

AMERICAN a few weeks ago, recently completed the restoration of a chimney at Bolton, which is second in height to the famous Townsends stack at Glasgow, the tallest chimney in the world. This chimney was erected in 1843, but a few years elapsed before it was extended to its present height.

It is a massive substantial octagonal structure 367½ feet in height, with a circumference of 127½ feet at the base, and 34 feet at the top. About 1,000,000 bricks and 120 tons of stone were employed in its erection. The reason for the chimney being of such extreme height is due to its connection with a large chemical manufactory, since it was found necessary to dissipate the noxious chemical fumes into the atmosphere at a high altitude so as not to cause any inconvenience to the densely populated district below.

From the date of its erection the chimney had undergone no repairs whatever beyond the slight extension, which is a sufficient testimony of the substantial nature of the structure. Generally speaking, from twenty to thirty years is the average life of a chimney before it requires renovation. The hot air and gases that pass upward through the shaft, and the elements, play havoc with the masonry, and if the internal heat is very great, the stack will bulge at the weakest points, so that the work of repair has to be carried out with skill and care.

The overhauling of this chimney presented many difficulties that are not generally encountered in the repairing of chimneys. There was its great height, and also its shaky condition near the summit, to be considered. Under normal conditions, it would have been possible to have inclosed the shaft in scaffolding from top to bottom, but in this instance the erection of such an immense staging would have occupied several weeks. It was therefore decided by the steeplejack to carry out the work from the top, which, by the way, is his general method of procedure, since it is more convenient, more expeditious, and cheaper than the customary method. To accomplish this the stack was laddered from the bottom to the top, with a series of ladders each about ten feet in length, of the minimum weight consistent with the maximum strength. This part of the work is carried out with astonishing celerity. An iron dog is driven firmly into the masonry at the base of the chimney, and the lower end of the first ladder firmly lashed thereto. The steeplejack then climbs this ladder and drives another iron dog into the masonry, to which he attaches the top of the ladder; this dog also constituting the support for the lower end of the second ladder, which in turn is climbed, and the process repeated until the summit is gained. A platform was then built round the top of the chimney, from which all operations were conducted.

Upon close examination the stack proved far more decayed than it appeared to be from the ground below. From a point a little above halfway a wide crack extended to the top of the structure, while much of the masonry in the upper portion was in a crumbling condition. It also appeared that at some time the structure had been struck by lightning.

The only possible repair to the upper portion of the stack was by belting. Successive stagings were erected below the uppermost platform from which to carry out this work. At the corners of the building large heavy iron flanges were let deeply into the masonry and secured in Portland cement. These flanges were then connected by heavy iron tie-rods, by screwing up the nuts of which the brick work was drawn closely together and further opening of the cracks prevented.

When the topmost platforms were erected it was found impossible to haul up the materials from the ground to such an altitude at one lift, owing to the action of the wind on the line and its loads. Three other temporary platforms were therefore constructed nearly half way up, to which the materials were first conveyed, and thence hauled to the upper platforms.

The crack in the side of the stack was successfully repaired by the men working from seatboards suspended from the platform above. In addition to repairing all the defects in the crumbling masonry, and installing lightning conductors, the shaft was repointed from top to bottom, and subsequently two or three coats of linseed oil were applied to the whole structure as a temporary protection against the weather. The work of restoration occupied no less than eight months, and the task constituted the record contract for chimney repairing ever placed in Great Britain.

The Water Supply of Lake Nicaragua.

We are in receipt of an article by Prof. Angelo Heilprin, in which he replies to criticisms by the Hydrographer of the Nicaragua Canal Commission. As limitations of space prevent its insertion in the present issue of the SCIENTIFIC AMERICAN, it will be found in full in the current SUPPLEMENT. The subject of the Nicaragua Canal water supply is one of the most live questions in connection with that stupendous project, and Prof. Heilprin's article will be found to possess timely and very real interest.

A LARGE LATHE FOR TURNING GRANITE COLUMNS.

