7·35 respectively. The colour, both external and that of the fractured specimens, approaches that of steel. The "malleableised" metal takes readily a very fine polish, which is not very easily destroyed upon exposure to moisture. Its resistance under cutting tools, or when exposed to friction, is not, however, great. The metal is very porous, as is proved by the gradual diffusion of oil over a considerable surface where only a portion was placed in a reservoir of that liquid. The Ulverstone white iron is very sonorous, and good clock bells are cast from it. The treatment for malleable castings diminishes this property of communicating sound, but of two objects of the same form, that in malleable cast iron can be distinguished from that in wrought iron by the superior note given off on striking it. On breaking a malleable casting the converting process appears to have penetrated only to the depth of 1-8th and 1-6th inch, and instead of gradual transition from one condition to another, there is a well-defined line of demarcation. Yet the core, originally brittle, is found to have become soft and easily workable. Worked under cutting tools the outside of a malleable casting gives long and elastic shavings, while, as the tool enters beneath the surface, the chips, towards the centre of the casting, become more and more brittle. Under twisting and other strains the interior crack, while the exterior presents its customary appearance of toughness. Malleable cast iron is easily stamped, drawn, and hammered without heating. It can also be worked well under the hammer at a low heat, and at this stage hammering appears to improve the grain. At a higher heat it breaks into fragments. Very small sections may be, now and then, welded, but, on the whole, malleable cast iron is not weldable. It is, however, readily brazed with copper. It melts only under a very high heat, and, indeed, it stands fire so well that it is employed for foundry ladles, crucibles for the precious metals, and for the tubes of some descriptions of boilers. Malleable cast iron may be case hardened more readily and to a greater depth than wrought iron. The castings are not blistered, sealed, or warped in the process, and the case hardening may be effected either with bones, hoops, or leather in the ordinary manner, or with prussiate of potash.

MM. Morin and Tresca have made an extensive series of experiments upon the resistance to rupture, limit of elasticity, &c., of malleable cast iron, all of which are recorded in the "Annales du Conservatoire des Arts et Metiers." The strength, per unit of section was found to diminish greatly as the dimensions of the pieces submitted to experiment were increased. The direct resistance rupture was found, in some of the experiments, to be about 50,000 lb. per square inch, or exactly 35 killogrammes per square millemètre. As to the general results of these experiments M. Brüll observes that they indicate a general resistance, a co-efficient of elasticity, and a limit of elasticity as great in malleable cast iron as in good wrought iron. This was, indeed, to have been expected from the ordinary practical acquaintance which we have of the first named material. M. Brüll touches upon the prices at which malleable cast iron is produced in various countries. In Switzerland, for example, it costs upwards of a shilling a pound, while at Liége the cost of castings in this material is not much greater than that of English cast iron. The whole question of the employment of malleable cast iron turns really upon that of its cost. If it can be cheaply produced, and we have no doubt that, with simple improvements it may be, it may be readily substituted in place of many applications of wrought iron. A Glasgow firm has already done something in this direction, but the subject should be more generally pursued by others.

RIVETTED JOINTS IN WROUGHT IRON.

One of the most important operations in engineering is the making of joints in wrought iron, or joining two or more pieces of wrought iron together. It is equally important to have a good and proper joint in a wrought iron girder as in a wrought iron steam boiler. Many lives and valuable property may depend upon the quality of the joint in either case.

In a wrought iron girder whose length is too great to have the plates, bars, or angle irons in one piece, extending from end to end, except by welding, which is generally too expensive, and not always safe until each weld has been tested, it is necessary to connect the two or more pieces of metal in such a manner that the whole of any strain on any one plate or bar shall be taken through, or conducted to the next plate or bar, with as much safety as if the two pieces of metal were one. This conduction of strain from one bar to another ought always to be done with the least possible amount of metal in the joint, for self-evident reasons. Any excess of metal in the joints of course adds to the weight of the girder, and not only adds the excess in the joints, but also increases the sectional area of the girder throughout, so that the girder must be calculated to carry that excess of dead weight, and is therefore so much heavier.

The quantity of wrought iron now used in various constructions which are "built up" of separate plates and bars of wrought iron is so great that, with a good and proper arrangement of joints, a large amount of metal would be saved. It can easily be imagined that any excess of metal in the construction of a girder must diminish the span that it would otherwise carry itself over with safety.