



Wm Rouse

A
PROFESSIONAL SURVEY
OF THE
OLD AND NEW LONDON BRIDGES,
AND
THEIR APPROACHES,
INCLUDING
HISTORICAL MEMORIALS
OF
BOTH STRUCTURES ;
WITH
REMARKS ON THE PROBABLE EFFECTS
OF
THE CHANGES IN PROGRESS
ON
The Navigation of the Thames.

WITH A PORTRAIT OF THE LATE JOHN RENNIE, ESQ.
AND THIRTEEN OTHER ILLUSTRATIVE PLATES.

London :
M. SALMON, WINE OFFICE COURT, FLEET STREET.

1831.

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NOTICE.

The engravings which illustrate the present "Survey," have been, with a few exceptions, made from drawings furnished by Mr. Christopher Davy, architect, to illustrate a series of papers *on the Bridges over the Thames*, which is in the course of publication in the *Mechanics' Magazine*. Considerable assistance has also been derived from the letter-press explanations, with which they were accompanied in that publication. The author has much pleasure in thus recording the obligation he is under, on the present occasion, to the pencil and pen of an esteemed and ingenious friend.

London, 13th August, 1831.

A PROFESSIONAL SURVEY,

§c. §c.

“ Then men
Observe the strength, the height, the why and when
It was erected, and still passing under,
Meet some new matter to look up and wonder.”

CHURCHILL.

THE utility of a bridge over the Thames, at that part where it separates the City of London from the Borough of Southwark, appears to have been fully appreciated from the remotest times. Two, if not three, bridges of timber had been erected here and had perished, through flood or flame, before the Normans established themselves in the country ; and in the reign of Henry I. the estates which had been bequeathed by pious and patriotic individuals for the constant repair and maintenance of a bridge at this spot were already considerable.

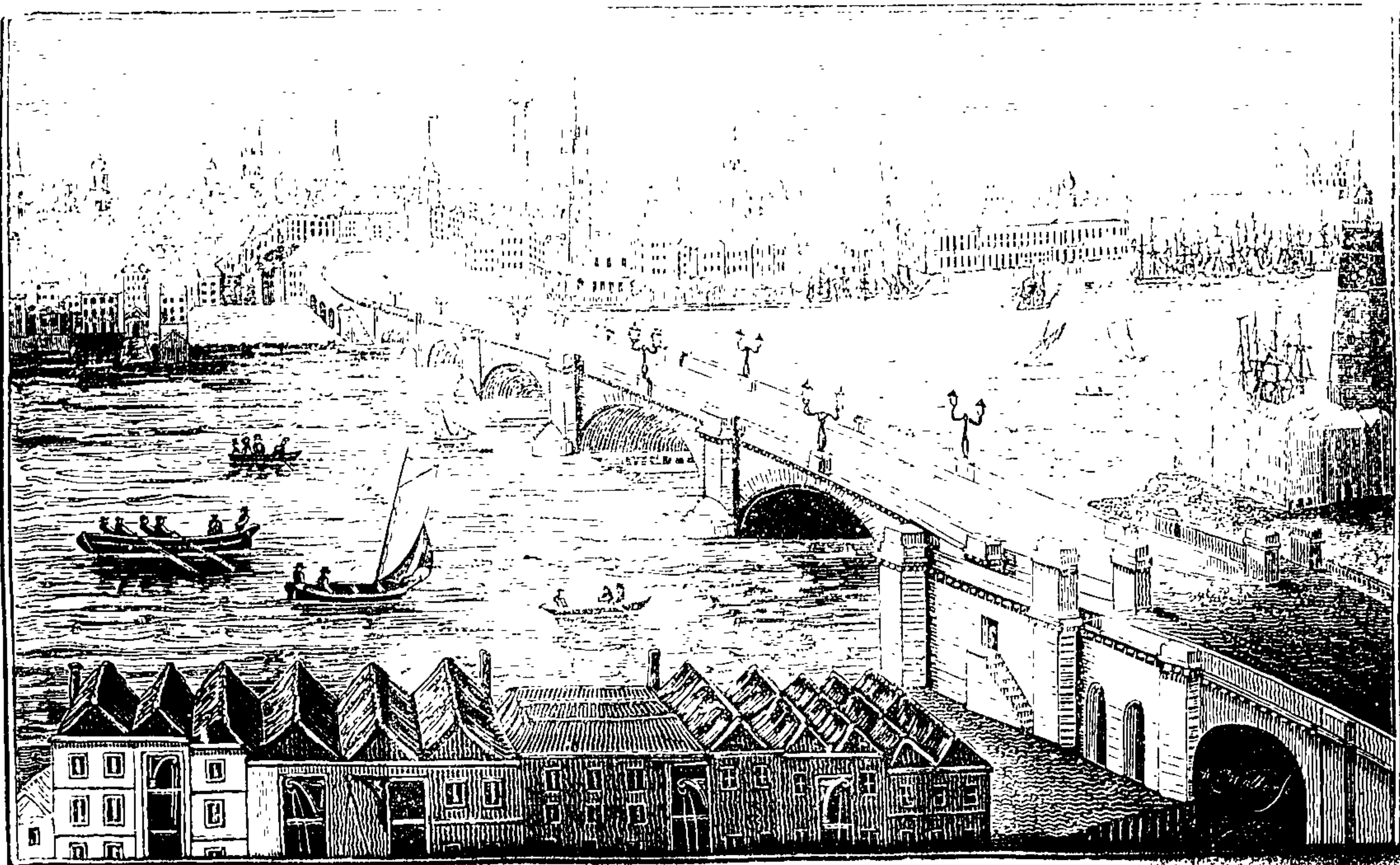
It was not, however, till near the beginning of the thirteenth century that that particular stone structure arose, which is now known by the name of the “ *Old London Bridge*.” It was founded in 1176, by Peter of Colechurch, a person of some eminence, who, as was common in those days, united the professions of priest and architect. The founder did not live to witness the completion of his task ; he died in 1205, and was buried in a crypt within the centre pier of the bridge, over which a chapel was erected, dedicated to St. Thomas-à-Becket. Mr. Brayley thinks (*Londoniana*) that “ if due care be taken when the old bridge is pulled down, the bones and ashes of its venerable architect may still be found.” A view of the central part of the bridge as it appeared when completed in 1209, with the chapel above alluded to, is given in Plate II. fig. 1.

The manner in which this bridge was constructed reflects but little credit on the talents of the architect. The most obvious of its defects was the disproportionate size of the arches, and the extreme smallness of most of them ; it had as many as nineteen, no

two of which were alike, and some of them were higher at one side than the other. In this respect, indeed, Peter of Colechurch may be said to have but erred in common with all the bridge builders of the period in which he lived; for, strange to say, though our Gothic ancestors displayed in the use of the arch in their castles and cathedrals, a skill and grandeur which have never to this day been excelled, nothing could be in a ruder or worse taste, than their attempts to apply it to the spanning of rivers. In nearly all the old Gothic bridges still extant throughout the country, the arches are so near the water as to render any navigation under them impracticable for masted vessels; and wherever an arch does rise to any considerable height, there is sure to be one next to it of excessively small dimensions—as if it had been intended that the diminutiveness of the one, should serve as an apology for the magnitude of the other! The piers of these bridges, too, are of all shapes and sizes, agreeing in nothing but a prevailing clumsiness.

That the bridges of the country should have been constructed in so contemptible a style, at a time when its places of worship exhibited some of the proudest triumphs of architectural art, is the more unaccountable, considering that the clergy, who must be supposed to have had a principal share in the merit of the latter, had also the chief direction of the former. The superintendence of the bridges formed one of the principal duties of the priesthood in the earlier ages of the church; and hence it was they obtained the honorary title of *Pontifices*. But though they carried into the execution of their *pontifical* duties none of that skill or taste in architecture which they doubtless possessed, they did not fail to leave many traces of their influence of a less creditable character. Witness the old triangular bridge at Croyland, made of a triangular form in honour of the Trinity; witness also the chapels with which the centres of all the bridges of their erection were encumbered.

Hawkesmoor, who published, in 1736, a description of the old London Bridge, accounts in rather a curious way for the magnitude of the pier which supported the chapel, raised on the centre of that structure. He says—"To be a steadying for the whole machine, instead of making an angle, as it is in the famous bridge of Prague, and in some of the bridges in France, so this fortress was placed in the middle of the bridge, to stem the violence of the floods, ice, and all other accidents that might be forced against it." That the creating of a stoppage, in the centre of the current of a large river, would give an additional stability or "steadying" to a



bridge over it, is a notion which one would have scarcely expected from a pupil of the great Sir Christopher Wren ; for such Hawkesmoor was, and a " favourite " one too.—(*Elmes's Memoirs.*) It was reason enough for making the central pier so strong, that it had so cumbersome a monument of priestly ascendancy, as the chapel of St. Thomas, to support, through many a future age ; but if we must seek for scientific considerations, where apparently none was thought of, we should conjecture that this pier was erected before any other part of the fabric, and made stronger than any other part, because it was considered desirable, if not essential, to have such a central point of support, from which the building of the bridge could be extended with convenience, and safety, to either side of the river.

To the external defects of Peter of Colechurch's bridge are to be added, some others of not less magnitude, which, an examination of its foundations, has brought to light. Like most bridges, of the same antiquity, it was erected on stilts,—that is, on piles driven into the bed of the river. Had these piles been sunk to a proper depth, and the masonry been carried low enough, there might have been nothing improper in this mode of construction. But, in Old London Bridge, the piles appear to have been sawn off generally at low water ; they were then surrounded, at a short distance, by other rows of piles, not so deeply imbedded (the starlings as they are called) ; and the space, thus enclosed, being filled in with chalk, stones, and loose rubbish, the piers were then carried up ; which, to make matters worse, consisted merely of rubble work, cased with an ashlar of stone. Neither was the piling itself of the best description. The ^{piles} piers are described as being rough, round, and unshewn ; and, though shod with iron, and driven close, not connected by (capciles) or any other contrivance. The piers being thus at once weak in themselves, and weakly supported, were but ill calculated to sustain the thrust of the arches ; and hence, in the progress of time, the necessity for fresh casings of stone, in front of the original ashlar, and for fresh starlings to protect the stone from the action of the river. In consequence, moreover, of the great contraction of the water-way, caused by the extent of these starlings, the impeded and swollen waters rushed through the arches with such velocity, that, to prevent the ground or bed of the river from being torn away, through the violence of the current, it was found necessary to adopt the farther expedient of binding it together, by what are technically called *drip shot*

piles ; that is, piles driven in irregularly, and with their heads so low in the water as to offer no obstacle to the navigation.*

Notwithstanding all the props and stays applied to this ill-built structure, eighty years had not elapsed, from the time of its erection, when it was in a state of complete ruin ; and though often repaired, in the course of succeeding years, it can scarcely be said to have been ever in a state of perfect renovation, down to as late a period as the great fire of 1666. Few parts of the metropolis suffered more from that disastrous visitation than the bridge. It had, by that time, become covered with houses, and all of these, with a few exceptions, fell a prey to the flames ; many of the piers and arches, too, were greatly damaged. As it was now necessary the structure should undergo a thorough reparation, Sir Christopher Wren proposed that advantage should be taken of the occasion to clear it from houses entirely, and to widen and enlarge several of the arches ; but, like too many of that enlightened individual's suggestions, for the improvement of the metropolis, at this auspicious crisis, his proposition was overruled. The piers and arches were restored to a sound state, but kept of the same form as before ; and the whole, of both sides of the surface of the bridge, were let out anew, on long building-leases. The bridge was accordingly soon covered over again with houses ; which, in conformity with a condition of the building leases, were of the uniform height of four stories, with an open roadway between them of twenty feet. A view of as much of the structure as will give an idea of its general appearance, about this period, is given in the sketch Fig. 2. Plate II.

In 1754 the bridge was once more in so dilapidated a state, and presented, with its overhanging masses of brick and mortar, so unsightly a contrast to the open and spacious new bridge, which had been then just erected at Westminster, that it came to be seriously debated in the Corporation, whether it would not be expedient to pull it down altogether, and erect a new bridge. Mr. Dance (the elder) and other scientific gentlemen, who were consulted on the subject, reported, however, that the foundations of the bridge were still perfectly sound ; and that, by clearing away the houses, and making a few alterations and repairs in the piers and arches, the edifice might be rendered, for ages to come, quite as serviceable, if not as elegant, as that of Westminster. An Act of Parliament was

* Report of Messrs. Dance, Chapman, Alexander, and Montague, November, 1814.

Fig. 1.

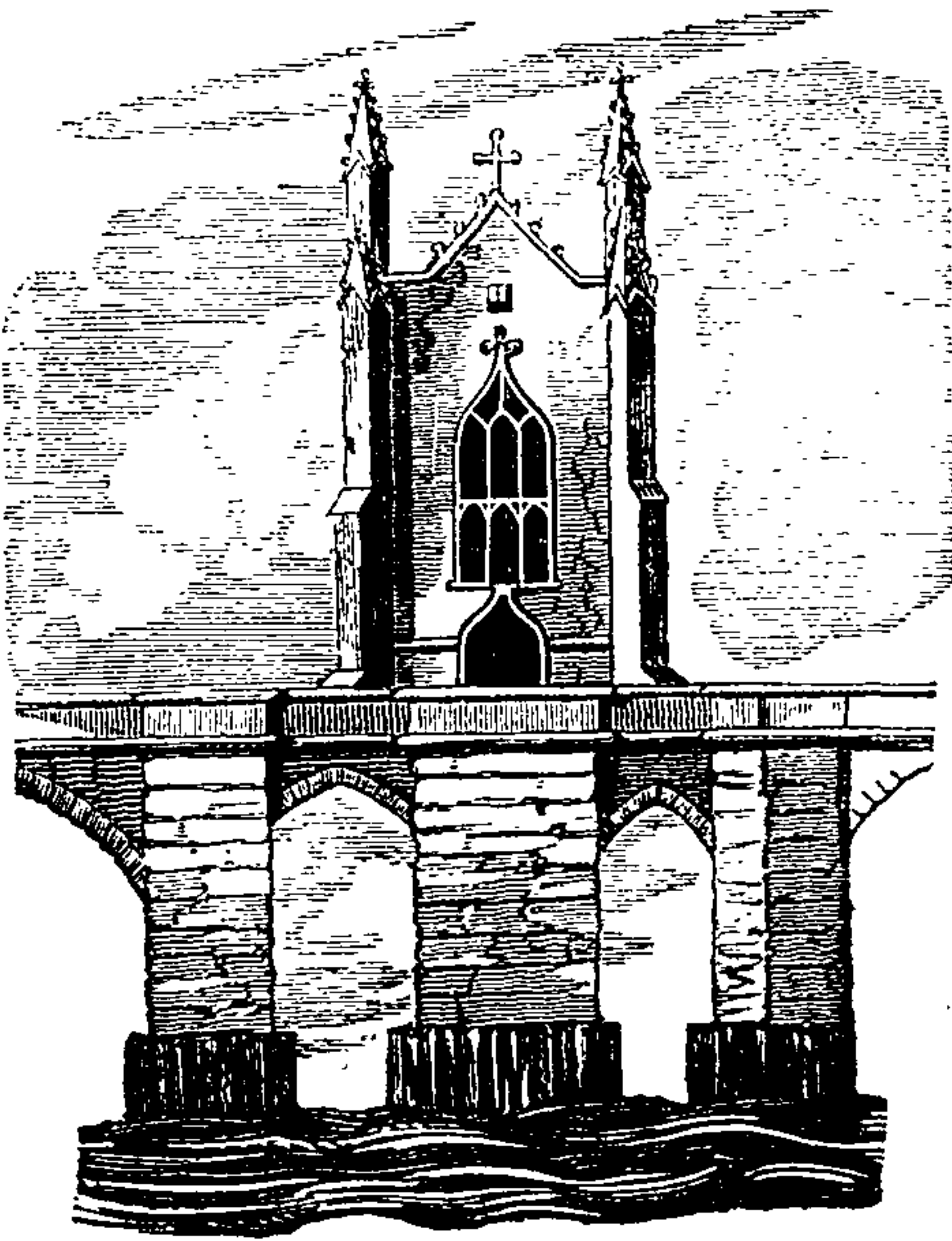
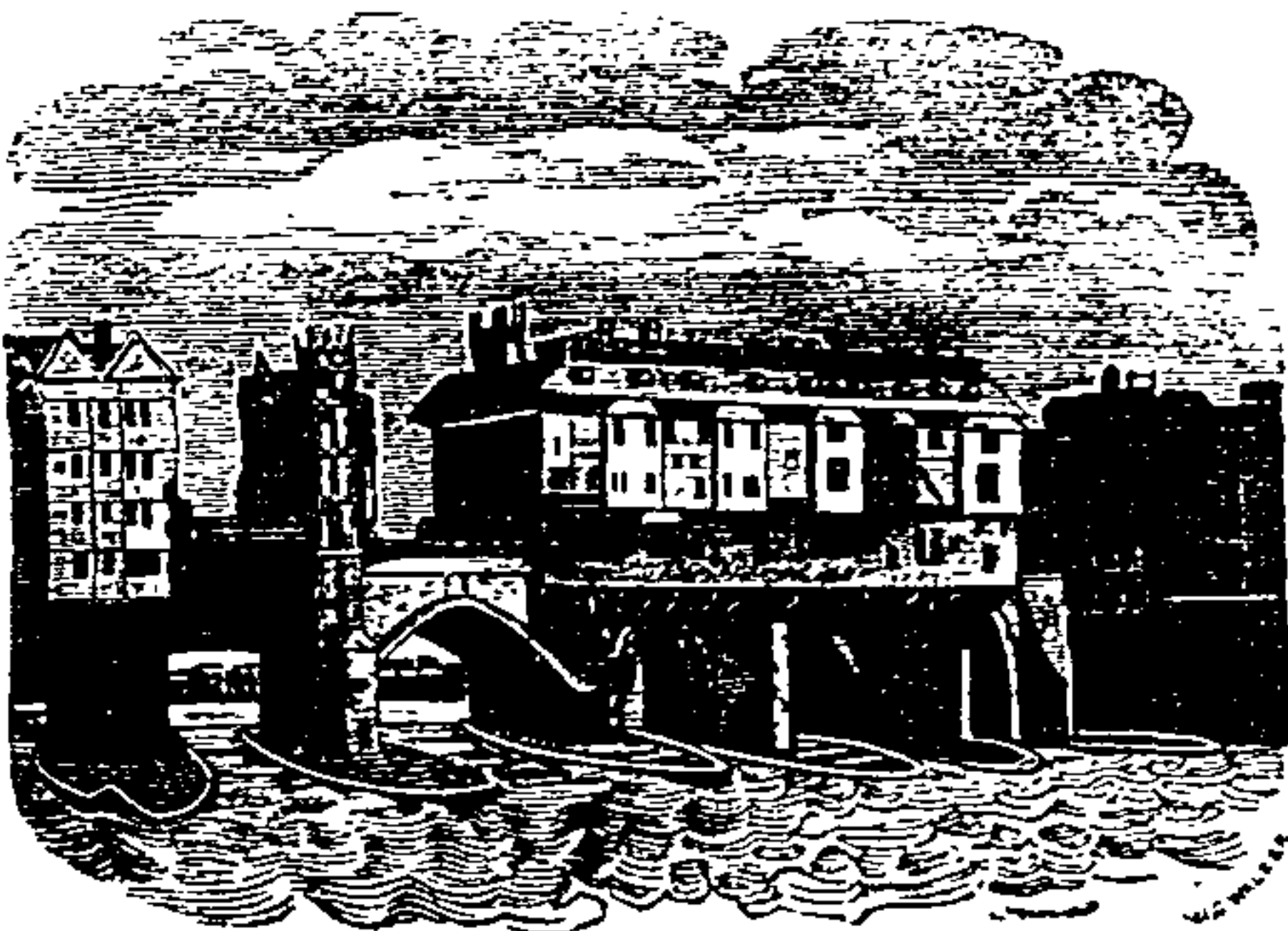


Fig. 2.



accordingly soon after (1756) obtained, empowering the Corporation to purchase and remove the houses—to enlarge the approaches, and improve the roadway over the bridge—to widen the arches—and generally to make such alterations as might be thought advisable.

The most important of the improvements effected under this Act—next to that of clearing away the buildings which had so long encumbered and disfigured the surface of the bridge—was the demolition of the central pier, on which the chapel of St. Thomas-à-Bcket was erected, and the conversion of the two adjoining arches into one large arch, which now forms the principal water-way under the old bridge. The effect of this change is exhibited in the engraving, Fig. 2. Plate III.

A circumstance occurred, in connection with the construction of this arch, which exemplifies, in a striking manner, the sort of economy which is but too generally characteristic of Corporation jobs. It may, perhaps, help to account for the enormous sums which this structure is stated to have, at different times, cost the citizens of London. The Corporation contracted with the City carpenter, to pay him at the rate of two shillings per foot, for the timber which might be required for the centering of the arch, labour included; it being further stipulated, that he should get back the timber when done with. The temptation which the terms of this agreement offered, to employ as much timber in the work as possible, was irresistible; nearly three times as much was made use of as there was any occasion for, and 1,700*l.* were paid for what need not have cost 1,000*l.* The centering of the middle arch of Westminster Bridge, which was larger by some feet than that of London Bridge, contained only 6,500 feet of timber, but the City contractor contrived to cram into his centering no less than 17,000 feet! In the one case, the study of the constructor was how to obtain the strength required, with the least quantity of materials; in the other, how to increase the materials employed, so as to multiply his own gains. An engraving of this precious specimen of contract carpentry is given in Plate III. Fig. 1.; though certainly more as a matter of curiosity than instruction.

After the Bridge had been thus altered and repaired, it was thought by contemporary engineers to be a very efficient structure, and so in most respects it undoubtedly was. It was perfectly straight, broader than even Westminster Bridge, and so stable as to give a promise of very long duration. The water-way was still

too contracted; but, with that exception, there seemed to be nothing, in point of utility, left to be desired.

True it is, however, that before another half-century had elapsed, rumours of its being again in a fearful state of decay, and of its being the cause of prodigious injury to the commerce of the river, began to prevail, and gained at length such a height as to produce a general call for its demolition. Respect for architectural elegance has sometimes interfered to save the most ruinous structures from destruction; but here there was none to respect—the bridge was as ugly as it was reputed to be dangerous. The citizens saw on every hand new bridges arising, the beauty of which covered them with shame for the homeliness of their ancient structure; and it was with something like a feeling of delight, they seized on every pretext which was furnished them for consigning it to destruction. How much the disinterested endeavours of expectant jobbers and contractors may have helped to give this turn to the popular feeling, we will not take upon us to say; we shall content ourselves with observing, that it would take more than all the trickery which has been ascribed to this source, to account for so strong an impression being produced by such slender considerations, as appear to have predominated in the present instance. If there were persons who, for their private ends, misrepresented and exaggerated the real facts of the case, it must be allowed that there was at least as great a readiness to be deceived on the subject, as to deceive. The truth was, the citizens were tired of their ancient bridge, and intent on having a new one; and like all persons who are in that resolved state, their ears were open to such representations only as coincided with their inclinations. It is due to the Corporation of London to observe, that they were far from participating in the feelings of their constituents on this matter. They opposed the measure of a new bridge through many of the earlier stages of its progress, and they only gave way at last when the influence of Government united with the popular opinion to make resistance unavailing.

