COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA __1986__, July

CRITICAL EVALUATION:

An Evaluation of the Solubility of Mercury in Water from 273 to 773 K.

Christoff (ref. 1) was the first to show that metallic mercury is soluble in water. He passed ten liters of water slowly over a mercury sample and measured the amount dissolved by weight loss of the mercury. The solubility values he reported are only about 30 percent of the values accepted today. Since Christoff's pioneering work the solubility of mercury in water has been reported in at least seventeen papers from fifteen laboratories. The reported solubility values were measured over the 273 to 773 K temperature interval and the 0.1 to 100 MPa pressure range. The molal (mol kg^{-1}) solubility increases with increasing temperature, and decreases with increasing total pressure. However, when expressed as Henry's constant the solubility shows a maximum, and as the Ostwald coefficient the solubility shows a minimum as a function of temperature. These inflections vary with the total pressure and occur between 473 K and 512 K.

There are two earlier evaluations of the solubility of mercury in water. They are Khodakovskii *et al.* (ref. 19) and Clever *et al.* (ref. 20). The present work uses additional data not available at the time of the earlier evaluations.

Table 1 summarizes the analytical methods used by various workers to determine the amount of dissolved mercury. Some workers used more than one method.

Table 1. Analytical methods used to determine dissolved mercury.

Method	References
1. Mercury weight loss	1
2. Ultraviolet absorption (253.7 nm, 256.0 nm, 236.5 nm)	2, 7, 11
3. Weight increase on amalgamation with gold	2, 10, 13
4. Electrodeposition	3
5. Colorimetry with dithizone	4, 10, 13
6. Radioactive Hg-203	5, 8, 18
7. Neutron activation	6
8. Cold vapor atomic absorption	9, 12, 14, 15, 16, 17
9. Titration with ammonium thiocyanate	10, 13

Most of the workers equilibrated liquid mercury directly with the water. Sanemasa (ref. 12) and Hursh (ref. 18) equilibrated mercury vapor with the water. Sanemasa controlled the mercury pressure by controlling the temperature of a sample of pure liquid mercury. He tested Henry's law by doing experiments with the mercury at several temperatures below the temperature of the solubility measurement. When both the mercury and the water were at the same temperature the result was the equivalent of the liquid mercury in contact with the water. The Henry law test is shown only on graphs. Hursh (ref. 18) equilibrated at an unknown mercury pressure at less than the equilibrium vapor pressure of mercury. He experimentally measured the concentration of the mercury in both vapor and solution phase to obtain an Ostwald coefficient. By using the equilibrium vapor pressure of mercury to calculate the vapor concentration at the temperature of the solubility determination one can obtain the solubility of liquid mercury in water. The value agrees satisfactorily with the results of those who equilibrated with liquid mercury. The Sanemasa solubility values at room temperature also agree satisfactorily with the liquid mercury solubility values. The Sanemasa values at other temperatures are discussed in more detail below.

Voigt and co-workers (ref. 5 and 8) used radioactive mercury-203. They found it was necessary to add a small amount of reducing agent, hypophosphorous acid, to prevent the oxidation of mercury by the products of radiolysis. Hursh (ref. 18) also used mercury-203. He used either an oxygen free carrier gas or added ethanol (to blood, plasma, and hemoglobin solutions) to prevent mercury oxidation.

Most workers have agreed with Reichardt and Bonhoeffer (ref. 2) that mercury dissolved in air-free water is monatomic and unionized with the zero-valent mercury in the spherically symmetric $^1S_0$ ground state. Glew and Hames (ref. 9) have been the most careful to insure a non-oxidizing environment. They avoided the use of radioactive mercury, they rigorously excluded oxygen, and they added trace amounts of reducing agent. Most other workers have tried to keep their systems air-free. Recently Sanemasa (ref. 12) has carried out experiments in which he obtains the same solubility in the presence and in the absence of air. In Sanemasa's experiment either air or nitrogen is circulated over liquid mercury and water in separate compartments. Mercury liquid-vapor equilibrium and mercury vapor-aqueous solution equilibrium are stated to be established within thirty minutes.

When the solubility values from the two laboratories are compared it is observed that at 278 K Sanemasa's values are smaller than Glew and Hames, near 298 K there is a cross-over and the values agree within a few percent, but by 333 K Sanemasa's values are three times larger than Glew and Hames. It is the evaluator's opinion that the Glew and Hames values are too large below 293 K and that Sanemasa's values are too small below 293 K and too large above 303 K. The evaluator has tried to test several models for the air oxidation of mercury in aqueous solution with available thermodynamic data. It is not possible to obtain a definitive answer, but the possibility of air oxidation of the mercury appears to be real. We suspect that the Sanemasa solubility values at the higher temperatures are too large because of air oxidation. Some of the solubility results of Choi and Tuck (ref. 6) and of Onat (ref. 11) agree with the higher Sanemasa results.

The problem of possible air oxidation of aqueous metallic mercury is not settled. The Sanemasa results may fall on a different line from the other values because pure liquid mercury may have different properties than liquid mercury in contact with water. However, this seems unlikely to us. We are concerned by the short time used by Sanemasa to establish both pure mercury liquid-vapor equilibrium and mercury vapor-saturated aqueous solution equilibrium. The short time could lead to undersaturation and the low solubility values at 278 and 283 K. The air oxidation may have a kinetic component, and be important at only the higher temperatures where the Sanemasa values are higher than others. We do not want to be overly critical of the Sanemasa experiment. Future work may show he is correct and all the other values are wrong. However, in this work the evaluator prefers the lower solubility results from air-free systems.

At temperatures of 473 K and above all of the data are from Sorokin and co-workers (ref. 10 and 13). The experiments reported in the two papers clearly show that the molal and mole fraction solubility decrease with increasing total pressure at 473, 573, 673, and 773 K. The solubilities at 573, 673 and 773 K (ref. 10) fall on a curve that is a reasonable extension of the lower temperature data (Figure 2). The solubilities at 473 K (ref. 13) show a greater variation with pressure than the values at the higher temperatures and do not fit the overall pattern as well as might be expected. It is possible that the solubility shows a different pressure dependence below and above the water critical temperature. It would take more experiments to clarify the matter.

Table 2 summarizes the available experimental mercury solubility values. The literature values have been calculated as concentration, c_1/mol dm^{-3}, molality, m_1/mol kg^{-1}, mole fraction, x_1, Henry's constant in the two units $(p_1$/kPa$)/(m_1$/mol kg$^{-1})$ and $(p_1$/kPa$)/(x_1)$, and the Ostwald coefficient, $(c_1$(liq)/mol dm$^{-3})/(c_1$(gas)/mol dm$^{-3})$. The last two columns of the table give mercury liquid-vapor equilibrium properties. There is the equilibrium vapor pressure, p_1/kPa, and concentration in the vapor, c_1/mol dm^{-3}. The mercury vapor pressure and vapor concentration were calculated from the evaluation of mercury vapor pressure of Ambrose and Sprake (ref. 21). The equilibrium mercury vapor pressure was corrected for any excess external pressure by (d ln f/dp)$_T$ = V/RT and assuming ideal gas behavior.

Table 2. Solubility of Mercury in Water Summary.

T/K	$10^7 c_1/\text{mol dm}^{-3}$	$10^7 m_1/\text{mol kg}^{-1}$	$10^9 x_1$	$10^{-3}H = p_1/m_1$	$10^{-4}H = p_1/x_1$	$L = c_1(1)/c_1(g)$	Mercury Vapor		Ref
							p_1/kPa	$c_1/\text{mol dm}^{-3}$	
393.15	50	53	95	20	105	0.163	1.002×10^{-1}	3.066×10^{-5}	2
303.15	1.0 – 1.5	1.3	2.3	3.0	17	0.820	3.857×10^{-4}	1.53×10^{-7}	3
358.15	15	15	28	11	57	0.280	1.595×10^{-2}	5.36×10^{-6}	
373.15	30	31	56	12	66	0.253	3.690×10^{-2}	1.189×10^{-5}	
301.15	1.5	1.5	2.7	2.2	12	1.15	3.280×10^{-4}	1.310×10^{-7}	4
298.15	3.0	3.0	5.4	0.85	4.7	2.90	2.562×10^{-4}	1.034×10^{-7}	5
	2.9	2.9	5.2	0.88	4.9	2.80			
	3.0	3.0	5.4	0.85	4.7	2.90			
298.15	3.14	3.15	5.67	0.813	4.52	3.04	2.562×10^{-4}	1.034×10^{-7}	6
308.15	5.40	5.43	9.79	1.055	5.85	2.41	5.731×10^{-4}	2.237×10^{-7}	
323.15	8.72	8.82	15.9	1.98	11.0	1.34	1.744×10^{-3}	6.491×10^{-7}	
338.15	10.6	10.8	19.5	4.44	24.6	0.621	4.798×10^{-3}	1.707×10^{-6}	
353.15	12.6	13.0	23.4	9.31	51.7	0.306	1.210×10^{-2}	4.121×10^{-6}	
363.15	16.1	16.7	30.0	12.9	71.5	0.227	2.146×10^{-2}	7.107×10^{-6}	
298.15	1	1	1.8	2.6	14	0.97	2.562×10^{-4}	1.034×10^{-7}	7
273.15	1.2	1.2	2.2	0.22	1.2	10.35	2.632×10^{-5}	1.159×10^{-8}	8
288.65	2.1	2.1	3.8	0.54	3.0	4.46	1.131×10^{-4}	4.713×10^{-8}	
293.15	2.4	2.4	4.3	0.70	3.9	3.48	1.677×10^{-4}	6.880×10^{-8}	
298.15	2.8	2.8	5.1	0.92	5.0	2.71	2.562×10^{-4}	1.034×10^{-7}	
303.15	2.9	2.9	5.2	1.3	7.4	1.89	3.857×10^{-4}	1.530×10^{-7}	
308.15	3.4	3.4	6.2	1.7	9.2	1.52	5.731×10^{-4}	2.237×10^{-7}	
277.45	2.33	2.33	4.19	0.172	0.957	13.40	4.01×10^{-5}	1.738×10^{-8}	9
	2.21	2.21	3.99	0.181	1.005	12.72			
284.56	2.37	2.38	4.28	0.329	1.83	7.18	7.82×10^{-5}	3.305×10^{-8}	
	2.31	2.31	4.17	0.339	1.88	6.99			
	2.22	2.23	4.01	0.351	1.95	6.72			
288.12	2.14	2.14	3.86	0.504	2.80	4.75	1.079×10^{-4}	4.504×10^{-8}	
292.95	2.39	2.39	4.31	0.690	3.82	3.53	1.648×10^{-4}	6.766×10^{-8}	
	2.49	2.49	4.49	0.661	3.67	3.68			
298.17	2.98	2.99	5.39	0.858	4.76	2.88	2.566×10^{-4}	1.035×10^{-7}	
303.17	3.58	3.59	6.47	1.076	5.97	2.34	3.864×10^{-4}	1.533×10^{-7}	

Table 2. (continued)

T/K	$10^7 c_1/\text{mol dm}^{-3}$	$10^7 m_1/\text{mol kg}^{-1}$	$10^9 x_1$	$10^{-3}H = p_1/m_1$	$10^{-4}H = p_1/x_1$	$L = c_1(1)/c_1(g)$	Mercury Vapor		Ref
							p_1/kPa	$c_1/\text{mol dm}^{-3}$	
303.24	3.43	3.44	6.20	1.129	6.27	2.23	3.885×10^{-4}	1.541×10^{-7}	9
	3.48	3.49	6.29	1.113	6.18	2.26			
312.31	4.35	4.39	7.90	1.73	9.62	1.49	7.600×10^{-4}	2.927×10^{-7}	
318.22	4.58	4.62	8.33	2.65	14.69	0.990	1.224×10^{-3}	4.626×10^{-7}	
	4.40	4.45	8.01	2.75	15.28	0.951			
322.95	5.42	5.48	9.88	3.04	16.88	0.873	1.668×10^{-3}	6.212×10^{-7}	
323.39	4.51	4.56	8.22	3.88	21.5	0.684			
	5.32	5.38	9.70	3.33	18.2	0.806			
	4.85	4.91	8.85	3.60	20.0	0.735			
326.86	5.31	5.38	9.70	4.08	22.6	0.657	2.197×10^{-3}	8.084×10^{-7}	
333.13	6.77	6.88	12.4	5.02	27.9	0.543	3.455×10^{-3}	1.247×10^{-6}	
	6.06	6.16	11.1	5.61	31.1	0.486			
335.43	7.25	7.38	13.3	5.32	29.5	0.515	3.927×10^{-3}	1.408×10^{-6}	9
341.34	8.75	8.94	16.1	6.58	36.5	0.422	5.882×10^{-3}	2.073×10^{-6}	
	8.31	8.49	15.3	6.93	38.4	0.401			
345.59	9.48	9.71	17.5	7.75	43.0	0.362	7.524×10^{-3}	2.619×10^{-6}	

T/K	$c_1/\text{mol dm}^{-3}$	$m_1/\text{mol kg}^{-1}$	$10^3 x_1$	$10^{-3}H = p_1/m_1$	$10^{-4}H = p_1/x_1$	$L = c_1(1)/c_1(g)$	p_1/kPa	$c_1/\text{mol dm}^{-3}$	Ref
573.15	0.0010	0.0014	0.026	27.8	150	0.123	38.88	8.159×10^{-3}	10
	0.00085	0.0012	0.022	33.9	185	0.099	40.71	8.543×10^{-3}	
571.15	0.00064	0.0009	0.017	47.3	250	0.071	42.53	8.956×10^{-3}	
673.15	0.00884	0.0168	0.302	14.0	77.9	0.210	235.4	4.206×10^{-2}	10
	0.00800	0.0138	0.248	17.6	97.7	0.185	242.3	4.329×10^{-2}	
	0.00932	0.0161	0.289	15.0	83.7	0.216	·242.0	4.324×10^{-2}	
	0.00786	0.0123	0.222	20.9	116	0.171	256.6	4.585×10^{-2}	
	0.00895	0.0140	0.251	18.3	102	0.195	256.6	4.885×10^{-2}	
671.15	0.00758	0.0111	0.200	23.9	133	0.160	265.1	4.751×10^{-2}	
674.15	0.00722	0.0106	0.191	26.1	145	0.146	276.8	4.938×10^{-2}	
773.15	0.03161	0.1202	2.162	7.76	43.1	0.218	932.7	0.1450	10
775.15	0.03191	0.1182	2.125	8.09	45.0	0.215	956.7	0.1484	
773.15	0.02812	0.1008	1.812	9.29	51.7	0.193	936.9	0.1457	
768.15	0.04048	0.0920	1.654	10.2	56.7	0.276	938.4	0.1469	
780.15	0.0407	0.0992	1.784	10.7	59.6	0.248	1064.0	0.1640	
771.15	0.0432	0.0816	1.467	12.6	70.4	0.268	1032.1	0.1610	

