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Volume 29

MERCURY IN LIQUIDS, COMPRESSED GASES, MOLTEN SALTS AND OTHER ELEMENTS

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SOLUBILITY DATA SERIES

Editor-in-Chief
A. S. KERTES

Volume 29

MERCURY IN LIQUIDS, COMPRESSED GASES, MOLTEN SALTS AND OTHER ELEMENTS

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FOREWORD

> *If the knowledge is*
> *undigested or simply wrong,*
> *more is not better*

How to communicate and disseminate numerical data effectively in chemical science and technology has been a problem of serious and growing concern to IUPAC, the International Union of Pure and Applied Chemistry, for the last two decades. The steadily expanding volume of numerical information, the formulation of new interdisciplinary areas in which chemistry is a partner, and the links between these and existing traditional subdisciplines in chemistry, along with an increasing number of users, have been considered as urgent aspects of the information problem in general, and of the numerical data problem in particular.

Among the several numerical data projects initiated and operated by various IUPAC commissions, the *Solubility Data Project* is probably one of the most ambitious ones. It is concerned with preparing a comprehensive critical compilation of data on solubilities in all physical systems, of gases, liquids and solids. Both the basic and applied branches of almost all scientific disciplines require a knowledge of solubilities as a function of solvent, temperature and pressure. Solubility data are basic to the fundamental understanding of processes relevant to agronomy, biology, chemistry, geology and oceanography, medicine and pharmacology, and metallurgy and materials science. Knowledge of solubility is very frequently of great importance to such diverse practical applications as drug dosage and drug solubility in biological fluids, anesthesiology, corrosion by dissolution of metals, properties of glasses, ceramics, concretes and coatings, phase relations in the formation of minerals and alloys, the deposits of minerals and radioactive fission products from ocean waters, the composition of ground waters, and the requirements of oxygen and other gases in life support systems.

The widespread relevance of solubility data to many branches and disciplines of science, medicine, technology and engineering, and the difficulty of recovering solubility data from the literature, lead to the proliferation of published data in an ever increasing number of scientific and technical primary sources. The sheer volume of data has overcome the capacity of the classical secondary and tertiary services to respond effectively.

While the proportion of secondary services of the review article type is generally increasing due to the rapid growth of all forms of primary literature, the review articles become more limited in scope, more specialized. The disturbing phenomenon is that in some disciplines, certainly in chemistry, authors are reluctant to treat even those limited-in-scope reviews exhaustively. There is a trend to preselect the literature, sometimes under the pretext of reducing it to manageable size. The crucial problem with such preselection - as far as numerical data are concerned - is that there is no indication as to whether the material was excluded by design or by a less than thorough literature search. We are equally concerned that most current secondary sources, critical in character as they may be, give scant attention to numerical data.

On the other hand, tertiary sources - handbooks, reference books and other tabulated and graphical compilations - as they exist today are comprehensive but, as a rule, uncritical. They usually attempt to cover whole disciplines, and thus obviously are superficial in treatment. Since they command a wide market, we believe that their service to the advancement of science is at least questionable. Additionally, the change which is taking place in the generation of new and diversified numerical data, and the rate at which this is done, is not reflected in an increased third-level service. The emergence of new tertiary literature sources does not parallel the shift that has occurred in the primary literature.

With the status of current secondary and tertiary services being as briefly stated above, the innovative approach of the *Solubility Data Project* is that its compilation and critical evaluation work involve consolidation and reprocessing services when both activities are based on intellectual and scholarly reworking of information from primary sources. It comprises compact compilation, rationalization and simplification, and the fitting of isolated numerical data into a critically evaluated general framework.

The *Solubility Data Project* has developed a mechanism which involves a number of innovations in exploiting the literature fully, and which contains new elements of a more imaginative approach for transfer of reliable information from primary to secondary/tertiary sources. *The fundamental trend of the Solubility Data Project is toward integration of secondary and tertiary services with the objective of producing in-depth critical analysis and evaluation which are characteristic to secondary services, in a scope as broad as conventional tertiary services.*

Fundamental to the philosophy of the project is the recognition that the basic element of strength is the active participation of career scientists in it. Consolidating primary data, producing a truly critically-evaluated set of numerical data, and synthesizing data in a meaningful relationship are demands considered worthy of the efforts of top scientists. Career scientists, who themselves contribute to science by their involvement in active scientific research, are the backbone of the project. The scholarly work is commissioned to recognized authorities, involving a process of careful selection in the best tradition of IUPAC. This selection in turn is the key to the quality of the output. These top experts are expected to view their specific topics dispassionately, paying equal attention to their own contributions and to those of their peers. They digest literature data into a coherent story by weeding out what is wrong from what is believed to be right. To fulfill this task, the evaluator must cover *all* relevant open literature. No reference is excluded by design and every effort is made to detect every bit of relevant primary source. Poor quality or wrong data are mentioned and explicitly disqualified as such. In fact, it is only when the reliable data are presented alongside the unreliable data that proper justice can be done. The user is bound to have incomparably more confidence in a succinct evaluative commentary and a comprehensive review with a complete bibliography to both good and poor data.

It is the standard practice that the treatment of any given solute-solvent system consists of two essential parts: I. Critical Evaluation and Recommended Values, and II. Compiled Data Sheets.

The Critical Evaluation part gives the following information:

(i) a verbal text of evaluation which discusses the numerical solubility information appearing in the primary sources located in the literature. The evaluation text concerns primarily the quality of data after consideration of the purity of the materials and their characterization, the experimental method employed and the uncertainties in control of physical parameters, the reproducibility of the data, the agreement of the worker's results on accepted test systems with standard values, and finally, the fitting of data, with suitable statistical tests, to mathematical functions;

(ii) a set of recommended numerical data. Whenever possible, the set of recommended data includes weighted average and standard deviations, and a set of smoothing equations derived from the experimental data endorsed by the evaluator;

(iii) a graphical plot of recommended data.

The Compilation part consists of data sheets of the best experimental data in the primary literature. Generally speaking, such independent data sheets are given only to the best and endorsed data covering the known range of experimental parameters. Data sheets based on primary sources where the data are of a lower precision are given only when no better data are available. Experimental data with a precision poorer than considered acceptable are reproduced in the form of data sheets when they are the only known data for a particular system. Such data are considered to be still suitable for some applications, and their presence in the compilation should alert researchers to areas that need more work.

The typical data sheet carries the following information:

(i) components - definition of the system - their names, formulas and Chemical Abstracts registry numbers;
(ii) reference to the primary source where the numerical information is reported. In cases when the primary source is a less common periodical or a report document, published though of limited availability, abstract references are also given;
(iii) experimental variables;
(iv) identification of the compiler;
(v) experimental values as they appear in the primary source. Whenever available, the data may be given both in tabular and graphical form. If auxiliary information is available, the experimental data are converted also to SI units by the compiler.

Under the general heading of Auxiliary Information, the essential experimental details are summarized:

(vi) experimental method used for the generation of data;
(vii) type of apparatus and procedure employed;
(viii) source and purity of materials;
(ix) estimated error;
(x) references relevant to the generation of experimental data as cited in the primary source.

This new approach to numerical data presentation, formulated at the initiation of the project and perfected as experience has accumulated, has been strongly influenced by the diversity of background of those whom we are supposed to serve. We thus deemed it right to preface the evaluation/compilation sheets in each volume with a detailed discussion of the principles of the accurate determination of relevant solubility data and related thermodynamic information.

Finally, the role of education is more than corollary to the efforts we are seeking. The scientific standards advocated here are necessary to strengthen science and technology, and should be regarded as a major effort in the training and formation of the next generation of scientists and engineers. Specifically, we believe that there is going to be an impact of our project on scientific-communication practices. The quality of consolidation adopted by this program offers down-to-earth guidelines, concrete examples which are bound to make primary publication services more responsive than ever before to the needs of users. The self-regulatory message to scientists of the early 1970s to refrain from unnecessary publication has not achieved much. A good fraction of the literature is still cluttered with poor-quality articles. The Weinberg report (in 'Reader in Science Information', ed. J. Sherrod and A. Hodina, Microcard Editions Books, Indian Head, Inc., 1973, p. 292) states that 'admonition to authors to restrain themselves from premature, unnecessary publication can have little effect unless the climate of the entire technical and scholarly community encourages restraint...' We think that projects of this kind translate the climate into operational terms by exerting pressure on authors to avoid submitting low-grade material. The type of our output, we hope, will encourage attention to quality as authors will increasingly realize that their work will not be suited for permanent retrievability unless it meets the standards adopted in this project. It should help to dispel confusion in the minds of many authors of what represents a permanently useful bit of information of an archival value, and what does not.

If we succeed in that aim, even partially, we have then done our share in protecting the scientific community from unwanted and irrelevant, wrong numerical information.

A. S. Kertes

PREFACE

Mercury is a liquid metallic element of many useful applications. It is also an element with properties hazardous to the environment and work place, and corrosive to many materials. A knowledge of the solubility of mercury is useful in addressing problems requiring knowledge of the metal's concentration in the liquids and vapors of our surroundings.

The present volume of the Solubility Series presents all data published through 1986, June on the solubility of liquid mercury in water, aqueous electrolyte and nonelectrolyte solutions, hydrocarbons, alcohols, ethers, halocarbons, and nitrobenzene. The solubility of liquid mercury in molten and solid salts and in other elements is included as well as the solubility (enhanced vapor pressure) of liquid mercury in compressed gases.

The primary data are the solubility of liquid mercury in other liquids. By combining the solubility data with the mercury equilibrium vapor pressure, Henry's constant and Ostwald coefficients can be calculated. The Henry's and Ostwald solubilities not only give the solubility of liquid mercury in the solvent, but can be used to determine the mercury liquid-vapor distribution at pressures less than the equilibrium vapor pressure of liquid mercury. These measures of the solubility have been calculated in the evaluation of the mercury + water system. In principle they could be calculated for all of the mercury + liquid systems. The calculation assumes ideal gas behavior of the mercury vapor which appears to be justified at the low partial pressures usually encountered.

Mercury physical properties needed to convert to Henry's constant and Ostwald coefficients and to carry out other calculations of interest to scientists working with mercury are in the several appendixes. Included in these appendixes are various physical and thermodynamic data from several sources. There are density, vapor pressure, molar volume, enthalpy of vaporization, and solubility parameter of liquid mercury as a function of temperature, and the second viral coefficient of mercuy vapor.

A problem in evaluating the mercury solubility data was the effect of air (oxygen) on mercury. There is evidence that mercury may be oxidized by air in aqueous systems and possibly other systems. The evaluations are prejudiced in favor of workers that either used air (oxygen) free systems or traces of reducing agent to keep the mercury in a reduced state. In some papers it is not clear whether air was excluded or not, and some workers claim the effect of air is negligable. It is a point of some controversy which needs further work. Of course air is usually present in the environment, and the possible continous oxidation of mercury must be taken into account in the study of natural systems.

This volume is intended to compliment Solubility Series Volume 25, METALS IN MERCURY, edited by C. Hirayama, Z. Galus, and C. Guminiski. In the metals in mercury volume the mercury is the solvent for metals, while in the present volume the mercury is the solute in various liquids or gases. Data on a few of the mercury + other element systems may overlap in the two volumes, otherwise they are independent volumes.

We are aware of several on going studies of the solubility of mercury in liquids. There are new studies of the solubility of mercury in water at elevated temperatures and pressures, a redetermination of the solubility of mercury in some hydrocarbons and alcohols, and a projected study of the liquid-vapor distribution of mercury in hydrocarbon systems. The user will need to check for future publications of mercury solubility data to combine with the data summarized here.

H. Lawrence Clever

Atlanta, Georgia
1986, September

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H. Kawahara, T. Yamada, M. Nakamura, T. Tomoda, H. Kobayashi, A. Saijo, Y. Kawata, and S. Hikari *Shika Rikogaku Zassi* 1981, *22*, 295 - 9, published by the Japanese Society for Dental Materials and Devices for the figure on page 100.

L. Haar and J. M. H. Levelt Sengers *J. Chem. Phys.* 1970, *52*, 5069 - 79, published by the American Institute of Physics for figures on pages 191, 193, 194, 196, 198, and 199.

N. B. Vargaftik, Tables on the Thermophysical Properties of Liquids and Gases, 1975, 2nd Ed. (Engl. Transl.) published by the Hemisphere Publishing Co., New York for mercury vapor pressure values tabulated in Appendix IV.

We thank Professor A. F. Voigt, Iowa State University, and Dr. S. Okouchi, Honsei University, for providing the experimental data reported in their papers as equations from linear regressions.

We appreciate the advice and encouragement of colleagues associated with IUPAC Commission V.8. Especially Steven Kertes, Mark Salomon, and Allan Barton, all of whom took and early interest in the preparation of the volume, and Colin Young who prepared the indexes. Although the present project had no outside support, it was initiated from the literature search for a project on the solubility of sparingly soluble mercury salts supported by the Office of Standard Reference Data of the US National Bureau of Standards. We are greatful for that support.

Last, but not least, I want to express my appreciation to Marian Iwamoto who helped compile the data, recalculated many solubility values, carried out numerous linear regressions, prepared figures, and then with a NEC APC III computer, WordStar, and a NEC Spinwriter typed and printed the camera ready manuscript.

HLC

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, $c_1/\mathrm{mol\ dm^{-3}}$, molality, $m_1/\mathrm{mol\ kg^{-1}}$, mole fraction, x_1, Henry's constant in the two units $(p_1/\mathrm{kPa})/(m_1/\mathrm{mol\ kg^{-1}})$ and $(p_1/\mathrm{kPa})/(x_1)$, and the Ostwald coefficient, $(c_1(\mathrm{liq})/\mathrm{mol\ dm^{-3}})/(c_1(\mathrm{gas})/\mathrm{mol\ dm^{-3}})$. 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, $c_1/\mathrm{mol\ dm^{-3}}$. 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 $(\mathrm{d}\ \ln f/\mathrm{d}p)_T = V/RT$ and assuming ideal gas behavior.

Table 2. Solubility of Mercury in Water Summary.

							Mercury Vapor		
T/K	$10^7\ c_1$/mol dm^{-3}	$10^7\ m_1$/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)	p_1/kPa	c_1/mol dm^{-3}	Ref
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	$10^7\ c_1$/mol dm^{-3}	$10^7\ m_1$/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 p_1/kPa	Mercury Vapor c_1/mol dm^{-3}	Ref
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}	
	c_1/mol dm^{-3}	m_1/mol kg^{-1}	$10^3\ x_1$						
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)

							Mercury Vapor		
T/K	c_1/mol dm^{-3}	m_1/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/mol dm^{-3}	Ref
776.15	0.0347	0.0667	1.202	16.3	90.3	0.206	1085.0	0.1681	10
	$10^7\ c_1$/mol dm^{-3}	$10^7\ m_1$/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^{-2}	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	Pure Mercury Vapor Pressure	Mercury Vapor Pressure At Total Pressure	Mercury Concentration In Vapor	Mercury Concentration In Liquid	Ostwald Coefficient	Water Density
	p_t/MPa	p_1/kPa	p_1/kPa	$c_1(g)$/mol dm^{-3}	$c_1(l)$/mol dm^{-3}	L	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:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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1986, 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:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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1986, July

CRITICAL EVALUATION:

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	$10^8 x_1$
273.15	2.53
278.15	2.92
283.15	3.37
288.15	3.89
293.15	4.49
298.15	5.18
303.15	5.98
308.15	6.91
313.15	7.97
318.15	9.20
323.15	10.6
328.15	12.2
333.15	14.1
338.15	16.3
343.15	18.7
348.15	21.6
353.15	24.8
358.15	28.5
363.15	32.8
368.15	37.6
373.15	43.2
378.15	49.6
383.15	56.8
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 $(K/(\text{kPa kg mol}^{-1})) = (p_1/\text{kPa})/(m_1/\text{mol kg}^{-1})$ and $(K'/\text{kPa}) = (p_1/\text{kPa})/x_1$. 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 $\ln(K/\text{kPa kg mol}^{-1})$ vs. $1000/(T/\text{K})$. 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

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

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 = $(c_1(\mathrm{liq})/\mathrm{mol\ dm^{-3}})/(c_1(\mathrm{gas})/\mathrm{mol\ dm^{-3}})$.

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:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

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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

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

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 coefficient 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 coefficient 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 calculated 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 concentration 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.

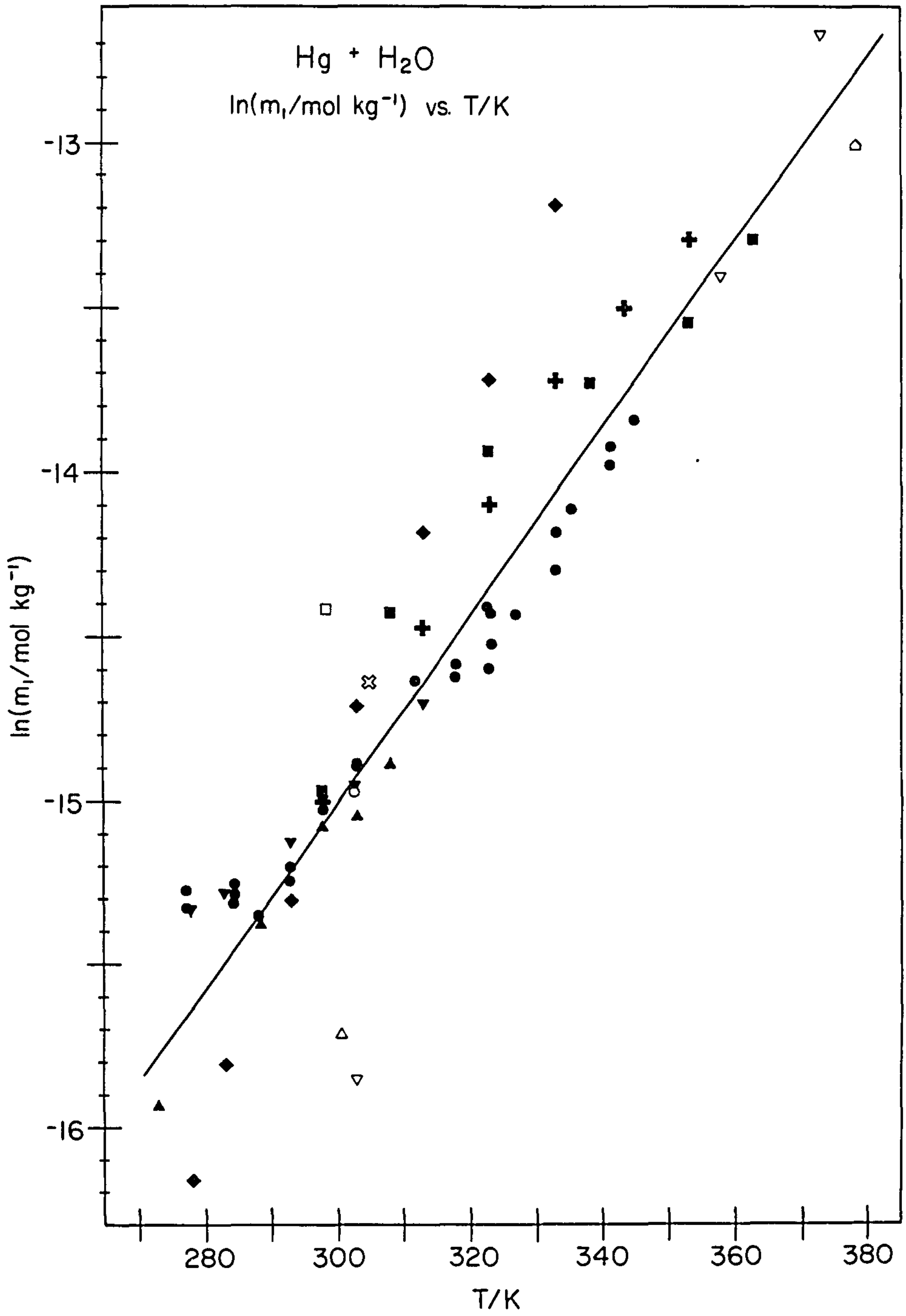

Figure 1. Mercury + Water, ln m vs. *T* (273 to 383 K).

◇ Reichardt and Bonhoeffer (ref. 2)

▽ Stock *et al.* (ref. 3)

△ Pariaud and Archinard (ref. 4)

■ Choi and Tuck (ref. 6)

□ Kuntz and Mains (ref. 7)

▲ Spencer and Voigt (ref. 8)

○ Baltisberger *et al.* (ref. 15)

● Glew and Hames (ref. 9)

✚ Onat (ref. 11)

◆ Sanemasa (ref. 12)

⌂ Sorokin *et al.* (ref. 13)

✣ Kawakara *et al.* (ref. 14)

▼ Okouchi and Sasaki (ref. 16)

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

H. Lawrence Clever
Chemistry Department
Emory University
Atlanta, Georgia 30322 USA

1986, July

CRITICAL EVALUATION:

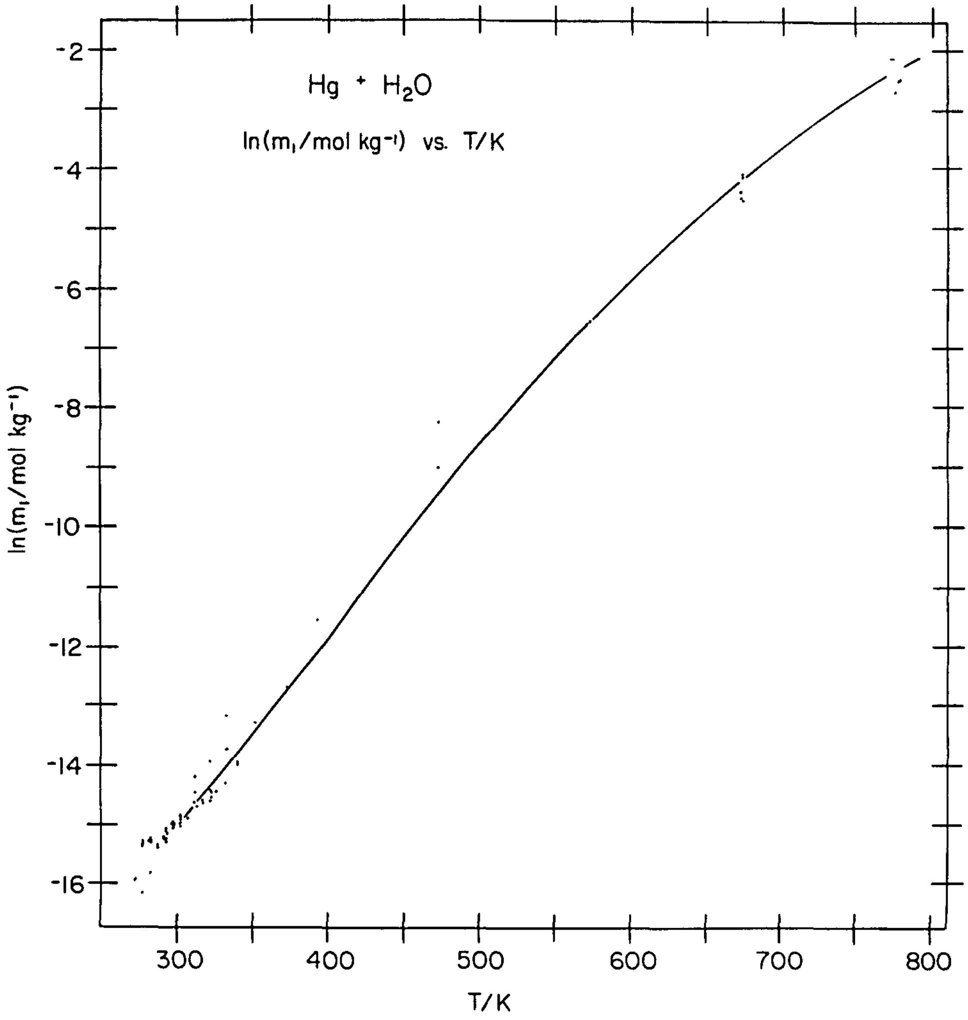

Figure 2. Mercury + Water, ln m vs. *T* (273 to 773 K).

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).

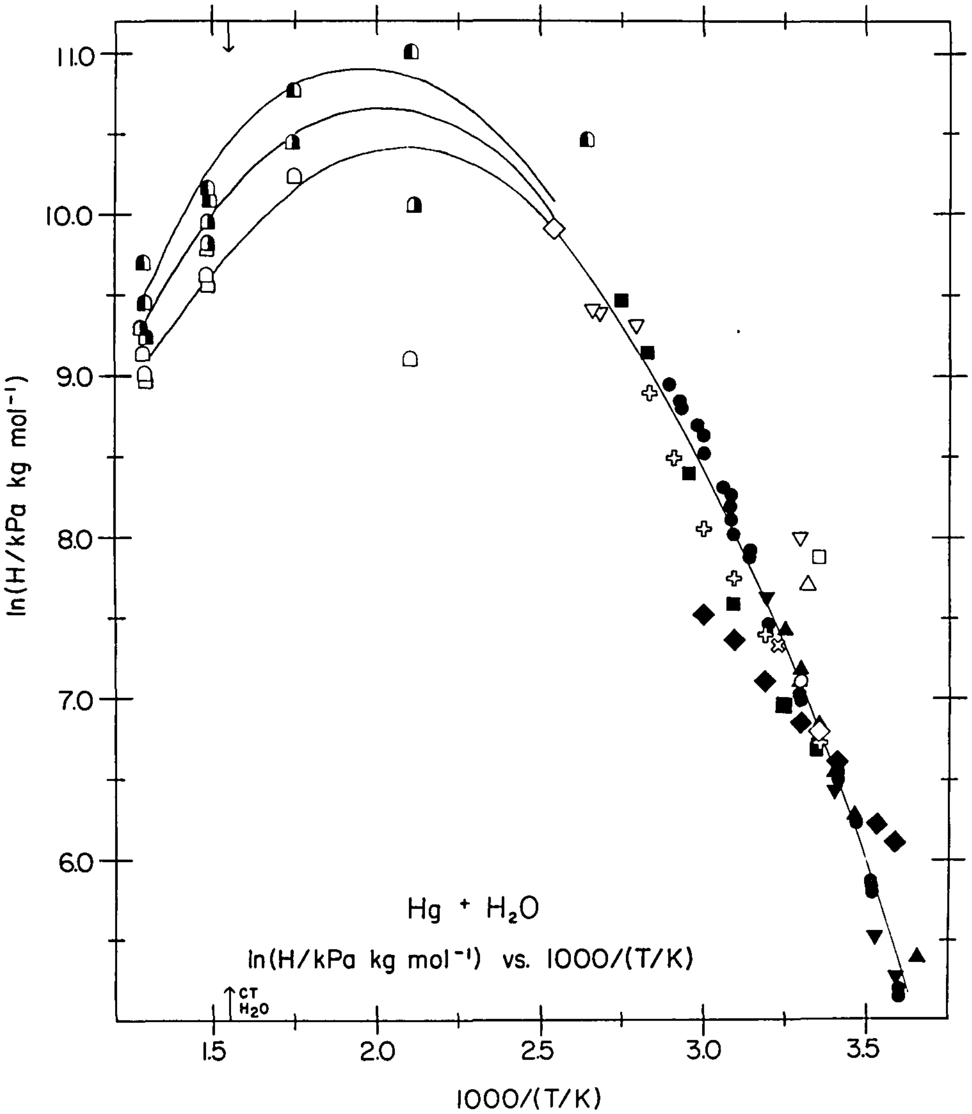

Figure 3. Mercury + Water, Henry's constant. $\ln(K/(\mathrm{kPa\ kg\ mol^{-1}}))$ vs. $1000/(T/\mathrm{K})$.

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_2O; [7732-18-5]	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1986, July

CRITICAL EVALUATION:

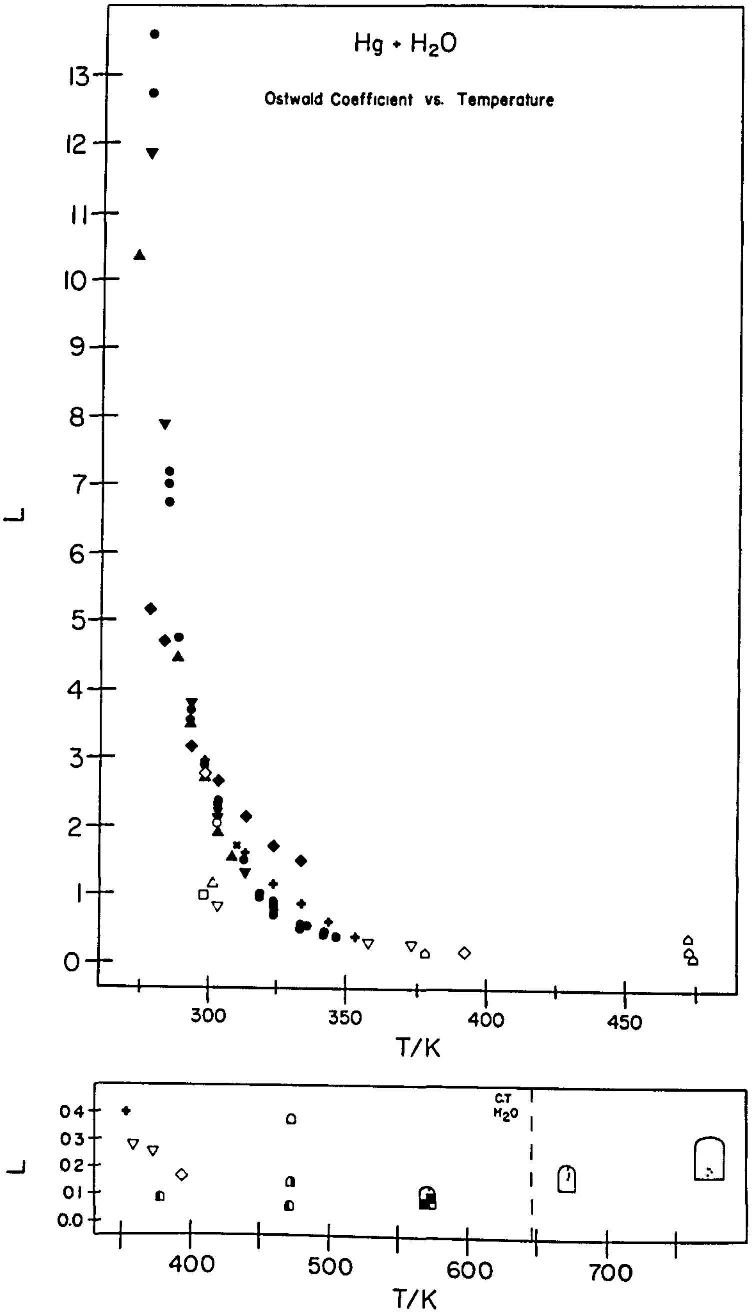

Figure 4. Mercury + Water, Ostwald coefficient, L vs. Temperature, *T*/K.

The 350 to 773 K temperature range is shown on an expanded scale. Same symbol key as Figure 1.

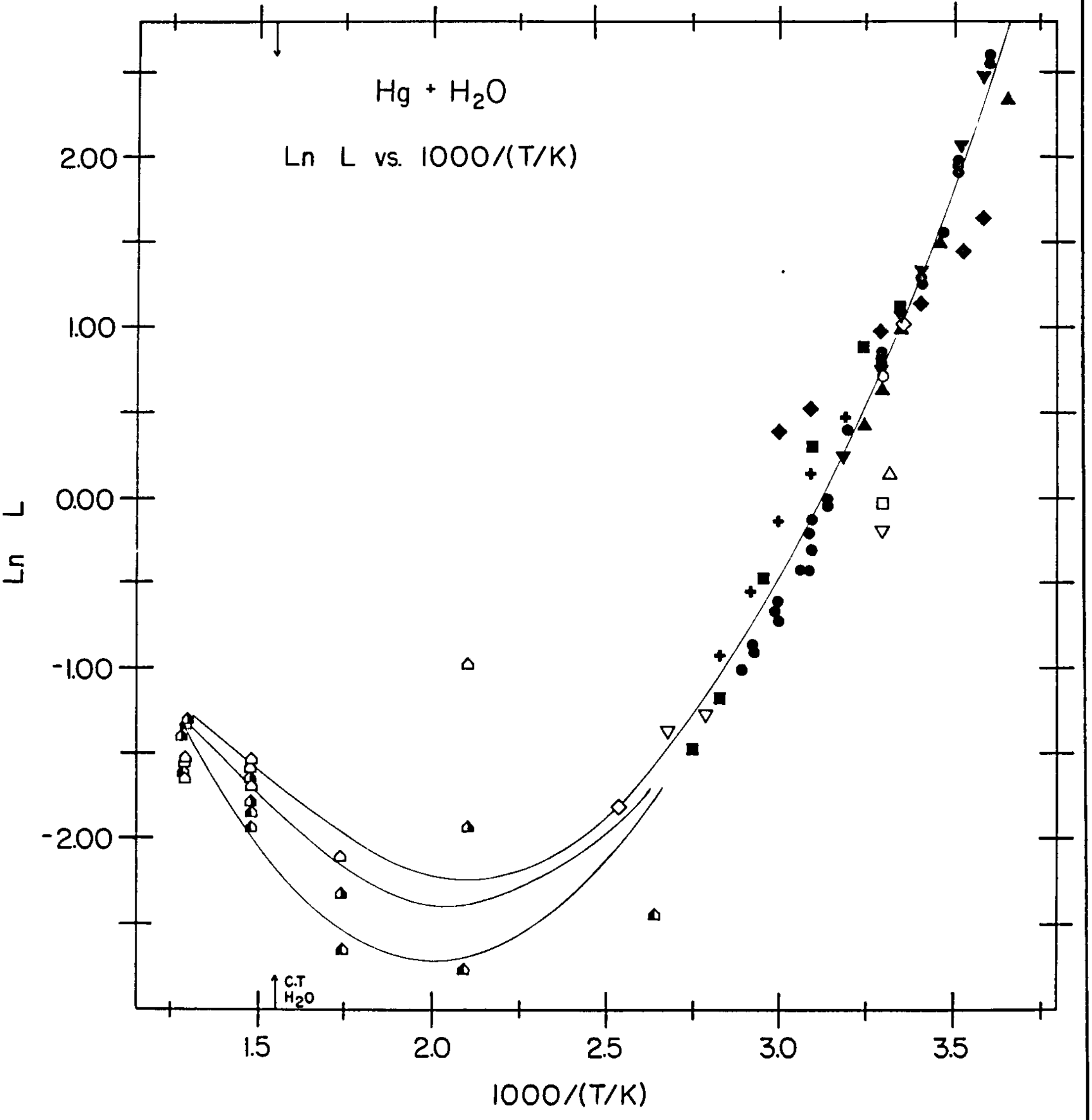

Figure 5. Mercury + Water, ln L vs. 1000/(*T*/K).

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.

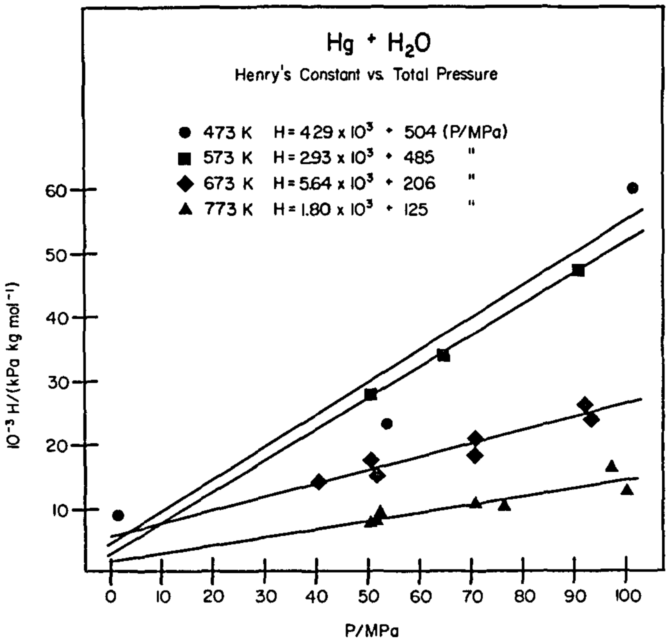

Figure 6. Mercury + Water, Henry's constant vs. Total pressure.

Evidence of a different pressure dependence of the Henry's constant above and below the water critical temperature of 647 K.

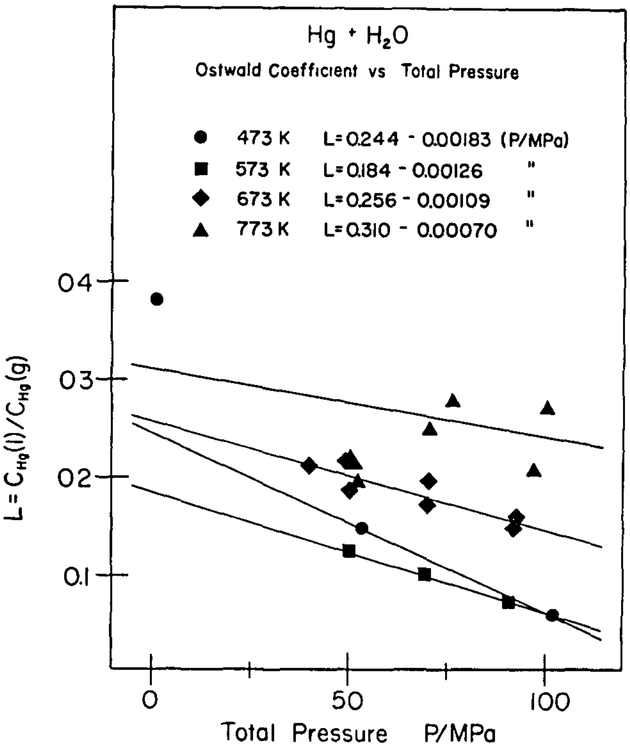

Figure 7. Mercury + Water, Ostwald coefficient vs. Total pressure.

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

CRITICAL EVALUATION:

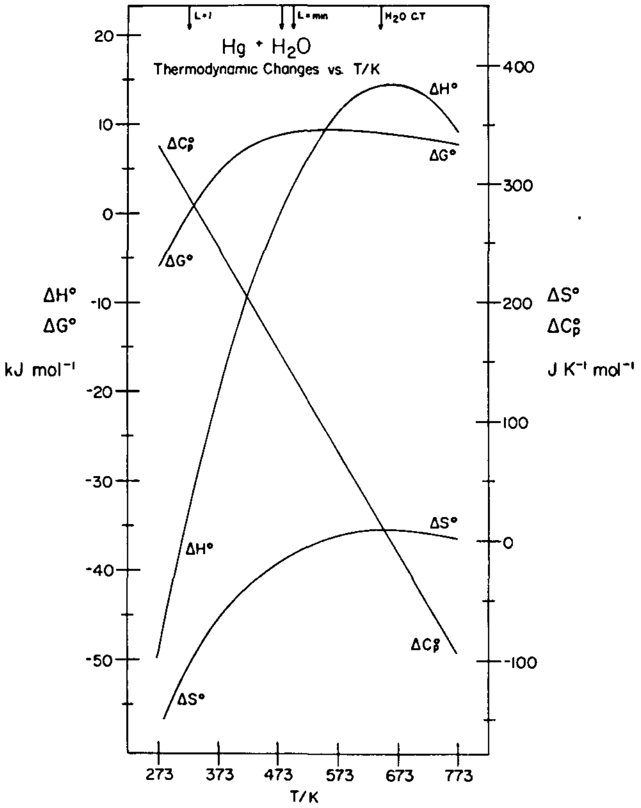

Figure 8. Mercury + Water.

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_2O; [7732-18-5]	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1986, July

CRITICAL EVALUATION:

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COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

Addendum I

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}		$10^8 x_1$		$L = c_1(\text{liq})/c_1(\text{gas})$	
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}		$(5.42 \pm 0.22) \times 10^{-8}$ 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 dm³ 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 dm³ of water in kg. At the lower temperatures this difference is negligible. For example at 298.15 K the recommended values are 862 kPa dm³ 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 dm³ 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

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

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 temperature 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

$$\mathrm{Hg(aq,\ hyp\ 1\ mol\ dm^{-3})} = \mathrm{Hg(g,\ 1\ kPa)} + \mathrm{H_2O(liq)}$$

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:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Christoff, A.

Z. Phys. Chem. 1908, *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	$10c_1/\text{mg dm}^{-3}$	$10^7c_1/\text{mol dm}^{-3}$
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:

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.

SOURCE AND PURITY OF MATERIALS:

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:	PREPARED BY:
$T/K = 313.15 - 336.15$	H. L. Clever M. Iwamoto

EXPERIMENTAL VALUES:

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

[a] Calculated by compilers.

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

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) Water. No information given.

ESTIMATED ERROR:

$\delta c_1/\text{mg dm}^{-3} = \pm(0.1 - 0.2)$

REFERENCES:

1. Bonhoeffer, K. F.; Reichardt, H. *Naturwissenshaften* 1929, *17*, 933.

2. Reichardt, H.; Bonhoeffer, K. F. *Z. Electrochem.* 1930, *36*, 753.

COMPONENTS: (1) Mercury; Hg; [7439-97-6] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Stock, A.; Cucuel, F.; Gerstner, F.; Kohle, H.; Lux. H. *Z. Anorg. Allgem. Chem.* 1934, *217*, 241 - 53.
VARIABLES: $T/K = 303.15 - 373.15$	PREPARED BY: S. H. Johnson M. Iwamoto H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility			
			Concentration[a]	Mole Fraction[a]	Molality[a]
$t/°C$	T/K	$10^{-1}c_1/\text{mg dm}^{-3}$	$10^7c_1/\text{mol dm}^{-3}$	10^9x_1	$10^7m_1/\text{mol kg}^{-1}$
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: Electrodeposition on a copper wire.	SOURCE AND PURITY OF MATERIALS: (1) Mercury. (2) Water. Distilled.
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

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	10^6c_1/g dm^{-3}	10^7c_1/mol dm^{-3}	10^9x_1	10^7m_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:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Electroanalytically pure.

(2) Water. Triply distilled and degassed.

ESTIMATED ERROR:

See uncertainty in table above.

REFERENCES:

COMPONENTS:

(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]

ORIGINAL MEASUREMENTS:

Moser, H. C.; Voigt, A. F.

J. Am. Chem. Soc. 1957, *79*, 1837 - 9.

VARIABLES:

T/K = 298.15

PREPARED BY:

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}	10^7c_1/mol dm^{-3}	10^9x_1	10^7m_1/mol kg^{-1}
25.0	298.15	0.1	0	3.0 ± 0.3	5.4	3.0
		0.01	0.01	2.9 ± 0.1	5.2	2.9
		0.001	0.01	3.0 ± 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

$Hg_2^{2+}(aq) = Hg(l) + Hg^{2+}(aq)$ K = 0.0060 - 0.0120 (Literature)

to estimate the disproportionation constant in aqueous solution of

$Hg_2^{2+}(aq) = Hg(aq) + Hg^{2+}(aq)$ K = (1.9 - 3.6) x 10^{-9}.

The authors' distribution study resulted in a slightly larger value of (5.3 - 5.6) x 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 x 10^{-7}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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).

SOURCE AND PURITY OF MATERIALS:

(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* 1957, *ISC-892*.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Choi, S. S.; Tuck, D. G.

J. Chem. Soc. <u>1962</u>, 4080 - 8.

VARIABLES:

T/K = 298.15 - 363.15

PREPARED BY:

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] $10^9 x_1$	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:

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].

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 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 x 10^{-9} of Hg.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Johnson Matthey and Co. Spectroscopically pure, sodium impurity 1 ppm.

(2) Water. Distilled three times, deoxygenated in an air free system.

ESTIMATED ERROR:

See authors probable error on mean values in table above.

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kuntz, R. R.; Mains, G. J.

J. Phys. Chem. 1964, *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 $10^7 c_1/\text{mol dm}^{-3}$	Mole Fraction^a $10^9 x_1$	Molality^a $10^7 m_1/\text{mol kg}^{-1}$
25	298.15	1	1.8	1

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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 $\varepsilon_{2560} = 7.35 \times 10^3 \text{ dm}^3 \text{ mol}^{-1} \text{ cm}^{-1}$ at 25°C. The value was used to calculate the solubility in the other solvents.

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) Water. No information given.

ESTIMATED ERROR:

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

T/K = 273.15 - 308.15

PREPARED BY:

S. H. Johnson
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H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$	T/K^a	Concentration $10^7 c_1$/mol dm^{-3}	Mole Fraction^a $10^9 x_1$	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:

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.

SOURCE AND PURITY OF MATERIALS:

(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:

$\delta T/K = \pm 0.1$; See random error reported by authors with concentration values above.

REFERENCES:

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.* 1971, *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 $10^9 x_1$	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:

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

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.* 1971, *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, $H/\text{atm} = (p_1/\text{atm})/x_1$, were obtained from the same experimental solubility values and mercury vapor pressures from the equation of Douglas, Ball and Ginnings (ref. 5).

Temperature $t/°C$	 T/K	Mole Fraction 10^9x_1	Standard Deviation σ	Henry's Constant $H/\text{atm} = (p_1/\text{atm})/x_1$	Standard Deviation 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:

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

and

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Glew, D. N.; Hames, D. A.

Can. J. Chem. 1971, *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 cm^3 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_2SO_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.* 1931, *67*, 780.

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

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

4. Choi, S. S.; Tuck, D. G. *J. Chem. Soc.* 1962, 4080.

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

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sorokin, V. I.

Dokl. Akad. Nauk SSSR 1973, *213(4)*, 852 - 5.

**Dokl. Chem. (Engl. Transl.)* 1973, *213*, 905 - 8.

VARIABLES:

T/K = 571.15 - 780.15
p/MPa = 40.5 - 100.3

PREPARED BY:

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:

The 50 cm³ reaction vessel and the 5 cm³ 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.

SOURCE AND PURITY OF MATERIALS:

(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:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Onat, E.

J. Inorg. Nucl. Chem. 1974, *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	$10^9 x_1$	$10^7 m_1$/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 x 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:

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.

SOURCE AND PURITY OF MATERIALS:

(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.* 1951, 1438.
2. Palmer, W. G. *Experimental Physical Chemistry*, C. U. P., Cambridge, 1949, p. 203.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sanemasa, I.

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

VARIABLES:

T/K = 278.15 - 333.15

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Henry's constant	Mercury Solubility		
$t/°C$	T/K	K/atm	Concentration $10^6c_1/g\ dm^{-3}$	Mole Fraction[a] 10^9x_1	Molality[a] $10^7m_1/mol\ kg^{-1}$
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:

$$\begin{aligned}\ln(K/\text{atm}) &= \ln((P_1/\text{atm})/x_1)\\ &= -1078/(T/K) + 6.250\end{aligned}$$

The enthalpy of solution:

$$\Delta H/\text{kcal mol}^{-1} = 5.3$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(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 1962, *27*, 325.

2. Omang, S. H.
Anal. Chim. Acta 1971, *53*, 415.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sorokin, V. I.; Alekhin, Yu. V.; Dadze, T. P.

Ocherki Fiz.-Khim. Petrol. 1978, *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:

These are assumed to be similar to that described in the authors earlier work (ref. 1).

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

1. Sorokin, V. I. *Dokl. Akad. Nauk SSSR* 1973, *213(4)*, 852 - 5.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.;
Ishizaki, N.; Yamada, T.;
Kawamoto, T.; Hikari, S.;
Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/K = 310.15$
$pH = 7.2 \pm 0.1$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Shaking Time	Mercury[a]			
t/days	ppm[b]	Concentration $10^7 c_1$/mol dm^{-3}	Mole Fraction $10^9 x_1$	Molality $10^7 m_1$/mol kg^{-1}
1	$0.020 \le 0.045 \le 0.070$	2.2 ± 1.0		
3	$0.025 \le 0.060 \le 0.096$	3.0 ± 1.4		
5	$0.078 \le 0.086 \le 0.090$	4.2 ± 0.2		
5	$0.078 \le 0.087 \le 0.095$	4.3 ± 0.3		
5	$0.070 \le 0.095 \le 0.120$	4.7 ± 1.0		
		4.4 ± 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 ± 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.
$\delta T/K$ Not given.

