RODNEY HUNT TURBINE PLANT AT THE GREAT NORTHERN PAPER COMPANY'S MILL.

It is not always the largest industrial enterprises that are the most prominent in the public eye, and the truly enormous paper mill, whose hydraulic power plant forms the subject of our front page engravings, is a case in point. Located within the vast forests which lie in the northern parts of Maine, and far removed from the more active centers of industry, there has been constructed, during the past twenty-four months, a great establishment, which is considerably the largest plant of its kind in the world. The location of the mill at this particular point was determined by certain topographical features favorable to the development of hydraulic power. Two rivers—the Millinocket stream and the west branch of the Penobscot—form a junction at this point, and there is a natural difference of level a short distance above the point of their confluence of about 110 feet. The site chosen for the mill lies at a point on the Millinocket, just above and within the fork of the rivers, where the two streams are about a mile apart. A little further down, and before the streams unite, there is a fall in the Penobscot; and although the intervening country between the two streams is approximately level, the land falls suddenly to the valley of the Millinocket stream, and provides an admirable site for the mill, with the necessary difference in head for the development of water power. A dam was thrown across the Penobscot which raised the level of the water about 10 feet, and formed a reservoir of 250 acres' area on the high land between the two rivers, thus providing an excellent storage basin for the logs from which the paper is manufactured. The water is led from the Penobscot through a set of gates into a short canal which terminates in a head-bay, from which it is led by a number of steel penstocks down the slope of the hill to the paper mill.

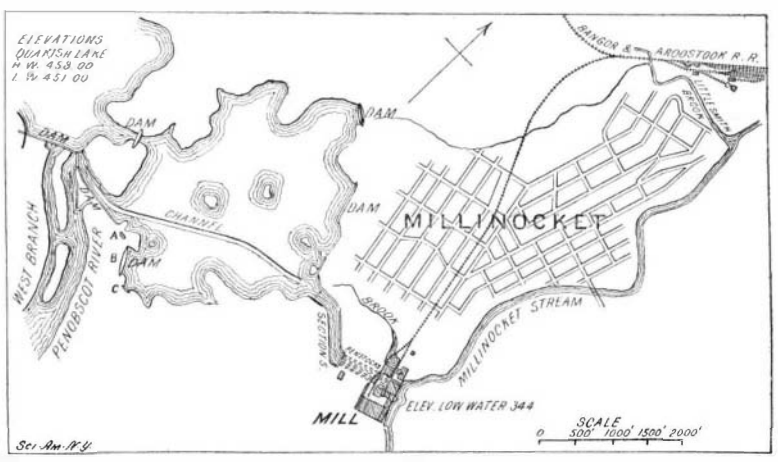
As it is the purpose of the present article more particularly to describe the hydraulic power plant, we will simply state that an adequate idea of the large amount of power required for the mill may be gathered from the fact that when the whole establishment is completed and in full swing, about 400 tons of paper will be turned out every day, and that over a third of a cord of wood will be worked into pulp every minute that the mill is in operation. The total cost of the whole plant was $2,500,000, and a further idea of its magnitude may be gathered from the fact that the 3,000 inhabitants of the town of Millinocket are all directly or indirectly supported by this enterprise.

After a careful consideration of the various methods of developing and utilizing the necessary power, it was decided to use water power in large turbines, direct-connected to grinding machines, for the important work of grinding the wood into pulp, and to use electricity developed by turbine-operated generators for driving motors suitably distributed throughout the other departments of the mill.

