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By His Honor's command,
J. C. RICHMOND, Provincial Secretary.

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Provincial Secretary's Office, Nelson,
March 10, 1865.

HIS Honor the Acting Superintendent directs the publication of the following Report, for general information.

ALFRED GREENFIELD,
Chief Clerk.

Provincial Engineer's Office, Nelson,
January 26, 1865.

The Provincial Secretary, Nelson,

SIR—

Having by direction of his Honor the Superintendent visited, in company with Mr. Burnett, the cities of Sydney and Melbourne, for the purpose of inspecting (amongst other business) the waterworks at those places, and of obtaining information that might be useful and applicable to the proposed water supply of Nelson, I have the honor to forward the following report descriptive of these works.

We were furnished with letters of introduction to the Commissioner of Public Works at Melbourne, who freely offered us every facility in furtherance of our enquiries, and also introduced us to the Engineer of the Waterworks, Mr. C. Taylor, who took the greatest pains to show and describe everything of importance connected with the water supply. He accompanied us to the Yan-Yean, where the large reservoir is situated, and also to the Preston reservoir, minutely explaining everything of interest.

In Sydney we had no difficulty in seeing all that we required connected with the waterworks, and were freely furnished with any information we desired.

Without further introductory remarks I shall at once proceed to the description of

SYDNEY WATERWORKS.

The City of Sydney is supplied with water from Botany Bay; the water is obtained from what appears to be a swamp or lagoon of fresh water, separated from the salt water of the Bay only by a narrow sand bank.

From this latter circumstance it would appear, at first sight, that the water must inevitably be brackish, but it is not so in the slightest degree.

This may be accounted for by supposing that a powerful spring of fresh water exists in the swamp itself, a supposition which is strengthened and confirmed by the fact that with the full power of the pumping engines, employed for a length of time, they are unable to reduce the water in the swamp below a certain level, viz.: about 2 feet below the overflow weir.

Alongside of the swamp are the boiler and engine-houses, the latter containing three engines which are employed in pumping the water from the swamp to a reservoir elevated 140 feet above the sea level, and also to an overflow beyond at an elevation of 216 feet above the sea level.

Each engine is of 70-horse power, condensing, with a cylinder of 58 inches diameter, and 8 feet stroke, and makes 11 strokes per minute, with a pressure of steam 25lbs per square inch, and working a pump of 2 feet diameter and 8 feet stroke.

Two of these engines are connected to one crank shaft and fly-wheel, but may be worked separately, as they usually are, except on Saturdays, when both are worked at a speed of six to eight strokes per minute, in order to fill the reservoir quickly, and enable them to stop in the afternoon. The third engine is quite separate and independent, and kept as a reserve in case of accidents to the others; each pump will throw about 144 to 150 gallons every stroke.

There are six boilers, each about 8 feet diameter and 24 feet long; two only being used for one engine.

The banks of the swamp are piled round where necessary, and at the lower end is a waste weir 8 feet wide, and a safety weir with flood gate about 8 feet wide, which can be lifted in time of heavy floods:—The weirs are built of solid masonry in cement, laid on a sandstone rock bottom, the outfall of the safety weir being planked over for about 20 feet; the salt water at high spring tides flows against the outside of the floodgates.

The main delivery pipe from the engines to the reservoir is 30 inches diameter inside, and from 1 inch to 1⅛ and 1¼ thick; its course is nearly straight and its length about 4½ miles.

At Crown-street, Surrey Hills has been excavated out of the hill, the reservoir, which will hold about 3½ million gallons, is 20 feet deep, lined with English bricks, (no clay being obtainable near Sydney fit for the purpose,) laid in cement and backed by puddle.

The walls are upright, and the reservoir is divided in the centre by a wall, built up to about 3 or 4 feet below high-water level: the whole is arched over with brick arches, covered with gravel and soil, and sown with grass, the area on the top being used as a store yard for pipes, &c.

