be readily turned into a sun-printing machine. At such times as the sun is available this represents an economy of some considerable moment, for it not only saves the cost of the current, but also makes the prints somewhat quicker, thereby increasing the capacity of the apparatus.

So general has the use of blue-prints become, that it is now one of the features of the business of the cabinet maker and office furniture manufacturer to build cabinets designed especially as a receptacle for these sheets. For large offices they are generally designed to meet the particular requirements of the establishment, and are necessarily quite extensive. Smaller sizes are, however, carried in stock by the larger dealers in this sort of material. The cabinets consist of a series of receptacles of varying sizes, with the openings protected by means of hinged and falling doors. In the center and toward the top is a small drawer, with an index system in which a record of each print in the cabinet is kept. The top of the cabinet offers a smooth flat surface for the examination of the prints.

THE FIRST ATLANTIC CABLE STATION IN AMERICA.

It is a curious coincidence that the first signal sent from the Old World to the New by means of wireless telegraphy should have been received not far from where the first Atlantic cable message was also received. Signal Hill, which marks the entrance to the harbor of St. Johns, Newfoundland, was the site of the first Marconi station in this country. On the shore of Trinity Bay on the northeastern coast of the same island is located a little village bearing the attractive name of Heart's Content. In it reside less than a thousand souls, and it differs little in appearance from other Newfoundland settlements, with the exception that the houses are somewhat more pretentious and it does not contain as many flakes for drying codfish. This is because the town owes its existence to the fact that it is one of the terminal points for the cables which extend between the eastern and western hemispheres. Heart's Content might be called the birthplace of submarine communication, for in one of its buildings was received the first message sent under the seas—in which Queen Victoria congratulated the President of the United States upon this connection between the nations. The cablegram consisted of ninety words and required sixty-seven minutes to transmit, owing to the crudity and the imperfections of the apparatus. Shortly after being placed in operation the cable failed entirely as a means of communication. Seven years later the "Great Eastern" entered the harbor of Heart's Content, and another cable was completed, to be severed within a year. Again this famous steamship crossed the Atlantic with a third cable, and her crew finally spliced the one laid in 1865, so that the Newfoundland operators could receive messages over two separate systems, the newer one containing no less than 4,000 tons of wire and covering.

In the early days of the cable service the receipt of messages depended largely upon the operator's eyesight, as the words were indicated by electric flashes of different lengths, which appeared on the surface of a small mirror. Then came the invention of Lord Kelvin—the siphon recorder—which has been in service nearly thirty years, translating the breaks in the electric current sent under the sea into legible characters upon a roll of paper with which it is connected. So many communications are going to and fro between the two worlds that although other cables have been laid, a force of nearly thirty operators is required in this little town in the far North. They are divided into a night and day staff, and are in charge of a general superintendent—Mr. William Bellamy.

The cable office is the principal building in Heart's Content—a plain two-story structure built of brick and stone. The principal apartment is the operating room, where are placed the siphon recorders and other instruments. Considerable space, however, is required for the battery, as a large quantity of chemicals are required to fill the several hundred cells used. These are placed in racks in the battery room, and the services of one man are continually required to clean and replenish the jars. The cables are laid to the operating room through an underground conduit which is walled with masonry. The shore section and that which extends into shallow water is considerably smaller than the deep-sea cable, as it requires less protection. The one which was last laid consists of eighteen strands, each strand composed of seven iron wires forming a metallic sheath for the copper wires which convey the electric current. The copper is embedded in gutta percha incased in hemp which is saturated with a combination consisting principally of beeswax, paraffine, and oil; this casing is surrounded by the iron wire, which is also covered with a waterproof compound. Several coatings of the hemp covering are wound about the gutta percha, so that the copper wires of the deep-sea cable are really protected by five wrappings. The shore section differs from the deep-sea principally in the absence of the wiring on the outside.