The contract for making and installing the hydraulic plant was given to the Rodney Hunt Machine Company, of Orange, Mass. (Boston office, 70 Kilby St.), who have equipped the power house with sixteen of their well-known new pattern Hunt turbines, of the horizontal type, with plain cylinder gates. The aggregate capacity of the turbines, as determined by the Holyoke tests, to which more detailed reference is made below, is about 22,000 horse power under the normal head. By far the greatest demand for power comes from the grinding room, where at present there are installed turbines of an aggregate of 15,600 horse power, and which, when completed, will contain a total of 23,400 horse power. This room, of which we present a half-plan, contains at present forty-eight grinders, which are arranged in four lines, twelve on a line. Down through the center of the grinding room runs the tail-race, and above it, each carried on a massive 5-foot wall of masonry, are four pairs of 57-inch turbines, each pair being placed at the center of its own line of shafting, with twelve grinders direct-connected to it—six on each side. The water is led to the turbines by four 10-foot steel penstocks, each of which is 1,000 feet in length, the whole set containing some 2,000 tons of steel. The penstocks pass into the building in parallel lines, and extend beneath the level of the floor until they enter the tail-race, where they make a bend of 90 degrees, entering the turbine casings at an inclination of 45 degrees, as shown in the lower drawing on the front page of this issue. The water passes centrally into the casings, flows right and left through the wheels, and leaves by pairs of draft-tubes, one on each side, which discharge at an angle of 30 degrees with the vertical into the tail-pits. The weight of the turbines, casing, etc., is carried by the 5-foot masonry walls above mentioned, while the tail-race is floored over with heavy I-beams, which serve to carry the standards for the main shafting bearings. The flooring of the I-beams is carried upon vertical posts which are placed in pairs, one on each side of each draft-tube, a girt being bolted in between each pair of posts, just below the level of the water, to carry the weight of the lower end of the tubes. Each pair of turbines as above described develops about 4,000 horse power when running at 225 revolutions per minute.

We also show on our front page a general perspective view and transverse sections of the generating room, in which there are installed three units, each consisting of a pair of 36-inch turbines, mounted on horizontal shafting in the same way as the 57-inch turbines in the grinder room. Each unit is direct-connected to a 1,000-kilowatt, 600-volt, General Electric Company's tri-phase generator. In front of these three units are two single 24-inch turbines, each of which is direct-connected to a 60-kilowatt exciter. These five turbines are supplied by a single 11-foot penstock, which extends centrally beneath them, the diameter of the penstock reducing as connection is made in turn to each of the turbines, a slide-valve gate being provided in each connection. The draft-tubes for the 36-inch wheels are carried down, one on each side of the penstock, to the tail-race; while the exciter turbines discharge at one side of the penstock, as shown clearly in the engravings. The exciter turbines also serve to operate two brass, 1,000-gallon underwriter fire-pumps, made by the Rodney Hunt Machine Company. These pumps are shown in the perspective view of the generator room, where they are arranged on the opposite side of the turbines to the exciters. They are provided with powerful, friction, grooved wheels by which they can be thrown in or out of gear, as desired. We also present a detailed view of one of these pumps.

The mechanism for controlling the cylindrical gates of the large turbines in the generator room consists of a hand-wheel on a horizontal shaft, mounted transversely across the turbine casing, which carries two pairs of machine-cut, sector, bevel gears, to which is attached a Lombard governor. Attention is also drawn to the regulators, made by the Rodney Hunt Machine Company, which are attached to the gate shafts, at the side of the 24-inch wheel cases. The regulator is of the duplex relay type, and acts directly on the gate. It is shown in detail in the small engraving above the general perspective view.



MAP SHOWING LOCATION OF MILLINOCKET MILL

EFFICIENCY TESTS.—Particular interest attaches to the tests for efficiency, which were carried out upon two of the turbines before they were shipped to Millinocket. The test was made at the flume of the Holyoke Water Power Company, of Holyoke, Mass. The 57-inch turbine showed an efficiency of 85.93 per cent at full gate; from ¾ gate to full gate it showed an average efficiency of 83.17 per cent. The 36-inch turbine showed an efficiency of 85.89 per cent at full gate, and an average efficiency of 84.70 per cent from ¾ gate to full gate, as compared with the guaranteed efficiency of 80 per cent from ¾ gate to full gate. The horse power guarantee was also exceeded considerably. This is certainly a very remarkable showing, particularly if we bear in mind that, on account of the exceptional head of 110 feet under which the turbines operate, the runner and guide chutes had to be made of steel and of unusual thickness, conditions which are not by any means conducive to high efficiency.

