THE CARNEGIE STEEL WORKS, HOMESTEAD.

Undoubtedly one of the principal reasons for the location of the great steel industry at Homestead, and a leading cause of the rapid development there of such an immense plant, lies in the fact that natural gas is here to be had in such abundance that no other fuel is required. There is here no handling or storage of coal, none of the thousand inconveniences attending the heating of furnaces and forges by such means, but natural gas is used exclusively throughout all the operations. And so great have been found to be the advantages of this method of heating that, should there at any time in the future be a failure in the supply of natural gas, it is expected that those now using it would manufacture gas for use in the furnaces, instead of going back to the direct employment of coal, a practice already adopted to some extent in Europe.

The great steel works of Homestead, general views of which appeared in the SCIENTIFIC AMERICAN of last week, occupy a ground space of 110 acres, on which are a dozen large and substantial buildings, and the production includes nearly every kind of structural ironwork, which is largely of Bessemer steel, up to the making of open hearth nickel-steel armor plates of the largest dimensions. In our illustrations on the first page, Fig. 1 represents the working of the great armor plate rollers, drawn by our artist a few days after the attempt of the mob to stop all operations at the works. The plate being rolled is 6 feet wide, 20 feet long, and 6 inches thick. The rollers, as will be seen, are both horizontal and vertical, the latter being set to the required width for the plate to be produced, and forming a true and uniform edge. The upper and lower rolls are held firmly to their position by other rolls above and below running in contact with them. Armor plate up to 112 inches in width can be produced with these rolls. On each side of the entrance to the rolls is a revolving roller table, the rolls of which are rotated by a system of gearing, and carry the heated plates or ingots upon their upper surface toward the rolls, also receiving the plates after compression. The rolls and the roller table are readily reversible, so that the plate being formed is successively passed back and forth from one side to the other until it has been reduced to the proper thickness. This operation is entirely under the control of a skilled workman upon the platform above, who judges as to the amount of pressure it is best to apply upon each passage of the plate between the rolls, and regulates the pressure by means of the graduated wheel and scale rods shown in Fig. 2. When the plate or ingot is at a pretty high heat, as in going through for the first time, the rolls may be adjusted for a "bite" of as much as three-quarters of an inch or more, this being gradually reduced to a quarter of an inch or less as the metal parts with its heat and becomes more dense. By means of the graduating device, such accuracy of adjustment is possible, for both the vertical and horizontal rolls, that the plates may be rolled to within one-hundredth part of an inch of the required dimensions.

The ingot of steel ready to go to the rolls, shown in Fig. 3, is said to have been the largest ever produced in America. It is the product of several open hearth furnaces united. It is now over four feet thick, but is to be rolled down to 17 inches thick, and 112 inches wide; it weighs 72 tons. The tongs handling it have an opening of 9 feet, and are capable of picking up an ingot weighing 160 tons. This ingot had just been started on its course to be worked up into an armor plate of the largest size, and four days will be required to heat the mass to a rolling heat. Some of the special requirements for the working of such large pieces are shown in the oven-bottom railway car over which the ingot is suspended, the sanded top of the car being really the bottom of the oven when run into the latter to be subjected to the natural gas heat.

Another form of ingot-heating furnace, known as the pit form, is shown in Fig. 5. There are four of these pit furnaces near the rollers. Ingots weighing less than 72 tons each may be heated in any of these furnaces, the furnace being covered with a fire-bricked lid after the ingot has been lowered to place, and the lid being so neatly balanced on its handle that it may be conveniently swung aside as desired.

By means of the powerful hydraulic shears, shown in Fig. 4, the ends of the plates are trimmed with the greatest accuracy. The plates are moved to position for cutting by the shears by the same system of revolving roller table as that shown in Fig. 1, and by these shears steel plates six feet wide and six inches thick are sheared off, apparently with as much ease as one would cut off a slice of bread.

In Fig. 6 is represented the pump house and the landing to the works on the Monongahela River. It was from the windows of this house, after it had been taken possession of by the mob on July 6, that the most deadly fire was kept up on the men aboard the scows, and up this bank from the landing were marched the men who had been obliged to surrender to the mob, the latter inflicting upon their victims a continued series of outrages, compared with which death in open fight would have been far preferable.

