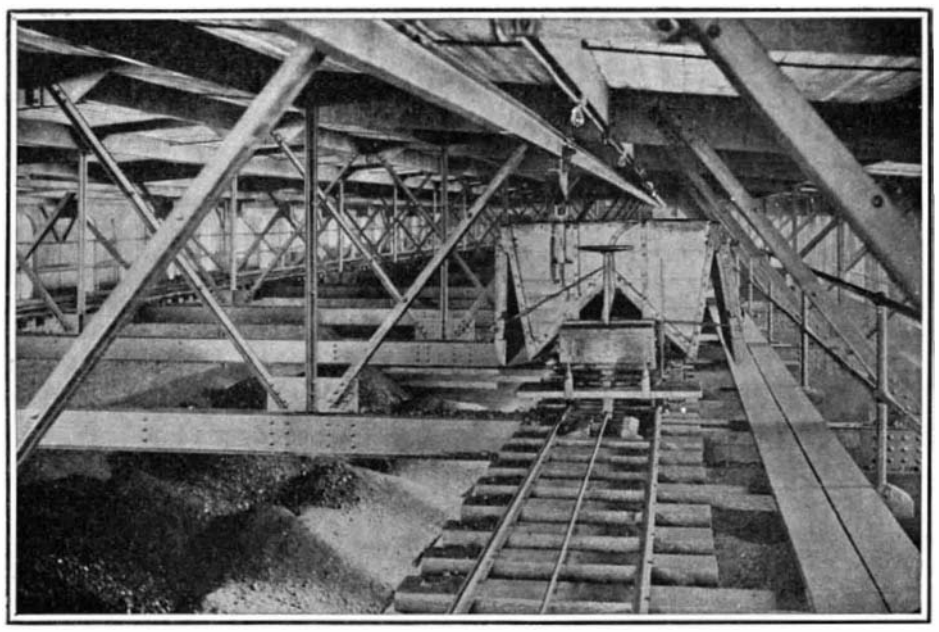
PENNSYLVANIA RAILROAD'S EXTENSION TO NEW YORK AND LONG ISLAND.—THE LONG ISLAND CITY POWER STATION.—I.

The Pennsylvania Railroad Company has had under consideration for a number of years plans for establishing a terminal for its lines on Manhattan Island. The earliest of these contemplated a bridge over the Hudson River, with elevated approaches and terminal in the city of New York. The demonstration that electric traction was practicable for heavy train units made possible, however, an entrance by means of tunnels, which would enable the adoption of a well-rounded-out plan for a terminal, which would embrace not only the Pennsylvania Railroad main line business, but through connection with New England and the railroad system on Long Island. The announcement that the Pennsylvania Railroad Company proposed to enter New York city was made in May, 1902, and since that date the project in all its features has been actively under way.

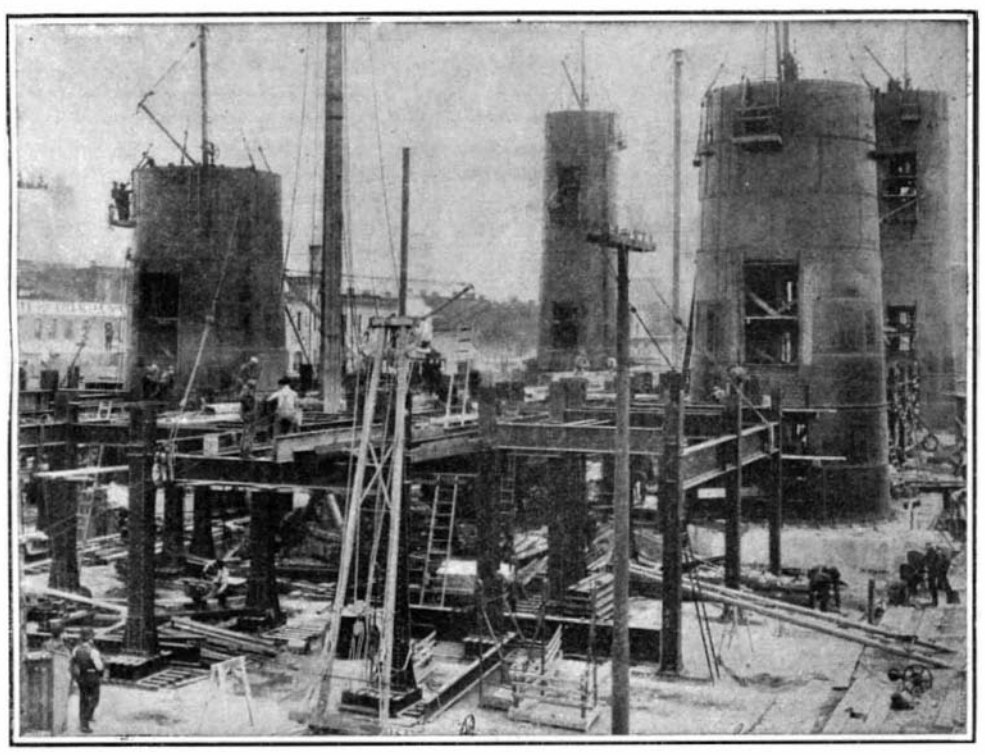
It is the purpose of the present series of articles to describe the progressive development of the terminal plans in their transportation, engineering, and architectural features, the present article being a description of the first unit in the construction, which has been completed in operative condition, namely, the Long Island City power house. Other articles will follow as rapidly as they are prepared and as the development of the plans warrants.