A simple form of Wehnelt interrupter has been devised by J. von Pallich, of Germany. The negative electrode is formed by a copper wire about 1-5 inch in diameter, and the positive electrode by a steel wire of 1-25 to 1-10 inch. These wires are surrounded up to their ends by glass tubes; the tube containing the steel wire is drawn out by the blowpipe so as to make a sliding fit with the wire. The two tubes are passed through a rubber stopper which fits in the neck of a one-pint glass flask containing dilute sulphuric acid. The flask is placed in a water-trough in order to avoid heating. The two glass tubes are closed at the top by rubber stoppers through which the wires pass. The steel wire fits snugly in its stopper and in this way its length in the tube is regulated. The wire is attacked somewhat rapidly when in action, but by lowering it by degrees, the proper length for working the interrupter may be maintained.

The Gold-Mining Industry of the Transvaal.

Now that the war in South Africa is rapidly drawing to a close, public attention is once more being directed toward the commercial and industrial development of the country, especially in connection with the gold-mining industry.

Some idea of the wealth of the country may be gleaned from the records of the gold mines during the past thirteen years, which, notwithstanding the fact that they have been hampered in their working by corrupt practices, yet have proved very prosperous. In the year 1887 only 23,125 ounces of gold were produced, but in the next year the quantity was multiplied nearly nine times, to 208,121 ounces. The prosperity continued to increase during the next four years, and the industry assumed such large proportions that endeavors were made with a view to simplifying the process of extracting the gold from the ore. There was also a proportionate heavy importation of machinery, in order to cope with the increasing industry. In the year 1892 was introduced the process which has completely revolutionized the work of gold mining, both with regard to quantity and celerity of output, economy, and cheapness. This was the cyanide process, followed by the treatment and concentrates of tailings, and the systematic sorting of waste rock. So successful was the new method that it is now adopted throughout the country with conspicuous success, and has since been introduced into the gold fields of Australia with equal satisfaction.

In 1892 no less than 1,974,354 tons of ore were mined, which yielded 973,291 ounces of mill bullion; 200,526 ounces from tailings and concentrates, and 37,051 ounces from banks and other sources, making an aggregate output of 1,210,868 ounces, with a value of $21,488,050.

The machinery for the production of the ore at the end of this year comprised 2,530 stamps, and 1,700 boilers, 730 of the latter of which were in operation at Johannesburg, while the others were distributed among the numerous other gold-mining centers throughout the Republic, representing a total value of about $10,000,000. The industry gave employment to about 3,500 whites and 30,000 natives.

But the industry has grown tremendously since 1893, despite the more stringent restrictions that were continually levied by the Republican government, and which considerably retarded the progressive development of the industry to anything approaching its possible capacity. At the end of the year 1897, 8,500 whites and 60,000 natives were at work in the mines. Heavy shipments of machinery, which had been considerably improved in both design, manufacture, and capacity of output, had been made. In December, 1897, no less than 2,282 boilers and 1,239 steam engines were in active operation. Electricity had also been introduced, both for lighting and power, with conspicuous success. Johannesburg, which is by far the most modern and enterprising city in the Transvaal, was supplied with 280 dynamos which provided light and power equivalent to 13,853,625 watts to 1,408 motors and nearly 33,000 lamps. The total value of the machinery and plant at work in 1897 was estimated to amount to $31,775,185. From the beginning of the year 1893 until the end of May, 1899, 17,531,562 ounces of bullion had been extracted, representing a sterling value of $305,488,135. It will therefore be apparent that, though the development of the industry in the past has been rapid, there is every augur of a much more successful and progressive era in the near future.

New Magnetic Observatory.

An interesting series of buildings has been erected at Cheltenham, Prince George's County, Md. This is the new magnetic observatory of the United States Coast and Geodetic Survey. Copper and brass are employed for all pipes and metal work, and the stove, which burns wood exclusively, is built of soapstone. The observatory is composed of two buildings, in one of which the magnetic influences on the compass will be measured. The instruments will be kept at a constant temperature of 65 deg. Fah. by means of a series of walls sheathed with thick paper, and other spaces are also provided. There are four sets of doors. The observatory is far away from any disturbing electrical influences, so there is no question that the observations will be most accurate.

