
"THE BOASTFUL EDITOR OF A SECOND-RATE SOCIETY PAPER."

people trouble about me, so I can sit and study human nature at my ease ; and I am not sure that I don't get more pleasure than most people out of the comings and goings, the manners and customs, the quips, cranks, and humours generally of life in a big hotel.

## THE TOWER BRIDGE.

BY HENRY FRITH, AUTHOR OF "THE ROMANCE OF ENGINEERING," ETC. ETC.

AS one pauses upon London Bridge or saunters upon Tower Hill the most prominent object in the middle distance is the wondrous Bridge which was opened to the public on the 30th of June last.

The Tower Bridge has occupied about eight years in construction, and altogether ten in incubation, for it was in 1884 that the Bill of the Corporation was brought before the Committee of the House of Lords, and was so vehemently opposed by wharf-owners and traders, upon the plea of interference with the Thames traffic.

Whether it interferes with it we shall presently see ; but leaving that question for the moment there is no doubt of the advantages it confers upon the road traffic, and the boon and blessing it is to land-carriers. Fortunately, therefore, the arguments of the water-side opponents were overcome, the Corporation persevered, and have now expended nearly a million sterling upon the bridge.

There is the result! Look at this "bascule" from the Surrey side, and confess that it is a magnificent achievement. Solid, handsome, useful, it combines attributes which are not generally present in engineering monuments. Utility, not beauty, is usually the aim of the engineer, who is nothing if not practical, but Mr. Wolfe Barry, who with the late Sir Horace Jones designed the structure, has contrived to give London a strikingly pleasing bridge, the largest of its kind in the world.

Independently of its utility, it affords to the ordinary pedestrian a delightful panorama. As we halt on London Bridge we admire the busy scene upon the river but when we saunter over the upper roadway of the Tower Bridge we obtain a view of London, its life and its monuments, its traffic and its commerce, which no other coign of vantage can provide. St. Paul's and the Monument can give us satisfaction for our outlay ; but the Tower Bridge surpasses them in its situation, and excels them in the variety of the scenes it presents so widely yet so nearly —so near and yet so far.

Take what the late Richard Doyle would have termed "a Bird's Eye View of Society" from the platform, watch the river-traffic beneath and "below" the bridge, traffic above it and beyond, the old legend-and ivy-clad Tower, the Pool, Horselydown, and the Surrey side so celebrated by Dickens. Gaze your fill upon the prospect, which save for the "Betterment" bogie would not fail to please on both sides, and then ask your conductor in astonishment—"How can this

thing be? How has this bridge arisen? Who made it? How was it built? What has it cost? and what uses does it fulfil?" He could reply to the last question in one word—"*Circumspice!*"

Let us then "look around" and find out the satisfactory answer to these several questions, many though they be, and each one capable of expansion into others, as the conjurer's box is found to contain within it many smaller boxes ere we reach the desired object.

In the first place, the Tower Bridge is a "bascule" bridge, and is so called because the centre spans open upwards upon a horizontal axis and do not "swing" upon the ordinary vertical axis. There are other such structures, one which we have seen in Copenhagen is a fine specimen, but its water-span is only about one-fourth the extent of our Tower Bridge, the span of which measures two hundred feet. The "leaves" are of course one hundred feet each in length, and they were lowered for the first time upon the 27th of March, 1894.

