COMPONENTS:	EVALUATOR:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

Although readily wetted by mercury, the solubility of copper in mercury at room temperature is low. There have been numerous reports of solubility measurements near room temperature. Gouy (1) reported the first solubility determination, but this author's value of 3×10^{-3} at % at 288 to 291 K is too low and therefore rejected. Humphreys (2), from his investigation of the solution and diffusion of copper in mercury, estimated a solubility of 8.5×10^{-3} at % at 299.4 K. Richards and Garrod-Thomas (3) determined a solubility of 7.42×10^{-3} at % at 293 K; these authors' result was based on colorimetric and potentiometric analyses of the equilibrated liquid amalgam. Tammann and Kollmann (4) utilized potentiometry to determine a solubility of 1.02×10^{-2} at % at 288 K. Irvin and Russell (5) performed careful analytical measurements of the solubility at 293 K, but their value of 6.3×10^{-3} at % is lower than those of the earlier authors. Without presenting experimental details, Hickling and Maxwell (6) reported a solubility of 6×10^{-3} at % at 293 K; these authors had studied the electrochemical oxidation of copper amalgams. Liebl (7) employed coulometry to determine a solubility of 1.0×10^{-2} at % at room temperature, but no experimental details for this determination were presented. Sagadieva and Kozlovskii (8) employed amalgam polarography and also determined a solubility of 1.0×10^{-2} at % at 293 K. From potentiometric measurements, Schupp and coworkers (9) determined a solubility of 8.5×10^{-3} at % at 298 K. Jangg and Kirchmayr (10) measured the potentials of various copper amalgams at 288 K, and though numerical data were not presented, a solubility of 8.9×10^{-3} at % was estimated from the graphical presentation; employing polarographic oxidation of the copper amalgam they estimated the solubility of 8.4×10^{-3} at % at 293 K. Jangg and Palman (11), from measurements based on a filtration method, reported solubilities over a temperature range of 293 to 823 K; the solubility at 293 K was 6.3×10^{-3} at % and it increased to 3.7 at % at 823 K. The experimental results of the latter authors at temperatures above 298 K were much higher than the predicted liquidus from the phase diagrams which were proposed earlier by Tammann and Strassfurth (12) and by Schmidt (13).

Levitskaya and Zebreva (14) employed potentiometric measurements at 293 to 323 K and obtained solubilities which increased from 1.07×10^{-2} to 2.4×10^{-2} at % in this temperature range. Chao and Costa (15) also employed potentiometry and obtained a solubility of 9.3×10^{-3} at % at room temperature.

Baletskaya and coworkers (16), from voltammetric measurements on the amalgam, determined a solubility of 1.02×10^{-2} at % at room temperature. Dragavtseva and Bukhman (17) performed chronoamperometric oxidation of heterogeneous copper amalgams and determined a solubility of 9×10^{-3} at % at 293 K. Lange and coworkers (18) also carried out similar measurements as the previous authors, but at 313 to 363 K, and determined that the solubilities increased from 1.7×10^{-2} to 4.3×10^{-2} at % in this temperature range. Ostapczuk and Kublik (19) employed voltammetric oxidation of a saturated copper amalgam at 298 K and found a solubility of 1.09×10^{-2} at %. Hurlen and coworkers (20) employed potentiometry and determined a solubility of 6.2×10^{-3} at % at 298 K. Sasim and coworkers (21) also used potentiometric measurements and determined a solubility of 1.1×10^{-2} at % at 298 K; the latter result is in agreement with the most dependable determinations at this temperature.

Grønlund and Kristensen (22) performed precise concentration cell measurements at 283.4 to 298.3 K and reported solubilities of 7.46×10^{-3} to 13.9×10^{-3} at % in this temperature range. The latter measurements were made in evacuated cells; probably because of the reduced pressure the results obtained are higher than those determined under normal conditions. Ignateva and coworkers determined Cu solubility at 298.2 K of 1.1×10^{-2} at % (23), 1.0×10^{-2} at % (24), and 1.25×10^{-2} at % (25); chronoamperometric oxidation of the Cu saturated amalgams was applied in these works.

There were a number of other solubilities reported near room temperature, but these are rejected because the results are too high (26-29), or the data were presented without sufficient definition of experimental conditions (30-32). Kozin predicted a solubility of 5.7×10^{-3} at % at 298 K (33).

It is clear that there is wide scatter in the solubility data near room temperature. As indicated by Chao and Costa (15), the crystallization of copper attains equilibrium very slowly, so that the determinations based on electrochemical methods in which the copper is crystallized from an amalgam may result in solubilities that may be too high.

COMPONENTS:	EVALUATOR:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

The solubility measurements at 293 to 824 K, by Jangg and Palman (11), were extended to higher temperatures by Lugscheider and Jangg (34). The latter authors analyzed samples of the immiscible, mutually saturated copper and mercury phases in the temperature range of 883 to 1073 K, and they established the corresponding values of maximum and minimum solubility in this temperature range. The solubility of 0.67 at % at 644 K, reported by Wang (35), is more than an order of magnitude too low, and is rejected.

The solid phases in equilibrium with the saturated amalgam consist of unstable Cu-Hg compounds (15,34,36,37); the peritectic temperature has been reported to be 369.4 (12), 371 (37) and 401 K (34). The phase diagram is shown in Figure 1 (34). The solid compounds, CuHg, Cu_4Hg_3, Cu_3Hg_2, and Cu_7Hg_6 have been reported, but the existence of the last of these is the most probable.

Tentative values of the solubility of Cu in Hg:

T/K	Soly/at %	Source
293	9.2×10^{-3} [a]	[3,7,8,10,17]
298	1.00×10^{-2} [a]	[2,9,15,19,23,21,24]
373	4×10^{-2}	[11]
473	0.2	[11]
573	0.6	[11]
673	1.1	[11]
773	2.1	[11]
873	5.5 [b]	[11,34]
933	8	[34]
973	14	[34]
1073	40	[34]

a. Mean value from cited references.

b. Interpolated value from cited references

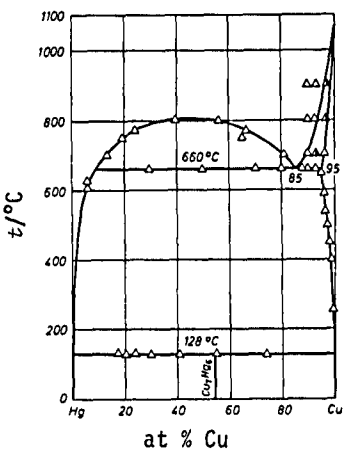

Fig. 1. The Cu-Hg system (34).

COMPONENTS:	EVALUATOR:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

REFERENCES

1. Gouy, M. *J. Phys.* 1895, *4*, 320.
2. Humphreys, W.J. *J. Chem. Soc.*, 1896, 243.
3. Richards, T.W.; Garrod-Thomas, R.N. *Z. Phys. Chem.*, 1910, *72*, 165.
4. Tammann, G.; Kollmann, K. *Z. Anorg. Chem.*, 1927, *160*, 242.
5. Irvin, N.M.; Russell, A.S. *J. Chem. Soc.*, 1932, 891.
6. Hickling, A.; Maxwell, J. *Trans. Faraday Soc.*, 1955, *51*, 44.
7. Liebl, G.; cited by H. Spengler, *Metall*, 1958, *12*, 105.
8. Sagadieva, K.Zh.; Kozlovskii, M.T. *Izv. Akad. Nauk Kaz. SSR, Ser. Khim*, 1959, *1 (15)*, 22.
9. Schupp, O.E.; Youness, T.; Watters, J.I. *J. Am. Chem. Soc.*, 1962, *84*, 505.
10. Jangg, G.; Kirchmayr, H. *Z. Chem.*, 1963, *3*, 47.
11. Jangg, G.; Palman, H. *Z. Metallk.*, 1963, *54*, 364.
12. Tammann, G.; Strassfurth, T. *Z. Anorg. Chem.*, 1925, *143*, 357.
13. Schmidt, W. *Metall.*, 1949, *3*, 10.
14. Levitskaya, S.A.; Zebreva, A.I. *Tr. Inst. Khim. Nauk Akad. Nauk Kaz. SSR*, 1967, *15*, 66.
15. Chao, F.; Costa, M. *C.R. Acad. Sci., Ser. 2* 1965, *261*, 990; *Bull. Soc. Chim. Fr.* 1968, 549.
16. Baletskaya, L.G.; Zakharova, Z.A.; Zakharov, M.S. *Izv. Akad. Nauk Kaz. SSR, Ser. Khim.*, 1969, *19*, No. 1, 34.
17. Dragavtseva, N.A.; Bukhman, S.P. *Izv. Akad. Nauk Kaz. SSR, Ser. Khim.*, 1970, *20*, No. 6, 33.
18. Lange, A.A.; Bukhman, S.P.; Kairbaeva, A.A. *Izv. Akad. Nauk Kaz. SSR, Ser. Khim.*, 1974, *24*, No. 5, 37.
19. Ostapczuk, P.; Kublik, Z. *J. Electroanal. Chem.*, 1977, *83*, 1.
20. Hurlen, T.; Staurset, A.; Eriksrud, E. *J. Electroanal. Chem.*, 1977, *83*, 263.
21. Sasim, D.; Srudka, M.; Guminski, C. *Monatsh. Chem.*, 1984, *115*, 45.
22. Grønlund, F.; Kristensen, B. *Acta Chem. Scand., Ser. A* 1984, *38*, 229.
23. Ignateva, L.A.; Zakharova, E.A.; Nazarov, B.F. *Dep. ONITEKhim*, 1731-78, 1978.
24. Kataev, G.A.; Zakharova, E.A.; Ignateva, L.A. *ONITEKhim*, 3092-79, 1979.
25. Zakharova, E.A.; Kataev, G.A.; Ignateva, L.A.; Morosova, V.E. *Tr. Tomsk. Gos. Univ.*, 1973, *249*, 103.
26. Strachan, J.F.; Harris, N.L. *J. Inst. Metals.*, 1956-57, *85*, 17.
27. Igolinskii, V.A.; Shalaevskaya, V.N. *Elektrokhimia*, 1974, *10*, 536.
28. Igolinskii, V.A.; Shalaevskaya, V.N.; Guryanova, O.N.; Igolinskaya, I.M.; Kotova, N.A. *Sovremiennye Problemy Polarografii Nakopleniem*, Tomsk, 1975, p. 150.
29. Shalaevskaya, V.N.; Igolinskii, V.A.; Kataev, G.A. *Dep. VINITI*, 588-75, 1975.
30. Spencer, J.F. *Z. Elektrochem.* 1905, *11*, 681.
31. Zebreva, A.I.; Filippova, L.M.; Omarova, N.D. *Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.*, 1977, *20*, 19.
32. Zebreva, A.I.; Filippova, L.M.; Omarova, N.D.; Gayfullin, A.Sh. *Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.* 1976, *19*, 1043.
33. Kozin, L.F. *Fiziko-Khimicheskie Osnovy Amalgamnoi Metallurgii*, Nauka, Alma-Ata, 1964.
34. Lugscheider, E.; Jangg, G. *Z. Metallk.*, 1971, *62*, 548.
35. Wang, J.Y.N. *Nucl. Sci. Eng.*, 1964, *18*, 18.
36. Lihl, F. *Z. Metallk.*, 1953, *44*, 160.
37. Noer, S.; Grønlund, F. *Ber. Bunsenges. Phys. Chem.*, 1975, *79*, 517.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Humphreys, W.J. *J. Chem. Soc.* 1896, 243-53.
VARIABLES: One temperature: 26°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of copper in mercury at 26.2°C was reported as $(2.7 \pm 0.1) \times 10^{-3}$ mass %.

