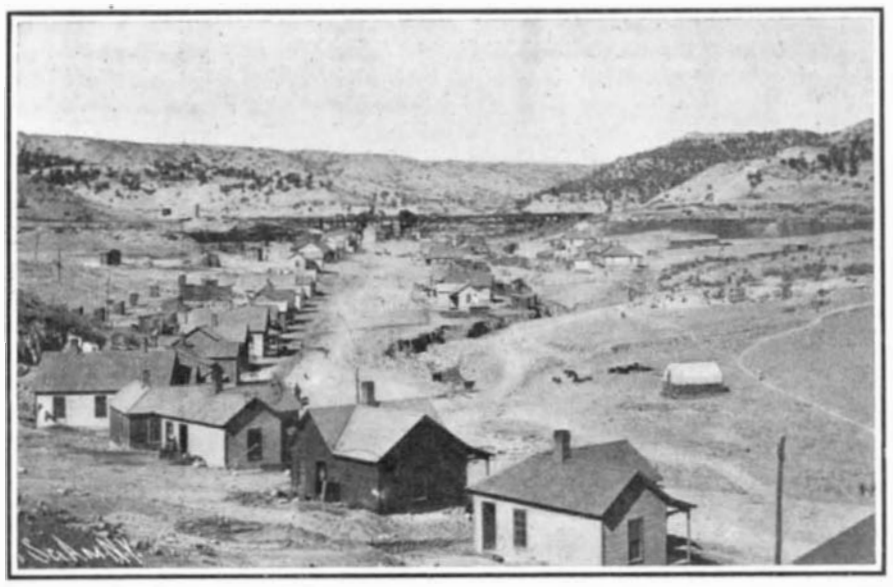
THE MINNEQUA WORKS OF THE COLORADO FUEL AND IRON COMPANY.

BY LAWRENCE LEWIS.

Ten per cent of Colorado's population, it has been estimated, is dependent upon wages earned by employees of the Colorado Fuel and Iron Company, which is engaged in the mining of iron ore and coal, together with the production of coke and all sorts of iron and steel products, although the mining of precious metals is generally supposed completely to overshadow all other industries in that State.



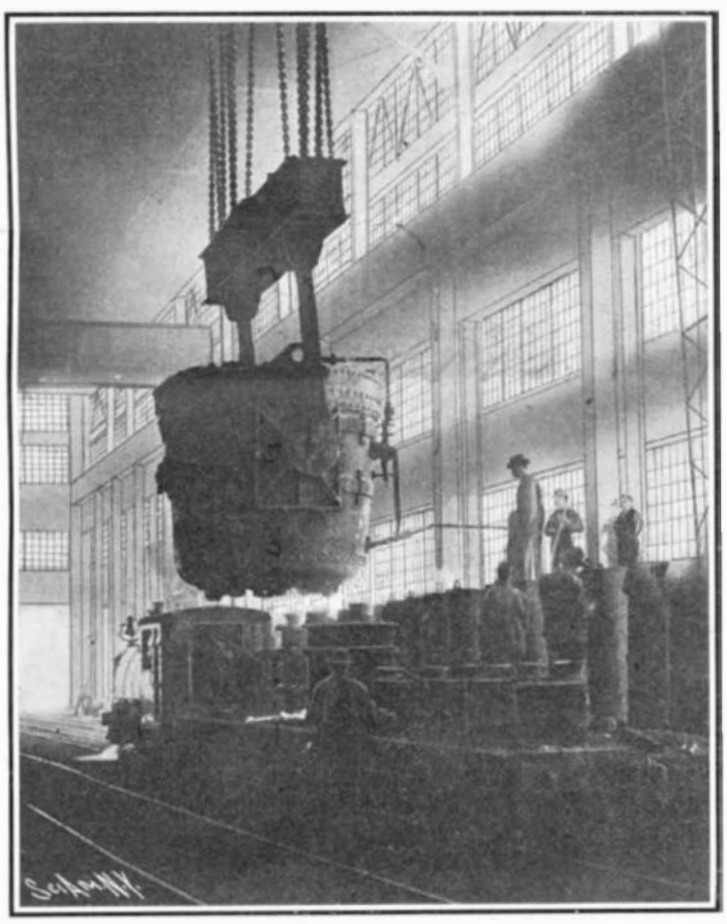
Pimero, Colorado : the Largest Coal Camp of the Colorado Fuel and Iron Company.

In 1891 the Colorado Fuel and Iron Company was represented by a small and unimportant steel plant at Pueblo, worth about $3,000,000, the chief product of which was steel rails that only partly supplied the requirements of the local market. The phenomenal growth of the plants is shown by the fact that at present the Minnequa Works of the Colorado Fuel and Iron Company is one of the largest iron and steel plants of America, representing the investment of over twenty-five millions of dollars, employing between four thousand and five thousand men, and producing a wide variety of products.

