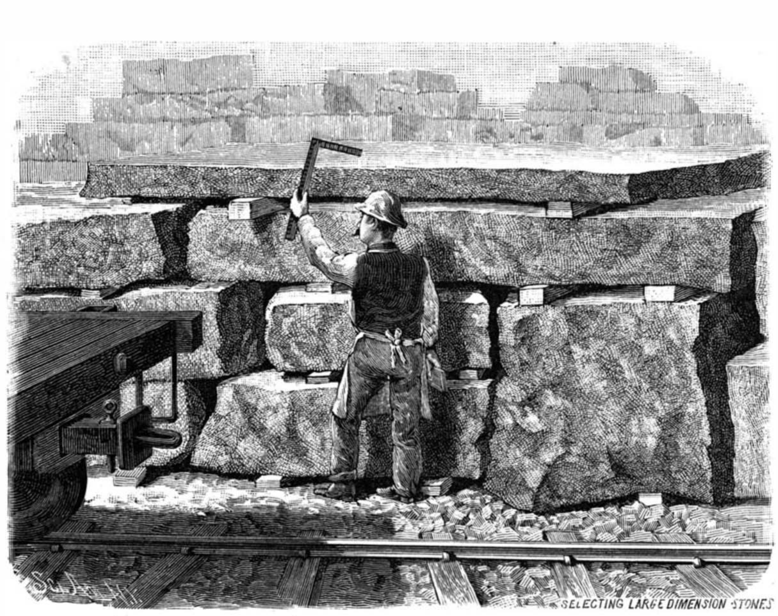
THE POTSDAM RED SANDSTONE QUARRIES.

A perfect building stone is far from being a common product of nature. To be qualified as a perfect building material, a stone must unite the qualities of resistance to weather and to fire, must be of good appearance and impervious to moisture. It should also not be of such a tint as to become dingy or of ugly color when exposed. The streets of this and other cities furnish the best possible example of defective building stones. Brownstone buildings are seen whose carved portions are disintegrating and the faces of whose smooth wall pieces are flaking off. To avoid this destruction various suggestions and experiments have been made either in the way of chemical treatment or of method of laying, but nothing seems to stop it. The experience of Boston and of other cities has demonstrated how poor a resistant to fire is granite. Granite is often a stone of handsome appearance, and will in some cases stand any amount of exposure to the elements, but it is very unsatisfactory in the presence of a conflagration. Although stone is everywhere recognized as the noblest and most desirable of building materials, yet so great has the difficulty of securing good stone become that many large buildings are built entirely of brick and terra cotta, the art of man being relied on to surpass nature.

The Potsdam sandstone is a member of the lower Silurian group and rests upon the primitive rocks of the Eozoic. This lower portion of the Potsdam formation varies from an absolute quartzite to a sand. In the present issue we illustrate the quarries at Potsdam, N. Y., from which this stone is extracted for building purposes. Here the famous sandstone is attacked at the place where it seems to be of the best average quality. A thickness of 70 feet is exposed in the quarries. At this point it is almost a quartzite.



