SESS. II.—1897.
NEW ZEALAND.

WATER-CONSERVATION FOR MINING AND IRRIGATION PURPOSES, OTAGO AND WESTLAND DISTRICTS

(REPORT ON), BY T. PERHAM, A.M. INST., C.E.

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

Mr. T. PERHAM, A.M. Inst. C.E., to the UNDER-SECRETARY, Mines Department, Wellington.

SIR,— Mines Department, Wellington, 18th August, 1897.

Acting on instructions, by memorandum, 27th April (Mines 97/895), to report on water-conservation for mining purposes and irrigation in the colony, and especially in Central Otago, I proceeded to and arrived at Naseby on the 14th May, and commenced by an examination of the Eweburn Dam site.

In dealing with the different localities visited I propose to take each in rotation from Naseby onward by way of Clyde to Lawrence. In some cases, where convenient and advantageous, water required for mining and irrigation have been taken together; others have been taken separately.

I regret not being able to start on the work a month sooner as the winter had set in and snow had accumulated on the hills on my arrival at Naseby, and therefore many places I had intended to visit could not be examined.

I have, &c.,
T. PERHAM.

The Under-Secretary, Mines Department, Wellington.

EWEBURN DAM.

The site is about six miles from Naseby, in a north-westerly direction, and about 200 ft. above the Courthouse, in a valley under Mount Ida, and just above where the Mount Ida Water-race takes the water from the West Eweburn. It is a flat valley, confined at the entrance, and widens out at the back, and is in every respect suitable for a reservoir, provided the nature of the ground for foundation of the dam is proved to be favourable.

Mr R. H. Browne, Maniototo County engineer, who surveyed for and designed the dam, accompanied me to make an examination of the line of foundation, and to consult generally upon the manner and cost of construction. Considerable doubts have been expressed by engineers who have examined the site as to the nature of the bottom being sound enough to prevent leakage, and have recommended pits being sunk or borings taken to determine the bed-rock. I concur in this, and have marked on the sketch-plan attached the positions in which the work should be done on line A B.

Looking up the valley from the race fluming and on the right bank of the stream the rock (sound schist) is almost perpendicular, and the strata lies in a favourable inclination—that is, leaning away from the water or reservoir side—and would form at the base a suitable foundation on the centre-line of dam as far as the creek. On the left bank, however, the terrace or spur against which that end of the dam would rest is gravel-wash, and clay overlying schist, which crops out sharply on that side of the creek. It then seems to dip considerably, and it is here the boring is required. It may, I think, be found that a puddled core could be stepped in the rock, called "Maori bottom," generally overlying the schist rock, and, if so, Mr. Browne agrees with me there would be no leakage. Fairly good clay can be obtained by sinking near the site in the terrace up the valley for the core.

It has been suggested to bore higher up, with a view of finding more favourable ground, and shift the site, but in my opinion this is not wanted. I consider, however, that the centre-line of dam should be taken on the line of borings shown on line A B, for the reason that the dam will be of less depth at this (terrace) end, will have a better backing against the bend of the terrace, and will be less costly. I estimate cost of boring at £150, and recommend that arrangement be made for Mr. Browne to superintend, subject to consent of the County Council.

Rainfall and Drainage Area.

The rainfall here, and all over the Maniototo Plain, is so slight—from all information I could obtain only 13 in. annually—that it is hardly worth taking into account, as evaporation and leakage from various causes would consume it.

The drainage area at the reservoir-site is limited, and confined to the top of the low ridge on one side, and the terrace on the other, both steep to the reservoir. The creek runs out at the head of the valley, and is the under drainage of the snow. To fill the reservoir the water is almost entirely dependent on melting snow down a large gully from the summit of Mount Ida. In such a locality there is no sure or even average data to base calculation upon, as much depends on the frequency of frosts or otherwise to withold the snow-water, or discharge it intermitently during the warm winds and rains of October and November, or, in fact, with any degree of regularity. This applies not only to the source of supply for this reservoir, but generally over the whole of the centre of Otago, and especially the Maniototo Plain.

During the end of summer, autumn, and winter months all the creeks are mere shingle-beds, with perhaps in some cases water percolating underneath. At the melting of the snow in spring they become mountain torrents, and it is then that the water on the low levels must be conserved for midsummer, autumn, and winter use. The necessity for strong dams to withstand the rush of water is obvious.

It is considered, if the dam is built, it will supply all demands for six years. Then, if claims are worked out, the water can be utilised for a complete and extended system of irrigation, or a race can be taken across to supply the Little Kyeburn and portion of Spec Gully. With the exception of the two winter months, July and August, when operations cease on account of frost, the Government race, supplemented by the Eweburn reservoir, will keep all the miners employed all the year round.

The Mount Ida Race at present supplies six heads and a half. This is barely half a supply. There is wanted from the proposed dam for about two months and a half twelve heads running night and day; and providing for future wants and extension, twenty-four heads. All the water in Spec Gully is in the hands of companies. The Government race will not reach there, and water is from other sources difficult to obtain. From year's end—March, 1897—the increase in consumption was 5·25 over that of same date in 1896.

Each elevator working by day only employs six men, and uses four heads an elevator. The elevators, in the event of the dam being constructed, could work night and day, or employ two elevators in place of one now. From the above information, supplied by Mr Murray, the water-race manager, and others, it appears that the majority of the water from the dam is likely to be consumed by the miners for elevating and sluicing, and that other provision should be made for irrigation purposes.

Mr. Browne estimates the "area enclosed by a dam 70 ft. high to be about 50 acres; and the contents of the reservoir once filled about 58,000,000 cubic feet, or 361,181,250 gallons of water, which means a capacity of thirty Government sluice-heads for sixty-six days of eight hours, or twenty heads for a hundred days; and, taking the scale at 8s. 4d. per head per day, a revenue of £883 odd, which would yield 8 to 10 per cent. on cost of construction at £10,000."

Having doubts under the conditions above stated as to the rainfall, drainage area, and dependence on the melting snow, I would recommend that the dam should be raised only at first, say, 50 ft. instead of 70 ft., provision being made on the lines laid down for the foundation for a future extension if the source of supply is found to justify the additional outlay. The water conserved would be about a third less than with the 70 ft. dam, and would supply about twenty heads for forty-four days of eight hours. The by-wash could be carried as orginally designed by a tunnel or cutting through the rock round into the gulley which opens into the Eweburn at the race fluming, the outlet being afterwards raised to the required level in the event of the addition being constructed.

There is already a tunnel roughly cut carrying the water of the Eweburn into the Government race, in which the discharge-pipe would be laid in concrete for the dam. I do not think it necessary to provide for a flushing-pipe. The silt likely to accumulate in the reservoir will, from the nature of the ground, be small, and it will tend to caulk and solidify the water side of the dam.

In the method of construction I differ from Mr. Browne, who favours sluicing in the material, which is often done by miners when and where water-power is available, but in this case it involves the expense of making a small catch-water dam at a sufficient elevation and laying pipes for the purpose. All the material can be obtained and run out from the spur or terrace direct on the dam on the left bank of the creek, and there is an abundant supply of sound rock for facing the inner or water slope. The outlet will join the Government race, and from that point to Naseby the race must be enlarged to carry the additional supply of water, at a cost estimated by the manager at £500.

Having as yet no definite information as to the nature of the bottom until the result of the borings are known, any estimate for a dam as I propose, say, 50 ft. in height, can only be roughly approximate. I am of opinion, however, that it may be constructed for a sum between £6,500 and £7,000.

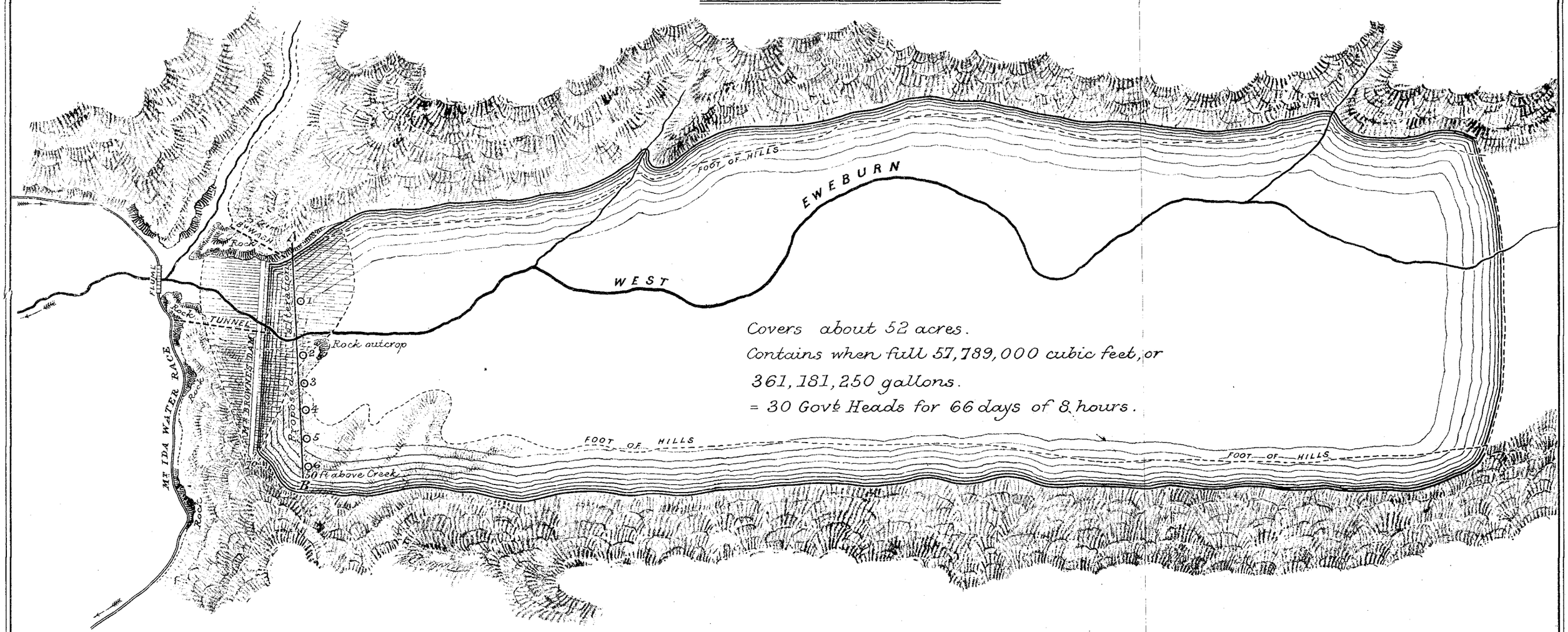
IRRIGATION, MANIOTOTO PLAIN.

