## AMERICAN INDUSTRIES, No. 33.

### MANUFACTURE OF ROLLED IRON.

The great revival of trade in the United States within the last few months has been marked by an unprecedented activity in iron and steel manufactures. This great activity is remarkable for the suddenness of its development as well as its universality.

There are at present more furnaces in blast in this country than ever before, and the rolling mills, although working up to their full capacity, are inadequate to supply the immense demand for manufactured iron. Now, as there is scarcely a mechanical occupation that does not depend for its tools, machinery, or raw material upon iron and steel, it follows that the condition of the iron industry is in some measure at least indicative of the state of other interests. It is not, therefore, to be regretted that the demand for iron is far in advance of the means of supply, as this state of things may be regarded as one of the best indicators of present and future prosperity.

For our principal illustration we have chosen from the many works devoted to the industry under consideration the Union Iron Mills, of Pittsburg, Pa., owned and operated by Messrs. Carnegie Brothers & Company.

These mills were established in 1860. They are devoted to the manufacture of structural iron for bridge building and architectural purposes, iron beams, channels, tees, angles, etc. Iron in these forms enters more and more into the composition of various structures, and this already extensive branch of manufacture must of necessity increase with the growth and development of the country.

The Union Iron Mills give employment to about 750 men, and are capable of turning out annually 40,000 tons of manufactured iron. The works cover eight acres of ground, with buildings as follows: Main building, 400 feet long and 80 feet wide, having attached to it five wings, each 137 feet long and 50 feet wide. The fitting shop is 100 feet long and 40 feet wide. The roll house is 150 feet long and 20 feet wide. The building covering the heating furnaces is 400 feet long and 37 feet wide. Two buildings in the puddling department are each 200 feet long by 65 feet in width. Two gas producer houses, one 100 by 50 feet, and the other 46 by 35 feet, cover twenty-four producers.

These extensive buildings contain the most approved modern appliances and machinery. The works are provided with thirty-one puddling furnaces, seven double Siemens heating furnaces, two single Siemens, and two reverberatory furnaces. The machinery is driven by seventeen engines located at different points, and arranged conveniently with reference to the work to be done. These engines are supplied with steam from fifteen boilers, twelve flue boilers, one Kilgore boiler, and two tubular boilers. The pump that supplies water for the purposes of the mill has a 16 inch cylinder and 3 feet stroke, and throws 700 gallons of water per minute.

The smaller view in the upper portion of the engraving, gives a good idea of the external appearance of the works, and some of the machinery is represented in the other views.

The first operation in the manufacture of wrought iron is that of puddling, which is simply a process of removing from pig iron, by the combined action of an oxidizing atmosphere and mechanical agitation, the carbon, silicon, sulphur, and phosphorus.

This operation is carried on in reverberatory furnaces, and attended by men whose business it is to stir the semi-fused pig iron on the hearth of the furnace until it is brought to the proper state of consistence, when it is gathered into balls as large as can be conveniently handled, and taken directly to the squeezer, which compresses the ball and forces out the greater portion of the scoria and cinder.

The squeezer is a powerful machine, consisting of a heavy corrugated cylinder revolving eccentrically in a concave frame. From the squeezer the bloom is taken while still hot to the rolls, through which it is passed several times, reducing it to the form of a bar called a puddled bar.

The puddled bars are piled together, reheated in the heating furnaces, and then passed through rolls, which shape them for market. There are six trains of rolls in the Union Iron Mills—one 20 inch train, two 18 inch trains, one universal plate mill, one 12 inch and one 8 inch train. The huge 20 inch train is represented in the larger view in the engraving.

These immense rolls, with their massive housings, seem the very embodiment of strength, and as they are revolved with a resistless power, it is a grand sight to see the heavy white-hot beams shoot out first from one side of the rolls and then from the other. The method of handling these large masses of hot iron is both simple and efficient. The mass of iron as it comes from the heating furnaces is delivered to the first pair of rolls by ponderous tongs, as it passes through it is caught upon the ends of levers whose fulcra are suspended from movable carriages above. The men holding the long ends of the levers, dexterously thrust the shorter end under the rapidly moving bar, immediately press down upon the longer end so as to give the bar support, and then follow the bar as it moves forward. After it has passed completely through the rolls in one direction, it is raised by the levers and guided between the middle and upper roll, and as it again issues from the rolls it is caught and supported by the men on the other side. The perfect ease with which these beams, weighing thousands of pounds, are handled is astonishing.