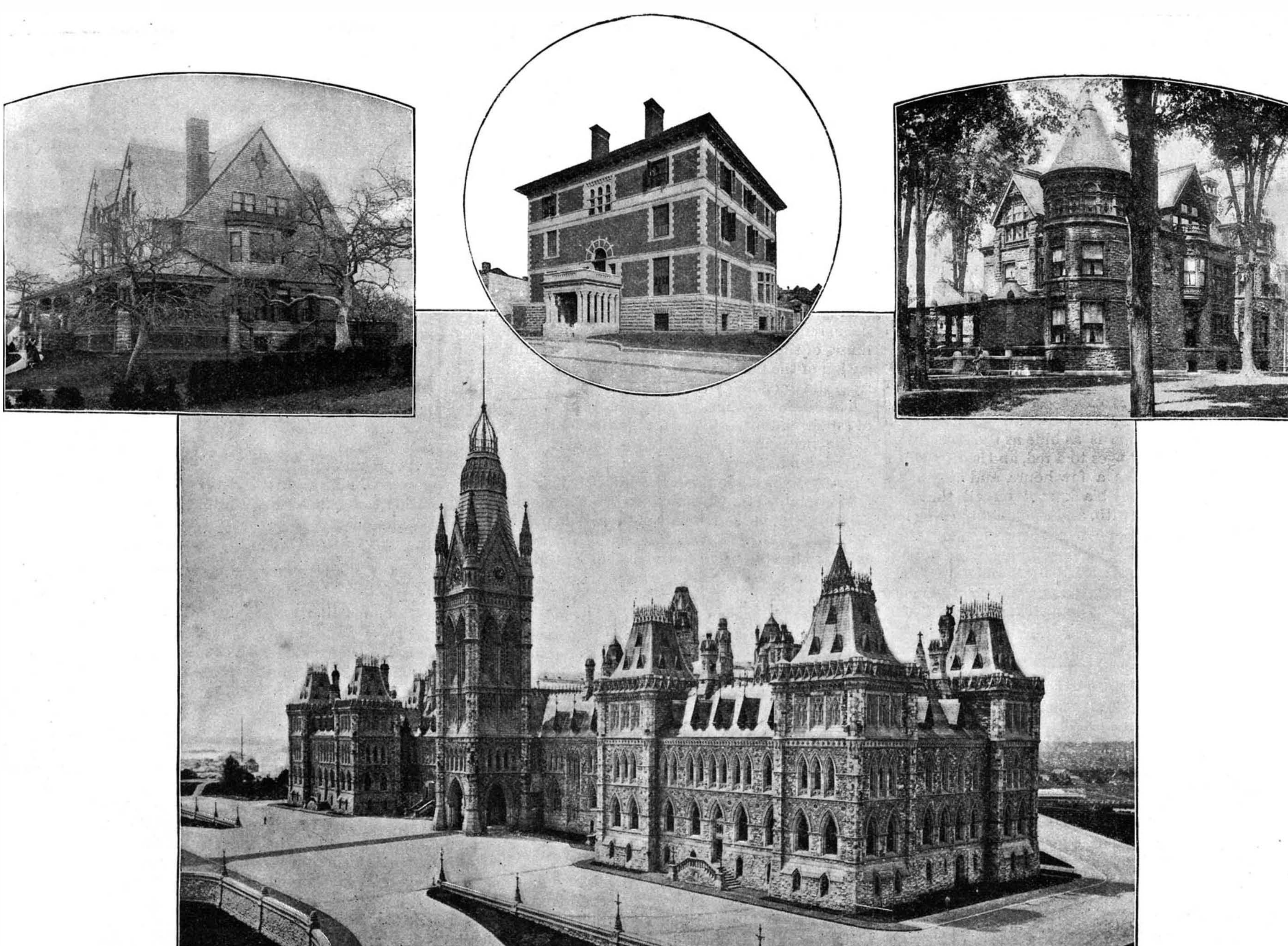
SELECTING LARGE BLOCKS OF STONE.

The examination of a microscopic section of the rock discloses the following characters: It is found to consist of angular grains of clear quartz, quite unmixed with other granular material. There is no feldspar or mica intermingled with it. The interstices between the grains contain a cementing material. This is found to be a clear, colorless silicious cement, so that the rock is virtually silica. On this point, Professor Thomas Egleston, of the Columbia College School of Mines, and an authority on building stones in the United States, in a paper read before the American Society of Civil Engineers, on the decay of building stones, says: "Of the sandstones having a silicious binding material, Potsdam sandstone, which has been used in the recently constructed Columbia College [an engraving of which is published herewith], and the silicious triassic sandstone, which was the material used in the lower part of the cathedral at Rodez, are the best examples, and in these no decomposition takes place. Of these sandstones, it will be noticed that there are two general varieties, one in which the quartz grains are more or less large, and are rounded, but are cemented together by silica. . . . In the Potsdam sandstone, on the contrary, the grain of the quartz is quite small; its shape, when it can be distinguished at all by a magnifying glass, is always angular. . . . This is the best of all building materials, though mouldings made of the other variety (large grains) will last for many years without suffering any appreciable amount of deterioration."

The other sandstones vary greatly from this. In many cases the quartz grains which form a body of sandstone are mixed with grains of feldspar and mica, which in themselves present at least a chance or probability of decay. The cementing material also varies; it may be of argillaceous nature or may be even a calcium carbonate. As cements all these are defective. They always tend to yield to the weather.

