HOW STEEL IS MADE.

The following description of the manufacture of steel is condensed from the *Ironmonger* (London). It is contained in an article by a correspondent, giving an account of the establishment of Watkin & Co., at Stourbridge, England; celebrated for its manufactures of shovels, spades, scythes, forks, anvils, pickaxes, horse shoes, nails and black ironmongery in general. We direct the attention of our American tool makers to the subject; because instead of making their own steel they purchase it, while almost all the great tool manufacturers in England make their own steel, being thus enabled to obtain the material at a much less cost:

"There are various kinds of iron, English, Russian, Spanish, German, but particularly Swedish, for making steel, by the process of cementation, which may be briefly described as follows: The converting furnace of cementation presents the shape of an oblong quadrangle, divided by a grate in the centre into two parts. On each side of the grate runs a long trough or chest, technically called a "pot," about 13 feet long by 3½ feet wide and 3½ feet deep. The furnace is covered in by a semi-circular arch, with a round hole, about 12 inches diameter in the centre, which is opened when the furnace is cooling. A large and tall conical chimney or hood, open at the top, is built over the furnace, which serves to shelter it within, to increase the draught of air, and to carry off the smoke. There are two openings about 8 inches square, in front of the arch, one above each chest or post; these serve for the introduction and removal of the bars, which are slid in and out upon a piece of iron placed to that end of the opening. A much larger opening in the middle, between the two pots, serves to admit the workman. An iron platform is laid along the grate between the two pots; upon this the workman takes his stand. He first sifts a layer of cement —that is, a mixture of about nine parts of ground charcoal made from hard wood, and one part of ashes, with a little salt added to it—on the bottom of each pot or chest, to the depth of about half an inch, taking care to spread the mixture as evenly as possible. He then proceeds to place on this a row of iron bars, cut to the length of the pots. He always leaves about an inch between every two bars. The row of bars thus placed is covered again with a layer of cement about one inch thick, as the carbon here is intended to serve for the bars above as well as for those below. Another row of bars is placed upon the second layer of cement, in such manner that the portion of the bar composing it corresponds vertically with the interstices left between the first row. Then comes another layer of cement and another row of bars, placed in the same relative position to the second as the latter is to the first, and so on alternatively in succession up to within six inches of the top (which makes about ten inches altogether). A final layer of cement is spread over the last row of bars, and the whole is then closely covered in with clay, or with so-called wheel-swarf (the earthy detritus found at the bottom of grindstone troughs) entire exclusion of the air being thus ensured. A few bars are left longer than the others; the extremities of these are left projecting through small openings made in the ends of the chests, closed by doors in the outer walls. These openings, which are called tap-holes, are placed near the center of the end stones of the chests, that the bars projecting through them may serve to indicate the average stage to which the process of conversion has proceeded throughout the entire mass of iron in the troughs. The projecting bars are called test-bars, or trial-rods; their projecting ends are encrusted with fire-clay, or imbedded in sand.

"When the pots are properly charged, all the openings in the furnace are bricked up air-tight. A large fire is lighted in the grate, the flame rising between the two pots, and passing below and around them, through a number of horizontal and vertical flues and air-holes leading to the chimney; the fire is carefully regulated and steadily maintained for the whole period of time required for the cementation of the iron bars in the furnace. It generally takes about four days to heat the iron through; on the sixth or seventh day, according to circumstances, a test-bar or trial-rod is drawn out through one of the tap-holes, to see how matters are going on. The conversion is considered complete when the cementation is found to extend to the centre of the test-bar, which generally takes about eight days for soft steel, and from nine to eleven days for the harder sorts.

"The furnace is solidly constructed of refractory bricks; the two chests or pots being mostly built of fire-stone grit.

"When the trial-rod shows that the desired end has been attained, the fires are extinguished and the furnace is left to cool. The converted iron bars, or, more properly speaking, steel bars, are taken out; they are found, upon examination, to have slightly increased in length and in weight, which is owing to the absorption of the carbon from the cement. On breaking a converted bar across, the texture is found to be no longer fibrous, as it was in the original iron bar, but granular or crystalline. The surface of the bar is covered with blisters, which have procured for the article the name of blistered steel. These blisters are occasionsd by imperfections in the iron, the metal dilating in the unsound parts, and gaseous carbon forcing its way between the imperfectly-welded laminæ. This blistered steel is chiefly intended for the manufacture of edge tools, &c. In the state, however, in which it leaves the converting furnace, it will not answer this purpose; but it has to pass through another process, viz., that of tilting, or, as it is also termed, shearing; to this end the converted bars are broken or clipped into lengths of about thirty inches. Six or eight of them are piled or fagoted together, the ends being secured within an iron ring, terminating in a bar of about five feet long, which serves as a handle. The faggot 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 liquid glass, forms a protecting coat to defend the metal from the ordinary action of the air. When the proper degree of heat has been attained, the faggot is removed from the furnace and placed under a hammer, which unites the piece into a rod or bar and closes up internal fissures. This bar is again brought to a welding heat, and is in that condition subjected to the action of the tilt-hammer, which makes from 200 to 300 strokes per minute. Water is constantly kept pouring on the frame-work to keep it cool. The