The services of a repair ship are frequently needed, as the terminals of the cables are liable to be injured by the masses of ice drifting down from the Arctic regions throughout the summer, as well as by other causes, and a repair ship is stationed in Trinity Bay ready for immediate service. The "Minia" is a schooner-rigged steamship carrying three masts, so that sail as well as steam can be employed when under way. The sails, however, are principally utilized in "lying to" when the vessel is making repairs where the water is too deep to permit anchorage. She carries lengths of extra cable coiled in tanks specially built for the purpose, and is provided with a set of steam winches and drums for hoisting and lowering. Her equipment also includes modern grappling appliances, electrical testing outfits, and in addition to the regular crew she carries several expert electricians and cable repairers.

APPROACH TO THE NEW EAST RIVER BRIDGE.

If the carrying capacity of a bridge is the true measure of its size and importance, then the new East River Bridge, now known as the Williamsburg Bridge, is the largest structure of its kind in the world. The length of the river span from tower to tower is 1,600 feet. This is 110 feet less than each of the two great cantilever spans of the railroad bridge across the Firth of Forth, Scotland; but although the Forth Bridge has longer spans and is a much longer bridge from approach to approach, it does not compare in carrying capacity with the new bridge across the East River which is now nearing completion. The Forth Bridge was intended simply to form a railroad connection for a double-track road, and provision is made merely for two lines of track and two footpaths, the total width of the roadway being about 40 feet, whereas the floor system of the Williamsburg Bridge measures 118 feet between the hand rails on the outside of the roadways, and provision is made for four street railway tracks, two elevated tracks, two 18-foot roadways for vehicles, two passenger footways, and two bicycle paths, or in other words the new bridge will have more than the capacity of a great city avenue.

When the bridge was planned some seven or eight years ago, the Bridge Commissioners, profiting by the experience gained with the Brooklyn Bridge, decided not to build any terminal station at each end of the bridge, but rather to consider the bridge as a great connecting thoroughfare between New York and Brooklyn, over which the traffic, elevated, trolley, vehicular, and pedestrian, could pass to and fro without the delays incidental to bridge terminals. Of the various kinds of traffic that will seek the new bridge, only that of the elevated railways will approach it above the normal street level. Surface cars, street vehicle traffic heavy and light, automobiles, bicycles, and pedestrians will enter the bridge approach at street grade. At the center of the bridge the trolley cars and the vehicular traffic will cross the river at an elevation of 140 feet above mean high tide; and both the roadways and the car tracks will rise from street grade at the approaches to the highest point of the bridge at midstream, on the regular grades corresponding to the curvature of the floor system. The foot passengers and the bicyclists will travel on an upper deck of the bridge, built at a sufficient height to clear the roofs of the trolley cars, while the elevated railways will enter the bridge approach at their normal elevation above street grade, and will continue above the approach on a level grade until they meet the rising grade of the bridge floor system, when they will pass over the bridge at the general level of the floor. The position of the various tracks and roadways was shown by this journal very clearly, in an illustrated article published in our issue of June 15, 1901.

Now to bring these various classes of traffic into their proper relative positions on the bridge required careful thought and judicious planning. The view of the bridge shown on the front page of this issue is drawn at a point near the anchorage on the Brooklyn side, and it shows how the traffic is segregated and brought to its proper relative position and level. In the first place, the foot passengers travel over the approach on a single passenger walk located on the center line of the bridge, until near the abutment, when the walk divides and passes to either side of the elevated structure, the traffic toward New York taking the right and that from New York the left of the center. Bicycles and motor vehicles approach the anchorage on a central driveway, located beneath the elevated structure and above the passenger footpath, and at the point shown in our engraving the pathway divides, the bicyclists and motor cyclists bound for New York taking the right-hand of the structure, and the travel from New York coming in on the left-hand side. At the anchorage the footwalk rises to the same level as the bicycle path, and diverges to join the latter, the bicyclists and foot passengers being separated by an iron railing. It will be understood that although at the point chosen for illustration the floor of the elevated structure is located at a considerably higher level than the roadways and trolley tracks, necessitating the use of columns of considerable length, the steep grade of the bridge causes the elevated and trolley tracks to rapidly approach a common level, until ultimately the bicyclists and foot passengers find themselves traveling at a higher elevation than the roofs of the elevated cars.