The new Cathedral of St. John the Divine, which is slowly rising on the site at the south of Morningside Park, bids fair to be many decades in building; and as it is one of the largest structures begun in the century just concluded, it naturally offers many engineering problems of great interest. The quarrying, turning, transportation and erection of the thirty-two granite columns of the choir presented many difficulties, as each weighs two-thirds as much as the obelisk in Central Park, usually known as "Cleopatra's Needle," and the successful solution of the questions involved may be regarded as a remarkable feat of engineering.

The choir, which is eastward of the great arch which is now such a prominent landmark in upper New York, has been built up from the footings to the height of the main floor. The eastern end of the choir is a semicircle, and on the massive foundations will rest great monolithic columns, 54 feet high and 6 feet in diameter, each weighing 160 tons. The blanks from which the columns are turned are quarried by the Bodwell Granite Company, Vinalhaven, Me. The blank shown in our engraving measured 64 feet in length and was 8 feet 6 inches in thickness one way by 7 feet the other, and weighed 310 tons. To turn an enormous mass like this required the construction of a lathe of vast proportions. It was designed and patented by E. R. Cheney and H. A. Spiller, of Boston, and was built by the Philadelphia Roll and Machine Company, of Philadelphia, Pa.

The lathe is 86 feet long, weighs 135 tons and swings 6 feet 6 inches by 60 feet long. Eight tools are used, each taking a 3-inch cut, so that the column is reduced 2 feet each time the cutters traverse the entire length of the bed. The head and tail stocks are carried on extensions of the bed, and the latter is made in six pieces, fastened together by stay-bolts. The entire length of the bed is 86 feet. The head and tail stocks weigh 15 and 14 tons respectively, and are securely bolted to the extensions of the bed. The hollow spindles each weigh 9 tons, and are made of cast open hearth steel. They run in Babbitt metal bearings. The main bearing is of ball design, 30 inches in diameter, and the bearing surface is 30 inches long. There is another bearing 20 inches long at the small end of the spindle; this construction is to obviate the tendency of any thrust on the head and tail stock. The latter is driven by back gears for cutting and is direct driven for the polishing speed. Pulleys 30 and 36 inches in diameter are used and are belted in the usual manner from a countershaft.

The platens which carry the cutting tools rest on friction rollers which raise them just off the bed. The two feed screws, one on each side, are 4 inches in diameter and are 66 feet 3½ inches long, 58 feet 6 inches being threaded. On the platen which carries the tool posts is secured a revolving table which is fitted on its upper side with slots which carry the lengthwise slide, this being operated by a feed screw and has a traverse of 18 inches. To each of the four slides are secured two tool-posts, each provided with feed screws operating at right angles to the feed screw of the lengthwise slide, so that each tool-post is independent and can be used or not as desired. The bearings of the tool-posts permit of a horizontal rotary movement, bolts controlling the angle of the tool. The latter, which is a circular disk of steel 10 inches in diameter and ¼ of an inch thick, with a V-shaped edge for cutting, is wedged on a mandrel which is in turn held in a sleeve in the tool-post, bolts securing the rear end of the mandrel in position.

Head and tail chucks made of open hearth steel hold the blank in position until it becomes a finished column. They each weigh about 16 tons. Twenty-four set-screws serve to hold the blank, and the entire weight of the great mass of moving stone is entirely supported by these chucks; blocks of irregular shape can be readily adjusted to position.

The corners are roughly dressed off by hand, and the stone begins its six weeks of dressing and polishing. As the stone revolves, it imparts a rotary motion to the cutting disks or tools. The cut is really a splintering of the stone, and three inches of the granite are removed at each cut. After the column is shaped it is polished with hardened steel shot, held in position by a kind of cup carried in the tool-holder. The final polishing is done with the aid of emery and water. When cutting, one and three-quarter revolutions are made a minute, and when polishing, three revolutions. The lathe is driven by a 50 horse power engine, and, notwithstanding the great weight and friction of the moving parts, the lathe runs for about fifteen seconds after the belt is thrown off the pulley.

THE British Postal Department Commission, which has been inquiring into the subject of wireless telegraphy for several months, will shortly report in favor of the earliest possible adoption of the Marconi system. The Commission is also arranging for the purchase of Marconi patents, and is negotiating with France and Germany relative to their attitudes toward the Marconi inventions.

Automobile News.

Consul-General Wildman states that Hong Kong is no place for motor carriages. There are only three carriages of any kind in the entire city.

