RAILWAY BRIDGE OVER THE GANGES AT CAWNPORE.

PLATE LXXX.

The figures on Plate LXXX, show elevations and sections of the wrought-iron trussed girder bridge now (1872) in course of erection across the river Ganges for the Cawnpore branch of the Oude and Rohilkund Railway. Considerable interest attaches to this structure, insomuch as it is the first bridge built across that river, which is prominent alike in the religion and the geography of the East. It is true that there is at present a bridge of boats at Cawnpore, by which the passage of the river is effected, but it is both unsafe and inadequate to the demands made upon it by traffic. An additional interest perhaps arises from the vicinity of the new bridge to the scene of one of the worst phases of the Indian mutiny. The structure consists of twenty-five river spans of 100 ft. each, and two land spans of 41 ft. each. The roadway is 9 ft. wide, and is carried on the bottom flanges of the main girders, which are braced together both at bottom and top, so as to form in effect an open box girder. On the top of this girder is carried a single line of railway, the platform being here carried out on each side about 3 ft. beyond the main girders, giving a width of 16 ft. between the hand-rails.

The course followed in erecting the bridge was to put the girders together on the Cawnpore bank of the river on roller bearings, and to move them bodily over on the piers into position. The girders are each 110 ft. long, and they are connected end to end in pairs, so that they are continuous over two spans. One pair of these girders having been built up and connected, they were carried on rollers over the piers to the opposite side of the river, so as to cover two spans. When the next pair were erected they were conveyed into position by the same means, and so on until the last girder was placed. This method of erection was rendered necessary from difficulties which lay in the way of building scaffolding out in the stream. We may also further observe that the reason why the work of construction was not to be carried on from both ends simultaneously is, that there are no facilities on the further bank of the river for that purpose. The railway works, too, would be retarded at both ends of the bridge instead of at one end only, which is unnecessary, besides which the material would have to be transported over the river, whilst by the arrangement adopted the ironwork was received at the erecting shops from off the railway direct.

In some experiments, conducted in October, 1870, at the works of Messrs. Campbell, Johnstone, and Co., one pair of girders put together were traversed for nearly the length of one-half span with perfect facility. The total length of the two girders was 220 ft., the depth 10 ft. 8 in., the breadth over the flanges 12 ft., and the weight of metal in them 142 tons. At first these girders were resting on timber supports, the roller bearings being placed at a distance of 110 ft. from each other. Each of these bearings consisted of a grooved pulley wheel, 18 in. in diameter, carried on the head of an hydraulic ram. On the shaft of the pulley wheel was fixed a worm wheel, which was actuated by a worm on a spindle set at right angles to the pulley shaft. Motion was given to the worm shaft by a projecting lever, which connected with the worm shaft by a ratchet arrangement. Thus as the lever was worked up and down the pulley rotated, and carried the girders forward for a given distance. There were ten of these hydraulic machines used on each pier, five on each side, forming a half set, which were connected together temporarily at their bases, whilst the five levers were attached to a handle worked by the men exactly in the same manner as manual fire engines. This method of working was, however, superseded by a hand wheel arrangement, whereby the travel of the girder could be made continuous instead of being intermittent. The total weight of the double girder being 140 tons, this weight, divided between the twenty rams, gives a burden of 7 tons to each ram to support. This is much less than half the weight each ram is calculated to carry, as they are provided with safety valves loaded to 18 tons. If, therefore, that pressure should, from any cause, be exceeded in any one ram, it would at once give out, and the weight would be distributed over the remaining rams. On the under side of the flange of each of the main girders is a rail rolled in one with the lower plate, and which takes into the grooved pulleys. At starting the hydraulic pumps were set to work, and the girders were raised sufficiently to admit of the timber intermediate supports being knocked away. The operation of moving the girders forwards was then commenced by five men working at each group of five roller bearings which were placed towards the front of the work. The rollers to the rearward were not worked, merely acting as guides, and carrying the rear portion of the girders. The