

dam, 10 inches apart, 14 feet below high water; the water was pumped from the dam until it was only about 1 foot above the heads of the piles. The work was carried on during the severest weather of last winter. The water in the dam was heated slightly by means of steam pipes, then concrete was poured in by means of funnels and pipes, as shown, until the mass of concrete was 7 feet above the top of the piles. A granite foundation, 12 feet high, was then built upon the concrete, 8 feet 2 inches wide at the base and 5 feet 2 inches at the top. The piles for the remainder of the foundation were driven about the same distance apart, but only 1 foot below the water. A concrete mass 8 feet 6 inches thick was formed upon the piles. This concrete mass extends under the entire buildings. Two granite piers, 41 feet by 47 feet at the base, 44 feet 8 inches by 35 feet 5½ inches at the top, and 6 feet 8 inches high, were built as a foundation for the engines. The engine house will be 128 feet by 168 feet and 70 feet high. All of the buildings above the foundations will be of brick and three story.

The chimney will be the highest in Brooklyn, being 325 feet high. Stone foundations for chimney at the base, 60 feet square; five layers of stone, the upper layer 42 feet square. Brickwork at the base, 38 feet. Flue of chimney, 17 feet diameter.

be readjusted to clear the trackways. The engineers' fight was a severe one, but, by perseverance and persistence, the great work has been accomplished, and now Broadway, with its great cable road, involving an outlay of millions of dollars, and with its grand buildings, stands forth as the leading thoroughfare of the world.

The road extends from the south end of Central Park, at 59th Street, New York, along Seventh Avenue to its junction with Broadway at 42d Street, thence along Broadway south to the Battery and South Ferry, the extreme southern point of the city, where the waters of the Hudson and East Rivers unite on their way to the sea. The distance is between five and six miles.

The cables in their present limits embrace four principal divisions, each capable of being driven independently, and covering a total cable length of over 60,000 feet—more than eleven miles of running cable.

Throughout the whole line a spare cable will be laid ready for use in any emergency.

There are two power stations, where are assembled some of the most perfect and remarkable examples of driving mechanism ever constructed. One of these stations occupies the great stables formerly devoted to the welfare of the 2,000 horses heretofore employed by

quired repairs may be made to any one or two of the rope driving systems without stopping the cables in either direction.

The cable drums are 14 feet in diameter, with five grooves in each, to fit the 1½ inch cables, which are wound over and over the driving drums to obtain the necessary friction for driving the cables. One of the latest improvements in cable driving is introduced on these cable drums, consisting of an independent grooved friction ring for each wind of the cable, which allows the strain from unequal wear in the grooves to become equalized by a movement of the rings among themselves, instead of the drawing of the cable in the grooves of a solid driving wheel, which causes friction and wear. A system of traveling cranes is arranged overhead, covering all of the machinery in the room, giving the best and most modern facilities for erecting or removing the heavy parts of this ponderous machinery.

In the upper corner is illustrated the tunnel from the engine room into and under 51st Street to Seventh Avenue, blasted out of solid rock, lined and arched with brick, the engine room being located on the corner of 51st Street and Sixth Avenue.

Through this tunnel, which is nearly 1,000 feet long, the two outgoing and incoming cables for both the



THE BROADWAY CABLE RAILWAY NEW YORK—RUNNING IN THE CABLE.

The method of making concrete in winter time is of interest, as heat is important to prevent freezing until it can set properly. In this case the sand was heated by being packed around a large boiler, in which a fire was kept going all the time.

The broken stone was heated by being placed in a large tank of hot water. Hot water was also used in the mixing machine. By these means the concrete mass was kept warm until it had set. The granite blocks placed on the concrete were also heated by having fires built around them.

These particulars were kindly furnished by Mr. W. A. Tenney, C. E. W. H. Ward, of Lowell, Mass., has the contract for building, and Mr. P. Casseday is the superintendent.

