COMPONENTS:	EVALUATOR:
(1) Arsenic; As; [7440-38-2] (2) Mercury; Hg; [7439-97-6]	G. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

The solubility of arsenic in mercury was speculated to be very low by Tammann and Hinnüber (1). Kozin estimated solubilities of 2.8×10^{-13} (2) and 1.6×10^{-9} at % (3) at 298 K. Gladyshev (4) reported on arsenic solubility of 1.6×10^{-9} at % at room temperature, a value identical to Kozin's second estimated solubility (3), but because no details of the experimental determination were presented for ref. (4) it is difficult to assess the validity of this result. Nevertheless, the data of Refs. (2-4) confirm that of (1). Strachan and Harris (5) reported a solubility determination of 0.646 at % at room temperature, but this value is much too high; the error in this determination is attributed to evaporation losses of arsenic during the analysis.

Kamenev and coworkers (6) reported that the saturated amalgam of arsenic should be in equilibrium with As_2Hg_3; however, the solubility could not be estimated from the experiments performed by these authors.

It is clear that further solubility measurements are needed in this system.

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2. Kozin, L.F. *Tr. Inst. Khim. Nauk Akad. Nauk Kaz. SSR* 1962, *9*, 101.
3. Kozin, L.F. *Fiziko-Khimicheskie Osnovy Amalgamnoi Metallurgii*, Nauka, Alma-Ata, 1964.
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5. Strachan, J.F.; Harris, N.L. *J. Inst. Metals* 1956-57, *85*, 17.
6. Kamenev, A.I.; Mustafa, I.; Agasyan, P.K. *Zh. Anal. Khim.* 1984, *39*, 1242.

COMPONENTS:	EVALUATOR:
(1) Antimony; Sb; [7440-36-0] (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 antimony in mercury near room temperature has been shown to be low. Tammann and Hinnüber (1) determined a solubility of 4.8×10^{-5} at % at 291 K by EMF measurements, whereas Strachan and Harris (2) reported a solubility of 3.3×10^{-2} at %. These values are too low and too high, respectively, when compared to more reliable measurements which have been reported subsequently. At 293 K the following solubilities have been reported: 3.5×10^{-4} at % by Levitskaya and Zebreva (3), 3.6×10^{-4} at % by Zebreva and Kozlovskii (4), 1.1×10^{-3} at % by Zaichko and Zakharov (5), and 9×10^{-4} at % by Lange and Bukhman (6). In refs. (4-6) voltammetry was used to determine the solubility of Sb by anodic oxidation of the amalgams of various concentrations, while in refs. (3) and (4) the determinations were made potentiometrically on the amalgam concentration cells. Verplaetse and coworkers (7) determined the solubility of Sb in Hg by cyclic and stripping voltammetry at 298 K and reported a value of 1.27×10^{-3} at %; this solubility is in good agreement with those reported above (5,6). Zaichko and Zakharov (8) also determined the antimony solubility by voltammetry, presumably at room temperature, and reported a value of 1×10^{-3} at %. Liebl (9) reported a solubility of 3.8×10^{-3} at % at room temperature, but no details of the coulometric method were described; the latter solubility is tenfold higher than that reported by Zebreva and Kozlovskii (4).

Zakharova and coworkers (10) determined the antimony solubility, probably at 298 K, by chronoamperometric oxidation of the amalgam, and reported a value of 1.0×10^{-3} at %. At 293 K Bukhman and Dragavtseva (11) reported a solubility of 6.8×10^{-4} at %. Ignateva and Dubova (12), without presenting experimental details and presumably at room temperature, reported a solubility of $6.6\text{-}7.0 \times 10^{-4}$ at %. Kozin's (13) estimated solubility of 5×10^{-5} at % at 298 K is much too low. Toibaev (14) stated that the saturated antimony amalgam at 293 K should contain less than 9×10^{-4} at % antimony; the solubility measurements reported above appear to confirm the latter statement.

Jangg and coworkers (15,16) determined the solubility of antimony at high temperatures and showed that the saturated amalgam is in equilibrium with pure antimony; they also showed that there is complete miscibility at temperatures above 904 K. The extrapolation of the high temperature solubilities to 298 K yields a solubility near 10^{-3} at %. The high temperature measurements of Jangg and coworkers showed a tendency for the antimony to supersaturate; if this tendency extends to room temperature the lower values of the solubility would probably be more reliable, as reported by other workers discussed above.

