THE NEW KNIPPELS BRIDGE AT COPENHAGEN.

BY OUR ENGLISH CORRESPONDENT.

Improved facilities for communication between Copenhagen and its suburb of Christianshavn on the island of Armager, which is divided from the city by the harbor channel, have recently been provided by the construction of a handsome new bridge of the bascule type. The present structure offers an interesting and convincing example of the possibility of carrying out a bascule bridge upon ornamental lines. In the preparation of the designs, due regard was given to the picturesque character of the neighboring buildings, with which the new bridge is in pleasing harmony. The bridge was constructed under the supervision of Mr. H. C. V. Moller, the chief engineer to the Harbor Board of Copenhagen, to whose courtesy we are indebted for the accompanying illustrations and particulars contained in this article. It was completed and opened for traffic at the end of 1908.

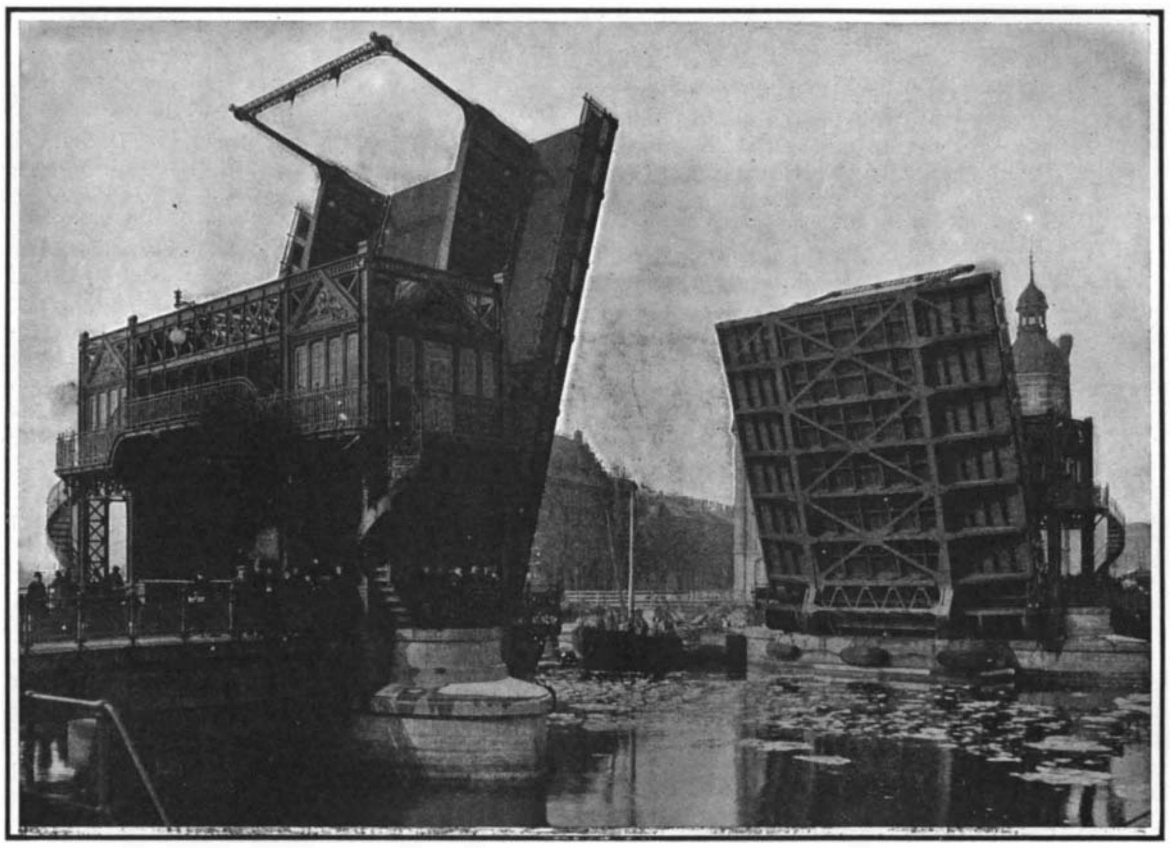
It is thrown across the waterway at a point directly north of the structure it superseded, and the banks of the channel had to be regulated and the bridge set at the correct angle to the current, so as to insure navigation on the river being completely satisfactory.