#### THE BROADWAY CABLE RAILWAY, NEW YORK.

The change of the power of the Broadway street railroad, New York, from horse power to cable driving, which has been going on for over a year past, is now completed, and the cable cars will soon be in motion. The construction of the cable line proved to be one of the most difficult works of its kind that has yet been undertaken—not so much in the construction of the road proper as in overriding the vast network of pipes for water, gas, steam, pneumatic, telegraph, and telephone service which occupy this great thoroughfare. In uncovering the subway a bewildering combination of pipework was exposed. Pipes had to be depressed or carried to one side. Manholes for sewers, water pipe valves, and the telegraph subway had to

be readjusted to clear the trackways. The engineers' fight was a severe one, but, by perseverance and persistence, the great work has been accomplished, and now Broadway, with its great cable road, involving an outlay of millions of dollars, and with its grand buildings, stands forth as the leading thoroughfare of the world.

Two of the cable divisions are here operated. The other power station occupies the lower part of the company's great building at the corner of Broadway and Houston Street.

We illustrate on our first page the magnificent engine room and power plant of the 51st Street power station.

The engines are of the latest style of Corliss type, made by the Dickson Manufacturing Company, Scranton, Pa. Cylinders 36 inches diameter, 60 inches stroke, each of 1,000 horse power.

The fly wheels are 24 feet diameter and weigh 80,000 pounds each. The main shafts are 18 inches diameter in the bearings and 20 inches in the swell, coupled to the main driving shaft with flanged couplings with bolts and cross keys. Upon the main shaft are four grooved driving wheels, each actuated by a friction clutch, making the use of any one or all of the driving gear under control for running or stopping, the driving pulleys hanging like a loose pulley on the running shaft when not in use.

The four driven wheels are grooved to match the drivers, are 32 feet in diameter; 20 cotton ropes 2 inches diameter are the transmitting medium for each of the four sets.

The large driven wheels are on separate shafts, each in pairs with friction clutches; each shaft connecting with one of the four cable drums, which are run in pairs and interlocked with gearing, so that any re-

quired repairs may be made to any one or two of the rope driving systems without stopping the cables in either direction.

The tunnel is lighted by electricity. At the opposite upper corner, first page, we illustrate a part of the power house at the corner of Sixth Avenue and 50th Street, used for the cable tension apparatus, which consists of large grooved wheels mounted on car trucks running on rails. The cables, coming from the driving wheels of this power room, pass over the tension wheels and back into the tunnel. The trucks are attached to a cable running over pulleys in the iron towers and fastened to weights adjusted to a proper tension for the running of the cables and for taking up the stretch and accommodating variations in length by changes of temperature.

After the roadbed for the Broadway cable railway was completed, it became necessary to run the cable into the interior of the slotted tube. This was done by means of a platform car weighted with iron. Projecting from beneath the car into the slotted tube of the roadbed was a strong colter, to the lower end of which the cable was attached at the power station. At 3 A. M., when the street was clear of traffic, the car was started, drawn by thirty-six splendid horses, and in the course of two hours a section of the cable was unreel and run into the tube. Each cable section was run in the same way.

The illustration on this page shows the platform car and teams at work on Broadway, drawing the cable into the tube, as stated.

### Important Prizes Offered by the Smithsonian Institution.

In October, 1891, Thomas George Hodgkins, Esq., of Setauket, N. Y., made a donation to the Smithsonian Institution, the income from a part of which was to be devoted "to the increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air in connection with the welfare of man."

With the intent of furthering the donor's wishes, the Smithsonian Institution now announces the following prizes to be awarded on or after July 1, 1894, should satisfactory papers be offered in competition:

1. A prize of \$10,000 for a treatise embodying some new and important discovery in regard to the nature or properties of atmospheric air. These properties may be considered in their bearing upon any or all of the sciences—*e. g.*, not only in regard to meteorology, but in connection with hygiene, or with any department whatever of biological or physical knowledge.

2. A prize of \$2,000 for the most satisfactory essay upon—

(A) The known properties of atmospheric air considered in their relationships to research in every department of natural science, and the importance of a study of the atmosphere considered in view of these relationships.

(B) The proper direction of future research in connection with the imperfections of our knowledge of atmospheric air, and of the connections of that knowledge with other sciences.

The essay, as a whole, should tend to indicate the path best calculated to lead to worthy results in connection with the future administration of the Hodgkins foundation.

3. A prize of \$1,000 for the best popular treatise upon atmospheric air, its properties and relationships (including those to hygiene, physical and mental). This essay need not exceed 20,000 words in length; it should be written in simple language, and be suitable for publication for popular instruction.