From this reservoir the pipes proceed to the top of a sandhill, near Botany Street, a further elevation of 76 feet or of 216 feet in all; and terminate merely in an open mouth, from which the water is pumped twice a day, each time for about 20 minutes, the sluices leading to the reservoir, being shut meanwhile:—during this time those persons who dwell on the higher levels must obtain their half-day's supply.

In the 30-inch main are three check valves of vulcanised India-rubber, 1 inch thick, at 30 feet, 80 feet, and 200 feet elevation, to check the tendency of the water to flow back, and to take the weight in a measure off the engines, and ease the concussion which occurs at every stroke.

The main pipes in several places on low ground are banked over with earth instead of being sunk in the ground to the required depth, in some places they are roofed over with wood. When crossing small streams they are held up by means of iron straps secured to strong wooden frames.

Where an opportunity occurred of observing the main pipes, I noticed that they were socket-pipes turned and bored at the ends, and requiring only a little tallow and whiting to joint them.

The elevation of the reservoir is sufficient to supply nearly all the thickly inhabited portions of Sydney with water, even in the upper stories, and, on the completion of the second reservoir, for which, I believe, a site has been chosen, all parts of the city will receive a constant supply.

The details of the street mains, house-services, street-watering apparatus, and fire-plugs, are much the same as those in Melbourne, which will hereafter be more fully described.

The streets in Sydney are well supplied with drinking places, the pipes for which are attached either to the cast-iron lamp-posts, or to cast-iron pillars erected for the purpose; many of these have also troughs for horses.

The charge for the supply of water in Sydney is according to the number of rooms in the house, and the present charge per annum is five shillings per room.

The water is supplied as it is pumped from the swamp, only passing through the reservoir, but it is not filtered in any way: nevertheless it is clear and tasteless.

Whilst in Sydney we took the opportunity of inspecting a dam of masonry built near Paramatta, a town about 14 miles from Sydney, for the purpose of impounding the water in a narrow rocky gully, and from thence obtaining a supply for Paramatta and its neighborhood.

Although the dam has been completed for several years, it is unfortunately the only part of the scheme that is so, as want of funds apparently prevents the completion of the remainder of the works.

The dam is a very beautiful solid piece of work, of freestone blocks, laid in cement, and is built in the form of a horizontal arch, the ends abutting against the rocky sides of the gully. It is about 220 feet long, 30 feet high, and about 9 feet wide at top, and 25 feet wide at bottom, and has two cast-iron discharge pipes through the bottom of it, fitted with sluice valves, and ready for the connection of the main pipes.

The cost I have heard stated at £15,000.

This method of constructing dams I have seen strongly recommended by some engineers, and where the sides are rocky and the width of the valley small, I think it must answer well, forming a really permanent structure. Having had in view the application of this principle in connection with Nelson Waterworks, I was pleased to be able to inspect a practical example of it.

Melbourne Waterworks.

These were completed December 31st, 1857. The water is supplied from the Yan-Yean Reservoir, situated at a distance of about 19 miles from the town, measured along the line of pipes.

The reservoir consists of a flat valley in the Plenty Ranges, across the mouth or lower part of which a dam has been constructed more than half a mile in length (1,053 yards), and about 31 feet in perpendicular height: thus impounding an area of water of above 1,400 acres, at an elevation of 640 feet above the sea level.

Besides the natural drainage from the basin formed by this valley and all its tributaries, there is another source of supply provided from the River Plenty, which flows on the other side of a range of hills bounding the first named valley.

This range of hills has been pierced by a tunnel, and beyond the tunnel a channel has been cut two and a half miles to the River Plenty. By means of this channel the waters of the river are brought into the reservoir when clear and pure, but shut out when muddy and impure by floods, by means of proper flood-gates, &c.

The water in the reservoir is thus continually changed, as besides what flows off to supply Melbourne, large quantities are let off by the discharge pipes provided for that purpose, through the bottom of the embankment. The supply of water thus provided may be said to be almost boundless, as a whole week's lavish consumption of water would only reduce its level in the reservoir by about two inches.