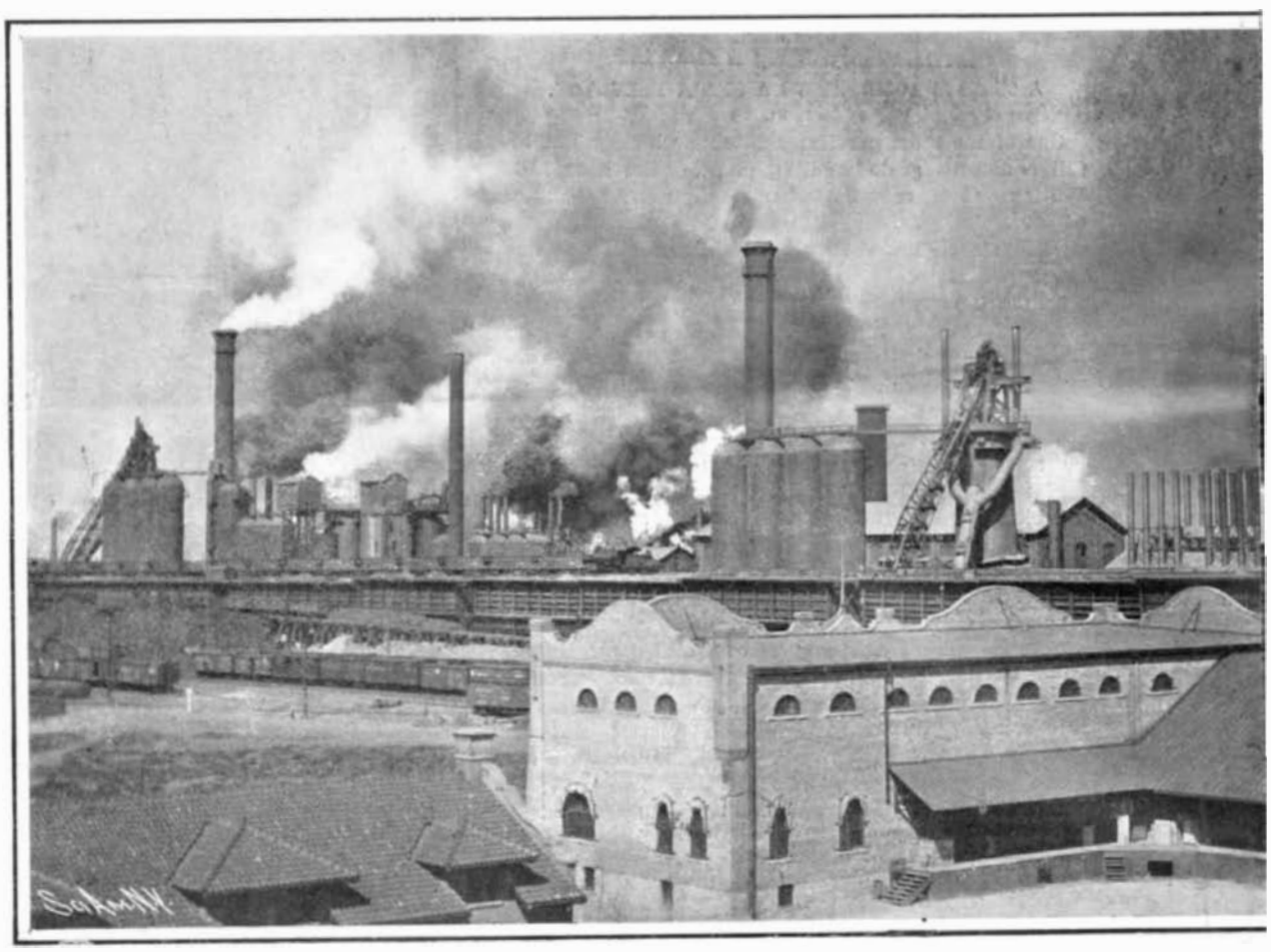
The history of the steel plant at Pueblo is that of the iron and steel industry west of Chicago. The Colorado Coal and Iron Company built a single small blast furnace and began to "make" pig iron during September, 1881. The first Bessemer steel was made in the small converter the following April. A puddle mill, cut-nail mill, bolt mill, merchant mill, and rail mill—all of small capacity—were soon added, and in 1889 a second small blast furnace. Ore came from small iron mines at Orient, the fuel from a few small coal mines and banks of coke ovens in "the southern field" near Trinidad and in Gunnison County on "the western slope." The extensive development of the Pueblo plant and of the iron and fuel industry in the West did not, however, begin until after August, 1892, when the capitalists at the head of the Colorado Fuel Company, the Grand River Coal and Coke Company, and the Huerfano Land Association took charge of the iron works. October 21, 1892, a merger of these last-named companies and of the Colorado Coal and Iron Company was effected under the name of "The Colorado Fuel and Iron Company." The fuel properties were first extensively developed, and upon the revival of business following the depression of 1893, the steel plant was improved and slightly enlarged. Rapid enlargements did not begin, however, until 1900, since which time the original departments have been increased several times in size and almost completely rebuilt and many new mills have been added. The capital stock was increased in October, 1904, from $40,000,000 to $46,200,000, to provide among other things for improvements made shortly thereafter at the Minnequa Works where now there is being spent in addition some four million dollars. A tract a mile long and half a mile wide is now covered by mills and trackage of the Minnequa Works, and an even larger area—including sites for proposed new mills and ground used for storage—is surrounded by the "mill fence." The plant now in operation includes two old, but recently rebuilt, and three larger blast furnaces erected since 1900, with a fourth under construction. Each of the larger furnaces is 20 feet in diameter by 95, 90, and 85 feet in height respectively, with an average daily capacity of 400 tons. The Bessemer steel department is equipped with two 15-ton vessels; two 300-ton molten metal storage tanks, which are served by two 50-ton electric traveling cranes; three 10-foot iron cupolas; three 7-foot spiegel cupolas; two Aiken duplex hydraulic ingot strippers.

