

TRACT IV.

ON THE CONSEQUENCES TO THE TIDES IN THE RIVER
THAMES, BY ERECTING A NEW BRIDGE AT LONDON.
BY MR. JOHN ROBERTSON.

WHILE it was in contemplation to erect the new bridge over the river at Blackfriars, there was much public conversation and speculation on the probable effects of such erection, relative to the tides in the river, and other matters connected with it. On this occasion, the magistrates of the city of London consulted many scientific men and practical engineers, touching those points. Among others, they requested the advice and opinion of Mr. John Robertson, then master of the Royal Mathematical School in Christ's Hospital, by a special letter from the Town Clerk, as follows.

“ To Mr. Robertson at Christ's Hospital.

“ Sir,—The Committee of Common Council appointed to consider, whether the Navigation of the river Thames will in any and what manner be affected by a new Bridge, intend to meet at Guildhall, on Thursday the 12th instant, at 10 o'clock in the forenoon, and desire you will be so kind as to favour them with your company at that time, in order to give them your opinion and assistance therein. I am, Sir,

“ Your most obedient, humble Servant,

“ James Dobson.”

Town Clerk's Office, Guildhall, 5 Dec. 1754.

Mr. Robertson's Answer.

“ Before I deliver my opinion concerning the question proposed, I think it necessary to premise some few principles

relating to the Tides, and particularly those which affect the river Thames; because a just solution to this question depends chiefly on the phenomena of the tides.

“ 1. It is now well known that the tides are regulated by the motion of the moon; and that this planet takes something less than 25 hours, between the times of its departing from any meridian, to its return to the same; in which time she causes two floods and two ebbs; so that in most parts of the earth there is a new time in every revolution of about 12 hours and a half.

“ 2. There is a flood tide which flows round the northern parts of Europe, and thence proceeds southward through the western ocean: a branch of this tide runs southward along the German sea, and makes high water to all the eastern coasts of Great Britain, in a successive order, in regard to the time the moon has passed the meridians of those places: this branch of the tide runs but a little to the southward of the mouth of the river Thames.

“ 3. While the said branch is running down the German sea, the grand body of the tide is marching southward along the western coasts of Ireland, and thence flowing partly southward, partly south-eastward; one branch runs up St. George's Channel, and another branch flows eastward, up the English Channel, and makes, in a successive order of time, the high waters upon all the southern coasts of England: this branch extends something to the northward of the mouth of the river Thames.

“ 4. The said tides, meeting near the mouth of the river Thames, contribute to send a powerful tide up that river; and so long as the said southern and northern branches continue to flow, so long will the waters continue to accumulate at the mouth of this river, and make their way up it, in order to restore the waters to a level.

“ 5. The flowing of the tide up the river Thames is greater or less, in proportion only to the accumulation of the waters at its mouth; and therefore, in the common course of things, there is, relative to the moon's age, a fixed quantity of tide which the river Thames is to receive; and therein to be

disposed of in the best manner that its situation will admit.

“ 6. On account of the water being confined between the banks of the river, the tide must flow up higher, in proportion as the river becomes narrower, till the fixed quantity is received. But then it must be observed, that when the tide acts against the stream of a river, the tide up that river becomes progressively stronger and stronger, for a time, according as the velocity of the natural stream is checked; and in this manner the river waters themselves by degrees obtain a contrary direction, and run up with the tide, and so may be considered as waters coming in with the tide of flood, and part of the fixed quantity which that river is to receive.

“ 7. The return of the tide, or the time of ebbing, is not every where performed in the same time as it took to flow in. For, in the ebb tide there is to be discharged, not only the waters which were brought in by the tide, but also all the river water which has been retarded by it.

“ 8. Whatever obstacles are laid in the way of the tide, across any channel, the utmost rise, or the high-water mark, at different times, will be respectively the same: because the water will continue to rise till the fixed quantity of tide is disposed of, and no longer. And, in like manner, the low-water mark will not be affected by such obstacles. Indeed, between the limits of high and low-water marks, the water will be raised higher against those obstacles, both in the flood and ebb tides, than they would be in those places, were the obstacles removed. For, as the velocity of the current must, on both sides of the obstacle, be equal, in order for one part of the water to run away, as fast as the successive ones follow; therefore the waters must rise on that side of the obstacle which they run against, till they be so high, that by their fall they acquire a velocity sufficient to carry them off, as fast as they arise at the obstacle.

“ These principles being premised, the solution to the question proposed naturally follows. And in order to this, let us for the present suppose, that between London and

Westminster bridges, another bridge were built; and to show what might be the consequences in the worst case, let us suppose it occasioned as great a fall as at London bridge.

“ Consequences during the time of the Flood Tide.

“ The flood tide, meeting with the obstruction of the new bridge, would accumulate on the eastern side thereof, much in the same manner as it does now at London bridge: this would cause the flood tide at first to run through London bridge with less velocity than it does at present. For, the new bridge, by penning up the water, would throw some of it back again, towards London bridge; and consequently the waters on the eastern side of London bridge, would rise higher than they now do, that they might run off with the same velocity, with which they came to the bridge.

“ The tide would not run up the river so far as it now does; and consequently the tide of flood would be sooner spent, than at present: nevertheless the rise of the waters would not, at any place, be lessened beneath the present standard. For, the more obstacles any moving body has to encounter with, the sooner will its motion be destroyed. But the fixed quantity of the tide being in no wise diminished, the waters must necessarily rise as many feet high, either above or below the bridges, as they would, were there no bridges over the river.

“ Consequences during the Tide of Ebb.

“ The ebb tide would be obstructed, on the western side of the new bridge, in the same manner as it is now at London bridge; but the rise of the water at the new bridge would be highest*. For, as London bridge, by penning up the water,

* It is manifest that all this reasoning, by Mr. Robertson, we must remember, has been on the supposition, that the new bridge would be built with piers and sterlings, like London bridge, and so cause a similar obstruction to the currents.

would cause it, at the beginning of the ebb, to revert or fall back again towards the new bridge: consequently the waters on the western side of the new bridge must rise higher, on account of the pen below, that they might run away as fast as they were succeeded by the following water.

“The length of the tide of ebb would be greater than it is at present, by as much time as the tide of flood would be shortened. For though the same quantity of flood tide, being poured through London bridge, would spend its force sooner than at present, yet the time of the return of the aggregate of the flood tide, and the retarded land waters, would be greater; in proportion as the obstacles, they would have to pass by, were increased.

“From what has been said, I apprehend it is evident, that a new bridge, built between London and Westminster bridges, cannot alter the present high and low-water marks; even though this new bridge should be so constructed, as to occasion a fall of the waters, equal to what they have at London bridge.

“But experience has shown, how a bridge may be built, so as to cause no sensible fall: and were such a bridge substituted in the place of that we have before supposed, the consequences already remarked would become so inconsiderable, in respect to the tides, that I believe, and it is my opinion, that there would ensue no apparent alteration in the present state of the navigation of the river Thames, either above or below London bridge.”

John Robertson.