The Bement collection of minerals and meteorites has been acquired by the American Museum of Natural History, New York city.

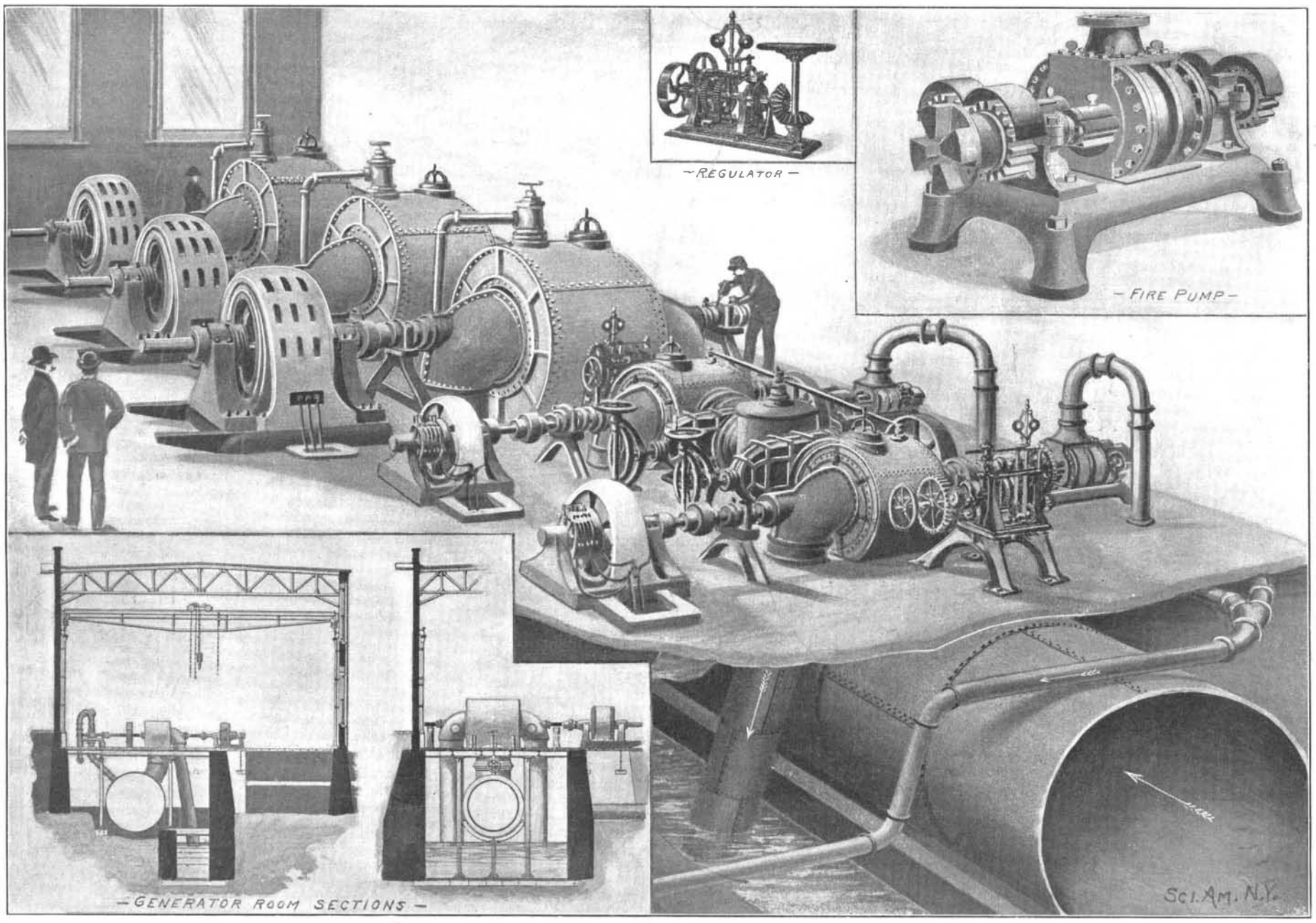
© 1901 SCIENTIFIC AMERICAN, INC.