The large extent of country so called is a misnomer. It may be better described as rolling downs with long, low, and flat-topped spurs running into it from the foot-hills of very irregular heights and contours, indented between, as a rule, by long, narrow, and flat gullies, or small shallow valleys containing the numerous stream-beds having sources in the surrounding mountains and hills. The water-supply is exceedingly limited, and in most cases entirely dependent on the melting snows; and six to seven months in the year at least the watercourses, after leaving the gorges, are dry above ground. There is a deep deposit of gravel and shingle in many places—as much as 10 ft., as proved

SKETCH PLAN
OF PROPOSED
EWEBURN RESERVOIR.

To accompany Report by T. Perham. A.M.Inst:C.E.

Scale 4 Chains to an Inch.



O 1.2.3.4.5.6. Positions of borings to be taken on line A.B.

C.H. Pierard. del.

by the sinking of wells—overlying irregular and undulating beds of clay. Any extensive gravitation system of general irrigation would be difficult and very costly, owing to the unsuitable surface of the ground and rapid percolation. The valley is of considerable extent (roughly about thirty miles by twenty), and the soil very fertile a few miles from the foot-hills, as evidenced in localities where water has been obtained for private irrigation on the alluvial silt from the hills, notably at Mr. Grier's farm, at Sowburn. In the centre of the plain, which is flat, the land is shallow and arid.

Sowburn I visited in company with Mr. Murray, the Government race manager, in quest of a site for a dam up the gorge seven miles from Patearoa Township. A small dam may be built here in the gorge for irrigation of the immediate neighbourhood, but at such a low elevation as to be of little use for mining purposes. There are three private races draining this creek with prior rights.

Pigburn.

It was my intention to examine this gorge to its source in the Rock and Pillar Range, but heavy snow and sleet set in. I ascertained, however, from reliable authority—old miners, resident shepherds, and others—that a fair site for a reservoir of from 25 to 30 acres existed, which would serve both the Hamilton and Sowburn miners, and could be supplemented by two or three smaller ones on the tributary creeks, especially one called Cave Creek. There would, in addition, be sufficient water from this source for irrigation of a large portion of the south end of the plain. The fall from Naseby to this locality is about 30 ft. to the mile.

By appointment, I met at Naseby Mr. Ryder, president of the Farmers' Club, and several other residents of the district, to obtain their views and requirements on the irrigation question. It is beyond doubt water is urgently required, not only to make the land productive, but for the bare existence of the stock at present being raised with difficulty in the valley. It therefore becomes necessary to save what water can be obtained, and which is at present going to waste, by tapping it at the gorges in wet weather for supply in times of drought. I pointed out that any scheme entered upon should be tentative, and be regarded as a nucleus for a larger scheme, which could be developed as necessity arose.

It would be advisable, if suitable sites could be obtained at sufficient elevations at the foot-hills, to erect storage-dams whence the water could be trained along the leading spurs in different directions to other and smaller receiving dams, such as Chain Gully, near the racecourse, and on the Little Eweburn, to serve, say, half a dozen farms in one locality. The cost of such small dams would not be great, and the farmers who would be benefited by such a dam could with advantage construct it with their own labour and teams. In such a work perhaps the Government may be asked to grant a subsidy of pound for pound, the farmers giving labour and plant as their share. Thus a series of small dams would be scattered over the plain in the localities at present urgently required. The large dam, hereafter described, at Wedderburn might be made to serve for this purpose by bringing in a head-race to command the subsidiary reservoirs. Every farmer could then cut his own small leading races, and pass the water on to his neighbours on the lower levels.

It will be seen that the primary object of this scheme is that the creek-waters will be caught before they percolate to the clay bottom, will be distributed over a large area, and be retained on the land for a lengthened period on their downward course to the Taieri River, which is the natural drainage of the plain. There is hardly a farm section on the Maniototo that could not be watered in this way by an equitable arrangement of sluices.

Windmills have been suggested for pumping water from the Taieri, but, as these are expensive, would have to be numerous, are costly to maintain, and would only serve the land running parallel to the river, I consider the system of supply by gravitation above described preferable.

Gimmerburn.

At Scott's farm, about 600 ft. below Naseby, there is an example of the depth of gravel and shingle 10 ft. below the surface. Here and at many similar localities any scheme of irrigation is almost impracticable unless water could be obtained in abundance, which I think is feasible for this and neighbouring country, from the Wedderburn.

Wedderburn Dam.

Up the Wedderburn about two miles and a half from the settlement, situate in a long, open, and nearly flat valley, with a good watershed, an earthern dam about 4 chains in length and 20 ft. in height (ruled by the confining terraces) would conserve about 90 to 100 acres of shallow water. A smaller site on a tributary, but not so good, would cover about from 30 to 40 acres. Both would command the Gimmerburn, Eweburn, and other districts.

From Wedderburn, being easy of access, I next visited the North Ida Valley with Mr. Browne, who pointed out an excellent site for a large and deep reservoir on the Idaburn, having the advantage of Hills Creek, with two smaller tributaries running into it. It is an extensive open flat, with a rock-bound gorge about 2 chains wide at the end of a spur, over which the main road runs. A rock-dam or weir, 50 ft. in height would throw the water back over an area half a mile by a quarter of a mile wide. It has two disadvantages, however: (1.) The main road would have to be shifted from the flat or bed of the proposed reservoir to a siding along the spur. (2.) The Otago Central Railway surveyed route runs alongside the road, and would also have to be shifted to the spur about 3 chains before cutting through the road saddle. The dam would command nearly the whole of the North Ida Valley. Mr. Browne's estimated cost is £5,000. There are prior rights in all the streams, and it is reported on the London market. There is a mill on the Idaburn in this valley near and above the dam site. The site is connected only with the Ida Valley irrigation, and cannot be used for any other purpose.

I next proceeded to St. Bathan's, having failed to find any other suitable sites for conservation in connection with irrigating the Maniototo.

St. Bathan's Company's Sludge-channel.

This channel, which seems to have had a varied history, runs from the road-bridge at the township towards and is discharged into the Dunstan Creek. The upper end is in fairly good condition, but here and there the walls require repairing. The lower end is completely blocked with tailings and fine silt, the result of the channel not being confined to its proper course by sufficiently-strong guide-walls. The gaps in the walls allow the waterbourne tailings to escape and spread over the surrounding land to such an extent that new waterways are cut in all directions, leaving the "channel" in many places high and dry. There is a good fall for scour of 25 ft. to the mile. Proper material for the walls is expensive and difficult to obtain, the only scrub to be got for fascine work being what is locally called "matakauri," at best unsuitable for the purpose. The walls were built of stone (round) and sods, and have nothing to bind them in position, and they have no batter. Well-bound fascines should be laid and staked well down, and stone placed at the back and on top.

There is an insufficiency of water to properly scour the channel of *débris* and the gravel and sludge from the daily working of the claims. It appears to be a matter of vital importance to the district. The channel is being maintained by the Channel Company, which has the control of the present head-water, and I am of opinion that if ordinary care had been taken to keep the lower end clear at the junction with the Dunstan Creek no trouble would have occurred. I do not think it can be put in a proper state to do the work required of it under at least £2,000.

It is proposed that the Government shall be asked to grant a subsidy of pound for pound for four years at the rate of £250 per annum, which I recommend for favourable consideration.

Muddy Creek Sludge-channel.

This channel is about four miles in length, discharges into the Manuherikia River, and is badly in want of repairs and training. From the claims down to the Main Road Bridge, about two miles, the first portion (which is deep) is choked up in three several places by the slipping and falling in of the banks. These places require forming and piling with slabs to keep it clear for the use of the tail-races, at a cost of about £500. Timber is expensive, or open culverts would be better and more lasting.

At the Main Road Bridge the road has had to be diverted, on account of the tailings backing the water up the Clear Creek. This place is very inconvenient for crossing at the ford, and, in times of flood, after the melting of the snow, dangerous for road-traffic. Below the bridge to the discharge into the river is about two miles and a quarter. The training-banks on both sides are broken, and the water and tailings run in all directions, filling up the large area on the right bank even to the terraces.

The channel (or what was originally so constructed) in this lower mile is completely blocked, and in many places is actually higher than the surrounding level of tailings. Where the channel discharges into the river there is a heavy accumulation of fine silt, requiring strongly constructed training-walls to free the sludge from above and keep the mouth open. This portion of the channel has been formed in an inexpensive manner, by driving blue-gum posts in double rows and straining fencing-wire from post to post, weaving in and tying thereto matakauri scrub. The posts are not by any means close enough together to stand the weight of tailings and water--hence the gaps and overflows. I consider to put this channel in order £2,000 will be required below the bridge to the junction with the river, and at the junction another £1,000 to free and keep it open into the Manuherikia River—£3,500 in all. A pound-for-pound subsidy is asked for to the extent of £2,000, to extend over four years. I am of opinion, however, that the work has been underestimated. I advised the manager, Mr. Nicholson, who is doing his best with the limited funds and poor material at hand, as to the best method of carrying on the work.

