the river this great height is not required, and the piers have, therefore, been kept much lower, the *top* of the spans in this part being level with the *bottom* of the large ones, and the rails being laid on cross sleepers resting on top of the girders. In this manner the roadway forms an unbroken line, while there seems to be a step in the girders.

On the Dundee side the line has to pass the town underground. To reach it the line must come down in time from its lofty position, and an incline of one foot, in every seventy-three of length, is, therefore, introduced in the part north of the large spans. The length of the spans on this part varies from 162 feet to 69 feet, and quite near the shore a large span of 170 feet is constructed, with a view of offering facilities for a future extension of the esplanade, which would necessitate the construction of a roadway under this span. For the same purpose it is built on the "bow-and-string" principle, and the rails kept at the bottom. Parallel girders, like those of the large spans, might, of course, have been used; but what is no disfigurement when carried out over a great length would look very bad indeed if applied to a single span. Now the curved top-boom makes the transition an easy one. The last six spans on the Dundee side, so far as they belong to the Tay Bridge contract, are short ones, being only 27 feet long. Three more of these, and a "bowstring" of 100 feet, complete the iron part of the bridge, bringing the total length to 10,612 feet, or two miles and fifty feet. On the south side the same reasons for constructing a strong incline did not exist. As the land at the south shore is about 70 feet above high water, an easy slope of one foot in three hundred and sixty-five was sufficient to bring the line to the required level. The spans on that side are mostly 145 feet and 130 feet in length. There are only two of 88 ft. and three of 67 ft. near the shore. To complete the general description of the bridge, it will only be necessary to mention that, in order to join the land portions of the line, a long curve had to be introduced on the north side extending over nearly a quarter of a circle, and one of less length on the south side; giving the bridge in plan the appearance of a gigantic **S**. From the shore the curves, especially the one on the Dundee side, appear to be very sharp, but in reality they are not, both having a radius of twenty chains, while on other lines curves of eight chains are frequently met with. Let us look at the means which were employed to construct this, the longest bridge in the world. Quite in the beginning Mr. Austin, another of Mr. de Bergue's managers, laid down a principle which was of the greatest bearing on the success of the work. It was to dispense with the staging and scaffolding which are generally used in bridge building. The piers and girders were to be erected on shore, and floated out to their destination. The consistency with which this principle was carried out would distinguish this bridge from all other structures of the same kind, even if its size and importance were less remarkable. No matter of what material the parts were constructed, whether they were iron receptacles for concrete, huge lumps of brickwork, weighing above 200 tons, or iron girders of 190 tons, they were all finished on shore and floated to their destination. During the execution the details had frequently to be modified to suit the altered circumstances, but the principle was adhered to as the only one which could produce good results in a tidal river subject to such vicissitudes, and with a continually shifting sandy bottom.

The pieces of iron forming the girders or spans were erected and riveted together on a staging near the shore, and connected with it by a gangway. Some of these pieces as they arrived from the contractors' works, at Middlesborough, were 35 feet long, and weighed three tons. Each span had four horizontal pieces or booms, two at the top and two at the bottom, and four vertical posts at the ends. Nine crosses, consisting of struts and tie bars, keep the booms at the proper distance and transmit the strains to the ends where the span is supported by the piers. The two girders of each of the 245 feet spans are 15 feet apart, their depth is 27 feet, and their weight 190 tons. To erect and rivet them on the staging required four weeks, no fewer than 18,000 rivets having to be put in each. According to one of the contractors, the materials used in the construction of the bridge comprised 3,500 tons of wrought iron, 3,700 tons of cast iron, 8,700 cubic feet of timber, 15,000 casks of cement, and 10,000,000 bricks.

Many theories have been advanced as to the cause of the fall of this bridge, which was regarded with pride and admiration as one of the great works raised by British engineers—whose works have, heretofore, been alike remarkable for the boldness of their conception and the stability of their construction. Among the theories advanced is one, in which the writer concludes that the bridge was well nigh conquered by the wind, when the advancing train offered to the wind an additional resistance, which turned the scale.

The central portion of the bridge consisted of thirteen spans—these spans consisted of what are spoken of as the *great* girders. The total number of spans were eighty-four. Thirteen of these spans went down. These thirteen central girders were raised above the level of the others, so that the rails, which ran level with the lower booms of the lower girders, were laid on a level with the lower booms of the great girders, therefore, a train, when travelling across the bridge, it appears, ran literally on the top of the structure for the first and last portions of its journey; but in crossing the thirteen central spans, it ran through a sort of *cage or tunnel of lattice work*. This the writer considers important to be borne in mind, because a theory has been started to the effect that the force of the wind blew the train off the rails, and so caused the destruction of the bridge, which he considers untenable, first, because there is, or rather was, a double guard rail right across the bridge, and secondly, because the train traversed in safety the portion of the bridge where, being on the top of the lower girders, it was exposed to the full fury of the gale.

Furthermore, the writer considers that the inquiry will, if fully carried in that direction, show that the stability of the train was greater than that of the bridge; or, in other words, that it would have required a greater force of wind to overturn the train than to upset the bridge. Taking the first of the great girders from the south end, we find that it was 227 feet in span. Next came eleven spans of 245 feet each, and then one of 227 feet. This gives a total length of 3,149 feet for the elevated portion of the bridge. The whole of this has gone into the river beneath. From the accounts of eye-witnesses, and also from the researches of the divers, it is known beyond all doubt that the train had passed com-