XI.—*The Reaction between Ferric Sulphate Solution and Cuprous Sulphide.*

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THE reaction between ferric sulphate solution and cuprous sulphide has been investigated by Thomas (*Metallurgie*, 1904, **1**, 8) and Thompson (*Electrochem. Ind.*, 1904, **2**, 228). Using excess of acid ferric sulphate solution, at 60—65° and 80°, respectively, each arrived at the following equation:

$$Cu_2S + 2Fe_2(SO_4)_3 = 2CuSO_4 + 4FeSO_4 + S \quad . \quad . \quad (1)$$

In order to obtain data as to the reaction (if any) that occurs at the ordinary temperature, the action of hydrogen sulphide (obtained from aluminium sulphide and water) upon electrolytic copper foil was used to prepare cuprous sulphide (Found: Cu, 80·26; S, 21·1. Calc.: Cu, 79·86; S, 20·1%), small quantities of which were immersed for 15 minutes in 10 c.c. of ferric sulphate solution (containing 40 g. of anhydrous ferric sulphate and 100 g. of sulphuric acid per litre). The black residue was collected on a Gooch filter, washed rapidly with cold water, dried at 110°, and weighed (Found: Cu, 67·8; S, 34·2. Calc. for CuS: Cu, 66·5; S, 33·5%). Carbon disulphide extraction showed the absence of free sulphur. Hence the reaction at the ordinary temperature may be expressed thus:

$$Cu_2S + Fe_2(SO_4)_3 = CuS + CuSO_4 + 2FeSO_4 \quad . \quad . \quad (2)$$

This equation requires that the residue of cupric sulphide should be 60·0% of the original cuprous sulphide. Actual experiments, in which 0·0264 g. and 0·1968 g. of cuprous sulphide were employed, yielded, respectively, 56·4 and 52·7% of cupric sulphide; these low values may be explained, however, by the great ease of oxidation of cupric sulphide. Equation (2) was further confirmed by determining the amounts of ferric sulphate solution reduced by known weights of cuprous sulphide, the results obtained agreeing exactly with those calculated from this equation.

It was found, however, that prolonged exposure of the cupric sulphide to ferric sulphate solution caused a further oxidation, with dissolution of copper and production of free sulphur. It is highly probable that this reaction is

$$CuS + Fe_2(SO_4)_3 = CuSO_4 + 2FeSO_4 + S \quad . \quad . \quad . \quad (3)$$

as actually found by Thompson (*loc. cit.*) to take place at 80°. Hence, although the earlier workers were unable to detect reaction (2), presumably by reason of its increased velocity at the higher temperatures, there is little doubt that the total reaction (1) really consists of stages (2) and (3) under their conditions also.

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