Two companies have been incorporated through which the Pennsylvania Railroad Company is carrying on its New York extension work. One of these, the Pennsylvania, New Jersey & New York Railroad Company, will build all of that portion of the tunnel and approaches in the State of New Jersey and extending under the Hudson River to the boundary line of the States of New Jersey and New York; from this boundary the other, the Pennsylvania, New York & Long Island Railroad Company, will construct the tunnels, terminal station, and yards on Manhattan Island, under the East River, and in Long Island City. The officers of these companies are officers of the Pennsylvania Railroad Company, the president being Mr. A. J. Cassatt.

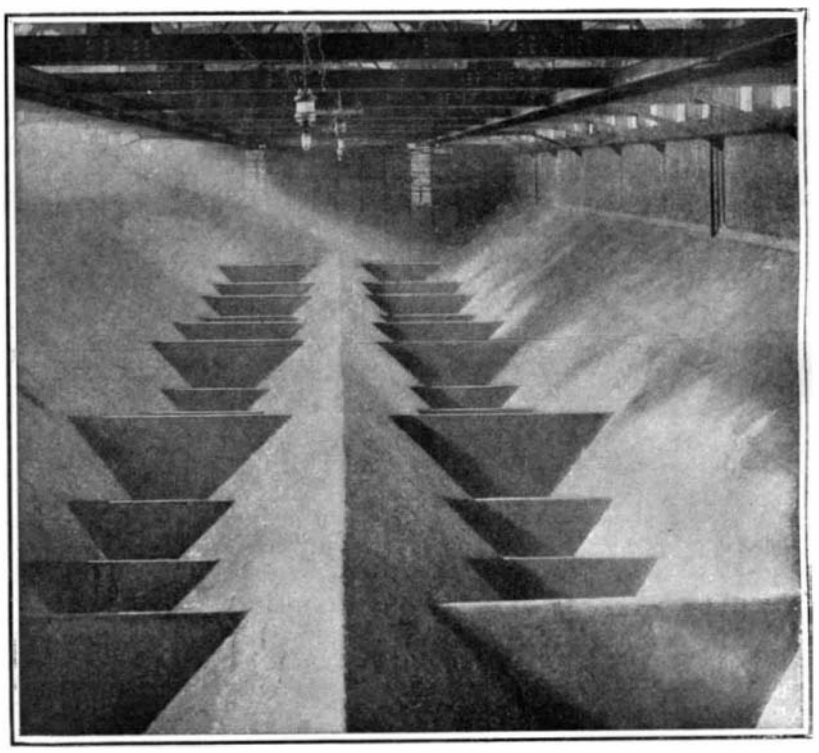
The tunnel work proper is divided into two parts; the East River Division being under the direct charge of Mr. Alfred Noble, chief engineer, and the North River Division under the direct charge of Mr. Charles M. Jacobs, chief engineer; the general railroad facilities and the electrical and mechanical features of the railroad and terminal are under the charge of Mr. George Gibbs, chief engineer of electric traction. These three officials, together with Brigadier-General Charles W. Raymond, chairman, constitute a board of engineers, to whom the general engineering features of the whole plan are confided. In addition, advisory committees consisting of officers of the road have been appointed to pass upon and work out the special problems relating to the required railway facilities, and pass upon the adequacy of the operating features as developed by the labors of the



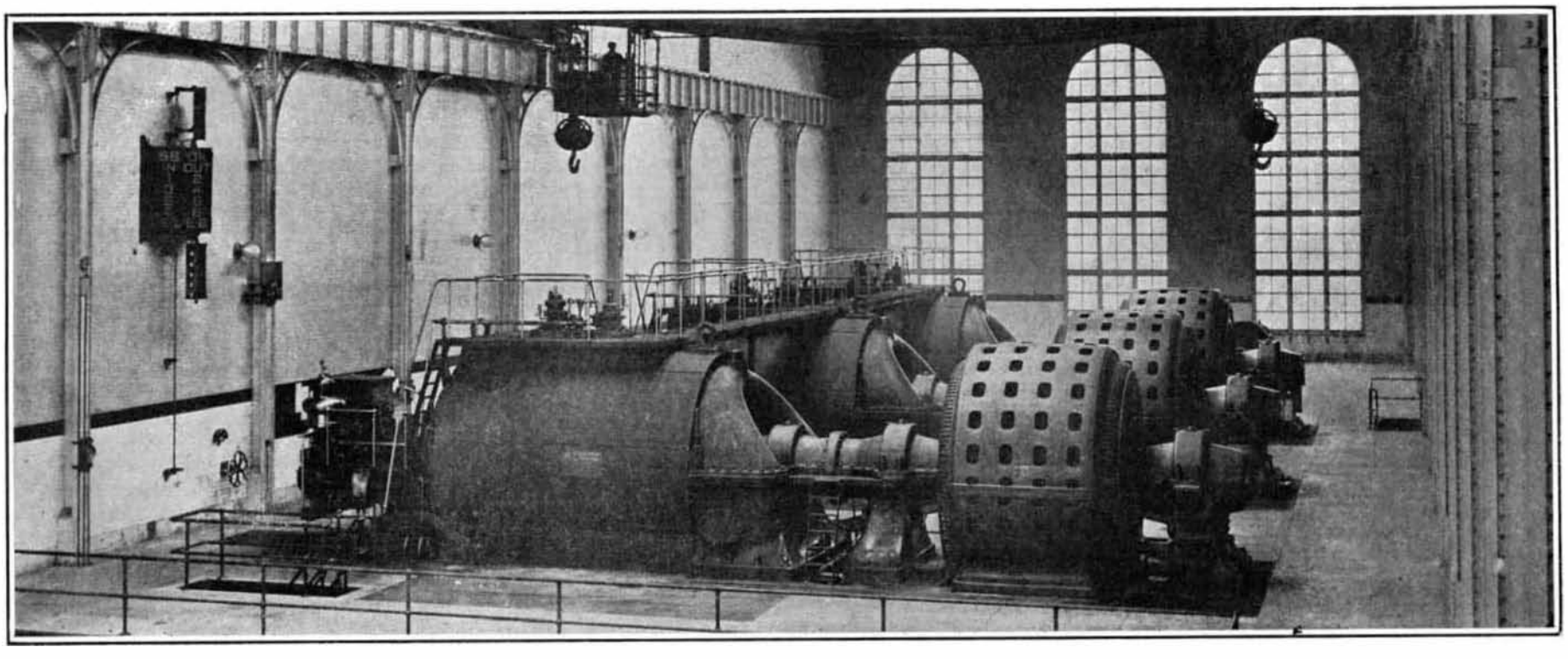
View in Coal Bin, Above Boiler House, Showing Cable Railway and Coal Car Ready to Dump Coal into Bin.



