THE JOURNAL
OF THE
Board of Arts and Manufactures
FOR UPPER CANADA.

MAY, 1864.

MALLEABLE CAST IRON.

(From the *Engineer.*)

Among a large majority of those engaged in the arts, malleable cast iron has always been a metallurgical mystery. The mode of its production is generally a secret in the few foundries where it is made, and the very ignorance of its true character has prevented its use to anything like the extent it deserves. M. Brüll not long since communicated to the French Society of Civil Engineers a very complete account of the history, mode of production, and properties of malleable cast iron, which deserves to become widely known. It appears that Réaumur, as early as 1722, read as many as six *memories* before the Academy upon the "art of softening cast iron," and, to quote literally, "de faire des ouvrages de fer fondu aussi finis que cieux de fer forgé." According to Réaumur, this art was a secret which, even before the eighteenth century, had been lost and recovered several times. Indeed, the art was then practised in Paris, but as a secret which not even Réaumur was allowed to penetrate. He made experiments for himself, however, and to an extent accomplished what was desired by enclosing ordinary iron castings in crucibles filled with a mixture of chalk and coal, or bone lime and coal, the crucibles being then exposed to a high and continued heat.

In 1804 Samuel Lucas, of Sheffield, patented a mode of producing malleable cast iron, and his specification clearly indicated the theory of conversion. It was that, simply, of partial decarbonization by exposing the castings to a high heat, when surrounded, in close vessels, with powdered iron ore, or other metallic oxides capable of abstracting a portion of the carbon in the iron. For the most complete results, the weight of oxide was to be from one-half to two-thirds that of the castings treated, and the heat was to be kept up for five or six days. Lucas's specification contains, indeed, nearly all that is essential to the production of good malleable castings, and his process is, substantially, that which has been followed for the purpose ever since the time of his description.

Taking Mr. Brüll's account of the converting process as now praticed, the castings should be of charcoal iron from Ulverstone — a locality which Mr. Brüll, by the way fixes "en Ecosse." The white iron is preferred for the larger class of castings and the gray for the smaller pieces. The iron, M. Brüll states, is to be melted in crucibles, heated over a steel converter's fire, the weight in each crucible being about 66 lb. The fusion is to be continued from an hour to an hour and a half. The articles to be cast are moulded either in green or dry sand as may be preferred, and are to be poured in the ordinary manner. The castings are very brittle, and unless well proportioned and very carefully handled they are apt to crack. They are then ready for treatment in the converting furnace. This is rectangular in form, and opens only at a small door for charging and discharging. The furnace, or more properly speaking, oven, has narrow fire grates beneath extending along its whole length. The castings to be treated are packed, in iron cylinders, in alternate layers of red hematite ore finely powdered. These cylinders are placed in the oven, which is closely sealed, so as to completely exclude the air, and then gradually heated until the contents are brought to a bright red. The time occupied in raising the heat is about twenty-four hours, and this heat is to be continued three, four, or five days afterwards, according to the size of the castings under treatment. At the end of this period the heat is to be gradually let down, another twenty-four hours being properly allotted to this. The annealing operation is one of great delicacy. If any air penetrates to the interior of the oven, or if the heat is raised too high, or if the oxide (hematite ore) employed is not properly mixed with a quantity which has already served before, the castings are certain to be burnt. If the heat is too low, or unequal, the annealing is insufficient, and the castings are liable to break. Care, too, or rather a considerable degree of experience, is requisite to prevent the fusion of lumps of the ore upon the surfaces of the casting. An American mode of rendering iron castings malleable consists in heating them in layers of oxide of zinc, which never forms lumps upon their surfaces. Care, too, is required in packing the castings in the powdered ore. If the thickness is not nearly equal, the castings are considerably warped. It is no wonder, with so many contingencies, that the price of malleable iron castings in Paris is from 7½d. to 10d. the pound.

M. Brüll states that the density of malleable castings is hardly greater than that of ordinary cast iron. Three samples of the former, selected at random, had a specific gravity of 7·10, 7·25 and