presented to the New Zealand Institute for publication in the Transactions of the Institute. Some important seismograms are reproduced herewith.

Magnetic Survey.—In July, 1911, a magnetic observer of the Carnegie Institution, Mr. E. Kidson, paid a visit to New Zealand on holiday leave from Australia. Mr. Kidson was visiting Nelson, and kindly reoccupied two of the Nelson stations. His checked official results are not yet available, but they will be valuable for the determination of the amount of secular change at Nelson.

Antarctic.—The recent return of part of Captain Scott's expedition to New Zealand is especially important from the fact that Dr. Simpson, the magnetician to the expedition, brought back with him a complete set of twelve months' magnetograms obtained at Winter Quarters, including term-hour quick runs. I believe these to be the best and most important set of magnetic records ever obtained by a polar expedition. They are being forwarded to Dr. Charles Chree, F.R.S., of Kew Observatory, for discussion. Since Dr. Simpson's departure from the Antarctic the magnetic work of the expedition is being equally well performed by Mr. Wright, who is also running his magnetographs during the term-hours now being observed by the Mawson Expedition on the other side of the magnetic pole. Very valuable results may thus be expected to be secured by the co-ordination of the work of Mr. Wright and Mr. Webb, magnetic observer to Dr. Mawson's expedition, and of the work of co-operating observatories.

Meteorological Observations.—These have been taken daily throughout the year at 9·30 a.m. and 5 p.m., and at noon on six days of the week. The observations include the temperature, pressure, and humidity of the air, the direction and velocity of its motion, the amount of cloud and rainfall, and the daily changes of temperature and pressure. Monthly abstracts have been forwarded to the Dominion Meteorological Office, and a daily summary has been published for the information of the public. The total rainfall for the year, 1st January to 31st December, 1911, was 29·853 in.

I have to express my indebtedness to my assistant, Mr. Thomas Maben, for his valuable services during the year.

Very many valuable reports and publications on magnetic science have been received from various British and foreign institutions and scientists, and thanks are gratefully tendered for them.

HENRY F. SKEY, B.Sc.,
Officer in Charge.

EARTHQUAKE RECORDS BY MILNE SEISMOGRAPH NO. 16, AT CHRISTCHURCH.

On the 11th May, 1911, the new type of recording-apparatus was installed on the Milne Seismograph No. 16. This recorder has a time-scale of 241 mm. to the hour; the former recorder had a time-scale of 59 mm. to the hour.

Date.	Commencement.	Max.	Max. Amplitude.	Duration.	Remarks.
1911.	H. M.	H. M.	MM.	H. M.	
April 6	9 55·1	10 01·3	0·3	0 14·5	Duration uncertain owing to tremors.
		7 36·5	0·2		
„ 7	7 33·2	7 41·6	0·2	0 50·7	
„ 8	2 16·2	2 18·4	0·5	..	
„ 11	13 40·0	13 41·9	1·5	0 24·0	In middle of tremor.
„ 13	10 14·7	10 18·3	1·1	0 19·6	
„ 15	4 59·9	5 05·0	2·5	..	
		5 13·4	1·6	..	L.W. commence 5h. 02·5m.
„ 21	2 15·5	2 20·4	1·5	..	
		2 33·0	1·0	1 17·5	
„ 23	12 43·3	12 50·6	2·1	0 23·8	Duration uncertain owing to tremor.
„ 26	1 18·3	1 27·5	0·4	0 59·5	
„ 27	3 03·3	3 04·8	0·2	0 06·9	
May 1	12 27·4	12 32·6	0·3	0 10·3	
„ 20	16 19·6	16 20·4	0·2	0 06·3	
„ 23	4 33·1	4 37·8	0·1	..	
		4 40·3	0·1	0 19·2	
June 3	..	20 39·1	1·5	..	Commencement obscured by tremors.
		20 41·6	2·0	..	Duration uncertain owing to tremors.
		20 45·6	1·7	..	
		20 47·5	1·5	..	
„ 6	13 05·1	13 06·6	0·5	..	
		13 12·6	0·5	0 18·0	
„ 7	7 44·2	7 49·5	0·5	..	
		0 53·2	..	0 28·3	
	11 17·5	11 31·5	0·7	..	
		12 00·5	1·0	..	
		12 09·5	0·8	..	
		12 14·5	0·8	2 52·0	
„ 10	17 00·8	17 07·6	1·1	1 14·0	
„ 12	7 12·6	7 17·6	0·1	0 14·0	
„ 15	14 36·4	14 46·9	5·5	..	
		14 48·7	4·0	..	
		14 52·4	3·0	..	
		15 04·5	3·8	3 08·0	
„ 28	19 57·3	19 40·4	1·5	0 28·5	
July 12	4 19·1	4 38·0	2·1	..	L.W. begin 4h. 28·2m.
		4 45·0	4·5	..	
		4 49·3	9·0	3 36·0	
„ 19	9 02·2	9 05·8	1·2	..	End obscured by tremors.
		9 07·3	1·0	..	
August 6 ..	1 26·0	1 28·6	0·4	0 17·5	
„ 10 ..	0 33·4	0 45·9	0·4	0 31·0	
„ 16 ..	22 51·2	..	..	..	L.W. commence 22h. 59·5m.
		23 18·3	9·0	..	
		23 21·7	6·0	..	
		23 23·7	6·0	..	
		23 27·4	6·2	4 40·5	
„ 19 ..	2 21·8	2 24·8	0·3	0 13·0	Duration approximate.
„ 21 ..	16 38·0	16 41·6	4·0	..	Duration obscured by tremors.
September 6 ..	1 17·9	1 20·7	0·6	1 12·0	
„ 12 ..	..	14 07·7	1·5	..	Beginning and end obscured by tremors.
„ 15 ..	12 25·2	12 25·4	0·6	..	End obscured by following quake.
„ 15 ..	13 44·8	13 48·8	2·0	0 11·0	
October 5 ..	7 38·9	7 41·3	1·0	..	
		7 44·5	0·5	0 55·0	Shock at Hastings, New Zealand.
November 2 ..	0 56·2	1 01·1	2·1	0 33·0	End uncertain.
„ 16 ..	11 45·9	11 47·9	1·7	..	
		11 49·6	1·8	0 11·3	
„ 30 ..	10 29·2	10 33·2	11·5	0 27·0	Duration uncertain owing to tremor.
December 3 ..	11 50·3	11 52·0	4·5	0 11·7	
„ 13 ..	12 01·8	12 03·2	0·9	0 01·9	Small local shock.
„ 23 ..	21 52·4	22 09·0	1·1	..	End indefinite owing to tremor.
1912.					
January 6 ..	18 01·4	18 07·3	0·7	0 58·1	
February 25 ..	5 43·0	5 50·0	2·5	..	
		5 52·0	2·0	1 30·5	
March 13 ..	..	19 39·0	0·8	..	Beginning and end obscured by tremors.
		19 45·5	0·6	..	
„ 25 ..	5 07·0	5 11·5	1·0	..	
		5 14·5	1·0	1 07·4	

Dec Ch'ch.
8th April, 1911.
9th April

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

H.F Ch'ch
8th April, 1911.
9th April

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

Dec. Ch'ch.
17th April, 1911.
18th April, 1911.

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

H.F. Ch'ch.
17th April, 1911.
18th April

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

7th May, 1911.
Dec. Ch'ch.

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

12th June, 1911.
11th June
Dec. Ch'ch.

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

12th June, 1911.
11th June
H.F. Ch'ch

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

8th July, 1911.
7th July
Dec. Ch'ch.

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

H.F. Ch'ch
8th July, 1911.
7th July

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

8th July, 1911.
7th July
V.F. Ch'ch

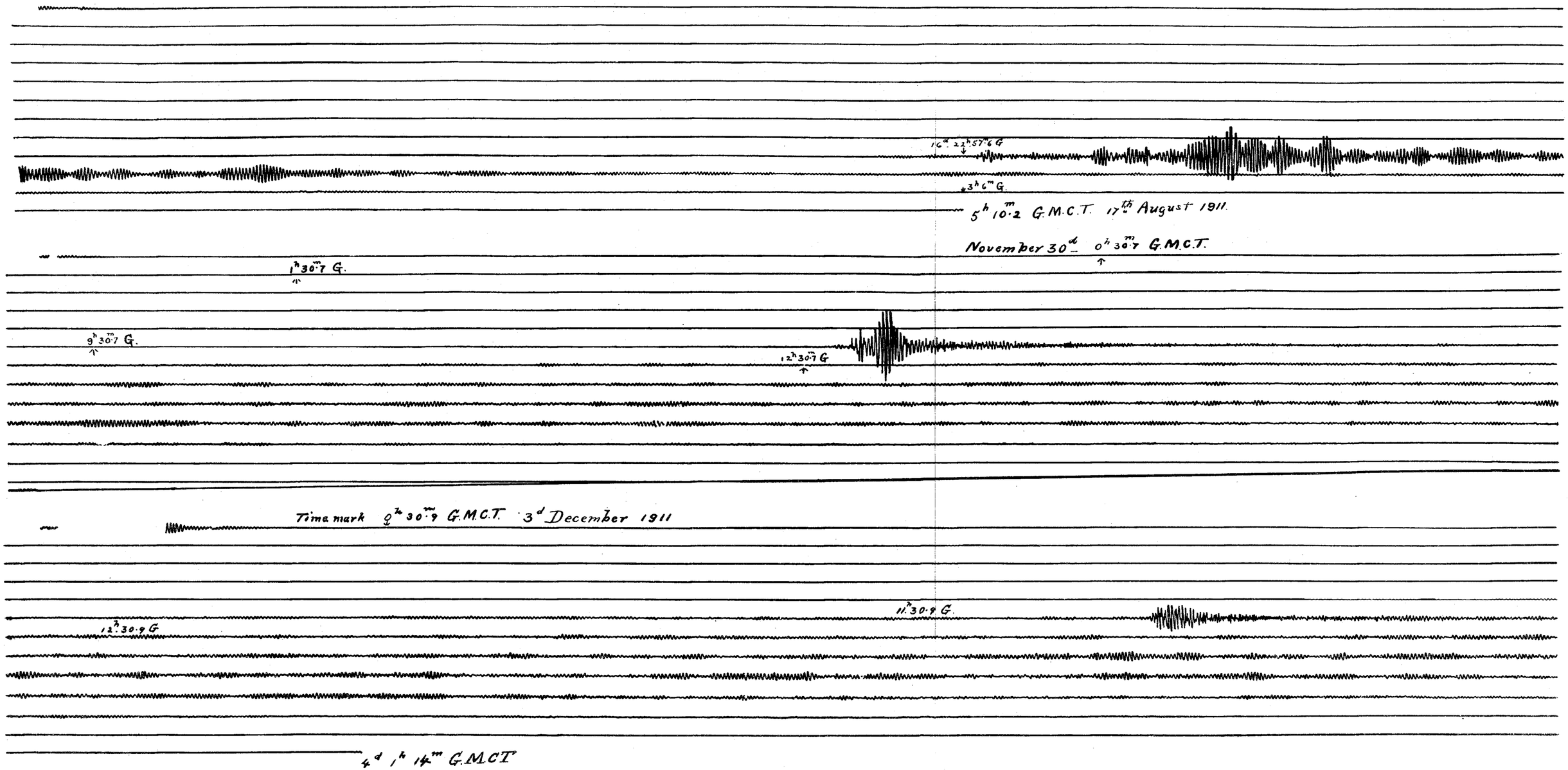
2h G 4 6 8 10 12 14 16 18 20 22
0 2 4 6 8 10 12 14 16 18 20 22

11th Dec, 1911.
12th Dec.
Dec. Ch'ch.

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

H.F.
11th Dec, 1911.
12th Dec.

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



1500-6/12.378

SEISMOGRAMS.—Christchurch Observatory.

APPENDIX III.—SECONDARY TRIANGULATION.

MEASUREMENT OF THE MATAMATA BASE-LINE, AUCKLAND DISTRICT.

[By J. LANGMUIR, Inspector of Surveys.]

Geographical Position of Base.—The north end is in latitude 37° 46′ S. and longitude 175° 45′ E. (approximately). The line selected starts from the new trigonometrical station, Waharoa, situated about half a mile west of the township and railway-station of the same name, on the Auckland to Rotorua Railway. Running on a bearing of about 163° 50′, it passes through the Matamata Settlement, which at the time of the measurement was mostly in English grass or under crop. As the country was fairly closely subdivided, sixty-four fences and hedges had to be crossed four times during the course of the measurements. The southern terminal is the new trigonometrical station, Mangawhero, on Section 16, Mangawhero Settlement.

Thanks are due to all the settlers through whose farms the line runs for the assistance given by freely consenting to the line being taken through, though in several instances it involved the damage incident to passing through standing crops. Messrs. Johnston, of Waharoa, and Wilson, of Mangawhero, were especially considerate in allowing the erection, without question, of the terminal marks and signals on their respective properties.

Selection of Base.—This base was provisionally selected by Mr. R. T. Goulding, who, working under my direction, examined all the country from Frankton Junction to Morrinsville, across to Waihou, and up the Thames Valley to Matamata. This examination included the positions recommended by the late Mr. Cussen, "along the railway from Hamilton to Morrinsville, and from Ruakura Junction eastwards." On both of these proposed sites there is far too much swamp land to allow of proper measurements being made. Owing to curvature and the configuration of the ground along the line I had some trouble in finally deciding on the position to be adopted, as from either end only a portion of the 27-ft. signals, as now erected, at the other end can be seen under the best conditions. From the top of the 7-ft.-high concrete mound at the southern end perhaps five-eighths of the signal at the northern end can be seen in the early mornings for from one to two hours after daybreak. From the ground at the northern end about one-third of the signal at the southern end can be seen during the same early hours, disappearing altogether before 8 a.m., as refraction lessens and the air becomes unsteady owing to the rising heat. The position of the line and the height of the necessary mound at the south end were finally decided upon after experimenting with sun-flashes from a point about 15 ft. above the ground at the northern end, viewed from a temporary staging 9 ft. high at the southern end.

MARKING.

The terminal marks at the northern end of the base are the same as those depicted in Fig. 5 of the report on the measurement of the Wairarapa base. For a representation of the marks at the southern end see Fig. 3 of this report. Signals of a height of 27 ft. from the ground to the tops of the finials were erected in totara timber at both ends. The principal ranging of the line was done with an 8-in. transit theodolite, great care being taken when fixing the positions of the intermediate marks, of which those numbered II, III, IV, V, VI, and VIII are galvanized trig. tubes set in concrete. Tubes II, III, V, and VIII are on the sides of roads, where they are sunk 4 in., and covered with jarrah blocks, 1 ft. square, thus forming standard points for the future control of ordinary surveys (See Fig. 4). Points I and VII are marked by 2 ft. by 3 in. totara pegs countersunk 1 ft. in the ground, where they will be well clear of all cultivation. These intermediate marks break the line up into eight sections, seven of which consist of nearly level country, Section 1 being the only one on which there are any steep grades, the highest inclination being $23\frac{1}{4}°$.

Standard of Length.—The standard of length for the measurement of this line is, for the present, the Imperial standard steel tape No. 3, with its balance No. 3 deposited in the District Survey Office, Auckland.

Field Measurements.—The measurements in the field were all executed with the same apparatus as figured and described in the reports on the measurements of the Wairarapa and Eltham to Okaiawa base-lines. The importance of the shelter-tent for the comparator was again recognized in the satisfactory results of the tape comparisons. Four measurements of the line with four separate tapes were made, the results of which are all shown in Table No. 1. The measurements were started on the 2nd December, 1910, and completed on the 27th January, 1911, a portion of this interval being taken up by the Christmas and New Year holidays, there being also some delay by wet and stormy weather. The air-temperatures during the measurements ranged from 49° Fahr. to 86° Fahr. The least probable error in any section is in Section 4, where it amounts to $\pm$ 0·0004, or 1 in 6,551,945. The greatest error in any section is in Section 5, where it amounts to $\pm$ 0·0043, or 1 in 1,271,825. The probable error of the whole line is $\pm$ 0·010051, or 1 in 5,452,225.

Fig. No. 1 shows the base net of triangles. Trig. 147, Mangakawa Station, is the present centre of the polygon in the so-called "major triangulation," but as a station on Tapui gave very much better conditions I had this hill cut out and a new station built. This work was rather expensive, owing to the heavy nature of the bush, but fully warranted by the infinitely better triangles obtained.

Fig. No. 2 gives a plan and section of the base.

Fig. No. 3 shows a cross section and plan of the station marks at the southern end of the base.

Fig. No. 4 shows the nature of some of the intermediate marks on the line.