In 1823, an Act of Parliament was passed “for the rebuilding of London Bridge, and for the improving and making suitable approaches thereto.” In the preamble to this act, the reason given for the measure is, that “the great fall of water at certain times of the tide occasioned by the large starlings and piers of the said bridge, renders the navigation through the said bridge dangerous and destructive to the lives and properties of his Majesty’s subjects.” No

frailty in the bridge itself is here assigned ; and so far, therefore, there is good reason for concluding that there was no foundation for the fears entertained, or professed to be entertained, on this head. Had there been the slightest ground for pretending that there was a chance of a tumble down from natural decay, we may be quite sure that so weighty an argument for the demolition of the bridge would not have been passed over in utter silence. The expediency of erecting a new bridge, is made to rest entirely on the fact of the injury done by the old one *to the navigation*. There is stated to be “a *great fall* of water at certain times of the tide,” and this fall is said to be “*occasioned* by the *large* starlings and piers of the said bridge. But how was this proved ? We have looked in vain through the mass of evidence which was produced to the House of Commons, in support of the Bill, for any proof of this assertion. The evidence shows, on the contrary, that the fall was occasioned by an actual difference in the level of the bed of the river, above and below bridge, and *not* by the starlings and piers. Whether the starlings and piers had any share in originally producing that difference of level, is another question, which, even the most experienced engineers, have not taken upon them to decide. The celebrated Smeaton, in one of his reports to the Corporation of London (23d June, 1767), on the state of the bridge, thus expresses himself on the subject :—“It is difficult, at this time, to determine whether the bed of the River Thames was as high above London Bridge before London Bridge was first erected, as it now is ; and whether the stoppage of the water at the bridge, acting as a dam, was an *expedient* to retain more water in the river, at low water over those shoals for the sake of navigation ; or, whether this stoppage arising from the obstruction has, in its *effects*, occasioned the swelling of the river gradually to gather, and the bed to rise nearly in the same proportion as the water’s surface at low-water is kept higher.” However this may be, it is certain that it is not now by the starlings and piers that the “great fall” is occasioned, but principally by the sudden change in the level of the bed of the river ; and such being the chief source of the evil complained of, it is evidently one which, neither the pulling down of the old bridge, nor the erection of a new one, could materially affect. The preamble goes on to state, that the “great fall” “renders the navigation, through the said bridge, dangerous and destructive to the lives and properties of his Majesty’s subjects.” But here again we look in vain for proofs. First, as to the lives destroyed,—all that we find

established in evidence is, that, in the course of twenty years,—namely, from 1800 to 1820, inclusive,—there were eighteen persons drowned in attempting to pass through London Bridge,—a fraction of a man per annum! Second, as to the destruction of property—the whole of the losses proved to have been sustained, during the same period of twenty years, by shipwreck, on London Bridge, amounted to no more than 4000*l.*—a fraction of a pound per day! All sorts of persons, most familiar with the bridge, and the river, for the previous half century, were interrogated as to all the accidents they had ever seen, experienced, or heard of; and yet such was all the danger, and all the destruction that could be established! Many of the accidents, too, appeared to have been caused by inebriety and wantonness; and, most of the others, were such as might have been avoided by the exercise of a little common prudence.*

Every part, in short, of the case, set forth in the preamble to the Act, turns out to be alike false and delusive; it vanishes altogether under the touch of inquiry. The starlings and piers are shown to be *not* the cause of the great fall; and the great fall is proved to be *not* so dangerous, or so destructive, by at least ninety-nine degrees, as the promoters of the New London Bridge pretended.

But even supposing, for a moment, that they had made out their case, in its fullest extent, what is the conclusion which it would have justified? Not that a new bridge must necessarily be erected; but this only, that an enlargement of the water-way was expedient. For, there would have been still this other question to determine—namely, whether the requisite enlargement could not have been as effectually obtained, by altering the old bridge, as by building a new one?

Sir Christopher Wren was of opinion that eighteen arches of the old bridge might with perfect safety be thrown into nine, by removing every alternate pier; and the practicability of such an alteration was fully established in 1759, when, as we have before seen, the present centre arch was constructed, by removing a pier, and throwing two arches into one. Mr. Dance, as late as 1799, thought that the piers of the centre arch which had already endured this operation, were still strong enough to bear the raising of the centre arch to double its actual height. Mr. Wm. Chapman, C. E.,

* How is it that we now hear so seldom of accidents at London Bridge? Is it because the purposes of delusion are fulfilled?

Fig. 1.

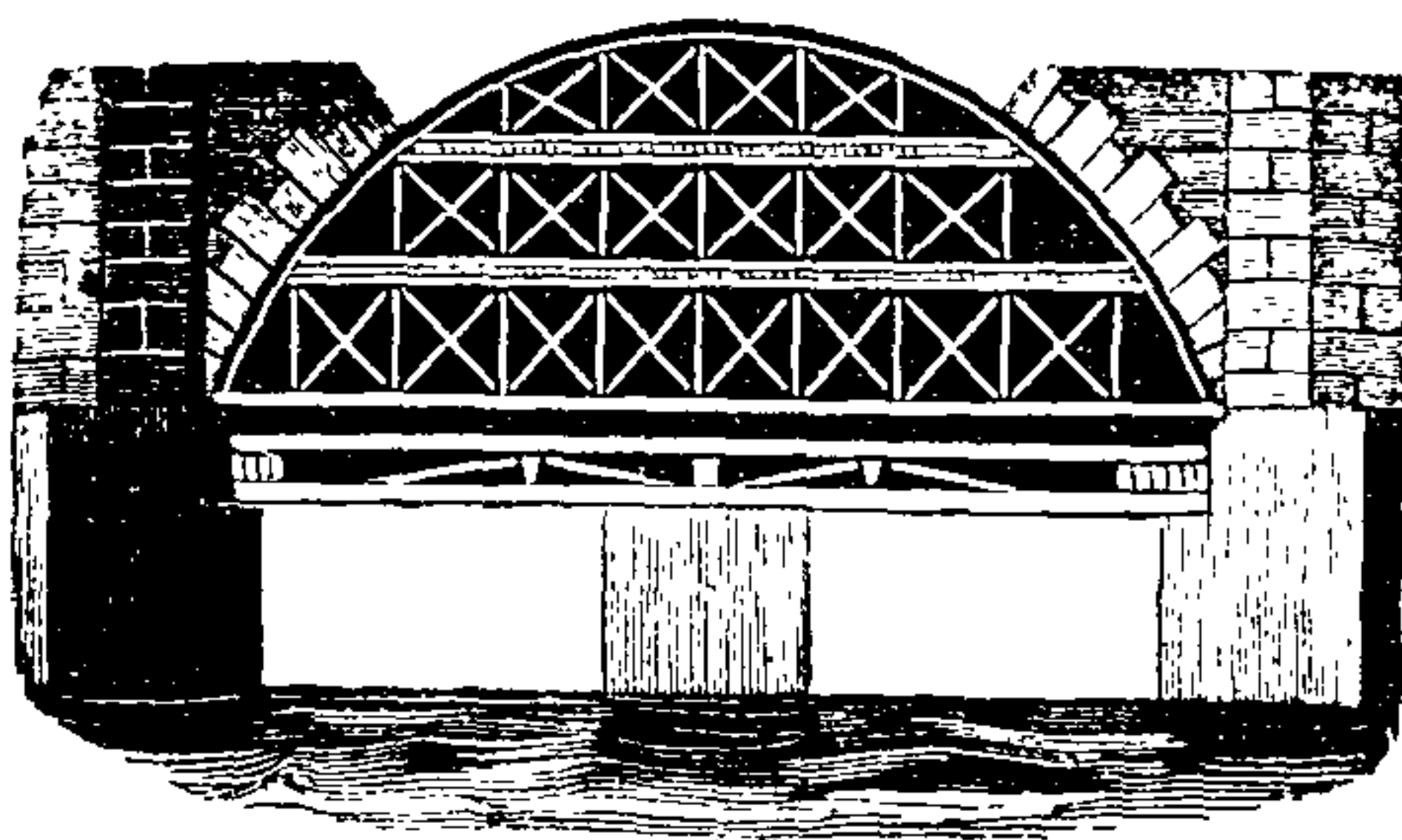


Fig. 2.

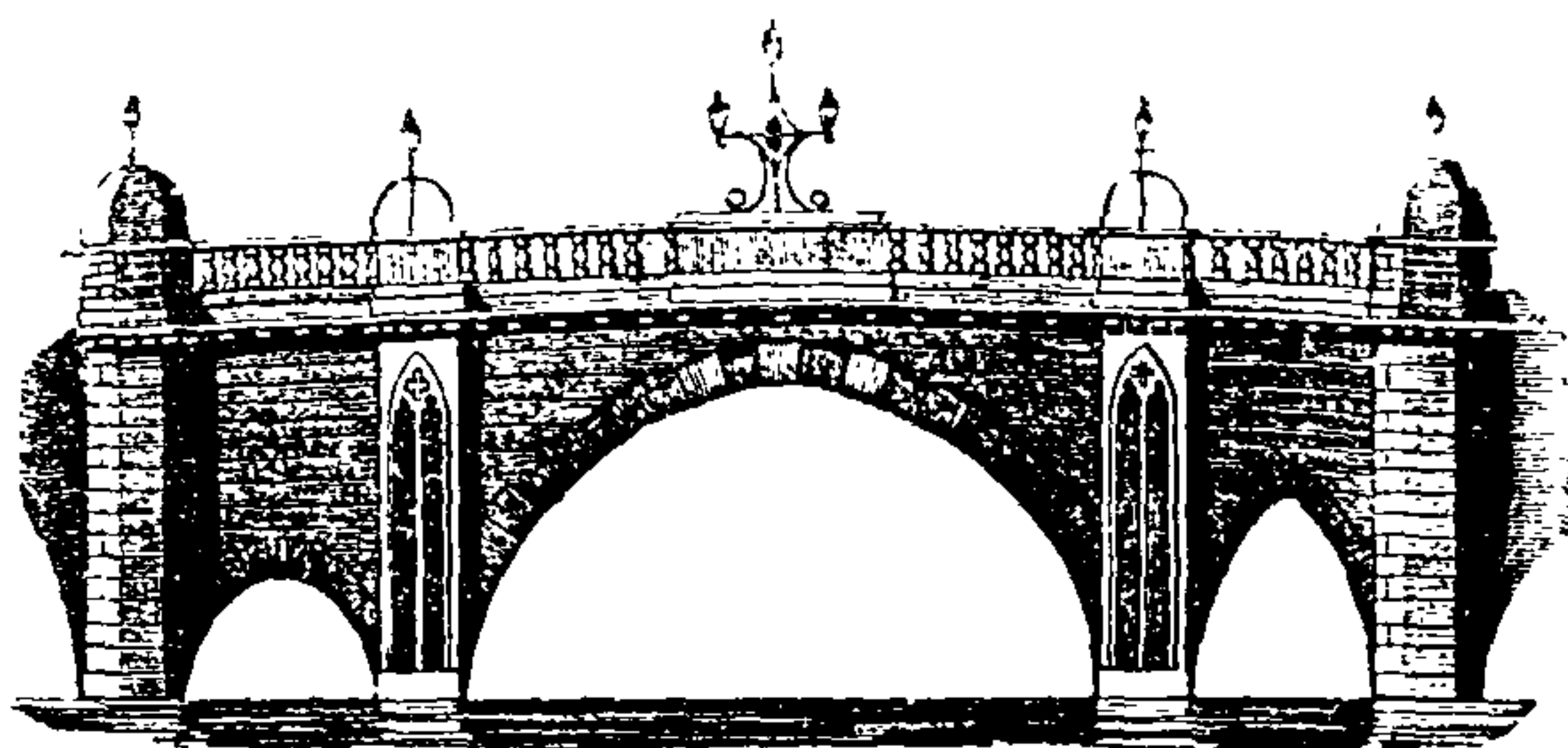
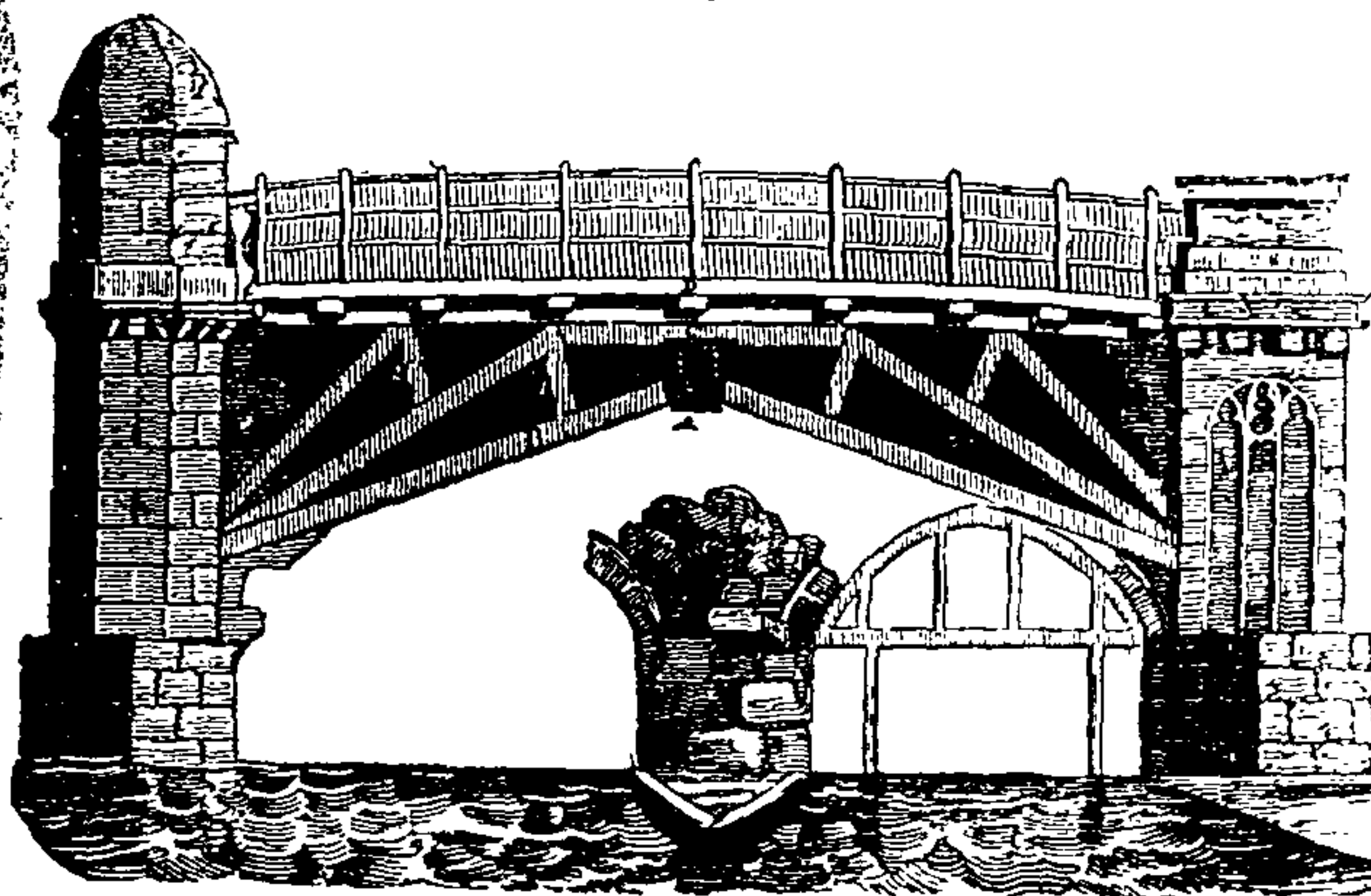


Fig. 3.



at a still later period, (1821), gave it as his opinion that "the water-way of the old bridge might be enlarged with perfect safety, and that the bridge so altered would last for ages with due attention." And about the same time, another experienced engineer, Mr. James Walker, the builder of Vauxhall Bridge, being asked whether he would pledge his professional reputation that it would be a better plan to make an alteration on the old piers than to build a new bridge entirely? replied, "I think it might be made as secure upon the present piers and starlings as the foundation of any new bridge."

Without further multiplying citations, it may suffice to state, that the entire tendency of the opinions which have been delivered by scientific men on the subject (with the single exception of Mr. Rennie) goes to the effect, that the foundations of the old piers were fully adequate to sustain any additional weight which the enlargement of the arches might throw upon them. Mr. Rennie did not absolutely assert the contrary, but, with that caution for which he was remarkable, drily observed, "that he should not like to risk *his* reputation on the construction of new arches on the old piers, without previously examining the piers through the means of coffer-dams."

The expense of converting the eighteen arches of the old bridge into nine would not, according to the estimates of the best practical engineers, have exceeded 100,000*l.*; and even supposing such a previous examination as that suggested by Mr. Rennie had been considered essential, it would not have more than doubled the cost. For about 200,000*l.*, therefore, the old bridge might have been made as good as new, and the extent of water-way been increased nearly one-half, while a new bridge, according to Mr. Rennie's calculations, could not be built for much less than 500,000*l.*

We have assumed, in the preceding remarks, that the expediency of enlarging the water-way was well established; but this is a point by no means free from doubt. It has been thought by many good judges that the obstruction offered to the course of the river, by the numerous piers of the old bridge, and by the sudden shelving of the bed at this spot, is productive on the whole of more good than harm; inasmuch as it serves, on the one hand, to diminish the height to which the tidal waters would otherwise flow above bridge at high spring tides, and, on the other, to maintain a greater head of water at all times in the upper part of the river than could be easily produced by any other means. It would even appear that the City authorities at

one time valued the obstruction so much on these accounts, that, instead of doing any thing to lessen it, they did every thing in their power to keep up and augment it. An Act of Parliament is mentioned, which authorised the Corporation to *stop up* some of the arches, and so to increase that fall which in later times has been so much complained of. (*Phil. Mag. Vol. IX. p. 33.*) And a living writer states, that he is old enough to remember “when several of the arches of the old bridge were called *locks*, some of the smallest had *gates*, and others had remainders of *strong iron hinges*.” (*Mech. Mag. Vol. XII. p. 452.*) How far the new lights which the citizens have obtained on the subject are preferable to the old, the reader will be enabled to judge when we have placed before him a few of the opinions which men of science have pronounced on the subject.

Mr. Smeaton,—than whom a greater authority, in matters of this sort, never existed,—says, in the report which we have before quoted :—

“If London Bridge were, therefore, to be taken away, the river would become so shallow above bridge, at low water, that the navigation would be greatly impeded FOR NOTES each tide.”

Mr. Telford, who stands, by universal consent, at the head of living engineers, made more recently an elaborate report to the same effect. He shows, 1. That, were the old bridge removed, “the velocity of the ebb above bridge would materially increase, and the time of low-water be earlier than at present.” 2. That the “navigation, which is now practicable up to Teddington,* would cease too early near that place.” 3. That “the bed of the river would be left nearly dry for several hours in the latter part of the ebb.” 4. That though these evils would, in part, be remedied by “the increased velocity and momentum scouring away the mud, sand, and small gravel, so as to deepen the bed”—yet, that this lowering of the bed would “seriously affect” the foundations of some of the other bridges—those of Blackfriars, Waterloo, and Westminster, in particular :† cause settlements of the wharfs, and houses on the banks of the river; walls to be undermined, &c. And, 5. That “all the river above bridge”—“all the banks and low-grounds, on

* Said to be so called (Tide-end town) from its being the farthest point to which the tide extends.

† Some of the piers of Westminster Bridge do not extend more than 3 feet under the present surface of the river bed; those of Blackfriars Bridge only 3 feet 9 inches: and even in the case of Waterloo Bridge, the foundations of the piers are but 6 feet 4 inches under the low-water mark.

each side, from Westminster to Teddington"—will, when the dam is removed, be more liable to be overflowed by high tides."

Dr. Olinthus Gregory, of Woolwich, whose particular scientific pursuits have led him to pay great attention to every thing connected with the navigation of the Thames, being asked, in the Committee on the New London Bridge Act, "What he thought would be the effect of removing the old bridge?" answered, that he was "decidedly of opinion that, after the removal of the old bridge, the bed of the river, between its site and Westminster Bridge, would, at and near low water, be *dry*, and the navigation *completely at a stand*,"—an opinion which, though it goes to the extremity of the case, will not probably be thought extravagant, when it is considered that the river, just above Westminster Bridge, is seldom, in the midstream, more than four feet deep at low water, and that this is only about equal to the fall through London Bridge at spring tides.

Sir H. C. Englefield, the author of a pamphlet "On the probable consequences of the Demolition of London Bridge," supports the view taken by the eminent individuals, whose testimony we have just cited, by several additional considerations. He states, that the water above bridge never ebbs out so low, by nearly the quantity of the whole fall, as it would do were the dam removed; that any additional depth of high water would be of no use to the navigation, the *current being*, at present, sufficient to carry craft from the Pool to the extent of the up-current in one tide, and lighters being known to go, occasionally, in one tide, from Gravesend to Richmond; that in proportion as the bed of the river is left dry, at the ebb of the tide, the quantity of silt deposited, from the various sewers, will be increased, and the salubrity of the neighbouring shores endangered; and that, unless some remedy for this last evil is provided, in due time, the greater part of the low lands, from Rotherhithe to Battersea, will be rendered uninhabitable.

Mr. Rennie, too, acknowledged, in 1820, that, "if London Bridge were removed, some part of the river banks, from Westminster up to Chelsea, would require to be raised from twelve to eighteen inches."*

We shall add to these authorities but one more; it is that of an

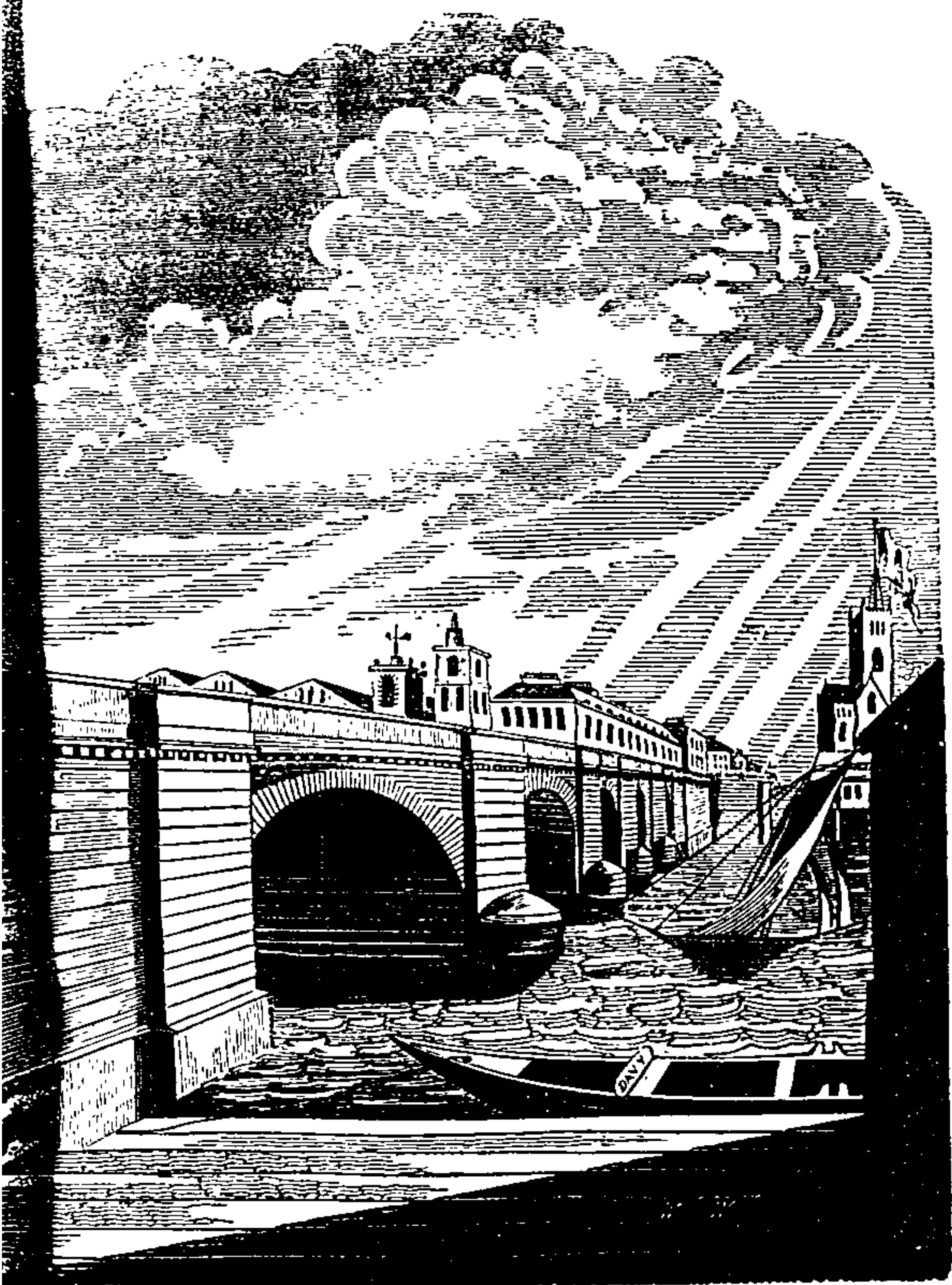
* Many of the wharfs by the sides of the river are not more than from $1\frac{1}{2}$ to 2 feet above Trinity high-water mark, and are even at present frequently overflowed.

acute writer, in the *Westminster Review*, who thus forcibly depicts the general result of liberating the river from its ancient trammels :—

“ The flow of the tide up a river is the propagation of a wave, and the higher the tide ascends (though with occasional variations) the greater is the height of the high-water line above that of the high-water of the sea. The high-water at London Bridge, as ascertained by experiments during the Trigonometrical Survey, is eighty feet above the high-water at the Nore. Any great obstruction diminishes or destroys this natural ascent of the high-water line by breaking the impulse at the point of obstruction, and lessening the volume which passes it. By removing the dam of the Old London Bridge the impulse will be greatly increased and the volume of water passing upwards will be doubled. The area at high-water will be increased from 7,360 feet to 14,500. The high-water line from London to Richmond is at present nearly *a dead level*. The obstruction is the only cause that can be assigned for the ascent of the high-water line stopping at the bridge. The dead level will be raised about fifteen inches, but the unbroken impulse and the double volume of water will in all probability cause the high-water line to ascend from Loudon to Richmond in the same proportion as from the Nore to London. This is at least highly probable; and if experience should confirm the theory, the mischief that will ensue defies calculation.

