On the Manufacture of Cast-Steel, by Dr. Karsten.

(Concluded from page 187.)

Although in the case of pig iron it is necessary to bring it into a liquid state, in order to convert the gray and soft variety into that which is white and hard, or, on the contrary, the former into the latter by rapid or slow cooling of the metal, in the case of iron with a smaller per centage of carbon or steel, mere rapid or slow cooling, without any previous alteration of the state of aggregation, is sufficient to convert the darker colored soft steel, into the whiter hard steel, and the reverse. Judging from analogy, therefore, it is highly probable that the changes in the state of combination of the carbon and iron take place in the hardening and softening of steel, corresponding to the different states of combination of this element in gray and white iron, although these differences in the state of combination have not yet been proved by chemical evidence to exist in the case of steel as they have in raw iron. However, the hard and soft steels have never been regarded as special varieties, and there is no greater reason for regarding white and gray pig iron as special varieties, because the differences in color, hardness, and tenacity are owing solely to the respective states of combination determined by conditions of temperature, and not to any alteration in the combining proportions. If however, gray and white iron are regarded as special varieties, in the same manner as graphite and diamond, it must not be forgotten that a perfectly analogous relation exists between hard and soft steels, which are not regarded as special varieties.

In the processes employed for decarbonizing pig iron and converting it into steel, it has not hitherto been possible to obtain a product of perfectly homogeneous nature. It is always necessary to sort the steel, in order to separate the harder parts containing more carbon from the softer, and these again from the steel-like iron. This absence of homogeneity in the product, resulting from the imperfection of the processes, led to an attempt to give the steel great uniformity of texture by melting. The so called cast steel is really a much more homogeneous and trustworthy product than the raw steel, or that obtained by cementation, although its characters likewise depend upon the proper and careful selection of the material from which it is made. In consequence of the fact, that steel may be prepared by fusion, which, together with a large per centage of carbon and consequent hardness, possesses homogeneity whatever may be the degree of hardness desired, cast steel has acquired such a well-merited reputation, that it is now always employed for articles in which great hardness is indispensable. However perfect the process for making cast-steel may appear to be, it is still open to the disadvantage, that the selection of the suitable material must be entrusted to the judgment of the workman, and consequently that however homogeneous the product, the per-centage of carbon, the hardness and solidity of the steel cannot be determined with precision beforehand. Such imperfections in the practice of metallurgical operations are in every case unavoidable, when determinations of weight must be replaced by the practised eye of the workman. The per centage of carbon in the material employed in making cast-steel—cementation-steel—is different in every part of the section of the bars, so that the average per centage of carbon in the charge of a crucible and the product of the casting cannot be determined with precision. Although the hardness of the English and good German cast-steel correspond tolerably well with that which is required, this result is solely attributable to the perfect acquaintance of the workmen with their materials, and their careful selection of it for this practical purpose.—There would be no uncertainty as to the result, if we possessed a material applicable to the preparation of cast-steel, in which the per centage of carbon could be calculated. The white pig iron made from pure spathic and brown iron ores free from disseminated copper pyrites, and the per centage of carbon in which may, without any considerable error, be assumed as 5·6, is a material of this description. The per centage of carbon in the best kinds of Swedish bar iron, and the iron which is made in Germany from the pure spathic and brown iron ores, may very safely be assumed as 0·25 on the average. The above pig iron and this bar iron are the purest kinds known, containing only traces of silicon, from which likewise the cementation steel used for making cast steel is never free. Both these kinds of iron are therefore of such a nature as to enable the operator to determine beforehand with precision the per centage of carbon in a crucible-charge, and to produce cast-steel of any desired degree of hardness by means of a simple calculation of the requisite proportion of the two kinds of raw material. If the per centage of carbon in the melted product obtained in this way, and the characters dependent upon that per centage, should be found to agree perfectly with calculation—a question to be determined only by experiments on a large scale—it might be expected that the production of cast steel from these materials would constitute a new phase of this branch of industry in Germany; for besides the trustworthiness of the operation, by which cast-steel could be made of any desired degree of hardness and tenacity, it possesses economical advantages in the cheapness of the raw material.

But the production of cast-steel by melting together white iron and pure bar iron appeared to be liable to an objection far greater than that founded upon the impurity of the raw material, and this arose from the doubt as to whether the product of the fusion would be homogeneous. However, the question of practicability could only be decided by direct experiment. Such experiments were made in the years 1846 and 1847.