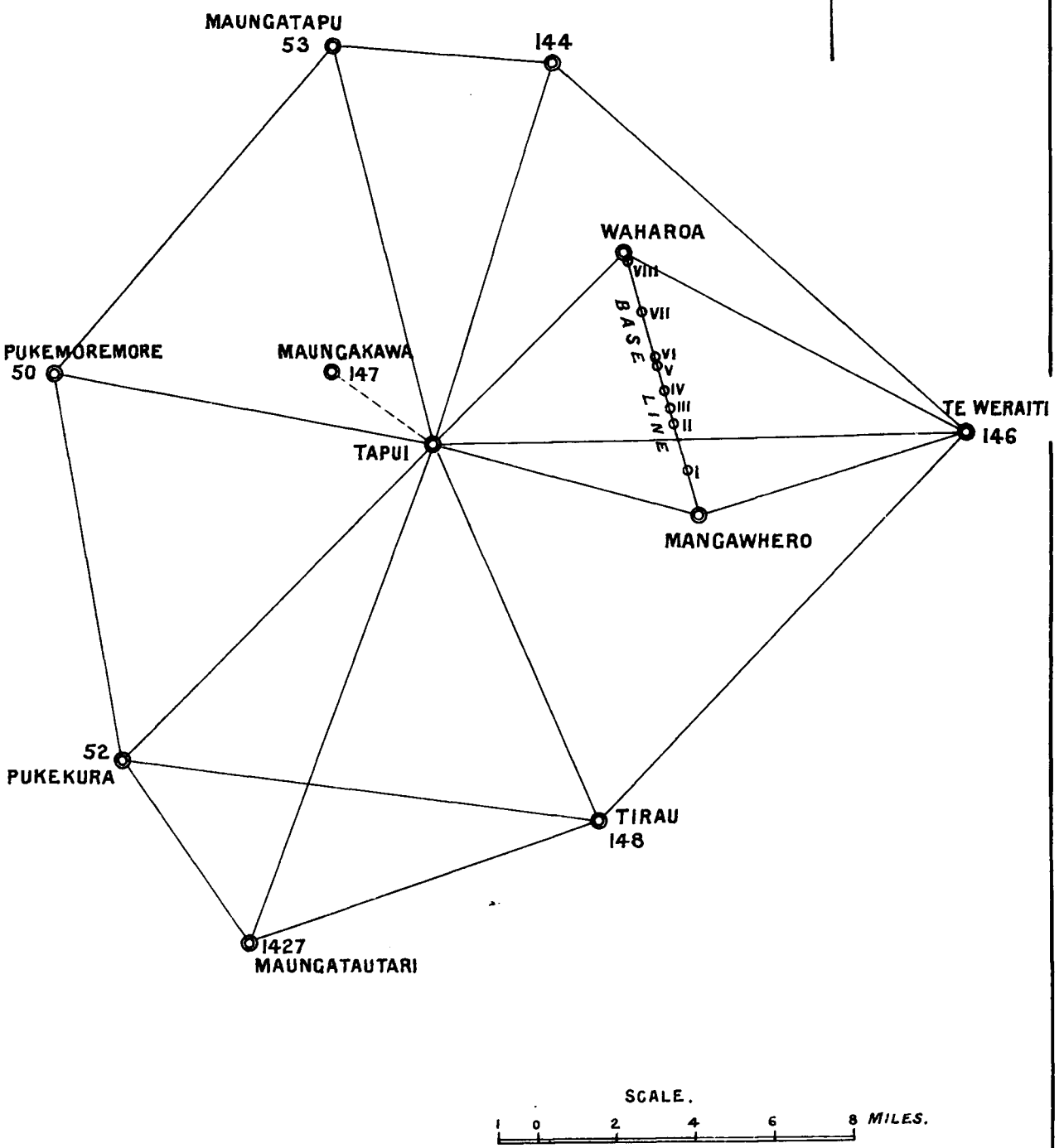
A plan on a scale of 10 chains to an inch is also attached to this report. This plan gives all the intermediate distances along the line, also three connections to the settlement surveys.

TABLE NO. 1.—RESULTS OF MEASUREMENTS, MATAMATA BASE, AUCKLAND.

No. of Section.	No. of Measurement.	No. of Tape.	Edge of Tape.	Date.	Direction.	Temperature-range.	Weather.	Individual Measurements of Sections.	Correction to Sea-level.	Measurements at Sea-level and Means.	Residuals Arithmetical Means, Measurements.	Probable Errors of Arithmetical Means.	Remarks.
				1911.		Deg. Fahr.		Links	Links.	Links.	Links.	Links.	
1	1	02	B	January 26, 27 ..	N.–S.	66–72	26th, dull and calm; 27th, light wind; 28th, very hot, with high wind in afternoon	9330·9487	—·1111	9330·8376	+·0034		
	2	03	B	,, ..	N.–S.	64–73		9330·9507	—·1111	9330·8396	+·0014	..	
	3	02	A	January 27, 29 ..	S.–N.	68–80		9330·9615	—·1111	9330·8504	—·0094		Steepest grade = 23° 15′ 24″.
	4	03	A	,, ..	S.–N.	68–79		9330·9473	—·1111	9330·8362	+·0046		
								4/37323·8082	..	4/33638			
								9330·9521	—·1111	9330·8410	..	±·0022	1 in 4,241,342.
2	1	02	B	January 21, 23 ..	N.–S.	73–82	21st, very warm, with strong north-west wind; 23rd, calm, very hot; 24th, mostly calm and very hot, with north-east wind in afternoon	9907·4172	—·1175	9907·2997	+·0210		
	2	03	B	,, ..	N.–S.	74–84		9907·4236	—·1175	9907·3061	+·0146	..	
	3	02	A	January 24, 25 ..	S.–N.	72–86		9907·4649	—·1175	9907·3474	—·0267		Steepest grade = 1° 19′ 14″.
	4	03	A	,, ..	S.–N.	73–85		9907·4470	—·1175	9907·3295	—·0088		
								4/297527	..	4/12827			
								9907·4382	—·1175	9907·3207	..	±·0074	1 in 1,338,843.
				1910.									
3	1	02	B	December 5, 6 ..	N.–S.	72–78	Very hot, with light variable winds	4086·9008	—·0471	4086·8537	+·0026		
	2	03	B	,, ..	N.–S.	72–78	,, ,,	4086·9022	—·0471	4086·8551	+·0012	..	
	3	02	A	December 6, 7 ..	S.–N.	70–83	Dull, with light north-west wind ..	4086·9080	—·0471	4086·8609	—·0046		Steepest grade = 2° 31′ 25″.
	4	03	A	,, ..	S.–N.	70–84	,, ,, ..	4086·9025	—·0471	4086·8554	+·0009		
								4/36135	..	4/34251			
								4086·9034	—·0471	4086·8563	..	±·0011	1 in 3,715,367.
4	1	02	B	December 5 ..	N.–S.	68–70	Fine, overcast, light south-east wind	2620·7769	—·0297	2620·7472	+·0010		
	2	03	B	,, ..	N.–S.	66–71		2620·7787	—·0297	2620·7490	—·0008	..	
	3	02	A	December 7 ..	S.–N.	70–79	Warm, overcast	2620·7788	—·0297	2620·7491	—·0009		Steepest grade = 0° 48′ 45″.
	4	03	A	,, ..	S.–N.	70–76	,, ,, ...	2620·7770	—·0297	2620·7473	+·0009		
								4/31114	..	4/29926			
								2620·7779	—·0297	2620·7482	..	±·0004	1 in 6,551,945.

Fig. 1.

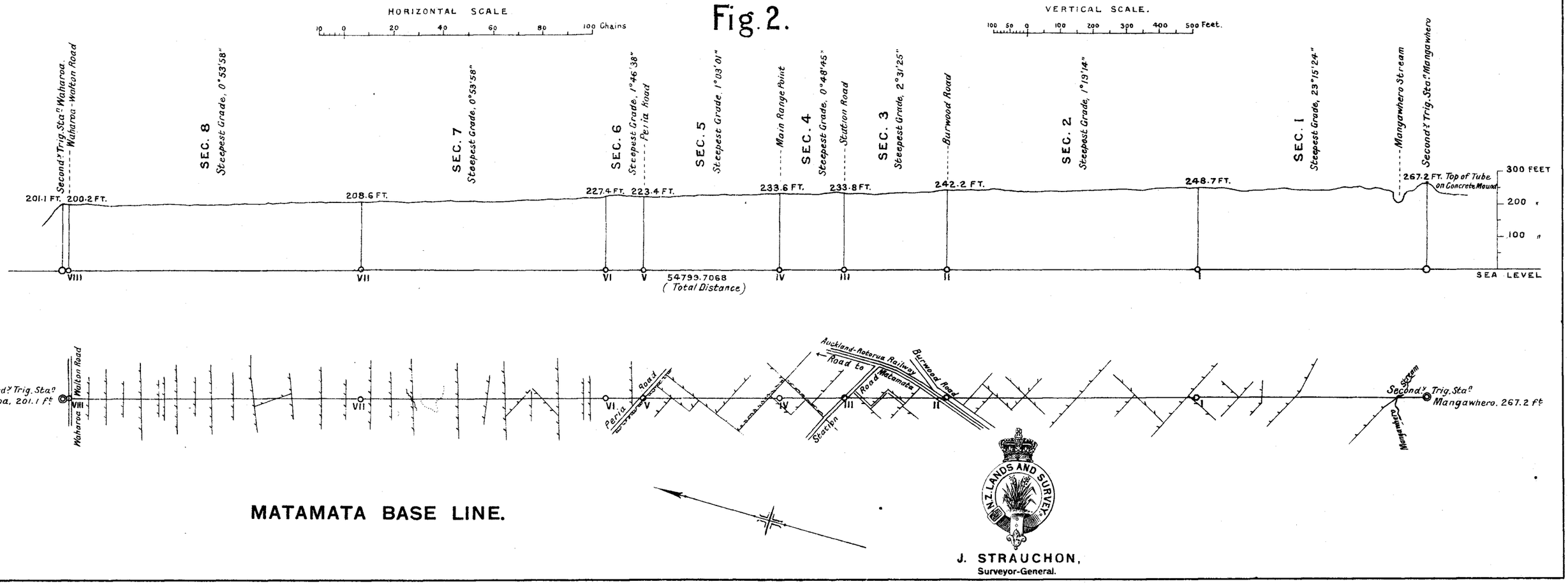
J. STRAUCHON,
Surveyor-General.



SCALE.
1 0 2 4 6 8 MILES.

MATAMATA BASE LINE.

Fig. 2.



MATAMATA BASE LINE.

N.Z. LANDS AND SURVEY

J. STRAUCHON,
Surveyor-General.

J. STRAUCHON.
Surveyor-General.

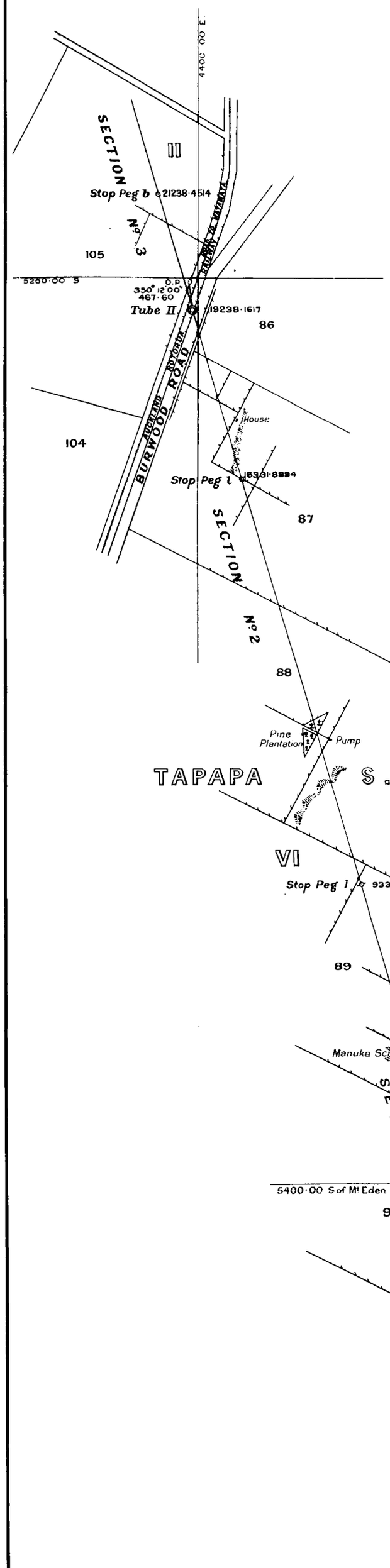
SECONDARY TRIANGULATION IN NEW ZEALAND.

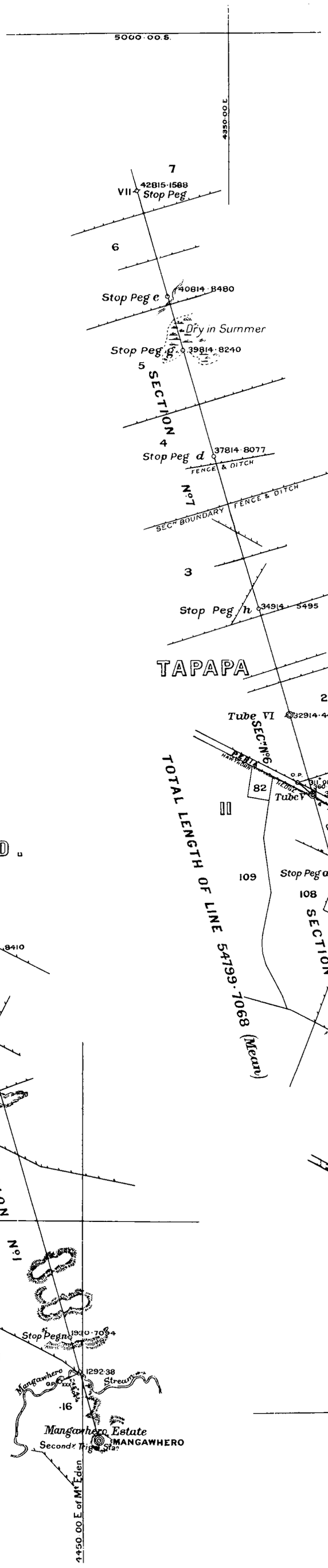
BASE LINE, MATAMATA.

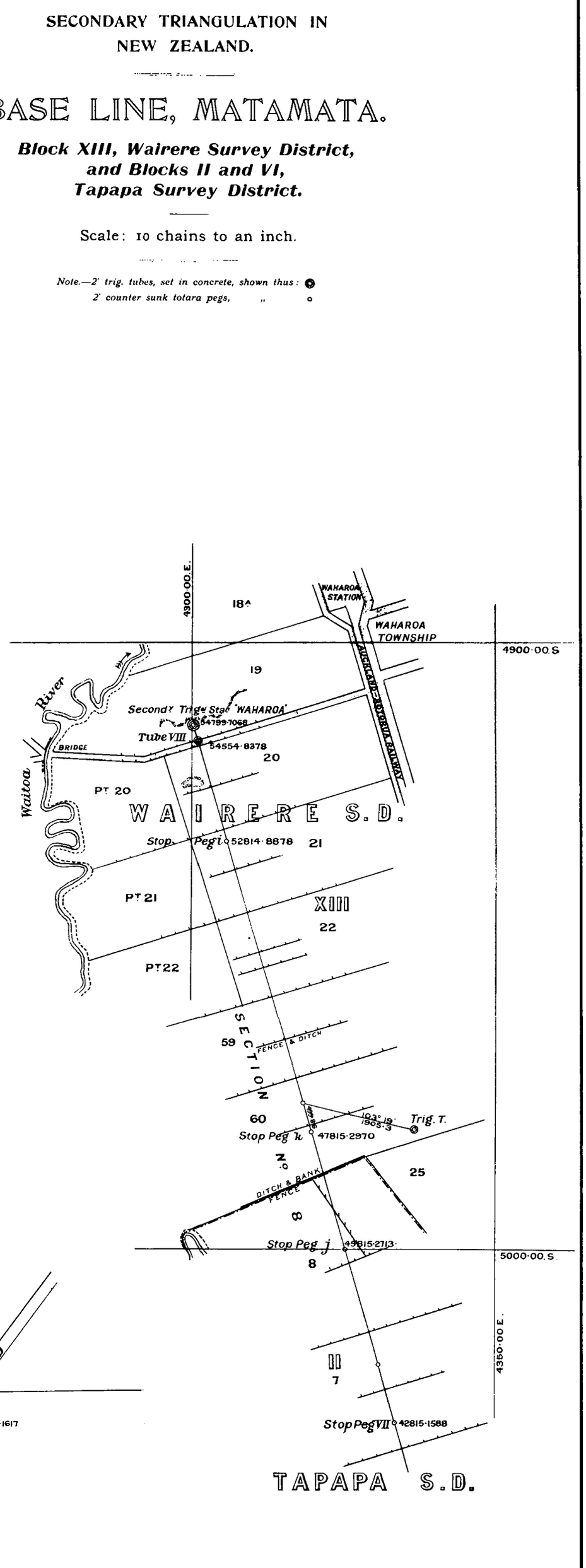
Block XIII, Wairere Survey District, and Blocks II and VI, Tapapa Survey District.

Scale: 10 chains to an inch.

