THE GREAT ROLLING MILL OF THE ST. JACQUES WORKS.

The preparation of metal melted in great masses in the Bessemer converter or Siemens furnace was the starting point of a complete transformation in the ancient metallurgy of iron. Such transformation has had its consequences in every branch of human activity, and to such an extent that in many respects it justifies the denomination of the new age, or the age of iron as compared with the age of steel, which is often applied at the present epoch to distinguish it from past epochs. We shall not examine here the numerous modifications that the use of this new metal has introduced into the industries of every nature; but, in dealing exclusively with the question of the elaboration of large masses, we shall recall the fact that the power of tools has had to be continually increased to keep pace with the dimensions of the ingots upon which they operate, and the 110,000 lb. pieces that the metallurgy of steel is now capable of producing evidently require other apparatus than the simple tilt hammers which sufficed for the spongy blooms of a thousand pounds that were formerly obtained upon the bottom of the puddling furnace.

The steam hammer, invented about 1841 by Boudon and Nasmyth, was, as may be seen, the principal cause of the wonderful extension that metallurgy has taken since that epoch. It was for a long time justly considered as the emblem of the work of elaboration of iron, the apparatus *par excellence*, the characteristic and pride of large forges; and, in fact, the spectacle that it offers in forges, in the center of the vast halls that have had to be heightened to receive it, never lacks a certain grandeur. It is really the center of all the activity that directs it, and it alone animates the halls which it fills with its strange sonorousness, and whose floor it shakes while it is kneading the bloom of iron with its powerful hands.

We do not desire to put a slight upon the glorious role and the important part that the steam hammer has taken in the progress of French metallurgy, but let it be permitted us to recall that, in the opinion of numerous experienced metallurgists, this machine, whose action is necessarily simple, is not always the one best adapted to the elaboration of great masses, and that in certain cases it may be preferable to have recourse to apparatus whose action is more continuous and effective, such as the rolling mill, and especially the forge press. It is because the steam hammer, which is particularly well adapted for blooms of puddled iron, which it is capable of freeing from their scoriæ, can no longer act the same upon ingots of cast steel which do not possess the same impurities. Its action, which is always abrupt, is necessarily superficial with large ingots; the external surface alone is drawn out, the heat of the mass not being reached, and the metal being badly forged in the center. When a semi-liquid is abruptly acted upon, the molecules, as correctly remarked by the Messrs. Casolanga, flow rather than draw closer upon concentrating. To this, add the internal tensions that often develop in the mass of the ingot under the abrupt impact of the hammer, and that may sometimes cause the apparently spontaneous breakage of the piece. As may be seen, there are here important considerations that well show how metallurgists come to-day to prefer tools whose silent action, exerted continuously, appears of a nature to penetrate more intimately the piece to be worked, and, in a word, to exert itself in the heart of the piece.

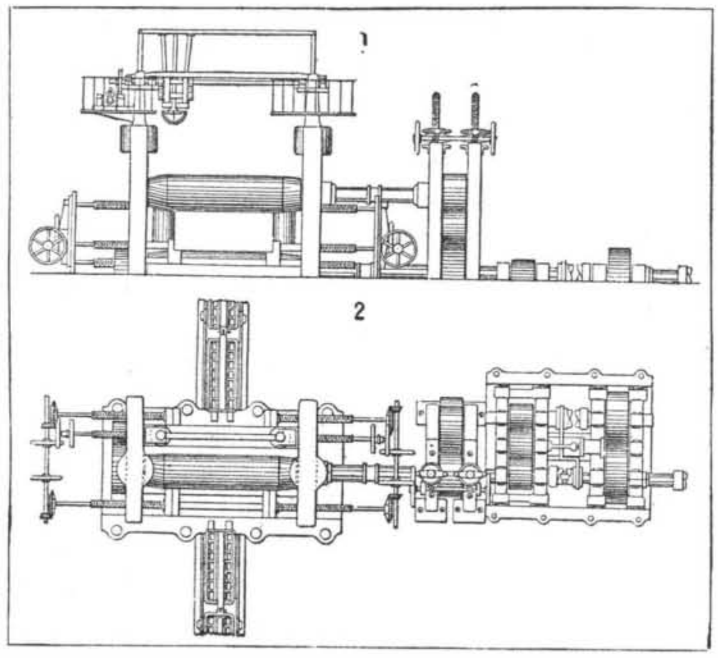

Fig. 1.—ELEVATION AND PLAN OF THE ST. JACQUES ROLLING MILL.