Table 2. (continued)

T/K	$c_1/\text{mol dm}^{-3}$	$m_1/\text{mol kg}^{-1}$	$10^3 x_1$	$10^{-3}H = p_1/m_1$	$10^{-4}H = p_1/x_1$	$L = c_1(1)/c_1(g)$	Mercury Vapor		Ref
							p_1/kPa	$c_1/\text{mol dm}^{-3}$	
776.15	0.0347	0.0667	1.202	16.3	90.3	0.206	1085.0	0.1681	10
	$10^7 c_1/\text{mol dm}^{-3}$	$10^7 m_1/\text{mol kg}^{-1}$	$10^9 x_1$						
298.15	3.05	3.06	5.51	0.837	4.65	2.95	2.562×10^{-4}	1.034×10^{-7}	11
313.15	5.12	5.16	9.30	1.63	9.04	1.59	8.405×10^{-4}	3.228×10^{-7}	
323.15	7.43	7.52	13.5	2.32	12.9	1.14	1.744×10^{-3}	6.491×10^{-7}	
333.15	10.78	11.0	19.8	3.15	17.5	0.863	3.460×10^{-3}	1.249×10^{-6}	
343.15	13.33	13.6	24.6	4.85	26.8	0.577	6.591×10^{-3}	2.310×10^{-6}	
353.15	16.37	16.8	30.3	7.20	39.9	0.397	1.210×10^{-3}	4.121×10^{-6}	
278.15	0.957	0.96	1.72	0.447	2.49	5.16	4.289×10^{-5}	1.855×10^{-8}	12
283.15	1.37	1.37	2.46	0.501	2.79	4.70	6.869×10^{-5}	2.918×10^{-8}	
293.15	2.24	2.25	4.04	0.745	4.15	3.14	1.677×10^{-4}	7.123×10^{-8}	
303.15	4.05	4.07	7.33	0.948	5.26	2.65	3.857×10^{-4}	1.530×10^{-7}	
313.15	6.83	6.88	12.4	1.221	6.78	2.12	8.405×10^{-4}	3.228×10^{-7}	
323.15	10.7	11.0	19.8	1.585	8.81	1.68	1.744×10^{-3}	6.491×10^{-7}	
333.15	18.3	18.7	33.6	1.85	10.30	1.47	3.460×10^{-3}	1.249×10^{-6}	
378.15		22.3	40.2	34.8	193	0.086	0.0777	2.471×10^{-5}	13
473.15		2580	4650	8.98	49.8	0.379	2.317	5.890×10^{-4}	
		1220	2200	23.3	129	0.146	2.838	7.214×10^{-4}	
475.15		608	1100	60.0	332	0.057	3.650	9.239×10^{-4}	
310.15	4.4	4.4	8.0	1.52	8.36	1.70	6.689×10^{-4}	2.594×10^{-7}	14
303.15	3.14	3.15	5.68	1.22	6.79	2.05	3.857×10^{-4}	1.530×10^{-7}	15
278.15	2.2	2.2	3.9	0.20	1.1	11.9	4.289×10^{-5}	1.855×10^{-8}	16
283.15	2.3	2.3	4.2	0.30	1.6	7.9	6.869×10^{-5}	2.918×10^{-8}	
293.15	2.7	2.7	4.8	0.62	3.5	3.8	1.677×10^{-4}	7.123×10^{-8}	
298.15	3.0	3.0	5.4	0.85	4.7	2.9	2.562×10^{-4}	1.034×10^{-7}	
303.15	3.2	3.2	5.8	1.21	6.7	2.1	3.857×10^{-4}	1.530×10^{-7}	
313.15	4.1	4.1	7.4	2.05	11.4	1.27	8.405×10^{-4}	3.228×10^{-7}	
Room	0.4	0.4	0.7						17
298.15	2.88	2.89	5.21	0.887	4.92	2.78	2.562×10^{-4}	1.034×10^{-7}	18

Table 3. Ostwald coefficents at elevated total pressures.

T/K	Total Pressure p_t/MPa	Pure Mercury Vapor Pressure p_1/kPa	Mercury Vapor Pressure At Total Pressure p_1/kPa	Mercury Concentration In Vapor $c_1(g)$/mol dm^{-3}	In Liquid $c_1(l)$/mol dm^{-3}	Ostwald Coefficient L	Water Density ρ_2/Mg m^{-3}
378	101.3	0.0479	0.0777	2.47×10^{-5}	2.13×10^{-6}	0.086	0.9547
473	1.6	2.303	2.317	5.89×10^{-4}	2.23×10^{-4}	0.379	0.8649
"	53.7	2.303	2.838	7.21×10^{-4}	1.06×10^{-4}	0.146	"
475	102.3	2.456	3.650	9.24×10^{-4}	0.524×10^{-4}	0.057	0.8625
573	50.7	32.94	38.88	8.16×10^{-3}	1.00×10^{-3}	0.123	0.7127
"	64.8	32.94	40.71	8.54×10^{-3}	0.85×10^{-3}	0.100	"
571	91.2	31.53	42.53	8.96×10^{-3}	0.64×10^{-3}	0.071	0.7166
647.14	Critical Temperature of Pure Water.						
673	40.5	210.0	235.4	4.21×10^{-2}	8.84×10^{-3}	0.210	0.526
"	50.7	"	242.3	4.33×10^{-2}	8.00×10^{-3}	0.185	0.580
"	50.2	"	242.0	4.32×10^{-2}	9.32×10^{-3}	0.193	0.579
"	70.9	"	256.6	4.59×10^{-2}	7.86×10^{-3}	0.171	0.639
"	70.9	"	"	"	8.95×10^{-3}	0.195	"
671	93.2	203.5	265.1	4.75×10^{-2}	7.58×10^{-3}	0.160	0.683
674	92.2	213.3	276.8	4.94×10^{-2}	7.22×10^{-3}	0.146	0.681
773	50.7	822.1	932.2	0.1450	0.0316	0.218	0.263
775	51.7	841.8	956.7	0.1485	0.0319	0.215	0.270
773	52.7	822.1	936.9	0.1457	0.0281	0.193	0.279
768	76.5	774.5	938.4	0.1469	0.0405	0.276	0.440
780	70.9	892.7	1064.0	0.1640	0.0407	0.248	0.410
771	100.3	802.8	1032.1	0.1610	0.0432	0.268	0.529
776	97.3	851.8	1085.0	0.1681	0.0347	0.206	0.520

The equilibrium vapor pressures of pure mercury were calculated from equations in the evaluation of Ambrose and Spraake (ref. 21).

The equilibrium vapor pressure of mercury at the total pressure of the solubility measurements was calculated from the thermodynamic equation $(d\ln f/dp)_T = V/RT$ assuming $f = p$.

The concentration of mercury in the vapor phase was calculated from the vapor pressure of mercury at the total pressure of the solubility measurement assuming ideal vapor behavior of the mercury.

Density of pure liquid water. Values below the critical temperature were taken from handbook tables, values above the critical temperature were taken from Sengers and Kamgar-Parsi (ref. 22).

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA <u>1986</u>, July

CRITICAL EVALUATION:

I.   The concentration (mol dm^{-3}), molality (mol kg^{-1}), and mole fraction solubilities.

The experimental values of solubility are given in either volume (mol dm^{-3}) or weight (mol kg^{-1}) units. The concentration and molal values differ negligibly from 273 to 323 K. Between 323 and 393 K the difference increases from 1 to 6 percent. At higher temperatures and into the water supercritical region the difference is much larger. The concentration, molal, and mole fraction values in Table 2 can be converted from one to another assuming the pure water density is a measure of the solution density. The assumption seems well justified for the dilute mercury solutions with the possible exception of the water supercritical region. The density of pure liquid water was taken from standard sources. The supercritical pure water density was taken from Sengers and Kamgar-Parsi (ref. 22). The densities have been used to calculate the solubility in the three units of concentration, molal, and mole fraction which are given in columns 2, 3, and 4 of Table 2. The molal values are shown in Figure 1 and 2.   In the supercritical region the solubility decreases with increasing total pressure (increasing water density).   Table 3 gives the water densities used in the calculations of solubility in the various units in the supercritical region.   It also gives the mercury vapor pressures corrected for the total pressure.

Only the molal and mole fraction values are smoothed in this section. Between 273 and 393 K one can use the concentration and molal values interchangeably and probably be within the experimental error.

The molal solubility. There are eight experimental values of the solubility of mercury in water at 298.15 K.   They are:

$10^7 m_1$/mol kg^{-1}	(ref.)
2.81	(ref. 8)
2.89	(ref. 18)
2.99	(ref. 9)
3.00	(ref. 16)
3.00	(ref. 5)
3.06	(ref. 11)
3.15	(ref. 6)
3.18	(ref. 12)

Av. $(3.01 \pm 0.12) \times 10^{-7}$ mol kg^{-1}

We take the value as the recommended solubility of mercury in water at 298.15 K.   The smoothed curves for the temperature dependence of the solubility of mercury do not go exactly through the recommended value, but the curve is within a standard deviation of the value.

In an earlier evaluation (ref. 20) 36 experimental mercury molal solubility values were treated by a linear regression to obtain the tentative solubility values between 273 and 393 K. We have added about 10 values from (ref. 14, 15, 16, and 18) to the data base and repeated the linear regression. Both three and four constant equations were tried. The four constant equation gave unacceptable curvature and was not satisfactory. The three constant equation agrees well our earlier result (ref. 20), although it gives slightly higher results from 273.15 to about 303.15 K.

All of the molal solubility values between 273 and 773 K were treated in one linear regression. This ignores the pressure dependence of the solubility at 473 K and higher temperatures. The pressure dependence is taken into account in the treatment of Henry's constant and the Ostwald coefficient later in the evaluation. The equation gives values which are probably reliable to within 50 % at the higher temperatures. Although the

equation is intended for use over the 423 to 773 K temperature interval it gives results within 2 % of the three constant linear regression over the 298.15 to 343.15 K temperature interval and could be used over the 298 to 773 K temperature interval to give values that are probably within the range of experimental error.

The linear regression constants for an equation of the type

$$\ln (m_1/\text{mol kg}^{-1}) = A_1 + A_2/(T/100 \text{ K}) + A_3 \ln(T/100 \text{ K}) + A_4(T/100 \text{ K})$$

are in Table 4. Smoothed values of molal solubility are in Tables 5 and 6. The line drawn in Figure 1 is from the three constant equation, and the line drawn in Figure 2 is from the four constant equation.

Table 4. Regression parameters for the molal solubility of mercury in water.

Temperature interval T/K	A_1	A_2	A_3	A_4
273.15 to 393.15	-42.4014	25.6254	17.1591	-
423 to 773	-112.8354	126.4586	62.9768	-4.4945

Table 5. Tentative values of the molal solubility of mercury in water between 273.15 and 393.15 K.

T/K	$10^7 \; m_1$/mol kg^{-1}	T/K	$10^7 \; m_1$/mol kg^{-1}
273.15	1.41	333.15	7.83
278.15	1.62	338.15	9.03
283.15	1.87	343.15	10.40
288.15	2.16	348.15	11.97
293.15	2.49	353.15	13.8
298.15	2.88	358.15	15.9
303.15	3.30	363.15	18.2
308.15	3.83	368.15	20.9
313.15	4.42	373.15	24.0
318.15	5.11	378.15	27.6
323.15	5.89	383.15	31.6
328.15	6.79	388.15	36.2
		393.15	41.5

Table 6. Tentative values of the molal solubility of mercury in water between 423 and 773 K. No account taken of total pressure.

T/K	m_1/mol kg^{-1}	T/K	m_1/mol kg^{-1}
423	0.0000148	598	0.00264
448	0.0000336	623	0.00486
473	0.0000754	648	0.00858
498	0.000163	673	0.0147
523	0.000346	698	0.0242
548	0.000704	723	0.0386
573	0.00139	748	0.0594
		773	0.0887

The mole fraction solubility. A linear regression of the mole fraction solubilities from the same data set as used for the molal solubilities was carried out. For the 273.15 to 393.15 K temperature interval the three constant equation is

$$\ln x_1 = -46.0770 + 25.1284/(T/100 \text{ K}) + 16.9998 \ln(T/100 \text{ K}).$$

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA <u>1986</u>, July

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Smoothed values from the equation are given below in Table 7.

Table 7.   Tentative values of the mole fraction solubility of mercury in water between 273.15 and 393.15 K.

T/K	$10^8 x_1$	T/K	$10^8 x_1$
273.15	2.53	333.15	14.1
278.15	2.92	338.15	16.3
283.15	3.37	343.15	18.7
288.15	3.89	348.15	21.6
293.15	4.49	353.15	24.8
298.15	5.18	358.15	28.5
303.15	5.98	363.15	32.8
308.15	6.91	368.15	37.6
313.15	7.97	373.15	43.2
318.15	9.20	378.15	49.6
323.15	10.6	383.15	56.8
328.15	12.2	388.15	65.1
		393.15	74.5

The mole fraction solubility data were not treated further in this evaluation. Total pressure has an effect on the solubility of mercury in the supercritical region of water. There is a suggestion of a pressure effect, perhaps of somewhat different character, below the water critical temperature. The effect of total pressure on the solubility of mercury seems to be better treated with the Henry's constant or the Ostwald coefficient which is done in the following two sections. Both the Henry's constant and the Ostwald coefficient can be used at mercury vapor pressures less than the saturation pressure of mercury. When they are used at the saturation vapor pressure they also represent the solubility when in equilibrium with liquid mercury. It is assumed that the solubility of water in mercury is negligible and does not effect the properties of pure mercury.

