

To Mr. Errington.

Sir,

In answer to your request, desiring my opinion in writing concerning the late calamitous accident at the Bridge of Hexham, and what is most adviseable to be done upon it; I must, in the first place, observe to you, that from reflecting upon every circumstance that has yet been communicated to me, with all the precision I am able, I am of opinion that the true cause of any failure was occasioned, not only by the great violence where-with the bridge was attacked, but by the great weakness of the stratum of matter that lies immediately under the bed of the river, and which has been said universally to prevail in that neighbourhood by those who made trial thereof, between the building of the first bridge and that of the second; which weakness of the under stratum I was not only aware of, but turned my thoughts towards every expedient that could tend to avert the ill effects that might arise therefrom; and having observed, that in all the attempts of those who had gone before me in this enterprize, they had dug considerably into the bed of the river, and thereby rendered that weaker which was already too weak, I did not doubt but that, by a contrary practice, my endeavours would have been crowned with the wished and expected success; for as I had read of buildings and bridges that had stood upon more weak natural foundations than this appeared to be, and even myself had a case of the kind, that I had effectually remedied, I did not doubt, but that with the precaution of not weakening the upper crust of hard gravel, but building immediately upon it, I should in like manner succeed in this place.

The instances, however, that had come to my knowledge, though the strata under the foundations might be naturally weaker, yet none of them are liable to be attacked with any thing near that degree of violence that this river now appears to be capable of; had it been possible for me to have been acquainted before hand that a flood of this river could come down with so much suddenness, as that, for want of time, for the lower reaches of the river to be filled from the upper, there could be created a fall or difference of level between the up stream end and the down stream salient point of the same pillar, of no less than five feet perpendicular, which would in effect create a velocity

velocity of the water of above a thousand feet in a minute; I say, could I have been informed of this single fact, as appeared to be at, and for some time before any degree of derangement was apparent in this bridge, I never could have thought of advising you, or any private gentleman, to have undertaken, at his own risk, a building of so much danger and hazard; and, exclusively of that danger and derangement which might naturally be expected to arise from the mere rapidity of the water, I am further of opinion from what now appears, that the mere difference of the weight of the body of water immediately above the bridge, which could not be counterbalanced by a body of water of an equal breadth immediately below, has, in reality, been sufficient to force down the under soft stratum out of its former position, so as to be more inclined to the west, and occasioned the upper stratum, upon which the bridge immediately stood, to follow it; and in both these respects, that is, of rapidity and unequal pressure upon the bottom, the violence would be greater than even in the great inundation of 1771; for though, according to accounts, the height of that was greater, yet its rise was far less sudden; and therefore its rapidity and tendency to derangement less.

To the question, What is now to be done? I answer, that though I do not conceive it impossible to re-erect the bridge in the former site, and where much expense is standing towards a completion; yet I do conceive it impossible to be done with any reasonable hope of its proving a permanent or successful undertaking. I am further fully convinced the bridge was perfectly safe against all common occurrences.

I remain, Sir,

Gray's Inn,  
6th April 1782.

Your most humble servant,

J. SMEATON.

P. S. The bridge I mentioned to have restored was the Bridge of Dumbarton, about 20 miles from Glasgow, undertaken by government. That part of it that failed was built upon a crust of gravel not above two feet thick; and, without any flood, external violence, or previous notice, one of the pillars went down, with the two adjacent arches, and crushed the centers, then standing, under them. On examining, I found the ground so soft under this crust of gravel, that a bar of 40 feet went down to the head by its own weight.