sion, three-cylinder engines, and was designed to make 20 knots with 13,500 horse power. In her boiler rooms are four single-ended and four double-ended boilers. She carries a normal supply of 650 and a maximum supply of 1,100 tons of coal, and her full complement of officers and crew is 525. Her protection consists of a complete belt of armor from stem to stern, which is 6 inches thick amidships and tapers to 4½ inches at the ends. With this is associated a complete deck 1½ inches in thickness, which slopes at the sides to meet the bottom edge of the side armor. The space between the slopes and the side armor is utilized for coal bunkers, and back of the sloping deck are other coal bunkers. Further protection is afforded by the main deck, which is of steel ¾ of an inch in thickness. The 6-inch side armor is carried up amidships through the height of two decks, extending from below the water line to the upper or main deck, through a height of over 20 feet. This armor is carried athwartships around the bases of the barbettes, the bulkheads thus formed being of 4½-inch armor. The armor, by the way, is of what is known as the Terni type, which has shown qualities which compare favorably with the best Krupp armor. The main battery consists of four 45-caliber, 8-inch, rapid-fire guns, mounted in two turrets protected by 5½-inch armor, one forward and one aft, on the longitudinal axis of the ship. The intermediate battery consists of fourteen 6-inch rapid-fire guns, ten of which are located on the gun deck within the 6-inch armored citadel, while the other four are mounted behind heavy shields on the main deck, two on either broadside. The four 6-inch guns at the corners of the gun-deck battery and the four guns above mentioned are able to fire dead ahead or dead astern, the concentration of fire ahead or astern being, therefore, two 8-inch and four 6-inch guns. There are also ten 3-inch rapid-firers, four of them being mounted on the gun deck, two forward and two aft, and firing through ports, and six of them being mounted in broadside on the upper or main deck, three on each side between the pairs of 6-inch guns. The vessel also carries four above-water torpedo tubes, which are mounted on the berth deck and fire through discharges in the 6-inch side armor of the vessel, the protection for these tubes being, therefore, very satisfactory. There are two conning towers, one forward and one aft, the forward tower being protected by 4¾ inches of Terni armor. The vessels have two smokestacks and a single central military mast, in the tops of which are mounted two Maxim guns.

Altogether, for their displacement, we consider that these are as effective fighting units as have ever been designed. Of course, they do not have the advantage that comes from great size and high speed, such as characterize the 24-knot, 14,000-ton British cruisers of the "Drake" type, or the 22-knot, 14,500-ton armored cruisers of the "Tennessee" class now building for our own navy. At the same time, because of their shorter length, these vessels will prove very handy in maneuvering, and with their powerful batteries will be able to stand up against ships of considerably greater size than themselves. The Russians have only one armored cruiser of the same displacement, the "Bayan," that can compare with them. Although the latter has two knots more speed and is slightly heavier in the belt protection, she carries only two 8-inch as against four 8-inch rapid-firers, and eight 6-inch as against fourteen in the "Kasaga."

In the event of hostilities between Russia and Japan, there is no question that these two vessels will prove to be an invaluable addition to the fighting strength of the Japanese navy.

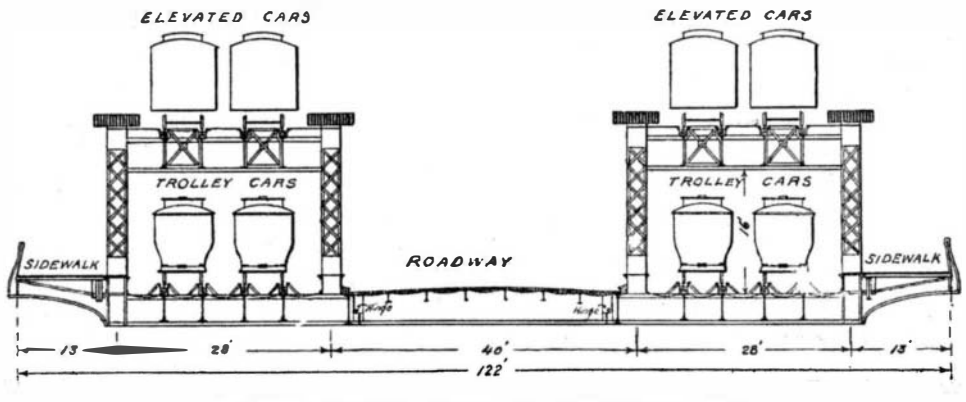
An apparatus in use in Germany for the purification of milk by ozonization is so constructed that the milk contained in a vessel flows thence in a thin stream into another vessel, placed below. An electric circuit is so arranged that sparking is caused through the stream or near it. The ozone which is thereby engendered from the oxygen of the air is said to be sufficient to kill all micro-organisms contained in the milk.