The channel which the new bridge spans has a total width of 257 feet 6 inches, with a depth of 25 feet 6 inches. The drawbridge itself spans a channel of 92 feet 6 inches clear width. The bridge is of the double-leaf type, the total length of the movable section being 109 feet 2 inches between centers. These are carried on two piers built in the channel, access thereto being gained from either bank over a short fixed span. The roadway of the bascule section has a clear width of 22 feet 7 inches, and carries two tracks for the electric surface tramway. On either side is a sidewalk 10 feet 3 inches wide on the bascules, opening out to 13 feet 8 inches wide at the approaches, where the whole bridge widens out funnel wise for the convenience of the traffic.

The erection of the work entailed the surmounting of several difficulties incidental to the heavy traffic on the waterway at this point. This was especially so in connection with the piers, the greater part of the building of which could not be done *in situ*, but had to be carried on at a convenient point in the harbor and subsequently towed into position and set upon the foundations.

The piers, which have an over-all length of 78 feet 8 inches and a width of 26 feet 6 inches beneath the bridge, are provided with chambers into which the tail ends of the leaves with their counterweights descend, when the bascules are raised, and they also contain a large proportion of the hydraulic machinery.

They were constructed on slips and were provided with strong watertight bottoms, built up of a ring-shaped iron girder and transverse members, to the under side of which the bottom plates were riveted. To the outside of the ring-shaped iron girder was attached the vertical sheet-iron plating forming the wall of the caisson. For purposes of launching this was only carried up to a height of a few feet. Launching was carried out in the usual manner. Concrete was then laid on the bottom to form a foundation for the masonry, which was so built as to form a circular wall, with transverse walls serving as buttresses and with locks between. This work was carried out while the pier was floating; and, as the mass gradually sank under the superimposed weight of the masonry, the sheet-iron lining was continued upward, a height of about three feet thereof always being maintained above water level. When the pier had been continued in this manner to the requisite height, the top was corbeled to receive the granite masonry forming the superstructure of the pier. To insure the pier maintaining an even keel during the attachment of the masonry, building was carried out symmetrically, and the parts filling out at the ends were subsequently removed.



Width of opening, 92 feet 6 inches. Width of bridge roadway, 22 feet 7 inches. Width of each sidewalk, 10 feet 3 inches.

The new bascule bridge at Copenhagen.

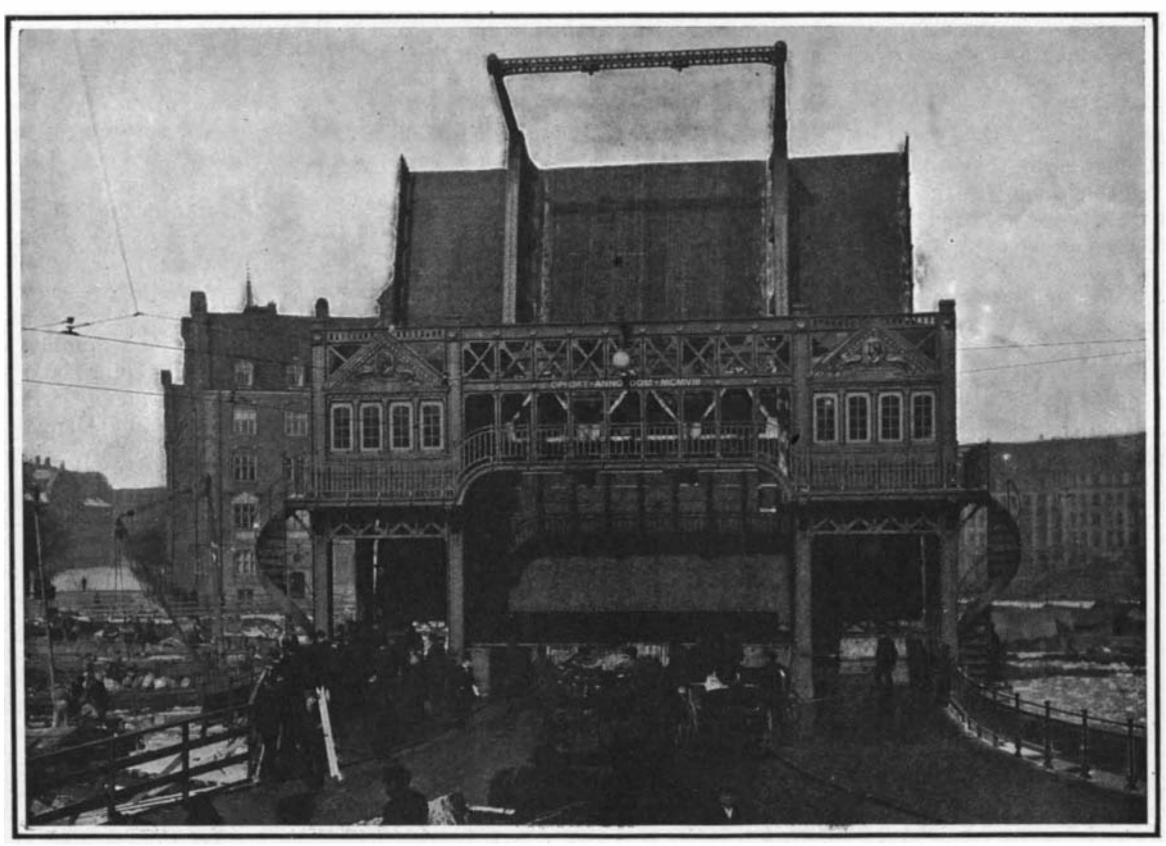
This method of construction was carried on until the bottom of the piers had sunk to a depth leaving only a space of about 12 inches between the under surface of the bottoms and the face of the foundations which were ready to receive them. The piers were ultimately towed into position above the foundations, and then slowly lowered until the iron ring girder of the piers bore upon the surface of the foundations. Divers then descended to see that the piers were in correct position, and drove wooden wedges between the rims of the plates of the bottoms and the foundations, and completed the clay packing all round to secure a water-tight joint. When this was done, the bottom of the pier was attached to its foundations by grouting with pure dissolved cement.