Converting to atomic %, the compilers calculated 8.5×10^{-3} at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Disc of Cu was placed on the surface of a column of Hg contained in a glass or wooden vessel, and the liquid sampled for analysis after several days of equilibration. The Hg was evaporated from the amalgam and the residual copper was determined as the oxide after treatment with HNO_3 and ignition.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: precision probably no better than ± 3% (compilers).

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Irvin, N.M.; Russell, A.S. *J. Chem. Soc.* 1932, 891-8.
VARIABLES: One temperature: 20°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of copper in mercury at 20°C was found to be $(2.0 \pm 0.1) \times 10^{-3}$ mass %.

Converting to atomic %, the compilers calculate 6.3×10^{-3} at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Amalgams were prepared by electrolysis and by chemical reduction of copper (II) with V(II) solutions. The prepared amalgams were filtered through their own paste on a ground-glass filter. Copper was removed from the homogeneous amalgam by oxidation with $KMnO_4$. In the final determination of copper the iodide-thiosulphate volumetric method was applied. When chamois leather was used instead of the sintered glass for filtration of the amalgam, some irregular and higher solubilities were obtained.	Not given
	ESTIMATED ERROR: Soly: accuracy ± 5%. Temp: nothing specified.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Richards, T.W.; Garrod-Thomas, R.N. *Z. Phys. Chem.* 1910, *72*, 165-201.
VARIABLES: One temperature: 20°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of copper in mercury at 20°C was found to be $(2.35 \pm 0.35) \times 10^{-3}$ mass %.

Converting to atomic %, the compilers calculate 7.42×10^{-3} at %.

The result was confirmed also by potentiometric measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Copper amalgam was prepared by the electroreduction of a $CuSO_4$ solution on a mercury cathode. The amount of the reduced copper was determined coulometrically. The amalgams were filtered through chamois leather after equilibration. The solid residue was analyzed by volatilizing the mercury and determination of copper by colorimetric method.

SOURCE AND PURITY OF MATERIALS:

Mercury was purified with $Hg_2(NO_3)_2$ and doubly distilled.

Pure $CuSO_4$ was recrystallized.

ESTIMATED ERROR:

Soly: precision no better than ± 15%.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Tammann, G.; Kollmann, K. *Z. Anorg. Chem.* 1927, *160*, 242-8.
VARIABLES: One temperature: 15°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of copper in mercury at 15°C was reported to be $(3.23 \pm 0.07) \times 10^{-3}$ mass %.

Converting to atomic %, the compilers calculate 1.02×10^{-2} at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgams of various concentrations were obtained by electrolysis of saturated $CuSO_4$ solutions by varying the current and the time of the electrolysis. Subsequently, the steady-state potentials of the cell, $Cu(Hg)_x | CuSO_4, Hg_2SO_4 | Hg$, were measured.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: precision ± 5%.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Sagadieva, K.Zh.; Kozlovski, M.T. *Izv. Akad. Nauk Kaz. SSR, Ser. Khim.* 1959, No. 1 (15), 22-5.
VARIABLES: One temperature: 20°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of copper in mercury at 20°C was reported to be 6.8×10^{-3} mol dm^{-3}.

Converting to atomic %, the compilers calculate 1.01×10^{-2} at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The amalgams were obtained by the exhaustive electrolysis of copper (II) from solution. The polarograms of amalgam dissolution were determined in 0.1 mol dm^{-3} solution of KNO_3. All operations were performed in a hydrogen atmosphere. Estimation of the copper concentration was based on the polarograms.	Nothing specified.
	ESTIMATED ERROR: Soly: nothing specified; ± 10% (compilers). Temp: ± 1 K.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Schupp, O.E.; Youness, T.; Watters, J.I. *J. Am. Chem. Soc.* 1962, *84*, 505-13.
VARIABLES: One temperature: 25°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of copper in mercury at 25°C was found to be 2.7×10^{-3} mass %.

Converting to atomic %, the compilers calculate 8.5×10^{-3} at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Potentials of the amalgams versus pure copper immersed in solution of ethylenediamine complex of Cu(II) were measured. The copper amalgams were prepared electrolytically, and the solubility was determined from EMF measurements on the cell, $Cu(Hg)_x \mid Cu(II)$ in ethylenediamine $\mid Cu$.	Nothing specified.
	ESTIMATED ERROR: Soly: nothing specified; accuracy probably better than a few percent (compilers). Temp: not specified.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Jangg, G.; Palman, H. *Z. Metallk.* 1963, *54*, 364-369.
VARIABLES: Temperature: 293-823 K	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of copper in mercury at 20 to 550°C was presented graphically as a plot of log N against temperature, where N was in mass %. The data points were read off the curve and converted to atom % by the compilers.

T/K	Soly/at %	T/K	Soly/at %	T/K	Soly/at %	T/K	Soly/at %
293	6.3×10^{-3}	508	0.28	663	1.0	823	3.7
323	1.3×10^{-2}	523	0.35	673	1.1		
373	4.0×10^{-2}	548	0.40	698	1.2		
383	5.0×10^{-2}	563	0.57	723	1.6		
423	9.6×10^{-2}	573	0.62	743	1.7		
438	0.14	608	0.78	763	2.1		
463	0.17	623	0.86	773	2.3		
473	0.19	643	0.93	798	2.9		

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Method of the amalgam preparation is not given. The amalgams were mixed and kept for 12 hours in thermostated glass cylinders and then filtered in an atmosphere of pure nitrogen. For temperatures above 600 K a pressure apparatus made of hard chromium steel was used. No method of analyzing of the filtrate is given.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: precision ± 5%.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Jangg, G.; Kirchmayr, H. *Z. Chem.* 1963, *3*, 47-56.
VARIABLES: Temperature: 15-20°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of copper in mercury.

t/°C	mol cm^{-3}	at %[a]
15	$(6.0 \pm 0.2) \times 10^{-3}$	8.9×10^{-3}
20	5.7×10^{-3}	8.4×10^{-3}

[a] by compilers

15°C data based on EMF measurements, and 20°C data based on polarographic measurements (see below).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgams were obtained electrolytically and the potentials of the cell, $Cu(Hg)_x|CuSO_4 + CH_3COOH|KCl, Hg_2Cl_2, Hg$, were measured at 15°C. The concentration of the saturated amalgam was determined from the breakpoint of the plot of EMF against the logarithm of the copper concentration in the amalgam. Anodic polarographic currents of various copper amalgams were determined at 20°C, and the current was plotted against the Cu concentration in the amalgam. The solubility was determined from the breakpoint in the plot. All experiments were performed in an inert gas atmosphere.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: accuracy better than ± 3%.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Chao, F.; Costa, M. *C.R. Acad. Sci., Ser. 2* 1965, *261*, 990-3.
VARIABLES: One temperature: 295 K	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of copper in mercury at 295 K was reported to be $(6.2 \pm 0.2) \times 10^{-3}$ mol dm^{-3}. The corresponding atomic % solubility calculated by the compilers is 9.3×10^{-3} at %.