The width of the embankment, which is of earth and clay, containing a puddle wall in the centre, is at top about 20 feet and at the bottom about 170 or 180 feet; the outer slope is 2 to 1 covered with turf, and the inner slope 3 to 1 pitched or faced with stone from top to bottom grouted with cement. The puddle wall in the centre is about 10 feet wide at top and 30 feet at bottom.

The size of the main pipe as it leaves the reservoir is 33 inches diameter inside, reduced at certain distances to 30 inches, then to 27 inches, and to 24 inches when it arrives in Melbourne.

It is one inch thick all through, and it is constructed with socket joints, made water-tight in the usual way by pouring in melted lead, a ring of hempen rope or spun-yarn being first caulked in all round.

This kind of joint is used throughout all the mains, large and small.

At Preston, a distance of about seven miles from Melbourne, the main is made to discharge the water, at pleasure, into a service reservoir 300 feet above the sea level, and capable of containing about 13,000,000 gallons.

This reservoir is dug partly out of the solid, and partly embanked, about 21 feet deep; the outer slopes 2 to 1, grassed, the inner slopes 1½ to 1 pitched with stone, the same as in the larger reservoir. The average length is about 545 feet, and the breadth 212 feet.

From this the supply for the town is usually drawn, it not being desirable to have the full pressure due to the height of the main reservoir continually in the pipes; but the full pressure can at any time be put on, by cutting off the connection between the main pipe and the small reservoir, (for which proper provision of sluices, &c., is made,) and allowing the water to flow uninterruptedly to town the whole way.

As the main pipes approach the town, they are made to branch off into smaller mains to supply the different districts, and these are again branched off into the different streets; the street mains varying from 3 inches upwards.

In the broad streets the mains are laid on both sides, just outside the foot-paths, and in the narrow streets one main only is laid, and that in the centre; fire plugs being introduced (on both sides in the main streets) about 50 yards apart.

These are, besides being used in case of fire, made serviceable for the purpose of watering the streets, an operation carried on to a great extent in Melbourne, during dry and hot weather; so much so that the waste water, with that lost by leakage in various places, forms continual streams running all day down the open water channels on both sides of the streets.

It has a wonderfully cooling effect on the atmosphere of the town, and by removing large quantities of refuse which might otherwise lie in the streets and become a nuisance, must conduce largely to the health of the town, in the absence of a proper and efficient system of underground drainage, which, although it has been proposed, has not yet been commenced with.

The houses are supplied from the mains either through leaden pipes or galvanised iron pipes, the Government laying the pipes to within one foot of the house front, or line of street.

A peculiar kind of cock is used under the high pressure system of supply; it consists of a brass shell very much like an ordinary water-cock in outward appearance, but containing a circular opening, covered by a flat disc, which is moved by a screw having a handle at the top: by this means the disc is necessarily lifted very gradually, and closed in the same manner, thus preventing all concussion in the pipes which would otherwise occur by a quick closing of the aperture, such as takes place in an ordinary cock. No cisterns are required in the houses, as the water is continually laid on.

The streets of Melbourne are well supplied with drinking places, mostly connected with the lamp posts, in which the supply pipe and cock are concealed and protected, and each of which is fitted with an iron ladle and chain.

There are also cast iron drinking fountains in the streets, but not in any great number; drinking troughs for horses are very numerous, in fact nearly all the hotels both in town and country have them in front of their doors.

The supply of water at such a high pressure is found to be of the greatest service in the case of fires, and as before explained the fire-plugs in the main streets are so numerous, that a hose-pipe can be attached at almost any point as close to the site of the fire as may be desired.

The effect of the water being driven against a burning house or store, with such force and velocity is described as being more to *beat* out the flames than to *quench* them with the moisture.

Such is the certainty of success with which the "Yan Yean," as it is popularly called, can be brought to bear on a recently discovered fire, that people do not insure their property to the extent they formerly did, and the insurance offices feel this to a serious extent.

