[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF ROCHESTER]

The Solubility of Gold in Mercury. IV[1]

BY GRAHAM MEES

The work of Weiner[2] has been repeated with a view to attaining increased precision of measurement. To attain this end two major changes were made: an oil-bath thermostatically controlled to ±0.02° was used in all but two runs and the tubes used in the oil-bath were slightly modified (capillary A in Fig. 2 of Weiner's paper was not bent but extended up straight) and filled with hydrogen. The materials used, the analytical method and experimental procedure were identical or nearly so with that in earlier papers from this Laboratory. Mention should be made of the distinct effort which was made to keep the gold residues down to about 0.5 g., both with the knowns and unknowns. As to the knowns, five tubes were made up containing about 2.5 atomic per cent. of gold. These were carried through the entire experimental procedure, the bath temperature being about 200°. On analysis it was found that four of the five tubes yielded results in error by only 1.5 p. p. t.; including the fifth tube the average error was 2.0 p. p. t.

Experimental Results

In Table I will be found data for run M-5 made at 282.3°. In Table II is given a summary of the results found in all of the runs. In Table III is presented the solubility of gold in mercury at rounded temperatures. All solubilities are given in atomic per cent. (atoms of gold per 100 total atoms).

TABLE I

SOLUBILITY OF GOLD IN MERCURY. COMPLETE DATA FOR ONE TEMPERATURE

No.	Temp., °C.	Gold, g.	Amalgams, g.	Atomic % soly.
M-5-1	Low side 282.3	0.4725	4.784	10.03
M-5-2		.3649	3.699	10.02
M-5-3		.5261	5.320	10.04
M-5-4		.5123	5.186	10.03
M-5-5	High side 282.3	.5350	5.436	10.00
M-5-6		.6492	6.590	10.00
M-5-7		.5008	5.087	10.00
M-5-8		.5261	5.326	10.03
			Average	10.02

It will be noted that in Table II, column two, some of the numbers are placed in parentheses, indicating those tubes omitted from the computation of the average because the results were more than four times the deviation from the mean. In series M-6 half the tubes were rejected in computing the average but it may be said that seven of the eight tubes gave an average only slightly larger (15.15), the average deviation from the mean being 6.3 p. p. t. It is believed that the double type tube was largely responsible for the poor results in this run.

All series designated by the letter M were carried out in the oil-bath, the order in which they were performed is given by the number following the letter. Series M-5 was made because series M-4 gave a rather large deviation from the mean. Series M-1 and M-8 also gave large deviations from the mean, but time did not permit of making further determinations. Series M-7 yielded an

TABLE II

SOLUBILITY OF GOLD IN MERCURY. SUMMARY OF EXPERIMENTAL DATA

Series	Detns.	Temp., °C.	Atomic % soly.	Av. dev. (from the mean) p. p. t.	Remarks
M-10	8	192.5	2.742	10	Capsules not quite down to constant wt.
M-1	7	207.2	3.40	31	
SU	5(3)	220.9	3.506	6.8	Air-bath. From low side only
M-2	5(2)	224.8	4.112	1.6	
M-3	6(2)	251.5	5.870	2.4	
SN	8	265.9	7.33	30	Air-bath. From low side only
M-5	8	282.3	10.02	1.5	
M-4	8	283.6	10.42	17	Capsules bumped?
M-8	8	296.1	14.01	25	
M-6	4(4)	307.8	15.11	1.5	Double type tube[a]
M-7	..	322.6	about 25	..	Double type tube;[a] insufficient gold taken

[a] These tubes had one equilibrium chamber and two fine capillaries leading to two sample tubes. It was hoped that the design would prove of value in the more concentrated range but it was not altogether successful, so need not be discussed further here.

TABLE III

SOLUBILITY OF GOLD IN MERCURY AT ROUNDED TEMPERATURES

Temp., °C.	190.0	200.0	210.0	220.0
Atomic % soly.	2.68	2.92	3.24	3.65
Temp., °C.	230.0	240.0	250.0	260.0
Atomic % soly.	4.17	4.80	5.58	6.55
Temp., °C.	270.0	280.0	290.0	300.0
Atomic % soly.	7.83	9.50	11.80	15.42

(1) Original manuscript received May 23, 1932.