The motor car is evidently destined to attain popular favor as a public vehicle in England. Wagonettes have been plying for public hire for some time past at Bournemouth, a popular seaside resort on the South coast. One car has been in service for 304 days, during which time it has only been withdrawn for five days; has conveyed 53,806 passengers, and traveled 22,009 miles. It earned \$3,225, and the cost of repairs during that period only amounted to \$145. The car has never occasioned any trouble, and the petrol motor with which it is provided has been found to be absolutely reliable.

A simple method of recording the speed of motor cars and other vehicles has been devised by M. L. Gaumont, and accounts of the device appear in Cosmos, and La Nature of November 3. The instrument consists simply of a camera with a double shutter, by which two exposures are made of the same plate, separated by a known interval of time. On developing the photographs, two images are obtained of the moving object, and by measuring the distance between them, the dimensions of the car being supposed known, and also measured on the plate, it is easy to calculate the speed of the car at the instant when the photograph was taken. The object is to assist the authorities in regulating the speed of these vehicles and checking furious driving.

Prof. Hele Shaw recently delivered an interesting lecture before the London Society of Arts upon the subject of the Improvement of Road Locomotion. In England, he stated, there had been a remarkable revival of interest regarding the question of the roads of Great Britain, their improvement, and the improvement of means of communication over them. The chief point to be noted in this direction was that while a few experiments had been made upon separate wheels, drawn by mechanical means, the bulk of the observations made by Gen. Morin and by other investigators of the subject were effected by employing the tractive agency of the horse; and with the exception of a few of the experiments with traction engines, the muscular effort of animals had hitherto been the sole means of investigating road resistance. The increased speeds for light and heavy traffic rendered observations of resistance at lower speeds of little use, when they came to the subject of self-propelled vehicles. Motors for such vehicles had now been constructed with a power of as much as fifty horses, but there were strict limitations to the possible power of such motors, and it was important that knowledge should be available in what was comparatively a new subject, as to the conditions by which the greatest economy might be effected. M. Forestier had given instances of the running of heavy motor vehicles in connection with the "Poids Lourds" service in the Department de la Meuse, in which the wear of the roads had been largely increased—in one case, for instance, a wear of 163 cubic yards per year per mile, which involved an increased cost of \$200 per mile, while in another it had been necessary to spend \$400 per mile in widening and drainage, and to increase the annual expenses in repair by \$140 per mile. At the last meeting of the British Association he had obtained the appointment of a committee to investigate the different causes of resistance for self-controlled vehicles on the common roads. Experiments had already been carried out at Liverpool with motor cars over macadam, stone sets, wood pavement, and asphalt. In the three matters of the regulation of speed, uniformity of tractive effort, and ability to maintain considerable speed, a few days' experiments sufficed to show that it was possible to secure accurate and scientific results. As to the effect of the vehicle upon the road surface, it was important to ascertain by experiment the best form of wheels, dimensions of the tire, the effect of the coning and canting of wheels, and of the results from loads of varying magnitude upon roads in all states and conditions. In the course of the discussion which followed, Col. R. E. Compton, who went through the South African campaign, stated that he was profoundly impressed by the alteration of the surface made by the wheels of the traction engines employed by the military in wet weather. The width and diameter of the wheel for conveyance of certain weights required careful consideration. To emphasize the fact that the design of the wheel was most important he observed that in South Africa they introduced a very broad wheel at the outset—absolutely contrary to the time-honored practice of the Boers, who used narrow wheels—and the result had been that the British had been enabled to transport enormous loads, day after day for months together, without hurting the surface; whereas two or three passages of the Boers' narrow wheels destroyed the surface to such an extent that the British could not afterward use the same route.

Science Notes.

Mr. Evelyn B. Baldwin has purchased the Dundee steam whaler "Esquimaux," of 466 tons, for use in his Arctic expedition.

A recent storm which passed over the south of England overthrew an upright and a cross-piece of one of the great trilithons at Stonehenge, on Salisbury Plain, and the cross-piece of this wonderful supposed Druidical monument was broken by the fall. In 1897 other stones fell.

