SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LIV.--No. 13.] [NEW SERIES.]

NEW YORK, MARCH 27, 1886.

[$3.20 per Annum. [POSTAGE PREPAID.]

THE CLAPP-GRIFFITHS STEEL PROCESS.

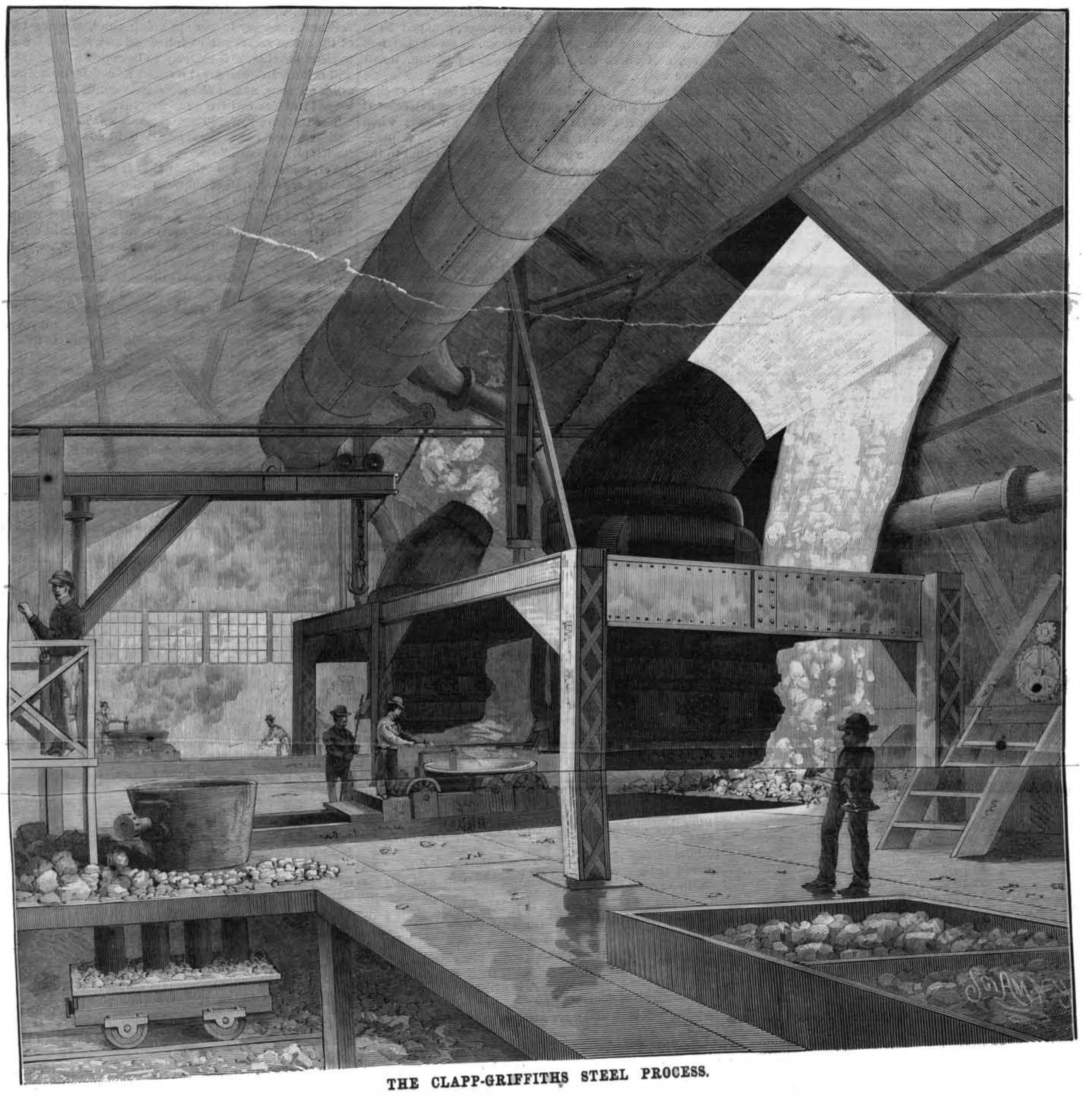
The metallurgy of iron has for several decades past attracted the closest attention of the chemists of both Europe and America. It has become, beyond question, the chief industry of the century, and therefore worthy of their best study. Each of the numerous departments of iron working has claimed its special investigators. In the reduction of the ores to the crude pig metal, the improvements have been marvelous. The clumsy stone furnaces of twenty and thirty years ago, with their weekly product of forty to a hundred tons, have given place to the graceful shafts of iron and fire-brick, which now produce as much as three hundred and twenty-five tons of pig metal in twenty-four hours. In the subsequent transformations which the crude metal undergoes, the changes have been no less remarkable. The introduction of the Bessemer process in this country, and the revolution effected by the cheap steel thus made possible, are within the memory of many of our readers.