REFERENCES:

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Baltisberger, R. J.; Hildebrand, D.A.; Grieble, D.; Ballintine, T. A.

Anal. Chim. Acta 1979, *111*, 111 - 2.

VARIABLES:

T/K = 303.15

PREPARED BY:

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 10^9 cm^3 of solution.

[c] Standard deviation of ten analyses.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

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).

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Prepared by distillation from mercury(II) oxide under a N_2 atmoshpere.

(2) Water. Triple distilled.

ESTIMATED ERROR:

See standard deviation of solubility in water above.

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

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.

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:

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 cm^3 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.

SOURCE AND PURITY OF MATERIALS:

(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:

$\delta T/K = \pm 0.1$
$\delta x_1/x_1 = \pm(0.03 - 0.05)$ (compilers)

REFERENCES:

1. Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1971, *49*, 3114.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gjessing, E. T.; Rogne, A. K. G.

Vatten 1982, *38*, 406 - 8.

VARIABLES:

T/K Not given, assumed to be room temperature.

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature	Mercury Solubility			
	Concentration		Mole Fraction	Molality
	10^6c_1/g dm^{-3}	10^7c_1/mol dm^{-3}	10^9x_1	10^7m_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:

The experiment was performed by adding five drops of mercury from a polarographic analyzer to a 500 cm^3 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).

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Stated to be pure mercury.

(2) Water. Distilled.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Hursh, J. B.

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

VARIABLES:

T/K = 295, 298

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Carrier Gas	Ostwald Coefficient[a]	Mercury Solubility at Equilibrium Vapor Pressure[b]		
t/°C	T/K		L	$10^7 c_1$/mol dm^{-3}	$10^9 x_1$	$10^7 m_1$/mol kg^{-1}
22	295.15	-	(3.05)[c]	2.47	4.49	2.48
25	298.15	N_2	2.79 ± 0.03(4)	2.88	5.21	2.89

[a] The Ostwald coefficient is ((ng Hg/mL fluid)/(ng Hg/mL gas)). Given above is the average ± 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°/Pa	19.90	25.62
c_1°/(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:

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.

SOURCE AND PURITY OF MATERIALS:

(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.* 1972, *4*, 603.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Sea water

ORIGINAL MEASUREMENTS:

Sanemasa, I.

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

VARIABLES:

$T/K = 278.15 - 303.15$

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility	
$t/°C$	T/K	Sea water $10^6 c_1/g\ dm^{-3}$	Water $10^6 c_1/g\ dm^{-3}$
5	278.15	17.2	19.2
10	283.15	23.6	27.4
15	288.15	31.6	
20	293.15	40.6	45.0
25	298.15	54.9	63.9
30	303.15	69.7	81.3

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Metallic mercury purified by distillation under reduced pressure.

(2) Sea water.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$

$\delta 10^6 c_1/g\ dm^{-3} = \pm 0.1$

REFERENCES:

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

2. Omang, S. H. *Anal. Chim. Acta* 1971, *53*, 415.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Aqueous Electrolyte and Nonelectrolyte Solutions	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1986, June

CRITICAL EVALUATION:

An Evlauation of the Solubility of Mercury in Aqueous Electrolyte and Nonelectrolyte Solutions.

The solubility of metallic mercury in aqueous elctrolyte solutions has been reported in seven papers. Not enough workers have measured the solubility of mercury in any one electrolyte system over common ranges of temperature and electrolyte concentration to recommend solubility values. Most of the available data are classed as tentative values. Some mercury nonelectrolyte + water systems are included in the section.

The solubility values have been converted to Sechenov salt effect parameters in order to have a common basis of comparison of the effect of the electrolyte on the mercury solubility. The notation used for the Sechenov salt effect parameter is discussed in detail in Solubility Series Volume 10, pp. xxix to xlii. Most of the mercury solubility data are given in one of two forms:

$$k_{scc}/\mathrm{dm^3\ mol^{-1}} = (1/(c_2/\mathrm{mol\ dm^{-3}}))\ \log(c^\circ_{1,\mathrm{sat}})/(c_{1,\mathrm{sat}})$$

and

$$k_{smm}/\mathrm{kg\ mol^{-1}} = (1/(m_2/\mathrm{mol\ kg^{-1}}))\ \log(m^\circ_{1,\mathrm{sat}})/(m_{1,\mathrm{sat}})$$

where subscripts 1 and 2 refer to mercury and electrolyte, respectively, and the superscript "o" refers to the mercury solubility in pure water.

The Sechenov salt effect parameters for the mercury containing systems are of a similar magnitude to the parameters for typical nonelectrolyte gas, liquid, and solid solutes. The mercury salt effect parameters are probably of a larger uncertainty than for other solutes because the mercury solubility values are of larger uncertainty. Some of the same electrolytes that salt-in typical solutes also salt in mercury. For example tetramethylammonium bromide, tetraethylammonium bromide and sodium thiocyanate. The change in the sign of the salt effect parameter with temperature observed for other solutes is also observed for mercury. The k_{smm} value of sodium chloride changes sign at 324 K from salting-out to salting-in as the temperature increases.

Alpha amino acids and some of their hydrochlorides are included in this section. They appear to abnormally "salt-in" at very low concentrations. All of these data come from one paper, and it would be desirable to have these systems studied further.

Most of the salt effect data come from three papers. These three papers deserve some special comments. Glew and Hames (ref. 2) measured the solubility of mercury in water and in 6.1 mol kg^{-1} NaCl solution from 278 to 343 K under oxygen free conditions in the presence of trace amounts of reducing agent. The study appears to be a carefully executed experiment and the results are considered to be reliable. The results are compatible with the results of Chviruk and Koneva (ref. 3) who measured the solubility of mercury at four temperatures in 3.42 mol dm^{-3} sodium chloride.

Sanemasa, Haraguchi, and Nagai (ref. 6) measured the solubility of mercury as a function of electrolyte concentration up to one mol dm^{-3} at 298.15 K. The data appears to be internally consistent and the salt effect parameters of the expected magnitude. The evaluator does have some doubts about the method used by the authors. The method does not exclude air, and it seems the times used to establish both liquid mercury liquid-vapor equilibrium and mercury aqueous solution equilibrium are very short. These problems were discussed in more detail in the mercury + water evaluation. However, the 293 - 303 K mercury solubility values in water agree well with the results of other studies. We believe the salt effect data at 298.15 K are reliable.

Kawakara *et al.* (ref. 5) report the mercury solubility values in the alpha-amino acid and alpha amino acid hydrochloride solutions in water and in Hanks' balanced salt solutions (composition given on p. 87). For many of these systems the mercury solubility is four to seven times larger in the presence of only 0.0002 to 0.01 mol dm^{-3} amino acid or its hydrochloride than it is in pure water. It is not clear why there should be such a large enhancement of solubility in these solutions. It is not clear whether or not oxygen was rigously excluded, or if some chemical interaction might be involved. The results are classed as tentative, but the systems deserve further study.

The individual systems are discussed below. The systems are given in the order of the standard arrangement for inorganic compounds used by the US National Bureau of Standards publications. The number before each system is the standard order number for the cation. The amino acid, amino acid hydrochlorides, and nonelectrolyte systems are at the end.

1 Mercury + Hydrochloric acid [7647-01-0] + Water

Baltisberger *et al.* (ref. 4) report the only salt effect parameter for the system. The k_{scc} = 0.072 at 296.15 K is classed tentative.

18(1) Mercury + Ammonium nitrate [6484-52-2] + Water

Tammann (ref. 1) reports no quantitative data.

18(2) Mercury + Tetramethylammonium bromide [64-20-0] + Water
18(3) Mercury + Tetraethylammonium bromide [71-91-0] + Water

Sanemasa *et al.* (ref. 6) measured the solubility of mercury in four solutions of different tetraalkylammonium bromide concentrations at 298.15 K. Mercury is salted in by both salts. The salt effect parameters below are classed tentative.

Electrolyte	k_{scc}	k_{scx}
Tetramethylammonium bromide	-0.0779	-0.112
Tetraethylammonium bromide	-0.116	-0.176

35 Mercury + Mercury (II) sulfide [1344-48-5] + Water
Mercury + Cinnabar [19122-79-3] + Water

Mukimova and Bykovskaya (ref. 11) experimentally determined the mercury solubility from mercury containing cinnabar in distilled and natural waters in contact with shales and carbonate rocks. This is not a real salt effect study, but a study of a natural system. According to the abstract the mercury dissolves in concentration of (0.2 - 2) x 10^{-6} g dm^{-3}. The original paper was not available.

96 Mercury + Barium chloride [10361-37-2] + Water

Sanemasa *et al.* (ref. 6) measured the solubility of mercury in solutions of 0.250, 0.500, and 0.750 molar barium chloride at 298.15 K. The mercury is salted out. The salt effect parameters are:

$$k_{scc}/dm^3\ mol^{-1} = 0.115$$
$$k_{scx}/dm^3\ mol^{-1} = 0.121$$

The values are smaller than expected for a 2-1 electrolyte. They are classed tentative, but should be used with caution.

99(1) Mercury + Sodium fluoride [7681-49-4] + Water

Sanemasa *et al.* (ref. 6) measured the solubility of mercury in solutions of 0.250, 0.500, and 0.750 molar sodium fluoride at 298.15 K. The mercury is salted out. The salt effect parameters are:

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Aqueous Electrolyte and Nonelectrolyte Solutions	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1986, June

CRITICAL EVALUATION:

$$k_{scc}/\text{dm}^3\ \text{mol}^{-1} = 0.157$$
$$k_{scx}/\text{dm}^3\ \text{mol}^{-1} = 0.174$$

The values are classed as tentative.

99(2) Mercury + Sodium chloride [7647-14-5] + Water

Glew and Hames (ref. 2), Chviruk and Koneva (ref. 3), Baltisberger *et al.* (ref. 4), Sanemasa *et al.* (ref. 6), and Hursh (ref. 7) report the solubility of mercury in aqueous solutions of sodium chloride. The salt effect parameters from the five papers are given in the following table.

T/K	Salt effect parameter, k_{scc}					k_{smm}
	Chviruk, Koneva (ref. 3)	Baltisberger *et al.* (ref. 4)	Sanemasa *et al.* (ref. 6)	Hursh (ref. 7)	Glew and Hames (ref. 2)	
273.2						0.112
278.2						0.095
283.2					(0.099)	0.080
288.2						0.065
293.2	0.119					0.053
295.2				0.54		-
296.2		0.70, 0.22				-
298.2			0.079			0.041
303.2						0.031
308.2					(0.056)	0.022
313.2	0.051					0.014
318.2						0.007
323.2					(0.027)	0.001
328.2						-0.004
333.2	0.000					-0.009
338.2						-0.013
343.2					(0.000)	-0.015
348.2						
353.2	-0.041					

The k_{smm} values of Glew and Hames are the authors' smoothed values. The values in ( ) are k_{scc} values calculated by the evaluator from the Glew and Hames results. The other values are calculated from the individual solubility values. The Baltisberger *et al.* and the Hursh values are for sodium chloride concentrations of 0.01, 0.1, and 0.155 mol dm^{-3}, respectively. Salt effect parameters measured at these low electrolyte concentrations are seldom reliable, and these are classed as doubtful. Chviruk and Koneva did not measure the solubility of mercury in water. The evaluator calculated the salt effect parameters using evaluated mercury solubilities in water. The results agree well with the Glew and Hames results including agreement on a change from salting out to salting in by sodium chloride between 333 K and 343 K. The results of Chviruk and Koneva, Sanemasa *et al.*, and Glew and Hames are classed as tentative. We prefer the use of the Glew and Hames data as a self-consistent data set extending over a 70 degree temperature interval.

Wu and Qi (ref. 10) report a study titled "Solubility factors of elemental mercury, mercury oxides and mercury sulfides". They give data and discuss the effect of chloride ion concentration as well as humic acids and weathered coal fulvic acids on the solubility of Hg, HgO, and HgS. We were unable to obtain a reliable translation of their paper and no data sheet was prepared.

99(3) Mercury + Sodium bromide [7647-15-6] + water
99(4) Mercury + Sodium iodide [7681-82-5] + Water
99(5) Mercury + Sodium perchlorate [7601-89-0] + Water
99(6) Mercury + Sodium sulfate [7757-82-6] + Water
99(7) Mercury + Sodium nitrate [7631-99-4] + Water
99(8) Mercury + Sodium thiocyanate [540-72-7] + Water

Sanemasa, Haraguchi, and Nagai (ref. 6) reported the salt effect parameters for the above sodium salts. They measured the solubility of mercury at four electrolyte concentrations at 298.15 K. The salt effect parameter is taken as the slope of a plot of log (solubility) *vs.* electrolyte concentration. The plot was not forced through the origin. Sodium thiocyanate salts in which has been observed for some other nonelectrolyte solutes. Sodium perchlorate salts out more than the sodium halides which is not the usual trend with other solutes. No data were obtained for the sodium iodide. Use of the iodide ion gave abnormal results possibly due to some chemical reaction with the mercury. Although we have expressed some doubt about the authors' method we believe their data at 298 K are reliable and the values are classed tentative. The salt effect parameters are summarized below.

Salt	k_{scc}	k_{scx}
Sodium bromide	0.017	0.023
Sodium perchlorate	0.117	0.114
Sodium sulfate	0.308	0.319
Sodium nitrate	0.062	0.065
Sodium thiocyanate	-0.035	-0.034

100 Mercury + Potassium chloride [7447-40-7] + Water

Sanemasa *et al.* (ref. 6) measured the solubility of mercury in four concentrations of potassium chloride between 0.250 and 1.000 mol dm^{-3} at 298 K. See section above for comments about method and reliabliity. The results are classed as tentative.

$$k_{scc}/\mathrm{dm^3\ mol^{-1}} = 0.070$$
$$k_{scx}/\mathrm{dm^3\ mol^{-1}} = 0.074$$

Mercury + Alpha-amino acids and hydrochlorides + Water

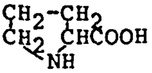
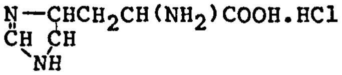
Kawakara *et al.* (ref. 5) have measured the solubility of mercury in water and in Hanks' balanced salt solution in the presence of up to 0.01 mol dm^{-3} alpha-amino acids and some of their hydrochlorides. The solubility of mercury is greater in the presence of the alpha-amino acid component than in either pure water or Hanks' salt solution. Mercury is 2.35 times more soluble in Hanks' balanced salt solution than in water. When alpha-amino acid or hydrochloride is added to either water or balanced salt solution the solubility is often increased by a factor of between four to seven. Salt effect parameters have not been calculated for these systems. The increase in mercuy solubilities are summarized below. The alpha-amino acids are identified by their Chemical Abstracts Registry Number, IUPAC abbreviation, and semiempirical formula.

Alpha-amino acid or Hydrochloride	Solvent	c_2	c_1/c_1°
[56-41-7] Ala $CH_3CH(NH_2)COOH$	water	0.00056	5.9
[56-84-8] Asp $HOOCCH(NH_2)CH_2COOH$	water	0.00045	5.9
[72-19-5] Thr $CH_3CHOHCH(NH_2)COOH$	water	0.00050	7.7

Table continued on next page.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Aqueous Electrolyte and Nonelectrolyte Solutions	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1986, June

CRITICAL EVALUATION:

Alpha-amino acid or Hydrochloride	Solvent	c_2	c_1/c_1°
[147-85-3] Pro 	water	0.00035	5.0
[56-85-9] Gln $HOOCCH(NH_2)CH_2CH_2CONH_2$	water	0.00068	12.4
		0.01	10.6
[63-68-3] Met $CH_3SCH_2CH_2CH(NH_2)COOH$	water	0.00020	1.1
		0.01	4.9
	Hanks'	0.01	2.2
[61-90-5] Leu $(CH_3)_2CHCH_2CH(NH_2)COOH$	water	0.000915	4.2
[73-32-5] Ile $CH_3CH_2CH(CH_3)CH(NH_2)COOH$	water	0.00030	2.6
[63-91-2] Phe $C_6H_5CH_2CH(NH_2)COOH$	water	0.0003	6.2
[60-18-4] Tyr $p\text{-}HOC_6H_4CH_2CH(NH_2)COOH$	water	0.00022	5.9
		0.01	3.1
[52-89-1] Cys.HCl $HSCH_2CH(NH_2)COOH.HCl$	water	0.00000063	19.4
		0.01	908.
	Hanks'	0.01	479.
[645-35-2] His.HCl 	water	0.01	10.8
	Hanks'	0.01	17.3
[3184-13-2] Orn.HCl $NH_2(CH_2)_3CH(NH_2)COOH.HCl$	water	0.01	1.8
	Hanks'	0.01	4.7
[657-27-2] Lys.HCl $NH_2(CH_2)_4CH(NH_2)COOH.HCl$	water	0.00038	1.8
		0.01	1.6
	Hanks'	0.01	5.8
[1119-34-2] Arg.HCl $NH{=}C(NH_2)NH(CH_2)_3CH(NH_2)COOH.HCl$	water	0.00033	4.8
		0.01	3.6
	Hanks'	0.01	1.6

The solubility ratios for the amino acid containing systems in Hanks' balanced salt solution are referenced to the solubility of mercury in the Hanks' balanced salt solution. The superscript "o" in the c_1/c_1° ratio refers to the mercury solubility in either water or Hanks' balanced salt solution.

Several trends show in the data. Solutions containing 0.0002 to 0.0007 mol dm^{-3} amino acid enhance the mercury solubility 4 to 8 times over its solubility in water, but there is a decrease in the ratio when one increases the concentration to 0.01. However, solutions containing methionine, ornithine HCl, or lysine HCl are exceptions to the trend. A compound containing -SH greatly enhances the mercury solubility, but one containing C-S-C does not. Mercury in the presence of alpha amino acid hydrochlorides is more soluble in the Hanks' balanced salt solutions than in the corresponding water solutions. Arginine HCl is an exception.

The reliability of these data is impossible to judge. It is not clear whether or not oxygen was rigoursly excluded, nor is it clear whether or not a direct chemical interaction occurs in some of the systems. These data need confirmation by further experimental studies. For now they are classed as tentative.

Another paper from the same laboratory, Kawahara *et al.* (ref. 9), reports the solubility of mercury from high copper, conventional, and copper dental amalgams in a tissue culture medium (YLH). Data sheets containing the graphical results were prepared (pp. 100 - 1). The data are classed tentative.

Mercury + Humus + Water

Gjessing and Rogne (ref. 8) have measured the solubility of mercury in various natural humus containing waters. They conclude that the presence of humus enhances the solubility of mercury. From our knowledge of the behavior of other humus containing systems we suspect this is true. However, the present study is not conclusive because it reports a mercury solubility in water that is much too small. The data are classed doubtful.

Mercury + Blood and Various Blood Components

Hursh (ref. 7) has measured the solubility of mercury vapor in whole blood, plasma, and aqueous hemoglobin solutions. Care was taken to prevent the oxidation of mercury by the oxygen of the air. The results are consistent with the hemoglobin of whole blood binding up to one-half the mercury dissolved. The experiments appear to have been carefully done, and the results are classed tentative.

REFERENCES:

1. Tammann, G. *Z. Anorg. Allgem. Chem.* 1922, *121*, 275.
2. Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1972, *50*, 3124.
3. Chviruk, A. P.; Koneva, N. V. *Urk. Khim. Zh.* 1975, *41*, 1162; *Sov. Prog. Chem. (Engl. Transl.)* 1975, *41(11)*, 39.
4. Baltisberger, R. J.; Hildebrand, D. A.; Grieble, D.; Ballintine, T. A. *Anal. Chem. Acta* 1979, *111*, 111.
5. Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S. *Shika Rikogaku Zasshi* 1979, *20*, 137.
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7. Hursh, J. B. *JAT, J. Appl. Toxicol.* 1985, *5*, 327.
8. Gjessing, E. T.; Rogne, A. K. G. *Vatten* 1982, *38*, 406.
9. Kawahara, H.; Yamada, T.; Nakamura, M.; Tomoda, T.; Kobayashi, H.; Saijo, A.; Kawata, Y.; Hikara, S. *Shika Rikogaku Zasshi* 1981, *22(60)*, 285; *Chem. Abstr.* 1982, *96*, 91615a.
10. Wu, D.; Qi, S. *Huanjing Kexue* 1984, *5(1)*, 30 - 3; *Chem. Abstr.* 1984, *100*, 161509w.
11. Mukimova, D. S.; Bykovskaya, L. P. *Vopr. Reg. Geol. Petrol. Sredn. Azii* 1975, 148 - 54; *Chem. Abstr.* 1977, *87*, 26346p.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Hydrogen chloride; HCl; [7647-01-0]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Baltisberger, R. J.; Hildebrand, D. A.; Grieble, D.; Ballintine, T. A.

Anal. Chim. Acta 1979, *111*, 111 - 2.

VARIABLES:

T/K = 296.15, 303.15

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Hydrogen chloride	Mercury solubility		Salt Effect Parameter
$t/°C$	T/K	$c_2/\text{mol dm}^{-3}$	ppb[a]	Concentration[c] $10^7 c_1/\text{mol dm}^{-3}$	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$
30	303.15	0	63 ± 2[b]	$3.1_4 \pm 0.10$	-
23	296.15	0.1	59	2.9_4	0.072

[a] ppb = parts per billion.

[b] Standard deviation of ten analyses.

[c] Calculated by compilers. The molar solubility was calculated assuming grams of mercury per 1 x 10^9 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

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).

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Prepared by distillation from mercury(II) oxide under a N_2 atmosphere.

(2) Hydrogen chloride. From analytical grade reagent and solution.

(3) Water. Triple distilled.

ESTIMATED ERROR:

See standard deviation of solubility in water above.

REFERENCES:

COMPONENTS: (1) Mercury; Hg; [7439-97-6] (2) Ammonium nitrate; NH_4NO_3; [6484-52-2] (3) Water; H_2O; [7732-18-5]	**ORIGINAL MEASUREMENTS:** Tammann, G. *Z. Anorg. Allgem. Chem.* 1922, *121*, 275 - 80.
VARIABLES: Room temperature to solution boiling point.	**PREPARED BY:** H. L. Clever

EXPERIMENTAL VALUES:

Tammann confirmed the report of Hodgkinson and Coot [*Chem. News* 1904, *90*, 142] that mercury was insoluble in 50 % aqueous ammonium nitrate. The report is of doubtful value considering present methods of measuring small amounts of mercury.

AUXILIARY INFORMATION

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) N,N,N-Trimethylmethanaminium bromide or Tetramethylammonium bromide; $(CH_3)_4NBr$; [64-20-0]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sanemasa, I.; Haraguchi, K.; Nagai, H.

Bull. Chem. Soc. Jpn. 1981, *54*, 1040 - 3.

VARIABLES:

$T/K = 298.15$
$c_2/\text{mol dm}^{-3} = 0 - 1.00$

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Electrolyte	Solubility Ratio	$\log(c_1^0/c_1)$ at lim	Salt Effect Parameter	
$t/°C$	T/K	$c_2/\text{mol dm}^{-3}$	c_1^0/c_1	$c_2 \to 0$	k_{scc}	k_{scx}
25	298.15	0.250	0.968		-0.056	
		0.500	0.923		-0.070	
		0.750	0.886		-0.070	
		1.00	0.845		-0.073	
				0.0051[a]	-0.0779[a]	-0.112

[a] Authors' values which are the intercept and slope of $\log(c_1^0/c_1)$ vs. c_2.

The other k_{scc} values were calculated by the compiler from:

$$k_{scc} = (1/c_2) \times \log(c_1^0/c_1)$$

The k_{scx} values were calculated by the authors from:

$$k_{scx} = k_{scc} + (0.036 - \Phi \times 10^{-3})/2.30$$

where Φ is the apparent molar volume of the salt. For this system $\Phi/\text{cm}^3\ \text{mol}^{-1} = 114.28$.

The solubility of mercury in water is based on Sanemasa's (ref. 3) earlier determination of 63.9×10^{-6} g dm^{-3}.

Note: $k_{scc}/\text{dm}^3\ \text{mol}^{-1} = (1/(c_2/\text{mol dm}^{-3}))\log(c_1^0/c_1)$; $k_{scx} = (1/c_2)\log(x_1^0/x_1)$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Purified by distillation under reduced pressure.

(2) Tetramethylammonium bromide. Analytical reagent grade. Dried and weighed.

(3) Water. Redistilled water. Both aerated and deoxygenated water were used with no difference.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$10^6 \delta c_1/\text{g dm}^{-3} = \pm 0.1$
$\delta(c_1^0/c_1) = \pm 0.005$

REFERENCES:

1. Kimura, Y.; Miller, V. L. *Anal. Chim. Acta* 1962, *27*, 325.
2. Omang, S. H. *Anal. Chim. Acta* 1971, *53*, 415.
3. Sanemasa, I. *Bull. Chem. Soc. Jpn*. 1975, *48*, 1795.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) N,N,N-Triethylmethanaminium bromide or Tetraethylammonium bromide; $(C_2H_5)_4NBr$; [71-91-0]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sanemasa, I.; Haraguchi, K.; Nagai, H.

Bull. Chem. Soc. Jpn. 1981, *54*, 1040 - 3.

VARIABLES:

T/K = 298.15
c_2/mol dm^{-3} = 0 - 0.995

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Electrolyte	Solubility Ratio	log(c_1^0/c_1) at lim	Salt Effect Parameter	
t/°C	T/K	c_2/mol dm^{-3}	c_1^0/c_1	$c_2 \to 0$	k_{scc}	k_{scx}
25	298.15	0.250	0.933		-0.120	
		0.500	0.870		-0.120	
		0.746	0.812		-0.121	
		0.995	0.766		-0.116	
				-0.0022^a	-0.116^a	-0.176

^{a}Authors' values which are the intercept and slope of log(c_1^0/c_1) vs. c_2.

The other k_{scc} values were calculated by the compiler from:

$$k_{scc} = (1/c_2) \times \log(c_1^0/c_1)$$

The k_{scx} values were calculated by the authors from:

$$k_{scx} = k_{scc} + (0.036 - \Phi \times 10^{-3})/2.30$$

where Φ is the apparent molar volume of the salt. For this system Φ/cm^3 mol^{-1} = 173.83.

The solubility of mercury in water is based on Sanemasa's (ref. 3) earlier determination of 63.9 x 10^{-6} g dm^{-3}.

Note: k_{scc}/dm^3 mol^{-1} = $(1/(c_2/\text{mol dm}^{-3}))\log(c_1^0/c_1)$; $k_{scx} = (1/c_2)\log(x_1^0/x_1)$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Purified by distillation under reduced pressure.

(2) Tetraethylammonium bromide. Analytical reagent grade. Dried and weighed.

(3) Water. Redistilled water. Both aerated and deoxygenated water were used with no difference.

ESTIMATED ERROR:

δT/K = ±0.05
$10^6 \delta c_1$/g dm^{-3} = ±0.1
$\delta(c_1^0/c_1)$ = ±0.005

REFERENCES:

1. Kimura, Y.; Miller, V. L. *Anal. Chim. Acta* 1962, *27*, 325.
2. Omang, S. H. *Anal. Chim. Acta* 1971, *53*, 415.
3. Sanemasa, I. *Bull. Chem. Soc. Jpn.* 1975, *48*, 1795.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Cinnabar; HgS; [19122-79-3]	Mukimova, D. S.; Bykovskaya, L. P. *Vopr. Reg. Geol. Petrol. Sredn. Azii* 1975, 148 - 54. *Chem. Abstr.* 1977, *87*, 26346p.
VARIABLES:	PREPARED BY:
	H. L. Clever

EXPERIMENTAL VALUES:

The paper was not available. Part of the abstract is reproduced below.

"The experimental solubility of mercury was determined in cinnabar and rocks of the primary dispersion haloes, which had mercury content: shale 0.001, dolostone 0.015, volcanic rocks 0.0001, and effusive-sedimentary rocks 0.005 weight %, in distilled, natural (pH 6.5 and 5.5), and aggressive natural (pH 6.5 and 5.5) waters. The mercury was dissolved from the mercury containing minerals and rocks and subsequently absorbed with the shales absorbing more mercury than the carbonate rocks. The mercury in intrusive and effusive rocks dissolved in concentrations of (0.2 to 2) x 10^{-6} g dm^{-3}; its concentration continually increased over a six month period. Zones with high and low content of mercury in water were observed during the dissolution because of dissolution and absorption of mercury in the rocks."

The paper may contain pertinent data but its usefulness can not be determined from the abstract. The paper is discussed in the salt effect evaluation, although it is not a salt effect study. It appears to be a study of a natural system of mercury containing minerals and rocks in contact with water.

AUXILIARY INFORMATION

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Barium chloride; $BaCl_2$; [10361-37-2]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sanemasa, I.; Haraguchi, K.; Nagai, H.

Bull. Chem. Soc. Jpn. 1981, *54*, 1040 - 3.

VARIABLES:

$T/K = 298.15$
$c_2/\text{mol dm}^{-3} = 0 - 0.750$

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Electrolyte	Solubility Ratio	$\log(c_1^0/c_1)$ at lim	Salt Effect Parameter	
$t/°C$	T/K	$c_2/\text{mol dm}^{-3}$	c_1^0/c_1	$c_2 \to 0$	k_{scc}	k_{scx}
25	298.15	0.250	1.080		0.134	
		0.500	1.148		0.120	
		0.750	1.233		0.121	
				0.0039[a]	0.115[a]	0.121

[a] Authors' values which are the intercept and slope of $\log(c_1^0/c_1)$ vs. c_2.

The other k_{scc} values were calculated by the compiler from:

$$k_{scc} = (1/c_2) \times \log(c_1^0/c_1)$$

The k_{scx} values were calculated by the authors from:

$$k_{scx} = k_{scc} + (0.036 - \Phi \times 10^{-3})/2.30$$

where Φ is the apparent molar volume of the salt. For this system $\Phi/\text{cm}^3\ \text{mol}^{-1} = 23.19$.

The solubility of mercury in water is based on Sanemasa's (ref. 3) earlier determination of 63.9×10^{-6} g dm^{-3}.

Note: $k_{scc}/\text{dm}^3\ \text{mol}^{-1} = (1/(c_2/\text{mol dm}^{-3}))\log(c_1^0/c_1)$; $k_{scx} = (1/c_2)\log(x_1^0/x_1)$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Purified by distillation under reduced pressure.

(2) Barium chloride. Analytical reagent grade. Dried and weighed.

(3) Water. Redistilled water. Both aerated and deoxygenated water were used with no difference.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$10^6 \delta c_1/\text{g dm}^{-3} = \pm 0.1$
$\delta(c_1^0/c_1) = \pm 0.005$

REFERENCES:

1. Kimura, Y.; Miller, V. L.
Anal. Chim. Acta 1962, *27*, 325.
2. Omang, S. H.
Anal. Chim. Acta 1971, *53*, 415.
3. Sanemasa, I.
Bull. Chem. Soc. Jpn. 1975, *48*, 1795.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Sodium fluoride; NaF; [7681-49-4]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sanemasa, I.; Haraguchi, K.; Nagai, H.

Bull. Chem. Soc. Jpn. 1981, *54*, 1040 - 3.

VARIABLES:

$T/K = 298.15$
$c_2/\text{mol dm}^{-3} = 0 - 0.750$

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature $t/°C$	Temperature T/K	Electrolyte $c_2/\text{mol dm}^{-3}$	Solubility Ratio c_1^0/c_1	$\log(c_1^0/c_1)$ at lim $c_2 \to 0$	Salt Effect Parameter k_{scc}	Salt Effect Parameter k_{scx}
25	298.15	0.250	1.102		0.169	
		0.500	1.207		0.163	
		0.750	1.321		0.161	
				0.0029^a	0.157^a	0.174

^{a}Authors' values which are the intercept and slope of $\log(c_1^0/c_1)$ vs. c_2.

The other k_{scc} values were calculated by the compiler from:

$$k_{scc} = (1/c_2) \times \log(c_1^0/c_1)$$

The k_{scx} values were calculated by the authors from:

$$k_{scx} = k_{scc} + (0.036 - \Phi \times 10^{-3})/2.30$$

where Φ is the apparent molar volume of the salt. For this system $\Phi/\text{cm}^3\ \text{mol}^{-1} = -2.37$.

The solubility of mercury in water is based on Sanemasa's (ref. 3) earlier determination of 63.9×10^{-6} g dm^{-3}.

Note: $k_{scc}/\text{dm}^3\ \text{mol}^{-1} = (1/(c_2/\text{mol dm}^{-3}))\log(c_1^0/c_1)$; $k_{scx} = (1/c_2)\log(x_1^0/x_1)$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Purified by distillation under reduced pressure.

(2) Sodium fluoride. Analytical reagent grade. Dried and weighed.

(3) Water. Redistilled water. Both aerated and deoxygenated water were used with no difference.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$10^6 \delta c_1/\text{g dm}^{-3} = \pm 0.1$
$\delta(c_1^0/c_1) = \pm 0.005$

REFERENCES:

1. Kimura, Y.; Miller, V. L. *Anal. Chim. Acta* 1962, *27*, 325.
2. Omang, S. H. *Anal. Chim. Acta* 1971, *53*, 415.
3. Sanemasa, I. *Bull. Chem. Soc. Jpn.* 1975, *48*, 1795.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Sodium chloride; NaCl; [7647-14-5] (3) Water; H_2O; [7732-18-5]	Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1972, *50*, 3124 - 8.

EXPERIMENTAL VALUES:

Temperature		Sodium chloride	Mercury Solubility		Salt Effect Parameter
t/°C	T/K	m_2/mol kg^{-1}	$10^8 m_1$/mol kg^{-1}	$10^9 x_1$^{a}	k_{smm}/kg mol^{-1}^{a}
5.24	278.37	0.0	21.8	3.93	0.104
		6.10	5.05	0.746	0.101
		6.10	5.25	0.775	0.096
		6.10	5.65	0.775	0.096
		6.10	6.35	0.938	0.088
5.35	278.48	0.0	21.8	3.93	-
		6.10	5.89	0.870	0.093
10.17	283.32	0.0	23.1	4.16	-
		6.10	7.40	1.093	0.081
		6.10	7.44	1.106	0.080
		6.10	7.61	1.124	0.079
15.01	288.16	0.0	24.7	4.45	-
		6.12	10.8	1.594	0.059
		6.12	11.2	1.653	0.056
19.92	293.07	0.0	26.8	4.83	-
		6.13	12.1	1.93	0.051
		6.13	13.7	2.02	0.048
		6.13	15.1	2.23	0.041
		6.13	15.2	2.24	0.040
25.02	298.17	0.0	29.3	5.28	-
		6.14	15.6	2.30	0.045
		6.14	15.6	2.30	0.045
		6.14	16.7	2.46	0.040
		6.14	16.9	2.49	0.039
30.27	303.42	0.0	32.5	5.85	-
		6.09	18.7	2.76	0.039
		6.09	19.6	2.90	0.036
		6.09	20.4	3.01	0.033
		6.09	20.4	3.01	0.033
34.96	308.11	0.0	36.0	6.49	-
		6.18	25.1	3.70	0.025
		6.18	26.3	3.88	0.022
		6.18	27.5	4.05	0.019
		6.18	27.6	4.07	0.019
40.02	313.17	0.0	40.3	7.26	-
		6.21	31.3	4.61	0.0177
		6.21	32.9	4.84	0.0143
44.86	318.01	0.0	45.4	8.18	-
		6.18	37.1	5.47	0.0142
		6.18	38.8	5.72	0.0110
		6.18	41.2	6.07	0.0068
50.07	323.22	0.0	51.8	9.33	-
		6.09	46.5	6.87	0.0077
		6.09	49.8	7.36	0.0028

[a] Calculated by compiler.

Continued on the next page.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Sodium chloride; NaCl; [7647-14-5]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Glew, D. N.; Hames, D. A.

Can. J. Chem. 1972, *50*, 3124 - 8.

VARIABLES:

$T/K = 278.39 - 342.92$
$m_2/\text{mol kg}^{-1} = 6.09 - 6.29$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Sodium chloride	Mercury Solubility		Salt Effect Parameter
$t/°C$	T/K	$m_2/\text{mol kg}^{-1}$	$10^8 m_1/\text{mol kg}^{-1}$	$10^9 x_1{}^a$	$k_{smm}/\text{kg mol}^{-1\,a}$
54.99	328.14	0.0	59.1	10.65	-
		6.29	58.9	8.65	0.0002
		6.29	61.9	9.09	-0.0032
		6.29	67.4	9.90	-0.0091
		6.29	68.7	10.09	-0.0104
		6.29	68.9	10.12	-0.0106
60.12	333.27	0.0	68.1	12.27	-
		6.18	74.3	10.95	-0.0061
		6.18	76.0	11.20	-0.0077
65.28	338.43	0.0	79.1	14.25	-
		6.18	96.8	14.26	-0.0142
		6.18	97.5	14.37	-0.0147
69.77	342.92	0.0	90.4	16.29	-
		6.18	112	16.5	-0.0151
		6.18	119	17.5	-0.0193

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility cell and temperature researching equipment were described earlier (ref. 1 and 2).

The water and mercury were distilled into the evacuated solubility cell. Sufficient NaCl was added under He to make the solution about 6.1 molal. About 0.001 molal hydrazine hydrate was added to ensure no Hg was oxidized by residual air.

The solubility cell was continuously stirred and Hg solubilities were determined at preselected temperatures starting from both above and below saturation.

The stirrer was stopped 2 hours before sampling, and 5 to 15 g samples of solution were expersed into a tared flask containing 1 ml 2% $K_2Cr_2O_7$ and 1 ml 20% H_2SO_4. The flask was reweighed and heated to boiling to oxidize the Hg.

The sample was cooled and transferred quantitatively to a wash bottle in the train for the atomic absorption spectrophotometer. The Hg^{2+} was reduced to Hg by $SnCl_2$. The mercury was vaporized into the quartz cell of the spectrophotometer. The spectrophotometer was calibrated by a standard Hg solution prepared from $HgCl_2$.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Technical electrolytic grade; purified as follows: agitated with air and washed with 10% NaOH, distilled water, 5% HNO_3; filtered through Au foil; rewashed with 5% HNO_3 and distilled water, distilled three times.

(2) Sodium chloride. Fischer Scientific Co.; ASC Grade.

(3) Water. Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$
$\delta x_1/x_1 = \pm 0.077$ Standard error on a single determination (authors).
$\delta k/\text{mol kg}^{-1} = \pm 0.0054$ Standard error on a single determination (authors).

REFERENCES:

1. Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1969, *47*, 4651.

2. Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1971, *49*, 3114.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Sodium chloride; NaCl; [7647-14-5] (3) Water; H_2O; [7732-18-5]	Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1972, *50*, 3124 - 8.

ADDITIONAL INFORMATION:

Authors' smoothed data. Solubility of mercury in 6.10 mol/kg ^{1} aqueous sodium chloride.

Temperature		Molality	Standard Deviation	Salt Effect Parameter	Standard Deviation
t/°C	T/K	$10^8 m_1$/mol kg^{-1}	σ	k_{smm}/kg mol^{-1} ^{a}	σ
0.0	273.2	4.31	0.10	0.1120	0.0028
5.0	278.2	5.75	0.12	0.0950	0.0020
10.0	283.2	7.58	0.14	0.0795	0.0014
15.0	288.2	9.91	0.16	0.0654	0.0011
20.0	293.2	12.8	0.17	0.0528	0.0011
25.0	298.2	16.5	0.20	0.0413	0.0012
30.0	303.2	21.0	0.24	0.0311	0.0012
35.0	308.2	26.5	0.30	0.0220	0.0012
40.0	313.2	33.2	0.39	0.0140	0.0011
45.0	318.2	41.3	0.54	0.0069	0.0011
50.0	323.2	51.1	0.74	0.0008	0.0011
55.0	328.2	62.8	1.0	-0.0044	0.0012
60.0	333.2	76.7	1.4	-0.0089	0.0015
65.0	338.2	93.1	1.9	-0.0125	0.0019
70.0	343.2	112.	2.5	-0.0153	0.0024

$^a k_{smm}/\text{kg mol}^{-1} = (1/(m_2/\text{mol kg}^{-1}))\log((m_1^{0}/\text{mol kg}^{-1})/(m_1/\text{mol kg}^{-1}))$

The authors' smoothing equations were

$$\log(m_1/\text{mol kg}^{-1}) = -6.043 - 1639.8/(T/\text{K}) + 1.9230 \log(T/\text{K})$$

with a standard error on a single determination of 7.7%, and

$$k_{smm} = -20.373 + 1072.2/(T/\text{K}) + 6.7966 \log(T/\text{K})$$

with a standard error on a single determination of 0.0054.

The salting out constant changes sign at 50.8 ± 1.0 °C (324.0 K).

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Sodium chloride; NaCl; [7647-14-5]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Chviruk, A. P.; Koneva, N. V.

Urk. Khim. Zh. 1975, *41*, 1162 - 4.

**Sov. Prog. Chem. (Engl. Transl.)* 1975, *41(11)*, 39 - 41.

VARIABLES:

$T/K = 293.15 - 353.15$
$p_1/kPa = 0 - 0.0112$
$c_2/mol\ dm^{-3} = 3.42$

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Pressure[a]	Sodium chloride[b]	Henry's Constant[c]	Mercury Solubility[d]
$t/°C$	T/K	$p_1/mmHg$	$c_2/g\ dm^{-3}$	p_1/c_1	$c_1/mg\ dm^{-3}$
20	293.15	1.1×10^{-3}	200	0.63	0.0192
40	313.15	5.7×10^{-3}		1.0	0.0591
60	333.15	24×10^{-3}		1.45	0.158
80	353.15	84×10^{-3}		2.1	0.377

[a] Calculated by compilers from literature equation (ref. 1) given in paper, $\log p_1 = 10.55 - 0.84 \log T - (3348/T)$, $p_1/mmHg$ and T/K.

[b] Equivalent to 3.42 mol dm^{-3} (compiler).

[c] Henry's constant defined as $K = (p_1/mg\ dm^{-3})/(c_1/mg\ dm^{-3})$. The authors' equation for K is $\log K = 0.34 + 0.28 \log(p_1 mg\ dm^{-3})$.

[d] Calculated by the compiler from authors' equation $\log(c_1/mg\ dm^{-3}) = 9.781 - 1.325 \log(T/K) - 2411/(T/K)$.

The authors also measured the solubility of mercury in a solution of 600 g dm^{-3} of sodium hydroxide at 20°C. They give no numerical data for the system, but they say that the results agree with the aqueous NaCl data.

Systems undersaturated, saturated snd supersaturated with mercury were studied. The authors show a fiqure which shows that the undersaturated solutions obey Henry's law, and the supersaturate solutions are in contact with mercury vapor at its equilibrium pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Formed in the solution by reduction of $HgCl_2$ by $SnCl_2$ (15 g dm^{-3}) at pH 2.

(2) Sodium chloride. Specified as "cp".

(3) Water. Distilled.

ESTIMATED ERROR:

REFERENCES:

1. Moelwyn - Hughes, E. A. *Physical Chemistry, Russian translation*, IL Press, Moscow.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Sodium chloride; NaCl; [7647-14-5]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Baltisberger, R. J.; Hildebrand, D. A.; Grieble, D.; Ballintine, T. A.

Anal. Chim. Acta 1979, *111*, 111 - 2.

VARIABLES:

T/K = 296.15, 303.15

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Sodium chloride	Mercury solubility		Salt Effect Parameter
t/°C	T/K	c_2/mol dm^{-3}	ppb^a	Concentration^c 10^7c_1/mol dm^{-3}	k_{scc}/dm^3 mol^{-1}
30	303.15	0	63 ± 2^b	3.1_4 ± 0.10	-
23	296.15	0.01	59	2.9_4	0.70
		0.1	57	2.8_4	0.22

[a] ppb = parts per billion.

[b] Standard deviation of ten analyses.

[c] Calculated by compilers. The molar solubility was calculated assuming grams of mercury per 1 x 10^9 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

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).

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Prepared by distillation from mercury(II) oxide under a N_2 atmosphere.

(2) Sodium chloride. From analytical grade reagent and solution.

(3) Water. Triple distilled.

ESTIMATED ERROR:

See standard deviation of solubility in water above.

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Sodium chloride; NaCl; [7647-14-5]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sanemasa, I.; Haraguchi, K.; Nagai, H.

Bull. Chem. Soc. Jpn 1981, *54*,

VARIABLES:

$T/K = 298.15$

$c_2/\text{mol dm}^{-3} = 0 - 1.00$

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Electrolyte	Solubility Ratio	$\log(c_1^0/c_1)$ at lim	Salt Effect Parameter	
$t/°C$	T/K	$c_2/\text{mol dm}^{-3}$	c_1^0/c_1	$c_2 \to 0$	k_{scc}	k_{scx}
25	298.15	0.250	1.050		0.0848	
		0.501	1.105		0.0866	
		0.752	1.154		0.0827	
		1.00	1.204		0.0806	
				0.0025[a]	0.0788[a]	0.0872

[a] Authors' values which are the intercept and slope of $\log(c_1^0/c_1)$ vs. c_2.

The other k_{scc} values were calculated by the compiler from:

$$k_{scc} = (1/c_2) \times \log(c_1^0/c_1)$$

The k_{scx} values were calculated by the authors from:

$$k_{scx} = k_{scc} + (0.036 - \Phi \times 10^{-3})/2.30$$

where Φ is the apparent molar volume of the salt. For this system $\Phi/\text{cm}^3\ \text{mol}^{-1} = 16.62$.

The solubility of mercury in water is based on Sanemasa's (ref. 3) earlier determination of $63.9 \times 10^{-6}\ \text{g dm}^{-3}$.

Note: $k_{scc}/\text{dm}^3\ \text{mol}^{-1} = (1/(c_2/\text{mol dm}^{-3}))\log(c_1^0/c_1)$; $k_{scx} = (1/c_2)\log(x_1^0/x_1)$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Purified by distillation under reduced pressure.

(2) Sodium chloride. Analytical reagent grade. Dried and weighed.

(3) Water. Redistilled water. Both aerated and deoxygenated water were used with no difference.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$

$10^6 \delta c_1/\text{g dm}^{-3} = \pm 0.1$

$\delta(c_1^0/c_1) = \pm 0.005$

REFERENCES:

1. Kimura, Y.; Miller, V. L.
Anal. Chim. Acta 1962, *27*, 325.
2. Omang, S. H.
Anal. Chim. Acta 1971, *53*, 415.
3. Sanemasa, I.
Bull. Chem. Soc. Jpn. 1975, *48*, 1795.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Sodium chloride; NaCl; [7647-14-5]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Hursh, J. B.

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

VARIABLES:

$T/K = 295$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		NaCl	Carrier Gas	Ostwald Coefficient[a]	Concentration[b]
t/°C	T/K	c_2/mol dm^{-3}		Av. ± SE (no.)	10^7c_1/mol dm^{-3}
22	295.15	0	-	(3.22)	2.61
		0.155	Air	2.65 ± 0.07(5)	2.15

[a] The Ostwald coefficient is ((ng Hg/mL fluid)/(ng Hg/mL air)). Given above is the average ± 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 at 295.15 K are 19.90 Pa and 16.27 ng Hg/mL air, respectively.

The author describes the solution as 0.9 wt. % NaCl. The compiler calculated the concentration as 0.155 mol dm^{-3} NaCl.

The water values in ( ) were added by the compiler for comparison. They were calculated from data in the mercury + water evaluation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Prepared by reduction of $^{203}HgCl_2$. The Hg vapor is swept into a leak-proof Saran bag.

(2) Sodium chloride. No information given. Solution specific gravity Handbook value of 1.0064.

(3) Water. Deionized and doubly distilled.

ESTIMATED ERROR:

REFERENCES:

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Sodium bromide; NaBr; [7647-15-6]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sanemasa, I.; Haraguchi, K.; Nagai, H.

Bull. Chem. Soc. Jpn. 1981, *54*, 1040 - 3.

