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THE WATER-POWER OF THE GREAT LAKE:

REPORT BY ENGINEERING INSPECTOR OF THE CENTRAL BOARD OF HEALTH.

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(No. 59.)

THE WATER-POWER OF THE GREAT LAKE.

The Honourable the Minister of Lands and Works.

Sir,

I have the honour, in accordance with the promise made in my Report on the River Shannon, to submit to your consideration the following facts relative to the water-power derivable from the Great Lake.

Attention has often been called to the use that might be made of the great central lakes of Tasmania for the purpose of irrigation, but so far as I am aware no information has been published as to the very large water-power they could supply for industrial enterprise. A very few mills, worked by water-wheels, have been established on the banks of the rivers flowing out of the lakes; but under present conditions it is quite impossible for a riverside miller to secure a proper continuous supply of water, the quantity in the wet season being as much in excess of requirements as that in the dry season falls short of them. The object of this report is to show not only the immense water-power that the lakes can furnish, but also how easily and economically the supply can be regulated so as to insure a constant and continual sufficiency.

The Great Lake is the largest and the highest above sea level of the more important lakes of Tasmania. It is situated on the great central plateau of the island, about 93 miles by rail and road north-west of Hobart. Its watershed basin has an area of 225 square miles, of which 44 square miles are occupied by the lake itself. In Walch's Red Book its height above sea level is given—I cannot find out upon what authority—as 3700 feet. My observations with an aneroid, and checked as far as I was able by continual readings when stationary, and with the known levels of Tunbridge and Apsley Railway Stations, made the height above sea level 3281 feet.

The River Shannon is the only outlet of the waters of the Great Lake. It is about 30 yards wide at the outlet, where a rocky bottom prevents the lowering of the surface of the lake more than about four feet below high winter level. The Shannon has a meandering course of about 36 miles through hilly country to the River Ouse, of which it is by far the most important affluent. From the confluence the Ouse has a further course of about 30 miles to its discharge into the River Derwent.

The valley of the Shannon is a narrow one of an average width of about eight miles, and consequently the river has no large affluents. The most considerable one is the Blackman's Rivulet, bringing in the water of the Lagoon of Islands, which drains a watershed of about 24 square miles. This rivulet comes in at a point about 20 miles below the Great Lake.

My observations gave the Shannon a fall of 1485 feet in the first 21 miles of its course from the lake, or 70 feet a mile on the average. I am sorry that I could not go to the confluence of the Ouse and Shannon and obtain a level there. But some years ago I levelled up the Derwent Valley to the Ouse Bridge, and so can state that in the course of the Shannon and Ouse for the 45 miles between the place of which I have given the level and the Derwent there is a further fall of more than 1500 feet, or an average of 33 feet to the mile.

The yearly rainfall on the Great Lake during the five years 1890-94—the only years of which I have been able to obtain the records (and, unhappily, the rainfall observations have been discontinued), averaged 35·86 inches, and rain fell on an average upon 176 days a year. In these five years the least quantity of rain, 25·25 inches, fell in 1891, with 175 rainy days; and the greatest quantity, 46·70 inches, in 1893, with 190 rainy days. The following table shows the monthly quantity in each of these extreme years, and the mean monthly fall for the whole five years :—

Month.	Minimum year 1891. Rainfall. inches.	Rainy days.	Maximum year 1893. Rainfall. inches.	Rainy days.	Mean of five years. Rainfall. inches.	Rainy days.
January	2·31	15	4·75	13	2·06	10
February	1·83	12	0·43	5	1·51	7
March	0·19	3	1·86	8	1·86	8
April	0·94	12	3·52	16	2·57	14
May	2·78	11	4·99	17	3·09	13
June	2·40	25	4·44	26	4·80	23
July	3·07	20	9·42	28	4·23	23
August	2·24	13	2·44	17	3·48	18
September	1·39	20	2·39	21	2·36	17
October	4·60	20	4·85	15	4·23	18
November	2·38	13	3·08	11	2·60	12
December	1·12	11	4·53	13	3·07	13
Whole year	25·25	175	46·70	190	35·86	176