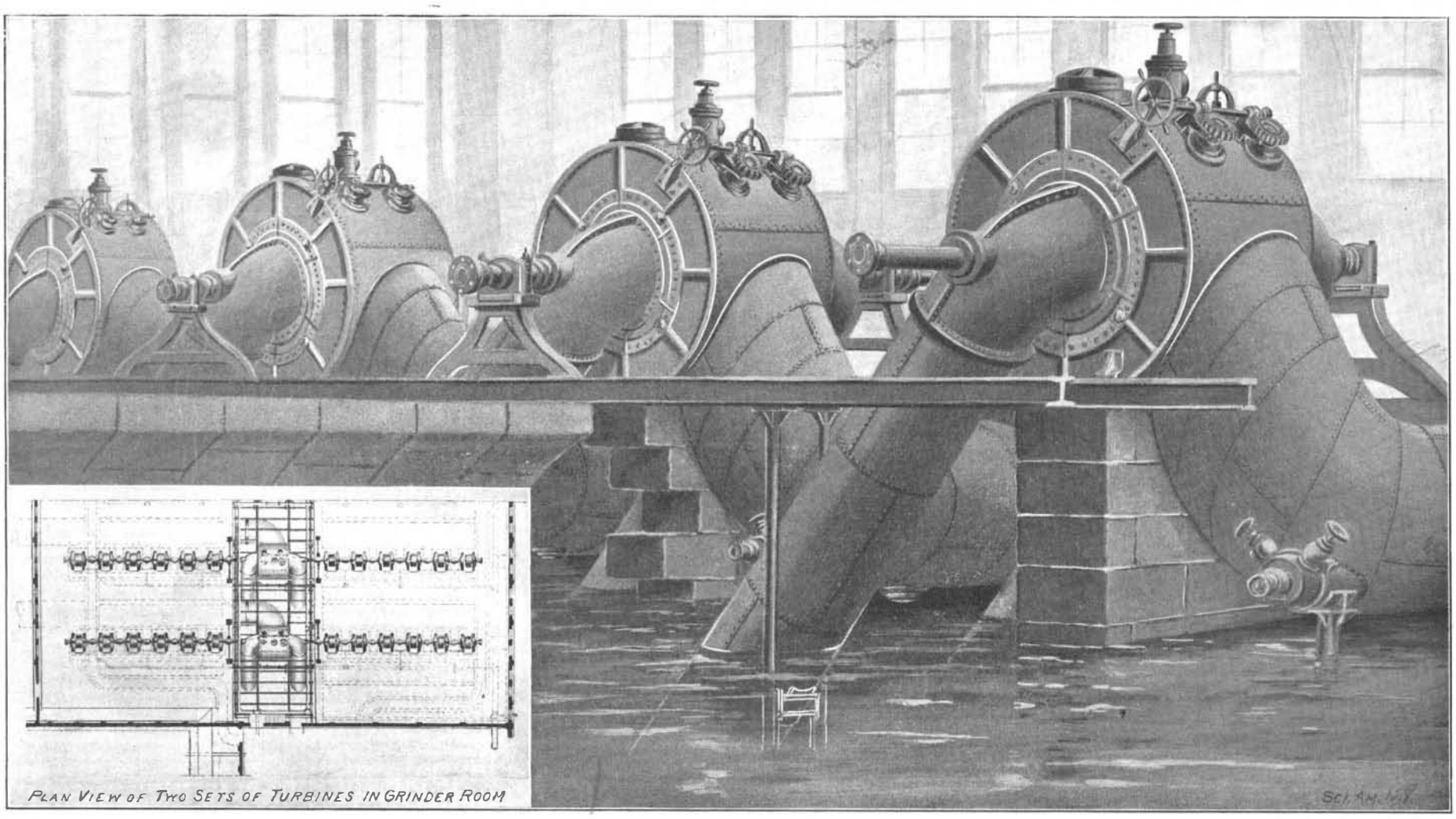
SCIENTIFIC AMERICAN

[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. 15. ESTABLISHED 1845. | NEW YORK, APRIL 13, 1901. | $3.00 A YEAR. 8 CENTS A COPY.