This work is part of an extensive study of copper amalgams by the same authors (1). The authors investigated the tendency toward the formation of semi-stable, supersaturated amalgams.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The copper amalgams were prepared electrolytically at constant current from 0.5 mol dm^{-3} $CuSO_4$ + 0.25 mol dm^{-3} H_2SO_4. Dilution was made by adding Hg to the amalgam in a nitrogen atmosphere. Potentials of the amalgams were measured in the cell of the type,

$$Cu(Hg)_x \left| \begin{array}{l} 0.5 \text{ mol } dm^{-3} \ CuSO_4 \\ +0.36 \text{ mol } dm^{-3} \ H_2SO_4 \end{array} \right| Hg_2SO_4, Hg$$

Concentration of the saturated amalgam was determined from the breakpoint of the plot of EMF against the logarithm of the copper concentration.

SOURCE AND PURITY OF MATERIALS:

Reagents were specified as "pure for analysis", and salts were recrystallized. Hg purity was specified as 99.99999%.

ESTIMATED ERROR:

Soly: precision ± 3%.

Temp: precision ± 0.5 K.

REFERENCES:

1. Chao, F.; Costa, M. *Bull. Soc. Chim. Fr.*, 1968, 549-55.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Levitskaya, S.A.; Zebreva, A.I. *Tr. Inst. Khim. Nauk Akad. Nauk Kaz. SSR* 1967, *15*, 66-8.
VARIABLES: Temperature	PREPARED BY: C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of copper in mercury.

t/°C	Soly/mol dm^{-3}	Soly/at %[a]
20	7.2×10^{-3}	1.07×10^{-2}
40	1.2×10^{-2}	1.8×10^{-2}
50	1.6×10^{-2}	2.4×10^{-2}

[a] by compilers

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Potentials of the galvanic cell, $Cu(Hg)\,|\,CuSO_4, H_2SO_4\,|\,Cu(Hg)_x$ were measured at various temperatures. The solubilities were determined from the breakpoint in the plot of cell EMF against the logarithm of the copper concentration in the amalgam.	Nothing specified.
	ESTIMATED ERROR: Nothing specified.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Dragavtseva, N.A.; Bukhman, S.P. *Izv. Akad. Nauk Kaz. SSR, Ser. Khim.* 1970, No. 6, 33-7.
VARIABLES: One temperature: 20°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of copper in mercury at 20°C was found to be 9×10^{-3} at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The amalgams were obtained by exhaustive electrolysis of solutions containing copper ions. Oxidation of the prepared amalgams were performed after 2 hours under chrono-amperometric conditions. Estimation of the copper concentrations was based on analysis of the current-time curves.	Nothing specified.
	ESTIMATED ERROR: Soly: nothing specified; precision better than ± 10% (compilers). Temp: not specified.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Lugscheider, E.; Jangg, G. *Z. Metallk.* 1971, *62*, 548-551.
VARIABLES: Temperature: 610-800°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of copper in mercury in the two regions at 610-800°C.

	Copper solubility, at %	
t/°C	Hg-rich region	Cu-rich region
610	5.9	
630	6.1	
700	14.1	⩾ 80.8
750	19.9	⩾ 65.1
770	24.4	⩾ 66.6
800	40.0	⩾ 56.5

The experiments were performed in the range of miscibility gap so that the solubility of copper in mercury may be higher than values given in the third column. When copper content in the amalgam is higher than 85 at % at 660°C the liquidus curve goes up to 100 at % of Cu at 1070°C. The experimental data have large scatter in the Cu-rich region.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgams were obtained by dissolution of copper in mercury (1:1) and heating up to 850°C. After annealing for 170 hours at the experimental temperature, the samples were quickly cooled and solidified as two separate phases. The samples were analyzed in hydrogen atmosphere after the mercury was removed by distillation.

SOURCE AND PURITY OF MATERIALS:

Nothing specified

ESTIMATED ERROR:

Soly: nothing specified; precision no better than ± 10% (compilers).

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Zakharova, E.A.; Kataev, G.A.; Ignateva, L.A.; Morozova, V.E. *Tr. Tomsk. Univ.* 1973, *249*, 103-9.
VARIABLES:	**PREPARED BY:**
One temperature: 25°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of Cu in Hg at 25°C was reported to be: 8.4×10^{-3} mol dm^{-3} from concentration dependence of Cu(II) vs. Cu(Hg), and 8.6×10^{-3} mol dm^3 from dependence of diffusion coefficient of Cu in Hg vs. concentration of Cu in Hg (see below).

Converting to atomic %, the compilers calculate 1.25×10^{-2} and 1.28×10^{-2} at %, respectively.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The experiments were carried out on a semi-spherical Hg electrode on a Ag base. The electrode was prepared by electrochemical reduction of Hg(II); the electrode was then transferred to a cell which contained the reference electrode of "manganese half element" and an auxiliary Pt net electrode. Cu was introduced into the Hg by electro-reduction from solution: 0.1 mol dm^{-3} of $(NH_4)_2C_2H_4O_6$ and Cu(II) of concentration ranging between 2.9×10^{-4} and 3.92×10^{-3} mol dm^{-3}. After various periods of waiting the chronoamperometric curves of oxidation were recorded. The results were analyzed from the curves: Concentrations of Cu(II) in the solution vs. Cu in the amalgam, and diffusion coefficient of Cu in Hg vs. concentration of Cu in Hg. Breakpoints on the curves correspond to saturation of Hg with Cu.

SOURCE AND PURITY OF MATERIALS:

Nothing specified

ESTIMATED ERROR:

Temperature: ± 0.2 K. Diffusion coefficients are accurate to ± 2% but the waiting times up to 15 min are too short to reach a true equilibrium in the system so the results may be overstated.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	1. Ignateva, L.A.; Zakharova, E.A.; Nazarov, B.F. *Dep. ONITEKhim.* 1731-78, 1978. 2. Kataev, G.A.; Zakharova, E.A.; Ignateva, L.A. *Dep. ONITEKhim.* 3092-79, 1979.
VARIABLES:	PREPARED BY:
One temperature: 298 K	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of copper in mercury at 298.2 K.

mol dm^{-3}	at %[a]	Ref.
$(7.5 \pm 0.2) \times 10^{-3}$	1.1×10^{-2}	(1)
6.9×10^{-3}	1.0×10^{-2}	(2)

[a] by compilers

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The experiments were performed in a cell containing 3 electrodes: (Ref. 1) Working - half spherical Hg; reference - the SCE; auxiliary - Pt net. The Cu amalgams were obtained by electroreduction of Cu(II) from 0.1 mol dm^{-3} solutions of $(NH_4)_2C_4H_4O_6$ at -1.20 V. The amalgams were conditioned for 30 min. at -0.40 V and then oxidized at 0.05-0.10 V in chronoamperometric conditions. The solubility was calculated from analysis of $it^{1/2}$ vs. $t^{1/2}$ curves, where i is the limiting current and t the time. (Ref. 2) Working - half sperhical Hg on Ag base; reference - manganese oxide electrode; auxiliary - Pt net. Cu amalgams were obtained by electroreduction of Cu(II) from 0.1 mol dm^{-3} solutions of $(NH_4)_2C_4H_4O_6$ at -1.8 V. The amalgams were conditioned for 15 min and then oxidized in chronoamperometric conditions at -0.46 V. When the amalgams contained more than 6.9×10^{-3} mol dm^{-3} Cu the curves obtained were irregular, indicating that the amalgams were not homogeneous.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: precision $\pm$ 3% in (1).

Temp: $\pm$ 0.2 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Lange, A.A.; Bukhman, S.P.; Kairbaeva, A.A. *Izv. Akad. Nauk Kaz. SSR, Ser. Khim.* 1974, No. 5, 37-41.
VARIABLES: Temperature: 40-90°C	PREPARED BY: C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of copper in mercury:

t/°C	Soly/mass %	Soly/at %[a]
40	5.4×10^{-3}	1.7×10^{-2}
50	7.1×10^{-3}	2.2×10^{-2}
60	8.0×10^{-3}	2.5×10^{-2}
70	9.6×10^{-3}	3.0×10^{-2}
80	1.16×10^{-2}	3.7×10^{-2}
90	1.36×10^{-2}	4.3×10^{-2}

[a] by compilers

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The copper amalgams were obtained by the exhaustive electrolysis of $CuSO_4$ solutions in 0.1 mol dm^{-3} H_2SO_4. Concentrations of Cu(II) were determined colorimetrically. Amalgams were kept 6-8 hours at a chosen temperature, then oxidation currents were recorded potentiostatically at +0.3 V (vs. SCE). The amalgam and the solution were mixed at a constant velocity during the measurements.	$CuSO_4$ was of reagent grade. Mercury purity not specified.
	ESTIMATED ERROR: Soly: no better than ± 3% (compilers). Temp: nothing specified.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Ostapczuk, P.; Kublik, Z. *J. Electroanal. Chem.* 1977, *83*, 1-17.
VARIABLES: One temperature: 25°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of copper in mercury at 25°C was found to be 7.4×10^{-3} mol dm^{-3}.

Converting to atomic %, the compilers calculate 1.1×10^{-2} at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A piece of copper was introduced into the mercury of the hanging drop electrode. The electrode was conditioned for 5 days with occasional shaking to ascertain saturation of the amalgam, then the chronovoltammetric oxidation peak currents were recorded. Constancy of such peaks was taken as evidence of amalgam saturation.

SOURCE AND PURITY OF MATERIALS:

Copper: spectroscopically pure.

Mercury: purified with $Hg_2(NO_3)_2$, then twice distilled under vacuum.

ESTIMATED ERROR:

Soly: accuracy no better than ± 5% (compilers).

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Hurlen, T.; Staurset, A.; Eriksrud, E. *J. Electroanal. Chem.* 1977, *83*, 263-72.
VARIABLES: One temperature: 25°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of copper in mercury at 25°C was reported to be $(4.2) \pm 0.3) \times 10^{-3}$ mol dm^{-3}.