4. A medal will be established, under the name of The Hodgkins Medal of the Smithsonian Institution, which will be awarded annually or biennially, for important contributions to our knowledge of the nature and properties of atmospheric air, or for practical applications of our existing knowledge of them to the welfare of mankind. This medal will be of gold, and will be accompanied by a duplicate impression in silver or bronze.

The treatises may be written in English, French, German or Italian, and should be sent to the Secretary of the Smithsonian Institution, Washington, before July 1, 1894, except those in competition for the first prize, the sending of which may be delayed until December 31, 1894.

The papers will be examined, and prizes awarded, by a committee to be appointed as follows: One member by the secretary of the Smithsonian Institution, one member by the president of the National Academy of Sciences, one by the president, pro tempore, of the American Association for the Advancement of Science; and the committee will act together with the secretary of the Smithsonian Institution as member *ex officio*. The right is reserved to award no prize if, in the judgment of the committee, no contribution is offered of sufficient merit to warrant an award. An advisory committee of not more than three European men of science may be added at the discretion of the Committee of Award.

If no disposition be made of the first prize at the time now announced, the institution may continue it until a later date, should it be made evident that important investigations relative to its object are in progress, the results of which it is intended to offer in competition for the prize. The Smithsonian Institution reserves the right to limit or modify the conditions for this prize after December 1, 1894, should it be found necessary. Should any of the minor prizes not be awarded to papers sent in before July 1, 1894, the said prizes will be withdrawn from competition.

A principal motive for offering these prizes is to call attention to the Hodgkins Fund and the purposes for which it exists, and accordingly this circular is sent to the principal universities and to all learned societies known to the institution, as well as to representative men of science in every nation. Suggestions and recommendations in regard to the most effective application of this fund are invited.

It is probable that special grants of money may be made to specialists engaged in original investigation upon atmospheric air and its properties. Applications for grants of this nature should have the endorsement of some recognized academy of sciences, or other institution of learning, and should be accompanied by evidences of the capacity of the applicant, in the form of at least one memoir already published by him, based upon original investigation.

To prevent misapprehension of the founder's wishes it is repeated that the discoveries or applications proper to be brought to the consideration of the Committee of Award may be in the field of any science or any part without restriction; provided only that they

have to do with "the nature and properties of atmospheric air in connection with the welfare of man."

Information of any kind desired by persons intending to become competitors will be furnished on application.

All communications in regard to the Hodgkins Fund, the Hodgkins Prizes, the Hodgkins Medals, and the Hodgkins Fund Publications, or applications for grants of money should be addressed to S. P. Langley, Secretary of the Smithsonian Institution, Washington.

### Decisions Relating to Patents.

#### INVENTION.

In letters patent No. 367,484, issued August 2, 1887, to Jeremiah M. Watson, claim 1 is for a machine for compressing shank stiffeners, having "two rotating die or compressing rollers, the meeting faces of which are formed to present a recess, having one straight and one curved face or side, to thereby curve transversely one face of the stiffener," etc. Claim 6 is for a method of finishing the edges of shank stiffeners, consisting "in cutting out a blank from a sheet of material, leaving the same with beveled edges and obtuse-angled corners, and thereafter passing the same between rolls having dies with rounded edges or margins, in order to round the obtuse angles and beveled portions as cut. It is held by the Circuit Court of Appeals that, in view of the fact that the patented machine is the only one thus far discovered operating with efficiency, rapidity, and economy, the patent is not void for want of invention over the prior machines having reciprocating instead of rotating dies, although ordinarily the one is only the mechanical equivalent of the other. 1.

The Circuit Court decides that letters patent No. 465,485, issued December 22, 1891, to Levi Maybaum, for "means for securing against excessive losses by bad debts," being a plan of insurance against losses from bad debts based on estimates of the different percentages of loss in different lines of business, and providing forms for ruling paper, with spaces for entering various details of the insurance transaction, are void for want of invention. 2.

The Circuit Court rules that letters patent No. 337,006, issued March 2, 1885, to David C. Mahon and others, for a "bending block," consisting of a block or former adapted to the bending or shaping of the loop in guide rods for grain car doors, are void for want of patentable invention. 3.

