MANUFACTURE OF STEEL.

Steel has been called a carbide of iron as it has been supposed that it was principally composed of iron, united to about one per cent of carbon. Latterly, however, according to M. Frémy, of Paris, and some others, it is supposed to be a nitro-carbide of iron, and that it is a small quantity of nitrogen which is the chief agent in giving to this iron alloy its well-known steel qualities. Steel is manufactured in different ways. In Germany it is produced direct from pig iron, which contains about 4 or 5 per cent of carbon, not however, it would appear, in chemical combination, but simply mechanically mixed with the metal. The pig iron is worked in a suitable furnace until the amount of carbon in it is reduced to the proper proportion. The process of decarbonization requires great care, skill and judgment on the part of the workman. German steel has always one great defect, viz., iron is produced along with the steel, and becomes intimately mixed up with it throughout the mass, thus destroying its hardening quality.

The English way of making steel is the reverse of the German, the article being produced by the carbonization of pure malleable iron bars; the process is generally called cementation, and the product converted or cemented steel. The best steel is produced from the iron obtained from the ores in Sweden.

The cementing furnace, in which iron is converted into steel, is of rectangular shape; it is covered in by a semicircular arch, with a circular hole left in the center, 12 inches diameter, which is opened when the furnace is cooling. A large cone or hood, 30 or 40 feet high, open at the top, is built around it, which serves to shelter the furnace within, also to increase the draught and carry off the smoke. The furnace contains two troughs or chests, technically called "pots," made either of fire stone or fire brick, and each of them 12 feet long by 3 feet wide and 3 feet deep. They are placed on opposite sides of the grate, which occupies the whole length of the furnace. Two openings in the front of the arch, one above each pot, serve to admit and remove the bars. These openings are about 8 inches square; a piece of iron is placed in each, upon which the bars slide in and out of the furnace; a third much larger opening in the middle, between the two pots, serves to admit the workman who charges the pots. The grate is open at each end, where it is supplied with fuel (coal); the flame rises between the two pots, and passes also below and around them, through a number of horizontal and vertical flues and air-holes leading to the chimneys. The pots are, of course, charged before the fire is lighted. The workman enters by the large opening in the middle, and proceeds to charge the pots with alternate layers of charcoal powder and iron bars. The charcoal powder or dust used in the process, is technically called cement: charcoal made from hard wood is generally considered the most suitable; some manufacturers, however, use soot instead; others, a mixture of nine parts of charcoal dust and one part of ashes; some add also a little salt. The workman spreads a layer, about two inches deep, over the bottom of the pots; on this he places a layer of iron bars, which he lays down flat, near each other, except those next to side of the pot, which he places and inch from it; he then spreads another layer of charcoal dust, about an inch thick, over the bars, then again a layer of bars, and so on, alternately, up to within six inches of the top. The top is now covered over, first, with a layer of charcoal about an inch or an inch and a half thick, then loamy earth, four or five inches thick, so as to cement the whole closely down, to ensure entire exclusion of the air. The full charge is about 10 or 12 tuns.

The fire is now lighted below and between the pots, and the iron gradually heated. It takes about four days to heat it through; the furnace has then attained its maximum heat, which is maintained for two or three days; after this a test bar is drawn out to see how the conversion is going on. The heat is subsequently regulated according to the degree of hardness which may be required. The process is considered complete when the cementation is found to extend to the center of the test bar. Eight days generally suffice to convert iron into soft steel, and from nine to eleven days to convert it into the harder sorts.

After the termination of the process, the converted bars are found to have slightly increased in length the one hundred and twentieth part, in weight the two hundredth part, on an average; on breaking a bar across the texture is found to be no longer fibrous, but granular or crystalline. The converted bars are also covered with blisters, which were formerly attributed by some to the expansion of the minute bubbles of air within them, by others to dilatation of the metal occasioned by the presence of sulphur, various salts or zinc, but which it would now appear are simply occasioned by imperfections in the iron, being thrown up in the unsound parts by the dilatation of the metal, and introduction of carbon between those laminæ which are imperfectly welded.

