WATER SUPPLY TO LARGE TOWNS.—(See Map.)

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[Addressed to the Members of the Society, at the Memorial Hall, Wednesday, April 4th, 1888.]

I ALWAYS think that it is very bad taste to begin to make apologies when about to perform a duty, and I will to-night simply make the statement that I am not a member of the Committee of the Manchester Waterworks. I am, therefore, not to be expected to be acquainted with all the details of the management of the water supply of Manchester. The responsibility of my being here to-night must be thrown on your Secretary, who happened to hear me once give an address to my constituents, in which, amongst other matters, I took occasion to make some remarks on the prospect of a water famine or panic with a view to encouraging economy in the use of the water supply. Your Secretary asked me to prepare a kind of lecture to be delivered before you, and this I have attempted to do. If I am not able to answer all the questions in detail, I will, at any rate, give you the best of the information I have on this subject.

Last summer there was a threatened water famine in Manchester and district. When a million of people are depending upon a supply of water it is a very serious matter that the supply should become perilously low, and threaten to interfere with trade and commerce generally, and especially so in respect to domestic comfort. We in Manchester were expecting a very much worse state of things than actually turned out to be the case. The scarcity of water during last summer was, however, not confined to Manchester, but was the case all over England. Many statements appeared in the papers which went to prove this. I cut out one such statement, and will read it to you to give you a sample of the then prevailing state of things in respect to water supply.

THE DROUGHT.—A RESERVOIR USED AS A CRICKET GROUND.—The water famine at Bacup is the most serious within the memory of the oldest inhabitant. The reservoir of the Rossendale Waterworks Company has been completely dried up for three weeks, and the bed has been utilised by a number of juveniles as a cricket ground. This is the first time the reservoir has been dried up since its formation more than thirty years ago. The private supplies are also showing signs of exhaustion. In consequence of the failure of the water supply, the Corner Dye Works, Bacup—Messrs. F. Steiner & Co.—at which between three to four hundred persons are employed, have been compelled to close, and will not be able to resume work until there is a very copious and continuous downpour.

There were many other such reports published in various quarters. I need not dilate upon the necessity of a supply of pure water being available in ever-constant and full volume. It is necessary to human life. We here in Manchester have an enormous population depending upon the city's supply. And besides the requirements on this account there has to be reckoned the requirements of our own various industries, and of the manifold industries which are carried on in the towns close to Manchester, which towns also derive their supplies of domestic water from the same sources as we ourselves. Ancient history will show us that the people of old times were very careful to utilise all the water they could get of the purest kind. Wherever they could pitch upon a site which had wells in the immediate neighbourhood, that locality was considered a most desirable one. And wherever they could find indications of water there they would sink wells. If you take India, for instance, it would be easy to show how, through want of water, and consequently of irrigation works, many disastrous famines arose, to the great loss of human life and disturbance to commerce and trade. In the eighteenth century many continental cities, through being ill provided with water, suffered from epidemics, the seeds of disease being sown in the dry seasons. I suppose that many total abstainers, on leaving England, have frequently to take to drinking the wines of the countries they visit. The water supply of Paris and other continental cities is so bad as to cause such travellers to forsake their customary beverage. But as education has advanced people have become more enlightened, and have come to see the necessity of having pure water. Consequently, waterworks have been established almost everywhere. The principal facts in relation to a number of British and Foreign Waterworks will be found in the table (see Appendix, pp. 66, 67). Manchester is able to boast of good water. Possibly, however, a reference to ancient history might convince us that we have little need to be too boastful. We find that Rome, though it had no steam power as we have, had its system of gravitation, had its waterworks, but on a far more extensive scale than we have now. Rome, with its million inhabitants, had three times the daily supply of water that London has now. They had nine aqueducts, 255 miles long, and these supplied to Rome 377,000,000 gallons daily. Our waterworks are about seventeen miles from Manchester. They supply Manchester and the district comprised under our powers (1,000,000 inhabitants) with about 19,000,000 gallons per day. We find that wherever the Romans went they left traces of their arrangements for supplying themselves with water. This was the case in Constantinople, Sicily, Greece, Spain, and other lands. We even read of extensive waterworks at Herculaneum and Pompeii.

At the commencement of the present century the population
of Manchester and Liverpool together amounted to 80,000 to 100,000. Now Liverpool, with Birkenhead, has 600,000. In Manchester and the district wherto water is supplied we have 1,000,000 inhabitants. Liverpool is supplied with water obtained from the red sandstone rock by means of pumping to elevated positions, so that it may gravitate down and enable them to make use of it in case of fires, &c. Three hundred years ago Manchester was supplied from a well in Fountain Street. From this well the water was conveyed in pipes and in an open conduit. Many had to have their water from what were called the "Shudehill Pits." The public conduit was where the new Exchange is now. People used to go and supply themselves by means of buckets and pails from this. Much might be said about the stone-pipe period. Stone pipes were put down to supply the city from this well in Fountain Street, also from the Shudehill pits, and from the ponds in connection with the Infirmary. A good deal of jobbery and corruption was practised on the part of the corporation, or the then governing body of Manchester, and the contractors of the company which supplied the stone pipes. Manchester was afterwards supplied from a well at Gorton, also from the canal at Peak Forest. There was also water obtained from the river Medlock by pumping. I wonder what kind of water we should get from that river now. The water then, though, was so pure that fish were found in it. This water was pumped into reservoirs. By-and-by larger supplies were required, and other sources, further removed from the city, had to be sought. The population was increasing in numbers, and there was a constant increase also in the number of industries carried on which required water in some abundance. Mr. Bateman, the eminent engineer, was employed to secure a site. A good deal depends upon the site selected as the gathering ground of the water, and consequently, amongst other considerations, much attention has to be paid to the geological nature of the soil in the neighbourhood. There needs to be perfect freedom from sewage; none must percolate from the gathering grounds into the reservoirs. Then care has to be taken to avoid expense, and to this end gathering grounds have to be selected of such an elevated position that the water will gravitate down to the city. Longdendale was chosen by Mr. Bateman. The purity of the water at Longdendale takes the second place in the United Kingdom, Loch Katrine being the first. Loch Katrine has one degree of hardness, whereas Manchester has one and a half degrees of hardness at Woodhead, or two degrees in the mains. You know what is meant by water being "hard." You feel as though you were using a sort of refined sandpaper. There is a softness in the Manchester water and a freedom from those salts and chemicals held in solution which give to other water supplies their varying hardness, varying from three to fifteen degrees. Owing to the hardness of the London water something like 100 tons extra per month of soap have to be used.

Last summer many people asked the question, why we depended upon Longdendale for our water supply, and why we did not make use of the water which can be procured in Manchester and the neighbourhood by sinking down to the sandstone. I may tell you that the sandstone water would not suit Manchester and its industries. I believe it is a fact that many manufacturers have wells of their own, capable of giving them large supplies of water, and yet will not use them, preferring to use the Longdendale water, on account of its softness and greater suitability for their manufactures and industries. I believe I am right in saying that one-third of the Manchester water is used for trade purposes and two-thirds for domestic purposes. In Liverpool much of the water is used for shipping purposes. The resources of Liverpool are becoming smaller and smaller in comparison with their increasing requirements, and they are now going to Wyrnwy for fresh supplies. At present the supplies in the reservoirs of Liverpool water are so reduced that the supply is cut off so much that water can only be obtained for six hours out of the twenty-four. The Liverpool Waterworks Committee have issued a notice restricting the supply to the hours between seven and ten in the morning and three and six in the afternoon. We here are in a very much better position than Liverpool in this respect. This sandstone water of Manchester might perhaps be made available, but it must be remembered that it is more costly to pump water than to get supplies from Longdendale, whence the water comes by the force of gravitation. To mix the sandstone water with the other water would not do. We should, however, have been obliged to resort to something or other in that way had we been driven to find other than the regular sources of supply. The committee of the Manchester Waterworks actually did make a move in this direction. They had nine samples offered them from various wells in the city, but of these nine, only three were found to be sufficiently pure for use in domestic purposes. Consequently they decided not to resort to the use of any of such supplies until actually driven to extremities. In 1865 Manchester and the district only required 8,000,000 gallons per day. We now require 19,000,000 gallons, but in addition to those figures must be reckoned thirteen and a half million gallons which we have to send down the stream daily for compensation purposes. The Longdendale gathering grounds will be seen on the map, where the valley into which the water flows and the river Etherow are shown. It was dammed up and made, as you see, into reservoirs. The area of this drainage ground is 19,300 acres, or thirty square miles. There are 975 acres of water. It is not possible for any sewage from this large area to percolate into
these reservoirs. There are no houses in the vicinity, and only a solitary farmhouse scattered here and there.

The height of Woodhead above the Ordnance level is 782 ft. The water is sent on from Rhodes Wood reservoir to Arnfield and Hollingworth by its own gravitation. Here [see map] is the lowest point from which it can gravitate to Godley, and thence to Prestwich. Prestwich reservoir supplies the higher parts of the town in connection with Cheetham Hill. There are reservoirs at Gorton, Audenshaw, and Denton which supply the lower lying parts of the city. Godley supplies another part of the city.