While engaged in fishing off Lowestoft recently, a fisherman landed in his net a unique piece of amber. It resembled a huge pebble, was oblong in shape, weighed 11 pounds 14 ounces, and is the finest specimen of amber that has been discovered on the English coast for several years. It realized \$137.50.

King Alexander, of Servia, has tried to have his life insured for \$2,000,000 in several companies, but one company to whom he applied for \$300,000 worth of insurance refused to write a policy on the ground of the great frequency of anarchist crimes, and this company had a \$600,000 payment to make on the assassination of King Humbert.

The British government encourages inventors and scientists by extending financial assistance to those whose work is considered of sufficient value to warrant such development. The grants are made through the British Royal Society, and range in value from \$50 to \$2,500, according to the nature of the invention to be exploited. At the present time the Society has in hand \$20,000 ready for distribution within the month of January.

The engineers of the cables engaged in repairing the cable from Galveston to the Mexican coast found that the cable was destroyed by a submarine earthquake, and the catastrophe at Galveston may have been due to the same cause. The destruction of deep-sea cables by earthquakes is so common that it attracts little attention nowadays. In the East Indian archipelago submarine earthquakes are so common that they are reckoned among the chief causes of the destruction of cables.

The work of excavating the Roman remains at Silchester, in Hampshire (England), has been suspended for the present year. It is stated that the work during the past season has been productive of valuable results. A number of tessellated floors have been unearthed, while a magnificent section of mosaic pavement, with a figure representing a dolphin, in a remarkable state of preservation, and over one thousand pots and vessels, of varying sizes and shapes, have been brought to light.

Some interesting and valuable additions have recently been made to the British Zoological Gardens. One is a lizard possessing two tails. As is well known, the lizard avoids capture by leaving its tail in the hands of its captor, the caudal appendage ultimately growing again. In this instance it appears that the tail of the lizard became damaged by some means, but was not detached. A second extremity protruded from the wound, which healed, so that now the lizard possesses two tails. Another unique addition is the three-striped California tree boa. This is the first specimen of this reptile that has come into the hands of the Zoological Society, while the British Museum does not even possess an example of the species. The largest white wolf in captivity also arrived at the Gardens a few weeks ago. A small colony of the tree frogs of Cape Colony has been introduced, representing a variety of colors coinciding with the hues of the particular trees which they infest.

At the Zoological Society of London, Mr. Nelson Annandale, who accompanied the Malay Expedition of 1899-1900, recently delivered a lecture regarding the insects discovered during their investigations. He described the remarkable likeness of some of the Mantidæ to the orchid flower, and it was impossible to discern in the photographs shown the insects from the flower. Mr. Annandale also stated that from prolonged examinations of the lantern-fly, he had discovered that the projection in front of the head was in reality a leaping organ. He followed the movements of one of these insects on the lark of a Curian tree. He attempted to catch it, but the insect remained almost still, and drew its legs toward its body and pressed its claws firmly against the bark. It then raised its head with great rapidity, and flew up into the air without spreading its wings, alighting on the roof of a native house about six feet distant. While in Malay, Mr. Annandale was unable to explain this extraordinary movement, but when he reached London and examined his spirit specimens, he discovered that across the nose there was a crease, and when the nose was bent back to the dorsal surface of the abdomen, held between the finger and thumb, and then suddenly released, the insect was propelled through the air for a considerable distance, in the same manner that a pellet may be projected through the air by means of a bent piece of whalebone.

Engineering Notes.

A firm of Hanau, Germany, has succeeded in welding aluminium without the use of any metal, solder or acid. No seam can be detected, and the welded pieces can resist blows and temperature variations as well as if there were no joint. The process is a secret one.

Some estimation of the disorganized and miserable state of the Belgian government railways may be gathered from the fact that recently, while a train was traveling at a moderate speed, one of the carriages dropped to pieces. The passengers were shaken up, and one man had both his legs cut off.

In thirty years the Calumet and Hecla Mining Company paid dividends amounting to \$70,000,000, and its corporate existence will expire April 21, 1901, and by that time \$4,000,000 more will be added, making the largest sum ever paid in dividends by any mine in the world. Articles of association for the renewal of the corporation have been filed.