The homogeneous amalgam is in equilibrium with pure Sb. However, as shown (17) on the inset in Fig. 1 there appears to be a break in the solubility curve near 473 K; the break suggests the peritectic formation of a compound, although this compound was not detected. The formation of Hg_3Sb_2 was reported by Ugai and Gordin (18).

Tentative values of the antimony solubility in mercury:

T/K	Soly/at %	Reference
293	4×10^{-4}	[3,4]
298	5×10^{-4} [a]	[3]
323	1.5×10^{-3} [a]	[3,6]
373	2×10^{-2}	[16]
473	0.12	[16]
573	0.7 [b]	[15,16]
673	13 [b]	[15,16]
773	54 [a]	[15]
873	91	[15]

[a] Interpolated value from cited references.

[b] Mean value from data of cited references.

(continued next page)

COMPONENTS:	EVALUATOR:
(1) Antimony; Sb; [7440-36-0] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION: (continued)

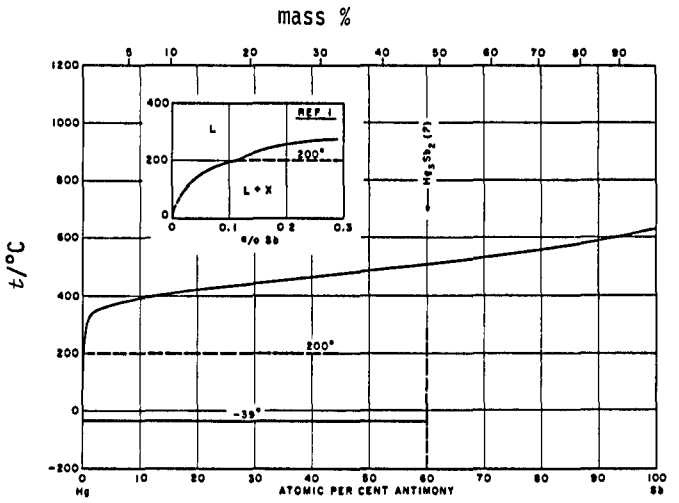

Fig. 1. Hg-Sb System (17).

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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Antimony; Sb; [7440-36-0] (2) Mercury; Hg; [7439-97-6]	Lange, A.A.; Bukhman, S.P. *Elektrokhimiya* 1974, *10*, 391-5.
VARIABLES: Temperature: 20-80°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of antimony in mercury:

t/°C	Soly/at %
20	0.9×10^{-3}
40	1.75×10^{-3}
60	2.55×10^{-3}
80	3.4×10^{-3}

The enthalpy of solution of Sb at saturation, calculated from the $(T/K)^{-1}$ dependence of the solubility, was 21.1 kJ mol^{-1}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Amalgams prepared by electrolysis of $Sb_2(SO_4)_3$ solutions in 1-3 mol dm^{-3} H_2SO_4 at a mercury cathode. Sb content of amalgam determined by difference in Sb(III) concentration before and after electrolysis; Sb(III) concentration determined by bromate titration. Limiting anodic currents (i.e., limiting diffusion currents, i_d (compilers)) were measured for amalgams of varying Sb content. A plot of i_d vs. Sb content gave a sharp break at the saturation value of Sb content. A second break in the i_d vs. Sb content curve was observed for supersaturated amalgams and was attributed by the authors to the oxidation of elemental Sb in a two-phase amalgam.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: precision of method probably around 10% (compilers).

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Antimony; Sb; [7440-36-0] (2) Mercury; Hg; [7439-97-6]	Bukhman, S.P.; Dragavtseva. N.A. *Izv. Akad. Nauk Kaz. SSR, Ser. Khim.* 1970, *20*, No. 5, 23-31.
VARIABLES:	**PREPARED BY:**
Temperature: 20°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of antimony in mercury at 20°C was reported to be 6.8×10^{-4} at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgam was prepared by electrolysis and then was aged for one hour. The antimony content was determined by the "bromate method". Polarization curves (i vs. E) of the amalgam oxidation were recorded to determine the potential of the limiting current. In other experiments the potentiostatic curves (i vs. t) were recorded at the potentials of the limiting current (0.3 V vs. NHE). There was a breakpoint in the curve when the amalgam became saturated with antimony.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: not specified; precision no better than ± 20% (compilers).