There being nothing in the way of water-conservation in the neighbourhood I went on to Ophir.

Ophir (Black's).

White Horse or Blackstone Hill Water-race.—A private company own a race about ten miles in length, catching the water from the Manuherikia River above the falls, and require to extend it three miles to reach payable ground. The company will hand over the constructed portion and all prior rights to the Government at a price to be settled by arbitration. Claim, fifty-five heads of water. It is reported that the race will command payable ground at Poolburn, about ten miles further on.

On my arrival I met Messrs. Purvis, Neville, and other farmers and miners, who made arrangements to meet and accompany me in an examination of the Poolburn and other gorges and streams in Ida Valley.

Ida Valley.

A long narrow flat valley between the Raggedy Range and the Rough Ridge, draining towards the centre from both ends, from the Idaburn by the north and the Poolburn from the south, the two streams uniting and cutting through a deep gorge in Raggedy Ridge, and running into the Manuherika River. The soil is fertile, and the contour of the country of a similar character to that of the Maniototo Plain, but, in proportion, with a larger extent of flat in the centre.

As before mentioned, the reservoir in the gorge of the Idaburn commands the country over the Poolburn Gorge to the end of the valley for irrigation purposes, and I now purpose to deal with the south end.

Moa Creek.

Here the first place visited was the Moa Creek Gorge, and a site was selected about two miles and a half from and 100 ft. above the opening of the gorge. The reservoir would cover about 25 acres, and command all the highest spurs and terraces on the plain. A rock-dam or weir 45 ft. in height and about 2 chains in length would be wanted, and a head-race in unavoidable rock

cutting about three miles in length. This reservoir would also command the Hard Hill and other low-level gold-workings. But, unfortunately, like many of these rock-bound gorges, in places it is narrow and deep, with broken almost perpendicular sides, then opens out behind and forms a favourable site for a good reservoir; but the bed of the stream is steep, and the dam requires height to gain any depth of water. Again, the strata of the rock is erratic and shattered, raising doubts as to its capability of retaining water after the dam is built, and, although as a reservoir for storage and distribution it has almost every advantage that could be desired, I fear it would be subject to interior leakage.

Dam at Woolshed Creek.

Near and above Mr. Neville's farm on this creek, a small tributary of the Poolburn, there is a good site for a small distributing reservoir for irrigation purposes. It would require an earthen dam about 3½ chains in length and 12 ft. high from spur to terrace, the material to be got from an interior and projecting spur and a knoll in the centre. It would impound about 10 acres, and command the low levels of the whole of the south-western end of the valley. The creek is small but permanent, running at about two heads at a minimum. It is one of the places I would recommend assistance from the Government on a pound-for-pound subsidy, the farmers giving their own labour and teams and cutting their own races, as suggested on the Maniototo Plain. I do not think the cost in this way would exceed £350 or £400. There are no prior water-rights.

O'Keefe's.

A permanent creek running from the Rough Ridge, with a private dam in use and other prior rights. Another small dam in the gorge higher up could be built as a catch-water for conservation during summer months, and would also be of use to miners on the low levels of German Hill. The miners do not object to a dam or weir if the same amount of water they now draw can be guaranteed, with an additional supply from the storage.

I think this is one of the localities where such an arrangement could be made with advantage both to the farmers and miners, and at comparatively small cost to the Government.

Bread and Water Gully.

Local miners advocate the erection of a dam which would supply part of German Hill gold-workings and irrigation on the eastern side of the plain, but a suitable site is not obtainable, the gorge being too narrow and steep.

I was shown some coarse gold here just washed out, and the miners speak hopefully of the locality (even expecting a rush) if water can be obtained. This creek runs about six heads, and is well worth conserving for the low levels, both for mining and irrigation.

Head-waters, Poolburn.

I heard much of this site from all quarters, as it is well known to command all the high levels of German Hill. It is 1,200 ft. above the "Carriers' Arms," on the margin of the plain, near which mining is carried on.

A rock-bound gorge requiring a dam 3 chains in length and 50 ft. high would throw the water back about a mile and three-quarters, averaging half a mile wide, and roughly 20 ft. in depth. Like the Eweburn Dam at Naseby, however, the site of the foundation is doubtful, and would require trial borings. The creek is permanent, and runs at a minimum in the driest season of about seven heads. For mining purposes it is undoubtedly a good site for a large conservation, on account of its elevation, but, as it commands only the south-eastern side of the valley embracing German Hill and contiguous workings, I do not think, under existing circumstances, a large expenditure justifiable. It is one of those places, looking to the future, however, of the gold-mining industry, that may become a valuable acquisition.

My visit to this site concluded my examination. From the south end of the plain to the Poolburn Gorge there is no indication of sites for water-storage along the Raggedy Ridge, and for irrigation purposes the water will have to be brought round the foot-hills from the eastward. That water is urgently required is beyond doubt. The country is in such a parched condition that even the settlers are obliged to import from Dunedin corn and chaff and roots for their horses and cattle and potatoes for domestic consumption. Cattle have to be driven long distances for water, and, owing to the ravages of the rabbits and the dry season experienced in the summer of 1896, there is little and in the centre of the plain no feed.

Given a nearer market for their disposal, I was seriously assured that farming rabbits would pay better than breeding sheep and cattle.

For localities of dam-sites, see map attached to separate report on the Maniototo Plain and neighbourhood.

MATAKANUI OR "TINKER'S," THOMSON CREEK DAM.

From Ophir I next went to Tinkers, with the intention of inspecting the site of a proposed dam or dams in Thomson's Gorge, and was met by Mr. Shephard, County Chairman. Unfortunately, on my arrival the hills were completely enveloped in mist, which afterwards turned to sleet and rain, and it was considered useless to wait another day on the chance of a personal inspection.

Mr. R. H. Browne, C.E., made the surveys and got out the plans for Mr. John Ewing, of St. Bathan's, who kindly forwarded them to me afterwards at Clyde, together with notes on the rainfall, drainage area, holding-capacity, &c. From the notes it appears the rainfall does not exceed 20 in. annually, although Mr. Ewing says, "I have seen streams I estimated at 800 heads coming down the creeks in floods. Such a stream would not continue for more than twenty-four hours, but it would take a week to get down to 100 heads. A rainfall of 5 in. in one week sometimes occurs. I think after such the dam might, if the ground were fairly saturated with water before it came, get half full. . . . The catchment-area is 15,349 acres, mostly steep and rocky, and for six months in the year all moisture falls as snow."

The plans and sections show a steep creek with two branches, the waters running together about eleven heads. Both gorges are deep and narrow, and it is proposed to trap the water just below the junction of the branches. There is an alternative scheme, however, for a dam in the left-hand branch, 118 ft. high and 395 ft. in length on the top.

A dam is also shown on the plans 150 ft. high and 540 ft. long on the top, estimated to conserve about 294,000,000 cubic feet of water. There is necessity here for high dams, the creek-beds being so steep, deep, and narrow; but this work would be very costly.

A 100 ft. dam just below the junction of the two creeks seems to be the one advocated, and certainly would be the most useful and practicable. It is 388 ft. long on the crest, and the water is intended to flow over like a weir stone pitched both back and front, and is estimated to store in both branches 88,726,188 cubic feet of water, equal to 1,026 heads for twenty-four hours.

There is no estimate of cost given in either case. I have, however, taken the quantities, on prices given me for similar work in the neighbourhood, of the 100 ft. dam, and formed the approximate estimate (supposing the foundations are favourable, &c.) to be £38,500. This is an undertaking I think will be considered of too great a magnitude to entertain.

Here, as elsewhere, there is a great demand for water for mining, but it is difficult to obtain.

Mr. Naylor, of the Clyde, has a fine farm here on the Ophir Road, showing what can be done with the soil by the means of a simple system of irrigation.

Clyde–Dunstan Flat Irrigation.

I left Ophir for Alexandra and Clyde in a snow-storm on the 29th May, and was met by Mr. McGeorge, County Engineer, and commenced, in company with Mr. Naylor and Mr. Ironsides, Stock Inspector, an examination of the Waikerikeri Valley and Gorge. Went about three miles up the gorge to the catchment dam of the Golden Gate and Clyde Town Water-races. The creek runs from six to seven heads at a minimum, and there are three prior rights, including one head owned by Mr. Bodkin, of the Monte Christo Farm.

It is proposed to dam the creek at the mouth of the gorge, which is 550 ft. above Clyde, is deep and narrow, with a small and very steep rocky watershed. The supply, as in many similar cases, is mainly dependent on the melting snow running down from Leaning Rock Gully, in the Dunstan Range, and a few small streams from the branch gullies. For six months in the year the main stream is reported to run nine heads. This is the only creek of any importance on the north-east side of the flat from which a permanent supply could be drawn for irrigation. The gorge is about 2 chains at the mouth, with rock at both sides, and then widens out to about 4 chains, with a fairly flat bottom. A dam 40 ft. high would throw the water back about 20 chains, with an average depth of 15 ft. to 20 ft. The rock, however, on the left bank of the creek is very broken, and the strata erratic, and would have to be removed in considerable quantities to get a good foundation for the core at that end of the dam, and, as in the case at Eweburn Dam, trial borings are necessary to determine the nature of the bottom for foundations.