Converting to atomic %, the compilers calculate 6.2×10^{-3} at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The amalgams were prepared by controlled electrolytic deposition of copper into a weighed amount of mercury, and the amalgams were used to determine the EMF of the cell, $Cu(Hg)_x \mid CuSO_4, MgSO_4 \mid Hg_2SO_4, Hg$. The solubility was determined from the breakpoint in the plot of EMF against the logarithm of copper concentration in the amalgam.	Nothing specified.
	ESTIMATED ERROR: Soly: precision better than ± 7%. Temp: not specified.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Sasim, D.; Srudka, M.; Guminski, C. *Monatsh. Chem.* 1984, *115*, 45-56.
VARIABLES: One temperature: 298 K	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of copper at 298 K was reported to be $(1.1 \pm 0.1) \times 10^{-2}$ at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The experiments were performed with the use of a hanging mercury-drop electrode in a solution of 0.10 mol dm^{-3} $CuSO_4$ at pH = 2. Controlled amounts of Cu were introduced into the electrode by electrolysis at constant current, and the concentration of Cu was varied over a range of 7.7×10^{-4} - 2.3×10^{-2} mol dm^{-3}. Potentials of the electrodes were recorded for 1000 s after the electrolysis; the potentials were practically constant after 600 s. A breakpoint on the curve relating potential to logarithm of Cu concentration corresponds to the saturation of the amalgam. A +6 mV correction was applied to the potentials of the heterogeneous amalgams because of very slow attainment of true equilibrium in the system [1,2].

SOURCE AND PURITY OF MATERIALS:

Mercury was purified with acidified solution of $Hg_2(NO_3)_2$ and then twice distilled. All reagents were analytically pure (Ciech) and solutions were prepared with triply-distilled water. The solution of $CuSO_4$ was cathodically electrolyzed.

ESTIMATED ERROR:

Soly: precision ± 10%.

Temp: precision ± 0.2 K.

REFERENCES:

1. Chao, F.; Costa, M.; *C.R. Acad. Sci., Ser. 2* 1965, *261*, 990; *Bull. Soc. Chim. Fr.* 1968, *549*.
2. Hurlen, T.; Staurset, A.; Eriksrud, E. *J. Electroanal. Chem.*, 1977, *83*, 263.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Mercury; Hg; [7439-97-6]	Grønlund, F.; Kristensen, B. *Acta Chem. Scand., Ser. A* 1984, *38*, 229-32.
VARIABLES: Temperature: 10-25°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of Cu in Hg:

t/°C	Soly/10^4 mol kg^{-1}	Stand. Dev.	Soly/10^3 at %[a]
10.2	3.72	0.05	7.46
15.8	5.00	0.10	10.0
22.1	6.08	0.07	12.2
25.1	6.95	0.05	13.9

[a] by compilers

The measurements are of high precision but it is not clear whether equilibrium was reached in the time span of the experiments (compilers).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The Cu amalgams were obtained by coulometric addition of Cu to the measuring Hg electrode. Cu anode served as a Cu source. Potentials (E) of the cell,

$Cu(Hg)_{sat.}|CuSO_4|Cu(Hg)_x$,

were monitored during 6 to 12 h. The electrolyte contained 0.7 mol dm^{-3} of $CuSO_4$ at pH = 2. The results were placed on a plot of E vs. log N_{Cu}. A line with the Nernstian slope was fitted numerically to the experimental points; its intersection with E = 0 gives the saturated concentration. The measurements were performed under vacuum.

SOURCE AND PURITY OF MATERIALS:

99.99999% pure Hg from Mercure-Industrie; 99.999% pure Cu from ASARCO; $CuSO_4$ analytically pure from Merck; H_2SO_4 analytically pure from BDH, and low-conductivity H_2O were used.

ESTIMATED ERROR:

Standard deviation is lower than 2% but see the comments.

Temp: probably ± 0.1 K (compilers).

REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Silver; Ag; [7440-22-4] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

The solubility of silver in mercury is rather low near room temperature. Gouy (1), by using a filtration method, was the first to report a measured solubility of 0.06 at % at 288-291 K. Humphreys (2) determined a solubility of 0.086 at % at 301 K wnile studying the diffusion of silver into mercury. Reinders (3) electrolytically saturated the amalgam with silver, and determined a solubility of 0.076 at % at 298 K; the latter solubility appears to be an acceptable determination. The determination by Strachan and Harris (4), 7.2×10^{-2} at % Ag at room temperature, is in good agreement with that of Reinders. Kozin (5) predicted a solubility of 4.3×10^{-2} at % at 298 K.

Several authors determined the solubility of silver in mercury over a range of temperatures. Joyner (6) reported that the silver concentration in the saturated amalgam varied from 0.07 to 1.13 at %, respectively, over the equilibration temperature range of 287 to 436 K. The results agree with precise measurements reported more recently by others.

Very careful determinations of silver solubility in mercury were made over a temperature range of 278 to 486 K in the same laboratory by Sunier and Hess (7), DeRight (8) and Maurer (9). These authors equilibrated and filtered the liquid amalgam at the various temperatures, and chemically analyzed the amalgams to determine the solubility. Smoothing equations were fitted to the data in all of the measurements.

Murphy (10) determined the liquidus over the temperature range of 651 to 1201 K from thermoanalysis, and he utilized previously published data to draw a complete phase diagram. Tammann and Strassfurth (11) earlier reported a phase diagram based on their thermal analyses and potentiometry, but their data do not agree with the accepted phase diagram (12) shown in Fig. 1.

Hudson (13a) equilibrated known weights of silver and mercury at temperatures varying from 289 to 718 K, and determined the solubility of silver from the loss in weight of the silver which was immersed in the liquid. These results agreed very well with those of refs. (7-9). Hudson combined his data with those of others and derived three equations of the form, $\log N = A - B/(T/K)$, where A and B are constants and N is the at % solubility of silver. These equations were derived for the temperature ranges: 290-603 K, 603-723 K, and 723-1234 K. These equations fitted the experimental solubilities with good agreement.

Jangg and Palman (14) equilibrated silver and mercury at various temperatures between 293 and 823 K, and found that the solubility varied from 0.071 to 44 at % Ag in this temperature range. Although the method of analysis for the solubility determination was not described, the solubilities from the latter work are in good agreement with the earlier reliable measurements (7-9, 13).

Other solubility determinations of silver are rejected in this evaluation because they are too high (15,16) or too low (17).

The kinetics of dissolution of silver in mercury was reported by Hinzner and Stevenson (18).

The saturated amalgams are in equilibrium with intermediate solid phases, and various compounds have been proposed. However, only the ε and γ phases have been confirmed (12,19).

The solubility of silver in saturated tin amalgam was reported by Joyner (6).

(Continued next page)

COMPONENTS:	EVALUATOR:
(1) Silver; Ag; [7440-22-4] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION: (continued)

Recommended (r) and tentative values of the solubility of silver in mercury:

T/K	Soly/at %		Reference
273	3.5×10^{-2} [a]		[9]
293.2	6.5×10^{-2}	(r)[b]	[8,9,14]
298.2	7.6×10^{-2}	(r)[b]	[2,3,8]
323	0.15	(r)	[8,14]
373	0.42	(r)	[7,13,13a,14]
473	1.8	(r)	[7,14]
573	5.1	(r)	[13,13a,14]
673	19[c]		[13,13a,14]
773	39		[14]
873	49[b]		[10,14]
973	61[b]		[10]
1073	76		[10]
1173	91[b]		[10]

[a] Extrapolated value from data of cited references.

[b] Interpolated value from data of cited references.

[c] Mean value from cited references.

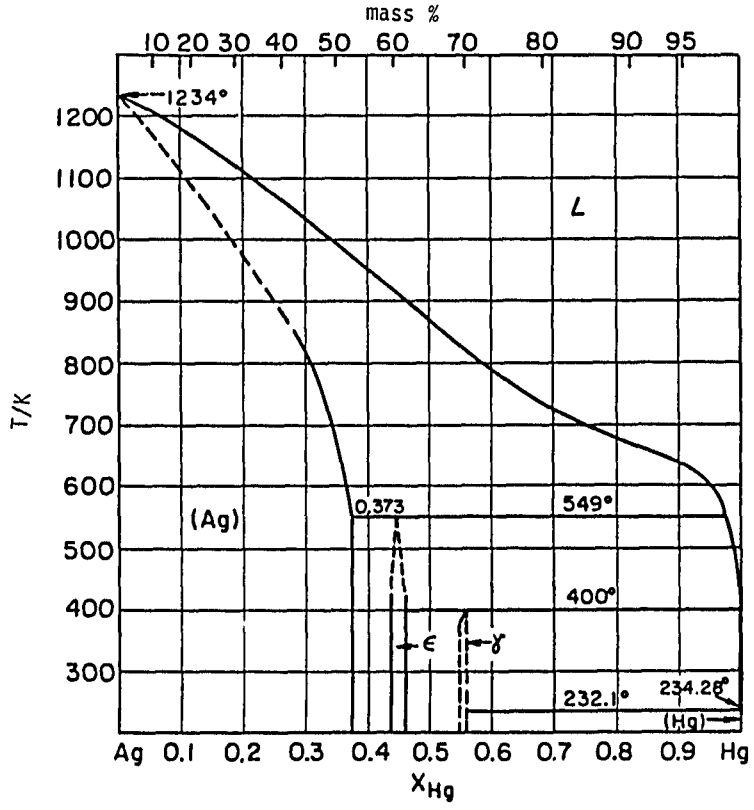

Fig. 1. Silver-Mercury System (12).