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Antimony, Sb; [7440-36-0] (2) Mercury; Hg; [7439-97-6]	Jangg, G.; Lihl, F.; Legler, E. *Z. Metallk.* 1962, *53*, 313-16.
VARIABLES: Temperature: 573-904 K	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Liquidus temperatures of the antimony-mercury system:

T/K	Soly/at %
573.2	0.8
655.2	6.4
673.2	11.9
683.2	15.5
713.2	28.6
738.2	39.7
758.2	50.0
766.2	51.9
783.2	59.5
801.2	67.5
833.2	79.5
868.2	91.0
903.7	100

Antimony and mercury did not form any compound over the complete composition range, but a single eutectic was observed on the Hg-rich side; the eutectic temperature was within ± 0.1 K from the freezing point of Hg.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The liquidus temperature was determined thermographically from cooling and heating curves of the amalgams which were sealed in an ampule of Supremaxglas. The undercooling of the melt was minimized by a strong mechanical vibration of the sample on a vibrating table. The liquidus temperature was determined from the breakpoint in the temperature versus time plot.	Nothing specified.
	ESTIMATED ERROR: Soly: nothing specified. Temp: precision ± 5 K.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Antimony; Sb; [7440-36-0] (2) Mercury; Hg; [7439-97-6]	Zebreva, A.I.; Kozlovskii, M.T. *Collect. Czech. Chem. Commun.* 1960, *25*, 3188-94.
VARIABLES: Temperature: 20°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of antimony in mercury at 20°C was reported to be $(2.4 \pm 0.2) \times 10^{-4}$ mol dm^{-3} from potentiometric measurements and 2.6×10^{-4} mol dm^{-3} from polarographic measurements. The respective atomic % solubilities calculated by the compilers are 3.5×10^{-4} and 3.7×10^{-4} at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The antimony amalgam was prepared by electrolysis of $Sb_2(SO_4)_3$ on the mercury cathode. The solubility was determined by polarography and potentiometry. In the former method the limiting current was linearly dependent on the concentration only up to the saturation point of the amalgam. In the case of potentiometry the potential of the amalgam electrode was linearly dependent on the logarithm of the antimony content for homogeneous solution in mercury. At saturation an inflection was observed in the curve of the latter relationship.

SOURCE AND PURITY OF MATERIALS:

Mercury was chemically purified with $Hg_2(NO_3)_2$ then distilled under vacuum.

Other chemicals were chemically pure.

ESTIMATED ERROR:

Soly: nothing specified, but may be greater than ± 10% (compilers).

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Antimony; Sb; [7440-36-0] (2) Mercury; Hg; [7439-97-6]	Jangg, G.; Palman, H. *Z. Metallk.* 1963, *54*, 364-9.
VARIABLES: Temperature: 96-453°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

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

t/°C	Soly/mass %	Soly/at %	t/°C	Soly/mass %	Soly/at %
96	0.012	0.020	272	0.19	0.31
130	0.020	0.033	300	0.38	0.62
150	0.026	0.043	310	0.84	1.3
190	0.054	0.089	333	1.2	2.0
200	0.074	0.12	340	2.0	3.2
210	0.080	0.13	350	3.0	4.8
240	0.091	0.15	375	6.5	10.3
250	0.12	0.19	400	9.2	14.3
260	0.13	0.21	425	13	20
			453	24	34

The saturated amalgam was reported to be in equilibrium with pure antimony.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The heterogeneous amalgam was introduced into a specially constructed apparatus made of refractory chromium steel. Such steel apparatus could be used because the solubility of iron in mercury is very low and the Cr(III)-oxide film inhibits the wetting of the steel by mercury. After twelve hours of equilibration at the experimental temperature the amalgam was filtered through a sintered-iron frit under purified nitrogen pressure. Usually 3- to 4-fold filtration was necessary. The metal content of the filtered, saturated amalgam was then determined by an unspecified method. For experiments carried out below 320°C the amalgam was equilibrated in a glass vessel.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: precision ± 5%.