Steam Shovel Loading Ore from Open

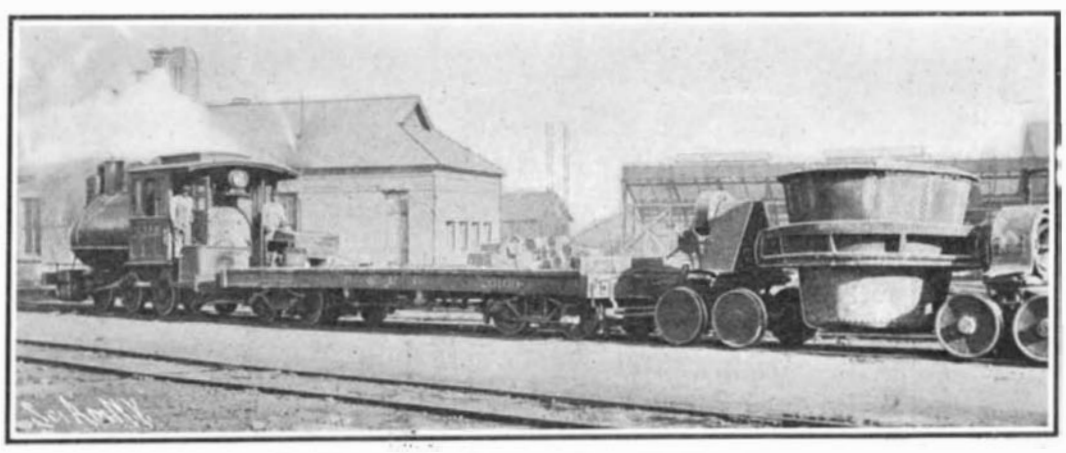
The open-hearth steel department consists at present of six stationary basic furnaces, each of fifty tons capacity, 60 feet 6 inches by 17 feet in size, in addition to which six additional basic furnaces and a 300-ton molten metal storage tank are now being added. The new main building will be 1,005 x 200 feet. Ingot stripping is performed by two Aiken duplex hydraulic strippers. Gas is supplied by forty-eight large-size water-seal Duff producers. The 2-high 40-inch blooming mill in which the O. H. ingots are reduced to 4-inch billets, is driven by a 55 x 60-inch



Filling Molds from Bottom of 50-ton Ladle at Open-Hearth Steel Plant.



General View of a Part of th



Pot Car for Carrying Slag from the Blast Furnaces.

Erecting One of the Blowing Engine Furnac

THE MINNEQUA WORKS OF THE CO

double reversing engine coupled direct to the mill. Two shears, one hydraulic and one driven by a vertical engine, cut the product. The five pit-heating furnaces for this blooming mill are served by two 5-ton automatic charging and drawing cranes. A roller conveyor about 900 feet long distributes the blooms and billets to the rod mill and storage yard.

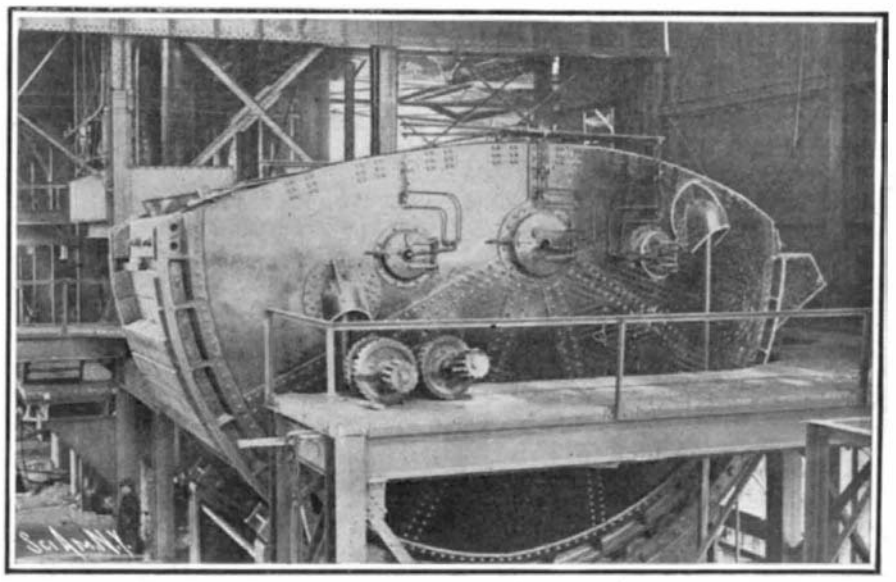
Cut to Cars at Sunrise Iron Mines.

The roll trains of the rail-mill, which is practically all new, are covered by a steel main building 55 feet x 580 feet. The hot-bed building is 121 feet 6 inches x 174 feet. The building covering the finishing department is 774 feet x 60 feet; that covering the soaking pits, 89 feet x 166 feet. The ingots, when taken from the soaking pits by two electric automatic charging and drawing cranes, are deposited in an automatic tilting car which conveys them to the blooming table. Gas used in this department is supplied by twelve Duff producers.