“ The effect on the ebb will be, that during several hours of every tide, the river above bridge will be at least as low as it now is at the lowest water of spring-tides. These several hours—the latter half of the ebb—are those during which it is now dangerous to pass over the bridge; *but what will the navigation have gained by having that which is now dangerous made impossible?*” —(*West. Rev. Vol. xiii. p. 408.*)

We need scarcely ask the reader what he now thinks of the new, as compared with the old lights on the subject of the river and its ancient bridge? We think it must by this time be abundantly manifest that there were circumstances of advantage in the case, which ought to have weighed as heavy in the balance as any inconvenience or danger that has been proved to be attendant on the “great fall.” An anxious desire to improve the *navigation* of the river is the motive professed in the preamble to the Act for the New Bridge; but the interests of the navigation seem to have pointed all the other way. A fraction of a life per annum, and a fraction of a pound per day, are such losses as should never



have stood in competition for one moment, with the vast interests involved in the preservation of the river above bridge in its ancient state.

The fact was, public opinion, — or, to speak more properly, public prejudice, — had decreed the downfall of the old structure; and only those parts of the evidence which favoured that issue, — no matter how slender, or how questionable, — had any regard paid to them. A boatman, who could give a touching account of how, in the dead of night, at the top of the flood, and in a pot-valiant fit, he once missed clearing the fall in safety, and caused, by his rashness, the death of a couple of companions in the adventure (Min. of Evid. p. 18.) ; or a lighterman, who could tell of the beer-casks and butter-firkins he had known to be canted overboard in going down that weary fall — bad stowage being a thing for which *nobody* is responsible — (Min. of Evid. p. 17-70.), — were in a case, so got up, and so fore-determined, witnesses of more avail than all the Smeatons, and Telfords, and Gregorys, in the world.

But could not a new bridge have been erected, without destroying the dam? Might not the popular love of novelty have been gratified, and the interests of the navigation, at the same time consulted? — We think it might. Dr. Gregory, while he represented the great evils that would result from the removal of the old bridge, pointed out, at the same time, how they could be effectually obviated in the erection of a new one. His proposal was to the following effect: — That the new bridge, instead of having five arches, as was proposed, should have *seven*; that under each arch there should be sluice-gates, similar to those in common use in Holland; that there should be similar sluice-gates at Westminster Bridge, and perhaps at Blackfriars' Bridge, — the whole of the river, between London and Westminster Bridges, being thus converted into a large wet-dock; that the river should be contracted by extending the wharfs and quays farther upon the present bed, both on the Surrey and the Middlesex sides;* that in these operations all sudden

* This proposal was made in 1822, which was prior, we believe, to the announcement of Colonel Trench's plan for a terrace between Waterloo and Westminster Bridges. But we think we can point out earlier claimants to such a scheme of improvement than either Dr. Gregory or Colonel Trench. In a "Discourse by way of Letter to the Earl of Marlborough," (afterwards the Great Duke,) published in 1691, in which is given "An Account of several new inventions and improvements now necessary for England," there occurs the following passage: — "I am here led to call to mind a fatal danger that the river above bridge escaped in the reign of the late King (Charles II.), when some were so hardy as to offer him a proposition, and in the way of a project, to

projections, and bold sinuosities in the river, should, as far as possible, be softened down; that, by the judicious shutting and opening of some, or of all, of the sluice-gates, at the three bridges, and by the employment of temporary aprons, or water-turners, so as to direct the stream upon deposits of mud, &c., under the constant superintendence of proper officers, appointed by the Conservators of the Thames, the evils which would otherwise inevitably result from taking down the old bridge might be greatly diminished, if not altogether prevented, and the navigation above bridge considerably improved.

Mr. Telford, who was then employed by the Corporation of London, to oppose the scheme of a new bridge, was so well pleased with this plan of Dr. Gregory's, that he said, if it were adopted he "would advise the City to withdraw their opposition."—(Letter of an Ear Witness, *Mech. Mag.* vol. xii. p. 339.)

But, unfortunately for the success of Dr. Gregory's plan, it was one which could be just as well carried into effect by means of the old, as of a new bridge; and it shared, therefore, the common fate of every thing calculated to awaken attention to the capabilities of the condemned structure. Had a new bridge, *with sluices*, been the thing proposed, the promoters of the undertaking must of course have thrown to the winds all their plausible speculations about the advantages of a wider and freer water-way; they must have admitted that the obstruction presented by the old bridge was a beneficial obstruction (though, perhaps, susceptible of some useful modifications); and having abandoned and admitted so much, they might have found it no easy task to make out a case

enlarge his revenue by shortening the river, and by building another street between the high and low-water mark from the Bridge to Whitehall. But though so great a straitening of the river there, would not have been so prejudicial to the public as lesser straitenings of it below bridge, where the great scene of navigation lies, yet his Majesty, with great judgment, gave a preremptory denial to the proposition, for this particular reason, namely, that such an alteration in the river might perhaps produce an alteration in the tide of flood, and be the cause of its not flowing so many hours as it doth, and which effect, too, he thought the building of a bridge at Lambeth, (a project that some offered to his consideration) might produce." It must be observed, however, that neither the projectors mentioned in the above passage, nor, if we recollect right, Colonel Trench, made any provision for the injury which the projection of a line of buildings into one side of the river might cause to the opposite bank, while Dr. Gregory's plan was altogether free from this objection, his proposition being, "that the river should be contracted by extending the wharfs and quays farther upon the present bed both on the Surrey and the Middlesex sides."

for erecting a new bridge, to effect exactly the same thing which was already accomplished by the old. Had they alleged, that the existing obstruction was too great, they would have been reminded of the ease and safety with which the arches of the old bridge could be reduced to any expedient number, on the plan of conversion, followed with so much success in the case of the centre arch. Or had they complained of the land approaches being bad, they would have been told that, though that might be an excellent reason for improving these approaches, it furnished none for pulling down the bridge itself. Or, again, had they called for a sentence of demolition, on the plea that the bridge was aged and ugly, they would have been met with a defiance to prove, that though aged and ugly, it was either infirm, hunch-backed, or crooked. At every turn, in short, they would have been foiled, in the attempt to show that a *new* bridge was necessary to the execution of the plan of sluices; and having jobs and contracts,—no, we beg pardon,—noble arches, and fine cutwaters, more at heart than any advantage which a good plan of sluices could confer on the navigation of the river, it was very natural that they should pronounce the latter to be altogether out of the question.

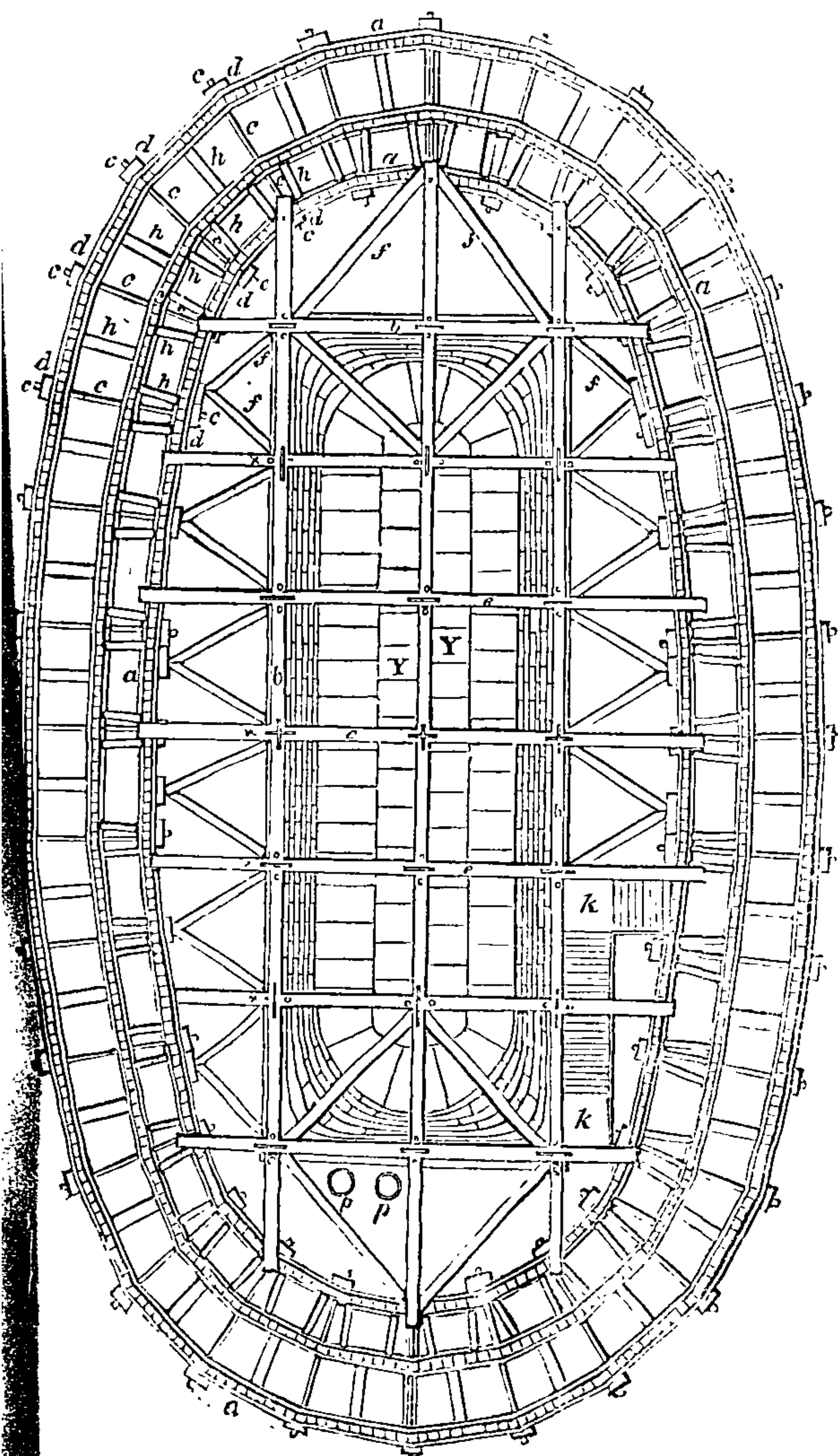
The scheme of a new bridge required two things to be allowed to give it plausibility; first, that it would improve the navigation of the river, to liberate it from all its ancient bonds, and allow it to flow as freely as possible;* and second, that the old bridge was in so decayed a state, that it could not be so altered as to admit of the free passage demanded for the river. These were the propositions to be proved by the promoters of the measure; but, unfortunately, the whole tendency of the evidence, brought forward

* If a wide and free water-way was really an object of the first importance, it might have been worth the consideration of the Corporation, whether the design of a bridge, proposed in 1800 by Messrs. Telford and Douglas, was not better than any. These gentlemen proposed to build a bridge about 200 yards from the present old bridge, so as to make the approaches to range with the Royal Exchange and the High-street of the Borough. It was to have been of iron, and the span of the arch (a segment of a circle) *six hundred feet*, the versed sine from above high-water being 65 feet. The drawings, &c., with certain queries, were submitted to Dr. Hutton, who, in his answers, gave his full approbation of the design. Perhaps the most remarkable circumstance connected with this design *for the removal of every obstruction*, is the fact, that it should have been proposed or at least sanctioned by Mr. Telford, who, as we have already seen, declared at another period that *without some obstruction or other*, similar to that offered by the London Bridge, the navigation above bridge would be destroyed.

on the subject, went to negative both. Parliament, however, was not nice; it kindly took for granted that which could not be proved,—nay, in the teeth of all proof; and so the bill for the new bridge passed into a law.

Shortly before the passing of the Act, the Corporation had offered premiums of 250*l.*, 150*l.*, and 100*l.*, for the three best designs for a new bridge, to consist of five arches, to rise in the centre 23 feet above high water mark (according to the Trinity House standard)*, and to afford a clear water-way of 690 feet; and the designs, furnished in consequence of this invitation having been referred to Messrs. Nash, Soane, and Smirke, the three architects of his Majesty's Board of Works, and Mr. Montague, the City surveyor, these gentlemen had awarded the preference to one sent in by Mr. Joseph Gwilt. The Corporation, however, refused to abide by the decision of their own referees, and assigned the first premium to Mr. Charles Fowler; the second to Mr. T. Borer; and the third to Mr. C. A. Busby,—not even awarding to Mr. Gwilt the lowest of the premiums offered! Strange as this result was, a stranger was yet to follow. The Corporation would not even adopt the plan which they had themselves placed first in degree, but producing another which had been prepared for them beforehand, by Mr. Rennie, declared that this was better than any that the public competition had called forth, and was the one which they preferred before all others. The Act accordingly ordained that the new bridge, to be erected, should be a bridge according to this plan by Mr. Rennie, and expressly excluded the adoption of any other.

* The terms of this condition have been thus justly animadverted upon by the author of a Letter to Holme Sumner, Esq. (then) M.P. for Surrey, published in 1823:—“*The centre arch is to rise 23 feet above the Trinity House high-water mark; whether to its soffit or its back is not stated. It is probable, however, that the Committee intended the former, and it is most likely that the limitation was stated with the view of avoiding the great expense attendant on extended approaches. Be it so; still the instruction would not lead to the object they had in view. The strictest compliance with it would not afford them a criterion to form a judgment of the expense of the approaches. It is quite clear that the Committee for letting the Bridge House estates were not aware of the variation in depth of the key-stones of the most celebrated arches in Europe; nor can that be a matter of surprise. Comparing them with the diameter of the circle of curvature at the vertex, it will be found that they vary as 35 and 1176. Hence it is clear that the Committee, to carry their economical intentions into effect, should have given the height of the road-way above high-water mark, and with that as a maximum, have offered the greatest encouragement to those artists who produced the greatest possible void in the arches under that limitation.*”



The conduct of the Corporation, in this matter of the plans, has been much censured; but more so than we think it strictly deserves. It has an appearance of greater impropriety than really belongs to it. We think Mr. Gwilt was used ungenerously—perhaps unfairly, and that Messrs. Nash, Soane, Smirke, and Montague, were very deliberately insulted; but we can carry our censure no farther. However natural it may have been for the competitors, to expect that the plan which obtained the first premium, should be that ultimately adopted, we cannot discover that the Corporation came under any obligation to that effect; and we should have thought it very unwise in them if they had. A plan may be the best of a great many presented, and yet not so good but that a much better may be found. Although, therefore, Mr. Gwilt may have had good cause to complain that the premium, awarded to him by his professional brethren, was withheld from him by a committee of revision, composed of mere merchants and tradesmen, it by no means follows, that he has more than the loss of the premium to impute to Corporation presumption. Even the gentleman to whom his laurels were transferred shared no better than himself, as regards the ulterior distribution of favour and employment. Every thing, in a case of this sort, depends on the ultimate result. Was the plan, which the Corporation preferred, really the best? Humble as their qualifications, to appreciate a work of art, may have been,—little even as judgment and taste may have had to do with their decision,—it will, doubtless, suffice, for the satisfaction of the public mind, that somehow or other they judged rightly in the end. For our own parts, we are decidedly of opinion that *Mr. Rennie's plan was the best*; but as we are aware, a strong impression prevails among the members of the architectural profession, that it was preferred to Mr. Gwilt's, for other reasons than any actual superiority it possessed, we have furnished the reader, in Plates I, IV, VI, and VIII, with ample means of judging for himself, whether we are correct in our estimate of the comparative merits of the two designs.

A particular description of Mr. Rennie's plan, as shown in Plates I. IV. and VI., will be more in place when we come to speak of its execution, than it would be here; it may suffice, for the present purpose of comparison, to state, that it was to consist of five semi-elliptical arches of very large dimensions.

Mr. Gwilt's design is the subject of Plate VIII. He also proposed to have five arches, but of the form of a segment of a circle. Fig. 1 exhibits an elevation of the centre arch, A and B denote the

high and low water lines. Fig. 2. is an elevation of the abutments and stairs : Fig. 3. a plan of the superstructure ; Fig. 4. a plan of the foundations for the abutments and stairs ; and Fig. 5. a plan of the piers.

The arches were proposed to be of the following dimensions:—

	Span.	Rise above high water.
Centre arch. -	150ft.	25ft. 0in.
Two arches, next the centre.	140ft.	23ft. 4in.
Abutment arches -	130ft.	22ft. 8in.

The cutwaters were to be 25 feet in thickness; the piers 20 ; the width of the bridge, between the parapets, 50 feet ; the inclination of the carriage-way 1 foot in 26.

We readily admit, that there would have been great elegance in a structure of the form and dimensions exhibited in these plans of Mr. Gwilt ; but, without stopping to inquire whether it would have been equal, in this respect, to the bridge actually erected, after the designs of Mr. Rennie, we shall merely remark, that the selection of the segment of a circle, for the form of his arches would have been, with us, reason enough for its rejection. “ Some people,” says Dr. Hutton, “ prefer the semi-circle for the figure of the arches : *though, perhaps, without knowing any good reason why.*” The truth is, it is one of the worst forms that can be employed ; and an arch, of any segment of a circle, is only less objectionable in degree. The preference so long given to this form, in bridge building, was one of those vulgar errors which the investigations of science have happily exploded, and which it is rather surprising any person should have proposed to revive, after the successful examples of elliptical construction, exhibited in Blackfriars and Waterloo Bridges. The elliptical arch has been shown to approach nearer than any other to that theoretical perfection of form, in which all the parts are in equilibrium, none of them having a tendency to give way more than the others. It is, therefore, more uniformly strong than any other sort of arch. It requires, at the same time, less materials, and is consequently lighter and cheaper. Farther, it admits of greater elevation in the haunches, in conjunction with greater flatness at top, and may be made of any height to the same span.*

We have reason to believe that much of the indisposition which prevails among professional men, to admit the inferiority of Mr. Gwilt's design, arises from a notion, that when the Corporation advertised for plans, they had already *decided* on adopting that of

* Hutton's Principles of Bridges.

Mr. Rennie, and that the competition, therefore, was all a farce, got up to give an appearance of fairness and impartiality to their proceedings, in utter disregard of the hopes which it might excite, or of the feelings which it might lacerate. We see no reasonable ground, however, for entertaining such a suspicion; and believe most sincerely that none exists. Granted, that the Corporation had Mr. Rennie's plan already in their hands, and were well satisfied with it, was it not natural that they should be desirous of ascertaining, by some decisive test, whether a better could not be obtained? And what surer test could they adopt than to invite all the genius and talent of the country to an open and public competition with their favourite? Among superstitious people, the good marksman is always sure to fire with a charmed bullet: it would be to judge the Corporation by the same rule, were we to conclude that because they happened to hit the mark at once, their success must be owing to some secret and unholy confederacy.

Mr. Rennie, whose plan of a new bridge was preferred by the Corporation — so justly preferred, in our opinion — and specially ordered by the Act of Parliament to be followed, died before the first steps were taken to carry it into effect. Unhappily for that art, with some of the noblest monuments of which his name is identified — unhappily for that country which he so greatly embellished by his labours, he was snatched away by the hand of death, while yet in all the vigour of his faculties. His merits as an architect have been questioned; but now that time must have gathered to oblivion, nearly all the envy and enmity with which his professional success was regarded by his contemporaries (we say “nearly all,” for there are men, as there are women, of a certain age, who never forget lost opportunities) — now that days and years enough have elapsed, to enable every one to contrast the employments heaped upon him, with their actual and enduring results, — we may assert, without much fear of contradiction, that there never was a high reputation more fairly earned. It owed its rise and growth neither to lucky accident, nor trucculent artifice. Talent, industry, prudence, perseverance, — boldness of conception, — soundness of judgment, — and habits of untiring application, — these were the elements of the good fortune of John Rennie.*

* Mr. Rennie was born on the 7th June, 1761, at Phantassie, in the parish of Prestonkirk, in the county of East Lothian. He was the son of a highly respectable farmer, who died in 1776, leaving a widow and nine children, of whom John was the youngest. The first rudiments of his education were acquired at the school of his native parish; and to a trifling circumstance,

The execution of the new bridge was, after the death of Mr. Rennie, entrusted to his son, the present Mr. John Rennie, under whom Messrs. Joliffe and Bankes were employed as the building contractors. The Government, looking on the undertaking as being of national as well as local importance, agreed to contribute to it the sum of 200,000*l.*, on condition that the Lords of the

connected with his daily journeys thither, his friends ascribe the acquisition of that mechanical taste, which fixed the destinies of the future man. The school was situated on the opposite side of a brook, the usual mode of crossing which was by means of a rustic bridge of stepping stones; but when the freshes were out it was necessary to have recourse to a boat which was kept at the workshop of Mr. Andrew Meikle, an ingenious millwright, well known in Scotland for his improvements in the threshing machine and other agricultural implements. In his visits to this workshop, young Rennie's attention was forcibly drawn to the various constructions he saw in progress, and he would often linger for hours, regarding them with unsated curiosity. The son of Mr. Meikle, and the other workmen, seeing the delight which the youth appeared to take in observing their labours, were in the habit of indulging him with a trial of their tools and shewing him their various uses. At length his evenings were almost entirely occupied in imitating such engines or models of engines as had particularly attracted his attention in Mr. Meikle's workshop; and ere he had completed his eleventh year he had constructed a windmill, a pile engine, and a steam engine. That of the pile engine is still in existence, and is said to be extremely well made. After perfecting his education at Edinburgh, Mr. Rennie proceeded to London, visiting on his way all the great manufacturing towns in the north of England, and inspecting their principal manufactories and public works. The first great undertaking in which he was engaged after settling in the metropolis, was the construction of the mill work for the Albion Mills, which he accomplished in so satisfactory a manner that it at once established his character as a machinist. It was as an architect, however, that Mr. Rennie was chiefly destined to excel. The limits of a foot note will not admit of an enumeration—far less a description—of all the works of which he was either designer or constructor. The one for which he stood most distinguished at the time of his death, was Waterloo Bridge, a structure which even foreigners were forward to own, had then no parallel in Europe for magnitude, beauty, and solidity. “That a fabric of this immensity,” observes Mr. Wells, in his History of the Bedford Level, (to which we confess ourselves indebted for the materials of the present note,) “presenting a straight horizontal line stretching over nine large arches, should not have altered more than a few inches (not five in any one part) from that straight line, is an instance of strength and firmness, elsewhere unknown and almost incredible. But all Rennie's works were made for posterity; they were never of slight construction; nor would he ever engage in any undertaking where a sufficiency of funds were not forthcoming to meet his views.” Mr. Rennie died, after a few days' illness, on the 11th of October, 1821. The vignette portrait of him, which is given in the title page of this pamphlet, has been copied from a portrait of him taken by Mr. Dance, in 1801.

Fig. 1.