The same apparatus is used for subduing a fire as for watering the streets; it consists of a brass pipe made like the letter T, the lower end of which can be rapidly attached to the fire plug by means of a screw, and to either or both of the heads of the T hose-pipes can be screwed in the usual way.

I had not an opportunity of inspecting the equipment of the fire-brigade, but it was described as being very simple, and consisting principally of a large-wheeled truck fitted with a revolving reel on which are coiled the Vulcanized India Rubber hose-pipes in so many lengths already screwed together.

The supply of water to individual consumers in Melbourne is unlimited, and it is certainly used *freely* and almost *lavishly* by every one: besides this there is a considerable amount of continual waste, by the leakage of pipes and cocks in different premises, and over which constant inspection cannot be exercised.

There is also a large quantity of water used in the Botanical Gardens and Public Parks, for irrigating the trees and plants, and in ornamental fountains.

During hot weather, especially in the afternoons, the demand on the pipes from all quarters is so excessive, that houses on high levels are not able to obtain an adequate supply at these times, the theoretical pressure in the pipes being so very much reduced by the large consumption which is taking place.

This reduction of pressure amounts sometimes to more than 75 per cent in certain places, and arises from the fact that the size of the main is not sufficient to transmit the quantity of water required on these extraordinary occasions.

This has been made the subject of a Government notice, requesting the consumers of water to be as careful as possible in their use of it—for although the supply in the reservoir is almost *unlimited*, the main pipes cannot deliver it quickly enough into town. The notice goes on to state that the daily consumption of water in Melbourne for a population supplied of about 150,000 is 10,000,000 gallons, more than equivalent to the total daily supply to the inhabitants of London, numbering between two and three millions.

Of this total daily consumption, 1,000,000 gallons are consumed in watering the streets.

The water in the Yan Yean reservoir was at first not very clear or pure, owing to the large surface of dead and growing vegetation covered by the waters after closing the embankment. This was gradually decomposed, and the water for a time thereby became discolored and impure. However, this is not now the case, and the water supplied to Melbourne, without being filtered, is both clear and tasteless.

The whole cost of the Waterworks is stated to have been about £800,000—much of the work was done during a time when wages were very high, masons earning about 25s. per day, and laborers in the same proportion.

Although the water supply of both Sydney and Melbourne is on a much larger scale than we shall have to adopt in Nelson, the examination of the works will, I have no doubt, prove to have been highly beneficial, pointing out in some cases errors we ought to endeavour to avoid; as well as many useful and ingenious contrivances, which will admit of application in our case, with a certainty of answering their intended purpose well, and the adoption of which to say the least, would save much time, and avoid the uncertainty and doubt attendant on the introduction of any new form of mechanism.

I shall however, reserve any further remarks, and will, at the earliest opportunity, make the proposed water supply of Nelson, the subject of a separate report, accompanied by a general plan and estimate of the cost.

I have, &c.,

JOHN BLACKETT,

Provincial Engineer.

Subjoined is the scale of Charges for Water supplied by meter.

[COPY.]

MELBOURNE WATER SUPPLY.

Scale of Charges for Water supplied by Meter, 27th August, 1862, approved by Board of Land and Works.

Exceeding Gallons.	Not exceeding Gallons per Quarter.	Per 1000 gallons s.	d.	
	500,000	1	0	
500,000	1,000,000	1	0	for 1st 500,000 gal.
		0	6	for excess of that quantity
1,000,000	...	0	9	for 1st 1,000,000
		0	4½	for excess of that quantity

"All persons using water for other than domestic purposes must consume by meter, but every tenement so supplied will, in accordance with the by-laws of the Board of Land and Works, be rateably assessed, and, in the event of the rate per meter not amounting to the assessed rate, the latter will in every instance be charged."

The rate charged for domestic purposes is 4 per cent. on the annual rental of the premises.

J.B.

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