VARIABLES:

$T/K = 298.15$
$c_2/\text{mol dm}^{-3} = 0 - 1.01$

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Electrolyte	Solubility Ratio	$\log(c_1^0/c_1)$ at lim	Salt Effect Parameter	
$t/°C$	T/K	$c_2/\text{mol dm}^{-3}$	c_1^0/c_1	$c_2 \to 0$	k_{scc}	k_{scx}
25	298.15	0.253	1.023		0.039	
		0.506	1.038		0.032	
		0.750	1.046		0.026	
		1.01	1.055		0.023	
				0.0063^a	0.0173^a	0.0227

^{a}Authors' values which are the intercept and slope of $\log(c_1^0/c_1)$ vs. c_2.

The other k_{scc} values were calculated by the compiler from:

$$k_{scc} = (1/c_2) \times \log(c_1^0/c_1)$$

The k_{scx} values were calculated by the authors from:

$$k_{scx} = k_{scc} + (0.036 - \Phi \times 10^{-3})/2.30$$

where Φ is the apparent molar volume of the salt. For this system $\Phi/\text{cm}^3\ \text{mol}^{-1} = 23.50$.

The solubility of mercury in water is based on Sanemasa's (ref. 3) earlier determination of 63.9×10^{-6} g dm^{-3}.

Note: $k_{scc}/\text{dm}^3\ \text{mol}^{-1} = (1/(c_2/\text{mol dm}^{-3}))\log(c_1^0/c_1)$; $k_{scx} = (1/c_2)\log(x_1^0/x_1)$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Purified by distillation under reduced pressure.

(2) Sodium bromide. Analytical reagent grade. Dried and weighed.

(3) Water. Redistilled water. Both aerated and deoxygenated water were used with no difference.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$10^6 \delta c_1/\text{g dm}^{-3} = \pm 0.1$
$\delta(c_1^0/c_1) = \pm 0.005$

REFERENCES:

1. Kimura, Y.; Miller, V. L.
   Anal. Chim. Acta 1962, *27*, 325.
2. Omang, S. H.
   Anal. Chim. Acta 1971, *53*, 415.
3. Sanemasa, I.
   Bull. Chem. Soc. Jpn. 1975, *48*, 1795.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Sodium perchlorate; $NaClO_4$; [7601-89-0]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sanemasa, I.; Haraguchi, K.; Nagai, H.

Bull. Chem. Soc. Jpn. 1981, *54*, 1040 - 3.

VARIABLES:

$T/K = 298.15$
$c_2/\text{mol dm}^{-3} = 0 - 1.00$

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Electrolyte	Solubility Ratio	$\log(c_1^0/c_1)$ at lim	Salt Effect Parameter	
$t/°C$	T/K	$c_2/\text{mol dm}^{-3}$	c_1^0/c_1	$c_2 \rightarrow 0$	k_{scc}	k_{scx}
25	298.15	0.250	1.093		0.154	
		0.500	1.172		0.138	
		0.750	1.252		0.130	
		1.00	1.338		0.126	
				0.0098[a]	0.117[a]	0.114

[a] Authors' values which are the intercept and slope of $\log(c_1^0/c_1)$ vs. c_2.

The other k_{scc} values were calculated by the compiler from:

$$k_{scc} = (1/c_2) \times \log(c_1^0/c_1)$$

The k_{scx} values were calculated by the authors from:

$$k_{scx} = k_{scc} + (0.036 - \Phi \times 10^{-3})/2.30$$

where Φ is the apparent molar volume of the salt. For this system $\Phi/\text{cm}^3\ \text{mol}^{-1} = 42.91$.

The solubility of mercury in water is based on Sanemasa's (ref. 3) earlier determination of 63.9×10^{-6} g dm^{-3}.

Note: $k_{scc}/\text{dm}^3\ \text{mol}^{-1} = (1/(c_2/\text{mol dm}^{-3}))\log(c_1^0/c_1)$; $k_{scx} = (1/c_2)\log(x_1^0/x_1)$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Purified by distillation under reduced pressure.

(2) Sodium perchlorate. Analytical reagent grade. Dried and weighed.

(3) Water. Redistilled water. Both aerated and deoxygenated water were used with no difference.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$10^6 \delta c_1/\text{g dm}^{-3} = \pm 0.1$
$\delta(c_1^0/c_1) = \pm 0.005$

REFERENCES:

1. Kimura, Y.; Miller, V. L.
Anal. Chim. Acta 1962, *27*, 325.
2. Omang, S. H.
Anal. Chim. Acta 1971, *53*, 415.
3. Sanemasa, I.
Bull. Chem. Soc. Jpn. 1975, *48*, 1795.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Sodium sulfate; Na_2SO_4; [7757-82-6]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sanemasa, I.; Haraguchi, K.; Nagai, H.

Bull. Chem. Soc. Jpn. 1981, *54*, 1040 - 3.

VARIABLES:

$T/K = 298.15$
$c_2/\text{mol dm}^{-3} = 0 - 0.501$

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Electrolyte	Solubility Ratio	$\log(c_1^{\circ}/c_1)$ at lim	Salt Effect Parameter	
$t/°C$	T/K	$c_2/\text{mol dm}^{-3}$	c_1°/c_1	$c_2 \rightarrow 0$	k_{scc}	k_{scx}
25	298.15	0.125	1.104		0.344	
		0.250	1.216		0.340	
		0.375	1.314		0.316	
		0.501	1.447		0.320	
				0.0053[a]	0.308[a]	0.319

[a]Authors' values which are the intercept and slope of $\log(c_1^{\circ}/c_1)$ vs. c_2.

The other k_{scc} values were calculated by the compiler from:

$$k_{scc} = (1/c_2) \times \log(c_1^{\circ}/c_1)$$

The k_{scx} values were calculated by the authors from:

$$k_{scx} = k_{scc} + (0.036 - \Phi \times 10^{-3})/2.30$$

where Φ is the apparent molar volume of the salt. For this system $\Phi/\text{cm}^3 \text{ mol}^{-1} = 11.56$.

The solubility of mercury in water is based on Sanemasa's (ref. 3) earlier determination of 63.9×10^{-6} g dm^{-3}.

Note: $k_{scc}/\text{dm}^3 \text{ mol}^{-1} = (1/(c_2/\text{mol dm}^{-3}))\log(c_1^{\circ}/c_1)$; $k_{scx} = (1/c_2)\log(x_1^{\circ}/x_1)$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Purified by distillation under reduced pressure.

(2) Sodium sulfate. Analytical reagent grade. Dried and weighed.

(3) Water. Redistilled water. Both aerated and deoxygenated water were used with no difference.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$10^6 \delta c_1/\text{g dm}^{-3} = \pm 0.1$
$\delta(c_1^{\circ}/c_1) = \pm 0.005$

REFERENCES:

1. Kimura, Y.; Miller, V. L.
Anal. Chim. Acta 1962, *27*, 325.
2. Omang, S. H.
Anal. Chim. Acta 1971, *53*, 415.
3. Sanemasa, I.
Bull. Chem. Soc. Jpn. 1975, *48*, 1795.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Sodium nitrate; $NaNO_3$; [7631-99-4]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sanemasa, I.; Haraguchi, K.; Nagai, H.

Bull. Chem. Soc. Jpn. 1981, *54*, 1040 - 3.

VARIABLES:

$T/K = 298.15$
$c_2/\text{mol dm}^{-3} = 0 - 1.00$

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Electrolyte	Solubility Ratio	$\log(c_1^0/c_1)$ at lim	Salt Effect Parameter	
$t/°C$	T/K	$c_2/\text{mol dm}^{-3}$	c_1^0/c_1	$c_2 \rightarrow 0$	k_{scc}	k_{scx}
25	298.15	0.250	1.037		0.063	
		0.500	1.074		0.062	
		0.753	1.106		0.058	
		1.00	1.156		0.063	
				-0.0002^a	0.0616^a	0.0652

^{a}Authors' values which are the intercept and slope of $\log(c_1^0/c_1)$ vs. c_2.

The other k_{scc} values were calculated by the compiler from:

$$k_{scc} = (1/c_2) \times \log(c_1^0/c_1)$$

The k_{scx} values were calculated by the authors from:

$$k_{scx} = k_{scc} + (0.036 - \Phi \times 10^{-3})/2.30$$

where Φ is the apparent molar volume of the salt. For this system $\Phi/\text{cm}^3\ \text{mol}^{-1} = 27.79$.

The solubility of mercury in water is based on Sanemasa's (ref. 3) earlier determination of 63.9×10^{-6} g dm^{-3}.

Note: $k_{scc}/\text{dm}^3\ \text{mol}^{-1} = (1/(c_2/\text{mol dm}^{-3}))\log(c_1^0/c_1)$; $k_{scx} = (1/c_2)\log(x_1^0/x_1)$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Purified by distillation under reduced pressure.

(2) Sodium nitrate. Analytical reagent grade. Dried and weighed.

(3) Water. Redistilled water. Both aerated and deoxygenated water were used with no difference.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$10^6 \delta c_1/\text{g dm}^{-3} = \pm 0.1$
$\delta(c_1^0/c_1) = \pm 0.005$

REFERENCES:

1. Kimura, Y.; Miller, V. L. *Anal. Chim. Acta* 1962, *27*, 325.
2. Omang, S. H. *Anal. Chim. Acta* 1971, *53*, 415.
3. Sanemasa, I. *Bull. Chem. Soc. Jpn.* 1975, *48*, 1795.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Sodium thiocyanate; NaSCN; [540-72-7]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sanemasa, I.; Haraguchi, K.; Nagai, H.

Bull. Chem. Soc. Jpn. 1981, *54*, 1040 - 3.

VARIABLES:

$T/K = 298.15$
$c_2/\text{mol dm}^{-3} = 0 - 1.062$

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Electrolyte	Solubility Ratio	$\log(c_1^\circ/c_1)$ at lim	Salt Effect Parameter	
$t/°C$	T/K	$c_2/\text{mol dm}^{-3}$	c_1°/c_1	$c_2 \to 0$	k_{scc}	k_{scx}
25	298.15	0.266	0.977		-0.038	
		0.531	0.964		-0.030	
		0.797	0.944		-0.031	
		1.062	0.917		-0.035	
				0.0008[a]	-0.0345[a]	-0.0338

[a] Authors' values which are the intercept and slope of $\log(c_1^\circ/c_1)$ vs. c_2.

The other k_{scc} values were calculated by the compiler from:

$$k_{scc} = (1/c_2) \times \log(c_1^\circ/c_1)$$

The k_{scx} values were calculated by the authors from:

$$k_{scx} = k_{scc} + (0.036 - \Phi \times 10^{-3})/2.30$$

where Φ is the apparent molar volume of the salt. For this system $\Phi/\text{cm}^3\text{ mol}^{-1} = 34.49$.

The solubility of mercury in water is based on Sanemasa's (ref. 3) earlier determination of 63.9×10^{-6} g dm^{-3}.

Note: $k_{scc}/\text{dm}^3\text{ mol}^{-1} = (1/(c_2/\text{mol dm}^{-3}))\log(c_1^\circ/c_1)$; $k_{scx} = (1/c_2)\log(x_1^\circ/x_1)$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Purified by distillation under reduced pressure.

(2) Sodium thiocyanate. Analytical reagent grade. Dried and weighed.

(3) Water. Redistilled water. Both aerated and deoxygenated water were used with no difference.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$10^6 \delta c_1/\text{g dm}^{-3} = \pm 0.1$
$\delta(c_1^\circ/c_1) = \pm 0.005$

REFERENCES:

1. Kimura, Y.; Miller, V. L.
Anal. Chim. Acta 1962, *27*, 325.
2. Omang, S. H.
Anal. Chim. Acta 1971, *53*, 415.
3. Sanemasa, I.
Bull. Chem. Soc. Jpn. 1975, *48*, 1795.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Potassium chloride; KCl; [7447-40-7]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sanemasa, I.; Haraguchi, K.; Nagai, H.

Bull. Chem. Soc. Jpn. 1981, *54*, 1040 - 3.

VARIABLES:

$T/K = 298.15$
$c_2/\text{mol dm}^{-3} = 0 - 1.00$

PREPARED BY:

S. H. Johnson
H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Electrolyte	Solubility Ratio	log(c_1°/c_1) at lim	Salt Effect Parameter	
$t/°C$	T/K	$c_2/\text{mol dm}^{-3}$	c_1°/c_1	$c_2 \to 0$	k_{scc}	k_{scx}
25	298.15	0.250	1.046		0.078	
		0.500	1.095		0.079	
		0.750	1.120		0.066	
		1.00	1.188		0.075	
				0.0018[a]	0.0703[a]	0.0743

[a] Authors' values which are the intercept and slope of $\log(c_1^\circ/c_1)$ vs. c_2.

The other k_{scc} values were calculated by the compiler from:

$$k_{scc} = (1/c_2) \times \log(c_1^\circ/c_1)$$

The k_{scx} values were calculated by the authors from:

$$k_{scx} = k_{scc} + (0.036 - \Phi \times 10^{-3})/2.30$$

where Φ is the apparent molar volume of the salt. For this system $\Phi/\text{cm}^3\ \text{mol}^{-1} = 26.85$.

The solubility of mercury in water is based on Sanemasa's (ref. 3) earlier determination of 63.9×10^{-6} g dm^{-3}.

Note: $k_{scc}/\text{dm}^3\ \text{mol}^{-1} = (1/(c_2/\text{mol dm}^{-3}))\log(c_1^\circ/c_1)$; $k_{scx} = (1/c_2)\log(x_1^\circ/x_1)$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Purified by distillation under reduced pressure.

(2) Potassium chloride. Analytical reagent grade. Dried and weighed.

(3) Water. Redistilled water. Both aerated and deoxygenated water were used with no difference.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$10^{6}\delta c_1/\text{g dm}^{-3} = \pm 0.1$
$\delta(c_1^\circ/c_1) = \pm 0.005$

REFERENCES:

1. Kimura, Y.; Miller, V. L. *Anal. Chim. Acta* 1962, *27*, 325.
2. Omang, S. H. *Anal. Chim. Acta* 1971, *53*, 415.
3. Sanemasa, I. *Bull. Chem. Soc. Jpn.* 1975, *48*, 1795.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Alanine; $C_3H_7NO_2$; [56-41-7]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

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:

$T/K = 310.15$
$c_2/\text{mol dm}^{-3} = 0 \text{ to } 5.6 \times 10^{-4}$
$\text{pH} = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time t/days	L-Alanine		Mercury[a]	
	$c_2/\text{mg dm}^{-3}$	$c_2/\text{mol dm}^{-3}$[c] (compiler)	ppm[b]	$10^7 c_1/\text{mol dm}^{-3}$[c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
5	50	5.6×10^{-4}	$0.525 \le 0.525 \le 0.525$	26.2

[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 1×10^6 cm^3 of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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:

(1) Mercury; Hg; [7439-97-6]

(2) L-Aspartic acid; $C_4H_7NO_4$; [56-84-8]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/K = 310.15$
$c_2/\text{mol dm}^{-3} = 0 \text{ to } 4.5 \times 10^{-4}$
$\text{pH} = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Aspartic acid		Mercury[a]	
t/days	c_2/mg dm^{-3}	c_2/mol dm^{-3} [c] (compiler)	ppm[b]	$10^7 c_1$/mol dm^{-3} [c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
5	60	4.5×10^{-4}	$0.483 \le 0.520 \le 0.552$	25.9

[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 1×10^6 cm^3 of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Threonine; $C_4H_9NO_3$; [72-19-5]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

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:

$T/K = 310.15$
$c_2/\text{mol dm}^{-3} = 0 \text{ to } 5.0 \times 10^{-4}$
$\text{pH} = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time t/days	L-Threonine $c_2/\text{mg dm}^{-3}$	L-Threonine $c_2/\text{mol dm}^{-3}$ [c] (compiler)	Mercury[a] ppm[b]	Mercury[a] $10^7 c_1/\text{mol dm}^{-3}$ [c] (compiler)
1	0	0	$0.020 \leq 0.045 \leq 0.070$	2.2
3	0	0	$0.025 \leq 0.060 \leq 0.096$	3.0
5	0	0	$0.078 \leq 0.086 \leq 0.090$	4.3
5	0	0	$0.078 \leq 0.087 \leq 0.095$	4.3
5	0	0	$0.070 \leq 0.095 \leq 0.120$	4.7
5	60	5.0×10^{-4}	$0.659 \leq 0.685 \leq 0.712$	34.1

[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 1×10^6 cm^3 of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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:

(1) Mercury; Hg; [7439-97-6]

(2) L-Proline; $C_5H_9NO_2$; [147-85-3]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/K = 310.15$

$c_2/\text{mol dm}^{-3} = 0 \text{ to } 3.5 \times 10^{-4}$

$\text{pH} = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Proline		Mercury[a]	
t/days	$c_2/\text{mg dm}^{-3}$	$c_2/\text{mol dm}^{-3}$[c] (compiler)	ppm[b]	$10^7c_1/\text{mol dm}^{-3}$[c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
5	40	3.5×10^{-4}	$0.415 \le 0.445 \le 0.493$	22.2

[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 1×10^6 cm^3 of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Glutamine; $C_5H_{10}N_2O_3$; [56-85-9]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/K = 310.15$
$c_2/\text{mol dm}^{-3} = 0 \text{ to } 0.01$
$\text{pH} = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Glutamine		Mercury[a]	
t/days	c_2/mg dm^{-3}	c_2/mol dm^{-3} [c] (compiler)	ppm[b]	$10^7 c_1$/mol dm^{-3} [c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
1	-	0.01	$0.588 \le 0.650 \le 0.712$	32.4
3	-	0.01	$0.618 \le 0.680 \le 0.742$	33.9
5	-	0.01	$0.790 \le 0.945 \le 1.101$	47.1
5	100	6.84×10^{-4}	$1.075 \le 1.105 \le 1.132$	55.1

[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 1×10^6 cm^3 of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Methionine; $C_5H_{11}NO_2S$; [63-68-3]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

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:

$T/\mathrm{K} = 310.15$

$c_2/\mathrm{mol\ dm^{-3}} = 0 \text{ to } 0.01$

$\mathrm{pH} = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time t/days	L-Methionine $c_2/\mathrm{mg\ dm^{-3}}$	L-Methionine $c_2/\mathrm{mol\ dm^{-3}}$ [c] (compiler)	Mercury[a] ppm[b]	Mercury[a] $10^7 c_1/\mathrm{mol\ dm^{-3}}$ [c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
1	-	0.01	$0.079 \le 0.086 \le 0.091$	4.3
3	-	0.01	$0.133 \le 0.168 \le 0.204$	8.38
5	-	0.01	$0.237 \le 0.262 \le 0.287$	13.1
5	-	0.01	$0.433 \le 0.433 \le 0.433$	21.6
5	30	2.0×10^{-4}	$0.097 \le 0.097 \le 0.097$	4.8

[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 $1 \times 10^6\ \mathrm{cm^3}$ of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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:

$\delta c_1/\mathrm{ppm}$ See ranges in table above.

$\delta T/\mathrm{K}$ Not given.

REFERENCES:

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Leucine; $C_6H_{13}NO_2$; [61-90-5]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.;
Ishizaki, N.; Yamada, T.;
Kawamoto, T.; Hikari, S.;
Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/\mathrm{K} = 310.15$
$c_2/\mathrm{mol\ dm^{-3}} = 0 \text{ to } 9.15 \times 10^{-4}$
$\mathrm{pH} = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Leucine		Mercury[a]	
t/days	c_2/mg $\mathrm{dm^{-3}}$	c_2/mol $\mathrm{dm^{-3}}$ [c] (compiler)	ppm[b]	$10^7 c_1$/mol $\mathrm{dm^{-3}}$ [c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
5	120	9.15×10^{-4}	$0.330 \le 0.375 \le 0.382$	18.7

[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 1×10^6 $\mathrm{cm^3}$ of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Isoleucine; $C_6H_{13}NO_2$; [73-32-5]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/\mathrm{K} = 310.15$
$c_2/\mathrm{mol\ dm^{-3}} = 0 \text{ to } 3.0 \times 10^{-4}$
$\mathrm{pH} = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Isoleucine		Mercury[a]	
t/days	$c_2/\mathrm{mg\ dm^{-3}}$	$c_2/\mathrm{mol\ dm^{-3}}$ [c] (compiler)	ppm[b]	$10^7 c_1/\mathrm{mol\ dm^{-3}}$ [c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
5	40	3.0×10^{-4}	$0.205 \le 0.227 \le 0.252$	11.3

[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 $1 \times 10^6\ \mathrm{cm^3}$ of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Phenylalanine; $C_9H_{11}NO_2$; [63-91-2]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/K = 310.15$
$c_2/\text{mol dm}^{-3} = 0 \text{ to } 3.0 \times 10^{-4}$
$\text{pH} = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time t/days	L-Phenylalanine $c_2/\text{mg dm}^{-3}$	 $c_2/\text{mol dm}^{-3}$ [c] (compiler)	Mercury[a] ppm[b]	 $10^7 c_1/\text{mol dm}^{-3}$ [c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
5	50	3.0×10^{-4}	$0.525 \le 0.552 \le 0.578$	27.5

[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 $1 \times 10^6 \text{ cm}^3$ of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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.
$\delta T/K$ Not given.

REFERENCES:

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Tyrosine; $C_9H_{11}NO_3$; [60-18-4]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.;
Ishizaki, N.; Yamada, T.;
Kawamoto, T.; Hikari, S.;
Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/K = 310.15$
$c_2/\text{mol dm}^{-3} = 0$ to 0.01
pH = 7.2 ± 0.1

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Tyrosine		Mercury[a]	
t/days	$c_2/\text{mg dm}^{-3}$	$c_2/\text{mol dm}^{-3}$[c] (compiler)	ppm[b]	$10^7c_1/\text{mol dm}^{-3}$[c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
1	-	0.01	$0.183 \le 0.251 \le 0.281$	12.5
3	-	0.01	$0.247 \le 0.251 \le 0.255$	12.5
5	-	0.01	$0.257 \le 0.271 \le 0.287$	13.5
5	40	2.2×10^{-4}	$0.274 \le 0.293 \le 0.303$	14.6

[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 1×10^6 cm^3 of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Cysteine hydrochloride; $C_3H_7NO_2S.HCl$; [52-89-1]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

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:

$T/K = 310.15$
$c_2/\text{mol dm}^{-3} = 0 \text{ to } 0.01$
$pH = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Cysteine HCl		Mercury[a]	
t/days	c_2/mg dm^{-3}	c_2/mol dm^{-3} [c] (compiler)	ppm[b]	$10^7 c_1$/mol dm^{-3} [c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
1	-	0.01	$34.825 \le 39.000 \le 43.184$	1944.3
3	-	0.01	$37.926 \le 40.000 \le 42.074$	1994.1
5	-	0.01	$37.852 \le 42.000 \le 46.185$	2093.8
5	-	0.01	$79.290 \le 80.670 \le 82.050$	4021.6
5	0.1	6.3×10^{-7}	$1.693 \le 1.723 \le 1.740$	85.90

[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 1×10^{6} cm^{3} of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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:

(1) Mercury; Hg; [7439-97-6]

(2) L-Histidine monochloride; $C_5H_{12}N_2O_3.HCl$; [645-35-2]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.;
Ishizaki, N.; Yamada, T.;
Kawamoto, T.; Hikari, S.;
Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/K = 310.15$
$c_2/\text{mol dm}^{-3} = 0 \text{ to } 0.01$
$pH = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Histidine HCl		Mercury[a]	
t/days	$c_2/\text{mg dm}^{-3}$	$c_2/\text{mol dm}^{-3}$ [c] (compiler)	ppm[b]	$10^7c_1/\text{mol dm}^{-3}$ [c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
5	-	0.01	$0.919 \le 0.960 \le 1.001$	47.9

[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 $1 \times 10^6 \text{ cm}^3$ of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Ornithine monochloride; $C_5H_{12}N_2O_2.HCl$; [3184-13-2]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/K = 310.15$
$c_2/\text{mol dm}^{-3} = 0 \text{ to } 0.01$
$\text{pH} = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time t/days	L-Ornithine HCl $c_2/\text{mg dm}^{-3}$	L-Ornithine HCl $c_2/\text{mol dm}^{-3}$ [c] (compiler)	Mercury[a] ppm[b]	Mercury[a] $10^7 c_1/\text{mol dm}^{-3}$ [c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
5	-	0.01	$0.158 \le 0.158 \le 0.158$	7.88

[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 $1 \times 10^6 \text{ cm}^3$ of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Lysine monohydrochloride; $C_6H_{14}N_2O_2 \cdot HCl$; [657-27-2]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/K = 310.15$
$c_2/\text{mol dm}^{-3} = 0$ to 0.01
$\text{pH} = 7.2 \pm 0.1$

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Lysine HCl		Mercury[a]	
t/days	c_2/mg dm^{-3}	c_2/mol dm^{-3}[c] (compiler)	ppm[b]	$10^7 c_1$/mol dm^{-3}[c] (compiler)
1	0	0	$0.020 \leq 0.045 \leq 0.070$	2.2
3	0	0	$0.025 \leq 0.060 \leq 0.096$	3.0
5	0	0	$0.078 \leq 0.086 \leq 0.090$	4.3
5	0	0	$0.078 \leq 0.087 \leq 0.095$	4.3
5	0	0	$0.070 \leq 0.095 \leq 0.120$	4.7
5	70	3.8×10^{-4}	$0.124 \leq 0.162 \leq 0.195$	8.08
5	-	0.01	$0.138 \leq 0.146 \leq 0.154$	7.28

[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 1×10^6 cm^3 of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Arginine monohydrochloride; $C_6H_{14}N_4O_2$.HCl; [1119-34-2]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

T/K = 310.15
c_2/mol dm^{-3} = 0 to 0.01
pH = 7.2 ± 0.1

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Arginine HCl		Mercury[a]	
t/days	c_2/mg dm^{-3}	c_2/mol dm^{-3}[c] (compiler)	ppm[b]	$10^7 c_1$/mol dm^{-3}[c] (compiler)
1	0	0	$0.020 \le 0.045 \le 0.070$	2.2
3	0	0	$0.025 \le 0.060 \le 0.096$	3.0
5	0	0	$0.078 \le 0.086 \le 0.090$	4.3
5	0	0	$0.078 \le 0.087 \le 0.095$	4.3
5	0	0	$0.070 \le 0.095 \le 0.120$	4.7
5	70	3.3×10^{-4}	$0.332 \le 0.425 \le 0.510$	21.2
5	-	0.01	$0.320 \le 0.320 \le 0.320$	16.0

[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 $1 \times 10^6\ \mathrm{cm}^3$ of solution.

[c] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) See following seven data sheets.

(3) Hanks' balanced salt solution; see formulation below.

ORIGINAL MEASUREMENTS:

Kawahara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

COMMENTS AND/OR ADDITIONAL DATA:

Paul (ref. 1) says that balanced salt solutions are media in which cell growth of tissues from warm-blooded vertebrates is maintained in either an air or special carbon dioxide atmosphere. The function of the balanced salt solution is to maintain the pH and osmotic pressure and to provide an adequate concentration of essential inorganic ions without allowing calcium deposition.

In preparing a balanced salt solution, it is essential that calcium and phosphate ions should not meet until the solution is quite dilute, and that the solution should not be made basic until the last minute. Thus, the calcium chloride is sometimes dissolved separately and slowly added to the solution of other components. Also, the sodium bicarbonate solution is prepared separately and added at the end to adjust pH.

Hanks (ref. 2 and 3) has described the solution. According to Paul (ref. 1), the solution is for use with an air atmosphere, but it has also been used with special carbon dioxide atmospheres. The solution used in the present work had the composition below.

Component	Registry Number	c/mg dm^{-3}	c/mol dm^{-3}
NaCl	[7647-14-5]	8000	0.137
KCl	[7447-40-7]	400	0.00536
$CaCl_2$	[10043-52-4]	140	0.00126
$MgSO_4 \cdot 7H_2O$	[7487-88-9]	200	0.00021
$Na_2HPO_4 \cdot 2H_2O$	[10028-24-7]	48	0.00031
KH_2PO_4	[7778-77-0]	60	0.00044
D-Glucose	[50-99-7]	1000	0.00555
Kanamycin	[8063-07-8]	60	-
(Kanamycin A)	[59-01-8]		
Phenol Red	[143-74-8]	6	-
$NaHCO_3$	[144-55-8]	350	0.0042

The balanced salt solution is prepared in several steps:

(1) Solution 1 is prepared by dissolving the first eight components listed above in a little less than one liter of distilled water.

(2) Solution 2 is prepared by dissolving one gram of phenol red in 100 cm^3 of one molar dm^{-3} NaOH solution.

(3) An 0.6 cm^3 volume of solution 2 is added to solution 1 and the solution is sterilized under high pressure.

(4) Solution 3 is prepared to be 6 wt % $NaHCO_3$. It is sterilized by filtration and then 3 cm^3 is added to the sterilized solution 1. The total solution is brought to one liter.

Note that sterilization by heat when the $NaHCO_3$ is present converts the bicarbonate to carbonate with evolution of CO_2. The reverse reaction occurs at room temperature, $2NaHCO_3(aq) = Na_2CO_3(aq) + CO_2(aq)$.

REFERENCES:

1. Paul, J. *Cell and Tissure Culture*, 4th Ed., Williams and Wilkins, Baltimore, 1970, Chapter VI.

2. Hanks, J. H. *J. Cell Comp. Physiol.* 1948, *31*, 235.

3. Hanks, J. H.; Wallace, R. E. *Proc. Soc. exp. Biol. NY* 1949, *71*, 196.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Hanks' Balanced Salt Solution

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

T/K = 310.15
pH = 7.2 ± 0.1
Composition: refer to page 87 .

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Shaking Time t/days	Mercury[a] ppm[b]	Concentration $10^7 c_1$/mol dm^{-3}	Mole Fraction $10^8 x_1$	Molality $10^7 m_1$/mol kg^{-1}
Water				
5	$0.078 \le 0.086 \le 0.090$	4.2 ± 0.2		
5	$0.078 \le 0.087 \le 0.095$	4.3 ± 0.3		
5	$0.070 \le 0.095 \le 0.120$	4.7 ± 1.0		
		4.4 ± 0.7[c]	8.0	4.4
Hanks' Balanced Salt Solution				
5	$0.173 \le 0.208 \le 0.243$	10.4 ± 1.7		10.4

[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 1×10^6 cm^3 of solution.

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

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Methionine; $C_5H_{11}NO_2S$; [63-68-3]

(3) Hanks' balanced salt solution

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

T/K = 310.15
pH = 7.2 ± 0.1
composition = See description on page 87 .

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Methionine	Mercury[a]	
t/days	c_2/mg dm^{-3}	ppm[b]	10^7c_1/mol dm^{-3}[c] (compiler)
5	0	$0.173 \leq 0.208 \leq 0.243$	10.4
5	0.01	$0.374 \leq 0.456 \leq 0.556$	22.7

[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] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Histidine monohydrochloride; $C_6H_9N_3O_2.HCl$; [645-35-2]

(3) Hanks' balanced salt solution

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/K = 310.15$
pH = 7.2 ± 0.1
composition = See description on page 87 .

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time t/days	L-Histidine HCl c_2/mg dm^{-3}	Mercury[a] ppm[b]	Mercury[a] 10^7c_1/mol dm^{-3}[c] (compiler)
5	0	$0.173 \leq 0.208 \leq 0.243$	10.4
5	0.01	$3.244 \leq 3.600 \leq 3.956$	179.5

[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] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) L-Cysteine hydrochloride; $C_3H_7NOS.HCl$; [52-89-1] (3) Hanks' balanced salt solution	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 ± 0.1 composition = See description on page 87 .	Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time t/days	L-Cysteine HCl c_2/mg dm^{-3}	Mercury[a] ppm[b]	Mercury[a] 10^7c_1/mol dm^{-3}[c] (compiler)
5	0	0.173 ≤ 0.208 ≤ 0.243	10.4
5	0.01	89.310 ≤ 100.000 ≤ 110.700	4985

[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] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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:

(1) Mercury; Hg; [7439-97-6]

(2) L-Ornithine monohydrochloride; $C_6H_{12}N_2O_2 \cdot HCl$; [3184-13-2]

(3) Hanks' balanced salt solution

ORIGINAL MEASUREMENTS:

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:

T/K = 310.15
pH = 7.2 ± 0.1
composition = See description on page 87 .

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Ornithine HCl	Mercury[a]	
t/days	c_2/mg dm^{-3}	ppm[b]	$10^7 c_1$/mol dm^{-3}[c] (compiler)
5	0	0.173 ≤ 0.208 ≤ 0.243	10.4
5	0.01	0.952 ≤ 0.988 ≤ 1.023	49.3

[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] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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:

(1) Mercury; Hg; [7439-97-6]

(2) L-Lysine monohydrochloride; $C_6H_{14}N_2O_2 \cdot HCl$; [657-27-2]

(3) Hanks' balanced salt solution

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

$T/K = 310.15$
pH = 7.2 ± 0.1
composition = See description on page 87 .

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Lysine HCl	Mercury[a]	
t/days	c_2/mg dm^{-3}	ppm[b]	$10^7 c_1$/mol dm^{-3} [c] (compiler)
5	0	$0.173 \leq 0.208 \leq 0.243$	10.4
5	0.01	$1.084 \leq 1.218 \leq 1.387$	60.72

[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] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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.
$\delta T/K$ Not given.

REFERENCES:

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) L-Arginine monohydrochloride; $C_6H_{14}N_4O_2 \cdot HCl$; [1119-34-2]

(3) Hanks' balanced salt solution

ORIGINAL MEASUREMENTS:

Kawakara, H.; Nakamura, M.; Ishizaki, N.; Yamada, T.; Kawamoto, T.; Hikari, S.; Sogawa, K.; Maehara, S.

Shika Rikogaku Zasshi 1979, *20*, 137 - 41.

VARIABLES:

T/K = 310.15
pH = 7.2 ± 0.1
composition = See description on page 87 .

PREPARED BY:

Hiroshi Miyamoto

EXPERIMENTAL VALUES:

Shaking Time	L-Arginine HCl	Mercury[a]	
t/days	c_2/mg dm^{-3}	ppm[b]	$10^7 c_1$/mol dm^{-3} [c] (compiler)
5	0	$0.173 \leq 0.208 \leq 0.243$	10.4
5	0.01	$0.315 \leq 0.340 \leq 0.365$	16.9

[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] This value calculated from the middle value of the three numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Metallic mercury (0.3 g) and 25 ml of amino acid 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 ± 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* 1962, *27*, 325.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Humus

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gjessing, E. T.; Rogne, A. K. G.

Vatten 1982, *38*, 406 - 8.

VARIABLES:

T/K Not given, assumed to be room temperature.

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Sample	pH		Color Pt, /mg dm^{-3}		TOC /mg dm^{-3}		Mercury Solubility
	Before	After	Before	After	Before	After	c_1/μgdm^{-3}
Ser. A							
H_2O	-	5.9	-	0	-	<0.5	7
1	4.5	4.6	154	181	-	16.5	14
2	6.7	6.7	26	30	-	4.2	7
3	6.8	6.8	24	28	-	4.9	8
4	6.8	6.8	51	55	-	6.2	10
5	6.6	6.7	24	26	-	4.3	8
Ser. B							
H_2O	-	5.7	-	0	-	0.6	9
6	4.4	4.4	74	80	13.3	11.6	19
7	4.4	4.5	96	104	14.8	16.1	21
8	5.4	5.5	78	82	9.9	10.1	13
Ser. C							
Blank	4.8	5.0	0	0	7.0	3.0	13
9	6.6	6.6	67	71	6.3	4.8	28
10	5.7	5.7	128	138	11.1	10.8	13
11	5.2	5.2	185	195	14.0	14.8	27
12	4.9	5.0	205	215	16.0	17.0	28
13	4.6	4.7	278	271	24.5	26.0	36

The before and after refer to before and after saturation with metallic mercury.

The H_2O samples are distilled water. The water solubility of 7 - 9 micrograms of mercury per liter of water correspond to a mole fraction solubility of (6 - 8) x 10^{-10} or a molality of (3.5 - 4.5) x 10^{-8}.

The blank was prepared to be an artificial "surface water" without organic material. Its composition is 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 samples are described further in the table below.

Sample Number	Location of Sample Taken	Date	Dilution of Mixing
1	Hellerudmyra	1980, Feb. 28	None
2	Byvann	1980, Mar. 4	None
3	Smavann	1980, Mar. 4	None
4	Smavannsbekk	1980, Mar. 4	None
5	Øvre Heffelivann	1980, Mar. 4	None
6	Hellerudmyra	1980, May 1	None
7			#1 and #6 mixed 1:1
8			#1 and #5 mixed 1:1
9			Blank and #13 mixed 3:1
10			Blank and #4 mixed 1:1
11			Blank and #4 mixed 1:2
12			Blank and #4 mixed 1:3
13	Hellerudmyra	1980, June 22	None

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Humus

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gjessing, E. T.; Rogne, A. K. G.

Vatten 1982, *38*, 406 - 8.

VARIABLES:

T/K Not given, assumed to be room temperature.

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

The color and the total organic carbon, TOC, are measures of the humus in the samples. The authors show that "dissolvable" mercury increases linearly with both color and TOC.

The problem with the results of this study is that the reported mercury concentration in water is about one-tenth the value reported by most other workers at 298.15 K.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The experiment was performed by adding an aliquot amount of pure mercury (5 drops per 500 cm^3 from a polarographic analyzer) to natural humus water samples from several different locations. Some of the samples were diluted with artificial "surface water" without organic material [see description of 'blank' on other data sheet]. Thus the experiment covered a wide range of humus concentrations. All samples were filtered through glass-fiber-filters (Whatman GF/C) before adding the mercury. The samples were left on a shaking table for 19 hours and the supernatant analyzed for mercury by atomic absorption spectrophotometry (Perkin Elmer 460).

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Stated to be pure mercury.

(2) Humus. Natural humus water. See information on other sheet.

(3) Water. Distilled.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Whole blood

ORIGINAL MEASUREMENTS:

Hursh, J. B.

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

VARIABLES:

T/K = 283 - 310

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature $t/°C$	Temperature T/K	Sample	Carrier Gas	Ostwald Coefficient[a] Av. ± SE (no.)	Concentration[b] $10^7 c_1/\text{mol dm}^{-3}$
10	283.15	Whole blood	Air	10.50 ± 0.25(5)	3.06
		Whole blood (heparin no ethanol)	Air	10.36 ± 0.22(3)	3.02
		Whole blood (heparin no ethanol)	N_2	11.12 ± 0.30(4)	3.24
22	295.15	Whole blood	Air	6.62 ± 0.06(5)	5.37
37	310.15	Whole blood	Air	4.20 ± 0.08(5)	10.9

[a] The Ostwald coefficient is ((ng Hg/mL fluid)/(ng Hg/mL air)). Given above is the average ± 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	283	295	310
p_1°/Pa	6.869	19.90	66.89
$c_1^{\circ}/(\text{ng Hg/mL air})$	5.85	16.27	52.03

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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. The whole blood results were adjusted to a hematocrit of 42 %. Blood specific gravity was taken as 1.057. An empirical correction was made for Hg oxidized during the experiment. The added ethanol inhibits the oxidation.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Prepared by reduction of $^{203}HgCl_2$. The Hg vapor is swept into a leak-proof Saran bag.

(2) Whole blood. Red Cross fresh blood was used within 72 hours of withdrawal. As received, each 450 mL of blood was mixed with 63 mL CPDA-1 anticoagulant containing 2.0 g dextrose, 1.66 g Na citrate, 206 mg citric acid, 149 mg Na_2HPO_4, and 17.3 mg adenine. At time of use 30 μL 95 % ethanol was added to 10 mL blood samples to inhibit Hg oxidation. Samples labelled (heparin no ethanol) were fresh drawn blood to check effect of additives. The effect was considered negligible.

REFERENCES:

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Plasma

ORIGINAL MEASUREMENTS:

Hursh, J. B.

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

VARIABLES:

T/K = 283 - 310

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	Carrier Gas	Ostwald Coefficient[a] Av. ± SE (no.)	Concentration[b] $10^7 c_1$/mol dm^{-3}
10	283.15	Air	5.76 ± 0.15(5)	1.68
22	295.15	Air	3.36 ± 0.04(5)	2.94
37	310.15	Air	2.40 ± 0.03(5)	6.23

[a] The Ostwald coefficient is ((ng Hg/mL fluid)/(ng Hg/mL air)). Given above is the average ± 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	283	295	310
p_1°/Pa	6.869	19.90	66.89
c_1°/(ng Hg/mL air)	5.85	16.27	52.03

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Prepared by reduction of ^{203}HgCl$_2$. The Hg vapor is swept into a leak-proof Saran bag.

(2) Plasma. Prepared from the Red Cross fresh whole blood described on the previous data sheet.

ESTIMATED ERROR:

REFERENCES:

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Hemoglobin

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Hursh, J. B.

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

VARIABLES:

T/K = 295

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	T/K	Hemoglobin wt. %	Carrier Gas	Ostwald Coefficient[a]	Concentration[b] $10^7 c_1$/mol dm^{-3}
22	295.15	0[c]	-	(3.05)	(2.47)
		2.32	Air	3.44, 3.51	2.79, 2.85
		6.50	Air	4.49, 4.65	3.64, 3.77
		(14.0)	-	(6.05)	(4.91)

[a] The Ostwald coefficient is ((ng Hg/mL fluid)/(ng Hg/mL air)).

[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 calculated values at 295.15 K are mercury vapor pressure 19.90 Pa and vapor concentration 16.27 ng Hg/mL air.

[c] The value for water, 0 wt. % hemoglobin, is from a graphical extrapolation of the other three values (Fig. 3 in the paper). The value is about 5 % smaller than the value of 3.22 at 295.15 K calculated by the compiler from the results in the mercury + water evaluation. The value at 14.0 wt. % hemoglobin is a value calculated from the whole blood Ostwald coefficient assuming a contribution of 0.57 from the lipid and the remaining solubility due to the hemoglobin and water (see Fig. 3).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Prepared by reduction of $^{203}HgCl_2$. The Hg vapor is swept into a leak-proof Saran bag.

(2) Hemoglobin. Fisher Hemoglobin powder. Content determined in subsequent analysis.

(3) Water. Distilled.

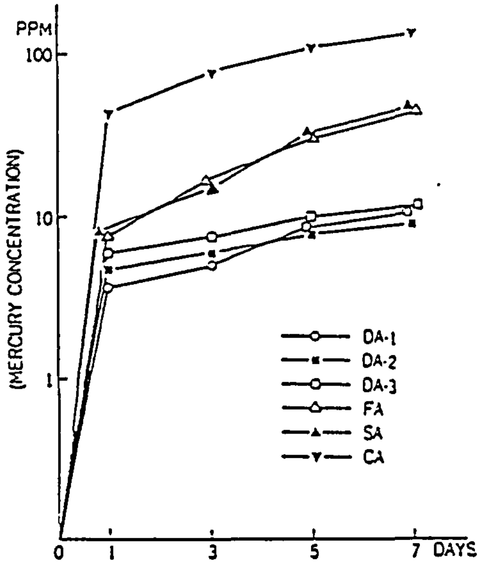
ESTIMATED ERROR:

REFERENCES:

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

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (From various dental amalgams) (2) Tissue culture medium; YLH	Kawahara, H.; Yamada, T.; Nakamura, M.; Tomoda, T.; Kobayashi, H.; Saijo, A.; Kawata, Y.; Hikari, S. *Shika Rikogaku Zassi* <u>1981</u>, *22*, 295 - 9. *Chem. Abstr.* <u>1982</u>, *96*, 91615a.

EXPERIMENTAL VALUES:



Mercury solubility from amalgams in YLH.

Solubility of mercury (ppm = parts per million) in YLH tissue culture medium as a function of time.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Six dental alloys were used. Their properties are listed below.

Dental Alloy	Manufacturer	Abbreviation	Composition / weight %				
			Hg	Ag	Sn	Cu	Other
Alloy for high copper amalgams							
Spherical D	Shofu	DA - 1	46	33	12	7	2
Dispersalloy	J and J	DA - 2	50	35	8	7	-
Dialloy	G - C	DA - 2	45	33	14	5	3
Alloy for conventional and copper amalgams							
Spherical amalgam alloy	Shofu	SA	46	38	15	2	-
Non zinc Luna alloy	G - C	FA	62	27	10	1	-
Copper amalgam	Nimi	CA	63-74	-	-	37-26	-

The figure reproduced from *Shika Rikogaku Zassi* by permission of the publisher and the authors.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
(From various dental amalgams)

(2) Tissue culture medium; YLH

ORIGINAL MEASUREMENTS:

Kawahara, H.; Yamada, T.; Nakamura, M.; Tomoda, T.; Kobayashi, H.; Saijo, A.; Kawata, Y.; Hikari, S.

Shika Rikogaku Zassi 1981, *22*, 295 - 9.
Chem. Abstr. 1982, *96*, 91615a.

VARIABLES:

$T/\mathrm{K} = 310$

PREPARED BY:

H. Miyamoto

SOURCE AND PURITY OF MATERIALS (continued):

(2) Tissue culture medium (YLH).

The following components are dissolved in water.

Component	c/mg dm^{-3}
NaCl	8000.0
KCl	400.0
$Na_2HPO_4 \cdot 2H_2O$	60.0
KH_2PO_4	60.0
$MgSO_4 \cdot 7H_2O$	200.0
$CaCl_2$ (anhyd.)	140.0
Glucose	1000.0
Lactalbumin Hydrolysate	5000.0
Yeast extract	1000.0
$NaHCO_3$	700.0
Phenol red	5.0
Penicillin	100.000 unit
Streptomycin	100 mg

The figure is reproduced in a review paper.

Kawahara, H.; Tomoda, T.; Kukizaki, H.; Ogitani, Y.; Mitsutani, M.; Nomura, Y.; Ikeda, H.; Kooda, Y.; Yokota, S.; Sakaguchi, K.; Iseki, T.; Yamanaka, M. *Bosei Kanri* 1982, *26(3)*, 84 - 92;
Chem. Abstr. 1983, *98*, 90150z.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solutes were six dental amalgams. The alloy powder and pure mercury were mechanically triturated. The triturated dental amalgam was placed in the tissue culture medium (YLH) at 37°C and rotated at 200 rpm for seven days. The amalgam surface area/YLH solution volume ratio is 1 cm²/50 ml.

Solution samples were taken on days 1, 3, 5, and 7. The mercury concentration in the YLH solution was determined by atomic absorption spectroscopy.

The results are presented graphically. A copy of the figure is shown on the previous page. The solubility is still increasing after seven days. The effect is greatest for the copper amalgam.

It is not clear that air (oxygen) was excluded.

REFERENCES:

Two additional studies on the solubility of metal from dental amalgams in saliva and in tissue culture media are:

Kawahara, H.; Tomoda, T.; Tomoda, S.; Sakae, H.; Yokoyama, A.; Suganami, S. *J. Jpn. Soc. Biomater.* 1983, *1(1)*, 69 - 76.

Kawahara, H.; Tomoda, T.; Tomoda, S.; Nomura, Y.; Matsumoto, A.; Kohda, H. *J. Jpn. Soc. Biomater.* 1983, *1(1)*, 77 - 84.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Alkanes	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1985, June

CRITICAL EVALUATION:

An Evaluation of the Solubility of Mercury in Alkanes.

The solubility of mercury in alkanes is reported in seven papers. Three of the papers are from the laboratory of A. F. Voigt. The other papers report independent measurements. The solvents include five normal alkanes and five branched alkanes. The solubility measurements were made over the 273 to 336 K range of temperature. Several of the papers report only smoothed data. Two authors, A. F. Voigt, Iowa State University, and S. Okouchi, Hosei University, kindly provided us with a full set of their experimental measurements to supplement the published values. The solubility of mercury in normal and branched alkanes is evaluated in separate sections.

I. Mercury + Normal Alkanes

When preparing the mercury + normal alkane molal solubility values for evaluation, it was observed that the solubility values at 298.15 K were independent of the solvent. The thirteen solubility values in pentane, hexane, heptane, octane and decane averaged 9.4 ± 0.6 mol kg^{-1}, or omitting the one outlaying value, the remaining twelve values averaged 9.6 ± 0.1 mol kg^{-1}. Further inspection of the data showed a similar constancy of the molal solubility at other temperatures although there were not as many data points to be as convincing as the data at 298.15 K.