These blisters on the surface have procured for this article the well-known appellation of blistered steel. In this state it is not suited for the manufacture of edge tools. To fit it for the latter purpose, it is passed through the process of shearing or tilting, by which it is made into shear-steel, so called, according to some, from its having been much used in the manufacture of shears for cloth mills; according to others, from being originally employed in the manufacture of shears for cutting the wool from sheep.

The blistered steel is prepared for tilting by breaking the bar into lengths of about thirty inches, piling six or eight of them together, and securing the ends within an iron ring, terminating in a bar about five feet long, which serves as a handle. The pile is then raised to a welding heat in a wind furnace, and is covered with sand, which, melting on the surface, and running over it like fluid glass, forms a protecting coat to defend the metal from the oxidizing influence of the air. When the proper degree of heat has been attained, the fagot or pile is removed from the furnace and placed under a hammer, which unites the pieces into a rod or bar, and closes up internal fissures. This rod is then again brought to a welding heat, and in that condition submitted to the action of the tilt-hammer which we shall have occasion to describe in the course of this paper. The effect of this process is to restore the fibrous character of the metal, and to close all the loose parts and seams. Shear-steel is close, hard, and elastic, and retains the property of welding; it is also capable of being polished. It is much used for tools composed jointly of steel and iron.

Shear-steel, though unquestionably vastly superior to blistered steel, is by no means free from defects, not even after having passed through several tiltings; the great inherent defect in it is inequality of texture and hardness, the outer parts of the bars being invariably and unavoidably more strongly carbonized than the inner and central layers. This defect may, however, be cured, and uniformity of texture and hardness ensured throughout the mass, by another process, viz., casting.

This process consists in melting blistered steel, pouring the melted metal into cast-iron moulds, and subjecting the ingot obtained to the action of the hammer or roller.

The blistered steel is broken in pieces and charged into crucibles made of Stourbridge clay; these crucibles are shaped like a barrel, and fitted with a cover, cemented down with a fusible lute, which, melting after a time, makes the joining the tighter. Each crucible can stand three charges a day, after which it is burnt through; the first charge, about 36 lbs., takes from three to four hours to melt; the second charge, about 32 lbs., about three hours; and the third, about 28 or 30 lbs., from two hours to two hours and a half. The furnaces are common brass-founders' air or wind furnaces, each of them just large enough to hold two crucibles. Coke is the fuel used, the consumption averaging 3½ tuns per tun of cast steel.

The ingots are re-heated in an open forge fire, then passed under a heavy helve hammer, weighing several tuns, the blows being dealt gently at first, in consideration of the crystalline structure of the cast metal; but as the fibrous structure is gradually restored, the strength of the blows is increased. The steel is reduced under the hammer to sizes as small as three-quarters of an inch square. Smaller bars are finished under the tilt hammer, and rollers are also occasionally used, especially for steel of round, semi circular, and triangular sections.

Cast steel is the most uniform in texture and hardness, and altogether best suited for the making of cutting tools, especially of those made entirely of steel. Some sorts of it, however, will not stand the ordinary process of welding, and are therefore altogether unfit for tools made jointly of iron and steel.

Photographing the Eclipse.

The Paris correspondent of the London *Photographic News* says:—

Photographers and astronomers are on the *qui vive*, making their preparations to observe the eclipse of the sun on the 31st December next, to which the recent discoveries of MM. Bunsen and Kirchoff in celestial chemistry impart a new and additional interest.

One point to which observation will be specially directed is the examination of the spectrum of the corona, with which the moon will be surrounded for a moment, in that portion nearest the sun, to see if this aureola exhibits an inversion of the ordinary solar spectrum, or not, that is to say, whether Fraunhofer's rays will be replaced by brilliant lines.

Since the publication of the labors of MM. Bunsen and Kirchoff, the question of a solar atmosphere has acquired a basis, and is susceptible of proof by direct experiment. If, for example, the spectrum of the aureola, which will be produced on the 31st December next, exhibits to us an inversion of the solar spectrum, the much vexed question will be solved, and the existence of a solar atmosphere will become a definite scientific fact. If the contrary should be the case, we may be compelled to admit that absorption takes place in the substance of the photosphere, the surface of which emits not only all the rays, but which doubtless contributes to the light of the sun by a part of its thickness; whichever it may be, the experiment is not impracticable, as it has already been performed. Sig. Fusinieri, of Vicenza, on the occasion of the magnificent solar eclipse of 1842, analyzed the spectrum of the aureola. It appears, however, that he did not attach that importance to it that recent discoveries have now rendered evident. He contented himself with remarking that green was entirely absent from the spectrum of the aureola. The season at which the coming eclipse takes place does not encourage the expectation of fair weather; but we hope for the best.