The rain-gauge was fixed, I believe, but a few feet above the surface of the lake; and, as in all probability more rain fell on the hills and higher grounds of the basin, the quantity registered may be taken as a low estimate of the actual rainfall of the watershed. The geological formation of the watershed is exclusively igneous, of the trap-rock series. Some of the surface is bare rock, and most of the rest has but a thin covering of soil with a good slope to the lake. Nearly all the watershed lies within five miles of the lake, and one-fifth of it is occupied by the lake itself. Under all these circumstances, it is reasonable to assume that if it be taken that three-quarters of the recorded rainfall reaches the lake, an ample allowance will have been made for loss by absorption, &c., but not for the loss by evaporation from the lake. If this be so, it means a depth of nine feet of water over the whole surface—a quantity that would give a mean daily outflow by the Shannon of 1,432,000 cubic yards.

Of the evaporation that has to be allowed for it is impossible to speak accurately without special observations, and none have been made. The facts bearing on the matter are, as far as I know them, the following:—That, though there are high winds, these are not often dry winds, as the country to the east, north, and west of the basin has more rainfall than the basin, and the winds from the south are not dry winds; the lake lies, as has been mentioned, about 3300 feet above sea level; rain falls on an average on nearly half the days of the year; there are frequent clouds and mists; and the mossy turf and timber indicates a prevalent wet condition of the air. Under these circumstances the evaporation from the surface of the lake probably varies from a maximum of 0·10 inch a day during the first three months of the year to a minimum of not more than 0·025 inch a day in June and July; for, as a matter of course, the evaporation is greatest when there is the least rainfall, and *vice versâ*.

We can now consider the supply that can be depended upon if the water-power of the lake is to be utilised. The following table is arranged to show the mean daily discharge from the lake during each month, based on the preceding table, and on the assumption that a quantity equal to 75 per cent. of the registered rainfall reaches the lake, and that the loss by evaporation from its surface is 0·10 inch, = 378,600 cubic yards a day in January, February, and March; 0·075 inch, = 273,950 cubic yards a day in April, November, and December; 0·05 inch, = 189,300 cubic yards a day in May, September, and October; and 0·025 inch, = 94,650 cubic yards a day in June, July, and August. When the rainfall is not sufficient to supply the evaporation the deficiency is given as a *minus* quantity. The *minimum* column shows the daily quantity for each month of 1891, when, as already said, the least yearly quantity of rain fell; the *maximum* column shows the same for 1893, when the greatest yearly depth fell; and the *mean* column the average daily quantity for the whole five years, 1890-94.

Mean Daily Discharge in cubic yards.

Month.	Minimum year 1891.	Maximum year 1893.	Mean of Five years 1890-94.
January	703,000	1,846,000	586,000
February	571,000	— 155,000	405,000
March	— 288,000	493,000	493,000
April	181,000	1,430,000	970,000
May	1,111,000	2,153,000	1,258,000
June	1,067,000	2,059,000	2,229,000
July	1,343,000	4,317,000	1,886,000
August	954,000	1,048,000	1,535,000
September	483,000	967,000	953,000
October	1,965,000	2,082,000	1,792,000
November	878,000	1,217,000	984,000
December	250,000	1,847,000	1,164,000
Whole Year	768,000	1,621,000	1,190,000

I may mention incidentally that when I was at the Great Lake last month I roughly gauged the outflow by the river at a place where there were great facilities for doing so, and though the past winter was described as having been exceptionally dry, and the month had certainly been so, the water was flowing out at the rate of more than 2,900,000 cubic yards a day. Of course, part of this large outflow was due to the still continued melting of last winter's snow on the higher grounds of the basin.