Temp: precision ± 2 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Antimony; Sb; [7440-36-0] (2) Mercury; Hg; [7439-97-6]	Levitskaya, S.A.; Zebreva, A.I. *Elektrokhimiya* 1966, *2*, 92-6.
VARIABLES: Temperature: 20-80°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of antimony in mercury:

t/°C	Soly/mol dm^{-3}	Soly/at %[a]
20	2.40×10^{-4}	3.6×10^{-4}
40	8.24×10^{-4}	1.22×10^{-3}
60	1.70×10^{-3}	2.52×10^{-3}
80	2.76×10^{-3}	4.08×10^{-3}

[a] by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgam was prepared by electroreduction of Sb(III) at the mercury cathode. EMF were determined on the cell,

$$\mathrm{Sb(Hg)} \left| \begin{array}{l} \mathrm{Sb_2(SO_4)_3}\ (10^{-3}\ \mathrm{mol\ dm^{-3}}) + \\ \mathrm{KNaC_4H_4O_6}\ (0.075\ \mathrm{mol\ dm^{-3}}) \\ + \mathrm{H_2SO_4}\ (1\ \mathrm{mol\ dm^{-3}}) \end{array} \right| \mathrm{Sb(Hg)_x}$$

The EMF varied linearly with the logarithm of the amalgam concentration up to the solubility limit. Beyond the latter the EMF remained virtually constant.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: nothing specified; precision may be no better than ± 15% (compilers).

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Antimony; Sb; [7440-36-0] (2) Mercury; Hg; [7439-97-6]	Verplaetse, H.; Donche, H.; Tammermann, E.; Verbeek, F. *J. Electroanal. Chem. Interfacial Electrochem.* 1978, *93*, 213-19.
VARIABLES:	**PREPARED BY:**
One temperature: 25°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of antimony in mercury at 25°C was reported to be 1.27×10^{-3} at %.

The enthalpy of solution of Sb in Hg was reported to be 16.7 kJ mol^{-1}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Antimony amalgam was prepared by the electroreduction of Sb(III) on the hanging-mercury and sitting-mercury drop electrodes. In the case of voltammetric oxidation of Sb from the heterogeneous amalgam, the shape of the peak current was changed. The charge corresponding to the oxidation curve where this deformation was just detectable was used to calculated the solubility of this metal in mercury. To ensure equilibrium in the amalgam the oxidation process was carried out some time after the preparation of the amalgam.

SOURCE AND PURITY OF MATERIALS:

Mercury was purified by distillation. It was then anodically dissolved and cathodically deposited in 0.5 mol dm^{-3} HNO_3.

All solutions were prepared with analytical grade reagents and double-distilled water.

ESTIMATED ERROR:

Soly: precision ± 4%.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Bismuth; Bi; [7440-69-9] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION:

Tammann (1) reported on the first study of the Bi-Hg system by determining the solidification temperatures upon addition of small amounts of bismuth to mercury. He found that the melting point of mercury was depressed by 0.30 K at a bismuth concentration of 0.217 at %.

The liquidus has been determined over wide concentration ranges by several workers. Pushin (2) reported the first extensive study of this system by thermoanalysis over the range of 1.4 to 97.3 at % Bi; however, Pushin's bismuth solubility at concentrations below 5 at % is too high by comparison with later measurements. Petot-Ervas et al. (3,4) determined the liquidus in the range of 0.1 to 30 at % Bi by measuring the EMF of concentration cells and from 30 to 90 at % Bi by thermoanalysis. Nosek and Yan-Sho-Syan (5) used thermoanalysis to determine the solubility of bismuth over a temperature range of 269 to 533 K, but the solubilities reported by these authors are lower than those of (3). Predel and Rothacker (6) redetermined the Bi-Hg phase diagram, but the solubilities of bismuth determined by these authors in the middle range of the amalgam composition lie between those of (3,4) and of (5). It has been shown (4-6) that the equilibrium solid phase in this system is bismuth. In the opinion of the evaluators, the data of Petot-Ervas et al. (3,4) are the preferred solubilities.

The solubility of bismuth was determined over narrower temperature ranges by the following authors with satisfactory agreement with those of (3,4): Dergacheva and Kozin (7) employed EMF measurements to determine the solubilities between 298 and 348 K; Kozin and Nigmetova (8) also used the same technique with satisfactory results; Schenk et al. (9) employed thermoanalysis over the temperature range of 303 to 373 K; Heycock and Neville (10) reported four points in the Bi-rich region.

Single determinations of the solubility of bismuth near room temperature have been reported by several authors (11-14).