Note.—2' trig. tubes, set in concrete, shown thus: ⊙
2' counter sunk totara pegs, „ o







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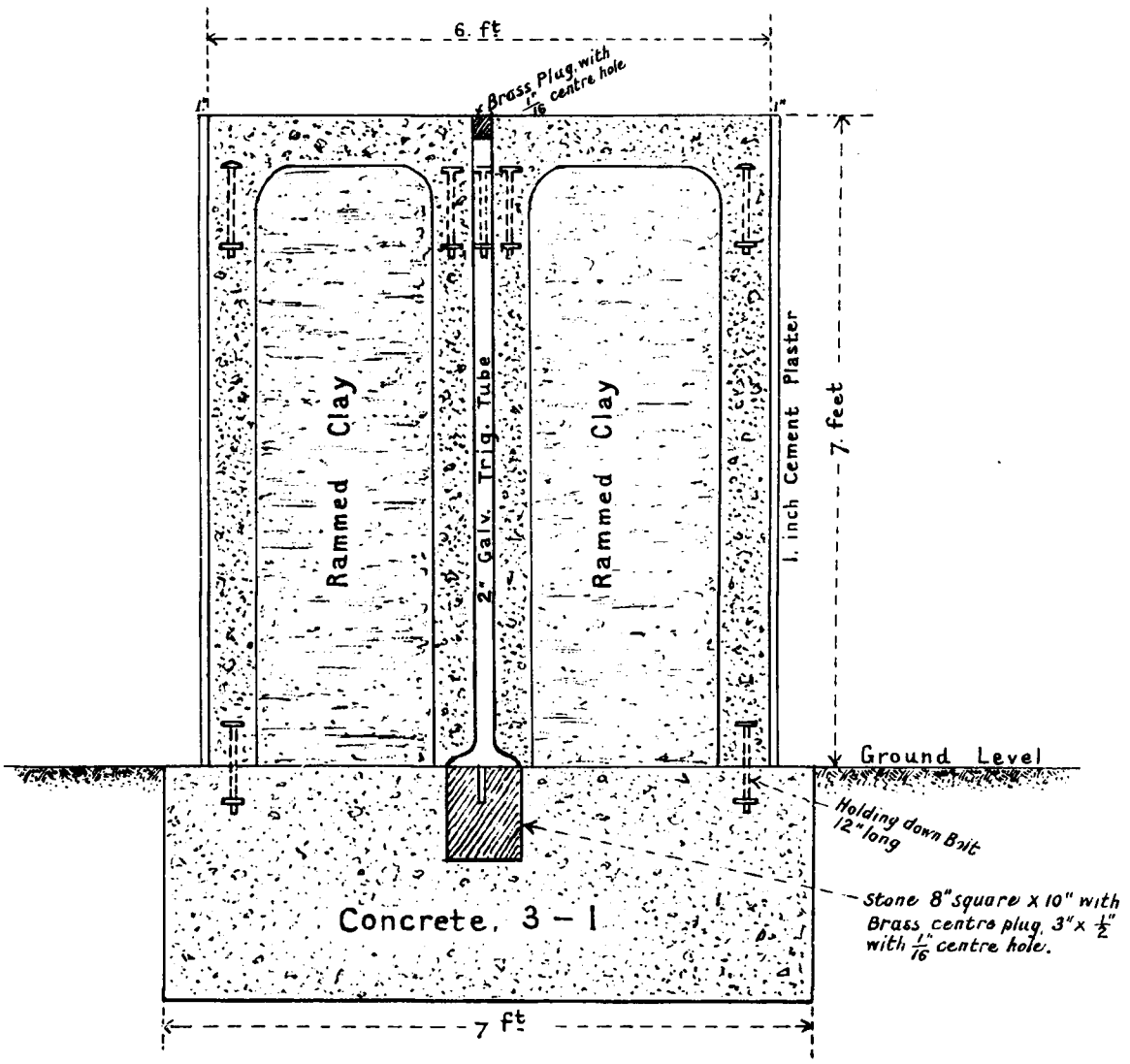
H. T. McCARDELL, CHIEF DRAUGHTSMAN HEAD OFFICE, WELLINGTON

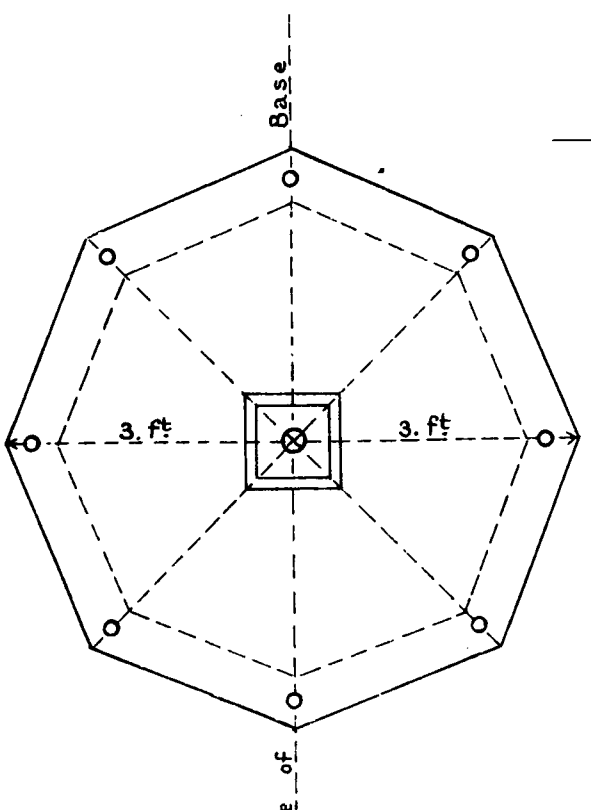
Fig. 3.

STATION MARKS,

At the Southern end of the

MATAMATA BASE LINE.





Scale, 2 Feet to an Inch.

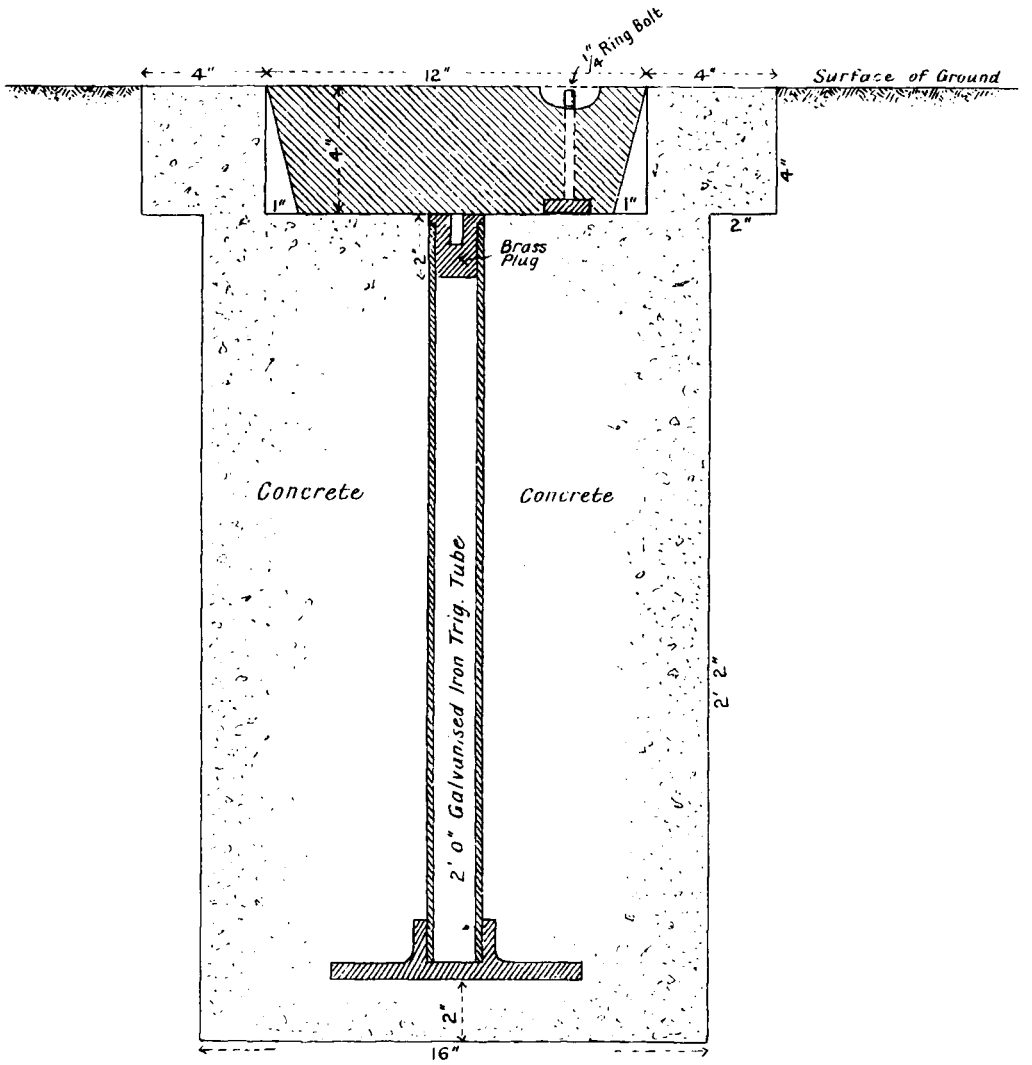
J. STRAUCHON,
Surveyor-General.

Fig. 4.

J. STRAUCHON,
Surveyor-General.

DIAGRAM—SHOWING LINE TUBES ON ROADS,
—— AS STANDARD POINTS ——
Covered with 12" square Jarrah Blocks.

MATAMATA BASE LINE.



SCALE, 2 INCHES TO A FOOT.

1500.3.12.200.

5	1	02	B	December 2, 3 ..	N.–S.	66–72	Fine, overcast, light south-east wind	5468·8347	–·0593	5468·7754	+·0134	..	Steepest grade = 1° 03′ 01″.
	2	03	B	,, ..	N.–S.	64–73		5468·8402	–·0593	5468·7809	–·0079		
	3	02	A	December 7, 8 ..	S.–N.	64–74	Partly overcast and fair, with south-west wind	5468·8625	–·0593	5468·8032	–·0144		
	4	03	A	,, ..	S.–N.	64–75		5468·8548	–·0593	5468·7955	–·0067		
								4/33922	..	4/31550			
								5468·8481	–·0593	5468·7888	..	±·0043	1 in 1,271,825.
6	1	02	B	December 2 ..	N.–S.	64–74	Fine, overcast, light north-east wind	1499·9079	–·0164	1499·8915	–·0005	..	Steepest grade = 1° 46′ 38″.
	2	03	B	,, ..	N.–S.	64–74		1499·9083	–·0164	1499·8919	–·0009		
	3	02	A	,, ..	S.–N.	70–71		1499·9055	–·0164	1499·8891	+·0019		
	4	03	A	,, ..	S.–N.	70–71		1499·9081	–·0164	1499·8917	–·0007		
								4/36298	..	4/35642			
								1499·9074	–·0164	1499·8910	..	±·00044	1 in 3,408,880.
7	1	02	B	December 15, 16	N.–S.	49–74	Blowing at times; 16th, overcast and warm	9900·8151	–·1047	9900·7104	+·0024	..	Steepest grade = 0° 55′ 58″.
	2	03	B	,,	N.–S.	50–74		9900·8251	–·1047	9900·7204	–·0076		
	3	02	A	December 9, 10, 12	S.–N.	59–71	9th, part cloudy, with thunder shower; 12th, delayed by wind and rain	9900·8156	–·1047	9900·7109	+·0019		
	4	03	A	,,	S.–N.	60–71		9900·8140	–·1047	9900·7093	+·0035		
								4/32698	..	4/28510			
								9900·8175	–·1047	9900·7128	..	±·0017	1 in 5,824,010.
				1910–11.									
8	1	02	B	December 20; January 10, 11	N.–S.	68–82	December 20, blowing, with very heavy rain; January 10th and 11th, very hot, with light north-east wind	11984·6631	–·1190	11984·5441	+·0039	..	Steepest grade = 0° 53′ 58″.
	2	03	B	Ditto ..	N.–S.	68–82		11984·6826	–·1190	11984·5636	–·0156		
	3	02	A	January 11, 12 ..	S.–N.	73–84	Very hot, with light winds ..	11984·6699	–·1190	11984·5509	–·0029		
	4	03	A	,, ..	S.–N.	72–85	,, ,, ..	11984·6522	–·1190	11984·5332	+·0148		
								4/26678	..	4/21918			
								11984·6670	–·1190	11984·5480	..	±·0043	1 in 2,787,131.
								54800·3116	–·6048	54799·7068	..	±·010051	1 in 5,452,225.

MEASUREMENT OF THE WAITEMATA BASE-LINE, AUCKLAND DISTRICT.

[By J. Langmuir, Inspector of Surveys.]

Geographical Position of Base.—The easterly end of the line, trig. station, Waitemata, is in latitude 36° 49′ S. and longitude 174° 38′ E. (approximately). Starting from the new secondary trig. station, Waitemata, the line runs on a bearing of 293° 3′ (approximately) to the original minor trig. station C, situated about one mile south by west from the Kumeu Railway-station, on the Auckland to Helensville line. The particular reason for selecting a base in this locality was that it appeared in a high degree desirable that a base should be measured, if possible, somewhere in the single polygon, where the triangulations from the north and south converged to meet on the Auckland Isthmus. The search for a line was carried out by myself personally, and owing to the somewhat irregular nature of the country was a little difficult to locate, but, though not as long as one might wish, is the best obtainable, and on the whole lies in a very satisfactory position for extension from to the principal lines of the triangulation.

Fig. 1 shows the base net of triangles. It is almost necessary that the angles of this net and principal polygon should be observed as soon as possible. Permanent signals in totara, 17 ft. high, have been erected at both ends of the line, and signals of the same size in jarrah have also been erected at trigs. P and Pukeatua, the central station of the polygon. The line is broken up into five sections by the intermediate marks (*a*), (*e*), II, and III. Points (*a*) and (*e*) are marked by 3 in. by 3 in. totara pegs countersunk about 1 ft. in the ground. Point II is a stone block, and point III is a large trig. tube, both finely centred and set in concrete. Point I, on the Main North Road, is also marked by a stone block set in concrete. These stone blocks are centred with brass tubes.

Standard of Length.—The provisional standard of length for this line is the same as that adopted for the Matamata base—viz., the Imperial standard steel tape No. 3, deposited in the Auckland District Survey Office.

The measurements were started on the 27th June, 1911, and completed on the 29th August. The intermediate time was not all taken up with the measurements, as a good deal of it was occupied in the preparation of parts of the line, and some wet and stormy weather also occurred. The air-temperatures during the measurements ranged from 47° to 68° Fahr.

The least probable error in any section is in Section No. 5, where it amounts to ± 0·00197, or 1 in 3,559,841. The greatest probable error in a section is in Section No. 1, where it is ± 0·00491, or 1 in 1,768,760. The probable error in the whole line is ± 0·007705, or 1 in 5,423,851.

The reduction to sea-level has been computed for each measurement.

When laying down comparators with the Head Office Imperial standard steel tape No. 1, six Centigrade thermometers reading to tenths of a degree are used for recording temperatures.

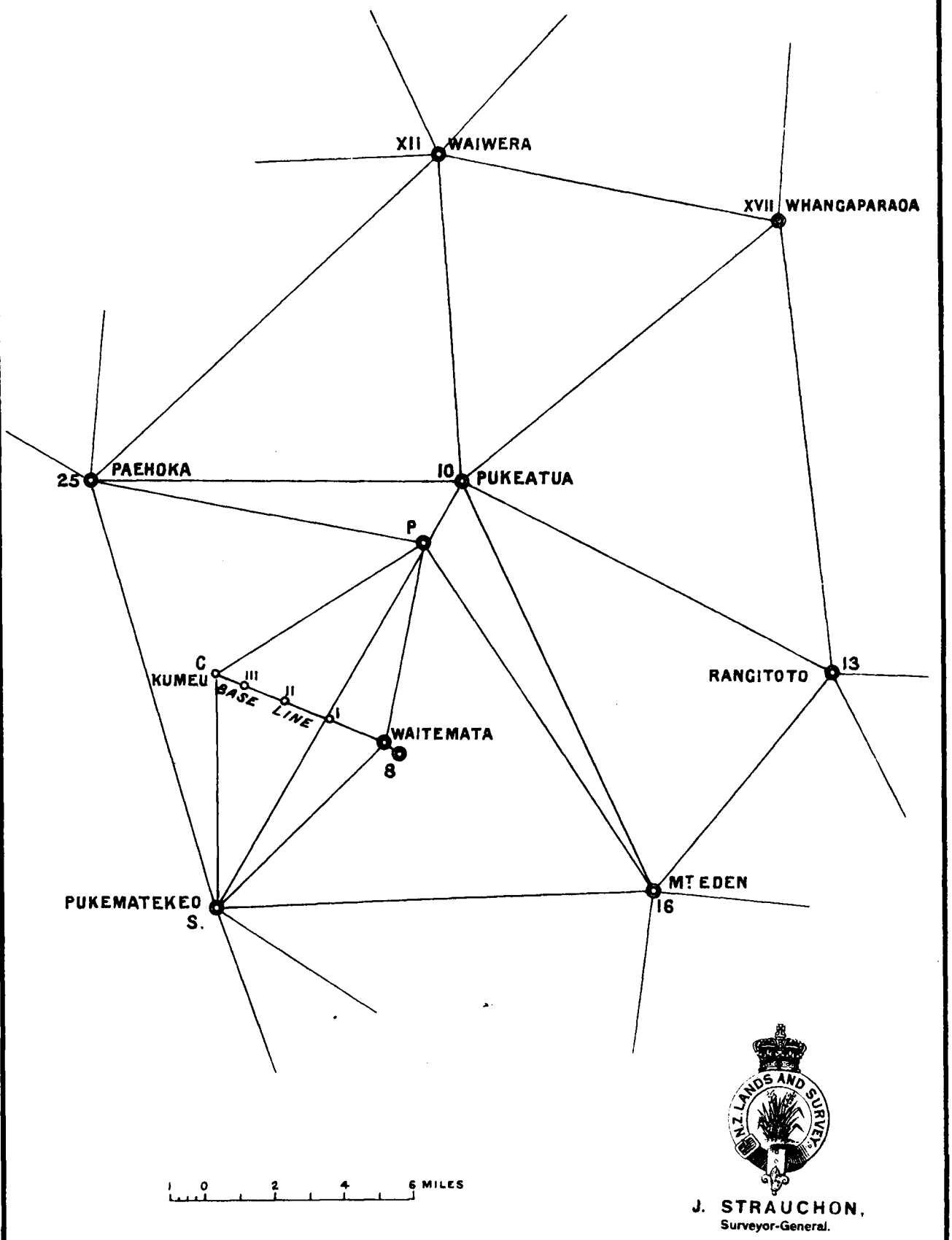
The following tables and illustrations are attached to this report:—

Table No. 1: Results of measurements.