COMPONENTS:	EVALUATOR:
(1) Silver; Ag; [7440-22-4] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

References

1. Gouy, M. *J. Phys.* 1895, *4*, 320.
2. Humphreys, W.J. *J. Chem. Soc.* 1896, 243.
3. Reinders, W. *Z. Phys. Chem.* 1906, *54*, 609.
4. Strachan, J.F.; Harris, N.L. *J. Inst. Metals* 1956-57, *85*, 17.
5. Kozin, L.F. *Fiziko-Khimicheskie Osnovy Amalgamnoi Metallurgii*, Nauka, Alma-Ata, 1964.
6. Joyner, R.A. *J. Chem. Soc.* 1911, 195.
7. Sunier, A.A.; Hess, C.B. *J. Am. Chem. Soc.* 1928, *50*, 662.
8. DeRight, R. *J. Phys. Chem.* 1933, *37*, 405.
9. Maurer, R.J. *J. Phys. Chem.* 1938, *42*, 515.
10. Murphy, A.J. *J. Inst. Metals* 1931, *46*, 507, 522.
11. Tammann, G.; Strassfurth, T. *Z. Anorg. Chem.* 1925, *143*, 357.
12. Hultgren, R.; Desai, P.D.; Hawkins, D.T.; Gleiser, M.; Kelley, K.K. *Selected Values of the Thermodynamic Properties of Binary Alloys*, Am. Soc. Metals, Metals Park, OH, 1973, p. 62.
13. Hudson, D.R. *J. Phys. Chem.* 1945, *49*, 483.

13a. Hudson, D.R. *Metallurgia* 1943, *28*, 203.

14. Jangg, G.; Palman, H. *Z. Metallk.* 1963, *54*, 364.
15. Ogg, A. *Z. Phys. Chem.* 1898, *27*, 285.
16. Maey, E. *Z. Phys. Chem.* 1905, *50*, 200.
17. Ostapczuk, P.; Kublik, Z. *J. Electroanal. Chem.* 1977, *83*, 1.
18. Hinzner, F.W.; Stevenson, D.A. *J. Phys. Chem.* 1963, *67*, 2424.
19. Trebukhov, A.A., as cited by Kozin, L.F.; Nigmetova, R.Sh.; Dergacheva, M.B. *Termodinamika Binarnykh Amalgamnykh Sistem*, Nauka, Alma-Ata, 1977, p. 136.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Silver; Ag; [7440-22-4] (2) Mercury; Hg; [7439-97-6]	Humphreys, W.J. *J. Chem. Soc.* 1896, 243-53.
VARIABLES:	**PREPARED BY:**
Temperature: 26-28°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of silver in mercury at 26.4 and 28.2°C was reported to be 0.043 ± 0.002 and 0.046 ± 0.002 mass %, respectively. The corresponding atomic % solubilities calculated by the compilers are 0.080 ± 0.004 and 0.086 ± 0.004 at %, respectively.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Disc of Ag was placed on the surface of a column of Hg contained in a glass or a wooden vessel, and the liquid was sampled for analysis after 10 days. Silver was determined as the metal by evaporating the Hg from the known weight of the amalgam.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: precision better than ± 5%.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Silver; Ag; [7440-22-4] (2) Mercury; Hg; [7439-97-6]	Reinders, W. *Z. Phys. Chem.* 1906, *54*, 609-27.
VARIABLES: One temperature: 25°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of silver in mercury at 25°C was reported to be 7.6×10^{-2} at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Aqueous solutions of $AgNO_3$ and $Hg_2(NO_3)_2$ were shaken with metallic silver in a thermostat. The cell was then opened and the potential difference between pure silver and the metallic residue was determined. Both the metallic residue and the solution were analyzed; the amalgams were analyzed gravimetrically after mercury was distilled off.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Silver; Ag; [7440-22-4] (2) Mercury; Hg; [7439-97-6]	Joyner, R.A. *J. Am. Chem. Soc.* 1928, *50*, 662-68.
VARIABLES: Temperature: 287-403 K	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of silver in mercury:

T/K	Soly/at %
287	0.07
298	0.082
303	0.086
336	0.19
363	0.34
403	1.13

The results obtained at 287 and 403 K are too high; the other values agree with most precise reported works.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Ag was carefully purified by chemical treatments, and filings of this metal were equilibrated with excess Hg in sealed, hydrogen-filled tubes at different temperatures. After opening the tubes, the amalgams were pipetted through a glass wool plug and dissolved in HNO_3. The solution was then treated with NH_4Cl to precipitate AgCl. The precipitate was redissolved in ammonium hydroxide, then the AgCl was reprecipitated by acidifying the solution with HNO_3. The AgCl was then estimated in the "usual way".

SOURCE AND PURITY OF MATERIALS:

Hg purity was not specified. Ag was dissolved in HNO_3, then precipitated as AgCl. The AgCl was dissolved in NH_4OH and reprecipitated as AgCl after filtration of the ammoniacal solution. The AgCl was then fused with Na_2CO_3, and the molten Ag was successively treated with KNO_3, NH_4Cl, and borax, with a bone ash support being employed.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Silver; Ag; [7440-22-4] (2) Mercury; Hg; [7439-97-6]	Sunier, A.A.; Hess, C.B. *J. Am. Chem. Soc.* 1928, *50*, 662-68.
VARIABLES: Temperature: 80-213°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of silver in mercury:

t/°C	Soly/at %	Ave. Deviation x 1000	t/°C	Soly/at %[a]
80.2	0.286	3.5	181.8	1.365
98.2	0.411	4.9	193.3	1.573
121.9	0.612	1.6	212.7	1.953
144.5	0.849	1.2		
160.6	1.057	7.6		
177.9	1.346	2.2		
198.9	1.746	5.2		

[a]Unpublished data of G. H. Reed from the same laboratory.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An excess of Ag was equilibrated with Hg in one of the bulbs of a Pyrex apparatus which was immersed and shaken in a thermostated bath. The amalgam was then filtered through an integral capillary by inverting the apparatus in the bath. The filtrate was analyzed by distilling the Hg, dissolving the Ag with HNO_3, then gravimetrically determining the Ag as the chloride.

SOURCE AND PURITY OF MATERIALS:

Ag was "999 fine" from the U.S. Mint and "1000 fine foil" from the Philadelphia Mint.

Mercury was first washed by dropping through a column of $Hg_2(NO_3)_2$, then triply distilling after drying.

ESTIMATED ERROR:

Soly: accuracy better than ± 0.7%.

Temp: precision ± 0.1 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Silver; Ag; [7440-22-4] (2) Mercury; Hg; [7439-97-6]	Murphy, A.J. *J. Inst. Metals* 1931, *46*, 507-22.
VARIABLES: Temperature: 378-928°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Temperatures of crystallization of silver amalgams:

	Silver Content	
t/°C	mass %	at %[a]
928	88.97	93.75
886	80.08	88.2
843	69.6	81.0
786	60.23	73.8
721	49.96	65.0
630	37.72	52.96
541	28.86	43.0
465	20.08	31.84
407	10.03	17.17
378	5.00	8.91

[a] by compilers

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Amalgams were prepared by mixing the required amounts of Hg and precipitated Ag in a shaking apparatus. The specimens were transferred into silica tubes which were sealed and contained in a pressurized bomb for the high temperature measurements. Cooling curve temperatures were measured with a Chromel-Alumel thermocouple. Analytical method for the amalgam analysis was not specified.

SOURCE AND PURITY OF MATERIALS:

Chemically precipitated silver was better than 99.9% pure. High purity mercury was redistilled.

ESTIMATED ERROR:

Temp: nothing specified.

Amalgam composition: accuracy better than ± 0.2%.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Silver; Ag; [7440-22-4] (2) Mercury; Hg; [7439-97-6]	DeRight, R. *J. Phys. Chem.* 1933, *37*, 405-16.
VARIABLES:	**PREPARED BY:**
Temperature: 9-81°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of silver in mercury:

t/°C	Soly/at %	% Ave. Deviation
8.92	0.0641	6.4
18.17	0.0643	1.0
19.01	0.0636	0.6
25.28	0.0766	2.1
25.60	0.0792	1.4
29.93	0.0881	1.3
30.15	0.0965	9.1
40.11	0.1139	0.5
50.02	0.1450	0.4
60.26	0.1901	2.7
70.54	0.2404	3.2
80.94	0.2892	0.4

Ag_3Hg_4 was reported to be in equilibrium with the saturated amalgam.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus consisted of two Pyrex bulbs connected by a capillary filter. Hg and excess Ag were sealed in one bulb under a pressure of hydrogen, and the system was equilibrated in a thermostat. The amalgam was then filtered through the capillary and the Ag analyzed gravimetrically as the metal after evaporation of the Hg.

SOURCE AND PURITY OF MATERIALS:

Mercury was purified by dropping through a column of 6 mol dm^{-3} HNO_3, washed with H_2O, dried and distilled. No residue upon evaporation of this Hg.

Silver was "1000 fine foil" from the Philadelphia Mint.

ESTIMATED ERROR:

Soly: ± 1% ave. deviation from mean, except ± 9% at 303 K.

Temp: precision ± 0.02 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Silver; Ag; [7440-22-4] (2) Mercury; Hg; [7439-97-6]	Maurer, R.J. *J. Phys. Chem.* 1938, *42*, 515-19.
VARIABLES:	**PREPARED BY:**
Temperature: 5-19°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of silver in mercury:

t/°C	Soly/at % x 100	Ave. dev. from mean x 1000
5.72	4.03	1.3
9.71	4.74	1.3
12.39	5.19	1.5
16.12	5.86	4.1
18.98	6.25	1.4
19.24	6.52	7.7

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgams were prepared by dissolution of silver in mercury and equilibrated in a thermostat. The amalgams were filtered through a G-1 Schott-Jena filter, then analyzed gravimetrically after evaporation of mercury.