As a weather resistant pure crystalline quartz would be the best of all materials. This, of course, being out of the question, the next best thing would be in the line of a flint rock or quartzite. To the latter type, the Potsdam sandstone is closely assimilated. It departs far enough from it to be workable. Although extremely hard, it can be wrought into all the shapes demanded by modern building, including the most exquisite carvings and mouldings. Its strength is very great. It has been tested on the Emery testing machine at Columbia College in this city, and proved to be of extraordinary compressive strength. Some pieces placed in the machine and subjected to stress broke at a little over 18,000 pounds to the square inch. This figure brings it as regards strength quite out of the range of most sandstones and limestones and makes it surpass the majority of granites. But one marble and one sandstone in a very long list approaches this strength. What is still more extraordinary is that two inch cubes from one of the quarries proved too strong to be broken by the testing machine, although the pressure was carried to 151,000 pounds. This test reduces to a compressive strength of nearly 43,000 pounds to the square inch, or more than double the strength of the best granite. This result, so extraordinary as to be properly termed an anomalous one, proves what the stone may be.

We have said that granite may be weather resisting. While this is very true, it may be equally true that other samples will fail to withstand the American climate. To determine, as well as possible, what the action of the weather, including a contaminated city atmosphere, might be on Potsdam sandstone, it has been tested by subjection to acid and sulphurous acid gas. Dilute sulphuric acid, after long action, dissolved only $\frac{2}{100}$ of one per cent, or a mere trace, while some stones lost over six per cent. Sulphurous acid gas only changed its weight $\frac{6}{1000}$ of one per cent. These two tests are designed to represent the action upon it of the city atmospheres. As a direct test, samples have



PARLIAMENT BUILDINGS, OTTAWA, AND PRIVATE RESIDENCES BUILT OF POTSDAM RED SANDSTONE.