II.   Henry's Constant.

Columns 5 and 6 of Table 2 contain values of Henry's constant. The constant is given in both molal and mole fraction forms. They are (K/(kPa kg mol^{-1})) = $(p_1/kPa)/(m_1/mol\ kg^{-1})$ and (K'/kPa) = $(p_1/kPa)/x_1$. The two values differ by a factor of 55.508, the number of moles of water in 1 kg. Thus, K = K'/55.508. Only the molal form has been plotted and fitted to smoothing equations. Figure 3 displays the values as ln(K/kPa kg mol^{-1}) vs. 1000/(T/K). The values go through a maximum and show the effect of total external pressure above 473 K. Figure 6 show the pressure dependence of the Henry's constant. The values are linear in pressure within experimental error, but the values below the water critical temperature (473, 573 K) have a much larger slope than the values above the critical temperature (673, 773 K). There are not enough experimental data to tell whether or not this is a significant difference. It is an area that deserves further experimental investigation. The curves on Figure 3 are reproduced by the equation

$$\ln(K/kPa\ kg\ mol^{-1}) = A_1 + A_2/(T/100\ K) + A_3 \ln(T/100\ K) + A_4(T/100\ K).$$

with the parameters given in Table 8. The 273 to 393 K equation does not merge as smoothly as one might like with the 473 to 773 K equations. It is believed this is an indication of the larger uncertainty in the higher temperature solubility values.

Table 8. Linear regression parameters for Henry's constant.

Temperature Interval, T/K	Total Pressure p_t/MPa	A_1	A_2	A_3	A_4
273.15 - 393.15	0.1	254.1649	-372.8229	-167.0119	20.1528
473 - 773	50	126.5286	-196.9318	- 60.0986	3.9986
473 - 773	75	107.8775	-170.5553	- 47.5540	2.6886
473 - 773	100	94.1291	-151.5763	- 37.8481	1.6065

The maximums at 50, 75, and 100 MPa total pressure occur at 483, 500, and 512 K, respectively.

Smoothed values of the Henry's constant are in the following two tables. For Henry's constant in the form (pressure/mole fraction) see the earlier evaluation (ref. 20). More care was taken to evaluate the effect of total pressure in the supercritical region in the present evaluation.

Table 9. Tentative values of Henry's constant.

T/K	K/kPa kg mol^{-1}	T/K	K/kPa kg mol^{-1}
273.15	134	323.15	3045
283.15	308	333.15	4490
293.15	627	343.15	6290
		353.15	8443
298.15	860	363.15	10,940
		373.15	13,760
303.15	1152	383.15	16,910
313.15	1942	393.15	20,395

Table 10. Tentative values of Henry's constant.

T/K	Henry's constant, K/kPa kg mol^{-1}, at		
	50 MPa	75 MPa	100 MPa
473	33,480	41,830	52,560
483	33,630 max	-	-
500	-	43,210 max	-
512	-	-	56,270 max
523	31,530	42,350	55,980
573	25,750	36,370	49,460
623	19,650	28,450	38,890
673	14,680	21,230	28,490
723	11,050	15,550	20,050
773	8,540	11,410	13,820

The values from 473 to 773 K are based on somewhat scattered data from one laboratory and should be used with caution.

III.   The Ostwald [Partition] Coefficient.

The Ostwald coefficient is the ratio of the equilibrium concentrations of solute in the liquid phase to the concentration in the gas phase. Thus, L = $(c_1(\text{liq})/\text{mol dm}^{-3})/(c_1(\text{gas})/\text{mol dm}^{-3})$.

Liquid phase concentration. The liquid phase concentrations were calculated from papers reporting molal or mole fraction solubilities using the density of pure water. The densities of subcritical pure water were taken from standard compilations. The densities of supercritical water were taken from (ref. 22). In the water supercritical region we do not have a true Ostwald coefficient, but a number that is the ratio of the concentra-

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6]	H. Lawrence Clever
	Chemistry Department
(2) Water; H_2O; [7732-18-5]	Emory University
	Atlanta, Georgia 30322 USA
	1986, July

CRITICAL EVALUATION:

tion of mercury in the supercritical water to the concentration of mercury vapor above pure liquid mercury at the same total hydrostatic pressure.

Gas phase concentration. The concentration of mercury in the gas phase was calculated assuming ideal behavior of the vapor pressure of pure liquid mercury calculated from a literature evaluation (ref. 21). At elevated total pressures the Poynting correction was applied assuming fugacity and pressure to be equal. Some details of the calculation at the elevated pressures are shown in Table 3. Column 7 of Table 2 contains all of the Ostwald coefficient values. Figures 4 and 5 give two representations of the Ostwald coefficient as a function of temperature.

The Ostwald coefficients were fitted to four constant equations of the type

$$\ln L = A_1 + A_2/(T/100 \text{ K}) + A_3 \ln(T/100 \text{ K}) + A_4(T/100 \text{ K}).$$

The constants for the equation over the 273.15 to 393.15 and 473 to 773 K temperature intervals are in the table below. Figure 4 shows the Ostwald coefficient as a function of temperature. The 350 to 785 K region is shown with an expanded scale for the Ostwald coefficient. Figure 5 shows the logarithm of the Ostwald coefficient as a function of the inverse Kelvin temperature. The lines are generated from the constants in Table 11.

Table 11. Linear regression parameters for the Ostwald coefficient.

Temperature Interval, T/K	Total Pressure p_t/MPa	A_1	A_2	A_3	A_4
273.15 - 393.15	0.1	-236.5852	358.1516	158.1918	-18.5469
473 - 773	50	-127.9489	208.0691	68.3318	- 5.1724
473 - 773	75	-116.4886	192.0615	60.3112	- 4.2749
473 - 773	100	- 94.3479	161.3909	44.4468	- 2.4351

The minimums at 50, 75, and 100 MPa occur at temperatures of 476, 486, and 500 K, respectively.

Some smoothed values of the Ostwald coefficient at selected temperatures are given in the Tables 12 and 13 below.

Table 12. Tentative values of the Ostwald coefficient between 273.15 and 393.15 K.

T/K	L	T/K	L
273.15	16.98	319.9	1.000
278.15	11.21	323.15	0.971
283.15	7.65	333.15	0.608
288.15	5.37	343.15	0.446
293.15	3.879	353.15	0.342
298.15	2.871	363.15	0.272
303.15	2.175	373.15	0.222
308.15	1.683	383.15	0.186
313.15	1.328	393.15	0.159

Table 13. Tentative values of Ostwald coefficient from 423 to 773 K at
           total pressures of 50, 75 and 100 MPa.

T/K	Ostwald coefficient at pressures of		
	50 MPa	75 MPa	100 MPa
423	0.123	0.112	0.0912
473	0.106	0.0921	0.0687
476	0.106 min	-	-
486	-	0.0915 min	-
500	-	-	0.0665 min
523	0.114	0.0960	0.0678
573	0.137	0.113	0.0786
623	0.170	0.141	0.100
673	0.210	0.177	0.134
723	0.249	0.218	0.182
773	0.281	0.269	0.248

Figure 7 shows the change of the experimental values of the Ostwald coef-
ficient with pressure below (473, 573 K) and above (673, 773 K) the water
critical temperature of 647 K. As noted with the Henry's constant there
may be a difference in the pressure dependence of the Ostwald coefficient
in the sub- and super-critical water regions. However, the case for the
different pressure dependence is not as compelling for the Ostwald coef-
ficient as for Henry's constant. See Figures 6 and 7.

IV.   Thermodynamic changes for the dissolution of mercury in water.

The parameters of the fitted equations can be used to calculate the Gibbs
energy, enthalpy, entropy and heat capacity changes on dissolving mercury
in water. Figure 8 shows these changes calculated from the parameters for
the Ostwald coefficient. These values were chosen because they represent
the simplest standard state change. They are for the transfer on one mole
of mercury from the gas to the solution at the hypothetical concentrations
of one mole per liter in each phase. The temperatures at which the
Ostwald coefficients equals unity (equal equilibrium concentration in both
phases), the temperature range at which the Ostwald coefficient goes
through a minimum at the three total pressures, and the water critical
temperature are marked on the figure. Table 14 gives the values as calcu-
lated from the Ostwald coefficient fit at 50 MPa total pressure.

Table 14. Standard thermodynamic changes for the transfer of one mole of
           mercury from the vapor to the solution at a hypothetical con-
           centration of one mole per liter. Values calculated from the
           50 MPa equation.

T/K	Gibbs Energy kJ mol^{-1}	Enthalpy Change kJ mol^{-1}	Entropy Change J K^{-1} mol^{-1}	Heat Capacity Change J K^{-1} mol^{-1}
273	-6.27	-49.9	-160	333
323	+0.34	-34.3	-107	290
373	4.68	-20.9	- 68.5	247
423	7.36	- 9.59	- 40.1	204
473	8.82	- 0.46	- 19.6	161
523	9.43	+ 6.52	- 5.6	118
573	9.46	11.4	+ 3.3	75
623	9.17	14.0	7.8	32
673	8.74	14.6	8.7	- 11
723	8.36	13.0	6.4	- 54
773	8.15	9.2	1.3	- 97

At 273 K the equilibrium concentration of mercury is ten times larger in
the water than the gas phase. This indicates a strong interaction between
water and mercury which is reflected in the exothermic enthalpy change at

| COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA **1986**, July

CRITICAL EVALUATION:

the lower temperatures. At all temperatures above 320 K the Ostwald coefficient is less than unity. Thus the mercury equilibrium concentration is larger in the vapor phase than in the liquid water. This indicates a change from a dominate attractive interaction between mercury and water to a repulsion as the temperature increases. This is reflected in an endothermic enthalpy of solution at temperatures of 473 and above. Some further comments about the thermodynamic changes on dissolution follow below.

Standard Gibbs Energy change. Negative over the temperature interval of 273 to 320 K where the Ostwald coefficient is greater than one, positive at the higher temperatures where the Ostwald coefficient is less than one, and zero at the 320 K where the Ostwald coefficient equals unity.

Standard Heat Capacity change. The linear decrease in the heat capacity change follows from the four constant equation which on taking two temperature derivates gives an equation linear in temperature. The important point is the decrease from a large positive value to a negative value as the temperature increases. The heat capacities at 298 K of the pure components are liquid water 75.0 J K^{-1} mol^{-1} and mercury vapor 20.8 J K^{-1} mol^{-1}. The heat capacity change in the room temperature range on dissolving the mercury indicates a loosening of the water structure when the mercury atom enters the solution and interacts with the water. The effect decreases with temperature and the heat capacity change become negative at about the critical temperature of water. It is probably only a coincidence that the change in sign occurs near the water critical temperature.

Entropy change. The large negative entropy change at low temperature appears to be consistent with a loosening of the water structure indicated by the large positive heat capacity change. However, there appears to be a strong attractive interaction between the mercury and water in the 273 to 320 K range, thus the effect may be a large cooperative loosening of the water structure even though the mercury-water interaction is large with the effect in the water primarily an entropy effect. At the higher temperatures the mercury-water interaction changes to a net repulsion and order is restored in the water structure.

Enthalpy change. The large exothermic enthalpy change at 273 K is a measure of the strong interaction between mercury and water. The effect decreases rapidly with increasing temperature. Above about 480 K the change is endothermic which is consistent with a repulsion between the mercury and water dominating at the higher temperatures.

ADDED NOTE:

Dr. V. I. Sorokin, Institute of Experimental Mineralogy, Academy of Sciences, Moscow, USSR, has informed the IUPAC Solubility Commission that he has prepared a new critical evaluation of the Hg + H_2O system. The evaluation takes into account the partial molar volumes and pressure dependence of solubility up to 773 K and 152 MPa (1500 atm). The evaluation will be published in 1987.

Dr. G. Kolonin, Institute of Geology and Geophysics, Academy of Sciences (Siberian Branch), Novosibirsk-90, USSR, has informed the IUPAC Solubility Commission that he has new measurements in progress on the solubility of mercury in water by UV spectrophotometry over the 423 to 523 K temperature interval.
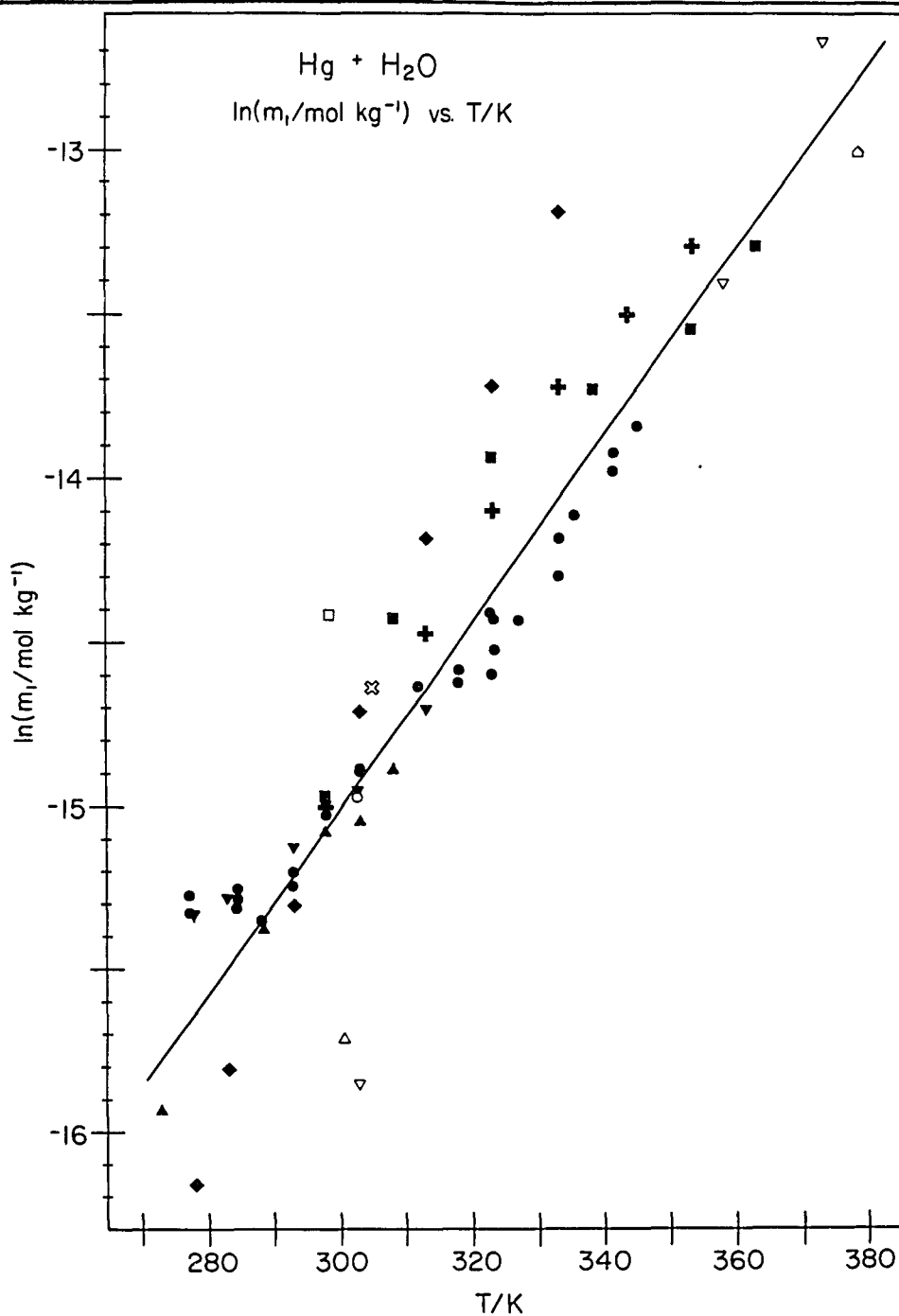
Figure 1. Mercury + Water, ln m vs. T (273 to 383 K).