Some of the beams are cut into lengths while hot, others are cut while cold. This firm use three saws for cutting iron when cold, and four hot saws. They were the first to use "cold saws" for cutting iron cold. The machinery for sawing the iron is seen at the further end of the train of rolls. It is very like a cross-cut sawing machine for wood, excepting that it is adapted to the heavy work of sawing the iron beams instead of wood. The beam to be sawed is placed upon a strong iron carriage capable of moving back and forth on a track, and is moved against the edge of the saw, which cuts its way through.

The gigantic machine shown in the small circular view is the universal plate mill for rolling the heavy plates used in building war vessels, turrets, etc. It is capable of rolling a plate 36 inches wide 3 inches thick, and almost any length. The plate as it passes from the rolls on one side or the other is supported by a series of large iron rollers. Among other pieces of heavy machinery employed in this establishment are two punches, one machine for slotting, and eleven heavy shears, all of which are massive, powerful, and well calculated to withstand the strain that must naturally come upon them.

In addition to the works above described, this firm own the Lucy Furnace for the manufacture of pig iron, employing 200 men and producing nearly 700 tons weekly. This furnace has two stacks, each 20 feet bosh and 75 feet high. The blast of each furnace is heated in four iron pipe stoves to a temperature of about 950 degrees. The blast is furnished to each furnace by two vertical direct acting engines, each having a steam cylinder 35 inches in diameter, a blast cylinder of 84 inches diameter, stroke 48 inches.

The supplies of ore used at this furnace are mainly from the Lake Superior region. The fuel consists of coke, about two thirds of which comes from the works of the firm at Carmenter's Station on the line of the Pennsylvania Railroad, the remainder coming from the Connelsville district.

## An Owl at Sea.

The White Star steamship Celtic, which arrived at New York from Liverpool on Wednesday, Feb. 11, brought a strange passenger who had boarded that vessel in mid-ocean. A large white owl dropped on one of the forward spars in an exhausted condition one evening, when the vessel was about 800 miles off the coast of Newfoundland. When brought to the deck by a sailor, the owl was found to be nearly dead from cold and hunger, and almost too weak to eat.

It had become greatly emaciated, and trembled violently in endeavoring to swallow the first morsel of meat which was placed in its beak. The owl slowly recovered, and is now perfectly well. It is a land bird, and is supposed to have been blown off the coast of Newfoundland by the westerly gales which had for some days previous prevailed there. Finding itself once out at sea, it had probably ceased making efforts to reach the land, and had drifted before the gale, its only efforts being to keep above water. The bird must have possessed remarkable powers of endurance, the officers say, to have kept up so long. The Celtic's owl, which is now quite tame, measures nearly five feet from wing to wing, and is white with the exception of a few small specks of dark color. It will probably live for some time to come on board the vessel which it selected as its home while in mid-ocean. Land birds have rarely been seen so far out at sea.

## Etching on Glass.

An article from the pen of William Gruene, of Berlin, on the process of etching drawings or letters on glass, in relief or opaque, has lately appeared in the Dresden *Glasshutte*, which, says the *American Pottery Reporter*, we have translated and present to our friends, the glassmakers of America. As is well known, indestructible drawings on glass are made by a cold chemical process, by etching with diluted fluoric acid, first covering the places not to be eaten away with an acid-resisting material. The fluoric acid dissolves the glass without affecting the appearance of the parts protected. In consequence the drawing or design appears slightly opaque. The desired effect is then obtained by mechanical means. The elevated parts are ground rough, so that the alternate rough and smooth portions form the picture. The drawings must be etched deep, in order to avoid the deep lines in the mechanical work. It is necessary that all parts which are to become opaque must be covered with the coating, in order to avoid their destruction by the fluoric acid.

The new process described by Herr Gruene avoids all the difficulties surrounding the present process of etching, and enables the workman to stamp, mark, and ornament glass as if it were paper. The principle applied is as follows: The quality of the fluoric acid used is the same as in the old process, but the drawing is no longer made with a substance absolutely proof against the acid, but with another, protecting the glass only to a certain point of time, thus showing in the drawing the elevated marked opaque appearance. For such a covering almost all the lacs, oil varnishes, greasy printing dyes, etc., except the solutions of asphaltum, gutta percha, and caoutchouc, can be used. If applied thin, they yield to the concentrated fluoric acid, even after a few seconds, no matter how firmly dried they may have become. If the substances for covering are used simply for the above named purposes, they yield only a very feebly marked design, partly marked and partly blank; but if dusted after application with a finely pulverized powder of metal, copal, or any other substance capable of rendering longer resistance to the fluoric acid, the opaque drawing is obtained directly. This is the essential point of the invention.