RODNEY HUNT TURBINE PLANT AT THE GREAT NORTHERN PAPER COMPANY'S MILL, MILLINOCKET, MAINE—GENERATOR AND GRINDER ROOMS.—[See page 230.]

© 1901 SCIENTIFIC AMERICAN, INC.

Science Notes.

Hamburg's naval observatory has been removed to the village of Bergesdorf, as the smoke and vibration interfered with the observations.

A fine specimen of the periophthalmus family, a species of fish that is supposed to be confined strictly to African waters, has been caught near Fernandina, Fla.

Great Salt Lake is beginning to show the drain upon it, due to irrigation, and is receding. A canal to the lake from the head waters of the Snake River has been suggested as a possible remedy.

It is estimated that at an altitude of over 60 miles, the atmosphere will consist of 95 per cent hydrogen. It is suggested that this may be the source of the occluded hydrogen usually found in meteoric fragments.

Congress has under consideration the establishment of a psychophysical laboratory in the Department of the Interior for the purpose of prosecuting the exact studies on the criminal, pauper, and defective classes of our population.

A commercial museum is to be established in San Francisco on the lines of the Philadelphia institution. A company has been organized with Irving M. Scott as president. The idea is, of course, to benefit the commercial interests of California.

Venice is trying to revive the picturesque ceremony of wedding the Adriatic, which has been discontinued since the last Doge was expelled in 1797. Plans are being made for a new "Bucentaur" on the model of the one used in the last ceremony.

A party of Swedish naturalists under the leadership of Gustave Kolthoff made a northern voyage of more than usual length last summer, for the purpose of studying the fauna in Arctic waters and lands. They were disappointed in not finding any more relics of Andrée on Prince Charles Island.

It is feared that legislation regarding the Palisades may fail, owing to a lack of interest. Many seem to think that the saving of the Palisades is a local matter which, of course, it is not. A canvass of the legislators, especially those on the central and southern New Jersey shores, shows that there is need for a careful campaign of education.

M. Camille Flammarion, the celebrated astronomer, has been studying the effect of colored light on silkworms. White light yields the maximum, and blue light the minimum, production of silk. Next to white light, the purple of the red end of the spectrum gives the best results. Blue rays increase the number of males, and "warm rays" the number of eggs laid by the females.

A Roman dealer in antiquities obtained the permission of the Roman municipality to erect in the Piazza Borghese a replica of the famous Neptune fountain at Bologna by Giovanni Bologna. The city of Bologna enjoined the municipality of Rome and the author of the project from taking any such action, alleging, besides the legal precedents, the moral right of any city to guard its own artistic heritage.

It is reported on good authority that the Misses Newton, daughters of the late Prof. Newton, the famous Yale mathematician and astronomer, will soon donate to Yale for the Peabody Museum the great collection of meteorites and aerolites which their distinguished father collected through his life. The Misses Newton are at present traveling in Europe. The collection is stored in boxes, which were placed in charge of Prof. Brown at the Yale Observatory.

The Geodetic Commission of Switzerland has undertaken an exact leveling of the whole country by the most scientific methods. The work has been going on for many years. and from time to time atlas-sheets are published which give the general topography of a region accompanied by a list of the points whose altitudes have been accurately determined and by comparisons with previous work of the same sort. Each point determined is fully described so that, in its turn, it may serve as a datum point for more detailed work, and all the points are referred to one origin—namely to a monument in Geneva whose altitude above the sea has been fixed.

A barometer has been designed by Mr. K. T. Fischer for balloon observations, says The Engineer. It may be described as a Cartesian diver. The float consists of stem, cylinder partly filled with water, the free space being taken up by air, and bulb charged with mercury; it is made of glass, and swims in a brass cylinder containing distilled water. This cylinder is surrounded by a shell of ice, placed within a chamber packed with ice. The temperature being thus kept constant, the position of the float will depend upon the volume of the air intercepted in the float, which varies with the atmospheric pressure acting on the water in the brass cylinder. For exact determinations the stem is sealed off, and the cylindrical part weighed together with the bulb.

Engineering Notes.