Our drawing also shows the architectural treatment which has been given to the bridge under the direction of the Municipal Art Commission. It includes the tall finials at the tops of the towers, a softening of the hard lines of the stiffening truss portals, and the provision of the two cut stone shelters above the anchorage. The effect has been to greatly improve the bridge by softening the hard, angular effect which characterized the structure.

Three More Airships for the St. Louis Contest.

Three more airships have been invented and will be entered in the World's Fair aerial tournament to compete for the grand prize of $100,000.

W. M. Morris, a Monte Vista, Col., mining engineer, is one of the contestants. His machine will be 30 feet in diameter and 150 feet long when fully rigged. Aluminium will be the material used in its construction, but no gas bag will be used as in other flying machines.

E. A. Kindler, a Denver, Col., man, has completed a model for an airship and conducted a satisfactory test. He will enter it in the contest for the $100,000 prize at the Fair. Safety appliances are a feature of the airship. Canvas flaps three feet wide extend entirely around the balloon as on Stevens' airship. These are limp except in case of sudden descent, when they open out like umbrellas or parachutes and are large enough to check descent to a gentleness devoid of danger should the gas bags fail completely. Motive power is furnished by a storage battery. The framework, which is made of aluminium and light steel tubing, with the motor, battery and propeller, which is six feet from tip to tip and has four blades, will weigh about three hundred pounds. A test was made recently of the model. The machine is said to have described a circle about fifty feet in diameter, rising, dipping, and finally descending to its moorings without a hitch in its mechanism.

Streator, Ill., will be represented in the aerial tournament by an airship planned by Mr. Reiferscheid, of that town. Reiferscheid's machine consists of a balloon pointed at both ends and lying in a horizontal position. Around this balloon are strips of aluminium strong enough to make a substantial framework. At each end are the propellers, six in all, to be used in raising and lowering the machine and to assist in guiding it. A six horse-power gasoline motor will provide the motive power and the balloon will be filled with hydrogen gas and hermetically sealed. Large fans will provide a safety device which will permit the ship to slowly descend in case the balloon collapses.

The British Antarctic Expedition.

On June 10, Sir Clements Markham, president of the Royal Geographical Society, lectured on the work of the British Antarctic expedition. Although he did not give much information in addition to that which has already been published, he did read a number of private letters containing some valuable data.

It seems that Commander Scott, on his ninety-four-day sledge journey, reached latitude 82 degrees, 17 minutes south, and longitude 163 degrees east, from which it would follow that the eastern coast line of Victoria Land, to which he adhered, extends almost due south of Mount Erebus, his starting point, with only a very slight deflection to the east. A range of mountains extended beyond this point as far as he could see in a southeasterly direction. Scott must have traveled over 980 statute miles on this remarkable journey. His most southerly point was only one mile farther from the South Pole than the corresponding record for the North Pole made by Peary in the Arctic. The "Discovery" was frozen in latitude 77 degrees, 50 minutes, or more than 500 miles further south than any ship ever wintered before. An extensive land mass was found in longitude 152 degrees, 30 minutes west, to which the name of King Edward VII. Land was given. Mountains tower above the land to a height of 2,000 and 3,000 feet above the sea level.

In the other sledge journey, which was undertaken by Armitage, longitude 157 degrees and 25 minutes east and latitude 77 degrees and 21 minutes south was reached. Armitage penetrated Victoria Land almost due west and reached an altitude of 9,000 feet.

An old subscriber, in remitting for renewal of his subscription for the coming fiscal year, writes us humorously, as follows: "A man might get along without his shirt, and could do without the cereals, Force and Oatmeal, but I defy a man to get along without the SCIENTIFIC AMERICAN if he wants to fatten his brains to meet men of brains in the common walks of life. Give me the SCIENTIFIC AMERICAN, and I will go without my breakfast. Yours always hungry for *top knot* food."

Engineering Notes.

