# SCIENCE AND MECHANICS.

In a late number of the *Agriculturist*, there appeared a short paper on case hardening, in which, however, the true theory of the *process* was by no means ful'y explained; as the tempering of various instruments is a matter of almost every day occurrence, it may perhaps be interesting to some of the readers of the Journal to obtain a definite idea, with regard to the cause of the different degrees of hardness in the various sorts of iron.

Metallic iron as obtained by the melting of the ores is never pure, but is always mixed with variable quantities of charcoal or carbon, but this substance is contained in the iron in two forms, either mechanically mixed, or in what the *chemists* call a "state of combination." The difference between these two states is, that in a mechanical mixture we can see the separate portions of iron and charcoal, while the chemical compound seems even upon the closest examination, to be a perfectly uniform mass.

When the iron is thus chemically combined with the charcoal, it produces what is called white cast iron, which consists of about 95 lbs. of iron to five of charcoal, when this latter substance is only mechanically diffused through the metal, it forms gray iron—the latter is always formed when the fused metal is allowed to cool slowly, the former is produced by rapid cooling, as for instance, by throwing the hot metal into water.

White cast iron is exceedingly hard and brittle, while the gray iron is soft and tough. If the former be fused and cooled slowly, it is converted into the latter and loses its hardness, the reason being apparently, that during the slow cooling the particles of charcoal have time to unite together and separate themselves from the iron, which they cannot do if the whole mass is suddenly brought to a low temperature. There can be little doubt that gray iron contains a small quantity of the hard white iron, but by far the greater portion has been decomposed or resolved into pure iron and charcoal.

Steel is nothing more than a compound of iron with charcoal, but the quantity of this substance does not amount to two per cent., while bar iron contains only one-half per cent. If bar iron has been slowly cooled, we may suppose it to be a mixture of pure iron with a very little gray iron, if cooled rapidly of pure iron with a little white iron.

If therefore, any instrument has been made of bar iron and has been cooled rapidly, it will be brittle from the formation of white iron, and in order to give it the toughness requisite for many purposes, we must heat it again and allow it to cool slowly.

Exactly the same is the case with steel, which as above mentioned, contains only about two per cent. of charcoal; during the various processes for forming any steel instruments, the metal of course cools slowly and is quite soft, it is then heated again and cooled rapidly by means of water, it then becomes hard and brittle, but by heating this again to a certain extent and cooling slowly, we can give it any degree of hardness we please. If we heat a piece of steel we shall find it will assume a pale yellow colour, if we then allow it to cool it will be fitted for the manufacture of lancets and razors; if we heat it still further, it becomes brown, and is then fitted for making chisels; applying the heat still further, it acquires purple spots when it is fit for axes, and on continuing the process it becomes light blue, blue and dark blue, when it is used respectively for swords, watch springs, awls and saws.

These different changes of colour take place at certain fixed temperatures, and as it has been found difficult to judge of the exact heat acquired by the metal, a much better and safer plan has been adopted, viz.: a bath of mercury is used, this can be heated exactly to any temperature we please, which we can observe by a thermometer, and on dipping a steel instrument into it, and then allowing it to cool slowly, we can always give to it the exact degree of temper that we desire.

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## ETHER SUPERSEDED.

This is pre-eminently an age of discovery. At least four or five have been made within the last two or three years, any one of which would alone be sufficient to rescue the year of its birth from oblivion —to make it the commencement of an era. One of these, and by no means the least important is the discovery of sulphuric ether, by the inhalation of which an insensibility to pain is produced, so that teeth may be extracted, limbs amputated, and various horrible surgical operations performed without suffering, and almost without the knowledge of the patient. But there were some instances in which the ether was attended with danger, and others in which it produced a contrary effect to the one desired. Another, and far more effective anaesthetic (a word, signifying loss of the sense of feeling,) agent has lately been discovered. It is called chloroform. We observe that Dr. Holmes, of Montreal, has used it with entire success. It has also been used in this city (Toronto) with the expected results. We must state, however, that in one of our last English exchange papers we are told, that a student in the Dublin Hospital was thrown into convulsions by taking it. It would thus appear that there are certain constitutions or conditions of the constitution under which it would be dangerous to administer even this substancee. The following is from an English paper:—

Its advantages over ether are so varied and palpable that the latter may be considered as already superseded. "It is a dense limpid colorless liquid, readily evaporating, and posessing an agreeable, fragrant, fruit-like odour, and a saccharine pleasant taste." As an inhaled and anaesthetic agent, it possesses over sulphuric ether the following advantages:—1st, A much less quantity will produce the same effect. 2nd, A more rapid, complete, and generally more persistent action, with less preliminary excitement and tendency to exhilaration and talking. 3rd, The inhalation is far more agreeable and pleasant than that of ether. 4th, As a smaller quantity is used, the application is less expensive, which becomes an important consideration if brought into general use. 5th, Its perfume is not unpleasant, but the reverse, and more evanescent. 6th and 7th, No particular instrument or inhaler is necessary; it is quite portable, and all that is required is to diffuse a little of the liquid upon a hollow-shaped sponge, or even the pocket handkerchief, and apply the same over the mouth and nostrils, so as to be fully inhaled. Professor Simpson has, since his discovery, applied it frequently to obstetric practice, and with entire success; but it has last week been applied for the first time by Professor Miller and Doctor Duncan to surgical operations.

The following case occurred on the 12th inst. to Mr Miller in private practice. The notes of it and the subsequent remark are in his own words:—

"A young lady wished to have a tumour (encysted) dissected out from beneath the angle of the jaw. The chloroform was used in small quantity, sprinkled upon a common operation sponge. In considerably less than a minute she was sound asleep, sitting in a chair with her eyes shut, and with her ordinary expression of countenance. The tumor was extirpated and a stitch inserted, without any pain having been either shown or felt. Her sensations throughout, as she subsequently stated, had been of the most pleasing nature; and her manageableness during the operation was as perfect as if she had been a wax doll or a clay figure. No sickness, vomiting, headache, salivation, uneasiness in the chest, in any of the cases. Once or twice a tickling cough took place in the first breathings."

Several other cases are given with similar results.

A NEW FOUR-HORSE POWER ENGINE IN A HAT-BOX.—Mr. Elijah Galloway has patented what has hitherto been esteemed more as a philosophers' stone of steam power than a practicable invention. It is said to be so wondrously portable as not to weigh more than two or three cwt. and not occupy more than half the space of an ordinary hat-box. A steam-pipe from the Boiler brings the steam into a little receptacle; an eccentric crank is turned by the rotary motion within it; and here is all the machinery said to be necessary to propel the largest engines, whether mining, marine, or locomotive. The Admiralty are said to have ordered an estimate for supplying the Minx with a fifty-horse power one. They could not do better, we think, than name such a whirling machine the Minx itself, and provide it with the all sufficient accommodation of a band-box.—*Builder.*

COMPOSITION BUILDINGS.—A friend informs us, that being it Southport, Wisconsin, a few days since, he observed a church in progress of building by the following mode:—A composition of sixteen parts gravel from the lake shore, and one part lime—the latter being slacked upon the gravel and mixed directly with it. Two planks were placed edgewise eight or twelve inches apart, and the space between filled to the depth of eight inches. This was suffered to stand till the next day, when it was sufficiently hardened to raise the planks and repeat the process. The walls were thus raised eight inches per day, and were as solid as stone. He informs us that he saw a brewery in the same town, which has stood two years, and which is in no way changed from its original firmness.—*Prairie Farmer.*