For practical use the following advantages become apparent: 1. As the etching is rapid and not deep, no special protection of the surface by coating with acid-resisting material is necessary. 2. As only slightly resisting covering substances are necessary, the workman can use not only brushes, gravers, pens, and patterns for drawing purposes, but can also easily make transfers from all typographical, lithographical, copper, zinc, glass, and other prints. In like manner elastic stamps and forms can readily be used. As one can use, *ad libitum*, thicker or thinner coats, as well as apply coarser or finer powders for dusting, the opaque parts can be produced in any grain desired. In one and the same etching graded designs with proportional shades can also be produced.

The practical execution of this style of etching is carried out as follows: The article to be decorated receives the drawing by hand, stamp, or, as the case may be, by transfer. For the material choose an oily lac mixed with a little paint, so as to show on the glass. This done, dust in the powder. When dry, dip the part with the drawing into the fluoric acid, or put the latter on with a brush, and allow to remain a few seconds, or until the powder begins to come off. Then rinse with water. The greasy substance need not be removed, as the fluoric acid absorbs it.

## The United States as a Wheat Country.

A little over thirty years ago the *Springfield Republican* notes that grain was imported to this country from the Black Sea. During the crop year on which the country is just entering, it claims that it is certain that 160,000,000 bushels of wheat will be exported to Europe, and the amount may reach 200,000,000 bushels. The grain is in this country; the only question is one of demand. The demand last year from Europe was for 159,000,000 bushels out of a crop estimated at 420,000,000 bushels. The production this year is larger. It is one-fourth larger in Kansas; in Minnesota the production this year is 40,000,000 bushels, a large advance over last year; the grain fields of Southern Ohio show an unprecedented yield; so do those of Iowa; and in Indiana the crop will, in some cases, pay for the ground on which it stands. The wheat acreage of the country is put at 31,000,000 acres, an increase of one-fifth in two years. The average yield is placed at 12 bushels an acre, and the acreage at 31,000,000 acres, by Alexander Delmar, who wrote to the *Times* in the close of July, after a trip through the wheat fields of the West, ending at Ogden. The statistician of the New York Produce Exchange puts the average yield at from 11 to 12 bushels; other more sanguine estimates carry it up to 13 or 14 bushels an acre. The lowest estimate yet made places the crop at 360,000,000, the largest at 440,000,000, and a crop of 420,000,000 may be reasonably counted upon. This is an increase in ten years of 133,000,000 bushels in the annual wheat production of this country, and an increase nearly equal to the total wheat harvest of twenty years ago.

Out of this year's harvest, reckoning the population in this country at 48,500,000 persons, 194,000,000 bushels will be needed for consumption and 50,000,000 for seed, in all 244,000,000; leaving, at the highest estimate, 196,000,000 for export, to which may be added 20,000,000 bushels left over from last year's crop. Whether the European demand will be equal the amount of surplus wheat in this country is considered by the *Republican* as doubtful. It will unquestionably equal last year's demand, and the value of the breadstuffs exported during the coming year will probably reach $150,000,000, and may rise to a higher figure. The unknown quantity in the wheat supply of the world is Russia. Its harvest has been pronounced far under the average for weeks past, but recent advices tell a different story. At best, however, nothing more than an average surplus for export is to be expected, not over 50,000,000 bushels; and if this is supplemented by the usual European import, 20,000,000 bushels from Roumania, and 5,000,000 from Canada and Australia, the total wheat supply which Europe is likely to receive from points outside of this country may be placed at 75,000,000. The current deficiency in Europe is placed at from 225,000,000 to 275,000,000 bushels.

The demand in England is clearly known. It will amount to about 110,000,000 bushels. The demand in France can be less accurately estimated. All Northern Africa is in a state of famine, or is producing barely enough for its own supply, leaving nothing for export. This cuts off one French source of supply in Algeria. The crops in Northern Italy have failed, and Italy is importing grain already, instead of exporting it, which closes another region from which France obtains grain. The potato crop in Northern France has generally failed, and the local food supply all over the republic is deficient. It is a low estimate, then, which places the French demand for wheat at 100,000,000 bushels. The rest of Europe will probably need 75,000,000 more, but may need less.