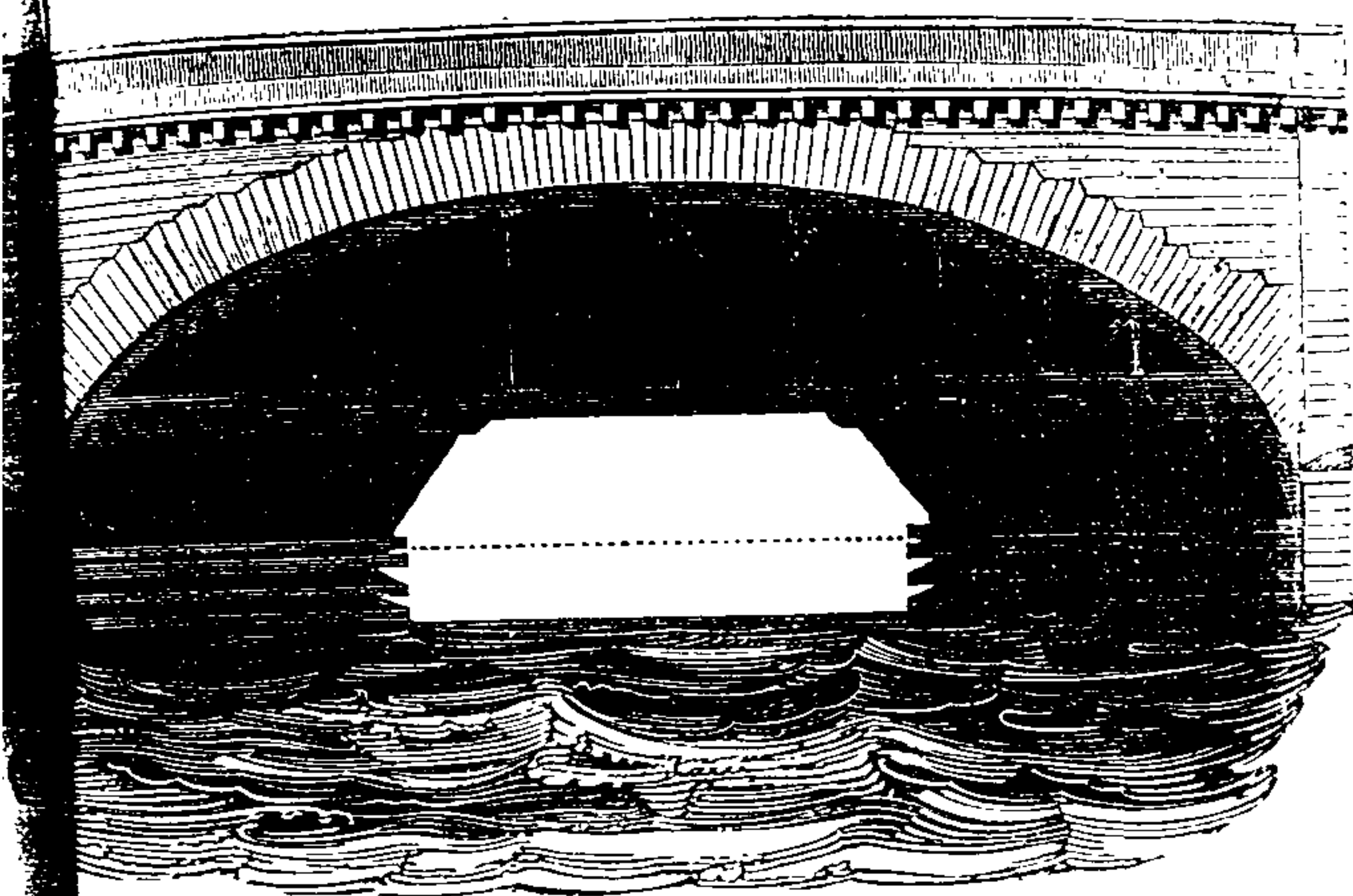
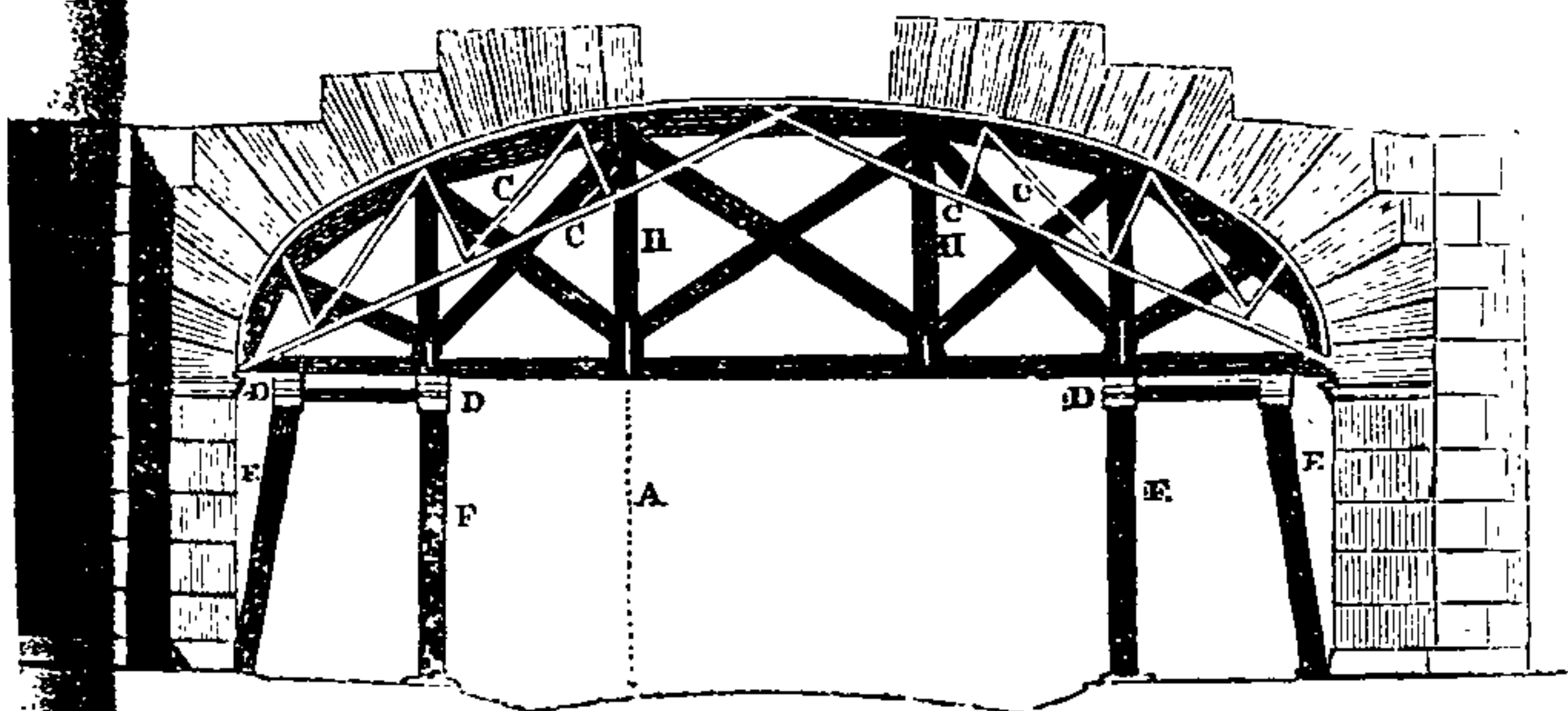


Fig. 2.



Treasury should exercise a joint control over it with the Corporation.

According to the original design of Mr. Rennie the new bridge was to have been built on the site of the old one,—a temporary bridge of wood being first thrown across (that is, a-top of the old bridge), to prevent any interruption of the traffic, during the progress of the work. The elevation of the bridge, too, was to correspond, at both ends, with the level of the ancient approaches; that is, of Thames and Tooley Streets. Mr. Rennie was led to adopt this not very convenient plan, in order to obviate the necessity of new approaches, “which would lead to a very heavy expence.” The Corporation, however, without caring for the provisions of the Act of Parliament, or for the “heavy expence,” and without consulting with the Lords of the Treasury, decided, that the bridge should be built one hundred and eighty feet higher up the stream. Had they proposed to themselves to get rid, by this arrangement, of the steep and narrow entrance into the City, by Fish Street Hill, we should have been inclined to say, the expense was, on that account alone, well hazarded; but such an improvement did not (at first, at least) enter into their contemplation. In Plate X. fig. 1. we have given a plan (copied from the original contract between the Corporation and Messrs. Jolliffe and Banks), showing the old and new bridges, with the new lines of approach, as they were fixed at this time; and from this it will be seen that the new bridge was still to terminate as before, on a level with Thames Street, and to lead, by a crescent-shaped way, to the bottom of Fish Street Hill. The dotted lines in the plan denote the new approaches; A the Monument; B St. Magnus church, at the end of the old bridge; C Fishmongers’ Hall; D St. Michael’s church; E St. Saviour’s church; F St. Olave’s; G St. Thomas’s Hospital. In fig. 2. of the same plate, we have also the levels, corresponding with the above plan—A representing the Trinity high water mark, B the back of the abutment, and C Thames Street. Another sectional sketch, marked Fig. A, shows the relative bearings which Upper and Lower Thames Streets were to have to the bridge. D represents Lower Thames Street; E Upper Thames Street; F the bottom of Fish Street Hill; G the centre of the new bridge. A more round-about, up-and-down, inconvenient, line of approach than the one thus chalked out, can scarcely be imagined. Proceeding from Cornhill, you were first to descend by a steep and narrow street, to nearly the level of the river, then to turn away suddenly to the right, and, after going

round a crescent, to turn up again to the left, in order to climb the bridge! The project, indeed, was so absurd, that one can scarcely suppose it was ever seriously entertained.

The intended approaches, on the Surrey side, were of a better description; not quite straight, but of gentle ascent, and sufficiently spacious. The levels on this side will be found exhibited in Fig. 2 and Fig. B of Plate XI. Fig. 2. shows the inclination of the line of approach, from the High Street of the Borough; D representing St. Saviour's church, C the end of Tooley Street, B the back of the abutment, and A the low and high water marks. Fig. B is a section of the lateral approach from Rotherhithe. E points out the situation of St. Olave's church, F Tooley Street, G the centre of the new bridge, and H the back of the abutment.

We have been thus particular, in pointing out—first, the deviation which took place from Mr. Rennie's plan, in regard to the site of the new bridge,—and next, the sort of approaches that were laid down in the original contract plan, because it is to these sources we must refer for an explanation of a difference, enormous beyond all precedent, between the estimated cost of this public improvement and the money which has been actually expended upon it. Mr. Rennie's estimate, for the new bridge, was 430,000*l.*, with an additional 20,000*l.* for the temporary bridge; and, so far as regards the bridge itself, this estimate has been very little exceeded. The change in the site, with the new approaches, originally chalked out by the Corporation, added 456,000*l.* to this estimate. But in consequence of the injudicious nature of these approaches,—the City portion of them, in particular,—others had afterwards to be substituted, which have raised the actual expenditure to nearly two MILLIONS!

The present Mr. John Rennie, on being subsequently examined before a Committee of the House of Lords, respecting the deviations which had caused so prodigious an outlay, stated, that they took place without his approbation; he thought the original plan, of his father, best, but considered it was not his business to remonstrate, or to ask reasons; the Corporation had decided that the site of the bridge should be changed,—had called for plans of approaches to correspond with that change,—and he had nothing to do but to carry their decision into effect. In saying that he thought "the original plan the best," we understand Mr. Rennie to have meant, that it would have been as easy to make good approaches to a bridge erected on the old site, as to a bridge erected on the new, while the expense, in the former case, would have been much less:

and so understanding him, we perfectly agree with him in opinion. Had the ancient site been adhered to, it would only have been necessary to elevate, straighten, and widen the ancient approaches ; and the saving in expense would have been just equal to all the difference, between cutting a way through a solid mass of valuable buildings, and cutting it through a space only about half occupied.

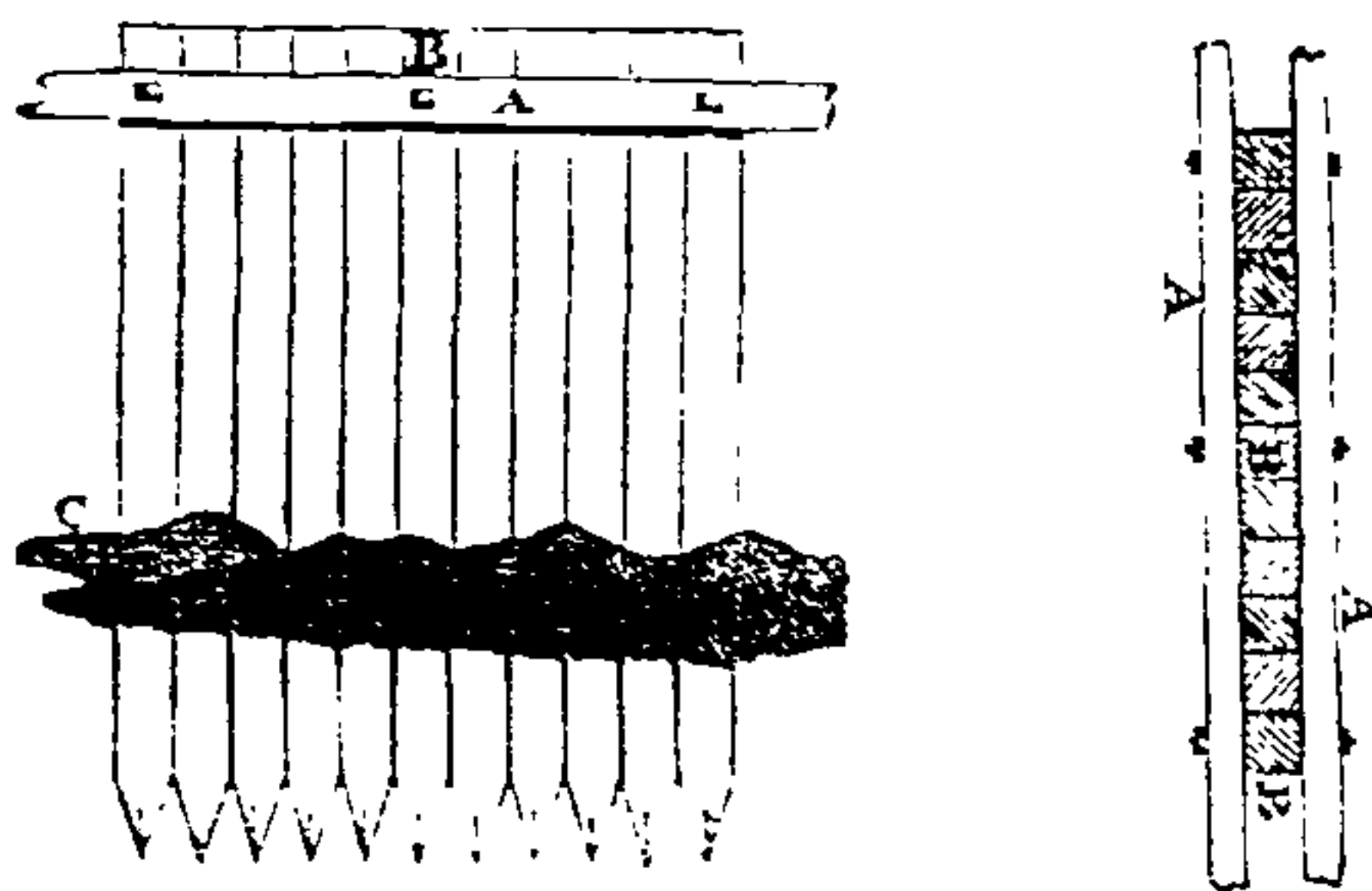
The contractors for the building of the new bridge commenced their arduous undertaking, by driving the first pile of a coffer dam for the south pier, on the 15th March, 1824. The reasons for adopting this mode of founding, in preference to that by means of caissons, are of course familiar to professional men ; but for the information of the general reader, a few words of explanation may not be out of place.

The *caisson method* is said to have been invented by Labelye, the architect of Westminster Bridge. What is more certain is, that it was first employed on a large scale in the building of that structure. A caisson is an immense raft of timber, constructed of a form and size suitable to the pier intended to be erected ;* it is furnished with a bottom, ends, and sides, the two latter made to draw away at pleasure. A portion of the pier proposed to be sunk to its proper place is erected in this sort of flat bottomed barge ; and when all is in readiness, water is admitted in order to sink it, and it is guided in its descent by ropes, &c. The sides and ends are then withdrawn, and float to the surface, the lower planking remaining under the stones. The ingenuity of this plan caused it to be at first much talked of and admired ; but before Westminster Bridge was opened, part of it gave way through a defect in its caisson-laid foundations, and the completion of the structure was thrown back by this accident nearly a year and a half. Since then there have been so many similar failures in this bridge, that it has been found necessary to build anew nearly every one of the piers. The cause of this decay is said by apologists to have been the indifferent quality of the material employed (fir), but it is more truly and generally ascribed by men of science, to circumstances inseparable from the mode of founding by caissons. The wooden platform, with the pier upon it, being dropped, as it were, by chance into the stream, is as likely to find an irregular as a perfectly flat foundation ; and whenever the foundation happens to be of the former description, currents and springs are sure to insinuate themselves beneath,

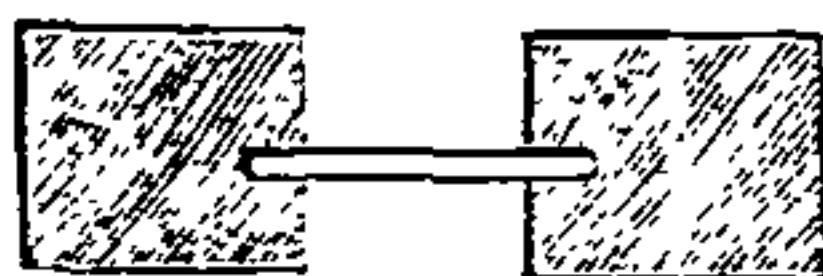
* The caissons at Westminster Bridge contained upwards of 150 load of timber, and were of more tonnage than a 40 gun vessel.—*Hutton's Tracts*.

and unsettle the whole superstructure. Besides, wooden foundations are only safe as long as they can be kept completely immersed in water, so that as often as a very low ebb takes place, there is a risk of the air gaining access to the timber and implanting the seeds of speedy dissolution.

The mode of founding *by coffer-dams* avoids all these risks, and is, therefore, that which is now universally followed. A coffer-dam is a space in a river enclosed by two or three rows of piles (generally of either oak, elm, or beach) driven into the ground close together by means of a steam-engine or any other adequate power. The water is withdrawn from within the included space in order that the foundations of the intended pier may be laid on the solid ground. There are two sorts of piling in common use, one known by the name of close piling,—the other called *grooved and plank piling*. *Close piling* is executed in the manner represented in the following plan and section :—



The piles being driven into the ground close together, are made fast at top by bolting to them longitudinally, two strong pieces of timber, technically termed waling pieces, (A, A,) one on each side ; bolts, however, are only driven through every fourth or fifth pile (as at B, B). In *grooved or plank piling*, again, the piles are grooved across, and planks of timber introduced into the grooves thus :—



This method gives great neatness to the dam, and generally supersedes the necessity of puddling with clay ; it is not, however, remarkable for security. In both cases, the lower ends of the piles are sharpened or cut into a pyramidal form, and shod with iron,

Fig. 1.

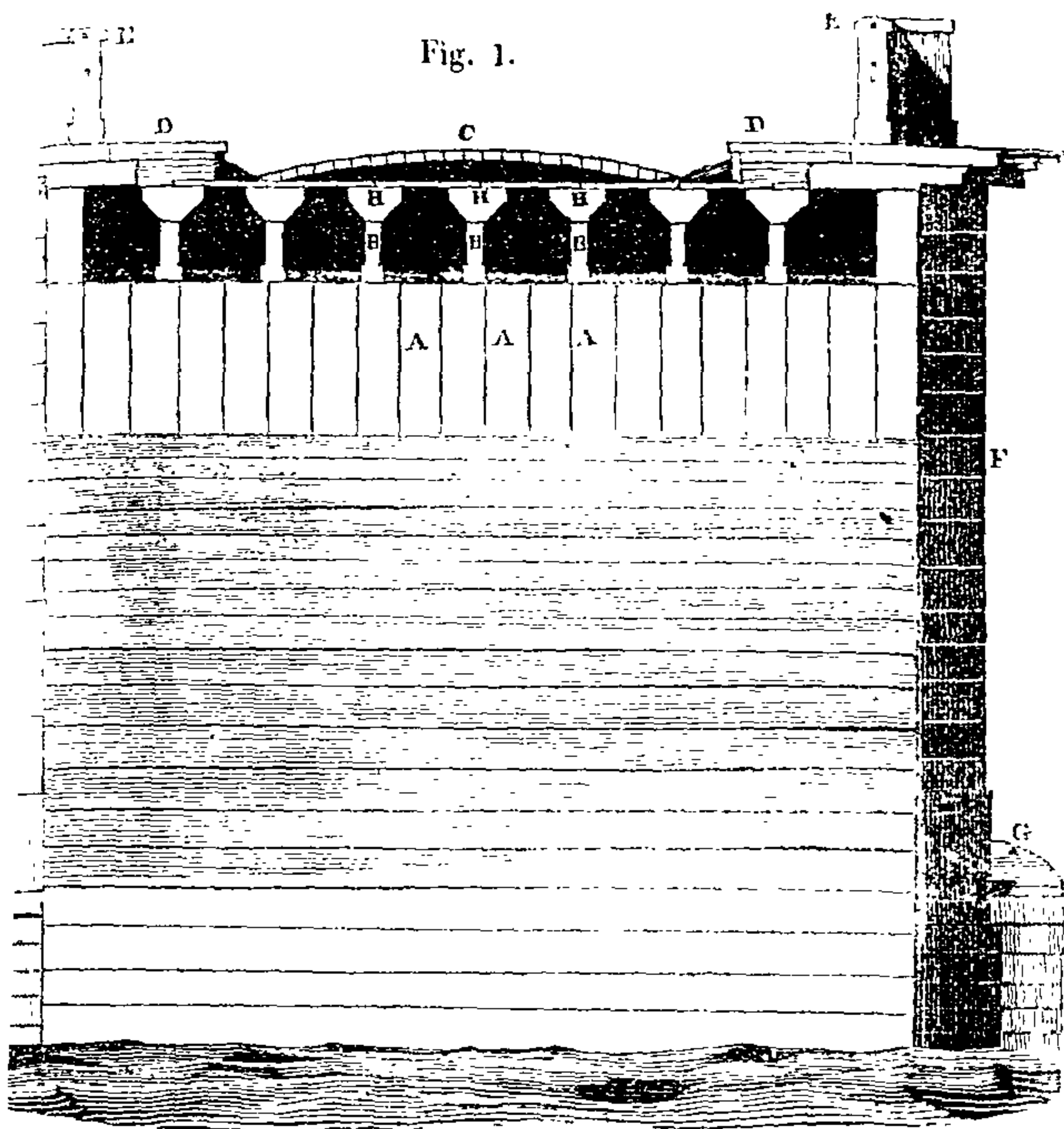
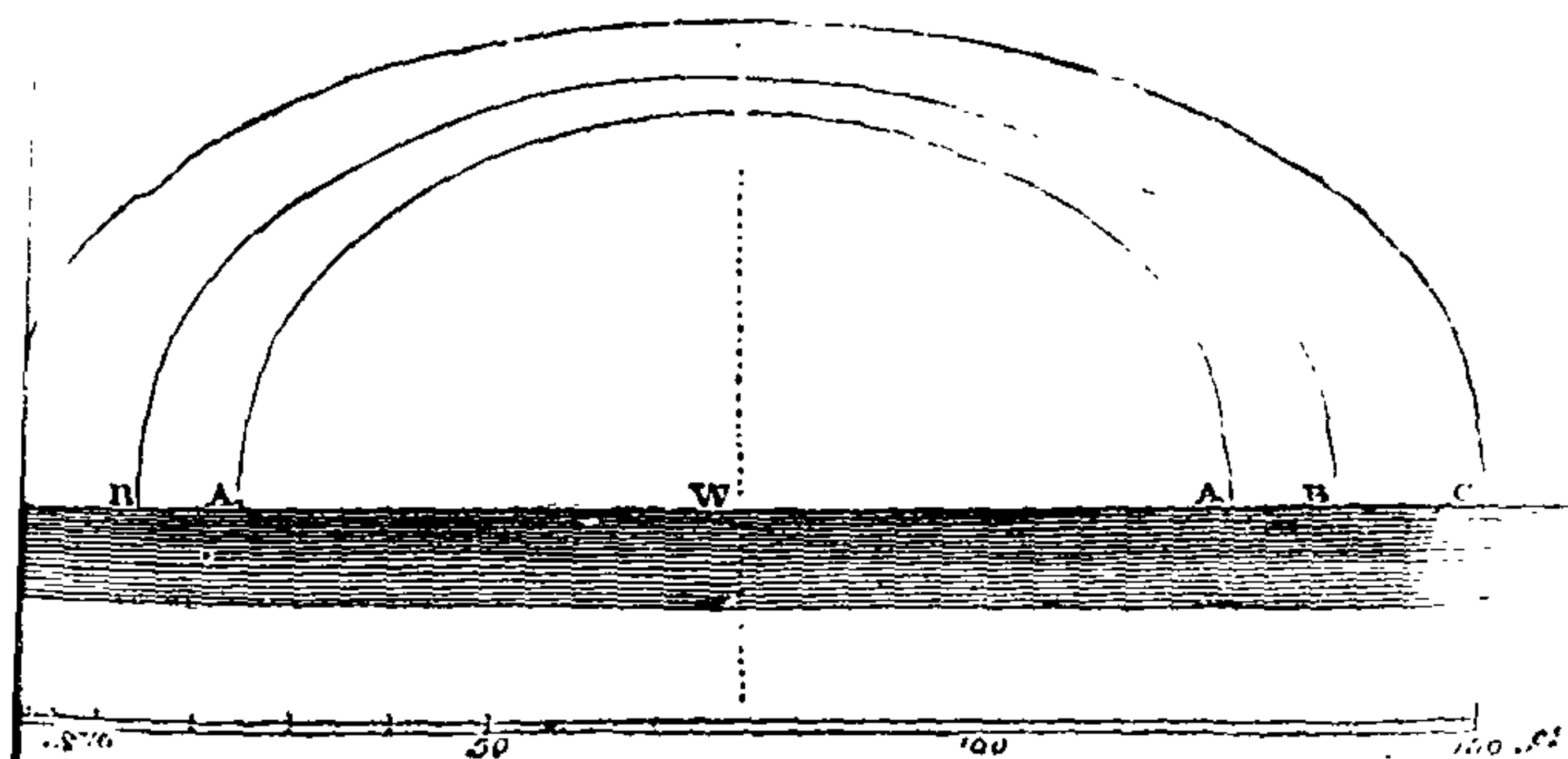


Fig. 2.



and the upper extremities are encompassed with a ring of the same metal, to prevent their splitting by the force of the iron ram with which they are driven into the earth.