Fig. No. 1: Diagram showing the base net of triangles.

Fig. No. 2: Plan and section of base.

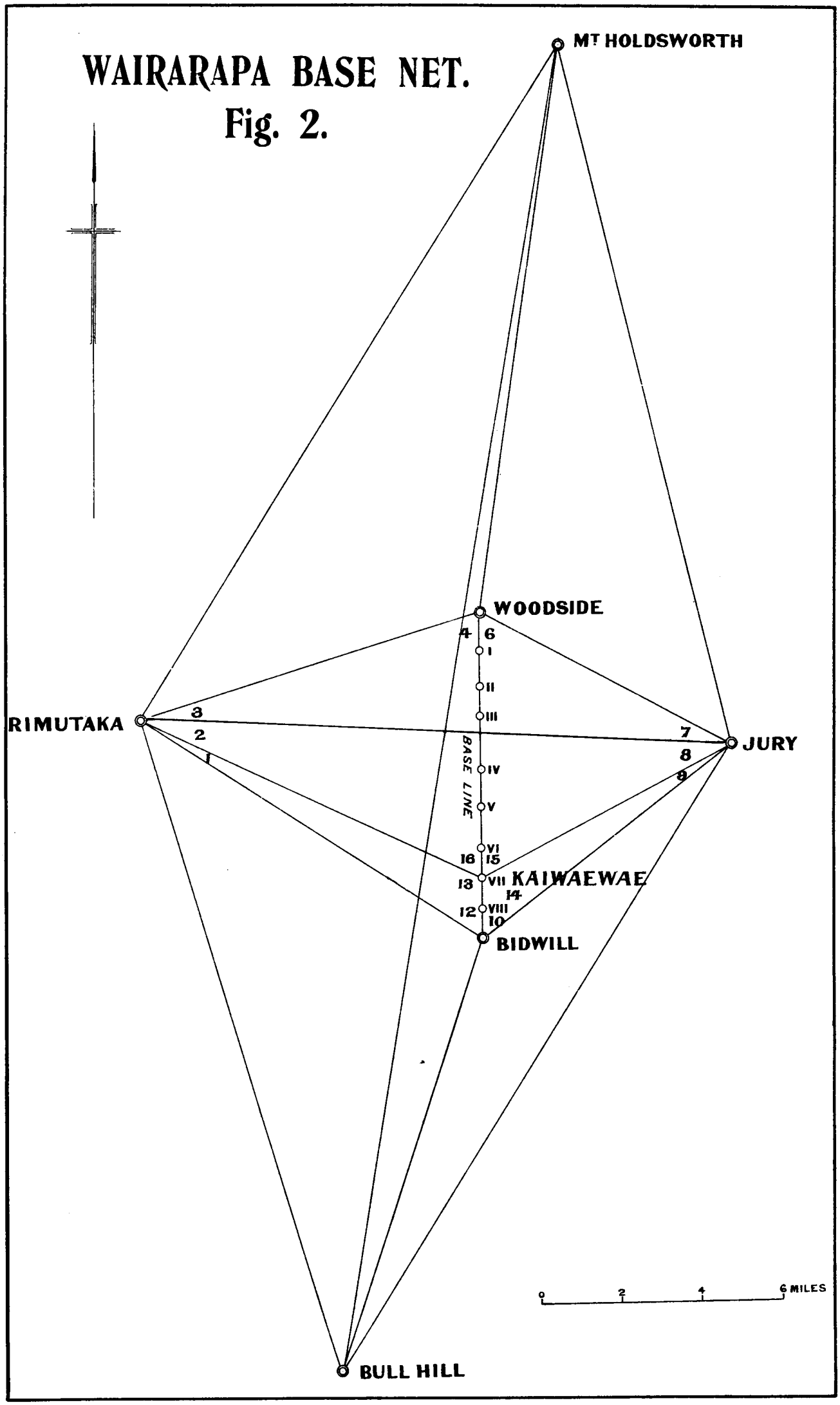
Also a tracing, on a scale of 10 chains to an inch, giving all the detail mean measurements along the line.



J. STRAUCHON,
Surveyor-General.

WAITEMATA BASE LINE.—Fig. 1.

1500.6.12.263.


WAIRARAPA BASE NET.
Fig. 2.
MT HOLDSWORTH
WOODSIDE
RIMUTAKA
JURY
KAIWAEWAE
BIDWILL
BULL HILL
BASE LINE
I
II
III
IV
V
VI
VII
VIII
1
2
3
4
6
7
8
9
10
12
13
14
15
16
0
2
4
6 MILES

J. STRAUCHON,
Surveyor-General.

NORTH ISLAND
TE IKA-A-MAUI

NEW ZEALAND

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

Reference
Cities
Boroughs
Towns
Railways
Roads
Boundaries of Land Districts
Projection: Rectangular Tangential

Reference to State of Public Surveys.
Meridional Circuit
Minor Triangulation
Section Survey under check
Section Survey built

RAOUL or SUNDAY Is
Denham Bay
Herald Islets
MACAULEY Is
CURTIS Is
L'ESPERANCE Rk
KERMADEC ISLANDS

COOK ISLANDS

TASMAN SEA

Bay of Plenty
North Taranaki Bight
South Taranaki Bight
Hawke Bay
Golden Bay
D'Urville Is
Tasman Bay
Karamea Bight
MIDDLE ISLAND
SOUTH PACIFIC OCEAN
TE MOANA-NUI-A-KIWA

172 173 174 175 176 177 178 East Longitude
34 35 36 37 38 39 40 41 South Latitude

BY AUTHORITY: H. MACKAY, GOVERNMENT PRINTER

J. STRAUCHON
Surveyor General

SOUTH ISLAND
(TE WAI-POUNAMU)
NEW ZEALAND

Scale of English Miles

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 Bay
Tasman Bay
Karamea Bight
Cloudy Bay
WELLINGTON
Pegasus Bay
Banks Peninsula
Canterbury Bight
Otago Peninsula
Stewart Island
South Latitude

T A S M A N S E A

S O U T H P A C I F I C

(TE MOANA-NUI-A-KIWA)

O C E A N

AUCKLAND [illegible]

CAMPBELL [illegible]

REKOHU or WHARE-KAURI
CHATHAM ISLANDS
Scale of English Miles
Hikokhu
East Coast Bay

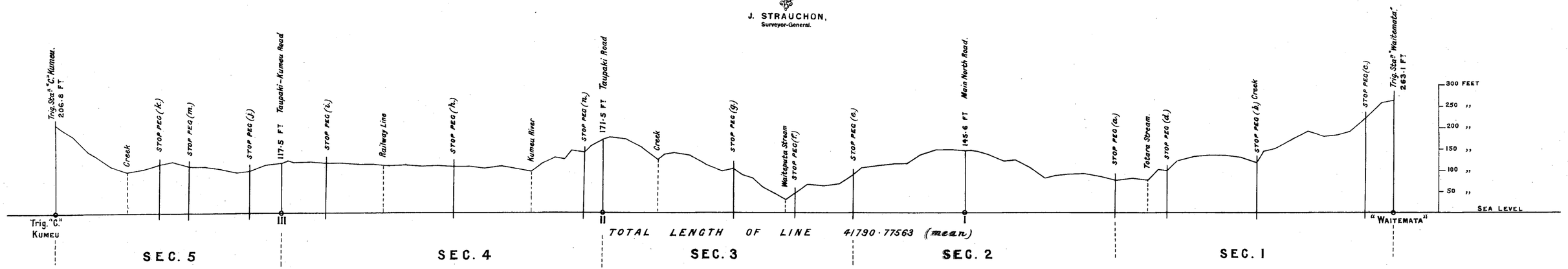
167° 168° 169° 170° East Longitude 171° 172° 173° 174°

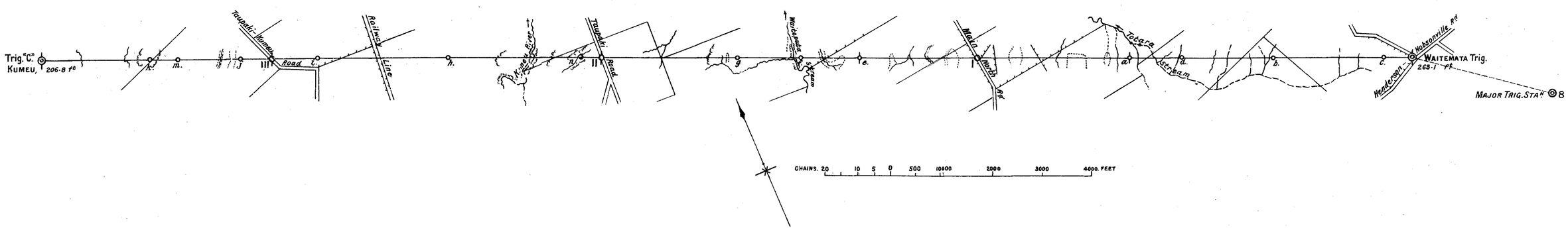
41° 42° 43° 44° 45° 46° 47° South Latitude

By Authority: John Mackay, Government Printer.

WAITEMATA BASE LINE.—Fig. 2.

J. STRAUCHON,
Surveyor-General.





A. S. 26/3/12

1500. 6. 12. 262.

Table No. 1.—Results of Measurements, Waitemata Base, Auckland.

No. of Section.	No. of Measurement.	No. of Tape.	Edge of Tape.	Date.	Direction.	Temperature-range.	Weather.	Individual Measurements at Sea-level and Means.	Residuals Means, Measurements.	Probable Error of Arithmetical Means.	Remarks.
				1911.		Deg. Fah.		Links.	Links.	Links.	
1	1	02	B	June 28, 30, and July 12	N.W.	49–62	28th, fine, very cold wind from south-east; 30th, fine, strong cold north-east wind; July 12th, fine, calm	8683·6119	+·0019		
	2	03	B	„ „	N.W.	48–62		8683·6011	+·0127	..	Steepest grade, 11° 22′ 31″.
	3	02	A	June 27, 28	S.E.	47–55	27th, dull, cold light south-east wind; 28th, fine, very cold wind from south-east	8683·6346	−·0208		
	4	03	A	„	S.E.	47–55		8683·6076	+·0062		
								4/·24552			
								8683·6138	..	±·00491	1 in 1,768,570.
2	1	02	B	July 13, 14	N.W.	49–62	13th, fine, calm; 14th, fine, light south-east wind	8213·0940	−·00385		
	2	03	B	„	N.W.	50–64		8213·0805	+·00965		
	3	02	A	July 14, 15	S.E.	47–60	15th, fine, calm	8213·0993	−·00915	..	Steepest grade, 4° 12′.
	4	03	A	„	S.E.	47–59	„	8213·0868	+·00335		
								4/·3606			
								8213·09015	..	±·00277	1 in 2,965,031.
3	1	02	B	July 27, 28	N.W.	51–58	28th, cold east wind; 27th, dull, calm; 26th, fine, calm	7805·3704	+·0060		
	2	03	B	„	N.W.	52–57		7805·3644	+·0120		
	3	02	A	July 26, 27	S.E.	48–60		7805·3888	−·0124	..	Steepest grade, 5° 49′ 10″.
	4	03	A	„	S.E.	50–60		7805·3820	−·0056		
								4/·15056			
								7805·3764	..	±·00372	1 in 2,098,230.
4	1	02	B	August 11, 14, 18 ..	N.W.	51–67	11th, part fine, part showery; 14th, clear, fine; 18th, fine, south-west wind	10075·82010	−·01222		
	2	03	B	„ ..	N.W.	51–64		10075·80830	−·00042		
	3	02	A	August 23, 24, 28, 29 ..	S.E.	56–66	23rd, fairly strong south-west wind; 24th, dull and calm; 28th, fair; 29th, calm	10075·80540	+·00248	..	Steepest grade, 8° 41″ 10″.
	4	03	A	„ ..	S.E.	56–65		10075·79770	+·01018		
								4/·323150			
								10075·80788	..	±·00314	1 in 3,208,856.
5	1	02	B	August 18, 19, 21 ..	N.W.	58–66	18th, south-west wind, fine; 19th, high south-east wind; 21st, fair; 22nd, clear, strong south-east wind; 23rd, fairly strong south-west wind	7012·8932	−·0058		
	2	03	B	„ ..	N.W.	58–65		7012·8870	+·0004	..	Steepest grade, 6° 25′ 44″.
	3	02	A	August 21, 22, 23 ..	S.E.	58–67		7012·8899	−·0025		
	4	03	A	„ ..	S.E.	58–68		7012·8795	+·0079		
								4/·35496			
								7012·8874	..	±·00197	1 in 3,559,841.
								41790·77563	..	±·007705	1 in 5,423,851.

WAIRARAPA BASE.

The amended final results of the measurement of the Wairarapa Base are given in the accompanying table. These supersede the provisional results given in Table No. 1, pages 26–28 in the report of the survey operations for the year 1909–10. The alterations are due to a small constant error in the correction for mean tension.

AMENDED RESULTS OF MEASUREMENT.

No. of Section.	No. of Measurement.	Individual Measurements.	Weights.	Weighted Means.	Reduction to Sea-level.	Length at Sea-level.	Remarks.
		Links.		Links.	Links.	Links.	
1	1	7498·3272	3	22494·9816			
	2	7498·2843	1	7498·2843			
	3	7498·3209	1	7498·3209			
	4	7498·2628	1	7498·2628			
	5	7498·2945	5	37491·4725			
	6	7498·2600	5	37491·3000			
			16	119972·6221			
				$7498{\cdot}2888_8$	0·0957	$7498{\cdot}1931_8$	
2	1	7197·5256	3	21592·5768			
	2	7197·5077	1	7197·5077			
	3	7197·5396	1	7197·5396			
	4	7197·4820	1	7197·4820			
	5	7197·5108	5	35987·5540			
	6	7197·4810	5	35987·4050			
			16	115160·0651			
				$7197{\cdot}5040_6$	0·0776	$7197{\cdot}4264_6$	
3	1	6016·0108	1	6016·0108			
	2	6016·0122	1	6016·0122			
	3	6016·0345	1	6016·0345			
	4	6015·9973	1	6015·9973			
	5	6016·0402	3	18048·1206			
	6	6016·0419	3	18048·1257			
			10	60160·3011			
				$6016{\cdot}0301_1$	0·0562	$6015{\cdot}9739_1$	
4	1	10614·8845	1	10614·8845			
	2	10614·8775	1	10614·8775			
	3	10614·9316	1	10614·9316			
	4	10614·8733	1	10614·8733			
	5	10614·9461	3	31844·8383			
	6	10614·9428	3	31844·8284			
			10	106149·2336			
				$10614{\cdot}9233_6$	0·0803	$10614{\cdot}8430_6$	
5	1	6360·3683	1	6360·3683			
	2	6360·3634	1	6360·3634			
	3	6360·3994	1	6360·3994			
	4	6360·3907	1	6360·3907			
			4	1·5218			
				$6360{\cdot}3804_5$	0·0376	$6360{\cdot}3428_5$	
6	1	8265·3369	1	8265·3369			
	2	8265·3321	1	8265·3321			
	3	8265·4048	1	8265·4048			
	4	8265·3862	1	8265·3862			
			4	1·4600			
				$8265{\cdot}3650_0$	0·0392	$8265{\cdot}3258_0$	
7	1	5676·4093	1	5676·4093			
	2	5676·4015	1	5676·4015			
	3	5676·4488	1	5676·4488			
	4	5676·4346	1	5676·4346			
			4	1·6942			
				$5676{\cdot}4235_5$	0·0276	$5676{\cdot}3959_5$	
				$51628{\cdot}9154_1$	0·4142	$51628{\cdot}5012_1$	Sections 1 to 7.

