ACTION OF SELENIC ACID ON GOLD.[1]

BY VICTOR LENHER.

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IN a number of text-books and works of reference on chemistry, it is stated that gold is attacked by hot selenic acid, the latter being reduced. The details of the reaction do not seem to have been worked out, nor the products investigated.

The statement that gold is dissolved by selenic acid finds its origin in the work of Mitscherlich,[2] who was the first to prepare and study the properties of selenic acid. He states that selenic acid dissolves gold but not platinum.

Inasmuch as selenic acid in presence of hydrochloric or hydrobromic acid is reduced to selenious acid with the liberation of halogen, which would act on gold, and since no selenate of gold appears to be described in the literature, it seemed well to investigate this reaction and ascertain whether gold would dissolve in pure selenic acid which contained no halogen, and if solution actually took place, what the products of the reaction would be.

In order to preclude the possibility of the presence of a halogen in the selenic acid used, the acid was prepared as follows: Resublimed selenium dioxide was fused with pure potassium nitrate. The resulting selenate was dissolved in water and to a dilute solution, a solution of lead nitrate was added; the resulting precipitate of lead selenate was repeatedly washed with water until pure. It was then suspended in water and treated with hydrogen sulphide gas. Lead sulphide was obtained along with any selenium existing as selenite. The dilute selenic acid which resulted was concentrated on the water-bath and was used in the following work. For a preparation of a part of the selenic acid used, the author is indebted to Mr. W. H. Richardson.

The fairly concentrated acid which was thus obtained was brought into contact with gold leaf. No action was apparent in the cold. By evaporation, it is possible to concentrate selenic acid, and when the acid is hot and concentrated, gold dissolves readily to a reddish yellow solution. The action begins at about 230°, but proceeds much more readily at about 300°; selenium dioxide is evolved, while the gold goes into solution as auric sele-

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[1] Read at the Philadelphia meeting of the American Chemical Society.

[2] Pogg. *Ann.*, **12**, 630.

nate, $Au_2(SeO_4)_3$. Analysis of the salt showed that it agrees with this formula. The gold leaf was replaced by small pieces of gold, and it was found that the latter dissolve nearly as readily as the leaf and at about the same temperature. In most respects the action is similar to that of sulphuric acid on copper, although no such complicated products arise as mentioned by Baskerville[1] in the study of this reaction.

The selenate has been obtained as very small yellow crystals. It is soluble in hot concentrated selenic acid, forming a reddish-yellow solution, and separates on cooling. It is insoluble in water, and can be completely separated from selenic acid by dilution, when it appears as a yellow precipitate. It is soluble in sulphuric acid and in nitric acid. Hydrochloric acid decomposes the salt with evolution of chlorine, forming auric chloride and selenious acid. It is decomposed by heat below redness, metallic gold being obtained. On exposure to the light, auric selenate is decomposed, becoming dark green then bronze colored. It is worthy of note that all the members of the subgroup B in the first group of the periodic system, dissolve in selenic acid with evolution of selenium dioxide and formation of the corresponding selenate. Silver dissolves in selenic acid when the latter is hot and concentrated, the selenate being produced and selenium dioxide being evolved. Copper also acts in a similar manner. During the solution of gold in selenic acid, selenium dioxide is produced, being evolved as fumes, and is also invariably found in the solution after the reaction. Moreover in the reaction of selenic acid on gold we have for the first time the solution of gold in a simple oxygen acid.

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NATURALLY OCCURRING TELLURIDE OF GOLD.[2]

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THE occurrence of gold in nature, according to the commonly accepted view, is either as native gold or as telluride. It is generally conceded that gold exists in pyrite or other sulphide ores uncombined and in the elementary condition. This, broadly speaking, is the manner in which gold is considered to exist in nature. No mineral containing gold as one of its constituents,

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[1] Baskerville: This Journal, 17, 904.

[2] Read at the Philadelphia meeting of the American Chemical Society.