The interior of the blast furnace may be divided into four distinct regions; the first and uppermost is that in which the mixture of ore and fuel is roasted; the water and volatile matters are there driven off, and the whole is gradually heated to redness. In the second region, immediately below the last, the already ignited ore is reduced to the metallic state by the ascending current of carbonic oxyd gas; the metal thus produced is however in the condition of malleable iron, nearly pure and very difficultly fusible; but in the third region it combines with a portion of carbon, and is converted into the fusible compound known as cast In addition to this, small portions of manganese, alumi-<sup>i</sup>ron. nium and silicium, whose combinations are always present in the contents of the furnace, become reduced, and alloying with the iron, affect very much its quality for better or worse. Cast iron generally contains besides these, small portions of sulphur, phosphorus, and other impurities less important.

In the fourth and lowest region of the furnace, which is near to the blast, the heat becomes more intense, the carburetted metal melts, together with the earthy matters, and both collect at the bottom of the crucible upon what is called the hearth, from which the two are drawn off from time to time. The cast iron thus obtained is very fusible, but brittle, and is far from possessing those precious qualities which belong to malleable iron or steel.

To convert the cast metal into malleable iron, it is exposed to a process which is called *puddling*, and consists essentially in fusing it in a furnace of a peculiar kind, where the metal is exposed to the action of the air. The carbon, manganese, silicium, and other foreign matters, are thus burned away, and the once liquid metal is converted into a pasty granular mass, which is then consolidated under hammers or rollers, and drawn out into bars of soft malleable iron.

To convert into steel the soft iron thus obtained, it is heated for a long time in close vessels with powdered charcoal, a small quantity of which is absorbed by the iron, and penetrating through the mass changes it into steel. This process is known by the name of *cementation*. The change is however irregular and imperfect; it is therefore necessary to break up these bars of cemented or blistered steel, as it is called, and after assorting them according to their quality, either to weld them together, or to melt down each sort by itself in large crucibles. The metal is then made into ingots, and forms cast steel, which is afterwards wrought under the hammer and drawn out into bars.