Considered from this standpoint, the forge press may be regarded as the machine of the future, and, alongside of this, the rolling mill, which through the velocity and diameter of its cylinders is allied to the two rival apparatus, and which is assuming a greater and greater importance in the elaboration of those large masses of steel whose complete homogeneousness it is desired to secure.

In Figs. 1 and 2, we represent *one* of the most powerful if not *the* most powerful of plate rolling mills, that of the St. Jacques works, belonging to the Company of Forges of Chatillon-Commentry. The cylinders are 3·28 feet in diameter at the table and 19 feet in length, with a total weight of 55,000 lb. each. They are capable of rolling fagots 4 feet in thickness, and, after certain modifications now making are finished, they will be capable of rolling fagots 5 feet in thickness. The cheeks in which they are mounted are 14 feet apart and are 15 feet in height. They are fixed upon one bed plate in common and are firmly cross-braced.

The lower cylinder, which rises scarcely above the level of the floor, is stationary, the upper one alone being movable, and being mounted in collars that are capable of sliding vertically in the frame guides. This cylinder and its collars are balanced by counterpieces arranged under the bed plate, and the preponderant action of which tends continually to raise the upper cylinder, this movement, moreover, being regulated by the action of pressure screws that traverse the frame.

The upper cylinder is capable of receiving an inclined position with respect to the lower one, so as to permit of the rolling of plates of decreasing thickness, of trapezoidal form, like those now used for the girdles of armor-clad ships. In order to obtain this oblique motion without forcing the collars in their guides, the latter are provided internally with spherical bearings that receive the journals of the cylinders, and thus allow them every liberty to oscillate.

The pressure screws that serve to control the position of the movable cylinder carry at the upper extremity a cylindrical piece upon which is mounted a helicoidal wheel actuated by an endless screw which thus causes its rotary motion. These screws are themselves actuated by a steam engine with two oscillating cylinders, arranged upon a platform as shown in the figure. A special gearing arrangement permits of acting upon both screws together or separately, so as to displace the two collars respectively in their guides to the necessary extent to incline or right the movable cylinder on the horizon. A special pendular system, arranged upon a traverse connecting the extremity of the two pressure screws, at once indicates the corresponding inclination of the cylinder.

In front of the train are arranged vertical cylinders which may be brought together or separated at will by the action of horizontal screws, according to the width of the piece to be rolled. They are designed to press upon the ingot in the direction of its width, so as to prevent the exaggerated sliding of the superficial parts and the hollowing of the edges, and to maintain a more uniform pressure throughout the entire mass. These vertical rollers are 18 inches in diameter and 4¼ feet in length. Their rotary motion is obtained by means of bevel wheels keyed upon their lower journal, and which are themselves actuated by a train of gear wheels mounted upon the axis of the lower cylinder.

