TRANSLATIONS FROM FOREIGN JOURNALS.

On the Cementation of Iron by Means of Carburetted Hydrogen. By M. DUFRENOY, *Chief Engineer of Mines.*

[Translated for this Journal, by Edward Poole.*]

Mr. Macintosh, one of the best informed mechanics in England, and to whom the chemical works in the neighbourhood of Glasgow are indebted for many improvements, conceived the idea of making steel of cementation, by exposing iron to a current of carburetted hydrogen gas. The apparatus which, after various trials, he found most convenient, consisted of a tube of cast-iron, coated inside with stiff clay, the same that is used in the construction of the furnaces on the Clyde. In order to prevent the usual contraction of clay, it is mixed with about a third of the same clay, baked, and afterwards reduced to a sufficiently fine powder. The tubes used by Mr. Macintosh, vary in length from five to six feet, the internal breadth from ten to eleven inches. The lining of clay is two inches thick; it should be well beaten, and have no fissures. To effect this, a cylinder of wood, rather less in diameter than the bore of the apparatus, is introduced, and the clay is then placed by small successive layers, as is practised in making pots for glass factories.

The tube has pipes at each end, one serving for the introduction of the carburetted hydrogen, while the gas escapes by the other; both these pipes are exactly closed, so that the carburetted hydrogen may remain in the tube as long as it is judged proper.

This tube is placed in a furnace, disposed in such a manner that it may be surrounded on all sides by charcoal.

Each tube is filled with from a hundred to a hundred and fifty pounds of iron; the bars are placed lengthways in the tube, taking care to keep them apart, and to separate every layer by small bars placed crossways, so that the hydrogen gas may be in contact with their whole surface. After the fire is lighted, and when the tube is sufficiently heated, a current of carburetted hydrogen gas, produced by the distillation of coal, is passed through. But, in order that the gas and the iron may acquire the proper temperature for cementation, the hydrogen is removed only every half hour. At the end of this time, the hydrogen gas is, in a great measure, deprived of the carbon it contained, and, on escaping from the tube, burns with a feeble light.

The time necessary for cementation depends upon the dimension of the iron bars to be cemented, and upon the temperature to which the apparatus is exposed. When the tube of cast-iron is of a reddish brown, and when the bars are two inches broad by six lines thick, only eighteen or twenty hours are requisite to complete the operation; the iron may be overcharged with carbon, with great facility. I have seen thin bars, which were almost in the state of graphite

* At the request of the Committee on Publications.

Proof bars, placed in the disks which close the tube, mark the state of cementation, and the moment when the operation should be stopped.

The steel, when taken from the tube, is covered with small blisters, or bubbles; it entirely resembles steel cemented by the ordinary process. Not having seen the apparatus in operation, I can give no detail as to the manner of conducting the process, neither do I possess any statement as to its economy. Mr. Macintosh, from whom I have received the few particulars that I have just given, is convinced that this process can, with regard to expense, sustain a competition with the ordinary method of cementation; he considers the steel obtained by the hydrogen gas as more homogeneous, and of a superior quality to that produced by the ordinary process. Mr. Macintosh has manufactured many tons of steel, to test the reality of his discovery, for which he has taken out a patent in England.

All the steel made by Mr. M. has been thrown into the market; the greatest part being converted into cast steel, has been used in the fabrication of fine cutlery, and for instruments which require steel of the first quality. [*Annales des Mines*, vol. v.

Report to the Directors of the London and Birmingham Railway Company, accompanied by Experiments on the Transverse Strength, &c. of Malleable Iron, with reference to its use for Railway Bars. *By* Peter Barlow, *Prof. Royal Mil. Acad., Woolwich.*

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Preliminary Remarks.

It is only since the very general adoption of railways in this country, that malleable iron has been employed to any extent to resist a transverse strain, and writers who have undertaken experiments to investigate the strength of materials, have hitherto passed over those inquiries which relate to the transverse strength of this metal.* The extraordinary extent, however, to which malleable iron is now applied, to resist transversely a passing load, renders it highly essential that this resistance, and its other properties, should be fully investigated; for it is obvious that every additional weight of metal, beyond that which is requisite for perfect safety, is not only uselessly, but injuriously employed, it being generally admitted that bars beyond

* Some few experiments on the transverse strength of malleable iron have certainly been made. I have given three in my Essay on the Strength of Materials. Mr. Hodgkinson has also glanced at this subject, in his valuable paper of Experiments on Cast-iron,† published in the Memoirs of the Manchester Philosophical Society; and M. Duleau has treated of the subject in his "Essai Theorique et Experimental," &c., but those points of greatest importance connected with the application of this metal to the purposes of railways, have never formed the subject of inquiry.

† Jour. Frank. Inst., vol. ix., pp. 202, 261, 325, 379—vol. x., p. 26.