This metallurgical activity has brought the introduction of so many improvements and modifications that, perfect as the art of the iron worker has now become, new changes must be expected at every turn. It is our present purpose to illustrate one of these improvements—the process of Messrs. Clapp & Griffiths—as it has now passed from the experimental to the practical stage, and its rapid introduction among American iron works indicates that it is destined to become an important factor in the metallurgy of coming years.

But it will, perhaps, be advisable to first point out the condition of the industry at the time of the introduction of this new process, and glance at the field which it is probably to occupy.

At present a strong tendency exists to substitute steel for wrought iron wherever possible. The change is not the result of any demand on the part of consumers, nor in many cases is it due to any superiority of steel over iron. The cause is even more potent. It is simply because it is easier and cheaper to make steel than iron, and this being the case, the substitution must inevitably follow. Yet this tendency has certain limitations. Crucible and open-hearth steel are still too expensive to be used for aught save the better grade of goods, while the Bessemer product is restricted by the quality of the crude materials it requires and the heavy expense of erecting and operating such a plant. For years the puddling furnace has been used to produce iron, but it has done so at a heavy cost and with a labor the severity of which in time becomes fatal.

(*Continued on page* 196.)



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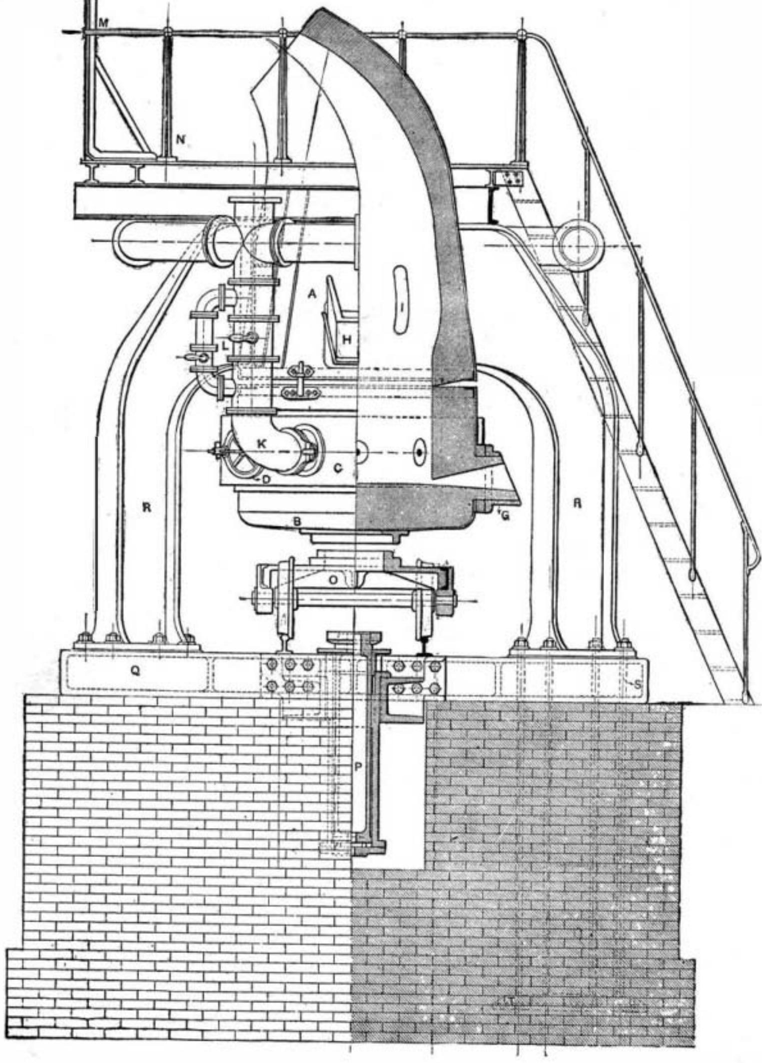
(*Continued from first page.*)

