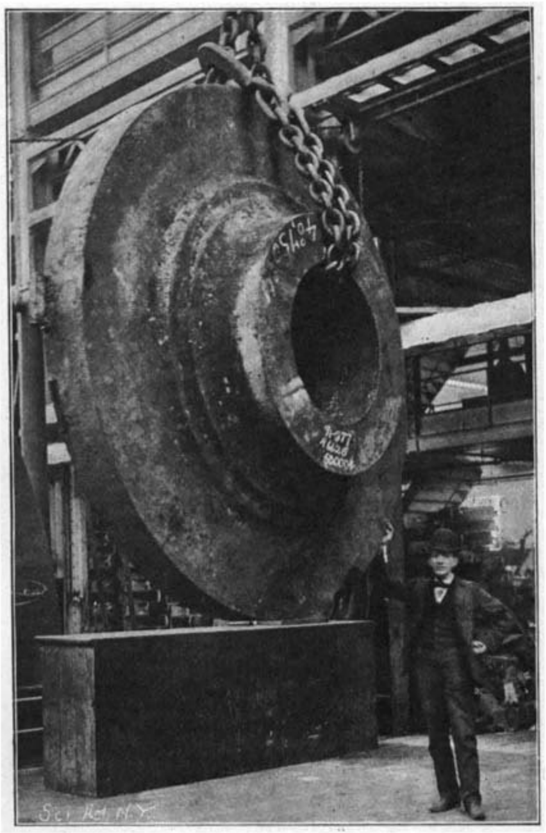
OPENING THE POWER STATION OF THE MANHATTAN ELEVATED RAILWAY.

In all the history of transportation in New York no event of greater historical significance has happened than the recent starting of the great power station of the Manhattan Elevated Railway Company at 74th Street and the running of the first electrically-equipped trains on Second Avenue. The power station is considerably the largest in the world. It is located between 74th and 75th Streets and the East River, and the combined boiler and engine house is a magnificent building measuring 513 feet on 75th Street and 587 feet on 74th Street, with an even width throughout of 205 feet. The building is of Roman arched construction with classic details and a color scheme of pink granite, brown brick, red tile and buff chimneys, with copper-faced ventilators. Its whole appearance is simple and dignified, and accords with the great size and importance of the plant which it contains. The building is divided into two parts by a longitudinal wall. The northern half of the building is devoted to the boiler plant, and the southern half to the engine plant. The building is of steel, concrete and brick construction, and an idea of its size may be gathered from the fact that it contains 6,000 tons of steel and iron structural work, which is equal to the total amount of steel in the Brooklyn Bridge, exclusive of the cables. To avoid disablement by accident four similar stacks are provided, each being 17 feet inside diameter by 278 feet high. In addition to the main power station there are a series of sub-stations placed at convenient points throughout the city. These stations measure 50 x 100 feet in plan, and contain on the two upper stories the storage batteries and on the lower floors the various transformers and converters. The plant is laid out on a scheme of eight units, each unit consisting of one engine and alternator, four batteries of boilers, one condenser and one boiler-feed pump. There are sixty-four Babcock & Wilcox horizontal, water-tube boilers of 500 horse power each. These are carried on two floors, and above them, ranging the full length of the building, are coal pockets capable of holding 15,000 tons of coal. The coal is brought in barges to the dock at the eastern end of the power house, where it is automatically unloaded and carried by conveyors above the coal pockets, into which it is discharged. Similar conveyors automatically remove the ashes. Roney mechanical stokers are used on all boilers. There is one economizer to every two batteries of boilers, and there are sixteen Sturtevant blowers, two on each floor, to be used in cases of emergency due to low barometer, bad coal, sudden increase in load, etc.

