CARDIFF CORPORATION WATERWORKS.

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(MEMBER.)

IN the year 1850 the population of the town of Cardiff was about 18,000, and up to this time the people were dependent upon wells and the water which was procured from the Dock Feeder, the River Taff, etc. Many of these wells were of doubtful purity, and in some cases private wells were in close proximity to cesspits and other fruitful causes of disease. In fact, only two years before this a cholera epidemic occurred in the town, over 350 deaths resulting therefrom. In 1850 a company was formed for the purpose of supplying water to the town, port, and neighbourhood. Parliamentary powers were obtained, which the company proceeded to put into operation. The first works constructed were near the River Ely, at the village of that name, about three miles from the City Hall. A pumping station was erected, and the water taken from the river, roughly filtered, and pumped into a service reservoir at Penhill, near Llandaff, from which the town was supplied by gravitation. Although this water was charged at a comparatively cheap rate, a large number of the existing wells still remained in use, and it was many years before these wells were entirely disused. From 1851 to 1861 the population very nearly doubled, from 18,000 to 33,000.

The consumption having increased accordingly, it became necessary to seek for further sources of supply, and the waterworks company obtained an Act of Parliament in 1860 for a gravitation scheme at Lisvane, four miles north of Cardiff, in addition to their powers at Ely. The works constructed there included a storage reservoir with a capacity in the first instance of 60 million gallons, afterwards increased to 80 million gallons, into which the water of a number of streams on the gathering ground of over 2,000 acres were conveyed. This gathering ground extends on the north towards the Caerphilly Hills, and east to Cefn-Mably Park. Sand filter beds were also constructed near the reservoir, together with a trunk main to the town. By the same Act the company's water limits were greatly

extended, including a large number of the surrounding parishes, many of which have since become populous, especially the seaside town of Penarth. Subsidiary service reservoirs and pumping stations at Cogan and Llandough were erected for the supply of the Penarth district. For a considerable time after the construction of the Lisvane Reservoir it was unnecessary to pump water from the River Ely; but as the population continued to increase very rapidly this source was again brought into operation; and to improve the quality of the water culverts were constructed alongside the river, which received water from a number of springs and from the higher ground by percolation. After the construction of these culverts the water was not taken from the river except occasionally in times of drought. The waterworks company continued to supply the town and district from these sources up to 1878.

The company then found it necessary to provide for a rapidly increasing population, and promoted a Bill in Parliament for further works and extensions at the Ely Pumping Station, and at Llanishen adjoining the Lisvane Reservoir. The Lisvane Reservoir had already been increased to a capacity of 80 million gallons.

In the meantime it had been felt by many of the inhabitants and members of the council that it would be in the interests of the consumers if the water-supply could be in their own hands. The Corporation were also advised that the proposed extensions were not of such a comprehensive character as to provide adequately for future wants. It was therefore decided by the council to oppose the company's Bill with a view to purchasing their undertaking. Negotiations were entered into with the company prior to the Bill coming before the Committees of the Houses of Parliament, and an understanding was arrived at whereby the Corporation were to pay £300,000 to the waterworks company for their undertaking. The Bill was then allowed to proceed without opposition from the Corporation, and obtained the Royal assent in July, 1878. The Corporation in the following year received Parliamentary sanction to purchase the works and borrow the money therefor, the purchase being completed and the works taken over by the Corporation on the 29th of September, 1879.

Following the purchase the waterworks committee took into consideration the whole question of supply with a view to constructing such works as might adequately meet the ever increasing needs of the town and district, and instructed their engineer to report generally upon all available sources of supply within reasonable distance of Cardiff. A scheme was eventually decided upon after much discussion, and on the advice of one of the most eminent water engineers in the kingdom, which was

known as the Taff Fawr or Brecon Beacons scheme. To meet the immediate requirements a reservoir of over 300 million gallons capacity was constructed adjoining the existing Lisvane Reservoir, this work having been authorised under the Company's Act of 1878.