Experiments are being carried out in the Austrian army with a new portable oven for field and transport purposes. The oven at present in use is a very unwieldy and heavy article, and has to be transported in sections. The new oven, however, may be carried intact upon a cart, and if necessary, can be utilized for baking purposes while on the march.

Work is to be resumed upon the construction of the Cape to Cairo railroad. It has now been decided to deviate from the route originally surveyed by traveling via Wanki. This decision has been made in view of the fact that the bridging of the Zambesi River will be much facilitated at this point, and also that rich coal fields have been discovered in the vicinity of Wanki. Wanki lies about two hundred miles distant from Bulawayo in a north-westerly direction. The coal is stated to be of great calorific value, and mines are to be sunk immediately.

The British consul at Vera Cruz has recently dispatched to the British Foreign Office an interesting report regarding the state of the trade of that port, and its prospective development when the present extensive harbor works at Coatzacoalcos on the Mexican Gulf, and Salina Cruz on the Pacific, have been completed, and the Tehuantepec railway connecting the two ports, which is at present in such a wretched condition, is reconstructed. Coatzacoalcos possesses a magnificent natural harbor, but its utility is somewhat nullified by the sand bar at the estuary of the river, which considerably impedes navigation. Salina Cruz possesses a fine roadstead, but it is not sufficiently protected from the open sea. It was, therefore, decided some time ago to improve the harbor accommodation of these two ports, and to improve the railway over the Isthmus of Tehuantepec. The Mexican government entered into a fifty years' partnership with Messrs. S. Pearson & Son, Ltd., the well-known contractors, of London, for the construction of harbor works at the two ports and the reorganization of the railway at an estimated cost of about \$15,000,000. The work is now in full swing, but progress has been considerably retarded by the effects of the pestilential diseases indigenous to the unhealthy climate and the swampy nature of the district. Yellow fever has played havoc with the engineers, though the health of the district has been appreciably improved by the installation of a thorough sanitary system. The bar at the entrance to Coatzacoalcos is being cleared by the erection of retaining walls, which, when completed, will give a depth of 34 feet of water on the bar, while wharves are to be provided along the river's banks with a depth of 30 feet of water alongside. At Salina Cruz an immense breakwater is being erected to inclose the harbor, which will have a depth of 30 feet of water. The reorganization of the railway will be a very protracted task, since it will have to be reconstructed almost throughout. It is 200 miles in length, and there are no less than 845 bridges and culverts crossed, all of which, with the exception of 12, will have to be rebuilt, since they are at present temporary structures of wood. At places the line, which is very circuitous, will be diverted and shortened, the stiff gradients moderated and curves improved. It is anticipated that three years will elapse before the railroad is overhauled and the harbor works advanced to a stage sufficient to enable steamers to discharge and to embark their cargoes. It is intended to transfer the freight from the steamers from one port to vessels in the other by means of the railroad in less than twenty-four hours, and the tariff will not exceed \$4 per ton. When this Mexican route is in full operation, it will afford facilities for the quicker transit of freight between Europe and the Northern Pacific coast, Japan, China, and Australia. It will also compete seriously with the inter-traffic of the Mississippi Valley, since San Francisco is 100 miles nearer to Coatzacoalcos, via Salina Cruz, than New Orleans, from which city it is at present served by the Southern Pacific Railway. The Tehuantepec inter-ocean route is destined to become one of the most important thoroughfares of the world.

Electrical Notes.

The city of Worcester is suing the street railway company in that city in order to compel them to issue three-cent fare tickets to school children, as provided in a recent act of the Legislature.

Open cars will be run all winter by the Union Traction Company, of Philadelphia, with no restrictions as to smoking. The open cars will be run one in five. Open cars are also being operated at intervals on various lines of the Metropolitan Street Railway Company of New York city.

A feature of the Republican parade at Cleveland, November 3, was two old horse cars, which were resurrected for the occasion. The signs upon them said, "Style of 1860. Think and Thank." Notices were given by the daily press that no fares would be collected on the cars and that the public was invited to have an "old time ride."

A message has been sent from the Channel steamer, the "Princess Clementine," to the wireless station at Dovercourt, Essex, by the Marconi system, a distance of 90 miles, including many miles of cliffs. The Belgian authorities are so pleased with the results obtained by the wireless telegraphic system that it will shortly be put on other vessels of the fleet.