AMENDED RESULTS OF MEASUREMENT—*continued.*

No. of Section.	No. of Measurement.	Individual Measurements.	Weights.	Weighted Means.	Reduction to Sea-level.	Length at Sea-level.	Remarks.
		Links.		Links. $51628{\cdot}9154_1$	Links. 0·4142	Links. $51628{\cdot}5012_1$	Brought forward.
8	1	5896·4425	1	5896·4425			
	2	5896·4426	1	5896·4426			
	3	5896·4470	1	5896·4470			
	4	5896·4403	1	5896·4403			
			4	1·7724			
				$5896{\cdot}4431_0$	0·0282	$5896{\cdot}4149_0$	
9	1	7251·8374	1	7251·8374			
	2	7251·8342	1	7251·8342			
	3	7251·8229	1	7251·8229			
	4	7251·8014	1	7251·8014			
			4	3·2959			
				$7251{\cdot}8239_8$	0·0732	$7251{\cdot}7507_8$	
				64777·1825	0·5156	$64776{\cdot}6668_9$	Total amended length of line.
				AUXILIARY BASE.			
	1	..	..	11463·7583			
	2	..	..	11463·7533			
	3	..	..	11463·7044			
	4	..	..	11463·7150			
			4	45854·9310			
				$11463{\cdot}7327_5$	0·04384	$11463{\cdot}6889_1$	Amended length of Auxiliary Base.

27th February, 1912.

J. LANGMUIR,
Inspecting Surveyor.

ADJUSTMENT OF WAIRARAPA BASE-NET.

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

DURING the year Mr. H. E. Girdlestone, assistant surveyor, has observed at the following trigonometrical stations in the Wellington District, using a 10-in. Everest theodolite with three verniers reading to 10″: Rangitumau, Rimutaka, Wainui, Kapakapanui, Taungata, Puketoi, Arawaru, Wharite, Moutere, Raetihi, Raetihi Hill, Kawai-o-tawaki, and Waipuna. The angles have been taken out from the field-books and the angular errors of the triangles ascertained. Mr. J. Langmuir, Inspector of Surveys, has slightly amended the lengths of the measurements of the Wairarapa base-line, the alteration being due to a small constant error in the correction for mean tension.

An extract from the field-book shows a portion of the observations of the horizontal angles at geodetic station, Arawaru. The observations are taken in four sets: set 1 is taken face right and in the clockwise direction; set 2 is taken face left and in the reverse direction. These two sets give one complete observation as shown at No. 1 on the abstract of horizontal angles. In a similar way the other seven observations are taken, and the mean of the eight observations is adopted as the observed angle.

Opaki Circuit, Arawaru Geodetic Station.

12th August, 1911, 9.30–10.40 a.m. 10 in. Everest instrument. Field-book No. 21, page 27. Origin: Puketoi, 103° 38′ 02·6″. Observer: H. E. Girdlestone.

Face.	Verniers.	Puketoi.			Rangitumau.			Mount Dundas.			Return.			Description of Stations and Remarks.
		°	′	″	°	′	″	°	′	″	°	′	″	
Right ..	A	103	42	20	166	12	45	212	11	15	103	42	20	
	B		42	15		12	40		11	05		42	20	
	C		42	10		12	45		11	15		42	10	
	C	133	45	00	196	15	30	242	14	00	133	45	05	
Left ..	B		45	00		15	30		14	05		45	00	
	A		45	10		15	35		14	05		45	05	Cold south-east breeze: atmosphere very clear.
	B	163	47	00	226	17	30	272	15	55	163	46	55	
Left ..	C		46	50		17	25		16	00		46	50	
	A		47	00		17	30		16	00		47	00	
	A	193	49	30	256	19	55	302	18	30	193	49	30	
Right ..	B		49	35		20	00		18	40		49	35	
	C		49	25		20	00		18	25		49	25	
			71	15		197	05		59	15		71	15	
Means ..		103	45	56·2	166	16	25·4	212	14	56·2	103	45	56·2	

Abstract of Horizontal Angles at Arawaru Geodetic Station.
Rangitumau and Mount Dundas.

No.	Page.	Angle.			v.	
		°	′	″		
1	27	45	58	30·00	+	1·05
2	27	45	58	31·66	+	2·71
3	29	45	58	31·66	+	2·71
4	29	45	58	26·66	−	2·29
5	30	45	58	26·66		2·29
6	30	45	58	28·33		0·62
7	31	45	58	27·50	−	1·45
8	31	45	58	29·16	+	0·21
			8	231·63	+	6·68
					−	6·65
		45	58	28·95		

The alterations in the length of the Wairarapa base-line have made necessary a recalculation of the triangle from the auxiliary base; and in this connection the opportunity was taken to include the whole of the observations of the angles, leading to slight alterations in them. The result of the recalculation shows that the direct measurement from IX to Bidwill differs only 0·0061 links from the calculated distance (see Fig. 1).

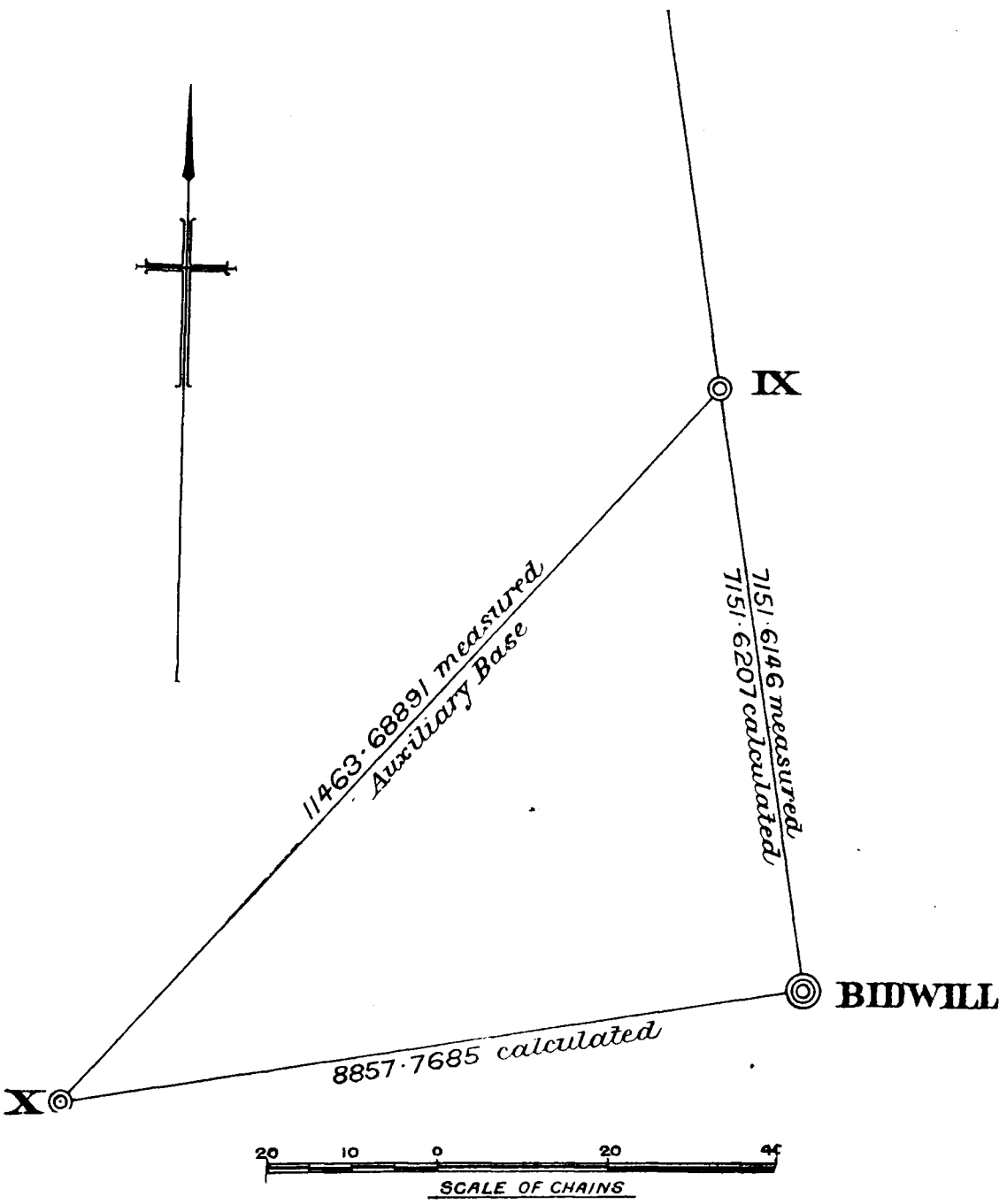


Fig. 1.

The Wairarapa base-net has been adjusted to the two measured lines, Woodside–Kaiwaewae and Woodside–Bidwill, and the results are given in detail hereunder.

Observed Angles.

No.	°	′	″	No.	°	′	″
1	8	27	58·96	9	10	42	09·62
2	21	38	11·15	10	53	04	10·00
3	19	42	20·73	11	00	00	05·97
4	73	15	14·44	12	56	56	13·75
5	00	00	01·18	13	114	35	38·54
6	62	19	42·71	14	116	13	40·28
7	24	42	42·80	15	63	46	28·44
8	29	11	09·24	16	65	24	10·70

NOTES.—Trig. station Kaiwaewae slightly to east of base-line. Angle No. 5 observed from Woodside, between Kaiwaewae and Bidwill. Angle No. 11 observed from Bidwill, between Woodside and Kaiwaewae (see Fig. 2).

Seconds of Observed Angles.

1 + 2 + 3 = 30·84″	7 + 8 + 9 = 01·66″	3 = 20·73″	1 + 2 = 10·11″
4 = 14·44	5 + 6 = 43·89	4 + 5 + 6 = 58·33	8 + 9 = 18·86
12 = 13·75	10 + 11 = 15·97	7 = 42·80	10 + 11 + 12 = 29·72
59·03	1·52	1·86	58·69
Sph. Ex. 0·45	0·34	0·29	0·50
Errors — 1·42	+ 1·18	+ 1·57	— 1·81

2 = 11·15″	6 = 42·71″	2 + 3 = 31·88″	1 = 58·96″
8 = 09·24	7 + 8 = 52·04	4 + 5 = 15·62	11 + 12 = 19·72
15 + 16 = 39·14	15 = 28·44	16 = 10·70	13 = 38·54
59·53	3·19	58·20	57·22
Sph. Ex. 0·34	0·27	0·36	0·09
Errors — 0·81	+ 2·92	— 2·16	— 2·87

	9 = 9·62″	5 = 01·18″
	10 = 10·00	11 = 05·97
	14 = 40·28	13 + 16 = 49·24
	59·90	= 56·39
Sph. Ex.	0·07	0·00
Errors	— 0·17	— 3·61

Measured base lines: Woodside–Kaiwaewae = 51628·5012 links; Woodside–Bidwill = 64776·6668 links.

Equations.

The angle equations are—

$$x_6 + x_7 + x_8 + x_{15} = + 2{\cdot}92 \quad \text{A.}$$
$$x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} + x_{11} = + 1{\cdot}18 \quad \text{B.}$$
$$x_2 + x_3 + x_4 + x_5 + x_{16} = - 2{\cdot}16 \quad \text{C.}$$
$$x_1 + x_2 + x_3 + x_4 + x_{12} = - 1{\cdot}42 \quad \text{D.}$$
$$x_1 + x_{13} + x_{11} + x_{12} = - 2{\cdot}87 \quad \text{E.}$$
$$x_3 + x_4 + x_5 + x_6 + x_7 = + 1{\cdot}57 \quad \text{F.}$$
$$x_{13} + x_{14} + x_{15} + x_{16} = - 2{\cdot}04 \quad \text{G.}$$

The side equations are—

$$6{\cdot}718x_1 - 1{\cdot}137(x_2 + x_3) + {\cdot}301(x_4 + x_5) - {\cdot}524x_6 + {\cdot}729(x_7 + x_8) - 5{\cdot}291x_9 + {\cdot}751x_{10} - {\cdot}651(x_{11} + x_{12}) = + 11{\cdot}167 \quad \text{H.}$$

$$1{\cdot}725(x_1 + x_2) - 2{\cdot}792x_3 + {\cdot}301x_4 - {\cdot}524(x_5 + x_6) + 2{\cdot}173x_7 - 1{\cdot}196(x_8 + x_9) + {\cdot}752(x_{10} + x_{11}) - {\cdot}651x_{12} = + 9.121 \quad \text{I.}$$

$$2{\cdot}521x_2 - 2{\cdot}792x_3 + {\cdot}301(x_4 + x_5) - {\cdot}524x_6 + 2{\cdot}173x_7 - 1{\cdot}790x_8 + {\cdot}493x_{15} - {\cdot}428x_{16} = + 6{\cdot}713 \quad \text{J.}$$

$${\cdot}651x_{12} - {\cdot}845(x_1 + x_2 + x_3) + 1{\cdot}137(x_2 + x_3) - .458x_{16} = + {\cdot}078 \quad \text{K.}$$

Let A, B, C, &c., be the indeterminate factors, then the values of the corrections (x) in terms of these factors are—

x_1	=				+D	+E		+ 6·718 H	+ 1·725 I			− ·845 K				
x_2	=			+C	+D			− 1·137 H	+ 1·725 I	+ 2·521 J	+ ·292 K					
x_3	=			+C	+D		+F	− 1·137 H	− 2·792 I	− 2·792 J	+ ·292 K					
x_4	=			+C	+D		+F	+ ·301 H	+ ·301 I	+ ·301 J						
x_5	=		+B	+C			+F	+ ·301 H	− ·524 I	+ ·301 J						
x_6	=	+A	+B				+F	− ·524 H	− ·524 I	− ·524 J						
x_7	=	+A	+B				+F	+ ·729 H	− 2·173 I	+ 2·173 J						
x_8	=	+A	+B					+ ·729 H	− 1·196 I	− 1·790 J						
x_9	=		+B					− 5·291 H	− 1·196 I							
x_{10}	=		+B					+ ·751 H	+ ·752 I							
x_{11}	=		+B			+E		− ·651 H	+ ·752 I							
x_{12}	=				+D	+E		− ·651 H	− ·651 I			+ ·651 K				
x_{13}	=					+E	+G									
x_{14}	=						+G									
x_{15}	=	+A					+G			+ ·493 J						
x_{16}	=			+C			+G			− ·458 J	− ·458 K					

Substituting the values of (x) in the original equations we get the following normal equations between the factors:—

4 A	+3 B				+2 F	+1 G	+ ·9340 H	+ ·4530 I	+ ·3520 J			= + 2·9200				
	7 B	+1 C		+1 E	+3 F		− 3·9560 H	+ ·2370 I	+ ·1600 J			= + 1·1800				
		5 C	+3 D		+3 F	+1 G	− 1·6720 H	− 1·2900 I	− ·1270 J	+ ·1260 K		= − 2·1600				
			5 D	+2 E	+2 F		+ 4·0940 H	+ ·3080 I	+ ·0300 J	+ ·3900 K		= − 1·4200				
				4 E		+1 G	+ 5·4160 H	+ 1·8260 I		− ·1940 K		= − 2·8700				
					5 F		− ·3300 H	− 1·3660 I	− ·5410 J	+ ·2920 K		= + 1·5700				
						4 G			+ ·0350 J	− ·4580 K		= − ·2·0400				
							78·6419 H	+ 20·5485 I	+ 1·0431 J	− 6·7645 K		= + 11·1672				
								23·5238 I	+ 19·2142 J	− 2·1930 K		= + 9·1210				
									22·9852 J	+ ·1305 K		= + 6·7139				
										1·5182 K		= + ·0784				

The solution of these equations gives—

A = + 0·0307″; B = − 0·3277″; C = + 0·8776″: D = −0·2713″; E = + 1·5942; F = − 0·6500; G = − 0·3522″; H = − 0·1634″; I = − 0·9817″; J = + 0·5397″; K = − 2·0248″.

Whence follow—

x_1	= + 0·2427″	x_2	= − 0·1320″	x_3	= + 0·7849″	x_4	= − 0·2259″
x_5	= + 0·5276	x_6	= − 0·6298	x_7	= − 2·0266	x_8	= − 0·2081
x_9	= + 1·7110	x_{10}	= − 1·1887	x_{11}	= + 0·6346	x_{12}	= + 0·7502
x_{13}	= + 1·2420	x_{14}	= − 0·3522	x_{15}	= − 0·0554	x_{16}	= + 1·2056

The seconds of the corrected spherical angles are therefore—

1 = 59·20″	2 = 11·02″	3 = 21·52″	4 = 14·21″
5 = 01·71	6 = 42·08	7 = 40·77	8 = 09·03
9 = 11·33	10 = 08·81	11 = 06·60	12 = 14·50
13 = 39·78	14 = 39·93	15 = 28·38	16 = 11·91

Lengths of sides in links—

	Links.		Links.
Woodside–Rimutaka	71066·92	Kaiwaewae–Rimutaka	74844·63
Woodside–Jury Hill	57322·06	Kaiwaewae–Jury Hill	56591·14
Bidwill–Rimutaka	81201·69	Rimutaka–Jury Hill	118977·76
Bidwill–Jury Hill	63506·70		

APPENDIX IV.