Taff Fawr Scheme.—This scheme included the construction of three large reservoirs in the Taff Fawr valley, over 30 miles from Cardiff, the highest of these being at the foot of the Brecon Beacons, and the lowest (yet to be constructed) being about five miles above the borough of Merthyr Tydfil, with a pipe-line or conduit running therefrom to the Llanishen reservoirs near Cardiff, and with balancing reservoirs as required *en route*. Parliamentary powers were obtained in 1884 for the impounding of the waters of the River Taff Fawr and the construction of the above works.

The watershed was divided into two areas in order that the reservoirs might be built as required, the upper area containing 4,000 acres and the lower area 6,400 acres of gathering ground. The sites of the two reservoirs are on the Old Red Sandstone formation, which is considered one of the best upon which to build watertight dams. It is outside the area of the South Wales coalfield, and some distance from the Mountain Limestone near Cefn Coed. Two out of the series of three reservoirs have been constructed on what was before mentioned as the upper area: the Beacons reservoir, which is at the foot of the Brecon Beacons, and has a capacity of 345 million gallons and a top water level of 1,340 ft. above ordnance datum, the Cantreff reservoir, some three miles lower down, which has a capacity of 323 million gallons and a top water level of 1,073 ft. above ordnance datum. The conduit and balancing reservoirs above mentioned were constructed at the same time as the Cantreff reservoir, the first portion of the supply from the Taff Fawr source being brought down to Cardiff in 1889, and the first section of the works included above completed in 1897. Compensation water has to be delivered into the river on account of the upper area to the extent of three million gallons per day. It is now proposed to go on with the construction of the third reservoir of the series which will have a capacity of over 900 million gallons and a top water level of 844 ft. above ordnance datum. When this reservoir is constructed a further quantity of $4\frac{3}{4}$ million gallons per day compensation water will have to be given to the river. The works already constructed in the Taff Fawr valley were designed and carried out by Mr. J. A. B. Williams, M. Inst. C.E. who was the waterworks engineer to the corporation up to 1895.

Simultaneously with the construction of the balancing reservoirs and

the Taff Fawr conduit, new filter beds and service reservoirs were built at the Heath, $1\frac{1}{2}$ miles from the city hall, for the low-level service, and at Rhubina, $4\frac{1}{2}$ miles from the city hall, where the last balancing reservoir for the high level service is also constructed. It has been necessary since this date to considerably enlarge the works at both these places, and also to construct several subsidiary service reservoirs and other works, in different positions near the city.

The population at present supplied by the corporation is estimated to be 222,000, of which over 30,000 are outside the city limits. The ordinary consumption of water averages about $6\frac{1}{2}$ million gallons per day, which in dry weather rises to a maximum of over $7\frac{1}{2}$ million gallons. For the year 1907 the actual average was 5,961,233 gallons per day, or 27·34 gallons per head on the then estimated population of 218,000. Out of this quantity 11 gallons per head was sold by meter for trade and municipal purposes, thus leaving a domestic consumption of between 16 and 17 gallons per head. There are no extra charges in Cardiff or the district of supply for any domestic purpose in addition to the water-rent payable in accordance with the rating of the property, which for all houses of over £20 ratable is 1s. in the £. There is no incentive, therefore, to restrict the use of water, and private baths are very general in all classes of property, even cottage-houses of £20 rental and under being provided therewith, thus helping to promote cleanliness and sanitary conditions amongst the people.

Since the waterworks undertaking has been in the hands of the corporation a full and constant supply for domestic purposes has always been maintained, with the exception of a short period during the dry season of 1887, and the legitimate use of water for all purposes has been encouraged.

The water being very soft, having from two to three degrees of hardness only, is suitable for all purposes, both domestic and trade consumption, and the chemical and bacteriological examination thereof always shows a high degree of purity.

MR. JOHN S. BRODIE (Blackpool) inquired whether Cardiff was altogether a water-closet city, as, if that was so, the extremely low consumption per head of the population for domestic purposes (sixteen to seventeen gallons) was evidence of a most successful management.