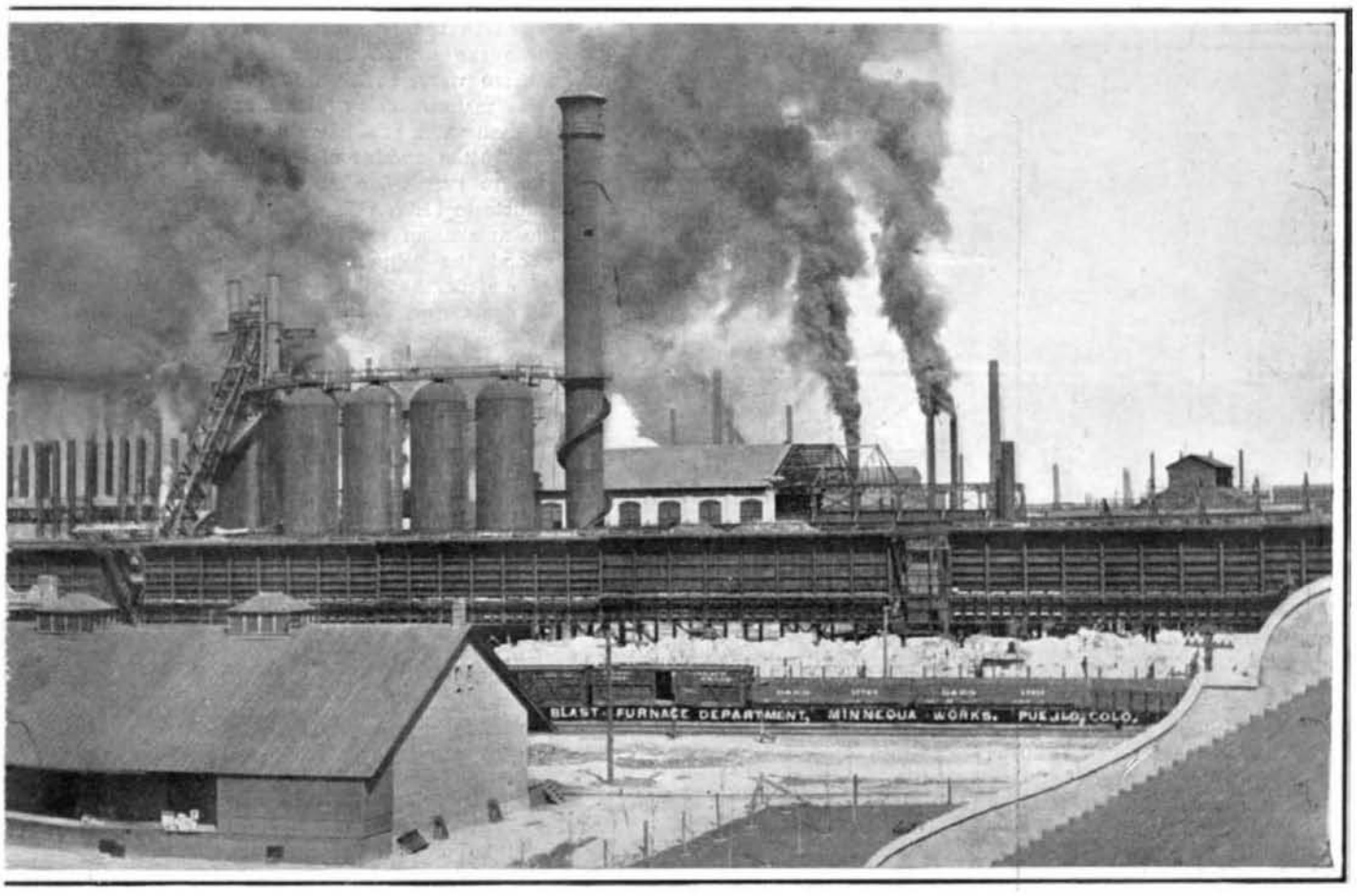
The double Garrett rod mill is practically of the standard type, the only difference being the location of some of the rolls. The 16-inch continuous mill and the 14-inch train are driven by a 40 and 72 x 60 inch tandem compound engine. The three 10-inch trains of each mill are driven by a 38 and 70 x 48 inch and a 27 and 46 x 42 inch cross compound engine. Four Laughlin furnaces heat the billets in 6-foot lengths. All the engines and rolls are covered by electric overhead traveling cranes. The main building of the rod mill is 137 feet by 534 feet. The furnace building is 90 by 126 feet.

The wire mill is one of the largest and most complete in America, being thoroughly equipped in every detail to manufacture all sorts, shapes, and sizes of wire and wire product. There are 360 blocks in the wire-drawing department; 280 machines in the mail department, with an approximate total capacity of 6,000 kegs in twenty-four hours; 81 machines in the barb-wire department, with an approximate total capacity of 150 tons in twenty-four hours. The wire mill is fully equipped with cleaning, annealing, painting, and dipping departments, repair shops, independent electric plant, rumbling department, and other accessories. For supplying the wire mill and other departments with kegs, the company has a cooperage shop with a capacity of 5,000 to 8,000 kegs every ten hours. Staves and headings come from sawmills, etc., operated by the company on its timber lands near Little Rock, Ark.

