with a formation of oxide of iron, which passes into the slag and sulphide of copper.

The charge consisting of :—

Calcined coarse metal	30 Cwt.
Carbonates and oxides	16 "
Slags from No's 5 and 6	5 "

is treated in a furnace similar to No. 3, except that the hearth has no cavity at the tap hole but slopes from all sides towards that point. The time necessary to complete this operation is about six hours and the resulting product fine metal.

Blue metal is produced when an insufficient quantity of oxidized ores have been added, and pimple metal when too great a quantity has been present, whilst the production of white metal indicates the presence of the proper proportion.

The following analyses of white, blue metal and metal slag gives the composition of each.

	White Metal	Blue Metal
Copper	77·4%	56·7
Iron	·7	16·3
Nickel, Cobalt and Manganese	traces.	1·6
Tin Arsenic	·1	1·2
Sulphur	21.	23·
Slag and sand mechanically mixed	.3	·5
Total	99·5	99·3

Metal Slag.	
Silica	33·8
Alumina	1·5
Ferrous Oxide	56·0
Cuprous Oxide	·9
Other Oxides	2·1
Lime	1·4
Magnesia	·3
Slag Mechanically Mixed — Copper	2·9
Slag Mechanically Mixed — Iron	·3
Slag Mechanically Mixed — Sulphur	·8
Total	100·00

V. *The composition* of the fine metal influences very largely the manner in which this process is carried out, but the principles involved are these : When cuprous sulphide is heated with excess of air sulphurous anhydride is formed, while copper enters into combination with oxygen, further, when oxide of copper is heated with a sulphide of that metal sulphurous anhydride is formed and metallic copper separates.

The charge 3 to 3½ tons of fine metal is placed in the furnace and roasted for some time with excess of air ; when it is thought a sufficient quantity of oxide of copper has been formed the furnace is closed and the temperature raised to fuse the metal. When fusion has taken place the furnace is allowed to cool slightly, but is again raised in temperature toward the close.

The time required for the completion of this operation varies with the quantity of sulphur present but occupies from 12 to 24 hours, the regulus, however, fusing in from four to six hours.

The resulting product is run into moulds and takes the name " Blister Copper" from its having a blistered appearance produced by the escape of sulphurous anhydride during cooling.

The following analyses of roaster slag and blister copper are by Laplay :—

Roaster Slag.	
Silica	47·5
Alumina	3·
Cuprous Oxide	16·9
Ferrous Oxide	28·0
Oxides of Cobalt, Nickel and Manganese	·9
Slannous Oxide	·3
Lime and Magnesia	traces.
Metallic copper	2·0
	98·6

Blister Copper in 100 Parts.	
Copper	98·4
Iron	·7
Nickel, Cobalt and Manganese	·3
Tin and Arsenic	·4
Sulphur	·2
Total	100·0

One method of making the purest variety of Commercial Copper, is to carry on the roasting of the fine or blue metal until about one half liquates out and is tapped off whilst the furnace temperature is raised and the remainder fused and tapped into moulds. The metal first drawn contains nearly all the arsenic tin, etc , as the alloys fuse more easily than the pure coppert, this is called bottom, or tile copper ; as the alloy is more dense than pure copper it settles to the bottom of the pigs and when cool is knocked off and " best selected" is left.

VI. Refining. *In this operation* the impurities contained in Blister Copper are removed by the action of the oxygen of the atmosphere. The furnace used is very similar to those used in operations No's 2 and 4 except that the fire grate is larger, there is no hopper, or hole through the roof. There is neither hole in the bed or tap hole, but the hearth is inclined towards the door at the end where the molten metal collects in a depression of the hearth.

The charge of from six to eight tons is piled in the furnace in such a manner that the air may circulate freely among the ingots and at first a moderate heat is applied to allow the oxygen to combine with sulphur to form sulphurous anhydride, with arsenic to form arsenious anhydride, and with iron, tin, etc., to form oxides.

When the metal has been subjected to this process for about six hours the furnace is closed and the metal fused and a thin film is formed on its surface ; this is skimmed off, and when a sample of the metal taken out contracts on cooling the roasting is finished.

In order to toughen the metal it has to pass through a process of poling, this consists of covering the surface with powdered anthracite or charcoal, to prevent oxidation of copper, inserting green poles and stirring the molten metal until a sample cut half through and then broken exhibits the characteristic color and fracture of copper.

The effect of this poling is the removal of the oxygen taken up in the last process, but a stage may be arrived at when it will be overpoled making it even more brittle than before poling was commenced ; this effect was at first attributed to absorption of carbon by the copper, but as analyses have failed to prove the