Provided the reservoir could be filled, it would be a fair conservation, even after the existing rights were satisfied; but I am of opinion the dam would be very costly—that is, in comparison to the benefit to be gained—and do not, therefore, think it can be recommended.

Picnic Valley.

A dam-site surveyed by Mr. Calder, District Surveyor, was next examined, in a flat dry branch of the Waikerikeri Valley. It has a deep shingle bottom, however, and the loss of water from percolation would in any case be great. Moreover, a reservoir here would require an expensive earthen dam, 50 ft. high and 7 chains in length, between the confining terraces to impound any quantity of water. There is no water running in the valley, and a race would have to be cut from the Waikerikeri, or borrow from the township water-race. Under all the conditions I do not consider the site a suitable one even for irrigation.

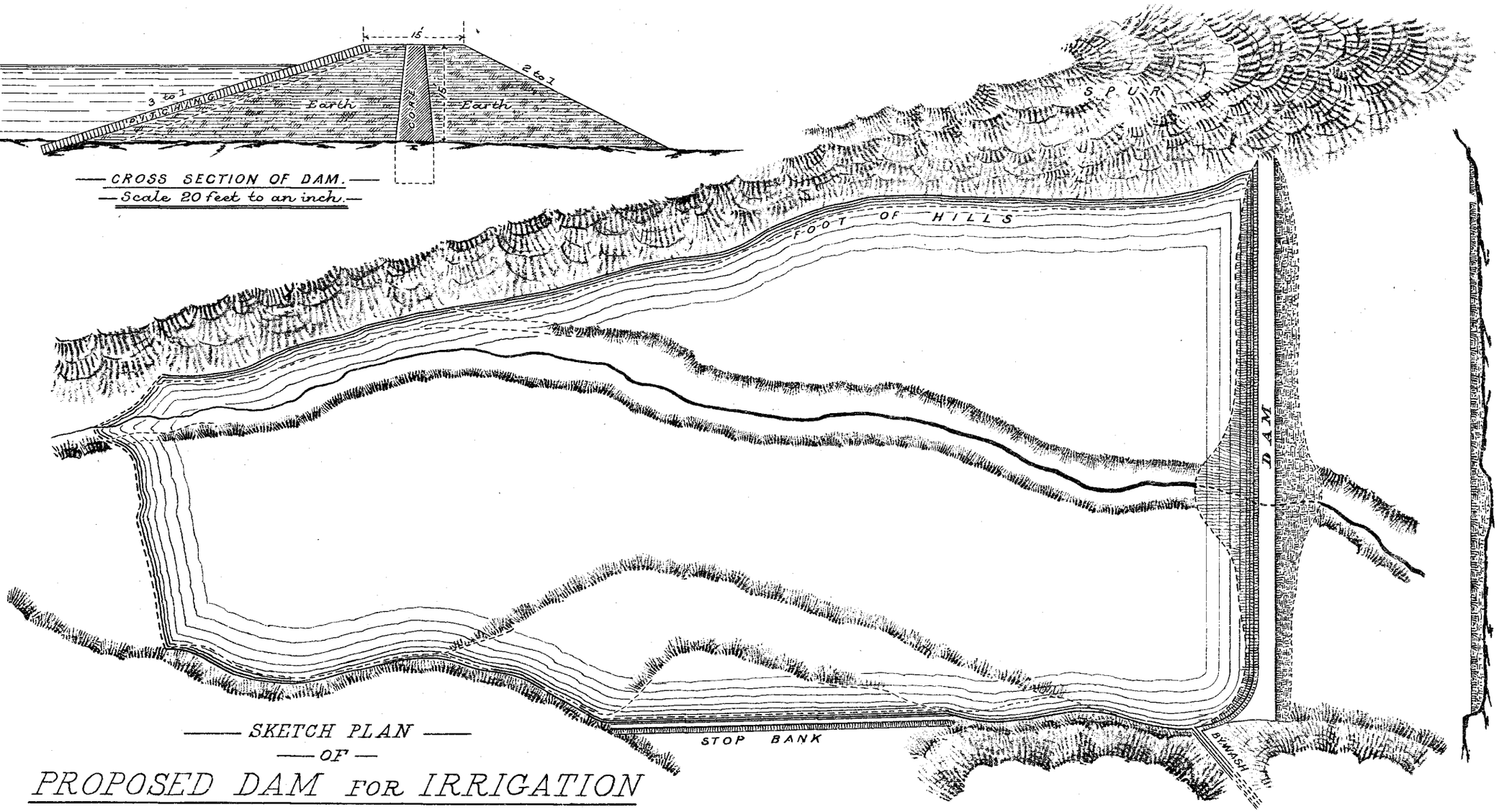
Waipuna or "Mutton Town Gully."

Considering the Waikerikeri water not available for the reasons above stated, I next explored for a site that would serve the experimental farm of two thousand acres lately set aside for the purpose, and found about a mile from it a suitable place where water could be conserved in a moderate quantity by an earthen dam 15 ft. high and about 6½ chains in length, running between the end of a spur on one side of an old creek-bed and a low terrace in the flat on the other. A small stop-bank would be required in addition to dam in depression in the terrace. It has been used as a sludge-channel, and may be again, but the channel could be diverted and led round the reservoir. There is a small stream running about two heads. A 15 ft. dam would throw the water back about 13 chains, with an average depth of 7 ft., and it would fill in flood-time. This is the only available site to be found on this side of the flat, and would conserve sufficient water to irrigate the farm and immediate neighbourhood. A sketch-plan is attached, and I think the dam may be built for a sum not exceeding £500.

With regard to irrigation of the flat on this side of the bank of the Clutha, the land is fertile, and with water there is no doubt it could be made highly productive—that is, with the exception of a portion about two miles and a half from Alexandra, which is perfectly useless, on account of a heavy and increasing deposit of fine wind-blown drift-sand from the constant cutting-away of the river-bank by the gold-workings.

The farm-land is flat, with a gentle slope to the river and Alexandra, and is suitable for a perfect and cheap system of irrigation. I recommend the above dam-site at the Mutton Town Gully for favourable consideration.

CROSS SECTION OF DAM.
Scale 20 feet to an inch.



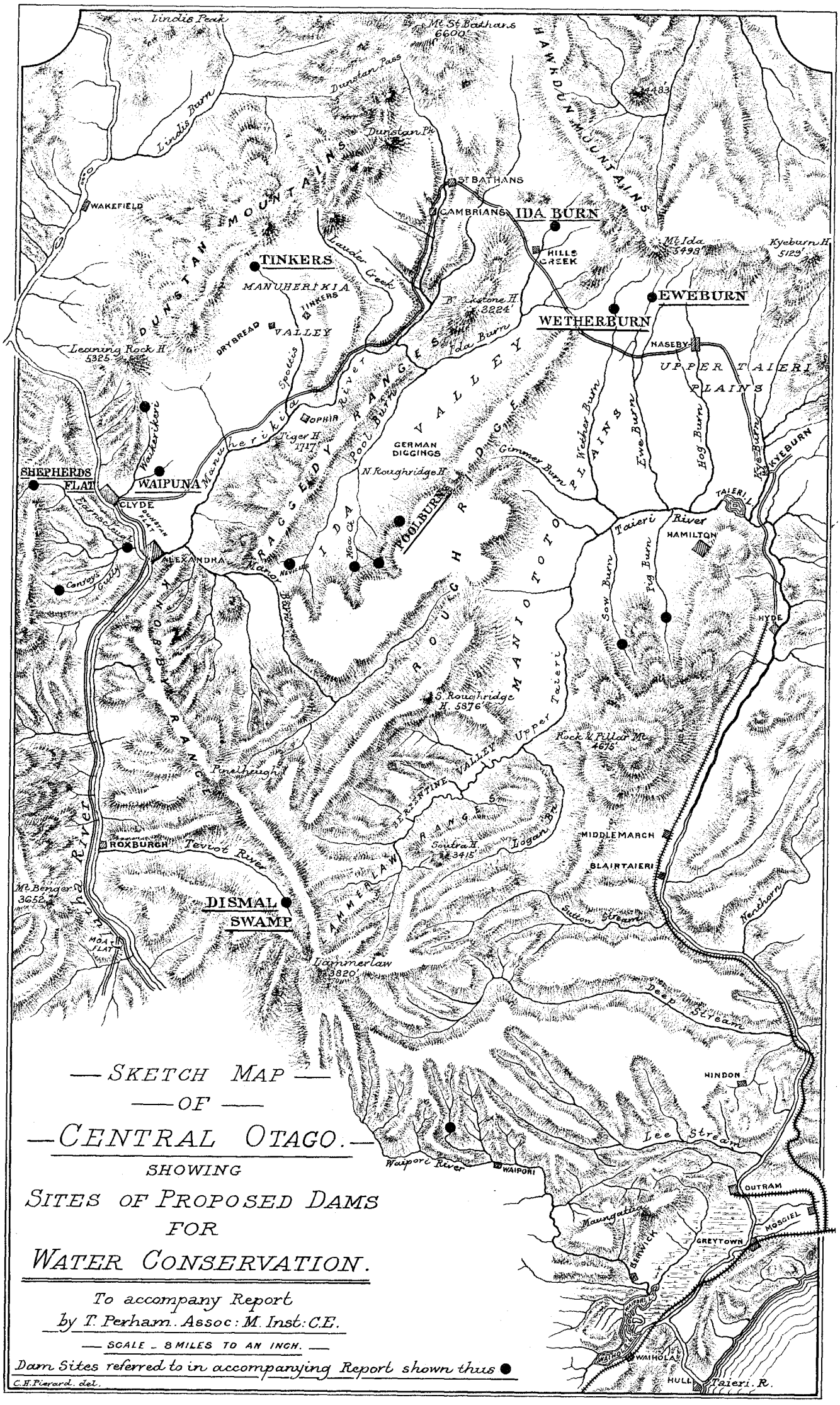
FRONT ELEVATION OF DAM.