THE MANHATTAN BRIDGE ACROSS THE EAST RIVER.

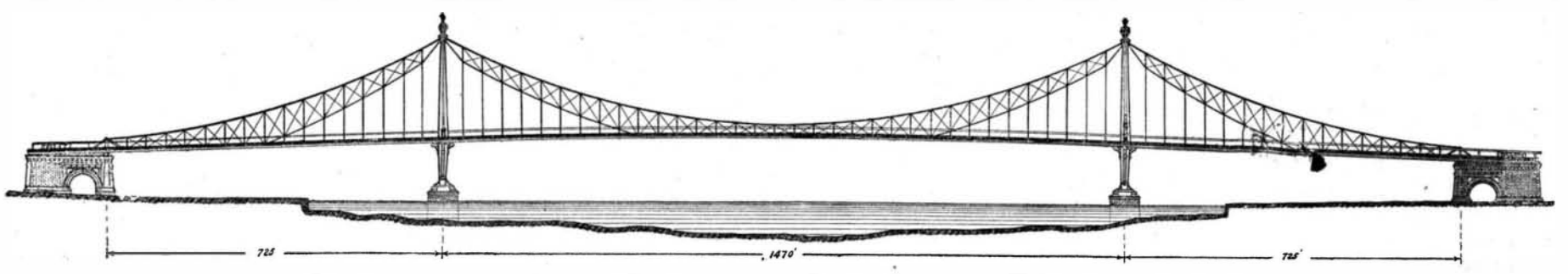
The foundations and piers for the new Manhattan Bridge across the East River are nearly completed, and the plans and specifications for the steel superstructure are in shape ready for the letting of the contracts. This bridge will run from near the intersection of the Bowery and Canal Street in New York to Willoughby Street between Prince and Gold Streets in Brooklyn. It will be considerably the longest of the big bridges across the East River, measuring about 10,000 feet between terminals. The original design of the structure, a small sketch of which is shown on the front page of this issue, called for a steel-wire, cable, suspension bridge, carried on four towers of a general rectangular cross section and consisting of heavily-trussed columns of a type resembling, in a general way, those of the recently opened Williamsburg Bridge. When the late Commissioner assumed control, it was decided to take advantage of the backwardness of the foundations for the bridge, and revise the plans and build a structure of greater capacity and more pleasing appearance. The work of preparing the plans was put in hand at once, and, as we have said, matters are now in shape for the immediate commencement of the construction. The floor of the bridge will be 122 feet wide over all, and therefore a little wider than the floor of the Williamsburg Bridge. The center span will measure 1,470 feet from center to center of towers, or 130 feet less than the center span of the Williamsburg Bridge, and each of the side spans will be 725 feet in length from center of towers to anchorages. The two steel towers will rise to a height of 400 feet above mean high water. With a view to expediting the construction and avoiding the great delays incidental to the laborious and necessarily slow process of stringing steel wire cables, and also with a view to bringing the structure up to the most modern and approved methods of design for long-span suspension bridges, it was decided to build the cables of nickel-steel eye-bars; and instead of constructing separate stiffening trusses as part of the floor system, it was decided to build these trusses as part of the suspension chains, utilizing the chains as the top chords of the trusses. Apart from the great ease and rapidity of erection, and the graceful appearance of the finished structure, there was a constructive advantage in the fact that the deepest part of the trusses occurs at the quarter lengths of the span, where the bending stresses are greatest, while the trusses are shallowest at the center of the span, where theoretically they ought to be shallow, in order to reduce the stresses due to changes of temperature. There will be four lines of eye-bar chains with their stiffening trusses. They will have fixed connections at the top of the towers, the cradles on rollers being dispensed with as an obsolete arrangement. The chains will be made up of 18-inch nickel-steel eye-bars. At the point of connection to the towers each chain will consist of four bars 18 inches in depth by 1⅝ inches in thickness and sixteen bars 18 inches in depth by 1 11-16 inches in thickness. The trusses will be built with panels 45 feet in length, and at each panel point there will be pin-connected suspension members, which will support the roadway.