But in spite of all this, the puddling furnace, though so often doomed to extinction, still remains. And it does so for two reasons. In the first place, it is a cheap affair. It can be built at little expense, and can handle a small output, or by easy duplications a very large one. Its mechanical working is, therefore, under easy control. In the second place—and this is the more important reason—the puddling furnace can produce an iron of high grade from indifferent materials. The operation of puddling eliminates phosphorus to a large extent, and it is this feature of the process which, in spite of its other disadvantages, has kept it in vogue. Recognizing these elements, mechanical puddlers, revolving hearths, and similar devices have been brought forward to remedy the existing defects; but while many of them possess considerable merit, they have hardly succeeded in making the system permanently desirable. The demand still remained for a process combining the advantages of an inexpensive plant and an ability to handle cheap grades of pig iron with the easy manipulations and large output of the Bessemer converter.

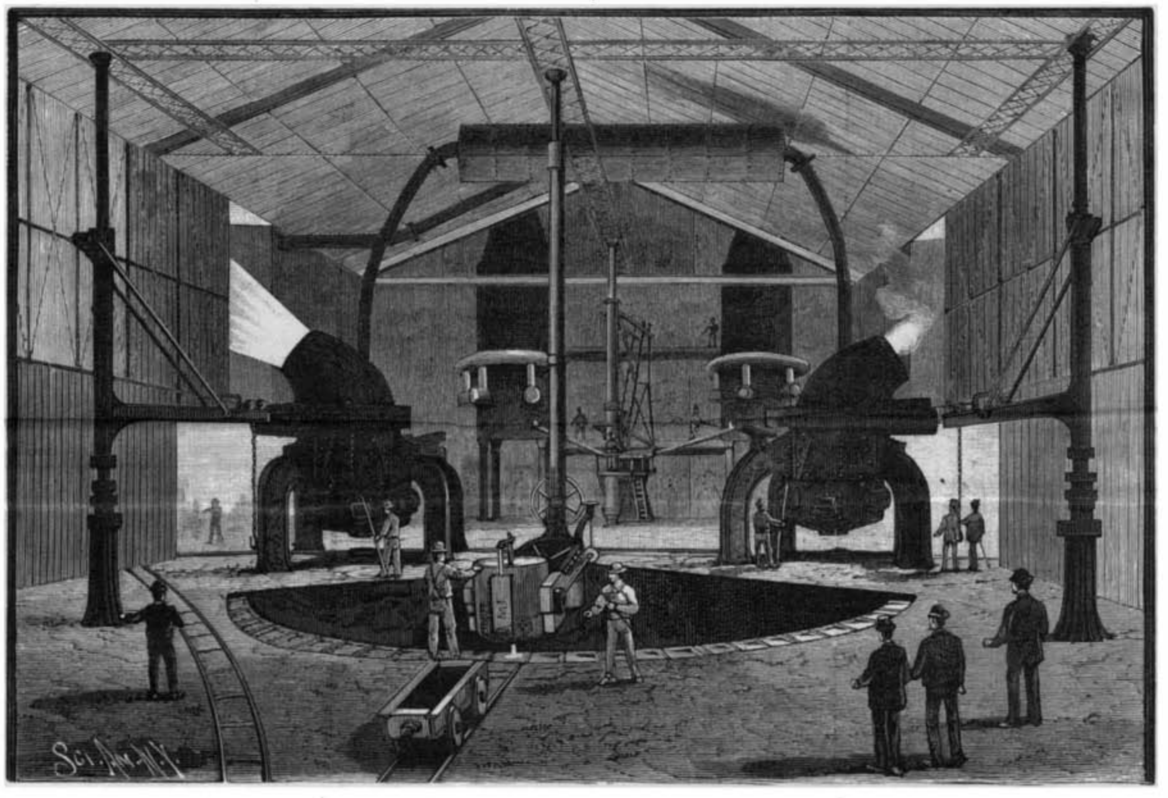
After an experimental run of several months and the practical operations of something more than a year, the Clapp-Griffiths process has so far demonstrated its ability to fulfill these conditions that metallurgists have turned to it as presenting the best answer to this demand which has yet been offered. The Clapp-Griffiths is a pneumatic system, similar in many respects to the Bessemer, and, like it, is an English invention. The principal difference is in the stationary converter, and the tuyeres in the side instead of the bottom. In addition to these features, the Clapp-Griffiths converter has an open slag hole and a charging hole, both in the side, and a tap hole at the bottom. At first sight these differences appear very small, and in one sense retrogressional, for Bessemer's earliest converters were stationary, and were abandoned for the present style of tilting vessels. But when we come to consider the chemistry of the process, it will be seen that these modifications in the construction of the converter are sufficient to so far change the reactions that the product of the new process is distinctive.



