other into a cast-iron yoke, and in every case the end fastened in the socket was the first to give way. The result was entirely in favour of the yoke. The yoke is simply an elongated eccentric (Figs. 7 and 9, Plate LX.), the least diameter of which is about twice the circumference of the rope, and the length about three times the diameter (i.e. 16 in. x 48 in.). There are two holes at the upper enlarged end—one of which is cylindrical, and of the same size as the rope; the other conical, into which the end is fastened. The rope is passed through the cylindrical hole, then round the eccentric in a hollow groove, and then fastened in the usual manner in the conical socket.

It may be interesting to know how this was done. The end of the rope being in the first place pulled 6 in. through and above the conical hole, every strand and single wire was opened out and arranged, so that from 1½ to 2 in. of each wire could be bent and doubled quite back, and inwards to the centre. This done, power was applied to pull the end by main force, aided by pounding with a wooden maul back into the socket, leaving the end flush with the top. Iron points—some long, some short—were then driven in between the wires until the socket was quite full, and made to ring like a piece of solid metal. Lastly, the top was sealed as a protection against the weather.

The point of attachment being eccentric, and near to one side of the yoke, falls directly in line with the rope, as soon as it is submitted to strain. The eye of the yoke is slotted to allow of a movement of 6 in. for adjusting the rope. It is obvious, from mechanical considerations, that if the fastening in this socket is only 25 per cent. of the strength of the rope, the rope must fairly be broken before the fastening will give way. But since fully 96¼ per cent. can be counted on, as decided by the Birkenhead test, it is quite impossible for the fastening to yield before the rope breaks, and therefore, by adopting this plan, the full strength of the rope can be relied upon. For suspension bridges more especially, the importance of this device cannot be overrated. The ropes were adjusted in the centre with great facility by means of the slot, and with perfect confidence in the unyielding nature of the fastenings at either end.

At the anchorage the ropes are connected with the underground anchor chains, by means of adjusting links of 4 ft., 8½ ft., and 13 ft. in length, of an uniform section of 6 in. x 1 in. (Fig. 8). Three of the yokes are in the direct line of tension, two are thrown down, and two up, in order that all the ropes may be gathered into cable form, and clamped as near as possible to the point of attachment. The sectional area of the two cables is 37.8 square inches; that of the anchor chains 84 square inches. The aggregate force, or ultimate strength of both cables is 121 x 14 = 1624 tons; that of the anchor chains 84 x 32 = 2688 tons net.

The ropes used for making the cables were manufactured by Messrs. R. S. Newall and Co., of Gateshead-on-Tyne, from wires drawn by Messrs. Richard Johnson and Nephew, of Manchester. As before stated, the wires were made by a new process, and were of sufficient length (1910 ft.) for making the ropes without weld, joint, or splice. The rods were rolled from billets by one operation in less than a minute. Billets weighing 140 lb., 15 ft. long and 1½ in. square, were heated to a white heat in a gas furnace, and passed through a series of rollers set close to the furnace, until they were gradually reduced to rods of No. 3 Birmingham wire gauge. One end of the billet was in the furnace while the other was being wound upon the reel. The rods were then drawn through three holes down to the required size—0.155 in. diameter.

As they were required to bear a tensile strain of 100,000 lb. to the square inch before breaking, tests were made from time to time as they were run off, and a daily register kept of the results, and forwarded to the engineer. By this register it appears that while a few of the wires fell short of the specified strength, nearly all of them exceeded it. Many of them were drawn to so high a degree of tension as 120,000 lb., as determined by direct weights and lever power, while by the hydraulic test it was much greater.

The Stays.—Apart from their important functions of stiffening the roadway, and preventing undulations and oscillations, the stays are a real support to the bridge. They form, as it were, two rigid and powerful brackets extending out from either shore, and carry one-half their weight, and one-half its distributed load. While they relieve the cables of half their duty, the two systems are so arranged as to work in harmony, the primary object of the construction being to combine these two independent systems so as to make them act in concert the moment a load comes upon the bridge.

There are twelve stays on each quarter, forty-eight in all, reaching half-way to the centre, and supporting one half of the suspended roadway. They are carried back to the anchorage, and secured there in the same manner as the cables, and to the same anchors, save as regards the means of adjustment, which for the stays is effected at the other end by means of a nut and screw (Fig. 1, Plate LX.). The longest stay is tangential to the curve of the cable at the point of suspension. The rest fall within this angle, and are attached to the platform at intervals of 25 ft. They are of various sizes according to position, and the strain they have to bear. The three outermost stays are made of 4½ in. rope of 45 tons ultimate strength, the next six of 3½ in. rope, and twenty-five tons strength, and