SCIENTIFIC AMERICAN

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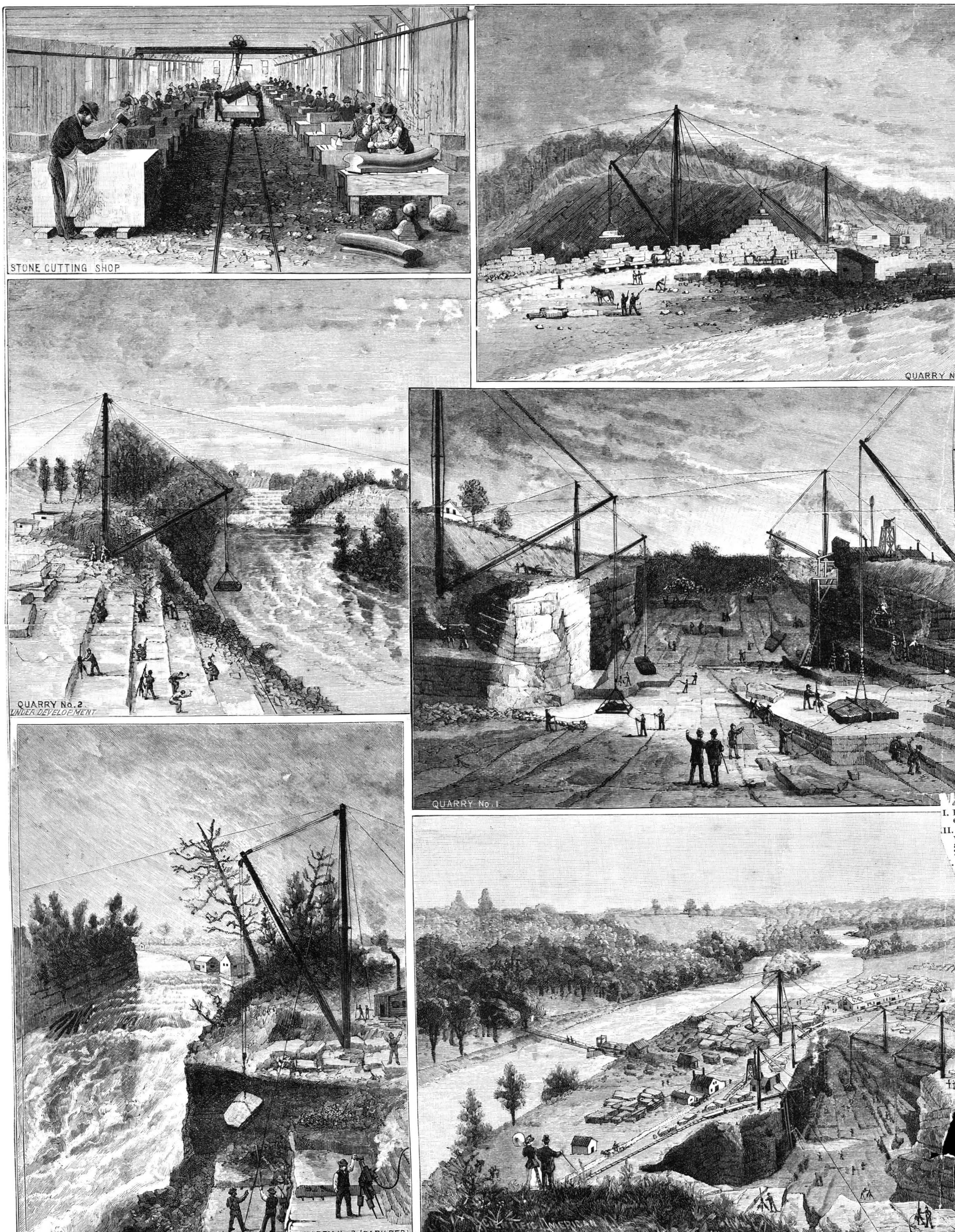
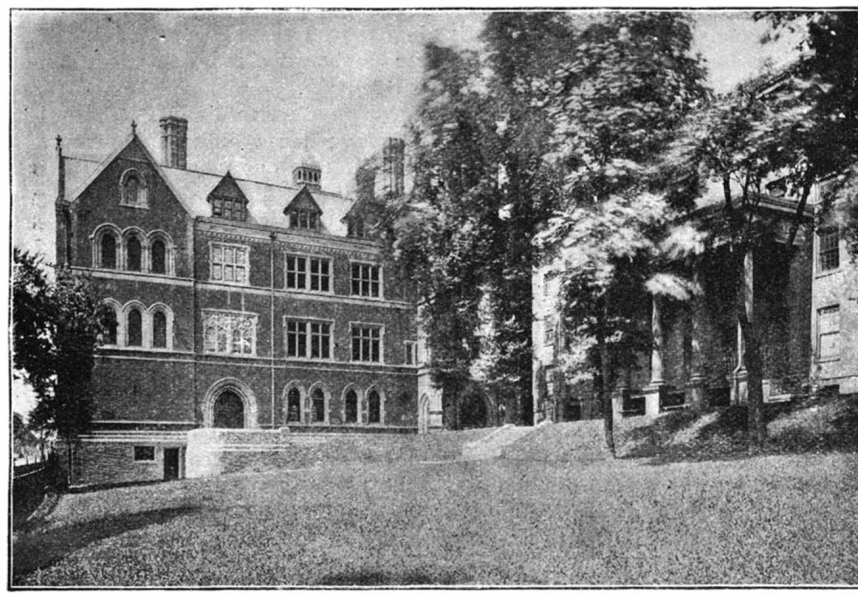


[ENSIVE RED SANDSTONE QUARRIES AT POTSDAM, N. Y.—[See page 8.]

been repeatedly subjected to the severest freezing and thawing, and have remained absolutely unaffected.

In the vicinity of the quarries, buildings have been constructed of this stone, which have stood for over seventy years. Yet exposed for this length of time to the trying climate of Northern New York, the stone has preserved its fresh appearance and has not yielded in the least, the tool marks being as clearly discernible as if made yesterday. Prof. Newberry has expressed the opinion that "had the obelisk now standing in our Central Park been composed of such a dense, homogeneous sandstone as Potsdam sandstone, it would to-day be as perfect as when erected at Tanis 1500 B. C." Here it may be noted that this very obelisk, which suffered so much on exposure to our climate, is made of granite.

We have spoken of the poor qualities of granite as a resistant of fire. The action of a conflagration upon granite is to cause it to flake off; walls composed entirely of this material may thus become so reduced in thickness as to fall. It is there that the qualities of Potsdam sandstone appear at their best. It is so absolutely fire-resisting, its granular structure so completely prevents it from cracking, that it can be heated to a red or white heat without injury. By many foundrymen it is preferred to firebrick for lining cupolas, and in the vicinity of the quarries is always used for lining lime kilns. The report of Prof. Wilbur, of Rutgers College, to Dr. Smock, the New York State Economic Geologist, showed that this stone withstood repeated heating to the temperature of melted copper, and sudden cooling, without injury or change of color—something which no other stone of the large number tested by him could do.