The larger horizontal cylinders receive their motion

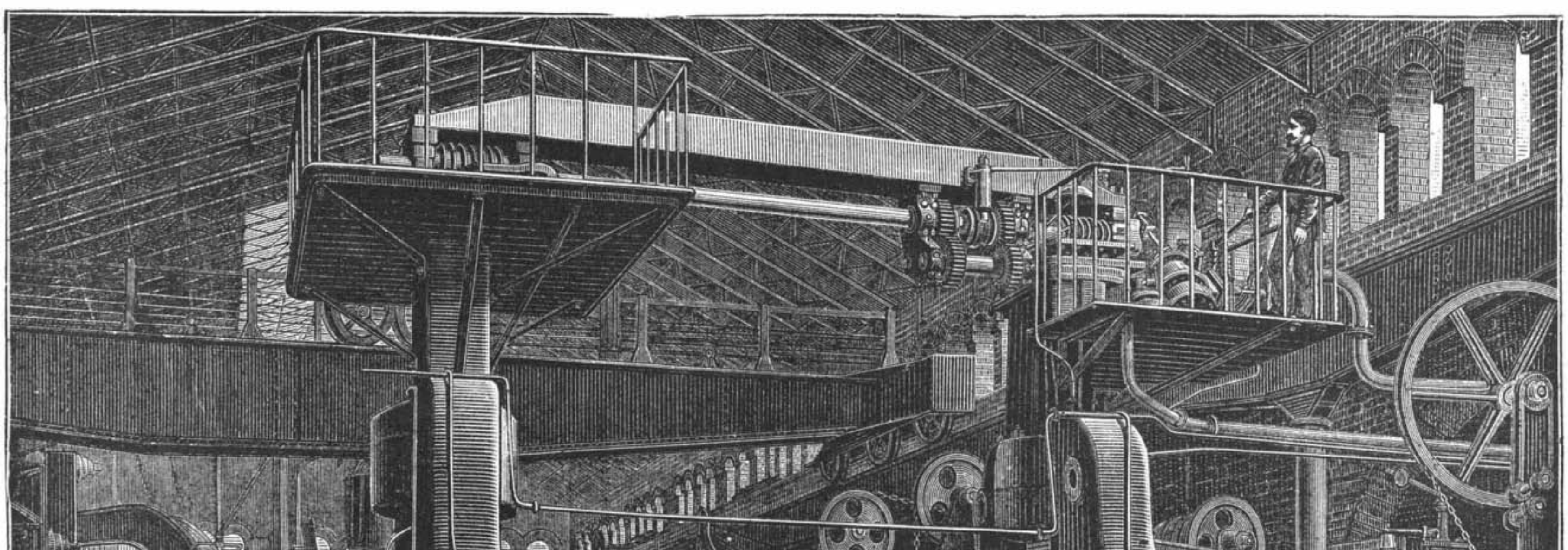

Fig. 2.—THE GREAT ROLLING MILL OF THE ST. JACQUES WORKS.

from the engine through the intermedium of a special rack arrangement. This latter comprises two cast iron uprights, between which are arranged the pinions serving to connect the axis of the movable cylinder with that of the lower fixed one. The pinions, moreover, are attached to the corresponding cylinders by lengthening pieces. As the distance apart of the two cylinders varies at every step, the lengthening pieces of the movable cylinder necessarily take an inclined position, which has the evident inconvenience of an irregular rotary velocity, causing sliding and shocks capable of producing breakages in the rolling. This inconvenience is overcome, to some extent, by changing the pinions when the inclination of the lengthening pieces becomes too great, and this makes it necessary to have two sets of pinions corresponding to the principal thicknesses that are had in view; but the patented arrangement now being introduced at the works is the only one that furnishes a perfect solution of this difficulty. The pinion of the movable cylinder is always controlled by that of the fixed one, but through the intermedium of two interposed pinions, one of which has a fixed axis and the other moves like a satellite around the first. The upper pinion, always controlled by the latter, is capable of moving freely in a vertical direction to an extent regulatable at will by means of an endless screw, and it always remains thus in the axis of the movable cylinder, whose connecting piece has no longer need of any inclination on the horizon. Under such conditions, the dimensions of the frame pieces will permit of varying the distance apart of the cylinders between limits that have never hitherto been attained, say from ½ an inch to 6½ feet.

The St. Jacques apparatus is reversible; that is to say, it rolls alternately in each direction, this being rendered necessary in order that the huge pieces that pass between the cylinders may not have to be carried back unnecessarily to the same side. The reversing gear is interposed between the pinion arrangement and the motor. It consists of two cages, one with one pinion and the other with three pinions of equal diameter. These are put alternately in play, according as it is desired to cause a rotation of the cylinders in one direction or the other. The pinions are thrown into and out of gear by means of clutches controlled by the rod of the pistons of a hydraulic cylinder, which is itself actuated by a pedal placed within reach of the workman.

On each side of the train are arranged tables at right angles with the axes of the cylinders. These carry two rows of rollers, upon which rest the pieces to be rolled. Between these are arranged two iron slides to which a to and fro motion can be communicated by means of a hydraulic cylinder placed under the floor of the works. The motion of the slide is obtained at will by a boy acting upon a lever that causes a hydraulic pressure in the cylinder. The plate is carried along in the motion by hooks that the workman engages to this effect in one of the holes of the row with which the slide is provided throughout its length.

It will be seen from this that the backward and forward motion is, as it were, effected mechanically. Five men and two boys, in fact, suffice to effect the rolling of ingots whose weight may exceed 110,000 lb., and it is certainly a most curious spectacle to see such heavy incandescent masses as this obeying an irresistible impulse to pass and repass docilely between the cylinders that crush them, and to see these cylinders stop rotating after the passage of the plate, in order to resume their operation at once in the opposite direction.