The main floor of the bridge will be carried upon plate-girder floor beams, one at each panel point, which will be supported at the ends and at two intermediate points from the suspension chains. The floor beams will have short cantilevers projecting beyond the outside points of support, which will carry the footways, each of which has about 12 feet of clear width. These footways being on the outside of the trusses will afford to pedestrians a clear view of the river. The space between each pair of trusses will be devoted to the elevated and street railroads. The elevated cars will be carried upon an upper deck which, at the center of the bridge, will be about on a level with the chain cables, while the street cars will run upon the floor of the bridge. The center of the suspended structure will be devoted to a 35½-foot carriage and vehicle roadway, which will provide sufficient space for four three-horse teams to drive abreast if need be.

The towers of the bridge are of novel construction, and are of extremely light and pleasing appearance. Each consists of four very massive columns standing in one transverse plane, the columns being located in the same vertical planes as the chain cables. Instead of the base of the towers being carried out to a broad base, as in the lately finished Williamsburg Bridge, the columns viewed from the side elevation taper from their greatest width of 22 feet at the platform down to a width of 14 feet, where they rest upon a large hollow forged steel pin, two feet in diameter. The pin itself rests in a massive ribbed cast-steel footing. The object of this construction is to insure that the load of the tower will be distributed evenly over the top of the masonry pier. By causing the load to pass through a central pin, from whence it is distributed through a broad steel pedestal, the possibility of uneven pressure on the masonry is entirely eliminated, and every part of the pier will receive its proper share of the load. Theoretically, the tower is free to rock on this two-foot pin, in the direction of the axis of the bridge, but actually the movement of a few inches one way or other at the top of the tower, due to changes in form of the chain resulting from live load and temperature, will be taken care of by the elasticity of the tower itself. It must not be supposed that the presence of the hinged joint threatens the stability of the tower; for it must be remembered that the chain cables are rigidly attached to the top of the tower, and consequently hold it permanently in its proper vertical position. The use of a massive saddle on roller bearings at the top of suspension bridge towers had come to be regarded by leading bridge engineers as an obsolete construction before this bridge was designed. In a study for a North River bridge of 3,000-foot span, the late George S. Morison omitted the movable saddle, and attached his cables rigidly to the top of the tower. For the erection of the towers temporary steel wedges are provided, which will afford a base sufficiently broad to give stability during erection; or, if it were preferred, the towers could be built with a slight inclination toward the river (sufficient to give a safe margin against overturning by wind pressure) and be tied back to the anchorage until their full height was reached. Four wire construction cables could then be laid from tower to tower, and the towers drawn back to vertical position. Calculation shows, however, that the towers could be run up vertically to their full height on the base provided and still have, because of their great weight, an ample margin of safety against overturning by wind pressure. After the towers are completed, erection cables will be run over the towers from anchorage to anchorage, and from these, traveling erecting cradles will be slung, from which the eye-bars will be lifted up and pinned together, commencing and working out from the towers. The first step would be to string the alternate two and three central eye-bars of each set of twenty, and then slip the other bars over the ends of the pins in pairs until the complete chain was assembled. There is absolutely nothing new about this system of construction, and it has been used for over half a century in the erection of bridges of this type. The web members of the stiffening trusses will be threaded on the pins in their proper relative positions, and then the bottom chord pieces of the trusses will be lifted into place and pinned together at the intersections, after the manner of the erection of any ordinary pin-connected truss bridge.