The melting crucibles employed were of such capacity, that from 30 to 35 lbs. could be melted at a time. The melted metal was as usual run off into cast-iron moulds. The following is a brief statement of the results obtained in a great number of meltings, and the subsequent treatment of the cast-steel:—

1. In the selection of the pig iron, it is of great importance to employ such as presents perfect lamellar structure, and not such as is partly fibrous or compact. The use of lamellar iron is necessary, and not only in order that the per centage of carbon in the charge may be calculated with accuracy, which cannot be done with fibrous or compact iron in which the per centage of carbon varies greatly, but likewise and especially because the lamellar iron exercises the greatest solvent action upon the bar iron, so that even a comparatively much larger quantity of these kinds is but an imperfect substitute for the lamellar iron. Consequently good cast-steel cannot be produced in this way without lamellar pig iron.

2. The extremely high temperature which bar iron requires for fusion appeared to render it necessary that it should be added to the charge in small fragments. On this account the first fusions were made with bar iron, which had been rolled into moderately thick sheets and then cut into pieces. However, it was subsequently ascertained that the solution of the bar iron in the liquid pig iron takes place without any difficulty, and that the product is equally good when thick pieces are used, so that finally masses of a cubic inch in dimension were employed. By this means the expense of cutting the bar iron is obviated; at the same time the iron is less oxidized, and less room is taken up in the crucible, than when it is in small fragments.

3. In order to produce a homogeneous cast-steel, the highest possible temperature is necessary for the fusion. Consequently very infusible crucibles, which are not liable to crack, are a much greater desideratum in the production of cast-steel from pig and bar iron, than even in the melting of steel itself. Of course the greater the number of meltings which can be made in one crucible, the greater is the economical advantage gained.

4. The melted metal must be run off into the cast-iron moulds as rapidly as possible, in order that the whole mass may cool uniformly. At the same time care must be taken that none of the slag is allowed to pass from the crucible into the moulds, for there is not time for the slag to separate from the metal; it solidifies in the midst of the steel and renders the casting defective, and causes the bar to rend in rolling. This may be most advantageously obviated by taking the cover from the crucible while it is still in the furnace, and skimming off the slag with a ladle-shaped iron. The small quantity which then remains may easily be kept back in the ordinary way during the casting.

5. The cast-steel, when allowed to cool slowly in the crucible, loses all coherence, and breaks down under the hammer or rollers. The cause of this appears to lie in the formation of carburets of iron, which do not remain combined with the rest of the steel containing less carbon.

6. The cast bars must, after they have cooled, be freed from all adhering granules of metal by means of a chisel. If this is neglected, the edges of the bars become broken in rolling.

7. In heating the cleaned bars for the purpose of further working, a bright red heat must be employed. This cannot be effected in a satisfactory manner before a blast, because the temperature is not sufficiently uniform, and a uniform heat is indispensably necessary for the favorable result of the rolling or hammering. This can only be effected in a well constructed reverberatory furnace, and most advantageously in one fed with gas, a slight excess of which is present.

8. It is preferable to roll the heated bars rather than to hammer them; but if a hammer is used it must be of considerable weight.

9. The cast bars presented a perfectly homogeneous appearance, even after rolling.—The bars were first rolled out square to a length of 4 feet, and then, after reheating brought into the desired form. They admitted of being rolled into the thinnest sheets without cracking at the edges.

10. Even in making soft steel, for which purpose the crucible was charged with 25 lbs. of bar iron, and 2 lbs. of pig iron, a perfect solution of the bar iron was effected by means of a strong heat. The product was a homogeneous steel, although, according to calculation, it could not contain more than 0·6 per cent of carbon. The best, hardest and most tenacious steel was obtained by fusing mixtures in which the calculated per centage of carbon was 1·5 or 1·6. For this purpose the crucible was charged with 24 or 25 lbs. of bar iron and 8 lbs. of pig iron.

11. The cast-steel, even that which is soft, and in which the per centage of carbon is only 0·6, differs essentially from the raw or melted steel from the circumstance that it cannot be welded without great difficulty. With a higher per centage of carbon it can only be welded under a coating of borax. With a per centage of 1·25, it can no longer be welded at all. Although, on the one hand, this behavior of the cast-steel obtained in this way indicates its homogeneity, still, it is a defect, one indeed which is likewise possessed by the English cast-steel in a somewhat less degree.

12. The cast steel bears only low tempering heat, and acquires a very high degree of hardness, although at the cost of its tenacity. The proper mode of tempering it still remains to be ascertained.