At the Ormesby Iron Works, Middlesborough (England) an interesting experiment has been in progress during the past twelve months with a blast engine worked direct by furnace gas, and the success achieved has been eminently satisfactory. In order that the gas may be suitable for use in the engine, and to achieve the desired results, it is cooled down so that when it enters the engine its temperature does not exceed 68 deg. F. The gas when passed into the engine must not contain more than 25 grm. of dust per cubic meter. A certain speed of running in conjunction with a certain volume of water is most advantageous, and it would appear that any variation of the one or the other proves disastrous. From the experiments with this engine it has been demonstrated that blast-furnace gas presents no insuperable difficulties for successful employment in large gas engines.

In view of the difficulty experienced by the British Admiralty concerning the storage of steam coal for the navy by the ordinary wharfing, whereby the fuel deteriorates in its calorific value, some important experiments are being made to ascertain whether the coal can be better preserved by storage under water. It is contended that when the steam coal is submerged its calorific quality is preserved. For this purpose five large wooden cases have been constructed; each has been filled with two tons of fresh Welsh steam coal, and sunk in Portsmouth Harbor, where they are to remain in a considerable depth of water for a year. A similar quantity has been stored upon the land in the orthodox manner. At the expiration of the twelve months the coal will be raised and, together with the land-stored coal, will be tested to determine whether the submerged coal has retained its steam-raising capacity better than the land-stored fuel.

The inventors of devices for preventing railway collisions flourish in Germany as well as in the United States. It seems that two German engineers, H. Pfirmann and Dr. M. Wendorf, have invented an apparatus, which underwent a successful trial recently on a specially prepared section of the Sachsenhausen-Goldstein Railway near Frankfurt-on-Main. Dr. Max Wendorf himself supplied the necessary locomotives, and the trial took place on a section of line containing a curve. The principle of the invention is as follows: Along the middle of the track runs an insulated metal rail, which is connected with the locomotive by means of a running contact. In the rail resistances are inserted, and these are overcome as soon as the locomotive approaches another engine, or a signal or crossing, which are also fitted with the same contrivance. If, for example, two engines are traveling toward each other on the same rails, then—and the distance is no object—each engine is immediately electrically connected with the other, a red light is flashed, and a bell is sounded to warn both engine drivers that danger is ahead.

According to the Zeitschrift des Vereins Deutscher Ingenieure, it has been ascertained by Herr Scholter, manager of the Nuremberg-Furth trainways, that the resistance of flywheels is very far from being a negligible quantity. This resistance may be divided into two parts; that exerted by the friction of the air against the rim and that due to the displacement of the air by the arms; the latter being by far the more important of the two. In the central station of the trainway there are two horizontal, tandem compound engines developing 450 horse power at a speed of 95 revolutions per minute. Each has a strong flywheel whose arms are formed of a double T with a central web set parallel to the center line of the shaft. The rotation of these flywheels produces a strong current of air which seemed to indicate the existence of a considerable resistance. The suggestion was made to cover the two faces with a smooth protection of sheet metal, which was done. In order to determine the difference in the resistance under the two conditions, with and without the covering, one dynamo was made to serve as a motor to drive the unloaded engine. With the flywheel in its original condition, the work required was 13,300 watts, while, after the wheel was covered, only 9,874 watts were needed—a difference of 3,426 watts or about 5.7 horse power. The cost is then estimated, which may be reduced to American standards as follows: Considering the engine to be running 17 hours per day for 365 days in the year on a consumption of 2 pounds of coal per horse power hour; the coal burned for the development of the power to overcome flywheel resistance will be about 35 tons, which at $2 per ton will be $70.00 per year. As the cost of covering the flywheels is an insignificant amount, the figures given above may be taken to represent a net annual saving. As long ago as 1888 Prof. Brauer, of Darmstadt, called attention to the advisability of filling in the space between the arms of flywheels and cited an experiment made by Inglis on a 630 horse power engine in which indicator cards showed a saving of 30 horse power or 4.8 per cent due to a reduction of flywheel resistances.

Electrical Notes.

