



RINGAROOMA WATER-RACE.

I HAVE the honor to submit the Plans and Estimates for the Ringarooma Water-race, for which surveys were authorised by the Hon. the Minister for Lands and Works in March last. There are 40 sheets of plan and section, two miles on each sheet; one sheet of river gauge diagram, showing the daily fluctuation in the level of the river at Upper Ringarooma Bridge from 24th January, when the observations were commenced, to 11th October, the date of the last return; and the Mining Chart of the District, on which the centre line of the proposed race has been laid down.

In my preliminary Report to the Hon. Minister of 16th February, 1885, I stated the object of the scheme as "The diversion, in whole or in part, of the water of the Ringarooma River, and the construction of a high-level canal on the left or western bank to carry this water and maintain a constant supply to the alluvial tin-mining districts between the upper part of the Ringarooma and the country about Mount Cameron."

As explained in my preliminary Report, I, when making a forecast of the best site for the intake, the probable course of the race, and the levels it would reach at various points, had no information that could be absolutely depended upon, having to rely on close personal observation of the country, supplemented by aneroid levels. Under such circumstances it would not be surprising if, in a rough and heavily timbered country, considerable variations in route and levels were found. Such is not, however, the case; and a comparison of the scheme now submitted as the result of the survey with that originally sketched out by me will show that in all essentials both agree.

Two survey parties were employed on the work, one under Mr. F. A. Cutten, C.E., the other under Mr. J. T. W. Boys, C.E. I was most fortunate in having these gentlemen associated with me, and cannot speak too highly of the manner in which they performed their duties. Mr. Cutten was first in the field, and on his shoulders the principal burden fell, as his portion of the line lay altogether in the rough country and dense bush between the intake and Moorina, which made his work during the months of a severe winter most trying and laborious. His services in connection with the preparation of the estimates were also very valuable. Mr. W. P. Hays was employed as assistant under Mr. Cutten in running the traverse and check levelling.

From end to end the levels have been carefully checked; the line has been marked throughout with numbered pegs at intervals of 1, 2, or 3 chains, according to the nature of the ground; it is also well blazed, and bench marks to fix the levels for future reference have been established at about every half-mile. The traverse lines of the survey were run by compass, the boundaries of private properties being noted wherever observed. In many cases in the uncleared country these boundaries could not be recognised, and in such cases they have been transferred from the maps issued by the Lands Office.

My instructions for laying out the line were:—As a general rule not to depart from the winding contour, by taking short cuts through spurs or across gullies and creeks, but to run it round the projections of the one, and up to the heads of the other. The length of the survey line was thus much increased, but the information so obtained determined with precision where "cuts off" might with greatest advantage be resorted to by means of siphons or flumes across creeks, and passing through the spurs in excavated channels. The length of survey on the contour line was 80 miles 4 chains, but the length of race according to the present scheme has been reduced by "cuts off" to 57 miles 1 chain.

Since the 24th January, when I measured the discharge of the river, up to the 11th October, daily observations of the depth of water have been taken from the gauge I erected. These readings, which were taken by Mr. T. W. Gorey, the District Constable at Ringarooma, I have had plotted on the gauge diagram, which I annex to the plans. From this diagram the daily fluctuations in the supply can be seen at a glance. I have made an analysis of the diagram, with the following results, the period embraced being 262 days:—The minimum supply in the river was 121 "sluice-heads," and for 181 days the supply ranged between this and 217.5 heads, the calculated capacity of the race. For 81 days the river brought down a greater supply than this. Taking a "sluice-head" at 9000 gallons per hour in round numbers (it is actually 9038), the least discharge in 24 hours would be 26 million gallons, and the carrying capacity of the race 47 million gallons. Taking the Coliban Scheme in Victoria as a standard of comparison, it will be found how favourable the water supply of this Colony is for the development of its resources, as the Water Commission give the maximum supply of the Coliban as 20 million gallons.

The site selected for the intake is about 500 feet below the junction of the Maurice and Ringarooma rivers. The foundation of the weir is a flat surface of solid rock. The weir I propose to make 10 feet in height, and the crest of the weir would be at the same level as the line of full supply at the intake. The length of the crest of the weir would be 110 feet. The intake would be 170 feet above the weir, and 140 feet below the weir would be a regulating bridge across the race, with sluices to control the supply. Immediately above this regulator would be an escape channel to carry into the river any excess water that in time of flood might come down the head supply channel between the intake and the regulator. These works near the intake—weir, head supply channel, escape channel, and regulator—are classed in the Estimates in the item "head works," the race proper commencing immediately below the regulator.

The general features of the scheme can be most easily noted by referring to the Mining Chart of the District, on which the line of the proposed race has been laid down. On this the surveyed contour is shown as a continuous red line, with the distances for each mile marked up to 80 miles. The "cuts off," which effect a saving of 23 miles, making the actual length of the race 57 miles, are shown by dotted red lines. When I refer to mileage at any time, it must be understood that distances on the long contour are meant.