COLUMBIA COLLEGE, NEW YORK.

The qualities of Potsdam sandstone have been carefully examined and tested by men of the highest scientific standing. Dr. J. S. Newberry had occasion to examine the stone in 1890, and his report fully carries out all that we have said above. Dr. Newberry is professor of geology in Columbia College School of Mines; the opinion of his eminent colleague Prof. Egleston, who has charge of the department of mineralogy in the same great institution, is sufficiently indicated by the extract from his famous essay on the Decay of Building Stone, read before the Society of Engineers, which we give above. Prof. John C. Smock, New York State Economic Geologist, and Prof. Francis A. Wilbur, of Rutgers College Scientific School, are among the authorities we may refer to. Dr. Geo. P. Merrill, of the Smithsonian Institution, at Washington, is our authority on what we have said of the microscopic examination of the stone. In his new work on the Building Stones of the United States, Dr. Merrill says, referring to Potsdam sandstone: "I consider this, from the standpoint of durability, almost an ideal stone. It is practically non-absorptive, and its surface affords no foothold for growing organism."

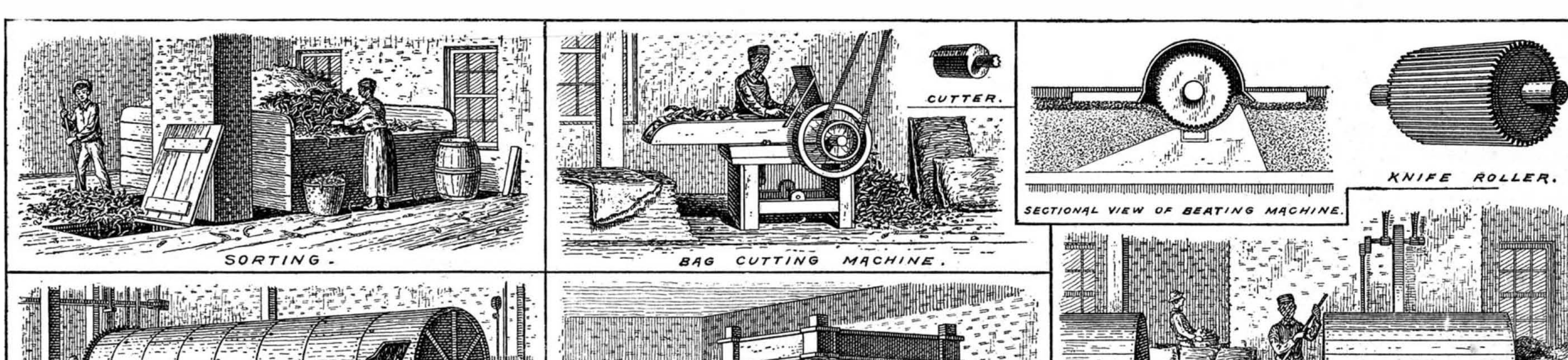
Our illustrations of the quarries and workshops of the Potsdam Red Sandstone Company, of Potsdam, N. Y., tell their own story. They show the immense scale on which the operations are there carried on. From the everyday point of view a valuable feature is the large accumulation of ready quarried stone, nearly 100,000 cubic feet usually being carried in stock, including 40,000 or 50,000 feet of the famous Potsdam random rock-faced wall facings, cut ready to ship, so that contracts can be filled immediately on receipt of orders. This puts the business on a par with the brick and terra-cotta makers, who from necessity are compelled to ship from stock, and absolutely avoids the proverbial delay in stone contracts, which is a standing joke among builders. Although it is the policy of the company to sell rough stone only, yet where local cut stone contractors refuse to make fair figures on work, their unrivaled facilities enable them to cut stone ready to lay in the building, and to set it if required in any part of the United States or Canada.

The peculiar stratification of the material as it lies in the quarries will be noticed. The natural beds are nearly perfect, which greatly reduces the cost of cutting. Immense blocks are got out almost of perfect shape, by the use of wedges and feathers, sometimes assisted by some of the patented methods of blasting. The equipment of machinery is of the most modern and complete description.

Dr. Newberry says: "The element of beauty is no less important in a building stone than strength and durability. In these three qualities this stone is certainly unrivaled."