◇ Reichardt and Bonhoeffer (ref. 2)   ● Glew and Hames (ref. 9)

▽ Stock *et al.* (ref. 3)   ✚ Onat (ref. 11)

△ Pariaud and Archinard (ref. 4)   ◆ Sanemasa (ref. 12)

■ Choi and Tuck (ref. 6)   ⬠ Sorokin *et al.* (ref. 13)

□ Kuntz and Mains (ref. 7)   ✖ Kawakara *et al.* (ref. 14)

▲ Spencer and Voigt (ref. 8)   ▼ Okouchi and Sasaki (ref. 16)

○ Baltisberger *et al.* (ref. 15)

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Water; H$_2$O; [7732-18-5]	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA _1986_, July

CRITICAL EVALUATION:

Hg + H$_2$O

ln(m_i/mol kg^{-1}) vs. T/K
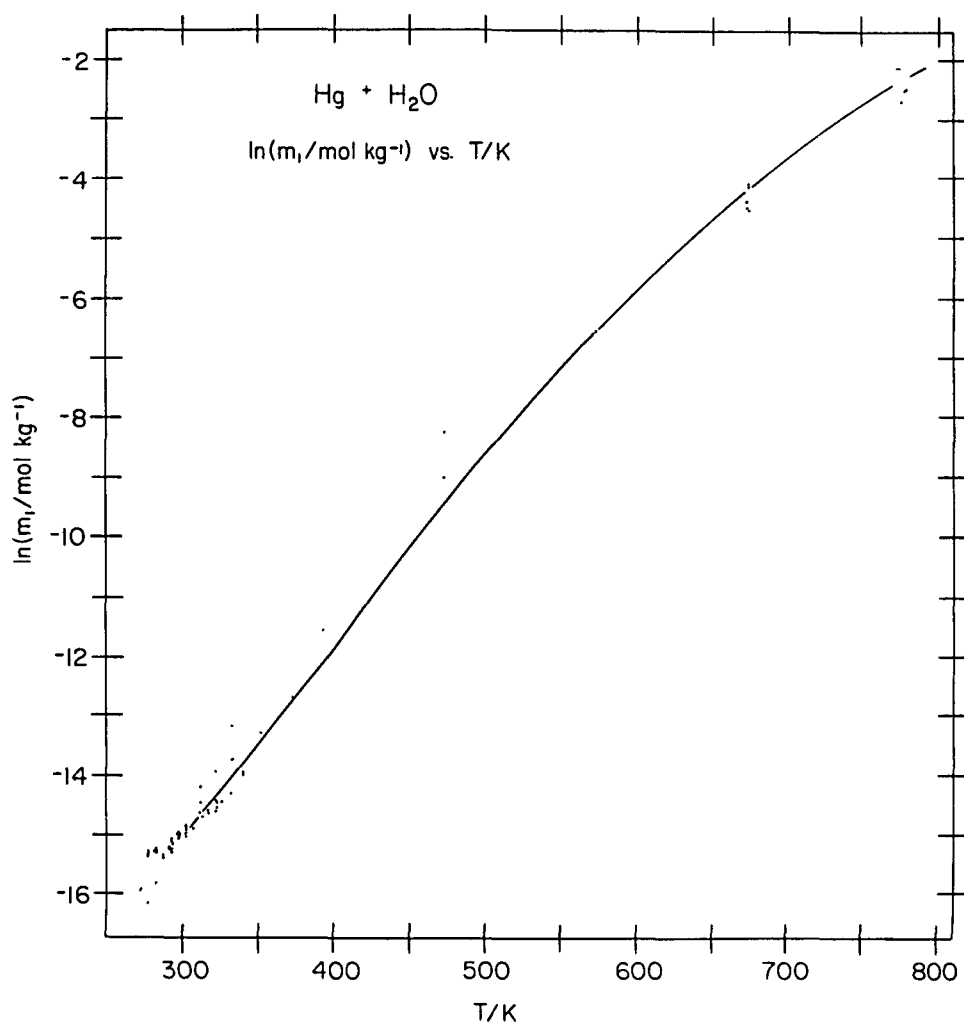
Figure 2.   Mercury + Water, ln m vs. T (273 to 773 K).

From top to bottom the total pressures were:
473 K   1.6, 54, 102 MPa
573 K   41, 65, 91 MPa
673 K   41, 50, 51, 71, 71,   92, 93 MPa
773 K   51, 52, 53, 71, 76.5, 100, 97 MPa.

The curve was drawn from 298 to 773 K from the parameters of
the four constant linear regression (Table 4).
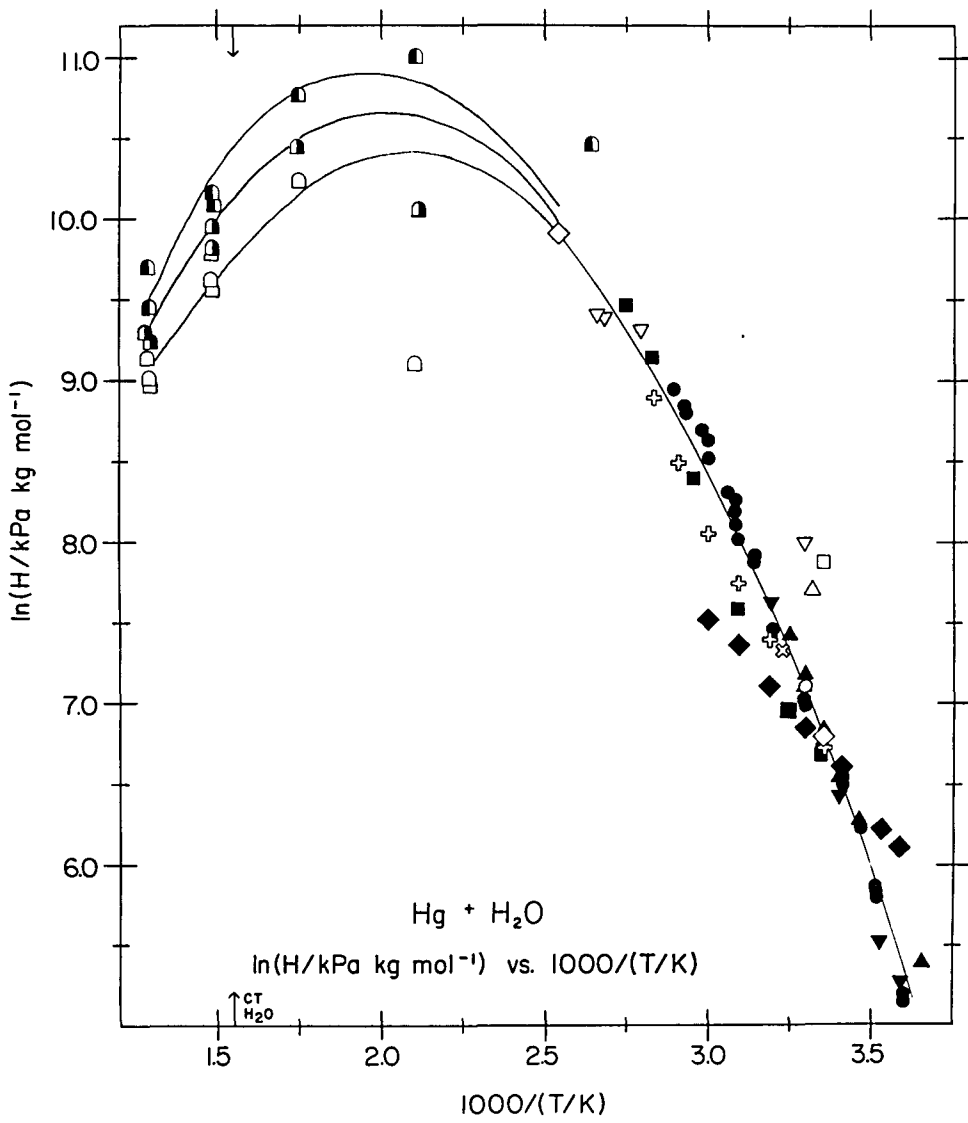
Figure 3. Mercury + Water, Henry's constant.
           ln(K/(kPa kg mol⁻¹) vs. 1000/(T/K).

           Curves drawn from linear regression constants in Table 8.
           The three curves represent 100, 75, and 50 MPa total pressure
           as one goes from top to bottom.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Water; H$_2$O; [7732-18-5]	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA **1986**, July

CRITICAL EVALUATION:

Hg + H$_2$O

Ostwald Coefficient vs. Temperature
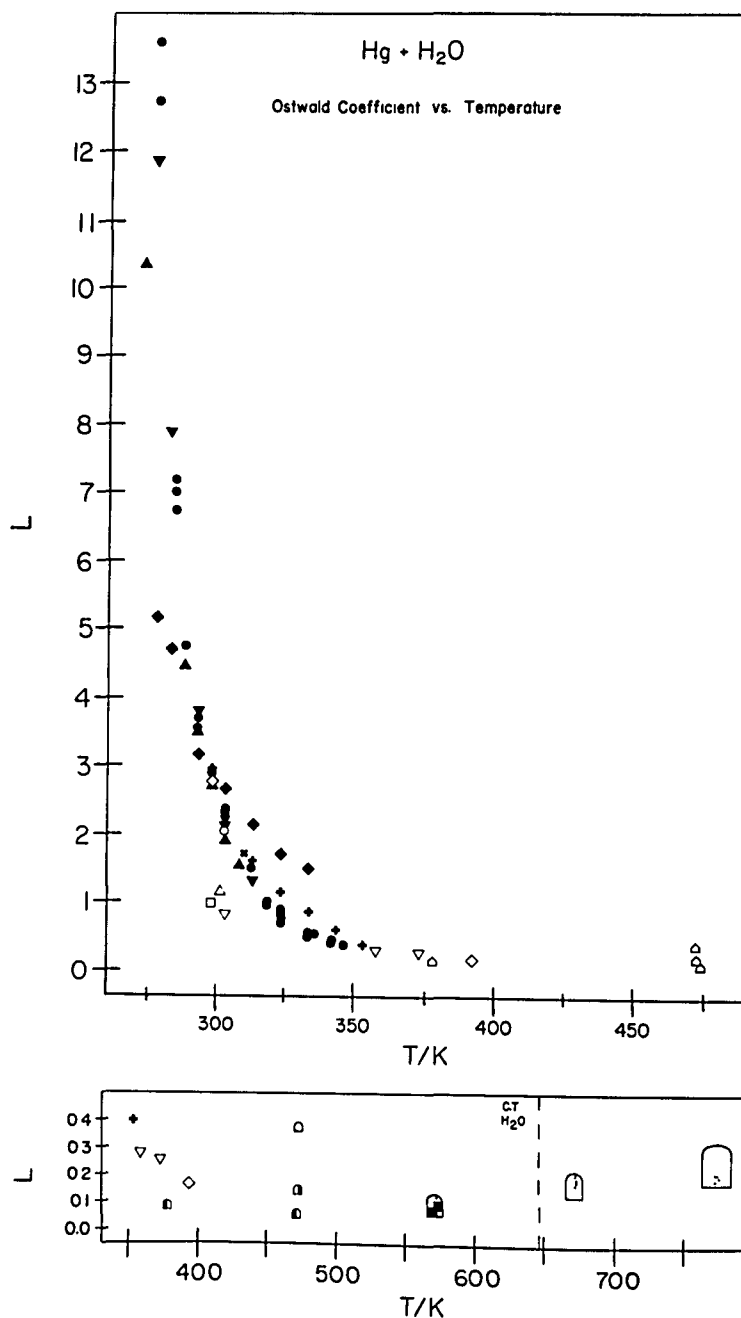
Figure 4.   Mercury + Water, Ostwald coefficient, L vs. Temperature, *T*/K.