The reported solubilities of 0.84 at % at room temperature (15) and of 0.82 at % at 298 K (16) are too low and are rejected. Kozin's (17) estimated solubility of 2.8 at % at 298 K is too high. Campbell and Kartzmark (18) reported that they exactly confirmed the results of Pushin (2), but no data were presented by these authors.

The phase diagram for this system is shown in Fig. 1 (19).

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

T/K	Soly/at %	Reference
234.1	0.072	[4]
243	0.15	[4]
253	0.26[a]	[4]
263	0.36	[4]
273	0.6[a]	[4]
293	1.1	[3,4,12]
298	1.3[a]	[3,4]
323	3.7[b]	[3,4]
373	22	[3,4]
473	70 (r)	[2-4]

[a] Interpolated value from cited references.

[b] Mean value from data of cited references.

(Continued next page)

COMPONENTS:	EVALUATOR:
(1) Bismuth; Bi; [7440-69-9] (2) Mercury; Hg; [7439-97-6]	C. Guminski; Z. Galus Department of Chemistry University of Warsaw Warsaw, Poland July, 1985

CRITICAL EVALUATION: (continued)

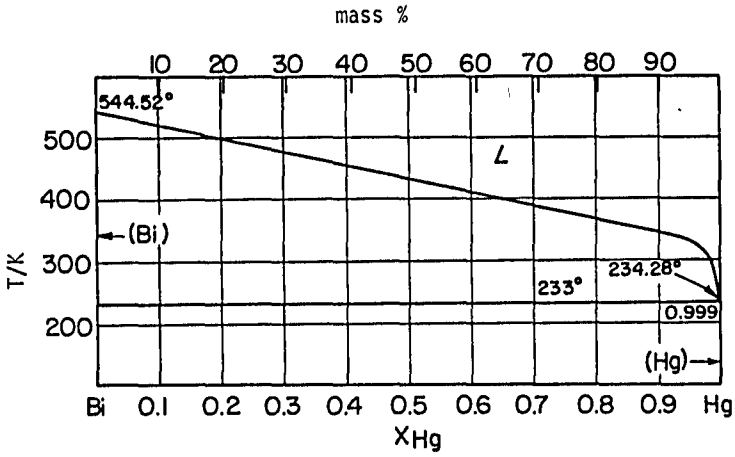

Fig. 1. The Bi-Hg system (19).

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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Bismuth; Bi; [7440-69-9] (2) Mercury; Hg; [7439-97-6]	Tammann, G. *Z. Phys. Chem.* 1889, *3*, 441-9.
VARIABLES: Temperature: -39°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Melting point depression of mercury, ΔT/K, upon addition of bismuth:

	Bi Content	
ΔT/K	mass %	at %[a]
0.15	0.054	0.052
0.30	0.109	0.104
0.30	0.227	0.217

[a] by compilers

The melting point of mercury was reported to be 244 instead of 234 K, but it is the opinion of the compilers that the former value was a typographical error in the original publication.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The melting points were determined thermometrically. No further details were given.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: precision better than ± 0.1 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Bismuth; Bi; [7440-69-9] (2) Mercury; Hg; [7439-97-6]	Heycock, C.T.; Neville, F.H. *J. Chem. Soc.* 1892, 888-914.
VARIABLES: Temperature: 258-267°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Freezing point of Bi-Hg amalgams:

t/°C	at. Hg/100 at. Bi	at % Hg[a]
266.65	-	0
266.17	0.225	0.224
264.65	0.911	0.903
259.77	3.27	3.17
257.80	4.29	4.11

[a] by compilers

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgams were prepared by thoroughly mixing weighed quantities of the metals at red heat after they had been sealed in evacuated hard-glass tubes. Freezing points of the amalgams were determined with carefully calibrated thermometers.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: precision no better than ± 0.05 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Bismuth; Bi; [7440-69-9] (2) Mercury; Hg; [7439-97-6]	Pushin, N.A. *Zh. Russ. Fiz. Khim., Obshch., Ser. Khim.* 1902, *34*, 856-904. *Z. Anorg. Chem.* 1903, *36*, 201-54.
VARIABLES: Temperature: 18-262°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Freezing points of bismuth amalgams:

t/°C	at % Hg	t/°C	at % Hg	t/°C	at % Hg
261.7	2.7	189.5	36.3	104.5	73.0
254	6.2	182.0	40.0	98.0	76.2
245	10.0	169.5	45.0	90.0	79.4
240.5	12.1	156.7	50.0	81.7	83.7
233	15.7	142.7	56.0	68	89.4
224	20.0	133.7	60.0	56	93.3
219.2	22.3	125.0	64.2	∿44	95.8
213.2	25.0	117.2	66.7	∿32	97.5
205	28.9	113.0	68.6	∿18	98.6
195.7	33.3				