REPORT OF THE SURVEYORS BOARD.

THE Board for 1912 consists of Mr. John Strauchon, Surveyor-General, to 31st March, *ex officio*, when he was succeeded by Mr. James Mackenzie, Surveyor-General; Mr. Thomas Humphries, President of the Institute of Surveyors, Lower Hutt; and Mr. T. N. Brodrick, Chief Surveyor, Christchurch, nominated by the Minister of Lands; Mr. H. Sladden, Councillor, Institute of Surveyors, Wellington; and Mr. J. W. Harrison, Auckland, nominated by the Council of the Institute of Surveyors. At the first meeting of the Board in 1912 Mr. John Strauchon was unanimously elected chairman.

The Board, acting in conjunction with the six Australian Surveyors' Boards, conducted examinations of candidates for surveyors licenses in September, 1911, and March, 1912.

At the September examination twenty-six candidates sat. Of these, Mr. Edward Fletcher Roberts, Dunedin, passed the examination with credit, obtaining over 80 per cent. of the maximum marks; Mr. David Nelson, Lands and Survey Department, Gisborne; Mr. Jarl Adolph Sylvester, Greytown; and Mr. Henry Louis Percy Dyett, Lands and Survey Department, Wellington, passed the examination; while Mr. Allan Francis Waters, Lands and Survey Department, Wellington, and Mr. Ernest Gordon Wilson, Gore, who had previously passed in some of the subjects, completed the examination.

At the March examination twenty-six candidates sat. Of these, Mr. William David Armit, Lands and Survey Department, Nelson; Mr. Burnham Hirst Horner, New Plymouth; and Mr. Arthur Campbell Cooke, Nelson, passed the examination; while Mr. Valentine Blake, Lands and Survey Department, Wellington; Mr. William Brian de Laval Willis, Lands and Survey Department, Auckland; Mr. John Kirwood Ledger, Lands and Survey Department, Auckland; Mr. Francis Alfred Stevens, Hamilton; and Mr. Frank Lewis Davie, Christchurch, completed the examination, having passed in some of the subjects at a former examination.

The Board issued certificates of competency and licenses to the successful candidates.

The papers for the September examination were set by the South Australian Board, while those for the March examination were set by the Western Australian Board.

The list of 452 licensed surveyors as at 1st January, 1912, was published in the *Gazette* of 25th January, and a copy of the list was posted to each surveyor.

The deaths of the following surveyors were reported during the year 1911: Eugene Bellairs, Auckland; Edwin Fairburn, Auckland; Charles Wilson Hursthouse, Wellington; John Henry Jennings, Karamea; Edward Iveagh Lord, Greymouth; Peter McKenzie, Dunedin; Samuel Hayward Mirams, Dunedin; John Ainslie Montgomerie, Reefton; Arthur O'Neil O'Donahoo, Gosford, New South Wales; Alfred Pearson Rawson, Masterton; Robert Charles Lucas Reay, Wairoa; John Alexander Robertson, Dannevirke.

The number of cadets and articled pupils is now sixty-two.

JOHN STRAUCHON, Chairman.
C. E. ADAMS, Secretary.

Wellington, 31st March, 1912.

APPENDIX V.

TIDAL SURVEY.

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

HARMONIC ANALYSIS.

THE records for the year beginning 1908, December 1, of the Auckland self-registering tide-gauge have been harmonically analysed from the hourly ordinates measured to the nearest one-eighth of a foot, using the tidal abacus of Sir G. H. Darwin, K.C.B., F.R.S. The period for the analysis was selected to give as complete a series of observations as possible, the total breaks in the record aggregating about six days, and ranging from five hours to two days. The missing records were interpolated, using the method described in last year's report. The scales of the Auckland tide-record were—vertical 1 in. to 1 ft., and horizontal, 1 in. to 1 hour. Generally, the same methods and equal care were taken as in the analysis of the Wellington records, and the whole work was done in duplicate. It is hoped therefore that no serious errors remain undetected.

Schedule of Harmonic Tidal Constants, Auckland, New Zealand.

Latitude, 36° 50′ S.; longitude, 174° 49′ E.

A_0, 9·237 ft. above the zero of the tide-gauge.

S_1	H	0·006 ft.	Q	H	0·008 ft.
	κ	50°·35		κ	56°·64
S_2	H	0·583	L	H	0·221
	κ	264°·36		κ	209°·57
S_4	H	0·018	N	H	0·797
	κ	340°·80		κ	173°·55
S_6	H	0·002	ν	H	0·236
	κ	27°·47		κ	152°·81
M_1	H	0·011	μ	H	0·126
	κ	143°·63		κ	178°·00
M_2	H	3·814	R	H	0·024
	κ	203°·73		κ	237°·40
M_3	H	0·052	T	H	0·058
	κ	202°·32		κ	102°·91
M_4	H	0·113	MS	H	0·169
	κ	126°·80		κ	194°·56
M_6	H	0·026	2SM	H	0·064
	κ	282°·96		κ	304°·96
O	H	0·059	Mm	H	0·127
	κ	148°·79		κ	291°·98
K_1	H	0·233	Mf	H	0·072
	κ	168°·93		κ	204°·75
K_2	H	0·145	Msf	H	0·075
	κ	255°·18		κ	122°·80
P	H	0·068	Sa	H	0·091
	κ	166°·21		κ	62°·55
J	H	0·017	Ssa	H	0·028
	κ	196°·39		κ	56°·77

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

These values are corrected for errors made in the printed computation forms supplied by the Cambridge Scientific Instrument Company (see Proc. Roy. Soc., Series A, Vol. 84, No. A 572, "On a Mistake in the Instructions for Use of Certain Apparatus in Tidal Reductions," by Sir G. H. Darwin, K.C.B., F.R.S.).

Other Values of the Harmonic Tidal Constants, Auckland, New Zealand.

Latitude, 36° 50′ S.; longitude, 174° 49′ E.

		(1.)	(2.)			(1.)	(2.)
A_0		..	5·871	P	H	0·079	0·088
S_2	H	0·626	0·633		κ	169°	169°
	κ	265°	266°	Q	H	0·018	
M_1	H	0·011			κ	85°	
	κ	144°		L	H	0·144	0·164
M_2	H	3·782	3·826		κ	209°	196°
	κ	204°·8	205°	N	H	0·760	0·778
M_4	H	0·200			κ	174°	175°
	κ	74°		ν	H	0·147	
M_6	H	0·100			κ	178°	
	κ	67°		μ	H	0·091	
O	H	0·071			κ	144°	
	κ	121°		T	H	0·037	
K_1	H	0·241	0·265		κ	265°	
	κ	167°	169°	Sa	H	0·357	0·354
K_2	H	0·171	0·172		κ	88°	139°
	κ	265°	266°	Ssa	H	0·185	0·224
					κ	266°	242°

(1.) Tide-tables for year 1912, p. 460, U.S. Coast and Geodetic Survey, Washington: High and low waters for two calendar years, 1896 * and 1900 †.

(2.) Harmonic Tidal Constants for Certain Chinese and New Zealand Ports, by Thomas Wright, Proc. Royal Society, London, A Vol. 83, p. 127: Times and heights of high and low water for the year 1901.

* Service Hydrographique de la Marine, France. † The Admiralty, London, England.

Prediction.

The predictions have been carried out generally in a similar manner to that of last year. The following modifications have, however, been made. The M curve is now composed of all the M tides (M_1, M_2, M_3, M_4, and M_6); the S curve of S_1, S_2, S_4, and S_6 tides; and the K curve of K_1 and K_2 tides. In Figs. 1 and 2 the separate K_1 and K_2 curves are shown as well as the combined curve $K_1 + K_2$, both for Auckland and Wellington, and on the same scale. The assumption involved in the use of the template curves is that the resultant curve, made up of the M curve with the addition of the corrections due to the other tides, is practically an M_2 curve of different amplitude. That this assumption is justified within practical limits is shown by the tests of the predictions, which agree very closely with actuality. As a further check on this assumption, whenever the correction to the M_2 tide of H. or L. water approaches 1 hour, a fourth measurement is made of the combined curves 2 hours from the time of M_2, H. or L. water, and it has been found that the template curve invariably goes through the fourth point so determined. An example of this check is shown in Fig. 3, where ACEJ represents the M combined curve for the 400th L.W. of Auckland, 1913. AB, CD, EF are the three measured corrections due to the other short-period tides. The template curve ($k = -8$) is fitted over the points BDF, keeping its centre-line FH parallel to CD, EF, and AB. In this case the apex to the curve coincides with F, and the correction to the time is -1 h., while the height is 1·83 ft. The fourth measurement made at -2 h. gave the correction JI, and it was found that the template curve passed exactly through the point I, thus showing, as far as the scale of the drawing permits, that the assumption is correct.

Check of Predictions.

Through the courtesy of the Engineer to the Auckland Harbour Board (Mr. W. H. Hamer, M.Inst.C.E.) the Auckland tide-records for 1912, January, were sent here as soon as they were available, and a portion of the check fo the prediction is shown in Fig. 4, where the results for the January 25th to 28th are shown plotted on a copy of the tide-record. The whole of the January record was checked in this way, and gave equally good results.

Datum Levels.

As in the case of Wellington, the suggested adoption of the datum of the Indian spring low-water mark for Auckland would result in the datum being—

Tide.	Semi-range.
M_2	3·814 ft.
S_2	0·583 ft.
K_1	0·233 ft.
O	0·059 ft.
	4·689 ft.

below mean sea-level. In this case also the comparatively large tides—

Tide.	Semi-range.
N_2	0·797 ft.
ν	0·236 ft.
L	0·221 ft.
MS	0·169 ft.
K_2	0·145 ft.
μ	0·126 ft.
P	0·068 ft.

are all greater than the O tide.

Other Methods of Harmonic Analysis.

Following a valuable suggestion made by Dr. P. H. Cowell, Superintendent of the Nautical Almanac, London, a method of analysis of tidal observations, where the observations are summed—first every 24 mean solar hours, and secondly every 25 mean solar hours—has been partly developed. An example as applied to the M_2 tide will show the general procedure, and reference should also be made to Dr. Börgen's papers. For this and other tides which have a period nearer to 25 than to 24 hours, the observations are summed every 25 hours throughout the year: thus, for the Auckland tides the following schedule of sums is made:—

List of Sums, beginning 1908, December 1.

Day.	0 h.	1 h.	2 h.	..	22 h.	23 h.	24 h.
0	80	85	78	..	44	59	71
1	160	167	154	..	88	117	142
2	239	249	230	..	130	176	214
353	17891	17574	17220	..	18363	18281	18087
354	17920	17600	17251	..	18418	18325	18121

In this schedule the hours are mean solar, the day is an arbitrary one of 25 hours, and the unit for heights is $\frac{1}{8}$ ft.

The height of the tide above its mean level: at any hour t (counted from 0 h to 24 h), on any day ν (beginning with 0), may be represented by a sum of terms of the form—

$$h_{t,\nu} = \mathrm{R}\cos(i\,t - \zeta + \nu.\,25\,i) + \mathrm{R}_y\cos(i_y t - \zeta_y + \nu.\,25\,i_y) + \ldots . (1)$$

where $\mathrm{R} = \mathrm{H}f$

$$\zeta = \kappa - (\mathrm{V} + u).$$

The problem is to determine the values of R and ζ for any particular tide. If the observations are summed continuously from day $\nu = o$ to day $\nu = n$, then

$$\sum_{\nu=o}^{\nu=n} h_t, \nu = \frac{R \sin (n + i\ 12{\cdot}5\ i)}{\sin 12{\cdot}5\ i} \cos (i\ t - \zeta + n.\ 12{\cdot}5\ i) + \ldots . \quad (2)$$

where for the purpose of illustration one term only of (1) is considered, and the sum of the observations from $\nu = n_1 - 1$ to $\nu = n_2$ is the difference between the total sums from $\nu = o$ in each case, or

$$P_t = \sum_{\nu=n_1}^{\nu=n_2} h_t, \nu = \sum_{\nu=o}^{\nu=n_2} h_t, \nu - \sum_{\nu=o}^{\nu=n_1-1} h_t, \nu \quad (3)$$

$$= \frac{R \sin (n_2 - n_1 + 1)\ 12{\cdot}5\ i}{\sin 12{\cdot}5\ i} \cos \{ i\ t - \zeta + (n_1 + n_2)\ 12{\cdot}5\ i \} + \ldots . \quad (4)$$

Put

$$\text{ff} = \frac{\sin (n_2 - n_1 + 1)\ 12{\cdot}5\ i}{\sin 12{\cdot}5\ i} \quad (5)$$

$$N = (n_1 + n_2)\ 12{\cdot}5\ i \quad (6)$$

$$\text{then } P_t = R\ \text{ff} \cos (i\ t - \zeta + N) + \ldots . \quad (7)$$

$$= A \cos i\ t + B \sin i\ t + \ldots . \quad (8)$$

$$\text{where } A = R\ \text{ff} \cos (\zeta - N) \quad (9)$$

$$\text{and } B = R\ \text{ff} \sin (\zeta - N) \quad (10)$$

Now, if the 25 values of P_t are submitted to analysis, we have—

$$\sum_{t=o}^{t=24} P_t \cos 28^\circ{\cdot}8\ t = F^1 = m\ A + n_1\ B + p\ A_y + q\ B_y + \ldots . \quad (11)$$

$$\sum_{t=o}^{t=24} P_t \sin 28^\circ{\cdot}8\ t = G^1 = n_2\ A + r\ B + s\ A_y + t\ B_y + \ldots . \quad (12)$$

$$m\ A + n_1\ B = F^1 - (p\ A_y + q\ B_y + \ldots .) = F. \quad (13)$$

$$n_2\ A + r\ B = G^1 - (s\ A_y + t\ B_y + \ldots .) = G. \quad (14)$$

$$A = \frac{r}{m r - n_1 n_2} F - \frac{n_1}{m r - n_1 n_2} G. \quad (15)$$

$$B = \frac{m}{m r - n_1 n_2} G - \frac{n_2}{m r - n_1 n_2} F. \quad (16)$$

$$\text{Cot } (\zeta - N) = \frac{A}{B} \quad (17)$$

$$R = \frac{1}{\text{ff}} \sqrt{A^2 + B^2} \quad (18)$$

For the M_2 tide, $i = 28^\circ{\cdot}9841042$ per mean solar hour, and the maximum value of ff is required. ff is a maximum when $\sin (n_2 - n_1 + 1)\ 12{\cdot}5i = 1$—that is, when $(n_2 - n_1 + 1)\ 12{\cdot}5i = 90^\circ$; hence the maximum value is given by $n_2 - n_1 + 1 = 39$. Hence, if the values of n_2 and $n_1 - 1$ are so chosen as to make $n_2 - n_1 + 1 = 39$, then the corresponding value of ff will be a maximum and give the best value of the tide M_2.

As it is desirable to use all the available observations, they are used in continuous sections throughout the year. Thus, beginning with $n_1 = o$, $n_2 = 38$ for first section, then $n_1 = 38$ and $n_2 = 76$ for second section; $n_1 = 76$ and $n_2 = 114$ for third section, and so on.