The premises 5 West 22d St., New York city, which were formerly occupied by Prof. S. F. B. Morse, were torn down for the erection of a business building. It is gratifying to know that Mr. McCutcheon has had the table, which used to mark the house replaced. It reads: "In this house S. F. B. Morse lived for many years, and died." Under this has been added, "This tablet removed from building formerly on this site and replaced A. D. 1900."

Experiments with the Marconi system of wireless telegraphy have been resumed on the Ostend-Dover mail boat; and while the steamer was making her way to Dover, in the teeth of a gale, communication was carried on satisfactorily, and messages were transmitted as usual. Messages were sent to and fro at the rate of twenty words a minute until Dover was reached, 61 miles from the mast at La Panne, between Ostend and Dunkerque.

The third cable has been laid between the Netherlands and England. It comprises four wires which extend from London to Rotterdam and Amsterdam. Telegraphing over these wires will be done by means of the Hughes apparatus, and at busy times with duplex Hughes apparatus. The cost of the construction of the cable will be borne by both countries. This will greatly accelerate telegraphic traffic between the Netherlands and England.

The first accident upon the new electric railway in London occurred a short time ago. A motor attached to one of the trains broke down, and all efforts to restart it were unavailing. Under the circumstances it was necessary for men to remove the motor and the current was interrupted. Some of the trains had stopped at the stations when the current was cut off, so that it was possible for the passengers to alight. The latter were not kept in darkness, since the circuit for lighting the arc lamps at the stations is an independent one. Other trains, however, were brought to a standstill in the tunnels between the stations.

The preliminary experiments with the Marconi wireless telegraph installation across the Bristol Channel, between Ilfracombe and the Mumbles Lighthouse, which was erected to the order of the British government, have resulted in complete satisfaction. The distance over which the messages are transmitted is 25 miles. The Ilfracombe station is situated upon an eminence known as Compass Hill. The mast for carrying the high wire is 116 feet in length and is built in three sections spliced together. It measures about 4 feet 6 inches in circumference at the base, tapering to about 10½ inches at the summit, and weighs nearly two tons. The pole is also provided with a yard-arm upon which a portion of the apparatus is suspended. In the trials the messages were recorded upon the tape machines with unfailing regularity and accuracy, even when the high wires were suspended considerably below their full height.

The value of the collections in the "gold room" of the Metropolitan Museum of Art is estimated at \$500,000, and they are protected by a most admirable series of burglar alarms. On Sundays and holidays the room is not open, owing to the fact that the large crowd which would attend would prevent the seizing of vandals or thieves. The visitors are carefully watched, and if anyone acts suspiciously, he is followed until he has left the building. The rooms are constantly patrolled both day and night. The entrance to the gold room is guarded by two men, and each individual object which is valuable is connected with a burglar alarm, as well as the cases themselves. The wires run direct to the office of the Director, and if any article is disturbed, the iron doors of the room are at once closed, thus catching the thief in a trap. The device is tested at intervals to make sure that the door-closing mechanism is in perfect order.