SKETCH PLAN
OF
PROPOSED DAM FOR IRRIGATION
WAIPUNA OR MUTTON TOWN GULLY.

To accompany Report by T. Perham. A.M.Inst:C.E.

Scale. 100 feet to an inch.

C.H. Pierard. del.



— SKETCH MAP —
— OF —
— CENTRAL OTAGO. —

SHOWING

SITES OF PROPOSED DAMS FOR WATER CONSERVATION.

To accompany Report
by T. Perham. Assoc: M. Inst: C.E.

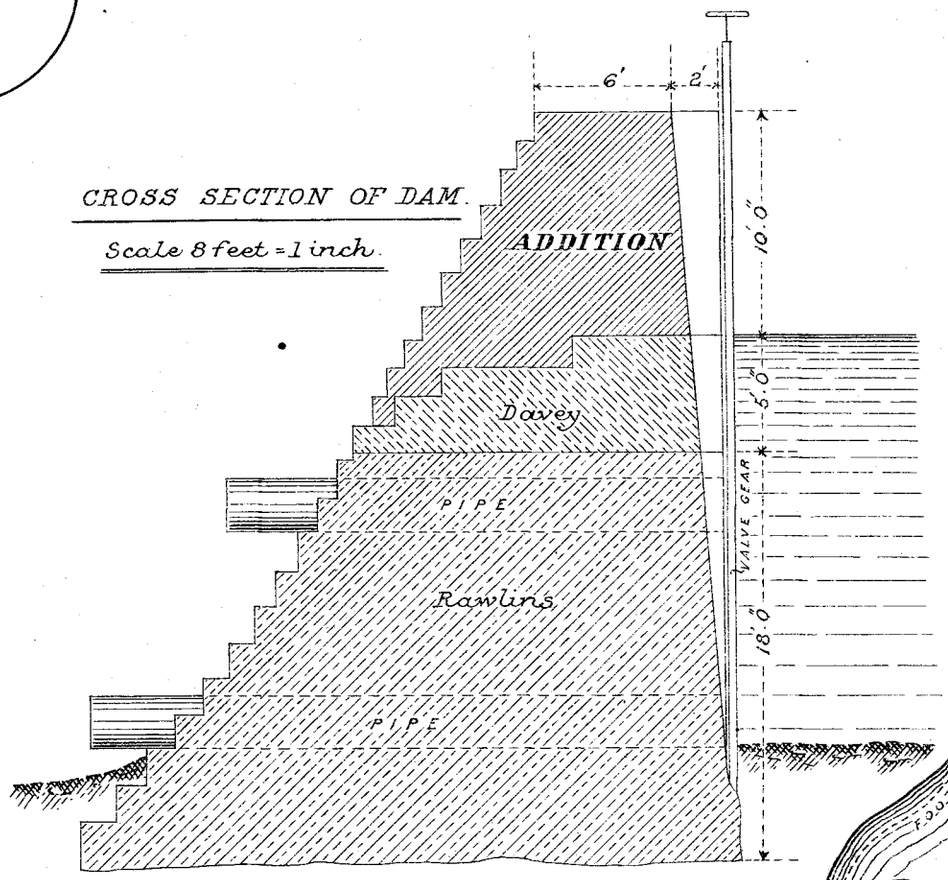
— SCALE - 8 MILES TO AN INCH. —

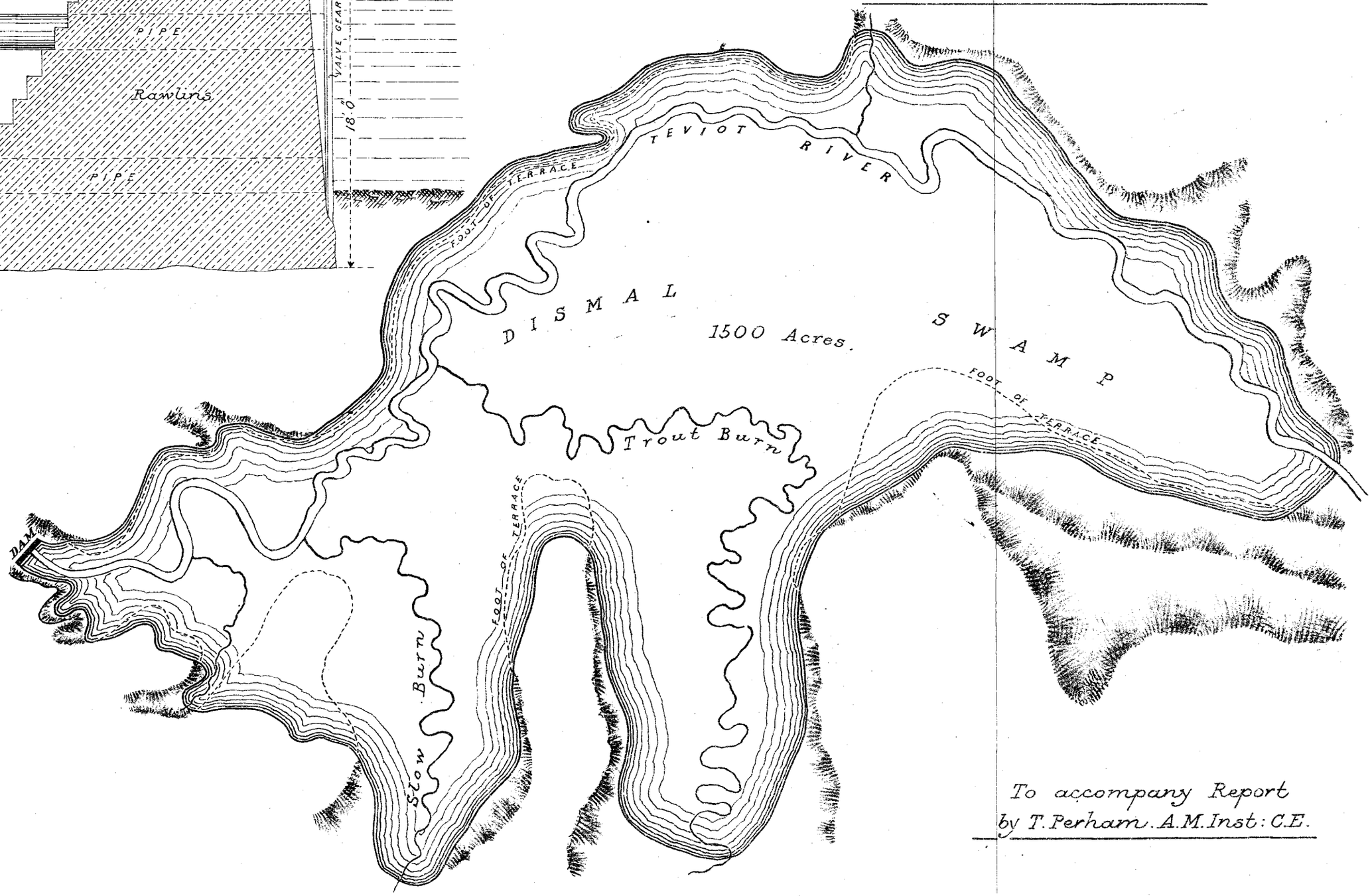
Dam Sites referred to in accompanying Report shown thus ●

PLAN
OF THE
DISMAL SWAMP RESERVOIR.
TEVIOT RIVER.

GRANTED TO ROXBURGH AMALGAMATED MINING AND SLUICING COMPANY.

Scale 20 Chains to 1 inch.





To accompany Report
by T. Perham. A.M. Inst: C.E.

C.H. Pierard. del.

Fraser's River, or Earnscleugh.

This is a fine creek, on the right bank of the Clutha, with its source between the Carrick and Old Man Ranges and the Obelisk, and is fed also by the McLellan, Meredith, and Conroy Tributaries.

With Messrs. Ironsides and Laidlaw, of Earnscleugh Station, I inspected a good site, known as Shepherd's Flat, about seven miles up the gorge and 975 ft. above Clyde. A large open flat, about 40 chains long and 15 average width, confined by a range on one side and a firm 50 ft. terrace on the other, with a narrow perpendicular rock-bound gorge only a chain wide. A 25 ft. dam here would conserve an average depth of water 15 ft. over the whole flat, and there are no signs of broken rock or probable leakage. It is without doubt the best site I have seen for the purpose, and, looking to the future of the mining interests, in my opinion, should be secured for a large conservation, as the dam could be raised to 50 ft. if necessity required. The creek runs about twenty-two heads in the driest season, and is permanent, but, on account probably of its being the only available water (except by pumping from the Clutha), is entirely monopolized by prior rights to such an extent that the water in the creek in a normal state could not supply the demands. From the returns of the Registrar I find that there are no less than seventeen licenses renewed and issued since 1890 for fifty-two combined Government heads, and fifty-two conditional on the water being returned up the river above the races running from the catchment of the creek at the mouth of the gorge. Under the circumstances, the building of this dam is either entirely dependent on the extinguishment of most, if not all, of these existing rights, or some satisfactory arrangement.

There is no doubt, I think, if investigated, many of them would be found to be forfeited under the conditions not having been complied with, but, with the limited time at my disposal, and for the purposes of this report, they cannot from their nature be now dealt with in detail. I may state that in my opinion this question of private prior rights to nearly all the available streams in the Central Otago district will prove a difficulty which must be settled before any system, however small, of water-conservation can be attempted.