Schedule for M_2 Tide from List of Sums.

n.	0 h.	1 h.	..	23 h.	24 h.
38	2275	1906	..	2701	2524
76	3711	3705	..	3792	3737
114	6050	5733	..	6423	6268
..	..	..	..	..	..
304	15001	15008	..	15110	14998
342	17635	17426	..	17667	17664

Example for the third section: $n_2 = 114$, $n_1 = 76$, $n_2 - n_1 + 1 = 39$. Here the sums of the hourly readings are evidently the differences between the total sums opposite $n = 76$ and $n = 114$, and are—

	0 h.	1 h.	2 h.	..	24 h.	25 h.
P_t =	2439	2028	1675	..	2631	2531

Then $F_1 = +5061{\cdot}8$, $G_1 = -7282{\cdot}7$, and for a first approximation the corrections due to the other tides are omitted and F assumed = F^1 and G = G^1. Hence

$$\frac{A}{B} = \frac{+425{\cdot}15}{-567{\cdot}88} = -{\cdot}74866 = \cot 306^\circ{\cdot}82$$

$$\zeta - N = 306^\circ{\cdot}82$$

$$(n_1 + n_2)\ 12{\cdot}5i = N = 77^\circ{\cdot}25$$

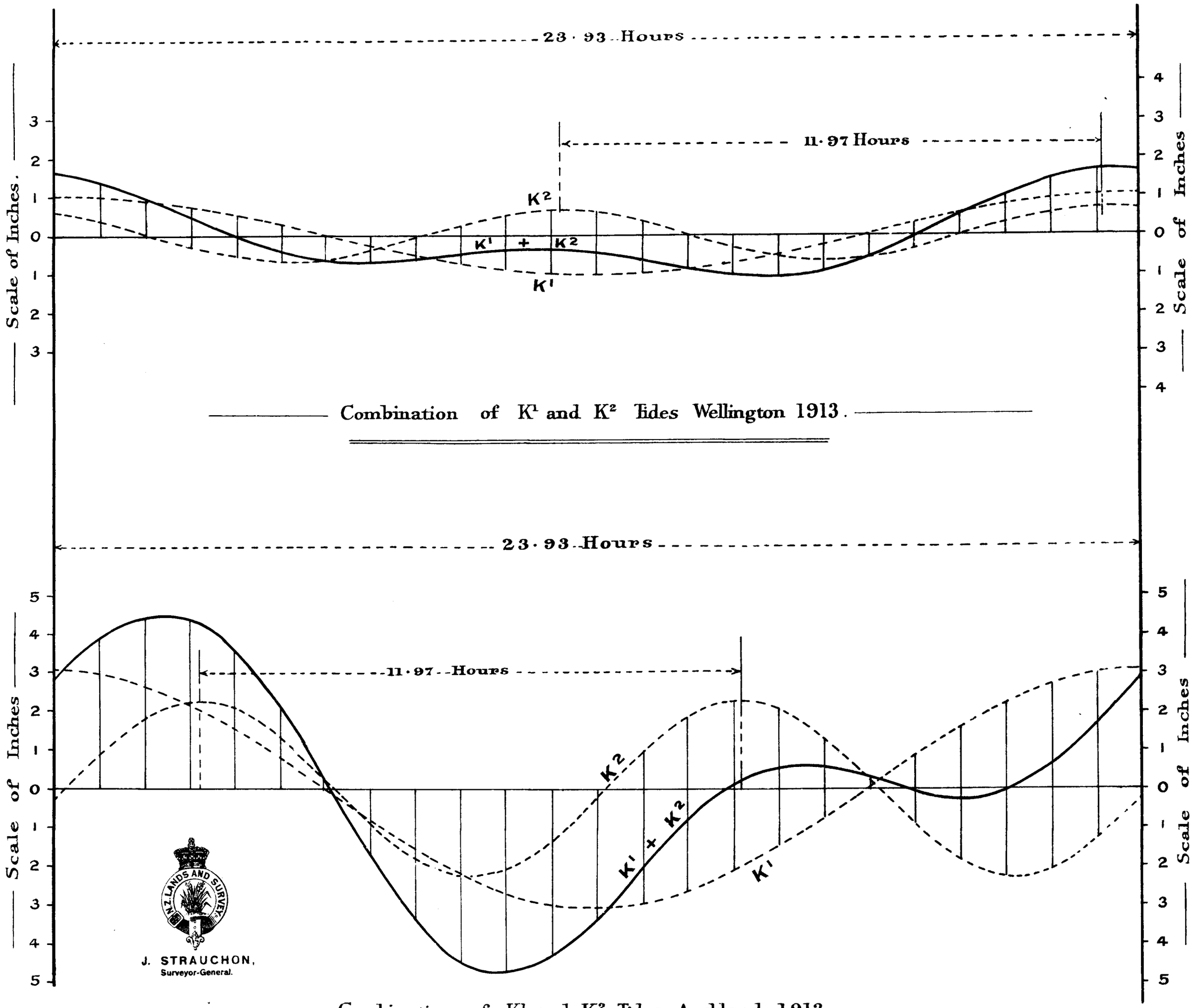
$$\therefore \zeta = 24^\circ{\cdot}07$$

$$A^2 + B^2 = 503233$$

$$\sqrt{A^2 + B^2} = 709{\cdot}39$$

$$\frac{1}{8\ \text{ff}} = {\cdot}00501935$$

$$R = \frac{\sqrt{A^2 + B^2}}{8\ \text{ff}} = 3{\cdot}5607 \text{ ft.}$$



Combination of K^1 and K^2 Tides Wellington 1913.

Combination of K^1 and K^2 Tides Anckland 1913.

1500.6.12.389.

FIG.3

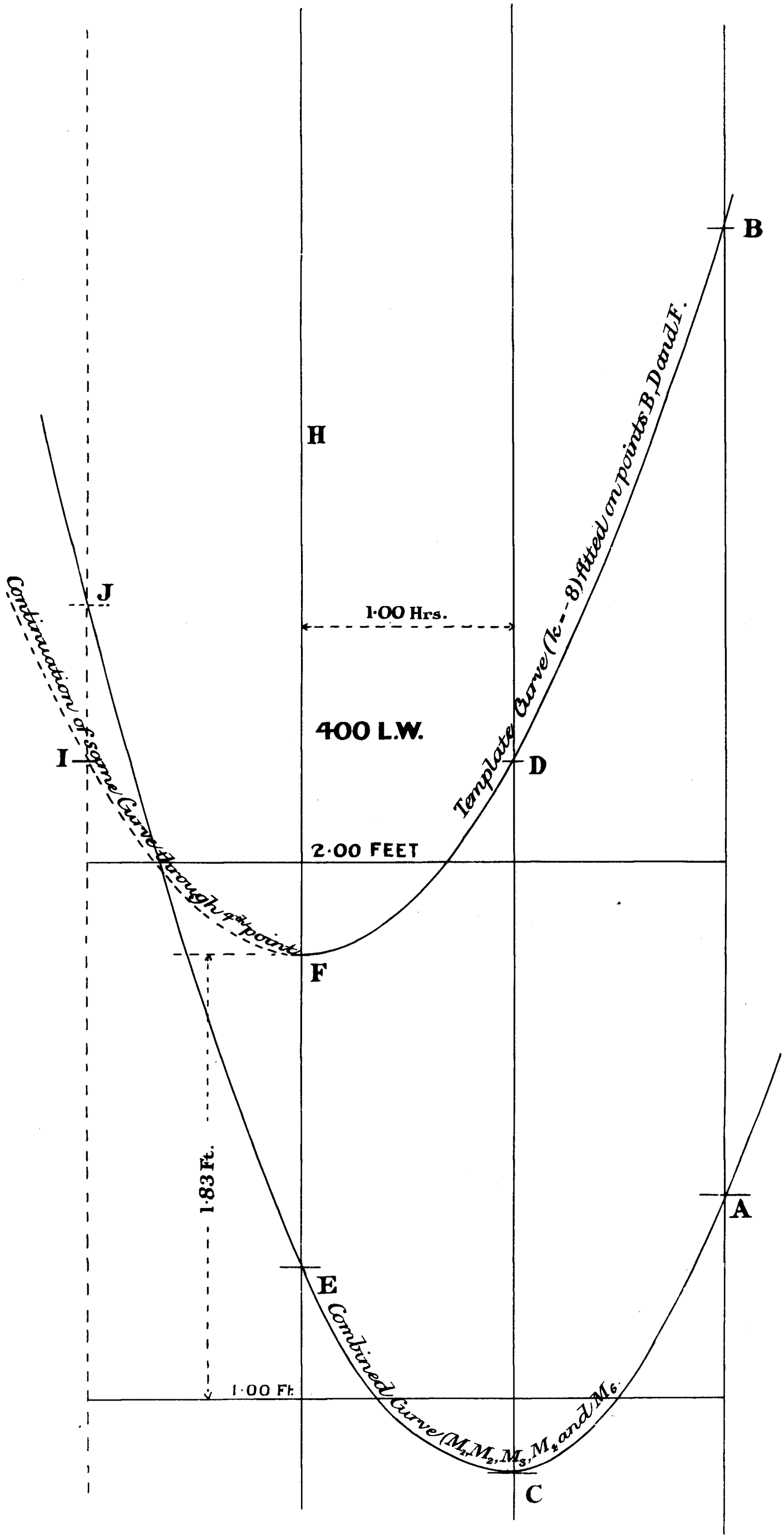
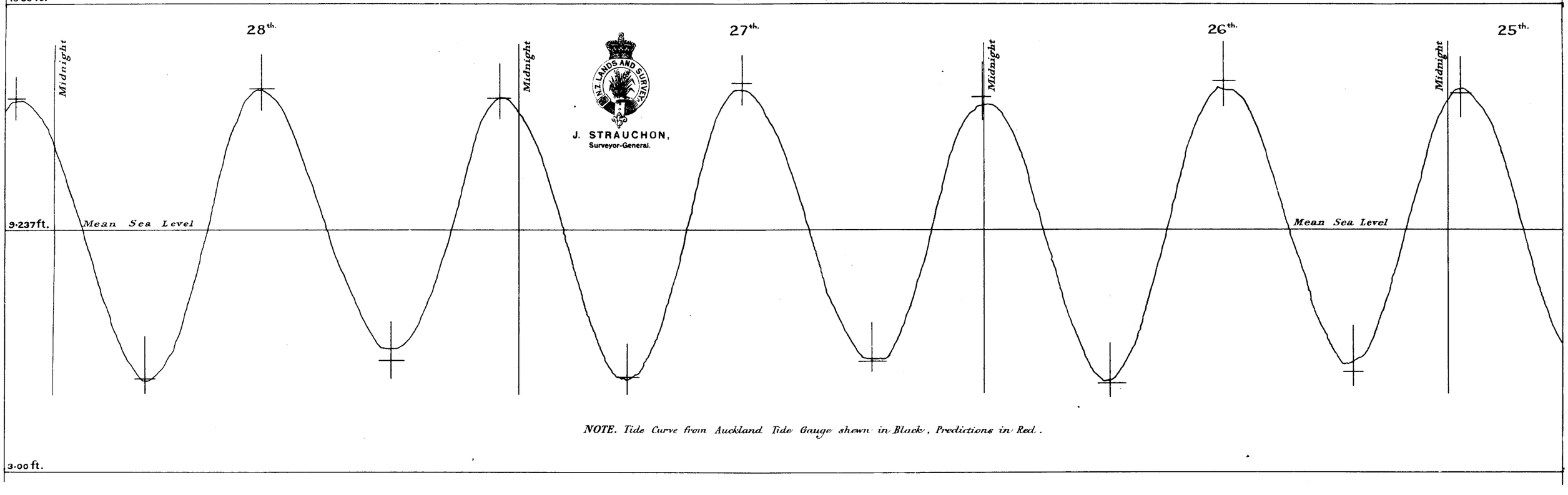


Diagram shewing 4th. Point check on 400th. " Low Water, Auckland 1913.

AUCKLAND, 1912, JANUARY.



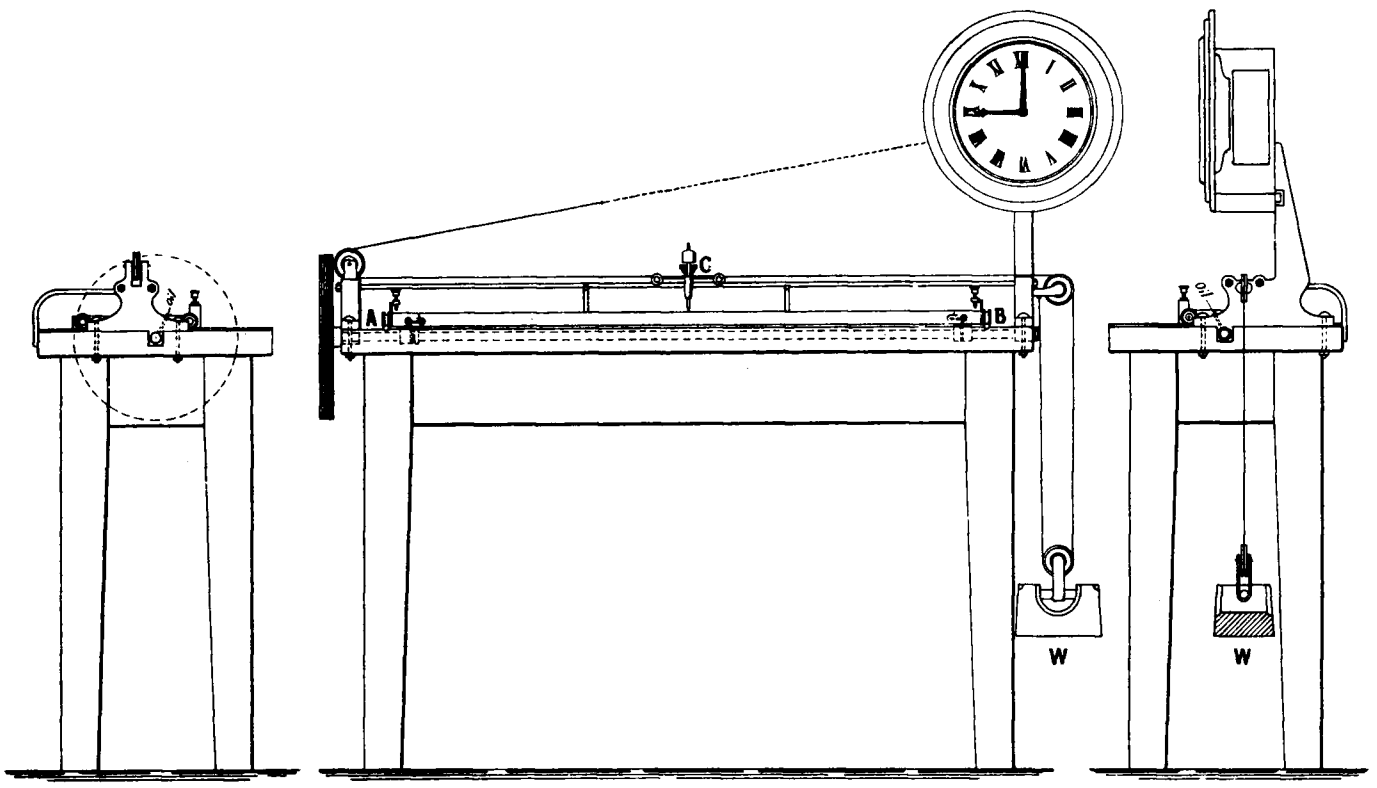
J. STRAUCHON,
Surveyor-General.

NOTE. Tide Curve from Auckland Tide Gauge shewn in Black, Predictions in Red.

1500. 5/12. 389.

—Tide Gauge—

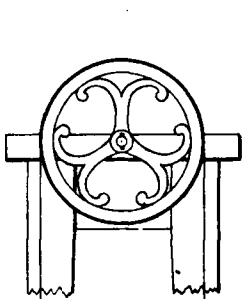
J. STRAUCHON,
Surveyor-General.



—End Elevation— —Front Elevation— —End Elevation—

Inches 12 6 0 1 2 3 4 Feet

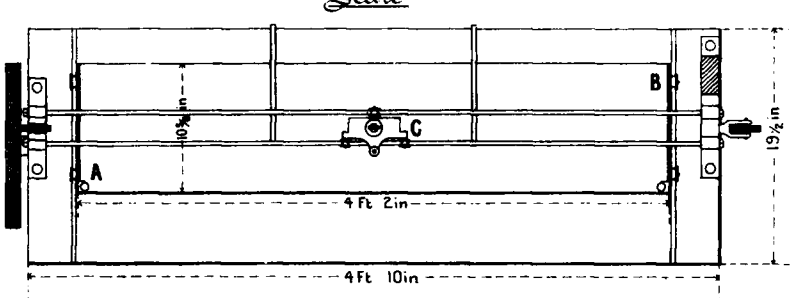
—Scale—



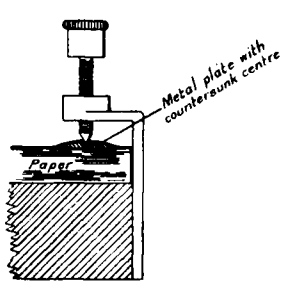
—Float Wheel—

to Float

to Counterpoise



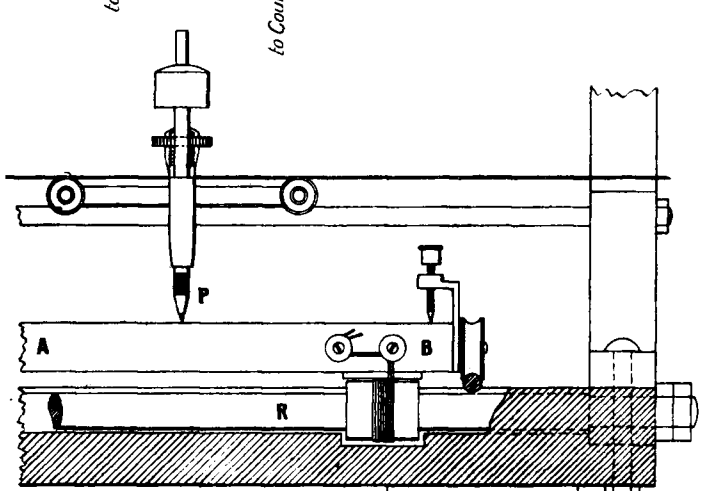
—Plan—

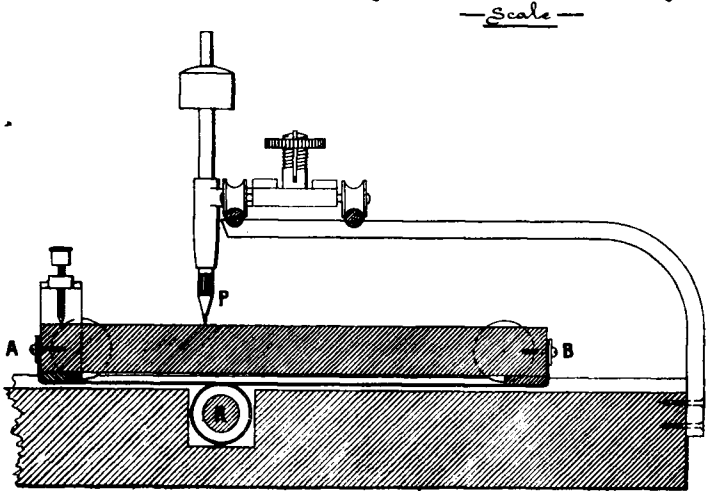


—Detail of Paper Clamp—

1 ½ 0 1 2 In

—Scale—





Measured & Drawn by
Harold Armstrong

—Details—

Inches 12 6 0 1 Foot

—Scale—

In a similar way the other eight sections are analysed, giving the following results:—

Section	n_2	n_1	R Feet.	ζ_0	
1 ..	38	0	3·8375	24·36	
2 ..	76	38	3·7969	25·56	
3 ..	114	76	3·5607	24·07	
4 ..	152	114	3·8707	22·00	
5 ..	190	152	3·7977	23·91	
6 ..	228	190	3·8220	22·74	
7 ..	266	228	3·6299	23·74	
8 ..	304	266	3·8116	20·92	
9 ..	342	304	3·8277	25·19	
			9) 33·9547	9) 212·49	
			3·7727	23·61	
		Compare	3·7828	25·51	from abacus.
		Difference	0·0101	1·90	

It will thus be seen that the results of analysis by this method agree closely with those obtained from the abacus. No corrections have been applied for the influence of other tides on the M_2 tide in the above results, while the results from the abacus are corrected ones.

The corrections due to the other tides depend on the corresponding values of $R\,\mathcal{F}$ in equation (7), and the following table shows the relative importance of these products:—

Tide.	R. Feet.	$8\,R\,\mathcal{F}$.
M_2	3·783	+753·6
ν_2	0·234	+ 19·18
S_2	0·583	− 12·74
N_2	0·791	+ 6·14

TIDE-GAUGE.

A NEW tide-gauge (see illustration) has been designed and constructed in Wellington, and as it possesses some novel features a description of it may be of interest. It is based on the Wellington Harbour Board tide-gauge designed by Mr. W. Ferguson, M.A., M.Inst.C.E., and described in "Transactions of the New Zealand Institute," Vol. xli (1908), page 407. The gauge consists essentially of the pencil actuated by the clock, and the paper moved by the tide. The pencil-carriage C is in train with the driving-weight W of the clock and moves 6 in. per day, so that the gauge will run for over a week without attention. The paper is attached to the flat table AB and consists of a block of paper cut to fit the table. The block remains on the table and a sheet is taken off once a week. The table oscillates with the tide, and the method of attaching it to the spindle of the float-wheel is shown clearly in the illustration. It is found convenient to have the record-paper on a flat table instead of on a cylinder, as in the more usual forms. The gauge is constantly referred to by the harbour engineer during dredging operations, and measurements can now be made without taking the record-paper off the gauge. The ratio for heights is $\frac{1}{1\frac{1}{2}}$ so that 1 ft. of movement of the float is shown as 1 in. on the record, and this gives a convenient scale for measurements. The gauge has been running for some months by the side of the Harbour Board gauge and is performing satisfactorily. It is proposed to instal the gauge at Suva to obtain sufficient records there for a harmonic analysis of the observations to be carried out.

Table 1.—Return of Field-work executed by the Staff and Contract Surveyors from 1st April, 1911, to 31st March, 1912.

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, 1911, to 31st March, 1912.
	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 ..	41,792	1·41	49,651	10·07	133,692	1·59	1,377·0	179	11·10	70·25	281	39·50	(a)172,757 (b) 44,973	947 123	18·39 20·53	596	7	4·64	111·60	26·46	4,590 16 11	37,725 7 10
Hawke's Bay	..	..	54,070	1·13	10,457	2·42	6·37	2	31·40	9·40	22	48·14	(a) 46,440 (b) 2,797	194 10	12·96 18·15	..	..	..	2·50	19·70	834 5 1	4,672 1 3
Taranaki ..	27,000	1·20	..	..	37,193	2·57	..	..	..	12·95	16	37·14	..	..	..	..	..	..	0·50	14·0	225 3 6	6,266 12 9
Wellington	48,900	1·12	1,990	3·25	31,347	2·36	..	..	..	192·58	128	31·34	(a) 58,116	405	20·25	..	..	..	26·75	9·35	1,223 9 8	12,774 12 6
Nelson ..	18,850	1·96	..	..	72,726	2·35	10·0	5	9·0	15·0	76	24·51	(a) 43,814	17	6·97	..	..	..	8·45	21·82	695 0 3	11,858 5 5
Marlborough	..	..	..	..	6,039	4·01	10·0	1	6·04	2·75	11	69·64	(a) 1,719	18	37·58	..	..	..	18·0	29·53	190 16 8	2,337 13 3
Westland ..	..	..	7,000	2·58	17,016	2·86	307·0	4	6·80	10·50	8	93·0	..	..	..	..	..	..	3·75	18·0	508 12 10	3,234 2 1
Canterbury	..	..	46,570	0·33	44,178	0·59	..	..	..	..	..	..	..	..	..	..	..	..	17·0	18·78	211 4 9	2,680 4 1
Otago ..	..	..	..	..	51,122	1·03	..	..	..	4·68	2	44·51	..	..	..	..	..	..	..	..	145 13 5	3,392 19 4
Southland ..	..	..	..	..	26,699	2·98	49·0	13	35·60	24·0	47	29·62	(a) 23	4	195·70	..	..	..	24·23	19·47	363 9 1	4,588 9 10
Means and totals	136,542	1·34	159,281	3·78	930,469	1·88	1,759·37	204	11·06	342·11	591	36·78	370,689	1,718	17·01	596	7	4·64	212·78	22·71	8,928 12 2	89,530 8 4
Licensed surveyors (paid by applicants)					9,715	..	84·5	34	..	1·0	12	..	81,810	417	..	1,570	35	..	4·25	..		
Totals					440,184	..	1,843·87	238	..	343·11	603	..	452,449	2,135	..	2,166	42	..	217·03	..		

(a) Native Land Court. (b) Maori Land Board.

Table 2.—Return showing Surveyors employed and the Work on Hand on 1st April, 1912.

Chief Surveyors.	Surveyors employed. Staff.	Temporary.	Contract.	Land District.	Work on Hand. Trig.	Settlement.	Town.	Native Land Survey.	Roads.
					Sq. Mi.	Acres.	Acres.	Acres.	Miles.
H. M. Skeet ..	14	6	..	Auckland ..	29*	169,880	..	146,445	170·75
C. R. Pollen ..	6	..	..	Hawke's Bay ..	..	145,750	..	35,000	26
G. H. Bullard ..	4	2	..	Taranaki ..	170*	98,634	70	3,700	20
J. Mackenzie ..	6	..	..	Wellington ..	4,500†	46,365	..	18,937	..
R. T. Sadd ..	6	2	..	Nelson ..	200*	77,025	..	..	20·25
W. H. Skinner ..	1	1	..	Marlborough ..	..	7,400	..	..	18
H. D. M. Haszard	2	..	..	Westland ..	..	12,132	15	..	..
T. N. Brodrick ..	4	..	..	Canterbury ..	..	78,700	..	..	17
E. H. Wilmot ..	3	..	..	Otago ..	..	1,030	..	..	..
G. H. M. McClure	4	..	..	Southland ..	..	22,565	..	..	11·25
Total staff surveyors	50	11	..	..	4,899	659,481	85	204,082	283·25
Contract surveyors	..	..	53	Auckland ..	..	14,752	..	482,167	22·5
	..	..	17	Hawke's Bay	..	..	..	29,425	..
	..	..	11	Taranaki ..	..	7,500	..	29,303	10
	..	..	18	Wellington ..	..	..	..	62,280	..
	..	..	6	Nelson ..	..	27,363	25	5,864	..
Total contract surveyors	..	..	105	..	..	49,615	25	609,039	32·5
Total staff and contract surveyors	50	11	105	..	4,899	709,096	110	813,121	315·75

* Minor triangulation † Secondary triangulation.

Table 3.—Plans placed on Crown Grants and other Instruments of Title from the Crown from 1st April, 1911, to 31st March, 1912.

Land District.	Number. Singly.	In Duplicate.	In Triplicate.	In Quadruplicate	Total Copies.	Cost. £	s.	d.
Auckland	2	653	981	133	4,783	237	7	0
Hawke's Bay ..	1	283	154	23	1,121	91	4	5
Taranaki	..	111	144	14	710	48	2	8
Wellington	13	58	484	..	1,581	79	1	0
Nelson	2	66	207	28	867	86	0	0
Marlborough ..	..	30	111	..	393	54	18	5
Westland	..	127	171	..	587	73	7	6
Canterbury	61	..	..	..	61	6	2	0
Otago	..	303	762	..	2,892	275	0	0
Southland	12	87	204	8	830	59	1	10
Totals	91	1,718	3,158	206	13,825	1,010	4	10

Table 4.—Work done under the Land Transfer Act, etc., from 1st April, 1911, to 31st March, 1912.

Land District.	Number of Plans passed.	Deeds and other Instruments passed.	Number of Plans placed on Certificates of Title. Singly.	In Duplicate.	In Triplicate.	In Quadruplicate.	Total Copies.	Miscellaneous Plans, &c.	Cost. £	s.	d.
Auckland ..	620	2,984	21	3,051	..	..	6,123	3,027	2,192	6	6
Hawke's Bay ..	239	719	..	1,046	55	..	2,257	..	666	5	11
Taranaki ..	128	1,296	10	568	50	..	1,296	1	281	11	0
Wellington ..	217	3,005	4,724	..	..	..	4,724	..	1,442	15	2
Nelson ..	78	148	..	196	..	..	392	..	164	17	4
Marlborough ..	16	..	2	123	19	..	305	..	49	9	9
Westland ..	35	..	..	107	72	..	430	..	96	6	0
Canterbury ..	458	3,534	88	2,444	26	..	5,054	23	1,625	17	0
Otago ..	116	1,298	14	997	1	..	2,011	..	390	11	10
Southland ..	115	606	22	675	8	..	1,396	..	390	11	8
Totals ..	2,022	13,590	4,881	9,207	231	..	23,988	3,051	7,300	12	2

Table 5.—LITHOGRAPHS AND PHOTOGRAPHS PRINTED AND SOLD, FROM 1ST APRIL, 1911, TO 31ST MARCH, 1912.

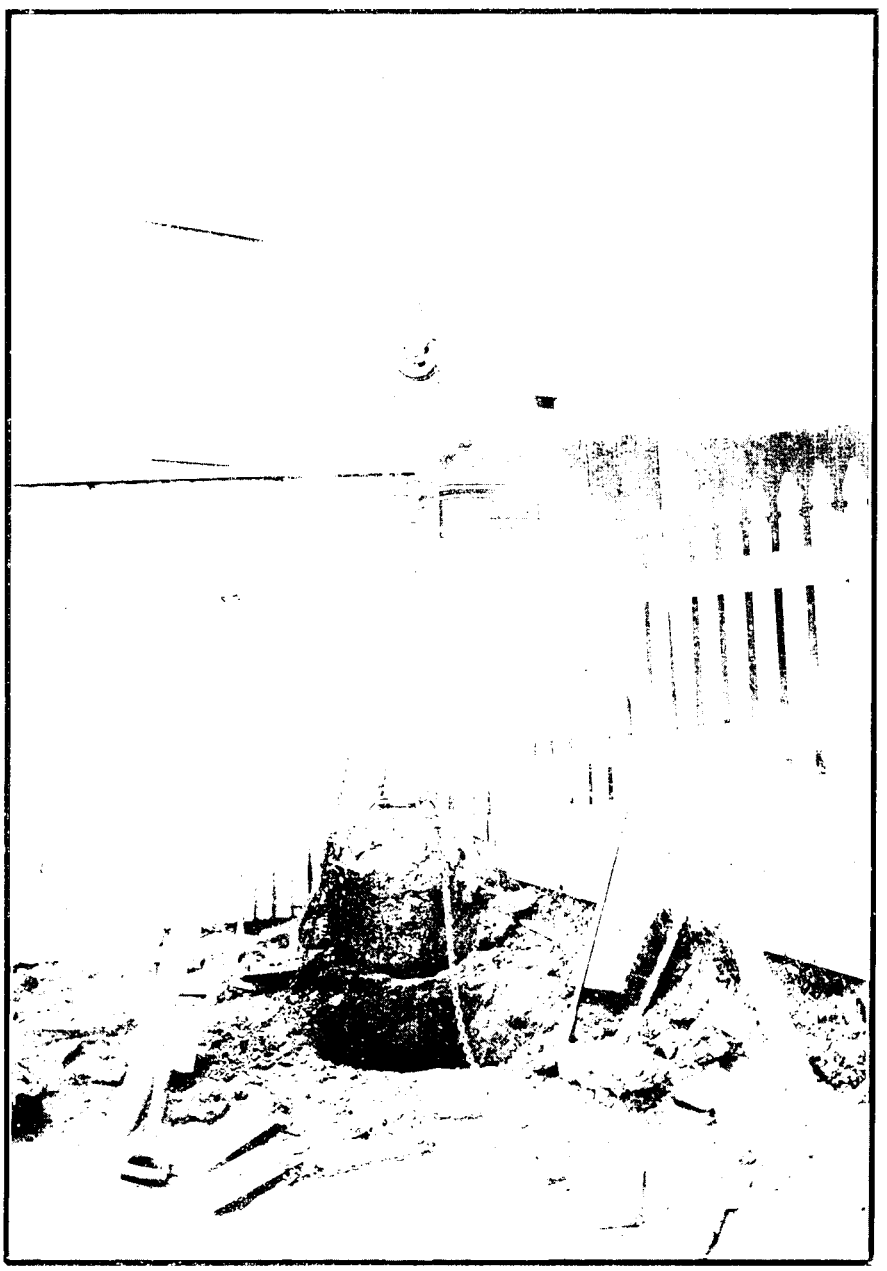
Land District.	Number of Lithographs printed.	Number of Photographs printed.	Amount of Fees received from Sale of Maps, Lithographs, &c.
			£ s. d.
Auckland	2,750	..	288 2 11
Hawke's Bay	..	..	80 17 11
Taranaki	..	..	62 8 0
Wellington	..	..	122 11 7
Nelson	..	..	6 10 0
Marlborough	..	..	45 18 9
Westland	..	..	15 11 11
Canterbury	..	..	54 18 7
Otago	3,350	..	80 17 5
Southland	..	..	68 2 0
Totals	6,100	..	825 19 1

Approximate Cost of Paper.—Preparation, not given; printing (1,500 copies, including maps, plans, illustrations, &c.), £132.

By Authority: JOHN MACKAY, Government Printer, Wellington.—1912.

Price 2s. 3d.]


6808



J. STRAUCHON,
Surveyor-General.

SECONDARY TRIANGULATION,
NEW ZEALAND.

BASE LINE, WAITEMATA.

Block VII, Kumeu Survey District,
and Blocks V, IX, and X,
Waitemata Survey District.

Scale: 10 chains to an inch.

Note.—2' trig. tubes, set in concrete, shown thus: ◎
2' countersunk totara pegs, " , ○

VII
KUMEU S. D.

V

WAITEMATA S. D.

IX

IX

X

WAITEMATA S. D.

KUMEU 'C'
SECONDARY TRIG. STN
41790·77563

1000·00 W.

900·00 W.

500·00 N.

450·00 N.

600·00 W. OF MT EDEN (16)

350·00 N. OF MT EDEN (16)

800·00 W.

700·00 W.

TUBE III

TUBE II

O.P.

17

18

8

7

19

6

102

99

32

98

27

39

28

188

29

40

56

41

54

42

53

45

51

52

39

49

48

SECTION No 5

SECTION No 4

SECTION No 3

SECTION No 2

SECTION No 1

RAILWAY RESERVE

ROAD

YAUPARK

Waitemata Stream

Kumeu River

Totara

Hakia and manuka

Manuka scrub, fern & hakia

English grass

Light scrub and fern

Light manuka

Tall manuka

Rough swamp

Light teatree and fern

Fence

B.W. Fence

P.W. Fence

Stop Peg a. 41790·77563 (MEAN)

Stop Peg b. 4287·5791

Stop Peg c. 887·1439

Stop Peg d. 1085·5416

Stop Peg e. 16896·7039

Stop Peg f. 18694·2070

Stop Peg g. 20589·2378

Stop Peg h. 29396·7618

Stop Peg j. 35777·8925

Stop Peg k. 38577·8925

Stop Peg m. 37677·9970

TUBE II 24702·0803

TUBE III 34777·8882

Stop Peg l. 33397·6788

TUBE II 25289·8719

TUBE II 24702·0803

TUBE III 13367·9383

293° 03' (APPROX.)

3693·6138

WAITEMATA SECONDARY TRIG. STN.

HENDERSON-HOBSONVILLE RD.

MAJOR TRIG. STN. 8

TOTAL LENGTH OF BASE LINE 41790·77563 (MEAN)

20 15 10 5 0 10 20 30 40
SCALE OF CHAINS

E.S.Wood. Delt 1912.

H. T. McCARDELL, CHIEF DRAUGHTSMAN, HEAD OFFICE, WELLINGTON.

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