Among other machines of immense power at the Homestead works may be mentioned a great press used for straightening or bending to a vessel's form the thickest armor plate made, also an enormous saw, made at the Krupp works, and capable of sawing steel of any thickness as readily as wood is ordinarily sawed, besides gigantic planers for truing the edges of plates, and drills of the largest capacity, etc. A new Bessemer plant is also just completed, which has within a few days turned out its first steel product.

The World's Fair.

It is estimated that the total outlay will be $17,000,000 when the gates are opened, and that it will cost about $3,000,000 to conduct the fair during the six months it is open, and to close and disband the different departments. Of the capital stock of $10,000,000, over $6,000,000 has been subscribed, and more than $5,000,000 paid in; the city of Chicago has appropriated $5,000,000 as a quasi-subscription, all but $500,000 of which has been paid in; the Congressional souvenirs are valued at $3,500,000, making a total of $14,500,000, paid in or subject to call. The actual expenditures thus far amount to $9,000,000, and there is a cash balance on hand of over $1,000,000. But to secure an amount to finish the work, it is now proposed to issue bonds to the extent of $5,000,000, secured by a lien on the gate receipts, and paying six per cent interest; and as there is every indication that these bonds will be readily taken, there need be no further delay in completing all the grand details originally planned, and making the exposition a success from the artistic point of view; $20,000,000 is the estimated amount that will be received from concessions, the gate receipts (already exceeding $75,000), and the sale of buildings and material after the close of the exposition—a sum amply sufficient to pay the running expenses, and to pay both bond and stock holders 100 cents for every dollar invested. Then, in addition to all these millions which are being expended by the exposition proper, there will be from $8,000,000 to $10,000,000 expended by various legislatures, States, associations, and foreign governments. In other words, when the gates are thrown open the visitors will derive the benefits of an exposition costing $30,000,000, the educational influence of which will be felt for years to come, adding to the material prosperity of the entire nation and promoting the growth of every art and every industry.

Transportation. — The Illinois Central Railroad, running along the lake front, is now at work elevating its tracks about twenty feet above datum on the main grade from Fifty-first Street to Sixty-seventh Street, and is laying four additional tracks. When these improvements are completed the officials believe they can handle 50,000 passengers an hour at the elevated stations along the World's Fair front. To do this they will use eight tracks, with 24 trains an hour, 10 cars seating 60 people each to a train. The other trunk railway lines will use the "Stub" system at the main stations, of which there are 36 tracks, arranged to hold 36 trains, that can deliver or carry away 40,000 visitors an hour, and should a rush come near the closing hours, there will be sufficient tracks and trains at a sub-station to carry away 15,000 more people. This "Stub" system is intended for convenience in handling country visitors coming in on excursion trains. The street railway lines claim they can deliver 40,000 visitors an hour, the lake steamers 15,000, and the Alley "L" road 20,000. On the State Street and the Cottage Grove Avenue lines 120 trains an hour, each train having three trailers and a grip car, with a seating capacity of 150, and a crowding capacity of 50 more, will be operated at half-minute intervals. Three hundred new cars are being added to these lines. The cross-town lines are also increasing their rolling stock in anticipation of the crowds. Thus the exposition managers are confident that, should occasion demand, they can handle 100,000 visitors an hour from within the city and 50,000 excursionists from out of town.

The Illinois Central Railroad Company is building a new passenger depot, costing over a million dollars, that will extend along the lake front from Park Row to Twelfth Street, with a frontage on Park Row of 220 feet. Arc and incandescent lamps will furnish the illumination, and electric motors the necessary power used within the building, contracts for which have not yet been signed. The unobstructed outlook over Lake Michigan will make the waiting room unequaled in attractiveness, while another feature will be a marble-lined subway, extending the entire width of the station, with marble steps on each side, by means of which any train can be reached without crossing a single track, or climbing over platforms. The Hall signal system is also being installed between Chicago and Kensington; and 50 engines and 500 coaches, estimated to cost over $2,000,000, will be added in time to handle the World's Fair business.