The fixed spans are of the ordinary plate-girder pattern, and the movable leaves are constructed in accordance with the well-known Strauss trunnion bascule principles. The counterweight, when the spans are down, rests in a position high above the roadway in the towers, being pivotally carried on two legs on pins in the tail ends of the leaves, the movement of the counterweight above being controlled by the usual links constituting the characteristic parallel motion of the Strauss design. As the leaf rises the counterweight descends toward the roadway, finally disappearing into a pit, when the limit of the upward travel of the span is reached. The equipoise of the leaf and its counterweight during this movement is dependent on the four axes of rotation, viz.: the axle of the platform; the counterweight leg's point of support on the tail end of the leaf; the axis of rotation of the guiding member on the counterweight; and fourthly, the fixed axis of rotation of the guiding member on the tower structure, lying in the angles of a parallelogram. The advantage of this arrangement is that the length of the tail ends may be considerably reduced, and space rendered available for a large heavy counterweight. The leaves of the Knippels bridge each weigh 146 tons, and the respective counterweight 247 tons.

In order to eliminate all vibration arising from traffic, the bridge has been constructed in such a manner that the leaves are locked against each other by hinges in the upper part of the top chords, while the pressure is transferred to abutment hinges on trestles in the piers.

The first operation in raising the bascules is the lowering of the counterweights upon the tail ends, so that they counterbalance the weight of the leaves. This is carried out hydraulically. The leaves are then raised by means of electrically-driven gearing. Each of the leaf girders carries a spur gear meshing with a series of fixed pinions, and vertical shafts extending through the columns of the towers.

When the bascules have been lowered again to their correct position, the pressure of the counterweights on the tail ends of each leaf is removed by hydraulic pistons, which lift the legs of the counterweights until they cease to bear upon the tail ends of the span. The mechanical action of raising and lowering each leaf is carried out by means of two 54-horsepower electric motors, one in each tower. About 13 kilowatts is expended in the raising and lowering of both leaves, and the time occupied in either raising or lowering the bascules is about 25 seconds, the same time being occupied in removing the pressure of the counterweights from the tail ends. When a small steamer passes the bridge the traffic is stopped for about two minutes, this interval increasing proportionately to the dimensions of a larger vessel. The construction of the whole bridge has entailed an expenditure of approximately $286,000.



Note the treatment of the architectural features of the bridge to harmonize with the neighboring buildings.

Portal view of Copenhagen bridge with bascule raised.

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The United States government has given permission to Horace G. Herold to remove a 12-ton meteorite which he discovered in the Washington National Forest in December, 1907. This is said to be one of the largest, if not the largest, meteorites in the world.