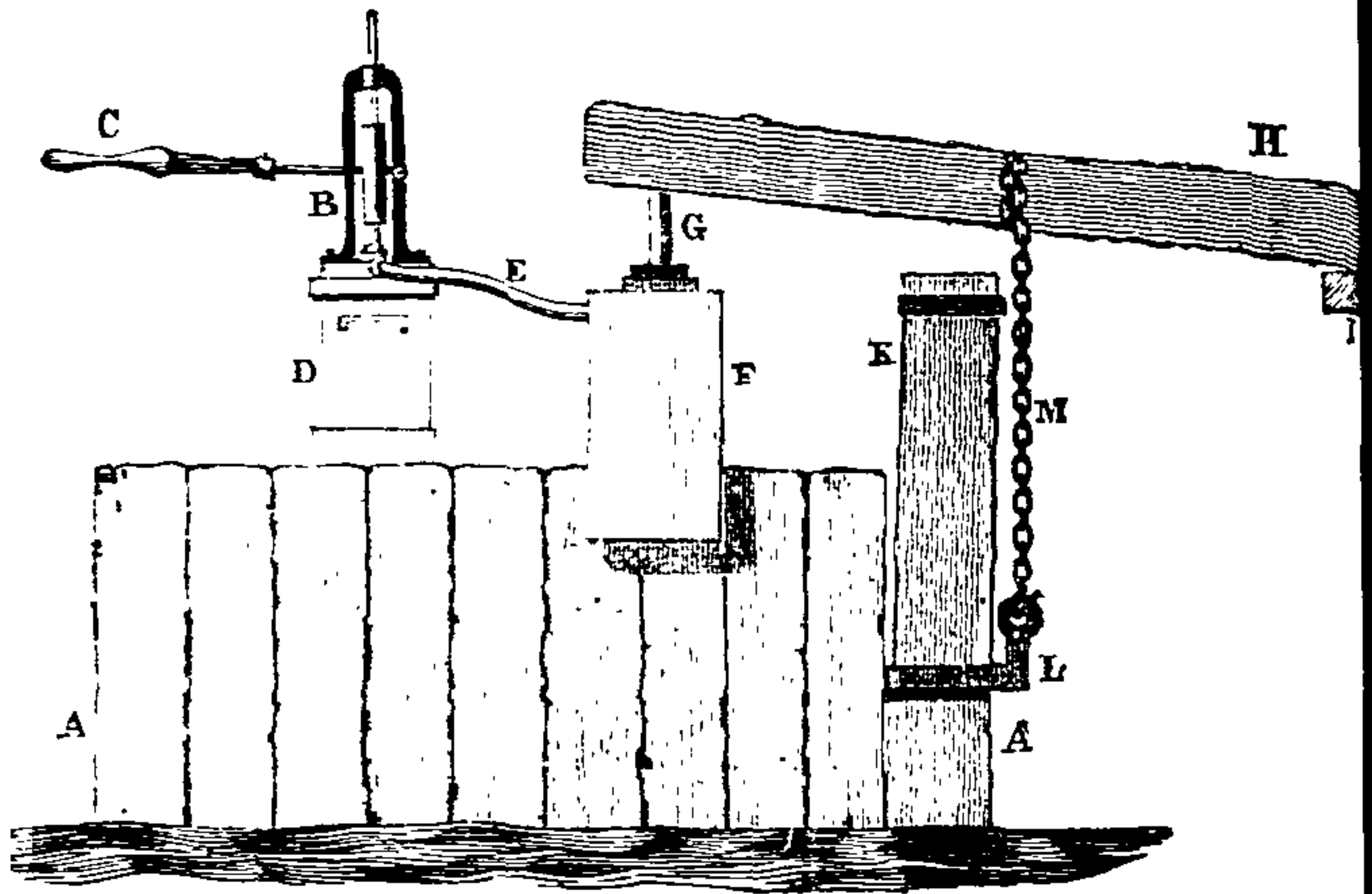
The mode followed in the construction of the coffer-dams at the New London Bridge differed somewhat from both of those we have just described. In consequence of the bed of the river at the site of the bridge being upwards of 30 feet deep at low-water of spring-tides, and the current being at all times extremely rapid, it was found necessary to have recourse to several additional expedients to give the coffer-dams sufficient strength to keep out the water. A plan of that which was constructed for the south pier is given in Plate V. The general form of the dam was elliptical. Three rows of piles, *d, d, d*, dressed in the joints, and shod with iron, many of them measuring from 80 to 90 feet, were driven into the ground, and after being firmly bolted together, in the way before described, were puddled with clay, &c. Wooden stays or props, *h, h*, were then introduced between the different rows of piers, and the whole of the interior space strongly truss-framed in the diagonal manner represented in the engraving (*f, f, f, b*). As timber when acted upon laterally is comparatively weak, the longitudinal beams, *b, b*, and *e, e*, are firmly strapped together, forming at their joints, abutments for the braces, *f, f*. At *k, k*, were stairs for descending into the coffer-dam; at *p, p*, pumps for withdrawing the water arising from springs or leakage. *Y, Y*, represent the pier of solid masonry in the course of erection within this dam, with its footings, mode of bonding, &c.

The skill displayed in the formation of this dam has probably not been exceeded in any instance, and is well worthy the attention of the practical engineer. So perfectly did it answer its purpose, that, notwithstanding the immense force of water which it had to withstand, the interior was, in general, in so dry a state, that the steam engine and pumps were but rarely used.

The machine commonly employed for withdrawing the piles on the removal of a coffer-dam, has been one on the tilting principle, recommended by Bellidor, in his *Architecture Hydraulique*; and first employed, with signal success, in 1749, in clearing the River Var of a forest of piles, with which it had become, through the chances of war, encumbered.* But the late Mr.

* Marshal Belleisle, in 1747, passed the Var, for the purpose of conquering an adjacent province (Nice); and to facilitate the communication with France, he caused to be constructed across it two magnificent bridges, measuring in length about 300 toises each, and of sufficient solidity to resist the force of one of the strongest currents in Europe,—at a time, too, when

Rennie has the merit of introducing a much simpler, and equally efficient, apparatus (represented in the subjoined engraving), founded on the prodigious power of the modern hydraulic pump, invented by Bramah. It was first used in the building of Waterloo Bridge.



A A show part of the piling of the coffer-dam, and B the pump fixed upon the top of the piling. By working the handle C, water is withdrawn from the cistern D, and forced through the copper pipe E into an iron cylinder, enclosed within a block of wood F, firmly fixed to the piles. The pressure of the water forces up the solid plunger G, and that raises a beam H, placed upon another beam I, as a fulcrum. Now a loose ring of iron L, being dropped round the pile K, and the chain M passed several times round the beam H: the ring L, on being drawn upwards by the chain, shifts itself into an angular position, and thus obtains such a purchase upon the pile, as causes it to follow the elevation of the beam H till it is completely withdrawn.

The coffer-dam—the mode of constructing and dismantling which, we have been just describing—having been completed on the 27th April. 1825, preparations were then made for laying the first stone of the bridge. A canvas awning was thrown over the coffer-dam, and the interior of it divided into four tiers or

the river was most subject to them. Afterwards, when there was no longer any need for the bridges, they were destroyed; and it was on this occasion Belidor constructed the machine alluded to in the text, for the purpose of withdrawing the piles on which they had been built.

galleries, along which rows of benches, covered with scarlet cloth, were placed. A ready means of access to it was also provided, by making an opening in the ballustrade of the old bridge, and carrying a temporary flight of stairs from thence directly into the dam. The ceremony took place on the 15th June, and was performed, with all due pomp and solemnity, by Mr. Alderman Garratt, then Lord Mayor, in the presence of the Duke of York, and a numerous assemblage of persons of rank and distinction.*

The stone was laid exactly in the centre of the space appropriated to the south pier. It is a cube of Heytor granite, 5 feet $\frac{5}{8}$ inches long, 3 feet $6\frac{1}{2}$ inches broad, and 2 feet 10 inches deep, and weighs between four and five tons. An excavation, in the centre, contains a brass plate, with an inscription, commemorative of the founding of the bridge, and specimens of all the coins of the reign of George the Fourth. The plate rests on four glass cylindrical supports, 7 x 3 inches, imbedded in plaster. Two blocks of granite, of the same size as the foundation stone, are placed at each side of it; and a fourth, of still greater dimensions, covers all three.

The inscription was written by Dr. Coplestone, the present Bishop of Llandaff, and Dean of St. Paul's. It is given in Latin on one side of the plate (in conformity with a most absurd usage), and on the other in English. We subjoin the English version:—

* How the river was *encrusted* with boats" on this occasion; and how the boats were "*decorated* with colours, awnings, *music*, and *animated countenances*,"—how "every wharf was covered like bees, in swarming time, with well-dressed persons,"—how "*music* added to the beauty of the picture,"—how "fruit wine, and other refreshments," were devoured the while,—how all the company "rose to receive their Royal visitor," and how low the Royal visitor bowed in return,—how the charity children sung, guns roared, the trumpets sounded, the people huzzaed,"—and how "*the day was completed* by a magnificent dinner," &c. &c.—we leave the reader, who is curious in such important matters, and not nice about the sort of phraseology in which they are recorded, to learn, in full detail, from either of the contemporary writers, who will recognize themselves in the above quotations. The following is in a better vein, though in almost as bad language:—

"The coffer-dam presented, on that occasion, one of the most extraordinary appearances that such a machine ever exhibited. The day was remarkably fine; the approach to the dam, from the regulations adopted, very easy; and when seated at the bottom of the capacious structure, formed in the midst of the roaring waters of that part of the Thames, no one would have believed, from the appearances around the crowded recesses of the dam, while they were pacing the crimson carpeting that covered its temporary boarded floor, and surveying the beautiful mass of granite that was suspended, as the first stone of the bridge, that they were then treading the newly-explored bed of old Father Thames, and were nearly five and forty feet below the high water mark of the mighty current that was divided to the right and to the left like a wall, and rushing by, and above them."

THE FREE COURSE OF THE RIVER
 BEING OBSTRUCTED BY THE NUMEROUS PIERS
 OF THE ANCIENT BRIDGE,
 AND THE PASSAGE OF BOATS AND VESSELS
 THROUGH ITS NARROW CHANNELS
 BEING OFTEN ATTENDED WITH DANGER AND LOSS OF LIFE
 BY REASON OF THE FORCE AND RAPIDITY OF THE CURRENT;
 THE CITY OF LONDON,
 DESIROUS OF PROVIDING A REMEDY FOR THIS EVIL,
 AND AT THE SAME TIME CONSULTING
 THE CONVENIENCE OF COMMERCE
 IN THIS VAST EMPORIUM OF ALL NATIONS,
 UNDER THE SANCTION, AND WITH THE LIBERAL AID OF
 PARLIAMENT,
 RESOLVED TO ERECT A BRIDGE
 UPON A FOUNDATION ALTOGETHER NEW,
 WITH ARCHES OF WIDER SPAN,
 AND OF A CHARACTER CORRESPONDING
 TO THE DIGNITY AND IMPORTANCE
 OF THIS ROYAL CITY :
 NOR DOES ANY OTHER TIME SEEM TO BE MORE SUITABLE
 FOR SUCH AN UNDERTAKING
 THAN WHEN IN A PERIOD OF UNIVERSAL PEACE
 THE BRITISH EMPIRE,
 FLOURISHING IN GLORY, WEALTH, POPULATION, AND DOMESTIC UNION,
 IS GOVERNED BY A PRINCE,
 THE PATRON AND ENCOURAGER OF THE ARTS,
 UNDER WHOSE AUSPICES
 THE METROPOLIS HAS BEEN DAILY ADVANCING IN ELEGANCE AND SPLENDOUR,

THE FIRST STONE OF THIS WORK
 WAS LAID
 BY JOHN GARRATT, ESQUIRE,
 LORD MAYOR,
 ON THE XVTH DAY OF JUNE,
 IN THE SIXTH YEAR OF KING GEORGE THE FOURTH,
 AND IN THE YEAR OF OUR LORD
 M.D.CCC.XXV.

JOHN RENNIE, F.R.S., ARCHITECT.

Fig. 1.

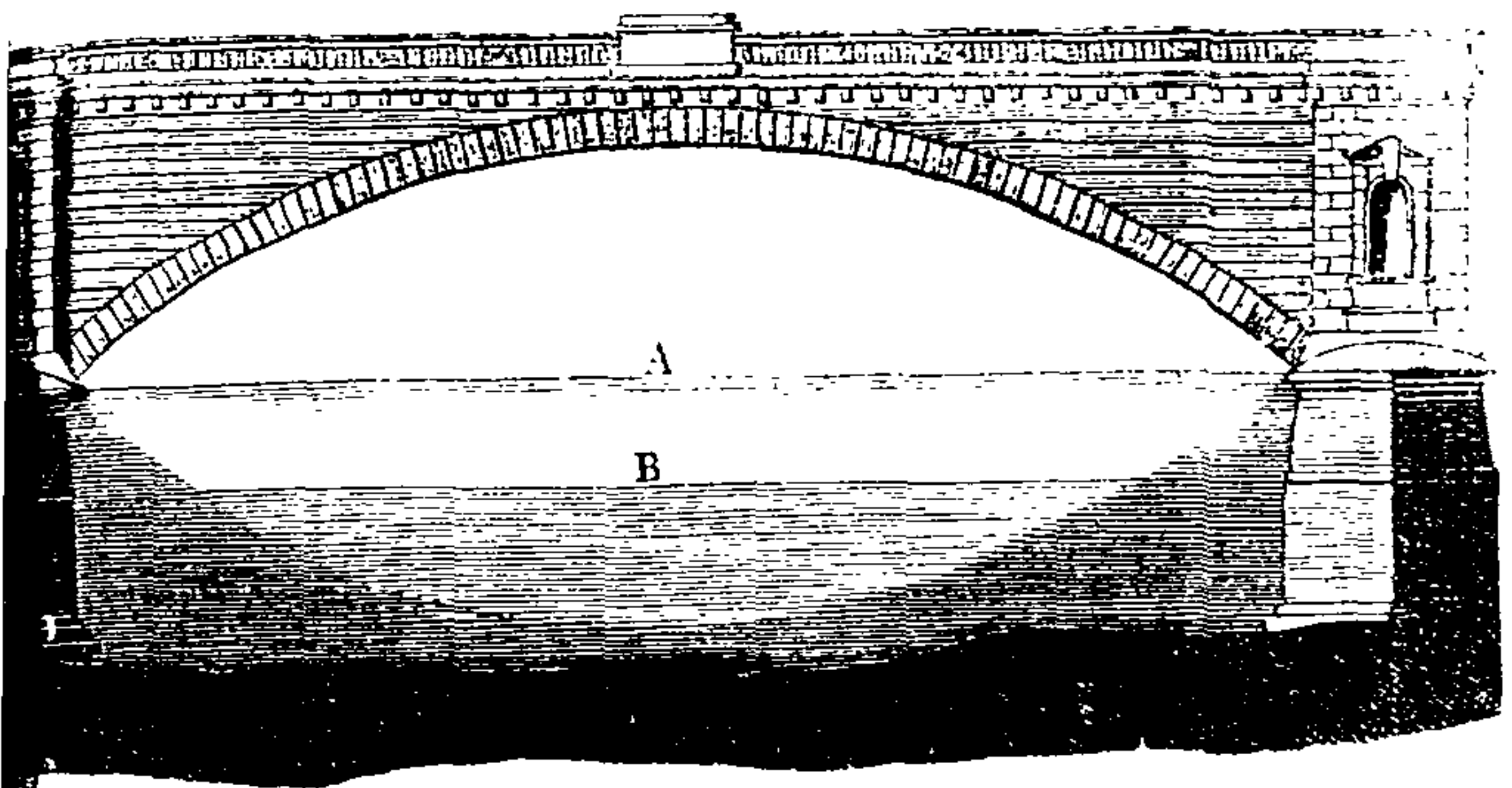


Fig. 2.

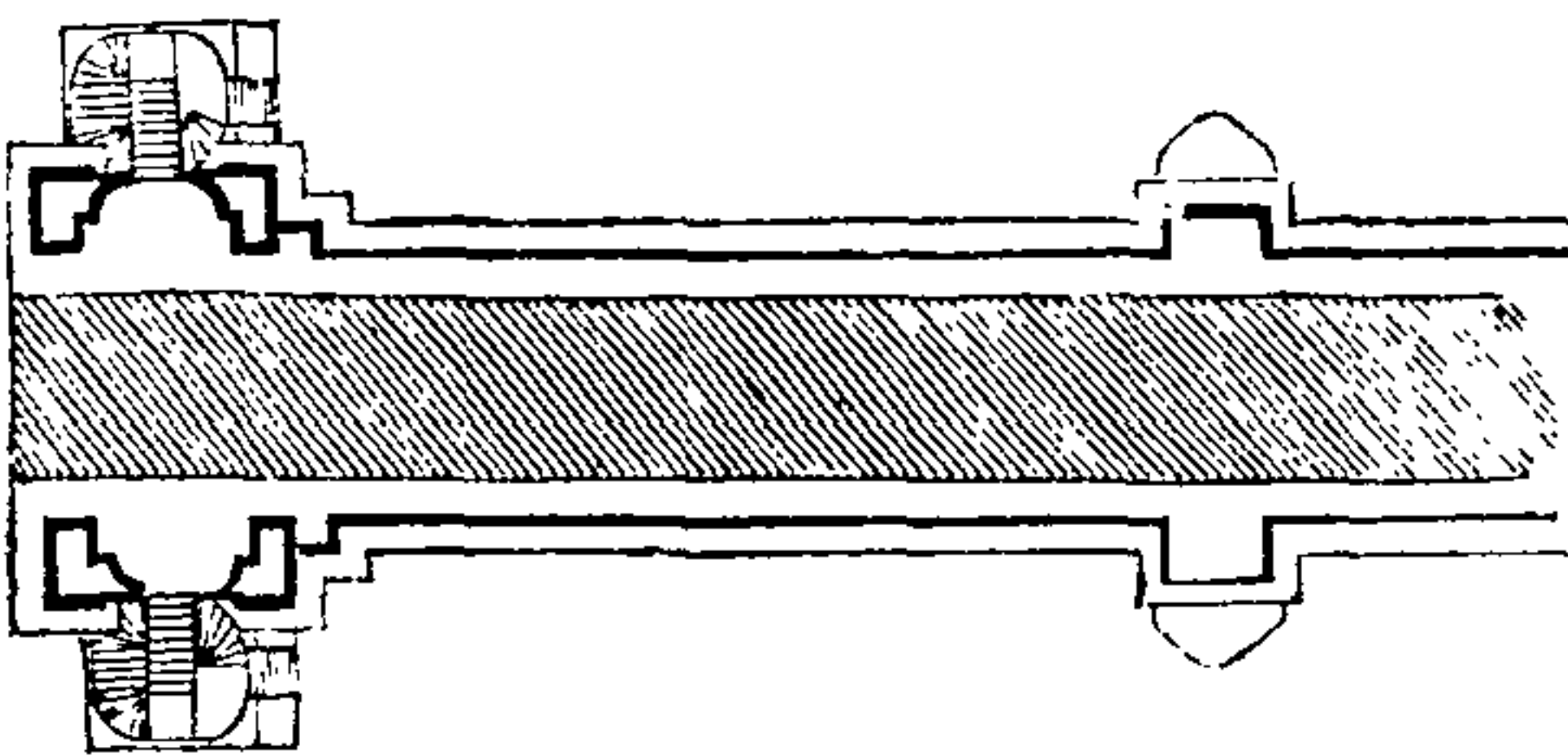


Fig. 3.

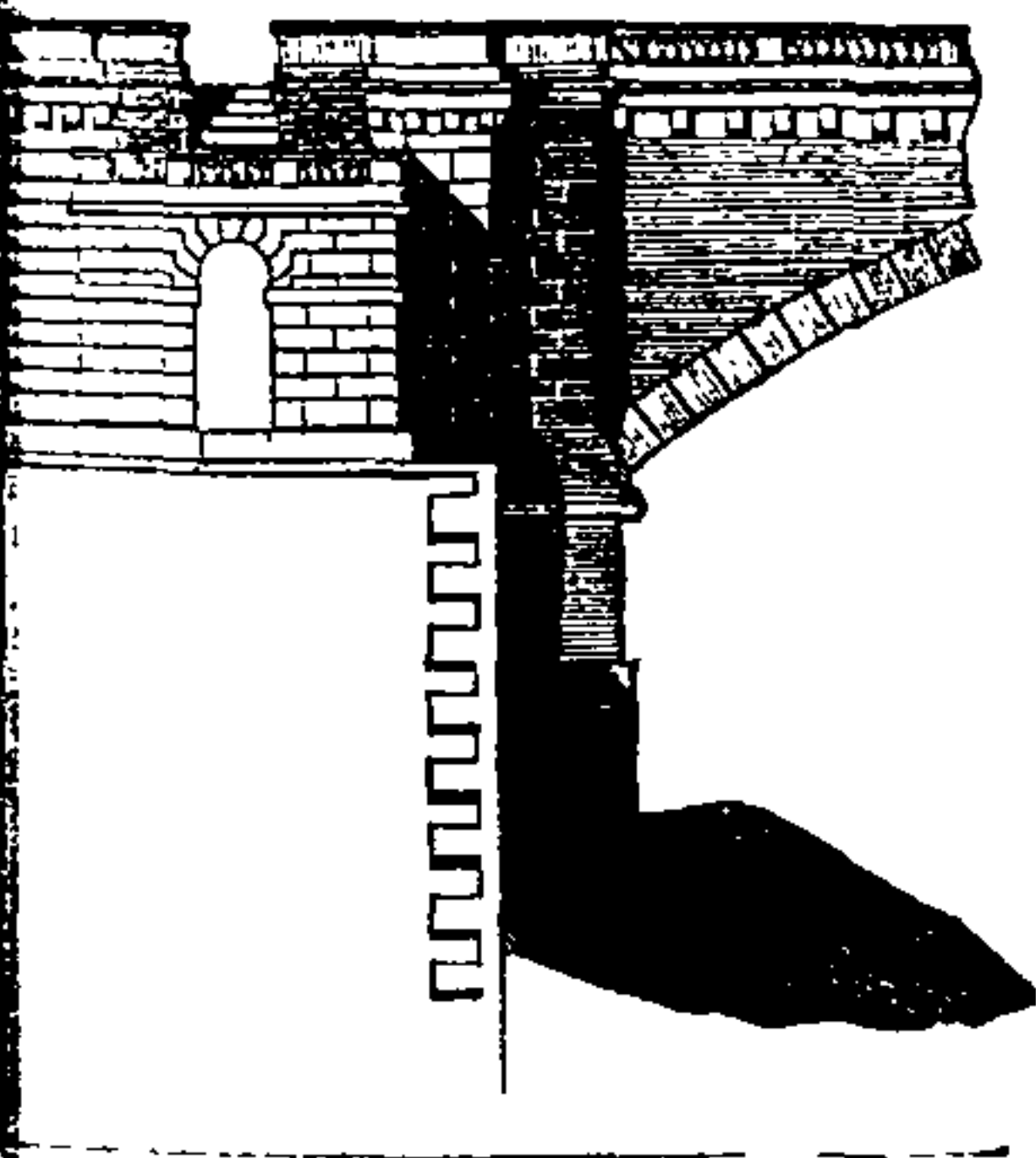


Fig. 4.

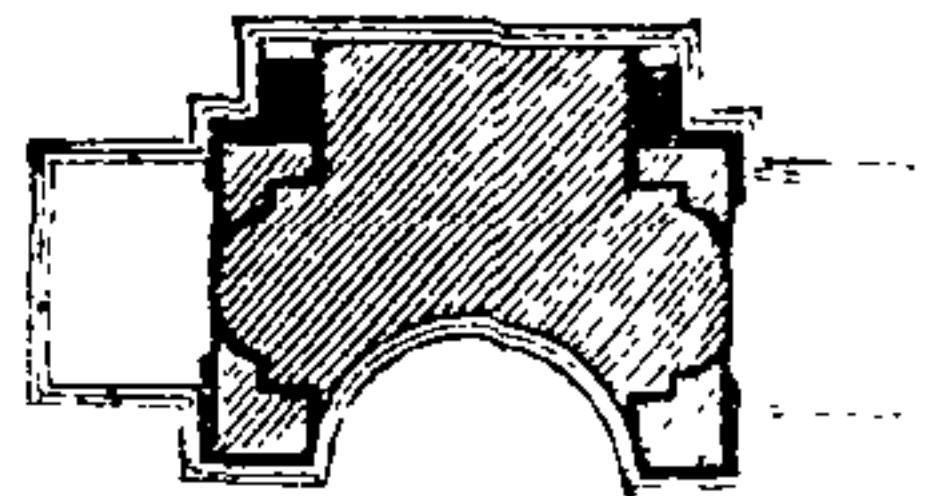
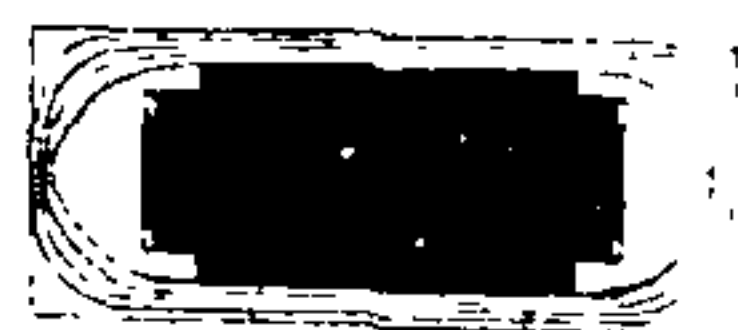


Fig. 5.



Neither the matter nor the style of this inscription can be much commended. It is Dr. Johnson, we believe, who observes that an epitaph ought at least to contain the name of the person whose virtues it is intended to hand down to posterity ; and under the shield of his authority, we may venture to assert that it is a blundering inscription for a bridge over a river, which never once mentions the name of that river. Dr. Coplestone speaks of "*the river*" in the style of a citizen who had never seen nor heard of any other. The Act for building the bridge affirmed, as we have before seen, that it was by reason of "the large starlings and piers" of the old bridge, that "the navigation was rendered dangerous and destructive to the lives and properties of his Majesty's subjects ;" Dr. Coplestone asserts that it is "by reason of the force and rapidity of the current." We wonder who gave his Lordship authority thus to deviate from his text. It matters, indeed, not much ; for the one version of the affair is just as false, in respect to the loss of life and property alleged, as the other. Dr. Coplestone further asserts, that it was "under the sanction of parliament" that the City resolved to erect a bridge "upon a foundation *altogether new*." It is a fact incontestably established, that the City adopted a new foundation or site in the very teeth of the sanction of Parliament.* The inflated expressions, with which the inscription concludes, about the "time" chosen for the undertaking being so "suitable," on account of "the flourishing in glory, wealth," &c. of the British empire, will, at some future day, contrast strangely with the fact that the date subjoined to this piece of *fanfarronade* is the same "year of our Lord" which is known in the chronicles of Britain by the name of "the year of the panic," when ruin and dismay stalked through the land, and this most "flourishing" nation seemed verging on a state of general bankruptcy ! Dr. Coplestone would probably have offended good taste and the integrity of history less, had he strained less after momentary effect—had he thought more of what posterity would think than of what his turtle-feasting friends of the Corporation would like to hear. Truth requires not such blown bladders to float it down the stream of time, as the worthy bishop seems to have been at pains to provide. The time when the structure

* It has been usual to enclose in the foundation stone of every structure like this, a copy of the Act of Parliament empowering its erection. Was it to avoid handing down to remote posterity, two such conflicting memorials of the origin of New London Bridge, as the Act of Parliament for its erection and Dr. Coplestone's Inscription, that the practice was departed from in this instance ?

was erected—the persons by whom—and the government under whose auspices:—these were the only things which it was needful to record; and recorded they might have been in as many words as Dr. Coplestone's inscription has lines. The merits of the bridge, and the prodigious public spirit of its founders, it might have been safely left to that bridge itself to vouch and proclaim. The inscription besides, in being thus docked and simplified,—reduced to few parts, and these parts divested of all frippery,—would have been more in accordance with the noble character of simplicity which belongs to the structure it was designed to honour.

The terms, *first stone*, and *foundation stone*, are in popular acceptation synonymous; but, in the present instance, this might lead to a misconception, against which it is proper to guard the reader. The *actual foundations* of the piers of the New London Bridge are not of stone, but of wood. Piles of beech were first driven from the interior of the coffer-dam which we have described, to a depth of nearly 20 feet into the stiff blue clay that forms the natural bed of the river: two rows of horizontal sleepers, about 12 inches square, were then laid on the heads of these piles; and these sleepers, again, were covered with beech planking, 6 inches thick; and on this well-supported floor the lowermost course of masonry was laid. The same plan was followed in the building of all the piers.

Foundations of this description have been shown, by long and various experience, to be superior to all others, in point of security. The very hardest ground—even rock itself—is not always to be trusted. Blondel instances a church, in Paris, which, though built on an apparently solid bottom, and with very thick walls, gave way on one side: because, at several fathoms deeper than its foundations, there were two or three cavities artificially formed at some remote period. Gautier relates a similar case of a fortification, in one of the isles of Oleron, which, though literally *built on a rock*, fell down in one part, in consequence of a natural cave or hollow in the heart of that rock,—in the same way as the most carefully fused bars of metal will sometimes break, from a bubble or flaw in their structure.

At the same time it must be allowed, that there is much force in what is said by Stephen Wren, in the *Parentalia*,—by way of apology for his father's neglect of piling, in the case of St. Paul's Cathedral,—namely, (we give the substance merely) that

unless you can make sure of the piles being *always wet*, there is no more security, in a foundation of piles, than in any other. "For, though piles may last for ever, when always in water, yet if they are driven through dry sand, though sometimes moist, they will rot." Alternately "wet and dry, they soon perish." And hence the danger to which the foundations of Blackfriars and Westminster Bridges (both being of timber) are so particularly exposed, from the anticipated change in the depth of the river, at low water, after the removal of the dam at Old London Bridge. Should the bed of the river above bridge be often dry, at the ebb, and that bed become lowered two or three feet, through the greater velocity given to the ebb current, the downfall of both structures (unless some adequate remedy be provided) must be inevitable.

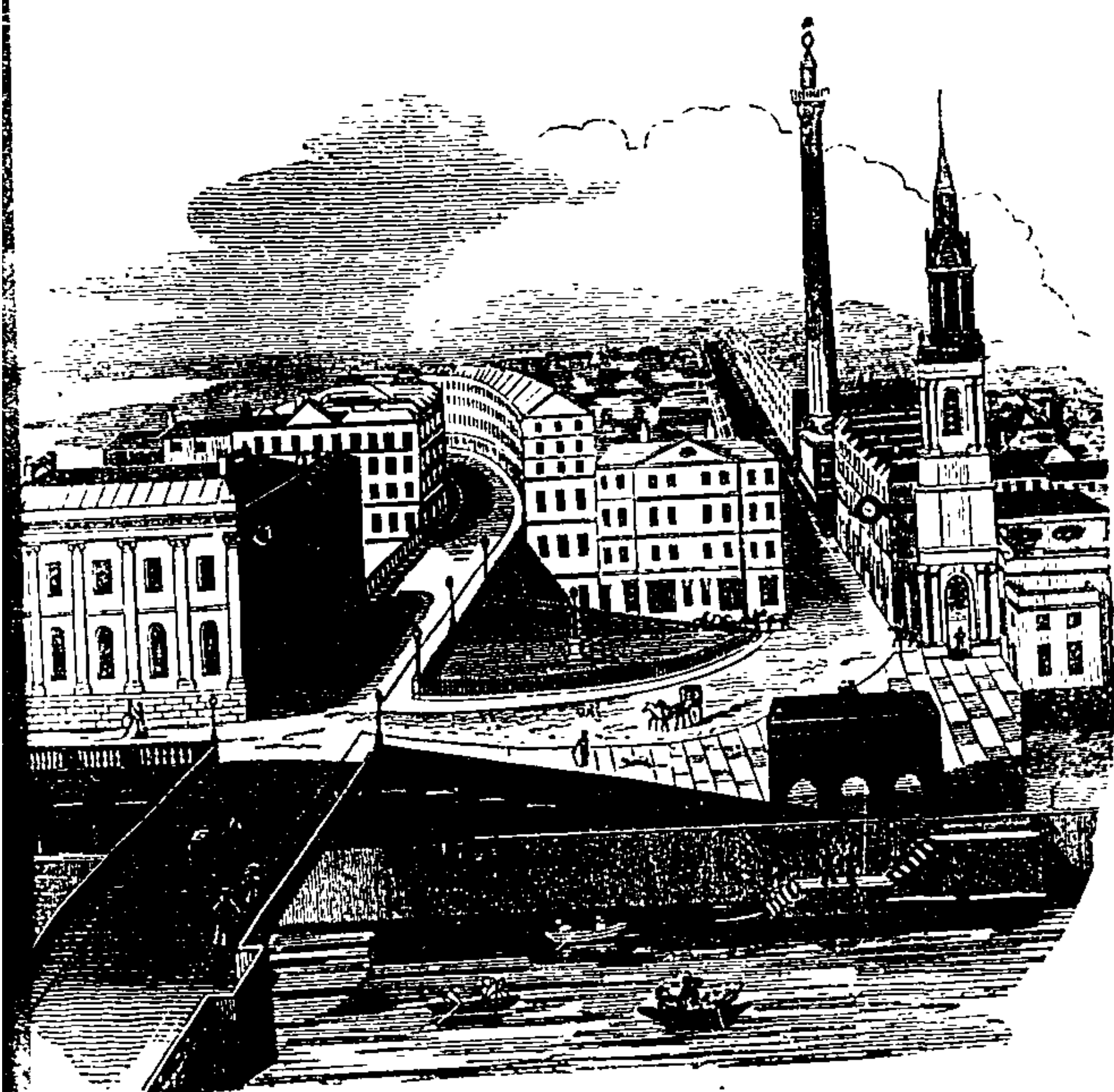
To compensate for the additional obstruction which the works of the new bridge occasioned to the navigation of the river, it was soon found expedient that two of the small arches of the old bridge, on each side, should be thrown into one. The ease and dispatch with which this conversion was accomplished furnishes an instructive commentary on the doubts expressed, as to the practicability and safety of such a mode of remedying the defects of the old bridge. The usual traffic was never once interrupted,—the heaviest weights passed over as before,—and vessels had the same facility as previously of sailing under ; yet, all the while, there was going on a shifting and changing of parts, which altered entirely the character of two large portions of the structure. The road-way was first boarded in, and taken up, one half at a time, and a space cleared away for the reception of a transverse iron girder A. (See Fig. 3. Plate III.) A set of massive timber principals (B B) were then laid on to this girder, from the extreme piers of the two arches,—bestriding as it were, the central pier that was to be removed ; and these, instead of being placed at intervals, as in roofs, were all fixed and bolted close together, from one side of the roadway to the other, forming one unbroken mass of timber. Above the girder there was inserted what may be not inaptly termed the brestsummer, C, into which purloins D D were mortised at intervals, for the support of a substantial planking, on which the pavement was laid as before. The strength of the truss-work was farther augmented by a number of counter principals (as 1, 2.), some of the struts being fixed close together, and others having

an interval of one-width between them. The skill and adroitness, were not more remarkable than the extreme rapidity, with which all these things were accomplished—not more than six weeks altogether having been occupied in the operation.

“With respect to the removed piers,” says the writer in the *Westminster Review*, whom we have before quoted, “they ought, according to the theory of their insecurity, as soon as the piles of the starlings were withdrawn from around them, to have been carried clear away from their foundations, by the force of the current. So far from this, however, they were, with infinite difficulty and delay, got down below the low water of spring tides. This was stated in the last published report respecting them (December, 1826): and, for any thing we know to the contrary, there they are still.”

The construction of the wooden centres, for supporting the arches, while in the course of erection, formed another difficult and interesting portion of this great undertaking. All arches may be turned to the extent of 30° of inclination, without any centre whatever; for the arch-stones or voussoirs, at that angle, will not slide from the position they are placed in,—they merely press on each other; but, in proportion as the stones advance towards a perpendicular position, their sliding or gravitating force increases, and they can only be kept in their places by wooden framing, of adequate strength. The amount of this gravitating force must, of course, be much greater in the case of very flat, elliptical arches, like those of the New London Bridge, than in any other; while, at the same time, the form of the arches makes it of more importance than usual, that none of the voussoirs should deviate in the least from their prescribed positions. It was requisite, therefore, in the present instance, not only to have centres of more than ordinary strength, but to have the tendencies of their component parts, so nicely distributed and balanced, that no change in their form should take place.

The principle of construction adopted, to obtain these ends, was that of the diagonal truss. Each centre was composed of ten frames, or ribs, of the form represented in Fig. 1. Plate VI., and rested, at the two ends, on piles, driven into the bed of the river. At top these frames were boarded over with stout planks, placed within two or three inches of each other. On account of the inequality of the arches, four sets of centres were used; and each of them, although consisting of nearly 800 tons of timber



and iron, were generally put in their place about ten days. All of them answered their purpose admirably; not the least failure, in any of them, having occurred.

The mode in which the arches themselves were constructed, next claims our attention. In Plate VII. Fig. 1. we have given a transverse section of one of the arches, taken at about one-third of the distance between the key-stone and the pier. A A represent the voussoirs; F F the piers; G G the cut-waters; E the parapet; C the roadway; and D the pathway. Till within these few years, it was the practice to fill up the spandrels of the arches with loose rubble-work, from an impression that this would prevent the arch bursting or springing at the haunches; but as every extra weight at the crown is apt to cause such loose materials to shift, longitudinal, or as they are technically called, hance-walls, have been introduced in the manner represented in the engraving (B B.) On the top of these walls large blocks of stone H H H are bedded, and surmounted by heavy stone-landings, on which is laid a course of tarras or cement, and, above that, the puddling for the roadway C.

The first arch was keyed in on the 4th of August, 1827; and, so much progress had been contemporaneously made in the other arches, that the last was keyed in on the 19th of Nov. 1828.

As the bridge advanced to completion, the necessity of fixing on some other approaches than those laid down in the original contract plans, began to press itself on the attention both of the Corporation and the public. The builders of the bridge were somewhat in the situation of the man who, erected a lofty house, and forgot to put a staircase in it. The line of tortuosity, as that down Thames Street and up Fish Street Hill, has been aptly styled, was allowed, on all hands, to be utterly inadmissible; and the chief object with every one, who occupied himself with the affair, was how to improve the approaches on the City side. One new plan after another, was submitted by the engineer to his employers (it is said no less than six), but rejected, or at least not adopted; and almost countless were the projects volunteered by ingenious individuals, who compassionated the scrape into which the Corporation had got. Among the latter, the most conspicuous for their exertions, and for the use apparently made of their suggestions, were, Messrs. Allen, Gwilt, Jefferys, and Lund. How much these gentlemen respectively contributed to the enlightenment of the Corporation, and their

engineer on the subject, and whether it be true (as alleged) that from one or other of them Mr. Rennie copied all the good features of his plans, are points which have been the subject of much controversy, but which we shall not stop to investigate. The inquiry would occupy more time, than we think it would be worth while to devote to it. We see nothing suggested, in the propositions of any of those volunteer auxiliaries, which was not likely to have occurred to hundreds besides themselves—to any person, indeed, of common intelligence and sagacity, who chose to give the subject an hour's attention; nothing, at all events, so singularly new or clever, that the world should be disturbed to ascertain with whom it originated.

One of the first conclusions, to which reflection on the subject would naturally lead every one, must have been the necessity of making the approach from the City side, on the same level with the bridge, or nearly so. Now, how was this to be done, if not by means of a series of land arches, in continuation of the bridge,—including, of course, and more particularly, one over Thames Street? In this method of carrying one roadway over another, there was nothing new: it had been long known and practised; and numerous examples of it were to be seen throughout the country,—an excellent one at no greater distance than Waterloo Bridge. Yet these facts notwithstanding, Mr. Jeffery, one of the volunteer auxiliaries before mentioned, was pleased to put forth the scheme of an arch over Thames Street, as an original and happy conception of his own, which could only be sufficiently rewarded by giving the name of “Jeffery's Arch” to any arch that might be there erected.* And thereupon, two new claimants for this original, and happy conception, appeared in the persons of a Mr. Fortune and Dr. Price; and much contention ensued among the three, for the privilege of being immortalized, in virtue of an idea that belonged to none of them! The reader may judge from this of what sort the suggestion were,—some of them, at least,—about the appropriation of which, by the City's engineer, so much has been said.

It is a curious fact, that, clear as the necessity for a dry arch over Thames Street was, it should not have occurred even to

* According to *my* design, the new street, from the bridge to Gracechurch Street, would have been on a level, “passing over the arch, I suggested to be made, at Thames Street, which I understand is to be called *Jeffery's Arch*.”—Letter of Mr. Jeffery, *Mech. Mag.* vol. xiii. p. 429.

Mr. Jeffery, till after he had delivered himself of quite a different project. Probably it may have been owing to his having no notion of such a thing in the first instance, that it came upon him afterwards, in all the effulgency of a new discovery. In Plate IX the reader will find a copy of a plan of approaches, which this gentleman sent forth to the world, March 16, 1827, in which, instead of the bridge being carried over Thames Street, it is proposed to carry Thames Street over the bridge, by means of two lateral ascending planes,—a scheme which, for absurdity, had no rival in any one of the many idle schemes produced on the occasion, although, truth to speak, it had, for a time, numerous advocates among the members of the Corporation. We do not recollect whether Mr. Jeffery proposed to identify this offspring of his genius with his name, as in the case of “Jeffery’s Bridge;” but, if he did, we presume the baptismal name must have been *Jeffery’s Folly*.

In the spring of 1829 the Corporation went before Parliament,—loaded to sinking, with plans of improved approaches—a very few supplied to order, the greater part the fruits of a public subscription—and humbly craved leave to refer the whole affair to its superior wisdom. The Parliament was at first very indignant (or affected to be), that the Corporation should apply to it again for advice and direction, after acting in such contempt of its former instructions on the subject, as to make that alteration in the site of the bridge which made these new approaches, and this application necessary; but after going through the formality of an enquiry on the subject, it came to the indulgent resolution, that as the Corporation had chosen to do as it pleased in the first part of the business, the best way would be to pass an Act, to the effect of empowering it, to do as it pleased to the end of the chapter. We really think we do not misrepresent the scope of the new Act obtained on this occasion, in this our paraphrase of its provisions. It first legalizes all that the Corporation had done in changing the site; speaks of different designs which the engineer had prepared by order of the Corporation for altering the approaches in conformity with that change of site; and ends by giving the Corporation power to carry into effect any one of these designs, or any modification of them which the Corporation shall, in conjunction with the Lords of the Treasury, think fit to adopt. We have seen that a similar power of control was given

to the Lords of the Treasury before; and we have seen also to what it amounted.

In the accompanying Plates, X, XI, and XII, will be found copies of the new designs referred to in the Act of Parliament.

Fig. 1, Plate X, exhibits what is called the *second* plan of Mr. Rennie (the original contract plan being the first). A denotes the Monument; B a place for a new Monument or Statue, which it was proposed to erect fronting the old one; C St. Magnus Church, D Fishmonger's-hall; E St. Michael's Church; F St. Olave's; G St. Thomas's Hospital; H St. Saviour's Church.

Fig. 3, Plate X, is the *third*, and Fig 4, Plate XI, the *fourth* plan of Mr. Rennie. The same letters of reference are used to denote the same places in both these plans. A the monument; B St. Magnus Church; C Fishmonger's Hall; D St. Michael's; E St. Saviour's; F St. Olave's; G. St. Thomas's Hospital.

Figs. 1 and 2, Plate XII, are sections illustrative of the different plans.

Fig. 1 is a section of the levels on the City side, with half the elevation of the bridge. A the arch over Thames-street; B Trinity high-water mark; C low-water mark; D back of abutment; E E (dotted line) section, according to plan No. 4; F centre of new bridge opposite the Monument; G, centre of Fish-street Hill, opposite the Monument; H point where the street is level with the roadway over the centre of the land arch.

Fig. 2.—Section of the levels, Southwark side, with half elevation of the bridge. A, centre of the bridge opposite the proposed line of Tooley-street; B Trinity high-water mark; C low water mark.

From these sketches a general idea may be gathered of the character which the principal approaches are likely to assume, as far as regards their direction, width, and levels; and, in these respects, we see little to complain of. The manner in which the residents of Upper and Lower Thames Streets, will be cut off from the like ready access to the bridge, which they so long enjoyed under the old state of things, has caused them much sorrow and lamentation; but there never yet was any great scheme of improvement, in which some partial sacrifice had not to be made for the general good. We do not

Fig. 1.

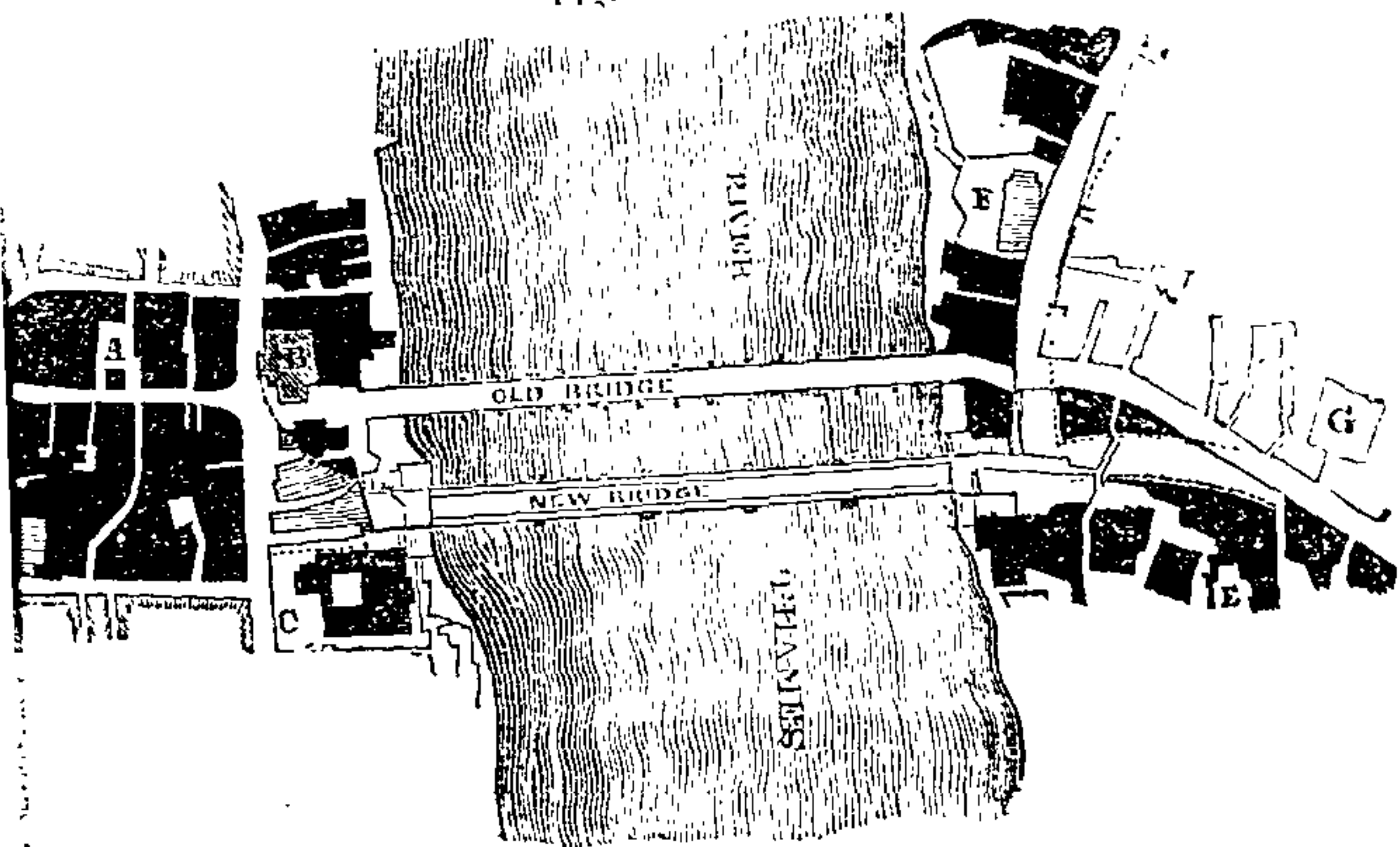


Fig. 2.

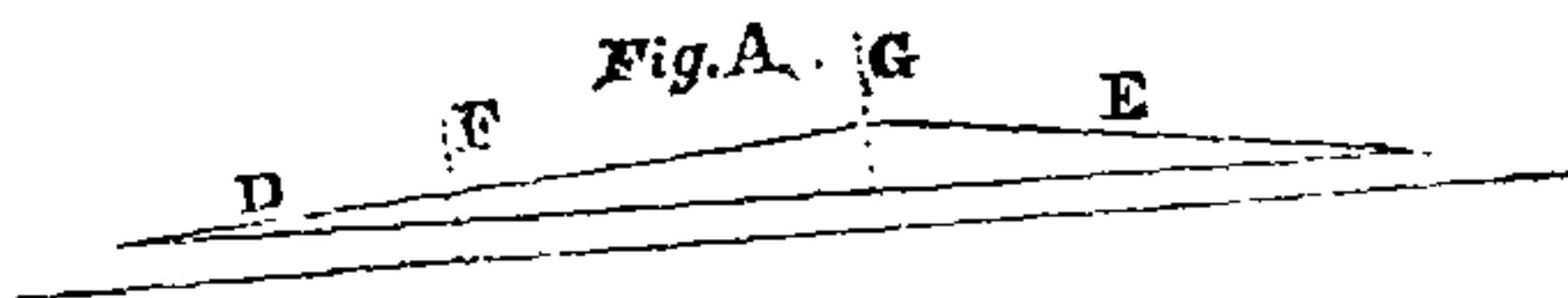
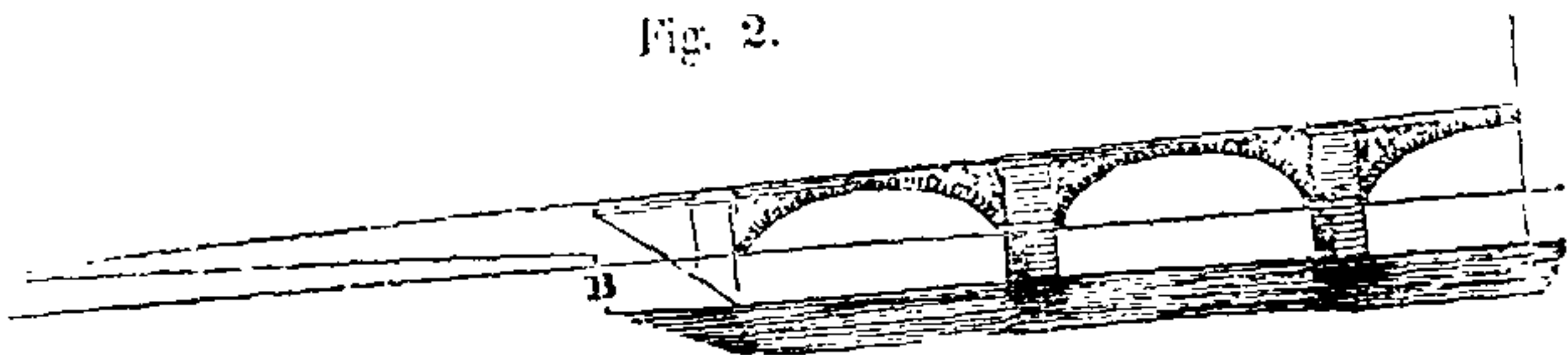
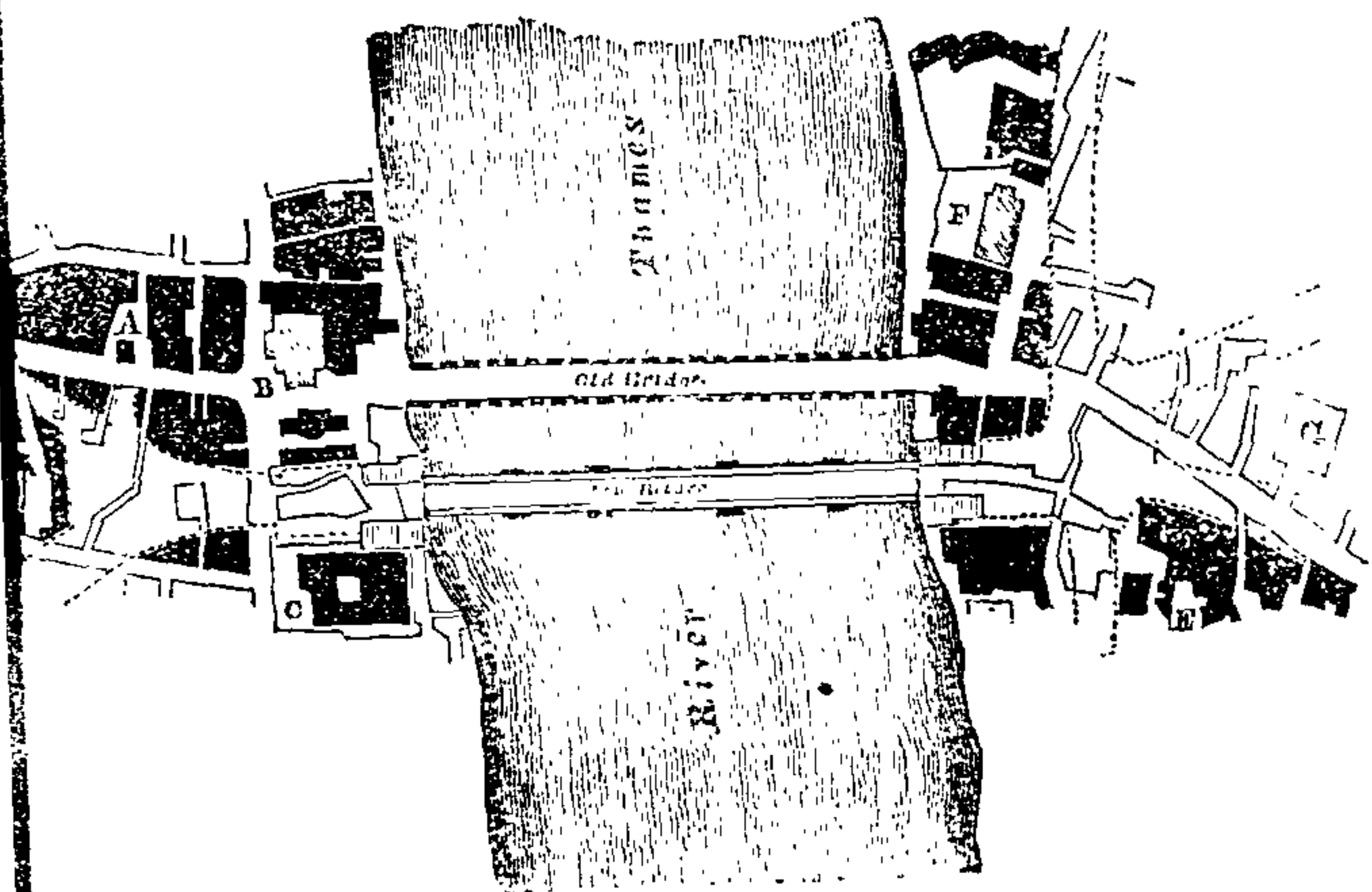


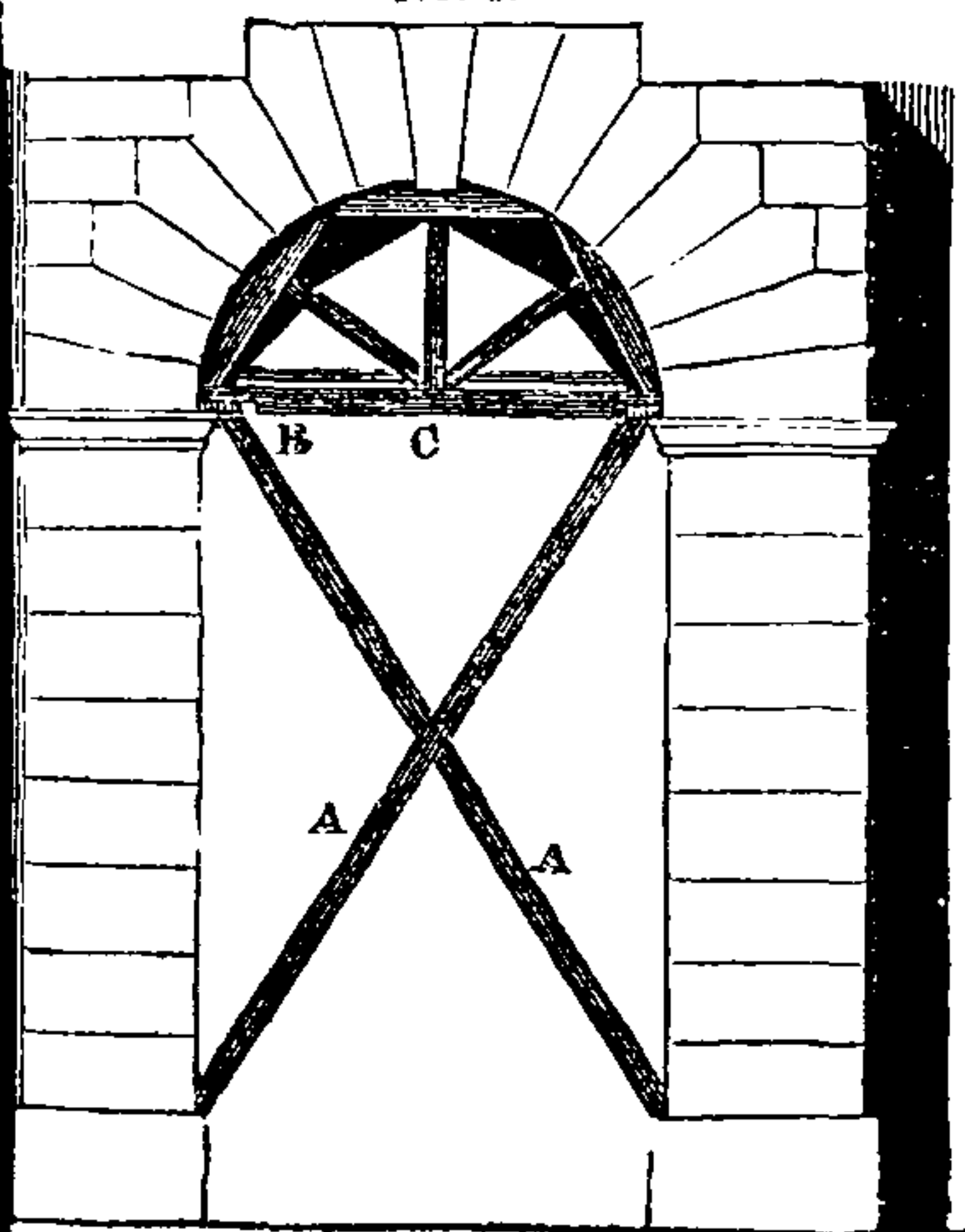
Fig. 3.



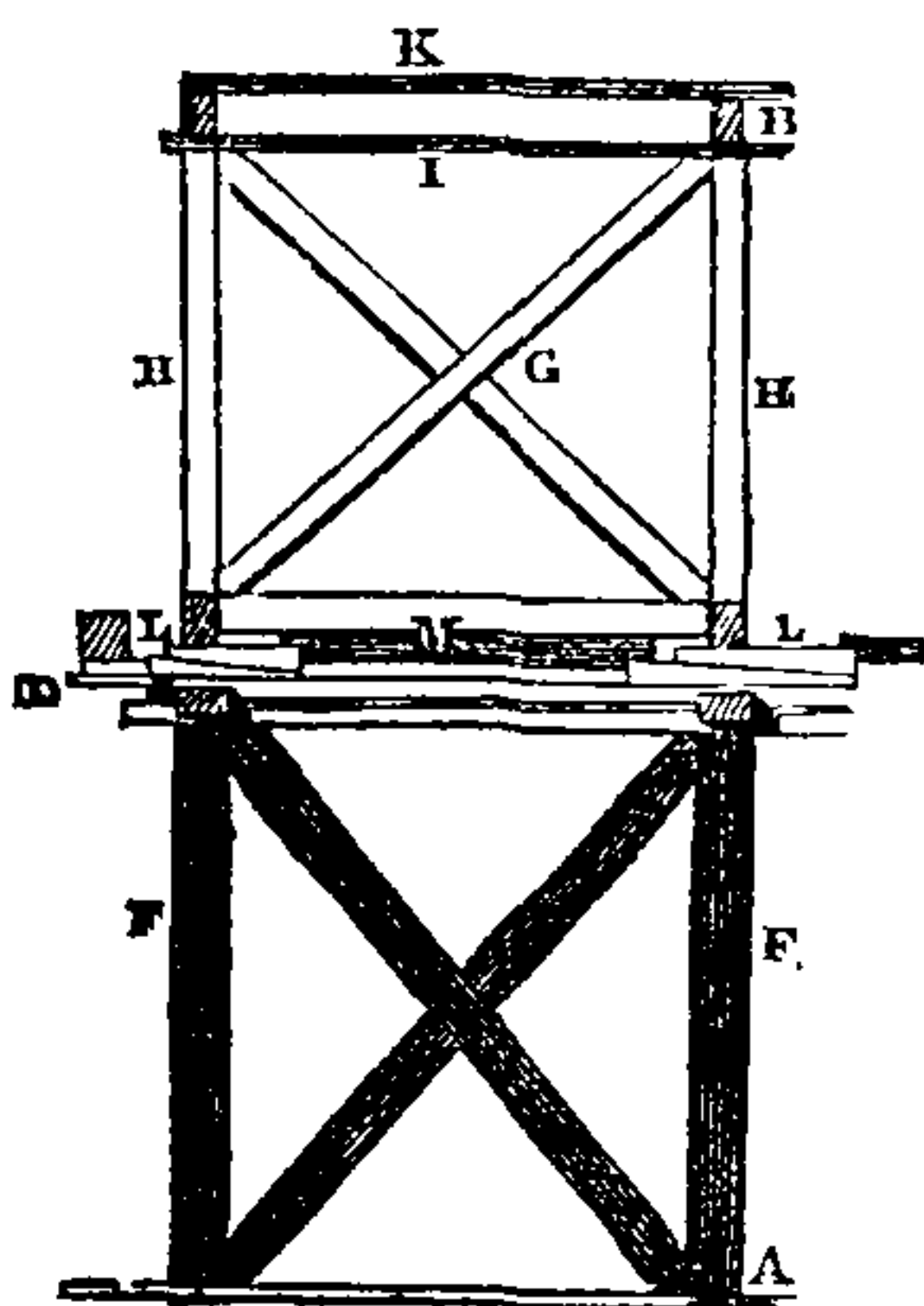
see how it could have been avoided, and the interests of the many consulted. Had the bridge been erected on the old site, and the old lines of approach been preserved, it seems quite certain that public convenience would have demanded that the roadway should be raised to a level, that would have left Thames-street, and its fruitmen and fishmongers, far below.

The arch over Thames-street, about which so much has been said, presented, while in progress, another useful lesson with respect to the construction of centres. The arch is a very flat ellipse, embracing both the roadway and footpaths of Thames-street; and the centre for it had to be constructed so as to leave a free passage for carriages and foot passengers. The manner in which this was effected is shewn in Fig. 2, Plate VI, and farther illustrated by the following diagrams:—

No. 1.



No. 2.



The centering, it will be observed, was almost entirely supported by struts and uprights E E and F F, placed so as to range with the lines of the footpaths. Each pair of principals belonging to the centre rested upon the wedges L L, No. 2, (which is a section taken through the line A B, Fig. 2, Plate VI,) and the wedges were kept in their proper places by the piece of timber M, notched down upon the wedges L L, so that, by removing M, the wedges could be withdrawn, and the centre lowered.

CC (Fig. 2.) was a mould for forming the true curvature of the planking on which the voussoirs rested: DD ends of the longitudinal timbers, wedges, &c. shown at DLM (No. 2). HH (Fig. 2 and No. 2.) were the queen-posts; the intervening spaces longitudinal with the arch, and parallel with these posts only, being filled with cross-bracings, as shown in the section (No. 2). To prevent the pressure of the voussoirs from distorting the centre, the head and feet of the queen-posts were secured with pieces of timber, laid longitudinally, immediately under the joggles of the cross-braces; one of these pieces is shown at II (No. 2). The centering of the lateral arch (No. 1.) was supported by cross-braces AA, resting upon the plinth: the other parts BB and C, in this figure, answered the same purpose as the wedges, &c. (No. 1.)

The only deviations in the principal part of the bridge, from the original plan of Mr. Rennie, consisted in an addition of six feet to the width of the roadway, and of two feet to the height of the abutment arches. The former was called for by the public; and thought of so much public advantage, that the Lords of the Treasury ordered that the expense of it (42,000*l.*) should be defrayed out of the public purse. The latter was pointed out by the present Mr. John Rennie, as being "necessary for the general security, and more perfect proportion of the bridge."

The last day of July, 1831, saw the bridge finally completed. The time occupied in its erection (from the driving of the first pile, on the 15th of March, 1824,) was seven years, five months, and thirteen days. Waterloo Bridge was built in six years; but it was attended with fewer local difficulties than the New London. Westminster and Blackfriars' Bridges were both about eleven years in erecting; a difference which illustrates, in a striking manner, the great improvement which has taken place in the art of bridge-building,—perhaps, also, in habits of business,—in the course of the last half century.

It would be to describe but feebly the merits of this structure, were we to say, that it is greatly superior to any of its fellow-bridges over the Thames. We do not think it has its rival in the world. Never have we seen, or heard, of a bridge which at once satisfied so completely popular taste, and the demands of science. We have viewed it in every variety of aspect, and seen only more and more cause for the most unqualified admiration.

Not a single blemish,—not a single incongruity,—not a single superfluous ornament,—nay, not any thing whatever of the nature of mere ornament,—intrudes itself on the eye. You behold realized the perfection of proportion, and the true greatness of simplicity. You see and feel, at once, that it is a structure about which all men must be agreed, and will continue to agree, to the end of time.

The bridge consists, as the reader has been before informed, of five semi-elliptical arches. The least of these is larger than the largest stone arch of this description ever before erected. The centre one is 152 feet in span, with a rise above high-water mark of 29 feet 6 inches; the two arches next the centre are 140 feet in span—rise, 27 feet 6 inches; the two abutment arches, 130 feet in span—rise, 24 feet 6 inches. A few years ago, Blackfriars and Waterloo Bridges were considered the largest elliptical stone bridges ever known; but the centre arch of the one is less by one-half, and that of the other by one-fourth, than the centre arch of New London Bridge. In Plate VII, Fig. 2, we have shown in juxta-position the form and size of the curve described by the centre arch of each of these bridges; and perhaps no better—certainly no fairer—method could be taken of exhibiting the superiority of the New London. A A is the curve of the Blackfriars arch; B B that of the Waterloo; C C that of the New London, stretching out far above and beyond either of the others.*

The piers which sustain these noble arches are of a rectangular form, and perfectly solid, but without the slightest appearance of heaviness. The great diminution in the total quantity of masonry, effected by the adoption of the semi-elliptical curve in the arches, has enabled the architect to reduce the piers in thickness much beyond the usual proportions. In Westminster Bridge the thickness of the piers is about one-fourth the span of the arches, in Blackfriars about one-fifth, in New London Bridge less than one-sixth. The bases of the piers are of a circular cone-topped form, and project boldly into the stream, harmonizing well with the waving line of the water, and breaking,

* There is a slight error in the scale subjoined to the engraving here referred to, but it can scarcely be said to affect the comparison. It should have been divided into 152 feet, the real span of the New London centre arch, and not 150 feet.

with admirable effect, the impression of sameness that would otherwise have resulted from the rectangular shape and rigid plainness of the shafts.

A simple modillion cornice runs along the upper part of the bridge,—marking externally the line of the roadway,—and is surmounted by a close parapet, which recedes in two elevations, like the *scamilli* of the ancients. When it was first known that the bridge was not to have an open balustrade as usual, an apprehension was generally expressed that the effect of the plain double blocking course would be dull and heavy; but now that people see what the effect really is, we hear of nobody being of this opinion. It forms, indeed, one of the most effective of those features of simplicity, which characterize the bridge; for, notwithstanding the preference which has been generally given to open balustrades in bridges, the truth is, there is but little natural accordance between pigmy pillars and gigantic piers,—small peep-holes, and lofty, wide spreading, arches. The parapet is only four feet high, so that passengers, though they cannot look through, can look over, with ease.

The line of the roadway, or upper surface of the bridge, is a segment of a very large circle; the rise being only about 1 in 132. The two inches of additional height which were given to the abutment arches, by the advice of the present Mr. John Rennie, have helped to flatten this line considerably; and, no doubt, this was the chief object which Mr. Rennie had in view.

The abutments are each seventy-three feet wide at the base, and radiate backwards, so as to meet the thrust of the bridge with the best advantage. Alongside of them are two straight flights of stairs, twenty-two feet wide, which lead to and from the water.

So just have been the calculations, on which the relative bearings of every part of this bridge have been adjusted,—and with such exactness has every stone been shaped and placed, according to the working plans,—that the sinking which takes place, in all such structures, has been, in the present instance, unprecedentedly small. The centre arch has only sunk 2 inches; those next to it $2\frac{1}{4}$; and the abutment arches 2. The sinking of Waterloo Bridge, which was thought, at the time, to be wonderfully small, was five inches.

The total width of the water-way, between the arches, is

Fig. 1.