MR. G. WILLIAM LACEY (Oswestry) said he noticed in Mr. Priestley's description of the works that no mention was made of mechanical filters,

whereas he believed that some were in use. He would like to know what make of filters was used and what were the results obtained from them, and how they compared with the results from the ordinary sand filters.

MR. ARTHUR J. MARTIN (Westminster) asked whether water for gardening purposes was supplied by meter or otherwise, and whether the water so used was included in the seventeen gallons per head per day?

MR. T. READER SMITH (Kettering) put a question as to whether, if the gathering ground had not been purchased, the corporation had any sanitary control by by-laws sanctioned by the Local Government Board, or by any special clause in this Act, which permitted of proper supervision of the area. Under a recent Water Act the Kettering Urban District Council had power to make by-laws for the protection of the gathering grounds for their reservoirs, and he was anxious to learn what other authorities had similar powers, and in what way they were making use of them.

MR. ARTHUR J. ABBOTT (Yeovil) asked whether the amount of compensation water returned to the river prevented cause arising for claims in respect of loss of water by tenants or others on lands outside the gathering area?

In the event of a compensation claim being sustained, did the Act provide a time limit within which such claims could only be made; if so, what period?

MR. PRIESTLEY (Cardiff) in replying, dealt first with the question as to the filtration of the water. The water came down from the Taff Fawr works, and they had ordinary sand filters for the high-level service, the water being passed through these and distributed. The water for the low-level service passed into the reservoirs at Llanishen and Lisvane, and there was no doubt that the subsiding reservoirs they had there were of great advantage to the water, the water delivered on to the filter-beds at the Heath being much better than when taken from the conduit into the Rhubina reservoirs. The longer the water was kept in the subsiding reservoirs the better the colour. A considerable amount of peaty matter was taken out, but a large proportion was left, and the acid from the peat had a very bad effect on the pipes. The delivering capacity of the pipe-line was originally 12,000,000 gallons a day, but it was now reduced by incrustation at least 25 per cent.

Cardiff was entirely a water-closet town, there being no other means of getting rid of the excreta.

Candy filters were in use at the Heath, but only to a limited extent at present, between 5,000,000 and 6,000,000 gallons being passed through the sand filters, while only 750,000 gallons went through the mechanical filters. The latter had been put down on economical grounds, and had proved a success,

the analyses obtained in connection with their operation being equal to those from the sand filters. Sometimes these varied a little.

The gathering ground of the impounding reservoirs had not up to the present been purchased by the corporation. He had urged that this was a desirable step to take, but although the matter had been taken into consideration some time ago, nothing had been done. There was only one house on the gathering ground.

They had a system of waste water prevention, Deacon's meters being in use, supplemented by house-to-house inspection. They were, however, helped in this connection by the very low pressure on the low level, this being not more than 35 lbs. per square inch over any part of the city. They could do with more, but the position of the filter-beds prevented it. The water for gardening purposes was included in the 17 gallons per day. They allowed the use of water with cans, but if a hose were employed a charge of 10s. per year was imposed, and the hose had to be held in the hand. When sprinklers were used meters had to be rented.

The consumption for trade purposes probably looked high, but large quantities of water were used at the Dowlais works, on the railway and at Penarth Dock, some of their consumers taking as much as from 30,000,000 to 35,000,000 gallons every quarter.

No claims had been received for additional compensation. He could not say what the waste of water per head amounted to exactly, but it varied very considerably. If it did not show more than 2 or 3 gallons per head on the waste water diagrams they did not trouble, but if more they made an inspection of the district affected. It was a great advantage to have these waste-water meters.

The information desired in regard to the balancing reservoirs was rather a large order, but he would be glad to show the questioner the plan, and provide him with particulars, at another time. The reservoirs in question were intended to break the pressure which would otherwise be carried in the pipes.

MR. WALKER SMITH and MR. W. HALL also took part in the discussion.