Ten locomotives are being completed by the Baldwin Locomotive Works for the Paris, Lyons, Mediterranean Railway of France.

The "Ermak" will make another voyage into the Arctic regions next summer to test her efficacy against the polar ice. She has been furnished with a new, longer and more powerful stem, which it is supposed will enable her to break through ice of enormous thickness.

A solid mass of finest gray granite, measuring 68 feet long, 20 feet wide, and 14 feet deep, has been successfully blasted at the De Lank quarries, Bodmin. The weight of the block is about 1,400 tons. It is now being cut up into blocks averaging five tons each, which will be used in the erection of the new lighthouse off Beachy Head.

The Berlin International Exhibition for Fire Prevention and Fire Protection is to be held in June and July of this year in commemoration of the fiftieth anniversary of the organization of the Berlin fire brigade. The United States easily leads the world in fire protection if not in fire prevention, and it is to be hoped that our inventors will be adequately represented.

A workman in a German chemical works has invented a substitute for coal, which costs about 25 cents per 220 pounds to manufacture. Peat is the basis of the fuel. It gives out great heat, burns with a bright flame, and leaves no slag and only a small quantity of white ash. The peat is dried, ground by machinery, mixed with chemicals, and pressed into brick shape.

A patent recently granted gives the following formula for a metal-cleaning composition: Pure water, 1 gallon; potassium carbonate, 1 ounce; potassium cyanide, ½ ounce; sodium carbonate, ½ ounce; chloride of sodium, 1-10 ounce. The solution is used at the boiling point, and a strong electric current employed. A formation of gas takes place, which immediately separates all grease or other impurities from the object exposed and renders it chemically clean.

A large amount of money is being spent on the National Tehuantepec Railroad, which has been leased by the Mexican government to English contractors. Five thousand men are now employed on the railroad construction work and the harbor improvement works, and more than twice this number could be utilized, and a thousand Chinese are now on their way to Mexico to work on the road. The railroad is being rebuilt all the way from Coatzacoalcos, the Atlantic terminus, to Salina Cruz, the Pacific terminus. New eighty-pound steel rails are being put down, and twenty thousand redwood ties from California are being placed under the rails. There are also many native mahogany and ebony ties being used on the road.

Since 1890 seventy-three accidents have occurred with water-tube boilers in the French navy, of which number forty-four were due to rupture of the tubes, says The Engineer. Seventeen of the tubes which failed were in the bottom row. Six fractured tubes belonged to the second or third row from the fire, while on the top row, where the evaporation is complete, there were six tube collapses, eighteen more being credited to the intermediate rows. Thirteen of the accidents were traceable to abnormally low water level, and bad circulation accounted for six of the others. Six tubes split because they were worn out, and six because they were defective.

The Japanese government propose in future to construct their own battleships and to manufacture their own armor plates. They are projecting enormous shipyards and the installation of modern plant. Tenders have been issued for the machinery for the manufacture of armor. This decision is rather disconcerting to the big shipbuilding firms of Great Britain and the armor-plate manufacturers of Sheffield, since some of the largest and most recent additions to the Japanese fleet have emanated from the English yards. The armor-plate manufacturers have received millions of dollars during the past few years for the supply of armor plates. In the largest Japanese battleships, such as the "Asahi," there are no less than 3,000 tons of steel protection which cost over $500 per ton.

The trustees of Purdue University are recognizing the fact that certain classes of locomotives will soon be thrown into the scrap heap to make way for later and more economical types, and they desire to preserve good examples of the disappearing types, and the university authorities have asked for the co-operation of railway companies. The proposition which the university makes is a most liberal one. It offers to meet the transportation charges and to care for the locomotives thus deposited, which will still be owned by the railroad company. Three engines have so far been secured. One of them is that class of engine which first performed the transcontinental trip; the second is of the B. & O. camel-back type; the third is an English engine which was exhibited at the World's Fair of 1893, which has since been in the possession of the Chicago, Milwaukee & St. Paul Railway. A suitable museum building will probably soon be provided.

Archæological News.

The walls of Avignon are threatened, and the council has voted to destroy a part of them.