Hawaiian Islands.

The Honolulu *Commercial Advertizer* says:—Persons, and even old residents, speaking about these islands, are often unable to remember common place data. The principal facts relating to our group should be familiar to every one.

Islands.—There are twelve islands in the group—seven of which are inhabited, the other five barren, but visited by native fishermen.

Population.—According to the census of 1860, the population was 69,800; of which 2,716 were foreigners. The population of Honolulu and suburbs is 14,310; of which 1,639 are foreigners.

Distances.—From Honolulu (in a direct line) to Lahaina, 78 miles; to Kawaihae, 142 miles; to Hilo *via* Kohala point, 215 miles; to Kealakeakua Bay *via* Lahaina, 180 miles; to Kau point *via* Lahaina and Kealakeakua, 220 miles. From Honolulu to Koloa, 125 miles.

Channels.—The Kauai channel is about 75 miles wide; the Oahu and Molokai channel, 24 miles; the Molokai and Maui channel, 10 miles; and the Hawaii channel, 22 miles wide.

Area.—The area of Hawaii has been estimated at 4,000 square miles, Maui at 600, Oahu and Kauai, each 520; and the area of the twelve islands at about 6,000 square miles, or 3,840,000 acres.

Parr's Tool Chest.—We take pleasure in calling the attention of our readers to an advertisement on another page of Parr's tool chest, fitted with all the implements necessary for a carpenter or cabinet maker, and furnished at a low price. Mr. Parr also makes small chests for amateurs, farmers and others who are not practically skilled in the use of tools, and who do not need so great a variety as the professional artizan.

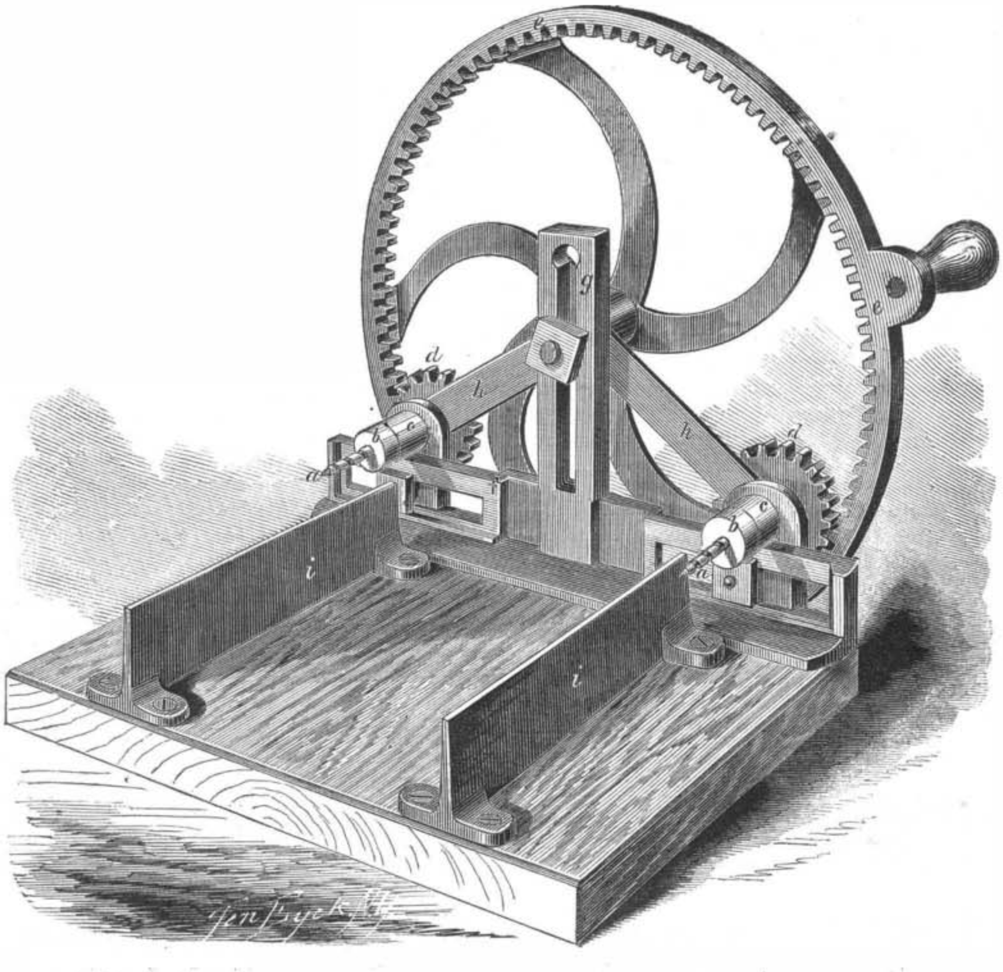
The English papers state that the cotton speculation is going on in England at a tremendous rate; it is at present carried on by ladies, clergymen, lawyers, and others not regularly engaged in business, who have fallen into the mania as others did into the railway mania of 1845. The professional cotton speculators have retired from action. They know that the bubble must burst.

