cations of a blossom bud, and when this appears, he knows the proper time has come to prepare to secure the juices of the plant. To "castrate" the plant, as the operation is termed, a long incision is made in the heart, or central thickened portion, and the tender leaves of the unopened leaf-cluster cut away. The opening thus produced is scraped and deepened until a cavity is made, into which the juices of the fully grown expanded leaves slowly filter. This sweetish, slightly acid liquor is known as *aguamiel* (honey water), and in its fresh state might suggest the odor of root beer. It is removed morning and evening, and can be collected from a plant for a month or more, about four quarts being the average daily product. This goes on until the plant is exhausted and the leaves withered.

The liquor is collected by means of a long narrow-necked gourd, hollow of course, and with a small hole at each end. Placing one end in the filled cavity of the plant, and the other to his lips, the collector withdraws the air by inhalation, the pulque filling its place. Then, closing the upper hole with his finger, the gourd and contents are carried to a waiting mule nearby, and the liquor transferred to goatskins or other receptacles secured to the saddle. In this way he goes from plant to plant where the juices are exuding. The larger illustration gives a good idea of the operation. I am indebted to Cox and Carmichael, photographers of Mexico City, for this illustration.

At the depot, or warehouse, the pulque is transferred to the reservoirs, which are often lined with oxhides, and a little sour pulque added to induce fermentation, the fermented liquor becoming cloudy, as though mingled with milk.

Having a wholesome fear of microbes, I did not feel equal to testing the virtues of pulque in any stage. The well-worn gourd with its mouth-hole, and the dark, greasy-looking goatskins, to say nothing of the general appearance of the peons in charge of operations, I think would deter a man with even a stout stomach. It has been stated that the distinguishing characteristic of pulque is the odor of decaying meat, and that in order to lessen this unpleasant smell, orange and lemon peel are thrown into the receptacles while the fermentation is proceeding. Nevertheless, the beverage is universally used, and is considered healthful when taken in moderation, especially in regard to its action on the kidneys. But many pulque drinkers in Mexico do not use it in moderation, and in a certain stage of fermentation it is quite intoxicating.

The earliest use of pulque is said to date back to the latter half of the eleventh century, and to the reign of the eighth Toltec chief, Tepzucoltzin.

Quite a different liquor is *mescal*, although it is the product of a similar plant, but with narrower leaves, for the group of plants called mescals are also *Agaves*. Some writers have stated that the mescal is distilled from pulque, but it is a mistake. The mescal distilleries are found in every portion of Mexico, but the best liquor comes from Tequila, in the state of Jalisco, west of Guadalajara, and is known as Tequila wine—or simply as "Tequila." It is a fearful intoxicant, although, aside from its fiery quality, its taste is not bad, faintly resembling Scotch whisky. The distilleries are for the most part primitive affairs, and, at Tequila especially, are interesting.

Tequila is a place of some 6,000 souls, located twenty miles from the railroad, and for miles in every direction around the city there are plantations of a particular form of *Agave* which sends forth its narrow leaves from a great bulb-like, cellular mass which forms the heart of the plant. This heart, when denuded of its stiff, sword-like leaves, and detached from the root, is cleft in two, and a dozen of these pieces make a fair load for a mule. Trains of mules or burros may be seen all day in the streets of Tequila transporting the Agave heads from the country to the distilleries. One of the small illustrations shows this process.

The first operation that the raw product goes through is the baking or roasting. This is done in pits dug within the distillery inclosure. These are four or five feet deep, and considerably wider. A hot fire is built of mesquite wood, large stones being distributed through the fuel. The cleft heads of the mescal plants are then heaped over the burning mass until a huge mound is formed. This is covered with grass, and finally with earth, and the mass left for several days to cook. When the mound is opened the raw product is found to have changed to a dull brown in color, and the juices to have been converted into sugar. While hot and steaming the material is taken to another pit, stone-paved, on the bottom of which revolves a big stone crusher, driven from a sweep by mule power. Here it is ground into pulp, and the semi-liquid mass transferred in deep trays, borne upon the heads of Indians, to the vats, where it remains until fermented. Then it goes to the still, and finally is run off as mescal.