SECTION OF CONVERTER AND HYDRAULIC LIFT.

Mr. Griffiths was the engineer in charge of the Gilchrist-Thomas basic process during its experimental stages, while his associate, Dr. Clapp, was a prominent physician in one of the English iron districts. After the consolidation of their interests, the process was submitted to a practical test in Wales. These first plants were small and imperfectly equipped, but the steel they produced had so many admirable qualities that it speedily attracted the attention of American metallurgists.

In the summer of 1883, Messrs. Witherow & Oliver, of Pittsburg, visited Wales, and their personal inspection resulted in the purchase of the American patents. An experimental plant was started in the fall of that year, at the works of Messrs. Oliver Brothers & Phillips. Great difficulty was experienced in finding a suitable lining for the converters, as the fire-clay bricks imported from Stourbridge and Wales burned out almost immediately. Finally, a ganister lining was substituted, with very good results. So many changes, however, became necessary from time to time, more especially in the cranes and other facilities for handling the product, that the plant was not in full practical operation until the spring of 1885.



THE CLAPP-GRIFFITHS CONVERTERS AT POTTSVILLE, PA.

The present plant at Pittsburg consists of two 3-ton converters, and has a capacity of about 125 tons a day. This could be largely increased were the means of handling the ingots with greater facility, at hand. Our first page illustration shows the appearance of these works—the first Clapp-Griffiths plant in America. The pig metal is melted in a cupola furnace, which stands back of the converters, and about 10 feet above the ground level. From this it is tapped into a weighing ladle, which runs on a track alongside the converters. The charging is done through an opening in the side of the converter. The tuyere holes, through which the blast enters, are about 10 inches above the bottom of the converter and 12 inches below the level of the molten iron. At first, only sufficient blast is turned on to keep the metal from entering the tuyeres, but when the converter is fully charged, the blast is allowed to enter the bath under a pressure of six to seven pounds.