The engine plant, which was built by the Allis-Chalmers Company, consists of eight units of 8,000 rated and 12,500 maximum horse power each; and each unit consists of two compound condensing engines, one at each end of the shaft, with the alternator carried at the center of the shaft and between the engines. The high-pressure cylinder, which is 44 inches in diameter, is placed horizontally, and the low-pressure, which is 88 inches in diameter, is placed vertically, the two connecting rods of each engine taking hold of a common crankpin. The two cranks are set at an angle of 135 degrees with each other, an arrangement which gives eight impulses to the shaft at equal intervals in each revolution. On account of the uniformity of rotation thus secured, it has been possible to dispense with the customary flywheel and depend upon the revolving field of the alternator to afford the necessary fly-

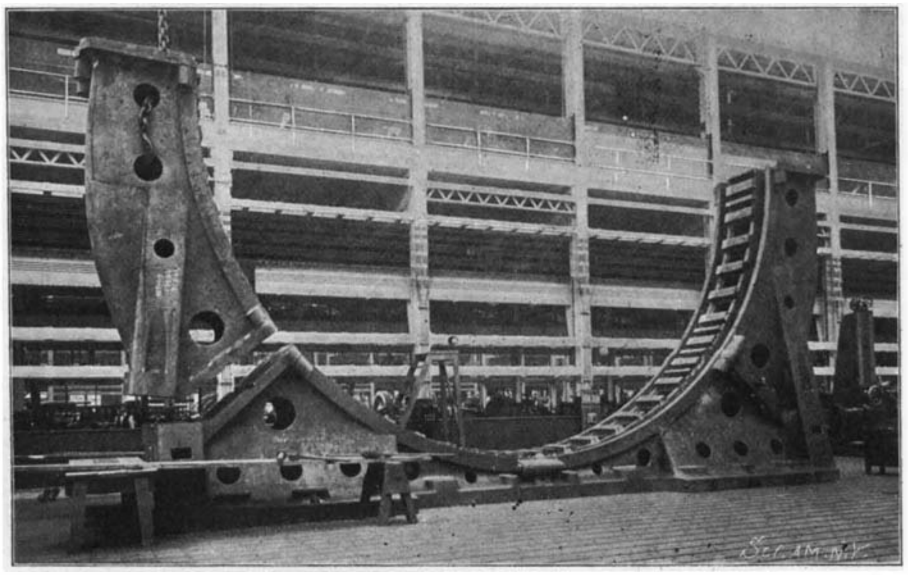


Massive Steel Hub Casting for the Field of the Westinghouse Alternator; Weight 25 Tons.

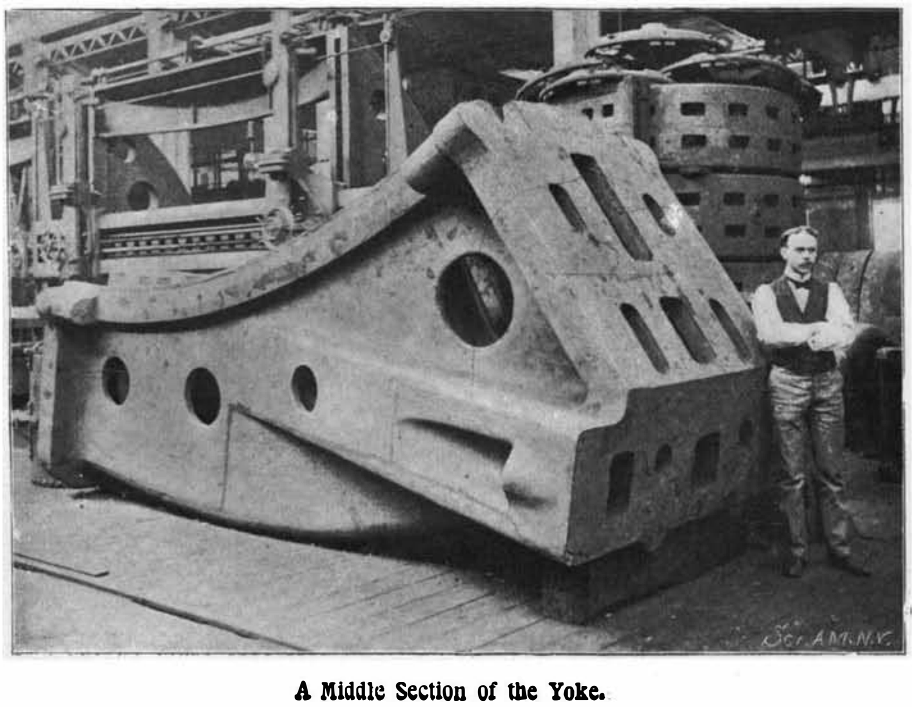
wheel effect. As this field weighs 185 tons, and is 32 feet in diameter, it will be seen that it is well calculated to do this. The common stroke of all the cylinders is 60 inches. The parts of the engine are necessarily very massive; thus the crankshaft, which is 25 feet 3 inches in length, has a diameter at the center of 37 inches and at the bearings of 34 inches, while each bearing is 60 inches in length. There is an axial hole 16 inches in diameter entirely through the shaft. The crankpins measure 18 inches x 18 inches, and the crosshead-pins are 12 x 12 inches. The piston rods are 8 inches in diameter; the steam consumption at the 8,000 horse power rating is 13 pounds per horse power per hour. The valves are of the double-ported Corliss type and they are driven by Reynolds-Corliss gear, there being a separate eccentric for each high-pressure cylinder and separate eccentrics for the steam and exhaust valves of the low-pressure. The weight of each pair of engines is 720 tons, or 180 pounds per rated horse power. The concrete foundations are 40 feet square and 21 feet high. For the present, partly on account of the difficulty of removing the oil from the water of condensation, and partly because of the difficulty of upkeep of the surface condenser, these engines are furnished with ordinary jet condensers.