Steel Framework and Stacks in Process of Erection.



Interior of Coal Bin, Showing General Appearance of Pockets.



Interior of Engine House, Showing Three 5,500-Kilowatt Turbo-Generators.

LONG ISLAND CITY POWER STATION OF THE PENNSYLVANIA RAILROAD'S EXTENSION TO NEW YORK AND LONG ISLAND.

various departmental bodies. Messrs. Westinghouse, Church, Kerr & Co. have been selected as engineers and contractors for the electrical and mechanical engineering, acting under the supervision of the chief engineer of electric traction.

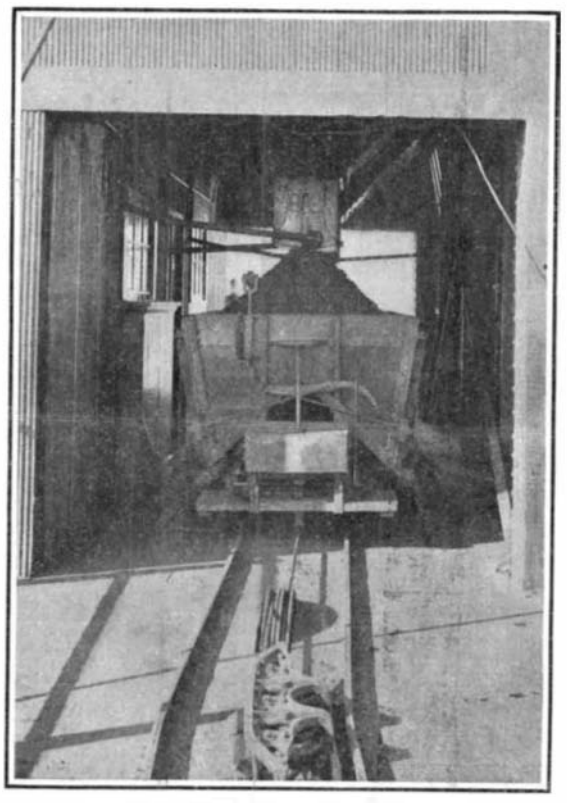
The Power House.—The power house building, designed by Messrs. McKim, Mead & White, is located on the Long Island shore of the East River, upon a rectangular block which extends 200 feet north and south, and parallel with the river, on Front Street and on West Avenue, and extends 500 feet in depth along Third and Fourth Streets. Although the immediate call for power does not necessitate the erection of a plant covering this whole area, the adopted design will permit the ultimate erection of a building capable of accommodating fourteen 5,500-kilowatt generating units, aggregating, in the total, 105,000 electrical horsepower. The present building has capacity for half this amount of machinery. A unit size of 5,500 kilowatts was adopted, because at the time this sation was designed, the largest turbo-generator that had been standardized was of that capacity. The first demand for power for the Long Island Railroad electrification called for the service of three of these units, and we present an illustration showing these units in place.

Foundations.—In view of the heavy concentration of loads involved in a power house of this character, it was decided to secure a uniform reaction over the whole area of the building by the use of a heavy, monolithic, concrete mass, overlaid upon uniformly spaced piling driven everywhere to refusal. Piles from 30 to 35 feet in length were driven on centers that averaged 2 feet 4 inches over the entire area. The total number of piles required was 9,115, the average designed load being 12 tons per pile. Cut-off was determined at 2 feet 6 inches below high-water level in a water-bearing stratum of river mud. The concrete cap overlying the piling is 6 feet 6 inches in thickness, while underneath the four great stacks the thickness has been increased to 8 feet 6 inches. Spruce piles, varying in length from 25 to 40 feet, were used. They were driven to refusal with a 2,000-pound hammer, falling 18 to 20 feet. There were as many as eight pile drivers at work at one time, the greatest number of piles driven in one day being 232, while as many as 83 were driven by one driver in one day.

The Coal Tower and Ash-Handling Structure.—As one approaches the power station from the water, the most striking feature is the lofty coal-handling tower and the bridges leading thence to the boiler house. This structure stands upon the coal dock and reaches to a height of 170 feet. At the height of 163 feet a steel hoisting boom projects 43½ feet over the slip. The boom, tower, bridge, and a lofty brick structure extending from the ground level to the bridge not far from the power house, constitute a most complete and efficient plant for the transfer of the coal from the river to the coal pockets in the boiler house, and for removing the ashes from the boiler house to the railroad cars. The tower consists essentially of four heavy box columns, thoroughly braced in all directions. The hoisting apparatus is located on a floor 25 feet above the dock in an inclosed engine room within the tower. The upper third of the tower above the level of the cable railway carries the hoisting boom before mentioned, the receiving hopper, coal crushing and weighing apparatus, and the cable railway machinery. The upper third of the tower for about 34 feet above the cable railway is inclosed, forming a two-story house, on the lower floor of which is the weighing mechanism and the engine for driving the crushing machinery and cable railway, and on the upper floor the crusher. Over the crusher is the heavy steel-plate receiving hopper. The distance from the coal tower to the boiler house, about 500 feet, is covered by four bridge spans which support the cable railway, and beneath it, and directly across Front Street, is the rectangular structure of the ash bin, to which ashes are delivered through another bridge leading to the boiler house at an elevation of 69 feet above the street. The ashes are carried by a telpherage system, which picks up the ash buckets from the ash cars in the boiler-room basement, carries them over this bridge into the tower, where they are dumped in a large bin capable of holding 300 tons of ashes. The material is dumped through grates in the bottom of the bin into gondola cars standing on the track below.