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgams were prepared by heating and mixing appropriate weights of each metal. Cooling curves were determined with the amalgams protected from oxidation by a surface film of paraffin or vaseline.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: precision ± 0.5 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Bismuth; Bi; [7440-69-9] (2) Mercury; Hg; [7439-97-6]	Schenk, H.; Steinmetz, E.; Frohberg, M.G. *Arch. Eisenhüttenw.* 1963, *34*, 562-63.
VARIABLES: Temperature: 18-100°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of bismuth in mercury was reported graphically as a plot of the logarithm of solubility versus $1/(T/K)$. The data points were read from the curve by the compilers.

t/°C	Soly/at %
18	0.46[a]
30	1.15
40	2.2
49	3.3
60	5.6
69	8.7
80	11.0
90	16.2
100	23.5

[a] From EMF measurement; the value is erroneous (compilers).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Bismuth particles were introduced into the mercury phase under argon atmosphere in small glass container. The container was placed in a thermostated bath. The amalgams were filtered through glasswool filter. The filtrate was analyzed by a complexometric method with Titriplex (from Merck). To test for saturation, the filtrations were made after various times from the moment of mixing of the metals.

SOURCE AND PURITY OF MATERIALS:

Bismuth and mercury were chemically pure grade.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Bismuth; Bi; [7440-69-9] (2) Mercury; Hg; [7439-97-6]	Nigmatullina, A.A.; Zebreva, A.I. *Izv. Akad. Nauk Kaz. SSR, Ser. Khim.* 1964, *14*, No. 4, 18-22.
VARIABLES:	**PREPARED BY:**
Temperature: 20°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of bismuth in mercury at 20°C was reported to be 1.07 at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgams were prepared by electrolysis and were used as the electrodes in a concentration cell. The concentration of one electrode was kept constant while the Bi concentration in the other amalgam electrode was varied. The curve of EMF vs. logarithm of the ratio of Bi concentration in the electrodes exhibited a breakpoint at amalgam saturation.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: precision no better than several percent.

Temp: precision $\pm$ 0.1 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Bismuth; Bi; [7440-69-9] (2) Mercury; Hg; [7439-97-6]	Nosek, M.V.; Yan-Sho-Syan, G.V. *Izv. Akad. Nauk Kaz. SSR, Ser. Khim.* 1965, *15*, No. 4, 26-32.
VARIABLES:	PREPARED BY:
Temperature: (-4)-265°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The data were presented graphically as a phase diagram; the experimental liquidus points were read from the curve by the compilers.

t/°C	Soly/at %	t/°C	Soly/at %
-4	1.00	196	57.49
46	2.65	205	60.16
62	5.04	209	65.09
81	7.63	210	69.82
85	10.24	213	67.56
102	14.78	227	75.04
109	20.05	228	77.41
110	17.50	233	80.16
121	25.20	241	84.98
134	27.51	242	87.56
137	30.16	248	89.91
144	35.06	260	94.95
153	37.50	265	97.34
160	40.05		
172	45.02		
177	47.52		
188	55.00		
175	50.13		

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The liquidus was determined by thermal analyses. For each composition, the alloy was heated to 573 K then cooled at a rate of 1-3 K per minute. A pyrometer of the Kurnakov-type was used for the thermal analyses.

SOURCE AND PURITY OF MATERIALS:

Mercury was purified by chemical and electrochemical methods, then distilled twice under reduced pressure.

Bismuth was 99.998% pure.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: precision $\pm$ 2 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Bismuth; Bi; [7440-69-9] (2) Mercury; Hg; [7439-97-6]	Predel, B.; Rothacker, D. *J. Less-Common Met.* 1966, *10*. 392-401.
VARIABLES: Temperature: (-16)-264°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The liquidus data were presented graphically as a phase diagram; the solubilities were read for each temperature from the curve by the compilers.

t/°C	Soly/at %	t/°C	Soly/at %
-16	0.9	125	40.6
- 6	1.3	132	44.5
17	1.4	162	55.2
35	3.0	178	63.7
38	4.0	194	72.1
42	5.0	208	77.4
57	8.5	225	84.2
75	16.6	238	88.1
90	22.	245	90.6
97	26.3	252	93.7
105	31.8	257	95.6
121	36.0	264	97.9

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgams were prepared from the pure metals in evacuated tubes. Temperatures on the liquidus curve were determined by differential thermal analysis.