Fig. 2 shows the passage of a trapezoidal plate through the mill. The various workmen are at their posts, and to the right is seen the foreman examining the plate with a pyrometric telescope. This most remarkable instrument, the invention of two engineers of the St. Jacques works, permits of accurately determining the temperature of a mass or of a furnace heated red hot, and is destined to render the greatest services in every industry in which there is need of regulating the high temperatures employed.—*La Nature.*

The Unsanitary Condition of Country Homes.

Dr. Lucy M. Hall, who recently lectured before the Academy of Anthropology, in Cooper Union, New York, on "Sanitation in the Country," told some plain and wholesome truths on the subject. She has, it appears, given this matter close attention, has examined over 150 country houses, both East and West, and gave the audience her opinion—that the average farm house is not the healthful place that it is supposed to be by the people who pour out of the crowded cities in the summer time. On the contrary, she has found that disease and death lurked within many a vineclad and moss-covered cottage, because simple hygienic laws were violated. Some of the evils she referred to were improper drainage, uncemented cellars, failure to ventilate sleeping apartments, exclusion of light, too much shade about the house, and the improper disposal of kitchen refuse. The prospect is not an encouraging one for "summer birds of passage," nor is it at all comforting to think that the seeds of disease implanted during the summer fructify in the winter after their return home.

The Advances in Electricity in 1888.

When we contrast the present state of electric science and industry with their condition a year ago, we are struck with the remarkable advances that have been made, especially in the latter. The most important experiments bearing on the theory of electricity have been those of Hertz on the propagation of electrical disturbances, with investigations by various workers on the effect of light on various electrical phenomena. Hertz has obtained electric oscillations of a very short period—several hundred millions in a second—and he has shown that electro-magnet waves caused by them are propagated in the surrounding space, and are reflected and interfere with one another as do waves of light. To those who have not believed the electro-magnetic theory of light, these experiments will be of great importance. For those who have believed the theory, they will add corroborative and strengthening evidence. Our general views of the electric current have been gradually changing, and the idea of the energy of the current being transmitted through the surrounding dielectric, and entering the wire at every point, is changing our methods of treating problems of current propagation and our conceptions as to the mechanical reality that underlies the phenomenon. A number of experiments on the discharge of condensers have been made, notably by Professor Lodge, with a view of developing a theory of lightning and of providing the best means of guarding against lightning strokes. There grew out of Professor Lodge's experiments a warm discussion before the British Association, on lightning conductors, in which there was shown a wide difference of opinion between "theoretical" and "practical" men as to the best means of protection against lightning, and the interest aroused promises to be the means of adding largely to our knowledge on the subject. The development of the alternating system of electric lighting has stimulated investigations in that direction, and a number of experiments on self and mutual induction, on induction coils, etc., have been made.

In the application of electricity the advance has been much more striking, especially in this country. In lighting, the increase in the number of lights has been steady and rapid; and, although no radical improvements nor fundamental discoveries have been made, yet the efficiency of all of the lighting systems has been increased, and the expense reduced. In arc lighting there have been only changes in detail of the important systems; but the number of new stations being equipped, and that have started in the last year, greatly exceeds the showing made in 1887. Incandescent lighting has progressed still more rapidly. The Edison company has erected central stations of large capacity—up to a maximum of 50,000 lamps—in New York, Philadelphia, Chicago, and other cities, besides adding to the already long list of small stations. They have increased the efficiency of their incandescent lamps, and have perfected their dynamos. The returns of stations using this system have been for the year most satisfactory, and it is stated in some of the technical papers that a large amount of capital--no less than ten million dollars—has been subscribed abroad for the extension of the system.

The number of electric motors that have been supplied from central stations has also largely increased. The Westinghouse Company has continued to distribute electricity by the alternating system, and has rivaled the increase of the older Edison company. The advantages of their system for distributing to scattered points, and even in cities where overhead wires are allowed, and where the lights are not concentrated in a particular neighborhood—the lighting of stores, halls, theaters, etc.—are apparent. The efficiency of their converters and lamps has been increased, and experiments are being carried on with a view to perfecting some motor that can be used on alternating circuits. Other companies are doing a great deal of business in a quiet way in putting in private installations for factories, offices, etc. There has been much rivalry in electric lighting, and three of the most important companies—the Edison, the Westinghouse, and the Thomson-Houston—are at swords' points, and much of the current technical literature consists of discussions as to the merits and demerits of the various systems.