The 350 to 773 K temperature range is shown on an expanded
scale.   Same symbol key as Figure 1.
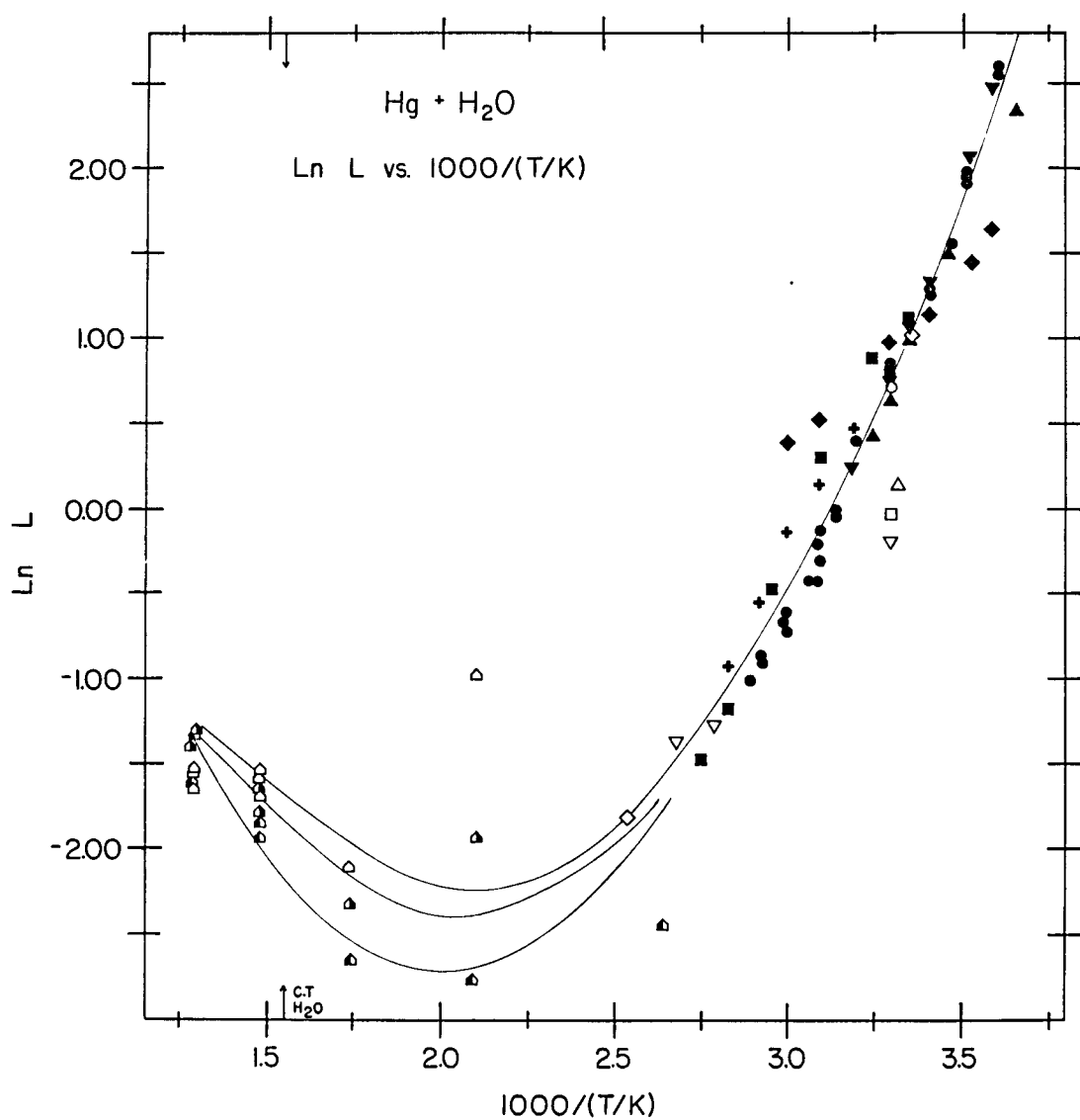
Figure 5.   Mercury + Water, ln L vs. 1000/(*T*/K).

Same symbol key as Figure 1.
The three curves represent total pressures of 50, 75 and 100
MPa as one goes from top to bottom.
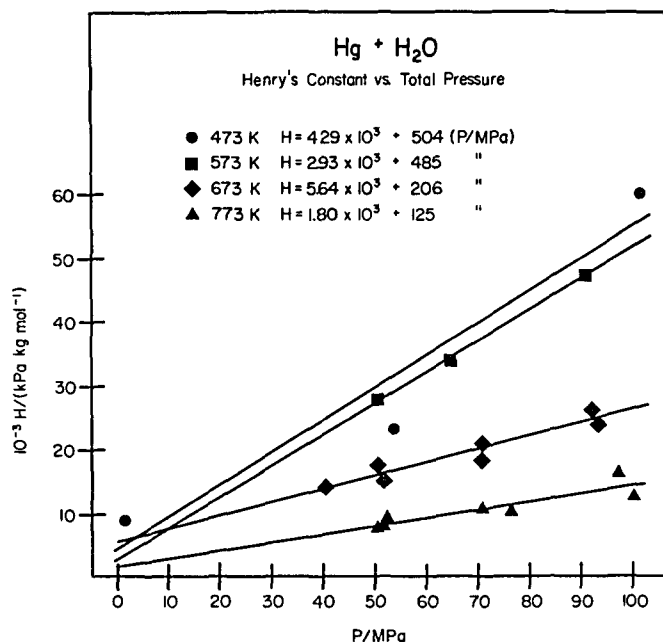
Figure 6. Mercury + Water, Henry's constant vs. Total pressure.

Evidence of a different pressure dependence of the Henry's constant above and below the water critical temperature of 647 K.
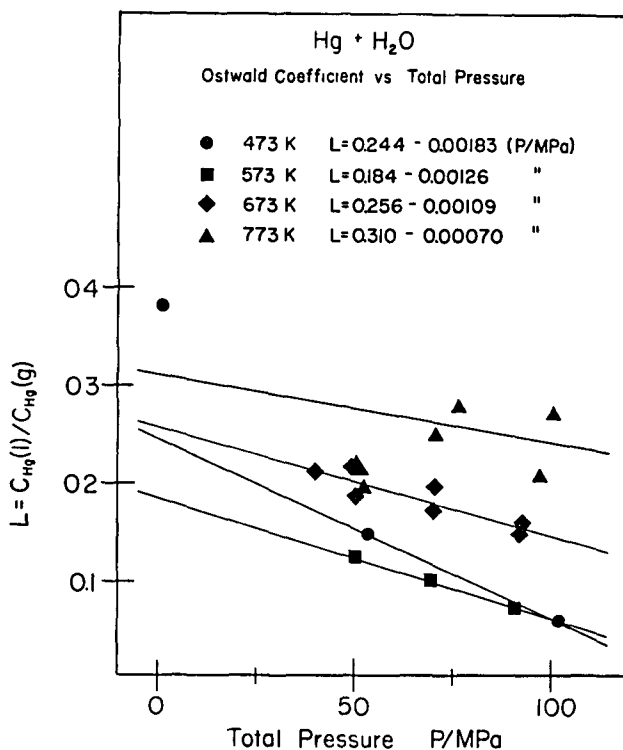
Figure 7. Mercury + Water, Ostwald coefficient vs. Total pressure.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Water; H₂O; [7732-18-5]	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA <u>1986</u>, July

CRITICAL EVALUATION:

Figure 8.   Mercury + Water.

Thermodynamic changes for the transfer on one mole of mercury
from the gas phase at one mole per liter to the solution at one
mole per liter. Calculated from the constants of the linear
regression of the low temperature data plus the 50 MPa total
pressure high temperature data.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Water; H$_2$O; [7732-18-5]	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1986, July

CRITICAL EVALUATION:

REFERENCES:

1. Christoff, A. *Z. Phys. Chem. Stoechiom. Verwandschaftsl.* 1908, *63*, 346 - 54.

2. Reichardt, H.; Bonhoeffer, K. F. *Z. Phys.* 1931, *67*, 780 - 9.

3. Stock, A.; Cucuel, F.; Gerstner, F.; Kohle, H.; Lux, H. *Z. Anorg. Allgem. Chem.* 1934, *217*, 241 - 53.

4. Pariaud, J.; Archinard, P. *Bull. Soc. Chim. France* 1952, 454 - 6; *J. Chim. Phys.* 1956, *53*, 765 - 9.

5. Moser, H. C.; Voigt, A. F. *J. Am. Chem. Soc.* 1957, *79*, 1837 - 9.

6. Choi, S. S.; Tuck, D. G. *J. Chem. Soc.* 1962, 4080 - 8.

7. Kuntz, R. R.; Mains, G. J. *J. Phys. Chem.* 1964, *68*, 408 - 10.

8. Spencer, J. N.; Voigt, A. F. *J. Phys. Chem.* 1968, *72*, 464 - 70; Spencer, J. N. *Dissertation,* Iowa State University, 1967.

9. Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1971, *49*, 3114 - 8.

10. Sorokin, V. I. *Dolk. Akad. Nauk SSSR* 1973, *213*, 852 - 5; *Dokl. Chem. (Engl. Transl.)* 1973, *213*, 905 - 8.

11. Onat, E. *J. Inorg. Nucl. Chem.* 1974, *36*, 2029 - 32.

12. Sanemasa, I. *Bull. Chem. Soc. Jpn.* 1975, *48*, 1795 - 8.

13. Sorokin, V. I.; Alekhin, Yu. V.; Dadze, T. P. *Ocherki Fiz. - Khim. Petrol.* 1978, *8*, 133 - 49.

14. Kawakara, H.; Nakamura , M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S. *Shika Rikogaku Zasshi* 1979, *20*, 137 - 41.

15. Baltisberger, R. J.; Hildebrand, D. A.; Grieble, D.; Ballintine, T. A. *Anal. Chim. Acta* 1979, *111*, 111 - 22.

16. Okouchi, S.; Sasaki, S. *Bull. Chem. Soc. Jpn.* 1981, *54*, 2513 - 4; *Report of the College of Engineering of Hosei University* 1983, (No. 22), 55 - 106.

17. Gjessing, E. T.; Rogne, A. K. G. *Vatten* 1982, *38*, 406 - 8.

18. Hursh, J. B. *JAT, J. Appl. Toxicol.* 1985, *5*, 327 - 32.

19. Khodakovskii, I. L.; Popova, M. Ya.; Ozerova, N. A. *Geokhim. Protsessov Migr. Rudn. Elem.* 1977, 86 - 118; *Chem. Abstr.* 1979, *90*, 57989s.

20. Clever, H. L.; Johnson, S. A.; Derrick, M. E. *J. Phys. Chem. Ref. Data* 1985, *14*, 631 - 80.

21. Ambrose, D.; Sprake, C. H. S. *J. Chem. Thermodynam.* 1972, *4*, 603 - 20.

22. Sengers, J. V.; Kamgar - Parsi, B. *J. Phys. Chem. Ref. Data* 1983, *13*, 185 - 205.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6]	Addendum I
(2) Water; H_2O; [7732-18-5]	Recommended solubility values at 298.15 K in several units.

CRITICAL EVALUATION:

Experimental values of the solubility of mercury in water at 298.15 K have been taken from eight papers. The experimental values were converted from the original unit to concentration, molal, mole fraction, Ostwald coefficient, and several forms of Henry's constant. There appear to be some minor inconsistencies because some values were converted on the basis of two significant digits and some on the basis of three digits. Other inconsistencies arise because the conversions are not necessarily made in the same order because the original unit varies from paper to paper. The values are arranged below along with the average value, the standard deviation, and the units. In general the standard deviation amounts to about 4 per cent of the average value.

Molality, mole fraction, and Ostwald coefficient.

Molal	Mole Fraction	Ostwald coefficient
$10^7 m_1$/mol kg^{-1}	$10^9 x_1$	L = c_1(liq)/c_1(gas)
2.81 (ref. 8)	5.1 (ref. 8)	2.71 (ref. 8)
2.89 (ref. 18)	5.21 (ref. 18)	2.78 (ref. 18)
2.99 (ref. 9)	5.33 (ref. 5)	2.84 (ref. 5)
3.00 (ref. 16)	5.39 (ref. 9)	2.88 (ref. 9)
3.00 (ref. 5)	5.40 (ref. 16)	2.90 (ref. 16)
3.06 (ref. 11)	5.51 (ref. 11)	2.95 (ref. 11)
3.15 (ref. 6)	5.67 (ref. 6)	3.04 (ref. 6)
3.18 (ref. 12)	5.76 (ref. 12)	3.09 (ref. 12)
$(3.01 \pm 0.12) \times 10^{-7}$ mol kg^{-1}	$(5.42 \pm 0.22) \times 10^{-9}$ mole fraction	(2.90 ± 0.13) Ostwald coef.

Henry's constants (several forms).

Pressure/Molal	Pressure/Mole Fraction	Pressure/Concentration
K = p_1/m_1	K' = p_1/x_1	K'' = p_1/c_1
813 (ref. 6)	45200 (ref. 6)	816 (ref. 6)
837 (ref. 11)	46500 (ref. 11)	840 (ref. 11)
846 (ref. 12)	47000 (ref. 12)	850 (ref. 12)
850 (ref. 16)	47000 (ref. 16)	854 (ref. 16)
858 (ref. 9)	47600 (ref. 9)	861 (ref. 9)
860 (ref. 5)	48000 (ref. 5)	864 (ref. 5)
887 (ref. 18)	49200 (ref. 16)	890 (ref. 16)
920 (ref. 8)	50000 (ref. 8)	923 (ref. 8)
(859 ± 30) kPa kg mol^{-1}	(47600 ± 1500) kPa	(862 ± 30) kPa dm^3 mol^{-1}

It is of some concern that when all of the experimental data are fitted by a linear regression as a function of temperature the smoothed 298.15 K solubility value does not reproduce the recommended value above. In this evaluation the smoothed values from the linear regression are classed as tentative values. The tentative 298.15 K solubility value is within one standard deviation of the recommended value above.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Addendum II Henry's constant in pressure and concentration.

CRITICAL EVALUATION:

Henry's constant, $(K''/kPa\ dm^3\ mol^{-1}) = (p_1/kPa)/(c_1/mol\ dm^{-3})$, is given here for comparison with the pressure/molal and pressure/mole fraction values given earlier in the evaluation. The pressure/concentration Henry's constant is larger than the pressure/molal constant by a percentage that reflect the difference in the mass of 1 kg and the mass of one dm^3 of water in kg. At the lower temperatures this difference is negligible. For example at 298.15 K the recommended values are 862 kPa dm^3 mol^{-1} and 859 kPa kg mol^{-1} which differ by 0.3 %. At the higher temperatures and especially in the water super critical region the differences are larger.

The feature that most distinguishes the pressure/concentration from the pressure/molal form of Henry's constant is the pressure dependence in the water supercritical region. The pressure/molal Henry's constant discussed earlier appears to be a continuous function of pressure through the water critical point and into the water super critical region (see Fig. 3, 6). In the super critical water region the pressure/concentration form of Henry's constant tends to be random with pressure. Average values of the constant are (31,100 ± 4,500) and (28,200 ± 3,800) kPa dm^3 mol^{-1} at 673 and 773 K, respectively.

The pressure/concentration Henry's constant has been fitted by linear regression to four equations of the type

$$\ln(K''/kPa\ dm^3\ mol^{-1}) = A_1 + A_2/(T/100\ K) + A_3 \ln(T/100\ K) + A_4 (T/100\ K)$$

for   0.1 MPa and 273.15 to 393.15 K,
         50   MPa and 423   to 647 K,
      100   MPa and 423   to 647 K, and
  all pressures and 648   to 773 K.

The regression parameters are given in the Table below.

Table 1. Linear regression parameters for the pressure/concentration form of Henry's constant.

Temperature Interval, T/K	Total Pressure P_t/MPa	A_1	A_2	A_3	A_4
273.15 - 393.15	0.1	71.9562 ± 3.3697	-120.1691 ± 5.3714	-22.8021 ± 1.4470	-
423 - 647	50	137.3658 ± 13.7699	-211.3420 ± 19.7969	-69.9926 ± 9.3807	5.6200 ± 1.0528
423 - 647	100	63.3040 ± 33.6868	-108.0239 ± 47.3560	-16.3612 ± 24.9924	-0.8248 ± 3.1950
648 - 773	all	9.6153 ± 0.5429	4.8348 ± 3.8948	-	-

Table 2. Tentative values of Henry's constant (pressure/concentration).

T/K	K/kPa dm^3 mol^{-1}	T/K	K/kPa dm^3 mol^{-1}
273.15	154	323.15	3000
283.15	327	333.15	4480
293.15	633	343.15	6370
		353.15	8660
298.15	856	363.15	11300
		373.15	14200
303.15	1136	383.15	17400
313.15	1900	393.15	20600

Table 3. Tentative values of Henry's constant (pressure/concentration).

T/K	Henry's constant, K/kPa dm^3 mol^{-1}, at		
	50 MPa	100 MPa	All
423	27,800	3,600	–
443	32,200	55,000	–
463	35,300	64,900	–
483	37,300	72,300	–
503	38,200	76,800	–
523	38,300	78,200	–
543	37,700	76,800	–
563	36,800	73,000	–
583	35,600	67,600	–
603	34,400	61,000	–
623	33,300	53,900	–
643	32,200	46,800	–
663	–	–	31,100
683	–	–	30,400
703	–	–	29,800
723	–	–	29,300
743	–	–	28,700
763	–	–	28,200

The tentative values of Henry's constant in Tables 2 and 3 are generated
from the linear regression parameters given in Table 1. The parameters
for the 50 MPa total pressure equation will generate Henry's constant
values within about 3 percent of the values above over the whole tempera-
ture interval of 273 to 773 K. The two sets of values are probably well
within experimental error of each other.

The standard state change for the transfer of one mole of mercury is

$$Hg(aq, hyp\ 1\ mol\ dm^{-3}) = Hg(g,\ 1\ kPa) + H_2O(liq)$$
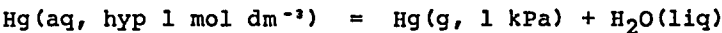
Summarized in Table 4 are values of the standard thermodynamic changes
calculated from the regression parameters of the 50 MPa total pressure
equation.

Table 4. Standard thermodynamic changes in kJ mol^{-1} and J K^{-1} mol^{-1} for
          the standard state change defined by the equation above.

T/K	Gibbs Energy	Enthalpy Change	Entropy Change	Heat Capacity Change
273	-11.4	51.6	231	-327
298	-16.8	43.7	203	-303
373	-29.6	23.6	143	-233
473	-41.3	5.0	98	-140
573	-50.0	- 4.3	80	- 46
673	-57.9	- 4.3	80	+ 47

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Christoff, A. *Z. Phys. Chem.* <u>1908</u>, *63*, 346-54.
VARIABLES: T/K = 281.15 - 3.15, 371.15 - 2.15	PREPARED BY: H. L. Clever M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Concentration	
$t/°C$	T/K	$10c_1$/mg dm^{-3}	$10^7 c_1$/mol dm^{-3}
8 - 10	281.15 - 3.15	0.1	0.5
98 - 99	371.15 - 2.15	0.93	4.6

The above results are of historical interest. Christoff was probably the first to show quantitatively that mercury dissolves in water and behaves as a "nonelectrolyte".

Christoff also showed that dissolved mercury could be detected in aqueous solutions of H_2SO_4 [7664-93-9] and of KOH [1310-58-3], and in the organic solvents benzene, C_6H_6, [71-43-2], ethanol, C_2H_6O, [64-17-5], and nitrobenzene, $C_6H_5NO_2$, [98-95-3].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
A pyknometer was partially filled with mercury and weighed. A supply of water was connected to the pyknometer and 10 liters of water slowly passed over the mercury surface. The pyknometer was dried and reweighed to find the mercury lost to the water. Obviously the time of contact between water and mercury was not long enough to saturate the solution. However, the experiment did show that a measureable amount of mercury did dissolve in water.	No information given.
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Reichardt, H.; Bonhoeffer, K. F. Z. Phys. 1931, 67, 780 - 9.
VARIABLES: $T/K = 313.15 - 336.15$	PREPARED BY: H. L. Clever M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility			
$t/°C$	T/K[a]	Concentration[a] $c_1/mg\ dm^{-3}$	$10^5 c_1/mol\ dm^{-3}$	Mole Fraction[a] $10^7 x_1$	Molality[a] $10^5 m_1/mol\ kg^{-1}$
120	393.15	1.0 ± 0.2	0.5 ± 0.1	1.0 ± 0.2	$0.5_3 \pm 0.1$

[a]Calculated by compilers.

Water density taken as 0.945 g cm^{-3}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Some of these results are mentioned in two earlier papers (ref. 1 and 2), but the present paper discusses the solubility work in the most detail. The solution is analyzed by weighing a gold foil before and after amalgamation with the mercury of the saturated solution. Ultraviolet absorption at 257.15 nm is also used.	(1) Mercury. No information given. (2) Water. No information given.
	ESTIMATED ERROR: $\delta c_1/mg\ dm^{-3} = \pm(0.1 - 0.2)$

	REFERENCES:
	
	1. Bonhoeffer, K. F.; Reichardt, H.
	   Naturwissenshaften 1929, 17, 933.
	
	2. Reichardt, H.; Bonhoeffer, K. F.
	   Z. Electrochem. 1930, 36, 753.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Stock, A.; Cucuel, F.; Gerstner, F.; Kohle, H.; Lux. H. Z. Anorg. Allgem. Chem. 1934, 217, 241 - 53.

VARIABLES:	PREPARED BY:
T/K = 303.15 - 373.15	S. H. Johnson M. Iwamoto H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility			
$t/°C$	T/K	$10^{-1}c_1$/mg dm^{-3}	Concentration[a] 10^7c_1/mol dm^{-3}	Mole Fraction[a] 10^9x_1	Molality[a] 10^7m_1/mol kg^{-1}
30	303.15	0.002 - 0.003	1.0 - 1.5	2.3	1.3
85	358.15	0.03	15	28	15
100	373.15	0.06	30	56	31

[a]Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Electrodeposition on a copper wire.	(1) Mercury. (2) Water. Distilled.
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Pariaud, J.; Archinard, P. *Bull. Soc. Chim. France* <u>1952</u>, 454 - 6. *J. Chim. Phys.* <u>1956</u>, *53*, 765 - 9.
VARIABLES: $T/K = 301.15$	PREPARED BY: S. H. Johnson M. Iwamoto H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Time of Mixing	Mercury in[a] Solution	Mercury Solubility		
				Concentration	Mole[b] Fraction	Molality[b]
$t/°C$	T/K[b]	t/days	$10^8 c_1$/g dm^{-3}	$10^7 c_1$/mol dm^{-3}	$10^8 x_1$	$10^7 m_1$/mol kg^{-1}
25	298.15	1	0			
		3	10, 15, 15			
		10	25, 20, 25			
28	301.15	18	30, 28			
		24	32, 30, 25			
			30 ± 10[c]	1.5 ± 0.5	2.7	1.5

[a]All of the experimental values are given with an uncertainty of ± 10.

[b]Calculated by compilers.

[c]The solubility and its uncertainty given in the author's second paper.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Colorimetric method with dithizone. Mercury and triply distilled degassed water were equilibrated for up to 24 days to insure saturation. The mercury was oxidized to mercury(II) and complexed with dithizone. The mercury dithizonate complex absorption was measured at 490 nm.	(1) Mercury. Electroanalytically pure. (2) Water. Triply distilled and degassed.
	ESTIMATED ERROR: See uncertainty in table above.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] Mercury-203; ^{203}Hg; [13982-78-0] (2) Hypophosphorus acid; H_3PO_2; [6303-21-5] (3) Nitric acid; HNO_3; [7697-37-2] (4) Water; H_2O; [7732-18-5]	Moser, H. C.; Voigt, A. F. *J. Am. Chem. Soc.* <u>1957</u>, *79*, 1837 - 9.

VARIABLES:	PREPARED BY:
T/K = 298.15	S. H. Johnson M. Iwamoto H. L. Clever

EXPERIMENTAL VALUES:

Temperature		H_3PO_2	HNO_3	Mercury Solubility		
				Concentration	Mole[a] Fraction	Molality[a]
$t/°C$	T/K[a]	c_2/mol dm^{-3}	c_3/mol dm^{-3}	$10^7 c_1$/mol dm^{-3}	$10^8 x_1$	$10^7 m_1$/mol kg^{-1}
25.0	298.15	0.1	0	3.0 $\pm$ 0.3	5.4	3.0
		0.01	0.01	2.9 $\pm$ 0.1	5.2	2.9
		0.001	0.01	3.0 $\pm$ 0.1	5.4	3.0

[a]Calculated by compilers.

The hypophosphorus acid, H_3PO_2, and nitric acid, HNO_3, were added to prevent oxidation of metallic mercury. The acids are assumed to be so dilute that they do not effect the solubility.

ADDITIONAL DATA:
The authors used their solubility value along with literature values of the disproportionation of mercurous ion
$$Hg_2^{2+} (aq) = Hg(l) + Hg^{2+} (aq) \qquad K = 0.0060 - 0.0120 \text{ (Literature)}$$
to estimate the disproportionation constant in aqueous solution of
$$Hg_2^{2+} (aq) = Hg(aq) + Hg^{2+} (aq) \qquad K = (1.9 - 3.6) \times 10^{-9}.$$
The authors' distribution study resulted in a slightly larger value of (5.3 - 5.6) $\times 10^{-9}$. No evidence of the dissociation of mercurous dimer, $Hg_2^{2+} (aq) = 2Hg^+(aq)$, was found. It can be inferred that the dissociation K is $< 1 \times 10^{-7}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The solubility of mercury in dilute aqueous acid solution was determined by shaking them with a drop of mercury of known specific activity. The saturated solution was treated to obtain a precipitate of HgS which was deposited on a planchet and analyzed for mercury-203 with a thin window Geiger counter. It was found necessary to add a small amount of hypophosphorus acid to prevent oxidation of metallic mercury by radiolysis. More details may be found in (ref. 1).	(1) Mercury. Oak Ridge National Lab. Obtained as a high specific activity solution of mercuric nitrate containing isotope 203. (2) Water. Distilled. Traces of hypophosphorus acid were added to prevent Hg oxidation by radiolysis.
	ESTIMATED ERROR: $\delta T/K = \pm 0.1$ $\delta c_1/c_1 = \pm 0.035$
	REFERENCES: 1. Moser, H. C.; Voigt, A. F. *USAEC Report* <u>1957</u>, *ISC-892*.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6]	Choi, S. S.; Tuck, D. G.
(2) Water; H_2O; [7732-18-5]	J. Chem. Soc. 1962, 4080 - 8.

VARIABLES:	PREPARED BY:
$T/K = 298.15 - 363.15$	S. H. Johnson M. Iwamoto H. L. Clever

EXPERIMENTAL VALUES:

Temperature			Mercury Solubility			
$t/°C$	T/K	$10^7 w_1/g\ g^{-1}$	Probable Error of Mean	Concentration[a] $10^7 c_1/mol\ dm^{-3}$	Mole Fraction[a] $10^8 x_1$	Molality[a] $10^7 m_1/mol\ kg^{-1}$
25	298.15	0.631	0.14	3.14	5.67	3.15
35	308.15	1.09	0.03	5.40	9.79	5.43
50	323.15	1.77	0.03	8.72	15.9	8.82
65	338.15	2.17	0.05	10.6	19.5	10.8
80	353.15	2.61	0.01	12.6	23.4	13.0
90	363.15	3.34	0.18	16.1	30.0	16.7

[a]Calculated by compilers.

The solubility values reported are mean values of two experiments (three at 298.15 K) with duplicate samples taken in each experiment.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
A Neutron activation method was used. The method does not require other reagents in the solution such as H_3PO_2. The isotopes of mercury selected for analysis were ^{197m}Hg and ^{197}Hg [13981-51-6].	(1) Mercury. Johnson Matthey and Co. Spectroscopically pure, sodium impurity 1 ppm.
Deoxygenated water and mercury were equilibrated 10 days without stirring to prevent suspended or colloidal Hg in the solution. Samples were taken and irradiated one week	(2) Water. Distilled three times, deoxygenated in an air free system.
in a neutron source. Carrier Hg was added, the Hg reacted and precipitated as HgS for counting in a crystal spectrometer. The method can detect 2×10^{-9} of Hg.	ESTIMATED ERROR: See authors probable error on mean values in table above.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Kuntz, R. R.; Mains, G. J. *J. Phys. Chem.* <u>1964</u>, *68*, 408 - 10.
VARIABLES: T/K = 298.15	PREPARED BY: S. H. Johnson M. Iwamoto H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K[a]	Concentration $10^7 c_1$/mol dm^{-3}	Mole Fraction[a] $10^8 x_1$	Molality[a] $10^7 m_1$/mol kg^{-1}
25	298.15	1	1.8	1

[a]Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Spectrophotometric method. It was assumed that the optical density at 2560 A is a reliable measure of the solubility. It was further assumed that the extinction coefficient of mercury was the same in all hydrocarbon solvents. The optical density of a saturated solution of Hg in hexane was measured and, when combined with the solubility measured by Moser and Voigt (ref. 1), gives an extinction coefficient ε_{2560} = 7.35 x 10^3 dm^3 mol^{-1} cm^{-1} at 25°C. The value was used to calculate the solubility in the other solvents.	(1) Mercury. No information given. (2) Water. No information given.
	ESTIMATED ERROR:
The Hg and solvent were equilibrated for 20 minutes and the optical density was measured by a Beckman DU Spectrophotometer. The reliability of the results depends on the Moser and Voigt solubility value in hexane.	REFERENCES: 1. Moser, H. C.; Voigt, A. F. *USAEC Report* <u>1957</u>, *ISC-892*, 65 pp.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6]; Mercury-203; ^{203}Hg; [13982-78-0] (2) Water; H_2O; [7732-18-5]	Spencer, J. N.; Voigt, A. F. *J. Phys. Chem.* 1968, 72, 464 - 470. Spencer, J. N. Dissertation, Iowa State University, 1967.