Figure 1 shows $\ln(m_1/\text{mol kg}^{-1})$ vs. $1000/(T/\text{K})$. Five solubility values deviated significantly from the line and were not used. They are Reichardt and Bonhoeffer's value in hexane at 336.15 K, Spencer and Voigt's value in octane at 313.15 K, Klehr and Voigt's values in decane at 308.15 and 318.15 K, and Kuntz and Mains's value in decane at 298.15 K.

Fifty-two of the fifty-seven mercury molal solubility values were combined in a linear regression to obtain the equation

$$\ln(m_1/\text{mol kg}^{-1}) = (5.105848 \pm 0.157626) - (49.70898 \pm 0.46401)/(T/100\ \text{K})$$

with a standard error about the regression line of 4.0 x 10^{-7}.

The constants of the equation give thermodynamic changes for the transfer of one mole of mercury from the liquid metal to the hypothetical one molal solution of

$$\Delta H_1/\text{kJ mol}^{-1} = 41.33 \pm 0.39 \text{ and } \Delta S_1/\text{J K}^{-1}\text{ mol}^{-1} = 42.45 \pm 1.31.$$

Table 1 summarizes the experimental molal solubility values, the average molal solubility at each temperature for all of the data for the five solvents, an average value omitting the doubtful value at each temperature, and the value from the smoothing equation. The smoothed values agree well with the experimental value averages. We believe the equation can be used with caution to predict the solubility in other normal hydrocarbons at temperatures beyond the experimental range.

The saturation concentration fits a similar pattern but with a little larger uncertainty. For the saturation concentration, the equation is

$$\ln(c_1/\text{mol dm}^{-3}) = (4.239037 \pm 0.247227) - (48.30896 \pm 0.72777)/(T/100\ \text{K}).$$

The smoothed values from the equation at selected temperatures are also in Table 1.

Each system is discussed separately with respect to the mole fraction solubility.

Mercury + Pentane; C_5H_{12}; [109-66-0]

Kuntz and Mains (ref. 4) report one solubility value at 298.15 K. Okouchi and Sasaki (ref. 7) report values at six temperatures between 278.15 and 313.15 K. The values at 298.15 K agree within 1.5 percent. All values were combined in a linear regression to obtain the equation for the 278 to 313 K temperature interval

Table 1. The solubility of mercury in normal alkanes.

Alkane	Molal solubility, $10^6 m_1$/mol kg^{-1}, at temperatures of											Ref.
	273.15	278.15	283.15	288.15	293.15	298.15	303.15	308.15	313.15	318.15	336.15	
Pentane	-	2.6	3.7	-	6.4	9.4	12.8	-	22.	-	-	(7)
	-	-	-	-	-	9.3	-	-	-	-	-	(4)
Hexane	-	2.8	3.9	-	6.8	9.6	13.	-	22.	-	-	(7)
	-	-	-	-	-	9.8	-	-	-	-	-	(4)
	2.1	-	-	5.6	7.3	9.6	12.6	16.1	-	-	-	(5)
	-	-	-	-	-	9.5	-	-	-	-	-	(2)
	-	-	-	-	-	-	-	-	21.	-	82.8	(1)
Heptane	-	2.9	3.7	-	7.1	9.6	12.0	-	22.	-	-	(7)
	2.0	-	-	5.4	7.0	9.7	12.6	16.2	-	-	-	(5)
Octane	-	2.9	4.1	-	6.9	9.6	12.0	-	20.	-	-	(7)
	2.2	-	-	5.4	-	9.6	12.4	15.5	18.2	-	-	(5)
	-	-	-	-	-	9.6	-	-	-	-	-	(6)
Nonane	-	-	-	-	-	-	-	-	-	-	-	
Decane	2.8	-	4.1	6.1	6.7	9.6	11.9	13.4	-	18.7	-	(3)
	-	-	-	-	-	7.6	-	-	-	-	-	(4)
Av. all	2.3 ±0.4	2.8 ±0.2	3.9 ±0.2	5.6 ±0.3	6.9 ±0.3	9.4 ±0.6	12.4 ±0.4	15.3 ±1.3	20.9 ±1.5	18.7	82.8	
omit one	2.1 ±0.1					9.6 ±0.1		15.9 ±0.4	21.4 ±0.9			
Equation molal (m)	2.06	2.86	3.92	5.31	7.13	9.48	12.48	16.28	21.06	27.03	62.4	
concentration (c)	1.45	1.99	2.70	3.63	4.83	6.37	8.32	10.78	13.84	17.64	39.8	

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Alkanes

EVALUATOR:

H. Lawrence Clever
Chemistry Department
Emory University
Atlanta, Georgia 30322 USA

1985, June

CRITICAL EVALUATION:

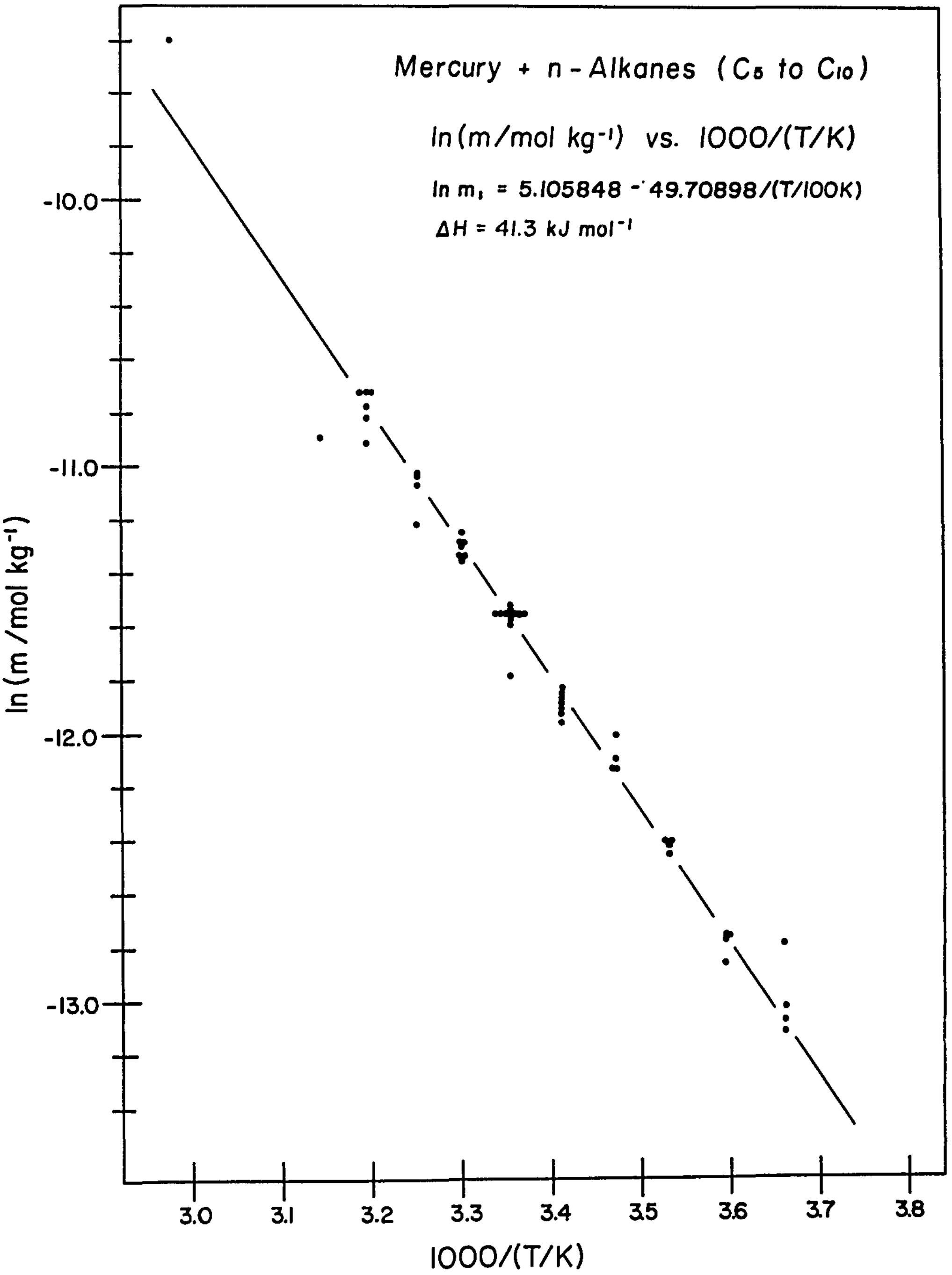


Figure 1. The solubility of mercury in normal alkanes. $\ln(m/\text{mol kg}^{-1})$ vs. $1000/(T/\text{K})$

Horizontal cluster of points indicate the number of independent data points of one value. Vertical clusters are independent values at a given temperature.

$$\ln x_1 = (3.58822 \pm 0.40979) - (53.06278 \pm 1.20755)/(T/100\ \text{K})$$

with a standard error about the regression line of 2.2×10^{-8}. The thermodynamic changes for the transfer of one mole of mercury from the liquid metal to the infinitely dilute solution are

$$\Delta H_1/\text{kJ mol}^{-1} = 44.1 \pm 1.0 \text{ and } \Delta S_1/\text{J K}^{-1}\text{ mol}^{-1} = 29.8 \pm 3.4.$$

Smoothed values of the mole fraction solubility are in Table 2.

Mercury + Hexane; C_6H_{14}; [110-54-3]

Reichardt and Bonhoeffer (ref. 1) report solubility values at 313.15 and 336.15 K, Moser and Voigt (ref. 2) report distribution data from which we estimated one solubility value at 298.15 K, Kuntz and Mains (ref. 4) report one value at 298.15 K, Spencer and Voigt (ref. 5) report six solubility values between 273.15 and 308.15 K and Okouchi and Sasaki (ref. 7) report six values between 278.15 and 313.15 K. At least three quite different methods were used. The only value that appears doubtful is the 336.15 K value of Reichardt and Bonhoeffer which appears to be about 15 percent too large. All except the 336.15 K value were treated by a linear regression to obtain the equation

$$\ln x_1 = (2.76226 \pm 0.16258) - (49.9972 \pm 0.4804)/(T/100\ \text{K})$$

with a standard error about the regression line of 2.5×10^{-8}.

The thermodynamic changes for the transfer of one mole of mercury from the liquid metal to the infinitely dilute solution are

$$\Delta H_1/\text{kJ mol}^{-1} = 41.6 \pm 0.4 \text{ and } \Delta S_1/\text{J K}^{-1}\text{ mol}^{-1} = 23.0 \pm 1.4.$$

Smoothed values of the mole fraction solubility are in Table 2.

Mercury + Heptane; C_7H_{16}; [142-82-5]

Spencer and Voigt (ref. 5) report six solubility values between 273.15 and 308.15 K; Okouchi and Sasaki (ref. 7) report six solubility values between 278.15 and 313.15 K.

The two data sets were combined in a linear regression to obtain the equation

$$\ln x_1 = (3.10124 \pm 0.19810) - (50.5916 \pm 0.58183)/(T/100\ \text{K})$$

with a standard error about the regression line of 2.9×10^{-8}.

The thermodynamic changes for the transfer of one mole of mercury from the liquid metal to the infinitely dilute solution are

$$\Delta H_1/\text{kJ mol}^{-1} = 42.1 \pm 0.5 \text{ and } \Delta S_1/\text{J K}^{-1}\text{ mol}^{-1} = 25.8 \pm 1.6.$$

The mole fraction solubility values have an average deviation from the regression line of 2.2 percent and a maximum deviation of 5.4 percent. The Okouchi and Sasaki data show more scatter (Av. dev. 2.9%) than the Spencer and Voigt data (Av. dev. 1.4%). Smoothed mole fraction solubility values are in Table 2.

Mercury + Octane; C_8H_{18}; [111-65-9]

As for the heptane, both Spencer and Voigt (ref. 5) and Okouchi and Sasaki (ref. 7) report six solubility values. Vogel and Gjaldbaek (ref. 6) report one value at 298.15 K. All three papers report a mole fraction solubility of 11.0×10^{-7} at 298.15 K. All data were combined in a linear regression to obtain the equation

$$\ln x_1 = (2.03628 \pm 0.23584) - (47.07542 \pm 0.69681)/(T/100\ \text{K})$$

with a standard error about the regression line of 6.2×10^{-8}.

The thermodynamic changes for the transfer at one mole of mercury from the liquid metal to the infinitely dilute solution are

$$\Delta H_1/\text{kJ mol}^{-1} = 39.1 \pm 0.6 \text{ and } \Delta S_1/\text{J K}^{-1}\text{ mol}^{-1} = 16.9 \pm 2.0.$$

Smoothed values of the mole fraction solubility are in Table 2.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Alkanes	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1985, June

CRITICAL EVALUATION:

Mercury + Decane; $C_{10}H_{22}$; [124-18-5]

Klehr and Voigt (ref. 3) report eight solubility values between 273.15 and 318.15 K. Kuntz and Mains (ref. 4) report one value at 298.15 K. The Kuntz and Mains value is one of the few values that does not fit the molality plot well (fig. 1). Thus, we consider it doubtful. The Klehr and Voigt paper is the first attempt of measuring mercury solubility in a hydrocarbon from that laboratory. Although the evidence is not as strong as we would like, we feel the Klehr and Voigt values at 308.15 and 318.15 K are also doubtful. The three doubtful values were omitted and the other values treated by a linear regression to obtain the equation

$$\ln x_1 = (0.05995 \pm 0.94229) - (40.5530 \pm 2.7261)/(T/100\ \text{K})$$

with a standard error about the regression line of 6.8×10^{-8}.

The thermodynamic changes for the transfer of one mole of mercury from the liquid metal to the infinitely dilute solution are

$$\Delta H_1/\text{kJ mol}^{-1} = 33.7 \pm 2.3 \text{ and } \Delta S_1/\text{J K}^{-1}\text{ mol}^{-1} = 0.5 \pm 7.8$$

smoothed solubility values are in Table 2.

We are concerned that the thermodynamic properties for decane differ so much from the values for the other normal alkanes.

Table 2. The solubility of mercury in normal alkanes. Tentative values of the mole fraction solubility as a function of temperature.

T/K	Mole Fraction solubility, $10^7 x_1$, in the normal alkanes Pentane	 Hexane	 Heptane	 Octane	 Decane
273.15	-	1.8	2.0	2.5	3.8
278.15	1.9	2.5	2.8	3.4	4.9
283.15	2.6	3.4	3.9	4.6	6.4
288.15	3.6	4.6	5.3	6.2	8.2
293.15	5.0	6.2	7.1	8.1	10.4
298.15	6.7	8.3	9.5	10.6	13.2
303.15	9.0	10.9	12.6	13.8	16.5
308.15	12.0	14.2	16.5	17.8	20.4
313.15	15.8	18.4	21.4	22.7	25.2
318.15	-	23.8	-	-	30.9
323.15	-	30.3	-	-	-
328.15	-	38.4	-	-	-
333.15	-	48.3	-	-	-
338.15	-	60.3	-	-	-
$\Delta H_1{}^a$	44.1 ± 1.0	41.6 ± 0.4	42.1 ± 0.5	39.1 ± 0.6	33.7 ± 2.3
$\Delta S_1{}^b$	29.8 ± 3.4	26.0 ± 1.4	25.8 ± 1.6	16.9 ± 2.0	0.5 ± 7.8

[a] units kJ mol^{-1}

[b] units J K^{-1} mol^{-1}

II. Mercury + Branched Alkanes.

Although there are solubility data on five branched alkanes, there are many fewer values than there were for the five normal alkanes. The molality correlation for the normal alkanes does not hold true for the branched alkanes. The mole fraction solubilities at 298.15 K fall in a narrow range of values, but there are not enough data to support a generalization. The solubility of mercury is less in the branched alkane than in the corresponding normal alkane at a given temperature. This is expected because the branched hydrocarbons are of smaller cohesive energy density than the corresponding normal alkane. Thus, the cohesive energy difference between mercury and branched alkanes is larger that between mercury and normal alkanes, and the branched alkane solvent is less ideal. Each system is discussed below.

Mercury + 2-Methylbutane; C_5H_{12}; [78-78-4]

The only measurement is that of Kuntz and Mains (ref. 4) at 298.15 K. It is classed as tentative. The value appears in the Tables 3, 4 and 5.

Mercury + 3-Methylpentane; C_6H_{14}; [96-14-0]

The only measurement is that of Kuntz and Mains (ref. 4) at 298.15 K. It is classed as tentative. The value appears in the Tables 3, 4 and 5.

Mercury + 2,2-Dimethylbutane; C_6H_{14}; [75-83-2]

Kuntz and Mains (ref. 4) report one measurement at 298.15 K and Spencer and Voigt (ref. 5) report six values between temperatures of 273.15 and 308.15 K. All of the data were combined in a linear regression to obtain the equations

$$\ln(c_1/\text{mol dm}^{-3}) = (1.89608 \pm 0.31898) - (42.21314 \pm 0.93774)/(T/100\ \text{K})$$

$$\ln(m_1/\text{mol kg}^{-1}) = (2.93988 \pm 0.32646) - (44.0108 \pm 0.9597)/(T/100\ \text{K})$$

$$\ln x_1 = (0.23496 \pm 0.43775) - (43.2397 \pm 1.2869)/(T/100\ \text{K})$$

with standard errors about the regression line of 1.5×10^{-7}, 2.6×10^{-7}, and 2.8×10^{-8}, respectively.

The thermodynamic changes for the transfer of one mole of mercury from the liquid metal to the solution and smoothed solubility values are in Tables 3, 4 and 5.

Mercury + 2,3-Dimethylbutane; C_6H_{14}; [79-29-8]

The only measurement is that of Kuntz and Mains (ref. 4) at 298.15 K. It is classed as tentative. The value appears in Tables 3, 4 and 5.

Mercury + 2,2,4-Trimethylpentane; C_8H_{18}; [540-84-1]

Kuntz and Mains (ref. 4) and Vogel and Gjaldbaek (ref. 6) each report one value at 298.15 K. Spencer and Voigt (ref. 5) report seven values between 273.15 and 308.15 K. At 298.15 K, the Vogel and Gjaldbaek and the Spencer and Voigt values agree within three percent while the Kuntz and Mains value is about 10 percent larger that the average of the other two. We classify all three data sets tentative, but we have used only the Vogel and Gjaldbaek and Spencer and Voigt data in the linear regression to obtain the equations

$$\ln(c_1/\text{mol dm}^{-3}) = (3.19617 \pm 0.44480) - (46.5373 \pm 1.3034)/(T/100\ \text{K})$$

$$\ln(m_1/\text{mol kg}^{-1}) = (3.97728 \pm 0.43080) - (47.7399 \pm 1.2624)/(T/100\ \text{K})$$

$$\ln x_1 = (1.84306 \pm 0.44990) - (47.8583 \pm 1.3184)/(T/100\ \text{K})$$

with standard errors about the regression line of 1.3×10^{-7}, 2.1×10^{-8}, and 2.3×10^{-8}, respectively.

Smoothed solubility data and thermodynamic changes for the transfer of one mole of mercury from the liquid metal to the solution are in Tables 3, 4 and 5.

The solubility values in Tables 3, 4 and 5 are classed as tentative. The enthalpy and entropy changes on solution are smaller for the branched than for the normal alkanes. Since there are only limited data on two branched alkane solvents, it is not possible to judge whether or not the smaller values are significant.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Alkanes	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1985, June

CRITICAL EVALUATION:

Table 3. Solubility of mercury in branched alkanes. Tentative values of the saturation concentration as a function of temperature.

T/K	Saturation concentration, $10^6 c_1$/mol dm^{-3}, in the branched alkanes				
	2-Methyl butane	3-Methyl pentane	2,2-dimethyl butane	2,3-dimethyl butane	2,2,4-trimethyl pentane
273.15			1.3		0.97
278.15			1.7		1.3
283.15			2.2		1.8
288.15			2.9		2.4
293.15			3.7		3.1
298.15	5.5	5.1	4.7	6.0	4.1
303.15			6.0		5.3
308.15			7.5		6.7
$\Delta H_1{}^a$			35.1 ± 0.8		38.7 ± 1.1
$\Delta S_1{}^b$			15.8 ± 2.7		26.6 ± 3.7

^{a} units kJ mol^{-1}
^{b} units J K^{-1} mol^{-1}

Table 4. Solubility of mercury in branched alkanes. Tentative values of the saturation molality solubility as a function of temperature.

T/K	Saturation molality, $10^6 m_1$/mol kg^{-1}, in the branched alkanes				
	2-Methyl butane	3-Methyl pentane	2,2-dimethyl butane	2,3-dimethyl butane	2,2,4-trimethyl pentane
273.15			1.9		1.4
278.15			2.5		1.9
283.15			3.4		2.5
288.15			4.4		3.4
293.15			5.7		4.5
298.15	8.9	7.7	7.3	9.1	5.9
303.15			9.4		7.7
308.15			11.9		10.0
$\Delta H_1{}^a$			36.6 ± 0.8		39.7 ± 1.0
$\Delta S_1{}^b$			24.4 ± 2.7		33.1 ± 3.6

^{a} units kJ mol^{-1}
^{b} units J K^{-1} mol^{-1}

Table 5. Solubility of mercury in branched alkanes. Tentative values of the mole fraction solubility as a function of temperature.

T/K	Mole fraction solubility, $10^7 x_1$, in the branched alkanes 2-Methyl butane	3-Methyl pentane	2,2-dimethyl butane	2,3-dimethyl butane	2,2,4-trimethyl pentane
273.15			1.7		1.5
278.15			2.2		2.1
283.15			2.95		2.9
288.15			3.8		3.9
293.15			5.0		5.1
298.15	6.5	6.7	6.4	7.9	6.7
303.15			8.1		8.8
308.15			10.2		11.4
ΔH_1[a]			36.0 ± 1.1		39.8 ± 1.1
ΔS_1[b]			2.0 ± 3.7		15.3 ± 3.7

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

REFERENCES:

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

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

3. Klehr, E. H.; Voigt, A. F. *Radioisotopes Phys. Sci. Ind., Proc. Conf. Use, Copenhagen* 1960, *1*, 517-29 (Pub. 1962).

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

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

6. Vogel, A.; Gjaldbaek, J. C. *Arch. Pharm. Chem. Sci. Ed.* 1974, *2*, 25-9.

7. 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.

8. Moser, H. C.; Voigt, A. F. USAEC Report 1957, ISC-892.

ADDED NOTE:

All of the solubility values reported by Kuntz and Mains (ref. 4) are based on the hexane solubility value at 298.15 K reported by Moser and Voigt (ref. 8). See the Moser and Voigt data sheet, p. 114. Thus, there is a relationship between the Kuntz and Mains solubility values and the Moser and Voigt data.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Pentane; C_5H_{12}; [109-66-0]

ORIGINAL MEASUREMENTS:

Kuntz, R. R.; Mains, G. J.

J. Phys. Chem. 1964, *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 $10^6 c_1/\text{mol dm}^{-3}$	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1/\text{mol kg}^{-1}$
25	298.15	5.8	6.7	9.3

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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 $\varepsilon_{2560} = 7.35 \times 10^3\ \text{dm}^3\ \text{mol}^{-1}\ \text{cm}^{-1}$ at 25°C. The value was used to calculate the solubility in the other solvents.

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) Pentane. Phillips "pure grade" hydrocarbon solvents; purified by passage through silica gel until optically pure, degassed and distilled.

ESTIMATED ERROR:

REFERENCES:

1. Moser, H. C.; Voigt, A. F.
USAEC Report 1957, ISC-892.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Pentane; C_5H_{12}; [109-66-0]

ORIGINAL MEASUREMENTS:

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.

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 $10^6 c_1$/mol dm^{-3}	Mole Fraction $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
5	278.15	1.7	1.9	2.6
10	283.15	2.4	2.7	3.7
20	293.15	4.0	4.6	6.4
25	298.15	5.9	6.8	9.4
30	303.15	7.9	9.3	12.8
40	313.15	13	16	22

^{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 two equations. The second is preferred.

$$\log x_1 = (17.375)\log(T/K) - 49.169$$
$$\log x_1 = 1.3840 - 2256.1/(T/K)$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Purified as did Glew and Hames (ref. 1).

(2) Pentane. Analytical reagent grade. Passed through activated alumina and distilled.

ESTIMATED ERROR:

δT/K = $\pm$0.1
$\delta x_1/x_1$ = $\pm$(0.03 - 0.05) (compilers)

REFERENCES:

1. Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1971, *49*, 3114.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) 2-Methylbutane or *Iso*pentane; C_5H_{12}; [78-78-4]

ORIGINAL MEASUREMENTS:

Kuntz, R. R.; Mains, G. J.

J. Phys. Chem. 1964, *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 $10^6 c_1$/mol dm^{-3}	Mole Fraction[a] $10^7 x_1$	Molality[a] $10^6 m_1$/mol kg^{-1}
25	298.15	5.5	6.5	8.9

[a] Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) *Iso*pentane. Phillips "pure grade" hydrocarbon solvents; purified by passage through silica gel until optically pure, degassed and distilled.

ESTIMATED ERROR:

REFERENCES:

1. Moser, H. C.; Voigt, A. F. USAEC Report 1957, ISC-892.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

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]	c_1/mg dm^{-3}	Concentration[a] 10^5c_1/mol dm^{-3}	Mole Fraction[a] 10^6x_1	Molality[a] 10^5m_1/mol kg^{-1}
40	313.15	2.7	1.3	1.8	2.1
63	336.15	10.3	5.13	7.14	8.28

[a]Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury.

(2) Hexane.

ESTIMATED ERROR:

δc_1/mg dm^{-3} = ±(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:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Moser, H. C.; Voigt, A. F.

USAEC Report 1957, ISC-892.
Chem. Abstr. 1958, *52*, 10691h.

VARIABLES:

T/K = 298.15

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration 10^6c_1/mol dm^{-3}	Mole Fraction^a 10^7x_1	Molality^a 10^6m_1/mol kg^{-1}
25	298.15	6.1 - 6.7	8.0 - 8.8	9.3 - 10.2

^{a}Calculated by compilers.

Note: All of the results of Kuntz and Mains (ref. 1) are based on the hexane solubility value of Moser and Voigt. Apparently Kuntz and Mains averaged the values from the range above and referenced all of their values to 6.4 x 10^{-6} mol dm^{-3} value in hexane at 298.15K.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A globule of Hg metal prepared from radioactive mercury(II) nitrate by reduction with hypophosphorous acid was equilibrated with 5 - 10 ml of liquid by shaking in a thermostat. Aliquotes of the liquid were withdrawn periodically for up to two weeks and the Hg concentration determined radiochemically.

The aliquot was diluted with acetone and equilibrated with $Hg(NO_3)_2$ carrier to exchange the radioactive mercury. The mercury was precipitated as HgS, mounted on a stainless steel planchet and counted with a Geiger-Mueller tube.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Oak Ridge National Lab; recieved as 0.31 M $Hg(NO_3)_2$ in 1.56 M HNO_3 solution. Initial activity 50 millicuries g^{-1}; half-life 48 days. Reduced to Hg by hypophosphorous acid; coagulated to a Hg droplet by addition of concentrated HI.

(2) Hexane. Phillips Petroleum Co. "pure grade"; shaken with concentrated H_2SO_4 and alkaline $KMnO_4$, passed through a column of dry activated Al_2O_3, and redistilled.

ESTIMATED ERROR:

δT/K = ± 0.1

REFERENCES:

1. Kuntz, R. R.; Mains, G. J. *J. Phys. Chem.* 1964, *68*, 408.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Moser, H. C.; Voigt, A. F.

J. Am. Chem. Soc. 1957, *79*, 1837 - 9.

VARIABLES:

T/K = 298.15

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Distribution Constant	Mercury Solubility		
t/°C	T/K[a]	$E° = c_1\text{aq}/c_1\text{org}$	Concentration[a] $10^6 c_1$/mol dm^{-3}	Mole Fraction[a] $10^7 x_1$	Molality[a] $10^6 m_1$/mol kg^{-1}
25.0	298.15	0.048	6.2_5	8.2	9.5

[a] Calculated by compiler.

The above mercury solubility value was calculated using the free mercury solubility in water of 3.0 x 10^{-7} mol dm^{-3}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The distribution of mercury-203 between aqueous and organic phases was measured. Dilute solutions of 0.01 molar HNO_3 containing a known amount of pure mercurous nitrate were shaken with an equal volume of organic liquid for about 12 hours. Both phases were analyzed for total mercury by first converting to Hg^{2+}, precipitation as HgS, and counting in a thin window Geiger counter.

In the aqueous phase the disproportionation

$$Hg_2^{2+}(aq) = Hg^{2+}(aq) + Hg(aq)$$

and possibly the dissociation

$$Hg_2^{2+}(aq) = 2\ Hg^+(aq)$$

take place. It is assumed that only metallic Hg is extracted into the organic phase.

The distribution of total Hg in the aqueous phase to total Hg in the organic phase is determined as a function of total Hg in the organic phase. From the slope and intercept, the authors obtain values of the metallic Hg distribution ratio.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Oak Ridge National Lab; obtained as a high specific activity solution of mercury(II) nitrate containing isotope 203. In the 0.01 molar HNO_3 solution of mercury(I) nitrate, the authors estimate 96% mercury(II) is Hg^{2+} and 99% of the mercury(I) is Hg_2^{2+}. At this acidity, there is no minimum hydrolysis and nitrato complex formation.

(2) Hexane. Phillips "pure grade".

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

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 $10^6 c_1/\text{mol dm}^{-3}$	Mole Fraction[a] $10^7 x_1$	Molality[a] $10^6 m_1/\text{mol kg}^{-1}$
25	298.15	6.4	8.4	9.8

[a] Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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 $\varepsilon_{2560} = 7.35 \times 10^3 \text{ dm}^3 \text{ mol}^{-1} \text{ cm}^{-1}$ at 25°C. The value was used to calculate the solubility in the other solvents.

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) Hexane. Phillips "pure grade" hydrocarbon solvents; purified by passage through silica gel until optically pure, degassed and distilled.

ESTIMATED ERROR:

REFERENCES:

1. Moser, H. C.; Voigt, A. F.
USAEC Report <u>1957</u>, ISC-892.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]; Mercury-203; ^{203}Hg; [13982-78-0]

(2) Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

T/K = 273.15 - 308.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
0	273.15	1.4 ± .1	1.8	2.1
15	288.15	3.7 ± .1	4.8	5.6
20	293.15	4.8 ± .1	6.3	7.3
25	298.15	6.3 ± .3	8.3	9.6
30	303.15	8.2 ± .3	10.9	12.6
35	308.15	10.4 ± .2	13.9	16.1

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (17.084 \pm .420)\log(T/K) - 48.366$$

for the 273.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A radioactive tracer method using mercury-203 was used.

The mercury and solvent were shaken continuously for 24 hours in 25 ml glass stoppered volumetric flasks in a thermostat. 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.

Solvents were treated to remove traces of peroxides. If peroxides were not removed a black coating formed on the mercury.

SOURCE AND PURITY OF MATERIALS:

(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) Hexane. Research grade obtained from Phillips; used without further purification.

ESTIMATED ERROR:

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

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Hexane; C_6H_{14}; [110-54-3]

ORIGINAL MEASUREMENTS:

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.

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 10^6c_1/mol dm^{-3}	Mole Fraction 10^7x_1	Molality^a 10^6m_1/mol kg^{-1}
5	278.15	1.9	2.4	2.8
10	283.15	2.6	3.4	3.9
20	293.15	4.5	5.9	6.8
25	298.15	6.3	8.3	9.6
30	303.15	8.3	11	13
40	313.15	14	19	22

^{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 two equations. The second is preferred.

$$\log x_1 = (17.111)\log(T/K) - 48.432$$
$$\log x_1 = 1.3441 - 2215.2/(T/K)$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Purified as did Glew and Hames (ref. 1).

(2) Hexane. Analytical reagent grade. Passed through activated alumina and distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta x_1/x_1 = \pm(0.03 - 0.05)$ (compilers)

REFERENCES:

1. Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1971, *49*, 3114.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) 3-Methylpentane; C_6H_{14}; [96-14-0]

ORIGINAL MEASUREMENTS:

Kuntz, R. R.; Mains, G. J.

J. Phys. Chem. 1964, *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 $10^6 c_1/\text{mol dm}^{-3}$	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1/\text{mol kg}^{-1}$
25	298.15	5.1	6.7	7.7

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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 $\varepsilon_{2560} = 7.35 \times 10^3 \text{ dm}^3 \text{ mol}^{-1} \text{ cm}^{-1}$ at 25°C. The value was used to calculate the solubility in the other solvents.

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) 3-Methylpentane. Phillips "pure grade" hydrocarbon solvents; purified by passage through silica gel until optically pure, degassed and distilled.

ESTIMATED ERROR:

REFERENCES:

1. Moser, H. C.; Voigt, A. F. USAEC Report 1957, ISC-892.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) 2,2-Dimethylbutane; C_6H_{14}; [75-83-2]

ORIGINAL MEASUREMENTS:

Kuntz, R. R.; Mains, G. J.

J. Phys. Chem. 1964, *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 10^6c_1/mol dm^{-3}	Mole Fraction[a] 10^7x_1	Molality[a] 10^6m_1/mol kg^{-1}
25	298.15	5.0	6.7	7.8

[a] Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Spectrophotometric method. It was assumed that the optical density at 2560 Å 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.

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) 2,2-Dimethylbutane. Phillips "pure grade" hydrocarbon solvents; purified by passage through silica gel until optically pure, degassed and distilled.

ESTIMATED ERROR:

REFERENCES:

1. Moser, H. C.; Voigt, A. F. USAEC Report 1957, ISC-892.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) 2,2-Dimethylbutane; C_6H_{14};
[75-83-2]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

T/K = 273.15 - 308.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration $10^8 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^8 m_1$/mol kg^{-1}
0	273.15	1.3 ± .1	1.7	1.9
15	288.15	2.8 ± .2	3.7	4.3
20	293.15	3.7 ± .1	4.9	5.7
25	298.15	4.7 ± .3	6.3	7.3
30	303.15	6.0 ± .1	8.1	9.4
35	308.15	7.3 ± .7	9.9	11.5

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (14.905 \pm .380)\log(T/K) - 43.089$$

for the 273.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A radioactive tracer method using mercury-203 was used.

The mercury and solvent were shaken continuously for 24 hours in 25 ml glass stoppered volumetric flasks in a thermostat. 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.

Solvents were treated to remove traces of peroxides. If peroxides were not removed a black coating formed on the mercury.

SOURCE AND PURITY OF MATERIALS:

(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) 2,2-Dimethylbutane. Research grade obtained from Phillips; used without further purification.

ESTIMATED ERROR:

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

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) 2,3-Dimethylbutane; C_6H_{14}; [79-29-8]

ORIGINAL MEASUREMENTS:

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 $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
25	298.15	6.0	7.9	9.1

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) 2,3-Dimethylbutane. Phillips "pure grade" hydrocarbon solvents; purified by passage through silica gel until optically pure, degassed and distilled.

ESTIMATED ERROR:

REFERENCES:

1. Moser, H. C.; Voigt, A. F. USAEC Report <u>1957</u>, ISC-892.

COMPONENTS:

(1) Mercury-203; ^{203}Hg; [13982-78-0]

(2) Heptane; C_7H_{16}; [142-82-5]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

T/K = 273.15 - 308.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration 10^6c_1/mol dm^{-3}	Mole Fraction^a 10^7x_1	Molality^a 10^6m_1/mol kg^{-1}
0	273.15	1.4 ± .1	2.0	2.0
15	288.15	3.7 ± .1	5.4	5.4
20	293.15	4.8 ± .1	7.0	7.0
25	298.15	6.6 ± .2	9.7	9.7
30	303.15	8.5 ± .4	12.6	12.6
35	308.15	10.9 ± .8	16.3	16.2

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (17.462 \pm .301)\log(T/K) - 49.234$$

for the 273.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A radioactive tracer method using mercury-203 was used.

The mercury and solvent were shaken continuously for 24 hours in 25 ml glass stoppered volumetric flasks in a thermostat. 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.

Solvents were treated to remove traces of peroxides. If peroxides were not removed a black coating formed on the mercury.

SOURCE AND PURITY OF MATERIALS:

(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) Heptane. Research grade obtained from Phillips; used without further purification.

ESTIMATED ERROR:

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

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Heptane; C_7H_{16}; [142-82-5]

ORIGINAL MEASUREMENTS:

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.

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 $10^6 c_1$/mol dm^{-3}	Mole Fraction $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
5	278.15	2.0	2.9	2.9
10	283.15	2.6	3.7	3.7
20	293.15	4.8	7.1	7.1
25	298.15	6.5	9.6	9.6
30	303.15	8.1	12	12
40	313.15	15	22	22

^{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 two equations. The second is preferred.

$$\log x_1 = (17.250)\log(T/\mathrm{K}) - 48.705$$
$$\log x_1 = 1.3461 - 2195.1/(T/\mathrm{K})$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Purified as did Glew and Hames (ref. 1).

(2) Heptane. Analytical reagent grade. Passed through activated alumina and distilled.

ESTIMATED ERROR:

δT/K = ±0.1
$\delta x_1/x_1$ = ±(0.03 - 0.05) (compilers)

REFERENCES:

1. Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1971, *49*, 3114.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Octane; C_8H_{18}; [111-65-9]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

T/K = 273.15 - 313.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration 10^6c_1/mol dm^{-3}	Mole Fraction^a 10^7x_1	Molality^a 10^6m_1/mol kg^{-1}
0	273.15	1.6 ± .1	2.5	2.2
15	288.15	3.8 ± .1	6.1	5.4
25	298.15	6.7 ± .1	10.9	9.5
30	303.15	8.7 ± .3	14.2	12.4
35	308.15	10.8 ± .3	17.8	15.5
40	313.15	12.6 ± 1.0	20.8	18.2

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (16.583 \pm .228)\log(T/K) - 47.003$$

for the 273.15 to 313.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A radioactive tracer method using mercury-203 was used.

The mercury and solvent were shaken continuously for 24 hours in 25 ml glass stoppered volumetric flasks in a thermostat. 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.

Solvents were treated to remove traces of peroxides. If peroxides were not removed a black coating formed on the mercury.

SOURCE AND PURITY OF MATERIALS:

(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) Octane. Research grade obtained from Phillips; used without further purification.

ESTIMATED ERROR:

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

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Octane; C_8H_{18}; [111-65-9]

ORIGINAL MEASUREMENTS:

Vogel, A.; Gjaldbaek, J. Chr.

Arch. Pharm. Chem. Sci. Ed. 1974, *2*, 25 - 9.

VARIABLES:

T/K = 298.15

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility			
$t/°C$	T/K^a	No. of Exps.	Concentration 10^6c_1/mol dm^{-3}	Mole Fraction^a 10^7x_1	Molality^a 10^6m_1/mol kg^{-1}
25	298.15	6	6.7 ± .5	11	9.6

^{a}Calculated by compilers.

The error is the standard deviation of an individual measurement.

ADDITIONAL COMMENTS:

The authors state that they found the same solubility after shaking mercury + solvent for 48 hours as for shaking times of up to one month.

The authors also found the same solubility within experimental error when the solvent was saturated with oxygen and with nitrogen.

The authors took special care to see that the glassware surface of the sampling pipet was equilibrated with the saturated solution of mercury. Special care was taken to see that colloidal mercury did not form in the solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mercury was analyzed by cold vapor atomic absorption spectroscopy (ref. 1).

The solvent was saturated with Hg in a special glass container in which a few grams of mercury was kept in a cellulose extraction thimble. The container was shaken at least 48 hours at 25°C.

A 10.00 cm³ sample of the saturated solution was taken. It was treated to convert the Hg to Hg^{2+} and extracted into an aqueous phase.

An aliquot of the aqueous phase was diluted, treated with tin(II) chloride to reduce the mercury, and the solution analyzed by cold vapor atomic absorption spectroscopy. The apparatus allowed measurements down to one part per billion of Hg.

Similtaneous measurements were made under the same conditions of samples containing a known amount of mercury.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given, purified by distillation.

(2) Octane. British Drug House; spectroscopic quality, used without further purification.

ESTIMATED ERROR:

$\delta c_1/c_1 = \pm 0.07$
See standard deviation above.

REFERENCES:

1. Hatch, W. R.; Ott, W. L. *Anal. Chem.* 1968, *10*, 2085.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Octane; C_8H_{18}; [111-65-9]	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.
VARIABLES:	PREPARED BY:
T/K = 278.15 - 313.15	H. L. Clever M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration^a $10^6 c_1$/mol dm^{-3}	Mole Fraction $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
5	278.15	2.1	3.3	2.9
10	283.15	2.9	4.7	4.1
20	293.15	4.9	7.9	6.9
25	298.15	6.7	11	9.6
30	303.15	8.5	14	12
40	313.15	14	23	20

^{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 two equations. The second is preferred.

$$\log x_1 = (16.500)\log(T/\mathrm{K}) - 46.800$$
$$\log x_1 = 1.1542 - 2122.0/(T/\mathrm{K})$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Purified as did Glew and Hames (ref. 1).

(2) Octane. Analytical reagent grade. Passed through activated alumina and distilled.

ESTIMATED ERROR:

$\delta T/\mathrm{K} = \pm 0.1$

$\delta x_1/x_1 = \pm(0.03 - 0.05)$ (compilers)

REFERENCES:

1. Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1971, *49*, 3114.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) 2,2,4-Trimethylpentane or
*Iso*octane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Klehr, E. H.; Voigt, A. F.

Radioisotopes Phys. Sci. Ind., Proc. Conf. Use, Copenhagen 1960, *1*, 517 - 29 (Pub. 1962).

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 10^8c_1/mol dm^{-3}	Mole Fraction^a 10^7x_1	Molality^a 10^8m_1/mol kg^{-1}
25	298.15	4.6 ± .1	7.6	6.7

^{a}Calculated by compilers.

The value above is from the direct measurement technique. The indirect measurement result is 4.7 x 10^{-8} mol dm^{-3} at 25°C.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Direct Method. A globule of mercury containing 203-Hg was placed in 50 ml of solvent in a 100 ml flask and agitated in a thermostated bath. Samples were taken until the solution appeared to be at equilibruim. Analysis were made by GM-counting by one of two techniques:

(i) Solid precipitate counting. The Hg in a 0.5 ml aliquote was exchanged and reprecipitated on a stainless steel panchet as the sulfide was dried and counted. Details in Moser an Voigt (ref. 1).

(ii) Liquid aliquote scintillation-counting. A 0.5 ml aliquote of the saturated solution was diluted and transferred to the counting tube with a known volume of benzene.

The 0.28 MeV gamma radiation was counted. Error due to radiation adsorbed by the benzene and water was shown to be less than one percent.

Indirect Method. The distribution coefficient between solvent and water was measured.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Reduced from a mercury nitrate sample. Half-life is 47 days.

(2) *Iso*octane. Pure grade, used without futher repurification.

ESTIMATED ERROR:

See random error reported by authors with concentration values above.

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *Radiochemical Studies of Mercury and its Ions in Dilute Solutions* US AEC Report ISC-892, March 1957.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6]; Mercury-203; ^{203}Hg; [13982-78-0] (2) 2,2,4-Trimethylpentane or *Iso*octane; C_8H_{18}; [540-84-1]	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 $10^6c_1/\text{mol dm}^{-3}$	Mole Fraction^a 10^7x_1	Molality^a $10^6m_1/\text{mol kg}^{-1}$
0	273.15	1.0 ± .1	1.6	1.4
13.5	286.65	2.1 ± .1	3.4	3.0
15	288.15	2.2 ± .1	3.6	3.2
20	293.15	3.3 ± .1	5.4	4.8
25	298.15	4.2 ± .2	7.0	6.1
30	303.15	5.3 ± .1	8.9	7.8
35	308.15	6.6 ± .3	11.1	9.7

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (16.583 \pm .228)\log(T/K) - 47.003$$

for the 273.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A radioactive tracer method using mercury-203 was used.

The mercury and solvent were shaken continuously for 24 hours in 25 ml glass stoppered volumetric flasks in a thermostat. 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.

Solvents were treated to remove traces of peroxides. If peroxides were not removed a black coating formed on the mercury.

SOURCE AND PURITY OF MATERIALS:

(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) *Iso*octane. Research grade obtained from Phillips; used without further purification.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; See random error reported by authors with molar solubility values above.

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) 2,2,4-Trimethylpentane or *Iso*octane; C_8H_{18}; [540-84-1]

ORIGINAL MEASUREMENTS:

Vogel, A.; Gjaldbaek, J. Chr.

Arch. Pharm. Chem. Sci. Ed. 1974, *2*, 25 - 9.

VARIABLES:

T/K = 298.15

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility			
$t/°C$	T/K^a	No. of Exps.	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
25	298.15	27	4.1 ± .25	6.8	6.0

^{a}Calculated by compilers.

The error is the standard deviation of an individual measurement.

ADDITIONAL COMMENTS:

The authors state that they found the same solubility after shaking mercury + solvent for 48 hours as for shaking times of up to one month.

The authors also found the same solubility within experimental error when the solvent was saturated with oxygen and with nitrogen.

The authors took special care to see that the glassware surface of the sampling pipet was equilibrated with the saturated solution of mercury. Special care was taken to see that colloidal mercury did not form in the solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mercury was analyzed by cold vapor atomic absorption spectroscopy (ref. 1).

The solvent was saturated with Hg in a special glass container in which a few grams of mercury was kept in a cellulose extraction thimble. The container was shaken at least 48 hours at 25°C.

A 10.00 cm³ sample of the saturated solution was taken. It was treated to convert the Hg to Hg^2 and extracted into an aqueous phase.

An aliquot of the aqueous phase was diluted, treated with tin(II) chloride to reduce the mercury, and the solution analyzed by cold vapor atomic absorption spectroscopy. The apparatus allowed measurements down to one part per billion of Hg.

Similtaneous measurements were made under the same conditions of samples containing a known amount of mercury.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given, purified by distillation.

(2) *Iso*octane. British Drug House; spectroscopic quality, used without further purification.

ESTIMATED ERROR:

$\delta c_1/c_1 = \pm 0.07$
See standard deviation above.

REFERENCES:

1. Hatch, W. R.; Ott, W. L.
Anal. Chem. 1968, *10*, 2085.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Decane; $C_{10}H_{22}$; [124-18-5]

ORIGINAL MEASUREMENTS:

Klehr, E. H.; Voigt, A. F.

Radioisotopes Phys. Sci. Ind., Proc. Conf. Use, Copenhagen 1960, *1*, 517 - 29 (Pub. 1962).

VARIABLES:

T/K = 273.15 - 318.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
0	273.15	2.1 ± .1	4.0	2.8
10	283.15	3.0 ± .1	5.8	4.1
15	288.15	4.5 ± .1	8.7	6.1
20	293.15	4.9 ± .1	9.6	6.7
25	298.15	7.0 ± .1	13.7	9.6
30	303.15	8.6 ± .1	16.9	11.9
35	308.15	9.6 ± .1	19.0	13.4
45	318.15	13.3 ± .1	26.6	18.7

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Direct Method. A globule of mercury containing 203-Hg was placed in 50 ml of solvent in a 100 ml flask and agitated in a thermostated bath. Samples were taken until the solution appeared to be at equilibruim. Analysis were made by GM-counting by one of two techniques:

(i) Solid precipitate counting. The Hg in a 0.5 ml aliquote was exchanged and reprecipitated on a stainless steel panchet as the sulfide was dried and counted. Details in Moser an Voigt (ref. 1).

(ii) Liquid aliquote scintillation-counting. A 0.5 ml aliquote of the saturated solution was diluted and transferred to the counting tube with a known volume of benzene.

The 0.28 MeV gamma radiation was counted. Error due to radiation adsorbed by the benzene and water was shown to be less than one percent.

Indirect Method. The distribution coefficient between solvent and water was measured.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Reduced from a mercury nitrate sample. Half-life is 47 days.