The system of generation and transmission adopted includes the production of three-phase current by eight large alternators at a single central station, the power being delivered at a pressure of 11,000 volts to three-conductor cables, which distribute it to seven sub-stations, conveniently located throughout the city with respect to the company's lines. At these sub-stations the current passes through step-down transformers, from which it issues as three-phase alternating current at 390 volts potential. It then passes through rotary converters, from which it is delivered as direct current at a pressure of 625 volts to single-conductor cables, which conduct the current from the sub-stations to the third rail with which the elevated roads are equipped.

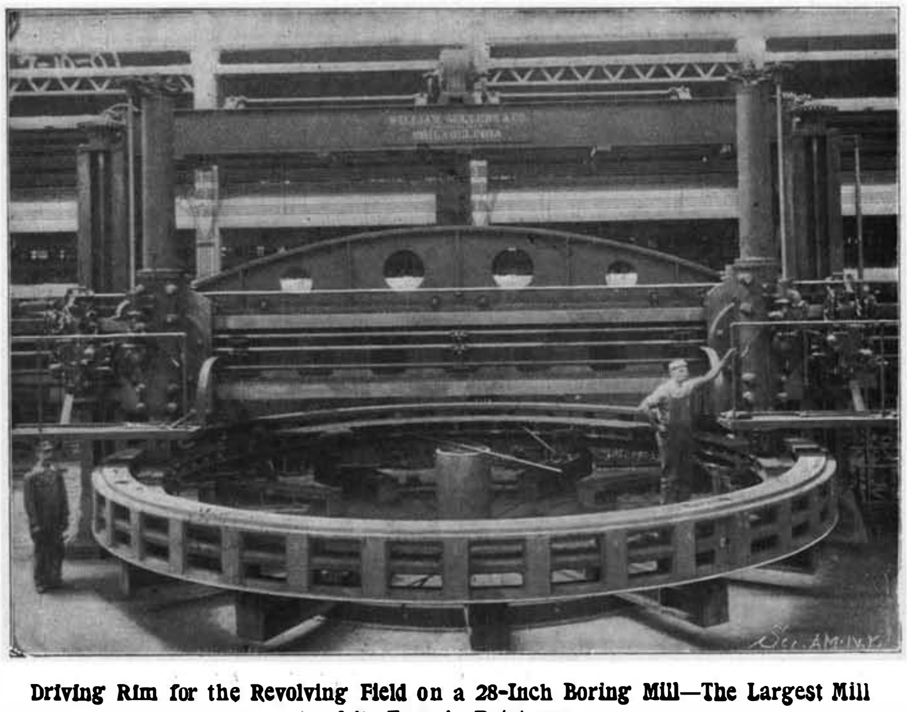
We are informed by Mr. L. B. Stilwell, the consulting electrical engineer of the company, who is responsible for the design of the whole electrical equipment, that in determining the capacity of the power station, it was estimated that at the busiest hours of the day there would be a call upon the station for the delivery to the third rail of 60,000 electrical horse power, the demand varying between this as a maximum, and a minimum of about 5,000 horse power during the early hours of the morning. Among the many alternative plans considered, it was decided to select one which contemplated one large alternating-current power house, located on the East River between 74th and 75th Streets, the current to be generated by eight alternators. These alternators, which are not only the largest yet built in America, but probably the largest ever seriously contemplated for any power station, are, as we have shown, direct-connected to the engine, with the revolving field carried upon the crankshaft. An excellent idea of the huge proportions of the alternator is gathered from the scale offered by the figures shown in our accompanying illustrations, which represent the alternators under construction at the shops of the Westinghouse Electric and Manufacturing Company; but for the sake of greater exactness we give the following dimensions: The foundation plate of the alternator measures 10 feet 3 inches in width by 43 feet in length. From the base of this plate to the top of the yoke which carries the stationary armature is 42 feet, while the width of the yoke, over all, is 4 feet 5½ inches. The cast-steel hub