(2) Sunier and Weiner, THIS JOURNAL, 53, 1714 (1931).

unexpected result—no gold residue remained after filtering. At this high temperature some mercury seemed to escape with the hydrogen when the tubes were sampled. The composition of the amalgams was about 25%, so this run yielded only a rough indication of the solubility. Series M-9 bumped very definitely during the evaporation of the mercury, so the analyses were not carried to completion; series M-10 was run to replace series M-9. The two series SU and SN were made, by another worker in this Laboratory, in essentially the same air-bath used by Weiner, and are included for the sake of completeness.

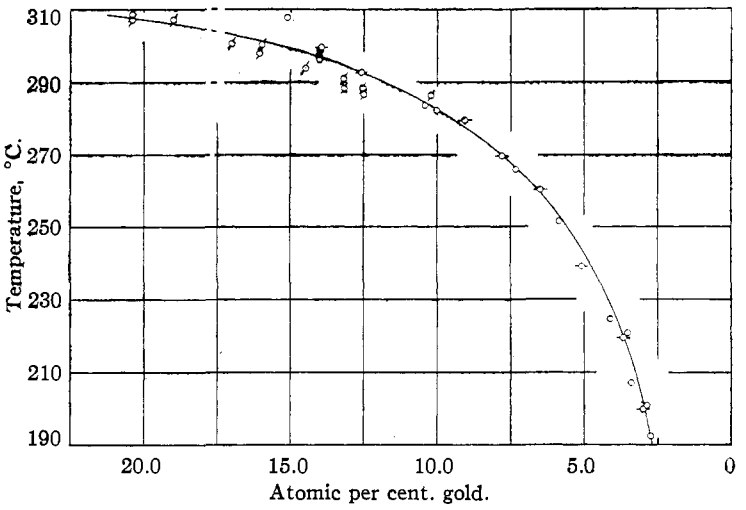

Fig. 1.—Solubility of gold in mercury: ◔, Fitzsimmons; -O-, Weiner; ◑, Anderson (where two or three determinations gave values which could not be distinguished on a plot of this size, this has been indicated by several cross bars); ○, author.

Discussion of Results

In Fig. 1 the results are plotted as atomic per cent. solubility *versus* temperature in °C. All of the data obtained in this interval of temperature in this Laboratory have been included in the plot;[3] the agreement in the various researches is seen to be quite satisfactory considering the different types of tubes, thermostats and thermometers used. A full discussion of the work of others as well as the nature of the solid phase is reserved for the fifth paper referred to.

The writer wishes to express his thanks and appreciation to Professor Sunier for the help which made this work possible.

(3) The data of Anderson are found in the fifth paper of this series [*J. Phys. Chem.*, **36**, 2145 (1932)]. The data of Parravano, Britton and McBain and Plaksin have been plotted in Fig. 4 of the last paper and Fig. 4 of the fifth paper. Complete references are found in the fifth paper.

Summary

About seventy determinations of the solubility of gold in mercury have been made, in the temperature interval 190 to 300°, with a modified solubility tube and an oil-bath. These determinations are in good agreement with an equal number of determinations made under different conditions in this Laboratory. No maximum in the solubility curve, in this interval of temperature, has been found.

ROCHESTER, NEW YORK RECEIVED FEBRUARY 28, 1938

[CONTRIBUTION FROM THE CHEMICAL LABORATORIES OF THE NEBRASKA STATE TEACHERS COLLEGE]

The Direct Current Conductances of Potassium Chloride Solutions[1]

BY LYLE V. ANDREWS AND WILLIAM E. MARTIN

A large number of determinations of the conductances of potassium chloride solutions have already been made using the conventional alternating current method, but no direct current measurements have been made except those of Newbery[2] and Eastman,[3] who measured the conductance of 1 normal solutions only.

We believe that a quantity as important as the conductance of electrolytes should be measured by as many methods as possible, and are presenting a direct current method which is different from any in the literature.

Apparatus, Materials and Experimental Procedure.—The cell and connections are shown in Fig. 1. Broken lines numbered 1 represent connections for method 1, and broken lines numbered 2 represent connections for method 2. The two electrodes of the cell were made up alike and consisted of a layer of mercury covered with a paste

(1) Presented at the Midwest Regional meeting of the American Chemical Society in Omaha, May, 1937.
(2) Newbery, *J. Chem. Soc.*, **113**, 701 (1918).
(3) Eastman, THIS JOURNAL, **42**, 1648 (1920).