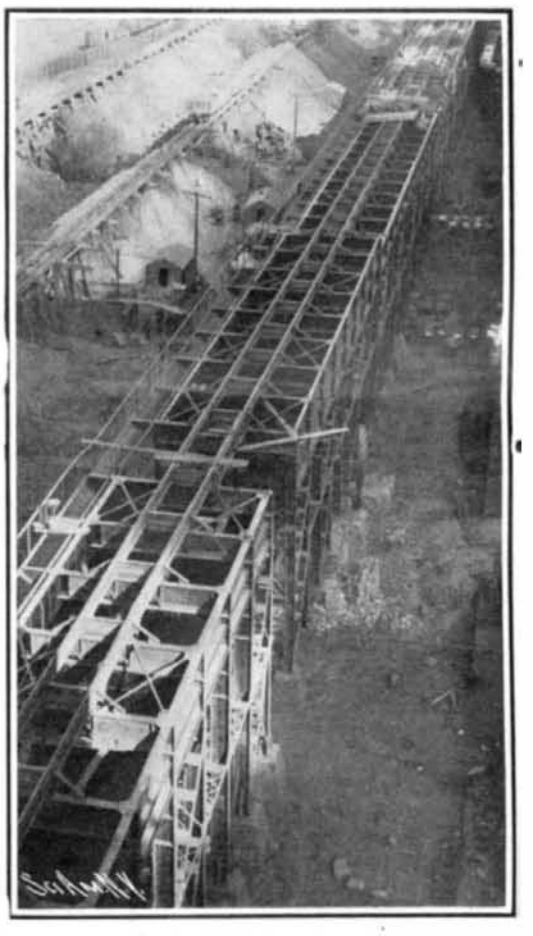
In addition to the new mills described above, the Minnequa Works includes a merchant iron department comprising 9, 12, and 20-inch mills for miscellaneous shapes and comparatively light tonnage; spike, bolt, and nut factories complete in all details; iron, steel, and brass foundry; cast-iron pipe foundry; complete electric power plant for supplying all departments except the wire mill. The approximate capacity of the several departments now in operation is as follows: Blast furnaces, 2,000 tons daily; Bessemer steel department, 2,000 tons daily; open-hearth steel department, 1,500 tons daily; rail mill, 1,500 tons daily; 40-inch blooming mill, 1,200 to 2,000 tons daily; rod mills, 600 tons daily; wire mill, 700 tons each twenty-four hours; 9, 12, and 20-inch mills, from 200 tons to 250 tons daily, varying with size of shapes; cast-iron pipe foundry, about 40 tons daily; bolt and nut factory, 500 tons per month; spike factory, 80 tons per day.



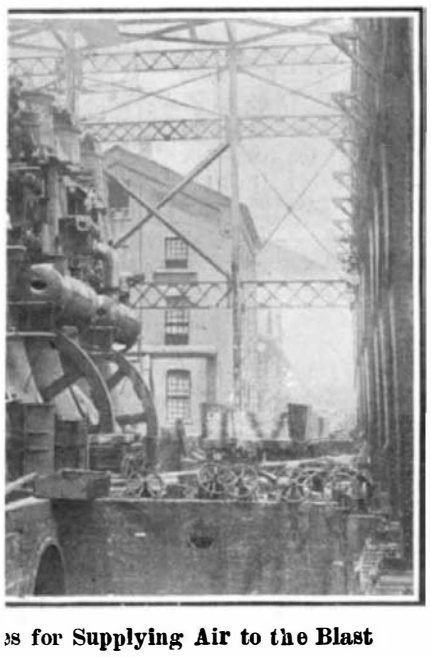
Metal Storage Reservoir, Into Which Molten Metal is Poured from the Pot Cars.



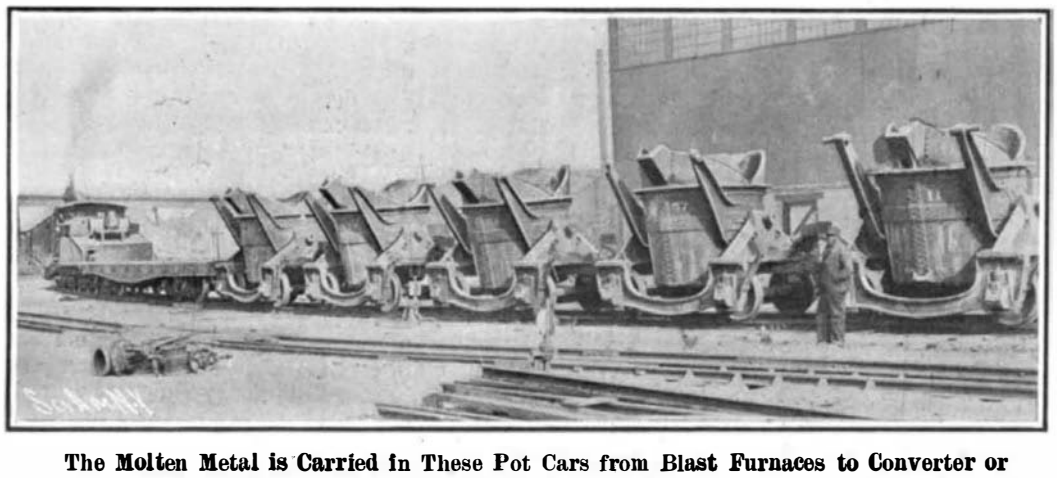
e Blast Furnaces of the Minnequa Works.



Bird's Eye View of Coke, Ore, and Limestone Bins.



s for Supplying Air to the Blast ces.



The Molten Metal is Carried in These Pot Cars from Blast Furnaces to Converter or Open-Hearth Furnaces.

During the year ending June 30, 1905, the Colorado Fuel and Iron Company produced 4,504,752.65 tons (2,000 pounds) of coal; 948,553.50 tons of coke; 483,570.86 tons of iron ore; 213,007.36 tons of limestone; and 1,444,177.19 tons of iron and steel and iron and steel products.

A perfectly reliable water supply is as essential to the operations of an iron and steel plant as is ore or coke. The Colorado Fuel and Iron Company has therefore taken the precaution to fortify itself well against a failure of water. It has completed reservoirs Nos. 1, 2, and 3 near Pueblo, having a total storage capacity of 3,000,000,000 gallons, besides two additional "sugar-loaf reservoirs" near Leadville, at the sources of the Arkansas River, which brings the total storage capacity up to 10,000,000,000 gallons.