The finished product is a colorless liquor, sometimes with a slight amber tint, though much of it is like alcohol. Some of the higher grades bear fancy names, such as "Crema-Sauza"—meaning the cream of production of the establishment controlled by the Sauza family—and such names become trade marks designating quality.

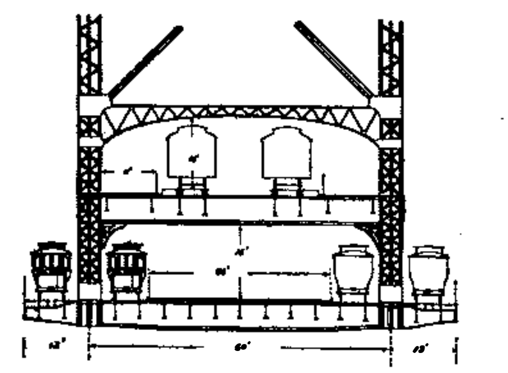
Another Mexican liquor, called *Zotol*, is produced in the more northerly portions of the country. It is likewise produced from the bulbous part of an *Agave*, a small species with extremely narrow leaves, like the true *Dasylirion*. I have not seen this spirit, but was told it is so strong that 95 per cent alcohol is mild in comparison.

Still another fiery liquor is distilled from sugar cane, and is called *aguardiente* (burning water). Why these strong liquors should be so popular with the Mexicans is surprising, but it should be remembered that these people are also fond of such hot substances as "chile" and "tabasco."

BLACKWELL'S ISLAND BRIDGE.

After a checkered career extending over a period of twenty years, the scheme for the construction of the greatly-needed bridge across the East River at Blackwell's Island has at last taken definite and final shape in the issuance of the plans and specifications for the superstructure from the office of the Commissioner of Bridges.

The first franchise for the bridging of the river in this vicinity was granted to a private individual as far back as 1884, but it was not until the latter part of the year 1898 that plans were drawn up by the Commissioner of Bridges and received the approval of the Board. The site selected has its Manhattan terminus on the block bounded by Fifty-ninth and Sixtieth Streets and Avenues A and B, and the original plan contemplated the erection of a cantilever bridge of five spans, carried on four piers, one pier on each shore of the river, and two intermediate piers on Blackwell's Island. Work was commenced on the piers in the latter part of September, 1901, and was carried forward so slowly that on the first of January, 1902, the value of the completed work was only about $42,000. The original plans were revised by the present Bridge Commissioner, the changes affecting chiefly the superstructure, the alterations in the piers themselves being of minor importance and largely of an architectural character. The revised plans call for two cantilever bridges consisting of the following spans: A shore span on the Manhattan side, 469 feet 6 inches in length; a river span of 1182 feet; a center span across the Island, 630 feet in length, followed by a river span 984 feet long over the easterly channel, and a shore span on Long Island, 459 feet in length. The changes in the piers include a system of elevators and stairways designed to afford access to the bridge from Blackwell's Island.



CROSS SECTION, BLACKWELL'S ISLAND BRIDGE.

On upper deck, two elevated railroad tracks and two 11-foot pathways. On lower deck, two overhead and two underground trolley tracks and a 36-foot roadway.

We present on the front page of this issue a perspective view of the bridge taken from a point on Manhattan Island which affords an excellent idea of the architectural and engineering features of the structure as they will appear when the structure is completed. The bridge will be made up of two lines of trusses, spaced 60 feet from center to center. The top chord, which is the main tension member, will consist of eyebars of nickel steel, which will be made 12 inches to 18 inches in depth and will vary in number according to the stresses that have to be provided for. The bottom chord will be of standard box construction, of the kind that is universally in use in long-span bridges in this country. The floor system will be carried on very heavy transverse floor beams, which will extend beyond the trusses for a sufficient distance to accommodate two lines of underground trolley cars. Between the floor beams will be worked in the usual plate steel stringers, and the whole floor will be covered with buckled plates. It is needless to say that the two great channel spans will take rank among the longest trussed spans in the world. In the United States, the longest bridge of the trussed type is the Wabash Bridge at Pittsburg, which has a clear span of 812 feet. The bridge will be double-decked throughout. On the upper floor provision will be made for two elevated railway tracks, with two foot-walks, each 11 feet wide, carried on the outside of the elevated tracks and between them and the cantilever trusses. On the lower floor, adjoining the trusses, will be two tracks for overhead trolley cars, and on the outside of the trusses will be two tracks for the underground trolley cars. Between the overhead trolley tracks will be a splendid roadway for vehicles, with a clear width of 36 feet.