SECTION THROUGH FLOOR AT CENTER OF SPAN.



THE NEW MANHATTAN SUSPENSION BRIDGE ABOUT TO BE BUILT ACROSS THE EAST RIVER, NEW YORK.

Because of the large ratio of the depth to the length of the bridge of 1 to 8, the rise and fall of 10 inches at the center of the span, due to changes of temperature, etc., will not produce any movement of the eye-bars on the pins. The greatest tendency to movement would be at the towers, but the friction of the eyes on the pins will be so great that the eye-bars will bend before they will turn, and to provide for this, an increased amount of metal has been put in the parts. These stresses are easily calculable, and they have been provided for by increased sections. Consequently, when these massive chains nave been hung, they will, as far as any movement of the integral parts is concerned, be as rigid as though forged from a solid piece. The bridge, if carefully erected and systematically painted, should do its work for a thousand years to come.

The anchorage piers are very lofty and massive. They will be pierced by large arches, to provide for street traffic, which will pass through them. They will be provided with stairways and elevators, by which passengers can have immediate access to the bridge at the anchorages, instead of having to go far inshore to enter at the terminal points. The large interior space which necessarily exists in all such large anchorages has, in the present case, been utilized to provide a spacious hall capable of seating 2,000 people. As there will be two of these, one in Brooklyn and one in New York, it is estimated that the rentals alone will be worth more than $30,000 to the city treasury.

When the bridge is completed, and connections with the transit systems made, it is estimated that the eight elevated and street car tracks alone will have an annual capacity of 200,000,000 passengers a year. The estimated cost of the tower and anchorage piers is about $3,000,000, while the superstructure, including the approaches, will cost about $10,000,000. The bridge was designed by Mr. Gustave Lindenthal, in collaboration with Mr. H. Hornbostel, as consulting architect; and a reference to the general design and the detailed plans shows how much can be done to beautify a mammoth structure of this kind without in any way belittling its dignity. If the appropriations are made and the contracts let at once, work can be carried on simultaneously upon the approaches and the towers; and while the erection of these is carried on, the manufacturers can be getting out eye-bars. These could easily be completed by the time the towers were up and the erection wires strung ready for the erection of the cables. By proceeding along these lines, there is no question that the bridge can be finished and open for public use within three and a half years from the present date.

Korea and the United States.

Korean commerce amounts, according to a statement just issued by the Department of Commerce and Labor through its Bureau of Statistics, to about fifteen million dollars per annum. Imports materially exceed exports, and according to the best statement that the Bureau of Statistics is able to obtain, amount to about ten million dollars, and the exports to about five millions. While in the case of China the foreign commerce of the country is carried on chiefly, almost exclusively, through the "treaty ports," this is not the case with reference to Korea, only about one-third of the foreign commerce above referred to passing through the treaty ports.

American products, both manufactured and otherwise, are popular in Korea, but the very large proportion reach that country through China and Japan, and the direct trade of the United States with Korea is extremely small. It is only within a comparatively short time that the direct trade of the United States with Korea was of sufficient importance to justify a separate record. In 1897 the exports from the United States to Korea were $509 in value; in 1898, $125,000; in 1902, $251,000, and for the eleven months ending with November, 1903, $366,919, indicating that for the entire calendar year 1903 the total exports to Korea from the United States will amount to about $400,000.

While this is a rapid growth, it does not show by any means the entire value of merchandise from the United States entering Korea. As above indicated, many of these articles from the United States consumed in Korea are sent first to Japan or China and from those countries shipped into Korea. The value of American petroleum consumed in Korea in 1901 is stated at over $300,000; machinery and supplies, $250,000, and electrical goods and lumber, $236,000. These importations of merchandise from the United States were due in part, largely, perhaps, to the presence of Americans engaged in mining operations in Korea and the purchase by them in the United States of machinery and supplies for that work.