The hoisting tower has been designed with a view to "one-man" operation, and the control of the whole system has been concentrated on a single floor at an elevation only a short distance above the coal barges from which the unloading is being done. By this arrangement the objectionable features of the old method of placing the operator at the level of the boom are avoided. The coal is hoisted by a two-ton clamshell bucket to the boom, run into the tower over trolley tracks on the bottom chords of the boom, dumped into the hopper, crushed, automatically weighed, dumped into cable cars, run by gravity into the boiler house, and finally dumped at the desired position into the great 5,200-ton coal pocket. The crusher has a capacity of about 400 tons in five hours. The tracks are arranged in a loop between the tower and boiler house, and the whole system is capable of handling coal at the rate of 150 tons per hour when operating twenty-nine two-ton cars at a speed of 180 feet per minute around a track loop which is approximately 2,500 feet in length.

Boiler Plants.—The boiler plant for the Long Island power station consists of thirty-two Babcock & Wilcox water-tube boilers set in batteries of two boilers each, eight batteries on the first floor and eight batteries on the second floor, immediately over the former. They are equally distributed on each side of the boiler house, with an 18-foot space for firing between boiler fronts. The working pressure is 200 pounds to the square inch, and the total effective heating surface of each boiler is 5,243 square feet. Each boiler also carries an internal superheater capable of superheating the output of the boiler 200 deg. Fah. at 200 pounds pressure, the total superheating surface amounting to 1,116 square feet. Each boiler is fitted with one of the well-known Roney mechanical stokers. Directly behind the boilers and over the flues are the economizers, which are designed for 250 pounds pressure. By the use of these economizers the hot gases are so reduced in temperature that they enter the base of the stacks at about 350 deg. Fah. temperature. The four lofty stacks which constitute a striking feature in the photographs of the power plant are built of steel and are entirely self-supported. They extend 275 feet above the base. The internal diameter of the straight portion is 17 feet 10 inches at the bottom and 16 feet at the top. They are lined throughout with brick, whose weight is transferred at intervals of 20 feet to the steel shell by means of Z-bars riveted to the shell.



Loading Platform in Coal Tower.

The outside shell decreases gradually from ½ inch in thickness at the bottom to 5-16 inch at the top. The space between the shell and the brick lining is grouted full of cement mortar. The stack is fastened down to its base by a segmental cast-iron ring 23 feet in diameter, which is held down by twenty 3-inch anchor bolts, that pass through a grillage in the bottom of the concrete foundation.

The Turbo-Generator Plant.—No attempt has been made to give the main building of the power station any elaborate architectural treatment, the general view, as shown in our photographs, showing great simplicity and quiet dignity of design. Any architectural character that it possesses is determined by the strictly engineering necessities of the case, and it will be noticed at once that it divides itself into two main portions, the taller section being the boiler house, and the other the engine house. The only feature which can be considered to be ornamental is the name "Pennsylvania," inscribed across the parapet of the engine house in neat terra-cotta letters. The boiler house proper is 82 feet high at the top of the parapet, and 118 feet to the parapet of the superimposed coal pocket inclosure. The interior height of the engine room from floor to trusses is 40 feet, while the exterior height of the engine room building is 70 feet, measured from the ground to the top of the parapet. The over-all dimensions of the present building are 200 feet by 262 feet, although, as already stated, its ultimate dimensions will be 200 feet by 500 feet. At present the engine room contains three 5,500-kilowatt Westinghouse-Parsons, single-flow steam turbines direct-connected to three-phase, 11,000-volt generators of the revolving field type. The rating of the turbines above given is on a basis of 175 pounds steam pressure, 27½ inches vacuum, and a speed of 750 revolutions per minute.

We have so frequently described this type of generator, that it is sufficient here to say that the steam flows parallel with the shaft through a series of alternating stationary and moving blades, the size of the blades and the intervals between them increasing gradually from the admission to the exhaust end of the turbines. The smaller blades are made from special bronze, the larger ones from steel. They are all originally rolled in long rods of a general crescent cross section then sawed into the proper lengths, set in grooves in the drum and cylinder, and calked securely in place. The length of each turbo-generator unit is 47 feet, its width 13 feet, and its height 14 feet to the top of the gallery ring. Compare this with the dimensions of a four-cylinder piston engine of equal capacity, and its huge 32-foot generator, which together would call for a floor space 55 feet long by 35 feet wide, and which would tower 35 feet above the floor. The turbine is governed by means of a "fluttering" main poppet valve. Steam enters, not in a continuous blast, but in puffs, the duration of which is controlled by the amplitude of vibration of a little oscillating pilot valve actuated by levers and worm gearing from the main shaft. The advantages of this intermittent action are that the turbine is always using boiler pressure steam, that the admission valve cannot get stuck, and that the continual movement of the governor balls in and out prevents wear.

A separate condenser is provided for each turbine. They are of the Alberger counter-current surface type, and each has 20,000 square feet of cooling surface. A somewhat unusual feature is the use of a small booster generator to prevent electrolytic corrosion of the condensing tubes.