Improved Boring Machine.

A person who will visit the yards of some of the large stave dealers of this city, and see the acres of ground covered with high piles of staves, may form a faint idea of the immense number of barrels that are annually made in the country. This industry being so large, any improvement in it, however slight, is of corresponding importance. The machine represented in the accompanying engraving is designed for boring the holes for the dowel pins, which are used to fasten the several pieces of a barrel head together. It was invented by N. R. Merchant, of Guilford, N. Y., and is in practical and successful operation.

Two bits are arranged, to be driven rapidly by a large spur wheel, so as to bore both of the dowels required in one piece of a barrel head at the same time, to bore them very quickly and with perfect accuracy of position, causing the pieces to fit together exactly at the holes. The bits, *a a*, are keyed securely into the revolving tubes, *b b*. These tubes are reduced in size at about half an inch from their outer ends, and the smaller portions pass through the stationary tubular bearings, *c c*, and carry the pinions, *d d*, upon their ends. These pinions mesh into a gear upon the inner side of the rim of the large wheel, *e*. It will be seen that as the wheel is turned, both bits are revolved in the same direction.

The distance apart of the bits is made variable to adjust it to barrels of different sizes. This is effected by securing the bearings of the bits to the horizontal bar, *f*, by set screws passing through long slots in the bar. The wheel, *e*, must of course be raised or lowered at the same time to preserve its connections with the teeth of the pinions, and it is consequently secured to its standard, *g*, by a set screw passing through a long slat. To preserve the proper relative positions of the wheel, *e*, and the pinions, *d d*, braces, *h h*, connect the centers of the pinions with the center of the wheel; the several bearings passing through holes in these braces near their ends. The stuff to be bored is laid upon the two supports or guides, *i i*.



MERCHANT'S BORING MACHINE.

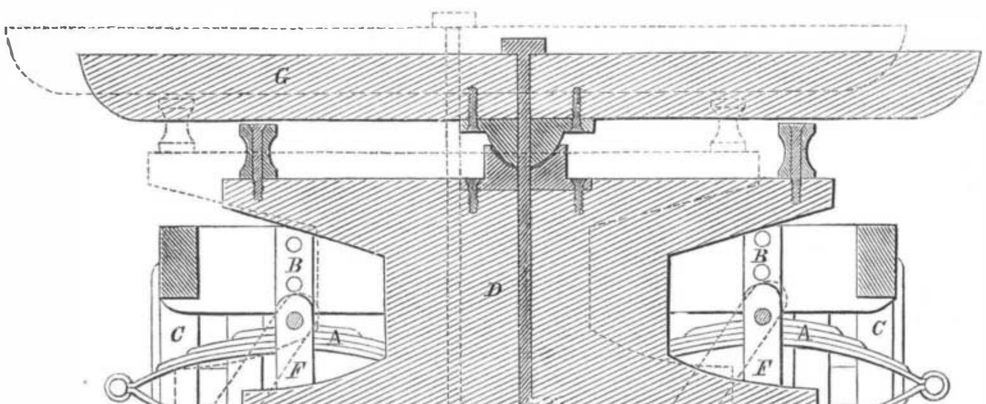
The patent for this invention was granted May 28, 1861, and further information in relation to it may be obtained by addressing A. P. Merchant, at Guilford, N. Y., or C. S. Little, No. 59 Fulton street, New York city.