The Buildings.—Several of the buildings are already completed, and the exterior of the majority needs only the finishing touches of the painter. The Machinery Building is not yet roofed in. The Electrical Building is about two-thirds finished, and nearly the entire exterior is ready for the painter, while the names of Wheatstone, Gauss, Jacobi and other noted workers in the science of electricity appear prominently in white letters nearly a foot in height. The Transportation Building is practically finished, while the exterior of the Manufacturers' and Liberal Arts Building, with its 44 acres of floor space, in which 300,000 people could be seated, is fast approaching completion. The first of the bonded warehouses has been opened as Warehouse A, and several carloads of exhibits are stored away to await the final arrangement. Heretofore these exhibits have been placed in the various freight houses in the city, but hereafter the railway lines will deliver shipments so marked direct to the exposition warehouse. Along the lake front, that ever-changing, horizon-bounded expanse of blue and green that will gladden the heart of our foreign and inland visitors, is a stretch of a mile and a half of graded, curbed, and paved roadway and wide promenade, embanked from the water's edge with a sloping wall of granite blocks. The long pier, extending 2,500 feet out into the lake, is well under way, and will afford ample landing room for passengers brought by lake craft. The lagoons and waterways are assuming artistic shape, reeds and other aquatic plants being placed at the water's edge, while the rich deposit of black earth is fast being covered by the soft green raiment springing up wherever its color and texture will beautify the scene. Referring to the spectacular and fantastic effects to be produced in these lagoons with the aid of electricity, a writer states that "these waterways will literally sparkle at night with tiny colored lights in unique and fantastic designs. Vari-colored lamps will glimmer in the dim green depths of the lagoons.

"Hidden and buried among flowers and translucent water plants, they will appear like veritable *ignis fatui*, or, as skimming over the surface of the water in electric launches, like giant submarine water flies. Great sea serpents, dragons, and sea nymphs will peer out of the depths of the water and cast horrible but harmless looks at the happy thousands who may glide over the rippling bosom of the world's fair waterways. Expensive designs for this feature of the electrical display will be brought from Europe at a great expense. They will consist of Chinese dragons, winged horses, sea monsters, and all the horrors of land, sea, and air that the imagination of man has in the course of centuries given birth to."

At the dedication ceremonies in October the visitors will be treated to a brilliant spectacular display entitled the Progress of the Centuries, and among the twenty-four floats will be one representing "The Genius of Invention," application of steam, etc., and one representing "Electricity." Sixty 6,000 c. p. search lights will illumine their course through the most picturesque portion of the lagoons, and as these stately barges average 50 feet in length and 30 feet in height, it is expected that a scene of unusual splendor will result. The float representing Electricity is thus described by the designer: "This float will need no search lights to reveal its beauties. Indeed, as it approaches, these lights will be darkened so that it may the more perfectly reveal its own glory. The golden barge is of capacious form. Within it seems to be filled with clouds supporting a huge sphere representing the world. This globe is banded in all directions with thousands of incandescent lamps of varying color, incessantly flashing, now green, now blue, now crimson, a hundred tints. Upon it stands an heroic figure of the Genius of Electricity, bearing aloft a brilliant electric lamp. On the high gilt prow stands Franklin with his kite. By ingenious appliances real lightning flashes are made to flash about his kite. On elevated platforms on either side of the great globe are seen Morse and Edison with their discoveries. Far forward sits a female figure representing Europe, and far behind another representing America. To the latter little winged figures are bringing messages. Her fingers rest upon a telegraphic key. Europe receives the message and reads it from a tape, while other winged figures with trumpets proclaim it to the world. This barge will be provided with powerful dynamos to produce the marvelous light effects."

Dedication Ceremonies.—By an act of Congress and proclamation of the President, Friday, October 21, will be a national holiday, and special exercises will be held in every one of the 170 schools in Chicago on Thursday, October 20. No charge will be made for admission to the fair while the dedicatory ceremonies are taking place on Friday. On Thursday and on Friday after 5 P.M. an admission of 50 cents will be charged, as the fireworks and floats will be of such magnitude and such brilliancy and the expenditure will have been so great that the exposition management has decided to charge for the enjoyment of these entertainments. The fireworks will be the most elaborate ever evolved, and in many cases the bombs and display pieces will be fired by electricity.—*Electrical World.*

YALE University had its beginning at Saybrook, Conn., in 1700, and removed to New Haven in 1716.