The food supply of a continent is not a thing to be easily reduced to figures. Moderate estimates, however, place the demand at a larger figure than the amount of the probable surplus in this country. It will probably all be needed, but our authority is not likely that it will be called for at high prices. This is the present outlook. Very trifling causes may change the existing condition of affairs in favor of high prices. One thing is certain: no crop of wheat ever harvested in this country will be carried to market more cheaply, and none, therefore, will leave a larger margin of profit in the hands of the farmers.

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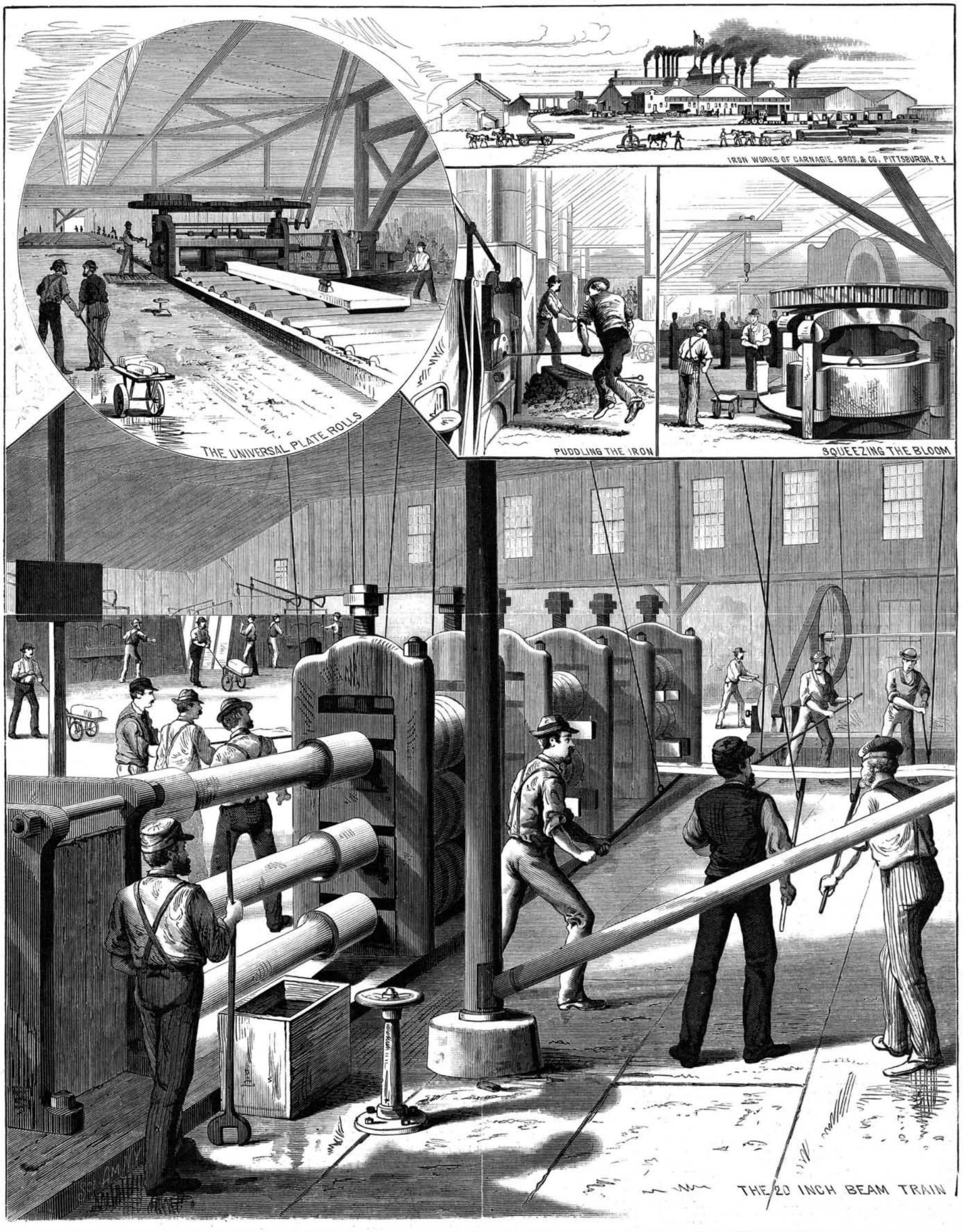


**THE UNION IRON MILLS, CARNEGIE BROTHERS & COMPANY. PITTSBURG, PA.**—[See page 149.]