The next theory is one which, if not yet precisely formulated in a public print, is, as far as I can learn, the popular one among the cyaniders, as it really appears to exactly fit the facts of the case. Taking cognisance of the fact that oxygen is a necessary factor in the process, and is far more plentiful at the surface of the cyanide-solution than in the solution itself, it claims that this rapid dissolution of gold at the surface is simply due to the plentiful supply of this gas. In this connection, it is right that I should take cognisance of the fact that Mr. Maclaurin, F.C.S., has given us a theory to explain the rapid action of cyanide-solutions on gold so placed that, as he suggests, it may be considered as only an extension of the under-surface of gold in the position described, and consequently is a theory that, if true, goes to explain the particular phenomenon under consideration here, and therefore has to be noticed in this communication. This theory, then, maintains that there is generated at the surface of the cyanide-solution on which gold is resting a current of electricity, and that this current causes the solution of the gold (at least, the gold immediately under that having contact with atmosphere)—that, in his own words, "the solution of this gold is due to electrolytic action obtained by the action of the cyanide and the oxygen of air."*

This is the theory that Mr. Maclaurin offers us to explain the rapid dissolution of the under-parts of gold resting on a cyanide-solution. However, as previous to the reading of the paper embodying this theory I had shown that the current which does obtain in this case is just in the reverse direction to what he affirms it to be, I need not do more than state the fact that this gold is not brought into solution by an electrical current at all. There is therefore no necessity for me to treat this theory separately, so I proceed with my discussion of the theory first stated—that of Professor Faraday.

In regard, then, to this theory, it appears to me that this scientist, in his eagerness to pursue the main investigation—the real object of his labour—contented himself here to take a course very unusual for him—to make, as it were, a snapshot; for had his mind not been so preoccupied he would certainly have followed up the matter, and just as certainly he would have solved the enigma—nay, it is my firm belief that he, with the wonderful all-round faculties he had for scientific investigation, the great capacity he had for entertaining and successfully grappling with phenomena, whether those of astronomical magnitude or those equally difficult and no less entertaining, so minute as almost to elude not only investigation but even perception itself—it is, I say, my firm belief that he would have followed up his labours in this direction, and crowned them by the discovery of the extraordinary, the unexpected potency of the weak cyanide-solution, and then, in his own good time, have conferred a gift to the world that would have anticipated that miner, to us unknown, who, in sheer desperation to make the cyanide process a workable one, blundered to the discovery of this strange potency of the weak solution. However, Faraday lost the opportunity to benefit the miner in this way, but only to take opportunities of serving man in the higher reaches of science, leaving us only, as I have said, a bare theory to interpret the phenomenon that he discovered, and which I have here to discuss.

Now, as to this matter, I would like to know the *modus operandi* of the production of these "air voltaic currents" that this scientist states are the agents for thus rapidly dissolving gold lying in the solution. As I take it, an air voltaic current is one that can exist in the air alone, or is produced there by the assistance of this surface gold and the cyanide-solution; but how is the current formed, and, when formed, how does it promote the solution of the gold? But, whatever answers may be framed to these questions, the following facts certainly appear to show that the "air voltaic current" theory is not tenable. If the gold-leaf and the surrounding cyanide-solution be covered with a thick layer of kerosene or gasoline the dissolution of that gold is but little retarded.† Ether can be substituted for these oils with like effects if only the cyanide-solution is very strong or has been heavily salted to prevent the downward diffusion of the ether, and so favour the existence of a hard line of demarcation between the two liquids. All these substances are, I find, slowly permeable by oxygen; still, apparently, not notably more so than water is: but the same results happened when they were depleted of their contained gases by passing coal-gas through them, and even when the gold-leaf itself was also depleted more or less of the air lodged in its pores by the same gas.

These facts, then, I think, clearly prove that, for the rapid dissolution of gold-leaf on the cyanide solution, a body of air resting on that solution is not at all necessary. They show, on the other hand, that there is entangled in the pores of the gold-leaf,‡ or mechanically absorbed by it, a sufficiency of oxygen to provide for a rapid dissolution of the metal. These facts, to my mind, strike, and fatally, at one and the same time at both the theory of Faraday and the popular theory that the profuse supply of oxygen has largely to do with this rapid dissolution of gold.

Now, the result just stated, while, as I think, disproving the two theories specified, raises a question of great pertinency to the subject—one which, if fairly answered, should lead to the settlement of the question that I set out with, How is the cyaniding of gold effected? And it is this: Why should gold-leaf in a cyanide-solution be very much longer in dissolving than gold-leaf lying on the surface, and under a layer of oil or ether, the necessary supply of oxygen being in each case, as it were, afoot—that is, lodged in the gold-leaf? Well, the answer—and I believe the only answer—to this question is one that rests largely for support on results and deductions therefrom which were started by the observation of another phenomenon almost as singular as the one that we have been attempting to explain, and which I announced in 1895,§ and it is this: A piece of gold (say gold-leaf) that is immersed in a cyanide partly-solution, weak or strong, not only dissolves rapidly at the surface of that liquid, as Faraday announced, but also rapidly—often just as rapidly—in the liquid itself, and even at those parts that are quite distant from the surface.

* "On the Action of Potassium-cyanide Solution upon Gold." (Trans. N.Z. Inst., Vol. xxviii., Art. lxxiii.).
† Trans. N.Z. Inst. for 1896, p. 581. ‡ Faraday shows this leaf is full of pores. § Mines Report, 1895, pp. 186–9.