#### PRELIMINARY INJUNCTION—WHEN GRANTED.

Letters patent No. 258,295, issued to Halstead, May 23, 1882, cover an egg-holding tray for incubators, having wires or cross bars, in combination with a muslin web below the same, on which the eggs rest, and which is movable by means of rollers so as to turn the eggs. In his application the patentee claimed as his improvement an arrangement whereby the eggs rested between cross bars not supporting the eggs, and disclaimed cross rollers on which the eggs rest. In defendant's incubator the eggs rest upon a cloth supported by cross bars, and the cloth revolves on rollers, but the rollers serve both to support the eggs and to hold them in place while the cloth is moved to turn them. Defendant's device had greater likeness to a prior patent than to that of complainant. There was no evidence that serious injury would be caused by withholding a preliminary injunction. The Circuit Court lays it down that the same should be denied. 4.

Letters patent No. 363,249, issued in 1887 to George H. Stahl, cover in claim 3 an incubator in which uniform heating is secured by a flat tank overlying the chamber, and divided by two partitions extending from one end nearly to the other, the hot water being discharged by pipes into the outer divisions, and carried off by a single return pipe, leading from a point between the partitions. Defendant substitutes pipes for the partitions, and it appeared that the patentee originally claimed substantially similar pipes, but, the same being rejected, he disclaimed the use of pipes for maintaining an even temperature. The Circuit Court holds that the claim should be strictly construed against him, and that a preliminary injunction should be denied, especially as it appeared that both pipes and partitions had been used prior to the patent. 5.

#### LIMITATION.

Letters patent No. 164,425, issued June 15, 1875, to Stephen Chester, for an improvement in fire alarm signal boxes, cover, in the third claim, "the combination of an independent pinion or equivalent device with a wheel, sector, or rack, and a key or equivalent implement which may pass through an orifice in a closed door, for the purpose of winding a spring or raising a weight." This claim was inserted after the rejection of a broad claim for the "winding up and preparing for action the motive force of said apparatus by turning the key, or similar device, inserted in the keyhole of a closed door or cover." It is decided by the Circuit Court that in view of this action and of the fact that the combination of a pinion, wheel, sector, or rack with a key or its equivalent, passing through an orifice in the door for the purpose of winding a spring or raising a weight, was old at the

time of the invention, the claim must be limited to the specific devices set forth, or their equivalents, and is not infringed by a signal box in which the devices are widely dissimilar. 6.

Letters patent No. 344,430, issued June 29, 1886, to John C. Wilson, for an electric signal box, cover in claim 6 a box in which a citizen's key removes an obstacle from the signaling crank, and the signal is then operated by turning the crank, whose handle projects through the door. The key, after performing its function, is entrapped so as to prevent its withdrawal by means of mechanism operated by the movement of the door, the key being held while the door is closed, and released when the door is opened. The claim is for a signal box in which the mechanism is "controlled" by a key, etc. The Circuit Court rules that, in view of the prior state of the art as shown by letters patent No. 157,002, issued November 17, 1874, to Z. P. Hotchkiss, and by the Wright, Holley & Miles patent of June 17, 1873, the claim cannot be construed to cover a signal box in which the transmitting mechanism is operated directly by the key, and without any further action by the operator. 7.

#### ACQUIESCENCE IN PATENT.

On a motion for preliminary injunction the patentee made affidavit that he put the invention into practical use about the time of the application, and it had been in practical use ever since; that the rights of the owner of the patent had been acquiesced in by the public; that the invention had been applied to many hundred machines; that he had never given any licenses, or sold any manufacturing rights; and that the validity of the patent had never been questioned. The assignee of the patent made affidavit that he had applied the patent since January, 1892. The Circuit Court holds that this was insufficient to show public acquiescence. 8.

#### WHO ARE INFRINGERS.

The Circuit Court decides that a person who is employed as manager of a partnership, and who in that capacity sells an article which infringes a patent, is guilty of infringement, and may be enjoined, but he will not be compelled to account if it fails to appear that he had any interest in the sale. 9.

1. *Watson v. Stevens*, 51 Federal Reporter, 757.
2. *U. S. Credit System Co. v. Am. Indemnity Co.*, 51 Federal Reporter, 751.
3. *Mahon v. McGuire Mfg. Co.*, 51 Federal Reporter, 681.
4. *Stahl v. Williams*, 52 Federal Reporter, 648.
5. Same.
6. *Gamewell Fire Alarm Tel. Co. v. Municipal Signal Co.*, 52 Federal Reporter, 471.
7. *Municipal Signal Co. v. Gamewell Fire Alarm Tel. Co.*, 52 Federal Reporter, 468.
8. *Stahl v. Williams*, 52 Federal Reporter, 648.
9. *Featherstone v. Ormonde Cycle Co.*, 53 Federal Reporter, 110.