According to the Street Railway Journal, the trolley system is being extended in Rome. The clanging of bells may now be heard in many of the ancient highways formerly trodden by the army of the Senate and the people of Rome. The seven hills of the city have created considerable difficulty in the way of electric railway construction. This has been especially true of the Quirinal hill, which formed a serious barrier between the old part and the new parts of the city. This difficulty has been finally overcome by constructing a tunnel under the Quirinal, upon which is the royal palace. The eastern end of this tunnel commences near the Art Museum on the Via Nazionale, and emerges at a point near the Piazza da Spagna near the Piazza Colonna and the Corso.

The New York Telephone Company has recently put into service a telephone automobile truck which is used in hauling the large reels of covered cable which are placed in the conduits under the surface. These reels are hauled to all parts of the city by this vehicle, but upon being delivered the wagon offers the mechanical means of drawing the cables through the holes. The front end of the truck is fitted with a device made of channel iron, which is sunk into the manhole, affording a rigid support for the pulleys over which the hauling cable runs. The cable drum by which this work is done is located under the driver's seat, and has six speeds varying from 10 to 40 feet of cable per minute. The total weight of the vehicle is 4½ tons, of which 2,800 pounds is battery. With one charge of the batteries, this truck is guaranteed to carry a load of five tons for a distance of 15 miles and to supply the power for placing the wire underground. When the cable-hauling machinery is not to be made use of, the load can be transported a distance of 25 miles. The vehicle has proven to be very economical in service, and does the work of two gangs of men working under the old system.

It is pointed out in Nature that, although the electrochemical equivalent of silver has been the subject of several very careful investigations, the results obtained by different experimenters indicate that the quantity of silver deposited by a given quantity of electricity is dependent to a certain small extent on the form of voltameter and on the conditions under which this is employed. Richards and Heimrod (Zeitschrift für physikalische Chemie) have investigated minutely the cause of these differences, and find that the most important disturbing factor in the ordinary silver voltameter is the formation of a complex silver ion at the anode which diffuses toward the cathode, and by its decomposition increases the quantity of silver deposited at the cathode. An improved form of silver voltameter is described in which the anode and cathode are separated by a porous cell which prevents the diffusion of the anode solution to the cathode, and the accuracy of the results obtained by the use of this instrument is demonstrated by several series of experiments. As a result of this investigation it appears that the electro-chemical equivalent of silver as determined by Lord Rayleigh's voltameter is at least 0.05 per cent too high, and that the quantity of electricity associated with one gramme equivalent must now be taken as 96,580 coulombs.

Owing to the rise in the price of coal during the last few years, M. Thormann, a prominent Swiss engineer, wished to find out whether it would not be an advantage to use electric energy, furnished by hydraulic plants, over the whole of the railroad system of Switzerland. After investigating the subject he published a report which has awakened considerable interest and will no doubt bring about some practical results in this direction. He finds that the substitution of electricity for steam on the railroads is quite practicable and has many advantages, although it will not bring about any considerable reduction in the cost of operating the roads. The five main railroads now existing in Switzerland require over 30,000 horse power daily. In order to organize a complete electric service it will be necessary to obtain about 60,000 horse power in the shape of alternating current of high tension, not counting the reserve supply which is indispensable. Not taking into account the considerable number of falls which are not utilized in the country, there exist already 21 large hydraulic plants which can give a total of 86,000 horse power. These include the plant of Siel, near Linsiedl, which has a capacity of 20,000 horse power, the Laufenburg plant, on the Rhine, giving also 20,000 horse power, then five others giving each 5,000 horse power, etc. He enumerates 21 plants which will be more than sufficient to supply the energy for the Swiss railroads. The cost of changing over the system would of course be considerable and this may be estimated at thirty-two millions, which includes eight millions for rolling stock, fourteen for lines and ten for the various sub-stations. It is to be noted, however, that the adoption of the electric system would have the great advantage of doing away with the present consumption of coal, which is now imported from outside, and that the use of hydraulic energy would be of great benefit in developing several branches of the national industry. The publication of this report aroused considerable attention in different quarters, and already one of the railroad companies has applied to the government for an authorization to use electric trains on a trial stretch of road twelve miles long.