SCIENTIFIC AMERICAN

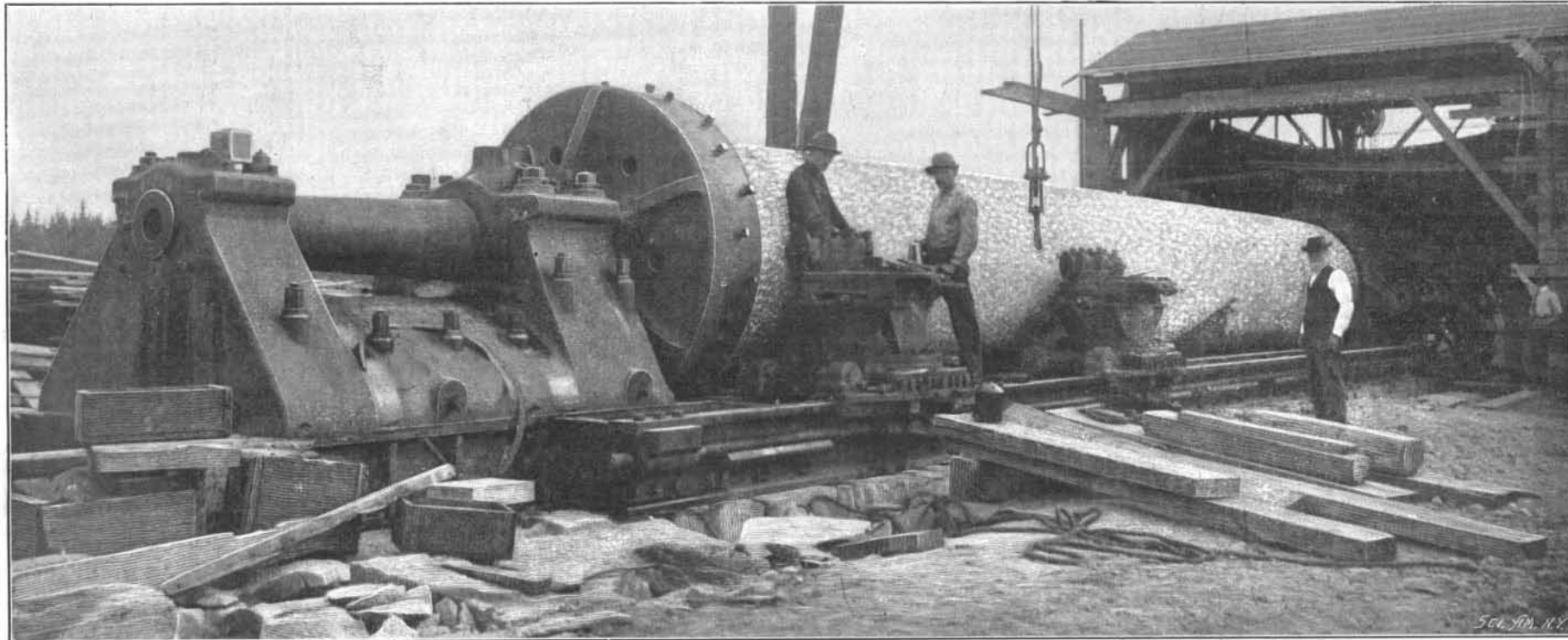
[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1901, by Munn & Co.]

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

Vol. LXXXIV.—No. 2.
ESTABLISHED 1845.

NEW YORK, JANUARY 12, 1901.

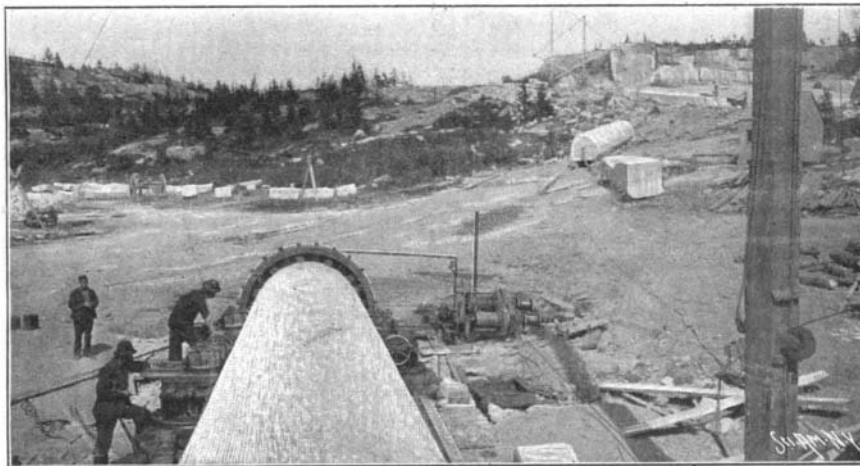
\$3.00 A YEAR.
8 CENTS A COPY.