If it were not for the above monopoly a strong rock-dam or weir could be advantageously erected at a sufficient elevation at the mouth of the gorge to command the whole of the flat on both sides of the Clutha by taking the water in a siphon over the bridge, and, by means of irrigation, enhance the value of the land for fruit-growing and agricultural purposes.

Conroy Gorge.

At the request of Messrs. Iversen and Dawson, fruit-growers at the south-eastern end of the valley, I went over the hills into Conroy's Gully and Blackman's, or Omeo, but both places pointed out were unfavourable, mainly on account of probable leakage and expense, and the water in both the small streams I found monopolized by existing rights. In this neighbourhood, however, the climate is so suitable, the land so rich, and water in such demand for irrigation that the holders of these rights are anxious to forego them if they can be guaranteed sufficient for their use by a system of general conservation. But the only source, in my opinion, for this is from Fraser's River.

Stone fruit to the extent of between twenty and thirty tons annually have been sent from this neighbourhood to Dunedin until last season, which was an exceptionally dry one; still, with the limited quantity available, it is made evident by the luxuriant appearance of the orchards that only water is wanted to make the rich deep soil productive. I think hops would do well here. Grapes yield well, and ripen in the open at Clyde. Compared with Maniototo and Ida Valley, this little flat, provided a supply of water from Fraser's River could be obtained, would pay well for irrigating. The soil and magnificent climate is everything in its favour.

Having concluded my examination here I proceeded to Roxburgh, and there met Messrs. Burton and Peters, the manager of the Amalgamated Gold-mining Company, from whom I obtained plans and information of the Lake Onslow or Dismal Swamp Dam.

LAKE ONSLOW OR DISMAL SWAMP DAM.

So late in the season, and the weather very unsettled, it was considered by experienced residents a risk of being snowed up to attempt to visit this dam. My assistant, however, Mr. McKegg, volunteered to undertake it, and, a reliable guide being procured, I left him at Roxburgh to go up from there, take measurements, and obtain all information required in view of the dam being raised. I then went on to Miller's Flat and met by appointment a number of local members of the Miners' Association, and found the agitation for an increased supply of water by an addition to the dam very strong, the general opinion being a desire to raise the dam as much as 20 ft. or 30 ft. I cannot recommend this idea for reasons shown hereafter. The area of payable ground the lake is reported to command is of great extent, from Roxburgh to Beaumont. A large alluvial flat on the left bank of the Clutha at Miller's Flat and another containing 1,300 acres are much talked of as being rich if water can be obtained for sluicing and elevating.

It is claimed that if the dam is raised only 10 ft. it will impound three times the quantity of water the lake now holds. I am, however, unable to give the approximate contents of the conservation by the present dam, having only a plan and no cross-sections. The area is 1,500 acres, and the watershed supposed to cover eighty-four square miles, and, as the dam is 23 ft. in height and the lake-bed nearly flat, with the surplus water running over the top of the dam, there must be many millions of cubic feet in store.

The dam is in the Lammerlaw Range, about twenty-three miles from and 960 ft. above Roxburgh, and is of stone courses set in cement mortar quarried on the site. It is a solid well-built structure of its kind, nearly vertical at the back or water side, and stepped to a batter in front, with an unfinished course on the top of 6 ft. It has two iron outlet-pipes, with sluice-valves worked by screws, and a sludge-pipe. The dam appears to have been built in two parts, 18 ft. at first by Mr. Rawlins, with another 5 ft. added since by Mr. Davey, of Dunedin, who kindly lent me the plans. It was built for and is the property of the Roxburgh Amalgamated Gold-mining Company.

The section shows a height of 23 ft. and a base of 28 ft. The total cost of the whole structure I found rather complicated and difficult to obtain, but it is generally—or, rather, variously—stated to be between £3,000 and £4,000. Computing the quantities, however, from Mr. Davey's section, and the contract prices furnished by him, it should have cost about £3,650; so that the recent offer of the company to dispose of the dam for £6,000 and the reservation intact of the existing rights in the reservoir to the company, it seems to me, should not be accepted.

The company hold a prior right to the water in the lake, and, in addition, there are no less than thirteen existing rights, with a total of 184 Government heads of water. It therefore appears that if the water is continuously drawn upon to this extent it is a question whether, except in times of an abnormal flood of melting snow or rainfall, the lake-level would remain at another 10 ft. over such a large area as 1,500 acres.

Attached is a plan of the lake and a cross-section of the existing dam with the proposed addition shown of 10 ft. The base is sufficiently wide and strong to carry this at the same stepped batter with a width on the top of 6 ft., and an extension of the outset or plinth for the lifting-gear for the sluices of 2 ft. on the top.

The dam in its present form should not, in my opinion, be raised more than 10 ft., and I estimate the cost of that addition at £1,260. This is not a large amount for such work if it could be shown that the mining interest generally would be benefited thereby, but I cannot help thinking that the only gainers under the circumstances would be the Roxburgh Amalgamated Gold-mining Company and the owners of the existing prior rights.

Lawrence and Upper Waipori.

From Miller's Flat to Lawrence along the road there are numerous fruit farms and gardens, which seem from their appearance to be well watered by the creeks and streams running in the gullies from the foot-hills, and from inquiries I found there was no great demand for water for irrigation purposes.

At Lawrence the only demand I heard of for mining purposes was a desire for a dam up the River Beaumont to work the river-bed and auriferous terraces in the vicinity. By report, a dam would be required 45 ft. in height and 140 ft. in length to form a reservoir of about 800 acres. A race three miles and a half in length would bring the water on the ground at a 700 ft. elevation. There are several existing prior rights above the dam to be considered.

As I had determined to push on to Upper Waipori, where it was reported water was required for mining, I did not inspect this site.

I may here mention that the Blue Spur Company own several small dams in the surrounding hills, from which water is drawn for working the claim, which had stopped operations through the pipes and boxes being frozen.

Upper Waipori.

There is a demand for water here, and on arrival I was told of a suitable site in Long Gully, about five miles from the township, the water depending on melting snow and a small stream running about one head and a half, with a fair watershed and drainage-area. It is reported to be a narrow rocky gorge, opening out behind in a small flat, in the usual manner in these places. I regret to say that I could not go up to inspect it as the hills were enveloped in a dense mist, and, being advised the weather would be likely to continue so for several days, to avoid useless expense in horse-hire, &c., I returned the same day to Lawrence.

The OPQ and the Blue Spur Companies hold prior rights to the head-waters of the Waipori River.

Conclusion.

It will be gathered, I think, from the foregoing that water is, both for mining and irrigation purposes, urgently required in Central Otago. The numerous prior rights monopolizing the water in all the principal creeks and streams is a serious drawback in the way of even any moderate system of water-conservation, involving as it would the extinguishment of rights either by purchase or compensation. Still, I am inclined to think that for mutual benefit there are instances in which equitable arrangement may be made, so that the owners of existing rights shall receive their granted number of heads of water and, in addition, the advantage of a supply from conservation in the dry time of year. That the conditions have not been complied with in many cases I am sure there is little doubt, and after a searching investigation they could be cancelled.

Speaking generally, it may be well to mention that, of the two, although both are of great importance, I think water is required more for irrigation than mining.

WESTLAND.

Wylde's Water-race, Wainihinihi River.

According to instructions to report on the Rimu and Back Creek Water-race, and the proposals of Mr. James Wylde for purchase of his rights in the Wainihinihi River in connection with a projected race to suppement the water-supply on the Kumara Goldfields, I proceeded to Kumara and consulted with Mr. Aitken, water-race manager, on the subject.

After an examination of the plans, &c., it was not considered necessary—as the line would have to be cleared for the purpose—to make a personal examination of the ground.

Briefly, the proposed race is intended to connect with the Government dam and water-race system, and a preliminary survey has been made of the route about 154 chains in length, with a grade of 8 ft. to the mile, and it is claimed to deliver 116 sluice-heads of water for twelve hours daily. The construction of the race presents no special difficulty, with some exceptions of precipitous rock-cutting and loose sidings, and the average amount of fluming. The termination

of the race, however, crosses the boundary of the Waimea-Kumara Water-race Reserve, and encroaches thereon to the extent of about six chains to enable a connection with the Kawhaka Creek about three miles and a half above the main dam. This connection appears to be the only object, for there is no known auriferous ground within many miles of any portion of the race.

Quoting from a report by Mr. Aitken, "The water-rights held by Mr. Wylde would be valuable for augmenting the supply in the Waimea-Kumara Water-races, but for no other purpose, and the race has been marked out with apparently that intention, and not for the purpose of bringing in an independent race to work any known auriferous ground." Again, he says, "There has been no outlay of money on the race by any one, except expenses of preliminary survey and applying for the rights." The conditions of the Act have therefore not been complied with.

The question seems to be, setting aside the point raised of legality of entrance on the reserve to form the connection, whether the water from this source is wanted now, although perhaps in the future the race may be of value to the district. By means of the new substantial timber byewash at the Loopline Dam, which is now nearly completed, the present level of the reservoir can be raised 18 in. at least, or even 3 ft. with safety, without adding to the embankment, by closing the sluice-doors. This additional level, spread over such a large area, will enormously add to the daily supply in dry seasons. At the time of my visit the surplus water which can now be stored was running over the byewash.

Mr. Aitken also has another inexpensive scheme for increasing the supply in this reservoir—costing about £1,000—by bringing in the water from a neighbouring creek which is now running to waste; and, as Mr. Wylde's proposals have now been declined, I recommend this scheme as worthy of favourable consideration, in the event of more water being immediately needed.

Looking to future requirements for opening out new claims, another race is in view which would be a more valuable addition to the present supply, as it would divert the headwaters of the Arahura-Wainihinihi into the Kawaka watershed. No survey has, I believe, yet been made, but it is known that the saddle, over or through which it would pass from the one watershed to the other, has the advantage of being 100 ft. lower than the Kawhaka saddle, through which Mr. Wylde's race would be brought.

In conclusion, I need only refer to former remarks in Otago Central reports on the necessity for investigation of existing rights held by individuals who have not complied with the conditions under which those rights were granted, and retain them greatly to the detriment of any general scheme of water conservation, in many instances evidently for no other object than anticipating ultimate pecuniary benefit.

Kanieri Lake and Back Creek-Rimu Water-race.

From Kumara, I arrived at Hokitika 1st July instant, and placed myself in communication with the Mayor, and next day, in company with Hon. J. A. Bonar and Mr. Stains, County Chairman, drove to Kanieri Lake.

Being requested to check the surveys of Messrs. McFarlane and E. A. Lord, with a view of ascertaining if the water by this proposed race from the lake would command the terrace on the left bank of the Hokitika River, as represented by the reports, I determined to run a series of barometric levels back from the lake at the race intake at Sunny Bight, by way of the road to Kanieri and Rimu Townships to the termination or point of discharge on Seddon's Terrace, deeming that course, with an examination of the plans and sections, quite sufficient for all practical purposes, inasmuch as considerable time would be required to clean out and relevel Mr. McFarlane's line, which would really involve another survey. The levels had already been closely checked by Mr. Lord, who has large experience in the survey and construction of water-races, and proved to be practically correct.

It may here be mentioned that a previous survey had been made by Mr. J. A. Smyth, who found that the loss of fall by the circuitous route he took would prevent the water being brought to a sufficient level to work the higher ground on Seddon's Terrace. Mr. McFarlane, who came next, reduced the length and fall of the race by taking a more direct line, and using tunnels instead of following the contour of the country, and claimed to deliver the water on the terrace at an altitude sufficient to command the whole field. But to accomplish this, a part of his scheme was the raising of the surface of the lake 11 ft., by throwing a dam or weir across the Kanieri River at the outlet from the lake. Now, clearly, to raise the level of the lake for the only purpose of gaining elevation, and taking the water from the surface, would defeat the object, because the water conserved below the embankment henceforth would be useless. The lake, in my opinion, rather should be tapped at its lowest summer level, thus gaining the benefit of the 3 ft. natural rise, and then, if found necessary, the storage could be afterwards increased by raising a weir or dam. However, a few feet on the terrace either way is not of vital importance.

The total length of the race as surveyed from the lake to Handley's Dam, on Seddon's Terrace, is six miles and a half, and follows the firm line shown on the plan attached in ditching, fluming, and tunnelling to Bluebottle Terrace, and from thence across the flat and the Hokitika River to Handley's Dam in a siphon with a total fall including the hydraulic grade of the siphon of 79 ft. Now, ignoring Mr. McFarlane's 11 ft. elevation, and starting at O, the lake surface, I levelled down the road to Kanieri and across the bridge to Rimu Township, where we were joined by Mr. McKay and other miners interested in the field, and found that point 180 ft. below the lake level. Then that 180′ – 79′ fall of race = 101′ discharge above Rimu. Thence following the road on top of Seddon's Terrace a mile and a quarter to the southward of Rimu, found it 100 ft. below the lake level. Then that 100′ – 79′ fall of race = 21′ discharge above the top of the terrace. Crossing Arch Creek at Prospector Claim, about one mile beyond, still on top of the terrace near and above the level of Handley's Dam found it 50 ft. below the lake. Then taking first the fall of race of 79′ – 50′ = 29′ below the top of the terrace.

Many other readings were taken of course, but the three here mentioned are on the highest points of the top of the terrace, the point to be gained. There are several claims at about the same level as the last mentioned on the top of the terrace, O'Connor's, Leary and Stains', Balkan's, &c., all on what used to be known as Back Creek, but which is now either sluiced away or obliterated by tailings, &c.

Returning to the 29 ft. delivery below the top of the terrace near Handley's Dam there is this point to be considered: The average depth from the surface of the known auriferous gravel drift seems, from recognized authorities, to be between 75 ft. and 80 ft. all along the terrace. So taking the least at 75 ft.; then 75′ − 29′ = 45′ discharge above the bottom of the auriferous drift, which means, in other words, 101 ft. pressure from the head or intake of the siphon for sluicing down the upper face of the terrace: at Rimu, 231 ft. pressure to the bottom of the auriferous deposit; and at Seddon's Terrace, 151 ft. pressure, &c. A diagram is attached illustrating the above.

I think the above figures show that the water from the Kanieri Lake does command the terrace so far, at a fair working pressure for sluicing for a distance of a mile and a quarter to the southward of Rimu as far as Arch Creek on the top of the terrace, and, if the estimate of the depth of the auriferous drift from the ground surface be correct, a considerable area of ground near the top of the terrace for another mile beyond to Handley's Dam. Beyond this point again the top of the terrace rises towards Overlook Hill.

On the lower level several claims are being worked to good advantage with the limited supply of water available. Five parties along the terrace face between the upper and lower roads are sluicing and breaking good ground, others are tunnelling and slabbing in anticipation of a better supply of water being laid on by the construction of the race. There is abundant tailing room on the flat at the foot of the terrace, and plenty of fall for the ground proposed to be sluiced. The promoters of the race have acquired the right to take 150 sluice-heads of water from the lake, eighty of which it is proposed to convey to the terrace by means of the race. Grimmond and Company have a special claim of 100 acres at Handley's dam, and they have also acquired the race constructed from it.

Mr. McFarlane says, referring to the auriferous nature of the terrace: "The bulk of this ground has been prospected by shafts sunk in various localities, some being over 150 ft. deep, and from information received from the miners who have sunk some of these shafts, as well as from prospects personally tried by myself, I am confident that the value of the dirt throughout the 1,300 acres for an average depth of 75 ft. may be taken at the low estimate of 4d. per cubic yard. This would give the value of the gold to be won £2,621,000 sterling."

Mr. Lord says: "The extent of auriferous ground commanded by the race is about 1,280 acres of deep ground in the vicinity of Back Creek, Rimu, and Brighton Terrace. Besides this there is room for future extensions right down to the sea beach."

Mr. Alexander Aitken says: "The area of auriferous ground in the locality referred to (*i.e.*, Seddon's Terrace) is not less than 1,250 acres, and future working will in all probability extend that area. A low estimate of the depth of the material—most of which contains gold—to be sluiced away on that area would be 75 ft. The quantity of material to be sluiced away would therefore be at least 121,000 cubic yards per acre." Again: "Besides the ground in the neighbourhood of Rimu, the proposed race will pass through a large and extensive belt of auriferous country between Lake Kanieri and the valley of the Hokitika River, portions of which are now being worked. There are workings at Butcher's Creek, Coal Creek, and right hand branch of the Kanieri River, all of which are crossed by the line of race, and fair prospects have been obtained at Blue Bottle Terrace. An area of more than 2,000 acres is commanded at this locality by the proposed race, and portions are known to be payable, and would be worked if water was available."

On the other hand Mr. J. A. Smyth, who made the first reconnaissance survey, does not give a very hopeful opinion of the scheme, both with respect to the area to be worked and the suitable position of the race. And Mr. H. A. Gordon, in the report on mines for 1893, says: "Water would have to be delivered at a height of 450 ft. above sea-level, in order to command the working in this locality." By actual levels it is now shown, however, that it can be done at an elevation of 358 ft.

Beyond the foregoing opinions there appears to be no data of the depth of the auriferous gravel or of its value, Mr. McFarlane being the only one who reports having made a personal examination.

It appears to me that there is a large area of auriferous ground to be worked towards the sea from Rimu. I have, however, no reliable data, the opinion is based upon statements made by members of the Miners' Association and other reliable judges, which although, perhaps, to a certain extent interested, I do not think should be altogether doubted. Opinions are very decided in the matter that if water is brought in profitable employment will be found for a large number of miners for many years; and, weighing the question in an impartial manner, I am of opinion that the construction of the race would be a desirable work in connection with a general scheme for water conservation on this goldfield.

The final conclusion I arrive at is: Although the proposed race will not command the whole of the highest parts of the top of the terrace, there is a considerable area of auriferous ground for a distance of two and a quarter miles along the terrace to the southward of the Rimu township that could be sluiced to advantage by water from the source in question, and that, after carefully considering the subject, I find there is no practical difference in the levels between Messrs. McFarlane, Lord, and myself, because my last barometer level of 50 ft. above the lake on top of the terrace agrees with their 350 ft. level at the race termination at Handley's reservoir, which is about 29 ft. below mine, thus showing our total fall of 79 ft. from Kanieri Lake coincide.

Ross United Gold Mining Company.—Race No. 1.

Receiving instructions by telegram, 3rd July, to report on drainage of Ross Flat, I left Hokitika for Ross, and met Mr. Ellis, acting-manager of the company, who wished me to accompany him up Donelly's Creek to inspect a site for a supplementary water conservation for sluicing purposes on the company's claim.