Like the original Carnegie Steel Company, the Colorado Fuel and Iron Company owns or controls sources for all its raw materials including

LORADO FUEL AND IRON COMPANY.

iron lands in Colorado, Wyoming, New Mexico, and Utah; some 600 square miles of the finest coal—anthracite as well as coking and non-coking bituminous—one tract being 250,000 acres in extent, all easily accessible from the steel plant; limestone quarries, manganese mines, etc. It has 39 coal mines and 3,500 coke ovens—a majority of them being of the "beehive" type, for there is no market for by-products sufficient to warrant the use of by-product ovens, which are comparatively very expensive, and against which there is prejudice because of the contention of some experts that the quality of coke produced from western coal in by-product ovens is inferior. Including those not yet thoroughly opened, the Colorado Fuel and Iron Company has in various parts of Colorado, Utah, New Mexico, and Wyoming, 65 properties scattered over an area of 260,000 square miles.

Fundamental differences exist between the problems of development in the Rocky Mountain region and those confronting iron and fuel corporations in the middle West. In the latter region, when development of the coal and iron resources was begun on a large scale, means of transportation were to a great extent already provided, or by the construction of short spurs of railroad and the utilization of natural waterways, raw materials could be transported to the steel works and the market at comparatively small cost and without great preliminary expenditure. Again, in the comparatively thickly-populated middle West, the securing of labor near at hand is possible and, to a great extent, places for workmen to live are already provided near the seats of industry. In the Rocky Mountain region, the pioneers of the iron and fuel industry found no such ready-made conditions. In the field which the Colorado Fuel and Iron Company operates there are no navigable lakes or rivers. To reach new properties railroads had to be induced to extend or the company had to build its own lines. It now operates 178 miles of railroad, and has supplemented existing lines of electric communication by 1,835 miles of telegraph. In fact, in a majority of cases, where the "prospects" have been in the midst of the desert or far off in "the hills," the company has had, in addition to the task of opening mines and providing means of transportation, those of building towns, of providing people to live in them, and of supplying water, food, and merchandise. In short, besides the ordinary problems of coal and iron mining, coke and steel making, the Colorado Fuel and Iron Company has had to solve those of general development.

Some 17,000 men, representing between twenty and thirty nationalities, are now employed by this corporation. Between 4,000 and 5,000 are employed at the steel plant.

The Colorado Fuel and Iron Company's principal source of iron ore is the Sunrise group of mines in Laramie County, southern Wyoming, 360 miles from the steel plant on the Colorado & Southern and the Burlington and Missouri River railways. The open-cut system of mining with steam shovels, which was the principal method employed earlier in the history of this property, is now largely replaced by the "milling" system of underground mining, the product being handled through shafts and tunnels. There are also smaller iron mines at Orient, Colorado, and Fierro, N. M. In the open-cut work the ore is loaded directly from the steam shovel into standard-gage railroad cars. In the underground work the ore is dumped from skips and mine cars into bins, from which it is drawn off into the automatic dump cars, in which it is carried to the steel works and dropped into the ore bins at the furnaces.

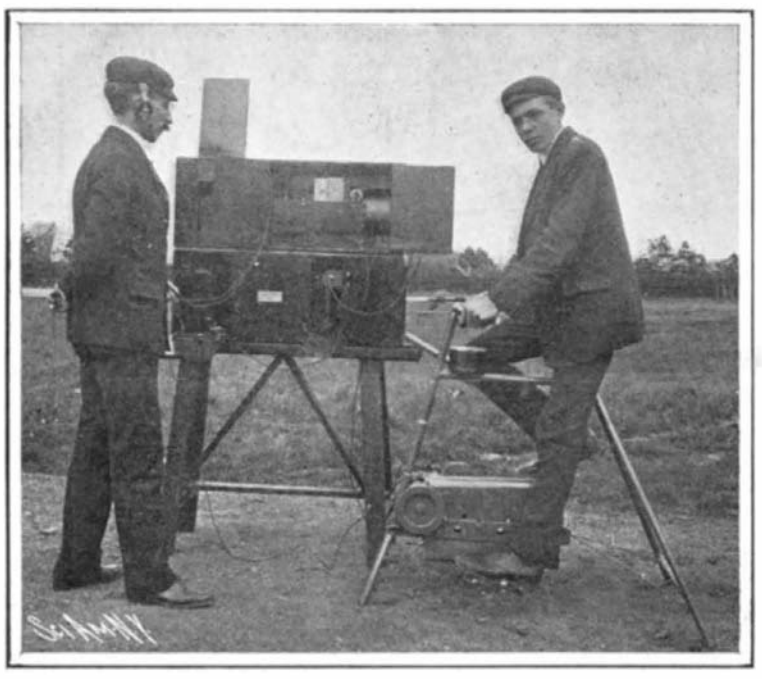
On a track beneath these bins run electric trolley "scale cars," into which are drawn from the bins, in proper proportions by weight, the coke, limestone, and ore to make up the "charge" for the blast furnaces. The contents of the scale cars are in turn automatically dumped into the "skip cars," which run up a "bridge" on the side of each blast furnace, and automatically drop their contents into the "upper bell"—a cone-shaped receptacle at the top of the blast furnace. Then this upper bell is lowered, allowing the charge to drop upon the lower bell, whereupon the upper bell is again raised. Next the lower bell is lowered, and the charge drops into the fiery interior of the furnace. The slag and molten iron are drawn off into immense pot cars.

The slag is hauled over a short railroad to one of the reservoirs three miles south of the plant, where it is dumped while still molten upon the sides and bottom. By this ingenious arrangement the problem of slag disposition is solved, and the seepage from the reservoirs reduced.

