

# DESCRIPTIVE METALLURGY OF IRON AND STEEL.

BY

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## Introductory.

In the primitive ages, when our ancestors dwelt in caves, they hunted the buffalo and the bear with bow and arrow and spear, tipped with *sharpened* flints and stones. It was this unique faculty of being able to *invent and form* tools and weapons of defence that "gave man dominion over the fowls of the air, the fish of the sea, and everything that creepeth on the face of the earth." Moreover, this capacity to give new shape and form to existing materials, makes an absolute line of demarkation between man and the lower animals. Monkeys will throw down cocoa nuts from the trees, then pick up a stone and crack the shells; but they always take something ready to their hand—never make a hammer, hatchet, or knife. Elephants tear down branches from the forest trees to drive away the tormenting flies, or to protect them from the burning rays of the tropical sun; but whoever heard of an elephant making an umbrella? There is not an authenticated instance in the history of the world, of an animal lower than man, inventing and making a tool or implement to aid his natural powers. By instinct,—“a propensity existing prior to experience and independent of instruction,” the beaver builds his dam, the bee his honeycomb, and the robin his nest, just as they did at the earliest dawn of civilization. The cave, tent, cabin, cottage, house, and palace indicate the progress made by the human race. By man's unique power of *invention* the desert has been made to blossom as the rose.

The earliest records of prehistoric times show palæolithic man dwelling in hillside caverns, supplementing his natural powers by making stone arrow heads and spear points to

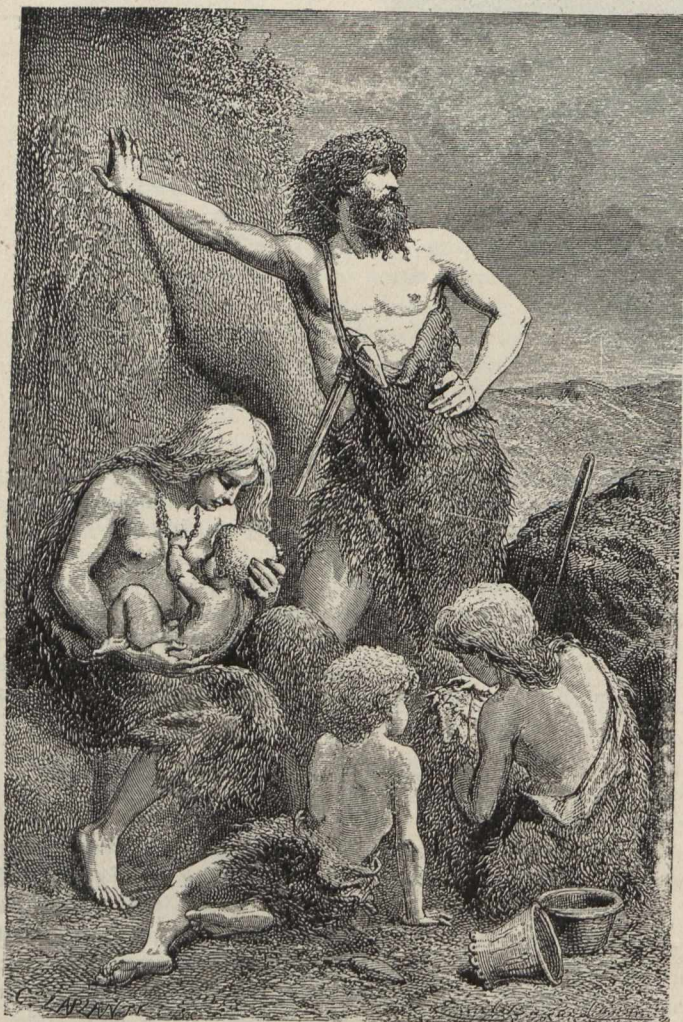


Fig. 1—A Family of the Stone Age.

protect him from the great carnivora, or to kill wild deer for food, and shaping stone hatchets, knives and hammers for cutting up the flesh and breaking the bones. Hence this first period of man's existence has been called the

## Stone Age.

Then came the discovery of copper, which was hammered into ornaments and various articles of domestic use, but was too soft for fine-edged tools and weapons of defence. It was found, however, that by mixing the ores of oxidized copper and tin together, and melting them over a hot charcoal fire, a new metallic alloy resulted, which could be poured as a liquid into moulds, making castings of all shapes and sizes, having any degree of hardness; in fact, a mixture of two parts copper and one of tin makes an alloy so hard that it cannot be cut by ordinary tool steel. It was further discovered that if the bronze was made

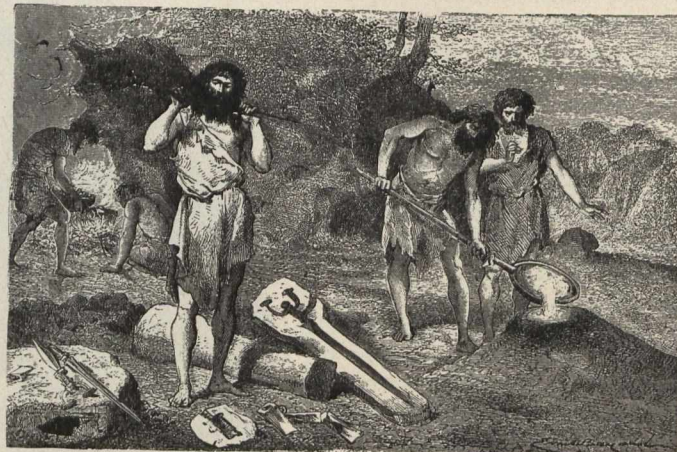


Fig. 2—A Founder's Workshop during the Bronze Period.

red hot, then suddenly plunged into cold water, it become comparatively soft and ductile, and could be hammered into any shape, but if made red hot again, and allowed to cool *slowly*, would once more regain its original hardness. The native workers of bronze in India still take advantage of this diverse process, for it is the very way in which they make their cymbals and tomtoms to-day.

We thus see, that in bronze, Neolithic man discovered a metallic composition admirably adapted to his nascent industrial skill, for without much trouble they could pour it as a liquid into moulds having the form of hatchets, poniards, swords, agricultural implements and mechanical appliances of all kinds.

In this way began the art of founding in metals. At what precise date and in which part of the globe this simple but important invention was made is enveloped in mystery. The earliest written record is found in Genesis 4:22, where Tubal Cain is described as "an instructor of every artificer in brass and iron," while tradition declares that bronze was first introduced into Central Europe by Phœnician traders about 1500 B.C.

This Epoch, or second period in the story of mankind, is known as the

## Bronze Age.

But although bronze was a great advance over stone as a means of aiding the natural powers of primeval man, yet, as organized communities took the place of the patriarchal family and tribe, and the wants of the social organism became necessarily more varied and complex, it was found that copper and tin, and the bronze alloy made therefrom, were not elastic and hard enough, and the supply of their ores not plentiful enough to meet the increasing demands of the newly-formed societies. And since "Necessity is the mother of invention," and the art of metallurgy had made great progress during this Epoch, as the unearthed prehistoric relics of the period show, it is not surprising that Tubal Cain, or some other skilful founder in "brass," tried the experiment of smelting in a hot charcoal furnace the red oxides of iron which they found in abundance cropping out of the hillsides, and succeeded in easily producing