Finances of the Year.

The Treasury department's figures for the fiscal year show that the excess of receipts over expenditures was $52,710,936, which may be compared with $92,000,000 in 1902 and $77,000,000 in 1901. Income was $558,887,526, and outgo $506,176,590. Owing to the repeal of war taxes, the internal revenue receipts were reduced by nearly $42,000,000, but the receipts from customs show a gain of about $29,500,000. This is due chiefly to enlarged imports of materials to be used by manufacturers, and of some finished products which could not be obtained from our own factories without much delay. It indicates activity rather than idleness in our own industries. While the total revenue was less than that of 1902 by $3,500,000, there was an addition of $35,000,000 to the expenditures. Of this increase, $15,000,000 is to be charged to the navy and $6,000,000 to the army. The treasury's available cash balance at the end of the year was $231,415,000 and the total amount of gold in the treasury was $631,639,000, an increase of $71,000,000 in twelve months. At the end of the year the national bank circulation had risen to $413,670,650, the addition for the year amounting to $56,000,000, or nearly 16 per cent. The treasury's figures do not include the revenue ($134,268,000) and the expenditures ($138,885,000) of the Post Office department. Here a deficit of $4,617,000 is disclosed, against $2,961,000 last year.

Important Egyptian Discoveries.

Prof. Flinders Petrie announces some important discoveries made while excavating at Abydos. At a depth of about 20 feet, an old temple site was discovered, in which the ruins of ten successive temples were found, ranging in age from about 500 to about 5,000 B. C. So far as religious discoveries are concerned, it would seem from some relics found that Osiris was not the original god of Abydos. Up to the twelfth dynasty Jackal, god of Vpuaut, and then Khentamenti was honored. About the fourth dynasty the temple was destroyed, only a great hearth of burnt offering remaining, full of votive clay substitutes for sacrifices. This confirms the account given by Herodotus that Cheops had closed the temples and forbidden sacrifices. An ivory statue of Cheops was found, which shows for the first time the face and character of the great builder who made Egyptian civilization what it was for thousands of years after.

The Current Supplement.

Pope Leo XIII. is the subject of the opening article of the current SUPPLEMENT, No. 1437. The events of the great Pontiff's life are narrated fully and accurately. An account is also given of the wonderful Vatican palace, the residence of the Popes. A machine for carving wood moldings is described. Mr. A. E. Potter tells something of interest about marine engines. An article on self-igniting devices for coal-gas should not be without value. Opticians will find of interest a discussion of the aberration of the sphericity of the eye. In an excellent article by the Paris Correspondent of the SCIENTIFIC AMERICAN, the famous Serpollet racers are analyzed. Mr. James Alexander Smith tells how a circular computing scale can be simply made. Dr. Fleming continues his admirable explanation of Hertzian Wave Telegraphy.

Most of the experiments made with X-rays, whether in connection with the germination of seeds, heliotropism, or chlorophyl formation, have failed to yield positive or satisfactory results. Circulating protoplasm, however, seems to be sensitive to the effect of X-rays, and, as H. Seckt has shown, the movement is hastened and prolonged thereby. The protoplasm of isolated hairs of *Cucurbita pepo* and *Tradescantia virginica* showing sluggish movement quickened under the influence of X-rays. A positive result was also obtained with *Mimosa pudica*; at a distance of about one foot from the tube the leaves began to close after being subjected to the rays for twenty minutes. In the most favorable cases the closing of the leaves could be followed from the youngest to the oldest, and the fall of the petiole ensued in due course.—Berichte der Deutschen Bot. Gesellschaft.

The Patent Office's work during the past year has been in every way remarkable. The number of patents issued amounted to 29,329, whereas last year's patents numbered only 26,031. The trade marks registered show an increase from 1,864 to 2,194. The recent court decisions, which hold that designs are to be restricted exclusively to ornamental things, have resulted in a decrease in the number of design patents granted.