The molten iron is hauled either to the pig-casting machines or to the metal storage reservoirs at the open-hearth and Bessemer steel departments where it is kept in a molten state and drawn off as required in the furnaces or the "converter." After the impurities in the form of silicon, carbon, manganese, sulphur, and phosphorus have been to a greater or lesser extent eliminated by these processes, the molten steel is drawn off and cast into ingots. After these are stripped from their molds they are taken either to the 40-inch blooming mill, where they are reduced to 4-inch billets and then worked into the other highly differential products, or else are taken to the rail mill and rolled into railroad rails. Although at the Minnequa Works the Bessemer process will always be a very important feature, it is likely, owing to the chemical constituents in the ore found in the new deposits of the company now being opened, that the open-hearth process will become more and more important.

Throughout all processes of mining and steel making the company uses the most improved labor-saving machinery. Indeed, from the time the ore lies in the earth until it is put into its final form as finished iron or steel, it is in many cases not handled over once or twice by manual labor, but altogether by automatic machinery.

That the Colorado Fuel and Iron Company is one of the few steel companies not a constituent part of the United States Steel Corporation, and that it operates the only large steel plant west of the Chicago district, are features that have important bearings upon the company's place in the iron trade. It is, moreover, absolutely independent of competitors, in that it owns sources for all its raw materials. In the days of the "old" management, the company suffered much from unfavorable freight rates and discriminations, and made several appeals to the Interstate Commerce Commission with more or, usually, less success. Arrangements undoubtedly will be made eventually to send Colorado steel products by way of the Gould system to San Francisco, and from thence by sea to the Orient, and by the direct railroad route to Galveston, and thence by water to all South American points. With the completion of the Panama Canal this natural advantage will be increased, for then this Colorado steel company will have two tidewater outlets to the Orient—south and west.



LODGE-MUIRHEAD PORTABLE WIRELESS TELEGRAPH PLANT FOR MILITARY USE. THE CURRENT IS GENERATED BY A SMALL CONTINUOUS-CURRENT MOTOR DRIVEN FROM A STATIONARY BICYCLE.

The Department of Anthropology of the University of California has just been enriched by the acquisition of the first skeletons of Pomo Indians possessed by any museum or institution. An expedition sent by the department to Mendocino County, California, has returned with five complete skeletons, several parts of skeletons, many beads and other objects buried with the dead. These will be of great value in determining the qualities and characteristics of the Pomos and their relationships with other tribes of California Indians.

The Pomos practised cremation, which explains the almost complete lack of remains of them. They were of middle height, with round, heavy skulls. Many living Pomos are to be measured and photographed for purposes of comparison with the skeletons, the bones of which are now being measured. When comparisons have been made with the remains of other Indian tribes, the results will be published by the University of California. It is expected that our knowledge of the origin, connections, and wanderings of the Indian tribes will be considerably increased by this determination of their characteristics, and that much information that is not supplied by a study of their language and customs will be obtained.

THE LODGE-MUIRHEAD PORTABLE WIRELESS TELEGRAPH PLANT FOR MILITARY PURPOSES.

An interesting and compact wireless telegraphic plant of the portable type has been constructed by Sir Oliver Lodge and Dr. Alexander Muirhead, the system employed being that evolved jointly by them. The installation, which is self-contained, is especially intended for military operations, and for facilitating transport particularly over difficult country it has been made as compact and light as possible, so that it can be easily stowed away for carriage by mule. It is of sufficient capacity to enable communication to be established over distances up to 50 miles across land, or 150 miles over sea.

The antennæ are carried by bamboo poles, of short, convenient lengths for transport, which poles, when fitted together, form a somewhat cubical structure 40 feet in height. No earth capacity is necessitated and indeed any such connection must be avoided when it is desired to insure the greatest degree of efficiency over long distances.

The transmitting and receiving installations are carried in a small cabinet and occupy the minimum of space. When in use this cabinet is supported upon a folding trestle. The necessary current is generated by means of a small continuous-current dynamo carried in a frame resembling that of a bicycle, the power being supplied by bicycle pedal action, as shown in the accompanying illustration, with the electric valve system devised by Sir Oliver Lodge to accumulate the impulses. For receiving messages the Lodge vibrating needlepoint-oil-mercury coherer with telephone receiver is fitted.

Decrease in Use of Lightning Conductors.

It seems probable that there has been a decided falling off in the use of lightning conductors within the last thirty years. According to the United States census statistics, there were, in 1860, twenty establishments manufacturing lightning rods, which turned out a product valued at $182,750. In 1870 the number of establishments had risen to twenty-five and the value of the products to $1,374,631. In the next decade the number of establishments fell to twenty and the value of the product to $801,192, and finally in 1890 the number of establishments rose to twenty-two, but the value of the product diminished to $483,296. At the census of 1900 the classification in vogue from 1860 to 1890 was abandoned and lightning rods were tabulated in the general classification "Foundry and Machine Shop Products." There are no means of determining absolutely whether the large decrease in the value of the manufactured product from 1870 to 1890 marks a decline in the use of lightning conductors; certain it is, however, that the "lightning rod man" is not so much in evidence as he was in the early seventies.