Fitting the Machined Pieces of the Yoke Together.



A Middle Section of the Yoke.



Driving Rim for the Revolving Field on a 28-Inch Boring Mill—The Largest Mill of its Type in Existence.

MANHATTAN ELEVATED RAILWAY POWER STATION.

SCIENTIFIC AMERICAN

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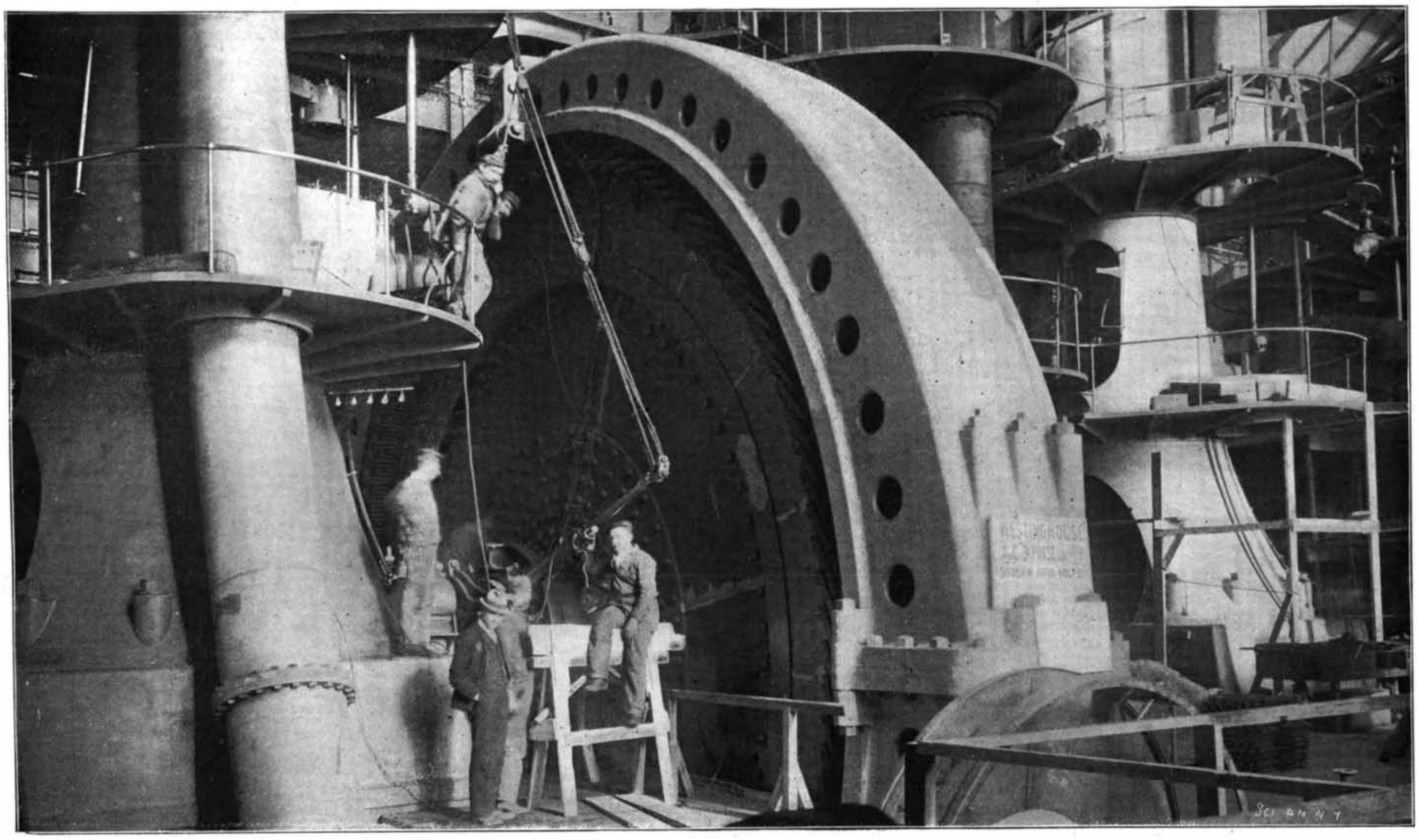
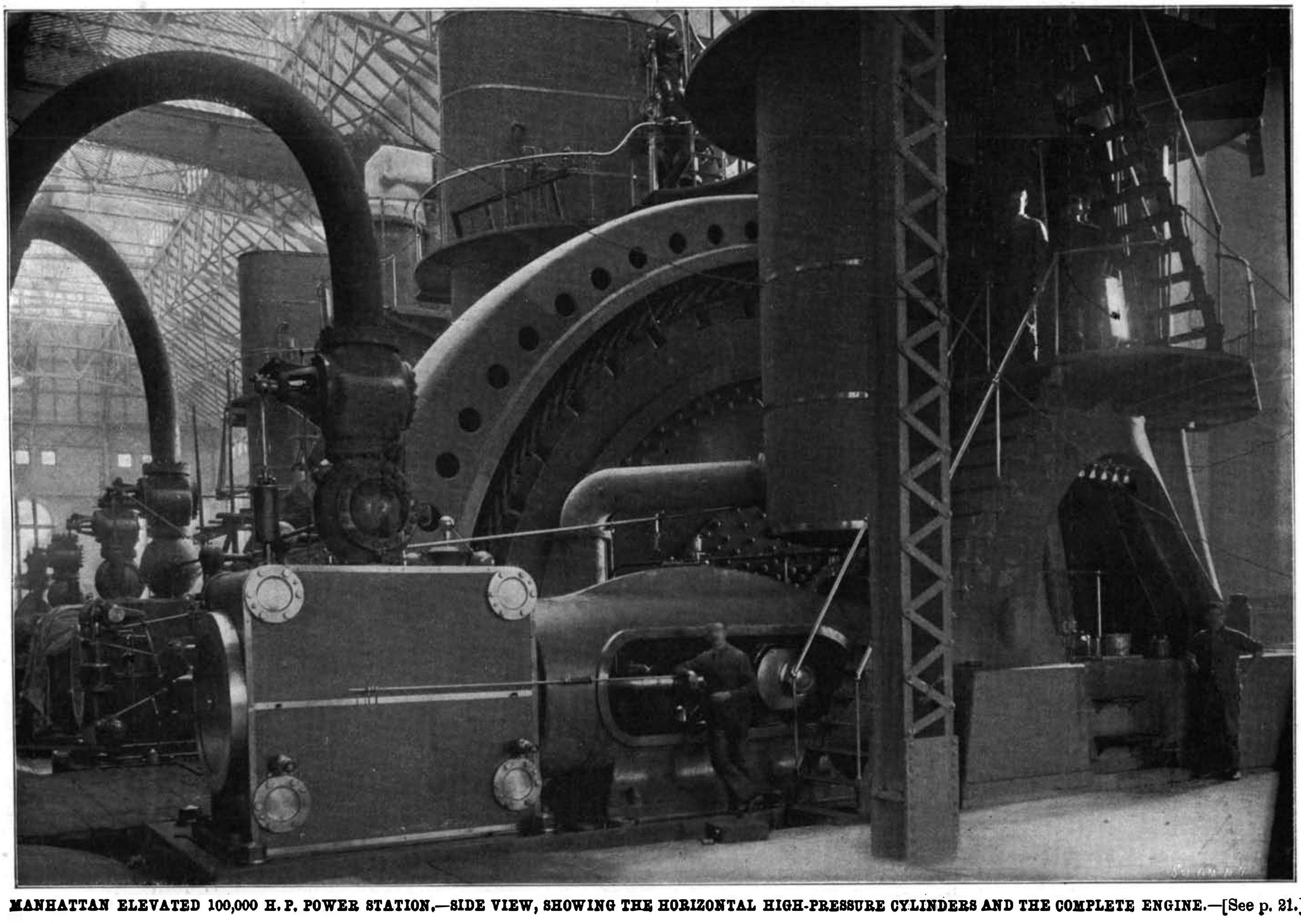


Front View of One of the 12,500 Horse Power Engines, Showing the 42-Foot Alternator.