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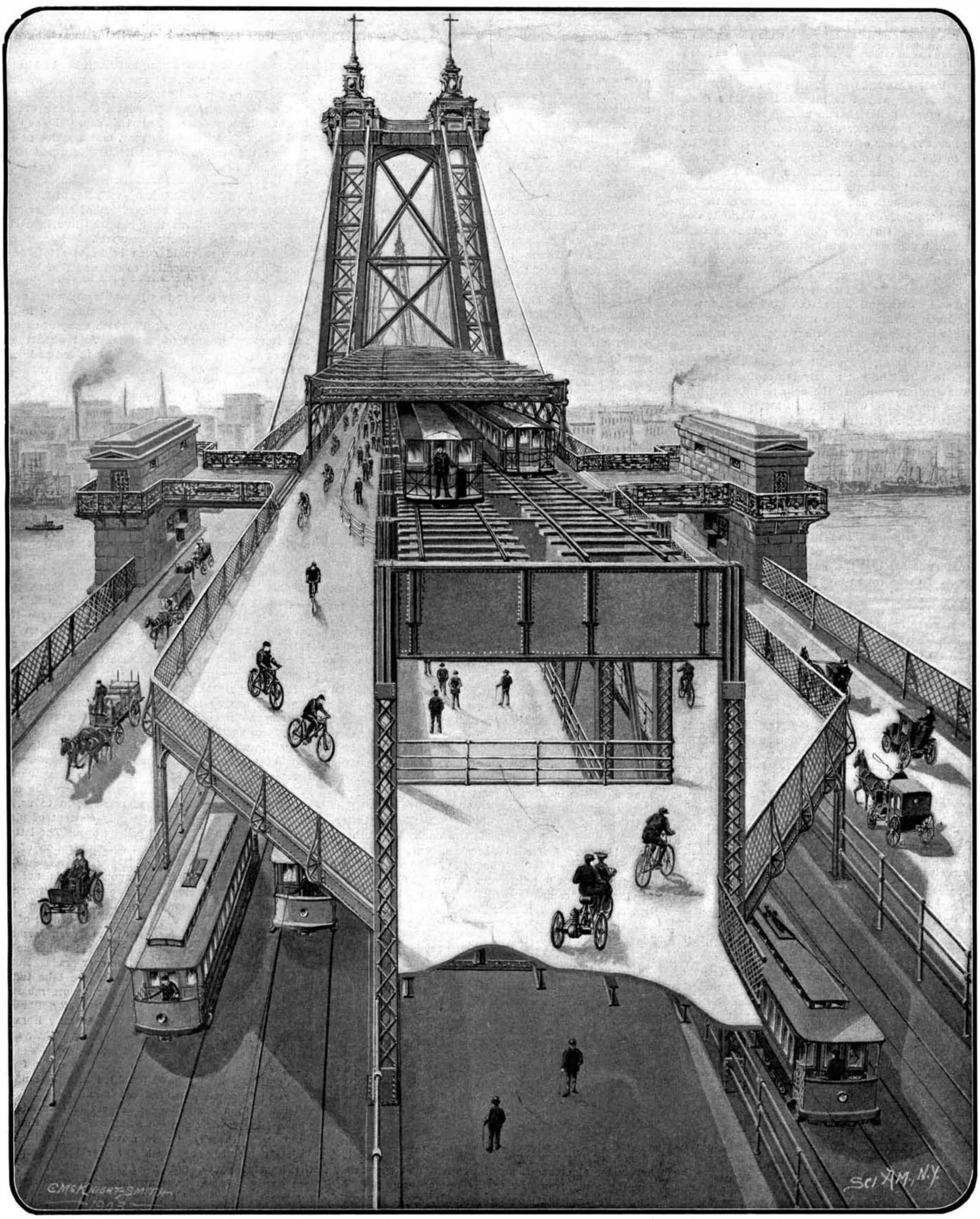

Total width, 118 feet, including four street railway tracks, two elevated railway tracks, two 18-foot roadways, and two foot-passenger and bicycle paths. The view is taken on the approach at the Brooklyn anchorage, looking across the East River.

APPROACH TO THE NEW EAST RIVER BRIDGE.—[See page 46.]