

through them in extremely fine particles, he adds sufficient alkali to feebly alkalize it, and afterwards adds thereto, say, three volumes of a 0·3-per-cent. solution of the cyanide, he will find that, as a rule, there will not be a complete dissolution of the gold until five minutes has elapsed; and he will further find that the disappearance of the gold—i.e., the discolouration of the fluid—is progressively slower as the operation goes on—that the last traces of gold linger, as it were, in the liquid in a very marked manner, instead of vanishing from sight in an abrupt manner, as we should expect. These were, at any rate, my experiences of the matter, and I took great care to prevent either any excess of auric chloride or any compound of phosphorus interfering with the experiment.

In a test experiment I made for comparative purposes, I had a square inch of gold-leaf dissolved, and the solution of gold resulting was then decomposed and made up to 6 cubic inches of the gold-fluid; and the gold in this fluid was found to be dissolved by three volumes of the 0·3-per-cent. cyanide in five minutes. Now, were the gold-leaf I took only divided by the precipitating-agent into cubes of the same thickness as that of the gold-leaf—say, $\frac{1}{280000}$ in.—the speed of dissolution should, if regulated by the extent of gold-superficies exposed to the cyanide, have taken place in about one minute, because the same kind of gold-leaf that I used in this case was dissolved as in its oxygenated state in eighteen minutes, and by the same stock solution of cyanide that I used for my former test. The gold-leaf, therefore, as thus divided, is three times longer in dissolving than the gold-leaf was. But it is certain that the gold has been much more finely divided than this; therefore it is certain that the retardation of the dissolution of gold by such a division of it as we have in these solutions, or, rather, auriferous liquids, is very much greater than the results of these calculations show; consequently the rate of dissolution for similar areas exposed is still more in favour of the leaf-gold. The fact should be noted that it is the finely-divided gold, which is, of the two, the most liberally supplied with oxygen.

As an abundance of time is given at the mines for dissolving fine gold, the fact I have here described does not concern the cyanider, and I only give it as being of possible interest to the chemist.

To present a complete record of all the experimental results that since my report to the Mines Department I have obtained in my investigation of the chemistry of the cyanide process, I insert here the following extracts from the Twenty-ninth Annual Laboratory Report, 1894–95:—

“1. In the exercise of selective action of potassic cyanide for gold, when paired with a conducting metallic sulphide, there is only a very slight conservation of that sulphide—so slight, indeed, as to be hardly appreciable.

“Now, this is exactly what any one would expect when he considers that the electric current—the very existence of the voltaic pair here—is founded upon an oxidizing process only, the oxidation either of the gold or the potassium of the cyanide by atmospheric oxygen; the gold or the potassium (as the case may prove) being more easily oxidized in this way than the metallic sulphide used. As I have proved (and shall show in due course), the solution of the sulphide in potassic cyanide which simultaneously occurs produces no electricity—at least, no dynamic electricity: it melts in the cyanide as sugar melts in water. Whether the sulphur of the ore goes to the basic side of the salt to form potassic sulphide, or to the acidic side to form a radical—sulpho-cyanogen*—it is all the same, no electric current is produced.

“2. Generally, any salt added to a good working-solution of potassic cyanide acts the same as an equal quantity of the cyanide in retarding or preventing dissolution of gold. Sugar and glycerine produce the same effects.

“3. Albumen added to a solution of potassic cyanide of 0·26 per cent., in quantity sufficient to well froth such solution when whipped with it, did not appear to exercise any retarding effect on the dissolution of gold.

“4. Potash when added to an aqueous solution of potassic cyanide does not, as is now authoritatively alleged, destroy the cyanogen of that salt by hydrolysis or in any other way, but, on the other hand, conserves it.

“Thus we see that, instead of being, as it is termed, a cyanicide, potash is a preservative; consequently the excess of it in the cyanide-solution that we are now urgently warned against we need not fear to have. Far better the excess, even to a great excess, than the deficiency, even if but slight. There is only this point to consider: that, as potash, soda, and salts generally (see 2) retard the dissolution of gold in potassic cyanide, it is certainly right that no large excess of it should be used.

“5. Ammonia, whether in large or in small proportion, decomposes the cyanogen of potassic-cyanide solutions, and this whether it is applied in its combined state, as the chloride, &c., or in its uncombined state.

“Here, then, is the cyanicide that the worker of cyanide plants should be warned against—this, the ever-present enemy that he has to contend with, and not caustic potash, one of his best friends.

“6. Ammonia decomposes the potassic cyanide of these solutions, gradually taking off the cyanogen as a part of ammonium-cyanide. Salts of ammonia effect the same decomposition.

“7. Contrary to what is now alleged, nitrogen does not decompose potassic cyanide and carry hydrocyanic acid off when it is passed over or through a solution of this salt.

“These results (Nos. 6 and 7) would seem to show that, in the case where a loss of cyanogen occurred by passing nitrogen through a cyanide solution, such loss was entirely due to the action of ammonia, this compound being frequently present in cyanide-solutions that have been made for some time. It is also present in all soils and many rocks, and would be taken up by potassic-cyanide solutions.

* I believe that I was the first to show that the cyanogen of potassic cyanide in dissolving metallic sulphides formed with a part of their sulphur sulpho-cyanogen (see “On the Production of Artificial Chromes,” Trans. N.Z. Inst., Vol. xxi., p. 360).