the last three of 3 in. rope of eighteen tons strength. The whole of the twelve ropes, on each quarter, are united with seven landward ropes that are bound up in one cable, and reach from the anchorage to the towers, over which they are carried by a saddle and rollers independently of the cables (Figs. 5 and 6). The three longest ropes pass over the towers unbroken from the anchorage to the suspended roadway—the next six ropes are yoked or coupled to three of the largest ropes on the river side of the towers—and the last three are joined to one of the largest ropes on the same side. The cast-iron yoke is used at both ends of the stays. The aggregate strength of the whole assemblage of stays, forty-eight in number, is 1344 tons net. By the resolution of forces this affords 628½ tons of vertical lifting power.

Riverward the stays pass in direct lines from the saddles to the roadway, down the inclined plane formed by the suspenders, and are seized to them at the crossings. Landward they are stayed to the cables, and, since contraction and expansion under the varying changes of temperature must affect them equally, they must always preserve their same relative position, and always bear the same share of the load.

The mechanical advantage of employing stays in this manner, within the tangent to the curve of the cables, is obvious, and the economy of the arrangement is conspicuous. One hundred and twenty tons of wire ropes were used in forming the cables, and only 25 tons in making the stays, both carrying an equal load. One ton of stays is equal in effect to nearly five tons of cable.

Four stay braces of 3 in. rope are placed horizontally between the cables, binding them together above the roadway to keep them from swaying about, and four bridle stays are attached to the cables, extending from the rock at the base of the tower to a distance of 110 ft. out upon the cables, serving to check vibrations under a moving load.

The Suspenders.—The suspenders are made of wire rope 2½ in. in diameter, 2 in. in circumference, and 10 tons ultimate strength. Being placed 5 ft. apart, there are 480 suspenders, of 4800 tons aggregate strength, which is more than ten times the load they have to sustain. The ends are "crowned" in wrought-iron sockets, connecting above to cable bands, and below to the tension bolts that pass through the floor beams, and hold up the bridge. Towards the middle of the bridge, where the suspenders are short (all of less than 12 ft. in length), they are made of solid rods of Lowmoor iron, ¾ in. in diameter. All the tension bolts are terminated by a screw, 6 in. long, to admit of adjustment (Fig. 2, Plate LXI.).

The Guys.—The overfloor stays, by virtue of their inclined position, have a very good effect in preventing any lateral movement in the suspended roadway, but the underfloor guys offer a more direct resistance to it. They check both the vertical and transverse motion. As far as both stays and guys reach, that is, half-way to the centre, there is little or no vibration. Beyond this the guys alone extend two-thirds of the way to the centre, and, owing to their great length, there must necessarily be some movement, but it is limited to the expansion of the material from changes of temperature, and the sagging of the rope under its different degrees of strain. Within these limits the wind can sway the platform, but it can do no harm.

The number of guys now attached is fifty-four. Of these twenty-eight are on the up-stream, and twenty-six on the down-stream side, the wind being stronger down than up the river. Some go out horizontally to the top of the cliff, some go down vertically, but the greater number occupy an inclined position, reaching down to large boulders embedded in the slope of the bank.

These guys are made of the same size rope as that used for the suspenders, and are attached to the chords by ring-bolts, as shown in Fig. 1, Plate LXI. Altogether they contain a reserve power of 540 tons, and offer a resistance of 260 tons to the force of the wind whichever way it blows; and yet, to all appearance, they are mere gossamer threads, scarcely visible to the naked eye. (See perspective view, Plate LXII.)

The ropes used for the stays, suspenders, and guys were manufactured by the Queen's Ferry Wire Rope Company from wires drawn by Messrs. Rylands Brothers of Warrington. They were drawn from the same kind of material as that used for the cables, and both at Birkenhead and at Niagara Falls bore tests that were perfectly satisfactory.

The Towers.—On each side of the river are twin towers, constructed of white pine of superior quality. Each tower presents the outline of a truncated pyramid, 28 ft. square at the base and 4 ft. square at the top. They are placed 13 ft. apart at the base, and the roadway passes between them. They are 105 ft. high on the Canada side, and 100 ft. on the New York side, and each is built up of four timbers, 12 in. x 12 in., in each corner of the pyramid, with a space of 1 in. between the timbers for ventilation, through which the connecting bolts pass. Horizontal girths 9 in. x 12 in. bind them together at every 10 ft. in height, and above the roadway these girths extend all across, binding the two pyramids together into one tower. A series of heavy diagonal braces on all four sides, combined with the girths and bolted together, serve to keep the posts fairly in line, and prevent any lateral bending or vibration. The lower ends of these timbers are stopped into cast-iron shoes, having cells for the reception of each post. The shoes are set in the solid rock in beds cut out fairly to receive them at right angles to the direction of the post.

The sixteen posts of each tower all come together at the top, where they are crowned by a heavy cast-iron cap,