The different quarries of the company afford a certain choice of color. The red stone is of an exceptionally pleasing and bright tint. About fifty feet of these layers is exposed in the quarries. Stone can be taken out from two to six feet or more in thickness, and can be wedged into any size from these thick stones, resembling granite in this. The company's quarries are distributed for about a mile up and down the Racquette River, and embrace the best outcrops of stone to be found in the district. Dr. Newberry reported, after personal examination, that these quarries were practically inexhaustible. We may, therefore, pronounce the company's quarries an almost ideal source of building material.

One of the cuts, showing a workman selecting dimen-



THE MANUFACTURE OF TRUNK AND BOOKBINDER'S BOARDS.—[See page 10.]

sion stone from stock, gives an idea of the form in which stone comes from the quarry. Another cut, showing the interior of a stone cutting shed, shows workmen getting out stoop rails and other forms.

Quarry No. 1, from which the main supply is derived, is shown in two cuts. The peculiar stratification of the stone is very noticeable. It is exceedingly regular, with sudden variations in the dip. The drainage of this quarry is effected by an undershot water wheel, shown in the bird's eye view to the left of the picture. From Quarry No. 2, now under development, a medium red stone is taken. This quarry, for a long time to come, will be self-draining, as will also be the case with Quarries Nos. 3 and 4. From Quarry No. 3 a dark red stone is taken.

The Racquette River, on account of falls and rapids, is not navigable, although it is the second largest river in New York, but great numbers of logs are floated down it every year from the Adirondack forests. A fall on their quarry property gives the company nearly twenty thousand horse power, the entire river falling about sixty feet, and this will be of great value in the future development of the business, giving by means of compressed air or electricity ample power for the working of machinery now using steam, and for other purposes.

There is one product of the quarries which should be mentioned, the banded stone. Some layers are strongly banded in different colors. With these the most beautiful architectural effects can be produced. The combination of light, medium and dark red stone in solid colors and the banded variety gives great latitude to the architect in producing color effects. The colors harmonize excellently with granite or brick, and instances of this use are numerous. Among the buildings where the stone has up to this time been used for the whole or a part may be mentioned the Dominion Parliament buildings at Ottawa, shown in the accompanying engravings; All Saints' Cathedral, Albany; Columbia College, New York City; the New York State Asylums at Ogdensburg and Matteawan (costing over a million each) and numerous buildings in New York City, Brooklyn, Buffalo, Syracuse, Rome, Albany, Troy, Lynn, Washington, D. C., Rondout, N. Y., New Rochelle, N. Y., Ogdensburg, N. Y., etc., and many smaller cities and villages in the United States and Canada.

The quarries are situated near the line of the Rome, Watertown and Ogdensburg Railroad, and ship their product by the New York Central system in all directions.

MANUFACTURE OF TRUNK AND BOOKBINDERS' BOARDS.

The illustrations on the preceding page were taken from the plant of W. O. Davey & Son, Jersey City Heights, N. J. These boards are also used in the manufacture of gaskets and buttons, and are made of scraps of paper and cardboard from box and paper manufacturers with a mixture of oakum dust, shade strips, grass rope and bagging rags. The refuse cardboard is carted to the factory in large sacks, sorted over and placed in a large soaking tub. When moist it is ready for the beating engines. These engines are oval shaped and made of iron and are lined with sheet brass. They are about 13 feet in length, 7 feet in width and 2½ feet in height. The oakum dust, shade strips, rags, etc., before they go into the beating engines, have to be cleaned. They are put separately with a quantity of lime into a rotary boiler, about 20 feet in length and 6 feet in diameter, its interior fitted up with iron pins placed about 3 feet apart. The pins are about 1 foot in length and catch and separate the material as the boiler revolves. The boiler is filled with steam of about 7 pounds pressure, and revolves slowly for 12 to 15 hours, making but one revolution in every 2¼ minutes. From 1 to 3 barrels of this mixture with about 500 pounds of scrap cardboard are placed in the beating engines with about 1,500 gallons of water. This mass keeps continually moving around the tub. Attached to the shafting across the center of one side of the engine is a roller 32 inches in diameter, containing 56 knives, 3 feet in length, the blades being 2 inches in width and about 2 inches apart.

