

LXXIII.—*The Relative Weights of Gold and Silver dissolved by Potassium Cyanide Solutions from Alloys of these Metals.*

By J. S. MACLAURIN, B.Sc., University College, Auckland,
New Zealand.

IN the extraction, by means of potassium cyanide solutions, of gold and silver from ores containing them, it is found that the percentage of gold recovered is almost always larger than the percentage of silver. This fact must be due to one or both of two causes; 1st, in an alloy of gold and silver the gold is more readily dissolved than the silver, or, 2nd, gold generally exists in the metallic state, whilst silver is often combined with sulphur, tellurium, &c., forming compounds which are only slowly dissolved by the cyanide. In order to test the first of these hypotheses, alloys of gold and silver of varying composition were prepared, and, after being rolled into sheets, circular plates were stamped out of them. These plates were then exposed, in Nessler test-glasses, to the action of a 0.5 per cent. solution of potassium cyanide for two hours. The cyanide solutions were evaporated to dryness, and the bullion and gold determined by ordinary assay methods.

The results are contained in the following table.

Percentage of gold in plate.	Percentage of gold in bullion dissolved by KCN.
20	20·0
50	47·8
80	77·5

These results show that, practically, gold and silver are dissolved from an alloy of these metals in the proportions (by weight) in which they exist in the alloy. At first sight this appears to be in direct opposition to my results on the rate of solution of the two metals when separate (Trans., 1895, 67, 199), as it was then shown that "the ratio of the amount of gold dissolved by any given cyanide solution to that of the silver dissolved by the same solution is nearly in the ratio of their atomic weights," or, in other words, for every 197 parts of gold dissolved only 108 of silver pass into solution. In an alloy of the two metals, let A represent the weight of gold, and B the weight of silver, then the relative areas of the metals exposed to the cyanide will be $\text{gold} = A/\text{sp. gr. of Au} = A/19\cdot3$, $\text{silver} = B/\text{sp. gr. of Ag} = B/10\cdot45$.*

But, as already shown (when the metals are separate), the weight of gold dissolved : the weight of silver dissolved from equal surfaces :: the atomic weight of gold : atomic weight of silver, or $\text{Au/Ag} = 196\cdot85/107\cdot66$, and, assuming that this relation holds good when the metals are alloyed, we get

$$\text{Weight of Au dissolved} = A \cdot 196\cdot85/19\cdot3 = A \cdot 1\cdot02.$$

$$,, \quad \text{Ag} \quad ,, \quad = B \cdot 107\cdot66/10\cdot45 = B \cdot 1\cdot0206.$$

But $196\cdot85/19\cdot3 = \text{atomic volume of gold}$, and $107\cdot66/10\cdot45 = \text{atomic volume of silver}$, and, as these atomic volumes are practically equal, the relative weights of gold and silver dissolved are proportional to A and B, that is, to the weights of the respective metals in the alloy. As the results given in the above table are in accordance with this hypothesis, we may conclude that it is correct, and that, from an alloy of gold and silver, the metals are dissolved in the ratio of their atomic volumes.

* This becomes evident if we consider a cube of the alloy to be divided into thin layers, and the layers into infinitely small prisms of gold and silver, the number of prisms of the respective metals being in the proportion of their volumes.