Improved Car Truck.

In the ordinary mode of constructing the trucks of railroad cars the bolster is supported on the top of the springs in such a manner as to have the motion of an inverted pendulum in its lateral oscillations, and consequently the car at best is very unsteady. The only mode yet adopted to provide for any oscillation, and at the same time render it safe, is so to construct the portion of the bolster between the wheel beams, as that its oscillation will be limited by the beams, against which it is consequently constantly striking, much to the injury of the car and the annoyance of the passengers. The invention here illustrated is designed to overcome this difficulty.

It consists essentially in suspending the bolster in swinging stirrups, which hang from the tops of the springs on pivots. The springs, A A, (see engraving,) are supported at their bottoms by straps, B B, attached rigidly to those cross timbers of the truck which rest on the blocks, C C, rising from the axle. The bolster, D, is then hung upon the lower ends of the stirrups, F F, which are supported by the tops of the springs on pivot pins, so that they may swing sideways, as shown by the dotted lines. Dotted lines also indicate the position which would be occupied by the bolster and by the lower timbers, G, of the car at the extreme limit of this lateral motion.

By this arrangement, while the full elasticity of the springs is obtained, the car is rendered more steady.



HARRISON'S PATENT CAR TRUCK.

As the swinging upward of the car is checked by its weight, there is no necessity for confining the bolster between the wheel beams of the truck.

A bolster may be applied in this way in the place from which an ordinary bolster has been removed, at small expense, and without any alteration of the truck. By a slight modification it is applicable to six-wheeled trucks, as well as to those having four wheels.

The patent for this invention was solicited through the Scientific American Patent Agency, the claims of which appear in another page, and further information in relation to it may be obtained by addressing Amos T. Hall, Treasurer, Chicago, Burlington and Quincy R. R., at Chicago, Ill. The inventor, M. La Rue Harrison, is in the army at present, stationed at Camp Rolla, in Missouri. Mr. Hall is authorized to act for the patentee, and he should be addressed by persons desiring to use the invention.

Making Chlorine.

Chloride of copper is prepared by dissolving the oxide or the native carbonate of copper in hydrochloric acid and then evaporating to dryness until the crystals are obtained. This product is dried thoroughly, then mixed with sand and introduced into retorts like those used for generating gas. These retorts are heated and the dry chlorine gas passes over. This is the most simple way to obtain pure dry chlorine gas for the laboratory. The residuum left in the retorts is a sub-chloride, which can be used over and over again by reconverting it into chloride by exposure to the action of the air in the presence of hydrochloric acid.

Patent Ointment.

C. Stevens, of London, England, has obtained a patent in his own country for an ointment composed of litharge one pound, and strong vinegar and olive oil each one pint. These substances are well incorporated, and then boiled till they form a thickish paste. It is applied by spreading it upon bibulous paper. Sugar of lead and olive oil will make a similar ointment, as the vinegar converts the litharge into sugar of lead. This is one of the mysteries of chemistry—sour vinegar unites with lead, forming the acetate or sugar of lead, a substance of a sweet taste.

Cheap Marine Glue.

The celebrated marine glue is composed of a solution of india rubber and lac varnish, and it really does not contain a particle of genuine glue. As lac is becoming dearer every year a substitute for it has been sought for in the manufacture of marine glue, which is so well adapted for coating the interior of aquariums, wooden water tanks and for caulking the seams of ships. It is stated that asphaltum dissolved in refined naphtha with some india rubber, makes a cheap and very good marine glue.

WHEN the bichromate of potash is heated with the phosphate of ammonia it forms a light but beautiful green color, which is not affected by a red heat.

WOOD may be bleached white, like cotton cloth or paper pulp, by exposing it to the action of warm chlorine liquor or to chlorine gas, when moist.

IN burning anthracite coal every tun of it requires to be supplied with 200,000 cubic feet of air in the furnace in order to produce perfect combustion.