In large cities the use of lightning rods is not imperative owing to the prevalence of modern steel structures and in general buildings with metal roofs. For buildings that stand isolated in the open country the prudent course would be to install thereon a system of protection from lightning. The extent to which the building should be protected and naturally the expense of installation should bear some definite relation to the value of the building. If the building is insured against loss by fire or lightning, it would not seem advisable to go to the additional expense of erecting lightning rods. In any event the final decision must be reached by the owner of the building. In arriving at his decision he should be guided by the fact that, while absolute security from damage by lightning is attainable only with great difficulty and considerable expense, a reasonable degree of protection can be secured by very simple means, provided the system of protection be devised and erected by a thoroughly competent person.—From a bulletin issued by the U. S. Weather Bureau.

Santos-Dumont's Flight.

Santos-Dumont recently succeeded in driving the "Bird of Prey" many yards into the air, and eleven yards through it. He then came to earth, smashing his propeller wheels and frame. There seems to be no doubt that he actually flew. Fortunately, M. Santos-Dumont was unhurt.

Although the Hall American patent for the manufacture of aluminium has expired, the Bradley patent is still in force, and will not expire until 1909. The Bradley patent is of fundamental importance for the manufacture of aluminium, covering, as it does, the use of the current, as well for the purpose of keeping the electrolytic bath in a molten condition as for effecting its decomposition and setting the aluminium free at the cathode.

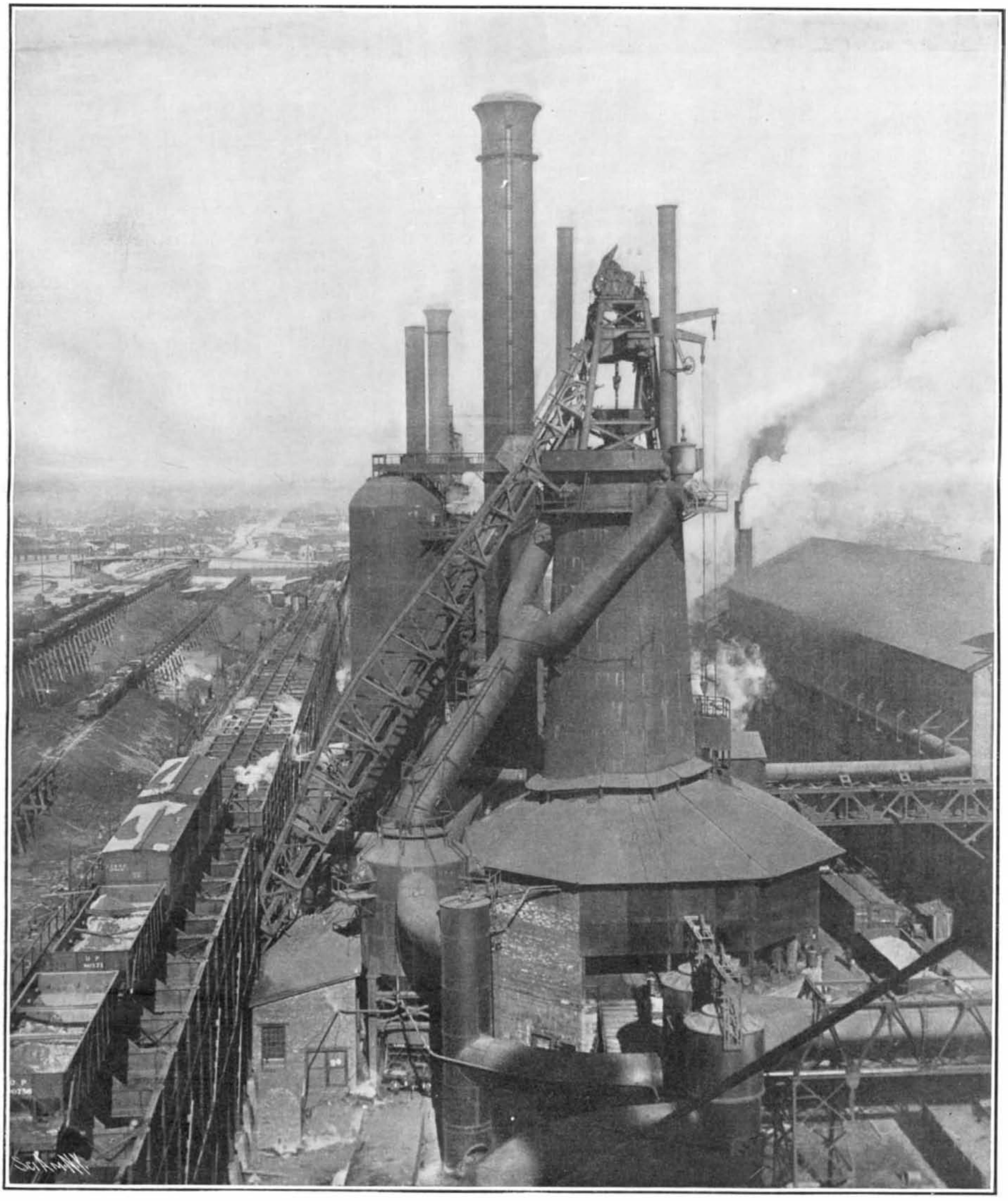
SCIENTIFIC AMERICAN

[Entered at the Post Office of New York. N. Y., as Second Class Matter. Copyright, 1906, by Munn & Co.]

Vol. XCV.—No. 12.
ESTABLISHED 1845.

NEW YORK, SEPTEMBER 22, 1906.

[10 CENTS A COPY
$3.00 A YEAR.



View of Complete Blast Furnace as Seen from the Charging Platform of Adjoining Furnace.

THE MINNEQUA WORKS OF THE COLORADO FUEL AND IRON COMPANY.—[See page 214.]