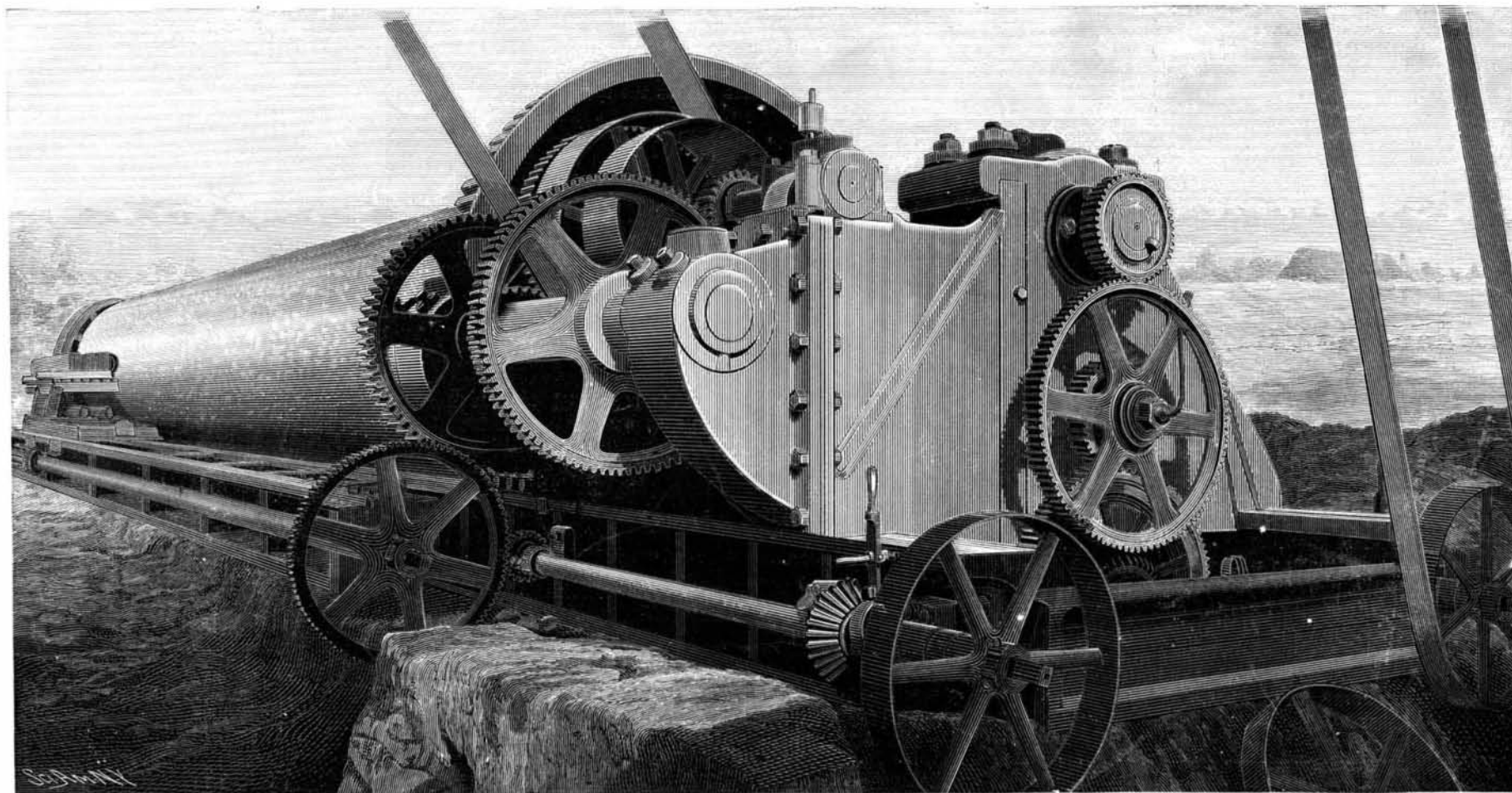
The Lathe Turning the First Column—View of Tailstock.



Blank for Column 64 Feet Long, 8 Feet 6 Inches by 7 Feet.



View Looking Down the Column.



The Lathe Turning the First Column—The Headstock.

The finished columns are 54 feet long and 6 feet in diameter; weight, 160 tons. Lathe weighs 135 tons, swings 6 feet 6 inches by 60 feet long. The eight cutters each take a 3-inch cut, thus reducing the column 24 inches at one cut.

TURNING THE GREAT COLUMNS FOR THE CATHEDRAL OF ST. JOHN THE DIVINE.—[See page 22.]