The blow lasts about 15 minutes, the general reactions being the same as in the Bessemer converter. First the brown smoke of burning iron is visible at the mouth of the converter. But this is very soon replaced by the brilliant flame caused by the combustion of the carbon in the pig iron. This, after a time, is in turn succeeded by a flame of smaller volume, but more intense heat, the result of the oxidation of the silicon. The end of the reaction is indicated, as in the Bessemer process, by the disappearance of the silicon flame. The metal must be tapped immediately, or the brown smoke of burning iron will again become visible and the metal will be overblown. In the Bessemer process, the steel, being poured instead of tapped, is very apt to suffer a slight oxidation at this stage of the process, because the blast must be kept on until the vessel is horizontal and the molten bath below the level of the tuyere holes. In the Clapp-Griffiths, however, there is less danger of over-oxidation. When the flame shows the decrease immediately preceding the end of the reaction, the blast is almost shut off again and the metal tapped into a ladle. In some forms of the converter, a differential plunger is used to effect this lessening of the blast, but, while generally in use in Great Britain, it is considered of less value in this country. The metal is tapped very quickly, so that only a few seconds elapse before the bath is below the level of the tuyeres and the blast may be turned off. About 1·1 per cent ferro-manganese (76 per cent manganese) is added to the molten iron in the ladle, in order to recarbonize it, and make the product steel.

While the reactions going on in the converter are in general those of the Bessemer process, they differ in degree. There are several points peculiarly characteristic of the Clapp-Griffiths. In the first place, the position of the tuyeres gives an early oxidation of the charge. This is shown in the immediate appearance of the brown smoke of burning iron. It is probable that the almost complete elimination of the silicon, which is characteristic of Clapp-Griffiths metal, is due to this feature of the blow, the oxide of iron formed uniting with the silicon to form a fusible slag. During the blow, limestone is added to furnish a base for the silica. The open slag hole is another distinctive feature of the process. As the metal boils and surges in the converter, a continuous slagging goes on, whereby the greater part of the slag is discharged, instead of being mixed with the metal, as in the Bessemer. These differences in the construction of the converter effect a marked change in the composition of the resulting metal. The well known Bessemer engineer, Captain R. W. Hunt, has made a chemical study of the steel, and his results have attracted wide attention from their unexpected character. The product is a very soft steel, containing only from 0·07 to 0·1 carbon, and the amount of silicon is usually so small as to be undeterminable. The best product is of course made from Bessemer pig, but astonishing results have also been obtained from steel made of cheap, phosphoric pig. Steel containing as much as 0·85 phosphorus gave a tensile strength of over 70,000 pounds, while another carrying 0·55 of this element gave a tensile strength of 79,780 pounds, an elongation of 23·5 per cent, and a reduction of area of 35·5. These qualities appear the more remarkable to us, because phosphorus has always been regarded as the one element above all others to be shunned by the iron master. In this process, however, it is rendered comparatively harmless by the almost total elimination of the silicon, and the low carbon. By careful manipulation, the Bessemer process can produce a steel very low in silicon, but there seems to be little dependence upon the certainty of such a result; but in the Clapp-Griffiths process, in spite of the variations in the composition of the pig iron, the silicon is always eliminated. This is a feature upon which the success of the process largely rests, because it makes it possible to produce a good steel with high phosphorus. The limit to which the phosphorus may be carried with safety has not been determined. In the product of the present works it seldom exceeds 0·3, but Captain Hunt's experiments have shown that a much larger amount can be borne without prejudicing the quality of the heavier products, such as nails, shovels, etc. In introducing this process into America, Messrs. Witherow & Oliver have made a great many improvements, unknown in the original converter. One of the most important of these is the movable bottom, shown in our sectional illustration. When the bottom is burned out, the hydraulic lift directly under it is raised, the bottom removed, and a fresh one put in place, the whole transfer occupying but twelve minutes. Natural gas has proved of great value in allowing a thorough drying of the converter bottoms before being put in place, for upon this depends their length of life. While a few have lasted for 80 and 86 blows, and quite a number for 60, the average life is about 45 blows. The lining of the body of the converter lasts about six months. No salamanders are formed on the sides, as the metal is tapped, in place of being poured. The loss from pig to ingot is about 11 per cent.

