

lumps of metal, unalloyed, which could be hammered into knives, hatchets, scythes, plowshares, etc., for domestic use or cultivation of their lands in the "piping times of peace;" and swords, spears, armor, etc., for use in the chase, or stirring times of war and conquest.

With the advent of Iron, began a new era in the social evolution of mankind, known as the

Iron Age.

As in the case of bronze, so in the case of iron, the exact time and place of the discovery is unknown; but archaeological remains, gold trinkets, bronze coins, ivory ornaments, iron swords, scythes, etc., together with rudely-built smelting furnaces, found in the hillsides and prehistoric tombs of Hallstadt, Austria, and Jura mountains of Switzerland, clearly prove that 2,000 B.C. a Gallic race inhabited these regions of central Europe, who, by taking advantage of the discovery of iron, and trading their manufactures with the Phœnicians, enjoyed material comforts and luxuries, and developed skill and taste in the cultivation of the arts of life, far in advance of the rugged nomadic tribes and people by whom they were surrounded, bearing out the famous dictum of Thenard, the Chemist, that we may judge of the state of civilization of any nation, by the degree of perfection at which it has arrived in the workmanship of Iron.



Fig. 3—Primitive Furnace for Smelting Iron.

The method by which these men of the early Iron Age extracted metallic iron from mineral ore, is graphically illustrated in Fig. 3. This picture was drawn from a model in relief, prepared in 1866 by a learned Swiss Engineer, M. Quiquerez, and designed from many specimens found in Hallstadt, Austria, and in the Bernese Jura. The furnace consisted of a cavity in the hillside, covered in with a concave wall about nine feet high, plastered with fire clay,

and surmounted with a conical chimney. Steps made of rough stone were arranged on each side of the mound to enable the workman to climb on top in order to charge with ore and fuel. On the right hand side is a heap of charcoal for fuel, while on the left is a store of ironstone, enclosed in a pen formed of long, wooden logs. In the foreground is a heap of scoria, hammer slag and scale, dropped as debris in the process of hammering the crude metal. A workman is pulling a cake of iron out of the ashes; another is hammering on the anvil a piece of spongy iron, just taken from the furnace. In all these researches, no trace was found of the use of bellows, natural draft only being used at this period; hence, there is no proof that *founding in iron* existed in Prehistoric times. To fuse iron ore, and reduce it to a liquid condition, requires a temperature of some 2,200° F., and this high temperature is not attainable in the natural draft furnace described. In these ancient furnaces, the iron in the mineral ore was only reduced to a red-hot spongy state, and dropped down among the ashes in the form of pasty lumps of malleable iron, weighing from twelve to sixteen pounds, which were worked on the anvil by artisans skilled in the craft of Tubal Cain.

So far we have followed the footprints of primitive man up through the mists of antiquity, guided only by the evidence furnished in roughly chipped flints and stones, cunningly worked bronze tools and ornaments, rudely formed iron weapons, implements, etc., found in deep caverns, embedded in solidified mud or under alluvial deposits of past geological ages.

It is not until 1050 B.C. that we cross the threshold of history, and enter the domain of scientific fact. The first historic record is found in Solomon's famous message to Hiram, King of Tyre (2 Chron. 2:7), where he requests the Phœnician monarch to assist him in building the Temple of Jerusalem, in the golden age of Judea. Said he:

"Send me now, therefore, a man cunning to work in gold, and in silver, and in brass and iron."

The next instance is found in Homer's Iliad, written about 850 B.C.:

"And the Greeks bought wine for shining steel, and some for sounding brass."—(Book VII.)

And where the Trojan captive spy, Dolon, tries to bribe the Greeks:

*"He, weeping, offered
A wealthy ransom for his life, and told them he had brass,
Much gold, and iron, that fit for many labors was, from
Which rich heaps his father would a wondrous portion
Give."—(Book X.)*

From this time forward, the material progress and civilization of the human race, especially in Europe, was greatly accelerated, and largely through the use of Iron, which has felicitously been called the "King of Metals."

(Continued.)

ON COMMERCIAL MILLING.

(Special correspondent.)

Commercial milling is generally understood to mean that which enables the work to be produced most quickly and economically, at the same time with a degree of accuracy that best adapts it to following operations and final assembling.

In this connection it is well to bear in mind, that while desirable to know how much work a machine can produce, it is many a time essential to know with what degree of accuracy the work can be commercially manufactured.

The rates of speed and feed need not necessarily be the limit of the capacity of the machine; but such feeds and speeds should be selected as will best produce the work commercially.

The Brown & Sharpe Mfg. Co., from whose shops the following examples of commercial milling were obtained, is probably one of the most widely known and best equipped

to furnish information relating to the subject in hand. As an example of the completeness of the facilities these shops contain for studying the requirements of commercial milling, we were informed that nearly 400 milling machines are kept in almost constant operation on all varieties of work and it is apparent that the advantages to be derived from such a wide experience in every line covering milling operations, is exceptional. This experience we understand is placed at the disposal of those desiring information as to the most economical method to adopt; if sample pieces or sketches are sent, information is gladly given.

The illustrations show some of the milling operations on the body and slide of a milling machine vise, and the writer perceived that the pieces were practically ready for assembling when received from the machine; the amount of hand-fitting required, being surprisingly small.