The Statesman's Yearbook puts the total trade passing through the "treaty ports" of Korea at ten million yen of imports and about nine million yen of exports in 1897, and in 1901 fifteen million yen of imports, but only nine million yen of exports, thus indicating the growth, especially in imports, which in 1901 were over 60 per cent in excess of those of 1897. These figures, however, relate to the treaty ports only. The value of the yen is about 50 cents, or practically identical in value with the Japanese yen.

The imports are chiefly cotton and woolen goods, metals, kerosene, silk, and machinery for the use of the railways and those engaged in their construction. The chief exports are rice, beans, hide, ginseng, and copper. The currency chiefly consists of copper cash and nickel coins, gold and silver coins being out of circulation. The total currency is stated as aggregating about $22,000,000, of which $6,000,000 is copper cash, $14,000,000 nickel, $1,550,000 Japanese coins, and $530,000 Korean silver dollars.

Eight ports of Korea are open to foreign trade and are classed as "treaty ports." Treaties were made between Korea and the United States in 1882, and in the same year with China; in 1883 with Germany and Great Britain; in 1884 with Russia and Italy; in 1886 with France; in 1892 with Austria; and in 1899 a further treaty with China. Under these treaties Chemulpo, Fusan, Wunsan, Seoul (the capital), Chinampo, Mokpo, Songchin, Masanpo, and Kunsan have been opened to trade. The actual trade through non-treaty ports, however, is, as already indicated, much greater than that through the treaty ports—probably fully double.

The trade of Korea with Japan is growing more rapidly than with any other country, the importation of cotton goods from Japan amounting to from two to three million yen annually. Cotton goods are the largest single article in the value of importations into Korea, amounting to between six and seven million yen annually. Silk goods amount to about one and a half million yen per annum. The chief articles of export are rice, four and a half million yen in value; beans, two million yen; hides, 650,000 yen; and ginseng, 527,000 yen.

The minerals of Korea are of considerable value. Copper, iron, and coal are reported as abundant, and gold and silver mines are being successfully operated, an American company having charge of and operating a gold mine at the treaty port of Wunsan under a concession granted in 1895. Concessions have also been granted to Russian, German, Japanese, and French subjects.

Railways, telegraphs, telephones, and a postal system have been recently introduced into Korea. A railway from the seaport of Chemulpo to Seoul, the capital, a distance of 26 miles, was built by American contractors, and has reduced the time between the seaport and capital from eight hours to one and three-quarter hours. The Seoul Electric Company, organized chiefly by Americans and with American capital, has built and operated an electrical railway near Seoul, which is much used by the natives. This electrical plant is said to be the largest single electrical plant in Asia. The machinery is imported from the United States, and the consulting engineer, a Japanese, is a graduate of the Massachusetts Institute of Technology.

Transportation in the interior is carried chiefly on by porters, pack horses, and oxen, though small river steamers owned by Japanese run on such of the streams as are of sufficient size to justify the use of steamers.

The area of Korea is estimated at 82,000 square miles, or about equal to that of the State of Kansas. The population is variously estimated at from eight to sixteen millions. The foreign population consists of about 30,000 Japanese, 5,000 Chinese, 300 Americans, 100 British, 100 French, 100 Russians, 50 Germans, and about 50 of various other nationalities. The postal system is under French direction and has, in addition to the central bureau at Seoul, 37 postal stations in full operation and 326 substations for registered correspondence.

The New York Automobile Show.

The New York Automobile Show opened at Madison Square Garden on January 16, 1904, under the auspices of the Automobile Club of America, the National Association of Automobile Manufacturers, and the Madison Square Garden Company. We shall review the show in our next issue, which will be our annual Automobile number, and will have an attractive colored cover. The distinctive features of the show this year are the fitting of canopy tops with glass fronts to most of the large touring cars, thus making them serviceable in bad weather; a decided increase in the number of cars with air-cooled motors, upon which are found several new and ingenious systems of air-cooling; and a slight increase in the number of cars employing a three-cylinder motor, which, it is claimed, gives higher efficiency than a four-cylinder. Cellular radiators are much in evidence, and horizontal motors are largely employed, especially on the runabouts. There are but few steam and electric machines, although it is thought the latter will enter new fields of usefulness, equipped with the Edison battery. Some exceptionally large gasoline buses are shown. The number of exhibitors is in the neighborhood of 200, nearly one-half of whom are manufacturers of cars. Still other makers, who were unable to obtain space, are exhibiting at the Herald Square Annex Show at the top of the Macy building. This show will last until January 30, while the Garden show ends January 23.