Turbo-Generators.—It is one of the great advantages of the steam turbine as an electrical drive that because of its high speed of revolution there is a great reduction in the size, weight, and cost of the direct-driven generators. The "engine" type of generator is an enormous affair, 42 feet in extreme diameter and 445 tons in weight, running at 75 revolutions per minute, whereas the turbo type of the same capacity, running at 750 revolutions, is only 13 feet in extreme diameter, and weighs very much less. The armature is stationary and is inclosed in a large cylindrical yoke of cast iron. The revolving field consists of a four-pole structure formed out of solid steel disks milled to receive the winding. It is about 6 feet 8¼ inches in diameter and about 6 feet long. Three separate sources are provided for exciting the fields of the main generators, namely, two steam-driven exciters, one motor-driven exciter, and a storage battery. In a later article we shall deal with details of the electrical plant, which, because of limitations of space, are excluded from the present article. The station was planned and built by Westinghouse, Church, Kerr & Co., engineers, for the Pennsylvania, New York & Long Island Railroad Company, which is the organization through which the Pennsylvania Railroad is carrying on its New York extension work. The design and construction were under the charge of Mr. George Gibbs, chief engineer of electric traction of the road, and under the general supervision of the Mechanical and Electrical Advisory Committee, New York Extension, a committee composed of officers of the Pennsylvania Railroad Company.

A New Arrangement for Enabling Spectators to Follow the Words and Music at the Opera.

A decidedly novel scheme for placing before the spectator the text of an opera libretto as it is being sung has lately been brought forward in Europe. In the upper part of the proscenium arch is arranged a screen upon which a magic lantern projects the line that is being sung. The text of the opera is arranged upon a transparent ribbon which is fed through the stereopticon by an electrically-operated apparatus under the control of the prompter, who changes the lines by pressing a button at the proper moment. This arrangement allows the spectator to tell at any moment just what is being sung by merely glancing upward at the illuminated screen. The new invention will doubtless prove a great aid to spectators and add considerably to their enjoyment.

The German naval authorities, according to the Cologne Gazette, have fixed the displacement of the latest type of torpedo boats at 570 tons, as against the 420 tons of S 131, the largest torpedo boat at present in the German navy. The new boats represent a considerable advance in several respects. They will have a more powerful gun equipment, greater speed, and light-armored protection for the engines and boilers. The speed will be 30 knots, as compared with the maximum of 27 knots hitherto attained. The armament will consist of four 5-centimeter (2-inch) and two 8.8-centimeter (3½-inch) quick-firing guns; hitherto only three 5-centimeter (2-inch) guns have been carried. The bunkers will be considerably enlarged, so that, in spite of the increased consumption of coal, the radius of action will be much increased.

Marconi and De Forest Wireless Litigation.

The United States Circuit Court for the Southern District of New York recently issued an injunction against the De Forest Wireless Telegraph Company as the result of a bill in equity filed by the Marconi Wireless Telegraph Company of America, alleging infringement of Marconi's fundamental patent issued July 13, 1897, and numbered 586,193.

In a very ably written opinion Judge Townsend reviews the state of the art previously to Marconi's first experiments, discusses the nature of Hertzian waves, and outlines the essentials of a commercial wireless telegraph installation. The injunction restrained the infringement of claims 3 and 5 of the Marconi patent. Claim 3, the broader of the two, reads as follows:

"3. The combination, in an apparatus for communicating electrical signals, of a spark-producer at the transmitting station, an earth connection to one end of the spark-producer, an insulated conductor connected to the other end, an imperfect electrical contact at the receiving station, an earth connection to one end of the contact, an insulated conductor connected to the other end, and a circuit through the contact, substantially as and for the purpose described."

The specific infringement complained of consisted in the installation and use by the De Forest Wireless Telegraph Company of its stations between New York city and Staten Island. In this particular installation the transmitting and receiving stations were equipped with high vertical wires insulated at the top. At the transmitting station were a dynamo, directly producing an alternating current, primary and secondary coils, Morse telegraph key, a spark-gap, and a condenser, most valuable adjunct to the practical operation of wireless telegraphy, but not directly involved in the suit. The high-frequency oscillations created or produced, as in the Marconi system, were radiated from the vertical wires of the transmitter and, traveling across to the receiver, impinged upon its wires and traveled down to a so-called detector or variable resistance conductor, closely corresponding in function and result with the coherer of Marconi's patent, and alleged to be its equivalent.

One of the main points at issue in the suit was the use of insulated conductors, described and illustrated in Marconi's patent as metallic plates suspended by poles on wires and insulated from earth. The conductors of the 1898 system of Marconi are aerial wires insulated at the top, but connected with the earth at the bottom.

Both complainant and defendant, at the time the bill was filed, used a construction where the conductors were insulated at the top, but only interrupted or obstructed as to the earth connection at the bottom. The complainant contended that defendant admitted that it is immaterial whether the aerial is insulated from the ground at the lower end. Dr. De Forest said that he preferred to employ earth connections because they permitted transmission to greater distances. Both sides agreed that the function of the earth was not satisfactorily understood; both agreed that such an earth connection is an advantage possibly due to a guiding and strengthening force to conduct the waves to the surface of the earth so that they may glide farther through the ether.

In this state of uncertainty as to the whole subject the court thought that Marconi should not be deprived of the benefit of his real invention upon any narrow limitation as to the earth connection or interruption at the lower end of the conductor, when it did not appear that even in the case of the spark-gap or tube filing obstruction the earth did not discharge the same functions as it is now supposed to discharge, and when presumably the question is merely one of degree, the strength being theoretically greater in degree where the earth connection is merely obstructed by a transformer.

The rather sensational press reports which gave to Judge Townsend's decision an exaggerated effect must be taken with the proverbial pinch of salt. The injunction is not directed against the present De Forest system or against the present American De Forest Wireless Telegraph Company. It is issued against a defunct De Forest company and against the use of an apparatus which, we are informed, was an experimental and discarded form of apparatus used but a short time in 1902. It is claimed that the apparatus enjoined has never been used by the present American De Forest Wireless Telegraph Company. Indeed, De Forest and Marconi are now engaged in patent infringement litigation which may continue for several years before the respective rights of the parties are decided by the courts.

Almost simultaneously with the granting of the injunction, there appeared in the Patent Office Gazette a disclaimer of the invention covered in claim 1 of the patent in suit. The patent had been reissued and claim 1 so broadened that its terms cover every form of imperfect contact in every possible kind of system for producing signals by means of Hertz oscillations. In view of the limitations imposed upon the Marconi coherer by the disclosures of Branly, Popoff, and Lodge, such a generic claim, much broader than those of the original patent for which it seems to have been substituted, should not have been permitted when the effect would be to enlarge the scope of the original invention.

In the original patent Marconi limited most of his claims to a combination in a receiver for electrical oscillations of his coherer, consisting of a tube and powder, and means for shaking the powder. But inasmuch as this had been disclosed by prior publications, he applied for the reissue, and by claim 1 attempted to cover not merely the coherer of his former claims or any such coherer in a receiver, or a coherer with means for shaking the powder therein, but every form of imperfect contact device, previously disclosed by others or which might be thereafter discovered, whenever combined with any electrical signal apparatus using Hertz oscillations. This claim, if allowed, would apparently cover the prior devices of Lodge and Popoff, the latter of which is claimed to have necessitated the disclaimer and reissue. Hence the injunction did not apply to claim 1, and hence the disclaimer.

Decomposition of Dust upon Heated Bodies.

In heated rooms we often perceive an unpleasant tickling odor, which irritates the mucous membrane of the larynx and causes coughing. It comes from burnt and decomposed dust, from which ammonia and other hurtful substances arise. This decomposition, which occurs only when the dust is damp, is most frequently found with the usual iron stoves whose sides easily become red-hot, in consequence of which the particles of dust lodging on the stove burn and vitiate the air. But the hot-air flues of furnaces also easily become overheated, in consequence of which dust lodging burns and the products of the burning mingle with the air. The Freie Deutsche Presse says that Prof. Esmarch, of Hanover, "found in his investigations that, on small heated bodies not above 70 deg. C. in temperature, the dust is always decomposed. On ground floors, indeed (where the air rushing in directly from the street is mingled with the dust from the horses' evacuations), the bad odor already begins to be perceptible when the surfaces are heated to 65 deg. Notable is the observation made by Nussbaum, that dust which proceeds from air artificially saturated with steam evolves vapors more evil-smelling and irritating than the dust from ordinary air. In order to prevent the vitiation of the air in a room, the heated surfaces must not be heated over 65 deg. to 70 deg., and every further addition of moisture to the air is to be avoided. Of course, the heated bodies themselves are to be kept scrupulously clean and are to be frequently washed off. But this cleansing does not fully protect from the decomposition of dust, because the air sweeping past the heated bodies always brings dust upon the heated surfaces again. In furnace heating, the air must be carefully kept free of dust, i. e., be filtered."

Gentian as a Cure for Malaria.

The root of gentian, often used as a tonic, is considered in many malarial countries a remedy against intermittent fever. Especially is this the case in Corsica in that section of the island near the town of Aleria, which is infested with malaria. The inhabitants recently protested violently against the introduction of quinine on the part of the medical authorities, declaring that they would not abandon the remedy which had been used among the islanders for centuries, namely, the gentian root either powdered or simply masticated.

Tancret declares that he has extracted from this root a hitherto unknown substance, which belongs to the chemical classification of glucoses. This he calls genziomcrina, and experiments in the laboratory prove that it possesses the same deleterious action upon the malaria bacillus at does quinine. Here, then, we have another example of how popular instinct often anticipates with a certain sureness the discoveries of science.

The Current Supplement.

An excellent article on the Isthmus of Tehuantepec and its interoceanic railway opens the current SUPPLEMENT, No. 1579. John F. Wallace, ex-Chief Engineer of the Panama Canal, gives his views on the way the canal ought to be constructed, and makes a strong plea for the sea-level canal. J. E. Petavel's report on the pressure of high explosives is concluded. "Some Notes on Fuel Briquetting in America" is the title of a very good article by Clarence M. Barber. F. F. Robin tells how filled capsules are made. Prof. Shaw's electric micrometer for measuring the seventy-millionth part of an inch is fully described by the English correspondent of the SCIENTIFIC AMERICAN. Something of the wonderful sensitiveness and accuracy of this instrument may be gathered from the fact that it must be used some twelve feet below the street level at night time, when all traffic and factory work have been suspended. A very good history of the marine turbine is published.

Correspondence.

The Soaring of Birds.

To the Editor of the SCIENTIFIC AMERICAN:

I have evolved a theory concerning bird flight which seems to be novel, and as this question is apparently still open for discussion, I have decided to submit the same to your readers.

A close observer of bird life knows that there must be some motive power other than that provided by the wings. While the air-current theory for soaring birds, and the wing theory for those that work the wings up and down, partially answer, how about those that almost seem to neglect spreading the wings when starting from a perch and then fly in graceful curves, downward and upward alternately, closing and opening the wings with each curve? In extending the wings the contraction of the muscles of the breast counterpulls against the shoulder joints, which are so formed as to create a vacuum or a partial vacuum. This, perhaps, may be regarded as the center of gravity; and thus, the air pressure being the same in all directions, the speed is acquired by the weight of the body back of the shoulders, less the weight forward of that point.

That the muscles of a flying bird's breast are vigorously exercised is shown by the dark color, while the breast of a domestic fowl is white.

Greenfield, Iowa. MRS. R. H. LOVELY.

The Mürren Railway.

To the Editor of the SCIENTIFIC AMERICAN:

The issue of February 24, 1906, No. 8, of the SCIENTIFIC AMERICAN contains an article about the Mürren Railway.

Please allow me to give you some other information concerning that line.

The Mürren Railway, on its section Lauterbrunnen-Grütsch Alp, was opened to traffic on August 14, 1891. It was operated on the water-counterweight system, as described in the article mentioned.

Some years ago, the number of travelers in Switzerland increasing very rapidly, it was found necessary to enlarge the capacity of the line, and in 1902 it was electrified. The station Grütsch Alp was equipped with electro-motors.

It turns around two large pulleys, one at each station. The cars are attached to the cable, and by this method are very accurately balanced, so that the emptying of the tank during the descent is not necessary. The line is 1,695 meters long, and the journey takes fifteen minutes.

The large front-page engraving in the same issue, that you give as " A Turnout on the Mürren Railway," is *not* on that line, but on the Salève electric railway, near Geneva, Switzerland, but on French territory. It is built on the third-rail system, which is clearly shown in the photograph. EDG. ROSSIAUD.

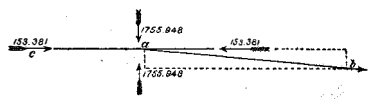
Zurich, Switzerland, March 14, 1906.

The Theory of the Hydroplane.

To the Editor of the SCIENTIFIC AMERICAN:

The paper by Ernest Archdeacon, "Sixty Miles an Hour on the Water," in your issue of March 3, is both interesting and important.

His statement, "the theory of the hydroplane, which is, moreover, identical with that of the aeroplane," is entirely correct. But the suceeding statement, that "the draft of water becomes zero, and the displacement also," contains error. The displacement can never become zero so long as the hydroplane has weight. The diagram of both the hydroplane and aeroplane is herewith given, with Count de Lambert's weight of 1,763 pounds. The resistance to motion in each case is fluid pressure and skin friction, the direction of both being fixed by the law of fluids, the first being normal to the plane, and the second along the plane, and for those reasons at right angles to each other.



Numerical values are given for an inclination of 5 degrees, and the sine and cosine of the angle are used in the usual way. Gravity being oblique to both reactions, is resolved into factors, 1,755.948 pounds, making normal pressure, and 153.381 pounds along the surface. Then the motive power is applied on *c*, canceling the small factor, and enough more to overcome skin friction, which is practically negligible. The diagram represents the activity at the instant of uniform motion, when inertia of mass no longer exists. *a b* is a resultant of two motions, and no energy is discharged on that line. The motive power of the boat has nothing to do with normal motion or displacement, since it is perpendicular to it, 90 degrees away, and cannot possibly act upon it.

I can see no reason why a hydroplane could not be urged to a velocity on water equal to that of an automobile on land. Resistance of air need be no greater in one case than in the other. I. LANCASTER.

Fairhope, Ala., March 7, 1906.

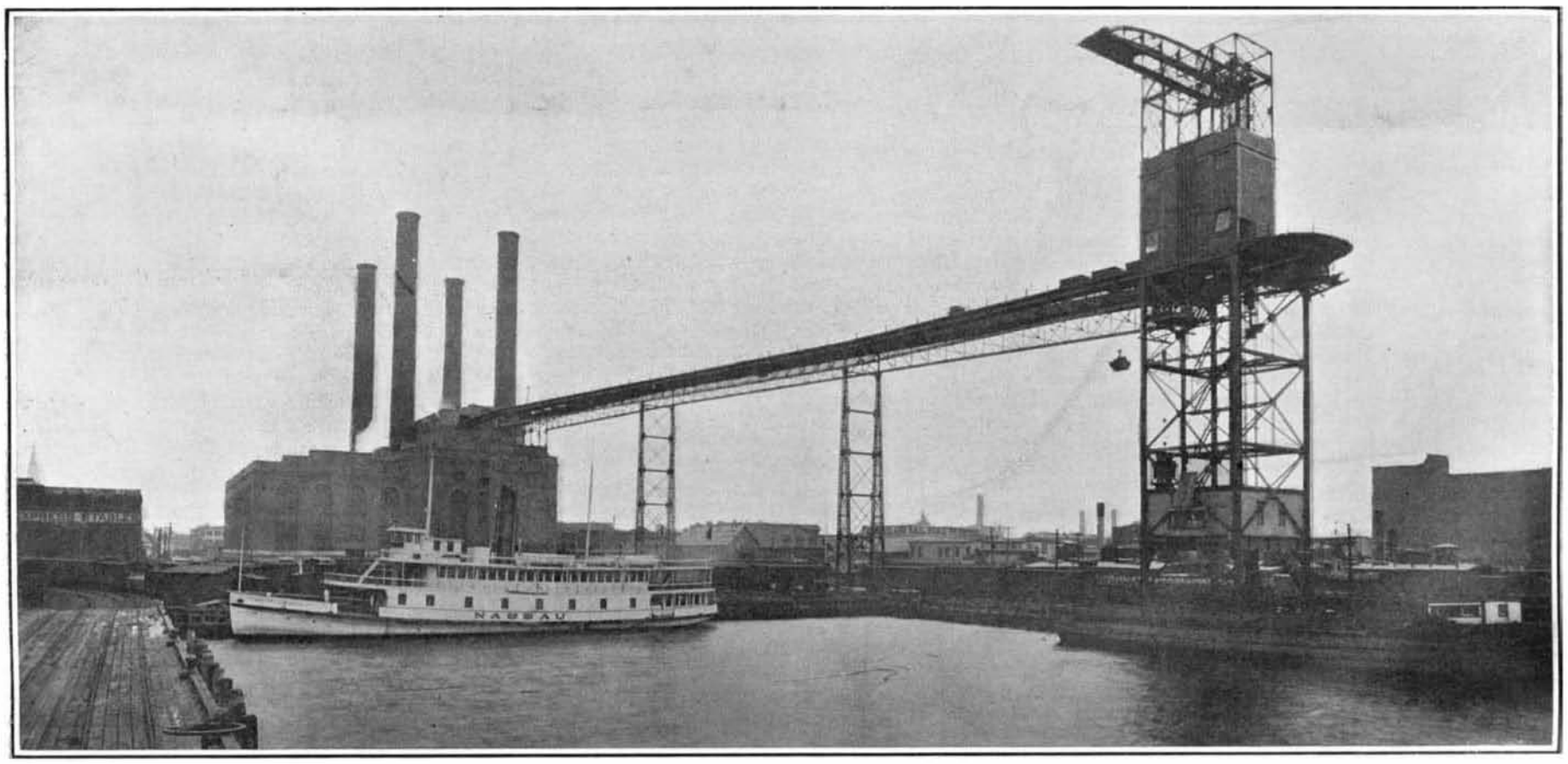
SCIENTIFIC AMERICAN

(Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1906, by Munn & Co.]

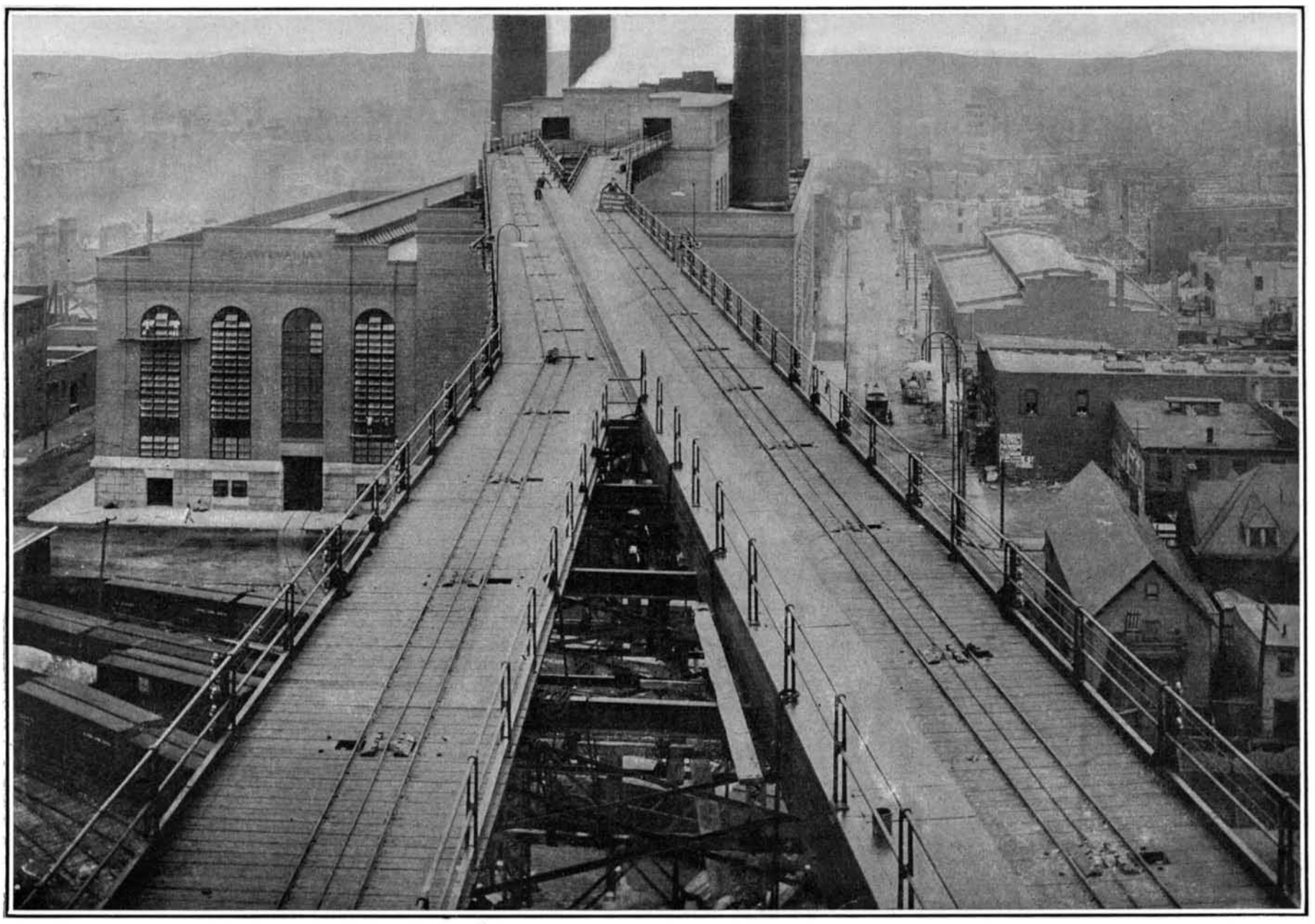
Vol. XCIV.—No. 14.
ESTABLISHED 1845.

NEW YORK, APRIL 7, 1906.

10 CENTS A COPY.
$3.00 A YEAR.



View of Power Station from River, Showing Coal Tower in Operation.



Coal Bridge and Cable Railway Over Which the Coal is Taken from the Coal Tower to the Coal Bin.

PENNSYLVANIA RAILROAD'S EXTENSION TO NEW YORK AND LONG ISLAND.—THE LONG ISLAND CITY POWER STATION – [See page 285.]