#### The Austrian Plate Glass Industry.

The United States consular officials in Vienna and Prague have sent reports to the government on the plate and mirror glass industries of Austria, which contain much technical detail. It seems for over two centuries the mirror glass industry has been established in Bohemia, just across the Bavarian border, where the surrounding forests guaranteed a plentiful and cheap supply of fuel. At first glass for beads and bottles only was produced. In the latter half of the last century Bohemia held the first place among the glass-producing countries of the world. The value of the glass manufactured there in 1799 amounted to about a quarter of a million sterling. Early in this century, however, the markets began to be flooded with cheap English and French pressed crystal glass, with which Bohemian glass could not compete, and notwithstanding the efforts of Bohemian glass manufacturers, the decline of the industry was inevitable. In recent years it has revived, and there are now in Bohemia about 150 glass works and nearly 3,000 grinding establishments, employing nearly 30,000 persons. There is a number of glass works in other Austrian provinces, and in Hungary there are over 70 in operation. The chief factories for producing plate and mirror glass are situated near Pilsen, in Bohemia. The value of these kinds of glass depends on the purity, and the greatest possible care is therefore taken to procure materials of the very best quality, and almost every manufacturer guards the formula of his own special mixture as a trade secret. The substances used, though the proportions differ, are quartz, purified potash, hydrate of lime or marble, saltpeter, arsenic, manganese, and smalt. The reports enter into numerous details of the various processes of manufacture—blowing, rolling, grinding, smoothing, and polishing.

**THE LENGTH OF THE DAY.**—By a simple rule the length of the day and night, any time of the year, may be ascertained by simply doubling the time of the sun's rising, which will give the length of the night, and double the time of setting will give the length of the day.