Rapid Photographic Manipulation for Newspaper Illustration.

An example of how the latest apparatus for quick photographic manipulation can be used to advantage in a novel way was demonstrated last summer by a representative of the Newark Evening News. He was commissioned to be stationed on the revenue cutter "Gresham," to photograph the international yacht race on August 25, 1903, the second day of the race. He took with him a Kodak camera, a Kodak developing machine, the material necessary for developing film negatives, and a number of carrier pigeons.

The yachts were photographed as they crossed the starting line at 11 o'clock A. M. Immediately after taking the picture he placed the developing machine, containing the developer, upon a table on the deck of the vessel, and in broad daylight developed and fixed the roll of exposed film. This was completed in about ten minutes. The finished film negative was hurriedly dried, then rolled up in small compass, and securely wired to a carrier pigeon under the tail, where it would in no way impede its flight. The pigeon was then released, and in exactly an hour and a half arrived at its loft in Newark, N. J.

The negative film was found upon it in good condition, and was at once removed forthwith to the newspaper office, where a print was made, and by 3:48 P. M. a half-tone plate was completed, by the usual half-tone process, placed on the press, and a few minutes later the paper appeared, containing a picture of the morning's yacht races. It was quite a novel idea to utilize the carrier pigeon for transporting picture film for purposes of quick reproduction, and in its way, is more positive than wireless telegraphy. We believe during the siege of Paris in 1870 letters reduced by photography down to extremely small size were transported by carrier pigeons to the outside world, and then enlarged by a lantern upon a screen large enough to read. But that was prior to the days of rapid photography or dry-plate or film machine daylight development.

An Edison Memorial.

Steps are being taken to celebrate the twenty-fifth anniversary of the introduction and commercial development of the incandescent lamp by founding a Thomas A. Edison medal, which will be intrusted to the American Society of Electrical Engineers.

The Institute, through its council, has already accepted the trusteeship of this fund, and the circular which is being issued by the Edison Medal Association announces that it is the intention that the medal shall be awarded each year to the graduating student who shall present the best thesis on some original subject from the universities and colleges of the United States and Canada which have regular courses in electrical engineering. Mr. Edison's mother was a Canadian.

The Current Supplement.

The floating workshop forming part of the new pontoon dock of Durban, described in a recent issue of the SCIENTIFIC AMERICAN, forms the subject of the opening illustrated article of the current SUPPLEMENT, No. 1464. Mr. B. J. Lamme discusses the application of single-phase alternating current for traction and railway service. Lord Kelvin's automatic tide predictor is described in a very instructive article fully illustrated. The grape, raisin, and wine production of the United States is the subject of a paper by George C. Husmann. Prof. A. Forsyth's address on "Universities: Their Aims, Duties, and Ideals," is also published. Mr. N. Monroe Hopkins shows how an electric water-bath for inflammable liquids can be made at home.

A Correction.

Concerning the article on "The Obelisk of Mont Pélé" in our issue of December 5, 1903, it should have been stated that both visits were made by Mr. E. O. Hovey under the auspices of the American Museum of Natural History, instead of one having been made under the auspices of the National Geographic Society. The American Museum of Natural History is now one of the foremost institutions in this country in exploration work, due largely to the liberality of Morris K. Jesup.

Marbled slabs of colored cement, for use as table-tops, are made by pouring the tinted cement in proper proportions on plates of highly polished mirror-glass, then stirring the paste. When hardened, it is removed from the glass. The pieces thus obtained have a polished surface that can be improved upon by brushing with a diluted solution of potassium silicate.

