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THE WATER SUPPLY OF LONDON—DECREASE OF RAIN FALL, AND POLLUTION OF STREAMS.

The constantly increasing demand of London for water, produced by the yearly augmentation to the population and the extension of manufactures, together with the continually lessening summer flow of the Thames, is a source of grave apprehension to Parliament and the thinking portion of the British Metropolis. Not only is the rapidly increasing demand, and the rapidly decreasing volume of water during the summer months, a source of uneasiness, but the pollution of the Thames and its tributaries by the modern system of sewage causes even greater solicitude. This sewage, the offspring as it is of the extension of population, is an evil, it seems, which, while it cannot be prevented, is capable, by proper engineering, of having its polluting influence so far ameliorated as to be comparatively innocuous.

This subject, of the London water supply, both with regard to maintaining a supply throughout the year adequate to meet the increasing demand as well as to correct the pollution of the streams—the sources of supply—by the contaminating effects of the sewage from the cities near their banks, has been the subject of a very valuable and interesting paper lately read by Mr. Denton before the London Society of Arts.

It is explained, in the first place, that the decrease in the summer volume of flow of the Thames is caused by the fact "that the rain fall is getting positively, though gradually, less in quantity from the disafforesting of the woodland, the improved cultivation of the soil, and the drainage of lands and districts; that although by the drainage of land we gain an increase of water in the winter season, we suffer a diminution in summer." And with respect to the pollution of the streams, that "the sewage of towns is corrupting our rivers and streams in their transit through the country to the sea, proportionally as the sewage of towns extends and the summer flow of rivers becomes less." Thus, while the increase of population and manufactures is rapidly increasing the sewage, the rivers into which this foul sewage is emptied are each summer becoming less and less in volume, and hence the pollution is increasing proportionally as these causes are augmented. This indeed is a state of affairs which we should be very loth to contemplate for our city of New York, and it is a matter which will tax the skill of the English Engineers to the utmost to render the sewage harmless and to maintain an adequate water supply for their metropolis throughout the year.

With respect to the diminution of the rain fall, the following table, prepared by Prof. Austed, and published in the Journal of the Royal Agricultural Society of England, is both interesting and instructive as illustrating the effects of the works of civilization on meteorological phenomena:

Years.	Mean rain fall. Inches.	Mean of 14 years. Inches.
1815-1821.....	23.7	28.3
1822-1828.....	27.9	26.1
1829-1835.....	24.3	24.7
1836-1842.....	25.1	24.6
1843-1849.....	24.1	24.0
1850-1856.....	23.8	23.8
1857-1863.....	23.7	

On this data Mr. Denton observes, "If we deduce that the rain fall is gradually declining, we cannot reject from consideration the counterbalancing circumstance that land drainage, which is taking place all over the country, discharges into the rivers from the land a larger quantity of water than found its way to them before drainage, and more than is actually lost to the rivers by the lessened rain fall." And if the whole of the land which sheds its water into the Thames was wet land, there would be a constant gain in the volume of the river by the extension of the drainage system, but as the wet lands form but a small portion of this surface, and "the wa-

ter of drainage issuing from our clay lands is not constant, it is, for the most part, discharged in the winter months, when both soil and air are frequently in a state of saturation, and when vegetation is dormant, and ceases to flow in summer, when evaporation is active and the demands for vegetation can hardly be satisfied." Thus the drainage adds to the derangement of the water supply, and the more the drainage is extended and improved, the more, proportionally, will this derangement increase, and "the floods of winter and the droughts of summer" will both increase.

Now there seems to be but one way that the great excess in winter—an excess sometimes so great as to cause serious floods—can be made to balance and supply the deficiency caused by the droughts of summer. This method is to store enough of the winter's surplus to supply the deficiency in summer, and this is the method recommended by Mr. Denton. Of course storehouses for such vast quantities of water means the construction of huge reservoirs, containing enough for two months, or thereabouts, metropolitan supply. This is a plan already being carried out in one of our largest eastern cities, by building a huge reservoir to be filled by the surplus of the season of plenty, to be let into the mains when the lake, from which the supply is drawn, runs low. To show how much in excess the rain fall is over the wants of the population—that is, if it can be collected and made available, it has been calculated, that while the mean average rain fall of the Thames Basin is twenty-six inches, "it only requires three-fourths of an inch of the surplus of winter, from the whole water shed of the Thames, or one and one-half inches from one moiety of the water shed to satisfy the whole population with it." Or, to put the matter more practically, as Mr. Denton remarks, "as it will only be necessary to collect water for six months of the year, one-half an inch of rain, falling on an acre of land, is sufficient to supply two persons with thirty gallons each per diem for six months, and no winter passes by in which there does not run off to the sea, without serving any useful purpose, in excess of the mean summer flow of the river, at least five times the quantity required to meet the supply of the metropolis in the dry times of the summer, when the river cannot fairly part with any portion of its volume; and this or any portion of it may be stored for compensation to the river if reservoirs were properly constructed for the purpose."