The low cost of erecting a Clapp-Griffiths plant is an essential part of the success of the process. It varies, of course, with the locality. Under ordinary circumstances, a two 3-ton converter plant can be put in running order, with all necessary accessories, for from forty-five to sixty thousand dollars. Compared with the hundreds of thousands necessary for the erection of a Bessemer plant, this is a very small sum, and will bring the process within reach of smaller iron works throughout the country. At the present time seven Clapp-Griffiths plants, in addition to the one at Pittsburg, are either in course of construction or have recently been completed. The one at Pottsville, shown in our illustration, has been planned to allow an output of 250 to 300 tons a day. The converters are similar in size and style to those in use at Pittsburg, but the more ample facilities for handling the product will permit a much larger output. At the Oliver Mill, the converters are blown alternately, and are out of blast Saturday afternoon and Sunday. The entire cost from pig iron to ingot steel is here $5 a ton. It was calculated that the cost would be $6 at mills and $4 at blast furnaces where the pig metal could be run directly from the furnace into the converter, and the men formerly employed at the pig bed transferred to the steel department. This, it is thought, will in time largely change the product of our blast furnace plants from pig to steel ingots, dispensing entirely with the puddling process and substituting a soft steel for wrought iron.

At the Pittsburg meeting of the American Institute of Mining Engineers, in the middle of February, the Clapp-Griffiths process was, as at the New York meeting of the year before, one of the chief subjects of discussion. The majority of the metallurgists present were very favorably impressed with what they saw of the operation of the process, and expressed themselves as having great confidence in the important role which it is henceforward to play in American metallurgy. From this verdict a few gentlemen dissented. As the process, however, will soon be in actual operation in at least eight different localities, it will undoubtedly receive extended and careful study, and will be judged from the dispassionate standpoint of whether it is or is not proving a success in the hands of those who have embarked their faith and capital in its practical working. For the present, it is sufficient that the results already obtained encourage a belief in the value of the process and its applicability to the present wants of American iron masters.

Alaska Gold.

A correspondent of the Marquette *Mining Journal* writes glowing reports about the prospects of Alaska as a gold field. He states that the mill on Douglas Island is running to its full capacity, and is turning out bullion at the rate of $100,000 a month, not counting the concentrates, which are rapidly accumulating for the want of sufficient roasters in the chlorination works. The capacity of the mine must not, however, be judged even by the value of both the bullion and concentrates now turned out; it is large enough to supply rock for half a dozen such mills, and the foundations for a second mill of the same size as the one now in operation are already laying. It is estimated that there are at least twenty million tons of quartz above the tunnel level. Concerning the Silver Bay (Fuller) claims, there is nothing new. In the Silver Bay District there are some very rich mines, and all that has been lacking until now has been a reasonable amount of capital to be honestly and judiciously applied in their development. The success of the Douglas Island venture will, it is thought, assure the erection of more stamp mills in Alaska during the next five years than were ever in operation in California and Nevada at one time.

Game Obtained by the Greely Expedition within the Arctic Circle.

In an appendix of Greely's "Three Years of Arctic Service," just published by Messrs. Charles Scribner's Sons, appears the following list of game obtained by the expedition within the Arctic circle in the three years from July, 1881, to June, 1884: One bear, 6 wolves, 32 foxes, 8 ermines, 8 lemmings, 103 musk ox, 57 hares, 35 seals, 84 brent geese, 91 ducks, 702 guillemots, 172 dovekies, 2 ravens, 18 owls, 178 skuas, 12 gulls, 99 ptarmigans, 99 turnstones, 28 knots, 1 sandpiper, 1 sanderling, 21 Arctic terns, 2 gray phalarope, 49 eider ducks, 1 red-throat diver, and 1 salmon. We should have thought the fish caught would have figured for more, especially as one of the illustrations is of Esquimau boys fishing with a line through a hole cut in the ice.

Correspondence.

A Paint to Preserve Ties.

To the Editor of the Scientific American:

I have what I call a "century paint," for posts, railroad ties, etc., made of linseed oil, resin, and charcoal dust. To one gallon of oil put two lb. of resin and enough coal dust to make the mixture the consistency of thick paint. Get the cross ties out of good timber well seasoned. Then dip them about one minute in a large vat of the paint, hot. Wipe off the ties, and they are ready for use. Bore an auger hole in the tie, fill it with the paint, then drive the spike home. I will guarantee *all* the ties treated in this manner to last 20 years. Fifty per cent will last 35 years, and 25 per cent will last 50 years sound. F. M. SHIELDS.

Coopwood, Miss., Jan. 25, 1886.

The Late Mr. Werdermann's Electro Magnetic Drills, Planers, and Lathes.

To the Editor of the Scientific American:

At a late meeting of the Electrical Section of the Franklin Institute, of this city, I made the accompanying statement, the subject matter of which caused some surprise; and as I have never noticed any public mention of it, or of the work having been attempted elsewhere, and as the members of the section could give no solution thereof, I am induced to make the communication to you, for you to make such use of as you may desire, with the view of eliciting from your correspondents, if deemed of sufficient importance, a true solution.

The statement was as follows:

While in London, in 1873–74, on telegraph business, I formed an acquaintance with Mr. Karl S. R. Werdermann (whose late death has recalled some very pleasant hours spent in his company).

On our New Year's Day I received the following note:

"LONDON, 1st January, 1874.

"DEAR MR. CHAPIN:

"I shall be happy to meet you to-morrow (Friday) at 2 o'clock P.M., at your hotel, to go with you to Bermondsey, where you will see some experiments with the magneto electric chucks, which will be, I hope, very interesting to you.

"My best wishes for all your family in the new year. Yours truly,

"R. WERDERMANN."*

The next day, in company with Mr. W. and a party of gentlemen who had also been invited, I visited a large factory at the place named.

On entering, our attention was first directed to a large drilling machine. This was arranged as usual, but the bed plate was cut into two parts, which formed the heads of a large pair of magnets. A piece of iron, about 4 inches thick by 10 wide and long, was placed on the bed plate, and the current being switched on, became firmly secured.

A one-fourth inch drill was then screwed down and the iron drilled through.

No lubrication was used. The particles of iron cut away assembled upon the drill, leaving the hole perfectly smooth—they being removed with the drill; and when the drill was withdrawn, *it*, as also the cuttings, *was found to be perfectly cool, no heat having been* (apparently) *created.*

To satisfy the company, the work was repeated several times, until each person felt assured of the fact stated.

We were then shown the planing machine, which was similarly arranged. A large piece of iron was lying upon the bed plate perfectly secured, although without any bolts or other usual fastening. As the planing tool passed along the face of the iron, we found that the surface was cut smoother than usual, and that there was no heat in cuttings or tool. We were told that the cutting point of the planer required much less attention or repair than in ordinary work.

We were then shown the lathe, the chuck of which was arranged as in the bed plates of the other machines, the current reaching the ends of the revolving magnets by sliding connections.

An iron T connection, weighing about forty pounds, was handled by two men and placed against the face of the chuck. When in right position, the current was switched on, and the iron was held firmly in place.

Change of position was made by striking the iron a sharp blow with a hammer. After one portion of the T had been turned off, it was released by switching off the current and put in a new position, as before.

Here again no heat was apparent, and the tools required very little repairs.

The currents for the work were furnished by a large Gramme magneto machine, the patents of which, for England and America, were owned by Mr. Werdermann.

Mr. W. informed us that he intended to introduce the work into the English Government factories, where cutting tools were kept cool by running water; but whether he succeeded in doing so I never heard.

Mr. Werdermann's solution of the matter was simply: It was supposed that the heat of the cutting tools was absorbed by the magnetized condition of the iron which formed the keeper of the heads of the magnets. Was this the true solution?