But it is in the extension of power distribution by means of electricity that the year has been most memorable. Large numbers of electric motors have been installed for supplying powers from one-tenth to forty or fifty horse power, and these are fed from the local lighting companies, and have displaced small steam and gas engines. The uses to which they have been applied are innumerable, and they are increasing in favor as their economy and efficiency become more apparent. More ambitious installations have been carried out in the Western mining districts, the most noteworthy being the power plants at Aspen, Col., and on the Feather River in California, where the Sprague Company has transmitted power (in the last case a distance of nine miles), and at Virginia City, where the Brush Company has just effected an installation.

Electric street railways have more than kept pace with stationary motor work. The first large road equipped was the Richmond road of the Sprague company, the largest and most difficult installation that had ever been attempted. After numerous disappointments, and after overcoming difficulties that would have disheartened any less energetic and efficient company, the road was successfully opened in March, and has been running without interruption ever since. There is little doubt that to the success of this tramway is due the boom in electric motor cars, that has given the Sprague and other companies a business even greater than their large capacity. The Sprague company has finished or is equipping thirty street railways, the Thomson-Houston company as many more, while the Daft company has under wayor finished a dozen or fifteen. All of these roads have overhead wires to convey the current from the dynamos to the motors. It is probable that the ultimate system of street car traction will be by storage batteries on the car, supplying current to motors beneath them, geared to the axles. During the year there has been little progress in this system of traction. One or two cars are being run in New York, in Philadelphia, and in some of the Western cities. The progress has hardly, however, been satisfactory. The present type of storage cell is heavy and inefficient, and rapidly deteriorates; and the year has not seen the introduction, either here or abroad, of any new type of battery nor any marked improvement in the old. For exceptionally favorable roads, where there are very light grades, storage battery cars will cost about the same as horses, or perhaps a little less; but there are few such in the States.

No important inventions in industrial electricity have been developed during the year, although several very promising ones have been patented and are being improved and tested. The Tesla motor for alternating currents is being developed by the Westinghouse company; several plans for continuous current conversion are being experimented on; new types of storage battery have been described, and will possibly prove successful.

Nothing important has been done in the telephone line. In telegraphy, Professor Gray has developed a writing telegraph, which will possibly do what is claimed for it, but which seems very complicated.

There has been much patent litigation, and important decisions have been rendered here and abroad. In an English suit, Edison's fundamental patent on carbon filaments for incandescent lamps was badly damaged, although the decision has been appealed from, and it is again being tried. The patents of the Westinghouse company for the alternating system have been decided against, both in England and this country. The Supreme Court has decided that the government has the right to bring suit against the Bell Telephone Company to annul Bell's patent, but this decision is of interest only as establishing the general right of the government to bring such a suit. A number of important suits are pending on patents for storage batteries, incandescent lamps, systems of distribution, etc.; and after the holidays a case before the Supreme Court will decide whether Edison's fundamental patents on electric lighting have expired with the limit of the foreign patents.

On the whole, the year has been one of solid advance and improvement, but with no startling development nor revolutionary discovery.—*Science.*

Testing Telegraph Poles.

A young man with a gimlet two feet long stopped in front of a telegraph pole in an uptown street the other day and began to bore into it. Another young man, a reporter on the New York *Sun*, stopped also and asked the first what he was about. "I am going to find out how long this stick will stand up," he said, twisting the handle rapidly. "I am employed by the company that owns the pole, and it is my business to go about the streets making inspections like this. Every pole is numbered, and when I make my report the company takes action according to the condition of the wood. This is the only way we can tell how strong a pole is, for decay begins beneath the surface and works toward the center. It shows on the outside last. So you can't tell from the looks whether a pole may not come down in the first high wind, or light one, either, for that matter. This one," and he withdrew his gimlet and looked at the fine shavings clinging to it, "will last at least a year without danger. There is one on the Bowery, near Fourth Street, that looks perfectly sound, much better than this one, in fact, and yet it is decayed almost from surface to surface, and is liable to fall any day." The young man did not know when the company would replace the dangerous pole, and, after making a memorandum in a book, he proceeded up the street to probe the next stick.

A REPORT from Elba states that the whole of the island is infected by phylloxera. In Toscana the efforts to check the plague have as yet proved unsuccessful. The insect has also made its appearance at Parmi, in Calabria, at Novara, and at Cervo in Liguria. Reports from the neighborhood of San Remo and from Lombardy state that the infected areas are constantly increasing.