SOURCE AND PURITY OF MATERIALS:

Silver was "1000 fine foil" from the Philadelphia Mint.

Mercury was purified by dropping into HNO_3, then washed, dried and triply distilled.

ESTIMATED ERROR:

Soly: precision better than 0.6%.

Temp: precision $\pm$ 0.02 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Silver; Ag; [7440-22-4] (2) Mercury; Hg; [7439-97-6]	1. Hudson, D.R. *J. Phys. Chem.* 1945, *49*, 483-506. 2. Same author *Metallurgia* 1943, *28*, 203-6.
VARIABLES:	PREPARED BY:
Temperature: 289-718 K	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of silver in mercury:

	Soly	
T/K	g Ag/100 g Hg	at %
289.4	0.030	0.0558
372.8	0.222	0.4121
457.6	0.768	1.4192
533.2	1.885	3.450
579.2	2.823	5.251
611.2	3.816	6.872
629.9	5.22	9.294
678.2	10.59	18.053
717.7	17.35	28.081

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubilities were determined by equilibrating a cube of Ag with Hg in a tube of refractory glass. The sealed tube with the known amounts of the metals was suspended in a constant temperature, vapor-bath for various periods. Knowing the total weight, the subsequent analyses were made by determining the loss in weight of the solid Ag core after Hg was removed by evaporation from the surface of the Ag.

SOURCE AND PURITY OF MATERIALS:

Silver: 99.95% pure.

Mercury: "analytical reagent" grade, 99.998% pure.

ESTIMATED ERROR:

Soly: not specified; precision better than ± 1% (compilers).

Temp: precision ± 0.25 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Silver; Ag; [7440-22-4] (2) Mercury; Hg; [7439-97-6]	Jangg, G.; Palman, H. *Z. Metallk.* 1963, *54*, 364-69.
VARIABLES: Temperature: 293-823 K	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of silver in mercury was presented graphically as a function of temperature. The mass % solubilities were read off the curve and converted to atomic % by the compilers.

T/K	Soly/at %
293	0.071
323	0.16
373	0.41
423	0.91
473	1.8
523	3.1
548	4.4
573	5.1
623	12
673	20
723	29
773	39
823	44

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Method of the amalgam preparation was not specified. The amalgams were shaken and kept for 12 hours in thermostated glass cylinders and subsequently filtered under pure nitrogen pressure. For temperatures above 600 K a pressure apparatus of hard chromium steel was used. The method of analysis of the amalgam was not specified.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: precision ± 5%.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	C. Guminski; A. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

Because of the ready wetting of gold by mercury, there has been a mistaken belief by many scientists that gold has a relatively high solubility in mercury at room temperature. Contrary to this belief, it was shown as early as 1855, by Henry (1), that the solubility of gold in mercury was approximately 0.14 at %, presumably at room temperature. Kazantsev (2), in 1878, employed a filtration method and reported solubilities of 0.112, 0.128, and 0.662 at % at 273, 293 and 373 K, respectively; the results at 293 and 373 K are in remarkably good agreement with more precise measurements reported approximately fifty years later. Gouy (3) also reported a solubility of approximately 0.13 at % at 288 to 291 K. More recently, Strachan and Harris (4) equilibrated the two metals at room temperature and determined a solubility of 0.128 at %, while Kozin and coworkers (5) utilized a capillary phase separation technique and determined a solubility of 0.135 at % at 295 K; these solubilities near room temperature are in good agreement with the most accurate measurements of Sunier and White (see below).

Tammann (6) determined that the freezing point of mercury is elevated by 0.1, 0.1 and 0.2 K upon dissolution of 6×10^{-3}, 1.2×10^{-2} and 2.5×10^{-2} at %, respectively, of gold.

The most detailed and accurate determinations of the solubility of gold in mercury were made by Sunier and coworkers (7-11). These authors equilibrated the metals in a glass apparatus at various temperatures from 280 to 662 K, then the liquid phase was separated at equilibration temperatures by filtration through a capillary which was constructed into the apparatus. The filtrate was then chemically analyzed to determine the solubility. A total of nearly three hundred data points was obtained in this series of papers, and the data were fitted with a smooth curve to form the liquidus. Sunier and White (8) fitted a smoothing equation to their data at 280 to 357 K, and obtained a solubility of 0.1306 at % at 293.2 K.

From vapor pressure measurements of gold amalgams, Eastman and Hildebrand (12) reported a solubility of 16.5 at % gold in mercury at 590 K. This solubility is in good agreement with Anderson's data (11). Parravano (13), from freezing point determinations, reported the solubility of gold in mercury at 353 to 598 K, but his solubilities are in agreement with the more accurate measurements (7-11) only for temperatures above 553 K; at lower temperatures, probably because of supercooling, the solubilities were as much as two times higher than those of Sunier et al. (7,8). Britton and McBain (14) determined the solubility of gold at 291 to 683 K by equilibrating the metals at various temperatures, then separating the solid phase by filtration through a sintered glass filter, followed by chemical analysis of the filtrate. These authors reported solubilities of 0.212 to 55.33 at % over their temperature range; the solubilities in the lower temperature region are too high compared to those of Sunier et al. (7,8). Plaksin (15), by employing thermoanalysis, determined the liquidus of gold amalgams from 395 to 733 K; the solubilities at temperatures below 500 K were higher than those determined by chemical analysis (7-9). Rolfe and Hume-Rothery (16) determined the liquidus from 402 to 1324 K from measurements of cooling curves, and the data were used to construct a complete phase diagram of the Au-Hg system. The data of the latter authors were in general agreement with those of Anderson (11).

Other solubility data have been reported but these are rejected in the evaluation because they are either too high (17-19) or too low (20).

In a brief review, Brown (21) tabulated selected values of the solubility of gold in mercury in the lower temperature range.

The phase diagram (22) for the Au-Hg system is shown in Fig. 1. The identification of the following compounds has been made: Au_4Hg (16), Au_3Hg (11,13,15-17,23) and Au_2Hg (15-17). Other compounds suggested for this system are Au_5Hg (23), Au_2Hg_3 (11,13,23,24), Au_2Hg_5 (17), $AuHg_2$ (15,17,23,24), $AuHg_4$ (17) and $AuHg_6$ (14).

(Continued next page)

COMPONENTS:	EVALUATOR:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	C. Guminski; A. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION: (Continued)

Recommended (r) and tentative values for the solubility of gold in mercury:

T/K	Soly/at %	References
273	0.08[a]	[8]
293.2	0.13 (r)	[2,4,5,8]
298.2	0.14[b]	[5,8]
323	0.25	[8]
373	0.68 (r)	[2,7,14]
473	3.0 (r)[c]	[7,9,10,14,16]
573	14 (r)[c]	[9,10,16]
673	44[b]	[16]
773	54[b]	[16]
873	62[b]	[16]
973	71[b]	[16]
1073	77	[16]
1173	82	[16]
1273	92	[16]

[a] Extrapolated from data of [8].

[b] Interpolated value from data of cited references.

[c] Mean value of data from cited references.

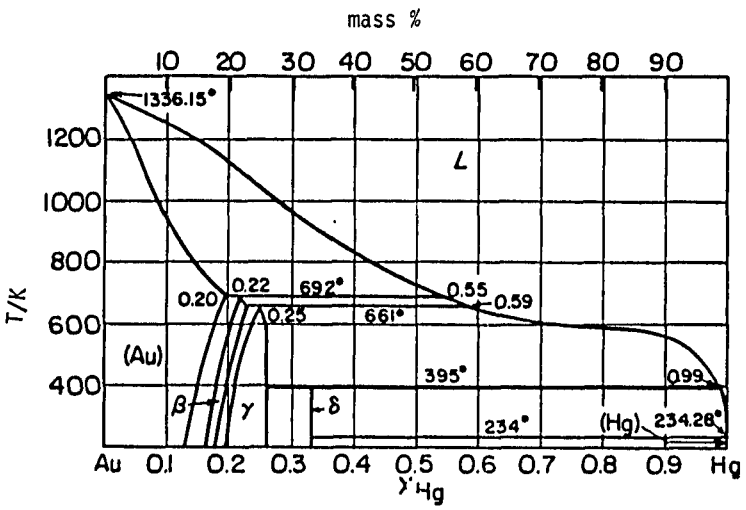

Fig. 1. The Au-Hg System (22).

