



OTAGO PROVINCIAL GOVERNMENT GAZETTE.

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W. CARGILL, Superintendent.

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[No. 91.]

GOVERNMENT SURVEY REPORTS ON THE PROVINCE OF OTAGO, NEW ZEALAND.

WITH NOTES UP TO DATE.

REPORT

TO THE COMMISSIONERS OF THE WASTE LAND BOARD ON THE RECONNOISSANCE SURVEY OF THE SOUTHERN DISTRICTS OF OTAGO, executed during the months of January, February, and March, 1857, by J. T. THOMSON, Chief Surveyor.

I LEFT Dunedin on the 5th of January, 1857, and arrived at Invercargill on the 11th of the same month.

The weather proved unpropitious for four days after my arrival at Invercargill, so I could not move from thence till the 15th; but during the interval the necessary steps of cleaning and testing the Instruments, preparing provisions and equipments, were attended to.

SURVEY.

On the 15th I started for New River, with the view of obtaining such preliminary knowledge of the nature of the country as would enable me to decide on the mode of survey to be proceeded with.

After viewing this part of the country,

and from thence to a considerable extent the districts coming within the limit of operations, I was led to adopt a system of survey hereafter described, which I judged would meet the requirements of the Board and the public, and be executed in so limited a period, that the results would be early at the service of the same

The object which the Commissioners of the Waste Land Board charged with the administration of the Lands of the Province had in view, being a survey that would enable them to mark off the proposed "Hundreds," and blocks reserved for sale under the "Land Sales and Leases Ordinance, 1856," as well as the positions of Pasturage Runs and Public Reserves, all of which measures called for immediate settlement, it appeared evident to me that the requirements of the Board and the public, numerous and urgent as they were, could not be met in a limited period by conforming to the most approved and necessarily tardy systems adopted in Land Survey, viz., Triangulation and Traverse.

Considering the above circumstances and the nature of the country to be submitted to survey, which possessed in every direction prominent features or natural survey stations in the numerous peaks of the hills and mountains; considering also the fact that the requirements of the Board did not demand absolute minuteness as a foundation to their measures above stated, it appeared to me that the system so much had recourse to in Nautical Survey, viz., the ascertaining of differences of latitude for the basis, and the observation of converging angles for the details, was admirably suited to compass the objects in view, by its rapidity of execution and correctness of principle.

In carrying out a series of triangles over a country, correctness demands the careful measurement of a base, and the erection of stations in every direction as minute points of observation; for were this not done, as the operations proceed from small to greater, every incidental error would increase with the progress. This is not the case with the other system; for the basis being founded on the distance between two objects at the extremes of the operations, any errors incidental to the same decrease as the operations contract from greater to smaller. Hence the propriety of adopting less defined natural objects instead of minute artificial stations, in this species of survey.

Having fixed upon the system of survey to be adopted, I proceeded to Campbelltown, in the vicinity of which is situated the well-known prominent object called the Bluff, this being chosen as the southern extreme of the survey operations. Here I carefully ascertained the latitude of the Custom House of Campbelltown, as noted below.

	deg.	m.	s.
22nd Jan.—Mean of 18 circum-			
meridional altitudes.....	46	35	58·8
23rd Jan.—Mean of 16 do. do.	46	35	53·8

Mean latitude of Custom House 46 35 56·3 S.

I also obtained observations for the true meridian, by which and local measurement, I ascertained that the summit of the Bluff was in latitude 46 deg. 36 min. 55·1 sec. South, and that the Dome Mountain, (the other proposed end of the basis of survey), bore from thence 7 deg. 47 min. East.

From the summit of the Bluff I took bearings to all prominent objects having sufficiently defined aspects to be

used as stations, after which I proceeded with the general operations of the survey. These I will hereafter shortly describe.

From Campbelltown I returned to Invercargill, and having procured a pack-horse, proceeded over the Waio-pai and Waimea Plains, diverging in every direction for observations, till I arrived at the foot of the Dome Mountain on the 15th February. From the top of this prominent and commanding object, having the Bluff summit as Zero, I obtained bearings of all the principal objects that I had observed from the latter position, besides other natural features eligible as stations. Near the base of the same mountain, I ascertained the latitude of Observation Bush to be as follows:—

	deg.	m.	s.
17th Feb.—Mean of 5 circum-			
meridional altitudes.....	45	34	51
„ Mean of 3 do. do.	45	34	45·6

Mean latitude of Observation Bush 45 34 48·3 S.

These and the preceding observations for latitude were taken by an excellent Sextant of Troughton's manufacture, and a Mercurial Horizon, accompanied by registers of the Thermometer and Barometer. The distance of Observation Bush on the meridian from the Bluff summit will thus be found to be 1 deg. 02 min. 06·8 sec., or 71·486 English miles.

With this as the basis of the survey, and the knowledge of the true bearing of the Station at Observation Bush from the Bluff summit, which is by calculation 4 deg. 28 min. 30 sec. East, the application of the rules of Plane Trigonometry fixes the position of the Dome Mountain, and thence all other main stations in the survey, where and to which the requisite angles were observed.

Regarding the degree of accuracy that may be attained to by the system of circum-meridional altitudes, while I may state that at prior periods I have had much greater agreement in sets of observations, yet it will be observed that the greatest difference in this instance is 5·4 sec., or as measured on the ground, 547 feet. But considering that this error is halved, by taking the mean of two sets, and that any error of instrument will not affect the length of the base, all the sets of observations being taken with the same instrument, on the same side of the Zenith, the real error may be assumed at considerably less than the maximum above stated.

Assuming the error at the maximum

given, viz., 547 feet in 71·486 English miles, or 377,448 feet, that is, 1 in 690, it will be allowed that the foundation of operations possesses a degree of accuracy not generally attained in chain measurements on unprepared ground such as that now submitted to survey.

Having explained the mode of constructing the basis of survey, it will now be necessary to notice the general operations depending on the same. They were shortly as follows:—The country was journeyed over in every direction, positions being fixed by taking angles with the Theodolite to three or more known stations by the system of “converging angles,” already mentioned as being so much had recourse to in nautical survey. These observations of angles were taken every two to four miles, as was found requisite, and the positions of the topographical features in their proximity, such as rivers, ridges, bush, &c., were ascertained by cross, transit, and tangent bearings to them, all being taken by the Theodolite. The prismatic compass was depended on only for very minor detail.

AREA.

Having thus briefly described the mode of operations, I will proceed to notice the extent and the areas of the classes of lands in the District submitted to survey. The District is bounded on the South by Foveaux Strait; on the East by the Mataura River; on the North East by the Umbrella and Slate Ranges; on the North West by the Eyre and Takitimo Mountains; and on the West by the Waiau River. These boundaries extend 92 miles North and South, and 60 miles East and West; the estimated area being 3728 square miles.

The above area is divided into the following classes of lands, the details of which will be found in Appendix A:—

Forest Land.....	570 square miles
Moss and Marsh do.....	108 "
Agricultural do.....	400 "
Pastoral do.....	2150 "
Barren do.....	500 "

3728 square miles

The 400 square miles of Agricultural Land are principally on the Mataura, Waiopei, and Oreti plains. One-third of the same is at present too wet for cultivation. Of the 2150 square miles of Pastoral Land, one-fourth may require drainage; and everywhere, in both the above classes of Land, there is sufficient fall for this purpose.

Beyond the limits of the surveyed Districts it would be improper to omit the mention of the existence of about 600 square miles of Pastoral country at the heads of the Waiau and Oreti Rivers; also the existence of an extensive undulating country to the North-east of the Eyre Mountains, stretching as far as the Canterbury Province, which being only viewed at a distance, cannot now be positively spoken of.

PHYSICAL GEOGRAPHY.

In the District are groups of mountains, undulating downs, and level plains. The groups of mountains are:—Eyre, attaining to the height of 6084 feet above the sea level; Takitimo, 4998 feet; Hamilton, 4674 feet; Dome, 4505 feet; Longwood, 2602 feet; and Hokanui, 2297 feet. The altitudes of these and other minor eminences will be seen on reference to Appendix B; and as such of them as have been taken by the *Acheron's* Survey Officers differ considerably from these, it is necessary to state that I would only ask for such dependence on my results as can be placed on work done by a 4-inch theodolite. Undoubtedly, also, the distances of the objects were generally too great for the attainment of accuracy; but still they will be useful in giving an approximate idea of the altitudes of these features.

The country that may come under the head of “Downs” are the Taringtura and Wairaki Downs; also that country in the vicinity of Twinlaw, Centre Hill, Lintley, and Round Down. The highest eminences among these are Taringtura Hill, 2093 feet; and Woodlaw, 1682 feet.

The Plains are the following:—Waiopei, extending 30 miles in length and breadth; Oreti, 25 miles in length and 20 in breadth; Waiau, 16 miles in length and 10 in breadth; Waimea, 25 miles in length and 8 in breadth. Five rivers 15 miles in length and 6 in breadth.

The principal rivers are the Mataura, Makerewa, Oreti, Aparima, and Waiau. Commencing with the first, the Mataura takes its rise in the Eyre Mountains, and has a course as the crow flies of 95 miles. Its principal head is in Eyre Peak, and the first thirty miles of its course is through a district abounding in narrow valleys and deep gorges, bounded by high snowy mountains, whose sides and spurs are steep and rugged, possessing all the picturesque and bold features of Alpine scenery.

Issuing out of a deep gorge of the mountains, it flows into the Waimea Plains; then holding a South-easterly course, it rounds the East base of the Hokanui Hills, where it enters into the fertile district called the Plains of Matura. On the East edge of these Plains, situated two miles above Tuturau, are the Falls of Matura. Here the river falls over a bed of limestone 20 feet in height, and when swollen, the cascade takes an appearance of considerable grandeur. From its Falls, the Matura meanders through the low lands that approach the sea, which it enters at the Toi-toi, forming by its issue the entrance to the harbour of that name.

The Makerewa has its sources in the Hokanui Hills, from which it issues by two main branches. From the junction of the branches it flows South-west about 15 miles, when it joins the Oreti; the combined rivers forming the tidal estuary called New River.

The Oreti has its sources in the Western spurs of the Eyre Mountains, at a distance from its junction with the Makerewa of 75 miles in a straight direction. Excepting close to its sources, it traverses a district generally undulating and level. Its peculiar feature is that it takes in no waters of importance below Five Rivers Plain. As its sources are thus entirely in a mountainous district, it is much subject to rapid rises and heavy freshes in the spring months, occasioned by the melting of the snow. At Five Rivers Plain it suddenly bends from an Easterly course towards the South, the bend being called the "Elbow."

The Aparima has its sources in the Takitimo Mountains, from whence it first flows Easterly, then Southerly, to Jacob's River, from which its sources are distant about 50 miles in a straight line.

The Waiau is the great River of the South-west of the Middle Island, and is about two-thirds the size of the Clutha. It has not been surveyed to its sources, but its upper course was viewed from Centre Hill, which commands a prospect of the same. Its two upper gorges were from this position judged to be 40 and 50 miles distant, which would bring them into close proximity with Bligh Sound and Milford Haven, situated on the West Coast. Mr. Howell, of Jacob's River, informed me that a Native track exists between Milford Haven and one of the

heads of the Waiau, which river was descended from, thence by the Maories in *moggies*, or flax rafts, to its mouth, near which the old settlement of Pahees exists. This would indicate the existence of a practicable pass for man to the West Coast; but from what I saw, it must be a very difficult one. The head of the Waiau cannot be less than 100 miles from its mouth, and I do not think it will exceed this, as throughout its course it is joined by large tributaries issuing out of the surrounding high mountains, so must increase very rapidly to the large volume that it attains. A Western spur of the Eyre Mountains will, I believe, be found to divide the heads of the Waiau from the heads of the Clutha. The current of the Waiau is very rapid and deep, so as to be unfordable; but it might be crossed by rafts or boats at the Limestone Gorge. About 50 miles from its mouth are the Te Anau Lakes, which, having been only viewed from a distance, nothing of consequence can be noted regarding them.

At the mouth of the Matura a harbour for small vessels exists; at the Bluff a harbour for vessels of any size; the New River may be entered by vessels of 300 to 400 tons, or probably more; and Jacob's River by vessels of 100 tons. The Waiau has a constant outward current, and is said not to be enterable even by boats. More extended notices of these will be found in the "New Zealand Pilot."

In connection with the river system is a remarkable configuration of certain plains and valleys, which lead to the inference of considerable changes of surface at recent dates (geologically speaking). Thus the valley of the Waimea stretches in nearly a dead level from the Matura to the Oreti, in the same direction as the upper course of the Oreti, and on the same level. Also the Oreti plains are on a dead level from the Oreti to the Aparima; and all the streams in the plains take their sources close to the banks of the Aparima, running from thence into the Oreti. The Hamilton Burn, a branch of the Aparima, and near its head, also joins closely on to the Oreti. These valleys and plains are filled with recent deposit, the *debris* of the mountains, so must have had some of the proximate rivers flowing over them. Thus, at no distant age, by slight variations of level, the courses of all these rivers may have been different to the present ones—the

Oreti joining the Mataura, the Aparima joining the Oreti, and again the Oreti flowing through the lower course of the Hamilton Burn into the Aparima.

The surface of the District is generally well supplied with timber—near the sea coast for agricultural requirements; and further inland there is mostly sufficient for pastoral purposes. The largest forest is that on the Long Wood range, which, on reference to Appendix A, will be seen to include 242 square miles. In this forest birch prevails, especially on the Eastern exposure; but Totara and Pine are found in abundance towards the Northern aspect. The next large forest is that of the Hokanui, including 72 square miles. Here the best descriptions of wood are found, including Black, White, and Red Pine, and Totara. The other forests of large dimensions are those of Seaward and Eyre, relatively 58 and 54 square miles in size. The former abounds in Pines, and the latter in mountain Birch.

Of Marshes, Mosses, and Bogs, there are eleven well defined—the most extensive being the Seaward Moss, including 72 square miles. This is situated on the sea coast, between the Bluff Harbour and the Mataura. Where the under structure is exposed, the formation is seen to consist of dead vegetable matter, in some places approaching the form of lignite. Lagoons and water-holes abound on the surface, and it is entirely impenetrable for quadrupeds, and in certain places even for man. The other Mosses do not in any case exceed 7 square miles in extent, and are distributed in various parts of the District.

The rest of the surface of the District is covered with natural grasses, which I will notice under the head of "Pasturage." The entirely barren land is only found on the tops of the higher ranges, where the snow rests for nine to eleven months in the year. Mount Eyre, 6084 feet high, is never divested of its snow. The entirely barren district I judged to be at an elevation of 5000 feet; for while I would rank the summit of the Dome Mountain as barren (4505 feet), being unfit for grazing purposes, yet a hardy vegetation was found even here, consisting of snow grass, lichens, and a species of heath. When we descend from higher altitudes, the unprofitable vegetation ends at the level of 2000 to 2500 feet above the sea, if the soil be good.

Of the climate of the District, Captain Stokes, in his Paper laid before the Geographical Society (see Vol. XXI., page 26), states that—"Speaking generally, the climate is very equal, although rather wet towards the sea coast, but less so in the interior, as is shown by the remarkable difference in the vegetation of these respective situations, and by Mr. Hamilton's experience of only 16 rainy days out of 46, whilst in the ship, out of 77 days, 35 were wet. Snow rarely lies on the low lands, though we saw very thin ice occasionally between the 15th of March and the 1st of June. During this interval the temperature ranged from 40 to 60 degrees, but on one or two occasions as low as 32 degrees, and the wind veered from North-West to South-West."

My own experience is limited to the months of October and November of last year, and January, February, and March of this year. I registered no observations during the first period, which is the spring; but may state my impressions of the same. These were, that the climate is by no means so severe as during the corresponding period in England, but that it is unsettled, with frequent showers and gales from the West.

On reference to Appendix D, a register will be found of the daily state of the atmosphere during my last visit, appended to which is one taken at Dunedin by the Rev. Mr. Burns, who politely placed his observations at my disposal. I did not think it necessary to draw on his kindness further than for a portion of the month of January, as my observations in the Southern Districts at the sea level were confined to that period; the rest being taken, often at a high elevation, in the interior. The comparison of the results shows an equal atmospheric pressure, the difference being the unappreciable one of 00.03 in.; and the temperature also has scarcely any variance—such variance amounting to only 1 degree, which, if greater heat be considered an advantage, is in favour of the Southern Districts. But regarding this subject, it is necessary to remark, that the observations not having been taken similarly in manner, some discrepancies are unavoidable. Notwithstanding this, the observations I believe will be found satisfactory for practical purposes. My observations would have probably been better taken at 5 a.m. and 1 p.m.; if

so, the minima and maxima would have had greater agreement with those of the Dunedin register. The thermometrical register of the Southern Districts points to a peculiarity in the weather, which is this, that a high temperature in the morning is succeeded by bad weather. (See February 5th, March 2nd, 5th, 23rd, and 30th.) Low temperature in the morning, on the contrary, indicated fine weather. (See January 15th, 23rd, and 29th, Feb. 9th, 15th, and 20th, also March 10th, 16th, and 23th.) The reason of this peculiarity appears obvious. The region being close bordering to the cold and ponderous atmospheric currents of the Southern Ocean, any rarefaction of the air by heat over the land causes an immediate influx from thence, as exemplified by the South-West gales. The coast weather is characterised by frequent showers, and the interior by strong breezes, but neither of such force as to injure crops. This characteristic is hinted at in the paper of Captain Stokes above quoted, and may be accounted for in the following manner. The winds of this latitude being generally Westerly, and charged with the moisture drawn from the ocean, in coming in contact with the high and cold regions of the South-West coast and of Stewart's Island, the moisture is condensed, and precipitates itself in showers on the neighbouring districts. From these data, and many conversations that I have had with Captain Ellis, the Resident Magistrate at Campbelltown, I am led to conclude that throughout the year there are no great extremes of temperature—the thermometer seldom rising above 75 degrees, or falling below 35; also that the rain fall does not exceed that of many counties in England. Captain Ellis also informed me that the weather is often more settled and agreeable in winter than in summer.*

In a district like this, situated on one of the great volcanic zones, where terrestrial galvanic currents may be supposed to prevail, it will be correctly surmised that the surface sometimes indicates forcibly the presence of magnetic disturbance. This disturbance was more or less sensibly indicated in our observations; but the most re-

* Two years having elapsed since these observations on the weather were recorded, it may be stated that they have been found to be substantially correct.

markable is on the Bluff Peninsula, as will be seen by the following:—

	deg. rein.
On the summit of Bluff, variation	6 54 E.
30 feet to North of the same	9 36 W.
30 feet to West of the same	5 04 E.
30 feet to East of the same	46 44 E.
On Macfarlane's Run	16 40 E.
At Invercargill	16 32 E.
* On Dome Mountain	17 12 E.

GEOLOGY.

In reporting on the formations of the surveyed district, it is necessary to premise, that as my attention was directed to another object, what I can now lay before the Board are only the results of such incidental observations as the exigencies of that object would permit of. That these observations will be meagre and unsatisfactory may be correctly surmised, owing to our survey tracks occupying the most easy routes, while the subjects of geological investigation are generally to be found in rugged districts difficult of access.

In the district, occupying as it does a central position in the great volcanic zone, of which the Islands of New Zealand form a link, it might have been expected that the phenomena peculiar to volcanic regions might have been found in the existence of vents or craters, but this is not the case; a circumstance which obtains all over Middle and Stewart's Island. Crystalline rocks are met with in the higher and interior groups of mountains, and also on the peninsula of the Bluff; while the minor groups of mountains and plains are, in formation, entirely sedimentary, having strata more or less disturbed in position and altered in texture as we descend from the former to the latter. Thus the river beds of the Maitara, Oreti, Aparima, and Waiau, having their sources in the Eyre, Takitimo, and other interior mountains, bring down granite, gneiss, and other rocks as may be expected to be in juxtaposition, such as porphyry, cherts, greenstone, and amygdaloids, proving the above groups of mountains to be of these rocks. The minor ranges, such as the Hokanui, Taringura, Wairaki, and Twinlaw, show a stratified formation, whose layers are much tilted up and broken. These ranges very generally disclose a metamorphic action, whether induced by

* The bearing of the magnet is affected in all parts of the Province where hard compact traps crop out. These are found principally on the higher parts of ridges and mountains.

internal heat or terrestrial galvanism, in the hardening of the strata, alteration of their texture, and introduction of veins and concretions of foreign substances, most abundantly exemplified in quartzose and ferruginous matter. The protuberances of these ranges seem to have been preserved from degradation and decay by the presence of these metamorphosed minerals; while the lower regions, being composed of softer materials, have proved to be sensible to the impressions of the usual dissolvents, viz., water, atmosphere, and time.

The minerals found in these ranges are porphyry, cherts, greenstone, breccias, and conglomerates. I have nowhere observed the true basalt, which may be termed the lava of ancient epochs, and so commonly disclosed in many districts of Great Britain and Ireland. On the contrary, here all development of subterraneous action is to be found in the crystalline (popularly called primary) rocks, and in the metamorphosed formations above noticed. On the plains and lower levels aqueous or sedimentary formations, as might be expected, prevail. The deposits of the present era are found in the shingle transported by water, from the high lands to the valleys, and in the vegetable deposits formed on the depressions not coming under the influence of the above action, but which a small change of level would in most cases have the effect of covering by shingle deposits of the rivers. Thus the Seaward Moss, covering 72 square miles of country by slight alterations in the courses of the Mataura and Oreti (both shingle transporting rivers), might, in a short geological epoch, be overrun by their deposits, which would have the effect of pressing down the vegetable matter to the consistency of the older beds found in the same district, and produced in the same manner.

Of the older formations of these plains, indications are brought to view by the scooping action of the rivers, also by land slips; thus the Mataura, 24 miles from its mouth, makes interesting disclosures of shingle strata, lignite, limestone, and shales, the latter containing fossil ferns. Here, at a prior epoch, had been a shingle transporting river, delivering its contents next a moss, then a depression under the sea level, and afterwards a rise to the present state.

Of useful minerals in the plains and

low lands, limestone was observed 12 miles from the mouth of the Waiau, at the west base of Twinlaw Range, at the east of Mount Pleasant, in the vicinity of Waimatook Moss, on the south slopes of the Taringtura Downs, and near the falls of the Mataura. The limestone abounds in fossil shells, amongst which were noticed shells resembling the *Terrebratula Porrecta*, and the *Pecten Lugdunensis* of Great Britain; the former in that region belonging to the Devonian group, and the latter to the Lias.

I am not aware what has been done in New Zealand towards classifying the fossils, or towards initiating a theory of the superposition of strata founded on the classes of fossils. It appears to me that considering the want of analogy between the existing animal and vegetable creations of the Antipodes, that it is but reasonable to suppose that in prior ages the same want of similarity obtained; consequently no theory can be ventured on, excepting from local observation and classification, a desideratum highly desirable.

Granite of excellent quality exists at the Bluff which might be adapted to building purposes. The limestone at the Waiau gorge is also of excellent quality for the same object, and brick earths everywhere prevail. The beds of sea shells in Bluff and New River estuaries will supply to any extent mortar or cement.

The existence of Coal has often been hinted at, but the only bed approaching to the qualities of this fuel, that I have met with, is on the Mataura, near Tutarau, and this is very inferior. At greater depths no doubt better may be met with, and the geological formations would tend to this conclusion; but I do not think there is sufficient indications to warrant the retention by Government of any tracts of land on account of the supposed existence of the mineral.

The existence of Gold is undoubted; a fact first brought to light by Mr. Ligar, Surveyor-General of New Zealand. The principal specimens yet found have been obtained in the gravel of the Mataura River, near Tutarau; but I am credibly informed that indications are everywhere met with in the Waiopai and Mataura Plains. I have nowhere yet known of any individual success at the occupation of gold-washing or digging as a business, nor have I seen above the small fraction of

an ounce in the hands of any one. Knowing that gold had been found, I paid some attention to the subject at various localities. The spots where I actually tried the sands and rocks for gold were on the Upper Mataura, to the north of the Dome Mountain; on the Aparima near Taringtura Hill; in the Orawia near Grassburn; and on the Waiau near the Limestone Gorge. The trials (and they must be admitted to be very imperfect) were made by washing the sands in our pannikins, these being the best utensils for the purpose in our possession, and by digging in the chinks of the rocks and scooping out the sand and mud with our knives. In all our attempts we were unsuccessful in finding the metal; but I must not omit to mention of one of my assistants having reported the obtaining one speck in the Waiau sands. Amongst the sands of the Waiau, the residue consisted of black grains, not unlike oxide of tin, and a few small crystals not unlike the garnet. The above black grains are also found in the Mataura.

Having never visited a gold-field, I can personally offer little to the Board which may claim their dependence; but if we proceed upon the information given by geologists, I would point to the districts of the Hokanui Hills, to the Slate Ranges, and to the valleys of the Mataura and Waiau, as being probably auriferous. In these districts quartz is disseminated amongst the cherty, schistose, and slaty rocks that abound; and the quartz, when found on the surface, is much intermixed with peroxide of iron. These are frequently the indications of gold-fields, and have been mentioned to me as often obtaining in the gold-fields of Australia. On reference to Professor Ansted's opinions on the subject, I find him concurring in the same; thus, in his work on Geology are the following remarks:—"The rocks in which gold is found are very variable, including granites, slates, schists, and even limestones. The alluvial deposits, containing particles of the metal, and most prolific when sifted and washed, are *quartzly sands with iron.*"—(Ansted's Geology, page 226.) The intervening rivers, viz., the Makerewa, Oreti, Aparima, and Otautau, do not possess the above indications. If, therefore, the authorities should at any time deem the subject to wear so important an aspect as to call for active measures in

the matter, I would point to the North Waiopai Plains and Upper Mataura as being the most promising fields of trial. The objections that I have heard stated by practical "diggers" as to the successful pursuit of the metal, is, in "washing," the frequent freshes; and in "sinking," the depth of the bottoms and porous nature of the strata to be gone through. These difficulties, no doubt, were sufficient inducements offering, ingenuity and perseverance would overcome; but the process appears to call for greater means than are generally possessed by individuals in this Province.

The existence of other metals I had few opportunities of ascertaining, as stated before. Small veins of iron exist on the Dome Mountain, but in so slight thicknesses as not to require further attention.

Whilst on the subject of minerals, though it be going beyond the range of my own observations, it will not be improper for me to mention that the settlers at Jacob's River, who frequented the West Coast for many years, report that in many of the Sounds, Coal and Copper are abundant.

PASTURAGE.*

The subject of Pasturage appears to me to be as important as any to this part of the Province of Otago. The natural grasses are always found to grow in bunches known by the name of *tussocks*, and these tussocks vary in colour and dimensions with the qualities of the soil and nature of climate. In the lower and moister districts near the sea, the *tussocks* are sombre coloured, varying from red to brown, and attain considerable dimensions, rising above the ground at times to the height of 4 and even 5 feet. In the higher and drier districts the tussocks are light coloured and small, affording fine and soft pasture. The exception to the above rule is in the limestone districts, which invariably afford pasture of superior quality wherever situated. The pasturage, generally speaking, is to be found adapted for cattle near the sea, and for sheep in the interior.

Commencing with the Waiopai and Mataura plains, in the vicinity of the Waiopai and Waikivi creeks, the grass consists entirely of coarse, dull coloured tussock, often rank and abundant, but at other places much overgrown with

* The whole of this district has since been taken up for Sheep Runs.

fern and flax. As we approach to the high terrace at the heads of these creeks the grasses improve in quality, the soil being drier and fitted for the pasturage of either sheep, cattle, or horses. The pasturage in the vicinity of the Linhurst creek generally bears good grass, though rather coarser than could be desired, but approaching to the southern base of the Hokanui Hills, which is drained by the Hedgehope Burn, the ground becomes damp, and consequently the grasses are often thin, and of inferior quality; this is equally the case as far as the east end of the above hills, adjacent to the upper courses of the Waimumu and Charlton. The Mataura plains, lying in the proximity of the Mataura, possessing as they do dry and alluvial flats of superior quality of soil, abound in fine pasture of soft tussock, intermixed with spear grass (the latter, one of the indications of good soil.) Much of these plains are however at present too wet for pastoral purposes, but having a rich soil and sufficient fall for drainage, on the district becoming populated, it will not be long ere this fine tract will be improved throughout.

To the north of the Waiopai and Mataura plains lies the hilly district of the Hokanuis, abounding in ridges and valleys. The southern aspect of these hills being timbered, it is only on their northern eminences, spurs, and valleys, that any remarks are required. Here good grass prevails, but frequently on too steep acclivities to be desirable for the flockowner; consequently, before these be taken up as runs, the plains will be occupied. The North-western end of these hills does not possess the qualities of the North-eastern, for here the grasses appeared to be coarse and much overrun with scrub. Proceeding further inland we come to the Waimea plains, and valleys of the Mataura and Wakaia; here a diversity of qualities in the grasses is met with, the plains producing superior qualities, the valleys moister and coarser, and the hill spurs grasses much overrun with the scrub called "*tomata guru*," but generally of excellent quality.

To the North of the Waimea plains, a mountainous region extends, giving issue to the upper feeders of the Mataura. To the altitude of 2000 feet, good pasturage is only found on superior qualities of soil, such as that produced by gritty shales; beyond the above altitude, a coarse valueless tussock, locally

called "snow grass," prevails, till the surface becomes entirely barren, which takes place at the altitude of 5000 to 6000 feet. Above 6000 feet the mountains were observed to be permanently covered with snow. Between the elevations of 1000 and 2000 feet a species of aloe, locally termed "Spaniard," abounds, also a silvery broad-leafed grass, whose local or botanic name I do not know. From 2000 to 4000 feet, an elegant mountain daisy discloses itself amongst the coarse vegetation; also a ground berry, having the taste of the rose apple, and one or two low plants, bearing odoriferous flowers of considerable beauty.

Situated in the midst of this mountainous region is the valley of the Upper Mataura, which being dry and well drained, bears grasses of superior quality; and in the proximity of the Southern slopes of the Eyre Mountains lies the Five Rivers Plain, which has good pasturage on a considerable portion of its surface, exceptions being at the bases of the ridges, and round the Southern aspect of the West Dome Mountain. Here coarse tussock and "honey-combed" country exists to some extent. It may be necessary for distant readers to observe that the term "honey-combed" is locally applied to country full of small holes closely approximate, an indication of wet ground.

Having reached to the Northern limit of the survey, I will again return to the sea coast, commencing at the mouth of the New River. The district stretching along the sea coast to Jacob's River abounds either in sand hills or swamps; to the North of this commence the Oreti Plains, which being of considerable extent, have some diversity of soil and pasture. Between the Makerewa and Oreti a considerable tract of good pasture is found, and in the low lands of the Tomoborakau is excellent summer feed for cattle; but approaching to the vicinity of Forest Hill, and stretching thence to Woody Knoll, the district assumes an unfavourable aspect, which, though possessing many dry ridges having excellent cattle feed, is much intersected by swamps and wet lands—all of which, however, are drainable.

In the neighbourhood of the Spar Bush much good pasture is found, also on the ridges and terraces to the West of Waimatook Creek, but stretching from these two localities to the base of the Taringtura Downs an extensive

tract of inferior country prevails, being low, honey-combed, and much intersected by swamps. What is exceptional to this description is found on the West banks of the Oreti and the East banks of the Aparima, where, especially on the latter, belts of superior grass of considerable area are found.

To the North of the Oreti Plains are the Taringtura Downs. Here the pasturage is generally of good quality for sheep, the Northern and Eastern slopes having dry and superior herbage, while the Western and Southern have what may come under the denomination of good. The exceptional tracts are in the vicinity of the Taringtura Moss and Dipton Creek. The drawback to these downs is in the scarcity of timber; yet I believe that sufficiency will be found for pastoral purposes.

North-west from the Taringtura Downs lies Mount Hamilton and its proximate ranges, spurs, and ridges. This country is diversified with good and inferior grasses. The level tops of the ridges have very frequently extensive mosses on them, while the slopes and valleys bear grass of good quality. I would infer, from the position of this tract being between two high ranges, viz., the Takitimo and Eyre mountains, that it is much subject to violent winds and drifting showers, yet there is everywhere abundant shelter for stock upon it.

Commencing again near the sea coast at Jacob's River, where it divides into two branches, called the Aparima and the Omot, generally a fine tract of pasture exists, and bounded as it is on the westward by the Longwood range, it is well sheltered from the prevailing winds. On this tract in the vicinity of Opork Creek and Groper's Bush, the grasses are good, while on Omot Creek they become inferior, being much overrun with fern.

To the northward, on the slopes of Mount Pleasant, Ferndunlaw, and Bald Hill, the country assumes an inferior character, being much overrun with fern; but to the north of the Otautau Creek, which bounds these, the fern disappears, and grasses of partly good and partly inferior qualities take its place. To the east of Woodlaw and Wairio Hill the pasturage is generally inferior, but the northern aspect of the congerie of hills to which these belong bears generally good grass, mixed at times with fern.

To the west of these is the Orawia River, which possesses a good pastoral district, especially about the middle part of its course. Here limestone ridges prevail (as stated before) as far as the Limestone Gorge of the Waiau. The northern districts of the Orawia, called the Wairaki Downs, are scrubby, and appear cold and inferior. Proceeding to the Waiau River, in the vicinity of the same, and stretching as far as the Wairarak, grasses of superior quality prevail on spacious terraces here existing; but stretching towards Marshburn and its sources, the country rapidly degenerates; the grass being scanty and covered with flax. The district in the vicinity of the Wairarak, and northwards to the base of the Takitimo mountains, improves, the grasses apparently being abundant, and of good quality.

In closing this description of the Pasturage of these districts, it will be useful to state that superior grasses are estimated in the Land Office to carry one sheep to two acres—good grasses one sheep to three acres—and inferior, one sheep to four or five acres.

AGRICULTURAL CAPABILITIES.

The Agricultural Lands are estimated in the preceding portion of this Report at 400 square miles, but this must be accepted under the following explanation, that in assigning the boundaries of these and the Pastoral, the present circumstances of the colony are taken into account. Under present circumstances lands distant from water carriage, or nuclei of population, while they may be of value to the flockowner, are valueless to the agriculturist, for it must be evident that the light and costly productions of the former can bear a great deal heavier carriage expenses than the bulky stuffs of the latter; consequently, however well adapted from climate or soil, it would be useless to class as agricultural what cannot now be used as such. Before agricultural operations can be successfully extended into the interior—and much of it is well adapted for the same—population must have increased, and communication have been improved; conditions that require time or unforeseen events to develop. The district that has been classed as agricultural is that contained within the tracts around Invercargill, Campbelltown, and Jacob's River. Here is easy access to markets by means of water communication or short land stages.

In the present infancy of colonization of this part of the Province of Otago, it may be correctly presumed that agriculture has advanced but little; indeed all such operations are simply confined to meeting the wants of home consumption for the few European and Native communities now settled in the district, and the productions hitherto have been confined to wheat and potatoes.

Of these products Jacob's River raises the greatest amount; and having been at this settlement during harvest, I will state shortly what I observed of the same. Of potatoes I need say little, as this is a production universally congenial to the climate and soil of New Zealand. Of wheat I observed the following,—that forest lands, in small plots, having been constantly under crop for 14 years, were yet bearing enough to induce the settlers to cultivate the same. On the more recent virgin soils, the crops of white wheat were yielding 40 to 50 bushels per acre, and the heads carried from 40 to 70 grains of excellent quality. The harvest was principally secured by the 6th of March, the spring crops being considerably later. I had various accounts of the nature of harvest weather from the settlers; but any difficulties that they may encounter, I have no hesitation in saying, are owing to the want of proper means and appliances; and I am informed by a practical agriculturist from the best district of Scotland, that in such a climate as that of South New Zealand, no fear for the security of the crops need be entertained if improved methods of farming be resorted to. This opinion was invariably supported by such *disinterested* settlers as I spoke to on the subject; they declaring that during their residence, sometimes extending beyond twenty years, crops had never been known to fail in the district. Excellent clover pasture is also to be seen at Jacob's River.*

* All grain crops are now grown in these districts with perfect success, though as yet in limited quantities. Settlers have mostly given their attention to pastoral pursuits.

At Omawi, Owi, and Tewais Point, I also observed crops of wheat; all of which had been secured at the time of my visit, which extended over the 24th to the 27th of March. The plot of wheat at Tewais Point, situated near the Bluff, from being on a very exposed position, I held to be of considerable importance in proving that neither the winds nor rains were sufficiently strong to injure the same. Small crops of wheat and oats have also been reaped by the settlers at Invercargill. Mr. Rowan, one of those having wheat, intimated his satisfaction of his crop, and the perfect ease with which it was secured in good order. He accompanied his remarks with the following observation, "that there was no still *moggy* weather to sprout the wheat in the *stook*, and the prevailing breezy hot weather of this period soon dried off any effects of a day's rain." The crops of oats that I saw were reared under great disadvantages; yet the returns promised so well that there is reason to believe that this district will excel in the production of this species of grain—a fact of some importance in this hemisphere.

As practical facts will be of most value to the Board, I will confine myself to the above observations on the agricultural capabilities, which, I must admit, are very imperfect for so important a subject; and in conclusion may state that the lands named under the head of Agricultural, being generally undulating and well wooded, with frequent intersecting streams, on the merits of the new settlement at Invercargill being generally known, such as its geniality to the European constitution—its temperate climate, and extensive area of superior soils—it may be presumed, that under the protecting care of a liberal Government, the adoption of the settlement as a home by the children of the Anglo-Saxon race will not be tardy.

Survey Office, Dunedin, 2nd June, 1857.

APPENDIX (A).

ESTIMATED AREA OF THE NATURAL DIVISIONS OF THE DISTRICT SURVEYED.

FOREST LANDS.

	Sq. Miles.		Sq. Miles	Sq. Miles
South Eyre	54	Brought forward.....	377	
Takitimo	14	Hokanui	79	
Wairaki	6	Makerewa	21	
Hamilton	4	Waiopai	10	
Wood Law.....	6	New River	7	
Bald Hill	6	Long Bush	2	
Longwood Range	242	Otaramika	3	
Spar Bush	11	Seaward Bush.....	58	
Waimatook	4	Bluff	3	
Forest Hill	26	Sundry.....	10	
South Taringtura	4			
Carried forward.....	377	TOTAL		570

MOSSES AND SWAMPS.

	Sq. Miles.		Sq. Miles.
Five Rivers	7	Brought forward	24
Taringtura	3	High Burn	2
Bogurn'	1	Low Burn	2
Marsh Burn	2	Makerewa	4
Waimatook	5	Waiopai	4
Woody Knoll.....	6	Seaward	72
Carried forward.....	24	TOTAL	108

AGRICULTURAL LAND.

Principally on the Mataura, Waiopai, and Oreti Plains 400

PASTORAL LAND.

Principally to the North of the above 2150

BARREN LAND.

Principally on the ridges of the Takitimo and Eyre Mountains, Umbrella and Hokanui Hills..... 500

GRAND TOTAL..... 3728

APPENDIX (B).

ALTITUDE OF VARIOUS OBJECTS ABOVE THE SEA LEVEL.

	FEET.		FEET.
Dome	4505	Mount Eyre.....	6084
Cupola	4045	Taringtura	2093
Forest Hill	898	Mount Hamilton	4674
East Dome	4179	North Peak, Takitimo	4998
Bare Hill.....	2297	South ditto ditto	4582
Ship Cone	2072	Wood Law.....	1682
East Peak, Hokanui	2205	Mount Pleasant	1284
Slopedown Hill	1891	Ferndunlaw	1974
North Longwood Range	2602	Howell's Hill	649
South ditto ditto.....	2451	Omawi Hill	696
The Bluff Summit.....	879		

APPENDIX (C).

POPULATION WITHIN THE LIMITS OF THE DISTRICT SURVEYED,
EXTRACTED FROM THE OFFICIAL CENSUS TAKEN DURING
THE MONTH OF FEBRUARY, 1857.

Europeans	253
Half-castes.....	70
Maories	119
TOTAL	442

APPENDIX (D).
REGISTER OF THE WEATHER IN THE SOUTHERN DISTRICTS.

PLACE.	DATE.	BAROMETER.		THERMOMETER.		REMARKS.
		7 A.M.	2 P.M.	7 A.M.	2 P.M.	
	1857. Jan.					
Invercargill ...	13	29.67	29.57	56	66	Gloomy and showery, but calm
Do	14	29.72	29.72	52	63	Wet; cleared up at evening
Do	15	29.72	29.72	52	63	Fair throughout
New River ...	16	29.65	29.65	55	72	Do.
Do	17	29.45	29.50	58	68	Rain, forenoon; fair afternoon
Do	18	29.45	29.55	60	69	Bright and fair
Oreti River ...	19	29.70	29.70	62	61	Slight squall from west at 9 a.m.; fair afterwards [wise
Do	20	29.60	29.80	57	56	Heavy shower 10 a.m.; fair other-
New River	21	29.10	29.10	54	60	Strong gale from west, with showers and squalls
Bluff	22	29.90	29.82	54	56	Fair, hazy in morning
Do	23	29.60	29.54	52	57	Fair, hazy, and windy [evening
Do	24		29.57		62	Windy during morning; calm
Invercargill ...	25	29.80	29.85	62	74	Very fine
Do	26	29.80	29.90	64	62	Fine morning; wet afternoon
Do	27	29.85	29.82	71	69	Do. do.
Do	28	30.10	30.25	57	62	Do. do.
Waiopai Plains	29	30.21	30.06	49	73	Fine
Do	30	29.74	29.85	54	65	Windy, but pleasant
Do	31	29.87	29.90	55	65	Dull and rainy during morning; clear afternoon
Do	Feb. 1	29.65	29.38	57	68	Mild and dull morning; wet and windy afternoon [afternoon
Do	2	29.78	29.85	62	66	Wind and rain morning; fine
Mataura Plains	3	29.80	29.90	60	67	Morning cold, wet, and windy; fine mild evening
Do	4	29.60	29.46	57	65	Fine [S.W. afternoon
Do	5	29.10	29.05	67	61	Morning rainy, furious gale from
Do	6	29.29	29.33	51	58	Gale from S.W.; rain & a little hail
Do	7	29.37	29.42	62	57	Wet and windy
Do	8	29.18	29.47	52	59	Wet and windy, but giving in
Do	9	29.76	29.65	47	76	Very fine
East Hokanui	10	29.20	29.32	56	56	Gales from west, with showers; cleared and settled at noon
Do	11	29.25	29.62	51	76	Very fine [calm
Waimea Plains	12	29.12	28.82	62	64	Drizzling rain; evening fair and
Do	13	28.82		51		Fine, but windy
Do	14	28.74	29.02	55	55	Rainy; cleared at sunset
Dome Pass	15	29.12	28.70	45	60	Fine; slight shower in afternoon
Do	16	28.75	28.77	53	70	Very fine and clear
Do	17	28.82	28.90	63	75	Dull
Do	18	28.72		65		Windy and dry
Aparima River	19	28.60	28.87	57	57	Dull and showery
Do	20	29.17	29.60	43	59	Commenced wet; ended fair
Do	21	29.65	29.52	53	65	Fine
Jacob's River ..	22	29.53	29.70	55	58	Showery
Do	23	29.95	29.95	55	58	Fine
Do	24	29.95	29.95	54	60	Commenced fine; ended showery
Do	25	30.00	30.01	55	66	Fine
Do	26	29.95	30.08	52	70	Do.
Do	27	29.84	29.79	55	66	Do.
Otautau River	28	29.62	29.43	54	64	Do.
Do	Mar. 1	29.17	29.12	59	65	Showery during forenoon; other-
Waiau Plains ..	2	28.85	28.98	66	57	Wet and blowy; drifting showers
Do	3	28.82	28.85	56	61	Blowy; commenced rainy, ended dry
Do	4	28.73	29.02	55	58	Blowy and showery
Do	5	29.37	29.37	65	48	Showery
Do	6	29.50	29.65	58	66	Fair
Otautau River	7	29.55	29.45	53	54	Fair, but blowy
Do	8	29.18	28.87	58	58	Commenced showery; ended dry
Do	9	29.15	28.68	56	69	Commenced fine; ended wet
Aparima River	10	28.86	28.86	46	69	Fine
Do	11	28.64	28.42	57	75	Fine, but blowy
Centre Hill ...	12	27.80	28.35	48	56	Wet and windy in morning; windy and dry in afternoon

APPENDIX (D). *Continued.*

PLACE.	DATE.	BAROMETER.		THERMOMETER.		REMARKS.
		7 A.M.	2 P.M.	7 A.M.	2 P.M.	
	1857.					
	March.					
Dome Pass	13	28.56	28.56	50	73	Very blowy
Upper Mataura	14	28.72		52		Fine
Do	15					Do.
Do	16	28.90	28.88	49	69	Do.
Oreti River....	17	28.50	28.67	59	73	Do.
Do	18	28.63	28.80	56	70	Do., but blowy
Do	19	28.80	28.65	49	55	Windy and showery
Do	20	29.02	29.00	49	53	Squally, with rain and hail
Aparima River	21	29.48	29.90	59	77	Fine, slight showers
Jacob's River .	22	29.85	29.96	67	66	Fine
Do	23	29.52		60		Heavy rain all day
New River	24	29.72	29.90	60	61	Blowy
Do	25	30.05	30.05	55	63	Fine
Bluff	26	29.90	29.93	50	60	Mild and dahl
Toitotes	27	29.99	30.08	54	65	Fine
Mataura East..	28	29.82	29.87	52	78	Very warm and fine
Do	29	29.43	29.80	59	80	Fine
Waiopai Plains	30	29.52	29.55	65	67	Drooping, ended in heavy rain
Do	31	29.80	29.86	62	67	Fine
Invercargill ...	April. 1	30.00	30.03	63	53	

REGISTER OF THE WEATHER AT DUNEDIN NEAR THE SEA LEVEL.

PLACE.	DATE.	THERMOMETER.		ANEROID BAROMETER.	REMARKS.
		Min.	Max.		
	1857.				
	Jan.			7½ A.M.	
Dunedin Manse	13	53	66	29.87	Fine forenoon, rain at night
"	14	47	70	29.84	Thick sky, small rain
"	15	47	54	30.00	Cloudy and calm in forenoon, strong gusts at night
"	16	53	60	29.95	Heavy gale
"	17	60	66	29.87	Ditto, calm at evening
"	18	61	73	29.79	Bright and fine throughout
"	19	49	74	29.93	Fine throughout
"	20	55	68	29.96	Ditto
"	21	47	67	30.17	Ditto
"	22	53	67	30.17	Ditto
"	23	52	60	29.93	Thick sky, and small rain
"	24	55	58	29.89	Cloudy, and strong breeze
"	25	55	63	30.07	Ditto ditto
"	26	57	68	30.11	Breezy, and rain in evening
"	27	54	65	30.15	Bright, and rain in evening
"	28	53	75	30.37	Fine throughout
"	29	48	63	30.52	Ditto
"	30	55	64	30.23	Ditto
"	31	51	71	30.32	Ditto

REPORT TO THE COMMISSIONERS OF THE WASTE LAND BOARD, ON THE
RECONNAISSANCE SURVEY OF THE NORTH-EASTERN AND INTERIOR DISTRICTS
OF THE PROVINCE OF OTAGO, executed during the months of October, November,
December, and January, 1857-8, by J. T. THOMSON, Chief Surveyor.

THE North-Eastern and Interior Districts may be generally defined to include that part of the Province that stretches from Dunedin to the Waitaki, and from the ocean to the ridges of the Southern Alps.

SURVEY.

Regarding the mode of survey operations, they may be stated to adhere to the same principles as adopted in the survey of the Southern Districts, reported on to the Board under date the 2nd of June 1857; the bases of this present survey being the differences of latitude between Observation Point, Port Chalmers, which is situated in latitude $45^{\circ} 48' 51.4''$, and Puke Ivi-tai, in $45^{\circ} 27' 55.8''$ south, equal to 24.080 English miles; and between the latter position and Big Hill, situated in latitude $44^{\circ} 59' 20.7''$ south, equal to 32.892 English miles. The above latitudes were each fixed by eighteen circum-meridional observations of the sun, taken with an excellent sextant and mercurial horizon of Troughton's manufacture.

AREA.

The extent of the districts will be seen on reference to Appendix A, together with an estimate of their natural divisions, and of which the following is an abstract:—

NORTH-EASTERN DISTRICTS.		sq. miles.	sq. miles.
Forests		93½	
Pasture		3409½	
Swamp		9	
Barren		235	
Lake		1	
			3748
INTERIOR DISTRICTS.			
Forests		41	
Pasture		1850	
Swamp		0	
Barren		354	
Lakes		57	
			2302
Total			6050

PHYSICAL GEOGRAPHY.

These districts may be described as mountainous—less so on the sea-board, but decidedly so in the interior; yet the mountains enclose extensive plains, eminently adapted for pastoral occupation.

The groups of mountains are:—The Southern Alps, attaining an elevation

above the sea of 12,460 feet; Benmore, 6111 feet; Dunstan, 6600 feet; Pisa, 6426 feet; Kurow, 6393 feet; Rock and Pillar, 4675 feet; Kakanui, 5195 feet; Silver Peak, 2536 feet; and Otago Peninsula, 2462 feet.

The downs are:—The Lower Waitaki, in which the highest eminence is Big Hill (962 feet); Moeraki, having no prominent elevations; and the Waitakouaiti, whose most prominent elevation is at Mount Watkins (2045 feet).

The plains are:—The Upper Taieri, rising from 986 to 1550 feet above the level of the sea, extending 30 miles in length and 18 miles in breadth; and the Upper Waitaki, rising from 1180 to 2136 feet, extending 40 miles in length and 20 miles in breadth.

The valleys are:—The Upper Clutha, having a general elevation of 1000 feet above the sea, extending 40 miles in length and 15 miles in breadth; the Manuherikia, rising from 541 feet to 1717, extending 40 miles in length and 10 miles in breadth; and the Ida Burn, having a general elevation of 1500 feet, extending 30 miles in length and six miles in breadth.

The principal rivers are:—The Taieri, having its source in Lammerlaw, from whence it flows first north-easterly, then southerly, to the sea, the distance in a straight line being 35 miles, but whose course is nearly 90 miles following the windings; the Waihemo or Shag, having its source in Kakanui Peak, from whence it flows south-easterly to the sea, the distance being 30 miles; the Kakanui, having its source in the Kakanui Mountains, from whence it flows easterly to the sea, the distance being 24 miles; the Waitaki, having its source in the Southern Alps, from whence it flows southerly through the Pukaki Lake, then south-easterly to the sea, the distance being 120 miles; the Clutha, having its source in the Southern Alps, from whence it flows south-easterly through the Wanaka Lake, then southerly, south-easterly, again southerly, then south-easterly to the sea, the distance being about 130 miles as the crow flies.

The lakes are:—Pukaki, having an elevation of 1377 feet above the sea, and measuring 10 miles in length and four miles in breadth; Ohau, having

an elevation of 1498 feet, and measuring 12 miles in length and $2\frac{1}{2}$ miles in breadth; Wanaka, having an elevation of 1036 feet, and measuring about 14 miles in length and four miles in breadth; Hawea, whose elevation not ascertained, but which may be stated as the same as Wanaka, measuring about 12 miles in length and two miles in breadth; Taieri, having an elevation of 906 feet, and measuring $1\frac{1}{2}$ miles in length and one mile in breadth.

The only swamp of any note is the Poolburn, measuring five miles in length and three miles in breadth.

The harbours are:—Otago, the only one available to large class ships; Saunders, Purakaunui, Blueskin, Waikouaiti, and Waitaki, available for boats, and the last only under very favourable circumstances.

The roadsteads are:—Otago, Waikouaiti, Moeraki, and Oamaru, in all of which large class ships may anchor during south-westerly weather.

The climate, under the limited observations that I can offer, will be best judged of by reference to Appendix B, so I will only state my general impressions—that the months of October and November were unsettled—wet and windy—while the months of December and January were warm, but frequently windy; it must also be remarked with reference to the latter months, that where snow showers are registered, the localities will be found to be at high elevations; for, where snow falls on the mountains, during the summer, rain falls on the plains.

Regarding routes into the interior districts, I may state that in this part of Otago province pack horses or bullocks may be taken anywhere, the surface being low grassed and free from scrub, while the creeks and rivers are hard bedded. After some improvements are undertaken and completed, the two main dray roads will be by the Waitaki and Shag river valleys; the former leading from the roadstead of Oamaru, and the latter from Waikouaiti, or else the Kartigi Beach. The produce of the Upper Waitaki must be shipped at Oamaru, and that of the Upper Clutha may also be shipped at the same place, while the produce of the Upper Taieri, Ida Burn, and Manuherikia, would be best exported at Waikouaiti or Kartigi Beach; the produce of the Upper Clutha may also reach these shipping places by the Dunstan pass. The Upper Clutha

may further be made accessible to Invercargill by the Wakatip Lake, and Upper Mataura, but on this point I cannot speak with certainty.*

FORMATIONS.

The formations of the sea-board are principally sedimentary, to a distance inland of 30 miles; in the interior the prevailing formations are plutonic and metamorphic.

The most prevailing class of the plutonic rocks is *trappean*, graduating from blue compact rock to light and drab coloured cherts. These are met with on the Kurow, Kakanui, Ben Olfau, Benmore, and Dunstan mountains, also on the Southern Alps. The most prevailing of the metamorphic rocks are *schist* and clay slates. These are abundantly met with on the Waikouaiti Downs, Rock and Pillar Mountains, Roughridge Hills, and Blackstone and Raggedy Ranges, in which the sharp serrated edges of the formations protrude, giving the country a most peculiarly tuberos and rough appearance.

In neither the plutonic nor metamorphic formations were any indications of minerals observed. The sedimentary formations on the sea-board and adjacent country possess much more interest by their containing minerals that may be of practical advantage to the province—these consist of coal and limestone; the former, and its indications, are met with round the bases of the Kurow and Kakanui Mountains, and the Horse Range, in the Waihemo, or Shag river, at Shag Point, Waimataitai, Waianakarua, Kakanui, and Waitaki rivers. It is also reported to exist at the head of the Upper Taieri plain, on the Kyeburn.† The latter is met with abundantly in the Maruwenua, Waireka, Awamoko, and Kakanui valleys; also at the head of the Shag river. Excellent flag-stone is found on the Kakanui, and roofing slate in the Waianakarua and Maruwenua. The curious phenomenon known to all travellers in the northern districts, viz., the round boulders on the Moeraki Beach, though of no utilitarian interest, must pass unobserved. They consist of spherical balls varying in diameter from 6 feet to 9 inches, and bear a remarkable resemblance to huge cannon balls. Their colour is bluish grey—and they are ob-

* This supposition has proved to be correct.

† Coal has been found since at the east end of the Taieri or Maniatoto Lake.

served to be washed by the action of the sea—out of the adjacent beds of soft, amorphous, blue clay of which the over-hanging cliffs are composed. The balls, on being examined internally, were found to be composed of the same material as the clay beds out of which they had fallen, but with this difference that they were much intersected by veins of carbonate of lime, radiating from the centre or nucleus, to all parts of the exterior. Under a natural process, induced by chemical affinity, the formation and augmentation of these veins of carbonate of lime appear to have been the medium of constructing the balls out of the clay; for, as the nuclei increased, they would press outwards on the surrounding plastic material, hardening it and altering its formless substance into layers parallel to the centre of action, and this with less and less energy and effect as the distance from the centres increased; consequently we see where little carbonate of lime has accumulated in the manner above described, the balls are small, and where much has accumulated, they are large. The disposal of clay in layers parallel to pressure, may readily be observed in broken bricks or common pottery, which may be taken as a familiar illustration of the process.

PASTURAGE.

In attempting a description of the pasturage, it will be most convenient to adhere to the natural divisions of the country.

Waikouaiti Downs—stretching from the Silver Peak Hills to the Horse Range, and from the sea backwards to the Upper Taieri—possess great diversity of descriptions of pasture. In the southern quarter the grasses produced on this very broken country are poor, coarse, and much overrun with fern; on the northern limits, the grasses produced on this gently undulating country are generally good, and in parts superior; on the interior limits the grasses are inferior, the country being generally at a high elevation.

Moeraki Downs—stretching from the Horse Range to Kakanui River, and from the sea to the Kakanui mountains—bear generally inferior pasturage on their southern quarter, the ridges being densely overrun with fern; while on the north the country improves so much as to bear the finest pasture in the province; when the eastern slopes of the Kakanui mountains are reached, the

pasturage rapidly deteriorates in quality, being here composed of coarse tussocks or snow grasses.

Waitaki Downs—stretching from the Kakanui River to the Waitaki, and from the sea to the Kurow mountains—include the largest and generally the finest pastoral country in the province; the grasses being good and so equal in quality, no particular detail need be entered into.

Upper Taieri Plains—may be described as colder than the country on the sea board, yet they are extensive, and eminently adapted for pastoral purposes, and bear good grasses on their surface till the bordering high lands are reached.

Ida Burn Valley—more circumscribed and higher, and somewhat colder than the Upper Taieri plains, yet bears generally good grasses on its surface.

Manuherikia Valley—extensive and lower than the Ida Burn—possesses at its lower end much fine pasture; this character gradually deteriorates to the head of the valley, as the high regions of the Dunstan mountains are entered into.

Upper Clutha Valley—more extensive and somewhat higher than the Manuherikia valley, possesses a large extent of good pasture, stretching from the Kawarau River up to the Wanaka and Hawea Lakes—north and west of these lakes the country becomes very mountainous and barren, unfit for the depasturing of stock.

Upper Waitaki Plains—lie on a higher elevation than the other districts described, and the grasses are generally scanty; yet, owing to the dry, light, nature of the soils, these plains are well fitted for rearing stock. In the north and west of the Upper Waitaki plains, the very rugged and mountainous regions of the Southern Alps are entered upon, where the surface becomes utterly sterile at an elevation of 6000 feet above the sea.*

AGRICULTURAL CAPABILITIES.

The Northern and Interior Districts of the Province of Otago, in regard to their soil and climate, are eminently adapted both for pastoral as well as agricultural settlement; but the great paucity of forest, while it does not materially militate against the former interests, acts as an effectual obstacle to the

* Since this was written the whole country has been applied for or taken up for Sheep Runs.

latter; it is therefore only in such parts where forest exists that an agricultural population would have a tendency to overspread. Excepting in the far inland districts, forest lands are confined to a strip on the sea coast, stretching from Blueskin Bay 40 miles northward, and having a general breadth of 10 miles. This district, though circumscribed in limits, besides those advantages of climate and soil and abundance of timber, has facilities for the shipping

of produce at the little harbours of Blueskin, Waikouaiti, and Moeraki, from whence the connection with the capital is easy and rapid. These advantages induce me to believe, on any great increase of the influx of immigrants into the Province, under the present Regulations relating to land, that the agricultural population will have a tendency in this direction.

Survey Office, Dunedin,
21st May 1858.

APPENDIX (A).

ESTIMATED AREAS OF THE NATURAL DIVISIONS OF THE NORTH-EASTERN DISTRICTS.

FORESTS.		FORESTS.	
Sq. Miles.		Sq. Miles	Sq. Miles
Otago Peninsula	61	Brought forward ...	79½
Silver Peak	4	Moeraki	1
Blueskin	10	Kuri	6
Hawksbury	2	Otepopo	1
Goodwood	2	Waianakarua	4
Puketapu	0½	Kanroo	2
Carried forward.....	79½	TOTAL	93½
PASTURE.			
General			3409½
SWAMP.			
Poolburn			9
BARREN.			
Sq. Miles.		Sq. Miles	
Hawkdun	60	Brought forward....	165
Kurow	60	Dunstan	50
Kakanui	45	Rock and Pillar	20
Carried forward.....	165	TOTAL	235
LAKE.			
Taieri			1
			TOTAL
			3748

ESTIMATED AREAS OF THE NATURAL DIVISIONS OF THE INTERIOR DISTRICTS.

FORESTS.		FORESTS.	
Sq. Miles.		Sq. Miles	Sq. Miles
Ohau (excluding upper part)	5	Brought forward ...	26
Hawea do. do. do.	21	Lindis	13
Carried forward.....	26	Sundry	2
			TOTAL
			41
PASTURE			
			1850
SWAMP			
			0
BARREN.			
Sq. Miles.		Sq. Miles.	
Hawkdun	30	Brought forward.	130
Dunstan	100	Pisa	24
Carried forward.....	130	Ahuriri Head	200
			TOTAL
			354
LAKES.*			
Sq. Miles.		Sq. Miles.	
Lower part of Ohau	23	Brought forward ...	39
Do. Hawea	16	Lower part of Wanaka	18
Carried forward.....	39		57
			TOTAL
			2302

* Ohau measures 27 square miles; Hawea, 18 square miles; and Wanaka, 37 square miles.

APPENDIX (B).
REGISTER OF THE WEATHER.

DATE.	PLACE.	THERMOMETER.		REMARKS.
		6 A.M.	1 P.M.	
1857.				
Oct.				
15	Blueskin	42	67	Fair, with Cumulo-strati; dull at evening
16	Waikouaiti	59	62	Showers last night; strong gales and slight showers
17	Goodwood	45	54	Fair, with breezes all round compass [afternoon
18	Horse Range	41	50	Heavy gale with rain last night; moderating in
19	Do.	42	49	Squally from S.W.; showers of rain and hail
20	Do.	44	62	Fair, light winds, and sunshine
21	Moeraki	44	56	Dull in morning; light winds and sunshine at noon
22	Otepopo	49	73	Dull in morning; light winds and sunshine in afternoon
23	Oamaru	53	61	Boisterous, with squalls and a little hail
24	Papakiu	51	56	Breezy day with sunshine
25	Big Hill		53	Dull and drizzling
26	Kaik Penomeru	51	56	Dull and drizzly; cleared up at evening; wet night
27	Maruenua	42	59	Fair in morning; heavy rain in afternoon
28	Otakeik	44	74	Fair and sunshine
29	Waitaki Gorge	48	66	Do. do.
30	Otametakau	47	68	Do. do.; cloudy at evening
31	Kurow	46	76	Do. do.
		Mean, 47—61.		Highest 76, Lowest 41.
Nov.				
1	Maruenua	50	72	Fair with sunshine; fog in evening
2	Upper Kakanui	54	69	Shower last night; fair, but dull [ternoon
3	Waitaki	49	57	Sunshine in morning; windy with showers in af-
4	Waitaki Mouth	46	58	Do. do. do.
5	Teneraki	45	60	Fair, with sunshine
6	Otepopo	50	62	Fair morning; squalls and showers in afternoon
7	Do.	46	56	Fair throughout, with strong gales from S.W.
8	Do.	48	61	Fair throughout, with light winds [ternoon
9	Do.	50	80	Fair in morning; squalls with light showers in af-
10	Horse Range	44	55	Morning fair and dull; afternoon rainy
11	Shag River, Lower ..	60	65	Furious gale all day; rain at noon; fair afternoon
12	Do. Upper ..	47	51	Snow showers and gales from S.W. [evening
13	Highlay Hills	48	51	Frost in morning; fair with sunshine; overcast at
14	Taieri Lake	32	64	Slight hail showers and gales from S.W.
15	Upper Taieri Plain ..	42	62	Showers in morning; fair afternoon
16	Taieri, West Head ..	45	63	Dull in morning; heavy rain in afternoon
17	Blackstone Hill	53	60	Showers in morning; heavy rain in evening
18	Tiger Hill	48	65	Showery all day
19	Do.	50	58	Do. do.
20	Roughridge East	52	58	Slight showers all day
21	Taieri Lake	41	55	Fair throughout
22	Mid Taieri Plain	42	71	Fair and sunshine
23	Highlay Hill	52	68	Do. do.
24	Barewood	58	66	Morning and afternoon fair; evening raining
25	Goodwood, back run	56	62	Wet day
26	Do.	58	68	Fair; mist on hills
27	Do.	56	75	Fair throughout, with sunshine
28	Waikouaiti	65	60	Fair morning; wet afternoon
29	Clump of Trees	47	67	Showers occasionally
30	Mihiwaka	47		
		Mean, 49—63.		Highest 80, Lowest 41.
Dec.				
9	Otepopo	57	58	Fair throughout
10	Kauroo Mouth	56	73	Rain last night; fair and dull day
11	Maruenua	51	63	Fair, with sunshine throughout
12	Otiak	57	76	Do. do. [west
13	Big Gully Creek	62	79	Fair morning; dull afternoon, with strong wind at
14	Otametakau	62	76	Fair, with sunshine throughout
15	Robison's	55	86	Do. do.
16	Ahuriri Pass	56	85	Do. do., strong gale at west
17	Do.	50	82	Do. do. do.
18	Grandview Mountain	63	65	Do. do. do.
19		50	63	Do. do., gentle breezes
20	Lindis Burn	57	77	Do. do.
21	Ahuriri Pass	62	80	Do. do.
22	Cloud Hill	63	88	Do. do., strong breezes at west
23	Ohau Lake	49	77	Do. do. do.

APPENDIX (B). *Continued.*

DATE.	PLACE.	THERMOMETER.		REMARKS.
		6 A.M.	1 P.M.	
1857. Dec.				
24	MacMurdo's	61	80	Fair but cloudy in morning; strong gales and showers in evening
25	Ohau Junction	56	58	Fair in morning; windy and showery at even
26	Do.	50	56	Do. do.
27	Do.	56	76	Do. with sunshine throughout
28	Do.	55	74	Do. do.
29	Do.	52	80	Do. do.
30	MacMurdo's	63	63	Dull—rain in afternoon
31	Waitaki Elbow	50	57	Fair in morning; thunder and sleet showers at [even Highest 88, Lowest 49.
1858. Jan.		Mean, 56—73.		
1	* Otametakau Head...	42	50	Snow showers all day
2	Do.	48	51	Dull—sleet showers at evening
3	Do.	40	47	Snow showers; cleared at even
4	Do.	56	67	Fair, with sunshine throughout
5	Do., Foot	46	84	Do. do.
6	Waitaki Gorge	59	68	Fair and windy
7	Otiak	53	66	Do. do.
8	Awamoko	63	72	Do. do.
9	Otepopo	60	72	Fair, with gentle breezes
10	Do.	71	73	Fair, and windy at noon
11	Do.	62	66	Fair, with gentle breezes
12	Horse Range	62	71	Do. do.
13	Shag Valley	56	68	Fair in forenoon; slight showers in afternoon
14	Do.	47	85	Fair day throughout
15	Do.	53	62	Fair forenoon; rain afternoon; thunder showers at [night
16	Do.	58	75	Fair throughout.
		Mean, 55—67.		Highest 85, Lowest 40.

APPENDIX (C).

ALTITUDES ABOVE SEA LEVEL.

	FEET.		FEET.
Mihiwaka	1895	Blueskin Hill.....	3224
Mount Cargill	2297	Taieri Lake	986
Gorge North do.	1285	N.W. Head of Upper Taieri Plain ...	1550
Gorge West do.	1339	Hawkdun	6225
Swamp Hill	2462	Mount St. Bathans.....	6600
Silver Peak	2536	Mount Aspiring.....	9135
Rock and Pillar Mountains	4675	Mount Pisa.....	6426
Hummock, Waikouaiti Downs	2427	Leaning Rock.....	5325
Mount Ida	5498	Tiger Hill	1717
Kyeburn Hill.....	5129	Clutha junction with Manuherikia ..	541
Kakanui Peak	4796	Otametakau Ford (Andrew's).....	775
Kakanui Mountain	5195	Grandview Mount	4703
Mount Watkins.....	2045	Benmore.....	6111
Blueskin Hill.....	1491	Black Cone.....	7328
Derdan Hill	1447	Wanaka Lake	1036
Puketapu	1092	Cloud Hill	2876
Highlay	2615	St. Cuthbert	4962
Double Hill	1460	Robison's Station, Ahuriri	1180
Big Hill, Papakaia	962	Ohau Lake.....	1498
Westernmost Hill, Kakanui	4586	Turnagain Hill	4483
Domot	6230	Pukaki Hillock	2126
Little Domot	5982	Pukaki Lake	1377
Kurow	6393	Mount Cook	12460
Totara Peak	5876		

* The survey party were camped at an elevation of 4500 feet above the sea level for three days, detained by the storm.

REPORT ON THE RECONNAISSANCE SURVEY OF THE SOUTH-EASTERN DISTRICTS
OF THE PROVINCE OF OTAGO, executed during the months of October and November, also February, March, and part of April, 1857-8, by ALEX. GARVIE,
Assistant Surveyor.

THE South-Eastern Districts may be generally defined to include that part of the Province stretching from Dunedin to the Mataura river, and from the Dunstan and Rock and Pillar mountains to the Ocean.

SURVEY.

The basis of the survey was the triangulation of the Otago block, in which I was engaged last year, the details and topographical features being laid down by the usual methods had recourse to in reconnaissance—principally, converging angles, cross and transit bearings taken by the Theodolite.

AREA.

The total estimated area of these districts is 5807 square miles, comprising the following natural divisions:—

Forest	614 square miles
Pasture	4936 "
Swamp	28 "
Barren	220 "
Lakes	9 "

Total..... 5807 square miles

A detailed estimate of these divisions will be found in Appendix A.

PHYSICAL GEOGRAPHY.

These districts are divided by the Clutha river into two portions somewhat different in their general features. The eastern portion may be described as a succession of ranges and alternate valleys parallel to the coast and to each other, extending from the sea to the valley of Manuherikiā. These ranges have few well-defined peaks, but consist mostly of long-rounded or flat-topped spurs, traversed by deep gullies. The first range runs along the coast from Saddlehill to the mouth of the Clutha river; its average height is not above 900 feet, the well-defined wooded peak of Saddlehill rising to 1565 feet. The second range extends from Flagstaff to Mount Stuart, running down in long spurs to the Clutha river, towards Ivikatea ferry. The flat summit of Maungatua, 2985 feet is its highest elevation, but the average is not above half that height. The third range stretches from the Rock and Pillar mountain to Lammerlaw, from whence it also runs down in long rounded spurs to the Clutha river. On the top are two or three parallel ridges, rising to a flat summit, with an eleva-

tion of 3820 feet. These ranges average about 3200 feet high, and from their peculiarly bleak, moorish appearance, have been called the Lammermoors. The fourth range in order is the Roughridge, rising to a height of nearly 4000 feet; and the fifth are the Raggedy ranges, attaining an elevation of 3000 feet. These last are thickly dotted with blocks of schist rocks of all forms and sizes, giving rise to some strikingly peculiar scenery. The valley between the first and second ranges contains the Taieri and Tokomairiro plains, the general level of which is low, not above 10 to 150 feet above the sea. The space between the second and third ranges is occupied by part of the second Taieri plain, rising from 800 to 1500 feet above the sea. To the south-west is the valley of the Waitahuna, intersected by deep gullies and long flat-topped spurs.

In the western portion of the district the Kaihiku ranges and their continuation form a northern limit to a tract of country differing in its features from all the other parts. This tract is characterised by razor back ridges and conical hills, so similar to each other as to be perplexing to travellers, it also contains by far the largest quantity of wood in the district. The streams here generally run in valleys and on rocky beds. North of this the country between the Kaihiku ranges on the one hand, and the Pomahaka, and Clutha rivers on the other, consists chiefly of low ranges, not averaging more than 400 or 500 feet, and intersected by numerous creeks, many of which have sluggish, winding courses through narrow alluvial flats. Still farther north are the Tapanui ranges, rising to a height of 3350 feet; and towards the north-west the Umbrella and other snowy mountains, varying in height from 4000 to 6000 feet. Between these ranges occur the valleys of the Upper Pomahaka and Wakaia.

The principal rivers and streams of this district, are—the Clutha, by far the largest which enters the northern extremity, issuing out of a deep gorge at the south end of the Dunstan mountains; its general course is southerly, passing through another gorge between the Tapanui ranges and Lammerlaw. It divides

into two branches at Ivakatea, which unite again near its mouth, and enclose the flat, alluvial island of Inch Clutha. This river increases very little in size during its course of about 100 miles through the district, appearing to have all its principal sources among the Snowy mountains near the West coast. Its breadth varies from 100 to 200 yards, with a deep and rapid current; and its waters, though clear, have a peculiar blue tint. It is affected by the tide for several miles, but, notwithstanding, the current runs constantly outwards at its mouth. The next river in point of size is the Taieri, which rises in Lammerlaw, from whence it winds through an alluvial flat, in a north-westerly direction; into the north-eastern districts of the Province; after flowing round the north end of the Rock and Pillar mountain, and through the plain at its foot, it enters a deep, rocky ravine, from which it emerges into the Lower Taieri plain, after winding through which, and about five miles from its mouth, it receives a tributary from the Waiholo and Waipori lakes, and then entering a deep gorge in the coast hills, it finds its way to the sea. This river is affected by the tide as far as Scroggs's creek, to which it is navigable for large boats—a distance of ten miles from its mouth. Its principal tributaries in the south-eastern districts are—the Waipori, Sutton's, Lee's, and the Deep stream, by which it receives nearly all the drainage of the Lammermoors.

The Pomahaka is nearly the same size as the Taieri, being the principal tributary of the Clutha in this district. It rises in Mount Benger, one of the Umbrella Mountains, and drains the south-east face of these ranges, together with the country between them and the Tapanui hills. Its course is first southerly, the first few miles being through a deep ravine, where it is joined by several mountain streams; it then winds through a marshy plain, and, passing a gorge in a low range, enters a fine, well-wooded valley, on leaving which it is joined by the Waipahi, which drains the country about Otaraiā. The Pomahaka now bends to the east, and enters the Clutha river, after a course of 43 miles in a straight line from its head. The other streams in the districts are considerably smaller. The Tokomairiro rises by two branches in the Maungatua ranges; these run in deep gullies till they enter the plain

where they form a junction, and then flow through a gorge in the coast hills to the sea.

The Waitahuna rises among the long spurs running down from Lammerlaw, and flows generally in a south-west direction through deep gullies and over a slippery, rocky bed to the Clutha, which it enters a little below the junction of the Pomahaka. The Tuapeka rises in Lammerlaw near the heads of the Waipori, and, after passing through some pretty little valleys, falls into the Clutha at the lower end of the Scrubby Gorge. The Waiwera rises in a mossy valley behind the Kaihiku ranges, through which it passes out by a deep gorge, when it receives some smaller streams and falls into the Clutha close below the junction of the Pomahaka. The Kaihiku rises behind the range of that name, and its general course to the Clutha is parallel to the Waiwera.

The Puerua rises among the razor back ridges, behind the Kaihiku ranges, after emerging from which it receives several half-stagnant tributaries, and falls into the Clutha close to the sea. The lower part of its course is through an alluvial flat, where it is deep and sluggish, which renders it navigable for boats as far as Tanemomo bush, where is situated the landing-place for goods destined for Warepa and the interior stations. Catlin's river has two branches, the larger rises in the Forest range, near Bleak hill, runs a few miles in a deep valley, and then enters the bush. Its smaller branch rises out of the same peat bog with the Waiwera, and runs through a narrow open valley surrounded with wood. After entering the bush it appears to join the larger branch, and soon afterwards falls into the sea. At the mouth of this river is a boat harbour, where was once a native settlement. The Tautuku rises also near Bleak hill, its course seems to be entirely among dense bush, and only the upper part of its valley was seen. It falls into the bay of the same name, and at its mouth used to be a whaling station. The Waikawa is formed by the junction of several streams running in narrow, open valleys. About three or four miles below its main junction it enters the bush, through which it flows for about five miles, when it enters the sea, forming a small harbour at its mouth, where also used to be a whaling station.

The Mokoreta rises among the peat bogs near the sources of the Waipahi,

and has a general westerly course of 23 miles to the Mataura, of which it is one of the principal tributaries. It generally runs broad and shallow on a rocky bed, through some pretty valleys well supplied with wood; but the country around is still so rough and scrubby as to make travelling rather difficult. The other main tributaries of the Mataura in this district are the Wakaia and Waikaka. The former was not examined to its head, but the latter is formed of two branches, running generally in fine, alluvial, grassy flats. The remaining streams are still smaller, and require no particular notice.

The *Lakes* in these districts are the Tuakitoto, Kaitangata, Waiholā, and Waipori, situated in the valley adjacent to the coast. They are all at so low a level as to be affected by the tide; are very shallow, and are probably gradually silting up. The two first are connected, and have their outlet by the Clutha, and the other two have their outlets by the Taieri river.

The only *Swamps* deserving particular notice are the tussock swamps of the Taieri plain, which appear to be only a few feet above the sea, and so nearly on a dead level as to render improvement by drainage impossible without expensive artificial appliances. The middle of Inch Clutha is also low, flat, and swampy; but both it and the Taieri plain are said to become perceptibly drier every year.

In the southern parts of the district are numerous small patches of peat bog, seldom extending to more than 40 or 50 acres. A quantity of peats were dug and stacked this season at one of these bogs near Mr. Chalmers' station; they seemed of fair quality, and will form a cheap substitute for wood as fuel.

The *Harbours* along the coast are only adapted for small vessels, they are at the mouths of the Clutha, Taieri, and Waikawa river. The latter I have not seen, but it is said to be accessible for vessels of 200 to 300 tons. The mouth of Catlin's river has been known as a boat harbour; but, judging from a distant view, I think it may probably be found suitable for coasting craft also; there seemed to be no break of surf across the entrance. The only roadsteads hitherto used are, Molyneux and Tautuku bays, which have good holding ground, sheltered from westerly winds.

The *Geological formations* of the district appear to belong to the primary

and transition periods, except on such places as the basins of the Pomahaka and Mataura, Tokomairiro, Coal point, and some other places where sedimentary deposits of a very recent date are met with. The eastern portion, from the coast to the Manuherikia, appears to be composed almost entirely of rocks belonging to the *mica schist* systems. Towards the south-west, clay slate and altered rocks appear as at Tapanui, the lower part of the Pomahaka, and the Clutha, below the Tuapeka. South-west of the Kaihiku ranges, a hard compact sandstone is common. It appears to be a good building stone, is of a dingy brown colour, and in some places splits into good flags. It seems to have been driven up by some disturbing cause into the sharp ridges and conical hills so peculiar to this part of the country. The curious crested summits seem to have been caused by the strata breaking at the ridge. All these ridges were sharp and well-defined, are found to be almost exactly parallel to each other, ranging W.N.W. and E.S.E. nearly. The Kaihiku ranges have also this general direction, and appear to be formed of the same rock in a more altered state. Clay slate and conglomerate also occur in several places among these ranges. Fragments of granite are found on the surface and in the streams, but were not observed to crop out anywhere; no igneous rocks of any kind having been met with except the whinstone, in the neighbourhood of Dunedin. Considerable beds* of coals or lignite occur in various parts of the district. The principal deposits are found on the coast at Coal Point, and in the Pomahaka, Tokomairiro, and Tuakitoto valleys; it is said also to be found about Saddle Hill and the Mataura, and some drift pieces were picked up in the bed of the Waikaka. Pieces of gum or resin are found imbedded in this formation; also half-bitumenized wood and branches of trees. There is generally only a bed of loose conglomerate between it and the superficial deposits; in one place it was observed to rest on a bluish clay, full of impressions of bi-valve shells similar to those to be found on the present shores. This clay was incrusting with white crystals having an astringent taste like alum, so that it may probably

* Coal is now being worked at the mouth of the Clutha River, and arrangements have been made for its regular shipment to Dunedin.

be similar to the clay or shale from which the alum of commerce is derived. In another place were found oyster-shells, very little changed or decayed. The thickest beds of coal at Coal Point and the Pomahaka probably exceed 20 feet in both places, the water preventing the full thickness from being seen; this coal, however, does not extend in seams of regular thickness like the true coal, but appears to occur in patches, which thin out and disappear in a very irregular manner. One of these beds at the Pomahaka has been on fire for several years, and has been long known by the name of the Burning Plain. It was still burning away pretty briskly when we passed it this season. Traces of gold were found in the gravel of several of the streams and rivers.* The trials were all made on the very surface, at such odd times as would not interrupt the proper work of the survey, by one of the party who happened to have previously visited the Australian gold-fields. The gold found was in every case small and scaly, varying from the smallest specks to about the roughness of bran, which it seems to resemble also in the manner of its formation, by being ground about among the stones of the streams. It was found in the Clutha river above the junction of the Manuherikia, and in the Tuapeka stream, in sufficient quantities to make it probable that it would pay to work if set about in a proper manner, with some wholesale system of washing, such as sluicing. Specks were also found in the Manuherikia, Pomahaka, and Waitahuna, and it will probably be found also in some of the tributaries of the Mataura and Pomahaka. Along with the gold was found black sand—in some places fine and resembling emery, in other places coarser, and sometimes in square block crystals, which are probably oxide of tin. Limestone crops out about the Horse-shoe Bush and Tokomairi Gorge, but was not observed in any other place; it is of a grey and white colour, and hard crystalline texture. Various appearances seem to indicate that the lower lands of the district have been elevated from the sea at a comparatively recent date; slight shocks of earthquakes have been felt at intervals during the last few years.

* The best sample of gold yet brought into town was found in the Tokomairi River (south branch). This sample indicates a workable gold-field.

The principal extent of bush land in this district is found near the coast. The forest of Tautuku stretches from the mouth of the Clutha nearly to Otara Point, and covers an area of more than 500 square miles. Besides the usual timber found about Dunedin, it abounds in white birch, the bark of which has been found well adapted for tanning. There is also plenty of iron-wood, which is very hard and tough, and suitable for wheels and agricultural implements. There is a fair sprinkling of wood generally along the other parts of the coast, and the Tapanui ranges are well wooded; but it becomes extremely scarce towards the north. In some places a few patches of black birch are found in the gullies, and *manuka* scrub on the ranges; but towards the Manuherikia only a few patches of *matakaru*, and a dark, small-leaved scrub, like what grows below the junction of the Tokomairi are to be met with.

PASTURAGE.*

For the first five or six miles from the coast; the pasture is much mixed with fern, flax, *tutu*, and scrub, and a great part of it would be reckoned inferior compared with the inland parts, yet experience has shown that it is capable of sustaining a considerable number of cattle. Farther from the sea the fern begins to disappear, or is found with *tutu* only in gullies, and towards the north disappears altogether, the country being covered entirely with grasses of various kinds. The pasture generally becomes very coarse when the elevation reaches 2000 feet; here snow grass, mixed with cotton plants, prevails on the spurs, and mosses make their appearance in the gullies. On the Lammermoors, at an elevation of 3500 feet, the vegetation consists of snow grasses, spear grass, snow flowers, and several kinds of pretty veronica shrubs—moss in all the hollows, and the ground in places carpeted with lichens or similar low plants. The Upper Taieri Plain and adjoining slopes are finely grassed, but the plain itself is a little marshy. On the summit of the Roughridge, at 3800 feet, the snow grass is about equally mixed with a fine soft green grass—a kind of *poa*, which appears to be peculiar to this locality; it looks to be a nutritious grass, and gives a green appearance to

* The whole district has been applied for or taken up as runs since the date of this report.

these ranges. The Long Valley is well grassed, and the pasture continues tolerably good on the Raggedy ranges up to nearly 3000 feet altitude; this is caused probably by a drier climate. The pasture on the south side of the Manuherikia, near its mouth, is very fine, but the ground is much encumbered by rocks and stones, which however will be useful as shelter—and as wood is scarce, will be found a ready material for huts and fences. On the opposite side, and also farther to the east the grass becomes rather thin, and consists almost entirely of one species—a kind of oat grass, with a black seed. The table-land between Sutton's and the Deep Stream, and between that and Lee's Stream, has excellent pasture for sheep, also generally all the Mount Stuart ranges and the Waitahuna and lower part of the Tuapeka country. All the eastern margin of the Clutha bears good pasture, except that at present much of it is encumbered with *matakuru* scrub. This, however, is always a sign of good land, and can be completely destroyed by fire in two or three years. On the west side of the Clutha, and between it and the Kaihiku ranges, the pasture is generally good—rather ferny near the sea, and becoming somewhat sour and coarse about Popotunoa, Wairuna, and the Waipahi. It is probable, owing to the low level, that if the snow grass on these parts was burnt out at the proper season, finer grass would in a year or two take its place. The pasture about Otarua, Mokoreta, the head of Catlin's river, and the Puerua, is generally good, and on many of the hills superior, but it becomes sour and coarse in places near the Mataura, and ferny near the sea. Farther north, the pasture about the Waikaka, Pomahaka, and Mataura, is also generally good, except where the elevation is too great. In some few places, however, the flats and low spurs incline to retain wet during the winter in what are called "podge holes." The south-east slopes of the Umbrella Mountains are so steep as to be almost unavailable, and the pasture on the Tapanui ranges is much limited by bush and scrub. The frequent fires which occur in the district appear to have considerable effect in altering the character of the vegetation. In one instance, where a fire had been stopped by a creek, coarse snow grass was observed to prevail on one side, and superior pasture, consisting of brood-grass, anise, &c., on the other.

Both sides had evidently at one time been of the same quality, for the black stumps of the snow grass still remained. This fire had occurred about three years before, and in the month of March. At another creek, coarse grass and scrub were found on one side, and fine grass on the other. These are instances of the good effects of fires; but, on the other hand, a very great deal of mischief may be done by reckless and unseasonable burnings: a great part of the pasture in and around the Otago Block has been much deteriorated by this cause. The small patches of bush and *manuka* scrub are also fast dwindling away.

AGRICULTURE.

The parts of the districts adapted for agriculture are of course limited for the present by the heavy expense of land carriage; and besides good soil, access to wood and a run for cattle are required. The most of the agricultural produce of this district is raised in the Taieri and Tokomairiro plains, and the lower valley of the Clutha. The plain of the Taieri contains much excellent soil, and grows very heavy crops where the ground had been naturally covered with grass; the fern land is not so good. The Tokomairiro Plain also grows generally fair crops, but as it lies open to the north-east and south-west, it is swept by the prevailing winds, and is also subject to untimely frosts. Heavy crops are grown on the alluvial flats of the Clutha, but cattle-keeping has hitherto been the principal employment of the settlers there. Cultivation is now rapidly extending at Warepa, and the crops are generally good. The only other places suitable for farms at present might perhaps be the valleys in the Tautuku bush, about the Waikawa river, and other places, where are many pretty sites that might be fancied, having at the same time plenty good soil, wood, and water. The principal drawbacks to these localities might be in the cattle straying into the bush, but the North-east Valley and Anderson's Bay districts are as badly situated in this respect.

ROUTES.

The district generally admits of being travelled with horses in almost any direction, the principal obstacles being the Clutha river, the Snowy mountains in the north-west, and Tautuku bush on the south coast. Drays can now be taken from Dunedin to Popotunoa, from whence there is a

APPENDIX (B).

ALTITUDES ABOVE THE LEVEL OF THE SEA.

	FEET.		FEET.
Flagstaff	2190	Bleak Hill	2182
Boulder Hill	1790	Slopedown Hill	1891
Saddle Hill Peak	1565	Otarua (cairn)	1238
Do. Trigonometrical Station.	1414	Kuriwao Peak	2110
Scroggs' Hill	1160	Steel's Accommodation House (near Popotunoa	432
Stone on Rock and Pillar Mountain.	4614	Wairuna Peak	1726
Do. on Plain below	906	Landslip Hill	1091
Kaikorai Hill	1098	Conical Hill (Pomahaka)	1183
Gledknow	992	Spy Law (do.)	2222
Taiari Ferry Hill	707	Dusky Hill (do.)	2180
Tokomairiro Gorge Hill	1332	Wart Hill (do.)	2648
Tokomairiro Plain—Cargill's Barn...	66	Wendon (do.)	2840
Mount Misery	1098	Black Umbrella (do.)	3580
Maungatua	2985	White Comb (do.)	5083
Waitahuna Hill.....	2256	Mount Bengier	3652
Mount Stuart.....	1433	Obelisk	5607
Lahmerlaw	3820	Rocky Mount	6350
Soutra Hill	3415	Tapanui Summit	3350
Roughridge Peak	3879	Wakaia Hill	1345
Warepa Trigonometrical Station.....	650	Brough's Station	520
Warepa Hill	1252	Glenkenich Valley	440
Rocky Dome (Kaihiku)	1750	Burning Plain	899
Wisp Hill (Catlin's River)	2257	Anise Hill	743
Slopedown Range (cairn).....	2131		
Tautuku Hill.....	2190		

NOTE.—From the data given in the foregoing reports, the natural divisions of the surveyed districts appear to be as follows:—

Forest	1329 square miles
Pasture	12,516 "
Swamp	144 "
Barren	1309 "
Lakes.....	109 "

TOTAL

15,407 square miles.

The country adjacent to the West Coast remains unsurveyed, and is estimated to comprise 11,233 square miles; the whole area of the Province being 26,640 square miles, or, 17,049,600 acres. The unsurveyed districts have not yet been penetrated by any parties known to the writer of this, but a general idea of them may be gained from the following extract from the *New Zealand Pilot*:—
 "A view of the surrounding country from the summit of one of the mountains bordering on the coast, of from 4000 to 5000 feet elevation, is perhaps one of the most grand and magnificent spectacles it is possible to imagine, and standing on such an elevation, rising over the south side of Caswell's Sound, Cook's description of this region was forcibly called to mind. He says—'a prospect more rude and craggy is rarely to be met with, for inland appeared to be nothing but the summits of mountains of a stupendous height and consisting of rocks that are totally barren and naked, except where they are covered with snow. We could only compare the scene around us as far as the eye could reach—north to Milford Sound, south to Dusky Bay, and eastward inland for a distance of 60 miles—to a vast area of mountains, of every possible variety of shape and ruggedness. The clouds and mists floated far beneath us, and the harbour appeared no more than an insignificant stream.'"

The writer of this has viewed the eastern slopes of these ranges of mountains from Foveaux Straits as far northwards as latitude 43° 30' S.—1st, from Centre Hill, in the Waiau District. The tops of the ranges conformed to the above description of the celebrated navigator; and the lower hills, slopes, and valleys, stretching down to the mouth of the Waiau River, appeared to be covered with forest. 2nd, from Grandview Mountain, in the Upper Clutha district. Here the ranges were equally lofty and covered with snow, but the forest in a great measure had disappeared; the lower slopes and valleys being mostly covered with natural grass. 3rdly, from Benmore, in the Upper Waitaki district, from whence the loftiest ranges, of the Southern Alps, were in full view. Here, Mount Cook, 12,460 feet in altitude, in the middle of summer, was covered with snow down to the level of 6000 feet above the sea; below this level the slopes and spurs were covered with coarse grass, and the deep valleys with forest or scrub.

Nearly the whole of the unsurveyed districts have been already applied for for pastoral purposes.

J. T. THOMSON, *Chief Surveyor*.

Survey Office, Dunedin, 10th August 1859.

REPORT ON THE WATER SUPPLY OF DUNEDIN,

By J. T. THOMSON, *Civil Engineer.*

BEFORE entering on the subject of works for Dunedin, a few preliminary remarks seem called for. The sources from whence water supplies are obtained for towns are, rivers, springs, artesian wells, and surface collections. The works necessary for conveying the supplies are modified by the nature of the topography of the district, and superficial contour of the town and suburbs. Rivers generally afford the most ample supplies; springs and artesian wells seldom afford more than limited quantities, and the power of steam in this case is for the most part held in requisition to raise the water to the proper level; surface collections, on the other hand, while affording extensive supplies, are frequently available by the force of gravity unaided by steam power, and, if the area of collection be within a reasonable distance of the town, are to be preferred, as the expense of steam power, with wear and tear of machinery, together with the cost of attendance, is avoided. In determining plans for a town water supply, purity is the most important consideration. Generally speaking, the comparative purity of water may be said to stand in the following order:—1st, rain water; 2nd, water from mountain brooks; 3rd, soil drainage and water from rivers; and lastly, water from deeply-seated springs or subterranean sources. The impurities of water are four kinds: mechanical, animal, vegetable, and mineral or saline. The quality of water is of great importance for economical purposes, not to mention the health of man, especially in manufacturing towns; the action of hard water having a perceptible influence in the production of steam and effects on boilers. In breweries, bleaching-grounds, washeries, &c., much depends on the quality of water supplied.

The several purposes for which water is required in a town are—1st, ordinary domestic uses, including drinking, washing of persons, clothes, utensils, houses, yards, watering gardens, &c.; second, manufactures; third, supply of public buildings, baths, wash-houses, &c.; fourth, extinction of fires; fifth, cleansing and watering of streets and thoroughfares; sixth, supplying fountains, public gardens, and pleasure grounds.

In projecting water-works the number of the population is the datum from

whence the calculations are made as to the quantity required. The quantity varies in different towns from 30 down to 10 gallons per head per diem—towns possessing trades and manufactures having greater requirements than others. The quantities supplied by the four leading companies of London are as follows:—

East London ..	100	gals.	per	house	per	diem
New River	114	"	"	"	"	"
West Middlesex.	150	"	"	"	"	"
Chelsea	154	"	"	"	"	"

This will average 20 to 30 gallons for each individual.

The cost of water supply in London amounts to £3 per individual supplied,* and in the provincial towns of Great Britain the cost varies from the above down to fifteen shillings, according as the difficulties attending the supply are greater or smaller.

With the above preliminary remarks, I will now proceed to the subject in hand. The site of Dunedin fronting the harbour, as laid out for occupation, extends two and a half miles in length, and five furlongs in breadth, and its surface rises to an altitude of about 350 feet above the sea level. Immediately behind the town a ridge runs, whose greatest elevation—Bellevue Hill—is 700 feet, and whose lowest depressions are 404 and 378 feet, the former at Balmacuen, and the latter at Lookout Point. Rising beyond this ridge, and closing in the town site in a westerly and northerly direction, are a range of hills of the following elevations:—

Kaikorai	1096	feet
Waikari	2096	"
Cargill	2255	"
Signal	1276	"

Out of the ridge immediately behind the town several springs issue, and their waters flow through the town. The three principal of these have been gauged, and their capacity will be noted in Tables A and B hereto appended. From the higher range of hills three streams issue, namely, the North-east Valley stream, the Water of Leith or

* The expense of machinery or capital invested in the arrangements for supplying the metropolis with water—exclusive of the communication-pipes to the houses, the tenants' water-butts, tanks, &c.—amounts to about £3,310,342, or about £3 per individual supplied.—*Dempsey on Water-works.*

Waikari, and the Kaikorai, whose capacities also will be noted in Tables A and B. Table A gives the minimum supply, *i. e.*, the supply afforded by the streams in their average low state, without being impounded. Table B gives the maximum supply, *i. e.*, the supply afforded by the streams were all their waters, including flood waters, impounded and stored up in reservoirs. From these Tables it will be seen that the various streams in the town vicinity, without availing of their flood waters, will serve a population of 165,629 people; while availing of their flood waters they will serve a population of 493,515—both calculations at thirty gallons per head per diem.

Regarding the respective quality of the waters of these streams, I am not in a position to afford sufficient information, the subject requiring the aid of a chemist to properly investigate; but if we may judge from common experience, a comparative idea may be formed. All the streams come out of high ridges, and have rapid courses; their waters may therefore be expected to be little impregnated with mineral matter; but as all their gathering grounds are more or less covered with forest, except the Kaikorai, they may be expected in several degrees to be tainted with vegetable matter. The Kaikorai, issuing from the bare ridges of the Wakari and Kaikorai hills, may be judged to be the purest and best for the use of the population, and the streamlets from the town belt next to it. The minimum supply of the Kaikorai will be seen to be for 31,110, and its maximum for 95,040 individuals.

The population of Dunedin being under 2000, and probably more than half that number so scattered and detached as not to be benefitted by water supplies, it is evident that the subject must be considered from two points: first, in relation to present requirements; and second, in relation to what may be required in the future. On the latter point it would appear irrelevant to aim at approximate numbers, or supposed times, so much of our increase and prosperity depending on extraneous causes not to be controlled. Considering therefore that the streamlets issuing from the town belt afford at minimum a supply for upwards of 5000 individuals, and at maximum for upwards of 18,000, at 30 gallons per head per diem—a rate doubly ample for a town such as this without manu-

factures—it would be from these streamlets close at hand, and distributed equally in the town, that we may derive at least expense, and for many years to come, most abundantly all requisite supply.

Regarding these streamlets, it will be proper to remark that in their course they do not present favourable basins for the formation of impounding and settling reservoirs. Considering the above circumstance, also that their basins lead into populous, or what will be populous, parts of the town, it would not be expedient to embank up waters so immediately overhanging the same—dangerous, if accident occur, to population and property. All that I would recommend, therefore, would be works at a high level for preserving the streamlets in their average low state, and, connected with these, main pipes, public stand pipes, &c. With the above views, we will be justified in concluding that works applied to one of these streamlets will suffice for the present, and that the three will serve the town till it contains a population of 10,000; after which, the waters of the Kaikorai or Water of Leith might be availed of—due consideration of which will no doubt be given by the Engineer at that future time.

Presuming that all that is now necessary to furnish is such general information as to enable Government to consider the course to be adopted, I will at this time do no more than indicate the position and extent of the works, together with approximate estimates of cost, leaving the particular works that may be ordered for more detailed consideration hereafter.

On reference to the accompanying plan,* the positions of the service reservoirs *a b c* will be noted in the vicinity of London, Maclaggan, and Regent Streets, from whence the main pipes lead to the principal streets of the town. The course that I would respectfully recommend would be to construct works at *a b c* respectively, as required by the population. In the course of years, when the population has greatly increased, works in like manner could be constructed at A, B, and C, on the larger streams. The elevation of the service reservoirs at *a, b, and c*, need not exceed 150 to 200 feet, but on the larger an elevation of 500 feet should be adopted;

* The plans were attached to the manuscript, but cannot be given here.

the former would give sufficient pressure by gravitation for the lower and populated parts of the town, while the latter would do equal service to the higher.

The cost of the works at *a, b, c*, may be estimated at *thirty* shillings per head of population to be served; and those at *A, B, C*, when the population to be served exceeds 10,000, at *forty* shillings. A much higher estimate would require to be given in the latter works for a smaller population. Thus, were it thought desirable to provide

for the present population from the town belt streamlets, only estimated at 1000 individuals, the cost would be £1500; for 2000 individuals £3000, and so forth. Prior to works being undertaken, however, it would be necessary to prepare detailed plans and more minute estimates and specifications; but it is to be hoped that the present report will suffice for initiating measures.

J. T. THOMSON, C. E.

Civil Engineer's Office,
23rd June 1859.

TABLE A.

Table showing Minimum Water supply of Dunedin from various sources, the data being obtained by gauging the Streams in their average unflooded state.

NAME OF STREAM.	Width of Weir.	Level of Water above Sill.	Supply per Minute.	Supply per diem in gallons.	Population supplied at 30 gals. per head per diem.
Maclaggan Street Streamlet ..	4 inches	1 $\frac{1}{2}$ inches	2.59 cube ft.	23.042	774
London Street do.	4 "	2 "	7.31 "	65.599	2.186
Regent Road do.	4 "	2 "	7.81 "	69.997	2.333
North-east Valley Stream	3 feet	3 "	94.80 "	843.556	28.118
Water of Leith do.	4 "	6 $\frac{1}{2}$ "	338.24 "	3.033.238	101.108
Kaikorai do.	3 "	3 "	104.79 "	933.304	31.110
Totals	4.968.936	165.629

TABLE B.

Table showing the Maximum supply of Water from various Streams near Dunedin, the data being area of surface drained and annual rainfall.

NAME.	Discharge per acre per diem, rainfall being 24 in. per Annum.	Area of Valley.	Discharge per diem, loss from absorption and evaporation being deducted.	Population supplied at 30 gals. per head per diem.
Maclaggan Street Streamlet ..	} 1485 gallons	100 acres	148.500	4.950
London Street do.		150 "	222.750	7.425
Regent Road do.		120 "	178.200	5.940
North-east Valley Stream		2240 "	3.326.400	110.880
Water of Leith do.		5440 "	8.078.400	269.280
Kaikorai do.		1920 "	2.851.200	95.040
Totals	14.805.450 gallons.	493.515

ROAD WORKS.

REPORT OF THE CIVIL ENGINEER TO HIS HONOR THE SUPERINTENDENT.

SIR,—I do myself the honour of reporting on the progress of Road Works during this last season, in order that your Honor may have early information of what has been done, with the view of considering the measures for the coming season.

At this time, works beyond the neighbourhood are in abeyance, owing to the inclemency of the weather and the softness of the ground preventing labour of any kind being beneficially employed. This state of matters exists till the middle of September, at which time it would be desirable that I be put in possession of your Honor's instructions as to the various works of the coming season.

It takes some time to organize parties and forward them to their various stations; so when this can only be effected late in the summer months, as was the case last year, the road parties are overtaken by the coming winter, when their works must be abandoned unfinished.

This has been much the rule this last season in regard to roads in all directions, from which not only much public inconvenience has been felt, but much of the labour of our road parties has been laid out to disadvantage.

The accompanying abstract of expenditure will show a total vote for Roads of £20,050, of which £6986 8s. 4d. only has been expended. The separate items I will notice in order.

1st, *Metalled Road to Saddle Hill.*—This road has been completed only for a distance of two miles from the Jetty, its further progress being impeded owing to the want of labour.

2nd, *Metalled Road at Invercargill.*—This road (combined with 19th) has had a party of men sent specially for its construction. The distance completed from the landing is $1\frac{1}{2}$ miles gravelled, and about 3 miles formed.

3rd, *Dray Track from Dunedin to Invercargill.*—This track was to be done in settled districts by contracts—beyond by hired parties. Three parties of four men each were at once forwarded to their stations, and have completed the most essential portions of the communication by cutting side-ways, and bridging gulleys and creeks. In settled districts, the works were delayed till February, in order that opportunity might be given to settlers to contract

for the same. On this being found unattainable at reasonable rates, hired parties were engaged and maintained as long as they would remain by the works. The lateness of the season and scarcity of labour combined to dissipate these parties, so that the necessary works were abandoned by them without completion. This subject has already been specially reported on.

4th, *Metalled Road to Town Belt.*—This road is combined with the 17th, for both of which £3500 was voted, and £2889 14s. 2d. has been expended. With the exception of a short distance near the Water of Leith, the whole has been completed, the scarcity of labour preventing the completion.

5th, *Metalled Horse Track from North-east Valley to Port Chalmers.*—This line required survey and purchase of lands before expenditure could take place, as it mostly runs through private property. Plans and estimates are now laid before the Government.

6th, *Town Belt to Head of North-east Valley.*—This road has been extended three miles from the Jetty, with one break left uncompleted from the want of labour.

7th, *Metalled Horse Track from North-east Valley to Blueskin.*—This line was subjected to survey, but has not yet been commenced.

8th, *Horse Track to Oamaru.*—Several hired parties have been engaged on this track, principally at Waikouaiti in carrying out arrangements with Mr. Jones, who consented to the intersection of his property by the road.

9th, *Invercargill and Riverton Horse Track.*—Two parties are now engaged in forming this track.

10th, *Invercargill and Campbelltown Horse Track.*—This has been found to proceed over very difficult, swampy country. Its partial construction across the Mokomok Neck has been sanctioned, but not commenced with for want of labour. With expected arrivals of immigrants, it is intended to forward a party for this line.

11th, *Abbott's Creek to North Taieri*—Dray Track.—This line required to be surveyed and purchased from landholders before any expenditure could take place. The purchases have not yet been completed.

12th, 13th, and 14th, *Pastoral Roads.*—No expenditure has taken place. As to this subject, I would desire to

state that these kinds of roads could be lined out and made good to far greater advantage by the flockowners interested in the same: they proceed through country only properly known to themselves. The roads are more extensive than could be overtaken by the Road Inspector, who could not spare that time and attention necessary for them without neglecting the more important roads in the settled districts. The stockowners and their men being on the spot, possess the advantages that no central directing power could pretend to have.

15th, *Branch Road—Anderson's Bay to Portobello.*—This road has been lined out but not yet surveyed. As it goes through private property for a considerable distance, no expenditure has taken place, as the right of way is not purchased. On the completion of the survey the same will be put into the hands of the Road Claims Commissioner.

16th, *Branch Road—Dunedin to Halfway Bush.*—Parties have been engaged in opening up this road since orders were received for the same.

17th, *Main Town Streets—Dunedin.*—Already noticed.

18th, *Main Town Streets—Port Chalmers.*—Plans and estimates have been formed preparatory to calling for tenders.

19th, *Main Town Streets—Invercargill.*—Already noticed.

Having, I trust, sufficiently explained what has been done towards carrying out the orders of the Government for last season, I will now proceed to solicit your Honor's notice to the works of the coming one. It will be quite evident to your Honor that much latitude is given to the term *main road*,* on which alone, I presume, will the Government spend the resources of the Province. At this period it would seem desirable to seek out a principle which might be consistently adhered to, in order to apply the Provincial funds in

* I would suggest the term to be altered to *provincial road*, as being more appropriate. The sense in which the settlers take *main road* would call for a vote of a main road to every man's back door. Thus, the settlers of the Taieri plain have had three *main roads* declared in their district, running parallel at distances of $1\frac{1}{2}$ miles apart. Were this approved of by Government, the more distant districts, from whence the land revenue is principally derived, must remain neglected. A general project for provincial roads may be inspected at the Survey Office.

such a manner as will be most conducive to the general benefit of the Province. To arrive at a perception of the general wants for improved communication, it will be necessary to examine the map of the Province, find out the important districts, and mark their towns, villages, harbours, and landing-places, and for these design a system of main lines irrespective of local interests. Thus, proceeding south from the capital, we have the Taieri, Tokomairiro, Clutha, Mataura, Waiopai, Bluff, and Jacob's River districts, all of them important. A main road through these districts would connect Dunedin, Taieri, Clutha ferry, Popotunoa, Tutarau, Invercargill, Riverton, and Campbelltown, the foci of communication in these districts. Proceeding north from the capital we have Port Chalmers, Shag River, Moeraki, and Waitaki districts, in which are the harbour of Port Chalmers, and the landing-places of Waikouaiti, Moeraki, and Oamaru. A main road to and through these districts would connect Dunedin, Port Chalmers, Waikouaiti, Moeraki, and Oamaru, the foci of communication to the above districts. Again, proceeding into the heart of the Province from the capital, we have Maniatoto, Manuherikia, and Upper Clutha Plains, all important interior districts. A main road through these districts would connect Dunedin with the principal wool-growing districts in the meantime, and pave the way to settling towns and villages on their most commanding points. Lastly, proceeding into the heart of the Province from Invercargill, we have the Makerewa, Oreti, and Upper Mataura Plains, all important interior districts, and which would be connected with the last main line by the waters of the Wakatip Lake, on whose shores an interior town ere long will be founded, owing to its commanding central position.

As population progresses, these main lines, I have no doubt, may be further extended and modified; but in the meantime I trust it will appear that they have been drawn so as to intersect the greatest quantity of available land, and to connect the most important foci of traffic, thus fulfilling conditions necessary to general development of the resources of the Province, whether agricultural or pastoral.

Under the above impressions I would respectfully propose the following Road works for this coming season, in con-

tinuation of what has been already accomplished:—

DUNEDIN TO INVERCARGILL—	
Metalled Road to Taieri Plain, 7 miles, at £800	£5600
Do. from Invercargill to Waiopai Plains, 4 miles, at £500	2000
Dray Track from Taieri to Waiopai, about 140 miles	1500
DUNEDIN TO PORT CHALMERS—	
Metalled Road to Head of North-East Valley, 1½ miles, at £700 ...	1050
DUNEDIN TO PORT CHALMERS—	
Metalled Road in Port Chalmers, ½ mile	300
North-east Valley to Port Chalmers—Metalled Horse Track, 6 miles, at £300.....	1800
DUNEDIN TO OAMARU—	
Metalled Horse Track through 3 miles bush to Blueskin, at £300 per mile	900
Dray Track to Oamaru	500
DUNEDIN TO INTERIOR DISTRICTS—	
Dray Track from Kaikorai Mill to Upper Taieri Ferry, about 10 miles	1000
INVERCARGILL TO RIVERTON—	
Horse Track to New River Ferry, 7 miles	500
INVERCARGILL TO CAMPBELLTOWN—	
Metalled Horse Track over Mokomok, about 1½ miles	500
INVERCARGILL TO INTERIOR DISTRICTS—	
Horse Track to Ryal Bush, about 10 miles	500
	<u>£16,150</u>

If it be found desirable to contract for any of these works, it would be advisable to call for tenders as early as possible, for, in case no available tenders be offered, the works would then require to be undertaken with hired parties before the summer season be at all advanced, to avoid their non-completion. I may suggest that contracts can only be advantageously given out for properly formed and metalled roads. In dray or horse tracks such latitude may be taken in the execution that neither specification nor supervision can be extended over the same; thus I think it preferable to carry out all tracks by hired parties, furnished with tents, tools, and other equipments. Into these parties settlers along the line can be amalgamated if such offer themselves.

In conclusion I would solicit your Honor's favourable consideration of Mr. Oliver's services. The country roads are so spread over the Province that he requires to be almost constantly on horseback. His salary of £225 is not adequate to the fatigue and extra expenses he incurs from constant absences in travelling. I therefore trust that some addition may be made to it this year.

I have the honour to be, Sir,
Your most obedient servant,
J. T. THOMSON, C. E.

Civil Engineer's Office,
1st August 1859.

ABSTRACT OF EXPENDITURE ON THE MAIN ROADS OF THE PROVINCE OF OTAGO,
For the Season ending 30th June 1859.

DESIGNATION OF ROAD.	SUM VOTED BY COUNCIL.			SUM EXPENDED.		
	£	s.	d.	£	s.	d.
DUNEDIN TO INVERCARGILL.						
1. Metalled Road to Saddle Hill	5700	0	0	1292	3	3
2. Metalled Road at Invercargill	1200	0	0	957	9	3
3. Dray Track from Dunedin to Invercargill	2000	0	0	1002	10	5
DUNEDIN TO PORT CHALMERS.						
4. Metalled Road to Town Belt.....	1500	0	0	889	14	2
5. Metalled Horse Track from North-east Valley to Port Chalmers	900	0	0	0	0	0
6. Town Belt to Head of North-east Valley	1000	0	0	407	5	7
DUNEDIN TO OAMARU.						
7. Metalled Horse Track from North-east Valley to Blueskin Bay	400	0	0	0	0	0
8. Horse Track to Oamaru.....	500	0	0	216	15	4
INVERCARGILL TO RIVERTON.						
9. Horse Track	1000	0	0	34	3	8
INVERCARGILL TO CAMPBELLTOWN.						
10. Horse Track.....	500	0	0	44	6	2
Carry forward,.....	14,700	0	0	4,844	7	10

ABSTRACT OF EXPENDITURE ON MAIN ROADS—*continued.*

DESIGNATION OF ROAD,	SUM VOTED BY COUNCIL.			SUM EXPENDED.		
	£	s.	d.	£	s.	d.
Brought forward,.....	14,700	0	0	4844	7	10
ABBOT'S CREEK TO NORTH TAIERI.						
11. Dray Track	1000	0	0	0	0	0
PASTORAL ROADS,						
12. Oamaru to Upper Waitaki.....	333	6	8	0	0	0
13. Waikouaiti to Manuherikia	333	6	8	0	0	0
14. Invercargill to Upper Mataura	333	6	8	0	0	0
BRANCH ROADS.						
15. Anderson's Bay to Portobello	250	0	0	0	0	0
16. Dunedin to Half-way Bush	500	0	0	141	10	6
MAIN TOWN STREETS.						
17. Dunedin	2000	0	0	2000	0	0
18. Port Chalmers.....	300	0	0	0	0	0
19. Invercargill	300	0	0	0	0	0
	20050	0	0	6986	8	4

J. T. THOMSON, C. E.

PUBLIC WORKS.

REPORT OF THE CIVIL ENGINEER TO HIS HONOR THE SUPERINTENDENT.

SIR—I have the honour of reporting on the progress of Public Works during the last season, 1858-9, in order that your Honor may be put in early possession of what has been done, with the view to consider the works for this coming season.

On reference to the enclosed Abstract of Expenditure, the total sums voted will be seen to be £13,212, and the total sum expended up to date, £2396 15s. The items I will notice in order.

1st, Council Hall and Court House.—Contracts have been entered into for the completion of this work.

2nd, Gaol, Dunedin.—Plans and specifications have been before the Government. The expenditure of £170 relates to cost of enlarging the present temporary gaol.

3rd, Gaol and Lock-up, Invercargill.—This work has been completed according to contract.

4th, Public Offices, Invercargill.—This work has been completed according to contract.

5th, Land Office, Invercargill.—No orders have yet been received for the execution of this work.

6th, Mataura Bridge.—This work, in a remote district, and over a large, rapid, and dangerous river, was completed most satisfactorily by the con-

tractors, Messrs. Kay and Nicol. The extra expenditure over the original contract was caused by the addition of length found necessary for the convenience of the traffic, and the application of iron fastenings found advisable as a security against floods of more than usual height.

7th, Mataura Bridge House.—This has been completed according to contract.

8th, Buoying and Improving Navigation of Clutha River.—These works are in progress. Their execution was detained till the low state of the river allowed of survey.

9th, Buoying and Improving Navigation of Taieri River.—This has been surveyed and reported on, but no orders yet received.

10th, Improvements at the North.—The sum voted was expended on a store at the landing-place.

11th, Working Coal-fields.—Regarding this subject I may mention that I reported on the 17th December last that 115 tons were extracted and laid on the banks of the Clutha River ready for shipment.

12th, Buoying New River.—Two buoys were sent, and others are now in preparation.

13th, Removing Bar of Pooni Creek

—Contracts were called for, but were held in abeyance, as a pier is considered of more utility for facilitating landing and departure from the Southern districts.

14th, Jetty at Port Chalmers.—This work has been contracted for.

15th, Works not provided for above. The note appended to the Abstract detail these.

As public works are so various, and connected with so many departments of whose wants I am not in a position to judge, I would suggest that heads of departments be called upon to make known their various requirements; in the meantime I can only offer with diffidence the following works that have occurred to me as being consistent with the present progress of the colony, and worthy of attention:—

COAST.

Light-house, with 2nd class dioptric fixed light, for Dog Island, Foveaux Straits.

HARBOURS.

Light-house, with 3rd class dioptric fixed light, for entrance of Otago Harbour; house for Pilot at New River Harbour; buoying Otago, New River, and Clutha.

LANDINGS.

Piers or Jetties at Dunedin, Port Chalmers, Invercargill, Oamaru, Moeraki, Waikouaiti, Taieri, Clutha, Bluff, and Jacob's River.

FERRIES.

Additions to Clutha and Mataura Ferry Houses.

PUBLIC DEPARTMENTS.

Additions to Provincial Government Offices, Dunedin; New Jail, Dunedin; Land Office, Invercargill; Districts Survey Offices, Tokomairiro, Waiopai, and Waikouaiti.

I have the honour to be, Sir,

Your most obedient Servant,

J. T. THOMSON, C. E.

Civil Engineer's Office,
Dunedin, August 2nd 1859.

ABSTRACT OF EXPENDITURE ON PUBLIC WORKS IN THE PROVINCE OF OTAGO, For the Year ending 30th June 1859.

DESIGNATION OF WORK.	SUM VOTED BY COUNCIL.			SUM EXPENDED.		
	£	s.	d.	£	s.	d.
1. Council Hall and Court House.....	3500	0	0	9	10	5
2. Jail, Dunedin	5000	0	0	170	0	0
3. Jail and Lock-up, Invercargill—balance by contract, &c.....	137	0	0	22	12	0
4. Public Offices, Invercargill	380	0	0	381	0	0
5. Land Office, Invercargill	200	0	0	0	0	0
6. Mataura Bridge	260	0	0	338	5	0
7. Ferry House	245	0	0	185	0	0
8. Buoying and Improving Navigation of Clutha River	300	0	0	172	18	5
9. Buoying and Improving Navigation of Taieri River	550	0	0	0	0	0
10. Improvements at the North	250	0	0	300	0	0
11. Working Coal Fields	500	0	0	363	11	5
12. Buoying New River	150	0	0	15	18	11
13. Removing Bar of Pooni Creek	100	0	0	0	0	0
14. Jetty at Port Chalmers	500	0	0	0	0	0
15. Works not provided for above	1000	0	0	*337	18	10
* Hospital Repairs, £12 1s. 2d.; Addition to Land Office, £68 13s. 2d.; Old Barracks, £20 11s. 8d.; Road Office, £6 4s. 4d.; Treasurer and Solicitor's Office, 18s.; Store-room, £21 3s.; Provincial Council Fittings, £28 12s. 9d.; Enclosing Old Cemetery, Dunedin, £88 19s. 2d.; Contingencies, Sundries, £90 15s. 6d.						
TOTALS	13212	0	0	2396	15	0

J. T. THOMSON, C. E.

Civil Engineer's Office, Dunedin, 2nd August 1859.

ESTIMATE FOR ROADS AND PUBLIC WORKS.

To His Honor Captain CARGILL, Superintendent of Otago.

SIR—I have the honour to acknowledge the receipt of your letter dated 6th instant, and in compliance with the instructions contained therein, beg to forward the accompanying estimate for Roads and Public Works, amounting to £40,000, all bearing on the general interests of the Province.

Those of immediate importance I have marked with an asterisk (*); those unmarked might remain over for some time.

As the Clutha cannot now be made a place of regular call by the steamer,

it appears to me that the connection of the Tokomairiro District with the Clutha navigation becomes of little importance. The works on the Kaitangata Lake which I had brought to your Honor's notice, need not therefore be carried out.

The survey of the mud flats of Otago Harbour will be duly attended to.

I have the honour to be, Sir,
Your most obedient Servant,

J. T. THOMSON, C. E.

Dunedin, August 9, 1859.

PRELIMINARY ESTIMATE FOR ROADS AND PUBLIC WORKS, FOR THE SEASON 1859-60.

ROADS.						
	£	s.	d.	£	s.	d.
DUNEDIN TO INVERCARGILL—						
* Metalled Road to Taieri Plain.....	5600	0	0			
* Do. from Invercargill to Waiopai Plain ...	2000	0	0			
* Dray Track from Taieri to Tokomairiro	1400	0	0			
Do. from Tokomairiro to Waiopai	600	0	0			
DUNEDIN TO PORT CHALMERS—						
* Metalled Road to Head of North-east Valley	1050	0	0			
* Do. in Port Chalmers	300	0	0			
Metalled Horse Track from North-east Valley to Port Chalmers	1800	0	0			
DUNEDIN TO OAMARU—						
* Metalled Horse Track to Blueskin Bay	900	0	0			
* Dray Track to Oamaru.....	500	0	0			
DUNEDIN TO INTERIOR DISTRICTS—						
* Dray Track from Kaikorai Mill to Upper Taieri Ferry	1000	0	0			
INVERCARGILL TO RIVERBTON—						
* Horse Track to New River Ferry	500	0	0			
INVERCARGILL TO CAMPBELLTOWN—						
* Metalled Horse Track over Mokomok	500	0	0			
INVERCARGILL TO INTERIOR DISTRICTS—						
* Horse Track to Ryal Bush	500	0	0			
* Main Streets, Invercargill	500	0	0			
				17,150	0	0
PUBLIC WORKS. -						
* Court House and Council Hall	3000	0	0			
* Jail	5000	0	0			
Light-house, Dog Island	4000	0	0			
* Do., Otago Harbour	200	0	0			
* Jetty, Dunedin	1500	0	0			
* Do., Port Chalmers	800	0	0			
* Do., Invercargill	1000	0	0			
Do., Oamaru	3000	0	0			
Do., Moeraki	200	0	0			
Do., Waikouaiti, South Heads	500	0	0			
Do., Taieri Ferry	200	0	0			
Do., Clutha	200	0	0			
Do., Bluff.....	600	0	0			
Do., Jacob's River	600	0	0			
* Clutha Ferry House and Punt.....	300	0	0			
* Mataura do. do.....	200	0	0			
* Provincial Government Offices, Dunedin	400	0	0			
* Do. do., Invercargill.....	300	0	0			
District Survey Offices.....	300	0	0			
				22,300	0	0
PILOTAGE.						
* Pilotage Works, Otago.....	200	0	0			
* Do., New River	300	0	0			
* Do., Clutha	50	0	0	550	0	0
TOTAL.....				40,000	0	0

J. T. THOMSON, C.E.

SURVEY REPORT.

Survey Office,
Dunedin, 20th July 1859.

SIR—I have the honour to report, for the information of the Waste Land Board, the results of last year's Survey operations, and would solicit the attention of the Board to them and other matters affecting the Survey.

On reference to the accompanying Return, it will appear that 156 square miles have been triangulated, 122½ miles of road have been lined out and surveyed, 70,870 acres have been marked on the ground and surveyed, and 1594 town allotments have been laid out. The total cost of the above service, as will be noted, amounts to £2965 6s. 1d.

Regarding Mr. Garvie's services, I beg leave to state that they were principally directed to surveying and marking main lines of road through the Otago Hundreds, a pressing necessity having arisen for the same owing to the original contract surveys executed at the foundation of the colony not having embraced these important operations. Nine miles of heavy bush have been cut through, and ten miles of side cutting on open land were marked on the ground by a rut with the spade; further, 16 miles of bush lines have been cut, but whose survey has not yet been overtaken. Included in these services are the main lines over Hillside, altitude 90 feet, and Look-out Point, altitude 370 feet, being part of the main southern road; and the main lines over Mihiwaka, altitude 1100 feet, and Signal Hill ranges, altitude 1000 feet, being part of the main northern roads. These lines have been marked to a gradient of 1 in 16, which will admit of carriage traffic on the lines being formed and metalled. These surveys have involved much labour and exposure, and I have no doubt will prove of great public benefit.

Mr. Gillies' services have principally been directed to the triangulation and section survey of New River Hundred; also to the survey of part of the 2000-acre blocks. It becomes me to particularly notice these surveys, which have all been executed with a 4-inch Everest Theodolite. In the triangulation, each bearing was the mean of nine readings, and the accuracy of the work will be seen by the following:—

NEW RIVER TRIANGLES.

The average error in each angle is 4½ seconds
 „ greatest on an angle 13 „
 „ least do. 0½ „

2000-ACRE TRIANGLES.

The average error in each angle is 4 seconds
 „ greatest error on an angle is 11 „
 „ least error on an angle is 0 „

The base lines were measured on level ground by a standard chain, carefully adjusted, each base line being the mean of three measurements. The greatest difference in any of these measurements amounted to no more than 0.88 of a link per mile, and the least no more than 0.14 of a link per mile, the average being 0.51 of a link per mile. Thus it will appear that Mr. Gillies' minor triangulation on the whole involves only an error of 15-100ths of a foot per mile in bearing, and 33-100ths of a foot in distance, an accuracy ten-fold greater than the chain measurements which follow, and which the triangulation is intended to check.

The chain measurements conducted for the survey and marking off of the sections have been found to close with the calculated measurements of the triangulation by which the former are checked, by 3 to 6 links in the mile, as the ground was favourable or unfavourable. This amount of error proves careful measurement, and is as close as can be attainable on such ground as we have in this part of New Zealand.

Mr. Briscoe's party was employed in laying out two villages (Moeraki and Oamaru), and in surveying and marking on the ground the main southern road between the Taieri and Popotunoa. 57½ miles are reported as completed, but only 28 miles have been given in available for record.

Regarding the services of Mr. Hately, I beg leave to report, that he joined the staff in the latter end of October as a sub-assistant only, not having had experience as a surveyor previously. His first operations were under the eye of Mr. Gillies. This officer, besides having done a fair amount of survey, has executed the same satisfactorily, as shown by his closing with the points of Mr. Gillies' triangulation. His greatest error is 9 links to a mile, and least 1½ links, the average being 3 to 4 links.

The cost of the public surveys of the year prior to this was found to be 7½d. per acre, including the cost of triangulation. This year the cost may be arrived at by analyzing Messrs. Gillies and Hately's operations, the times being given to effect the same.

MR. GILLIES.

128 square miles triangulation,	12 weeks, £365 16 0
or £2 17s. per square mile.	
7 lineal miles road survey,	1 week, 30 9 6
or £4 7s. per lineal mile.	
47,975 acres, 2000-acre sections,	9 weeks, 274 7 0
or 1½d. per acre.	
6500 acres, 80-acre sections,	6 weeks, 182 18 0
or 6¾d. per acre.	
100 quarter-acre sections, 1 week,	30 9 6
or 6s. 1d. per section.	
	29 weeks, £884 0 0

MR. HATELY.

13,365 acres, 80-acre sections,	16 weeks, £323 13 10
or 6d. per acre.	
1220 quarter-acre sections,	10 weeks, 202 6 2
or 3s. 4d. per section.	
	26 weeks, £526 0 0

The above includes the expense of going and coming from and to head quarters, and mapping. These surveys embrace 1st, selection of town, village, and ferry sites; 2nd, the laying down of permanent roads and reservation of present available tracks; 3rd, bush and timber reserves; and lastly, division of districts systematically into sections allotted so as best to provide for general occupation.

Having thus reported on the Government surveys of last season, it becomes me to report on the surveys given in by private surveyors for record in the public maps. Prior to this so little had been done that these did not call for report to the Board: now, these surveys so generally affect the Crown lands that they become a matter of serious public concern.

There are three authorized private surveyors practising, and during last year 2652 acres of survey have been given in for record. Small as this extent is, as compared with the labours of the Government surveyors, they penetrate into every district, "spotting" the whole irregularly. The practice in this species of survey is for the applicant for Crown lands to employ a surveyor at his own expense, who goes out and marks off the required land. These choices are as various as the members of the population, and being out of the surveyed districts, have no supervision either in the Land or Survey Departments. Thus, as they progress, it early becomes apparent that

public interests are not attended to, but simply the interests of the applicant.

1st, Town, village, and ferry sites are absorbed; 2nd, Permanent roads and available tracks are closed; 3rd, Bush and timber are monopolized; and lastly, the district is not laid off for the purposes of general occupation, but in a manner that solely suits the applicant. A glance at the record maps is only required to prove these assertions.

The method of survey is obsolete, and not permitted in approved practice, the surveys being "built" on each other, or connected with each other by a string of lines and angles. The method admits of no check, and is pregnant with errors: these remain on the maps undisclosed till an independent survey joins them; thus at best the recording of these surveys requires "humouring." A chain of overlapping is a frequent error, and at this early stage of the labours of the private surveyors, one allotment has been found three chains out in a 16-acre section, and another 16 chains misplaced in a 46-acre section. Few of these surveys have yet stood the test of "closing" with subsequent surveys; the difficulties may thus be said only to be coming to light.

With errors so great in magnitude, it may be quite possible for parties to build their houses on the lands sold to their neighbours, in which case it will be a question of law as to whether the Government or the private individual will have to stand the consequences.

Apart from the incorrectness attached to the unsystematic and obsolete methods employed in private survey, the cost at present and in future is a subject to be enquired into. The applicant is allowed 10 per cent. deduction for his survey expenses, or 1s. per acre: this will be seen to be only double the cost of the Government surveys, but it is nominally so. Scattered as these small patches of surveys are in every district, in the progress of the Government surveys over them, all, as a measure preliminary to systematic division of the country, will require to be re-surveyed. It is well known to the profession, that re-survey of obliterated boundaries costs double of an original one: thus the saving of the survey expenses to the public by private survey is imaginary. Private survey entails on the Government not only future double cost of survey, but the loss of village, road, and bush reserves, or the

cost of re-purchase of the same; further, from what has transpired since I took charge of the Survey Department, I cannot conceal the result that the two systems of survey cannot go on together—one must give way to the other. The same district cannot be irregularly and incorrectly “spotted” over and be systematically surveyed and marked out at the same time, and the more confusion thus created, the greater will be the burden on the Government to unravel the same; and it will be found at an early date that the complication of titles and disputes in boundaries will demand that the burden of systematic survey be borne by the public, the cost of which will be fivefold more than it could be executed now, unhampered by disputed boundaries and uncertain titles. Again, the Government survey service, under present circumstances, will not maintain itself. I cannot avoid concluding that it must go to the wall, when I note that of the six competent surveyors in the Province, five owe their knowledge of the profession to experience gained in the Government Survey service within these last three years, yet they cannot be retained in the service; the greater profits and independence of the private practice have greater inducements than the Government service affords.

I trust that it will be apparent to the Board, from the above statement, that on grounds of accuracy, expense, and reservation of public rights, the Government Survey Department has the best claim to their support; and it only now remains with me to show that policy and expediency are equally in its favour for the future.

There is an area of 17,000,000 of acres in the Province, 10,000,000 of which, in course of time, will be applied for and occupied. The question appears to me to be—How will the survey of this area be best met, by public or private survey? Seeing that they cannot go on together, and when we refer to the accompanying return, and note that two Government surveyors laid off upwards of 67,000 acres last year, while the three private surveyors returned less than 3000 acres, the conclusion need not be suggested. So much for the Province in its future requirements. Then as to present: the applications being confined to the Hundreds, these comprise an area of 908,000 acres. Of these, 260,000 acres have been surveyed, leaving 648,000

acres. Of these, 200,000 acres may be estimated as unavailable for agricultural settlement; 448,000 acres thus remain to be surveyed.

Then is it expedient for the general public to have these surveyed by private survey with the concomitant evils, disjointly and confusedly in the space of half a century, or get the whole completed correctly and systematically in one-twentieth of that time by Government officers? True, the Government service will not comply with the immediate and urgent wants of the solitary village and bush reserve absorbing “spotter,” but it will rapidly overtake the settling of the multitude of the *bona fide* occupiers and improvers of the soil who congregate in the best districts.

If five assistant surveyors be judiciously directed, applying their energies to the most valuable and most available districts first, they would put our increasing population in possession of the whole in less than three years—the remaining 200,000 acres of the Otago Block in one season, and the 280,000 acres in the Southern Block, in two seasons.

The only objection to systematic survey that has been suggested is, that it does not put the solitary erratic or wandering “spotter” in possession of his claim at once, but defers the marking out of it till the general public is served, and thus injures present revenue to this solitary extent; but can this be stated to be an objection, seeing that the “spotter” absorbs village sites, blocks up roads, and monopolizes bush: immediate possession to him of these can evidently be of no public advantage; and I may suggest that a far greater and more certain revenue would be derived from lands well selected, and made ready for the occupation of the multitude, than can possibly be derived from the “spotter.”

Having thus endeavoured to lay before the Board the present circumstances that affect the survey of this Province, I will await their decision on the course to be adopted by them before laying any plan of survey operations before them for the coming season. Before concluding, I may mention that contract survey has been under consideration. The Province has already had experience of this system. The same objections exist against contract survey as against unsystematic private surveys; besides, for triangulation, village and

road reserving (the most important operations to the public), where much judgment is required, and a great deal of trouble involved, the services of an officer in the Government interest are absolutely necessary.

I therefore most earnestly recommend that the Board continue all future surveys by Government officers, whereby they will be able to give them continuous service, maintain them in comfort and respectability; and in return for this I feel assured that they will do most important benefits to the colony by promoting rapid and sure settlement of land claims.

What I have advanced against private survey, I only apply to the system—not the persons. I simply regret

that such competent and efficient surveyors should be employed to so little public benefit, and I would be glad if the Government could offer them such terms as would induce them to enter the public service and assist with their skill and energy the extension of a systematic survey conducted on proper principles, and thus promote an object so much to be desired—the settlement of immigrants in their properties, secure in their road and timber reserves, and untrammelled with disputed claims and expensive law-suits."

I have the honour to be, &c.,

J. T. THOMSON,
Chief Surveyor.

W. H. Cutten, Esq.,
Chief Commissioner.

RETURN OF FIELD WORK OF THE SURVEY DEPARTMENT OF OTAGO,
For the Year 1858-9, ending the 30th day of June 1859.

Surveyors' Names.	Reconnaissance Survey.	Triangulation.	Road Survey.	Rural Section Survey.	Town Section Survey.	Cost.
	Square Miles.	Square Miles.	Lineal Miles.	Acres.	No. of $\frac{1}{4}$ -Acre Sections.	
Alex. Garvie	...	28	58	...	44	£950 13 7
Robt. Gillies	...	128	7 $\frac{1}{2}$	54,475	110	884 10 0
E. V. Briscoe	57 $\frac{1}{2}$	3,030	220	604 1 3
Geo. Hatley.	13,365	1220	526 1 1
...	...	156	122 $\frac{3}{4}$	70,870	1594	£2965 5 11

J. T. THOMSON, Chief Surveyor.

Survey Office, Dunedin, 1st July 1859.

REMARKS OF THE CHIEF COMMISSIONER.

I have read the above report of the Chief Surveyor, and—if it were possible to state more strongly than he has done the evils attending the present system, my experience in the Crown Lands Department would fully justify me in doing so—I entirely agree with Mr. Thomson's remarks; but it is my duty to point out to the Board the difficulties, under the existing state of the laws and regulations relating to the sale, letting, disposal, and occupying of the Crown lands, of carrying out Mr. Thomson's suggestions. The law ought to be that no land should be sold until it has been surveyed by the Government, or at least the Board ought to have the power to refuse to sell land on that account alone. It is a question whether this could be done under the 18th clause of the Regulations. I think it very

doubtful. Another method of meeting Mr. Thomson's suggestion would be for the Chief Commissioner to give, on every application, the decision that the applicant should take the section as laid off by the Government; but, under such circumstances, the Government would be bound to lay off the land; and if, as at present, persons are allowed to take any quantity of land, and in any part of the province not within a run, it is next to impossible that the Government could overtake the work. For instance, several persons apply for land at Jacob's river adjoining each other. One wants 10 acres, the next 500, another 25, another 10, and so on; supposing the same thing to occur in four or five distant places, I cannot see how the Survey Department could carry on the work satisfactorily or with speed, and if the land should be bush

land the difficulty of selling in 10 acre lots would be materially increased.

If the Board, under the 18th clause, could determine that, in given districts, they would sell land only in such quantities as the nature of the survey would conveniently allow, there would be comparatively little difficulty; but, as matters now stand, if the Government lay off sections, and the public are allowed to take 10 acres of them, the confusion as to record and survey is interminable. Suppose, for instance, a surveyed section of irregular shape should contain 93 acres, and nine persons apply for ten acres each out of it, how would it be possible to record the sales satisfactorily without resurveying each allotment? If this were done by the Government it would be extremely expensive. If done by private surveyors the allowance of 15 per cent., allowed for roads and surveys, would increase the confusion, because the only satisfactory means of record is to have every section entered in a book prior to its purchase, and in the order of its position. Breaking sections once recorded in this way, excepting by dividing them in halves or so, makes it impossible to keep the books satisfactorily. It is, therefore, for the Board to consider what are its powers under the 18th clause of the Regulations, and having done so, to determine how it will act, or to suggest some course to meet the difficulty, and with that view the report of the Chief Surveyor will be handed to each member of the Board prior to calling a meeting to consider it.

W. H. CUTTEN,
Chief Commissioner.

REMARKS BY THE CHIEF SURVEYOR.

Having considered carefully the remarks of the Chief Commissioner on

my annual report of 1858-9, it appears clear that the Land Regulations do not permit of a regular system of rural section survey to be conducted solely by the public survey staff; for, as the public have a right to choose indiscriminately unsurveyed lands in all directions and in any quantities from ten acres upwards (where not specially reserved), the wants of the public can only be administered to by a mode of survey operations desultory and disconnected as are the separate applications. These services, numerous and widely diffused as they are, can never be undertaken by the Government with the slightest hope of meeting the same at anything within reasonable cost or time. They will of necessity, therefore, require to be executed by private authorised surveyors.

Having arrived at this conclusion, it now becomes me to recommend the measures required by the above circumstances. The services of the public survey staff should at once be directed to triangulate the country—thus preparing the ground for the chain surveys that depend on the stations fixed by triangulation—and, following the triangulation, a chain survey of roads, bush, and village reserves should be as early as possible executed. I need scarcely explain that the object of triangulation is to afford points of departure and referring marks to found and test the chain measurements of the various surveyors, and that the road, bush, and village reserve survey is to secure to settlers the privileges connected with these three species of reserves.

J. T. THOMSON,
Chief Surveyor.

Dunedin, 8th August 1859.

REPORT ON THE CLUTHA COAL FIELDS,

By J. G. LEWIS, Esq.

To His Honor CAPTAIN CARGILL, Superintendent of Otago.

Clutha Coal-field, 21st June 1859.

SIR—Having brought the important task which your Honor was pleased to confide to me to a successful termination, I beg most respectfully to lay before you a report of the operations, showing the nature and quality of the coals, the capability of the mine, and the cost at which it may be delivered on the banks of the Clutha River.

In a former report I expressed an opinion that the site of our operations was part of an extensive coal-field. Upon a closer examination this opinion is corroborated by several facts; the shaft we have sunk being situated nearly on the extreme southern boundary; whilst the original Coal Point, which lies about four miles to the northward, is nearly on the northern one. Between these two points coal is visible on the sea beach at several places, but whether it is an additional bed, or a part severed from the main seam, cannot at present be stated with certainty; but the appearance of the accompanying measures seem to indicate that it is an additional one.

At the northern point greater regularity in the measures prevails, and the coal possesses one decided advantage in having a firm compact roof, formed by the conglomerate sandstone, which is here a continuous rock, whilst at the southern point it lies in immense boulders upon the top of the coal. In other respects there is a great similarity in the seams as to quality and thickness. An opinion generally prevails that the black beds seen at low water, considerably out to sea at the northern point, are beds of coal—this, upon a close examination made at low water, is found not to be the case—they are beds of blaise which form the floor of the coal, the whole of which has been denuded up to the beach.

The shaft is planted, as shown by the accompanying rough sketch and section, upon a high cliff, at a distance of 70 yards from high water mark, and about 15 yards from the boundary line between sections 2 and 3, Coast district. The following is a descending scale of the measures there proved:

No.	feet. inches.
1. Turf, Day Earth, and Clay...	18 6
2. Sand of various colours, very loose	13 10

No.	feet. inches.
3. Quicksand with water	3 3
4. Top Coal	0 10
5. Black Coal	2 9
6. Upper Splent Coal	3 7
7. Middle Splent Coal	3 3
8. Lower Splent Coal	3 6
9. Black Bas	0 6
10. Bottom Coal	4 7

The aggregate thickness of clear coal is about 18 feet 6 inches, which is greater than that of any seam in Great Britain with the exception of the Ten Yard Coal of South Staffordshire. The seam dips regularly under the sea to the south-east at an angle of $8\frac{1}{2}$ degrees. It is sometimes bare and visible at low water to a considerable distance, but is generally covered with sand.

The nature and quality of the different beds of the seam are as follows:—

1st, The top coal, No 4 on the section, 10 inches thick, is a black, rather dirty-looking coal, much mixed with earthy matter, pyrites, and sulphur, and may be considered as of very little value.

2nd, The black coal, No. 5, is a clear, long-grained, black coal, 2 feet 9 inches thick, burns well, and seems suitable for smithy purposes, and would probably make good cokes. Both this and the top coal are of a perishable nature. It was from these two beds, and a very small portion of the upper splent bed, that the parcel furnished for trial to the "Queen" steamer was obtained. This, coupled with the fact of its having been quarried from the sea beach, where it had been washed by the salt water and exposed to the action of the weather, is sufficient to account for the unfavourable report made by the engineer of that steamer. The parcel furnished to the "White Swan" steamer, was a mixture from all the beds, and was extracted from a spot where the salt water could not reach, but was exposed to the weather.

3rd, The upper, middle, and lower splent coals, Nos. 6, 7, and 8, although occasionally separated by distinct partings, may be considered as one bed. It is scarcely distinguishable from the splent coal of Fifeshire—is of a greyish black lustre and conchoidal fracture. It forms together a fine valuable bed, 10 feet 4 inches thick, burns well, makes a clear cheerful fire, and affords

a strong glowing heat—is durable, and possesses the property of retaining fire when smothered up for several days. The whole of the cargo shipped by the “Ann Jane” for trial has been mined from this bed.

4th, Black bas, No. 9—a hard, bituminous, black clod, 6 inches thick within the mine, but on the beach, when first cut through, 20 inches thick; and there contained a few imperfect fossil plants.

5th, The bottom coal, No. 10, is a fine bed, 4 feet 7 inches thick, appears to be of a superior quality, approaching very near to the Cannel coal of England and the Parrot coal of Scotland. It will probably prove a valuable coal for gas, bakers’ ovens, stoves, and other purposes. Being under water, great difficulty was experienced in cutting through to prove it. When the mine is effectually drained, this might be advantageously worked with the other beds.

The coals from all the beds emit a slightly sulphureous smell when first placed or broken upon the fire; but this may not be the case when they are worked at a greater distance from the sea. The ashes being white affords good reason to hope this; those from really sulphureous coals being red.

As regards the capability of the mine to produce quantity, it must be obvious from the great thickness of the seam and the extent of unbroken ground, that any demand that is likely to arise for some time to come may be supplied, supposing capital and skill to be brought into action.

The only real difficulty that presents itself arises from the weak, heavy, tender nature of the roof, rendered doubly so by the weight of water in the quicksand. This is a serious difficulty, and unless it can be removed may prove an insuperable one. That the quicksand and coal are both supplied with water from the same source is evident from the fact that when the coal was first touched by forcing a crow-bar through the quicksand, a strong rush of tar water immediately followed; and in cutting through the joints in the coal, they are found full of sand from above.

This being the case, it would be possible to find the feeder and cut it off, there being prop wood of the best description. In estimating the probable cost of the coal on the river bank, the expense of conveying it from the mine to the river forms a very heavy item; and should any considerable quantity be required, it would become necessary to substitute a cheaper and more expeditious mode of conveyance than by bullocks. The cost of a metalled road would be enormous, on account of the absence of material. A railway, then, appears to be the only alternative; and with a view to ascertain the practicability of one, I have carefully examined the nature of the ground and taken such levels as are necessary, and find it is admirably suited for a line, which may be carried from the mine delivery on a level to the river, except down the hill, near jetty, where a self-acting incline plane might be advantageously worked. A firm, well-framed timber railway, with iron bands, forms a cheap, serviceable, and durable line. The cost of carriage by such a line would be reduced to one-third of its present amount, including the interest upon the outlay.

I have estimated as nearly as circumstances will allow, the cost, including the Government royalty and a fair remunerating profit, at which the coals may be offered on the banks of the Clutha River, and have taken it in two ways.

1st, Supposing the coals to be continued to be worked upon the present imperfect system, and to be conveyed as at present by bullocks: in this case a less price than 20s. per ton would not be remunerative.

2nd, In the event of an adequate capital being employed, the most improved system of management and working to be introduced, and railway laid down, with proper conveniences for shooting the coals into the vessels, the price may be reduced to 12s. per ton.

I remain, with due respect,

Your Honor’s most obedient Servant,
JAS. GEO. LEWIS.