MANHATTAN ELEVATED 100,000 H. P. POWER STATION.—SIDE VIEW, SHOWING THE HORIZONTAL HIGH-PRESSURE CYLINDERS AND THE COMPLETE ENGINE.—[See p. 21.]

for the revolving field weighs 25 tons. The revolving field is 32 feet in diameter and weighs 185 tons, and the total weight of the whole alternator complete is 445½ tons. The external frame or yoke carries the armature windings, which for convenience of construction and handling is built up in six sections. The field poles and the rim of the revolving field are built of thin overlapping plates of sheet steel, each plate having a length equal to the width of two poles, and these plates are dovetailed into the spider, while the rim, the poles and their end-plates are bolted together. The driving rim is carried by two webs of steel plate, which are bolted to the cast-steel hub. It will thus be seen that the parts which are subjected to the heaviest stresses of a mechanical nature are formed practically of nothing but rolled steel. The field winding is made up of copper strap, wound on edge, insulating material being cemented in place between the turns, and the edges of the strap left exposed. The stationary armature consists of a huge cast-iron frame or yoke holding a built-up laminated ring, with slots on its inner face in which lie the windings. The construction of the yoke is shown clearly in our photographs.

The auxiliary equipment of the power house includes the employment of 250-kilowatt multipolar Westinghouse generators as exciters, and three 800-kilowatt rotary converters. There are nine 300-kilowatt transformers and 24 of 75-kilowatt capacity employed for various auxiliary purposes about the system. In the sub-stations there are 26 1,500-kilowatt rotary converters and 78 550-kilowatt transformers.

New Iron Mines at Michipicoten, Canada.

BY W. FRANK M'CLURE.

That the vast iron ore resources of the Lake Superior districts of the United States should find their counterpart just across in Canada is not altogether an unlooked-for development. It has long been a matter of wonderment in this country that Canada has been so slow to investigate the mineral resources of Algoma, in view of the favorable topography of the land, and the existence of the great ore bodies as near as Minnesota and Michigan.

To-day, the same capital from the United States that is building up the giant industries about Sault Ste. Marie, including the water power canals, is opening rich mines at Michipicoten. This will result in Canada becoming the location of her own steel and iron industries. Already this evolution is rapidly progressing, and the Midland, Hamilton and Buffalo furnaces are using ore from the Helen mine, the first of the newly-discovered properties. The new steel mill at the Sault Ste. Marie, when completed, will use the Canadian product exclusively, and four vessels of the Algoma Steamship Company are bringing Helen ore to Ohio ports, from whence it reaches the Pittsburg furnaces. Some 350,000 tons have already been shipped to the United States at a profit in spite of the duty of forty cents a ton.

For shipping the product of these new mines a harbor with extensive dockage has been established at Michipicoten, twelve miles from the Helen mine, and about 130 miles from Sault Ste. Marie.

The Helen iron mine is situated on Boyer Lake. The ore deposit has been exposed to the extent of 28,000,000 tons, and the limit has not yet been found in two directions. The Josephine mine, more recently opened, is in the same belt, but on Park Lake. This mine also is very promising. Then there are the Frances and Brotherton mines on the same range. The output of the new Canadian mines is about 5,000 tons daily, but this will be greatly increased next season. The mining facilities are of the best.

Mr. E. V. Clargue, a brother of Francis H. Clargue, the promoter of all the giant industries in Algoma, is in charge of the ore mining. He found, early in the mining operation, that the bulk of the ore taken from the Helen mine contained an average of about 61 per cent metallic iron and 0.08 phosphorus; also that at the point where the ore body comes to the lake a Bessemer ore is found running as low as .02 to .03 per cent in phosphorus and in sulphur from a trace to .05 per cent. The ore has a high grade in the market, also, on account of its low percentage of water.