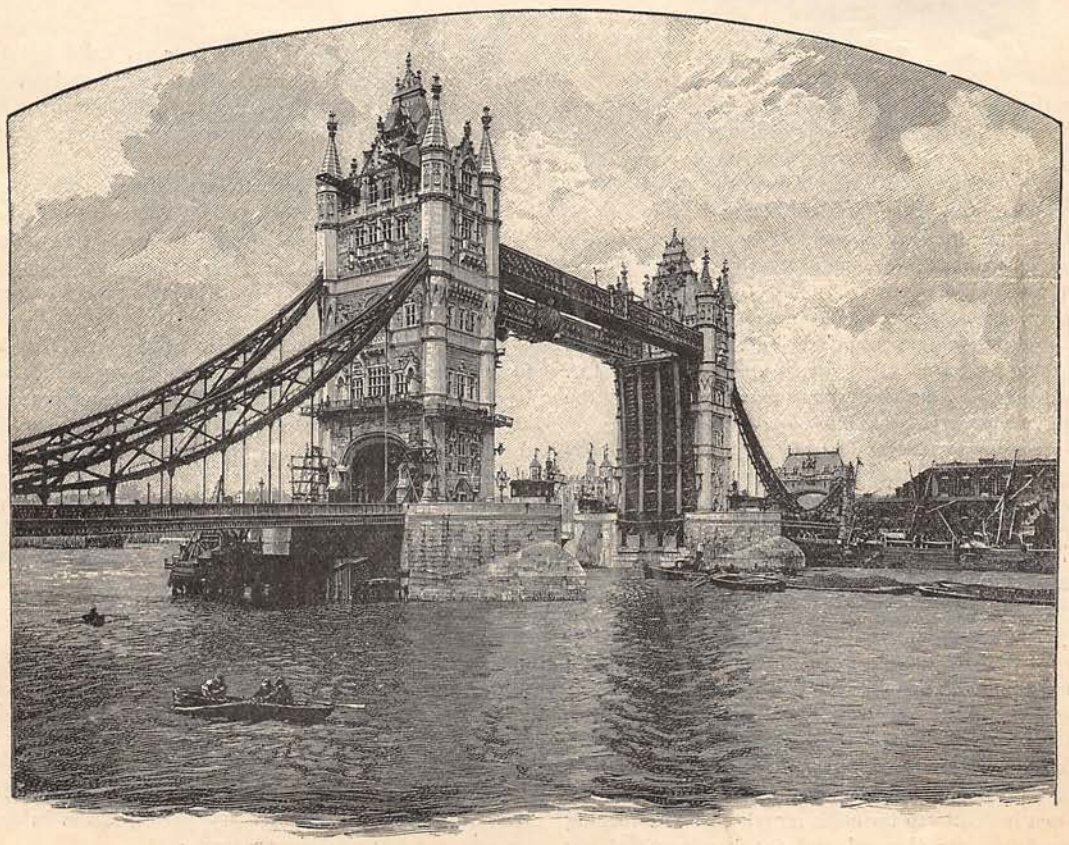
This is a date to be remembered. Chronicles of London Bridge assure us that for upwards of ten hundred years the "name-bridge" of the metropolis of our country has been the great viaduct for passengers and traffic into the city, and this is now relieved by the most modern structure of the kind.

The Tower Bridge is composed of steel. If anyone be inclined to question its metal let him look within the masonry towers, which are so very conspicuous, and he will find that the bridge is practically of steel, combining the bascule and suspension principles, illustrated in the centre and side-spans, respectively. We may now give the dimensions.

The length of the bridge, and its abutments, is nine hundred and forty feet. Of this span the centre leaves demand two hundred feet. The side spans claim two hundred and seventy feet apiece, the piers account for the remainder of the width. So, practically, only about seven hundred and forty feet of water are available across stream, and the cost may roughly, but insufficiently, be remembered by allowing one thousand pounds sterling for each foot span of the bridge.

The first section which claims our attention is undoubtedly the centre span; the draw-bridge, we may term it. The leaves, which fit accurately, are moved vertically by hydraulic machinery, and the short section, or arm, of the "leaf" is accommodated in its own pier, within a chamber made for its reception, while the long arms are sustained against the lofty towers, which rise two hundred and ninety-three feet from base to summit. The actual portion disclosed is less by twenty-six feet of foundation, plus the portion under water varying with the state of the tide.

The height of the "roadway-leaves" above stream when lowered is about thirty feet at high water, and



THE TOWER BRIDGE, FROM THE SURREY SIDE.

BUTTRESS, SUSPENSION CHAINS, AND TOWERS.

when the draw-bridges are raised, of one hundred and forty feet. To this elevation the pedestrian may rise and contemplate the moving panorama below him, and almost touch the "trucks" of the masts which glide beneath his feet—high above the vessel's deck.

This upper footway is reached by lifts which each carry eighteen persons, and occupy one minute in the ascent to the upper air. The "high-level" road is composed of four cantilevers supporting a girder one hundred and twenty feet long. The footpaths (this is only a footway, of course) are twelve feet wide. The cantilevers project ninety-five feet beyond the columns, and two sustain each footpath.

We may now descend again and see the draw-bridges raised by the hydraulic motors which, by pinion and sector arrangements, pull up the leaves. There was at one time a hint thrown out, of the possible danger to traffic crossing the bridge when the leaves had to be raised.

But at busy times the road traffic may be temporarily delayed for twenty minutes—the estimated longest time for the passage of ships—in succession—and in ordinary times five minutes. When the movement is desired the machinery itself precludes any opening until the traffic is off the centre-span—thus :—

There are four accumulators upon the piers, with a small "leading" accumulator in the engine-house. The last indicates to the engineer whether the working accumulators are charged, and *the leaves cannot rise until they are full.* Moreover, chains fixed by the police on duty are stretched across the roadway to stop traffic, and, until these are fixed, and held by the hydraulic machinery, the engineer cannot raise the leaves.

There is, of course, some expenditure connected with the working of the bridge, and this is estimated at £1,600 a year. But there is no allowance for wear and tear, so this estimate is likely to be greatly exceeded, and may reach £3,000 a year. The actual cost remains to be ascertained.

Let us now penetrate under water, and see the foundations of the handsome structure upon which we have already spent some time. The centre piers will at once demand our attention, for upon them depends the structure—the bascule structure of the bridge.

Necessarily, the most exact and mathematical care had to be exercised to ensure uniformity of foundation level. The smallest deviation would prevent the exact meeting and uniting of the twin leaves, for into the piers the "short arms" fall when the leaves are raised; and the untoward fall of the leaf would be a serious and most melancholy occurrence.

To the most minute calculations, the weight and settling capability of bridge and soil, the engineer had to address himself. Four tons upon the square foot is no small pressure, but this is the allowance, and the "foundation area" is 100 feet by 204½ feet for each pier. But this is not excessive, as the engineer, Mr. Barry, has already stated that Charing Cross bridge presses seven tons to the square foot.

Caissons were employed in the usual manner, filled in with Portland cement, concrete, and granite and masonry upwards. Each pier is seventy feet wide and one hundred and eighty five feet long, being hollowed to admit the bascule and the hydraulic machinery. These piers sustain the towers already mentioned.*

The abutment towers do not demand any special attention, though the design of these structures adds to the imposing nature of the approaches.

The suspension bridge arrangements are not of the ordinary character. The terminal towers are about 183 feet high from base (foundation) to the battlemented summit—not the top of the roof, which is extremely elevated and sloping. But the chains which hold the side spans are of a rather uncommon design. The ordinary system, observable at Clifton and on other suspension bridges is the "flat bar and rivets." In the Tower Bridge each chain consists of two segments of steel. The ties are normal.

Having now mentioned the chief technical points in the construction we can turn to the uses of the bridge—and its uses no one can deny. The traffic over London Bridge is so enormous, and the gradients but if the way be not considerable the means are. The gradients are steep in the Borough, and when the proper approaches have been made upon the Surrey side, the Tower viaduct will possess all the advantages which were originally claimed for it.

The caissons were commenced in September, 1886, the piers were finished in January, 1890. There are 14,000 tons of iron and steel in the super-structure, and the total cost is £830,000! One very important item in the engineering is the "wind pressure." We all recollect and deplore the fate of the first Tay Bridge across that Firth, and with a view to obviate any chances of failure from storm or hurricane, the Tower Bridge is constructed to sustain a pressure of fifty-six pounds to the square foot. An enormous margin! The ill-fated Tay Bridge succumbed at a far less pressure, and as Sir B. Baker remarked to the committee the ordinary gasometer can only resist eighteen pounds to the foot, and traffic was stopped in the Forth at sixteen and a half pounds' pressure.

Under the circumstances, then, London, thanks to the Corporation, may congratulate herself that she possesses such a bridge. The security of the revenues of

BUTTRESS ON THE SURREY SIDE.

of Southwark Bridge so great that time, horses, and much money are daily expended in the struggle. The distance saved by the new bridge is not important, the Bridge Estates—the proceeds of the property granted to maintain the London Bridge—have supplied the funds. The ratepayers are not taxed, and Londoners may hope for a proper approach to this magnificent monument of civic enterprise.

* For details see Mr. Crutwell's paper in "Proceedings of the Institution of Civil Engineers."—Vol. 113.