(2) Decane. Pure grade, used without futher repurification.

ESTIMATED ERROR:

See random error reported by authors with concentration values above.

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *Radiochemical Studies of Mercury and its Ions in Dilute Solutions* US AEC Report ISC-892, March 1957.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Decane; $C_{10}H_{22}$; [124-18-5]

ORIGINAL MEASUREMENTS:

Kuntz, R. R.; Mains, G. J.

J. Phys. Chem. 1964, *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 $10^6 c_1$/mol dm^{-3}	Mole Fraction[a] $10^6 x_1$	Molality[a] $10^6 m_1$/mol kg^{-1}
25	298.15	5.5	1.1	7.6

[a] Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) Decane. Phillips "pure grade" hydrocarbon solvents; purified by passage through silica gel until optically pure, degassed and distilled.

ESTIMATED ERROR:

REFERENCES:

1. Moser, H. C.; Voigt, A. F. USAEC Report 1957, ISC-892.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Cycloalkanes	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1985, July

CRITICAL EVALUATION:

An Evaluation of the Solubility of Mercury in Cycloalkanes.

There are data on the solubility of mercury in six cycloalkanes. A. F. Voigt and co-workers (ref. 1 - 4) have measured all but one of the reported cycloalkane solubilities by a radioactive tracer technique. A single value is reported by Vogel and Gjaldbaek (ref. 5) by atomic absorption spectroscopy. The data on the six cycloalkanes are discussed below.

Mercury + Cyclohexane; C_6H_{12}; [110-82-7]

There are four values of the solubility of mercury in cyclohexane at 298.15 K. They are:

$(12.1 \pm 0.3) \times 10^{-6}$ mol dm^{-3}	Spencer and Voigt (ref. 3)
$(11.0 \pm 0.2) \times 10^{-6}$ mol dm^{-3}	Moser and Voigt (ref. 1)
9.7×10^{-6} mol dm^{-3}	Moser and Voigt (ref. 2)
$(9.6 \pm 0.4) \times 10^{-6}$ mol dm^{-3}	Vogel and Gjaldbaek (ref. 5)

In addition, Spencer and Voigt (ref. 3) report five additional values in the 288.15 to 313.15 K interval. The Moser and Voigt (ref. 2) value was calculated from their cyclohexane/water distribution coefficient by the evaluator. It is of lesser reliability than the other values since it assumes unit activity coefficients and depends on the value chosen for the solubility of mercury in water.

The agreement among the values at 298.15 K is not as good as one would like. They differ by about 25 percent. Vogel and Gjaldbaek (ref. 5) took special care to see that the glassware surface of the sampling pipet was equilibrated with a saturated solution of mercury to prevent loss of mercury by adsorption on the surface and that colloidal mercury did not form in the sampled saturated solution. Their first precaution would result in a larger solubility and the second would result in a smaller solubility if adsorption of mercury by glass and colloidal mercury formation were problems. Vogel and Gjaldbaek suggest their smaller value is due to the precaution about colloidal mercury. Vogel and Gjaldbaek did four determinations of the solubility of mercury in cyclohexane by direct shaking without the precaution to remove colloidal mercury. The average solubility was $(12.4 \pm 1.5) \times 10^{-6}$ mol dm^{-3} which does agree with the Spencer and Voigt value. However, Vogel and Gjaldbaek also measured the solubility of mercury in octane and in 2,2,4-trimethylpentane. Their solubility values in these solvents agree well with the Spencer and Voigt values. At present, there is no reason why colloidal mercury would be a problem in cyclohexane but not with the octanes. It is a point that deserves futher experimental investigation. Vogel and Gjaldbaek also show that they obtain the same solubility value with an oxygen atmosphere or with a nitrogen atmosphere. They obtained equilibrium within 48 hours and found the same result after equilibrating for one month.

For this evaluation we prefer the Spencer and Voigt data because it is a self-consistent set of data over a 25 degree temperature interval. If Vogel and Gjaldbaek are correct, then the values from the Spencer and Voigt experiments should be reduced by about 20 percent. The six experimental values of Spencer and Voigt (ref. 3) and the one value of Moser and Voigt (ref. 1) were combined in a linear regression to obtain the equations for the 288.15 to 313.15 K interval.

$$\ln(c_1/\text{mol dm}^{-3}) = (1.6014 \pm 0.5296) - (38.6262 \pm 1.5886)/(T/100\ \text{K})$$

with a standard error about the regression line of 4.9×10^{-7}.

$$\ln x_1 = (0.2949 \pm 0.5246) - (39.5782 \pm 1.5740)/(T/100\ \text{K})$$

with a standard error about the regression line of 5.3×10^{-8}.

$$\ln(m_1/\text{mol kg}^{-1}) = (2.2128 \pm 0.5213) - (39.6850 \pm 1.5639)/(T/100\ \text{K})$$

with a standard error about the regression line of 6.2×10^{-7}.

Smoothed data from the equations are in Table 1 below. Also in the table are the values of the enthalpy and entropy changes for the transfer of one mole of mercury from liquid mercury to the hypothetical unit concentration solution.

Table 1. Solubility of mercury in cyclohexane. Tentative values of c_1/mol dm^{-3}, m_1/mol kg^{-1}, and mole fraction, x_1, solubility as a function of temperature.

T/K	Mercury Solubility		
	Concentration 10^6c_1/mol dm^{-3}	Mole Fraction 10^7x_1	Molality 10^6m_1/mol kg^{-1}
288.15	7.5	8.1	9.5
293.15	9.4	10.2	12.1
298.15	11.7	12.8	15.1
303.15	14.5	15.9	18.9
308.15	17.9	19.7	23.3
313.15	21.8	24.2	28.7
$\Delta H_1{}^a$	32.1 ± 1.3	32.9 ± 1.3	33.0 ± 1.3
$\Delta S_1{}^b$	13.3 ± 4.4	2.5 ± 4.4	18.4 ± 4.3

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

Mercury + Methylcyclohexane; C_7H_{14}; [108-87-2]
cis-1,2-Dimethylcyclohexane; C_8H_{16}; [2207-01-4]
trans-1,2-Dimethylcyclohexane; C_8H_{16}; [6876-23-9]
cis-1,4-Dimethylcyclohexane; C_8H_{16}; [624-29-3]
trans-1,4-Dimethylcyclohexane; C_8H_{16}; [2207-04-7]

Spencer and Voigt (ref. 3 and 4) made the only measurements on these systems. The data are classed as tentative. The data were fit by a linear regression in the solubility units of concentration, c_1/mol dm^{-3}, mole fraction, x_1, and molality, m_1/mol kg^{-1} to a two constant equation. The constants of the equations and the smoothed data are given in Tables 2 - 7.

The solubility of mercury in the substituted cyclohexanes has a significantly more positive enthalpy of solution than in cyclohexane, but less positive enthalpy than for normal alkanes of the same carbon number. The enthalpy of solution of mercury in the substituted cyclohexanes is the same within experimental error for the five solvents. The solubility of mercury parallels closely for methylcyclohexane and the *cis*-1,2- and *cis*-1,4-dimethylcyclohexanes as a function of temperatures. The *trans*-1,2- and *trans*-1,4-dimethylcyclohexanes mercury solubilities parallel quite closely, but at about a 10 percent lower value than the solubility in the other three substituted cyclohexanes at a corresponding temperature.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Cycloalkanes

EVALUATOR:

H. Lawrence Clever
Chemistry Department
Emory University
Atlanta, Georgia 30322 USA

1985, July

CRITICAL EVALUATION:

Table 2. Constants for the equation $\ln(c_1/\text{mol dm}^{-3}) = A(1) + A(2)/(T/100\ \text{K})$.

Compound	A(1) ± Error	A(2) ± Error	Std. error about the Regression Line
Methylcyclohexane	3.6095 ± 0.1461	-45.4364 ± 0.4285	1.33×10^{-7}
cis-1,2-DMC	2.6380 ± 0.6568	-42.3938 ± 1.9581	3.33×10^{-7}
trans-1,2-DMC	2.9009 ± 0.7042	-43.5886 ± 2.0979	3.76×10^{-7}
cis-1,4-DMC	3.3771 ± 0.4927	-43.7188 ± 1.4679	2.14×10^{-7}
trans-1,4-DMC	2.9205 ± 0.6169	-43.7078 ± 1.8378	3.30×10^{-7}

Table 3. Solubility of mercury in cycloalkanes. Tentative values of the concentration as a function of temperature at 0.1 MPa.

T/K	Concentration, $10^6 c_1$/mol dm^{-3}, in				
	Methyl-cyclohexane	*cis*-1,2-dimethyl-cyclohexane	*trans*-1,2-dimethyl-cyclohexane	*cis*-1,4-dimethyl-cyclohexane	*trans*-1,4-dimethyl-cyclohexane
273.15	2.2	-	-	-	-
278.15	3.0	-	-	-	-
283.15	4.0	-	-	-	-
288.15	5.2	5.7	4.9	5.3	4.8
293.15	6.9	7.3	6.3	6.9	6.2
298.15	8.9	9.3	8.1	9.0	8.0
303.15	11.4	11.8	10.4	11.5	10.2
308.15	14.6	14.8	13.1	14.6	12.8
ΔH_1[a]	37.8 ± 0.4	35.2 ± 1.6	36.2 ± 1.7	37.2 ± 1.2	36.3 ± 1.5
ΔS_1[b]	30.0 ± 1.2	21.9 ± 5.5	24.1 ± 5.8	28.1 ± 4.1	24.3 ± 5.1

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

Table 4. Constants for the equation $\ln x_1 = A(1) + A(2)/(T/100\ K)$.

Compound	A(1) ± Error	A(2) ± Error	Std. error about the Regression Line
Methylcyclohexane	2.0035 ± 0.1608	-46.7699 ± 0.4716	1.98×10^{-8}
cis-1,2-DMC	1.0312 ± 0.7068	-43.4305 ± 2.1072	5.00×10^{-8}
trans-1,2-DMC	1.2975 ± 0.7096	-44.5584 ± 2.1139	5.56×10^{-8}
cis-1,4-DMC	1.7676 ± 0.5097	-45.6945 ± 1.5185	3.14×10^{-8}
trans-1,4-DMC	1.3569 ± 0.5931	-44.7394 ± 1.7669	4.78×10^{-8}

Table 5. Solubility of mercury in cycloalkanes. Tentative values of the mole fraction solubility as a function of temperature at 0.1 MPa.

T/K	Mole Fraction, $10^7 x_1$, in				
	Methyl- cyclohexane	*cis*-1,2- dimethyl- cyclohexane	*trans*-1,2- dimethyl- cyclohexane	*cis*-1,4- dimethyl- cyclohexane	*trans*-1,4- dimethyl- cyclohexane
273.15	2.7	-	-	-	-
278.15	3.7	-	-	-	-
283.15	5.0	-	-	-	-
288.15	6.6	8.0	7.0	7.6	7.0
293.15	8.7	10.3	9.2	10.0	9.1
298.15	11.4	13.2	11.8	12.9	11.8
303.15	14.8	16.8	15.1	16.6_5	15.1
308.15	19.0	21.2	19.2	21.3	19.2
ΔH_1[a]	38.9 ± 0.4	36.1 ± 1.8	37.0 ± 1.8	38.0 ± 1.3	37.2 ± 1.5
ΔS_1[b]	16.7 ± 1.3	8.6 ± 5.9	10.8 ± 5.9	14.7 ± 4.2	11.3 ± 4.9

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Cycloalkanes	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1985, July

CRITICAL EVALUATION:

Table 6. Constants for the equation $\ln(m_1/\text{mol kg}^{-1}) = A(1) + A(2)/(T/100\ \text{K})$.

Compound	A(1) ± Error	A(2) ± Error	Std. error about the Regression Line
Methylcyclohexane	4.2093 ± 0.1477	-46.4212 ± 0.4331	1.67×10^{-7}
cis-1,2-DMC	3.2107 ± 0.6326	-43.4077 ± 1.8858	4.03×10^{-7}
trans-1,2-DMC	3.3971 ± 0.6784	-44.2926 ± 2.0210	4.72×10^{-7}
cis-1,4-DMC	3.9300 ± 0.5118	-45.6200 ± 1.5245	2.80×10^{-7}
trans-1,4-DMC	3.5862 ± 0.6524	-44.8727 ± 1.9436	4.63×10^{-7}

Table 7. Solubility of mercury in cycloalkanes. Tentative values of molality as a function of temperature at 0.1 MPa.

T/K	Molality, $10^6 m_1$/mol kg^{-1}, in				
	Methylcyclohexane	*cis*-1,2-dimethylcyclohexane	*trans*-1,2-dimethylcyclohexane	*cis*-1,4-dimethylcyclohexane	*trans*-1,4-dimethylcyclohexane
273.15	2.8	-	-	-	-
278.15	3.8	-	-	-	-
283.15	5.1	-	-	-	-
288.15	6.8	7.1	6.3	6.8	6.2
293.15	8.9	9.2	8.2	8.9	8.1
298.15	11.6	11.8	10.6	11.5	10.5
303.15	15.1	15.0	13.5	14.8	13.5
308.15	19.3	18.9	17.1	18.9	17.1
$\Delta H_1{}^a$	38.6 ± 0.4	36.1 ± 1.6	36.8 ± 1.7	37.9 ± 1.3	37.3 ± 1.6
$\Delta S_1{}^b$	35.0 ± 1.2	26.7 ± 5.3	28.2 ± 5.6	32.7 ± 4.3	29.8 ± 5.4

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp. Chem. Abstr. 1958, 52, 10691h.

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

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

4. Spencer, J. N.; Voigt, A. F. *J. Phys. Chem.* 1968, *72*, 1913 - 7; Voigt, A. F. Personal communication.

5. Vogel, A.; Gjaldbaek, J. C. *Arch. Pharm. Chem. Sci. Ed.* 1974, *2*, 25 - 9.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Moser, H. C.; Voigt, A. F.

USAEC Report 1957, ISC-892.
Chem. Abstr. 1958, 52, 10691h.

VARIABLES:

T/K = 298.15

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration $10^8 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^8 m_1$/mol kg^{-1}
25	298.15	11.0 ± 0.2	12.0	14.2

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A globule of Hg metal prepared from radioactive mercury(II) nitrate by reduction with hypophosphorous acid was equilibrated with 5 - 10 ml of liquid by shaking in a thermostat. Aliquotes of the liquid were withdrawn periodically for up to two weeks and the Hg concentration determined radiochemically.

The aliquot was diluted with acetone and equilibrated with $Hg(NO_3)_2$ carrier to exchange the radioactive mercury. The mercury was precipitated as HgS, mounted on a stainless steel planchet and counted with a Geiger-Mueller tube.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Oak Ridge National Lab; recieved as 0.31 M $Hg(NO_3)_2$ in 1.56 HNO_3 solution. Initial activity 50 millicuries g^{-1}; half-life 48 days. Reduced to Hg by hypophosphorous acid; coagulated to a Hg droplet by addition of concentrated HI.

(2) Cyclohexane. Eastman Co. Spectro-Grade; shaken with concentrated H_2SO_4 and alkaline $KMnO_4$ passed through a column of dry activated Al_2O_3 and redistilled.

ESTIMATED ERROR:

δT/K = ±0.1

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Moser, H. C.; Voigt, A. F.

J. Am. Chem. Soc. 1957, *79*,
1837 - 9.

VARIABLES:

$T/K = 298.15$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Distribution Constant	Mercury Solubility		
$t/°C$	T/K^a	$E° = c_1aq/c_1org$	Concentration^a 10^6c_1/mol dm^{-3}	Mole Fraction^a 10^7x_1	Molality^a 10^6m_1/mol kg^{-1}
25.0	298.15	0.031	9.7	10.5	12.5

^{a}Calculated by compiler, assuming activity coefficients are unity.

The above mercury solubility value was calculated using the free mercury solubility in water of 3.0×10^{-7} mol dm^{-3}

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The distribution of mercury-203 between aqueous and organic phases was measured. Dilute solutions of 0.01 molar HNO_3 containing a known amount of pure mercurous nitrate were shaken with an equal volume of organic liquid for about 12 hours. Both phases were analyzed for total mercury by first converting to Hg^{2+}, precipitation as HgS, and counting in a thin window Geiger counter.

In the aqueous phase the disproportionation

$$Hg_2^{2+}(aq) = Hg^{2+}(aq) + Hg(aq)$$

and possibly the dissociation

$$Hg_2^{2+}(aq) = 2\ Hg^{+}(aq)$$

take place. It is assumed that only metallic Hg is extracted into the organic phase.

The distribution of total Hg in the aqueous phase to total Hg in the organic phase is determined as a function of total Hg in the organic phase. From the slope and intercept, the authors obtain values of the metallic Hg distribution ratio.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Oak Ridge National Lab; obtained as a high specific activity solution of mercury(II) nitrate containing isotope 203. In the 0.01 molar HNO_3 solution of mercury(I) nitrate, the authors estimate 96% mercury(II) is Hg^{2+} and 99% of the mercury(I) is Hg_2^{2+}. At this acidity, there is no minimum hydrolysis and nitrato complex formation.

(2) Cyclohexane. Eastman Spectro Grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

T/K = 288.15 - 313.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration 10^6c_1/mol dm^{-3}	Mole Fraction^a 10^7x_1	Molality^a 10^6m_1/mol kg^{-1}
15	288.15	7.6 ± 0.2	8.2	9.7
20	293.15	9.4 ± 0.2	10.2	12.1
25	298.15	12.1 ± 0.3	13.2	15.6
30	303.15	14.8 ± 0.4	16.2	19.2
35	308.15	17.4 ± 0.2	19.2	22.8
40	313.15	22.3 ± 1.5	24.7	29.3

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (13.140 \pm .359)\log(T/K) - 38.405$$

for the 288.15 to 313.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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 volumetric flasks in a thermostat for 24 hours. Aliquots of the equilibrated solution were counted by a conventional single channel scintillation 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.

SOURCE AND PURITY OF MATERIALS:

(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) Cyclohexane. Phillips Petroleum Co., Research Grade, used as received.

ESTIMATED ERROR:

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

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];

(2) Cyclohexane; C_6H_{12}; [110-82-7]

ORIGINAL MEASUREMENTS:

Vogel, A.; Gjaldbaek, J. Chr.

Arch. Pharm. Chem. Sci. Ed. 1974, *2*, 25 - 9.

VARIABLES:

T/K = 298.15

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility			
t/°C	T/K[a]	No. of Exps.	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction[a] $10^7 x_1$	Molality[a] $10^6 m_1$/mol kg^{-1}
25	298.15	24	9.6 ± 0.4	10.4	12.4

[a]Calculated by compilers.

The error is the standard deviation of an individual measurement.

ADDITIONAL COMMENTS:

The authors state that they found the same solubility after shaking mercury + solvent for 48 hours as for shaking times of up to one month.

The authors also found the same solubility within experimental error when the solvent was saturated with oxygen and with nitrogen.

The authors took special care to see that the glassware surface of the sampling pipet was equilibrated with the saturated solution of mercury. Special care was taken to see that colloidal mercury did not form in the solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mercury was analyzed by cold vapor atomic absorption spectroscopy (ref. 1).

The solvent was saturated with Hg in a special glass container in which a few grams of mercury was kept in a cellulose extraction thimble. The container was shaken at least 48 hours at 25°C.

A 10.00 cm³ sample of the saturated solution was taken. It was treated to convert the Hg to Hg^{2+} and extracted into an aqueous phase.

An aliquot of the aqueous phase was diluted, treated with tin(II) chloride to reduce the mercury, and the solution analyzed by cold vapor atomic absorption spectroscopy. The apparatus allowed measurements down to one part per billion of Hg.

Similtaneous measurements were made under the same conditions of samples containing a known amount of mercury.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given, purified by distillation.

(2) Cyclohexane. Merck; Uvasol grade spectroscopic quality, used without further purification.

ESTIMATED ERROR:

$\delta c_1/c_1 = \pm 0.07$
See standard deviation above.

REFERENCES:

1. Hatch, W. R.; Ott, W. L.
Anal. Chem. 1968, *10*, 2085.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Methylcyclohexane; C_7H_{14};
[108-87-2]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

T/K = 273.15 - 308.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
0	273.15	2.2 ± 0.1	2.7	2.8
15	288.15	5.2 ± 0.1	6.6	6.7
20	293.15	6.9 ± 0.2	8.8	9.0
25	298.15	9.1 ± 0.1	11.7	11.9
30	303.15	11.3 ± 0.2	14.6	14.9
35	308.15	14.5 ± 0.4	18.8	19.2

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (16.011 \pm .226)\log(T/\mathrm{K}) - 45.563$$

for the 273.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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 volumetric 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.

SOURCE AND PURITY OF MATERIALS:

(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) Methylcyclohexane. Phillips Petroleum Co., Research Grade, used as received.

ESTIMATED ERROR:

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

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]; Mercury-203; ^{203}Hg; [13982-78-0]

(2) *cis*-1,2-Dimethylcyclohexane; C_8H_{16}; [2207-01-4]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 1913 - 7.

Voigt, A. F.
Personal communication

VARIABLES:

T/K = 289.15 - 308.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K[a]	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction[a] $10^7 x_1$	Molality[a] $10^6 m_1$/mol kg^{-1}
16	289.15	5.8 ± 0.1	8.1	7.25
20	293.15	7.5 ± 0.2	10.6	9.4
25	298.15	9.57 ± 0.14	13.56	12.08
30	303.15	12.0 ± 0.2	17.1	15.2
35	308.15	14.4 ± 0.9	20.6	18.4

[a] Calculated by compilers.

Professor Voigt provided the experimental molar solubility values from J. N. Spencer's research notebook that do not appear in the published paper.

The authors smoothed their data according to the equation:

$$\log x_1 = (14.57 \pm .73)\log(T/\mathrm{K}) - 41.93$$

for the 289.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method and procedure are reported in an earlier paper (ref. 1).

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 glass stoppered volumetric 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 3 day period.

At some temperatures the solubility increased with time unless the system was protected from light.

SOURCE AND PURITY OF MATERIALS:

(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) *cis*-1,2-Dimethylcyclohexane. Matheson Coleman and Bell. Distilled, refluxed twice with NaOH and hydroquinone to reduce peroxides.

ESTIMATED ERROR:

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

REFERENCES:

1. Spencer, J. N.; Voigt, A. F. *J. Phys. Chem.* 1968, *72*, 464.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) *trans*-1,2-Dimethylcyclohexane;
C_8H_{16}; [6876-23-9]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 1913 - 7.

Voigt, A. F.
Personal communication

VARIABLES:

T/K = 288.15 - 308.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
15	288.15	4.8 ± 0.2	6.9	6.2
20	293.15	6.3 ± 0.2	9.1	8.1
25	298.15	8.49 ± 0.30	12.34	11.00
30	303.15	10.6 ± 0.1	15.5	13.8
35	308.15	12.6 ± 0.5	18.5	16.5

^{a}Calculated by compilers.

Professor Voigt provided the experimental molar solubility values from J. N. Spencer's research notebook that do not appear in the published paper.

The authors smoothed their data according to the equation:

$$\log x_1 = (15.12 \pm .80)\log(T/\mathrm{K}) - 43.29$$

for the 288.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method and procedure are reported in an earlier paper (ref. 1).

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 volumetric 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.

SOURCE AND PURITY OF MATERIALS:

(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) *trans*-1,2-Dimethylcyclohexane. Phillips Petroleum Co., Research Grade, used as received.

ESTIMATED ERROR:

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

REFERENCES:

1. Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) *cis*-1,4-Dimethylcyclohexane;
C_8H_{16}; [624-29-3]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 1913 - 7.

Voigt, A. F.
Personal communication

VARIABLES:

T/K = 288.15 - 308.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
15	288.15	5.2 ± 0.3	7.4	6.6
20	293.15	7.1 ± 0.4	10.2	9.1
25	298.15	9.20 ± 0.18	13.26	11.81
30	303.15	11.3 ± 0.5	16.4	14.6
35	308.15	14.5 ± 0.5	21.1	18.8

^{a}Calculated by compilers.

Professor Voigt provided the experimental molar solubility values from J. N. Spencer's research notebook that do not appear in the published paper.

The authors smoothed their data according to the equation:

$$\log x_1 = (15.38 \pm .61)\log(T/K) - 43.96$$

for the 288.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method and procedure are reported in an earlier paper (ref. 1).

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 volumetric 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.

SOURCE AND PURITY OF MATERIALS:

(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) *cis*-1,4-Dimethylcyclohexane. Matheson Coleman and Bell. Refluxed with NaOH and hydroquinone, distilled twice to remove peroxides.

ESTIMATED ERROR:

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

REFERENCES:

1. Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) *trans*-1,4-Dimethylcyclohexane;
C_8H_{16}; [2270-04-7]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 1913 - 7.

Voigt, A. F.
Personal communication

VARIABLES:

T/K = 288.15 - 308.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
15	288.15	4.7 ± 0.2	6.9	6.1
20	293.15	6.2 ± 0.2	9.1	8.1
25	298.15	8.24 ± 0.20	12.19	10.87
30	303.15	10.4 ± 0.4	15.5	13.8
35	308.15	12.4 ± 0.4	18.6	16.5

^{a}Calculated by compilers.

Professor Voigt provided the experimental molar solubility values from J. N. Spencer's research notebook that do not appear in the published paper.

The authors smoothed their data according to the equation:

$$\log x_1 = (15.06 \pm .73)\log(T/\mathrm{K}) - 43.19$$

for the 288.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method and procedure are reported in an earlier paper (ref. 1).

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 volumetric 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.

SOURCE AND PURITY OF MATERIALS:

(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) *trans*-1,4-Dimethylcyclohexane. Matheson Coleman and Bell. Refluxed with NaOH and hydroquinone, distilled twice to remove peroxides.

ESTIMATED ERROR:

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

REFERENCES:

1. Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] Mercury-203; ^{203}Hg; [13982-78-0] (2) Cyclohexene; C_6H_{10}; [110-83-8]	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1985, August

CRITICAL EVALUATION:

An Evaluation of the Solubility of Mercury in Cyclohexene.

Only Spencer and Voigt (ref. 1) report measurements of the solubility of mercury in cyclohexene. They report five measurements in the 273.15 to 303.15 K interval. The data are classed as tentative.

The five solubility values were subjected to a linear regression in concentration, mole fraction and molality. The results are in Tables 1 and 2 below.

Table 1. The solubility of mercury in cyclohexene. Least square parameters of the equation ln (soly) = A(1) + A(2)/(*T*/100 K).

Solubility	A(1) ± Error	A(2) ± Error	Std. error about the Regression Line
c_1/mol dm^{-3}	4.9664 ± 0.2723	-48.2391 ± 0.7914	2.4 x 10^{-7}
x_1	2.8777 ± 0.3261	-48.8341 ± 0.9476	2.9 x 10^{-8}
m_1/mol kg^{-1}	5.5816 ± 0.2461	-49.4324 ± 0.7153	2.8 x 10^{-7}

Table 2. The solubility of mercury in cyclohexene. Tentative values of the concentration, mole fraction and molality as a function of temperature at 0.1 MPa and thermodynamic changes.

T/K	Mercury Solubility		
	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction $10^7 x_1$	Molality $10^6 m_1$/mol kg^{-1}
273.15	3.1	3.1	3.7
278.15	4.2	4.2	5.1
283.15	5.7	5.7	7.0
288.15	7.7	7.7	9.4
293.15	10.2	10.4	12.6
298.15	13.5	13.7	16.7
303.15	17.6	17.9	22.0
ΔH_1^{a}	40.1 ± 0.7	40.6 ± 0.8	41.1 ± 0.6
ΔS_1^{b}	41.3 ± 2.3	23.9 ± 2.7	46.4 ± 2.0

^{a} units kJ mol^{-1}
^{b} units J K^{-1} mol^{-1}

The solubility of mercury in cyclohexene is larger than in the other six carbon substances: hexane, cyclohexane and benzene. For example the mole fraction solubility at 298.15 K in cyclohexene is 40 percent larger than in hexane, 7 percent larger than in cyclohexane, and 23 percent larger than in benzene.

REFERENCES:

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Cyclohexene; C_6H_{10}; [110-83-8]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

$T/K = 273.15 - 303.15$

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$	T/K^a	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
0	273.15	3.1 ± 0.1	3.1	3.7
15	288.15	7.5 ± 0.1	7.5	9.2
20	293.15	10.4 ± 0.3	10.5	12.8
25	298.15	13.3 ± 0.3	13.5	16.5
30	303.15	17.9 ± 1.0	18.3	22.3

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (17.148 \pm .230)\log(T/K) - 48.294$$

for the 273.15 to 303.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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 scintillation 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.

SOURCE AND PURITY OF MATERIALS:

(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) Cyclohexene. Phillips Petroleum Co., 99.34 mol %. Matheson Coleman and Bell, 99.9 mol %. Both washed with aqueous NaOH, dried, refluxed over and distilled from sodium stabilized with hydroquinone to prevent peroxide formation.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; See random error reported by authors with concentration values above.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Aromatic Hydrocarbons

EVALUATOR:

H. Lawrence Clever
Chemistry Department
Emory University
Atlanta, Georgia 30322 USA

1985, July

CRITICAL EVALUATION:

An Evaluation of the Solubility of Mercury in Aromatic Hydrocabons.

The solubility of mercury in five aromatic hydrocarbons was measured by a radioactive tracer method in the laboratory of A. F. Voigt, Iowa State University. The results are reported in three papers (ref. 1 - 3).

Mercury + Benzene; C_6H_6; [71-43-2]

All three papers report solubility values at 298.15 K. The values are:

$(11.0 \pm 0.6) \times 10^{-6}$ mol dm^{-3}	Moser and Voigt (ref. 1)
$(11.4 \pm 0.3) \times 10^{-6}$ mol dm^{-3}	Klehr and Voigt (ref. 2)
$(11.9 \pm 0.6) \times 10^{-6}$ mol dm^{-3}	Spencer and Voigt (ref. 3)

Spencer and Voigt report five additional values at various temperatures between 288.15 and 308.15 K.

All of the data were treated by a linear regression. The Moser and Voigt value at 298.15 K was dropped because it was just at two standard deviations from the regression line. The data were treated again to obtain two constant equations in concentration, mole fraction and molality. The equation constants are in Table 1. The smoothed data and values of the thermodynamic changes for the transfer of mercury from the liquid metal to the hypothetical unit concentration solution are in Table 2. The enthalpy of solution is similar in magnitude to the value for alkanes of similar carbon number.

Table 1. The solubility of mercury in benzene. Least square parameters for the equation ln(soly) = A(1) + A(2)/(*T*/100 K).

Solubility	A(1) ± Error	A(2) ± Error	Std. error about the Regression Line
c_1/mol dm^{-3}	5.6307 ± 0.4801	-50.6159 ± 1.4287	3.9×10^{-7}
x_1	3.6560 ± 0.4621	-51.9295 ± 1.3752	3.4×10^{-8}
m_1/mol kg^{-1}	6.0509 ± 0.5041	-51.4670 ± 1.3008	4.6×10^{-7}

Table 2. The solubility of mercury in benzene. Tentative values of the concentration, mole fraction and molality as a function of temperature.

T/K	Mercury Solubility		
	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction $10^7 x_1$	Molality $10^6 m_1$/mol kg^{-1}
288.15	6.6	5.8	7.4
293.15	8.8	7.8	10.1
298.15	11.8	10.6	13.5
303.15	15.6	14.1	18.0
308.15	20.5	18.6	23.7
ΔH_1[a]	42.1 ± 1.2	43.2 ± 1.1	42.8 ± 1.1
ΔS_1[b]	46.8 ± 4.0	30.4 ± 3.8	50.3 ± 4.2

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

Mercury + Methylbenzene; C_7H_8; [108-88-3]

All three papers report solubility values at 298.15 K. The values are:

(12.5 ± 0.2) x 10^{-6} mol dm^{-3}	Moser and Voigt (ref. 1)
(13.4 ± 0.1) x 10^{-6} mol dm^{-3}	Klehr and Voigt (ref. 2)
(12.0 ± 0.1) x 10^{-6} mol dm^{-3}	Spencer and Voigt (ref. 3)

In addition Klehr and Voigt report seven more values in the 273.15 to 318.15 K interval and Spencer and Voigt report five more values in the 273.15 to 308.15 K interval.

The Klehr and Voigt, the Spencer and Voigt, and the combined data set were treated by linear regressions to obtain two constant equations of the type

$$\ln(\text{soly}) = A(1) + A(2)/(T/100\ \text{K}).$$

The Klehr and Voigt data showed more scatter and gave significantly smaller solubility values in the 308.15 to 318.15 K temperature interval than the other data sets. The enthalpy of solution was nearly 5 kJ mol^{-1} less than the benzene enthalpy value for the combined fit. The Klehr and Voigt values at 308.15 and 318.15 K did not quite deviate a full two standard deviations from the combined data regression line. However, they were arbitrarily omitted and the remaining data refit by the linear regression to obtain the values in Tables 3 and 4 for concentration, mole fraction and molality. The enthalpy of solution is the smallest for this system amoung the five aromatic hydrocarbon solvents by several percent.

Table 3. The solubility of mercury in methylbenzene. Least square parameters for the equation ln(soly) = A(1) + A(2)/(T/100 K).

Solubility	A(1) ± Error	A(2) ± Error	Std. error about the Regression Line
c_1/mol dm^{-3}	3.5029 ± 0.5883	-44.2469 ± 1.7135	7.5 x 10^{-7}
x_1	1.6227 ± 0.5686	-45.3066 ± 1.6563	7.8 x 10^{-8}
m_1/mol kg^{-1}	3.9894 ± 0.5724	-45.2540 ± 1.6673	8.5 x 10^{-7}

Table 4. The solubility of mercury in methylbenzene. Tentative values of the concentration, mole fraction and molality as a function of temperature.

T/K	Mercury Solubility		
	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction $10^7 x_1$	Molality $10^6 m_1$/mol kg^{-1}
273.15	3.1	3.2	3.4
278.15	4.1	4.3	4.6
283.15	5.4	5.7	6.2
288.15	7.1	7.5	8.2
293.15	9.3	9.8	10.7
298.15	11.9	12.7	13.8
303.15	15.2	16.4	17.8
308.15	19.3	20.9	22.6
313.15	24.3	26.4	28.6
318.15	30.3	33.1	35.9
ΔH_1[a]	36.8 ± 1.4	37.7 ± 1.4	37.6 ± 1.4
ΔS_1[b]	29.1 ± 4.9	13.5 ± 4.7	33.2 ± 4.8

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Aromatic Hydrocarbons	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1985, July

CRITICAL EVALUATION:

Mercury + 1,2-Dimethylbenzene; C_8H_{10}; [95-47-6]
+ (1-methylethyl)Benzene; C_9H_{12}; [98-82-8]
+ (2-methylpropyl)Benzene; $C_{10}H_{14}$; [538-93-2]

Only Spencer and Voigt (ref. 3) report solubility data on these systems. The data are classed as tentative. Each system was subject to a linear regression in concentration, mole fraction and molality. The results are in Table 5. The smoothed solubility values as a function of temperature and the enthalpy and entropy changes for the transfer of one mole of mercury from the liquid metal to the hypothetical unit solutions are in Tables 6, 7 and 8.

It is interesting to note that the mole fraction solubilities for the three hydrocarbons above are the same within experimental error at a given temperature. The mole fraction solubilities in benzene and methylbenzene are about 28 and 15 percent smaller, respectively, than the average mole fraction solubility of the C_8, C_9 and C_{10} hydrocarbons above. The enthalpy of solution in mercury in the aromatic hydrocarbons is similar in magnitude to the values in the alkanes.

Table 5. The solubility of mercury in 1,2-dimethylbenzene, (1-methylethyl)benzene and (2-methylpropyl)benzene. Least square parameters for the equation ln(soly) = A(1) + A(2)/(T/100 K).

Solubility	A(1) ± Error	A(2) ± Error	Std. error about the Regression Line
	1,2-Dimethylbenzene or *ortho*-Xylene		
c_1/mol dm^{-3}	5.4863 ± 0.2771	-50.1083 ± 0.8157	4.2 x 10^{-7}
x_1	3.5834 ± 0.2744	-50.7252 ± 0.8079	5.3 x 10^{-8}
m_1/mol kg^{-1}	5.8912 ± 0.2858	-50.9159 ± 0.8414	5.0 x 10^{-7}
	(1-methylethyl)Benzene or *Iso*propylbenzene		
c_1/mol dm^{-3}	3.7336 ± 0.2107	-45.2228 ± 0.6203	2.6 x 10^{-7}
x_1	2.0351 ± 0.2155	-46.0108 ± 0.6343	3.7 x 10^{-8}
m_1/mol kg^{-1}	4.0998 ± 0.2056	-45.8465 ± 0.6052	3.0 x 10^{-7}
	(2-methylpropyl)Benzene or *t*-Butylbenzene		
c_1/mol dm^{-3}	4.1354 ± 0.3899	-46.9025 ± 1.1555	5.7 x 10^{-7}
x_1	2.5225 ± 0.3729	-47.6384 ± 1.1052	8.4 x 10^{-8}
m_1/mol kg^{-1}	4.5045 ± 0.3503	-47.5591 ± 1.0383	6.1 x 10^{-7}

Table 6. The solubility of mercury in 1,2-diethylbenzene. Tentative values of concentration, mole fraction and molality as a function of temperature.

T/K	Mercury Solubility		
	Concentration 10^6c_1/mol dm^{-3}	Mole Fraction 10^7x_1	Molality 10^6m_1/mol kg^{-1}
273.15	2.6	3.1	2.9
278.15	3.6	4.3	4.1
283.15	5.0	6.0	5.6
288.15	6.8	8.1	7.7
293.15	9.1	11.0	10.4
298.15	12.1	14.7	13.9
303.15	16.0	19.5	18.4
308.15	20.9	25.5	24.1
ΔH_1[a]	41.7 ± 0.7	42.2 ± 0.7	42.3 ± 0.7
ΔS_1[b]	45.6 ± 2.3	29.8 ± 2.3	49.0 ± 2.4

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

Table 7. The solubility of mercury in (1-methylethyl)benzene. Tentative values of concentration, mole fraction and molality as a function of temperature.

T/K	Mercury Solubility		
	Concentration 10^6c_1/mol dm^{-3}	Mole Fraction 10^7x_1	Molality 10^6m_1/mol kg^{-1}
273.15	2.7	3.7	3.1
278.15	3.6	5.0	4.2
283.15	4.8	6.7	5.6
288.15	6.4	8.9	7.4
293.15	8.4	11.7	9.7
298.15	10.8	15.2	12.7
303.15	13.9	19.6	16.3
308.15	17.7	25.1	20.8
ΔH_1[a]	37.6 ± 0.5	38.3 ± 0.5	38.1 ± 0.5
ΔS_1[b]	31.0 ± 1.8	16.9 ± 1.8	34.1 ± 1.7

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Aromatic Hydrocarbons	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1985, July

CRITICAL EVALUATION:

Table 8. The solubility of mercury in (2-methylpropyl)benzene. Tentative values of the concentration, mole fraction and molality as a function of temperature.

T/K	Mercury Solubility		
	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction $10^7 x_1$	Molality $10^6 m_1$/mol kg^{-1}
273.15	2.2	3.3	2.5
278.15	3.0	4.5	3.4
283.15	4.0	6.1	4.6
288.15	5.3	8.2	6.1
293.15	7.0	10.9	8.1
298.15	9.2	14.3	10.7
303.15	11.9	18.7	13.9
308.15	15.3	24.1	17.9
313.15	19.6	30.8	22.9
$\Delta H_1{}^a$	39.0 ± 1.0	39.6 ± 0.9	39.5 ± 0.9
$\Delta S_1{}^b$	34.4 ± 3.2	21.0 ± 3.1	37.5 ± 2.9

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp.; *Chem. Abstr.* 1958, *52*, 10691h.

2. Klehr, E. H.; Voigt, A. F. *Radioisot. Phys. Sci. Ind., Proc. Conf., Copenhagen*, 1960, *1*, 517 - 29 (pub. 1962); *Chem. Abstr.* 1962, *57*, 6681b.

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

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Moser, H. C.; Voigt, A. F.

USAEC Report 1957, ISC-892.
Chem. Abstr. 1958, 52, 10691h.

VARIABLES:

$T/K = 298.15$

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$	T/K^a	Concentration $10^6 c_1/\text{mol dm}^{-3}$	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1/\text{mol kg}^{-1}$
25	298.15	12.0 ± 0.6	10.7	13.7

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A globule of Hg metal prepared from radioactive mercury(II) nitrate by reduction with hypophosphorous acid was equilibrated with 5 - 10 ml of liquid by shaking in a thermostat. Aliquotes of the liquid were withdrawn periodically for up to two weeks and the Hg concentration determined radiochemically.

The aliquot was diluted with acetone and equilibrated with $Hg(NO_3)_2$ carrier to exchange the radioactive mercury. The mercury was precipitated as HgS, mounted on a stainless steel planchet and counted with a Geiger-Mueller tube.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Oak Ridge National Lab; recieved as 0.31 M $Hg(NO_3)_2$ in 1.56 HNO_3 solution. Initial activity 50 millicuries g^{-1}; half-life 48 days. Reduced to Hg by hypophosphorous acid; coagulated to a Hg droplet by addition of concentrated HI.

(2) Benzene. Baker and Adamson; reagent grade, thiophene-free. Used without further purification.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Klehr, E. H.; Voigt, A. F.

Radioisotopes Phys. Sci. Ind., Proc. Conf. Use, Copenhagen 1960, *1*, 517 - 29 (Pub. 1962).

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 10^8c_1/mol dm^{-3}	Mole Fraction^a 10^7x_1	Molality^a 10^8m_1/mol kg^{-1}
25	298.15	11.4 ± 0.3	10.2	13.0

^{a}Calculated by compilers.

The value above is from the direct measurement technique. The indirect measurement result is 11.1 x 10^{-8} mol dm^{-3} at 298.15 K obtained by multiplying the mercury solubility in water, 3.0 x 10^{-7} mol dm^{-3}, times the distribution coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Direct Method. A globule of mercury containing 203-Hg was placed in 50 ml of solvent in a 100 ml flask and agitated in a thermostated bath. Samples were taken until the solution appeared to be at equilibrium. Analyses were made by GM-counting by one of two techniques:

(i) Solid precipitate counting. The Hg in a 0.5 ml aliquot was exchanged and reprecipitated on a stainless steel panchet as the sulfide was dried and counted. Details in Moser and Voigt (ref. 1).

(ii) Liquid aliquot scintillation-counting. A 0.5 ml aliquot of the saturated solution was diluted and transferred to the counting tube with a known volume of benzene.

The 0.28 MeV gamma radiation was counted. Error due to radiation adsorbed by the benzene and water was shown to be less than one percent.

Indirect Method. The distribution coefficient between solvent and water was measured.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Reduced from a mercury nitrate sample. Half-life is 47 days.

(2) Benzene. Repurified by stirring with repeated portions of concentrated sulfuric acid and then redistilling.

ESTIMATED ERROR:

See random error reported by authors with concentration values above.

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Benzene; C_6H_6; [71-43-2]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

T/K = 288.15 - 308.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration 10^6c_1/mol dm^{-3}	Mole Fraction^a 10^7x_1	Molality^a 10^6m_1/mol kg^{-1}
15	288.15	6.6 ± 0.1	5.8	7.5
20	293.15	8.9 ± 0.1	7.9	10.1
22.5	295.65	10.4 ± 0.2	9.27	11.9
25	298.15	11.9 ± 0.6	10.6	13.6
30	303.15	15.2 ± 0.2	13.7	17.5
35	308.15	21.1 ± 1.3	19.1	24.4

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (17.407 \pm .360)\log(T/K) - 49.047$$

for the 288.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

The solubility of mercury in benzene was followed for several days. It was found that the mercury concentration was constant after about 24 hours of shaking and remained constant over a period of several days. Radiation damage sufficient to affect the solubilities would have caused a noticeable increase with time.

SOURCE AND PURITY OF MATERIALS:

(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) Benzene. Phillips Petroleum Co. Research Grade, used as received.

ESTIMATED ERROR:

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

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Methylbenzene or Toluene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Moser, H. C.; Voigt, A. F.

USAEC Report <u>1957</u>, ISC-892.
Chem. Abstr. <u>1958</u>, *52*, 10691h.

VARIABLES:

$T/K = 298.15$

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$	T/K^a	Concentration $10^6 c_1/mol\ dm^{-3}$	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1/mol\ kg^{-1}$
25	298.15	12.5 ± 0.5	13.4	14.5

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A globule of Hg metal prepared from radioactive mercury(II) nitrate by reduction with hypophosphorous acid was equilibrated with 5 - 10 ml of liquid by shaking in a thermostat. Aliquotes of the liquid were withdrawn periodically for up to two weeks and the Hg concentration determined radiochemically.

The aliquot was diluted with acetone and equilibrated with $Hg(NO_3)_2$ carrier to exchange the radioactive mercury. The mercury was precipitated as HgS, mounted on a stainless steel planchet and counted with a Geiger-Mueller tube.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Oak Ridge National Lab; recieved as 0.31 M $Hg(NO_3)_2$ in 1.56 HNO_3 solution. Initial activity 50 millicuries g^{-1}; half-life 48 days. Reduced to Hg by hypophosphorous acid; coagulated to a Hg droplet by addition of concentrated HI.

(2) Toluene. Eastman Co.; prepared from toluene sulfonic acid. Shaken with aqueous NaOH, passed through dry silica gel and redistilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]; Mercury-203; ^{203}Hg; [13982-78-0]

(2) Methylbenzene or Toluene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Klehr, E. H.; Voigt, A. F.

Radioisotopes Phys. Sci. Ind., Proc. Conf. Use, Copenhagen 1960, *1*, 517 - 29 (Pub. 1962).

VARIABLES:

T/K = 273.15 - 318.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
0	273.15	3.4 ± 0.1	3.5	3.8
10	283.15	5.1 ± 0.1	5.4	5.8
15	288.15	6.6 ± 0.1	7.0	7.6
20	293.15	8.5 ± 0.1	9.0	9.8
25	298.15	13.4 ± 0.1	14.3	15.5
30	303.15	14.4 ± 0.1	15.5	16.8
35	308.15	16.5 ± 0.1	17.8	19.3
45	318.15	26.9 ± 0.2	29.4	31.9

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Direct Method. A globule of mercury containing 203-Hg was placed in 50 ml of solvent in a 100 ml flask and agitated in a thermostated bath. Samples were taken until the solution appeared to be at equilibrium. Analyses were made by GM-counting by one of two techniques:

(i) Solid precipitate counting. The Hg in a 0.5 ml aliquot was exchanged and reprecipitated on a stainless steel panchet as the sulfide was dried and counted. Details in Moser and Voigt (ref. 1).

(ii) Liquid aliquot scintillation-counting. A 0.5 ml aliquot of the saturated solution was diluted and transferred to the counting tube with a known volume of benzene.

The 0.28 MeV gamma radiation was counted. Error due to radiation adsorbed by the benzene and water was shown to be less than one percent.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Reduced from a mercury nitrate sample. Half-life is 47 days.

(2) Toluene. Research grade, used without further purification.

ESTIMATED ERROR:

See random error reported by authors with concentration values above.

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]; Mercury-203; ^{203}Hg; [13982-78-0]

(2) Methylbenzene or Toluene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

$T/K = 273.15 - 308.15$

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$	T/K^a	Concentration $10^6c_1/\text{mol dm}^{-3}$	Mole Fraction^a 10^7x_1	Molality^a $10^6m_1/\text{mol kg}^{-1}$
0	273.15	3.1 ± 0.3	3.2	3.5
15	288.15	6.5 ± 0.1	6.9	7.5
20	293.15	9.7 ± 0.6	10.3	11.2
25	298.15	12.0 ± 0.1	12.8	13.9
30	303.15	16.1 ± 0.3	17.3	18.8
35	308.15	19.8 ± 0.9	21.4	23.2

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (16.034 \pm .538)\log(T/K) - 45.567$$

for the 273.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(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) Toluene. Phillips Petroleum Co. Research Grade, used as received.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; See random error reported by authors with concentration values above.