The towers will consist each of two massive legs of box-section, which will be spaced 93 feet from center to center transversely at the base and 60 feet from center to center at the top of the towers. The height measured from center to center of the chords at the towers will be 185 feet. The two legs of the tower will be heavily sway-braced, and at the top they will be connected by deep lattice trusses and by a blunt arch designed to harmonize architecturally with the general treatment of the whole bridge. Above the towers will extend lofty, ornamental finials of open ironwork.

The tests required of the nickel-steel eyebars call for an ultimate strength, unannealed, of 90,000 pounds to the square inch, an elastic limit of 54,000 pounds to the square inch, and an elongation of 18 per cent in 8 inches, with 35 per cent reduction of area. The annealed specimens must show 85,000 pounds ultimate strength, 50,000 pounds elastic limit, 20 per cent elongation in 8 inches and 40 per cent reduction of area. An annealed test piece of 4 inches width or more must be capable of being bent cold 180 degrees around a pin, whose diameter is twice the thickness of the test piece, while the unannealed specimen must bend 180 degrees around a pin whose diameter is three times the thickness of the test piece.

In addition to its own dead load the bridge is designed to carry live loads of 6,300 pounds per linear foot of bridge, as ordinary traffic, and 12,600 pounds as congested traffic, while unusually heavy, concentrated loads are assumed for the floor system. The foot-walks are to be constructed to carry a maximum load of 100 pounds on every square foot. The under side of the floor of the bridge will have a clear height above mean high water of 118 feet, and the maximum grade will be 3.4 per cent on both the New York and Brooklyn approaches. The total length of the bridge, including the approaches, will be 7,636 feet, and the total estimated cost, including the purchase price of the necessary land, is $12,548,500. It is expected to have the bridge completed by the first of January, 1906.

Aftermath of the International Wireless Congress.

The United States, Germany, Austria, Spain, France, and Russia have signed the protocol adopted at the recent International Congress for Wireless Telegraphy held in Berlin. Great Britain and Italy have so far withheld their signatures. The protocol provides for the construction of coast stations to allow communication with ships at sea regardless of the particular system of wireless telegraphy which a vessel may happen to use. To facilitate the transmission of messages the protocol also provides for the technical explanations of all systems. A general system of charges is to be introduced. Services are to be so regulated that signal stations will disturb one another as little as possible.

Great Britain thought no system should be used unless a certainty of connection was guaranteed. Italy supported Great Britain, declaring that it could not repudiate its agreement with Marconi.

Fossil Pollen Grains.

M. B. Renault contributes an article on the occurrence of fossil pollen grains. These may be preserved either in organic media, lignite, bog-head or pit-coal, or in such mineral substances as calcium carbonate and silica. They are found in primary beds, and are generally dispersed or may be located in the pollen sacs or in the interior of pollen chambers. The structure is so well preserved that projections representing the pollen tubes are evident, and in some cases the division of the grain into cells, e. g., the prothallus, may be clearly distinguished. In the case of *Stephanospermum*, which is assigned to the gymnosperms, there is evidence of quite a definite pollen tube, and similar appearances are noted for the genus *Aetheotesta*. In some cases the pollen grain is devoid of the outer layer, the exine, which Renault believes has been shed that the pollen grain may pass through the entrance into the pollen chamber. In the case of *Dolerophyllum*, a genus placed in the Cordaiteæ, part of the wall becomes detached like an operculum to allow the prothallus to grow out or possibly to allow the antherozoids only to escape, and find their way to the archegonium.—Comp. Rend.

It is reported that a hot spring has been struck in the workings of the Simplon Tunnel, and the increased heat is unbearable. About two miles remains to be bored.

Electrical Notes.

Henri Moissan has succeeded in reducing tantalum acid in the electric furnace with powdered carbon and has obtained tantalum in a fused state. Hitherto the metal had been known only as a more or less pure powder with a density of 10.50. The electrical product has a brilliant metallic appearance, and a density of 12.79. It is very hard, easily scratching glass and quartz, has a crystalline fracture, and is infusible in the oxyhydrogen blowpipe. Certain reactions class it with the metalloids rather than with the metals proper.

The system of posting and collecting letters by electric trams which has been successfully tried in some of the northern towns of Great Britain, is being adopted on the electric tramway system at Sydney, in New South Wales, but on a more extensive scale. The scheme includes the erection of a small clearance office at one of the important termini, and letters as they are cleared will be sent off by messengers to the general post office every 15 minutes. In this way, it is believed, communication between the suburbs and the city will be greatly expedited, and this has certainly been the experience of those places which have adopted the system in this country. It is also proposed to arrange for boxes to be put on cars running to the railway station, so that letters too late for the general mail at the post office may be posted on any car reaching the station before the departure of the mail train. There is some difference of opinion at present as to the rates to be paid by the post office for these privileges, but it is hoped that a fair agreement may be come to which will allow the scheme to be put into operation.

In a paper published in a recent issue of Glaser's Annalen, M. E. Cserháti makes an interesting comparison as to the relative advantages of steam and electric locomotives for main line traffic, using as basis figures noted on the Valtellina line. On this line it has been found that on the average each ton moved a kilometer requires 33.5 watt-hours, as measured at the central station switchboard. The daily output averages 9,600 kilowatt-hours, the cost per unit being 1.94 centessimi (.352c.), and 1,000 ton kilometers cost therefore 65 centessimi (11.8c.). With steam traction on the same line the cost for coal was 235.6 centessimi (43c.). An increase in the traffic density would still further improve the showing of the electrical plant. For equal tractive power the electric locomotive is much lighter than a steam locomotive, even when the tender, weighing from 20 to 50 tons, is not taken into account. It appears further that, for some reason or another, the coefficient of adhesion is markedly greater with the electric locomotive, ranging from 25 to 30 per cent of the weight on the axles, while with steam engines it generally runs at about 16 per cent. This feature of the electric locomotive is particularly favorable in the case of mountain lines. The internal friction is also much less. Thus, in the case of a steam engine running at 40 miles per hour, the resistance is about three times as great as that of wagons carrying an equal load; while with the electric engine it is only 20 per cent more than in the case of ordinary wagons.

In a report presented to the International Congress at Düsseldorf, L. Gérard gives his experience with electric traction on the Charleroi-Brussels canal. He finds that the ordinary towpath is quite unserviceable, the coefficient of traction being 4 or 5 kilogrammes per ton. The number of units taken per barge-kilometer varied with the time of year, i. e., with the condition of the towpath, between 3.04 in March and 2.24 in October, 1901. The efficiency of the tractors after a year's service is about 0.48. Unloaded and traveling at 4 kilometers per hour, the tractor takes 4.1 kilowatts; when hauling a barge of 70 tons at the same rate, the power required is 4.86 kilowatts. The wear and tear on the wheels of the tractors, which are of cast Martin steel, is very serious; and the author considers that repairs of all kinds cost three times as much as they do on an ordinary tram line of the same length. It had been supposed that either heavy tractors would be necessary to secure adhesion or that a rack rail would be necessary. Experiments were undertaken on the canal with a view to finding the pull at starting. With a heavy tractor running on the towpath, and a pull falling from 625 kilogrammes to 120 kilogrammes, a speed of about 3.5 kilometers per hour is reached in 50 seconds, with a barge of 70 tons; with a tractor weighing 1,650 kilogrammes, and giving a steady pull of 264 kilogrammes, the same speed would be reached in about 30 seconds. Some experiments which were carried out at Oisquercq under rather unfavorable conditions showed that full speed could be reached in about 45 seconds with a light tractor on rails; and this tends to confirm the result of theoretical calculations. Gérard therefore advises that rails should be laid on the towpath, and the experiments continued.

Engineering Notes.

On June 30 last there were 57 warships of 319,700 tons displacement in course of construction in England. Of this number 12 vessels were being built in royal dockyards and 45 in private yards.

According to the latest account the great Simplon tunnel of the Alps is about three-quarters completed, and when finished will be 14 miles long, or twice the size of the Mont Cenis bore. It is expected that the Simplon tunnel will be ready for use in about two years. One of the greatest obstacles encountered in the work is the high temperature in the center of the bore, which compels the employment of two gangs of men on short shifts. Power for compressing air for the drills and refrigerating the tunnel is furnished by a flow of water from the south end of the bore at the rate of 15,000 gallons per minute. It is estimated that the cost of the tunnel alone will be about $1,000,000 per mile, or nearly the same as the contract for the subway under New York city.—Engineering and Mining Journal.

In a paper read before the Aberdeen Mechanical Society, a few suggestions were made on the subject of belt-dressing. Leather belting can be made to transmit the maximum of power when careful attention is paid to its condition. The driving face of the belt should be kept in a clammy or mastic state by applying a good coating of a trustworthy belt dressing at intervals of about eight weeks. The dressing should be made up of fish oils and animal fat to a consistency of soft ointment, spread over both sides of the belt with a square brush like a shoe brush. A belt attended to in this way will run much slacker than a dry belt, and the pulling side will hug and suck to the pulleys, while lifting the load without slip. There will be no loss of power from overstrained bearings; a dressing of this sort keeps the leather fresh and prevents the atmosphere from penetrating into and drying the natural sap out of the leather, while preserving its life for many years. Mineral or vegetable oils should never be used. Castor oil dressing soon causes leather to perish and rot. Boiled linseed oil makes a capital dressing for cotton belting; it soon oxidizes and gives the cotton belt an elastic gummy driving face.

The most reliable method to determine the steam consumption of an engine is to make an evaporation test; that is, to measure the water fed to the boiler in a given time and delivered to the engine in the form of steam. This method, however, entails considerable trouble and expense. So engineers often figure out the water consumption from indicator diagrams. The terms water consumption and steam consumption are here used indiscriminately, for a pound of water will produce a pound of steam at any pressure. Figuring that way can never be wholly accurate, because the data requisite to insure results are not thus procurable. That is, the amount of water accounted for by the indicator is always considerably less than it ought to be because of cylinder condensation, valve and piston leakage, to the extent that it might be that only 50 per cent, or at best not more than 90 per cent, of the water passing through the cylinder would be accounted for by the indicator. But if the cylinder were properly steam jacketed, or if superheated steam were used, and there were no leakage of steam from valves or pistons, the water consumption could be closely calculated from an indicator diagram.—Mining and Scientific Press.

A German invention recently announced comprises a system for obtaining motive power economically by the use of working fluids having widely different boiling points, which are employed in the motor cylinders at temperatures above the critical temperature. From a general description, it seems that the invention embodies a combined steam and gas engine and a liquefied carbonic acid apparatus. In this combustible gas drawn from the producer or generator, or from any other suitable source, is forced into the motor cylinder along with oxygen, or air rich in oxygen, drawn from a holder, and is there ignited. At the same time superheated water is injected from a heater, and is converted into steam, the quantity of heat supplied being such as to keep the temperature above the critical point. The exhaust from this cylinder is then circulated round the carbonic acid cylinder, and through a coil tube generator, in which the liquid carbonic acid is gasified, and a portion is then finally delivered into the gas producer, to be reduced, and the remainder is discharged into the chimney. The exhaust from the carbonic acid engine is again liquefied to be used again in a coiled tube condenser, cooled by an ammonia compression apparatus, consisting of a compressor and water-jacketed condensing coil. When liquid oxygen is employed, its pressure may first be utilized in another working cylinder before it is passed into the gas producer or generator. Among the liquids of low boiling point that may be utilized are alcohol, benzol, ether, acetone, and sulphurous acid.

German Toy Industry.

The toy industry of the Erzgebirge, or Ore Mountains, which has been developing for centuries, has been slowly drifting into economic difficulties. With the application of steam power and modern machinery to the production of toys the house industry has been gradually forced to the wall. With an increase in the price of wood and a decrease in the price of the finished product these people of the mountains have been put into a position where it is necessary to toil night and day for a meager existence, which is apparently becoming more and more severe.

For some years the labor press of this part of the country has busied itself with a portrayal of the wretched conditions existing among the peasants of the mountains, with the result that an investigation was recently made by the industrial commission of Freiburg which largely substantiates even the strong representations of the labor organs. The main point of the report of this commission may be summarized as follows:

The number of large establishments engaged in the manufacture of toys is increasing. This might be considered *prima facie* as a welcome sign were it not for the fact that the toys are not manufactured upon the regular factory plan with hired hands, but are made by men who have rented space and machines quite independently of one another, and who form a sort of voluntary association banded together only for the sake of economy in roof and equipment, but carrying on their own separate businesses. A disinclination is said to prevail among the young men to enter a factory on the basis of wage-earners and be subjected to the immediate control, supervision, and direction of an employer. Rather than earn the higher income afforded by the factory wage the young men in the hills prefer a much more meager existence in the independence and freedom of their own homes. Because of the fact that the inhabitants of the mountains make but few and simple demands upon life, the real wretchedness of their situation is said to be but rarely fully appreciated.

The wage conditions existing in the toy industry can be readily observed from the following figures prepared by the commission referred to: The most remunerative branch of the trade affords a gross income of from 24 to 40 marks ($5.71 to $9.52) per week, one-half of which may be considered as profit. In other branches the net income is as low as 6 to 9 marks ($1.42 to $2.14) per week. It must be remembered that these incomes are not the earnings of a single person, but represent the labor of entire families.

How inconceivably small the price paid for certain kinds of toys is can be seen in the case of pencil boxes of the cheapest quality, for which the maker gets from 48 to 58 cents per gross.

The daily meals of these people are reported by the commission to be confined largely to potatoes, linseed oil, bread, and coffee, and, at times, meat on Sundays.

With the price of wood rising, toy factories increasing in numbers in other parts of the country, and the price of toys falling, it seems that the people of the Erzgebirge must, in their increasing wretchedness, find some other means of sustenance. Exporters of toys who operate large factories in this neighborhood report good business and are of the opinion that the house industry of the Erzgebirge is doomed, and that the peasants will be forced to give up their independent production and enter factories.

Cerium Silicide.

Sterba has obtained cerium silicide, $CeSi_2$, in the form of steel-gray, brittle, microscopic crystals, by heating together in the electric furnace cerium oxide and pure crystalline silicon. Reaction is immediate, and is complete on fusion. The button of crude silicide is freed from adhering silicon by digestion on the water-bath with caustic potash, when $CeSi_2$ is left in a pure crystalline condition. It is insoluble in water, has the specific gravity of 5.67 compared with water at 17 deg. C., and is insoluble in organic solvents. Hydrogen is without action on it at all temperatures. Fluorine combines with it, in the cold, with incandescence; iodine, bromine, and chlorine only when heated. At ordinary temperatures, air and oxygen are without action on it, but when heated to redness the latter combines, and, in a flame, $CeSi_2$ burns with brilliant sparks. Sulphur and selenium combined with it at their boiling points with a slight emission of light. Gaseous HCl attacks it at a red heat. HCl and HF in solution and other mineral acids decompose it, liberating hydrogen. Organic acids only react with it when heated. Alkalies in aqueous solution have no action, but the same in a state of fusion combine, with incandescence. $CeSi_2$ melts in the electric furnace, forming a crystalline, silvery mass when cooled. In general properties it differs from calcium silicide, and resembles the compounds of silicon with the heavy metals. It is quite distinct from the cerium silicide, Ce_2Si, obtained in 1865 by Ulik, by the electrolysis of cerium fluoride and of potassium.—Comptes Rend.

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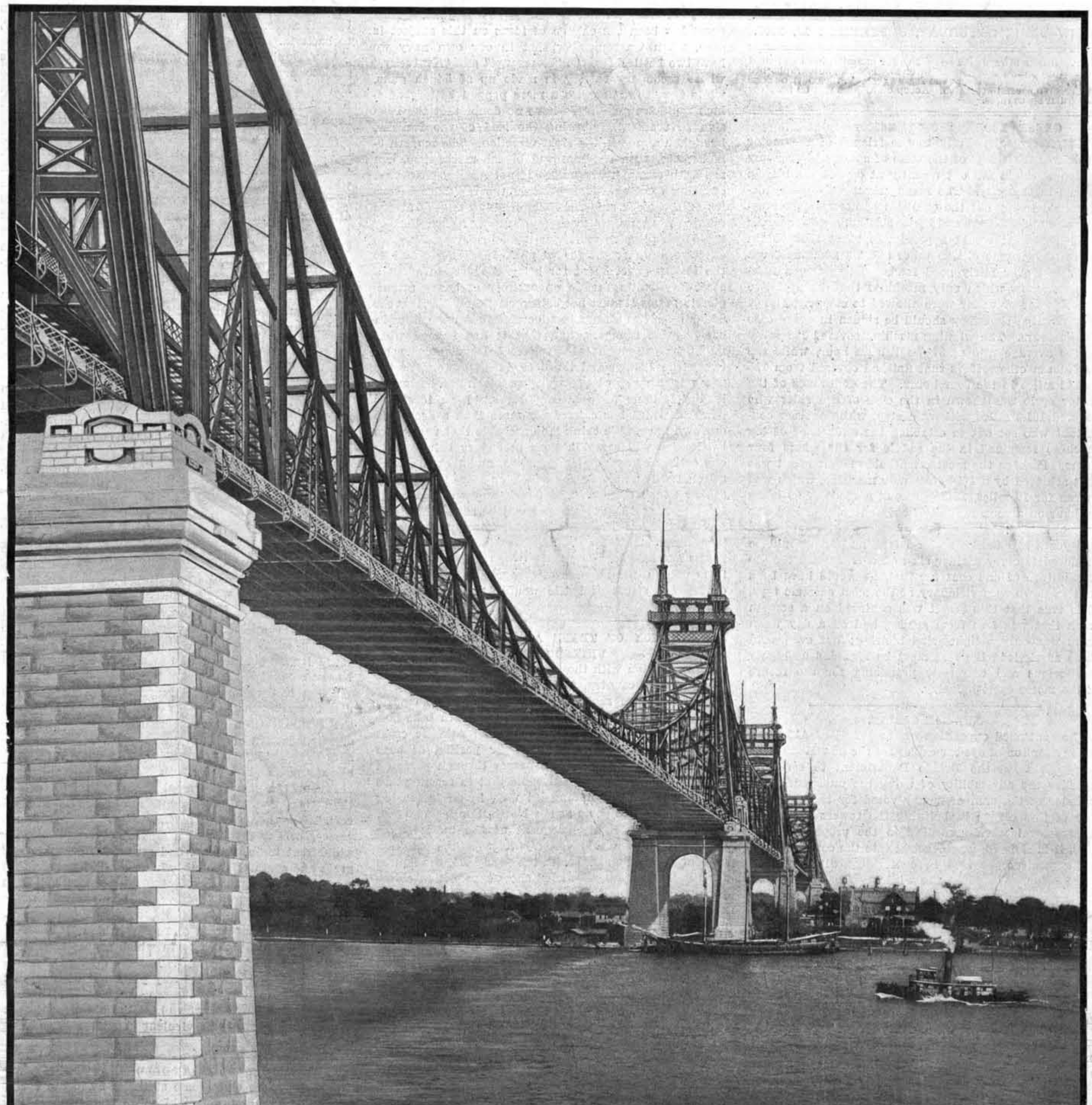

THE NEW BLACKWELL'S ISLAND BRIDGE, NEW YORK CITY, NOW UNDER CONSTRUCTION.

Total length, 7,636 feet. The two river spans are 1,182 feet and 984 feet in length.—[See page 202.]