Running up to the roller is an inclined plane, the top of which conforms to the shape of the roller and runs up at the back about 1 foot. Directly underneath and within an inch of the bottom blades of the roller are about a dozen other knives fitted into an iron slot the same length as the roller blades. As the roller revolves, the wet mass is drawn under and through the narrow space between the knives and is forced up at the back and falls over. This is continued for three hours, until the materials become thoroughly cut up and mixed. If the pulp is not dark enough, a few pounds of copperas are added. The pulp then passes out through the bottom of the engine to a large tank below, where it is forced into a cylinder paper machine. The pulp is thoroughly mixed with water, which passes through and up against a fine sieve roller. This roller is 29 inches in diameter and 70 inches in length, and is covered with a double layer of fine wire netting, the meshes of which are 18 and 40. The water passes through this sieve roller, leaving the pulp sticking to the meshes. The felt belting on the roller above takes up the pulp from the sieve roller as it passes over the top. This is carried on the felt belt to the roller where the boards are formed. These rollers are hollow and made of iron, and run from 18 to 21 inches in diameter.

The pulp sticks to the upper roller as it passes between the two, the belt passing around the lower one and back to the sieve to take up the pulp again. The sound of a bell notifies the attendants of the machine when the pulp or board is of the right thickness. A sharp hook-shaped knife is then passed through two slots in the roller, and through the board as it passes around, the boards being then taken off.

After a certain number of boards have accumulated, they are taken to a hydraulic press, where a pressure of 50 tons is placed on them, which forces out most of the water. They are then taken to the drying plates, which are book-shaped, and made of copper ¾ of an inch in thickness, and hollow. They are filled with steam, which enters at the ends of the plates by means of small pipe connections with rubber joints, which connect with the exhaust pipe. The plates or leaves are 8 feet in length and 3 feet in width. After the boards have been sufficiently dried they are taken to a calender press, where they pass between two 18 inch heated rollers, which straightens and puts a gloss on them. The edges are then trimmed up and the boards are ready for the market. The boards are made of different sizes, ranging from 19 × 30 to 34 × 44 inches, and are sold at 5 and 6 cents per pound. They are about ¼ inch in thickness.

Wind the Great Force in Nature for Carrying Off Heat.

Discussing the means whereby heat is lost in buildings heated by a steam or hot water plant, *Hot Water Heating* says:

"Few people have given much thought to the many difficulties that must be met and overcome in the planning of a heating apparatus; and with a view of showing the importance of the subject, we will try to explain a few of the natural laws by which heat is lost from a building, and also the laws that may be utilized to replace it.

"Wind is the greatest force in nature for carrying off heat, and is the most difficult of all elements to contend with in heating buildings. It is, therefore, necessary that its cooling power should be thoroughly understood, that it may be provided against in the construction of a heating apparatus. The importance of this will be recognized when we explain that experiments with wind currents in glass houses have shown that a room heated to 70° in zero weather, with a still atmosphere, will be cooled 20° in 5 minutes and 45 seconds.

"The same room will be cooled 20° in 2 minutes and 35 seconds when the wind is blowing at the rate of 3 miles per hour, and it will be cooled 20° in 48 seconds when the wind is blowing at the rate of 27 miles per hour. When the fact is considered that it is a common occurrence for the wind to blow from 20 to 30 miles per hour, it will be seen how important it is to carefully consider the number and size of the windows and the exposed walls before designing an apparatus for warming a building.

"Very little has been said on the above important subject—important because the materials used in the construction of a building determine how much heat it will lose, as the heat can only be lost through the materials of which the building is constructed. All building materials have a known conducting power for heat, and, though we cannot here go into elaborate tables of comparison, we will give a few facts of interest.

"A granite wall, 18 inches thick, will lose 67 per cent more heat than a brick wall of the same thickness. A frame building, plastered on the inside and covered with paper felt and sheathing on the outside, will lose 75 per cent less heat than a brick wall of the same thickness. A frame house built without a paper felt covering on the outside will lose 25 per cent more heat than the same house if covered with felt.

"One square foot of glass will lose as much heat as 6 square feet of 12 inch brick wall. If closely fitted double sashes are used, 75 per cent less heat will be lost than with the single sash.

"The manner in which the joints of a building are fitted affects very materially the amount of heat lost; for example, a loosely fitted house may take twice the quantity of heat that would be required for one well built.