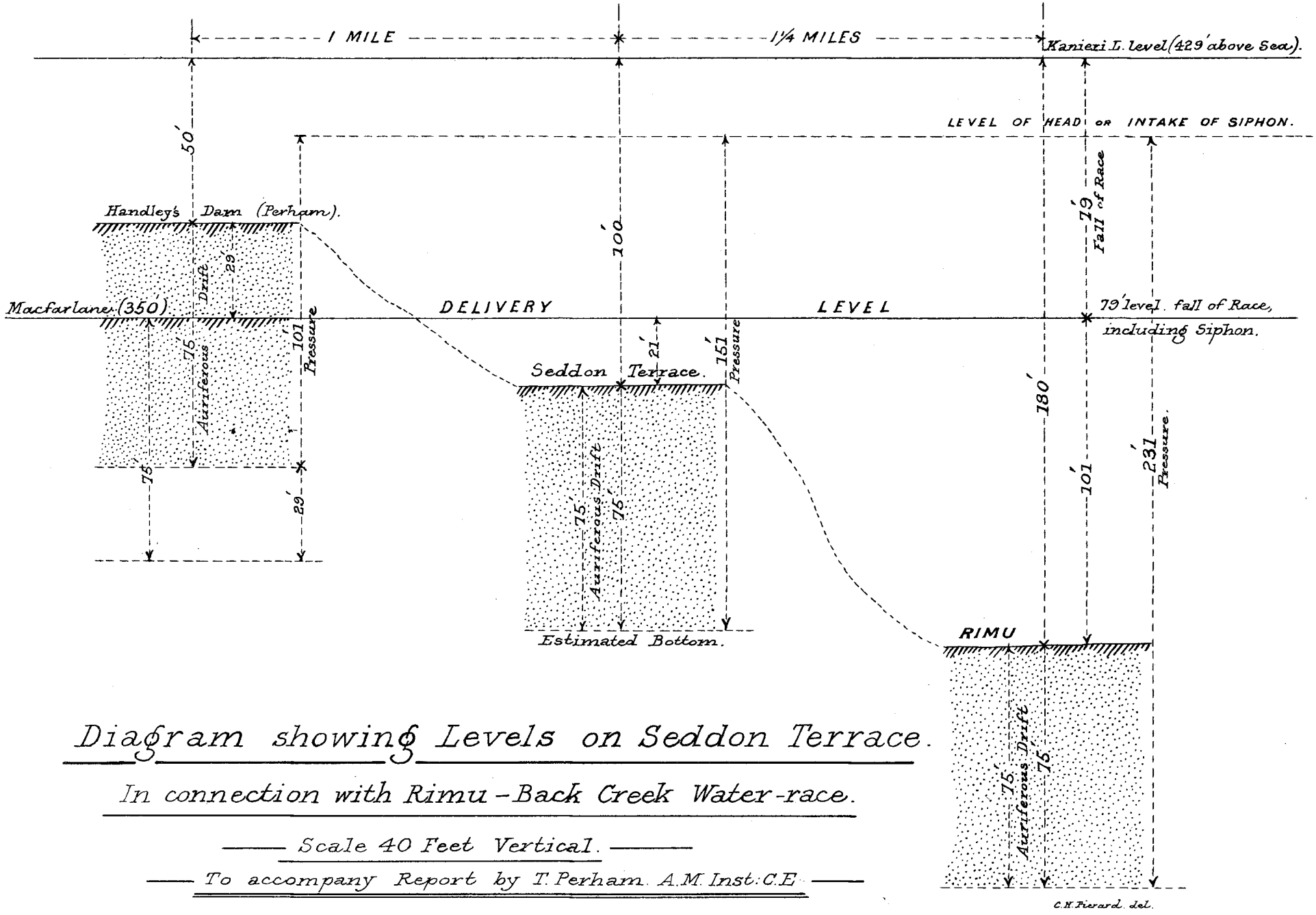


Diagram showing Levels on Seddon Terrace.

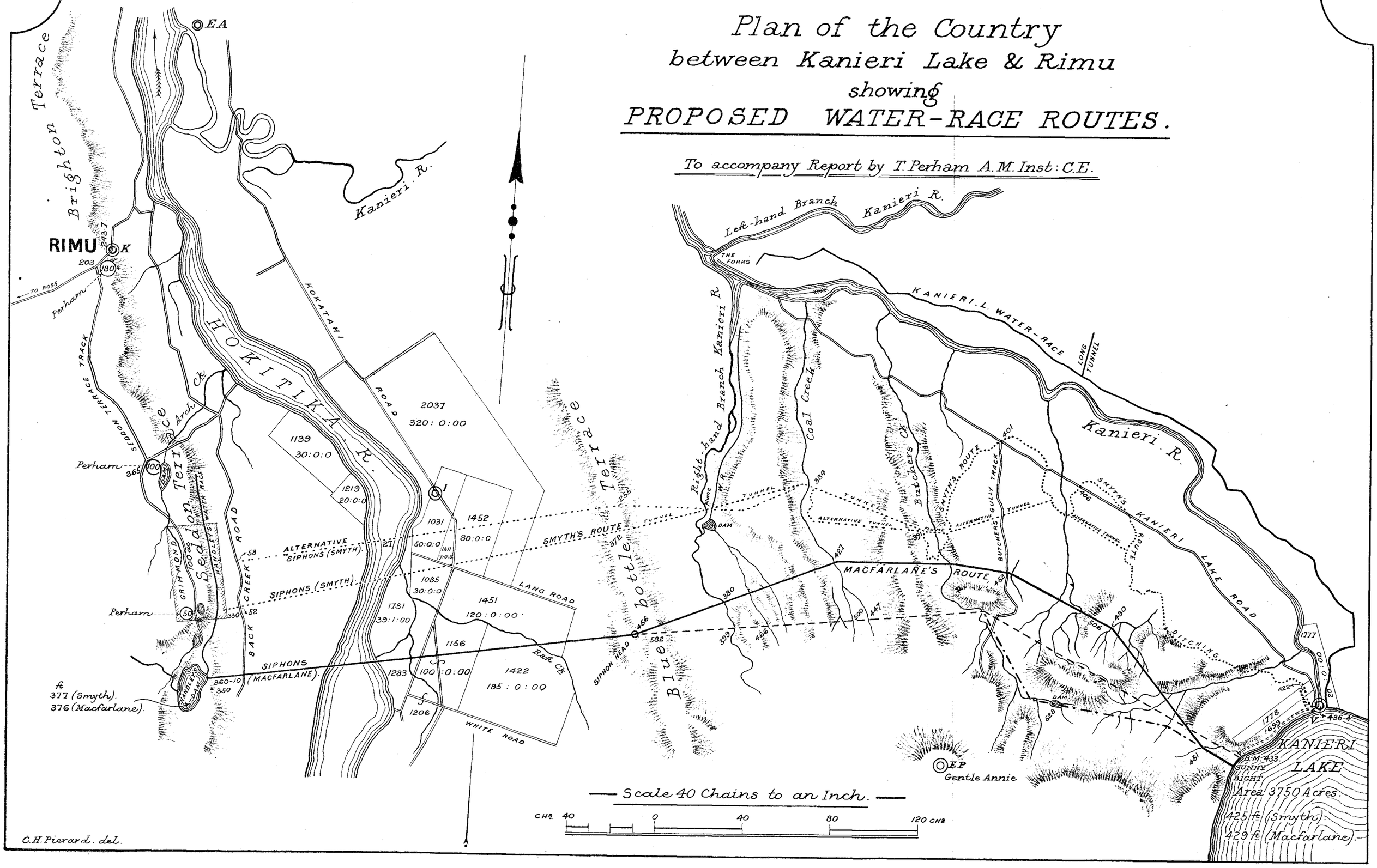
In connection with Rimu-Back Creek Water-race.

Scale 40 Feet Vertical.

To accompany Report by T. Perham. A.M. Inst. C.E.

Plan of the Country between Kanieri Lake & Rimu showing PROPOSED WATER-RACE ROUTES.

To accompany Report by T. Perham A.M. Inst: C.E.



C.H. Pierard. del.

At present a portion of the creek waters are diverted into a race about three miles and a half from, and 250 ft. above, Ross Township, and 370 ft. above sea-level. The race runs on the left bank of the stream, and is served by a small rough catchwater dam or weir, about 7 ft. high.

Although the present supply is sufficient, a larger amount of water is required to work the claims during the dry season, and it has been for some time proposed to construct a high earthen dam on the same site if the locality is considered suitable. The catchwater weir has been placed in a narrow gorge, rock-bound, in the best available position in the creek, and the head-race carries at a minimum two Government sluice-heads continually day and night in the dry season, and in flood-time the creek is reported to run as much as 240 heads.

It is a rapid heavily bouldered creek, with deep firm banks, and a considerable sum would have to be expended alone in preparation for the foundations of a strong dam. There is a fairly flat open space free of timber at the back of the Gorge, averaging about 5½ chains in width and 14 chains in length, and a dam 50 ft. in height would be required to impound the water with any serviceable utility at an average depth of about 20 ft. Looking up the gulley on the left bank of the Creek, the rock is almost perpendicular, and outwardly appears to be sound, but on the other bank is loose and broken, and slopes away from the creek at about 1½ to 1. All this portion I think would require to be cleared away to the bed-rock, not only for the core, but for the foundation of the dam itself. From the left bank of the Creek about 66 ft. of the dam would have a nearly uniform depth of 50 ft., then probably rising at an inclination of 1½ to 1 for 2½ chains, a mean depth of 25 ft., and a total length on the crest of 230 ft. Considering its size, however, it would be a comparatively inexpensive dam to construct; there being an abundance of good small gravel material and rock. The Creek-bed rises rapidly at the back of the proposed reservoir, and a small temporary dam could be constructed and a service-pipe with a good pressure brought down to sluice in the material. The dam could be constructed approximately for, if there is no trouble with the foundations, £3,000.

With reference to reporting on the drainage of the Ross Flat, there appears to have been some misunderstanding in communicating by telegram from Hokitika, because to have made such an exhaustive examination as the importance of the subject requires would have involved at least a month's work, a proceeding I knew at the time the department did not contemplate, or would be likely to approve.

I have, &c.,
T. Perham.

The Under-Secretary, Mines Department, Wellington.

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