VARIABLES:	PREPARED BY:
T/K = 273.15 - 308.15	S. H. Johnson M. Iwamoto H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K[a]	Concentration $10^7 c_1$/mol dm^{-3}	Mole Fraction[a] $10^8 x_1$	Molality[a] $10^7 m_1$/mol kg^{-1}
0	273.15	1.2 ± 0.2	2.2	1.2
15.5	288.65	2.1 ± 0.1	3.8	2.1
20	293.15	2.4 ± 0.2	4.3	2.4
25	298.15	2.8 ± 0.1	5.1	2.8
30	303.15	2.9 ± 0.1	5.2	2.9
35	308.15	3.4 ± 0.1	6.2	3.4

[a]Calculated by compilers.

The authors smoothed their data according to the equation:
$$\log x_1 = (8.600 \pm .575)\log(T/K) - 29.597$$
for the 273.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
A radioactive tracer method was used. A high activity sample of mercury-203 nitrate was added to mercury(II) nitrate, reduced to metallic mercury by hypophosphorous acid, coagulated into a drop, washed and dried. The mercury and solvent were shaken continuously in 25 ml glass stoppered flasks in a thermostat for 24 hours. Aliquots of the equilibrated solution were counted by a conventional single channel scintilation counter. The window width was set to count only the photopeak at 279 kev. The solubility values were the average of at least six determinations over a three day period.	(1) Mercury and Mercury-203. The isotope decays by emission of a beta particle at an energy of 210 kev, accompanied by a gamma ray of 279 kev. The isotope half-life is 47 days. (2) Water. Doubly distilled from alkaline permanganate solution.

ESTIMATED ERROR:
δT/K = ±0.1; See random error reported by authors with concentration values above.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6]	Glew, D. N.; Hames, D. A.
(2) Water; H$_2$O; [7732-18-5]	*Can. J. Chem.* <u>1971</u>, *49*, 3114 - 8.

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility			Reducing
$t/°C$	T/K^a	Concentration^a $10^7 c_1$/mol dm^{-3}	Mole Fraction $10^8 x_1$	Molality^a $10^7 m_1$/mol kg^{-1}	Agent^b
4.30	277.45	2.33	4.19	2.33	iv
4.30	277.45	2.21	3.99	2.21	iv
11.41	284.56	2.37	4.28	2.38	ii
11.41	284.56	2.31	4.17	2.31	ii
11.41	284.56	2.22	4.01	2.23	ii
14.97	288.12	2.14	3.86	2.14	i
19.80	292.95	2.39	4.31	2.39	i
19.80	292.95	2.49	4.49	2.49	i
25.02	298.17	2.98	5.39	2.99	iv
30.02	303.17	3.58	6.47	3.59	iii
30.09	303.24	3.43	6.20	3.44	i
30.09	303.24	3.48	6.29	3.49	i
39.16	312.31	4.35	7.90	4.39	i
45.07	318.22	4.58	8.33	4.62	ii
45.07	318.22	4.40	8.01	4.45	ii
49.80	322.95	5.42	9.88	5.48	i
50.24	323.39	4.51	8.22	4.56	i
50.24	323.39	5.32	9.70	5.38	i
50.24	323.39	4.85	8.85	4.91	i
53.71	326.86	5.31	9.70	5.38	ii
59.98	333.13	6.77	12.4	6.88	i
59.98	333.13	6.06	11.1	6.16	i
62.28	335.43	7.25	13.3	7.38	ii
68.19	341.34	8.75	16.1	8.94	i
68.19	341.34	8.31	15.3	8.49	i
72.44	345.59	9.48	17.5	9.71	ii

^{a}Calculated by compilers.

^{b}i   sodium sulfite
  ii   hydrazine hydrate
  iii sodium borohydrate
  iv   none

The authors fit the data above by the method of least squares to obtain
the equation:

$$\log x_1 = -122.811 + 4475.3/(T/K) + 40.2205 \log(T/K).$$

The estimated standard error on a single measurement is 7.5 percent.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Glew, D. N.; Hames, D. A. *Can. J. Chem.* <u>1971</u>, *49*, 3114 - 8.

ADDITIONAL INFORMATION:

Author's smoothed data: Solubility of mercury in water.

The experimental solubility values of Glew and Hames between 4° and 72° (preceeding page), the value of Bonhoeffer and Reichart (ref. 1) at 120°C, the value of Stock *et al.* (ref. 2) at 85°C, the value of Moser and Voigt (ref. 3) at 25°C, and the values of Choi and Tuck (ref. 4) at 25°, 80° and 90°C were combined to obtain the equation and the smoothed values below. The Henry's constant, $H/atm = (p_1/atm)/x_1$, were obtained from the same experimental solubility values and mercury vapor pressures from the equation of Douglas, Ball and Ginnings (ref. 5).

Temperature		Mole Fraction	Standard Deviation	Henry's Constant	Standard Deviation
t/°C	T/K	$10^5 x_1$	σ	$H/atm = (p_1/atm)/x_1$	σ
0.0	273.2	3.73	0.14	70	3
5.0	278.2	3.91	0.11	109	3
10.0	283.2	4.15	0.10	165	4
15.0	288.2	4.46	0.08	242	5
20.0	293.2	4.83	0.08	346	6
25.0	298.2	5.28	0.08	482	7
30.0	303.2	5.83	0.08	658	10
35.0	308.2	6.48	0.10	878	13
40.0	313.2	7.27	0.11	1150	18
45.0	318.2	8.20	0.13	1470	23
50.0	323.2	9.31	0.15	1860	30
55.0	328.2	10.6	0.17	2300	38
60.0	333.2	12.2	0.20	2800	46
65.0	338.2	14.1	0.23	3370	56
70.0	343.2	16.4	0.28	3980	69
75.0	348.2	19.1	0.35	4640	85
80.0	353.2	22.4	0.44	5350	110
85.0	358.2	26.3	0.58	6080	140
90.0	363.2	31.0	0.78	6840	170
100.0	373.2	43.6	1.5	8360	280
110.0	383.2	62.1	2.7	9810	430
120.0	393.2	89.1	5.0	11100	630

Linear regression resulted in the equations for 0° to 120°C:

$$\log x_1 = -128.089 + 4715.2/(T/K) + 42.0288 \log(T/K)$$

and

$$\log(H/atm) = 135.636 - 8031.1/(T/K) - 42.8448 \log(T/K).$$

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H$_2$O; [7732-18-5]	Glew, D. N.; Hames, D. A. *Can. J. Chem.* <u>1971</u>, *49*, 3114 - 8.
VARIABLES: T/K = 277.45 - 345.59	PREPARED BY: S. H. Johnson M. Iwamoto H. L. Clever

EXPERIMENTAL VALUES:

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 300 cm³ of water was distilled directly into a special solubility cell, then about 30 g of mercury was vacuum distilled into the cell. Atmospheric pressure was restored with helium. Reducing agent (see table) (0.001 M) was added to prevent oxidation of mercury by any residual oxygen. The cell contents were stirred continuously for up to a day and the temperature set to the operating level.

The stirrer was stopped two hours before sampling. A helium pressure 15 mmHg above atmospheric pressure was used to express a 10 - 20 g sample of saturated solution into a weighed flask containing 1 ml 4 percent KMnO$_4$ and 1 ml 20 percent H$_2$SO$_4$. The flask was reweighed and the sample immediately analyzed for mercury by an atomic absorption method. Solubilities were approached from both above and below saturation.

Further details are in the paper and in the authors later paper on mercury + sodium chloride + water (ref. 6).

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Technical electrolytic grade, washed with 10% NaOH in an air stream, washed with 5% HNO$_3$, filtered through gold foil, rewashed with fresh 5% HNO$_3$ and distilled three times.

(2) Water. Distilled, degassed and purged several times with nitrogen at atmospheric pressure. Distilled under vacuum directly into the solubility vessel.

ESTIMATED ERROR:
$\delta T/K$ = $\pm$0.01
$\delta x_1/x_1$ = $\pm$0.075 Standared error of a single measurement (authors).

REFERENCES:

1. Bonhoeffer, K. F.; Reichert, H.
   Z. Phys. <u>1931</u>, *67*, 780.

2. Stock, A.; Cucuel, F.; Gerstner, F.; Kohle, H.; Lux, H.
   Z. Anorg. Chem. <u>1934</u>, *217*, 241.

3. Moser, H. C.; Voigt, A. F.
   J. Am. Chem. Soc. <u>1957</u>, *79*, 1837.

4. Choi, S. S.; Tuck, D. G.
   J. Chem. Soc. <u>1962</u>, 4080.

5. Douglas, T. B.; Ball, A. F.; Ginnings, D. C.
   J. Res. N. B. S. <u>1951</u>, *46*, 334.

6. Glew, D. N.; Hames, D. A.
   Can. J. Chem. <u>1972</u>, *50*, 3124 - 8.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H$_2$O; [7732-18-5]	Sorokin, V. I. *Dokl. Akad. Nauk SSSR* <u>1973</u>, *213(4)*, 852 - 5. *Dokl. Chem. (Engl. Transl.)* <u>1973</u>, *213*, 905 - 8.

VARIABLES:	PREPARED BY:
T/K = 571.15 - 780.15 p/MPa = 40.5 - 100.3	H. L. Clever M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Pressure	Equilibration Time	Mercury Solubility		
t/°C	T/K	p/atm	t/h	m_1/g kg^{-1}	Molality[a] m_1/mol kg^{-1}	Mole Fraction $10^3 x_1$
300	573.15	500	48	0.29	0.0014	0.0260
300	573.15	640	72	0.24	0.0012	0.0216
298	571.15	900	138	0.19	0.0009	0.0171
400	673.15	400	24	3.37	0.0168	0.302
400	673.15	500	24	2.76	0.0138	0.248
400	673.15	495	24	3.22	0.0161	0.289
400	673.15	700	24	2.47	0.0123	0.222
400	673.15	700	48	2.80	0.0140	0.251
398	671.15	920	24	2.23	0.0111	0.200
401	674.15	910	48	2.13	0.0106	0.191
500	773.15	500	24	24.12	0.1202	2.16
502	775.15	510	28	23.71	0.1182	2.12
500	773.15	520	24	20.21	0.1008	1.81
495	768.15	755	48	18.45	0.0920	1.65
507	780.15	700	24	19.90	0.0992	1.78
498	771.15	990	24	16.36	0.0816	1.47
503	776.15	960	25	13.41	0.0667	1.20

[a]Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The 50 cm^3 reaction vessel and the 5 cm^3 sample collector were constructed of VT-8 titanium alloy. The solution was stirred by a magnetic stirrer. The apparatus was designed so that there was no change in temperature or pressure during sampling. Neither gas liberation from the sample nor the appearance of oxidized Hg or titanium were observed in the course of the work. Three analytical methods were used with parallel samples: (i) amalgamation with a gold cap, (ii) colorimetric titration with dithizone, and (iii) volumetric titration with ammonium thiocyanate. The author does not state what gas was used to pressure the system. It was probably argon.	(1) Mercury. Doubly distilled. (2) Water. Doubly distilled. Freed of dissolved gases by boiling and subsequent purging with pure argon. The pH of the water was 6.50 before and after the experiment.
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Onat, E. *J. Inorg. Nucl. Chem.* <u>1974</u>, *36*, 2029 - 32.
VARIABLES: $T/K = 298.15 - 353.25$	PREPARED BY: H. L. Clever M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		No. of	Concentration[a]		Avg.% Dev.	Mole Fraction[b]	Molality[b]
$t/°C$	T/K	Detns.	$10^7 c_1$/mol dm^{-3}		from	$10^8 x_1$	$10^7 m_1$/mol kg^{-1}
25	298.15	5	3.05	3.09	3.3	5.51	3.06
40	313.15	4	5.12	5.19	1.9	9.30	5.16
50	323.15	3	7.43	7.47	4.0	13.5	7.52
60	333.15	3	10.78	10.87	3.0	19.8	11.0
70	343.15	4	13.33	13.37	3.0	24.6	13.6
80	353.15	4	16.37	16.40	0.6	30.3	16.8

[a]The two concentration values represent two ways of converting the experimental absorbance of Hg_2^{2+} at 236.5 mm into a solubility value. The average values to the left are from the calibration curve. The average values to the right were calculated from Beer's law using the molar absorption of 2.8×10^4 (ref. 1).

The mole fraction and molality solubility values were calculated from the concentration in the left hand column.

[b]Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:

450 ml of water and 10 g of mercury were equilibrated with stirring for 24 hours in a thermostat. The system was oxygen free.
  Duplicate 100 ml samples were taken and transferred to flasks containing 5 ml 0.001 *M* Hg(ClO)$_4$ and 0.837 g concentrated HClO$_4$. The flask contents were shaken continuously, made oxygen free by bubbling N$_2$, and brought to 25°C in a thermostat. The solution was left in the thermostat over night. The solution was analyzed for soluble Hg by measuring the absorbance of Hg$_2$(ClO$_4$)$_2$ at 2 nm intervals over the 212 to 256 nm interval in a 10 cm cell on a Beckman DU spectrophotometer. The absorbance was compared with a calibration curve to obtain the Hg$_2^{2+}$ concentration which was taken to be one-half the Hg concentration resulting from the reaction
    Hg^{2+}(aq) + Hg(aq) = Hg$_2^{2+}$ (aq),
which was complete under the analysis conditions.
	(1) Mercury. Reagent grade. Purified chemically (ref. 2). Redistilled under reduced pressure.
	
	(2) Water. Triply distilled.

	ESTIMATED ERROR: $\delta T/K$ No information. δc_1/mol dm^{-3} See % average deviation from mean above.

	REFERENCES:
	
	1. Higginson, W. C. E.
	   J. Chem. Soc. <u>1951</u>, 1438.
	
	2. Palmer, W. G.
	   Experimental Physical Chemistry,
	   C. U. P., Cambridge, 1949, p. 203.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Sanemasa, I. *Bull. Chem. Soc. Jpn.* <u>1975</u>, *48*, 1795 - 8.

VARIABLES:	PREPARED BY:
T/K = 278.15 - 333.15	S. H. Johnson H. L. Clever M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Henry's constant K/atm	Mercury Solubility		
$t/°C$	T/K		Concentration $10^6 c_1/g\ dm^{-3}$	Mole Fraction[a] $10^8 x_1$	Molality[a] $10^7 m_1/mol\ kg^{-1}$
5	278.15	233	19.2	1.72	0.957
10	283.15	262	27.4	2.46	1.37
20	293.15	391	45.0	4.04	2.25
30	303.15	500	81.3	7.33	4.07
40	313.15	650	137	12.4	6.88
50	323.15	852	218	19.8	11.0
60	333.15	1010	368	33.6	18.7

[a]Calculated by compilers.

Values in the paper above 333.15K were extrapolated by the author.

Henry's constant:
$$\ln(K/atm) = \ln((P_1/atm)/x_1)$$
$$= -1078/(T/K) + 6.250$$

The enthalpy of solution:
$$\Delta H/kcal\ mol^{-1} = 5.3$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The solubility apparatus is a closed system which consists of several flasks connected by tubing. A 20 g portion of Hg is placed in one flask immersed in thermostat I, and up to 200 ml of water are placed in a second flask immersed in thermostat II. The Hg vapor pressure is controlled by the temperature of thermostat I. Nitrogen gas at atm pressure is circulated by the pump. The gas passes over the Hg and bubbles through the water (or solution). One hour circulation saturates both the gas space and water. The Hg is determined by cold-vapor atomic absorption. The method is based on a reduction-aeration method found by Kimura and Miller (ref. 1). The procedure used is similar to that reported by Omang (ref. 2). The sample and working standard are put through the same procedure. Analyses are done in triplicate. Measurements were made at up to six Hg pressures at each temperature.	(1) Mercury. Metallic mercury purified by distillation under reduced pressure. (2) Water. Redistilled water. Both aerated and deoxygenated water were used with no difference.
	ESTIMATED ERROR: $\delta T/K = \pm 0.05$

	REFERENCES:
	
	1. Kimura, Y.; Miller, V. L.
	   Anal. Chim. Acta <u>1962</u>, *27*, 325.
	
	2. Omang, S. H.
	   Anal. Chim. Acta <u>1971</u>, *53*, 415.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Sorokin, V. I.; Alekhin, Yu. V.; Dadze, T. P. *Ocherki Fiz.-Khim. Petrol.* <u>1978</u>, *8*, 133 - 49.
VARIABLES: T/K = 378.15 - 475.15 P_t/MPa = 1.6 - 102.3	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Total Pressure		Mercury Solubility		
t/°C	T/K	P_t/atm	P_t/MPa	Weight $10^2 w_1$/g kg^{-1}	Molality $10^5 m_1$/mol kg^{-1}	Mole Fraction[a] $10^7 x_1$
105	378.15	1000	101.3	0.0460	0.229	0.402
200	473.15	16	1.6	5.17	25.8	46.5
200	473.15	530	53.7	2.44	12.2	22.0
202	475.15	1010	102.3	1.22	6.08	11.0

[a]Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
These are assumed to be similar to that described in the authors earlier work (ref. 1).	
	ESTIMATED ERROR:
	REFERENCES: 1. Sorokin, V. I. *Dokl. Akad. Nauk SSSR* <u>1973</u>, *213(4)*, 852 - 5.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S. *Shika Rikogaku Zasshi* <u>1979</u>, *20*, 137 - 41.

VARIABLES:	PREPARED BY:
T/K = 310.15 pH = 7.2 $\pm$ 0.1	H. L. Clever

EXPERIMENTAL VALUES:

Shaking Time	Mercury[a]			
		Concentration	Mole Fraction	Molality
t/days	ppm[b]	$10^7 c_1$/mol dm^{-3}	$10^8 x_1$	$10^7 m_1$/mol kg^{-1}
1	0.020 $\leq$ 0.045 $\leq$ 0.070	2.2 $\pm$ 1.0		
3	0.025 $\leq$ 0.060 $\leq$ 0.096	3.0 $\pm$ 1.4		
5	0.078 $\leq$ 0.086 $\leq$ 0.090	4.2 $\pm$ 0.2		
5	0.078 $\leq$ 0.087 $\leq$ 0.095	4.3 $\pm$ 0.3		
5	0.070 $\leq$ 0.095 $\leq$ 0.120	4.7 $\pm$ 1.0		
		4.4 $\pm$ 0.7[c]	8.0	4.4

[a]The compiler assumes that the five day shaking time represents solubility equilibrium.

[b]The compiler calculated the concentration of mercury assuming that ppm means grams of mercury in 1 x 10^6 cm^3 of solution.

[c]The average is from the five days of shaking time.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of water solution were placed in an Erlenmeyer flask. The rubber stoppered flask was rotated 1 to 5 days in a thermostat at 37°C.

The aqueous phase was sampled. Acidified (H_2SO_4) potassium permanganate solution was added. The sample was wet ashed and the mercury reduced by air and vaporized as described in ref. 1.

The mercury was determined by flameless atomic absorption spectrophotometry using a mercury analyzer (JEOL AA-HG 01) and an atomic absorption spectrophotometer (JEOL JAA-7000).

Three determinations were performed on each sample.

The solubility was pH dependent. Much larger solubility values were obtained in the pH 2 - 3 and pH 10 - 11 ranges. All reported solubility values are for solutions at pH 7.2 $\pm$ 0.1. There was no mention of exclusion of oxygen from the samples.

SOURCE AND PURITY OF MATERIALS:

No information was given on the source and purity of materials.

ESTIMATED ERROR:

δc_1/ppm   See ranges in table above.
δT/K   Not given.

REFERENCES:

1. Kimura, Y.; Miller, V. L.
   Anal. Chim. Acta <u>1962</u>, *27*, 325.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Baltisberger, R. J.; Hildebrand, D.A.; Grieble,D.; Ballintine, T. A. *Anal. Chim. Acta* <u>1979</u>, *111*, 111 - 2.

VARIABLES:	PREPARED BY:
T/K = 303.15	H. L. Clever M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$ T/K	ppb^a	Concentration[b] $10^7 c_1$/mol dm^{-3}	Mole Fraction[b] $10^9 x_1$	Molality[b] $10^7 m_1$/mol kg^{-1}
30 303.15	63 ± 2^c	$3.1_4 \pm 0.10$	5.6_8	3.1_5

[a] ppb = parts per billion

[b] Calculated by the compiler. The concentration was calculated assuming grams of mercury per 1 x 10⁹ cm³ of solution.

[c] Standard deviation of ten analyses.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The solutions were sparged with nitrogen gas for 45 minutes, a drop of mercury was added, and then the mixture sparged another 30 minutes with nitrogen. Solutions were stirred for 24 hours with a glass-covered stirring bar. Samples of solution were withdrawn by syringe with a maintained nitrogen flow to prevent oxygen diffusion into the solutions.	(1) Mercury. Prepared by distillation from mercury(II) oxide under a N_2 atmoshpere. (2) Water. Triple distilled.

An aliquot of the saturated solution was transferred to a non-reducing cell. The mercury was collected by nitrogen sparging and analyzed by cold vapor atomic absorption. The non-reducing cell was a cell that had never contacted reducing agents. Hg + H_2O was quite prone to oxidation. The presence of Cl^- prevented the disproportionation of any Hg(I).	**ESTIMATED ERROR:** See standard deviation of solubility in water above. **REFERENCES:**

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Okouchi, S.; Sasaki, S. *Bull. Chem. Soc. Jpn.* <u>1981</u>, *54*, 2513 - 4. *Report of the College of Engineering of Hosei University* <u>1983</u>, *(No. 22)*, 55 - 106.
VARIABLES: T/K = 278.15 - 313.15	PREPARED BY: H. L. Clever M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration[a] 10^7c_1/mol dm^{-3}	Mole Fraction 10^9x_1	Molality[a] 10^7m_1/mol kg^{-1}
5	278.15	2.2	3.9	2.2
10	283.15	2.3	4.2	2.3
20	293.15	2.7	4.8	2.7
25	298.15	3.0	5.4	3.0
30	303.15	3.2	5.8	3.2
40	313.15	4.1	7.4	4.1

[a]Calculated by compilers.

Dr. S. Okouchi kindly provided the experimental mole fraction solubility values which did not appear in the original papers.

The authors fitted the data to the following equation:

$$\log x_1 = -147.56 + 5581.3/(T/K) + 48.723\log(T/K)$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Solubility experiments were conducted by shaking the solvent with a drop of mercury for 24 hours in a thermostat. Separate experiments showed the mercury concentration remained constant after 24 hours of shaking. A 0.5 cm³ sample of the equilibrated solution was analyzed by the cold-vapor atomic absorption method. Steps in the procedure included tin(II) chloride reduction, nitrogen bubbling and passage through magnesium perchlorate to dry the Hg vapor. The mercury was determined from the area under the atomic absorption peak at 253.7 nm compared to a calibration curve. In experiments with water, phosphinic acid (0.001 mol) was added to prevent mercury oxidation. Water-hydrocarbon distribution constants of Hg were also directly determined.	(1) Mercury. Purified as did Glew and Hames (ref. 1). (2) Water. Distilled, containing 0.001 mol/dm^{-3} of phosphinic acid to prevent mercury oxidation.
	ESTIMATED ERROR: $\delta T/K$ = ±0.1 $\delta x_1/x_1$ = ±(0.03 - 0.05) (compilers)
	REFERENCES: 1. Glew, D. N.; Hames, D. A. *Can. J. Chem.* <u>1971</u>, *49*, 3114.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	Gjessing, E. T.; Rogne, A. K. G. *Vatten* 1982, *38*, 406 - 8.

VARIABLES:	PREPARED BY:
T/K Not given, assumed to be room temperature.	H. L. Clever

EXPERIMENTAL VALUES:

Temperature	Mercury Solubility			
	Concentration		Mole Fraction	Molality
	$10^6 c_1/g\ dm^{-3}$	$10^7 c_1/mol\ dm^{-3}$	$10^9 x_1$	$10^7 m_1/mol\ kg^{-1}$
"Room"	7	0.3_5	0.6_3	0.3_5
	9	0.4_5	0.8_1	0.4_5
	13^b	0.6_5	1.2	0.6_5

[a] All mercury solubility values calculated by the compiler except values in the left column. The authors labelled the values in the left column as micrograms per liter.

[b] The first two values were measured in distilled water. The third value was measured in an artificial "surface water" without organic material. It contained 5.62 mg dm^{-3} $NaHCO_3$, 1.18 mg dm^{-3} $MgCO_3$, 7.17 mg dm^{-3} $CaSO_4$, and 10.96 mg dm^{-3} $CaCl_2$. The total ionic strength is 6.3 x 10^{-3}.

These measurements appear to give solubility data that are too small. In addition the mercury solubility is greater in the electrolyte solution indicating salting in which is not normal behavior.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The experiment was performed by adding five drops of mercury from a polarographic analyzer to a 500 cm³ sample of water. The samples were placed on a shaking table for 19 hours. The supernatant liquid was analyzed for mercury atomic absorption spectrophotometry (Perkin Elmer 460).	(1) Mercury. Source not given. Stated to be pure mercury. (2) Water. Distilled.
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] Mercury-203; ^{203}Hg; [13982-78-0] (2) Water; H_2O; [7732-18-5]	Hursh, J. B. *JAT, J. Appl. Toxicol.* <u>1985</u>, 5, 327 - 32.

VARIABLES:	PREPARED BY:
T/K = 295, 298	H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Carrier Gas	Ostwald Coefficient[a] L	Mercury Solubility at Equilibrium Vapor Pressure		
$t/°C$	T/K			$10^7 c_1$/mol dm^{-3}[b]	$10^8 x_1$	$10^7 m_1$/mol kg^{-1}
22	295.15	–	(3.05)[c]	2.47	4.49	2.48
25	298.15	N_2	2.79 $\pm$ 0.03(4)	2.88	5.21	2.89

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[a] The Ostwald coefficient is ((ng Hg/mL fluid)/(ng Hg/mL gas)). Given above is the average $\pm$ standard error (number of determinations).

[b] The concentrations were calculated by the compiler for mercury vapor in equilibrium with pure liquid mercury from the vapor pressure evaluation of Ambrose and Sprake (ref. 1). The mercury vapor pressure and vapor concentration used at each temperature are:

T/K	295	298
p_1^0/Pa	19.90	25.62
c_1^0/(ng Hg/mL gas)	16.27	20.73

[c] The Ostwald coefficient in ( ) is not an experimental value. It is an extrapolated value from measurements of the mercury solubility in the water + hemoglobin system. See that data sheet for more details. Ostwald coefficients estimated from data in the mercury + water evaluation by the compiler are 3.22 and 2.75 for 295 and 298 K, respectively.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The equilibrium cell is a 50 mL syringe thermostated in a Dewar flask. A 10 mL liquid sample and a 40 mL carrier gas with Hg vapor sample are drawn into the cell. The cell is turned and rolled on the cylinder axis for 120 to 300 sec. Equilibrium is rapidly attained through the large contact area between liquid and vapor phases. Both the liquid and vapor phases are sampled. The liquid phase is aerated and the Hg adsorbed on Hopcalite. The Hg radioactivity is measured on a liquid scintillation counter. Corrections are applied for the counter efficiency, and for radioactive decay of the Hg. Nitrogen carrier gas was used to prevent oxidation of mercury during the experiment.	(1) Mercury. Prepared by reduction of ^{203}HgCl$_2$. The Hg vapor is swept into a leak-proof Saran bag. (2) Water. Deionized and double distilled.
	ESTIMATED ERROR:
	REFERENCES:
	1. Ambrose, D.; Sprake, C. H. S. *J. Chem. Thermodynam.* <u>1972</u>, 4, 603.