The steel may be used for making the finest kinds of cutlery for files and chisels. For all purposes in which it is submitted to sudden and violent blows, it has proved destitute of the requisite tenacity. While very hard, it possesses considerable brittleness.

14. The last mentioned character of the steel affords a ground for doubting its certainly apparent homogeneity, and this conjecture is confirmed by the fact, that its tenacity and capability of being welded are considerably increased by remelting. If, however, it should prove to be impossible to produce a good cast-steel in one melting, the economical advantages of this process would probably be altogether lost.

Ice Houses.

Messrs. Editors—I want to construct immediately a small ice fixture in my cellar for family use. My cellar is 44 by 40 feet, and 8 feet high; the wall is split granite, with a plank flooring; it is pretty dry. I would prefer placing it in the north corner. Here is my plan:—I would first line off upon the cellar corner floor 8½ feet square; within this space stud up a room 6 feet 2 inches, with 4 inch joist and board up upon the inside. This room is then 6 feet square and 8 high which is to receive the ice; pitch this room all round upon the outside to keep moisture from getting in or out, then board up upon the studs which leaves a 4 inch space all round between studs; then stud up again on two sides, and plank up, the other two being formed by the stone wall), 15 inches from the inner studding. This 16 inches of space all round to be filled with dry saw-dust (perhaps wet saw-dust would do as well.) For convenient ingress to this fixture, I purpose to fit in, near the bottom, a box or case about 7 feet long, one foot deep, and 2 wide, to extend from the outside through the ice room; the ice is to be lowered in from the top and packed in and around this pitched case, which has double doors lined with cloth; in this case is to be a provision chest to move in and out easily upon rollers; this chest is to be in separate apartments, for the reception of fruit, butter, meats, &c. But instead of this horizontal case and chest, I could insert them in a vertical position under the hatchway at less expense, although it would be more inconvenient in getting the chest in and out; then again I should not have so compact a body of ice. What do you think of it? Will it answer? Is the horizontal or the vertical way best? Am I right in leaving the 4 inches air space? Should the saw-dust be wet or dry? Will moving the provision chest in and out once or twice a day melt away the ice too fast? C. J. F.

North Lincoln, Me., 1853.

[This plan of an ice house we consider is an excellent one; the saw-dust should be *dry*. The air space is a good idea, and we would prefer the horizontal drawer. There should be some allowance below for drainage.

The Birmingham of America.

Waterbury, Conn., is the Birmingham of America, as it regards the kind and extent of its manufacture. It is situated in the beautiful valley of the Naugatuck, embosomed among the hills, built on an extensive scale, affording room for gardens, shrubbery, trees, &c., in connection with the dwellings, and a public square in the centre. This town was settled in 1677. For thirty years previous to the introduction of manufactures, the population rather diminished. The first water-wheel was put in motion about the beginning of the present century. For a number of years the manufacture of clocks was the principal business of the place. In 1802 the manufacture of gilt buttons was commenced, a business which has tended to develope the resources of the town. In 1810 the manufacture of woolen goods was introduced, and in 1837 that of the lasting or covered button. There are now over thirty companies, embracing more than two millions and a half of capital, engaged in the manufacture of brass, copper, plated metal, German silver, suspenders, and webbing, hosiery, cutlery, felt cloth, pins, hooks and eyes, buttons, umbrella trimmings, files, dressed leather, buckles, shawl pins, jewelry, &c., and in the mercantile business, connected with them. The town contains seven thousand inhabitants. It has its water-works, furnishing the sparkling pure water from a spring on the hill, so high as to run in the upper stories of the hotels. It has also its gas works and other appendages of our sea-board cities.

By the news from various places we perceive that the heat has been nearly as oppressive as in New York City, but not so fatal because there is such an eternal driving in sunshine and storm here, to advance in the world of evil spirits.

To a weak mind a name is of more consequence than the thing itself. This has been manifested by one of our cotemporaries, by an exhibition of spleen against the People's College, because it was not named an "Industrial School."

A correspondent in a cotemporary in writing about navigating the air, says, "if it is within nature's law, it is practicable at the present moment, if not it is impossible."—Bright idea this; ask the birds if it is within nature's law; and John Wise if it is possible.

Two young men in Danvers, Mass., recently pegged 160 pairs of women's shoes in ten hours. One Alex. Steel pegged 82 pairs, J. Bunker, the challenger, 78 pairs—beat by 4.