SOURCE AND PURITY OF MATERIALS:

Both mercury and bismuth were 99.9995% pure.

ESTIMATED ERROR:

Soly: nothing specified.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Bismuth; Bi; [7440-69-9] (2) Mercury; Hg; [7439-97-6]	1. Petot-Ervas, G.; Allibert, M.; Petot, C.; Desrè, P.; Bonnier, E. *Bull. Soc. Chim. Fr.* 1969, 1477-81. 2. Desrè, P.; Bonnier, E. *C.R. Acad. Sci., Ser. 2* 1965, *261*, 3406-9.
VARIABLES:	PREPARED BY:
Temperature: (-39)-240°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of bismuth in mercury:

Electrochemical Measurements				Thermal Analysis	
t/°C	Soly/at %	t/°C	Soly/at %	t/°C	Soly/at %
-35.4	0.1	37	2	120	30
-30.3	0.15	47	3	135	40
-22.1	0.22	54	4	155	50
-9.85	0.36	62	5	170	60
-2.6	0.46	71	8	200	70
17.6	0.97	79	11	240	90
22.5	1.12	81	13		
32.4	1.75	86	15		
42.2	2.75	90	17		
50.85	4.0	96	20		
61.6	5.8	108	25		
69.5	7.7	118	30		

Eutectic point was determined at 0.072 ± 0.004 at % Bi and -39.10 ± 0.04°C. It was reported that the equilibrium solid-phase consisted of pure Bi.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubilities were determined by EMF measurements and by thermal analysis. EMF were determined with the concentration cell,

Bi|Bi(III)|Bi(Hg).

Various electrolytes were used, including: BiI_3-KI, $BiCl_3$-$ZnCl_2$ in glycerine or H_2O, and H_2O-LiCl eutectic mixture. The liquidus temperatures above 393 K were determined by thermal analysis.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Soly: nothing specified; precision no better than few percent (compilers).

Temp: precision ± 0.02 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Bismuth; Bi; [7440-69-9] (2) Mercury; Hg; [7439-97-6]	Dergacheva, M.B.; Kozin, L.F. *Zh. Fiz. Khim.* 1977, *51*, 417-20.
VARIABLES: Temperature: 25-75°C	**PREPARED BY:** C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

Solubility of bismuth in mercury:

t/°C	Soly/x(Bi)
25	0.0150
40	0.0244
65	0.0646
75	0.0860

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amalgam was prepared electrolytically and was used to construct the cell

Bi(Hg)|Bi(III)|xBi(Hg)

The concentration of Bi in the left-hand half-cell was kept constant, while that in the right-hand side was varied. At concentrations of the amalgam exceeding the saturation point, the EMF of the cell was independent of the amalgam concentration.

SOURCE AND PURITY OF MATERIALS:

Mercury was chemically purified and distilled twice.

Bismuth was 99.999% pure.

All other chemicals were specified as very pure.

ESTIMATED ERROR:

Soly: nothing specified. Precision of EMF measurement was $\pm 10^{-4}$ V.

Temp: nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Bismuth; Bi; [7440-69-9] (2) Mercury; Hg; [7439-97-6]	Filippova, L.M.; Zhumakanov, V.Z.; Zebreva, A.I. *Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.* 1978, *21*, 1450-3; 1980, *23*, 204-7.
VARIABLES:	**PREPARED BY:**
One temperature: 25°C	C. Guminski; Z. Galus

EXPERIMENTAL VALUES:

The solubility of bismuth in mercury at 25°C was reported to be 1.55 ± 0.05 at %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Heterogeneous amalgam was obtained by addition of bismuth to mercury. The amalgams were titrated with Hg and employing calorimetric end-point detection. The solubility was determined from the change in slope of the plot of the enthalpy of dilution as a function of bismuth content in the amalgams.	Nothing specified.
	ESTIMATED ERROR: Soly: nothing specified; precision no better than several percent (compilers). Temp: nothing specified.
	REFERENCES: