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978-1-108-07195-6 - A Description of Westminster Bridge: To Which are Added, an Account of the Methods Made Use of in Laying the Foundations of its Piers and an Answer to the Chief Objections, that Have Been Made Hitherto.

Charles Labelye

Excerpt

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A  
 DESCRIPTION  
 O F  
*Westminster Bridge.*

**B**Y an Act of Parliament past in the 11th Year of his present Majesty's Reign, it was enacted, that the (then intended) Bridge should be built from the *Woolstaple*, or thereabouts, in the Parish of St. *Margaret*, in *Westminster*, to the opposite Shore, in the County of *Surry*.

In Consequence of this Determination, and in Obedience to the Orders of the Commissioners, several Observations were made to find out the Direction of the Stream in that Part of the River, at different Times of the Flood and Ebb; and accurate Surveys of the adjacent  
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Shores, were taken by myself and others, which having thoroughly examined, I laid before the Board what Situation appeared the most advantageous; which being approved, proper Marks were made on each Shore, in order to place the Bridge in that Situation, which is as follows:

The Position of the new Bridge, in respect to the Points of the Compass, is almost due East and West. And the Streams of the Tide (both Flood and Ebb) do pass thro' the Arches, without any sensible Obliquity. This Position of the Bridge has also this great Advantage, that if a Street be ever made through the City of *Westminster*, in the Continuation of the Direction of the Bridge, that Street will open a View to, or terminate in St. *James's-Park*, at the End of *Princes-Court*, near *Story's-Passage*.

The Breadth of the River at high Water, at the Place where the Bridge is built, was measured two different ways, first, by Trigonometry, *viz.* having measured a Basis of near 700 Feet along the *Surry Shore*, and observed the proper Angles, the Calculation gave for the Distance intercepted between the *Woolstaple Dock*, and the opposite Wharf, 1216 Feet. *2dly.* It was actually measured with a wooden Beam of 100 Feet in Length, laid on the Surface of the River, at dead low Water, and it was found 1223 Feet; whence taking a mean between the Trigonometrical, and this actual Mensuration, which is likely to exceed the Truth

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Truth (on Account of the Difficulty of laying the Beam precisely in the same Line) it may safely be concluded, that the Breadth of the River at that Place is nearly 1220 Feet; which is about 300 Feet wider than at *London Bridge*, very near 400 Feet wider than at the *Horse Ferry*, and about 200 Feet narrower than over-against *Whitehall* and *Scotland Yard*, on Account of the elbowing of the River, over-against those last mentioned Places.

The Stream of the River, where the Bridge is built, is divided into two Channels; in the one, called the Ebb Channel, which runs along near the *Surry* Shore, the Water is about 8 Feet in Depth at a common low Water; and in the other, call'd the Flood Channel, which runs along near *Westminster* Shore, the Water is about 6 Feet deep at a common low Water. These two Channels are divided by a Shoal of a considerable Length and Breadth, made up of Sand, and of the Washing or Silting of the River. Upon the Shoal, the Water is seldom more than 4 Feet in Depth, at a common Low Water.

The Rise of the Tide in this Part of the River, is very uncertain, being seldom less than 7 Feet at Neap Tides, and droughty Seasons, especially when the Wind is upon any Point of the Compass, between the South and the West; and the Rise of the Tide is seldom more than 17 Feet at extraordinary Spring Tides, joined with the Land Waters, after rainy Weather of  
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some continuance ; particularly, if the Wind blows from any Point of the Compass, between the North East and the North West, at a mean Tide, the Water may be computed to rise about 10 or 12 Feet perpendicular.

As to the Velocity of the Stream of the River, I made several Observations, from which it may be concluded, that the Velocity of the Surface of the Water, during some part of the Tide of Flood, is something greater than at any Time of the Tide of Ebb ; the former being near 3 Feet *per* Second, and the other never above  $2 \frac{1}{2}$  Feet *per* Second in this Part of the River.

The Nature of the Ground under the Bed of the River where the Bridge is built, has been examined in several Places, especially under the Foundation of every Pier, by boring into the said Ground with sharp and well steel'd Drills, urged round, and downwards, by the Force and Weight of several Men, besides some additional Weights, and it plainly appeared from all those Borings, that there is a very considerable Bed of Gravel, quite across the *Thames* where the Bridge is built ; that the Surface of this Bed of Gravel, is not at all parallel to the Bottom or Bed of the River ; for near the *Westminster* Side, the Gravel is found very near under the said Bed, but the top Part thereof is intermixed in that Place, with some thin Layers of Sand, about the Middle the Gravel lies lower, being covered with 3 or 4 Feet of Sand, Dirt,

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Dirt, and Mud ; and the Heighth or Thicknes of this muddy Sand, above the Bed of Gravel, increafes more and more towards the *Surry* Shore, where the Bed of Gravel lies from 10 to 12 and 14 Feet below the Bottom of the River. The absolute Depth or Thicknes of this Bed of Gravel under the Bridge, is certainly very confiderable, but ftill unknown. For tho' with a great deal of Time, Patience, and Difficulty, the boring Tool has penetrated in fome Places 12, and even 17 Feet into that Bed of Gravel, it was found to vary, as to Size and Compactnes, but in no Place did it ever reach any other Substance than Gravel, after the boring Tool had once entered into it, nay, in fome Places, it was not poffible to get in the boring Drills above 8 or 10 Feet, and in thofe Places, when the ballaft Men dug into it, for laying the Foundations of the Piers, the Gravel was found extremely clofe, and as it were petrified.

Before I proceed to describe the prefent *Westminster Bridge*, I believe my Readers will not take amifs, that I premise a fhort Defcription of the firft Design of the Bridge ; in order to which, I muft inform them, that among the feveral Designs that were laid before the Commiffioners, I prefented to the Board, in the Beginning of *May*, 1738, a Design of my own for a Stone Bridge, (of which I published a Plate and Explanation, in *May*, 1739,) confifting of 13 large femi-circular Arches, fpringing

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from about 2 Feet higher than Low Water Mark, 2 smaller Arches of 25 Feet each, under each Abutment, and 14 Piers, the greatest Arch not exceeding 76 Feet in Diameter, all the other large Arches decreasing by 4 Feet each, on each Side. The two largest of the 14 Piers, 17 Feet wide, all the other Piers decreasing, each by one Foot in Breadth, on each Side of those large Piers. The Foundation of each of those Piers, to extend several Feet all round the Piers, in order to give them a proper Basis or Footing, and none of them to be laid at a less Depth than 5 Feet, below the Surface of the Bed of the River.

The Number and Dimensions of the Arches and Piers, were approved by the Commissioners, and they resolved, that such Piers should be erected as high, as where the Springing of the Arches should be, that is, 2 Feet or thereabouts above Low-water Mark.

On the 10th of *May*, 1738, the Commissioners did me the Honour to appoint me their Engineer, and on the next Board Day after, giving me a general Charge of directing the Works, under the Orders of their Board and Committees only, the Chairman concluded it, by adding, in the Name and by the Direction of the Board, very generous Promises, in case I should succeed in the Methods I proposed to follow, in building the Piers, which Promises have since been very fully, and honourably

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ably made good to me, without any Sollicitations.

The very first Orders that I received, were, *That I should take the utmost Care to lay the Foundations of the Piers, and to see that the Stone Piers themselves, should be erected in such a solid Manner, of such Dimensions, and with such Precautions, as might make those Piers capable of supporting at any Time hereafter, the Arches, and the Superstructure of a Stone Bridge, such as my Design (then upon the Table) represented.* The Commissioners ordered also, at that Time, that over these broad Piers, there should be erected little Piers, or Shafts of solid Stone, each of these to be as long as the Bridge was to be wide, (which was then fixed by the Board at 44 Feet) and 15 Feet in Height, in order to reach some Feet above the Surface of the High-water Mark; the Breadth of each of those Shafts, to be 8 Feet, for the first 5 Feet in Height; 7 Feet for the next 5 Feet in Height; and 6 Feet for the last 5 Feet in Height; finishing with a large Torus, or *Cordon*. Over those Shafts, the Honourable Board ordered a curious wooden Superstructure, of the Invention and Design of the late Mr. *James King*, to be erected. As the Model of this Superstructure, was then shown and explained to a great many Persons of the first Rank in the Kingdom, and to many others, and generally approved of, as the most curious of its Kind, and the Design of it has since been

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Engraved and Printed, I must refer the Reader to that Design, for further Particulars. What I cannot omit, even in this short Account, is, That by Building these Shafts of Stone over the broad Stone Piers, a great deal of Time and Money would be saved ; and yet, if at any Time hereafter, the Commissioners thought proper to finish this Bridge with Stone, (which they did in less than two Years after) the Arches might be turned, without pulling down any Part of either those Shafts, or of the broad Piers, as it must have been done, if the broad Piers, had been continued of the same Breadth, quite up to the Height above High-water Mark.

From what has been mentioned, it will appear, that supposing the Length of the Bridge, or the whole Breadth of the River, 1220 Feet, the greatest Breadth of all the Piers taken together, did not amount to more than 198 Feet, and the Voids or Openings of all the Arches, would never be less than 870 Feet, left free for the Water-way

From these Numbers, and the Observations of the Velocity of the Stream, mentioned above, I computed the perpendicular Height of the greatest Fall, that could ever happen under the Arches of such a Bridge, and notwithstanding the very large Allowances I made, found it could never amount to  $3\frac{1}{2}$  Inches, which is so insensible a Fall, as could prove no Obstruction at all to the Navigation ; and it appeared



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peared also from Calculations, neither long nor difficult, that such a Bridge could not raise the Water in the River at Spring Tides, sensibly higher than usual, or sensibly alter the Duration of either Flood or Ebb.

And by the same Method, applied to the Circumstances of *London Bridge*, the perpendicular Height of the Fall, which the Calculation gave, came very near the same as I observ'd it in the Year 1736, when I found the greatest Velocity of the Surface of the Stream above the Bridge, at the Time of the greatest Fall, 3 Feet 2 Inches *per Second*; and the Fall about 4 Feet 9 Inches. And this very Method of Calculation, being adapted properly to the Circumstances attending *Westminster Bridge*, as it is now finished, it appears, that at that Time of the Ebb, when the greatest Fall is observed, it does not exceed  $\frac{1}{4}$  of an Inch, and is certainly less than  $\frac{1}{2}$  an Inch, there is then no running Water, but only thro' the 13 large Arches, and no Obstacles to the Stream, but the 12 intermediate Piers, and the Velocity of the Surface of the Stream, just above and below the Bridge, is barely 2 Feet and  $\frac{1}{4}$  *per Second*; from which Numbers and *Datas*, the Calculation gives, for the perpendicular Height of the greatest Fall under the Arches of *Westminster Bridge*, about  $\frac{3}{8}$  of an Inch, as it really is.

I cannot conclude this Article, without observing, that it is no Wonder, that the pretended

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ed Calculations of the Fall under *Westminster Bridge*, published in several Pamphlets, should be all false ; since the Authors never thought at all, or inquired, about the greatest Velocity of the ebbing Waters, or ever had taken that Velocity (on which the Fall chiefly depends) into any of their Calculations ; nay, some of them were so intirely ignorant of the very first Principles on which those Computations are founded, that they attempted very gravely, to compute and compare the Fall under *Westminster Bridge*, with that under *London Bridge*, by the Rule of Three ; by which alone, they might as well attempt to find the Moon's Place, or the present Value of the Reversion of an Estate, after two or three Lives. The Tides, and all other Circumstances attending the *River Thames*, and the Nature of the Ground under its Bed, being duly considered, the Method of laying the Foundations of the Piers, which I thought most likely to succeed, was that which I had the Honour of explaining twice upon working Models, before the Commissioners, a short Account of which is as follows.

That the Foundation of every Pier should be laid on a strong grating of Timber, planked underneath. --- That this Grating of Timber should be made the Bottom of a Vessel, such as is called *Caiſſon*, by the *French* ; (which Term I shall make Use of) That the Sides of this *Caiſſon*, should be so contrived, as to be taken away, after the Pier should be finished : That the