SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class matter.

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXV.—No. 11.] ESTABLISHED 1845. NEW YORK, SEPTEMBER 12, 1896. [$3.00 A YEAR. WEEKLY.

THE NEW EAST RIVER BRIDGE.

The promoters of the great and costly suspension bridge which forms the central subject of our front page illustration are abundantly warranted in their enterprise by the statistics of travel over the existing bridge across the East River, New York, which was opened some thirteen years ago. The total number of passengers to cross the bridge during the first year, 1883-1884, was 8.823,000. In ten years' time the total had grown to 43,000,000—an increase of 500 per cent; and to-day the capacity of the cable road is quite inadequate to meet the increasing volume of traffic. The intervening quarter of a century since the commencement of work on the Brooklyn Bridge has seen a great change in the problem of transportation between New York City and Brooklyn. Undoubtedly the location was a good one for the needs of the two cities as they then existed. The Brooklyn approach on Fulton Street connected with the main artery of travel in that city, and the City Hall Park, on the New York side, might be reasonably supposed to represent a central point between the downtown business center as it then lay and the possible future developments on the upper part of Manhattan Island. So rapid, however, has been the growth of the two cities in a northerly direction that the present bridge now lies far to the south of the center of population, and for some years there has been an urgent need for another bridge to the north of the present structure.

The Brooklyn Bridge, moreover, labors under the disadvantage that it has no through connection with the elevated and surface railroads of the two cities, an evil which not only delays and inconveniences the passenger, but seriously limits the capacity of the bridge itself, inasmuch as its carrying power is determined by

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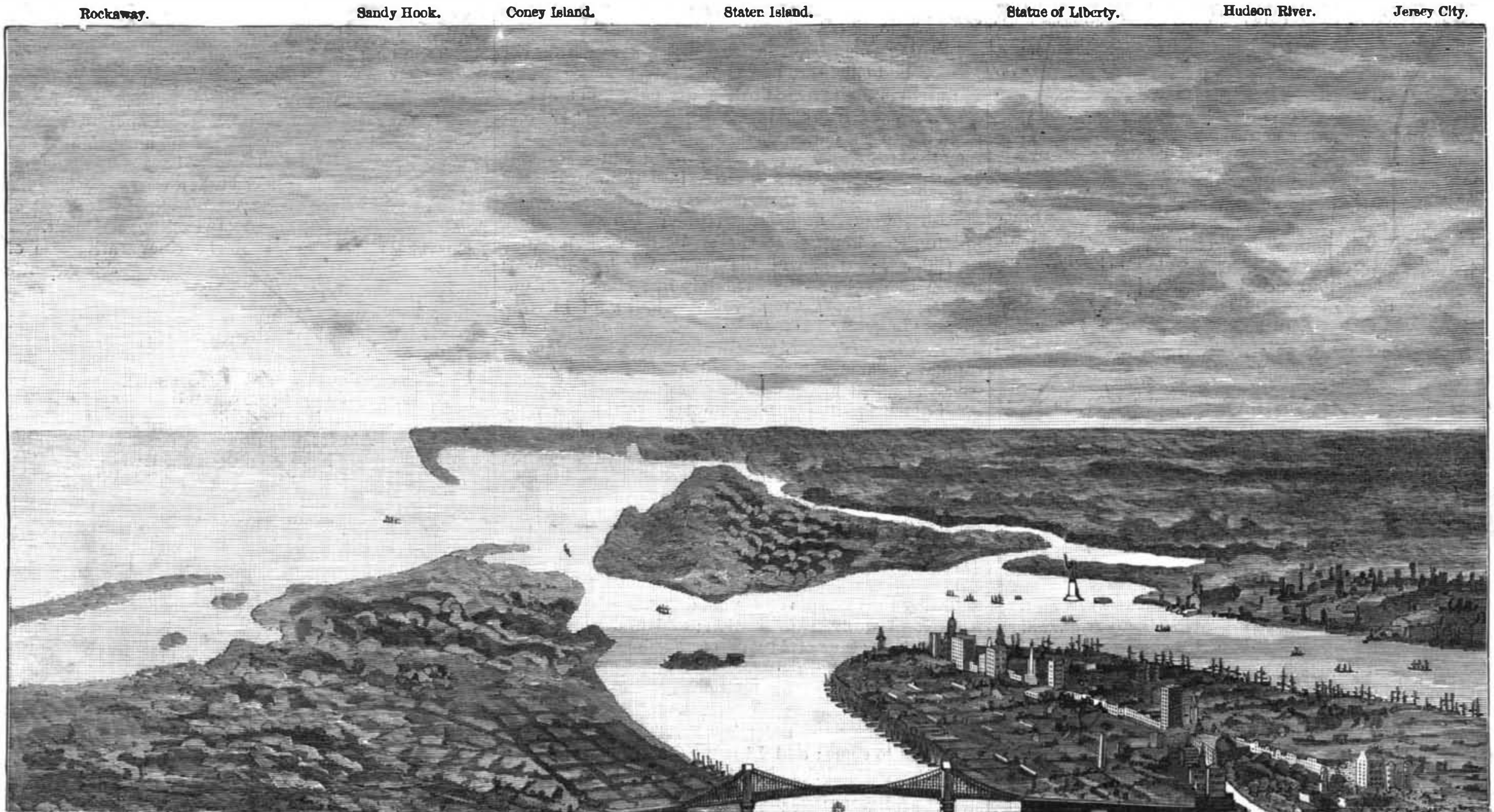