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) 1,2-Dimethylbenzene or *o*-Xylene;
C_8H_{10}; [95-47-6]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

T/K = 273.15 - 308.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
0	273.15	2.6 ± 0.3	3.1	2.9
20	293.15	9.3 ± 0.1	11.2	10.6
25	298.15	12.0 ± 0.3	14.5	13.7
30	303.15	15.5 ± 0.5	18.9	17.8
35	308.15	21.4 ± 1.7	26.2	24.7

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (17.635 \pm .316)\log(T/K) - 49.473$$

for the 273.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(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) 1,2-Dimethylbenzene. Phillips Petroleum Co. Research Grade, used as received.

ESTIMATED ERROR:

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

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) (1-methylethyl)Benzene or
*Iso*propylbenzene; C_9H_{12};
[98-82-8]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University,
1967.

VARIABLES:

$T/K = 273.15 - 308.15$

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$	T/K^a	Concentration $10^6c_1/\text{mol dm}^{-3}$	Mole Fraction^a 10^7x_1	Molality^a $10^6m_1/\text{mol kg}^{-1}$
0	273.15	2.7 ± 0.1	3.7	3.1
20	293.15	8.5 ± 0.2	11.9	9.9
25	298.15	10.6 ± 0.3	14.9	12.4
30	303.15	13.7 ± 0.3	19.3	16.1
35	308.15	18.0 ± 1.3	25.5	21.2

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (15.957 \pm .235)\log(T/K) - 45.307$$

for the 273.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(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) *Iso*propylbenzene. Phillips Petroleum Co. Research Grade, used as received.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; See random error reported by authors with concentration values above.

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) (2-methylpropyl)Benzene or
t-Butylbenzene; $C_{10}H_{14}$;
[538-93-2]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

T/K = 273.15 - 313.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
0	273.15	2.1 ± 0.1	3.2	2.4
15	288.15	5.5 ± 0.2	8.5	6.3
25	298.15	9.6 ± 0.3	14.9	11.1
30	303.15	12.3 ± 0.9	19.2	14.3
35	308.15	15.1 ± 0.5	23.7	17.7
40	313.15	18.6 ± 1.0	29.4	21.9

^{a}Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (16.689 \pm .388)\log(T/\mathrm{K}) - 47.140$$

for the 273.15 to 313.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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 scintillation 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.

SOURCE AND PURITY OF MATERIALS:

(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) *t*-Butylbenzene. Phillips Petroleum Co. Research Grade, used as received.

ESTIMATED ERROR:

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

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Alcohols

EVALUATOR:

H. Lawrence Clever
Chemistry Department
Emory University
Atlanta, Georgia 30322 USA

1985, August

CRITICAL EVALUATION:

An Evaluation of the Solubility of Mercury in Alcohols.

There are measurements of the solubility of mercury in only two alcohols. They are methanol and 2-propanol. The systems are discussed below.

Mercury + Methanol

Reichardt and Bonhoeffer (ref. 1) measured the solubility at 313.15 and 336.15 K, Kuntz and Mains (ref. 2) at 298.15 K, and Spencer and Voigt (ref. 3) at five temperatures between 288.15 and 308.15 K. Three quite different methods were used: an amalgamation method, a spectroscopic method and a radioactive tracer method.

Figure 1 show the mole fraction solubilities on a ln x_1 vs. $1000/(T/K)$ plot. The Kuntz and Mains (ref. 2) value was obtained assuming the mercury extinction coefficient is the same in a hydrocarbon and methanol. As the authors mention, this is a poor assumption and may be the reason for the apparent low value. The extinction coefficient was obtained by the spectroscopic measurement of a mercury saturated hexane solution assuming the solubility value of mercury in hexane of Moser and Voigt (ref. 4) was correct. The Reichardt and Bonhoeffer values were obtained by a method that has not been thoroughly tested as some other methods. The dotted line of Figure 1 is the linear regression line for all of the data. The solid line is for the Spencer and Voigt (ref. 3) data only. We have arbitrarily chosen to use the Spencer and Voigt data only as the basis for the tentative values.

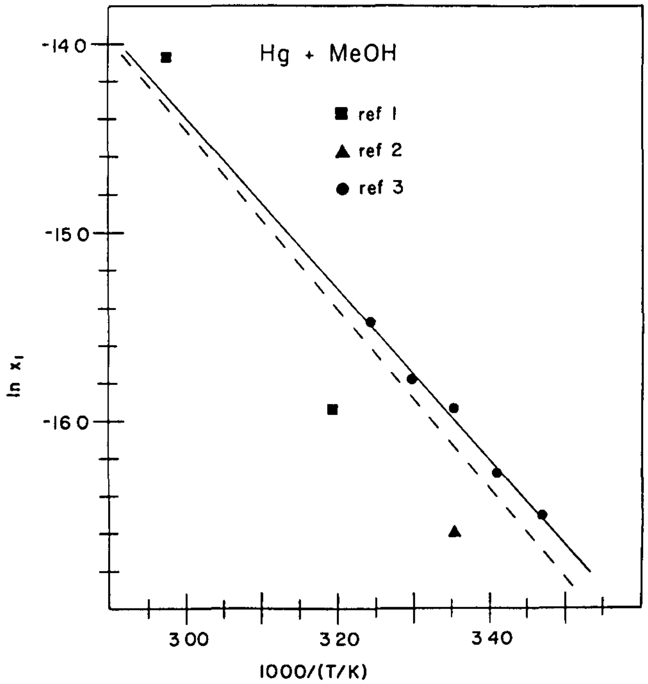


Figure 1. The solubility of mercury in methanol. ln x_1 vs. $1000/(T/K)$

The Spencer and Voigt data in units of concentration, mole fraction and molality were treated by linear regression to obtain the constants of Table 1. Table 2 contains the smoothed tentative solubility values and the thermodynamic changes for the transfer of one mole of mercury from liquid metal to the hypothetical unit concentration solution.

Table 1. Mercury + Methanol. Linear regression for the equation ln(soly) = A(1) + A(2)/(T/100 K).

Solubility	A(1) ± Error	A(2) ± Error	Std. Error about the Regression Line
c_1/mol dm^{-3}	2.3763 ± 0.7650	-45.1788 ± 2.2789	1.2 x 10^{-7}
x_1	-0.7753 ± 0.8625	-45.3539 ± 2.5693	5.7 x 10^{-8}
m_1/mol kg^{-1}	3.0153 ± 0.6046	-46.3685 ± 1.8012	1.3 x 10^{-7}

Table 2. The solubility of mercury in methanol. Tentative values of the solubility in concentration, mole fraction and molality as a function of temperature at 0.1 MPa and thermodynamic changes.

Temperature		Mercury Solubility		
t/°C	T/K	Concentration 10^6c_1/mol dm^{-3}	Mole Fraction 10^8x_1	Molality 10^6m_1/mol kg^{-1}
15	288.15	1.7	6.7	2.1
20	293.15	2.2	8.8	2.8
25	298.15	2.8	11.4	3.6
30	303.15	3.6	14.7	4.6
35	308.15	4.6	18.7	6.0
40	313.15	5.8	23.6	7.6
50	323.15	9.1	37.0	12.0
60	333.15	13.9	56.4	18.4
ΔH_1[a]		37.6 ± 1.9	37.7 ± 2.1	38.6 ± 1.5
ΔS_1[b]		19.8 ± 6.4	-6.4 ± 7.2	25.1 ± 5.0

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

Mercury + 2-Propanol

Only Spencer and Voigt (ref. 3) report the solubility of mercury in 2-propanol. Their data, classed as tentative, were treated by linear regression in the units of concentration, mole fraction and molality. The regression constants are in Table 3 and the smoothed data and thermodynamic changes are in Table 4.

The enthalpy changes are the same within experimental error for the solution of mercury in methanol and 2-propanol. The mole fraction solubility of mercury in methanol is only about one-tenth of the solubility in an alkane, but it is 22 times more soluble than in water.

Table 3. Mercury + 2-Propanol. Linear regression for the equation ln(soly) = A(1) + A(2)/(T/100 K).

Solubility	A(1) ± Error	A(2) ± Error	Std. Error about the Regression Line
c_1/mol dm^{-3}	1.8159 ± 0.1402	-43.6772 ± 0.4175	1.7 x 10^{-8}
x_1	-0.4575 ± 0.1901	-44.5711 ± 0.5665	1.6 x 10^{-8}
m_1/mol kg^{-1}	2.5947 ± 0.2825	-45.2572 ± 0.8417	4.0 x 10^{-8}

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Alcohols	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1985, August

CRITICAL EVALUATION:

Table 4. The solubility of mercury in 2-propanol. Tentative values of the solubility in concentration, mole fraction and molality as a function of temperature at 0.1 MPa and thermodynamic changes.

Temperature		Mercury Solubility		
		Concentration	Mole Fraction	Molality
t/°C	T/K	$10^6 c_1$/mol dm^{-3}	$10^8 x_1$	$10^6 m_1$/mol kg^{-1}
15	288.15	1.6	12.1	2.0
20	293.15	2.1	15.8	2.6
25	298.15	2.67	20.4	3.4
30	303.15	3.4	26.1	4.4
35	308.15	4.3	33.1	5.6
$\Delta H_1{}^a$		36.3 ± 0.3	37.1 ± 0.5	37.6 ± 0.7
$\Delta S_1{}^b$		15.1 ± 1.2	-3.8 ± 1.6	21.6 ± 2.3

^{a} units kJ mol^{-1}
^{b} units J K^{-1} mol^{-1}

REFERENCES:

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

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

3. Spencer, J. N.; Voigt, A. F. *J. Phys. Chem.* 1968, *72*, 1913 - 7.

4. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp.

ADDENDUM:

A recent paper reports the partition coefficient of mercury between water and octanol-1. The evaluator estimates a solubility of mercury in water saturated octanol-1 (4.6 wt % water) of 1.18 x 10^{-6} mol dm^{-3} at 298.15 K. In dry octanol-1 the solubility may be 4 x 10^{-6} mol dm^{-3}. See the data sheets and original paper for more details.

5. Okouchi, S.; Sasaki, S. *Bull. Chem. Soc. Jpn.* 1985, *58*, 3401 - 2.

C. H. Kim and G. K. Vemulapalli (University of Arizona, Tucson) have new measurements in progress on the solubility of mercury in methanol, ethanol, hexane, and 3-methylpentane by atomic absorption. They are also measuring the absolute extinction coefficient of mercury in the solvents.

6. Vemulapalli, G. K. private communication.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Methanol or Methyl alcohol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

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]	c_1/mg dm^{-3}	Concentration[a] 10^5c_1/mol dm^{-3}	Mole Fraction[a] 10^7x_1	Molality[a] 10^5m_1/mol kg^{-1}
40	313.15	0.6	0.3	1.2	0.4
63	336.15	3.6	1.8	7.7	2.4

[a] Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) Methanol. No information given.

ESTIMATED ERROR:

δc_1/mg dm^{-3} = ±(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:

(1) Mercury; Hg; [7439-97-6]

(2) Methanol or Methyl alcohol;
CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Kuntz, R. R.; Mains, G. J.

J. Phys. Chem. 1964, *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 $10^6 c_1$/mol dm^{-3}	Mole Fraction[a] $10^8 x_1$	Molality[a] $10^6 m_1$/mol kg^{-1}
25	298.15	1.52	6.19	1.93

[a] Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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 $\varepsilon_{2560} = 7.35 \times 10^3$ dm^3 mol^{-1} cm^{-1} at 25°C. The value was used to calculate the solubility in the other solvents.

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) Methanol. Phillips Petroleum Co. Pure Grade hydrocarbon solvent, purified by passage through silica gel until optically pure. Degassed and distilled.

ESTIMATED ERROR:

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
    Mercury-203; ^{203}Hg; [13982-78-0]

(2) Methanol or Methyl alcohol;
    CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 1913 - 7.

Voigt, A. F.
Personal communication

VARIABLES:

T/K = 288.15 - 308.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$	T/K^a	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
15	288.15	1.7 ± 0.1	6.8	2.1
20	293.15	2.1 ± 0.1	8.5	2.7
25	298.15	2.94 ± 0.09	12.0	3.74
30	303.15	3.5 ± 0.1	14	4.5
35	308.15	4.7 ± 0.3	19	6.0

[a] Calculated by compilers.

Professor Voigt provided the experimental molar solubility values from J. N. Spencer's research notebook that do not appear in the published paper.

The authors smoothed their data according to the equation:

$$\log x_1 = (15.76 \pm .66)\log(T/K) - 45.93$$

for the 288.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method and procedure are reported in an earlier paper (ref. 1).

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 volumetric 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.

Studies were made to show the solubility of mercury in methanol was not changed by the presence of up to 5 % water. There was no evidence of mercury oxidation during the course of the experiment.

SOURCE AND PURITY OF MATERIALS:

(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) Methanol. Fisher Scientific Co. Stated to be 99.9 mol %. Fractionally distilled prior to use.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; See random error reported by authors with concentration values above.

REFERENCES:

1. Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6]; Mercury-203; ^{203}Hg; [13982-78-0] (2) 2-Propanol or *Iso*propyl alcohol; C_3H_8O; [67-63-0]	Spencer, J. N.; Voigt, A. F. *J. Phys. Chem.* 1968, *72*, 1913 - 7. Voigt, A. F. Personal communication
VARIABLES:	PREPARED BY:
T/K = 288.15 - 308.15	S. H. Johnson M. Iwamoto H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K^a	Concentration 10^6c_1/mol dm^{-3}	Mole Fraction^a 10^7x_1	Molality^a 10^6m_1/mol kg^{-1}
15	288.15	1.6 ± 0.1	1.2	2.0
20	293.15	2.1 ± 0.3	1.6	2.7
25	298.15	2.65 ± 0.07	2.04	3.39
30	303.15	3.4 ± 0.2	2.6	4.4
35	308.15	4.3 ± 0.3	3.3	5.6

^{a}Calculated by compilers.

Professor Voigt provided the experimental molar solubility values from J. N. Spencer's research notebook that do not appear in the published paper.

The authors smoothed their data according to the equation:

$$\log x_1 = (15.33 \pm .49)\log(T/K) - 44.61$$

for the 288.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method and procedure are reported in an earlier paper (ref. 1).

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 glass stoppered volumetric 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 3 day period.

There was no evidence of mercury oxidation during the course of the experiment.

SOURCE AND PURITY OF MATERIALS:

(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) 2-Propanol. Fisher Scientific Co. Stated to be 99 mol %. Fractionally distilled prior to use.

ESTIMATED ERROR:

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

REFERENCES:

1. Spencer, J. N.; Voigt, A. F. *J. Phys. Chem.* 1968, *72*, 464.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Water; H_2O; [7732-18-5]

(3) Octanol-1; $C_8H_{18}O$; [111-87-5]

ORIGINAL MEASUREMENTS:

Okouchi, S.; Sasaki, S.

Bull. Chem. Soc. Jpn. 1985, *58*, 3401-2.

VARIABLES:

$T/K = 278.15 - 308.15$
Water saturated 1-octanol.

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

T/K	Octanol-1 Water Content wt %	Partition Coefficient KOH	Estimated Solubility in Water sat. Octanol-1 $10^6 c_1/\mathrm{mol\ dm^{-3}}$
278.15	3.7	4.80 ± 0.20	0.76
288.15	4.4	4.75 ± 0.20	1.01
298.15	4.6 ± 0.1	4.15 ± 0.20	1.18
308.15	4.9	3.80 ± 0.20	1.45

Dr. S. Okouchi provided the experimental partion coefficients that did not appear in the original paper.

Values of the water content of octanol-1 were taken from "Alcohols in water", Barton, A. F. M., Editor, *Solubility Series* 1984, *15*, 364 - 7. The same source says water is saturated with 0.054 ± 0.005 wt % octanol-1 at 298 K.

The compiler assumed mercury solubility in water saturated with octanol-1 was the same as the mercury solubility in pure water to estimate the solubility of mercury in the water saturated octanol-1.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Mercury was dissolved in octanol-1 containing 0.001 mol dm^{-3} hydrazine as a reducing agent (ref. 1). Two mL of octanol-1 + mercury and 20 mL of water were shaken together for 214 hours in a thermostated 25 mL centrifuge tube. After equilibration, then centrifugation, the two phases were separated and analyzed by means of cold-vapor atomic absorption (ref. 2).

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Analytical grade, source not given. Purified according to Glew and Hames (ref. 1).

(2) Water. Doubly distilled.

(3) Octanol-1. Analytical reagent grade. Distilled twice to remove impurities.

ESTIMATED ERROR:

REFERENCES:

1. Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1971, *49*, 3114.

2. Okouchi, S.; Sasaki, S. *Bull.Chem. Soc. Jpn.* 1981, *54*, 2513.

COMPONENTS: (1) Mercury; Hg; [7439-97-6] (2) Octanol-1; $C_8H_{18}O$; [111-87-5]	ORIGINAL MEASUREMENTS: Okouchi, S.; Sasaki, S. *Bull. Chem. Soc. Jpn.* 1985, *58*, 3401-2.
VARIABLES: $T/K = 298.15$	PREPARED BY: H. L. Clever M. Iwamoto

EXPERIMENTAL VALUES:

	Solubility	Concentration	Mole Fraction
T/K	$10^6 c_1/\mathrm{g\ cm^{-3}}$	$10^6 c_1/\mathrm{mol\ dm^{-3}}$	$10^7 x_1$
298.15	0.8	4	6

The above values are approximate values that represent a lower limit to the solubility of mercury in 1-octanol. They are based on the author's statement that their stock solution of mercury in 1-octanol was prepared by dissolving approximately 0.8 micrograms of mercury per cubic centimeter of the alcohol.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Mercury was dissolved in octanol-1 containing 0.001 mol dm^{-3} hydrazine as a reducing agent (ref. 1).

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Analytical grade, source not given. Purified according to Glew and Hames (ref. 1).

(2) Octanol-1. Analytical reagent grade. Distilled twice to remove impurities.

ESTIMATED ERROR:

REFERENCES:

1. Glew, D. N.; Hames, D. A. *Can. J. Chem.* 1971, *49*, 3114.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Oxybisalkanes or Ethers

EVALUATOR:

H. Lawrence Clever
Chemistry Department
Emory University
Atlanta, Georgia 30322 USA

1985, August

CRITICAL EVALUATION:

An Evaluation of the Solubility of Mercury in Oxybisalkanes.

Spencer and Voigt (ref. 1) have measured the solubility of mercury in the two ethers, 2,2'-oxybispropane and 1,1'-oxybisbutane at six temperatures between 273.15 and 308.15 K by a radioactive tracer method. We know of no other data on the solubility of mercury in ethers.

Mercury + 2,2'-Oxybispropane; $C_6H_{14}O$; [108-20-3]
+ 1,1'-Oxybisbutane; $C_8H_{18}O$; [142-96-1]

The data of the two systems are classified as tentative. Both data set were treated by a linear regression to obtain a two constant equation in the units of concentration, mole fraction and molality in the form:

$$\ln(\text{soly}) = A(1) + A(2)/(T/100\ \text{K})$$

Tentative values of smoothed data and thermodynamic changes for the transfer of one mole of mercury from the liquid metal to the hypothetical unit concentration solution were obtained from the equation.

Tables 1 and 2 contain information on the 2,2'-oxybispropane and Tables 3 and 4 on the 1,1'-oxybisbutane system.

Table 1. Mercury + 2,2'-Oxybispropane. Linear regression for the equation $\ln(\text{soly}) = A(1) + A(2)/(T/100\ \text{K})$.

Solubility	A(1) ± Error	A(2) ± Error	Std. Error about the Regression Line
c_1/mol dm^{-3}	2.5672 ± 0.4717	-44.1825 ± 1.3840	2.2 x 10^{-7}
x_1	1.2221 ± 0.4690	-45.9941 ± 1.3761	3.1 x 10^{-8}
m_1/mol kg^{-1}	3.4006 ± 0.4416	-45.6728 ± 1.2955	3.0 x 10^{-7}

Table 2. The solubility of mercury in 2,2'-oxybispropane. Tentative values of the solubility in concentration, mole fraction and molality as a function of temperature at 0.1 MPa and thermodynamic changes.

Temperature		Mercury Solubility		
t/°C	T/K	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction $10^7 x_1$	Molality $10^6 m_1$/mol kg^{-1}
0	273.15	1.2	1.7	1.6
5	278.15	1.6	2.2	2.2
10	283.15	2.2	3.0	3.0
15	288.15	2.9	4.1	4.0
20	293.15	3.7	5.2	5.1
25	298.15	4.8	6.8	6.7
30	303.15	6.1	8.7	8.6
35	308.15	7.7	11.2	11.0
$\Delta H_1{}^a$		36.7 ± 1.2	38.2 ± 1.1	38.0 ± 1.1
$\Delta S_1{}^b$		21.3 ± 3.9	10.2 ± 3.9	28.3 ± 3.7

^{a} units kJ mol^{-1}
^{b} units J K^{-1} mol^{-1}

Table 3. Mercury + 1,1'-Oxybisbutane. Linear regression constants for the equation ln(soly) = A(1) + A(2)/(T/100 K).

Solubility	A(1) ± Error	A(2) ± Error	Std. Error about the Regression Line
c_1/mol dm^{-3}	3.0686 ± 0.5316	-44.5568 ± 1.5597	4.4 x 10^{-7}
x_1	1.6691 ± 0.5356	-45.6601 ± 1.5715	7.6 x 10^{-8}
m_1/mol kg^{-1}	3.5306 ± 0.4980	-45.1263 ± 1.4610	5.5 x 10^{-7}

Table 4. The solubility of mercury in 1,1'-oxybisbutane. Tentative values of the solubility in concentration, mole fraction, and molality as a function of temperature at 0.1 MPa and thermodynamic changes.

Temperature		Mercury Solubility		
t/°C	T/K	Concentration 10$^{6}c_1$/mol dm^{-3}	Mole Fraction 10$^{7}x_1$	Molality 10$^{6}m_1$/mol kg^{-1}
0	273.15	1.8	2.9	2.3
5	278.15	2.4	3.9	3.1
10	283.15	3.2	5.3	4.1
15	288.15	4.1	7.0	5.4
20	293.15	5.4	9.1	7.0
25	298.15	7.0	11.9	9.1
30	303.15	8.9	15.3	11.7
35	308.15	11.3	19.5	14.9
ΔH_1[a]		37.0 ± 1.3	38.0 ± 1.3	37.5 ± 1.2
ΔS_1[b]		25.5 ± 4.4	13.9 ± 4.5	29.4 ± 4.1

[a] units kJ mol^{-1}

[b] units J K^{-1} mol^{-1}

REFERENCES:

1. Spencer, J. N.; Voigt, A. F. *J. Phys. Chem.* 1968, *72*, 464; Spencer, J. N. Dissertation, Iowa State University, 1968.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]; Mercury-203; ^{203}Hg; [13982-78-0]

(2) 2,2'-Oxybispropane or *Iso*propyl ether; $C_6H_{14}O$; [108-20-3]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

T/K = 273.15 - 308.15

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K[a]	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction[a] $10^7 x_1$	Molality[a] $10^6 m_1$/mol kg^{-1}
0	273.15	1.2 ± 0.1	1.6	1.6
15.5	288.65	2.9 ± 0.1	4.1	4.0
20	293.15	4.0 ± 0.2	5.6	5.5
25	298.15	4.8 ± 0.1	6.8	6.7
30	303.15	6.1 ± 0.1	8.7	8.6
35	308.15	7.4 ± 0.1	10.7	10.5

[a] Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (15.633 \pm .578)\log(T/\mathrm{K}) - 44.855$$

for the 273.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

The measured mercury concentrations were larger than expected, not reproducible, and increased with time unless the hypophosphorous acid was added. The solubility was not affected by small variations in the acid.

SOURCE AND PURITY OF MATERIALS:

(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) *Iso*propylether. Matheson, Coleman and Bell. Stated to be no better than 99 mol %. Degassed, 0.1 % hypophosphorous acid added.

ESTIMATED ERROR:

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

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) 1,1'-Oxybisbutane or Dibutyl ether; $C_8H_{18}O$; [142-96-1]

ORIGINAL MEASUREMENTS:

Spencer, J. N.; Voigt, A. F.
J. Phys. Chem. 1968, *72*, 464 - 470.

Spencer, J. N.
Dissertation, Iowa State University, 1967.

VARIABLES:

$T/K = 273.15 - 308.15$

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$	T/K^a	Concentration $10^4c_1/mol\ dm^{-3}$	Mole Fraction^a 10^7x_1	Molality^a $10^6m_1/mol\ kg^{-1}$
0	273.15	1.7 ± 0.1	2.8	2.2
15.5	288.65	4.4 ± 0.3	7.4	5.7
20	293.15	5.6 ± 0.1	9.5	7.3
25	298.15	7.1 ± 0.2	12.1	9.3
30	303.15	9.1 ± 0.5	15.6	12.0
35	308.15	10.5 ± 0.2	18.1	13.9

[a] Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (15.666 \pm .650)\log(T/K) - 44.696$$

for the 273.15 to 308.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(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) Dibutyl ether. Matheson, Coleman and Bell. Stated to be better than 99 mol %. Washed with acidified solution of $FeSO_4$, dried and distilled. Hydroquinone (10 ppm) added to pervent peroxide formation.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; See random error reported by authors with concentration values above.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Sunflower Seed Oil

ORIGINAL MEASUREMENTS:

Hursh, J. B.

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

VARIABLES:

T/K = 295

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	 T/K	Carrier Gas	Ostwald Coefficient[a] Av. ± SE (no.)	Concentration[b] $10^7 c_1$/mol dm^{-3}
22	295.15	Air	80.8 ± 0.8(5)	65.5

[a] The Ostwald coefficient is ((ng Hg/mL fluid)/(ng Hg/mL air)). Given above is the average ± 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). At 295.15 K, the mercury vapor pressure is 19.90 Pa, and the vapor concentration is 16.27 ng Hg/mL air.

The author states that the mercury partition coefficient between sunflower seed oil and water is 28 at 295.15 K. The compiler estimates this implies a mercury Ostwald coefficient of 2.89 for water at 295.15 K

Sunflower seed oil is a semi-drying oil containing 21.3 % oleic acid, 66.2 % linoleic acid, and smaller amounts of several other acids. (Merck Index, 10th Ed., 1983.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Prepared by reduction of ^{203}HgCl$_2$. The Hg vapor is swept into a leak-proof Saran bag.

(2) Sunflower seed oil. Purchased at local grocery store. Handbook value of 0.923 specific gravity used.

ESTIMATED ERROR:

REFERENCES:

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

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Halocarbons	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1985, August

CRITICAL EVALUATION:

An Evaluation of the Solubility of Mercury in Halocarbons.

The solubility of mercury in four halocarbons is reported in five papers. Three of the papers are from the laboratory of Professor A. F. Voigt of Iowa State University. A fourth paper referenced their data to a solubility value from one of the Voigt papers. Thus, the data are not as independent as one would like for a good evaluation. The halocarbons include one cyclic perfluoronated compound, tetrachloromethane, and two monohalo benzenes. Each system is discussed briefly below.

Mercury + Hexafluorobis(trifluoromethyl)cyclobutane; C_6F_{12}; [28677-00-1]

Kuntz and Mains (ref. 3) report one solubility value at 298.15 K and Spencer and Voigt (ref. 4) report five solubility values between 273.15 and 298.15 K. At 298.15 K the Kuntz and Mains value is 10 percent smaller than the Spencer and Voigt value. Considering the difference in methods, the difficulty of the measurement, and possible differences in the isomer composition, the agreement is considered satisfactory. The tentative values for all of the data were treated by a linear regression in the solubility units of concentration, mole fraction and molality. The regression constants are in Table 1 and the smoothed data and thermodynamic changes are in Table 2. The solvent is a mixture of at least two isomers. The four possible isomers are *cis*- and *trans*-perfluoro-1,2-dimethylcyclobutane and *cis*- and *trans*-perfluoro-1,3-dimethylcyclobutane (ref. 6).

Table 1. Mercury + Hexafluorobis(trifluoromethyl)cyclobutane. Linear regression constants for the equation ln(soly) = A(1) + A(2)/(T/100 K).

Solubility	A(1) ± Error	A(2) ± Error	Std. Error about the Regression Line
c_1/mol dm^{-3}	9.4968 ± 1.2713	-72.3371 ± 3.6912	2.8 x 10^{-8}
x_1	8.0555 ± 1.2545	-73.1675 ± 3.6422	5.0 x 10^{-9}
m_1/mol kg^{-1}	11.0061 ± 1.4985	-78.3298 ± 4.3509	2.0 x 10^{-6}

Table 2. The solubility of mercury in hexafluorobis(trifluoromethyl)-cyclobutane. Tentative values of the solubility in concentration, mole fraction and molality as a function of temperature at 0.1 MPa and thermodynamic changes.

Temperature		Mercury Solubility		
t/°C	T/K	Concentration $10^7 c_1$/mol dm^{-3}	Mole Fraction $10^8 x_1$	Molality $10^7 m_1$/mol kg^{-1}
0	273.15	0.42	0.73	0.21
5	278.15	0.68	1.2	0.35
10	283.15	1.08	1.9	0.58
15	288.15	1.7	3.0	0.94
20	293.15	2.6	4.6	1.5
25	298.15	3.9	6.9	2.3
$\Delta H_1{}^a$		60.1 ± 3.1	60.8 ± 3.0	65.1 ± 3.6
$\Delta S_1{}^b$		79.0 ± 10.6	67.0 ± 10.4	91.5 ± 12.5

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

Mercury + Tetrachloromethane; CCl_4; [56-23-5]

Three papers report mercury solubility values in tetrachloromethane at 298.15 K. Moser and Voigt (ref. 1) and Klehr and Voigt (ref. 2) both used a radioactive tracer method. Klehr and Voigt also obtained the same value by a distribution method. Vogel and Gjaldbaek (ref. 5) used an atomic absorption spectroscopy method and found a solubility that increased with time.

The results are below.

T/K	Saturation Time, t/days	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction $10^7 x_1$	Molality $10^6 m_1$/mol kg^{-1}	ref.
298.15	3+	7.5 ± 0.3	7.3	4.7	1
	up to 10	7.5 ± 0.1	7.3	4.7	2
	2	9	9	6	5
	9	30	29	19	5

Both Moser and Voigt (ref. 1) and Klehr and Voigt (ref. 2) treated the tetrachloromethane with aqueous bisulfite solution to remove any traces of chlorine, then dried and distilled the solvent. Vogel and Gjaldbaek (ref. 5) apparently used no purification procedure. Vogel and Gjaldbaek point out a slow reaction between mercury and tetrachloromethane is known at 670 K; however, the purification of the tetrachloromethane appears important. The possibility of reaction of mercury and tetrachloromethane is important, but until the reaction is better characterized the data from the Voigt laboratory is classed as tentative.

Mercury + Bromobenzene; C_6H_5Br; [108-86-1]

Klehr and Voigt (ref. 2) measured the solubility by a radioactive tracer technique at 298.15 K. The value is classed as tentative and is given below in units of concentration, mole fraction and molality.

Temperature		Mercury Solubility		
t/°C	T/K	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction $10^7 x_1$	Molality $10^6 m_1$/mol kg^{-1}
25	298.15	16.0 ± 0.3	16.9	10.8

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Halocarbons	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1985, August

CRITICAL EVALUATION:

Mercury + Chlorobenzene; C_6H_5Cl; [108-90-7]

Klehr and Voigt (ref. 2) measured the solubility of free mercury in chlorobenzene as a function of temperature from 273.15 to 308.15 K. Their data are classed as tentative. The data were treated by a linear regression in each of the solubility units of concentration, mole fraction, and molality. the reqresion constants are in Table 3 and the smooth solubility values at five degree intervals are in Table 4.

Table 3. Mercury + Chlorobenzene. Linear regression constants for the equation ln(soly) = A(1) + A(2)/(T/100 K).

Solubility	A(1) ± Error	A(2) ± Error	Std. Error about the Regression Line
c_1/mol dm^{-3}	4.4111 ± 0.5013	-47.0116 ± 1.4539	5.0 x 10^{-7}
x_1	2.3982 ± 0.5378	-47.8134 ± 1.5596	5.3 x 10^{-8}
m_1/mol kg^{-1}	4.5404 ± 0.5160	-47.6801 ± 1.4966	4.7 x 10^{-7}

Table 4. Solubility of mercury in chlorobenzene. Tentative values of the solubility in concentration, mole fraction, and molality as a function of temperature at 0.1 MPa and thermodyanmic changes.

Temperature		Mercury Solubility		
t/°C	T/K	Concentration $10^8 c_1$/mol dm^{-3}	Mole Fraction $10^7 x_1$	Molality $10^8 m_1$/mol kg^{-1}
0	273.15	2.8	2.8	2.5
5	278.15	3.8	3.8	3.4
10	283.15	5.1	5.1	4.6
15	288.15	6.8	6.8	6.1
20	293.15	8.9	9.1	8.1
25	298.15	11.7	11.9	10.6
30	303.15	15.2	15.6	13.8
35	308.15	19.5	20.1	17.9
ΔH_1[a]		39.1 ± 1.2	39.8 ± 1.3	39.6 ± 1.2
ΔS_1[b]		36.7 ± 4.2	19.9 ± 4.5	37.8 ± 4.3

[a] units kJ mol^{-1}
[b] units J K^{-1} mol^{-1}

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp.
2. Klehr, E. H.; Voigt, A. F. *Radioisot. Phys. Sci. Ind., Proc. Conf., Copenhagen* 1960, *1*, 517 (pub. 1962).
3. Kuntz, R. R.; Mains, G. J. *J. Phys. Chem.* 1964, *68*, 408.
4. Spencer, J. N.; Voigt, A. F. *J. Phys. Chem.* 1968, *72*, 464.
5. Vogel, A.; Gjaldbaek, J. C. *Arch. Pharm. Chemi Sci. Ed.* 1974, *2*, 25.
6. Hauptshein, M.; Fainberg, A.; Braid, M. *J. Am. Chem. Soc.* 1958, *80*, 842.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Hexafluorobis(trifluoromethyl)-cyclobutane or Perfluorodimethylcyclobutane; C_6F_{12}; [28677-00-1]

ORIGINAL MEASUREMENTS:

Kuntz, R. R.; Mains, G. J.

J. Phys. Chem. 1964, *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 $10^7c_1/\text{mol dm}^{-3}$	Mole Fraction[a] 10^8x_1	Molality[a] $10^7m_1/\text{mol kg}^{-1}$
25	298.15	3.4	6.1	2.0

[a]Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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 $\varepsilon_{2560} = 7.35 \times 10^3 \text{ dm}^3 \text{ mol}^{-1} \text{ cm}^{-1}$ at 25°C. The value was used to calculate the solubility in the other solvents.

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.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) Perfluorodimethylcyclobutane. Phillips Petroleum Co. Pure Grade hydrocarbon solvent. Purified by passage through silica gel until optically pure, degassed and distilled.

ESTIMATED ERROR:

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6]; Mercury-203; ^{203}Hg; [13982-78-0] (2) Hexafluorobis(trifluoromethyl)-cyclobutane or Perfluorodimethylcyclobutane; C_6F_{12}; [28677-00-1]	Spencer, J. N.; Voigt, A. F. *J. Phys. Chem.* <u>1968</u>, *72*, 464 - 470. Spencer, J. N. <u>Dissertation</u>, Iowa State University, <u>1967</u>.
VARIABLES:	**PREPARED BY:**
T/K = 273.15 - 298.15	S. H. Johnson M. Iwamoto H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
t/°C	T/K[a]	Concentration 10^7c_1/mol dm^{-3}	Mole Fraction[a] 10^8x_1	Molality[a] 10^7m_1/mol kg^{-1}
0	273.15	0.4 ± 0.1	0.7	0.2
16.5	289.65	2.1 ± 0.3	3.7	1.2
18	291.15	2.2 ± 0.2	3.9	1.3
21	294.15	3.0 ± 0.1	5.4	1.8
25	298.15	3.8 ± 0.1	6.8	2.3

[a] Calculated by compilers.

The authors smoothed their data according to the equation:

$$\log x_1 = (26.921 \pm .347)\log(T/K) - 73.746$$

for the 273.15 to 298.15 temperature interval.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

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 scintillation 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.

The solvent density at 298.15 was taken from Hauptschein *et al.* (ref. 1). For the other temperatures, it was assumed the temperature coefficient of density was the same as that observed for perfluoromethylcyclohexane (ref. 2).

SOURCE AND PURITY OF MATERIALS:

(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) Perfluorodimethylcyclobutane. Research grade obtained from Du Pont. Mixture of isomers; used as received.

ESTIMATED ERROR:

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

REFERENCES:

1. Hauptschein, M.; Fainberg, A. H.; Braid, M. *J. Am. Chem. Soc.* <u>1958</u>, *80*, 842.
2. Clever, H. L.; Saylor, J. H.; Gross, P. M. *J. Phys. Chem.* <u>1958</u>, *62*, 89.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Tetrachloromethane or Carbon tetrachloride; CCl_4; [56-23-5]

ORIGINAL MEASUREMENTS:

Moser, H. C.; Voigt, A. F.

USAEC Report 1957, ISC-892.
Chem. Abstr. 1958, *52*, 10691h.

VARIABLES:

$T/K = 298.15$

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$	T/K^a	Concentration $10^6 c_1/\text{mol dm}^{-3}$	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1/\text{mol kg}^{-1}$
25	298.15	7.5 ± 0.3	7.3	4.7

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A globule of Hg metal prepared from radioactive mercury(II) nitrate by reduction with hypophosphorous acid was equilibrated with 5 - 10 ml of liquid by shaking in a thermostat. Aliquotes of the liquid were withdrawn periodically for up to two weeks and the Hg concentration determined radiochemically.

The aliquot was diluted with acetone and equilibrated with $Hg(NO_3)_2$ carrier to exchange the radioactive mercury. The mercury was precipitated as HgS, mounted on a stainless steel planchet and counted with a Geiger-Mueller tube.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Oak Ridge National Lab; recieved as 0.31 M $Hg(NO_3)_2$ in 1.56 HNO_3 solution. Initial activity 50 millicuries g^{-1}; half-life 48 days. Reduced to Hg by hypophosphorous acid; coagulated to a Hg droplet by addition of concentrated HI.

(2) Carbon tetrachloride. Eastman Co. Spectro-grade; shaken with aqueous Na_2SO_3, passed through a column of dry silica gel and redistilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Tetrachloromethane or Carbon tetrachloride; CCl_4; [56-23-5]

ORIGINAL MEASUREMENTS:

Klehr, E. H.; Voigt, A. F.

Radioisot. Phys. Sci. Ind., Proc. Conf., Copenhagen 1960, *1*, 517 - 29 (Pub. 1962).

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 $10^6 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1$/mol kg^{-1}
25	298.15	7.5 ± 0.1	7.3	4.7

^{a}Calculated by compilers.

The value above is from the direct measurement technique. The indirect measurement result is 7.5 x 10^{-6} mol dm^{-3} at 298.15 K. Obtained by multiplying the mercury solubility in water, 3.0 x 10^{-7} mol dm^{-3}, times the distribution coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Direct Method. A globule of mercury containing 203-Hg was placed in 50 ml of solvent in a 100 ml flask and agitated in a thermostated bath. Samples were taken until the solution appeared to be at equilibrium. Analyses were made by GM-counting by one of two techniques:

(i) Solid precipitate counting. The Hg in a 0.5 ml aliquot was exchanged and reprecipitated on a stainless steel panchet as the sulfide was dried and counted. Details in Moser and Voigt (ref. 1).

(ii) Liquid aliquot scintillation-counting. A 0.5 ml aliquot of the saturated solution was diluted and transferred to the counting tube with a known volume of benzene.

The 0.28 MeV gamma radiation was counted. Error due to radiation adsorbed by the benzene and water was shown to be less than one percent.

Indirect Method. The distribution coefficient between solvent and water was measured.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Reduced from a mercury nitrate sample. Half-life is 47 days.

(2) Carbon tetrachloride. Shaken with an aqueous solution of sodium sulfate, dried by passing it through a silica gel column, and redistilled.

ESTIMATED ERROR:

See random error reported by authors withthe concentration value above.

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];

(2) Tetrachloromethane of Carbon tetrachloride; CCl_4; [56-23-5]

ORIGINAL MEASUREMENTS:

Vogel, A.; Gjaldbaek, J. Chr.

Arch. Pharm. Chem. Sci. Ed. <u>1974</u>, *2*, 25 - 9.

VARIABLES:

T/K = 298.15

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility			
t/°C	T/K[a]	Time t/day	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction[a] $10^7 x_1$	Molality[a] $10^6 m_1$/mol kg^{-1}
25	298.15	2	9	9	5
		9	30	29	19

[a] Calculated by compilers.

ADDITIONAL COMMENTS:

The authors' suspect a slow reaction between mercury and carbon tetrachloride, but they were unable to characterized the reaction.

The authors took special care to see that the glassware surface of the sampling pipet was equilibrated with the saturated solution of mercury. Special care was taken to see that colloidal mercury did not form in the solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mercury was analyzed by cold vapor atomic absorption spectroscopy (ref. 1).

The solvent was saturated with Hg in a special glass container in which a few grams of mercury was kept in a cellulose extraction thimble. The container was shaken at least 48 hours at 25°C.

A 10.00 cm^3 sample of the saturated solution was taken. It was treated to convert the Hg to Hg^2 and extracted into an aqueous phase.

An aliquot of the aqueous phase was diluted, treated with tin(II) chloride to reduce the mercury, and the solution analyzed by cold vapor atomic absorption spectroscopy. The apparatus allowed measurements down to one part per billion of Hg.

Similtaneous measurements were made under the same conditions of samples containing a known amount of mercury.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given, purified by distillation.

(2) Carbon tetrachloride. Merck, Uvasol grade spectroscopic quality, used without further purification.

ESTIMATED ERROR:

REFERENCES:

1. Hatch, W. R.; Ott, W. L. *Anal. Chem.* <u>1968</u>, *10*, 2085.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Chlorobenzene; C_6H_5Cl;
[108-90-7]

ORIGINAL MEASUREMENTS:

Klehr, E. H.; Voigt, A. F.

Radioisot. Phys. Sci. Ind., Proc. Conf., Copenhagen 1960, *1*, 517 - 29 (Pub. 1962).

VARIABLES:

$T/K = 273.15 - 308.15$

PREPARED BY:

S. H. Johnson
M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$	T/K^a	Concentration $10^6 c_1/\text{mol dm}^{-3}$	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1/\text{mol kg}^{-1}$
0	273.15	2.8 ± 0.1	2.8	2.5
10	283.15	5.0 ± 0.1	5.0	4.5
15	288.15	6.8 ± 0.1	6.9	6.1
20	293.15	8.4 ± 0.1	8.5	7.6
25	298.15	12.5 ± 0.1	12.8	11.4
35	308.15	19.3 ± 0.1	19.9	17.7

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Direct Method. A globule of mercury containing 203-Hg was placed in 50 ml of solvent in a 100 ml flask and agitated in a thermostated bath. Samples were taken until the solution appeared to be at equilibrium. Analyses were made by GM-counting by one of two techniques:

(i) Solid precipitate counting. The Hg in a 0.5 ml aliquot was exchanged and reprecipitated on a stainless steel panchet as the sulfide was dried and counted. Details in Moser and Voigt (ref. 1).

(ii) Liquid aliquot scintillation-counting. A 0.5 ml aliquot of the saturated solution was diluted and transferred to the counting tube with a known volume of benzene.

The 0.28 MeV gamma radiation was counted. Error due to radiation adsorbed by the benzene and water was shown to be less than one percent.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Reduced from a mercury nitrate sample. Half-life is 47 days.

(2) Chlorobenzene. Used without further purification.

ESTIMATED ERROR:

See random error reported by authors with concentration values above.

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]; Mercury-203; ^{203}Hg; [13982-78-0]

(2) Bromobenzene; C_6H_5Br; [108-86-1]

ORIGINAL MEASUREMENTS:

Klehr, E. H.; Voigt, A. F.

Radioisot. Phys. Sci. Ind., Proc. Conf., Copenhagen 1960, *1*, 517 - 29 (Pub. 1962).

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 $10^8 c_1$/mol dm^{-3}	Mole Fraction^a $10^7 x_1$	Molality^a $10^8 m_1$/mol kg^{-1}
25	298.15	16.0 ± 0.3	16.9	10.8

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Direct Method. A globule of mercury containing 203-Hg was placed in 50 ml of solvent in a 100 ml flask and agitated in a thermostated bath. Samples were taken until the solution appeared to be at equilibrium. Analyses were made by GM-counting by one of two techniques:

(i) Solid precipitate counting. The Hg in a 0.5 ml aliquot was exchanged and reprecipitated on a stainless steel panchet as the sulfide was dried and counted. Details in Moser and Voigt (ref. 1).

(ii) Liquid aliquot scintillation-counting. A 0.5 ml aliquot of the saturated solution was diluted and transferred to the counting tube with a known volume of benzene.

The 0.28 MeV gamma radiation was counted. Error due to radiation adsorbed by the benzene and water was shown to be less than one percent.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Reduced from a mercury nitrate sample. Half-life is 47 days.

(2) Bromobenzene. Repurified by shaking with stannous chloride and redistilling.

ESTIMATED ERROR:

See random error reported by authors with the concentration value above.

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Nitrobenzene; $C_6H_5NO_2$; [98-95-3]	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1985, August

CRITICAL EVALUATION:

An Evaluation of the Solubility of Mercury in Nitrobenzene at 298.15 K and 0.1 MPa.

In 1908 Christoff (ref. 1) showed that dissolved mercury could be detected in nitrobenzene. There are two modern reports of the solubility of mercury in nitrobenzene at 298.15 K. Both (ref. 2 and 3) are from the laboratory of A. F. Voigt. One value (ref. 2) was determined directly by a radioactive tracer method, the other (ref. 3) was by a distribution method. The two results are within experimental error of each other. Arguments can be made that the distribution method is more uncertain than the direct radioactive tracer method, but here we treat the two equal and average the results to obtain a tentative value of solubility.

T/K	Mercury Solubility			Method/
	Concentration $10^6 c_1$/mol dm^{-3}	Mole Fraction $10^7 x_1$	Molality $10^6 m_1$/mol kg^{-1}	Reference
298.15	9.3 ± 0.7	9.6	7.8	Tracer/ref. 2
	8.8	9.0	7.3	Distribution/ ref. 3
	9.1	9.3	7.6	Average (tentative value)

REFERENCES:

1. Christoff, A. *Z. Phys. Chem.* 1908, *63*, 346.
2. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp; *Chem. Abstr.* 1958, *52*, 10691h.
3. Klehr, E. H.; Voigt, A. F. *Radioisot. Phys. Sci. Ind., Proc. Conf., Copenhagen* 1960, *1*, 517 (Pub. 1962); *Chem. Abstr.* 1962, *57*, 6681b.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Nitrobenzene; $C_6H_5NO_2$; [98-95-3]

ORIGINAL MEASUREMENTS:

Moser, H. C.; Voigt, A. F.

USAEC Report 1957, ISC-892.
Chem. Abstr. 1958, *52*, 10691h.

VARIABLES:

$T/K = 298.15$

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$	T/K^a	Concentration $10^6 c_1/mol\ dm^{-3}$	Mole Fraction^a $10^7 x_1$	Molality^a $10^6 m_1/mol\ kg^{-1}$
25	298.15	9.3 ± 0.7	9.6	7.8

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A globule of Hg metal prepared from radioactive mercury(II) nitrate by reduction with hypophosphorous acid was equilibrated with 5 - 10 ml of liquid by shaking in a thermostat. Aliquotes of the liquid were withdrawn periodically for up to two weeks and the Hg concentration determined radiochemically.

The aliquot was diluted with acetone and equilibrated with $Hg(NO_3)_2$ carrier to exchange the radioactive mercury. The mercury was precipitated as HgS, mounted on a stainless steel planchet and counted with a Geiger-Mueller tube.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Oak Ridge National Lab; recieved as 0.31 M $Hg(NO_3)_2$ in 1.56 HNO_3 solution. Initial activity 50 millicuries g^{-1}; half-life 48 days. Reduced to Hg by hypophosphorous acid; coagulated to a Hg droplet by addition of concentrated HI.

(2) Nitrobenzene. Baker Chemical Co. Purified Grade; used without further purification.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6]; Mercury-203; ^{203}Hg; [13982-78-0] (2) Nitrobenzene; $C_6H_5NO_2$; [98-95-3]	Klehr, E. H.; Voigt, A. F. *Radioisot. Phys. Sci. Ind., Proc. Conf., Copenhagen* 1960, *1*, 517 - 29 (Pub. 1962).
VARIABLES:	PREPARED BY:
$T/K = 298.15$	S. H. Johnson M. Iwamoto H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility		
$t/°C$	T/K^a	Concentration 10^8c_1/mol dm^{-3}	Mole Fraction^a 10^7x_1	Molality^a 10^8m_1/mol kg^{-1}
25	298.15	8.8	9.0	7.3

^{a}Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Indirect Method. The distribution coefficient between nitrobenzene and water was measured by a radioactive tracer method. The solubility in nitrobenzene was obtained by multiplying the mercury solubility in water, 3.0×10^{-7} mol dm^{-3}, times the distribution coefficient.

Solutions were analyzed by one of two counting techniques. Either the Hg in an aliquot was exchanged, precipitated as HgS on a stainless steel panchet, and counted, or a liquid aliquot was diluted and placed in a scintillation tube for counting.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Reduced from a mercury nitrate sample. Half-life is 47 days.

(2) Nitrobenzene. Steam-distilled from dilute sulfuric-nitic acid solution and redistilled.

ESTIMATED ERROR:

REFERENCES:

1. Moser, H. C.; Voigt, A. F. *USAEC Report* 1957, *ISC-892*, 65 pp.

COMPONENTS: (1) Mercury; Hg; [7439-97-6] (2) Compressed Gases	EVALUATOR: H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1986, June

CRITICAL EVALUATION:

The Solubility of Mercury in Compressed Gases.

The equilibrium concentration of mercury vapor above liquid mercury is affected by the presence of a second component gas in several ways:

i) The mercury vapor pressure is enhanced by the hydrostatic pressure of the gas on the liquid (Poynting effect).
ii) The mercury vapor pressure is influenced by interaction between the mercury vapor and added gas molecules. Although both attractive and repulsive interactions are involved the net effect may be either an attraction or repulsion depending on the properties of the added gas.
iii) The non-ideal nature of the gas phase mixture.
iv) The solubility of the gas in liquid mercury.

Factor iv is considered negligable. Factors i, ii, and iii have been taken into account by several theoretical approaches. Rowlinson and co-workers (ref. 1, 2, 3 and references within) have derived expressions for the enhancement of the liquid phase component in the gas phase by another gas using a virial equation of state. Haar and Sengers (ref. 4) Have derived an analytic relation in terms of molecular interactions for the density dependence of the solubility of a liquid or solid in a dense gas using a modified van der Waals equation.

Although Haar and Sengers consider the virial equation the more fundamental equation they point out it has short comings in this application. The virial equation is an expansion around the low density limit while the experimental data that show the effects of enhanced vapor concentration are most significant at high density. The pressure correction arising from the virial equation approach has the mixed third virial coefficient in the lead term. There are few good data for the term.

The equation of Haar and Sengers from the van der Waals approach explains qualitatively many of the results observed in the study of mercury + gas systems. These results are:

i) The mercury vapor concentration decreases with increasing gas density for helium, hydrogen and neon, but increases for argon, nitrogen and krypton.

ii) The initial slope of the concentration ratio, n_1/n_1°, vs. gas density curves tends to decrease with increasing temperature.

iii) In the cases of nitrogen and argon there are indications the enhancement levels off at the higher densities. In the case of nitrogen the curve goes through a maximum.

In general Haar and Sengers find the enhancement of mercury solubility is less than suggested by the earlier work of Rowlinson and co-workers.

Five papers from three laboratories report data on the enhancement of mercury concentration in the gas phase over liquid mercury. Rowlinson and co-workers (ref. 1, 2, 3) and Rosenberg and Kay (ref. 5) report results of direct experimental studies on the vapor concentration as a function of gas density. Haar and Sengers (ref. 4) calculate the concentration enhancement from literature data of the total absorption resonance of mercury at 253.7 nm as a function of foreign gas density. Jepson, Richardson and Rowlinson (ref. 1), Stubley and Rowlinson (ref. 3), and Rosenberg and Kay (ref. 5) used a tracer method with mercury-203 at pressures up to about 30 bar. They determined directly the concentration of mercury in the gas phase in a sealed tube with a counter outside the tube. They used times of saturation of three times those calculated from diffusion properties to obtain equilibrium. Rosenberg and Kay modified the method by placing the mercury reservoir at the top of the tube and adding an efficient stirring system.

Richardson and Rowlinson (ref. 2) and Stubley and Rowlinson (ref. 3) used a weight loss method at gas pressures over 30 bar. A small reservoir containing a known weight of mercury was introduced into a known volume of gas. The systems was sealed and maintained at a fixed temperature until the equilibrium amount of mercury had dissolved. The system was cooled, opened and the mercury reweighed to give the amount of mercury transferred to the gas phase.

Haar and Sengers (ref. 4) calculated the mercury vapor concentration enhancement from the total absorption of the 253.7 nm resonance line of mercury as a function of the added gas density. The experiment effectively measures the enhancement of the mercury vapor concentration if the absorption per mercury atom is independent of the gas density. That was assumed, and small scale graphs of log (n_1/n_1^0) vs. gas number density were prepared for a number of gases from literature absorption data referenced on the data sheets. There were consistent data for helium, argon, hydrogen and nitrogen. Data for other gases showed more scatter with some results varying up to 25 percent. Only small scale graphs are given in Haar and Sengers' paper. There are no numerical results. The graphs are reproduced on the data sheets. Stubley and Rowlinson (ref. 3) calculated enhancement in the mercury + argon system from literature data by a similar method.

Only the mercury + argon system was studied by all three methods. The mercury + butane system was studied by the two direct methods. Unfortunately the methods give only fair agreement. All of the data are classed tentative. For some of the systems, especially neon and krypton, the uncertainities are quite large.

The figure below is from Haar and Sengers (ref. 4). Shown is the mercury enhancement in nine mercury + gas systems at temperatures of 323, 423, 523, and 673 K as defined by their van der Waals based equation using literature van der Waals constants for the pure materials and mixing rules discussed in the paper. The sharply reduced enhancement at high gas density for over one-half of the systems is confirmed experimentally for the mercury + nitrogen system.

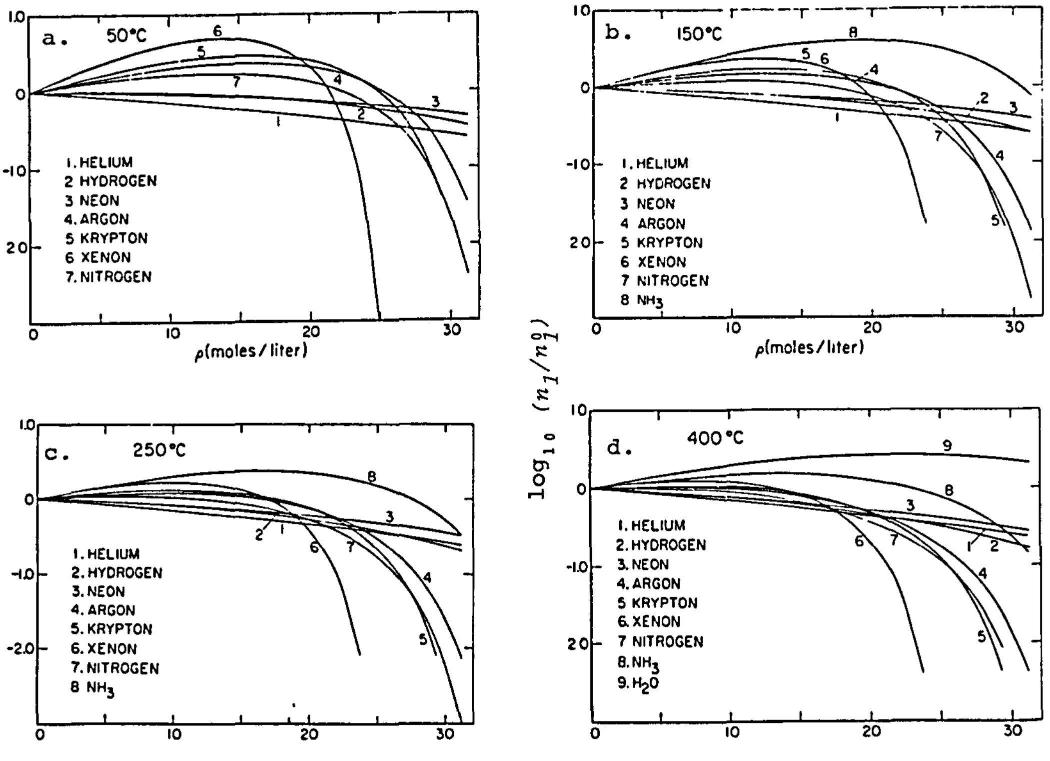


Figure 1. Mercury vapor solubility enhancement in compressed gases. log (n_1/n_1^0) *vs.* ρ_2/mol dm^{-3}. Isotherms at a. 323 K, b. 423 K, c. 523 K, and d. 673 K calculated by Haar and Sengers (ref 4).

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Compressed Gases

EVALUATOR:

H. Lawrence Clever
Chemistry Department
Emory University
Atlanta, Georgia 30322 USA

1986, June

CRITICAL EVALUATION:

The mixed second virial coefficients for the five systems studied by direct analysis are given in the table below.

Table 1. Mixed second virial coefficients for some mercury + gas systems.

Temperature		Second Virial Coefficients, B_{12}/cm³ mol⁻¹				
t/°C	*T*/K	Hg + Ar (ref. 3)	Hg + C_3H_8 (ref. 1)	Hg + C_4H_{10} (ref. 1)	Hg + CH_3OH (ref. 5)	Hg + CH_3COCH_3 (ref. 5)
184.0	457.2	-47	-125	-197		
218.0	491.2	-45	-107	-176		
220.0	493.2				-126	-156
240.0	513.2				-120	-154
256.0	529.2	-19	-85	-158		
260.0	533.2				-112	-146
280.0	553.2				-114	-136
300.0	573.2				-110	-123
305.0	578.2	-11				

Values of the mercury vapor second virial coefficient are given in Appendix V.

REFERENCES:

1. Jepson, W. B.; Richardson, M. J.; Rowlinson, J. S. *Trans. Faraday Soc.* 1957, *53*, 1586.

2. Richardson, M. J.; Rowlinson, J. S. *Trans. Faraday Soc.* 1959, *55*, 1333.

3. Stubley, D.; Rowlinson, J. S. *Trans. Faraday Soc.* 1961, *57*, 1275.

4. Haar, L.; Levelt Sengers, J. M. H. *J. Chem. Phys.* 1970, *52*, 5069.

5. Rosenberg, H. S.; Kay, W. B. *J. Phys. Chem.* 1974, *78*, 186.

Figure 1 on page 191 reprinted from *J. Chem. Phys.* by permission of the copyright owner, The American Institute of Physics, and the authors (ref. 4).

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Helium; He; [7440-59-7]

ORIGINAL MEASUREMENTS:

Haar, L.; Levelt Sengers, J. M. H.

J. Chem. Phys. 1970, *52*, 5069 - 79.

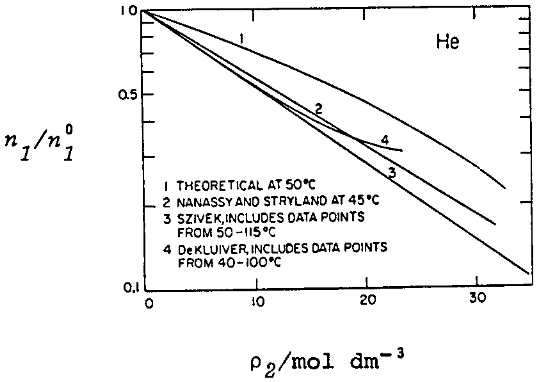
VARIABLES:

T/K = 318.15 - 388.15
ρ_2/mol dm^{-3} = 0 - 30

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:



n_1/n_1^0	Concentration enhancement for mercury vapor in the gas.
ρ_2/mol dm^{-3}	Number density of the gas, component 2.

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mercury vapor concentration enhancement was calculated from the total absorption of the 253.7 nm resonance line of mercury as a function of foreign gas density.

If the absorption per mercury atom is taken to be independent of density, the experiment effectively measures the enhancement of mercury vapor concentration in the gas phase. For the figure above the experimental data were reduced as if the absorption (oscillator strength) per mercury atom remained constant.

For this system the experimental data were taken from Stryland and Nanassy (ref. 1), Nanassy (ref. 2), De Kluiver (ref. 3), and Szivek (ref. 4). Additional information will be found in Michels and De Kluiver (ref. 5), Michels, De Kluiver and Castle (ref. 6), and Michels, De Kluiver, and Middelkoop (ref. 7ab).

REFERENCES:

1. Styrland, J. C.; Nanassy, A. J.
Physica 1958, *24*, 935.

2. Nanassy, A. J.
Ph.D. dissertation, 1959, Toronto.

3. De Kluiver, H.
Ph.D. dissertation, 1959, Amsterdam.

4. Szivek, J.
M.S. dissertation, 1961, Toronto.

5. Michels, A.; De Kluiver, H.
Physica 1956, *22*, 919.

6. Michels, A.; De Kluiver, H.; Castle, B.
Physica 1957, *23*, 1131.

7. Michels, A.; De Kluiver, H.; Middelkoop, D.
(a) *Physica* 1958, *24*, 543;
(b) *Physica* 1959, *25*, 163.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Neon; Ne; [7440-01-9]

ORIGINAL MEASUREMENTS:

Haar, L.; Levelt Sengers, J. M. H.

J. Chem. Phys. 1970, *52*, 5069 - 79.

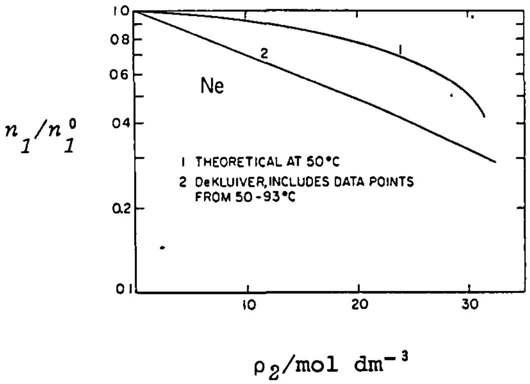
VARIABLES:

$T/K = 323.15 - 366.15$
$\rho_2/\text{mol dm}^{-3} = 0 - 30$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:



n_1/n_1^0	Concentration enhancement for mercury vapor in the gas.
$\rho_2/\text{mol dm}^{-3}$	Number density of the gas, component 2.

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mercury vapor concentration enhancement was calculated from the total absorption of the 253.7 nm resonance line of mercury as a function of foreign gas density.

If the absorption per mercury atom is taken to be independent of density, the experiment effectively measures the enhancement of mercury vapor concentration in the gas phase. For the figure above the experimental data were reduced as if the absorption (oscillator strength) per mercury atom remained constant.

For this system the experimental data were taken from De Kluiver (ref. 1). Additional information is found in the papers of Michels and De Kluiver *et al* . (ref. 2 - 4ab).

REFERENCES:

1. De Kluiver, H.
Ph.D. dissertation, 1959, Amsterdam.

2. Michels, A.; De Kluiver, H.
Physica 1956, *22*, 919.

3. Michels, A.; DeKluiver, H.; Castle, B.
Physica 1957, *23*, 1131.

4. Michels, A.; DeKluiver, H.; Middelkoop, D.
(a) *Physica* 1958, *24*, 543;
(b) *Physica* 1959, *25*, 163.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Argon; Ar; [7440-37-1]

ORIGINAL MEASUREMENTS:

Stubley, D.; Rowlinson, J. S.

Trans. Faraday Soc. 1961, *57*, 1275 - 80.

VARIABLES:

T/K = 457.15 - 578.15
P/MPa = 0.000 - 3.108

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Pressure		Gas Density	Solubility Ratio
t/°C	T/K	P/atm	P/MPa	c_2/mol dm^{-3}	c_1/c_1^o
184.0	457.15	0.000	0.000	0.000	1.000
		8.975	0.9093	0.239	1.032
		18.24	1.848	0.485	1.049
		24.16	2.448	0.642	1.058
218.0	491.15	0.000	0.000	0.000	1.000
		9.646	0.9773	0.239	1.030
		19.62	1.988	0.485	1.049
		25.99	2.633	0.642	1.058
256.0	529.15	0.000	0.000	0.000	1.000
		10.39	1.053	0.239	1.010
		21.16	2.144	0.485	1.023
		28.04	2.841	0.642	1.030
305.0	578.15	0.000	0.000	0.000	1.000
		11.36	1.151	0.239	1.010
		23.16	2.346	0.485	1.012
		30.67	3.108	0.642	1.036

Pressures were estimated by the compilers from the tables of Angus, S.; Armstrong, B. International Thermodynamic Tables of the Fluid State, Argon. Butterworths, 1972. Additional measurements were made at 215 and 300°C up to densities of 10 mol dm^{-3} which were reported graphically.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Below 30 atm -
Radioactive tracer method (ref. 1). Irradiated Hg and gas are equilibrated with stirring in a 0.5 x 40 cm tube until a counter at the top indicates equilibrium.

Above 30 atm -
Weight loss method (ref. 2). The weight loss of a liquid mercury sample was determined when a known volume of gas had been brought to equilibrium by diffusion of the Hg vapor in an autoclave, over a period of two weeks.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) Argon. British Oxygen Company, Limited. 99.8 percent pure.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta(c_1/c_1^o)/(c_1/c_1^o) = \pm 0.01$

REFERENCES:

1. Jepson, W. B.; Richardson, M. J.; Rowlinson, J. S. *Trans. Faraday Soc.* 1957, *53*, 1586.
2. Richardson, M. J.; Rowlinson, J. S. *Trans. Faraday Soc.* 1959, *55*, 1333.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Argon; Ar; [7440-37-1]

ORIGINAL MEASUREMENTS:

Haar, L.; Levelt Sengers, J. M. H.

J. Chem. Phys. 1970, *52*, 5069 - 79.

VARIABLES:

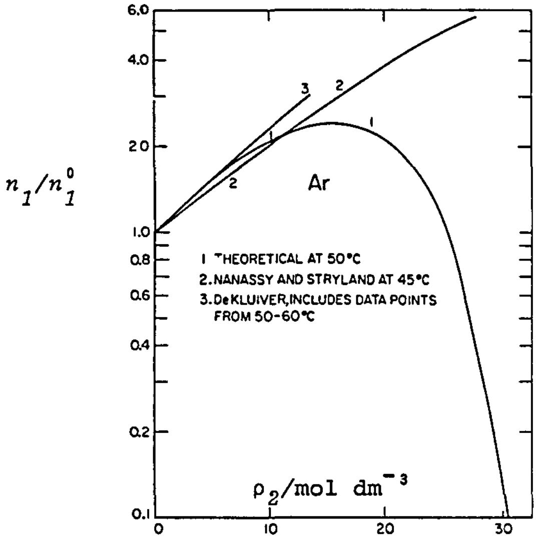
$T/K = 318.15 - 333.15$

$\rho_2/\text{mol dm}^{-3} = 0 - 30$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:



n_1/n_1^0 Concentration enhancement for mercury vapor in the gas.

$\rho_2/\text{mol dm}^{-3}$ Number density of the gas, component 2.

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mercury vapor concentration enhancement was calculated from the total absorption of the 253.7 nm resonance line of mercury as a function of foreign gas density.

If the absorption per mercury atom is taken to be independent of density, the experiment effectively measures the enhancement of mercury vapor concentration in the gas phase. For the figure above the experimental data were reduced as if the absorption (oscillator strength) per mercury atom remained constant.

For this system the experimental data were taken from Stryland and Nanassy (ref. 1), Nanassy (ref. 2), and De Kluiver (ref. 3). Additional information will be found in Szivek (ref. 4), Michels and De Kluiver (ref. 5), Michels, De Kluiver and Castle (ref. 6), and Michels, De Kluiver, and Middelkoop (ref. 7ab).

REFERENCES:

1. Styrland, J. C.; Nanassy, A. J. *Physica* 1958, *24*, 935.
2. Nanassy, A. J. Ph.D. dissertation, 1959, Toronto.
3. De Kluiver, H. Ph.D. dissertation, 1959, Amsterdam.
4. Szivek, J. M.S. dissertation, 1961, Toronto.
5. Michels, A.; De Kluiver, H. *Physica* 1956, *22*, 919.
6. Michels, A.; De Kluiver, H.; Castle, B. *Physica* 1957, *23*, 1131.
7. Michels, A.; De Kluiver, H.; Middelkoop, D.
   (a) *Physica* 1958, *24*, 543;
   (b) *Physica* 1959, *25*, 163.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Krypton; Kr; [7439-90-9]	Haar, L.; Levelt Sengers, J. M. H. *J. Chem. Phys.* 1970, *52*, 5069 - 79.
VARIABLES:	PREPARED BY:
T/K = 340.15	H. L. Clever

EXPERIMENTAL VALUES:

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mercury vapor concentration enhancement was calculated from the total absorption of the 253.7 nm resonance line of mercury as a function of foreign gas density.

If the absorption per mercury atom is taken to be independent of density, the experiment effectively measures the enhancement of mercury vapor concentration in the gas phase. The experimental data were reduced as if the absorption (oscillator strength) per mercury atom remained constant.

De Kluiver (ref. 1) and Michels *et al.* (ref. 2) report a study of the mercury 253.652 nm line in the presence of krypton. However, the study was carried out with unsaturated mercury vapor

REFERENCES:

1. De Kluiver, H.
   Ph.D. dissertation, 1959, Amsterdam.

2. Michels, A.; De Kluiver, H.; Middelkoop, D.
   (a) *Physica* 1958, *24*, 543;
   (b) *Physica* 1959, *25*, 163.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Hydrogen; H_2; [1333-74-0]

ORIGINAL MEASUREMENTS:

Haar, L.; Levelt Sengers, J. M. H.

J. Chem. Phys. 1970, *52*, 5069 - 79.

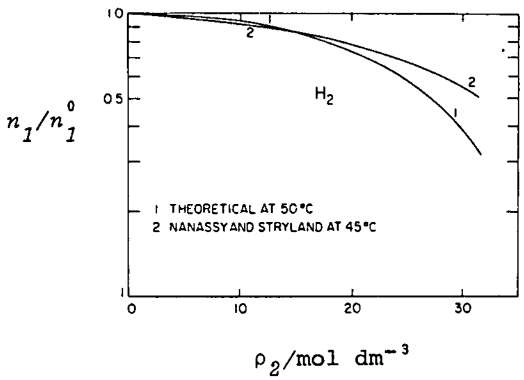
VARIABLES:

T/K = 318.15
ρ_2/mol dm^{-3} = 0 - 30

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:



n_1/n_1^0	Concentration enhancement for mercury vapor in the gas.
ρ_2/mol dm^{-3}	Number density of the gas, component 2.

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mercury vapor concentration enhancement was calculated from the total absorption of the 253.7 nm resonance line of mercury as a function of foreign gas density.

If the absorption per mercury atom is taken to be independent of density, the experiment effectively measures the enhancement of mercury vapor concentration in the gas phase. For the figure above the experimental data were reduced as if the absorption (oscillator strength) per mercury atom remained constant.

For this system the experimental data were taken from Stryland and Nanassy (ref. 1) and Nanassy (ref. 2). There are additional data in Szivek (ref. 3).

REFERENCES:

1. Styrland, J. C.; Nanassy, A. J. *Physica* 1958, *24*, 935.

2. Nanassy, A. J. Ph.D. dissertation, 1959, Toronto.

3. Szivek, J. M.S. dissertation, 1961, Toronto.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Nitrogen; N_2; [7727-37-9]

ORIGINAL MEASUREMENTS:

Haar, L.; Levelt Sengers, J. M. H.

J. Chem. Phys. 1970, *52*, 5069 - 79.

VARIABLES:

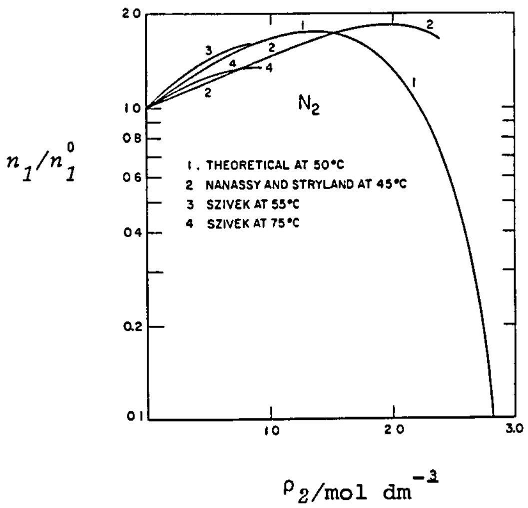
$T/K = 318.15 - 348.15$

$\rho_2/\text{mol dm}^{-3} = 0 - 30$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:



n_1/n_1^0 Concentration enhancement for mercury vapor in the gas.

$\rho_2/\text{mol dm}^{-3}$ Number density of the gas, component 2.

The figure reprinted from the *J. Chem. Phys.* by permission of the copyright owner, The American Institute of Physics.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mercury vapor concentration enhancement was calculated from the total absorption of the 253.7 nm resonance line of mercury as a function of foreign gas density.

If the absorption per mercury atom is taken to be independent of density, the experiment effectively measures the enhancement of mercury vapor concentration in the gas phase. For the figure above the experimental data were reduced as if the absorption (oscillator strength) per mercury atom remained constant.

For this system the experimental data were taken from Stryland and Nanassy (ref. 1), Nanassy (ref. 2), and Szivek (ref. 3).

REFERENCES:

1. Styrland, J. C.; Nanassy, A. J. *Physica* 1958, *24*, 935.
2. Nanassy, A. J. Ph.D. dissertation, 1959, Toronto.
3. Szivek, J. M.S. dissertation, 1961, Toronto.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
    Mercury-203; ^{203}Hg; [13982-78-0]

(2) Propane; C_3H_8; [74-98-6]

ORIGINAL MEASUREMENTS:

Jepson, W. B.; Richardson, M. J.; Rowlinson, J. S.

Trans. Faraday Soc. 1957, *53*, 1586 - 91.

VARIABLES:

T/K = 457.15, 491.15, 529.15
P/MPa = 0.00135 - 3.29

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Pressure		Gas Density	Solubility Ratio
t/°C	T/K	P/atm	P/MPa	c_2/mol dm^{-3}	c_1/c_1°
184.0	457.15	0.0133	0.00135	0.000	1.000
		9.8	0.99	0.273	1.076
		18.9	1.92	0.549	1.156
218.0	491.15	0.0398	0.00403	0.000	1.000
		10.6	1.07	0.273	1.066
		20.6	2.09	0.549	1.133
		29.4	2.98	0.815	1.180
256.0	529.15	0.1144	0.01159	0.000	1.000
		11.6	1.17	0.273	1.050
		22.5	2.28	0.549	1.104
		32.5	3.29	0.815	1.145

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility ratio measured by a tracer technique. A 25 mg sample of irradiated Hg is placed in a 5.00 mm ID pressure bore tube 40 cm long. A spacer and stirrer are put in place then a measured amount of gas in added.

The tube is thermostated by a vapor bath of boiling liquid. Samples are stirred for seven hours. The radioactivity is measured at the top of the tube by a Geiger counter. The count was corrected for decay and background.

The count ratio with and without the gas is equivalent to the molar mercury ratio with and without gas. c_1° represents the concentration of pure mercury at its equilibrium vapor pressure.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Sample irradiated at Harwell. Isotope ^{197}Hg $t_{1/2}$ 2 - 7 days allowed to decay, activity 1.6 curie mol^{1} of isotope ^{203}Hg $t_{1/2}$ 47.9 days.

(2) Propane. Chemical Research Lab, Teddington. Purity not less than 99.5 percent.

ESTIMATED ERROR:

$\delta(c_1/c_1^\circ)/(c_1/c_1^\circ) = \pm 0.01$

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]
Mercury-203; ^{203}Hg; [13982-78-0]

(2) Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Jepson, W. B.; Richardson, M. J.; Rowlinson, J. S.

Trans. Faraday Soc. 1957, *53*, 1586 - 91.

VARIABLES:

T/K = 457.15, 491.15, 529.15
P/MPa = 0.00135 - 3.10

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Pressure		Gas Density	Solubility Ratio
t/°C	T/K	P/atm	P/MPa	c_2/mol dm^{-3}	c_1/c_1°
184.0	457.15	0.0133	0.00135	0.000	1.000
		9.6	0.97	0.277	1.115
		17.8	1.80	0.562	1.234
		24.1	2.44	0.838	1.350
218.0	491.15	0.0398	0.00403	0.000	1.000
		10.5	1.06	0.277	1.101
		19.6	1.99	0.562	1.201
		27.2	2.76	0.838	1.297
256.0	529.15	0.1144	0.0159	0.000	1.000
		11.5	1.17	0.277	1.088
		21.9	2.22	0.562	1.176
		30.6	3.10	0.838	1.245

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility ratio measured by a tracer technique. A 25 mg sample of irradiated Hg is placed in a 5.00 mm ID pressure bore tube 40 cm long. A spacer and stirrer are put in place then a measured amount of gas in added.

The tube is thermostated by a vapor bath of boiling liquid. Samples are stirred for seven hours. The radioactivity is measured at the top of the tube by a Geiger counter. The count was corrected for decay and background.

The count ratio with and without the gas is equivalent to the molar mercury ratio with and without gas. c_1° represents the concentration of pure mercury at its equilibrium vapor pressure.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury and Mercury-203. Sample irradiated at Harwell. Isotope ^{197}Hg $t_{1/2}$ 2 - 7 days allowed to decay, activity 1.6 curie mol^{1} of isotope ^{203}Hg $t_{1/2}$ 47.9 days.

(2) Butane. Chemical Research Lab, Teddington. Purity not less than 99.5 percent.

ESTIMATED ERROR:

$\delta(c_1/c_1^{\circ})/(c_1/c_1^{\circ}) = \pm 0.01$

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Butane; C_4H_{10}; [106-97-8]

ORIGINAL MEASUREMENTS:

Richardson, M. J.; Rowlinson, J. S.

Trans. Faraday Soc. 1959, *55*, 1333 - 7.

VARIABLES:

T/K = 488.05 - 566.65
P/MPa = 7.1 - 38.5

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Pressure		Gas Density	Weight of Mercury	Solubility Ratio
t/°C	T/K	P/atm	P/MPa	c_2/mol dm^{-3}	m_1/mg	c_1/c_1°
215.5	488.65	70	7.1	2.728	14.6	1.86
215.3	488.45	90	9.1	4.617	20.3	2.67
214.7	487.85	200	20.3	6.916	25.2	3.52
212.9	486.05	200	20.3	6.934	23.9	3.53
215.1	488.25	220	22.3	7.112	27.7	3.70
257.6	530.75	80	8.1	2.678	44.4	1.75
254.5	527.65	130	13.2	4.726	51.6	2.35
254.8	527.95	270	27.4	6.732	67.2	2.85
299.8	572.95	100	10.1	2.725	87.0	1.54
296.0	569.15	170	17.2	4.636	105.8	2.02
293.5	566.65	380	38.5	6.905	121.3	2.37

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Weight loss method. A small reservoir containing a known weight of mercury is placed in an all-glass bulb containing a known volume of gas. The glass bulb fits in a steel bomb. Temperature is established and maintained for up to three weeks which is three times to time calculated from the diffusion coefficient to reach 98% saturation. The system is cooled to room temperature, the bulb cut open, and the mercury reservoir weighed to determine mercury loss. The mercury reservoir is so designed that mercury condensed from cooling does not enter.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information given.

(2) Butane. Prepared from 1-bromobutane Grignard reagent and 1-butanol. Distilled serveral times to insure absence of air and stored in sealed bulbs.

ESTIMATED ERROR:

δT/K = $\pm$0.2

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Methanol or Methyl alcohol;
CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Rosenberg, H. S.; Kay, W. B.

J. Phys. Chem. 1974, *78*, 186 - 9.

VARIABLES:

T/K = 493.15 - 573.15
P/MPa = 0.00429 - 3.16

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Pressure		Gas Density	Solubility Ratio
t/°C	T/K	P/atm	P/MPa	c_2/mol dm^{-3}	c_1/c_1°
220.0	493.15	0.0423	0.00429	0.000	1.000
		10.1	1.02	0.267	1.063
		13.8	1.40	0.374	1.087
		17.4	1.76	0.479	1.109
		21.6	2.19	0.634	1.132
		24.5	2.48	0.744	1.143
240.0	513.15	0.0748	0.00758	0.000	1.000
		10.7	1.08	0.267	1.059
		14.5	1.47	0.374	1.083
		18.1	1.83	0.479	1.105
		23.0	2.33	0.634	1.125
		26.3	2.66	0.744	1.136
260.0	533.15	0.1267	0.01284	0.000	1.000
		11.2	1.13	0.267	1.056
		15.3	1.55	0.374	1.080
		19.1	1.94	0.479	1.100
		24.4	2.47	0.634	1.126
		27.9	2.83	0.744	1.135
280.0	553.15	0.2064	0.02091	0.000	1.000
		11.8	1.20	0.267	1.055
		16.1	1.63	0.374	1.081
		20.1	2.04	0.479	1.099
		25.8	2.61	0.634	1.120
		29.6	3.00	0.744	1.131
300.0	573.15	0.3247	0.03290	0.000	1.000
		12.4	1.26	0.267	1.055
		16.9	1.71	0.374	1.075
		21.1	2.14	0.479	1.098
		27.1	2.75	0.634	1.114
		31.2	3.16	0.744	1.125

The data above appeared only in the microfilm edition of the Journal.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Methanol or Methyl alcohol;
CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Rosenberg, H. S.; Kay, W. B.

J. Phys. Chem. 1974, *78*, 186 - 9.

VARIABLES:

T/K = 493.15 - 573.15
P/MPa = 0.00429 - 3.16

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A modification of the radioactive tracer technique of Jepson, *et al.* (ref. 1), was used.

A 0.500 x 40 cm Pyrex precision-bore tube was used. The 27 mg sample of radioactive Hg was held in a cup at the top of the tube. A magnetically driven stirrer reciprocated the length of the tube. The tube was thermostated by refluxing vapor. The gas was distilled into the tube and its mass determined from the equation of state up to the second viral coefficient (ref. 2).

Temperature was established and the equilibrium cell stirred continuously until successive readings at four hour intervals differed by no more than 0.3 percent in 100,000 accumulated counts (usually two days).

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Liquid Hg sample tagged with ^{203}Hg ($t_{1/2}$ = 46.59 days) at initial specific activity of 7.5 *mCi*/g.

(2) Methanol. Source not given. Described as ultra-high-purity and distilled *in vacuo* into the apparatus before use.

REFERENCES:

1. Jepson, W. B.; Richardson, M. J.; Rowlinson, J. S. *Trans. Faraday Soc.* 1957, *53*, 1586.

2. Lambert, J. D.; Roberts, G. A. H.; Rowlinson, J. S.; Wilkinson, V. J. *Proc. Royal Soc., Ser A* 1949, *196*, 113.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) 2-Propanone or Acetone; C_3H_6O; [67-64-1]	Rosenberg, H. S.; Kay, W. B. *J. Phys. Chem.* 1974, *78*, 186 - 9.
VARIABLES: T/K = 493.15 - 573.15 P/MPa = 0.89 - 2.82	PREPARED BY: H. L. Clever M. Iwamoto

EXPERIMENTAL VALUES:

Temperature		Pressure		Gas Density	Solubility Ratio
t/°C	T/K	P/atm	P/MPa	c_2/mol dm^{-3}	c_1/c_1°
220.0	493.15	8.8	0.89	0.241	1.077
		12.8	1.30	0.371	1.115
		16.1	1.63	0.492	1.154
		19.1	1.94	0.631	1.191
		21.0	2.13	0.730	1.216
240.0	513.15	9.3	0.94	0.241	1.073
		13.6	1.38	0.371	1.110
		17.1	1.73	0.492	1.147
		20.6	2.09	0.631	1.172
		22.7	2.30	0.730	1.196
260.0	533.15	9.8	0.99	0.241	1.068
		14.4	1.46	0.371	1.104
		18.2	1.84	0.492	1.140
		22.0	2.23	0.631	1.165
		24.5	2.48	0.730	1.185
280.0	553.15	10.3	1.04	0.241	1.065
		15.2	1.54	0.371	1.097
		19.3	1.96	0.492	1.130
		23.4	2.37	0.631	1.152
		26.1	2.64	0.730	1.174
300.0	573.15	10.9	1.10	0.241	1.058
		16.0	1.62	0.371	1.089
		20.4	2.07	0.492	1.123
		24.9	2.52	0.631	1.146
		27.8	2.82	0.730	1.164

The raw data above appreared only in the microfilm edition of the Journal.

The mercury vapor pressure at each temperature is given in the mercury + methanol data sheet, p. 203.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) 2-Propanone or Acetone; C_3H_6O; [67-64-1]

ORIGINAL MEASUREMENTS:

Rosenberg, H. S.; Kay, W. B.

J. Phys. Chem. 1974, *78*, 186 - 9.

VARIABLES:

T/K = 493.15 - 573.15
P/MPa = 0.89 - 2.82

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A modification of the radioactive tracer technique of Jepson, *et al*. (ref. 1), was used.

A 0.500 x 40 cm Pyrex precision-bore tube was used. The 27 mg sample of radioactive Hg was held in a cup at the top of the tube. A magnetically driven stirrer reciprocated the length of the tube. The tube was thermostated by refluxing vapor. The gas was distilled into the tube and its mass determined from the equation of state up to the second virial coefficient (ref. 2).

Temperature was established and the equilibrium cell stirred continuously until successive readings at four hour intervals differed by no more than 0.3 percent in 100,000 accumulated counts (usually two days).

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Liquid Hg sample tagged with ^{203}Hg ($t_{1/2}$ = 46.59 days) at initial specific activity of 7.5 *mCi*/g.

(2) Acetone. Source not given. Described as ultra-high-purity and distilled *in vacuo* into the apparatus before use.

REFERENCES:

1. Jepson, W. B.; Richardson, M. J.; Rowlinson, J. S. *Trans. Faraday Soc.* 1957, *53*, 1586.

2. Lambert, J. D.; Roberts, G. A. H.; Rowlinson, J. S.; Wilkinson, V. J. *Proc. Royal Soc., Ser A* 1949, *196*, 113.

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Molten and Solid Salt Systems	H. Lawrence Clever Chemistry Department Emory University Atlanta, Georgia 30322 USA 1986, June

CRITICAL EVALUATION:

The Solubility of Mercury in Some Molten and Solid Salt Systems.

There are several papers reporting the solubility of metallic mercury in molten salts. Most, if not all, of these systems involves a chemical reaction. Also included in this section is a paper on emulsification of mercury by freshly precipitated oxides and a paper on the retrograde solubility of mercury in solid mercury telluride. There are no confirming data for any of the systems. All of the data are classed tentative. The individual systems are discussed below.

Mercury + Sodium chloride; [7647-14-5] + Aluminum chloride; [7446-70-0]

Plotnikov and Fortunatov (ref. 1) report the solubility of mercury in a melt of 0.680 mole fraction sodium chloride. The mercury solubility increases from 0.065 weight percent at 491 K to 1.521 weight percent at 623 K. The authors state that the solubility of mercury obeys Henry's law and there is no chemical reaction between mercury and the molten salt components. In view of the reactions in other mercury + molten salt systems the last statement is of doubtful validity.

Mercury + Iron; [7439-89-6] + Iron (II) sulfide; [1317-37-9]

Vogel (ref. 2) studied 24 elements as additives to the Fe + FeS system. The paper contains a small scale figure of the Hg-Fe-S system at an undefined high temperature. He implies the reaction Hg + FeS = Fe + HgS takes place and the equilibrium lies well to the left. There are no quantitative data for the system. No data sheet was prepared.

Mercury + Mercury (II) chloride; [7487-94-7]

Yosim and Mayer (ref. 3) report the solubility of mercury in mercury (II) chloride by a freezing point depression method. The mercury solubility increases from 0 to 0.0485 mole fraction as the temperature decreases from 552.65 K (the mp of pure $HgCl_2$) to 545.61 K. The authors present evidence that the reaction

$$Hg + HgCl_2 = Hg_2Cl_2$$

takes place, and that the dissolved species in not mono-atomic Hg, but the disproportionation product Hg_2Cl_2.

Mercury + Lithium chloride; [7447-41-8] + Potassium chloride; [7447-40-7]

Delmaskii *et al.* (ref. 4) report a mercury solubility of 0.113 mass percent at 673 K in the eutectic salt mixture of 0.583 mole fraction LiCl. The dissolution of mercury is accompanied by the reaction

$$2\ Hg + 2\ LiCl = Hg_2Cl_2 + 2\ Li$$

Mercury + Lead (IV) oxide; [1309-60-0]
Mercury + Mercury (II) oxide; [21908-53-2]

Pichugina (ref. 5) reports that active PbO_2 and HgO precipitates are good emulsifiers for metallic mercury. No data sheet was prepared.

Mercury + Mercury telluride; [12068-90-5]

Levitskaya *et al.* (ref. 6) studied solid HgTe between 477 and 873 K in the presence of excess Hg and Te. The systems has a retrograde solidus curve. At the mercury boundry, mercury is soluble in HgTe between 553 and 673 K. The maximum solubility of mercury in HgTe is 1.7 x 10^{-5} percent at 626.7 K.

REFERENCES:

1. Plotnikov, V. A.; Fortunatov, N. S. *Mem. Inst. Chem., Ukr. Acad. Sci.* 1936, *3*, 123.

2. Vogel, R. *Chalmers teka Hogskolas Handl.* 1943, No. 18, 24 pp.

3. Yosim, S. J.; Mayer, S. W. *J. Phys. Chem.* 1960, *64*, 909; *USAEC Report* 1960, NAA-SR-5094.

4. Delimarskii, Yu. K.; Tumanova, N. Kh.; Prikhod'ko, M. U. *Zh. Neorg. Khim.* 1971, *16*, 559; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1971, *16*, 298.

5. Pichugina, A. *Acta Univ. Voronegienis* 1935, *8(2)*, 18 - 20; *Chem. Abstr.* 1938, *32*, 5680.

6. Levitskaya, T. D.; Vanyukov, A. V.; Krestovikov, A. N.; Bykharov, I. M. *Izv. Akad. Nauk SSSR, Neorg. Mater.* 1970, *6(5)*, 849; *Inorg. Mater. (Engl. Transl.)* 1970, *6*, 747.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6];

(2) Sodium chloride; NaCl; [7647-14-5]

(3) Aluminum chloride; $AlCl_3$; [7446-70-0]

ORIGINAL MEASUREMENTS:

Plotnikov, V. A.; Fortunatov, N. S.

Mem. Inst. Chem., Ukr. Acad. Sci. 1936, *3*, 123 - 8.

VARIABLES:

$T/K = 491.15 - 623.15$
solvent, NaCl, $x_2 = 0.680$

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature $t/°C$	T/K^a	Mercury Weight Percent	
218	491.15	0.066	
		0.066	
		0.064	
		0.065	avg.
223	496.15	0.074	
		0.078	
		0.076	
		0.076	avg.
268	541.15	0.880	[sic.]
302	575.15	0.559	
		0.560	
		0.561	
		0.560	avg.
307	580.15	0.560	
350	623.15	1.521	

[a] Calculated by compilers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility of mercury was determined in a NaCl + $AlCl_3$ melt which was 48.3 wt % NaCl, and 51.7 wt % $AlCl_3$. This corresponds to a mole fraction of 0.680 NaCl.

The authors state the solubility of mercury obeys Henry's law and there is no chemical reaction between the Hg and solvent.

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Lithium chloride; LiCl; [7447-41-8]

(3) Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:

Delimarskii, Yu. K.; Tumanova, N. Kh.; Prikhod'ko, M. U.

Zh. Neorg. Khim. <u>1971</u>, *16*, 559 - 60.
Russ. J. Inorg. Chem. (Eng. Trans.) <u>1971</u>, *16*, 298 - 9.

VARIABLES:

T/K = 673.15

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Potassium chloride Mole fraction	Mercury as Hg_2Cl_2	Mercury as Hg Mole fraction
t/°C	T/K	x_3	mass %	$10^4 x_1$
400	673.15	0.417	0.113	2.8

The system is liquid mercury in equilibrium with the LiCl + KCl eutectic mixture at 673.15 K. The dissolution of the mercury in the LiCl + KCl is accompanied by the reaction:

$$2Hg + 2LiCl = Hg_2Cl_2 + 2Li.$$

The mass % Hg_2Cl_2 was read from a small graph in the paper. The value with respect to mercury was given in the paper. From the 2.8 x 10^{-4} mole fraction value, we calculated a Hg_2Cl_2 mass % of 0.118, which is five percent larger than the graph value. The authors did not state the LiCl + KCl eutectic composition. The eutectic mixture is 0.417 mole fraction KCl and 0.583 mole fraction LiCl (ref. 1 - 3).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mercury and the LiCl + KCl salt eutectic were added to a special cell. The system was heated at 2 deg min^{-1} to a temperature of (400 ± 5)°C. The system was maintained at the temperature for 3 hours, with periodic agitation. The solubility experiment was carried out in a atmosphere of argon and also under vacuum conditions.

The saturated solution was analyzed by polarography with solid platinum wires as electrodes. The mercury ion was reduced in a single wave with n = 1. A calibration wave was prepared using known amounts of Hg_2Cl_2.

SOURCE AND PURITY OF MATERIALS:

No information on the source or purity of the compounds.

ESTIMATED ERROR:

$\delta T/K = \pm 5$
$\delta x_1/x_1 = \pm 0.05$ (compiler)

REFERENCES:

1. Keitel, H.
Kali <u>1923</u>, *17*, 248, 261.
2. Richards, T. W.; Meldrum, W. B.
J. Am. Chem. Soc. <u>1917</u>, *39*, 1816 - 28.
3. Elchardus, E.; Laffitte, P.
Bull. Soc. Chim. France <u>1932</u> *51*, 1572 - 9.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6]; (2) Mercury(II) chloride; $HgCl_2$; [7487-94-7]	Yosim, S. J.; Mayer, S. W. *J. Phys. Chem.* <u>1960</u>, *64*, 909 - 11. USAEC Report <u>1960</u>, NAA-SR-5094, 9 pp.
VARIABLES:	**PREPARED BY:**
T/K = 545.61 - 551.60	H. L. Clever

EXPERIMENTAL VALUES:

Temperature $t/°C^a$	T/K^a	Freezing Point Depression $\Delta T_f/K$	Mole Fraction 10^2x_1
272.4_6	545.6_1	7.04	4.85
273.1_6	546.3_1	6.34	4.27
274.4_6	547.6_1	5.04	3.16
276.1_9	549.3_4	3.31	2.15
277.7_7	550.9_2	1.73	1.09
278.4_5	551.6_0	1.05	0.69
279.5^b	552.6_5	0	0

[a] Calculated by compiler.
[b] Melting point of pure $HgCl_2$.

The authors present evidence that the dissolved species is not monoatomic Hg, but the disproportionation product Hg_2Cl_2.

$$Hg + HgCl_2 \rightarrow Hg_2Cl_2.$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Freezing point depression method. The salt and mercury were sealed in a 18 mm Pyrex or Vycor tube which had a thin-walled thermocouple well sealed in the bottom of the tube. Temperatures were measured with a calibrated chromel-alumel thermocouple. The samples were heated in a furnace automatically controlled by a regulator-pyrometer operating through a variable transformer.

The paper contains data on the Hg + $HgCl_2$ system over the entire composition range and temperatures up to 825 K.

The AEC Report is identical to the published paper.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given; triple distilled.