CHAS. L. CHAPIN,
formerly Supt. Fire Alarm Telegraph, New York;
lately Gen. Supt. Am. Dis. Tel. Co., Philadelphia.
No. 29 Carlisle Sq., Philadelphia, Pa., March 11, 1886.

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*Mr. W. always used his baptismal name of Richard.

The Roosen Fish Preserving Process.

M. August Roosen, of Hamburg, has brought forward a process for preserving fish and meat which depends upon the well known antiseptic properties of boracic acid. The acid is perfectly harmless, and can be taken in quantities of fifteen grammes or more every day without danger to the human system. It is favorably known as a preventive of disease, being strongly recommended in times of cholera epidemic. M. Roosen's experiments covered a series of years. He finds that in the case of small fish, such as herrings, a sprinkling of boracic acid and salt between each layer will keep the fish fresh for a certain length of time if the temperature be kept low. With higher temperature, however, and larger fish the process is not quite so simple. In order to make it complete, steel barrels are employed, which are filled one-third with sea water, in which the antiseptic compound is dissolved. After filling the barrel with fish, the manhole is closed and a pressure pump connected. An additional quantity of water is then pumped into the barrel, the air escaping through an opening which is afterward hermetically sealed. A pressure of six atmospheres is put upon the contents of the barrel before it is closed. This makes the solution penetrate the fish, and prevents the air from finding access to the contents. No blood is drawn out of the fish, and the solution remains clear and pure all through. By the use of boracic acid, mutton has been kept thirty-three days, and still bled freely after that length of time, and fish after several days were found perfectly fresh and sweet.

A High Speed Engine.

During the last last year or two, it has come to be generally understood that large machines, driven at a comparatively low speed, were the best for electric lighting purposes; but the lighting at the Lincoln's Inn dining hall and library must be considered as an exception to this rule. The dynamo here is driven at no less than 12,000 revolutions per minute, by a Parsons high speed engine, which justifies its title by running at the same rate. It requires some mental effort to take a statement of this kind seriously; yet there is no reason to regard the Parsons motor as a toy. It was shown in action at the Inventions Exhibition, running with unimpaired steadiness from the commencement to the close of the show. It is, in reality, a combination of turbines driven by steam, and consists of two series of parallel flow turbines to the right and left of a central steam inlet, the steam exhausting directly from the first turbine into the second, from the second into the third, and so on through 20 turbines in each series. The steam parts with a portion of its energy in each turbine, and finally escapes at a pressure not much above that of the atmosphere. It is claimed that this is the first motor that has ever been made to work at the actual velocity of the steam as it escapes from the boiler.—*Engineer and Iron Trades Advertiser.*

A Powerful Gas Light.

At a recent meeting of the Dublin Royal Society, Prof. F. W. Barrett gave an account of experiments which he had made to test the penetrative power of the Wenham double quadriform burner in fogs. This burner consists of four superposed 88-jet gas burners placed alongside of four similar superposed burners. The eight burners are in one plane, parallel to which, and at the proper focal distance, are eight annular lenses on one side, and a similar set of lenses on the other. The lights blend into one at a distance of 1,500 feet from the lighthouse. The experiments were made on two foggy evenings, on the second of which the fog was so dense as to cut off a powerful revolving light at half the distance, and to silence a fog siren driven by a gas engine and placed beside the Wenham light. The latter was easily seen by the naked eye, and its position determined, at six miles distance. The revolving light in that case was cut off at something under three miles distance. The Wenham burner will be found illustrated in our SUPPLEMENT, No. 526.

A Fire Banked for Sixteen Months.

One of the blast furnaces of the Kemble Iron and Coal Company at Riddlesburg, Pa., was banked up in November, 1884. After being out of blast nearly sixteen months, it was recently opened for the first time, and the fire found still burning. The coke glowed brightly, and on the admission of the blast soon became hot enough to melt cinder. The furnace was started with as little difficulty as if it had only been standing a week.