"Each square foot of outside wall of a building, each square foot of glass or window surface, and each entrance door, have a given conducting power for taking heat from the inside of a building and dispensing it to the outer air. After measuring these various surfaces and determining the loss of heat by the conducting power of the material of which it is built, we ascertain how much heat any building will lose in zero weather; by adding to this 15 per cent (which is a necessary loss up the chimney to make a draught) we have the total amount of heat lost by the building, and can easily determine the amount of coal that ought to be burned to warm it."

Street Car Mail Distribution in St. Louis.

The recent annual report of the Postmaster-General contains the following letter from J. B. Harlow, postmaster of St. Louis, regarding the electric mail car service in that city:

"In presenting the following concerning the St. Louis and suburban street railway postal car service, I desire to describe not only the car as it is, its present limited schedule, but to enlarge somewhat on the future of the system which will almost entirely change the present method of collections reaching the main office from street letter boxes, as well as the dispatch of city mail on the line of the road to letter carriers for delivery.

"The car is a miniature railway postal car, twenty feet long, and the regulation width of a street car, run under the electric system with its own motor on front and rear platform, with motorneer and conductor, sliding doors at each end, and wide sliding doors with four windows on each side of car, with slot for mailing letters on each side, with appropriate signs. The interior is well lighted with electric lights, the furniture consisting of stove, letter case amply large enough for all distribution, a rack for sixteen sacks, a stamping table, and all the conveniences of a modern railway postal car. Its run is from Sixth and Locust Streets westward to the city limits, about six miles, the schedule time being forty minutes.

"The following sub-stations are on the line of road: Sub-station 9, Fourteenth and Franklin Avenue, with three carriers; sub-station 11, 3901 Morgan Street, with four carriers; sub-station 12, the Arcade, Cabanne, 5500 West, with five carriers.

"All mail for these carriers is made up at the main office ready for delivery and is dispatched at 6:25 A.M., 9:50 A. M., and 1:45 P. M. This leaves the clerk in charge of car free to handle and distribute mail received *en route*.

"By these men reporting at the several sub-stations in lieu of the main office, or station C, there is shown by a fair estimate an aggregate saving of time to the twelve men of ten hours daily.

"It is proposed to place three more sub-stations on the line of this road, for which application has been made, and at proper intervals a number of accumulation street letter boxes where carriers will deposit their collections, these boxes to be collected by the clerk in charge as the car passes, going both east and west; mail to be distributed *en route* and dropped off at the proper sub-station for delivery. All mail not intended for line to be dropped off as car passes main office.

"From the limited opportunity to observe the possibilities of the street railway postal service it is plainly evident that the results will be to expedite the delivery and collection of mail, and thereby result in great good to the service."

We hope Congress will lose no time in passing such laws as may be necessary to extend this admirable system in New York, Chicago, and all our towns and cities. It will greatly increase the revenues and the facilities of the Post Office department.

To Keep Iron and Steel from Rusting.

The number of articles in photographic use constructed from iron and steel, from rolling presses and head rests downward, will render serviceable a couple of recipes, adapted for the purpose in other directions, which we append. One of the simplest, and which has been in use for many years, consists in coating the article with a solution of India rubber in benzol, made of about the consistency of cream. It may be applied with a brush, is easily rubbed off when needed, and effectually prevents rust. A coating of more use where the "tooth" imparted by rubber would be disadvantageous is prepared in the following way: Dissolve two parts of crystals of chloride of iron, two of antimony chloride, and one of tannin in four of water. Apply with a sponge or rag and allow to dry. A second or third coating, or more, is given in the same way that a dark color is produced. When dry, it is washed with water, again allowed to dry, and polished with linseed oil. The antimony solution should be as nearly neutral as possible.—*Br. Jour.*

The 40-inch Telescope of the Yerkes Observatory.

The large disks of optical glass made by Mantois for the University of Southern California have been purchased by the University of Chicago. They are nearly 42 inches in diameter, and will allow of a clear aperture of 40 inches. The glass is said by Mr. Alvan Clark to be exceptionally good. Mr. Clark will shortly undertake the work of grinding the objective, which he has contracted to complete within eighteen months. The contract for the mounting will be let within a short time. The site of the observatory is still undecided, but it will probably be several miles outside the city.

The contract for mounting the great telescope has been awarded to Warner & Swasey, of Cleveland, Ohio.