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Reports of the late John Smeaton

Smeaton, John

London, 1812

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[On the water-works at Halifax.]

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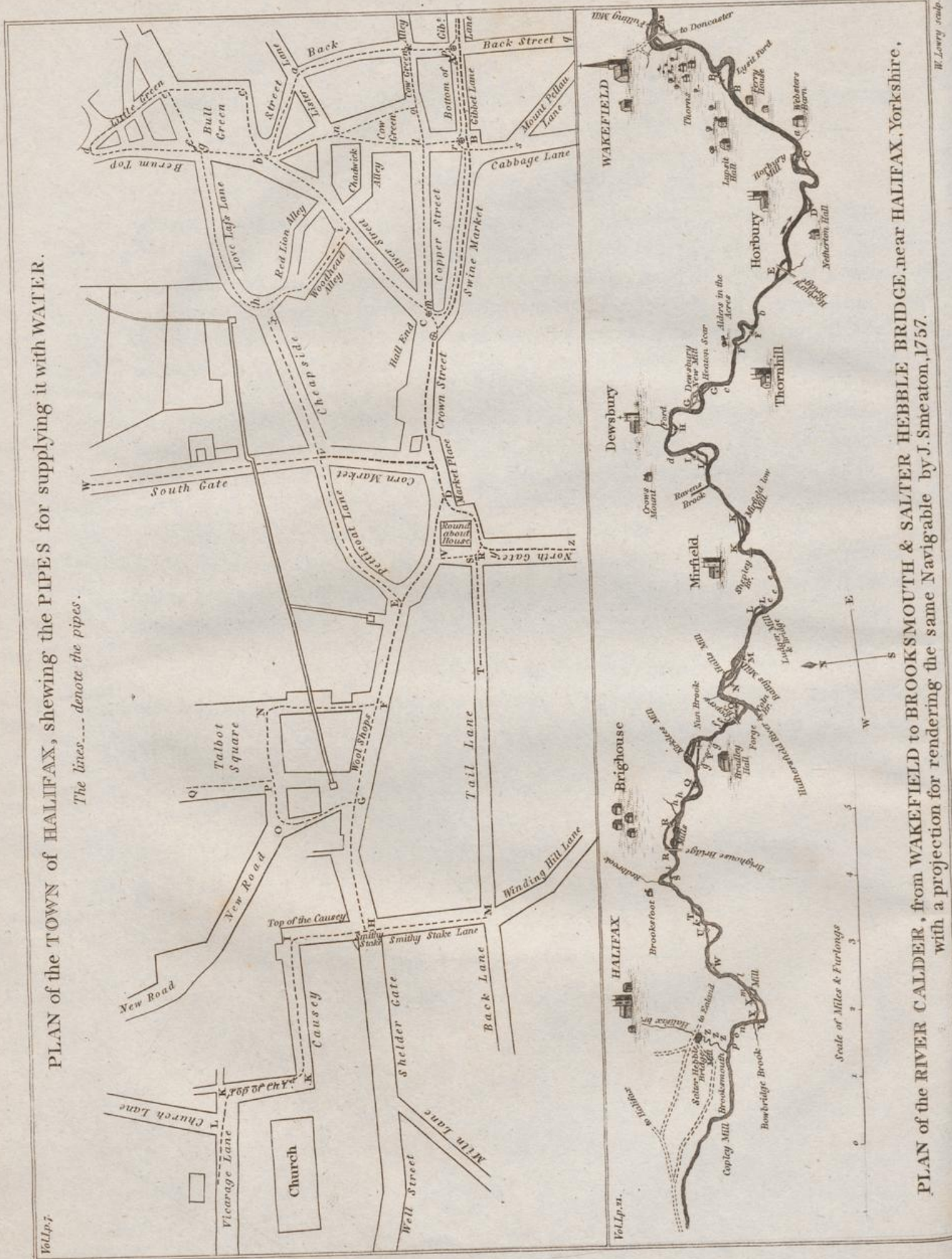
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PLAN of the TOWN of HALIFAX, shewing the PIPES for supplying it with WATER.

The lines..... denote the pipes.



PLAN of the RIVER CALDER, from WAKEFIELD to BROOKSMOUTH & SALTER HEBBLE BRIDGE, near HALIFAX, Yorkshire, with a projection for rendering the same Navigable by J. Smeaton, 1757.

W. Lowry sculp.

Published as the Act directs, 1757, by Longman, Hurst, Ross, Orme and Brown, Stationer, Bow Church Lane, London.

J. Ewing del.

On the water-works at *Halifax*.

To Mr. SIMPSON.

S I R,

ENCLOSED you have a sketch of the method which I would propose for laying of the pipes of the intended Water-works at *Halifax*, and an estimate referring thereto, which I hope will be near the matter, having spent some time in the consideration and forming thereof; however, I would not wholly rely upon my own judgment, but desire that those papers may be overlooked and considered by my ingenious friend JOSEPH KNIGHT, whose natural sagacity and acquirements in these kinds of affairs will, I am persuaded, lead him to discover and point out such oversights and mistakes as I may have been guilty of, notwithstanding the care I have taken; and I must take this opportunity of desiring, that, though the Gentlemen have thought proper to consult me on this occasion, I may not be considered as any bar to his merit, but rather as jointly concerned.

It may not be amiss, however, to point out the general principle upon which I have conducted myself; and, in the first place, as the town lays very unequal in point of level, and of consequence, a very great perpendicular pressure will lay upon the pipes, especially towards the lower parts, I have endeavoured to avoid the additional expence, that naturally would arise from proportional encrease of thickness, by taking advantage of such circumstances in the situation, as have a tendency to relieve the disadvantages thereof; and, with this view, I have assigned the bores of the pipes in general considerably less than I should have done, in case the town had been more upon a level, because the declivity has a tendency to force the water through the pipes with greater velocity, and make them give as much water through a given orifice, as would be done by a larger pipe more upon a level, and with a lesser pressure upon it.

2dly. Considering that the supply will come from above the head of the town, and that the pipe of conduct, at its first entrance into the town, must carry all the water necessary for the supply of the whole, but that in going lower down it has only the water to convey for such parts as lay still lower; of consequence, the necessary bore of the pipe of conduct will grow less and less the further and lower it goes; but as it is a certain principle in hydraulics, that pipes become stronger in proportion as their diameters are less, when the thickness of the shell of the metal is the same, it follows, that if their bores are diminished in proportion as their perpendicular pressure is increased, the smaller pipe will be as able to sustain its weight of water as the larger will be to sustain the pressure peculiar thereto;

thereto: for these reasons, instead of adding to the weight of metal as we go lower down, I have proposed the same thickness for the main all the way, and by diminishing the diameter, and consequently the weight, have added the necessary strength; by which advantage a great weight of metal will be saved, without injury to the main design. As to the branches, I have proportioned their thickness to the thickness of that part of the main which is upon the same level, regard being had to the difference of their bores; by these means every part of the system of pipes will be equally strong, with respect to the stress that will come upon it. I don't mean, however, that every part is adjusted with a mathematical exactness; for as I have allowed every part to be considerably stronger than what may be barely called sufficient, that would be not only unnecessary, but by making every yard of pipe of different bore and thickness, would be more unreasonably troublesome in the execution. That that part of the main which lays between the reservoir at the *Gibbet*, and the back street, I have supposed of the same bore and thickness all the way, for the ease of calculation; but, in reality, I propose it to be considerably wider towards the reservoir, yet, as the pressure diminishes that way, it can be done with the same metal as the calculation supposes.

3dly. Considering, likewise, the inequality of the ground in another view, in case there should be, at any time, any defect in point of quantity furnished to the reservoir for the supply of the whole town, it is evident that the lower parts of the town would be first supplied, because the water will naturally run down hill, and accumulate in the lowest parts first, by which means the lower parts would be well supplied, when the upper parts were partially, or scarce at all supplied: and even when the reservoir would furnish as much water as the pipes could take, as the water would issue with much greater velocity from the lower cocks than from the higher; should many of the lower cocks be open together, this would still abate the issuing of the water from the higher, and especially those at a distance from the main, so that while the lower cocks were kept running in this manner, the upper ones would be but faintly supplied; for remedying of which defects, as well as others that would accrue from the sensible effects of the leakage and waste of all the cocks in the town at once, I propose to part the town into two divisions, the upper and the lower, to receive the water alternately: the upper division to consist of all the streets above the Hall end, and the lower division of all below, which will be done by placing a stop-cock upon the main at * ⊕, and three others at the three principal branches at ⊕ A, ⊕ B, and ⊕ C; by which means, the * cock being shut, and A, B, and C open, the upper division will be served alone: on the contrary, the cocks A B C being shut, and the * cock open, the lower division will be served, and no part of the upper. And here it must be remarked, that I propose the two streets,

called

called the bottom of *Gibbet-lane* and the *Swine-market*, to be served out of the branches p r, p m, and not from the main A B, B C; for otherwise, those two streets, with the upper branches dependant thereon, would be perpetually supplied, whereas the supply of every other part of the town would be intermitted, and consequently the distribution unequal.

The equality proposed hereby might, perhaps, be still greater, in case the town was divided into more divisions than two; but as the scheme would be embarrassed with a greater number of branches and stop-cocks, I was unwilling to destroy its simplicity for trifling advantages. Perhaps the division that I have proposed may not consist of an equal value of water-rents; but as this may be adjusted by proportioning the time that each division shall receive the water, I would rather propose this method of preserving the equality, than by taking any other point of division, which, as the town is shaped, I think would not be so convenient.

4thly. Respecting the method of conveyance of the water from the spring to the reservoir; though I am still of opinion it may effectually be done in a gutter lined with clay and gravel; yet, considering that this gutter must be covered, and well secured from evaporation and diversion, I have, upon second thoughts, (at least for the sake of coming to an estimate) supposed this conveyance to be in wooden pipes of four inches bore, which there is no doubt will answer, and not give the water any ill taste, as the descent from *Broadby Laitb* to the *Gibbet* is great enough to give the water a rapid current, consequently its time of continuance in the pipes will probably not exceed half an hour.

5thly. I have only further to observe, that I have not included the purchase in my estimate, which, added to the amount thereof, will make a sum much beyond what seemed to be imagined when I was at *Halifax*; and, on this account, I have been the more minute, and have inclosed a copy of the amount of each particular part of the lead-work, that in case I have inserted or omitted any street which ought to have been otherwise, a proper correction may be made; and also that the whole may be submitted to examination, from whence I flatter myself it will appear that the matter is not exaggerated. And I am, with the utmost respect to the gentlemen promoters of this scheme,

S I R,

Your most humble servant,

J. SMEATON.

C

P. S. Please

P. S. Please to tell my friend, Mr. STANSFIELD, that the improvements I supposed might be made in fulling as well as other mills, when this matter came in question on the *Calder*, is no longer a matter of theory; and, contrary to the determination of Mr. BANKS, that a fulling-mill is a machine so simple, that it is not capable of any farther improvement, a fulling-mill that has been erected from one of my plans, in dry times, goes with less than a quarter of the usual quantity; and in freshes goes with 3 feet 8 inches tail water; though the greatest difference between head and tail water, when the last is most down, in dry seasons, never exceeds 4 feet 6 inches.

ESTIMATE for the Water-works at *Halifax*.

	£.	s.	d.
To expences in walling and securing the spring head, - - - - -	30	0	0
To piping from <i>Broadby Laith-spring</i> to the <i>Gibbet</i> , being two miles, to be wood pipe four inches bore, laying and compleating, at 5 s. per yard, - - - - -	880	0	0
To erecting a water-house and reservoir near the <i>Gibbet</i> , - - - - -	200	0	0
To 653 cwt. of lead piping in the main, leading from the reservoir to <i>Smithy Stake</i> , folder-work, laying, and making good the streets, at 1 l. 4 s. per cwt. - - - - -	783	12	0
To 931 cwt. in the branches at ditto, - - - - -	1117	4	0
To four large brass stop-cocks and a valve, at 4 l. each, - - - - -	20	0	0
	<hr/>		
	3030	16	0
To unforeseen expences, at 10 per cent. - - - - -	303	0	0
	<hr/>		
	3333	16	0
	<hr/>		

London, 14th February, 1761.

Place.	Bore.	Thick- ness.	Length.		Weight.		
			Ch.	L.			
* A	3 1/2	1 1/2	12	10	25,555	N. B. The Mark * is sup- posed to be placed at the Gibbet.	
AB	3 1/2	1 1/2	2	80	5,914		
BC	3 1/4	1 1/2	5	85	11,624		
CD	3	1 1/2	5	30	9,864		
DE	2 3/4	1 1/2	3	13	5,433		
EF	2 1/2	1 1/2	3	18	5,123		
FG	2 1/4	1 1/2	3	10	4,604		
GH	2	1 1/2	3	68	5,005		
					C. qrs. lbs.		
					73,122		= 652 3 14
Branches.							
A a	2 1/2	3/8	4	81	5,714		
ab	2 1/4	5/16	2	52	2,223		
B b	2 1/4	5/16	6	00	5,292		
C b	2 1/4	3/4	7	23	7,852		
b c d b	2	1/4	13	00	7,937		
e f	1 3/4	1/4	1	92	1,042		
g h i	1 3/4	5/16	8	62	6,141		
k l	2	5/16	2	76	2,201		
l m	1 3/4	5/16	5	00	3,562		
n o	1 1/2	1/4	2	85	1,354		
p q	1 3/4	1/4	4	00	2,171		
r s	1 1/2	1/4	1	75	831		
p r	2 1/4	5/16	2	90	2,558		
r m	2 1/4	3/8	6	00	6,516		
t v	2 1/4	3/8	3	20	3,475		
v w	2	5/16	8	00	6,378		
v x	1 3/4	5/16	4	10	2,921		
v E	1 1/2	5/16	5	10	3,200		
D y	2 1/4	7/8	3	00	3,870		
y z	2	3/8	5	30	5,215		
R V	1 1/2	5/16	1	50	941		
S T	1 1/2	5/16	2	60	1,632		
E N O G	1 3/4	3/8	9	20	8,115		
Q P	1 1/2	5/16	2	40	1,506		
H M	1 1/2	3/8	3	60	2,808		
H I	1 3/4	7/16	2	17	2,282		
I K K L	1 1/2	7/16	7	00	6,528		
					C. qrs. lbs.		
					126 53	104,265 = 930 3 21	
					165 67	177,387 1583 3 7	