

river, the mouth of the suction pipe should face the way the water flows, because by so doing the best water will be drawn in, while the floating impurities will pass forward with the current. When from a lake, it should face downward for the same reasons. Taking water from a lower level than the town is built on is often injudicious, because it may be fouled by the sewage from the population living within the watershed, which sometimes contains an area of several thousand square miles, and should the population be small at present, and the impurities from the sewage imperceptible, it may soon alter. All large towns should have forethought sufficient to arrange for a good permanent supply while the opportunity serves. To depend on a supply by pumping and long suction conduits is risky and expensive, and it is probably cheaper to carry a supply fifty miles and have a proper gravitation system. (1) Because the source of supply being necessarily at a higher elevation than a pumping source, it is less liable to be contaminated. (2) Though the first cost of works may be more on account of the long length of trunk mains which might have to be conveyed through tunnels and across ravines on viaducts, yet the annual expenses of pumping in wages, repairs, renewals, etc., will probably amount to more than would pay the interest on the capital expended on a comprehensive, well engineered scheme. Such a plant would be safe and permanent, besides free from contamination, because by making judicious arrangements to supply the villages located on the route of the pipe, by measure, sufficient revenue might be collected to pay the interest on the cost of running the trunk pipe through their section of territory.

When it is necessary to store water in reservoirs so that the supply can be abundant when the rainfall is least, such reservoirs should be carefully covered over and ventilated. In form they should be deep rather than extended, so as to lessen the evaporation, to keep the water cool and at an even temperature as far as possible all the year round, to prevent the water from absorbing the impure gases from the atmosphere, and prevent the sun's rays from increasing the microbes and bacteria. When large natural reservoirs are made in the hills they must necessarily be open, and the face of the water exposed to the sun and air; such water should be passed through a good, clean filter immediately before entering the supply pipes. In fact all water, however collected and stored, should be filtered.

It is a fact that the purer and softer the water is the easier it is to contaminate. It will attract and absorb minerals and poisonous gases with a wolfish appetite. At Harrogate in England there are eleven springs of water, each loaded with different minerals and chemicals, which each stream has taken up on its passage through the earth from the seat of the rainfall to the springs.

Then another example: Six families living in good, airy, isolated houses, went on their holidays for a few weeks to the seaside. A short time after each family returned home some of its members were taken ill with typhoid fever. Being superintendent of the water supply, it was my duty to investigate so remarkable an occurrence, and found that the owner had broken the laws of water distribution by allowing his tenants to take the whole of their water supply from a large shallow open cistern hidden in the false roof that was open from end to end over all the sleeping rooms of the six houses, and that the loft had no ventilation whatsoever; so that all the poison contained in the atmosphere of the sleeping rooms

passed through the porous plastered ceiling, and having no other means of escape was absorbed by the sheet of water in the cistern, and the water became poisoned before being used by the inmates. A French writer, has indeed proved that the human system can be trained to receive large doses of poison without serious injury. If his theory was incorrect, how could so many people live in a poisoned atmosphere, yet have general good health. The trouble with this group of families was that they had lived at another place for a time and broken the continuity of the doses, and when they returned home and began to take them up again on a healthy, well-ordered constitution, the sudden start upset them. The water would be worse than usual on account of a small quantity only having been used during the time of absence. I have related this at length to show the great importance of covering fresh water tanks and reservoirs, and the advisability of erecting them in places sufficiently removed from any chance of contamination.

With the object of removing dirt from the lower points of street water mains, some engineers connect the ends of the pipes together and form a circuit of water down one street and up another. The method does not remove the evil, but distributes over a larger area the dirt or polluted water in the pipes. I believe the circulating policy is adopted in Toronto, for I am sometimes engaged to remove fish and other obstructions from taps and valves. I also notice if a bath full of fresh water stands for a few days, there is a sediment at the bottom. Then water taps and other waterworks appliances only keep in good condition about a quarter as long as at places where the water is free from fine sand and grit. The cost of repairs and renewals on account of fittings being injured by the grit must amount to a large sum throughout the whole city. I once witnessed water flowing from a branch pipe from which a fire hydrant had been removed run black for about fifteen minutes, leaving a large quantity of gritty deposits on the ground, and at another time a six-inch water main that had been taken out on account of a defect, had about one inch of black and green sludge adhering to the lower side.

The dirt could not lie in that position, nor the water get so far polluted as to run dirt for so long a time, if reasonable provision were made to clean out the pipes and suction conduit, and the conduit were laid in such a mechanical way that the joints could be kept permanently water tight. I don't see how they can be kept tight during the alteration of the temperature of the water they lie in, if the sketch shown in the *Telegram* newspaper be correct and reliable. The proper way in my opinion to lay down distribution water mains for a town is to lay the large carrying mains along the roads having the highest elevation, and take out branches commencing with a cut-off valve and air ball, then continue them down along the streets to the lowest points of each street or section of streets, and on the terminating end of each branch pipe affix a full-sized sluice valve about ten yards beyond the last service pipe. Round the sluice valve build a well or valve chamber with a gully trap and drain pipe twice as large as the water pipe, and construct the bottom one foot below the valve. Solids and impurities of all kinds contained in water mains that are under pressure are always forced to the lowest points, and can be easily removed by opening the terminating valves, about once a month or oftener, according to the quality of the water, for about one half minute.