NEW EAST RIVER BRIDGE CONNECTING NEW YORK AND BROOKLYN.

THE NEW EAST RIVER BRIDGE.

(Continued from first page.)

the rapidity with which the terminal stations can load up and dispatch the trains.

The Bridge Commission has been guided in the location and design of the new structure by the above mentioned facts, as will be seen by reference to the accompanying bird's eye view of the two bridges and the surrounding districts. It will span the East River at a point a mile and a half to the north of the present bridge. The terminus of the New York approach being located on the northern half of the block lying between Delancey and Broome, Clinton and Attorney Streets, will be within easy reach of the Second and Third Avenue elevated roads, and it will be centrally situated with regard to the cross-town car lines, which connect with the North River ferries, and transfer with the various surface roads running north and south on Manhattan Island.

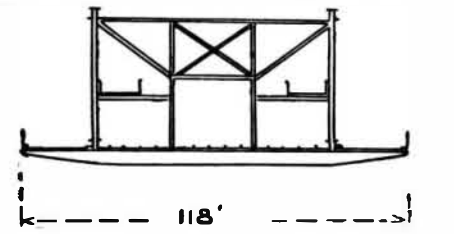
The terminus of the Brooklyn approach is at present on the block between South Fourth and South Fifth, Driggs and Roebling Streets, though it is to be hoped that permission will ultimately be granted to place it on the adjoining block to the south, which would enable the bridge and approaches to be run in a continuous straight line from one end to the other, and would do away with the present unsightly curve and avoid the inconvenience which it would cause in subsequent operation. This change would also place the Brooklyn approach in close touch with Broadway, which has been chosen as the most central thoroughfare in Brooklyn north of the present bridge. It is as important a terminal point for elevated and surface roads in North and East Brooklyn as Fulton Street, the terminus of the Brooklyn Bridge, is for Brooklyn in general and South Brooklyn in particular. The carrying capacity of the bridge will be very large. There will be two elevated railroad tracks, four tracks for surface cars, two eighteen foot roadways and two footwalks twelve feet wide. The elevated tracks will connect the Brooklyn and New York elevated systems, and will enable an unbroken journey to be made from any of the elevated lines of New York across the river to Brooklyn, and a similar convenience will be afforded to passengers on the surface roads.

The new structure will be a steel wire suspension bridge, and larger in every way than the Brooklyn Bridge. When it is completed it will take rank as the most notable single span in the world, its six lines of railroad track, its two roadways and two footwalks more than outweighing the extra one hundred and ten feet of length in the single spans of the Forth Bridge in Scotland, which carry two railroad tracks only.

The foundations for the piers will be four in number, two under each tower. They will be sunk by means of caissons and the pneumatic process to a bearing upon the solid gneiss rock, which, on the New York side, is found at a depth of about 65 feet, and on the Brooklyn side at 86 and 100 feet, below mean high water. The caissons will be filled with concrete, and upon them piers of solid masonry will be built up to 23 feet above high water. Four massive steel footings will be placed upon each pier, upon which will rest the eight legs of the steel towers. The legs, four feet square, will be built up of plates and angles, and will be tied together with a strong system of bracing. The distance between centers of piers will be about 97 feet, and the two halves of the tower will rise vertically as far as the level of the bridge floor, when they will be battered slightly inward. The top of the towers will be 335 feet above the river.

