by approximating the size of the graphite particles in pig-iron Wilson has succeeded in obtaining good results.

If we examine the utilization of the heat developed by the combustion of a given quantity of coal in this process, and compare it with the result of the combustion of an equivalent amount of fuel in a blast furnace, we shall soon see the theoretical economy of the process. The coal is burned on the grate of the puddling-furnace to carbonic acid, and the flame is more fully utilized than in an ordinary puddling-furnace, for besides the ordinary hearth there is the second or rear hearth, where additional heat is taken up, and then the products of combustion are further utilized in heating the retorts in which the ore is partly reduced. After this the heat is still further utilized by passing it under the boilers for the generation of steam, and the heat lost in the gases, when they finally escape, is very small. In a blast-furnace the carbon is at first burned only to carbonic oxide, and the products of combustion issue mainly in this form from the top of the furnace. Then a portion of the heat resulting from the subsequent burning of these gases is pretty well utilized in making steam to supply the power required about the works, but the rest of the gas can only be utilized for heating the blast, and here there is an enormous waste, the amount of heat returned to the furnace by the heated blast being very small in proportion to the amount generated by the burning of that portion of carbonic oxide expended in heating it, and the gases escape from both the hot-blast and the boilers at a high temperature.

In the direct process under consideration the fuel burned is more completely utilized than in the puddling process to which the cast iron from the blast-furnace is subjected to convert it into wrought-iron.

The economy claimed for this process, over the blast-furnace and puddling practice for the production of wrought iron, is that nearly all the fuel used in the puddling operation is saved, and that with about the same amount of fuel used in the blast furnace to produce a ton of pig iron, a ton of wrought-iron blooms can be made. I had no opportunity of weighing the charges of ore and coal used, but I saw the process in actual operation at Rockaway, N.J. The iron produced was hammered up into good solid blooms, containing but little cinder. The muck-bar made from the blooms was fibrous in fracture, and showed every appearance of good iron. I am informed by the manager of the Sanderson Brothers' steel works, at Syracuse, N.Y., that they purchased blooms made by the Wilson process in 1881—1882, that *none* of them showed red-shortness, and that they discontinued their use only on account of the injurious action of the titanium they contained on the melting-pots. These blooms were made from magnetic sands from the Long Island and Connecticut coasts.

The drawing page shows the construction of the furnace employed. I quote from the published description.

"The upper part, or deoxidizer, is supported on a strong mantle plate, resting on four cast-iron columns.

"The retorts and flues are made entirely of fire-brick, from special patterns. The outside is protected by a wrought-iron jacket made of No. 14 iron. The puddling-furnace is of the ordinary construction, except in the working-bottom, which is made longer to accommodate two charges of ore, and thus utilize more of the waste heat in reducing the ore to metallic iron.

"The operation of the furnace is as follows: The pulverized ore is mixed with 20 per cent. of pulverized charcoal or coke, and is fed into an elevator which discharges into the hopper on the deoxidizer leading into the retorts marked C. These retorts are proportioned so that they will hold ore enough to run the puddling furnace twenty-four hours—the time required for perfect deoxidization. After the retorts are filled, a fire is started in the furnace, and the products of combustion pass up through the main flue, or well B, where they are deflected by the arch, and pass out through suitable openings, as indicated by arrows, into the down-takes marked E, and out through an annular flue, where they are passed under a boiler.

"It will be noticed that the ore is exposed to the waste heat on three sides of the retorts, and owing to the great surface so exposed, the ore is very thoroughly deoxidized, and reduced in the retorts before it is introduced into the puddling-furnace for final reduction. The curved cast-iron pipes marked D are provided with slides, and are for the purpose of introducing the deoxidized ore into the second bottom of the furnace. As before stated, the furnace is intended to accommodate two charges of ore, and as fast as it is balled up and taken out of the working-bottom, the charge remaining in the second bottom is worked up in the place occupied by the first charge and a *new* charge is introduced. As fast as the ore is drawn out from the retorts the elevator supplies a new lot, so that the retorts are always filled, thus making the process continuous."

The temperature of the charge in the deoxidizer is from 800° to 1000° F.

THE ELECTRIC TRANSFER OF ENERGY. (*Electric Review.*)

RESEARCHES OF M. MARCEL DEPREZ.

Summary of Experiments.

(*For illustrations see pages* 136, 137, 140, 141 *and* 145.)

To the theoretical explanation which has just been put forward, it is necessary, in order to give the reader a complete idea of the researches of M. Marcel Deprez, to append a radid sketch of his experimental studies—the trials which have been successively made, and which have taken up the years 1881, 1882 and 1883.

The starting point of these labours may be, perhaps referred to the Electric Exhibition of 1881. Doubtless M. Marcel Deprez had experimented before this date, but it was in his laboratory, on a limited scale. Several persons have, indeed, had the opportunity of seeing an instance of distribution effected in his laboratory, but it was at the Palace of Industry that he displayed his results for the first time to the public.

The installation which he erected there was an instance of the electric transfer and distribution of energy. As regards the transfer, it does not differ widely from what had been effected by others. The total length of the cable was about 1,800 metres; very well at that date, but not exceptional. The power collected was not measured, but about four horse-power was expended. It may be said, further, that at that date there was no great interest felt in measuring, with precision, the power and the result, an affair which shortly afterwards became of such importance. To succeed in transferring power under any conditions seemed then an interesting result. From this point of view the installation of M. Marcel Deprez seemed about as good as any other. The feature in which it was unrivalled and altogether exceptional was, that not content with merely transmitting power, it distributed such power among numerous distinct machines, each acting independently of the others; in a word, it worked with distribution. This was the first realization of the principles which have been already expounded. We reproduce here, fig. 1, the two dynamo machines which produced the current. The double cable conveying the current went entirely round the Palace of Industry, with derivations both on the ground floor and on the first storey, to 27 distinct apparatus, some detached, and others arranged as in a worshop, and comprising sewing machines, folding machines, machines for ribbon sawing, for wire weaving, arc and incandescence lamps, and, lastly, a printing press. Each apparatus had its electro-motor, most of them a magneto-electric motor on the Marcel Deprez system; some, among others the press, had small Siemens dynamo machines.

This was certainly a mere experiment, but on a large scale, approaching to practical dimensions. At any rate it was very novel, and, as was generally remarked, it was at least a brilliant departure which promised well for the future.

In the International Congress of Electricians, in 1881, M. Deprez had explained his ideas and the general theory of the transfer of power such as he had conceived it; this theory, we may remember, has encountered much contradiction. The application, as it was said, was limited both as to the distance and the quantity of power. It was necessary to go further—to confirm the theory by precise experiments, and to carry out its application on a scale of industrial utility.

It is true that the author was not obliged himself to undertake these tasks. Many men of science, having announced an idea, stop, and do not consider themselves called upon to carry it personally into practice. This is doubtless allowable, and they have, after all, fulfilled their duties as savants and theorists. But if we cannot blame them, we should praise those who do not recoil from the arduous task of giving a material form to their ideas—an arduous task which demands, besides the attributes of the savant, others lower perhaps, but not less rare, among which must rank first and foremost a persistence which nothing can weary.