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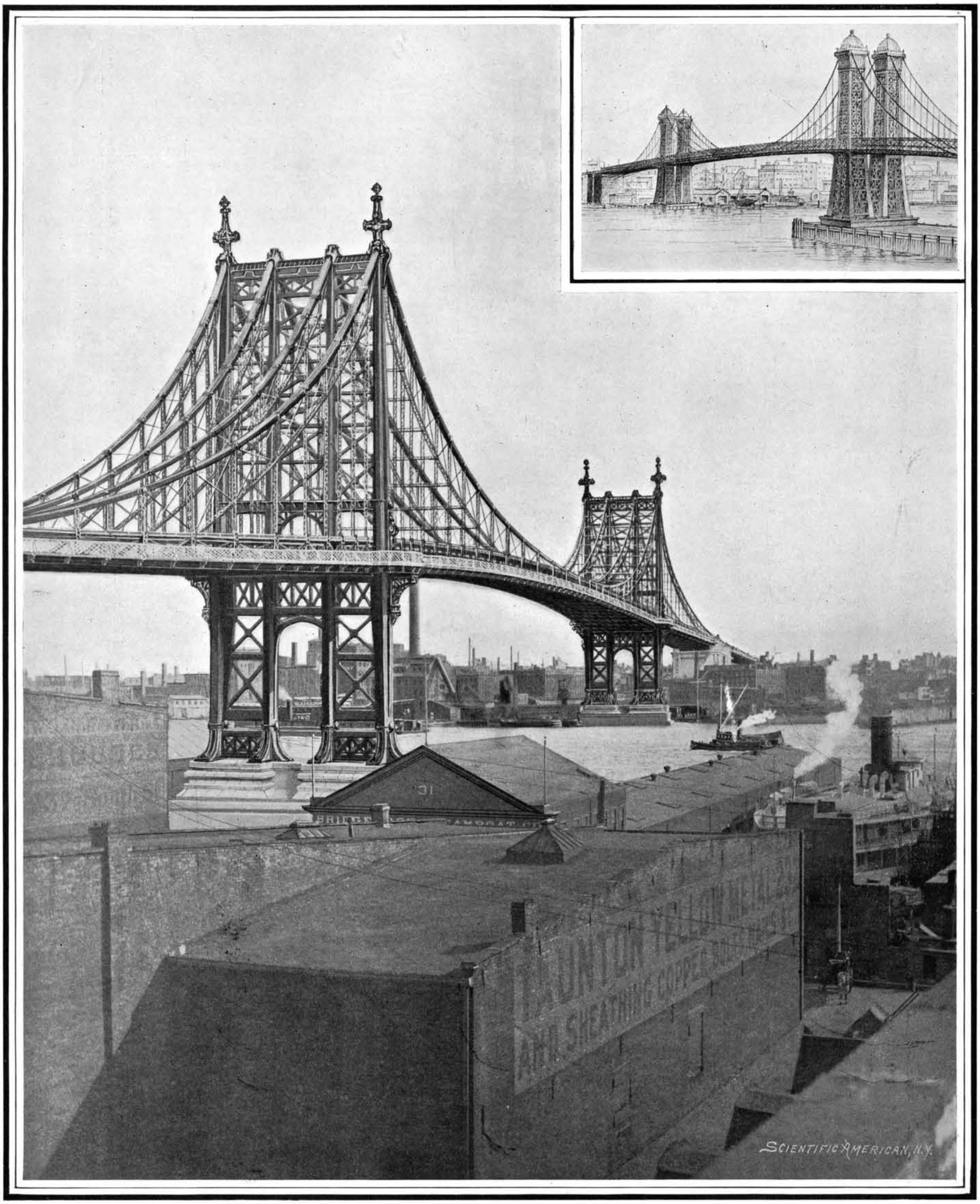

The first design, with wire cables.

Total length, 10,000 feet; length between anchorages, 2,920 feet; main span, 1,470 feet; height of towers, 400 feet; width of platform, 122 feet. Capacity of bridge: eight railroad tracks; a 35½-foot roadway; and two 12-foot foot-walks.

THE ACCEPTED DESIGN FOR THE MANHATTAN BRIDGE ACROSS THE EAST RIVER, NEW YORK, AS IT WILL APPEAR WHEN COMPLETED.—[See page 62.]