

that is either insoluble or but very slowly soluble in these strong solutions, but is soluble to a considerable extent in weak solutions. It is, I think, very probable that the cyanide of gold that first forms on the gold has to be dissolved as the simple cyanide before it can be so acted upon by the potassic cyanide as to pass into the comparatively soluble auro-cyanide of potassium.

In this connection I would here observe that the function of the negative metal or metallic sulphides as above employed is to dispose the potassic cyanide to rapidly dissolve these auro-cyanide films off the gold as they form thereon, or it may be simply to allow of the electricity generated by oxidation to become dynamic or current-electricity, so that the gold still remaining undissolved is not charged with the educts of chemical action.

There is one very important matter in connection with the cyanide process that I have not yet touched upon, as being one outside the questions raised in your instructions to me, but it so deeply concerns all those who have monetary interest in this process that I make bold to treat it here, and it is this:—

Are weak solutions of cyanide best to use for the cyanide process? and, if so, for what reasons?

In regard to this, I have first to say that I have not had the opportunity for testing the correctness of the idea that is generally held, that such solutions are the best to use. I have, however, made a series of experiments to show the point of dilution at which the maximum of rapidity of the solution of gold by the cyanide is attained; and it is certainly under 1 per cent.; and, as near as I have to the present time made out, the maximum is got with solutions of about 0.25 per cent. of the salt.

Solutions of the cyanide at about this strength, therefore, being the most rapid in their action upon gold, would certainly be the best to use for its extraction at the mines, and especially if it acts upon the ores of copper, &c., at a rate in some degree proportional to their strength; and that they do so, a series of very carefully-conducted experiments of mine have just shown.

On the ground of economy, therefore, at least the very dilute solutions of the cyanide are certainly best.

But besides this, such solutions are the best for another and a far graver reason, and it is this:—

As I have already shown (page 187), when certain very commonly-occurring metallic sulphides are present, the cyanide solution, whether weak or strong, become contaminated with sulphur as a component of potassic sulphide; and, as I have further shown, this sulphide attacks gold with considerable energy and great rapidity, forming thereon films that greatly retard, if not altogether prevent, the action of chemical agents upon the metal underneath them.

It is true that, with free access of air thereto, this sulphur is oxidized to compounds that are innocuous;* but this oxidation is a slow process; therefore, if we form this potassic sulphide rapidly and in quantity, as we are very likely to do when working on impure quartz with strong cyanide solutions, we by so much intensify the evil that it is our business at least to mitigate if we cannot entirely prevent.

Thus it may be seen that weak solutions should be the best to use in the cyanide process, for two grave reasons, each of which is sufficient to make their use indispensable for the working of it.

Such are the results of my very much hurried investigations regarding the questions that you have set me to answer, and those closely related to them, that have cropped up in the course of my inquiry; and I will only add that the chemistry of the cyanide process is so intricate, the reactions by which the gold at our mines is ultimately secured by are so feeble, and, consequently, so easily retarded, that the first results of experimental researches, both at the mines and at the laboratory, need corroboration before they should be accepted in every part without reserve.

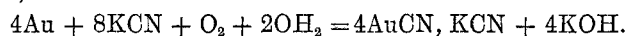
I therefore claim the privilege of being allowed, in a future communication, to correct any slight inaccuracies that may have crept into these statements.

MR. MACLAURIN'S EXPERIMENTS.

The results of Mr. MacLaurin's experiments are summed up in the following manner:—

1. Oxygen is necessary for the dissolution of gold in potassium-cyanide, and no gold is dissolved in its absence.

2. The ratio of gold dissolved to the oxygen requisite for its dissolution is 196 to 8, as demonstrated by the equation,—



3. The ratio of dissolution of gold in potassic-cyanide solutions varies with the strength of the solution, being small for concentrated solutions, increasing as the solution becomes more dilute, reaching a maximum of 0.25 per cent. of cyanide, and then again diminishing.

4. The ratio of dissolution in potassium-cyanide varies in the same way, and a maximum is reached at the same degree of dilution.

5. 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 the ratio of atomic weights.

6. The variation in the rate of dissolution of gold in cyanide solutions is not directly influenced by the amount of cyanide in solution, except in the case of very dilute solutions, but is mainly due to the solubility of oxygen in these solutions, the amount of gold dissolved being nearly proportional to the absorption of the co-efficients of oxygen in such solutions.

7. The ratio of dissolution of gold is, however, not exactly proportional to the above-mentioned co-efficients, but rather less than it should be for the more concentrated solutions.

8. The explanation of this diminishing ratio of the gold dissolved to the oxygen available as the concentration of the solution increases is to be found in the increasing viscosity of the solution as the quality of the cyanide augments.

* A solution of cyanide containing 8 per cent. of sulphide of potassium had all its sulphur oxidized by standing in a shallow vessel for one hour exposed to the air.