(Continued next page)

COMPONENTS:	EVALUATOR:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	C. Guminski; A. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION: (Continued)

REFERENCES

1. Henry, T.H. *Phil. Mag., Ser. 4*, 1855, *9*, 458; cited by [21].
2. Kazantsev, M. *Zh. Russ. Fiz. Khim. Obshch.* 1878, *10*, 233; *Bull. Soc. Chim. Fr.* 1878, *30*, 20; *Ber.* 1878, *11*, 1255; *Brit. Abstr.* 1878, 937.
3. Gouy, M. *J. Phys.* 1895, *4*, 320.
4. Strachan, N.F.; Harris, N.L. *J. Inst. Metals* 1956-57, *85*, 17.
5. Kozin, L.F.; Dergacheva, M.B.; Nikushkina, N.L. *Tr. Inst. Khim. Nauk Akad. Nauk Kaz. SSR* 1976, *42*, 82.
6. Tammann, G. *Z. Phys. Chem.* 1889, *3*, 441.
7. Sunier, A.A.; Gramkee, B.E. *J. Am. Chem. Soc.* 1929, *51*, 1703.
8. Sunier, A.A.; White, C.M. *J. Am. Chem. Soc.* 1930, *52*, 1842.
9. Sunier, A.A.; Weiner, L.G. *J. Am. Chem. Soc.* 1931, *53*, 1714.
10. Mees, G. *J. Am. Chem. Soc.* 1938, *60*, 870.
11. Anderson, J.T. *J. Phys. Chem.* 1932, *36*, 2145.
12. Eastman, E.D.; Hildebrand, J.H. *J. Am. Chem. Soc.* 1914, *36*, 2020.
13. Parravano, N. *Gazz. Chim. Ital.* 1918, *48*, 123.
14. Britton, G.T.; McBain, J.W. *J. Am. Chem. Soc.* 1926, *48*, 593.
15. Plaksin, I.N. *Izv. Sekt. Fiz. Khim. Anal.* 1938, *10*, 129.

15a. Plaksin, I.N. *Zh. Russ. Fiz. Khim. Obshch., Ser. Khim.* 1929, *61*, 521; abstracted in *Z. Metallk.* 1932, *24*, 56, 89; *J. Inst. Metals* 1928, *39*, 498; 1929, *41*, 459.

16. Rolfe, C.; Hume-Rothery, W. *J. Less-Common Metals* 1967, *13*, 1.
17. Braley, S.A.; Schneider, R.F. *J. Am. Chem. Soc.* 1921, *43*, 740.
18. Loomis, A.G. *J. Am. Chem. Soc.* 1922, *44*, 8.
19. Williams, T.C.; Evans, E.J. *Phil. Mag., Ser. 7*, 1928, *6*, 231.
20. Kozin, L.F. *Fiziko-Khimicheskie Osnovy Amalgamnoi Metallurgii*, Nauka, Alma-Ata, 1964.
21. Brown, J.B. *J. Chem. Educ.* 1960, *37*, 415.
22. Hultgren, R.; Desai, P.D.; Hawkins, D.T.; Gleiser, M.; Kelley, K.K. *Selected Values of the Thermodynamic Properties of Binary Alloys*, Am. Soc. Metals, Metals Park, OH, 1973, p. 279.
23. Aramian, K.T.; Shklar, R.Sh.; Kakovskii, I.A. *Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.* 1972, *15*, No. 1, 57.
24. Winterhager, H.; Schlösser, W. *Metall* 1960, *14*, 1.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	Kazantsev, M. *Zh. Russ. Fiz. Khim. Obshch.* 1878, *10*, 233-5.
VARIABLES: Temperature: 0-100°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of gold in mercury:

t/°C	Soly/mass %	Soly/at %[a]
0	0.110	0.112
20	0.126	0.128
100	0.650	0.662

[a] by compilers.

These data were also reported in (1-3).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Mercury was saturated with gold by contact of the metals for minimum of 1 hour. The amalgams containing excess of gold were squeezed through a chamois leather or a capillary of 0.15-0.40 mm dia. The filtrate was analyzed by an unspecified method after amalgam was dissolved in nitric acid. Rate of filtration, pressure applied and source of gold had no influence on the solubility.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Kazantsev, M. *Bull. Soc. Chim. Fr.* 1878, *30*, 20.
2. Same. *Ber.* 1878, *11*, 1255.
3. Same. *Brit. Abstr.* 1878, 937.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	Tammann, G. *Z. Phys. Chem.* 1889, *3*, 441-9.
VARIABLES: Temperature	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Elevation of the melting point of mercury, ΔT/K, upon addition of small amounts of gold:

g Au/100 g Hg	Soly/at %[a]	ΔT/K
0.006	0.006	0.1
0.012	0.012	0.1
0.025	0.025	0.2

[a] by compilers

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The melting temperatures of the amalgams were measured, probably with the use of a thermometer. No further details are given. The melting temperature of mercury was reported to be 244 instead of 234 K, but one may assume that the experimental ΔT values are correct.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: precision ± 0.05 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	Eastman, E.D.; Hildebrand, J.H. *J. Am. Chem. Soc.* 1914, *36*, 2020-30.
VARIABLES: One temperature: 317°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of gold in mercury at 317°C was reported to be 16.5 at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The metals were introduced into U-tubes in the desired proportions then they were heated and outgassed by boiling. The tubes, which were connected to a Hg manometer, were agitated in a thermostat. The vapor pressure of the amalgams was measured manometrically. The vapor pressure of pure Hg was concurrently determined in an identical apparatus, with the Hg tube immersed in the same thermostat. Temperature of sample was determined from the measured vapor pressure of Hg by correlating the pressure to the vapor pressure equation determined by earlier workers. The breakpoint in the relationship of amalgam vapor pressure to composition gave the solubility of gold.

SOURCE AND PURITY OF MATERIALS:

Mercury was carefully purified by washing with dilute nitric acid, then distilled in a current of air. Gold stated to be purified by "usual methods".

ESTIMATED ERROR:

Soly: precision better than ± 1% (compilers).

Temp: precision ± 2 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	Parravano, N. *Gazz. Chim. Ital.* 1918, *48*, 123-38.
VARIABLES: Temperature: 113-312°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of gold in mercury:

t/°C	Soly/at %[a]	Soly/mass %	t/°C	Soly/at %[a]	Soly/mass %
113	1.63	1.60	305	17.47	17.21
168	3.63	3.57	308	18.07	17.80
220	6.36	6.25	306	18.93	18.65
270	10.16	10.00	308	19.32	19.04
288	11.12	10.94	310	19.92	19.63
293	13.74	13.53	312	25.55	25.20
302	16.71	16.46			

[a] by compilers

These solubilities are generally high compared to those reported by other workers, but the data at temperatures above 293°C are nearly the same as those for more precise measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgams were prepared by dissolution of gold in mercury accompanied by heating. The melting points of the known compositions were then determined.

SOURCE AND PURITY OF MATERIALS:

Gold: 99.9% pure.

Mercury purified with HNO_3, washed and distilled under reduced pressure.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	Britton, G.T.; McBain, J.W. *J. Am. Chem. Soc.* 1926, *48*, 593-598.
VARIABLES: Temperature: 18-410°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubilities of gold in mercury determined with three different apparatus, as indicated by series numbers:

SERIES I		SERIES II			
t/°C	at % Au	t/°C	at % Au	t/°C	at % Au
18	0.212	64	0.379	143	1.591
18	0.287	65.4	0.378	147.5	1.628
47	0.388 ± 0.010	93.0	0.599 ± 0.002	149	1.630
52.5	0.293 ± 0.020	98	0.682 ± 0.006	153	1.785
77	0.538 ± 0.046	105	0.736	155	1.815
80.5	0.623 ± 0.012	106.5	0.753	158	1.920
92	0.721 ± 0.006	114.5	0.948	159	1.929
99.5	0.812 ± 0.073	115.5	0.944	163	2.028
103.5	0.906 ± 0.020	121	1.226 ± 0.010	163.5	2.052
108	0.952 ± 0.036	122.5	1.101	172	2.212
128	1.474 ± 0.014	133.5	1.421	173	2.212
132	1.462	136	1.409	174	2.260
145	1.667 ± 0.011	142.5	1.576	174.5	2.158

(Series II continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Three different apparatus, each compatible for the temperature ranges 18-150, 60-350, and 300-410°C, were used for the solubility measurements. In each case the amalgams were equilibrated in a glass bulb immersed in a thermostated system, and the liquid was drawn off through a capillary or glasswool filter for analysis. In the two higher temperature ranges the amalgams were equilibrated under an atmosphere of hydrogen at pressures up to 4 atm. Amalgams from the highest temperature range were analyzed by evaporation of the Hg in a stream of coal gas at 350°C in a Pyrex tube and weighing the Au residue. Amalgams from the other two ranges were analyzed by reduction of the dissolved $AuCl_3$ by standard $Fe(NH_4)_2(SO_4)_2$.

SOURCE AND PURITY OF MATERIALS:

Chemically pure Au from Johnson-Matthey.

Mercury was purified with $Hg_2(NO_3)_2$, then dried and distilled.