It would thus appear that the means necessary to be adopted to maintain an adequate water supply, as regards quantity, are clearly pointed out, and it only remains to free the river water from the pollution of the sewage, to have the supply amply sufficient both as regards quantity and quality. An enormous volume of water is pumped out of the Thames daily by the five water companies; they extract from that river sixty millions of gallons daily, which they have the power to increase to one hundred millions.

It is stated that the flow of the Thames—which should always, it is maintained, be kept at a standard flow of say 450 millions of gallons per diem, is often reduced in dry summers by the pumps of the water companies to 300 to 350 millions. With respect to neutralizing the polluting effects of the constantly increasing sewage, the problem appears to be much more difficult than to store up an adequate supply of water as regards quantity alone. As the summer flow is decreasing and the sewage is continually increasing, both the difficulties and necessities of a correction of this growing evil are apparent.

Rivers, to answer one of the purposes for which it seems nature intended them, must receive the liquid shed into them by the land which they drain, and at the same time supply the population with pure water; but if the river is dirtied by impurities, one of these important objects is at once defeated. And the very small quantity of sewage necessary to render the water unfit for culinary purposes is quite remarkable; it is concluded that "as soon as sewage can be detected by chemical analysis to exist in an appreciable degree in the water we are called on to drink, it is a vital error to use it."

Now, of all the methods proposed for the abstraction of the impurities from sewage, there is only one which scientific men regard as possible to be applied on a scale at all extensive, and that is the distribution of the sewage over land. And even this requires a surface and a proper subsoil, together with the right sort of vegetation to extract and assimilate sufficient of the impurities to render it safe to allow it to mix with water to be used for drinking purposes.

These conclusions, on this point, are thus briefly summed up in the paper alluded to:—

1st. That sewage run over a surface of land which has neither natural or artificial drainage to assist vegetation in retaining the deleterious elements, altogether fails to secure that degree of purity which will allow of its being discharged into rivers from whence may be taken water for drinking purposes, though the operation may serve to clarify and improve its character sufficiently to allow of its being utilized in rivers for navigation and for many other riparian uses.

2d. That land artificially drained to a depth of a few feet, affords, if irrigated, only an imperfect means, in conjunction with vegetation, of separating from sewage its objectionable elements.

3d. That when sewage can be lifted upon high and fertile grounds with a free and porous subsoil, which will admit of its penetration to a considerable depth after it has fed vegetation on the surface, a perfect means of purification may be attained.

The latter plan, which is the only one which thoroughly purifies the sewage, will in most cases require the use of steam engines, pumps, pumping stations, reservoirs, conduits, and other engineering appliances, and a constant outlay for attendance and repairs. It is estimated that it will annually cost some \$30,000 to raise the sewage of 250,000 persons 100 feet high and a distance of five miles.

The above remarks and extracts cannot fail to impress upon the reader the extraordinary degree of complication the uses and abuses of progress entail on such an absolutely essential matter as a proper supply of pure water. To maintain life, three wants must be supplied—air, water, and food. Formerly it was only the latter that demanded the sweat of one's brow; but now a supply of pure water not only demands the most skillful engineering talent, but also the expenditure of vast quantities of labor.

SPEED OF THE 15-INCH SHOT.

While Captain Noble and the British artillerymen are speculating on the capacity of the 15-inch American cast-iron navy smooth-bore cannon, with a velocity of shot less than 1,200 feet per second, we on this side of the Atlantic are wondering why they do not indulge in a little mathematics with respect to the effect of the 453-lb. ball at higher velocities. Are they afraid to "penetrate" "rack" or to produce a tremendous "non-local effect" on their targets—the representatives of the strength of the British navy—even on paper?