The following from a report of Dr. Bell, of the Canadian Geological Survey, concerning the Helen mine, is comprehensive: "The ore is a hard, but somewhat porous or spongy, red hematite, with a specific gravity of about 5. The ore body, from which a layer of muck or peaty moss has been removed, forms a point dividing the head of the lake into two small bays. It has a lumpy surface, with a dark bluish-gray color. Small quantities of brown hematite (limonite) and yellow ocher appear in joints and cavities, but they do not form any appreciable portion of the mass.

"The horizontal dimensions of the exposed ore are about 500 feet in every direction, and its greatest height above the lake is 100 feet. The ground rises steeply all around the head of the lake, so that the ore lies at the bottom of an amphitheater, open on the west or lake side. A drift has been run at the level of the general surface of the ore, southward into the hill, and this penetrates similar hematite for 250 feet, thus giving a known breadth of about 750 feet from north to south. During the winter of 1899-1900, by taking advantage of the ice on the lake, a number of holes were bored in the bottom along a north and south line, which passed the extremity of the point of ore at a distance of 250 feet to the westward. On this line and abreast of the point the lake had a depth of 100 feet, including 10 feet of soft mud, and at 150 feet below the bottom, where the boring ceased, the drill was still in hematite, like that on the dry land. A bore-hole from the surface of the exposed ore was sunk to a depth of 188 feet below the level of the lake without reaching the bottom of the hematite. The ore-mass has thus been proven to have a continuous depth of 300 feet, and as this follows the plane of the bedding, which is vertical, the probability is that the depth is very much greater. The general strike is parallel to the axis of the pond, which is about east and west. The railway approaches the mine from the west along the foot of the hill on the south side of the lake."

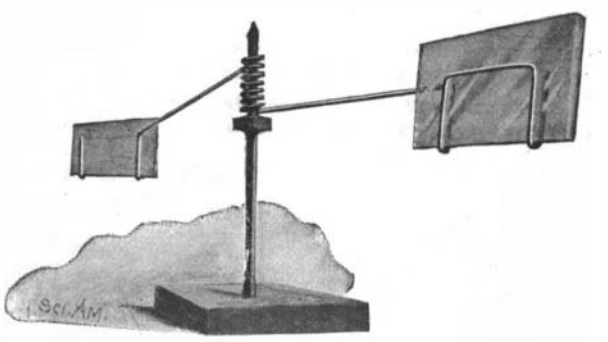
It has been figured by experts that at a shipment of 3,000,000 tons a year it would require a decade to exhaust the ore above ground at the Helen mine. Mining men from Minnesota are taking a great interest in the new territory. They are of the opinion that the deposits there are equal to those of Minnesota.

At Michipicoten harbor, vessels are loaded with ore at the rate of 1,000 tons per hour. Each ore pocket has a capacity of fifty tons. In all there are 500 feet of chutes, and more building.

A CONTRIVANCE FOR COLLECTING ATMOSPHERIC DUST FOR MICROSCOPIC EXAMINATION.

BY THOMAS R. BAKER.

In the accompanying illustration a simple and inexpensive apparatus for collecting atmospheric dust is



AN ATMOSPHERIC-DUST COLLECTOR.

shown, which will probably be of some interest both to bacteriologists and amateur microscopists.

The apparatus consists essentially of a wire, the middle portion of which is coiled into a spiral to fit over and turn on a vertical support. One end of the wire is bent so as to hold a strip of glass, and the other end is bent so as to clamp a piece of cardboard, serving the purpose of keeping the plane of the glass at right angles to the direction of the wind. The support comprises a tenpenny nail driven into a block of lead. Soldered upon the head of the driven nail is the head of a second nail. The heads thus placed in juxtaposition serve as a shoulder upon which the coil of wire rests.

The glass plate is smeared with glycerine upon which the dust adheres. The apparatus can be set in any convenient place where the wind blows, and the plate examined from time to time.

The First Interurban Line in Italy.