A special organ devoted to the papyri has been started. It is the Archiv für Papyruserforschung, and Prof. Wilcken, of Würzburg, is the editor.

A Roman chariot has been found near Philippopolis, Bulgaria, in a tumulus. All the metal parts of the chariot and the harness were found, as well as arms and human remains.

It is reported that a wealthy resident of Baltimore, a collector of pictures, has bought the Madonna of the Candelabra, of Raphael, at a very high figure. It is a superb picture, and is in a good state of preservation.

Mr. Lacey has reported a bill to provide for the setting aside of a "Cliff Dwellers' National Park" in New Mexico. The nearest railroad station to this proposed park is at Espanola, on the Rio Grande Railway.

Material from the excavations at Copan, in Honduras, is steadily accumulating at the Peabody Museum, Cambridge, Mass. The museum has been able to complete in this prehistoric city its investigations of the great hieroglyphic stairway on the face of the pyramid. Molds have been made of all the steps, with their carvings and inscriptions.

The Baptistery of Florence is being restored. A year ago the Cathedral authorities thought that the building looked too old, and ordered it to be cleaned with pumice stone, thus removing the rich, velvety color which rendered it so charming. The Cathedral authorities also desired "to clean" the base of the Campanile. Foreign public opinion is being aroused. The bad taste and vulgarity of the modern Italians are never shown to greater disadvantage than when some building is singled out for barbarous restoration.

Greek divers who have explored the sea bottom near the island of Cerigo have made discoveries of no little interest, both to the archæologist and the artist. Marble and bronze statues, fragments of vases, pieces of wood from some vessel, have been found, which indicate that here a trireme, laden with art-treasures and bound for Rome, was wrecked. Lucian, moreover, in his story of Zeuxis, mentions a vessel which Sulla had laden with statues and sent to Italy, and which foundered on these very coasts. Whether the vessel discovered be that referred to is questionable. The coincidence, however, is certainly remarkable.

Among the pieces brought to the surface may be mentioned the bronze head of a boxer or wrestler, and particularly the marble statue of a bending youth, which probably ornamented the pediment of some temple. The upper part of the statue is in an admirable state of preservation. The head and trunk are entirely intact. The two hands have also been recovered, one of which, still unfinished, is a veritable masterpiece. Although the statue has not been everywhere finished with equal care, it is nevertheless a work of art, remarkable for its rare grace and beauty.

The fall of two of the stones of the outer circle of Stonehenge, on the last evening of the nineteenth century, directs attention to the necessity for at once taking steps to preserve this remarkable phehistoric monument. The stones ought to be replaced while their original positions are clearly remembered, and before public interest in their fall has subsided. An engineer, writing to The Times, suggests a method of undermining the stones and imbedding them in a foundation of concrete or cement.

The Rev. Dr. William C. Winslow, vice-president of the Egypt Exploration Fund, says that in addition to the papyri from Oxyrhycus presented by the society to several universities, there is a valuable lot of forty-three papyri from several sites which have been received for distribution, largely treating of business and civil matters in the first centuries of our era. Among seven papyri for Columbia is a tax collector's returns, showing items and how the collectors made returns in A. D. 196. These were poll taxes in A. D. 122. In the papyrus for Hamilton College is the receipt for a voter named Philoxenus. One of two papyri for Vassar College is the official notice of the birth of a son from Ischyras and his wife, Thaisarion, A. D. 150, which is valuable for comparison with papyri at Berlin, which show how registry of births was then made. Of six papyri for Princeton one is a return of house property, A. D. 131, from Sambous to Dius and Herodes, keepers of the registry of property. The rise of the Nile was the greatest annual event, and upon it taxes were calculated. Hence one of the six papyri sent to Johns Hopkins, treating of the unwatered land tilled by Ptollarous, A. D. 163, is peculiarly interesting. She declares that her field at Euhemeria did not get the water. Her plea in a word is: "No crops, no taxes."

Our consul at Rouen considers that there is a great future for ice-making machinery, refrigerators, ice cream freezers, electric fans and kindred articles in France. Rouen, with a population of 150,000, has no ice plant.

© 1901 SCIENTIFIC AMERICAN, INC.