The following results, which I have only just obtained, show how extremely objectionable alkaline sulphides are, when present in the cyanide solution :—

A rather strong solution of the cyanide, containing a small proportion of sulphur, was placed over a strip of gold coupled with a piece of copper-glance (sulphide of copper), but no solution of gold was perceived; however, on substituting the copper-glance with chalcopyrites, the gold was rapidly removed.

This experiment shows that the gold was sulphurised at the outset by the alkaline sulphide present in the cyanide, and that it required connecting with a substance of a very negative kind in order to effect the decomposition of the auriferous sulphide so formed.

Further experiments of a different kind showed that while pure cyanide of 1-per-cent. solution dissolved a given weight of gold in ten minutes, a solution, of the salt of the same strength, but containing $\frac{1}{100000}$ part of sulphur (as a sulphide),* required two hours to dissolve the same weight of gold. The speeds are as 1 to 12 in favour of the pure cyanide.

The following table shows how very much even a gentle sulphuretting, or flouring of the gold, interferes with its solution :—

Gold sulphurised	60	seconds	in K.S. dissolved in cyanide in	62	minutes.
"	54	"	" "	50	"
"	1	second	" "	36	"
Gold, clean, dissolved in cyanide in			"	12	"

The gold was well washed from adherent potassic sulphide before being placed in the cyanide. Making the clean gold the unit, we have, approximately, the times thus : 1, 3, 4, and 5.

As connected with this subject, I should here state certain results that, in the prosecution of the work sent me, I have obtained in regard to the part that is played by oxygen in the working of the cyanide process.

Though unreservedly accepting, as I always have hitherto, Elsner's statement that free oxygen is necessary for the solution of gold in potassic cyanide, I felt somewhat staggered when I saw how very rapidly gold was dissolved in this salt when in voltaic contact with copper-glance; and I thought that it was just possible that, at least, some of the oxygen required to aid the solution of this metal was obtained by the decomposition of water, as Mr. McArthur supposes is always the case for gold dissolving in potassic cyanide. I therefore instituted the following experiments to show whether or not water is decomposed when gold is thus paired with a substance negative to it, in such solutions :—

1. A large sheet of gold (4in. square) was connected by platinum-wire with a very small piece of chalcopyrites, and immersed in a cyanide solution containing lead in very perceptible quantity. A galvanometer intervening showed that strong action was taking place, but there were no signs of any evolution of gas from the negative pole—that is, from the chalcopyrites—nor was there any discolouration of the liquid in the vicinity of that ore, which there would have been had water been really decomposed during the process.

2. A piece of gold was bound in metallic contact with platina, and immersed in a solution of 2 per cent. that had been charged with tannic acid, in sufficient quantity to take up all the free oxygen present therein. This solution was then covered with oil (to exclude the air). After the lapse of twelve hours the gold did not appear to be at all eroded. When air had been let into the solution afterwards, the gold entirely dissolved in a few minutes.

It is clear, therefore, and a fact not to be controverted, that, even in the extreme case where voltaic contact is provided, water is not decomposed, but the free oxygen of the air is all-sufficient for the reaction for the solution that is required.

So far, then, as I know, Elsner's statement in respect to the requisite agent for the solution of the gold in the cyanide process is correct, and I accept his formula for the reaction.

The reason why oxidation of gold, and its subsequent removal by the cyanide, is in certain cases so slow as it is, is one, which, in the interest of gold extraction by the cyanide process, should be ascertained.

Why very weak cyanide solutions act as swiftly as they do, while strong solutions do not act upon gold to a degree or at a speed in any way corresponding to what we expect, is a problem that has not, I think, been solved. To account for this it has been assumed that strong solutions of the cyanide do not dissolve oxygen, or are not permeated by it as readily as weak solutions are.

But that there is a plentiful supply of oxygen in these solutions is made manifest by the results of the following experiments :—

1. A newly-made cyanide solution of greatest strength is poured into a shallow vessel, and at the bottom of it a small slip of gold-leaf, gummed on paper, is placed. A long slip of the same is then placed so that one end rests also upon the bottom of the vessel, while the other end projects out of the solution. In a few minutes it may be seen that the whole of the gold on the long slip has been dissolved, while the piece that is wholly immersed in the fluid does not appear to be at all affected.

2. In the same solution place a slip of gold-leaf coupled with platina, so as to lie also at the bottom of the vessel, when in a short time it may be shown that the gold has entirely dissolved, while the gold-leaf that was not paired with any negative substance has not been affected.

With chalcopyrites for the negative pole, the solution of the gold was far more rapid than in the former experiment when platinum was used for this purpose, showing the advantage there is in pairing the gold with a substance that is strongly electro-negative to it.

I think the results of these experiments clearly prove that there is a sufficiency of oxygen present, even in the strongest solutions of potassic cyanide, to allow of the rapid solution of gold therein.

But why strong cyanide solutions have so little, or so very slow, an affect upon gold, as we find, is a question that, in the light of these results, appears as yet quite unanswered. For my part I am inclined to think that a compound forms upon the gold, when in strong cyanide solutions,—

* This impure potassic cyanide contained 1 per cent. of sulphur.