The Milan-Monza electric road, which has recently commenced operation, is the first interurban line to be installed in Italy. It is 10.2 miles long, and forms an extension of the Milan tramway lines. The whole system uses the energy furnished by the falls of the Paderno, 20 miles from the city. The interurban line is supplied with current at the Milan end by the tramway station, and along the route it is fed at different points by three lines coming from a sub-station which has been installed at Cesto. Here the 3-phase current from Paderno at 13,500 volts is transformed first to 340 volts and then changed to 550 volts direct current by two rotary converters. The rolling stock comprises 14 motor cars and 10 trailers. The former, which are roomy and of handsome design, have two 50 horse power motors of the General Electric 57 type and carry 48 passengers. The electric equipment has been carried out by the Thomson-Houston Company. This road has only been running for a short time, but it has already absorbed nearly all the passenger traffic between the two cities, which are, however, connected by railroad. As an example of the amount of traffic on the line, it may be mentioned that on special occasions it has carried more than 8,000 passengers in one day, without accident or detriment to the material.

Correspondence.

A Universal Language.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the letter of your correspondent "Arcadius Avellanus" on the above subject, in your edition of December 7, allow me to state that he evidently forgets that the Latin tongue was once practically the universal language of the world, and that was, as every schoolboy knows, in the palmy days of the universal sway of the Roman Empire, when her legions swept everything before them and established themselves as conquerors in all the countries of the then known world.

Now it is fair to presume that that being the case, if the Latin tongue had been able to maintain its supremacy, it would have done so; but any one versed in the grand science of comparative philology knows that the inherent difficulties of Latin—I mean the case endings and the conjugations—have undoubtedly caused its rejection by the people at large as the universal tongue.

With regard to the universality of the English language, which oddly enough seems "unfortunately" to give your worthy correspondent much uneasiness, that is doubtless an established fact; for although on the one hand it is the most difficult language—on account of its irregular orthography—yet at the same time it is the most easy of all the modern tongues to acquire as a means of speech. And I believe any fair-minded, educated person will readily concede the truth of this statement, especially when it must be acknowledged that the children of foreign-born parents "pick up" the English and drop their vernacular even before their entrance into the primary schools.

GEORGE WRIGHT.

Observing the Circulation of the Blood.

To the Editor of the SCIENTIFIC AMERICAN:

As far as I know from information gathered among physicians of this country (foreign and native), the classical method for observing the circulation of the blood in living animals stands at present where it stood thirty and odd years ago, confined to limited parts of certain organs in the frog and other batrachians, the wings of the bat, the transparent parts of embryos of mammals, etc.

It may be that the means I am to describe has already been applied and been known anywhere out of my notice and that of the physicians I refer to, but if it is still unknown, I hope it will be of some use to students of biological phenomena.

It is about 17 or 18 years since for the first time I had an opportunity of observing under the microscope the embryo of a small fish that swarms in the lake of Managua, in this country. This fish, about 6 to 7 centimeters long, 1 centimeter wide and 5 to 6 millimeters thick, lays its eggs on weeds and roots of plants growing along the lake shores, toward the beginning of the dry season, from November to March. The eggs are spherical, near two millimeters in diameter, transparent, and of albuminous appearance, and are furnished with a few hairy appendices by which they are fastened to the weeds or roots under water, clustered like grapes in bunches of many hundreds and many thousands, tied together. Being so numerous and laid in different days, embryos of different grades of development may be had for observing the circulation of the blood.

The eye catches at a glance a beautiful sight of the whole circulatory system, and follows with delighted attention the stream of blood starting from the heart, running in the arteries and veins, and returning to the heart, whose beatings are conspicuously seen.

The elongated globules of the fish's blood are distinctly seen, forming inside the blood vessels something like a stream of beans. F. J. MEDINA.

Corinto, Nicaragua, Central America.

The Current Supplement.

The current SUPPLEMENT, No. 1358, is opened with the second installment of a most interesting illustrated article entitled "The Building of a Modern Locomotive." "The Jig Habit in America" is by Oberlin Smith. "Practical Building of Lowland Protections" is continued. "The Position of the Engineer in Municipal Service" is by Alex. Dow. "Direct-Driven Continuous-Current Generators for Lighting and Power" illustrates a large direct-driven generator. An abstract of the Report of the Secretary of Agriculture is most interesting. "The Silent Chain Gear" is by J. O. Nixon.

According to Commercial Intelligence there is an immense future for the development of motor-van traffic in Italy. Ten days is the average time for goods by a slow train from Milan to Genoa, a distance of one hundred miles. Motor cars that could do the distance there and back in twenty-four hours would never lack a full load.