EXPERIMENTS BY W. SKEY, COLONIAL ANALYST, ON THE SOLVENT PROPERTIES OF ORES IN CYANIDE SOLUTIONS.

In answer to your memorandum to me, dated the 22nd March, I have the honour to report to you upon the question as to whether or not very weak solutions of potassic cyanide exercise any "selective action" upon gold, in preference to cupreous compounds generally, or upon any of them; also upon the question as to whether or not aqueous solutions of potassic cyanide of a strength as low as 0·03 per cent. decompose these compounds. The results of the experiments I have made to settle these questions very clearly show, as I believe,—

1. That aqueous solutions of potasic cyanide of every degree of possible strength have a "selective action," and a powerful one, both upon gold and silver, when these metals are in contact with any cupreous sulphide, also when they are in contact with ores and metals generally that are conductors of electricity.

2. That when any ore of this class of sulphides is thus placed in contact with either gold or silver in cyanide solution, the solution of these metals is very much accelerated, while the sulphide is partly conserved, being rendered negative to the cyanide by the electrical current that proceeds from the metal.

3. That in the cases of those sulphides or other compounds that are not electric conductors, also in the case of conducting sulphides, &c., that are not in voltaic contact with the metal, no truly "selective action" takes place in such a solution, however weak it is; but it rather appears, on the other hand, that these cupreous compounds, and the metals used, will appropriate the cyanogen of the solution to a degree somewhat proportional to the extent of their superficies.

4. That solutions of potassic cyanide containing even so little as 0·03 per cent of the salt attack all copper sulphides, including chalcopyrite.

The following statement gives the details of the experiment and results thereof upon which I base the foregoing conclusions. In them it will be seen that I have, in the strict pursuance of the subject, enlarged the scope of this inquiry so far as to take in it the behaviour of metallic sulphides generally with cyanide solutions. For this wider object my first step was to take advantage of the fact announced by myself in 1872,* that a great number of the metallic sulphides, also a few of the arsenides, are conductors of electricity; and, further, are capable of forming amongst themselves in suitable solutions of salts, &c., voltaic pairs, and which can produce well-marked chemical effects. Using, therefore, this groundwork I have been able to answer these questions expeditiously, and, as I think, absolutely, and this in a manner that admits of ocular demonstration.

First, I connected a gold-plate with a piece of chalcopyrite through a galvonometer, then plunged the two substances in a solution of potassic cyanide, when I observed that the needle—that is, the index—of the galvanometer was vigorously deflected, and in a direction that indicated the gold to be the positive element of the pair—that is, the element which was being dissolved by the solution.

Cyanide of 20 per cent., and cyanide of but 0·02 per cent., had the same effect on the pair. The chalcopyrite was not acted upon by the cyanide to any notable extent.

A quantity of other sulphides, including those of covelline (CuS), copper-glance, and enargite, I also tested in this manner, and I found all those that are electrical conductors are, like chalcopyrites, negative to gold.

Silver, like gold, I found to be electro-positive to all the conducting metallic sulphides that I tried.

As a knowledge of the electro-motive order of the more common of our native sulphides in cyanide solutions may be of use to the managers of mills using the cyanide process, I herewith append a table in which this is shown. The ones marked with an asterisk are those which I place provisionally, pending further experiments to determine their exact positions.

Attached to this table, and at foot thereof, as properly placed, I state the electro-motive order of certain metals in the same solution. This portion of the table is extracted from Vol. viii., "Transactions of the New Zealand Institute" for the year 1875, page 234.

The order observed in this compounded table is from negative to positive. When any one of the substances named therein is in electric contact with another in the cyanides it is the one named under it that is the substance attacked by the solution.

Electro-motive Order of Certain Metals and Ores in Potassic Cyanide.

Graphite	Sulphide of silver.*
Mispickel.	Sulphide of gold.*
Enargite.	Platinum.
Iron pyrites (cupric).	Mercury.
Chalcopyrites.	Lead.
Zinc-blende (ferruginous).	Gold.
Copper-glance.	Silver.
Covelline.	Tin.
Galena.	Copper.
Proustite.	Zinc.

Following up my experiments in this direction, I next tried whether the actual contact of a conducting sulphide, with gold or silver in a cyanide solution, would accelerate its action upon the metal (as the contact of platinum with zinc accelerates its solution in suitable solvents), when I found that a very marked acceleration of the action of the cyanide upon the gold did occur.

* Vol. iv., Trans. N.Z. Inst., page 311.