The floor of the bridge will be carried upon four steel cables 18 inches in diameter. The diameter of the Brooklyn Bridge cables is 15 inches. The increased size, and the superior quality of the steel wire in the new cables, will enable them to carry more than double the load of the Brooklyn Bridge cables. As at present estimated each cable will contain about 6,800 wires, each $\frac{3}{16}$ inch diameter. This will give a total of 27,200 wires in the four cables, and their united strength will amount to 68,000 tons, reckoning 5,000 pounds to the wire. The weight of the four cables per foot of the bridge will be 3,000 pounds. The length of the bridge from tower to tower will be 1,600 feet, and the cables, after passing over the movable saddles at the top of the towers, will be carried down and secured within massive masonry anchorages, which will be placed 570 feet inshore from the towers. The anchorages, which will be about 150 feet square and 100 feet high, will counteract the pull of the cables, and their united weight will be over 160,000 tons, or about thirteen times the weight of the main span, which will amount to some 12,500 tons. The bridge is designed to carry a maximum live load of 8,000 pounds per linear foot, the total combined dead and live load for the whole main span being 18,900 tons. A unit of stress is used which gives a margin of three on the cables, and of from five to six on the floor system.

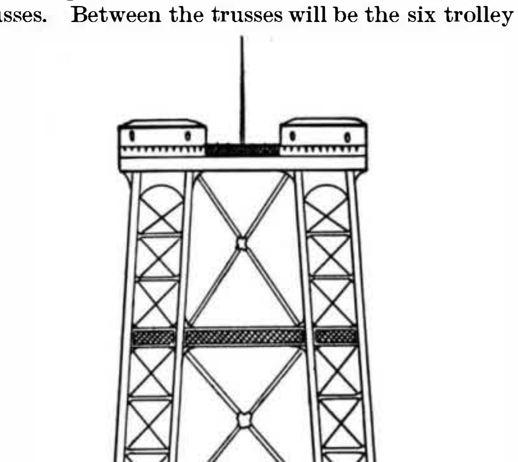
It will be seen from the illustrations that the bridge proper ends at the towers, the floor of that portion of the bridge between the anchorage and the towers being carried, not as in the Brooklyn Bridge, upon the main cables, but upon two independent deck spans supported by the towers, the anchorages, and an intermediate pier. Perhaps the most striking feature of the main span is the pair of massive stiffening trusses, 45 feet high (those on the Brooklyn Bridge are 17 feet high), which run continuously from tower to tower, to which they have a pin connection. These trusses have a special interest from the fact that they are of triple intersection, and that they will have riveted instead of pin connections throughout. This design is in keeping with a reaction which is noticeable among bridge engineers in favor of riveted construction for certain classes of work. It has been found that, for spans up to 175 and 200 feet, the ease with which a pin-connected structure can be erected is more than compensated by the rigidity of the riveted type, and the action of a shallow



CROSS SECTION AT CENTER OF SPAN, EAST RIVER BRIDGE.

stiffening truss of a suspension bridge under load brings it, despite its great length, under the category of short spans. Riveted railroad bridges have lately been built with spans as long as 234 feet, and are giving excellent results. The members of the web system of the trusses will consist generally of 3½ and 4 inch by 6 inch angles, and the chords will be built of plates and angles, and will be 30 inches wide by 36 inches deep.

There will be plate steel floor beams at each panel point, spaced 20 feet apart. In order to gain head room above high water these will be made shallow, be ing only 5 feet deep for a length of 118 feet; and to resist the heavy bending strains of the live load they will be reinforced by a supplementary overhead truss, to which they will be suspended at two intermediate points. The plate stringers, 2 feet deep, will be riveted to the floor beams, and will extend beneath the rails and roadways. The trusses will be placed 72 feet apart and on the outside of the car tracks, the roadways being carried upon extensions of the floor beams, outside the trusses. Between the trusses will be the six trolley and



FRONT ELEVATION OF TOWER, EAST RIVER BRIDGE.

elevated tracks, the two latter being in the center. Above the trolley tracks and against the trusses will be the footwalks.