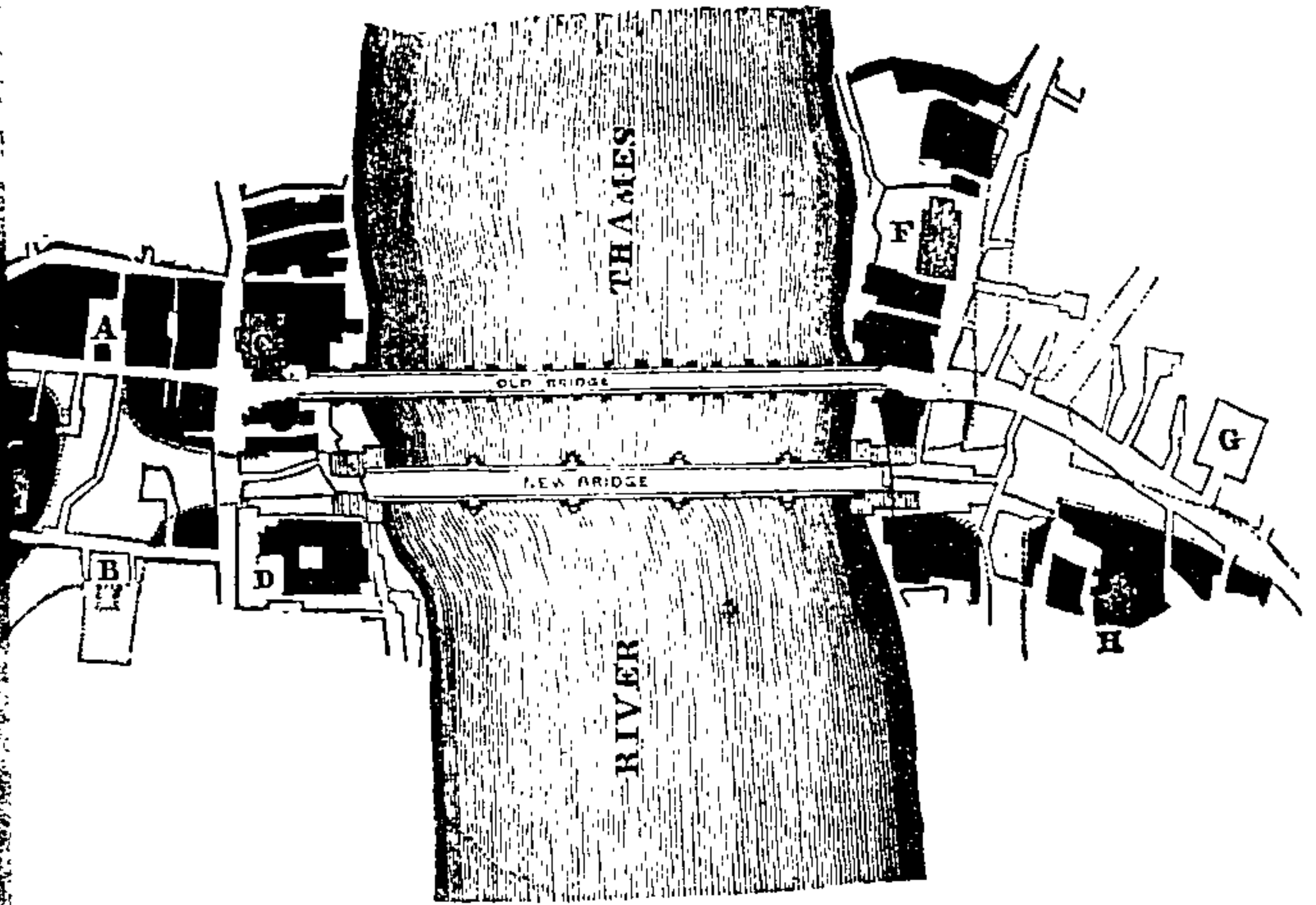


Fig. 2.

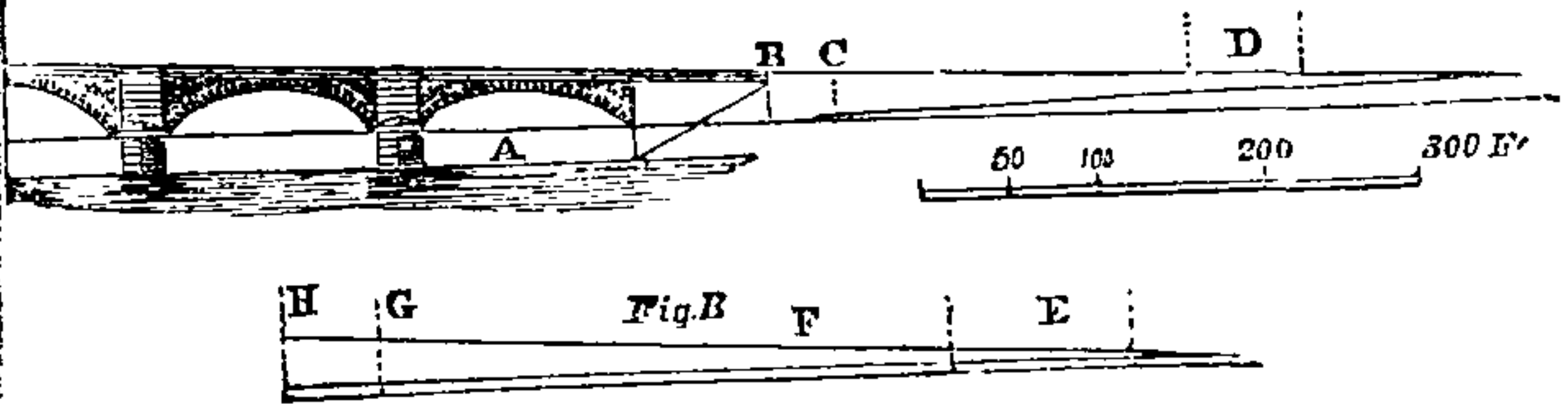
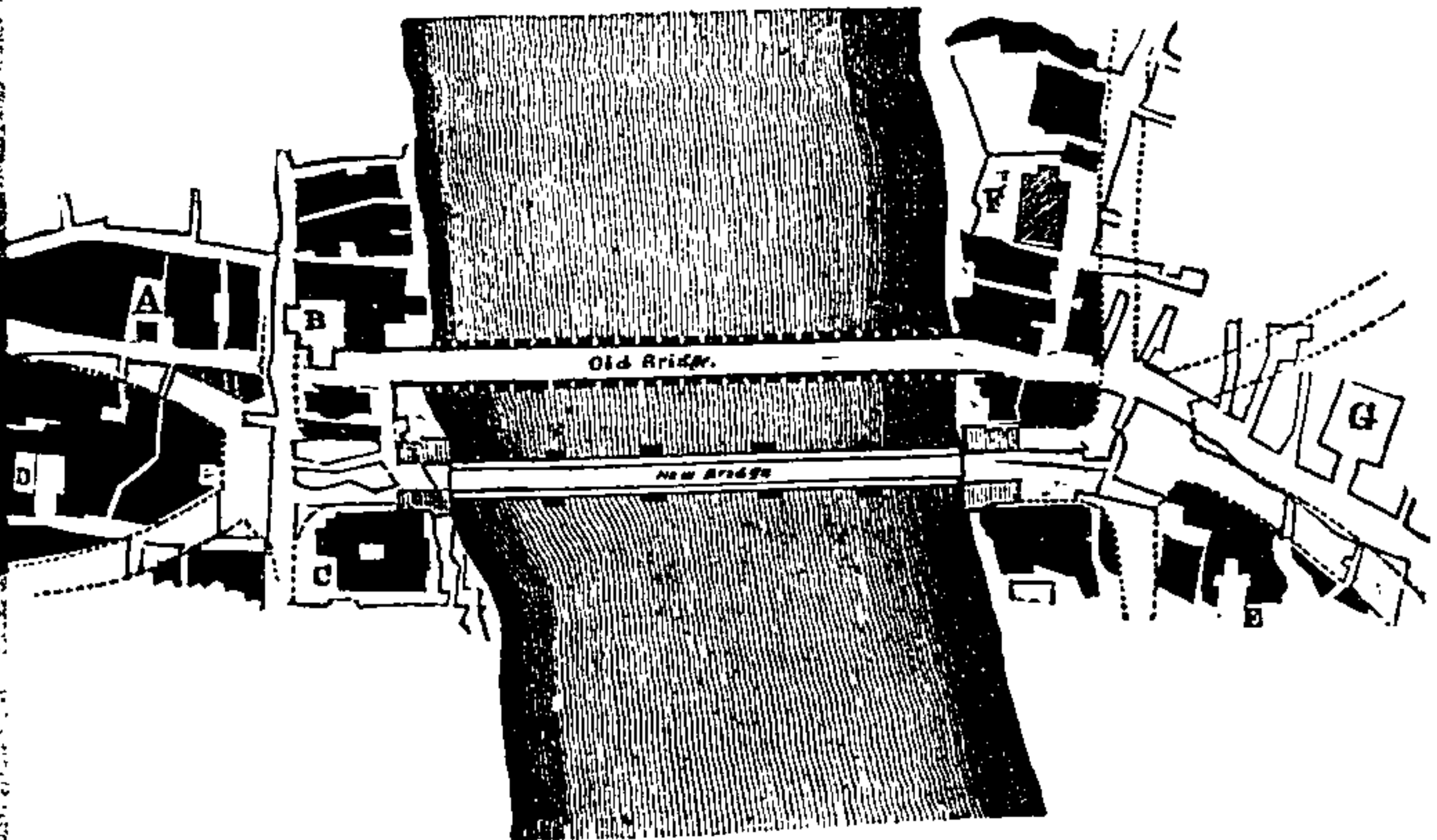


Fig. 3.



690 feet, at all times of the tide : which is 66 feet more than the old bridge afforded at high water mark.*

The length of the bridge, from the extremities of the abutments, is 928 feet ; within the abutments, 782 feet. The roadway is 53 feet between the parapets, being 8 feet wider than the old bridge, and 11 feet wider than any other bridge on the Thames. Of this width the footways occupy 9 feet each, and the carriage-way 35 feet.

The whole of the bridge, including the dry arches over Thames and Tooley Streets, is constructed of the very finest granite, selected from the quarries of Aberdeen, Heytor, and Penryn. The arches over which the approaches, on each side, are carried, with the exception of the two above mentioned, are built of brick. The total quantity of stone employed in the structure was about 120,000 tons. The raising and blasting at the quarries—the loading, removing, preparing, and setting of the stones,—along with other operations connected with the bridge, gave daily employment to upwards of 800 men, during the whole time the work was in progress.

The sum for which Messrs. Joliffe and Bankes contracted to construct the bridge and approaches was 426,000*l*. For widening the arches of the old bridge they were allowed the farther sum of 30,000*l*.; for extra centering, 8,000*l*.; and for making the bridge six feet wider than was originally intended, 42,000*l*. The building expenditure of the bridge itself, therefore, amounts at present to only 506,000*l*., and though (as usual) there are some claims for surplus-contract work, we are happy to learn they are not likely to swell this amount considerably.

No toll is in any event to be imposed on the bridge ; it is to be, like the old one, perfectly free. All the money required, either for the bridge itself or its approaches, has been furnished partly by the Corporation of London and partly by the country at large, in the shape of Treasury grants and of a duty of ten-pence

* The extent of the waterway of the old bridge has been much misrepresented. Hawksmoor, who made a personal survey of the river in the time of Wren, stated that the width above the starlings, at high-water, was only 450 feet, and below them at low-water 190 feet ; and this statement has been generally considered as correct by subsequent writers. But it appears from a survey, which was made, in 1824 by Mr. W. Knight, one of the assistant-engineers of the New London Bridge, that the actual width of the water-way in the former case was 524 feet, and in the latter 231 feet.

per chaldron, which the Corporation have been authorized to levy for twenty-six years on all coals entering the port of London.

A view of the new bridge in its complete state, taken from the top of St. Saviour's-church, on the Southwark side, will be found in Plate I.* Another view from the opposite shore is given in Plate IV; Fig. 1. Plate VI. presents a front view of the centre arch on a large scale; and Fig 3, Plate VIII. a geometrical elevation of the whole bridge.

The ceremony of opening the bridge to the public, took place on the 1st of August, 1831, and was distinguished by circumstances of unusual splendour:—the presence of the Sovereign and his Court,—a Royal Progress by water to and fro,—and a Banquet given on the bridge by the civic authorities to their illustrious visitors. Even Venice in her proudest days, when her Doges used to wed the sea with coronation pomp and circumstance, never exhibited a gayer pageant, than did the River Thames, on the day when William the Fourth went to proclaim the throwing open of the New London Bridge, to the free use of his people. In the course of the banquet which closed the ceremonies of the day, His Majesty took occasion to pass the following animated eulogium on the bridge and its founders:—"I cannot but refer on this occasion to the great work which has been accomplished by the citizens of London. The City of London has been renowned for its magnificent improvements, and we are commemorating a most extraordinary instance of their skill and talent. I shall propose the source from which this great improvement sprung,—'The Trade and Commerce of the City of London.'"

When Royal critics come upon the scene it is time for lesser critics to retire. We have already stated our own humble opinion of the bridge, and of the respective merits of the parties concerned in its erection; and we therefore, with the less reluctance, leave the citizens in quiet possession of whatever satisfaction they can derive from this assurance of their sovereign, that it is to "*their* extraordinary skill and talent" we owe this, equally with all the other "magnificent improvements," for which the City of London is renowned.†

* Copied, with some variations, from the *Observer* newspaper. For the sake of greater clearness, the old bridge has been left out of the landscape.

† One is almost tempted to think His Majesty in good earnest in this extraordinary compliment, when it is seen that but one title of honour has been

What the architectural character of the approaches to this noble structure may ultimately be, is still a matter of conjecture, mingled (spite of the "skill and talent" of the worthy citizens) with no small apprehension. Large spaces have been cleared at both ends, but how will they be occupied? Covered over again with mean or insignificant buildings? Or with edifices of suitable grandeur and elegance? The assistance of Mr. Smirke has been called in, and from his undoubted purity of taste (we wish we could add fertility of invention) much is to be hoped.

The main road into the City will, according to present appearances, take a winding direction, but not till it reaches a point, at which the bend will have rather a graceful than an injurious effect. And, as forward to that point, the old houses on both sides, and to a great extent backwards, have been cleared away, there is now a rectilineal space open, of length and breadth enough, to admit of great magnificence of effect being studied, in the style and arrangements of the buildings which may be erected upon it. The Monument, as matters at present stand, is fully exposed to view (see Plate XIII, which is a view of it as it appeared in June, 1831); and it is to be hoped that in any plan of building which may be adopted, care will be taken to keep it so. The erection of another Monument opposite to it, formed an excellent feature of one of Mr. Rennie's plans (Plate XI, Fig. 1), and we hope yet to see it realized.

Whatever the buildings may be, we shall at least have streets wide and well levelled; and few things are more to be prized in so thronged and busy a seat of commerce as London. The streets will be generally 70 feet wide, which is about double the width, of the old streets; and the ascent of the two principal ap-

conferred on this occasion, and that on an individual who has no other claim to the distinction, than what might arise from his being accidentally the re-official representative, of such "skill and talent" as that so wonderfully lauded. Why was not the architect of the bridge knighted? If not for his own merits (though these are not small) at least on account of the name he bears? What has John Key done, or his fathers before him, that can weigh heavier than *this* *thistledown* against the achievements of the Rennies, either father or son?

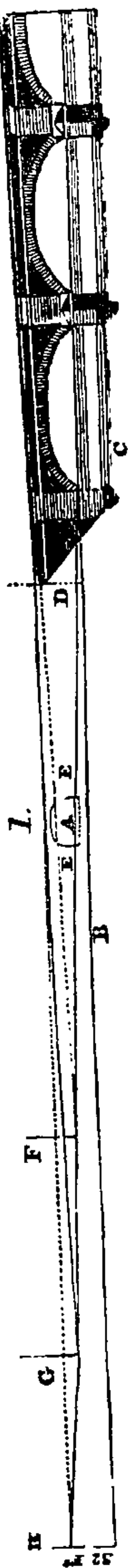
[Since the above note was written, a notification has appeared in the *Gazette*, that Mr. Rennie *has* been since knighted. We are glad to see it; but should have thought better of this mark of regard for *real* "skill and talent," had it been evinced a little earlier—only as early as the honour conferred on that *mock* sort of which the Lord Mayor was the chosen representative.

proaches not more than 1 in 30, which is also less by nearly one-half than the present rise of Old Fish Street Hill.

We must, of course, wait for the removal of the old bridge, before we can tell with certainty, what effects the greater waterway, afforded by the new bridge, will have on the river, and its banks. But even already, there are signs that the fears entertained on this head, are by no means visionary.

It will be recollected, that it was in order to compensate for the additional obstruction, arising from the coffer-dams employed in the erection of the new bridge, that two arches, on each side of the old bridge, were converted into one. Of course, now that these coffer-dams have been all removed, the river has the full advantage of the additional width which, this conversion gave to the ancient waterway. Now,—mark the result,—the fall, at the bridge, has been already reduced fifteen inches, and the water, at spring tides, rises two feet higher than it ever did before. If such an effect has been produced by so partial a diminution of the ancient dam, what may not be expected when it is reduced altogether? Even before the dam was lessened, it was unable to prevent high spring tides attaining an elevation above bridge, greater than the walls, on either side of the river, could withstand,—such a spring tide, for example, as that of the 28th December, 1821, when the whole of the up-country was so flooded, that boats were the only means of communication, where boats had never been seen before, time out of mind. We have no disposition to be alarmists; but we think the most sober-minded must be startled by such facts as these. We hope they will yet be well considered, before so powerful a river as the Thames is let *entirely* loose from its ancient bonds, on its low-laying and comparatively unprotected shores; peopled and occupied, as they have been, in the full confidence that as the river had been for centuries, so it would be allowed to remain.

“Raise your walls and fences,” has been the ready answer to all representation of danger from the occupiers of property on the river banks; but this, though an obvious plan of protection, is one which, to be effectual, must be universally adopted,—on both sides of the river, and in the case of every wall and fence on both sides; and it is quite vain to expect that any such universal plan could be accomplished through the spontaneous co-operation of individuals. Doubtless, if the



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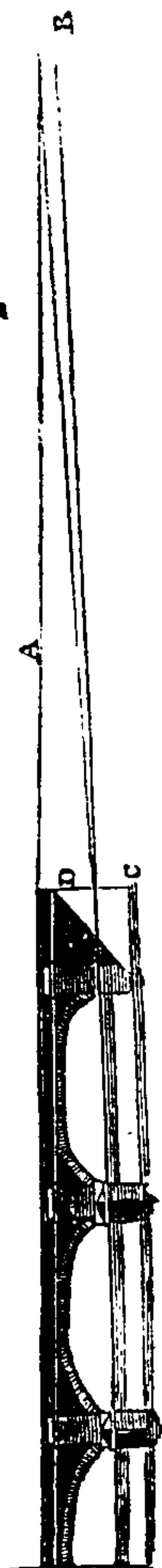


Fig. 3.



parties in jeopardy are left to take care of themselves, the walls and fences will, in the progress of time, be everywhere raised. But after how long a time? how many inroads of the river? and how much destruction of property?

We think the river-side proprietors might, with a great deal more reason say to the bridge destroyers, "If you will persist in removing that dam, which has been our protection for ages, the least we can expect from you is, that you will interpose some flood-gates between us and that tide of destruction with which you threaten to overwhelm us." The practicability of such a system of flood-gates, is a question which has been before discussed, and need not be here resumed.*

But the injury that may result from the danger in *the flow* of the tides constitutes, as we have seen, only one view of the case; that which is anticipated from the change in *the ebb*, is of scarcely less magnitude. The navigation suspended for an hour or two every tide; the foundations of all the other bridges over the river, and of many of the wharfs and houses on its banks undermined; the quantity of pestilential mud prodigiously increased;—such are a few of the consequences which we are taught to expect, will result from the scouring, or rather dredging, velocity given to the ebbing tide, and the entireness of the overflow at each ebb. And though these are effects which must, from their nature, be slow of demonstrating themselves, there are not wanting, even now, very sure indications of their approach. We have seen that, through the partial widening of the waterway of the old bridge, the scouring process has been already commenced,—nay, has gone on to a considerable extent; the fall has been lessened,—that is, the dam has been cut down, to *the extent of fifteen feet*.

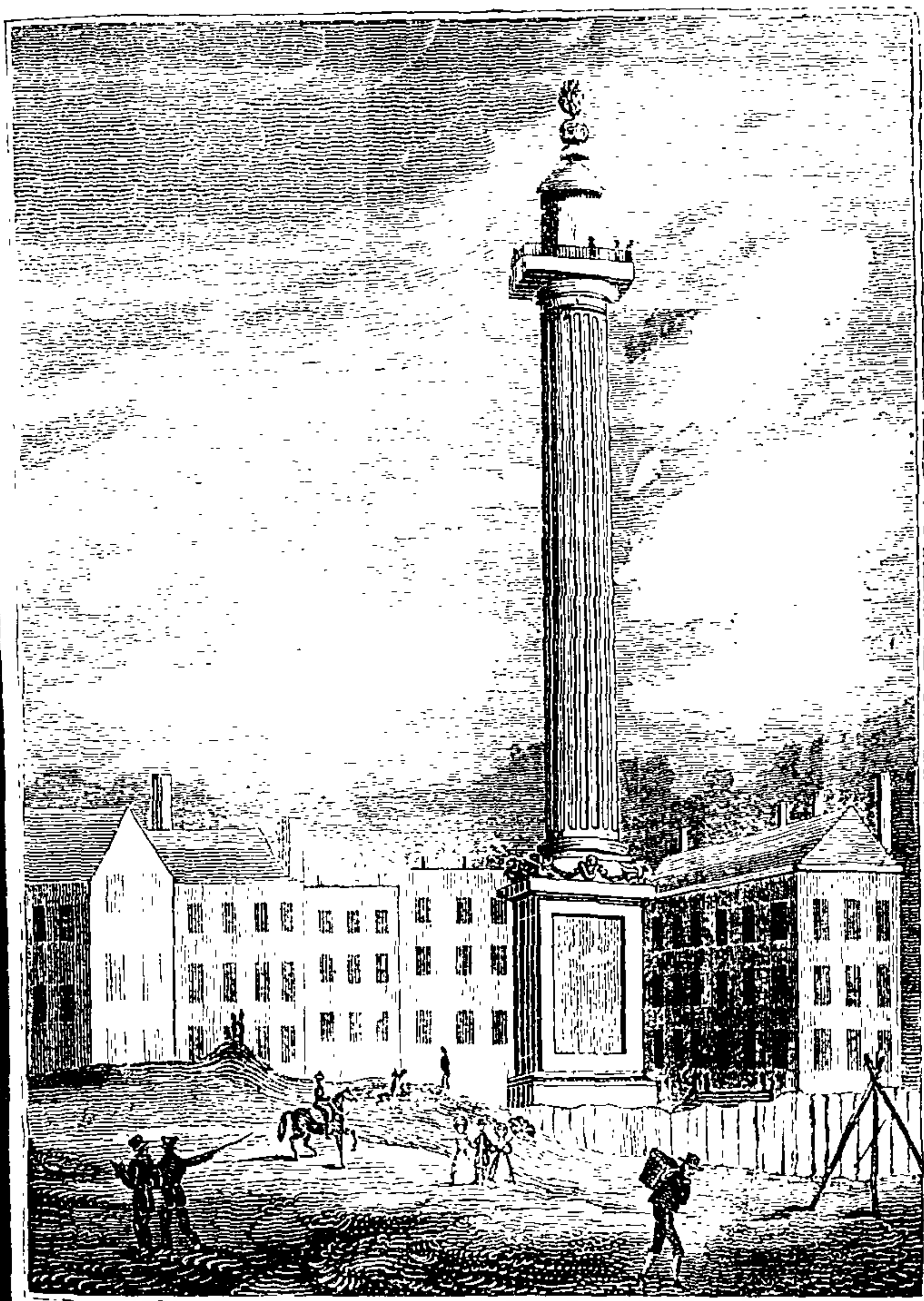
The trustees of Westminster Bridge seem to be the only parties duly sensible of the danger that is in the train of such changes; they are busy repairing its piers, and fortifying them,

* The following provisional hint seems deserving of attention:—"I have been thinking that, with a view to provide against the apprehended evils, it would be well, on pulling down the old bridge, *to leave five or six of the piers and starlings standing*, at nearly equal distances. Then, if it should be necessary to have sluice-gates below the new bridge, there would be, at least, *some piers ready*, with a little chipping, and paring, and facing, as a substantial basis for the work. To prevent mischief at night, they might be suitably lighted; and, in the day-time, they would occasion no harm.—*Mr. Isaac Sumner, Mech. Mag.* vol. xii. p. 453.

by every means which art can suggest. The fate of Blackfriars Bridge, we presume, is sealed ; it has been long, and is still, so shamefully neglected, though going fast to ruin, that one might almost conclude there are none to care for it. Want of funds is the excuse :

“ They answer, in a joint and corporate voice,
That now they are at fall, want treasure, cannot
Do what they would.”—

Strange end and upshot of civic economy ! They lack the few thousands which are required to uphold a bridge, which is an honour to their City, and free from every objection, on the score either of antiquity or inconvenience ; and yet spend a couple of millions on a new bridge, for which, admirable though it be as a work of art, there was neither pressing occasion nor reasonable pretext.



A Professional survey of the old and new London Bridges and their approaches, including historical memorials of both structures : with remarks on the probable effects of the changes in progress on the navigation of the Thames : with a portrait of the late John Rennie. M. Salmon, 1831. The Making of the Modern World, https://link.gale.com/apps/doc/U0109209370/MOME?u=bham_uk&sid=MOME&xid=3de24b42. Accessed 19 Nov. 2020.