For the first 54½ miles a fall of 4.5 feet per mile has been adopted, with a depth of water 4 feet, race 10 feet wide at water level, and 6 feet wide at bottom, and a calculated discharge of 217½ sluice-heads. On this length a great saving of distance can be effected by "cuts off," of which there are many; the more important of them I shall note. From 11 miles 57 chains to 14 miles 26 chains, a distance of 2 miles 49 chains is cut off by a siphon 19½ chains long across Barclay's Creek. From 19 miles 53 chains to 21 miles 28 chains, 1 mile 55 chains is saved by a cut of 8.3 chains through a saddle; and near the faces of the Triangle and North Brothers' Home claims a tunnel 35 chains in length is substituted for the contour of 76 chains from 32 miles to 32 miles 76 chains. This tunnel I decided upon in order to keep the race clear of the upper edge of the North Brothers' Home face, close to which the contour line passed. The race at this point is about 190 feet above the level of the Ringarooma, and about 25 feet above the level of the Company's high race. Further down, in the vicinity of David's Creek, the survey shows the long distance that may be saved—about 10 miles on a contour distance of less than 12. From 40 miles 27 chains to 44 miles 71 chains, and from 44 miles 71 chains to 46 miles 71 chains, 6 miles 44 chains is saved by cutting through a spur for 25½ chains and a siphon of 23 chains; and 47 miles 70 chains to 52 miles, 15 chains is cut off by tunnelling for 18 chains. The nature of the country on this section will not admit of the economical construction of storage reservoirs.

The proposed race will not interfere in any way with existing races. Of these there are two on the length I have referred to; both are the property of the North Brothers' Home Company, running from different sources, and at different levels. The proposed race passes above the intake of the Company's high-level race at the point on Boyd's Creek, from whence it derives its supply, and runs above it the whole way to the mine. The Company's low-level race, supplied by French's Creek, crosses the line of siphon at the "cut off" across Barclay's Creek.

About the 54th mile the level of the Boobyalla and Ringarooma water-shed is attained, and the country falls rapidly to the north in the direction of Mount Cameron. From 54 miles 20 chains to 54 miles 40 chains the line has been carried down a small creek, and from thence proceeds to the high land north of the mount, with a fall of 6 feet per mile. In this distance one long "cut off" will be noticed, from 57 miles 28 chains to 61 miles 20 chains, or 3 miles 72 chains saved by a cut through a saddle 13.7 chains long. From the 54th mile to the tail, at Gladstone, the capacity of the race has been calculated for 102 sluice-heads, having bottom width 6 feet, width at full supply level 8 feet, and 2 feet 6 inches depth of water. At 65 miles 55 chains commences the depression round the base of Mount Cameron, ending at 66 miles 60 chains. This distance, 1 mile 5 chains, it is proposed to cross by a wrought iron siphon, which would have the maximum pressure of a head of water of 125 feet, that being the greatest depth of the depression close to the down-stream mouth of the siphon. A projected race from the Boobyalla, shown on the Mining Chart as "Aikenhead's

Water-right," was surveyed to South Mount Cameron. The proposed line of race crosses this survey line of Aikenhead's, but has an advantage of level of about 60 feet. The section of the race I am now referring to is admirably adapted for the supply of storage reservoirs, running as it does close to the water-shed, and capable of throwing supplies into valleys on both sides that can be easily dammed.

In the last section, from the flank of Mount Cameron to the tail at Gladstone, a good deal of granite rock is met with on the line of the race,—there being hardly any rock, but soft slate, or rather schist, hitherto encountered. To avoid the expense of cutting a channel through the granite, I have estimated for $4\frac{1}{2}$ miles of surface fluming: otherwise the work on this section is very easy. The line winds round the base of the mountain and terminates in a branch of the Mount Cameron Creek, and at a level which, from all I can gather, will be satisfactory to the mining community, it being well above that of the Mount Cameron water-race. This section, like the last, is favorably situated for the supply of storage reservoirs.

In my first report I discussed at some length the question of reservoir accommodation, and see no reason to modify in any way the opinions I then expressed. The lower part of the district, from about David's Creek to the tail, offers a large number of suitable sites for reservoir construction, and thus differs from the upper country, where no good sites are to be found. These facts ought to tend to allay the fears so frequently expressed to me by many people in Gladstone, that water from this race would never reach so far, but would be all used in the upper country. Those above having no means of storage can only draw water during working hours, and must of necessity leave a large supply for the lower country. One question in connection with reservoirs I have discussed as much as possible with those interested, and my first suggestion on the subject appears to meet with general approval, *i.e.*, that the construction of all such works (except those for husbanding a supply for the race itself) need not be undertaken by Government, who might, in order to encourage private enterprise, sell water at a lower rate to the proprietors of reservoirs, who could take supplies at any time, and thus utilise water that would otherwise run to waste. If the race is ever constructed, a large reservoir above the intake will in the course of time, as the country becomes opened up, be almost a matter of necessity, in order to provide a full supply at all times. As I formerly pointed out, a splendid site is available a few miles above the intake. A narrow gorge through which the Ringarooma passes, on a rocky bed and with high granite sides, can be easily dammed; and, as the river valley above opens out to a considerable width, a large supply of water would be impounded each time the river is in flood.

