

ments, as far as they went, supported this result in the case of the Coromandel rocks. I found, moreover, that the decomposed country rock close to the rich Hauraki No. 2 reef, when separated from the secondary pyrites, contained no gold, the former gold content probably having been leached out, to be redeposited in the reef. Assuming, therefore, that the pyroxenes of the andesites are the source of the gold, it follows then that the auriferous reefs have been filled by a process of lateral secretion, and also that the reefs in the slaty shales on the Tokatea owe their gold to downward percolation rather than to the ascension of heated water carrying vein-matter in solution.

The following tabulation shows the various precipitants that may have been concerned in the precipitation of the gold after being leached from the country rock :—

(1.) The most obvious reducing agent is the ferrous sulphate or proto-sulphate of iron, which in the Hauraki Mine forms small green stalactites in dry places in the levels. In all probability the finely divided gold occurring as an impregnation in the quartz is due to this precipitant, if we may judge by the finely divided precipitate (Faraday's gold) resulting from laboratory experiments. The finely divided green gold from the Bismarck Claim has already been mentioned. In the absence, however, of any knowledge of the accretive power of finely divided gold, we must look in another direction for the slugs and leaves of gold found in the Coromandel reefs.

(2.) Native arsenic is undoubtedly competent to precipitate gold. In the course of laboratory experiments I suspended 15 grains native arsenic in a weak solution of gold-chloride (1 gr. AuCl_3 to 4 oz. water). In two hours and a half the arsenic was distinctly yellow-coated, and in twelve hours two plates of gold were precipitated. The plates were certainly only loosely coherent in texture, but it requires no great stretch of imagination to suppose the grains welded together by pressure into the slugs found in reefs. In twenty-four hours the solution was free from gold, and had lost its original amber tinge, giving no reaction either with tin-chloride or with the more delicate Skey test.

(3.) Metallic sulphides are probably the main precipitating agents. Following out the line of Skey's experiments*, I suspended all the sulphides found locally associated with the gold, in turn, in a weak solution of gold-chloride (1 gr. AuCl_3 to 4 oz. H_2O), and found that all precipitated gold from its chloride solution. The sulphides experimented on were iron-pyrites, copper-pyrites, stibnite, mispickel, and galena.

It has been generally insisted that the gold in solution is in the form of a sulphide, and that the solvent agent is an alkaline sulphide; but this appears to me to fail as a generalisation. On analysis of the Kathleen Mine waters, I found 0.254 per cent. of free hydrochloric acid, and in no case that has yet come under my notice have the local mine-waters been found to be alkaline. With the above percentage of free hydrochloric acid it is not difficult to trace the evolution of free chlorine, an excellent gold solvent, and the consequent formation of gold-chloride.

(4.) The researches of Daintree showed that organic matter is competent to precipitate gold from its chloride solution. I am, however, not in possession of any data that would lead to the belief that this had been the precipitating agent in the local reefs.

(5.) I am of opinion that the part played by gaseous agents in gold-precipitation has not received the consideration due to it, and I have accordingly made experiments with a view to finding possible gaseous precipitants. The best of these, and, so far as I can see, the only one worthy of consideration in the present connection, is arseniuretted hydrogen (AsH_3). On passing a weak current of this gas through a solution of gold-chloride, a beautiful floating film of metallic gold was formed—a film so coherent that it was possible to partly lift it from the solution. Complete precipitation took place in half a minute. The objection to this gas, however, as a precipitant is that it, so far as I could ascertain, fails in extremely weak solutions. That arseniuretted hydrogen may be produced naturally is very probable from the occurrence of the allied sulphuretted hydrogen and the deposits of native arsenic, the latter being deposited on decomposition of the arseniuretted hydrogen.

XV.—MINERALS OCCURRING ON THE FIELD.

A.—Non-metallic.

Coal.—Occurs under the conditions described in Chapter VII., and also in small quantities as carbonaceous partings in the andesites and in the breccias, representing a cessation of volcanic activity.

Calcite.—Occurs in rhombohedra, scalenohedra, prisms, and combinations of these, varying indefinitely in form. Generally colourless or milky, but occasionally yellow to amber, due probably to the presence of yellow iron-oxide. Iceland spar is common in the Tokatea mines, perfect crystals up to $\frac{1}{2}$ in. being obtainable. In the colourless varieties, however, the cleavage-planes are so visibly abundant as to render the crystals valueless for Nicol's prisms, &c. The calcite and carbonate of lime in the Tokatea area is derived from the underlying and surrounding calcareous slaty shales. Dogtooth and nailhead spar in scalenohedra are common in the Scotty reef in the Kapanga area. Argentine, a pearly lamellar calcite, is found in the Tribute reef, Tokatea.

Aragonite.—Found in stellate needles in Scotty's reef, and may indicate a deep-seated origin of the gangue of the reef. More probably, however, the rhombic form is due to the presence of impurities.

Glauber's Salts.—Occurs in minute quantities in old drives and workings.

Epsomite.—Long rhombic silky prisms occurring as an efflorescence on walls and roofs of old drives and workings.

Quartz.—The matrix of the gold. Generally finely crystalline, or crystallized in small prisms terminated by pyramidal faces. Sometimes amethystine in Tokatea area.

* Trans. Aust. Assoc. Adv. Sci., Vol. I., 1889.