ESTIMATED ERROR:

Soly: precision better than ± 10%.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	Britton, G.T.; McBain, J.W. *J. Am. Chem. Soc.* 1926, *48*, 593-598.
VARIABLES: Temperature: 18-410°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

SERIES II (concluded)				SERIES III			
t/°C	at % Au	t/°C	at % Au	t/°C	at % Au	t/°C	at % Au
186.2	2.616	247	5.300	280	6.89	366	34.48
189.5	2.746	258.5	6.585	289	8.30	370	39.48
192.5	2.615	259	6.036	321	10.67	378	42.99
201.5	3.137	259.5	6.725	327	20.49	386	42.96
206	3.302	260	6.753	327	23.27	398	52.00
207	3.265	288	8.542	331	18.32	410.5	55.33
206.5	3.345	291	8.716	334	18.92		
207.5	3.732			339	16.14		
234	4.559			343.5	27.16		
234.5	4.601			354	32.96		
241	5.225			361	33.32		

Most reliable results are those in Series II (compilers).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	1. Sunier, A.A.; Gramkee, B.E. *J. Am. Chem. Soc.* 1929, *51*, 1703-8. 2. Sunier, A.A.; White, C.M. *J. Am. Chem. Soc.* 1930, *52*, 1842-52.
VARIABLES:	PREPARED BY:
Temperature: 6-201°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of gold in mercury:

	Experimental Soly			Smoothed Soly	
	t/°C	at %	% Ave. Dev.	t/°C	at %
Ref. (1)	80.8	0.467	1.2	80	0.459
	101.2	0.697	0.6	100	0.684
	121.7	1.021	1.2	120	0.996
	142.1	1.482	0.1	140	1.385
	159.2	1.847	0.3	160	1.871
	182.3	2.434	0.2	180	2.380
	201.1	2.875	2.5	200	2.849
Ref. (2)	6.96	0.1006	0.82	0	(0.081)
	20.00	0.1290	0.77	10	0.1038
	29.68	0.1638	0.47	20	0.1306
	39.98	0.2045	0.54	30	0.1629
	49.50	0.2461	0.41	40	0.2014
	60.32	0.3152	0.52	50	0.2489
	70.36	0.3753	0.31	60	0.3076
	80.40	0.4647	0.43	70	0.3767
	69.2	0.375		80	0.4614
	83.8	0.498			

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus consisted of two Pyrex bulbs separated by a connecting capillary filter. Hg and Au were introduced into one bulb, evacuated, then sealed and equilibrated in a thermostat. Subsequently, the liquid was drawn through the capillary filter into the empty bulb. The weighed amalgam was analyzed by evaporating the mercury in a stream of hydrogen at temperatures up to 550°C for several hours. Equilibration of amalgams was approached from higher and from lower temperatures.

SOURCE AND PURITY OF MATERIALS:

(1) "Thousand-fine" gold foil from the Philadelphia Mint.
Mercury was passed through a column of $Hg_2(NO_3)_2$ then washed and distilled.

(2) 99.95% pure gold.
Mercury was purified with HNO_3 then distilled several times.

ESTIMATED ERROR:

Soly: precision better than ± 1% in (1) and ± 0.8% in (2).

Temp: precision ± 0.1 in (1) and ± 0.02 K in (2).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	1. Plaksin, I.N. *Izv. Sekt. Fiz. Khim. Anal.* 1938, *10*, 129-59. 2. Same author *Zh. Russ. Fiz. Khim. Obshch., Ser. Khim.* 1929, *61*, 521-34.
VARIABLES:	PREPARED BY:
Temperature: 122-515°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Crystallization temperatures of gold amalgams:

t/°C	at % Au	t/°C	at % Au
122	1.3	376	40.1
180	3.1	390	44.8
272	9.2	387	45.0
285	10.0	403	50.6
307	12.8	412	53.0
310 (315)	15.2	430	57.0
323	17.0	460	60.2
327	18.2	487	63.0
335	21.0	515	66.8
341	24.0		
351	28.1		
357	32.3		
361	33.8		
369	37.0		

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The alloys were prepared by mixing the metals in appropriate ratios in sealed, evacuated tubes. The samples were annealed for 10 hours at 300-400°C. The cooling and heating curves were recorded with the use of various thermocouples.

SOURCE AND PURITY OF MATERIALS:

Mercury: chemically pure from Kahlbaum, as well as that which was double-distilled under vacuum.

Gold was purified by dissolution in aqua regia, then reduced with oxalic acid or hydrazine; traces of silver were deposited upon treatment with HBr.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: precision ± 1 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	Anderson, J.T. *J. Phys. Chem.* 1932, *36*, 2145-65.
VARIABLES: Temperature: 286-390°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of gold in mercury:

t/°C	Soly/at %	t/°C	Soly/at %	t/°C	Soly/at %
286.3	10.22	300.2	15.99	321.7	26.97
286.5	12.50	300.4	17.02	327.5	29.02
288.2	13.17	300.7	17.01	328.6	29.04
288.3	12.55	307.2	15.99	334.5	31.00
290.8	13.19	307.2	20.40	351.0	34.26
291.1	13.17	309.4	22.78	352.6	34.26
293.5	14.48	310.2	22.94	373.4	37.96
293.9	14.50	315.2	25.07	374.8	37.96
297.9	16.07	315.4	23.97	386.8	39.94
298.7	14.01	320.7	27.05	388.8	40.25

The presence of some Pb had no influence on the solubility of Au in Hg.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Temperature at which the last crystal of the solid phase disappeared was determined in an evacuated Pyrex glass apparatus. The dissolution of the solid at various temperatures was observed as the liquid was passed over the solid which was retained on top of the capillary section of the apparatus. The amalgams were analyzed gravimetrically.

SOURCE AND PURITY OF MATERIALS:

Gold was 99.98% pure.

Mercury was purified with HNO_3 then distilled several times.

ESTIMATED ERROR:

Soly: precision no better than ± 1%.

Temp: precision ± 0.1 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	Sunier, A.A.; Weiner, L.G. *J. Am. Chem. Soc.* 1931, *53*, 1714-21.
VARIABLES: Temperature: 200-300°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of gold in mercury:

t/°C	Soly/at %	% Ave. Dev.
200.0	2.99	1.8
219.6	3.67	2.9
239.2	5.07	1.7
260.2	6.50	2.4
269.6	7.81	3.6
279.6	9.07	3.0
290.6[a]	10.89	-
292.6	12.58	4.5
299.5	13.95	1.5
299.7[a]	14.27	-

[a]Determined by thermal analysis.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An excess of Au was mixed with Hg in glass tubes and the latter were sealed after pressurizing with slightly less than an atmosphere of H_2. The tubes were equilibrated in an air bath, then the amalgams filtered through capillaries and analyzed gravimetrically by evaporating off the Hg. The thermal analyses were made by visual observation of disappearance and reappearance of the Au as the known mixture was heated and cooled.

SOURCE AND PURITY OF MATERIALS:

Gold was 99.99% pure.

Mercury was purified with HNO_3 then distilled several times.

ESTIMATED ERROR:

Soly: precision better than ± 4%.

Temp: precision ± 0.2 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	Mees, G. *J. Am. Chem. Soc.* 1938, 870-71.
VARIABLES:	**PREPARED BY:**
Temperature: 190-322°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of gold in mercury:

Experimental Solubility			Smoothed Solubility	
t/°C	at %	% Ave. Dev.	t/°C	at %
192.5	2.742	1.0	190.0	2.68
207.2	3.40	3.1	200.0	2.92
220.9	3.506	0.68	210.0	3.24
224.8	4.112	0.16	220	3.65
251.7	5.810	0.24	230	4.17
265.9	7.33	3.0	240	4.80
282.3	10.02	0.15	250	5.58
283.6	10.42	1.7	260	6.55
296.1	14.01	2.5	270	7.83
307.8	15.11	0.15	280	9.50
322.6	∿25		290	11.80
			300	15.42

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Experimental details were identical to those of ref. (1).	Same as in ref. (1).
	ESTIMATED ERROR: Soly: precision better than ± 3%. Temp: ± 0.02 K.
	REFERENCES: 1. Sunier, A.A.; Weiner, L.G. *J. Am. Chem. Soc.* 1931, *53*, 1714.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	Rolfe, C.; Hume-Rothery, W. *J. Less-Common Metals* 1967, *13*, 1-10.
VARIABLES:	**PREPARED BY:**
Temperature: 129-1051°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Liquidus temperatures of the gold-mercury system:

	at %			at %			at %	
t/°C	Hg	Au	t/°C	Hg	Au	t/°C	Hg	Au
129	99.1	0.9	351	64.9	35.1	861	19.9	80.1
172	97.8	2.2	375	59.9	40.1	893	18.3	81.7
202	96.7	3.3	418	55.1	44.9	940	14.8	85.2
290	92.5	7.5	469	50.0	50.0	958	13.0	87.0
292	90.0	10.0	514	45.0	55.0	978	11.1	88.9
303	85.1	14.9	567	40.2	59.8	984	9.8	90.2
308	79.7	20.3	629	35.1	64.9	998	8.1	91.9
321	75.1	24.9	680	30.2	69.8	1030	5.2	94.8
328	70.0	30.0	768	25.2	74.8	1051	4.1	95.9

Au_4Hg, Au_3Hg and Au_2Hg were found as solid phases.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

30 g of Au was heated with the required weight of Hg in evacuated silica capsules. The latter were very slowly heated to temperatures exceeding the freezing point of the alloy, then cooling and heating curves were recorded with calibrated thermocouples. After the experiments, the thermal analysis ingots were analyzed chemically by Johnson—Matthey Co., Ltd.

SOURCE AND PURITY OF MATERIALS:

Spectrographically pure mercury and 99.99% pure gold were obtained from Johnson—Matthey Co., Ltd.

ESTIMATED ERROR:

Temp: precision ± 2 K.

Analysis of amalgam: precision better than ± 1%.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Gold; Au; [7440-57-5] (2) Mercury; Hg; [7439-97-6]	Kozin, L.F.; Dergacheva, M.B.; Nikushkina, N.L. *Tr. Inst. Khim. Nauk Akad. Nauk Kaz. SSR* 1976, *42*, 82-7.
VARIABLES: One temperature: 22°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of gold in mercury at 22°C was reported to be 0.135 at %.

It was reported that bismuth and lead had no affect on the solubility of gold at this temperature.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gold amalgams were obtained by electrolysis of $HAuCl_4$ solutions. The solubility was determined by a hydrostatic separation method: the samples from various parts of a capillary, standing perpendicularly for a long time, were analyzed by evaporating the Hg under vacuum and treating the residue with nitric acid to determine the gold content.

SOURCE AND PURITY OF MATERIALS:

Pure $HAuCl_4$ was used.

Hg purity not specified.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: precision $\pm$ 0.1 K.

REFERENCES: