### THE NEW YORK AND LONG ISLAND BRIDGE, NEW YORK CITY.

We present in this issue an illustration of the great steel cantilever bridge by which the Long Island Railroad Company expects in due course to run its trains into New York City, and thereby add to the transit facilities of Greater New York. As our readers are doubtless aware, the New York Central and Hudson River Railroad is the only one of the trunk lines that possesses a terminus on Manhattan Island, and is able to land its passengers in the heart of New York without the inconvenience of a ferry trip across either the Hudson or the East River. Except the New York and New Haven Railroad, which has running privileges over the tracks of the New York Central, all the other companies are compelled to place their termini on the shores of New Jersey or Long Island, and subject their patrons to the delays and greater or less discomforts of ferry travel before they reach the metropolis itself. It was only a question of time before the problem of reaching Manhattan Island either by bridge or tunnel should be agitated, and at the present time there are three schemes on the New Jersey and three on the Long Island side for making a through rail connection. Two mammoth suspension bridges have been designed to cross the Hudson River, one at Fifty-ninth Street and the other at Twenty-third Street, and about a mile and a half below Twenty-third Street is the well known Hudson River tunnel, which has been constructed for three-quarters of the distance beneath the bed of the river. It is also proposed to make rail connection by a tunnel from the lower end of the city to Brooklyn, and by two bridges, the East River Bridge from Delancey Street, New York, to a terminus near Broadway, Brooklyn, and the New York and Long Island Bridge, which forms the subject of our front page illustration. Although all of the above mentioned schemes are primarily intended to give an all-rail connection with New York City, the bridges will in every case make ample provision for vehicular and pedestrian traffic, and will thus form important thoroughfares to link together the street systems of Greater New York.

The bridge now under consideration will carry the tracks of the Long Island Railroad Company into New York City, which it will enter between Sixty-fourth and Sixty-fifth Streets. A great terminal station will be built on Manhattan Island which will cover the entire block bounded by Second and Third Avenues and the streets above mentioned. The station will be 610 feet long by 200 feet wide, and the platforms will be 54 feet above the street level. The basement will be occupied by the machinery for elevators, etc., and by a large cold storage plant, the space devoted to cold storage alone comprising 480,000 cubic feet. On the ground floor there will be stores, a large restaurant, and a central hall 50 by 70 feet, facing which will be six large elevators, each having a floor space of 150 square feet. Behind the elevators will be two express rooms. A covered carriageway will lead from Sixty-fourth to Sixty-fifth Street. The space from the carriageway to Second Avenue will be given up to a market. The second floor will be at the same level as the platforms of the elevated roads on Second and Third Avenues. It will contain a large entrance hall 50 feet by 150 feet, several large restaurants, and a number of spacious galleries from which it will be possible to look down upon the market below. Above the entrance hall on the second floor will be a waiting room, 80 feet by 175 feet, and the various ticket and telegraph offices and bureaus of a large terminal station. Outside the waiting room will be a broad platform extending to the track buffers. There will be twelve tracks in the station, and the whole will be covered by a lofty roof, carried on arched steel trusses, in which liberal provision will be made for lighting and ventilation.

Outside the station the twelve tracks will converge to a massive four track steel viaduct, which will be of standard construction, and will be built parallel with the streets and through the middle of the blocks until the portal of the great western cantilever is reached. The viaduct approach on the Long Island side will be about a mile in length, the street grade being reached probably at Hulse Street and Middleburg Avenue.

The problem of crossing the East River at this point is greatly simplified by the existence of Blackwell's Island in the middle of the river. By locating two piers on each side of the island, and placing the cantilever piers close to the bulkhead lines of New York and Long Island, it has been possible to reduce the length of the channel spans to 846 feet, the intermediate span across the island being 613 feet in length. The bridge is built on the cantilever principle, and in its outline it will remind our readers of the high level bridge across the Hudson River at Poughkeepsie. The likeness is merely one of general outline, for in respect of weight and size the present structure will easily outrank every bridge of the kind in America, and, with one exception, in the world. The Forth Bridge, in Scotland, is the largest cantilever structure in existence, its two channel spans being 1,710 feet in length, and it is likely to remain forever the longest, for the reason that when the distance to be bridged exceeds 1,200 feet it is found that sufficient rigidity can be obtained in a stiffened suspension bridge—a type that costs considerably less than the cantilever, especially in bridges of exceptional length of span.

The bridge is made up of two cantilevers, each 500 feet long, one on the New York and the other on the Long Island side, a deep parallel truss across the island with overhanging cantilever arms at each end, and two intermediate spans, each 350 feet long, suspended above each channel. Perhaps the most striking, and certainly the most handsome, feature will be the six massive piers which carry the structure. Four of these will practically carry the whole of the weight, the end piers being used as anchorages for the inshore arms of the end cantilevers. The four channel piers measure 45 feet by 85 feet at the base, and will be carried up to 135 feet above high water, the requirements of the War Department calling for a clear headway of 135 feet below the bridge at high water. The foundations are carried down to solid rock, which has been found at from 20 to 50 feet below mean tide. As will be seen from the illustration, they are of very massive appearance, the four channel piers containing 810,000 cubic feet of Connecticut granite, and the two anchor piers 216,000 cubic feet of the same material. It was originally intended to carry the piers up solid from foundation to capstone, but subsequently the design was changed by piercing the center with an arched opening—a modification which will add greatly to the architectural appearance of the whole structure.

The trusses will be of the well known pin connected Pratt type with divided panels. They will be placed 56 feet apart and the space between them will be occupied by four lines of track, those which are laid next the trusses being used for local trains and the other for express service. The floor system will be of the standard type, consisting of deep plate steel floorbeams, riveted at their ends to the posts and vertical ties, with plate stringers, riveted to and between the floorbeams and extending the full length of the bridge beneath the rails.

On the outside of each truss is a wagon way and a six foot sidewalk, the sidewalk rails forming the extreme outside line of the bridge. This will be carried upon cantilevers or brackets, which are in reality extensions of the floorbeams. From the ends of the bridge the wagon ways will descend on a regular grade to the street level, and here they will be carried by the posts of the viaduct to which the brackets are riveted, as shown in our illustration.

The total width of the bridge outside the footwalks will be 98 feet. The greatest depth of the trusses will be 100 feet, measured from center to center of pins, and the total height of the top chords above high water will be 235 feet. The total length of the whole structure between terminals will be two miles. Thirty-six thousand tons of steel will be used in the superstructure, and the estimated cost of this great work, including the terminals, is $8,000,000.

It can well be imagined that the various members of a bridge of this size will be of exceptional size, and perhaps the best idea of this is conveyed by the dimensions of the steel pins which transmit the weight of one cantilever to the piers. Each of these is 20 inches in diameter, 9 feet 6 inches long, and weighs four tons. The many eyebars and compression members that are packed snugly against each other at this point represent, therefore, a solid mass of steel nearly ten feet in thickness.

In erecting the bridge, temporary falsework will be built between the two island piers and between the anchorage and river piers. Upon this the island span and the two shore arms of the cantilevers will be erected in the usual way. The ends of the shore arms will be bolted down to the anchor piers. The temporary falsework can then be removed, leaving the trusswork self-sustaining. The river or channel arms of the cantilevers can now be built out over the river, the weight of the overhanging parts being counterbalanced by the inshore portion. The center truss is built in the same way, the junction being finally made at the middle of the span.

It should be mentioned in conclusion that the bridge will embody in its construction the best features of the pin connected and riveted systems of bridge construction. The whole of the massive wind and sway bracing will consist of built up plates and angles with riveted connections to the trusses.

Our thanks are due to Mr. A. C. Bedford, treasurer of the Long Island Railroad, for courtesies extended during the preparation of the present article.

### A Copyright Decision.

Amberg File and Index Company v. Shea, Smith & Company, 79 O. G., page 514. An index for the storage of letters is not proper subject matter for copyright. It is not a book within the meaning of the word in the Constitution, since by itself, that is, without the letters for which it is used, it forms no medium of information or intelligence. Nor is the inventor of such an index an author as that word is used in the Constitution. A monopoly for the index might perhaps have been secured under the patent laws.

### Recent Patent and Trade Mark Decisions.

Imperial Chemical Manufacturing Company v. Stein (U. S. C. C. A., 2d Cir.), 77 Fed., 612.

Neglect to Sue for Infringement.—The patent in this case was for a process of dyeing hair and the chemical preparations constituting the dye bath. The defendant sold the patented hair dye for about fifteen years in New York City, during which period of time it seems that the owner of the patent lived in that city but did not protest against the infringer of the patent. The failure, however, to make such protest when there is no evidence that she knew of the infringement, excepting that she happened to live in the same city, should not defeat a recovery for the infringement.

Newton v. Buck (U. S. C. C. A., 2d Cir.), 77 Fed., 614.

Sale of Patent by a Receiver in Proceedings Supplementary to Execution.—Buck transferred, in writing, to a firm certain patents, but, accidentally, one patent included in the agreement was omitted in the writing. Afterward all rights under the agreement were assigned by the firm to Newton. Then a receiver of the property of Newton was appointed by the State Court in proceedings supplementary to execution. By order of the court the receiver sold Newton's interest in the omitted patent and the purchaser transferred the same back to Buck. The equitable title that Newton held in the omitted patent by the receiver's sale passed to Buck and a subsequent assignment thereof by Newton passed no interest.

Muller v. Lodge & Davis Machine Tool Company (U. S. C. C. A., 6th Cir.), 77 Fed., 621.

Increase of Efficiency Ground for Patentability.—If an inventor has greatly increased the effectiveness of a mechanism, his patent will be sustained although his elements are old and no origiual results are accomplished. The patent in controversy was on a tool holder for lathes. The patentee had arranged old elements in such a way that by a conjoint use of two nuts he much improved the effectiveness and accuracy of old devices serving the same object. The patentee is not only entitled to the conjoint use of the two nuts in combination with the rest of the device claimed, but also to the benefit of every suggested conjoint use of these nuts which adds to the effectiveness of his mechanism, although not claimed as within the purpose of the invention.

Limitation of Claims.—If the invention patented is not a pioneer or primary invention, and reference letters be used in the claims, they will be limited specifically to the combination of all the elements specified; but if the invention be broad and meritorious, working a decided advance in the art, it will require something more than the use of reference letters in the claims to limit them to the exact form of device described.

Tool Holders for Lathes.—The Muller patent, No. 272,304, must be limited, as to claims 2 and 4, to the precise structure claimed by reference letters and the patentee is not entitled to a liberal application of the doctrine of mechanical equivalents.

Steel Clad Bath Company v. Mayor, Lane & Company (U. S. C. C., N. Y.), 77 Fed., 736.

What Amounts to Invention.—The fact that one is the first to produce an article having features long desired, that he has succeeded where many others failed, entitles him to a patent; and this fact, even if there are doubts as to novelty, should resolve the question in his favor. On this ground a claim for a bath tub composed of a smooth sheet metal casing having a lining of copper, aluminum, etc., pressed into close contact therewith, is valid and is infringed by a tub in which an asbestos sheet of very slight thickness is placed between the casing and lining.

Bath Tubs.—The Booth patent, No. 458,995, has been held valid.

Repairing a Patented Machine.—The fact that a device is patented does not prevent the owner from putting it in order when it gets out of repair, but when it is accidentally destroyed or is practically worn out, the owner cannot make a new machine under the guise of repairing it.

Goodenough v. Cary (U. S. C. C., N. Y.), 77 Fed., 827.

Lacing Studs.—The Mathison patent, No. 525,152, for an improvement in lacing studs whereby nonmetallic, plastic metals, such as hard rubber or celluloid, may be fastened to the heads thereof by attachment to a crimped or corrugated flange, has been held void as lacking invention because it was like the old studs in every way except that the celluloid is held in place by minute depressions and elevations called crimps, instead of by minute depressions or elevations called lips.

Berry v. Wynkoop-Hallenbeck-Crawford Company (U. S. C. C., N. Y.), 77 Fed., 833.

Money Checks.—The Berry patent, No. 268,988, for an invention consisting in providing checks or other papers representing money values with marginal tables of figures to be torn off so as to prevent raising or altering the amount, is void for want of invention over the prior art, especially the Stanfield 1873 patent.

**The Sun and His Relations to the Earth as Parent, Ruler and Energizer.***

The sun is the most glorious of all objects. Swedenborg made the sun, in his system, the correspondent of the Deity; the agent by which power and life were given to the inhabitants of surrounding worlds. Of all the energy that keeps things moving on earth, 99 per cent comes from the solar heat. The meteors help and the moon gives us tides; but 99 per cent of all the force that moves our mills, actuates our own hands and voices, comes from the solar rays. If the winds blow, it is because of some disturbance in the air. What is the cause? At some point or other the air is unequally heated; masses of air rise; other portions rush in to take their place and you have winds established. If Niagara does not run out: if Lake Superior does not find its way permanently to the ocean; if the Delaware does not stop running; it is because somewhere or other there are pumps running that lift the water back to the source, and those pumps are in the sun's rays. The constructor of the first steam engine says it is "nothing but bottled sunshine." What built the carbon in the stick of wood from which we derive heat? Simply the solar rays putting the elements of wood together in a certain way, and when you burn the stick you are allowing the hydrogen to resume its old combination with the oxygen from which it has been separated before. The power that actuates results is solar power, because derived from the food built up by solar rays. If you use a galvanic battery, a zinc and carbon battery with acids in it, how was the acid got out of its combinations and put in such shape you could use it? If you trace back the chemical processes by which we get these things used in a battery, they were put in shape by the solar rays. If you leave out the heat coming from the stars (as much in a year as the sun gives in a second), and the heat from the meteors (about as much as that), and all the tidal power, all the rest is sun power.

I am speaking within a quarter of a per cent when I say the sun is about 93,000,000 miles away—12,000 times the diameter of the earth; so that the quickest railroad train, on a schedule of 60 miles an hour, would be 175 years on the journey. New York is a little better off than Pennsylvania for cheap railway fares, so that at two cents a mile it would be a little over one and three-quarter millions of dollars.

The unit employed in measuring star distances is 63,000 times the distance from us to the sun. Stellar distances are vastly greater, and our sun is no greater than any other sun. Our sun has a diameter of 860,000 miles, or $\frac{1}{108}$ part of its distance from us. The quantity of matter in it is 330,000 times that of the earth; the force of gravity upon it is twenty-seven times what it is here, so that a small man like myself would weigh about a ton, supposing there were life there. The average density of the sun is only a quarter part that of the earth. It averages a little more than the density of water. In all probability we don't see the sun itself at all; what we see is a great shell of cloud that overlies and covers it and sends out light and heat in somewhat the same way that the mantle of a Welsbach burner radiates light and heat from the gases within. The explanation of this low density is the intense heat of the sun. The temperature we don't know. The investigations of the past ten years show it to be between 10,000 and 20,000 degrees Fahrenheit, and probably not very far from 14,000 degrees. The effective temperature is no more than a thousand degrees one way or the other. The furnace in which our French friends make diamonds is possibly six or seven thousand degrees; but this double temperature indicates a vastly increased radiating power.

What is the temperature of the earth? Do you mean the temperature of the North Pole, at the equator, at the top of mountains? There isn't "a" temperature of the sun. On the whole, it acts as if it were a body covered with lampblack heated to a certain temperature, and we call that the "effective temperature." At a very small depth within the solar surface the temperature rises, rises, rises—just as it does as you descend in the earth. Then how is it that its temperature is maintained? The probability is that the temperature is maintained by the continuance of a process going on age after age—the process by which the worlds were made—the system that surrounds the sun. We are quite sure that it is not produced by any action of combustion in the first place. If so, I cannot stop to explain how the calculation can be made, but long ago the sun would have burned out. It could not last but about six thousand years in all. Neither can it be simply a warm body cooling and bringing the heat from inside to the outside and throwing it off by simply cooling as a ball of iron; it would not last long that way. Some have suggested that it was produced by the rotation of the sun, that the sun's heat is maintained by a sort of an electric arrangement like a Holtz machine; but it is very easy to calculate that no heat is produced in that way, that there is a hang back to the sun, just as power is required to drive a dynamo machine; and the sun's rotation would have been stopped, on that basis, in five hundred years. Then there is the older idea that the heat is produced by meteors falling on the surface. When Tyndall wrote his book upon the "Mode of Motion" the theory was maintained in that way. The idea was that the meteoric matter falling upon the sun might account for the radiation of the heat. A mass as large as the earth falling upon the sun with the velocity that the earth would acquire in dropping that distance would supply the sun for a hundred years. But Venus and Mercury say no! If there were any such quantity of meteoric matter near the sun, their orbital motions would be different. The earth would get as much heat from the meteors as it did from the sun. Helmholtz suggested about 1853 that the sun's heat is maintained by its slow shrinkage. Supposing I hold a book in my hand and drop it on the floor, what happens? Gravity acts upon it, with a little noise; but the main thing is, the book is warmed and the floor is warmed. Motion has been produced and has been stopped, and a certain amount of heat unquestionably produced. If we put a hole through a weight and put it on a post, and let it slide down, it would produce heat also. Suppose every portion of the sun's surface drops 150 feet toward the sun's center, diminishing its diameter about 300 feet; in that case, on any reasonable hypothesis of the constitution of the sun, that would account for all the heat the sun sends forth. If the sun continued shrinking faster than that, it is growing warmer; if it is shrinking more slowly, it ought to be cooling off a little. The sun is giving out 30 calories of heat for every square meter of its surface, which would heat 30 kilogrammes of water one degree every minute—equivalent to about 2¼ horse power energy. If, by some means or other, we could case the sun in with ice 60 feet thick and then let the heat start, it would be just one minute melting off. A yearly shrinkage of 300 feet in diameter of the sun would have to go on for 7,000 years before detection by the best telescopes that we or our posterity are likely to possess; and it could go on from seven to fifteen million years without disturbing anything; but the end will come; though just here we meet with a difficulty with reference to the past history of the system. The geologists want more time for the making of the solar system by the processes that seem to be indicated by the nebular hypothesis.

If the sun is throwing off heat alike in all directions, I do not think it can possibly be more than 150,000,000 years old. Can it be that energy is expended only in radiating from the sun to another material body? The whole solar system does not receive more than two-thousand-millionth of the heat that the sun radiates. It goes off into space. Our hundred millions of possible life for the solar system might easily become a million millions if it only loses heat when it gives it to something else.

Several diagrams were thrown upon the screen illustrating the nebular hypothesis of development of the solar system. By means of the actinometer the heat of the sun's rays is measured, though we do not know how much to allow for absorption by the atmosphere. The Wilson & Gray (1894-95) radiomicrometer is the most delicate apparatus yet devised for sun heat measurements. At the Columbian World's Fair of 1893 was shown a great reflector made of boiler iron lined with mirror glass, projecting light and heat that ran a two horse power engine as long as the sun would shine. The invention was Ericsson's, who had a great idea of the value of the sun's rays in Egypt and other such countries where the sun's rays could be depended upon constantly. Our best steam engines do not give one-sixth the power originally shot off from the sun, stored in the coal, and finally brought under the guidance and control of man as issuing from the steam engine. The general surface of the sun is at least 5,000 times as bright as the lime light and not more than four or five times as bright as the electric light you are using to night. The lime light is an intense jet black when held against the solar surface.

Sun spots are a very interesting phenomenon. One of the largest spots observed was over 100,000 miles in diameter. Sometimes spots do not last more than a day or two, and the Methuselah of the race lived eighteen months only. They very rarely last over a year. They do not lie below the sun's surface, on which they are a sort of a boil. Meteorologists have been discussing a theory of cold waves—spots formed by congealing taking place at certain portions of the solar surface; from certain portions of the material they rise and are congealed in rising. Usually the sun spots are cooler than the surrounding sun. The center of the sun spots gives usually not more than a quarter as much heat as the surface surrounding it; but when you get near the edge of the sun, they actually are hotter than the surrounding photosphere. The spot of 1893 appeared in connection with the great electric storm, when the telegraph lines worked without batteries for a whole day; and this great spot, just about the size of the earth, broke out just about the time of the occurrence of this electrical storm, one of the coincidences between a great solar disturbance and a great magnetic disturbance on the earth's surface.

We do not know the cause of the spots. Now they are rare and again abundant. The average interval is about eleven years. They were exceedingly numerous in 1872, almost disappeared in 1880, but in 1884 there was another maximum. There is no regularity about it. Nobody knows what makes the slight approach to periodicity of their occurrence. Do these variations in the sun spots affect the earth? Some consider them causes of storms, some, of disease (cholera for instance), some, commercial crises; all sorts of happenings are laid to the account of sun spots; but, as far as I can make out the evidences, the line of magnetic storms corresponds with the sun spots. If you watch the magnetic needle, you find it keeps swinging back and forth and at times will dance about for days at a time. And we call that a magnetic storm; for some reason or other the magnetic conditions of the earth are disturbed and the magnet vibrates. Some observers watch this change constantly, and records are kept.

In years of numerous sun spots, magnetic storms and the aurora borealis appear frequently, but the connection we cannot account for. We do not know if they be cause and effect. They go together. It is entirely possible that the disturbances are altogether from outside and affect the sun and the earth together. Each new accession of sun spot activity breaks out on one side of the sun's equator or the other. They move in well-defined zones.

When we look at the solar spectrum, we get a great multitude of diagrams. Fraunhofer discovered this in 1816, the Fraunhofer's lines being dark streaks across the spectrum. Prof. Young described the significance of these lines. The burning of gases produces beautifully brilliant spectra; but where you have a solid or a liquid you have a spectrum that is continuous—no markings. The explanation of these dark lines in the solar spectrum is that these photosphere clouds have an atmosphere of gases over them, and when the light from that photosphere passes through that atmosphere, then those lines turn dark. In the eclipse of the sun shown upon the diagram at the moment when the moon had covered up all the sun except this edge, the lines that had been dark before turned bright, and remained bright about a couple of seconds and then faded away. In getting the iron spectrum, the iron is not simply warm—not simply melted—but it is actually boiling, and the iron vapor is just like the steam from the tea kettle, and in that condition it gives a bright light, and then you could compare the spectrum of the sun with that of the iron and see if there is any iron in the sun. Two slides were exhibited giving the close resemblance of the iron and sun spectra. Rowland's concave grating spectroscope is the best extant. The spectrum of a sun spot shows that the darkening is due to the presence of cooler vapors in which vanadium is abundant. A blowpipe blister in a spectrum of the sun was due to a sudden blast of hydrogen gas moving 160 miles a second. A prominence of 200 miles length rose up from the sun's surface on one occasion.

During an eclipse occurring in 1882, visible in Egypt, and of which photographs were taken, a comet was seen for just two minutes, to which was given the name Tewfik, being that of the then ruling Khedive of Egypt.

* Condensed for the SCIENTIFIC AMERICAN from a lecture at the Drexel Institute, Philadelphia, by Prof. Charles A. Young, professor of astronomy at Princeton University.

---

**The Bicycle Wood Rim Patent.**

In a recent decision in a case before the United States Circuit Court for the Northern District of New York, Justice Coxe sustained the Fairbanks and Berlo patent of May 9, 1893, on wood rims for bicycle wheels. The great popularity which these rims have attained within a year or two renders this decision especially interesting. The patent is for a rim composed of a series of sections or plies of wood of varying course or direction of grain, cemented together, the ends of each section breaking joints with the ends of adjacent sections. The court held that "the introduction into the art of the marked and at the present day universally recognized improvement of the patent required an exercise of the inventive faculties. . . . Carriage wheels with the ordinary compression spokes and reinforced with iron tires had been made with laminated fellies, but there is no pretense that the break joint and varying grain features of the patent are found in any of these structures, which are not adapted for use in a wheel provided with suspension spokes and pneumatic tires. . . . The patentees have done much to make the modern bicycle a perfect machine."

---

DR. WM. T. BULL, says The Independent, has lately given to the world an account of the entire restoration to health of a woman who had carried a plate for artificial teeth in her esophagus for twenty-two months, her health meantime being at a low ebb, for the removal of which he successfully operated. In that connection he relates some most interesting experiments with the X rays. It seems that there are many things that may be swallowed—one surgeon enumerates twenty-five that have been—and more than half of them are substances that can be discerned by the aid of the X rays. Hence he considers that "this addition to surgical resources cannot be overestimated."

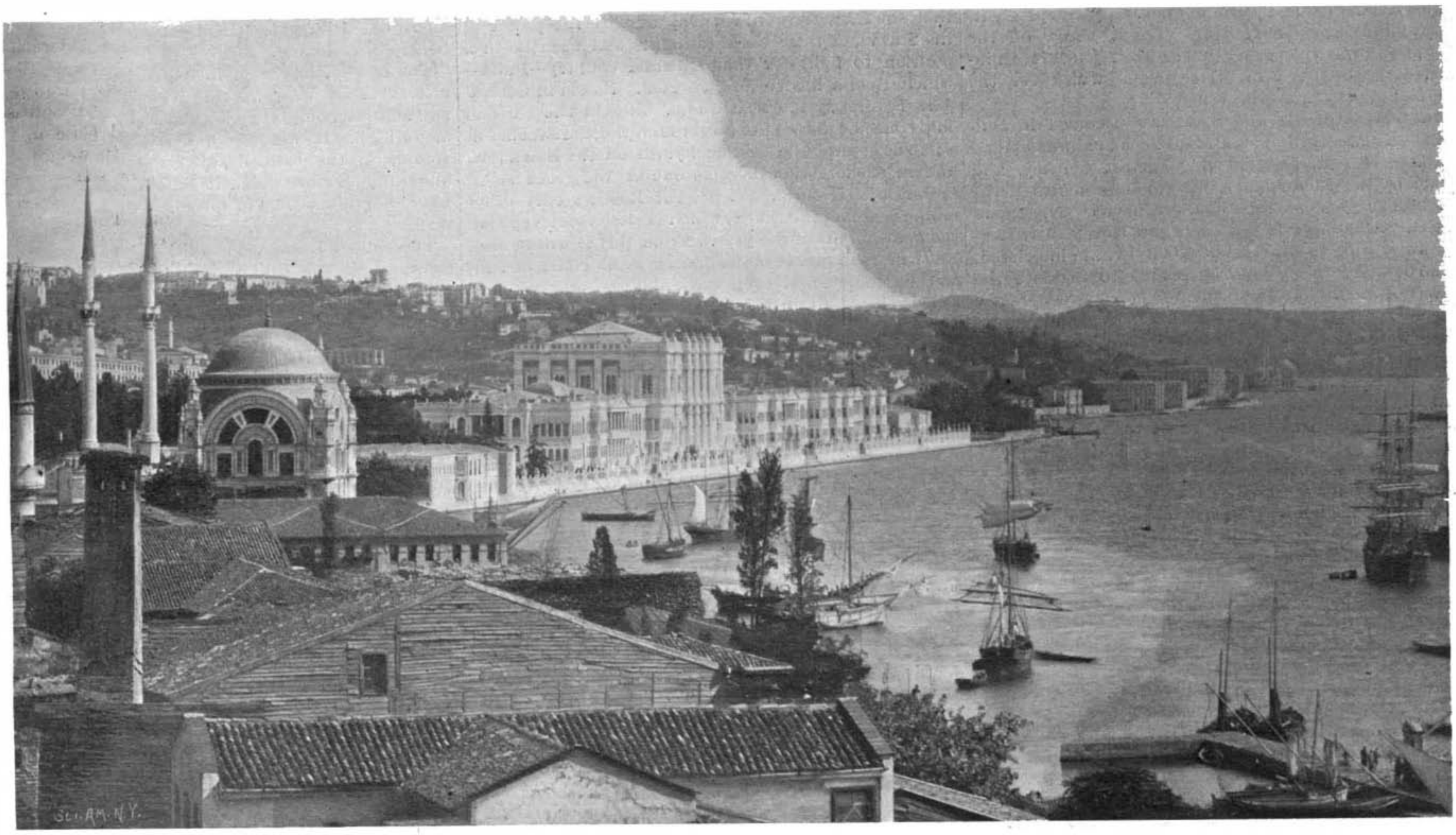
of the line was reached just as the sun was crimsoning in the west, and thus was brought to a close one of the most stirring marine spectacles ever witnessed by the city of New York.

### THE WAR IN THE EAST

The daily press has kept our readers well informed of the progress of the Greco-Turkish war. A struggle which involves the conflicting interests of so many nations is of such unusual interest that we will attempt to give a brief analysis of the "Eastern question" and the fundamental causes of the present Greco-Turkish war.

The birthplace of the Ottoman empire was Sugud, on the Sakaria River, for here was born the illustrious Osman, from whom the whole tribe took its name. It is from this we get the name "Ottoman." Osman enlarged the holdings of his people in Asia Minor, and in 1358 crossed the Dardanelles and seized Gallipoli, on the European shore, this being their first foothold in Europe. Constantinople fell into the hands of the Ottomans in 1453 and Greece in 1477. Three years later they gained a footing in Italy, at Otranto, and in the next century Syria, Egypt and Arabia fell into their hands.

Under Suleiman the Magnificent, who lived from 1520 to 1566, the Ottoman empire was at the height of its power, and included not only the entire Balkan Pe-



CONSTANTINOPLE—DOLMABAGHCHI PALACE ON THE BOSPHORUS.

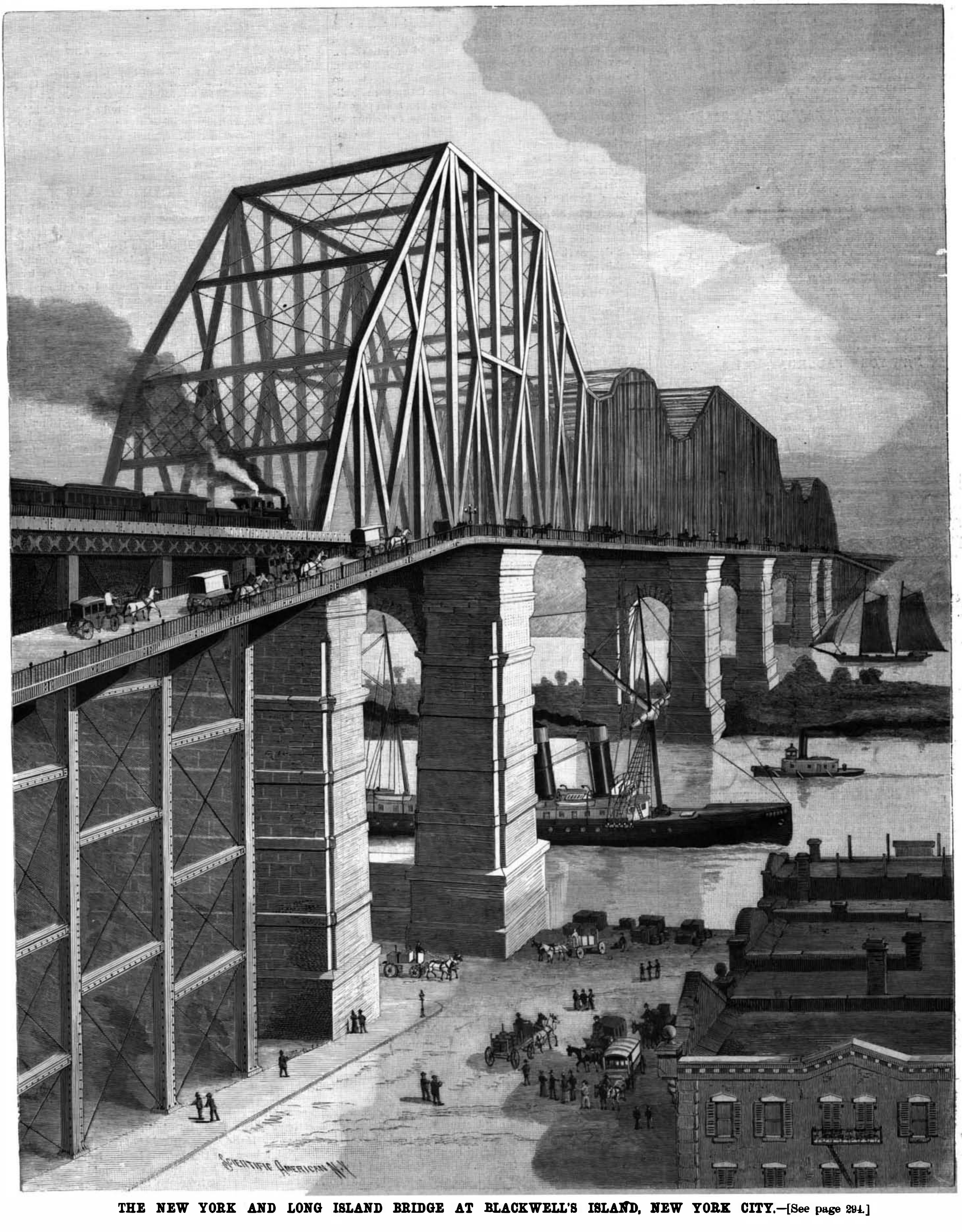
CONSTANTINOPLE—GALATA BRIDGE CONNECTING GALATA AND STAMBOUL.

# SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1897, by Munn & Co.]

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

Vol. LXXVI.—No. 19. ESTABLISHED 1845. | NEW YORK, MAY 8, 1897. | $3.00 A YEAR. WEEKLY.


THE NEW YORK AND LONG ISLAND BRIDGE AT BLACKWELL'S ISLAND, NEW YORK CITY.—[See page 294.]