Fifteen hundred feet is a common velocity with our 453-lb balls: it is given in the text book on ordnance used by the military schools all over the country, where the American idea is taught how to shoot.

And while Capt. Noble, the eminent ordnance mathematician of Her Majesty's service is astonishing his brethren and tickling the patentees of small-bore ordnance and the small-bore members of Parliament, by his skill in holding the 15-inch ball down to a velocity of less than 1,200 feet per second, with a harness of algebra, and the power "per circular inch" down to a certain number of "foot tuns," our farmer boys are using a school book which shows that the ball goes some 1,500 feet per second. That is, as the square of 1,170 is 1,368,900, and the square of 1,500 is 2,250,000, about 63 per cent more *vis viva* than this mathematical gymnast thinks to be possible.

The following extracts from Benton's text book on Ordnance speak for themselves and illustrate our meaning:

The navy 15-inch trial gun was fired 900 times with charges varying from 35 to 70 lbs., mostly mortar or navy cannon powder. . . . Our army 15-inch gun has been fired without injury 250 times with charges varying from 40 to 100 lbs. of mammoth powder—the same that was used in England in trials against the target. One hundred of these rounds were with 100 lbs. of powder and spherical projectiles of 450 lbs. each. 15-inch gun No. 105 has likewise been fired as follows, namely:

No. of times fired.	Charge.	Weight of ball.	Velocity.
2	60 lbs.	430 lbs.	1191 feet.
3	70 lbs.	431 lbs.	1278 feet.
3	80 lbs.	433 lbs.	1355 feet.
3	90 lbs.	452 lbs.	1433 feet.
2	100 lbs.	453 lbs.	1509 feet.

Now, ye artillerymen of Shoeburyness, the next time you project a 15-inch ball against your 8-inch solid slab backed by 18 inches of teak and a thin iron skin, or even against your much vaunted "Hercules" target, be sure and put plenty of powder behind it. We are not particular about the kind, no matter whether it is English, Dutch, French, or Japanese, only make sure to put in sufficient to drive the ball at least 1,500 feet per second.

At the late trials with the 15-inch at Shoeburyness, according to the official statements published in the scientific journals, it was demonstrated that 50 lbs. of the English powder was equal to 60 lbs. of the mammoth grain imported from America, hence, according to this ratio it will require 83½ lbs. of the Shoeburyness powder to equal 100 lbs. of the mammoth grain. So if it is the intention of the English trials to find out the real power of the gun, that is the charge which should be employed; and in order that the trial may be comparative, the gun should be exactly the same distance from the target that it was on the trial already made.

Waive your excessive delicacy just once; do not be afraid of bursting the big cast-iron smooth-bore. But it is not so much the success of this lump of cast iron that we are interested in, as it is in the pleasure of witnessing the demolition of the absurd small-bore system on which you have wasted millions. The English ordnance engineer started with a loud blowing of trumpets years ago to build 13.2-inch wrought-iron Armstrong rifles, but finding they were no go, these gun-makers were driven to smaller calibers, hence the arguments of their mathematicians to prove them to be the best.

We are willing to hazard the prediction that before long the British small-bore system of naval ordnance will be as completely smashed, as the "reputation of Sir William G. Armstrong, the whilom great "rifle engineer."

With respect to the character of the metal best adapted for projectiles for iron-clad warfare, it will not, we think, be denied but that the invention—or discovery—of the advantage, of chilled cast-iron shot for the penetration of armor, is as applicable and adds as much to the efficiency of smooth-bore ordnance as it does to the rifle.

Therefore, on the trials to which we have alluded, any advantage which the nine-inch rifle may have had over the big smooth-bore, owing to the peculiar character of the iron its shot was made of, or in the method of casting it, it is not an advantage in any way whatever due to the gun itself. And it is quite clear that, in order to make a fair test, each gun should be fired with the best projectile known, capable of being used in the gun. In other words, no advantage should be permitted of one gun over the other, except such advantages as are due solely to the piece itself, such as strength, caliber, and method of rifling.

PROGRESS OF THE PNEUMATIC RAILROAD.

The first practical example of the Pneumatic Railroad ever constructed in this country has just been completed by the Holske Machine Company, No. 528 Water street, and will