The work of providing against wind pressure is largely assisted by the great width of the bridge, 118 feet. It will be effected by "cradling" the cables, i. e., drawing each pair together so that they will lie within the vertical plane drawn between their points of support on the towers; and also by a double system of lateral bracing, one on the top and one on the bottom chord. That on the bottom chord will be riveted to the floor beams and to the chords, and the combined effect of cables and bracing will produce an exceedingly rigid structure. The viaduct at each end of the bridge will consist of plate girder spans carried upon braced towers. It is the object of the commissioners to erect a bridge which shall form a great thoroughfare for an uninterrupted stream of traffic between the two cities and their outlying districts, and thereby avoid the terminal delays which limit the capacity of the Brooklyn Bridge. To this end terminals and toll houses, or anything which might tend even temporarily to check the flow of traffic, will be reduced to the lowest practicable limit. The idea is an excellent one, and a study of our front page illustration, which is self-explanatory, will show how admirably the location has been chosen for this purpose.

This great undertaking is under the control of a joint commission of the cities of New York and Brooklyn, and its execution is now fairly under way. If the funds for construction are forthcoming as fast as the engineers can use them, the opening of the bridge should be contemporaneous with the opening of the twentieth century; and it is likely that the consolidation of the two cities will make such a speedy completion of the work entirely possible.

Our thanks are due to Mr. L. L. Buck, M. Am. Soc. C. E., who has kindly placed details and plans at our disposal.

Science Notes.

Canada proposes to erect a suitable monument to John and Sebastian Cabot at Bristol, England, to commemorate the voyage which these navigators took in 1497, which ended in the discovery of the Canadian coast.

Mr. Hiram Maxim, in a recent letter to the London Times, thinks that Prof. Langley was more sensible in making a small machine and projecting it from a boat, so that it would not be smashed when it fell into the water, than he himself was in building one twelve times as large and starting it from rails on the ground. Every fall would involve three months' time and $5,000 for repairs.

The following is vouched for by the Electrical World, which says that it is referred to by a German contemporary: This little device is called "Automatischespiegelglassplattenblitzschutzvorrichtung." As its name clearly indicates, it is an apparatusforprotectingagainstlightningconsistingof platesof mirrorglass actingautomatically. In this country we are in the habit of calling this simple device a "cutout."

Foreign books are admitted free of duty in all cases into 69 countries out of 110 whose laws have been investigated by M. Le Soudier. In 13 others unoound books are free, but there is a duty on the binding. In 28 countries books pay duty, though in eight of them exceptions are made in favor of books intended for teaching. In most cases the duties are very slight, hardly interfering with importations. In China the customs duties on the books imported by missionaries is a cent or two a pound on the weight.

Aconcagua, the highest peak on the Western Hemisphere, is to be attempted again this fall by Mr. E. A. Fitzgerald, who explored the New Zealand Alps. If he succeeds in getting to the top, which is 23,200 feet above sea level, he will beat the highest mountain climbing record, Sir W. M. Conway's 22,600 feet ascent of Pioneer Peak in the Himalayas. Dr. Gussfeldt has tried Aconcagua, but got into trouble with his guides and had to turn back 2,000 feet from the summit. Mr. Fitzgerald will have in his party the Swiss guide Zurbriggen, who accompanied him in New Zealand and was with Conway in the Himalayas.

A girl who can see the Roentgen rays has been found by Dr. Brandes, of Halle, who discovered her. Starting from the fact that the rays do not penetrate lenses, he hunted for some one the lens of whose eyes had been removed, an operation performed not rarely for extreme short-sightedness or for cataract. The girl, who had had the lens of her left eye removed, was able to see the light with it, though her right eye, which retained its lens, could see nothing. Dr. Brandes asserts that the rays affect the retina of the eye, and if any one's head is inclosed in an opaque vessel near the source of the rays, the light can be seen even with closed eyes.

The following passage, from a speech by Lord Kelvin, is worth recording in the most imperishable letters: "One word characterizes the most strenuous of the efforts for the advancement of science that I have made perseveringly during fifty-five years: that word is failure. I know no more of electric and magnetic force, nor of the relation between ether, electricity, and ponderable matter, nor of chemical affinity, than I knew and tried to teach my students of natural philosophy fifty years ago in my first session as professor. Something of sadness must come of failure; but in the pursuit of science inborn necessity to make the effort brings with it much of the certaminis gaudia, and saves the naturalist from being wholly miserable, perhaps even allows him to be fairly happy, in his daily work. And what splendid compensations for philosophical failures we have had in the admirable discoveries by observation and experiment on the properties of matter, and in the exquisitely beneficent applications of science to the use of mankind with which these fifty years have so abounded."