In fixing the water-power that can be depended upon as constantly available it must be borne in mind that one inch in depth over the whole surface of the lake would supply an outflow of 3,786,000 cubic yards; and this shows the great advantage of having so large a reservoir at the head of the water supply of a river. At present, when the lake is at full winter level, about four feet of the top water can be drawn off by the Shannon. At a very small outlay the channel could be deepened so as to make six feet in depth of water available, constituting a reserve of over 272 million cubic yards. And then to utilize the lake as a reservoir to store the excess rainfall of the wet months for use in the dry, it would be necessary to control the outflow by means of a weir with proper sluices, and this would not be an expensive work, as the Shannon, at its outlet from the lake, is exceptionally favourably conditioned for the purpose. A weir of less than 40 yards in length and three yards in height would be sufficient. The bottom of the river is rocky, and affords a good foundation, and one that would not be affected by the wash of the overflowing water.

If these works were carried out at the Shannon outlet, a constant outflow of 1,100,000 cubic yards a day could be counted on; for in the minimum year in the above table there appears a daily deficit of only 332,000 cubic yards from that quantity, or a total deficit of 121,000,000 cubic yards for the year—a quantity that could be supplied from the lake without lowering its surface more than 32 inches; so that the reserve in the lake would supply the deficit of two consecutive years as dry as 1891.

Eleven hundred thousand cubic yards of water a day falling 70 feet in a mile represents a total of 2723 horse-power a mile, or over 57,000 horse-power in the first 21 miles of the Shannon; the remaining 45 miles of the Shannon and Ouse, with the diminished fall of 33 feet to the mile, would give a total of 57,000 horse-power more. Of course, the whole of these totals cannot be made available, but with properly constructed turbines a very large per-centage of them could be. And this enormous power is produced by the utilization of the water of the Great Lake alone, without counting the probably larger quantity of water that flows down the Ouse.

To assist in forming a proper estimate of the value of this important asset of the wealth of the colony, will you permit me to call your attention to an article on the growing importance of water-power as a source of national wealth and prosperity, which appears in the *Spectator* of the 4th of September. The writer of the article says—"The closing years of the nineteenth century—a century which has been so full of change, and marked by progress in so many directions—are ushering in a change perhaps more important in its significance for our own country than any that has preceded it, even in this century of progress. The change is foreshadowed by the striking developments of water-power for industrial purposes that have been witnessed in both Europe and America during the last six years—developments which would appear to point to the substitution of water-power for steam-power at some future date, and to the transfer of the chief manufacturing industries from those countries rich in the possession of coal to those rich in the possession of this modern rival of coal—namely, water."

After pointing out in connection with this development the important influence that the use of turbines instead of water-wheels has had upon it, and the still more important results that have followed the modern system of converting by the dynamo the mechanical energy of the turbine into electrical energy and its transmission to be reconverted into mechanical energy that can be used where the power is required—so that mills and factories need not be situated on the banks of the stream in a secluded spot at a distance from means of communication, the writer goes on to show that in America the total of the larger installations is 72,000 horse-power, with the prospect of increase to 150,000 when the Niagara scheme is completed; Switzerland comes next with 32,000 horse-power, to be increased to 48,000 by further works on the Rhine; France has 18,000 horse-power, to be increased to 30,000; Italy has 18,000; Norway and Sweden, 20,000; while England and Scotland have only 4000.

From all this it appears that, in connection with the Great Lake alone, Tasmania possesses capabilities that if utilized would put her into the front rank of industrial communities employing the most economical of all sources of motive power—water.

I think I have shown enough in this Report to prove the desirability of having complete detailed surveys with levels made of the Shannon and lower part of the Ouse to show not only the actual fall that may be obtained, but also the most convenient sites for utilizing the fall so that a proper scheme could be set forth to employ the available power to the best advantage; and furthermore, that proper publication could be made, not only in Tasmania but elsewhere, of the enormous force that is awaiting profitable employment.

I have the honour to be,

Sir,

Your obedient Servant,

A. MAULT,

Engineering Inspector of the Central Board of Health.

Hobart, 22nd October, 1897.

WILLIAM GRAHAME, JUN.,
GOVERNMENT PRINTER, TASMANIA.