# SCIENTIFIC AMERICAN

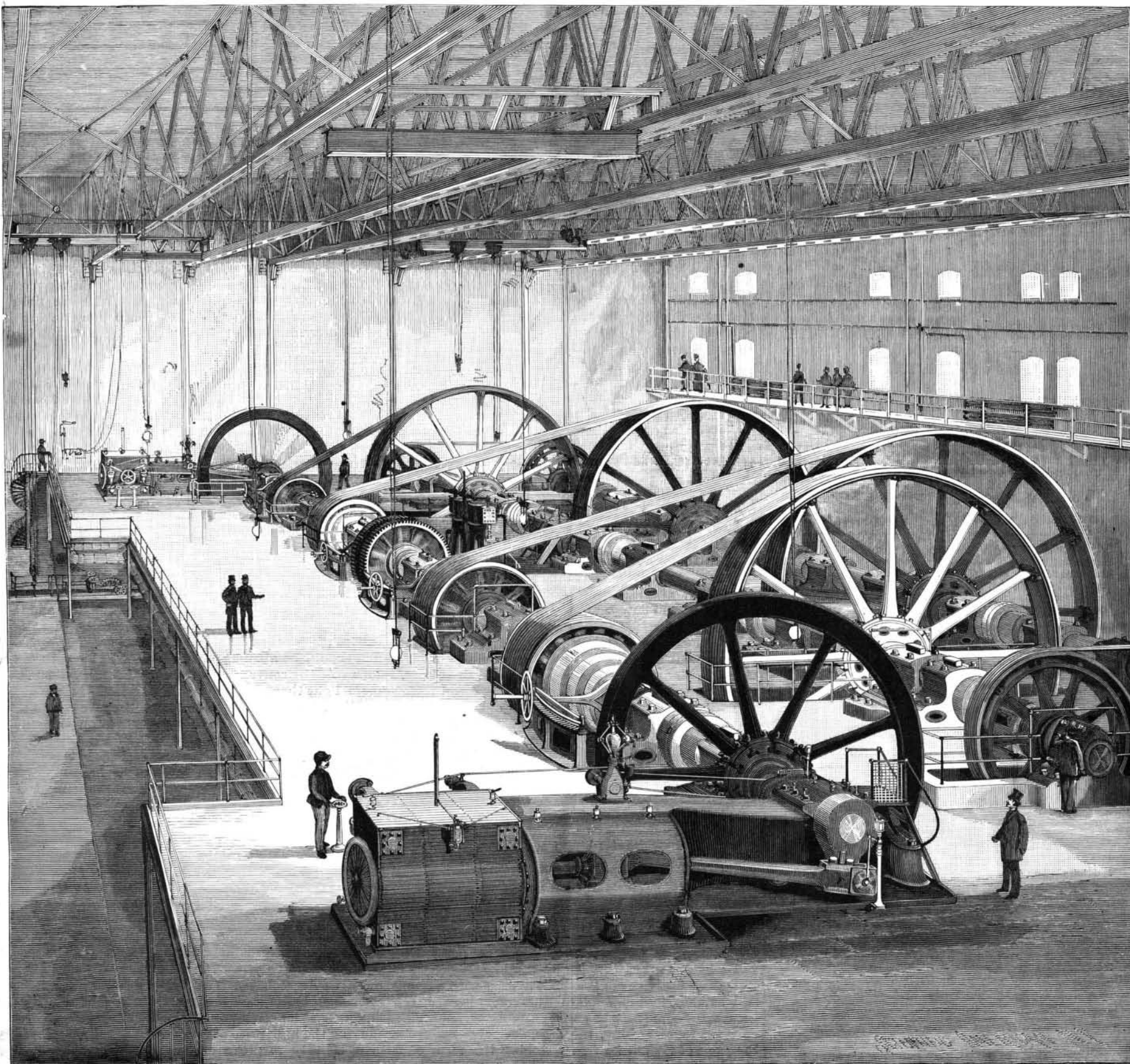
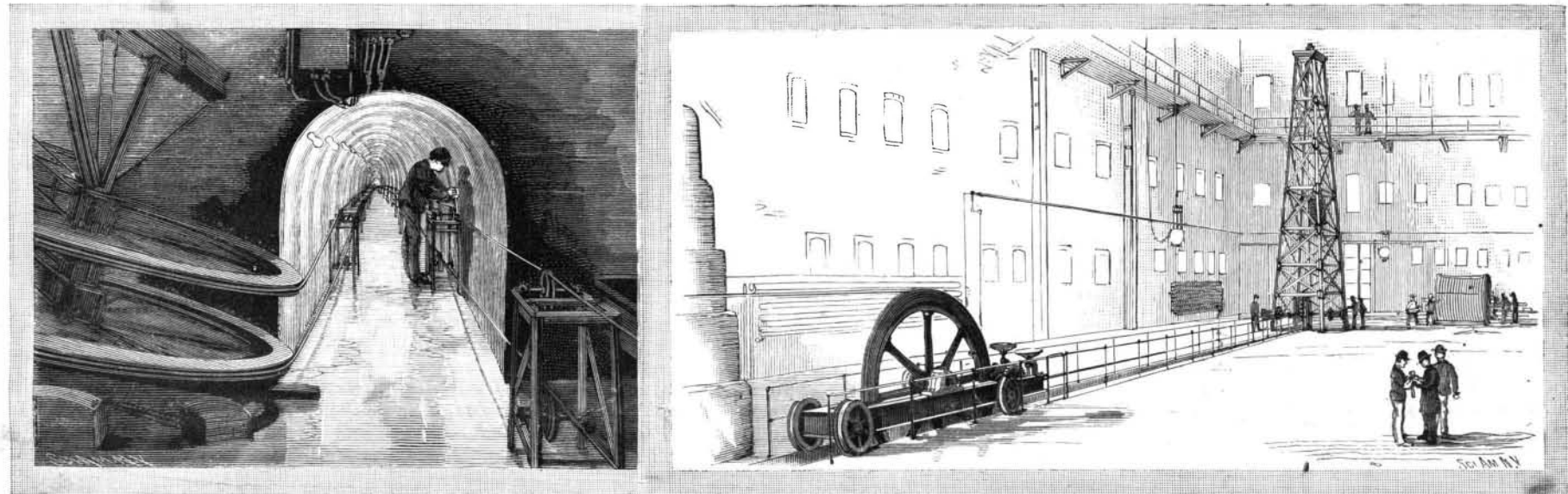
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THE BROADWAY CABLE RAILWAY—THE POWER STATION AT 51st STREET.—[See page 249.]