A considerable length of wrought iron piping for siphons has been estimated for, as a substitute for very high flumes to cross deep gullies and the Mount Cameron depression. The use of pipes recommends itself to an engineer for the following reasons, in such cases,—saving in original cost, subsequent saving in repairs and renewals, and less liability to accident. In considering this question I had the advantage of being able to refer to the large amount of valuable information on the latest American practice, recently collected for the Government of Victoria by Mr. J. D. Derry, M. Inst. C.E., who, as Consulting Engineer, accompanied the Chairman of the Victorian Water Commission on his tour of inspection to America this year.

The question now arises, what improvements might be effected in case the construction of this work is ever taken in hand? Regarding the site of the intake, I am more than ever confirmed in the opinion that it should not be below the present proposed position; and, except on the ground of cost, would advocate its being taken higher. Instead of intercepting the united waters of the Ringarooma and Maurice, it would be quite feasible, given the money, to dam the Ringarooma some miles higher up, carry its supply into the Maurice by a new channel, at the junction of this with the Maurice dam the latter, and then start a race much above the level proposed. This would be quite a practicable scheme, but enormously expensive, and on this ground alone need not be further considered. The line would be generally improved by adopting a slightly less fall than 4.5 feet per mile down to David's Creek, but against this must be placed the fact that a decrease of fall means either a larger channel to carry the same quantity of water, or a less quantity of water carried in a channel of equal size. Taking all things into account, I do not see much room for improvement here.

On the length between Bradshaw's Creek and South Mount Cameron a very great improvement can be effected, as the survey shows. This section can generally be carried some 25 or 30 feet higher with advantage, and by so doing will be diminished in length, and allow a greater head to force the water through the long siphon near the mount. From Mount Cameron on to Gladstone no change will, I anticipate, be asked for, as the race has such a good command of country. If such is the case, no improvement in route can be expected.

In my first Report I briefly drew attention to the importance of maintaining intact the public right to the water supply of the country. I did so, as many years' experience as an official having to deal with this subject, and general familiarity with the laws of various countries on the question, had convinced me of the great necessity of not neglecting it. Since that time public attention in

these Colonies has been prominently directed to the matter by the Report on Water Supply in America, written by the Hon. A. Deakin for the Victorian Government, which shows the many evils that have arisen in various places owing to the neglect in the first instance of the various States to define and maintain the common right. The forcible recommendation of the Victorian Water Commission may be quoted with advantage:—"It is further desired to record the opinion of the Commission that 'It is essential that the State should exercise the supreme control of ownership over all rivers, lakes, streams, and sources of water supply.'"—(Royal Commission on Water Supply, Victoria: Progress Report, August 31st, 1885, p. v., par. iv.)

In conclusion, I would venture to express a hope that those persons with local knowledge, and who are in favour of or adverse to the scheme, would make themselves familiar with its general features and examine as much of the line laid out as possible. By so doing much intelligent criticism will be brought to bear that could not fail to be of the greatest advantage.

G. J. BURKE, *M. Inst. C.E.*

Collins-street, Hobart, 20th October, 1885.

RINGAROOMA Water Race.—Abstract of Estimate.

Nature of Work.	Quantity.	Rate.	Amount.	Remarks.
			£ s. d.	
Excavation in clay	cubic yards. 353,000	1s.	17,650 0 0	Chocolate soil and granite drift.
Ditto in rock	47,500	2s. 6d.	5937 10 0	Soft slate or schist.
Tunnelling	lineal yards. 1170	25s.	1462 10 0	"Cuts off" at North Brothers' Home and beyond David's Creek.
Wrought iron piping, 30"	feet. 11,960	12s. 6d.	7475 0 0	"Cuts off" across creeks, and depression at Mount Cameron.
High fluming	1395	22s.	1534 10 0	
Low fluming	5550	12s.	3330 0 0	
Surface fluming	24,083	4s.	4816 12 0	Instead of cutting channel through granite rock.
Fencing	miles. 5 $\frac{3}{4}$	£128	736 0 0	Through cleared land only.
Clearing line .....	...	...	2400 0 0	
Head works .....	...	...	1250 0 0	
Land .....	...	...	805 0 0	
Intermediate regulators & escapes	...	...	500 0 0	For cutting off supply to effect repairs.
Interception channels.....	...	...	300 0 0	For intercepting water from minor creeks crossed.
Works for measurement of water	...	...	1000 0 0	
Road crossings .....	...	...	300 0 0	
Cottages for staff.....	1000 0 0	
Surveys, superintendence, and engineering	3000 0 0	
TOTAL	£53,497 2 0	

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20th October, 1885.