The water comes all the way by gravitation. Prestwich, Rhodes Wood, and Godley are at elevations of, respectively, 347 ft., 574 ft., and 478 ft. When Manchester went to Parliament to secure powers to dam up the river Etherow and store the water, the owners of the land on the sides of the river naturally complained, and opposed the granting of such powers. Manchester was constrained to satisfy them by agreeing to send down 17,000,000 gallons per day. This quantity was afterwards reduced to 13,500,000 gallons. There is a measuring basin at Tintwistle by which it can be shown that they receive their full quantity. This basin is a beautiful piece of engineering skill. It is possible to gather something like 25,000,000 gallons per day at Woodhead, besides sufficient for compensation purposes, and that with only the average rainfall, which is 50 in. per annum; but we have only required hitherto 19,500,000 gallons, in addition to the 13,500,000 gallons for compensation purposes.

Woodhead reservoir is not now used for supplying water for drinking or for commercial purposes. There are 200,000 gallons of peat mud in that reservoir. When I was speaking to my constituents on the subject of the water supply last October, I told them what was the then condition of the reservoirs. Woodhead, Vale House, and Bottoms were empty, Torside and Rhodes Wood were full, the next two were full, Godley was full. Hollingworth, Arnfield, and Rhodes Wood contain nothing but pure spring water. Woodhead, Vale House, and Bottoms simply supply water for compensation purposes, and were empty. There is a flood-watercourse, which goes along on the side, and which empties Woodhead directly into Vale House and Bottoms. Rhodes Wood, Torside, Hollingworth, and Arnfield are used for domestic and commercial purposes as the water comes on to Manchester.

There are innumerable springs. Each spring, as it is found, is tapped, and the flow conducted into what is called a pure spring-water conduit. There is an arrangement by which this conduit simply takes up the pure spring water and lets the flood water go into Woodhead reservoir. There is a weir which receives the water from Heyden Brook. This pure spring-water conduit goes underneath. The moment any rain or any flood comes it swells the stream at once, and instead of the water falling into the pure spring-water conduit it escapes over the sill. When the rain or flood subsides the volume is lessened, and at last again nothing but pure spring water comes into the pure-water conduit.

You would perhaps like to know how we get the water from the springs across the reservoirs. There is a very large spring at a place on the banks of the Torside reservoir near where an old paper mill stood, which was tapped. We did not want the water from this spring to go into these reservoirs. As this is rather higher than the water conduit on the other side, pipes were arranged to go under the reservoir and empty their contents into this pure-water conduit. We have several similar syphon pipes. This pure-water conduit collects 13,000,000 gallons a day of pure spring water (this quantity gradually lessened to 2,500,000 during the drought of last summer), and this quantity goes right on to Manchester, without any filtering, except where it is filtered at the end of Torside reserve. We collect in Torside and Rhodes Wood the water of innumerable springs.

Before the water goes to Manchester it passes through this settling tank. The wall is about 1½ ft. lower than the outside walls, so that any suspended matter, such as leaves or grass, which may be in the water falls down, and the water escapes over the bars. The settling tanks hold about 2,000,000 gallons.

We sometimes need to convey water from Torside into Rhodes Wood. It has usually been the practice to open the valves at the bottom, so as to admit the water into the lower reservoir; but this plan takes the mud with the water. The transference is done by means of a syphon, and the result is to transfer all the top clear water and avoid taking any of the mud. This purewater conduit is watched like a delicate baby. During the night keepers are constantly moving up and down the banks with lamps. They take samples from the pure-water conduit with a glass in order to test the quality. In the case of the least turbidity occurring by any means, the water is turned off into the compensation reservoirs, so that it may not get to Manchester in that state.

At Hollingworth we have houses for the incubation of fish.

A year or two ago there were complaints in the papers about our water tasting fishy. The city analyst made some reports, and suggested that fish should be put into the reservoirs to do away with the fishy taste. He suggested that char and trout should be introduced—char for the bottom of the reservoirs and trout for the top. There have been thousands of fish hatched, and at a certain stage of growth turned into the reservoirs. We have since then been free from the fishy odour and taste. This taste arose from a species of snails. The fish act as scavengers. Between each reservoir there are large embankments. The embankment between Torside and Woodhead, owing to the soft nature of the ground, cost £100,000. There had to be a large trench or cutting made into the hills on either side, 163 ft. below
the level of the reservoir, and this had to be filled up with lime cement.

There is not much fluctuation in the rainfall at Woodhead, except, of course, in the very driest seasons. 1887 was the driest year for ten years, and our condition at the end of last December was really alarming. I have, however, a note, just received from the superintendent of the waterworks, to the effect that we have now about 4,000,000,000 gallons of water in stock, whereas at the beginning of this year we had only half that quantity.

[Mr. Sherratt explained, by means of a specially-prepared diagram, the relative supplies and requirements of water during the various years from 1855 to 1887.]

We come now to Thirlmere. This is 533 ft. above Manchester. Hawes Water is 695 ft. above Manchester, and is really the highest water reservoir in the kingdom. At present there are 350 acres of water at Thirlmere. When the Manchester City Council was discussing the question as to the best place to go to for an increase of water supply, three samples of water were sent to as many eminent chemists in the kingdom for report. (See Appendix.) Two made reports, but one wrote back and asked the Waterworks Committee if they had not sent, in mistake, a bottle of distilled water. He asked if it was not a joke! The water was so pure as almost to be equal to distilled water! The reports came in to the effect that Thirlmere water was quite equal to Loch Katrine water, showing one degree of hardness. It is intended to enlarge the area of the lake by putting up an embankment. This will cost £25,000. There are 11,000 acres of gathering ground, but they are of a very different strata to that of Longdendale, which is gritstone—a porous stone—and the cause of a good deal of water being lost by absorption. Very little will be lost at Thirlmere, as the watershed is nothing but hard, impervious rock. There are no springs as at Longdendale. The moment the water comes down, it comes right down into the reservoir. There are 17 square miles of gathering ground. The rainfall of Thirlmere is on the average 104 in. per annum. At Longdendale it is on the average 50 in. There is a great difference indicated by these figures. The compensation water which we shall have to send down will be only 5,500,000 gallons per day. The map shows the intended top level of the water when the embankment is raised 50 ft. This embankment will lengthen the lake considerably. When the lake is full to the top level, as intended to be raised, we can get from Thirlmere 50,000,000 gallons per day for 100 days, and this in a time of the greatest drought, before it is reduced to its present level.

The following are the particulars of the tunnels, syphons, aqueducts, &c., in connection with this work now being carried on to bring the water from Thirlmere:

The aqueduct will commence at the south-east corner of the lake, and at such a level that the surface of the water running into it at the entrance will be about 531 feet above Ordnance datum. The water will be delivered into Prestwich service reservoir, 96 miles distant, at a height of 833 feet above datum, and will therefore have a fall in the length of 178 feet. In the first 22 miles after leaving Thirlmere, the aqueduct passes through the lake district to near Kendal, and in this portion there are 17 tunnels, having an aggregate length of 14,000 yards; 7 syphons, having an aggregate length of 9,000 yards; and the remainder, 15,700 yards, is what is known as "cut and cover." "Cut and cover" means an open trench, with vertical sides, excavated in the rock, about seven feet wide, but broader at the top, to allow of an arch springing from the two sides to form the "cover," the earth being filled in over the arch and the soil replaced. The largest tunnel is 5,225 yards, and the greatest depth of a tunnel below the surface 660 feet. The largest syphon 5,720 yards, and the maximum depth below the gradient 305 feet. The tunnels to the "cut and cover" parts of the aqueduct will be made large enough to convey 50 million gallons in 24 hours. In the valleys—that is, wherever the ground drops below the gradient line—iron pipes will be laid. The iron pipes will be 40 in. in diameter, and it will cost two millions sterling to bring the first ten gallons to Manchester. We are now erecting tunnels, and when these are erected we shall attach one 40 in. pipe. This will bring down 10,000,000 gallons per day. When we want more water from there it will cost us a half million sterling extra for every 10,000,000 gallons per day. We shall require four or five of these 40in. iron pipes before we can get the 50,000,000 gallons daily. I believe there will be no waterworks built between here and Thirlmere, for we shall be able to supply from that source all the towns on the route. It will be four years before we get the first supply, and the whole scheme for the getting of a supply of 50,000,000 gallons will cost something like £4,000,000.

The sections on the map from Woodhead to Manchester, and from Thirlmere to Manchester, will enable you to see the relative length of both works and the fall from the highest points to the place of delivery in each case. These works, when completed in about three years' time from now, will place Manchester in the proud position of supplying for domestic and other purposes an ample and pure supply of water at a cost, taking all the circumstances into consideration, which is fairly reasonable.

I beg to thank you for your patient attention, and all those who have helped me to obtain the facts to put before you and the diagrams to illustrate the subject.