seven of chlorine liberated. The latter quantity was sufficient to convert fifty-nine grains of copper into proto-chloride. It becomes therefore difficult to say why the whole copper contents, 47 grains, where not extracted. Since the temperature was kept very moderate, the only other cause which may possibly have affected the result unfavorably, was the continuing of the calcination beyond the proper point, and the consequent decomposition of proto-chloride into insoluble sub-chloride of copper.

In order to ascertain whether the copper unaccounted for in the last experiment remained in the residue or was volatilized, the following experiment was made.

200 grains copper pyrites.
500 grains iron oxide.
200 grains salt.

900 grains were mixed together.

The pyrites contained 23.6 per cent, equal to 47.2 grains of copper. The mixture was calcined at a low temperature until the evolution of sulphurous acid and then of chlorine ceased. The result weighed 911 grains, and contained—

| | |
|---|---|
| Iron oxide and other insoluble matter.... | 67.33 |
| Cupric oxide..... | 1.87 = 1.5 copper. |
| Sulphate of soda..... | 12.6 |
| Chloride of copper..... | 8.14 = 3.8 copper. |
| Chloride of sodium (by difference)..... | 10.06 |
| | 100.00 |

It is evident from this that seventy-three per cent of the copper contained in the original ore was rendered soluble, and that twenty-seven per cent was left in the residue insoluble, but whether in the state of sub-chloride or oxide I did not ascertain. If we calculate from the amount of sulphate of soda formed in this experiment, it would appear that but a very little more chlorine was developed than was necessary to take up the whole of the copper as proto-chloride, so that it is most reasonable to suppose that the copper which remained insoluble was in the state of oxide, and had never had an opportunity of uniting with chlorine. The result of the experiment as to the volatilization of the copper was decisive, inasmuch as the whole of the copper was found in the product; therefore none could have been sublimed. The experiment also indicated that in order to a perfect extraction, an excess of chlorine must be presented to the copper.