(2) Mercury(II) chloride. Source not given. Reagent grade; dried under a vacuum at 110°C for 24 hours.

ESTIMATED ERROR:

$\delta x_1 = \pm 0.0005$ (compiler)

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Mercury telluride; HgTe
[12068-90-5]

ORIGINAL MEASUREMENTS:

Levitskaya, T. D.; Vanyukov, A. V.; Krestovnikov, A. N.;Bykharov, I. M.

Izv. Akad. Nauk SSSR, Neorg. Mater. 1970, *6(5)*, 849 - 54; *Inorg. Mater. (Engl. Transl.)* 1970, *6(5)*, 747 - 51.

VARIABLES:

T/K = 553 - 653

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Type of Excess	Mercury Boundry	
t/°C	*T*/K		*c*/atom cm^{-3}	Excess Component, atom %
204	477	p	~8 x 10^{15}	~1.4 x 10^{-5} (Te)
300	573	n	3 x 10^{15}	5.1 x 10^{-6} (Hg)
353.5	626.7	n	9.9 x 10^{15}	1.68 x 10^{-5} (Hg)
400	673	p	(0.8 - 1.9) x 10^{16}	(1.4 - 3) x 10^{-5} (Te)
451	724	p	~3 x 10^{16}	~5 x 10^{-5} (Te)
505	778	p	2.3 x 10^{18}	3.9 x 10^{-3} (Te)
600	873	p	-	-

The system has a retrograde solidus curve. Mercury is soluble in the mercury telluride only between 553 and 653 K. The maximum solubility of Hg in HgTe is 1.7 x 10^{-5} atom percent.

Data for the tellurium boundy are also in the paper. At that boundry the maximum solubility of tellurium is 1.9 x 10^{-2} atom %.

The melting point maximum is displaced from the stoichiometric composition toward tellurium.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Mercury; Hg; [7439-97-6] (2) Other Elements	H. Lawrence Clever Chemistry Department Emory University Atlanta, Geogia 30322 USA 1986, June

CRITICAL EVALUATION:

The Solubility of Mercury in Other Elements.

The solubility data in this section includes both mercury(l) + element(l) and mercury(l) + element(s) systems. In only one case, mercury + gallium (ref. 8), was phase equilibrium measured and the solubility of the element in mercury determined too. The liquid + liquid systems are mercury + phosphorous and mercury + gallium. The other systems are liquid solute + solid solution systems. The mercury + zinc and the mercury + tin systems were studied by emf methods at room temperature with the solid an electrode in contact with aqueous solution. The mercury + sodium and mercury + potassium systems were studied by an electrical resistance technique. The other systems were studied by an x-ray method. In the x-ray method various amounts of mercury are heated with the element. The element lattice parameter is measured before and after the treatment. If the lattice parameter changes by less than 0.001 x 10^{-10} m the solubility of mercury in the solid is considered negligible. If the lattice parameter changes, the mercury composition at which the change stops is considered the solubility. There are no confirming papers in these studies except for the mercury + silver and mercury + gold systems. The data are classed tentative.

The papers in this section were found by a *Chem. Abstr.* search under the heading "Mercury, properties, soly of". Papers listed under "Mercury, properties, systems", which may contain additional data, were not covered. Papers from this heading can be found in *Solubility Series Vol. 25 Metals in Mercury* edited by Galus, Guminski and Hirayama.

The table below lists the systems for which data are known from our literature search. Given in the table is the element in order of its atomic number, the temperature and mole fraction solubility of mercury in the element, and the reference number.

Element	Temperature T/K	Mercury Solubility Mole Fraction, x_1	Reference
Liquid + Liquid Systems			
Phosphorus; P	298	0.000176	7
Gallium; Ga	308	0.020	8
	373	0.032	
Liquid + Solid Systems			
Sodium; Na	296	0.00045	13
	333	0.00006	
Silicon; Si + phosphorus; P	1473	-	12
Potassium; K	270	-	13
	318	-	
Manganese; Mn	773	0.004	11
Zinc; Zn	293	0.020	10
Silver; Ag	373	0.364	3
	549	0.372	
Tin; Sn	298	0.075	4
Tellurium; Te	573	0.014	9
	713	0.003	
Platinum; Pt	493	0.01	11
	528	0.153	
	713	0.183	
	903	0.226	
Gold; Au	477	0.168	6
	583	0.182	
	693	0.195	

Jangg and Lugscheider (ref. 11) found negligible mercury solubility in ninteen solid elements by the x-ray method. A small solubility below their limit of detection may exist. The elements are aluminum, titanium, vanadium, chromium, iron, cobalt, nickel, zirconium, niobium, molybdenum, ruthenium, rhodium, tantalum, tungsten, rhenium, osmium, iridium, thorium, and uranium. More information is summarized on a data sheet.

Some further comments about the systems above.

Mercury + Gallium (ref. 8). The mercury rich phase in equilibrium with the gallium rich phase contains 0.036 and 0.039 mole fraction gallium at 308 and 373 K, respectively.

Mercury + Silicon + Phosphorous (ref. 12). Silicon at 1473 K was doped with phosphorus. The mercury solubility is a function of the phosphorus concentration. We estimate from the abstract data that the mole fraction of mercury increases from 1×10^{-8} to 2×10^{-8} as the phosphorous mole fraction increases from 4×10^{-10} to 8×10^{-5}.

Mercury + Potassium (ref. 13). The authors were unable to obtain reproducible data. The solubility is less than in sodium. There were indications the solubility decreased as the temperature increased from 270 to 318 K.

Mercury + Silver. Earlier studies (ref. 1, 14, 15) give appreciably lower results than the results of Day and Mathewson (ref. 3) presented here. It is likely the earlier studies were carried out without proper precautions to prevent loss of the volatile mercury.

Mercury + Platinum (ref. 11). An abrupt increase in the solubility at about 523 K corresponds to a peritechtic reaction in the system.

Mercury + Gold. Mercury + gold solubility data are reported in at least five papers (ref. 1, 2, 3, 5, and 6). Data sheets were prepared from references 3 and 6. The data in the table above are from ref. 6. The papers agree that an alpha + beta = alpha + liquid transformation occurs at 693 K, which is the temperature of the maximum mercury solubility.

REFERENCES:

1. Stenbeck, S. *Z. anorg. Chem.* 1933, *45*, 16.
2. Zakharova, M. I. *Zh. Tekhn. Fiz.* 1937, *7*, 171.
3. Day, H. M.; Mathewson, C. H. *Trans. Am. Inst. Min. Metall. Pet. Eng.* 1938, *128*, 261.
4. Haring, M. M.; White, J. C. *Trans. Electrochem. Soc.* 1938, *73*, 211.
5. Plaksin, I. N. *Izv. Sekt. Fiz. - Khim. Analiza* 1938, *10*, 129.
6. Owen, E. A.; Roberts, E. A. O. *J. Inst. Metals* 1945, *71*, 213.
7. Rotatiu, G. J.; Schramke, E.; Gilman, T. S.; Hildebrand, J. H. *J. Am. Chem. Soc.* 1951, *73*, 2527.
8. Spicer, W. M.; Bartholomay, H. W. *J. Am. Chem. Soc.* 1951, *73*, 868.
9. Abdullaev, G. B.; Movlanov, Sh.; Shakhtakhtinskii, M. G.; Kuliev, A. A. *Izv. Akad. Nauk Tadzh. SSR, Otd. Geol. - Khim., Tekhn. Nauk* 1963, *(2)*, 13; *Chem. Abstr.* 1964, *61*, 1345e.
10. Bianchini, A.; Pozzoli, S. *Metall. Ital.* 1968, *60*, 495.
11. Jangg, G.; Lugscheider, E. *Monatsh. Chem.* 1973, *104*, 1269.
12. Arifov, A. A.; Rakhimbaev, D.; Islamov, D. U. *Legir. Poluprovochu.* 1975, 62; *Chem. Abstr.* 1975, *83*, 121536b.
13. Aleksandrov, B. N.; Dalakova, N. V. *Izv. Akad. Nauk SSSR, Met.* 1982, *(1)*, 133; *Russ. Metall.(Engl. Transl.)*, 1982, *(1)*, 117.
14. Preston, D. G. *J. Inst. Metals* 1931, *46*, 522.
15. Murphy, A. J. *J. Inst. Metals.* 1931, *46*, 507.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Phosphorous; P_4; [7723-14-0]

ORIGINAL MEASUREMENTS:

Rotatiu, G. J.; Schramke, E.; Gilman, T. S.; Hildebrand, J. H.

J. Am. Chem. Soc. 1951, *73*, 2527 - 8.

VARIABLES:

$T/\mathrm{K} = 298.15$

PREPARED BY:

H. L. Clever
M. Iwamoto

EXPERIMENTAL VALUES:

Temperature $t/°\mathrm{C}$	T/K	Equilibration Time t/m	Solubility mg Hg in 2 cm^3 P_4
Water saturated phosphorus			
25.0	298.15	12	0.8
		10	1.0
		15	1.0
		20	1.0
		30	1.0
		10	1.11[a]
		10	0.90[a]
Dry phosphorus			
25.0	298.15	17	1.45
		17	1.25
		17	0.74
		17	1.28

[a] These two runs were made using a microbalance. Their average was used along with a phosphorus density of 1.761 g cm^{-3} (ref. 1) to calculate the solubility in the following units:
0.285 mg g^{-1} (1.42×10^{-3} mol kg^{-1})
1.76×10^{-4} mol mol^{-1} (mole fraction, x_1)
3.7×10^{-5} cm^3 cm^{-3}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

About 2 - 4 g of carefully weighed Hg was placed in a J shaped 20 x 1.0 cm tube. Air free water was added and 2 cm^3 of liquid white phosphorus pipetted was in under the water surface at 44°C. The tubes were rocked slowly at 25.0°C.

The water and phosphorus saturated with Hg were poured out. Last amounts were removed by several washings with specially purified CS_2 and CH_3OH. The Hg was dried and reweighed.

For the dry phosphorus experiments, the water was removed by alternately melting the phosphorus and evaporation.

The solubility of water in phosphorus was reported in a later paper (ref. 2).

Experiments to 373 K indicated only a slight increase in solubility with temperature.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. No information.

(2) Phosphorus. Commercial c.p. white phosphorus. Cleaned by melting under a dilute H_2SO_4 - K_2CrO_4 mixture; allowed to stand several days in the dark. The clear colorless liquid phosphorus was used.

ESTIMATED ERROR:

$\delta T/\mathrm{K} = \pm 0.1$
$\delta c_1/c_1 = \pm 0.25$

REFERENCES:

1. Dobinski, S.
Z. Phys. 1933, *83*, 129.

2. Rotariu, G. J.; Haycock, E. W.; Hildebrand, J. H.
J. Am. Chem. Soc. 1952, *74*, 3165.

COMPONENTS: (1) Mercury; Hg; [7439-97-6] (2) Gallium; Ga; [7440-55-3]	ORIGINAL MEASUREMENTS: Spicer, W. M.; Bartholomay, H. W. *J. Am. Chem. Soc.* 1951, *73*, 868 - 9.
VARIABLES: T/K = 308.15, 373.15	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Rich Layer		Gallium Rich Layer	
t/°C	T/K	Mercury weight %	Gallium weight %	Mercury weight %	Gallium weight %
35	308.15	98.8	1.2	6.0	94.0
		98.6	1.4	6.7	93.3
		98.8	1.2[a]	6.6	93.4[a]
		98.7	1.3[a]	6.7	93.3[a]
		98.7 avg.	(3.6 atom %)	6.5 avg. (2.0 atom %)	
100	373.15	98.6	1.4	8.5	91.5
		98.6	1.4	8.5	91.5
		98.6	1.4	8.8	91.2
		98.6 avg.	(3.9 atom %)	8.6 avg. (3.2 atom %)	

[a] Equilibtated for two months.

ADDED NOTE: See Hirayama, C.; Galus, Z.; Guminski, C. *Metals in Mercury, Solubility Series Volume 25*, Pergamon Press Ltd., Oxford and New York, 1986, pp. 93 - 102 for a complete set of data and evaluation of the Hg + Ga system.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Weighed portions of the metals (*ca.* 3.5 g Ga and 7.0 g Hg) were placed in a glass tube under acidified gallium chloride solution to protect the gallium surface from oxidation.

Samples were equilibrated by frequent shaking in a thermostat. The two phases were sampled, weighed and the gallium was removed by dissolution in HCl. The remaining mercury was dried and weighed.

Two samples were allowed to stand for two months before analysis to show separation was complete.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Purified by washing with nitric acid and water, and then dried and distilled.

(2) Gallium. Aluminum Co. of America. Stated purity of 99.95% and confirmed by spectrographic analysis.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Metals listed below.	Jangg, G.; Lugscheider, E. *Monatsh. Chem.* 1973, *104*, 1269 - 75.

EXPERIMENTAL VALUES:

Mercury has negligible solubility at the temperature of heat treatment in the metals below.

Atomic Number	Name	Symbol	Registry Number	Heat Treatment Temperature $t/°C$	Heat Treatment Temperature T/K
13	Aluminium	Al	[7429-90-5]	260	533.15
22	Titanium	Ti	[7440-32-6]	280, 400 to 500	553.15
23	Vanadium	V	[7440-62-2]	800	1073.15
24	Chromium	Cr	[7440-47-3]	400	673.15
25	Iron	Fe	[7439-89-6]	800	1073.15
27	Cobalt	Co	[7440-48-4]	800	1073.15
28	Nickel	Ni	[7440-02-0]	260	533.15
40	Zirconium	Zr	[7440-67-7]	280, 400 to 500	553.15
41	Niobium	Nb	[7440-03-1]	800	1073.15
42	Molybdenum	Mo	[7439-98-7]	800	1073.15
44	Ruthenium	Ru	[7440-18-8]	800	1073.15
45	Rhodium	Rh	[7440-16-6]	800	1073.15
73	Tantalum	Ta	[7440-25-7]	800	1073.15
74	Tungsten	W	[7440-33-7]	800	1073.15
75	Rhenium	Re	[7440-15-5]	(100 to 500)[a]	373.15
76	Osmium	Os	[7440-04-2]	800	1073.15
77	Iridium	Ir	[7439-88-5]	800	1073.15
90	Thorium	Th	[7440-29-1]	800	1073.15
92	Uranium	U	[7440-61-1]	800	1073.15

[a] No evidence of compound formation with mercury over the temperature interval.

The elements above, which showed a negligible solubility for mercury, are shown below in an abbreviated periodic table.

							13 Al
22 Ti	23 V	24 Cr		26 Fe	27 Co	28 Ni	
40 Zr	41 Nb	42 Mo		44 Ru	45 Rh		
	73 Ta	74 W	75 Re	76 Os	77 Ir		
90 Th		92 U					

The authors observed measurable solubility of mercruy in manganese, atomic number 25, and platinum, atomic number 78. See following data sheets.

METHOD/APPARATUS/PROCEDURE:

Between 0.2 and 0.3 g of high purity powdered samples of each metal above was heated with 5 to 10 percent of its weight of mercury in a 2 mm inside diameter quartz tube for periods of up to 350 hours. The metal lattice parameter of each metal was measured by an x-ray method before and after the heating with mercury. If the lattice parameter changed less than 0.001 Angstrom the authors assumed negligible solubility of mercury in the metal.

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Sodium; Na; [7440-23-5]
Potassium; K; [7440-09-7]

ORIGINAL MEASUREMENTS:

Aleksandrov, B. N.; Dalakova, N. V.

Izv. Akad. Nauk SSSR, Met. 1982, *(1)*, 133 - 40; *Russ. Metall. (Engl. Transl.)* 1982, *(1)*, 117 - 21.

VARIABLES:

T/K = 270 - 333

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Element	Temperature t/°C	T/K	Mercury Solubility Atom %
Sodium	23	296	0.045
	60	333	0.006
Potassium	-3	270	Non-reproducible results. Evidence solubility decreased at T increased.
	45	318	

Distribution studies at 700°C (973 K) for sodium and 600°C (873 K) for potassium indicated negligible solubility.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubilities were determined by a residual electrical resistance method. Samples of 7 to 8 g of alloy were prepared in steel containers under a helium atmosphere. They were annealed for a number of days.

The alloy was extruded with a press to 150 - 400 mm by 3 mm diameter wire. The resistance was measured at room and liquid helium temperatures. Details of the method are in an earlier paper (ref. 1).

The solubility of about another 12 elements was determined.

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

1. Aleksandrov, B. N. *et al.* *Fiz. Nizk. Temp. (Kiev)* 1976, *2*, 1432.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Phosphorous; P; [7723-14-0] (3) Silicon; Si; [7440-21-3]	Arifov, A. A.; Rakhimbaev, D.; Islamov, D. U. *Legir. Poluprovodu.* 1975, 62 - 4; *Chem. Abstr.* 1975, *83*, 121536b.
VARIABLES:	PREPARED BY:
T/K = 1473	H. L. Clever

EXPERIMENTAL VALUES:

The paper was not available. The information is from the abstract. Silicon at 1200 °C and 1 x 10^{-4} torr was doped with 2 x 10^{13} to 4 x 10^{18} atom cm^{-3} of phosphorous. The mercury concentration (solubility) is a function of the phosphorus concentration and varies from 5 x 10^{13} to 1 x 10^{15} atom cm^{-3}.

The compiler estimated a silicon density of 2.3 g cm^{-3} at 1473 K from crytallographic data (R. O. A. Hall *Acta Crytl.* 1961, *14*, 1004) to calculate mole fractions. Thus, as the phosphorus mole fraction increases from 4 x 10^{-10} to 8 x 10^{-5} the mercury mole fraction (solubility) increases from 1 x 10^{-9} to 2 x 10^{-8}.

AUXILIARY INFORMATION

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

COMPONENTS: (1) Mercury; Hg; [7439-97-6] (2) Manganese; Mn; [7439-96-5]	**ORIGINAL MEASUREMENTS:** Jangg, G.; Lugscheider, E. *Monatsh. Chem.* 1973, *104*, 1269 - 75.
VARIABLES: T/K = 773.15	**PREPARED BY:** H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Solubility[a]
t/°C	T/K	Atom % Hg
500	773.15	0.3 - 0.5

[a]Compiler assumes this is the same as 10^2x_1, mole fraction.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Between 0.2 and 0.3 g of highly purified metal powder was placed in a 2 mm inside diameter quartz tube. Mercury was added. The tube was evacuated, sealed and heat treated for up to 350 hours at the stated temperature.

The metal lattice parameter was determined by x-ray before and after heating with mercury. A change in lattice parameter of 0.001 or less was interpreted as a negligible solubility of mercury in the metal. There was a direct relationship between the mercury solubility and the lattice parameter.

SOURCE AND PURITY OF MATERIALS:

Stated to be high purity metals.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Zinc; Zn; [7440-66-6]

ORIGINAL MEASUREMENTS:

Bianchini, A.; Pozzoli, S.

Metall. Ital. 1968, *60*, 495 - 500.

VARIABLES:

T/K = 293

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility	
t/°C	T/K	weight %	atom %
20	293	6.0	2.0

The compiler calculated the atom % solubility and added the Kelvin temperature.

The results were in graphs which could be read to within 0.2 weight %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The electrolytic behavior of amalgamated zinc was studied in seven aqueous electrolytes. The mercury content was varried up to 10 wt %. The potential became more negative up to 6 wt % mercury. Beyond 6 wt % mercury the potential remained constant. This suggests the limit of mercury solubility in zinc is 6 weight percent which is in agree ment with an (unpublished) x-ray study.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury.

(2) Zinc. Impurities were Cd 15, Pd 0.8, Cu 0.9, and Fe 0.5 parts per million. Some tests were made on 99.9999 % zinc.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS: (1) Mercury; Hg; [7439-97-6] (2) Silver; Ag; [7440-22-4]	ORIGINAL MEASUREMENTS: Day, H. M.; Mathewson, C. H. *Trans. Am. Inst. Min. Metall. Eng.* 1938, *128*, 261 - 81.
VARIABLES: T/K = 373.15 - 549.15	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility	
t/°C	T/K	Weight %	Atom %
100	373.15	51.6	36.4
186	459.15	-	-
245	513.15	-	-
276	549.15	52.4	37.2

The measurements at 459.15 and 513.15 K are shown on a graph, but are not tabulated. The four values fall on a smooth curve over the 373.15 to 549.15 K temperature interval.

The compiler calculated the atom % mercury and added the Kelvin temperatures.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The system was studied by a back-reflection method of x-ray analysis.

Particular attention was paid to sample preparation and annealing to avoid loss of the volatile mercury.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Redistilled. Tested to show it contained less than 0.001 % total Ag and Au.

(2) Silver. US Metals Refining Co. Analysed 99.993 % silver. Sample tested for Au, Cu, Fe, Pb, Bi, Se, Te, Sn, Ni, Mn, and Mg. Results in table in paper.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Tin; Sn; [7440-31-5]	Haring, M. M.; White, J. C. *Trans. Electrochem. Soc.* 1938, *73*, 211 - 21.
VARIABLES:	PREPARED BY:
$T/K = 298.15$	H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Mole Fraction
$t/°C$	T/K	x_1
25.00	298.15	0.075

The authors report the Sn + Hg solid to be 0.925 mole fraction tin.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A careful emf study of tin amalgams. The solubility of mercury in tin was calculated assuming the Nernst equation was valid for the 1.0 millivolt difference observed between tin and its saturated amalgam.

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$

REFERENCES:

COMPONENTS: (1) Mercury; Hg; [7439-97-6] (2) Tellurium; Te; [13494-80-9]	ORIGINAL MEASUREMENTS: Abdullaev, G. B.; Movlanov, Sh.; Shakhtaktinskii, M. G.; Kuliev, A. A. *Izv. Akad. Nauk Tadzh. SSR, Otd. Geol. - Khim. i Tekhn. Nauk* 1963, *(2)*, 13 - 22. *Chem. Abstr.* 1964, *61*, 1345e.
VARIABLES: T/K = 543 - 713	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility	
t/°C	T/K	c_1/atom cm^{-3}	Atom Fraction
270	543	-	-
300	573	4 x 10^{20}	0.014
440	713	1 x 10^{20}	0.003

The atom fractions were calculated by the compiler using the 293 K Handbook density of tellurium.

The paper was not available. The information is from the abstract. The solubility was measured from 543 to 713 K. Only the maximum value at 573 K and the minimum value at 713 K were given in the abstract. The authors state that HgTe is formed in the system. The solubility of mercury is smaller than the solubility of selenium which is also reported in the paper. There is a statement in the abstract that the saturation at 77 K is 0.1 % mercury. The value would represent an atom fraction of 0.0006.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Platinum; Pt; [7440-06-4]

ORIGINAL MEASUREMENTS:

Jangg, G.; Lugscheider, E.

Monatsh. Chem. 1973, *104*, 1269 - 75.

VARIABLES:

T/K = 373.15 - 903.15

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Solubility[a]
t/°C	T/K	Atom % Hg
100	373.15	0
200	473.15	0.2
220	493.15	1.0
255	528.15	15.3
307	580.15	16.1
367	640.15	16.5
395	668.15	18.5
440	713.15	18.1
482	755.15	18.7
540	813.15	18.9
630	903.15	22.6

[a] Compiler assumes this is the same as 10^2x_1, mole fraction.

The abrupt increase in solubility at about 250°C corresponds to a peritectic reaction in the Pt-Hg system.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Between 0.2 and 0.3 g of highly purified metal powder was placed in a 2 mm inside diameter quartz tube. Mercury was added. The tube was evacuated, sealed and heat treated for up to 350 hours at the stated temperature.

The metal lattice parameter was determined by x-ray before and after heating with mercury. A change in lattice parameter of 0.001 or less was interpreted as a negligible solubility of mercury in the metal. There was a direct relationship between the mercury solubility and the lattice parameter.

SOURCE AND PURITY OF MATERIALS:

Stated to be high purity metals.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Mercury; Hg; [7439-97-6]

(2) Gold; Au; [7440-57-5]

ORIGINAL MEASUREMENTS:

Day, H. M.; Mathewson, C. H.

Trans. Am. Inst. Min. Metall. Eng. 1938, *128*, 261 - 81.

VARIABLES:

T/K = 373.15 - 689.15

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility	
t/°C	T/K	Weight %	Atom %
100	373.15	17.2	16.9
186	459.15	16.1	15.8
245	518.15	16.0	15.7
300	573.15	16.3	16.0
320	593.15	17.1	16.8
390	663.15	18.5	18.1
416	689.15	18.7	18.4

The authors believe the inflection in the the solubility curve at about 603 K is real.

The compiler calculated the atom % mercury and added the Kelvin temperatures.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The system was studied by a back-reflection method of x-ray analysis.

Particular attention was paid to sample preparation and annealing to avoid loss of the volatile mercury.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Redistilled. Tested to show it contained less than 0.001 % total Ag and Au.

(2) Gold. Source not given. Contained unmeasurable trace of silver. No other impurities detected.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Mercury; Hg; [7439-97-6] (2) Gold; Au; [7440-57-5]	Owen, E. A.; Roberts, E. A. O. *J. Inst. Metals* 1945, *71*, 213 - 53.
VARIABLES:	PREPARED BY:
$T/K = 477 - 693$	H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mercury Solubility
$t/°C$	T/K	Atom %
204	477	16.8
310	583	18.2
420	693	19.5 (max)

The compiler added the Kelvin temperatures.

The transformation

(alpha + beta) = (alpha + liquid)

occurs at 693 K, the temperature of the maximum solubility.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The alpha phase boundry of the Hg + Au system was determined by the x-ray method.

Alloys of 17.45 and 19.5 atom % Hg were prepared by heating weighed samples in evacuated silica tubes. Melts were shaken for up to 15 min, then either slow cooled or rapidly quenched. They were tested for homgeneity. Lump annealed for up to seven weeks, powder annealed for up 12 hours at the temperature of the solubility measurement.

SOURCE AND PURITY OF MATERIALS:

(1) Mercury. Source not given. Stated to be 99.99 %.

(2) Gold. Source not given. Stated to be 99.99 %.

ESTIMATED ERROR:

$\delta T/K = \pm (2 - 5)$
± 1 atom % (authors).

REFERENCES:

COMPONENTS:	EVALUATOR:
(1) Copper; cu; [7440-50-8] Zinc; Zn; [7440-66-6] Silver; Ag; [7440-22-4] Lead; Pb; [7439-92-1] (2) Water; H_2O; [7732-18-5]	Appendix I The Solubility of Some Metallic Elements in Water

CRITICAL EVALUATION:

Those interested in the solubility of metallic mercury in water may want to compare the solubility of mercury with other metals in water. There are only a few papers that report studies of the solubility of unionized metallic elements in water. The results of two of these studies are given here (ref. 1, 2).

The determination of the solubility of an oxide-free pure metal in distilled, degassed, neutral water is a difficult experiment. The following data sheets report metallic element solubiliies in water of silver, copper, zinc, and lead. From the experiments of Krepelka and Toul (ref. 1), we conclude that when oxygen and carbon dioxide are rigoroursly excluded in experiments carried out in metallic vessels (which avoids alkali contamination from glass) the solubility of unionized silver in water is below the limit of detection of about 0.000002 g dm^{-3} used by the authors. We believe that the solubility values on the following data sheets are upper limits and the true metal atom solubility in water may be much smaller.

Reliable values of the solubility of the metallic elements in water would be of interest. New studies using modern analytical methods along with techniques to prepare ultra-pure oxide-free metals and bring them in contact with pure degassed neutral water would be desirable.

There are a number of papers in the literature that report metal solubilities in natural systems. Many of these are summarized in the Seidell-Linke Handbook (ref. 3), or can be found in *Chemical Abstracts*. These papers usually report the total metal in solution from a variety of sources after reaction with oxygen, carbon dioxide, and/or electrolyte. The reactions result in the metal surface coated with a mixture of solid oxides, hydroxides, and carbonates. The total metal concentration is the sum of the metal atom, metal ion, and metal ion complexes in solution. Various models are proposed to explain the total metal ion concentration relationship to the multiple equilibriums among the surface solids and the solution components. These studies are of great practical use for corrosion and enviromental problems. However, they take us to far from the scope of the present volume to consider further.

REFERENCES:

1. Krepelka, H.; Toul, F. *Coll. Czech. Chem. Comm.* 1929, *1*, 155.
2. Pariaud, J.; Archinard, P. *Bull. Soc. Chim. France* 1952, 454; *J. Chim. Phys.* 1956, *53*, 765.
3. Seidell, A.; Linke, W. F. *Solubilities of Inorganic and Metal Organic Compounds*, American Chemical Society, Washington, DC, Vol. I. 1958, Vol. II. 1965.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Copper; Cu; [7440-50-8] (2) Water; H_2O; [7732-18-5]	Pariaud, J.; Archinard, P. *Bull. Soc. Chim. France* 1952, 454 - 6. *J. Chim. Phys.* 1956, *53*, 765 - 9.
VARIABLES:	**PREPARED BY:**
T/K = 303.15	M. Iwamoto H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Time of Mixing	Mercury in[a] Solution	Copper Solubility		
				Concentration[b]	Mole[b] Fraction	Molality[b]
$t/°C$	T/K[b]	t/days	$10^6c_1/\text{g dm}^{-3}$	$10^6c_1/\text{mol dm}^{-3}$	10^8x_1	$10^6m_1/\text{mol kg}^{-1}$
30	303.15	6	170			
			160			
			165			
			170			
		29	175			
			180			
			180			
			170 ± 12[c]	1.89	3.42	1.90

[a] All of the experimental values are given with an uncertainty of ±12.

[b] Calculated by compilers.

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

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Colorimetric method with dithizone. Copper and triply distilled degassed water were equilibrated for up to 24 days to insure saturation.

The copper was oxidized to copper (II) and complexed with dithizone. The silver dithizonate complex absorption was measured at 490 nm.

SOURCE AND PURITY OF MATERIALS:

(1) Copper. Electroanalytically pure.

(2) Water. Triply distilled and degassed.

ESTIMATED ERROR:

See uncertainty in table above.

REFERENCES:

COMPONENTS:

(1) Zinc; Zn; [7440-66-6]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Pariaud, J.; Archinard, P.

Bull. Soc. Chim. France 1952, 454 - 6.

J. Chim. Phys. 1956, *53*, 765 - 9.

VARIABLES:

T/K = 305.15

PREPARED BY:

M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Time of Mixing	Mercury in[a] Solution	Zinc Solubility		
				Concentration[b]	Mole[b] Fraction	Molality[b]
t/°C	T/K[b]	t/days	$10^6 c_1$/g dm^{-3}	$10^5 c_1$/mol dm^{-3}	$10^7 x_1$	$10^5 m_1$/mol kg^{-1}
25	298.15	17	710			
			725			
			715			
24	297.15	32	700			
			710			
			710			
32[d]	305.15	32	700 ± 50[c]	1.07	1.94	1.08

[a] All of the experimental values are given with an uncertainty of ±50.

[b] Calculated by compilers.

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

[d] [sic.]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Colorimetric method with dithizone. Zinc and triply distilled degassed water were equilibrated for up to 24 days to insure saturation.

The zinc was oxidized to zinc(II) and complexed with dithizone. The mercury dithizonate complex absorption was measured at 490 nm.

SOURCE AND PURITY OF MATERIALS:

(1) Zinc. Electroanalytically pure.

(2) Water. Triply distilled and degassed.

ESTIMATED ERROR:

See uncertainty in table above.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Silver; Ag; [7440-22-4] (2) Water; H_2O; [7732-18-5]	Krepelka, H.; Toul, F. *Coll. Czech. Chem. Comm.* 1929, *1*, 155 - 64.

EXPERIMENTAL VALUES:

Temperature		Time	Mass of Silver Found $10^6 c_1$/g dm^{-3}			Method
t/°C	T/K	t/days	Exp. I	Exp. II	Avg.	

I. Thi silver leaves were brought into contact with freshly distilled water in heavy walled, hard glass, Erlenmeyer flasks filled to the top with water and sealed with parafin. The water contained only traces of air and carbon dioxide. The flasks were shaken in the dark at 18 to 20°C for the days stated below, then analyzed for silver by nephelometry.

t/°C	T/K	t/days	Exp. I	Exp. II	Avg.	Method
18 - 20	291.15 - 293.15	7	15	9	12	Nephelometry
		14	22	20	21	"
		21	37	33	35	"
		180	37	35	36	"

II. The water in contact with silver was analyzed for Ag^+ by an emf method. The cell used was

$$Ag/H_2O//KCl\ (sat.)//KCl\ (1\ mol\ dm^{-3})(Hg_2Cl_2)/Hg.$$

The Nernst equation was used to calculate the Ag^+ concentration at the Ag/H_2O electrode. The water was freshly distilled before use. The atmosphere was carbon dioxide free air. The time of contact between the silver and water was not stated. Average results are given below, the complete set of emf data are given in the paper.

t/°C	T/K	t/days	Exp. I	Exp. II	Avg.	Method
18.95	292.10				6.3(4)[a]	Emf
18.22	291.37				6.0(9)[a]	"
18.95	292.10				5.3(4)[a]	"
18.85	292.00				15. (7)[a]	"

III. Experiments similar to I above, but carried out in silver vessels with silver powder prepared by reduction of ammonical silver solution by sulfur dioxide. The experiments were done to avoid the effect of alkali leached from glass surfaces. Oxygen and carbon dioxide were rigorously excluded. All silver surfaces were treated with steam followed by reduction with hydrogen gas to insure an oxide free silver surface. The silver dissolved was below the limit of detection of the nephelometry method.

t/°C	T/K	t/days	Exp. I	Exp. II	Avg.	Method
18 - 20[b]	291.15 - 293.15	7	-	-	-	Nephelometry
		14	-	-	-	"
		21	-	-	-	"

IV. Same as III above, but without the hydrogen reduction step to make sure silver surface is oxide free.

t/°C	T/K	t/days	Exp. I	Exp. II	Avg.	Method
18 - 20[b]	291.15 - 293.15	7	10	10	10	Nephelometry
		14	21	20	20	"
		21	34	33	33	"

---

[a] Numbers in ( ) are the number of determinations. Standard deviations are 0, 0.1, 0.7, and 1. interval.

[b] Temperature not stated by authors. Values assumed by compiler because of temperatures used in first experiment.

COMPONENTS:

(1) Silver; Ag; [7440-22-4]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Krepelka, H.; Toul, F.

Coll. Czech. Chem. Comm. 1929, *1*, 155 - 64.

VARIABLES:

$T/K = 291.15 - 293.15$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

See comments above each set of experiments reported on the previous page.

Nephelometry. The water, separated from the silver leaves, was evaporated from a quartz dish to a volume of 60 - 80 cm^3, made up to a volume of 100 cm^3, then compared with a known standard containing a similar amount of silver in the presence of KBr.

Emf. Method of Beans and Oakes (ref. 2).

SOURCE AND PURITY OF MATERIALS:

(1) Silver. Standard sample (ref. 1) prepared for atomic weight work. Melted again on pure CaO in an atmosphere of dry, pure hydrogen. Silver etched with HNO_3, H_2O, and NH_3 to increase surface area. Thoroughly washed with H_2O, and dried at 110°C. Then rolled into thin leaves between well cleaned steel rollers. Surface etched again after each rolling.

(2) Water. Distilled water freed from organic material by action of $KMnO_4$, then twice distilled, the second time in Pt directly into the container used in the experiment.

ESTIMATED ERROR:

The lower limit of detection by nephelometry is about 10×10^{-6} g dm^{-3}.

REFERENCES:

1. Krepelke, H.
   J. Am. Chem. Soc. 1920, *42*, 925.

2. Beans, H. T.; Oakes, E. T.
   J. Am. Chem. Soc. 1920, *42*, 2116.

COMPONENTS:

(1) Silver; Ag; [7440-22-4]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Pariaud, J.; Archinard, P.

Bull. Soc. Chim. France 1952, 454 - 6.

J. Chim. Phys. 1956, *53*, 765 - 9.

VARIABLES:

$T/K = 301.15$

PREPARED BY:

M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Time of Mixing	Mercury in[a] Solution	Silver Solubility		
				Concentration[b]	Mole[b] Fraction	Molality[b]
$t/°C$	T/K[b]	t/days	$10^6 c_1/\mathrm{g\ dm^{-3}}$	$10^7 c_1/\mathrm{mol\ dm^{-3}}$	$10^8 x_1$	$10^7 m_1/\mathrm{mol\ kg^{-1}}$
25	298.15	1	0			
		3	10, 15, 10			
		8	25, 20, 20			
28	301.15	18	28, 25, 25			
		24	28, 30			
			26 ± 7[c]	2.41	4.36	2.42

[a] All of the experimental values are given with an uncertainty of ±7.

[b] Calculated by compilers.

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

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Colorimetric method with dithizone. Silver and triply distilled degassed water were equilibrated for up to 24 days to insure saturation.

The silver was oxidized to silver(I) and complexed with dithizone. The silver dithizonate complex absorption was measured at 490 nm.

SOURCE AND PURITY OF MATERIALS:

(1) Silver. Electroanalytically pure.

(2) Water. Triply distilled and degassed.

ESTIMATED ERROR:

See uncertainty in table above.

REFERENCES:

COMPONENTS:

(1) Lead; Pb; [7439-92-1]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Pariaud, J.; Archinard, P.

Bull. Soc. Chim. France 1952, 454 - 6.

J. Chim. Phys. 1956, *53*, 765 - 9.

VARIABLES:

$T/K = 297.15$

PREPARED BY:

M. Iwamoto
H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Time of Mixing	Mercury in[a] Solution	Lead Solubility		
				Concentration[b]	Mole[b] Fraction	Molality[b]
$t/°C$	T/K[b]	t/days	$10^6 c_1/\mathrm{g\ dm^{-3}}$	$10^7 c_1/\mathrm{mol\ dm^{-3}}$	$10^9 x_1$	$10^7 m_1/\mathrm{mol\ kg^{-1}}$
24	297.15	15	310			
			310			
		30	310			
			315			
			310 ± 18[c]	1.50	2.71	1.50

[a] All of the experimental values are given with an uncertainty of ±18.

[b] Calculated by compilers.

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

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Colorimetric method with dithizone. Lead and triply distilled degassed water were equilibrated for up to 24 days to insure saturation.

The lead was oxidized to lead(V) and complexed with dithizone. The mercury dithizonate complex absorption was measured at 490 nm.

SOURCE AND PURITY OF MATERIALS:

(1) Lead. Electroanalytically pure.

(2) Water. Triply distilled and degassed.

ESTIMATED ERROR:

See uncertainty in table above.

REFERENCES:

COMPONENTS:	EVALUATOR:
Mercury; Hg; [7439-97-6]	Appendix II Some Physicochemical Properties of Mercury

CRITICAL EVALUATION:

I. Atomic weight. The atomic weight of mercury is 200.59 ± 0.03. The isotopic composition of terrestrial mercury, $_{80}$Hg, is

Mass Number	Representative Isotopic Composition	
196	0.15	(5)
198	10.1	(5)
199	17.0	(5)
200	23.1	(6)
201	13.2	(4)
202	29.65	(75)
204	6.8	(3)

The uncertainties listed in parentheses cover the range of variations of the materials as well as experimental errors.

REFERENCES:

Holden, N. E.; Martin, R. L. *Pure Appl. Chem.* 1983, *55*, 1101 -18.
Holden, N. E.; Martin, R. L.; Barnes, I. L. *Pure Appl. Chem.* 1983, *55*, 1119 - 36.

II. Some enthalpy, entropy, and heat capacity values.

Mercury State	Values for 298.15 K and 1 bar (0.1 MPa)			
	$\Delta_f H°$/kJ mol^{-1}	$\Delta_f G°$/kJ mol^{-1}	$S°$/J K^{-1} mol^{-1}	$C_p°$/J K^{-1} mol^{-1}
Liquid	0	0	76.02	27.983
Gas	61.317	31.820	174.96	20.786
Aqueous Soln. hyp 1 *m*	37.7	39.3	71	-

Mercury Transition[a]	T/K	P/mmHg	ΔH/kJ mol^{-1}	ΔS/J K^{-1} mol^{-1}
Sublimation	234.39	2.5 x 10^{-6}	63.60	271.5
Fusion	234.39	2.5 x 10^{-6}	2.33	9.92
Vaporization	298.15	0.00209	60.84[a]	204.1[a]
Vaporization	629.73	760	58.12	92.30

[a] Values from 1952 evaluation. More recent literature should be checked.

[b] Better values from enthalpy of formations above are 61.317 kJ mol^{-1} and 205.7 J K^{-1} mol^{-1}.

The values above are from 1952 and 1982 evaluations of the U.S. National Bureau of Standards publications. The review paper of Hepler and Olofsson should be consulted.

REFERENCES:

Rossini, F. D.; Wagman, D. D.; Evans, W. H.; Levine, S.; Jaffe, I. *Selected Values of Chemical Thermodynamic Properties*, Part I. Tables, National Bureau of Standards Circular 500, U.S. Government Printing Office, Washington D.C., 1952 (reprinted 1961).
Wagman, D. D.; Evans, W. H.; Parker, V. B.; Schumm, R. H.; Halow, I.; Bailey, S. M.; Churney, K. L.; Nuttall, R. L. *NBS Tables of Chemical Thermodynamic Properties, J. Phys. Chem. Ref. Data* 1982, *11*, Supplement 2, 392 pp.
Hepler, L. G.; Olofsson, F. *Chem. Rev.* 1975, *75*, 585 - 602.

COMPONENTS: Mercury; Hg; [7439-97-6]	EVALUATOR: Appendix II Some Physicochemical Properties of Mercury

CRITICAL EVALUATION:

III. Melting point, triple point, normal boiling point, and critical properties of mercury.

Compared below are values from the evaluations of Ambrose and Sprake and of Vargaftik.

Value	Ambrose and Sprake	Vargaftik	
Melting point		-38.83°C	234.32 K
Triple point	234.53 K at 3 x 10^{-4} Pa		
Boiling point	629.815 K	356.95°C	630.10 K
Critical Properties			
Temperature	1765 K	1490°C	1763 K
Pressure	151 MPa	151 MPa	1510 Bar
Density			5.500 Mg m^{-3}

REFERENCES:

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

Vargaftik, N. B. *Tables on the Thermophysical Properties of Liquids and Gases*, Hemisphere Pub. Corp., Washington and London, 1975; *Chem. Abstr.* 1974, *80*, 137452v; 1976, *84*, 35655d.

IV. Other Properties of Mercury.

Density of liquid mercury	Appendix III
Vapor pressure of liquid mercury	Appendix IV
Second Virial coefficients of mercury vapor	Appendix V

The N. B. Vargaftik Handbook (reference above) contains about twelve pages of tables of liquid and gaseous mercury physical properties. There are values of vapor pressure, density, and specific volume of both liquid and vapor. There are values of coefficients of thermal expansion, coefficient of isothermal compressibility, latent heat of vaporization, entropy and constant volume and constant pressure heat capacities of the liquid at 10 degree intervals from 0 to 800°C.

A small table gives values of the liquid specific resistance, thermal conductivity, viscosity and other properties from the melting point to 800°C.

The mercury vapor specific volume, enthalpy, entropy, heat capacity and velocity of sound are given from 180 to 2000°C at pressures from 0.01 to 200 bar. A separate table gives values of the viscosity and thermal conductivity of mercury vapor.

COMPONENTS:	EVALUATOR:
Mercury; Hg; [7439-97-6]	Appendix III Density of Liquid Mercury

CRITICAL EVALUATION:

There are several evaluations of the density of liquid mercury. Density data are reproduced on the following page from two evaluations as a function of temperature between 253 and 1073 K. The values are given in the units of megagram per cubic meter, Mg m^{-3}, which conveniently have the same decimal location at grams per cubic centimeter.

Density values in the first column are from Herington, Brown and Lane (ref. 1). The values are described as the "absolute density of mercury at a pressure of 101.325 kPa for temperatures t/°C on the International Practical Temperature Scale of 1968". The values are based on data presented by Bigg (ref. 2) corrected to bring the values to the 1968 IPTS.

The Herington *et al.* table contains values at one degree intervals from -20 to 100°C, and at ten degree intervals from 100 to 300°C. Also presented are values of the temperature coefficient and error in density. Reproduced on the next page are density values at five degree intervals from -20 to 100°C, and at ten degree intervals from 100 to 300°C.

Density values in the second column are from Vargaftik (ref. 3). They are described as properties of mercury in saturation. They are credited to the evaluation of Vukalovich and Fokin (ref. 4). There are no mentions of the original data source or the temperature scale.

The Vargaftik table contains density values at ten degree intervals from 0 to 800°C. Reproduced here are the density values at ten degree intervals from 0 to 300°C, at 20 degree intervals from 300 to 400°C, and at 40 degree intervals from 400 to 800°C.

The two evaluations differ slightly with the Russian data being a little smaller at all temperatures over the 0 to 300°C range common to both tables. The difference in parts per million, ppm, is given below for several temperatures. The difference is negligible for most applications.

t/°C	0	50	90	200	300
Difference (ppm)	3.7	1.5	4.5	7.6	15.5

REFERENCES:

1. Herington, E. F. G.; Brown, I.; Lane, J. E.; Ambrose, D. *Pure Appl. Chem.* 1976, *45*, 1 - 9.

2. Bigg, P. H. *Brit. J. Appl. Phys.* 1964, *15*, 1111 - 3.

3. Vargaftik, N. B. *Tables on the thermophysical properties of liquids and gases*, Hemisphere Pub. Corp., Washington and London, 1975. (English translation of the 2nd Russian Edition, distributed by Halsted Press); *Chem. Abstr.* 1974, *80*, 137452v; 1976, *84*, 35655d.

4. Vukalovich, M. P.; Fokin, R. V. *Thermophysical properties of mercury*, Standards Press, 1971, 311 pp.; *Chem. Abstr.* 1973, *78*, 114619z.

COMPONENTS:

Mercury; Hg; [7439-97-6]

EVALUATOR:

Appendix III

Density of Liquid Mercury

CRITICAL EVALUATION:

Temperature		Density	
t/°C	T/K	(1)ρ/Mg m^{-3}	(2)ρ/Mg m^{-3}
-20	253.15	13.64459	
-15	258.15	13.63218	
-10	263.15	13.61978	
-5	268.15	13.60743	
0	273.15	13.59508	13.59503
5	278.15	13.58276	
10	283.15	13.57044	13.57039
15	288.15	13.55815	
20	293.15	13.54587	13.54583
25	298.15	13.53362	
30	303.15	13.52137	13.52133
35	308.15	13.50914	
40	313.15	13.49693	13.49689
45	318.15	13.48473	
50	323.15	13.47253	13.47251
55	328.15	13.46038	
60	333.15	13.44823	13.44819
65	338.15	13.43610	
70	343.15	13.42397	13.42393
75	348.15	13.41186	
80	353.15	13.39977	13.39971
85	358.15	13.38767	
90	363.15	13.37560	13.37554
95	368.15	13.36354	
100	373.15	13.3515	13.35142
110	383.15	13.3274	13.32734
120	393.15	13.3034	13.30330
130	403.15	13.2794	13.27929
140	413.15	13.2554	13.25531
150	423.15	13.2315	13.23137
160	433.15	13.2076	13.20745
170	443.15	13.1837	13.18356
180	453.15	13.1598	13.15968
190	463.15	13.1360	13.13582
200	473.15	13.1121	13.11197
210	483.15	13.0883	13.08814
220	493.15	13.0645	13.06431
230	503.15	13.0407	13.04048
240	513.15	13.0169	13.01665
250	523.15	12.9930	12.99282
260	533.15	12.9692	12.96898
270	543.15	12.9454	12.94514
280	553.15	12.9215	12.92127
290	563.15	12.8976	12.89734
300	573.15	12.8737	12.8735
320	593.15		12.8256
340	613.15		12.7776
360	633.15		12.7294
380	653.15		12.6811
400	673.15		12.6326
440	713.15		12.5348
480	753.15		12.4358
520	793.15		12.3336
560	833.15		12.234
600	873.15		12.130
640	913.15		12.025
680	953.15		11.918
720	993.15		11.809
760	1033.15		11.697
800	1073.15		11.584

COMPONENTS: Mercury; Hg; [7439-97-6]	EVALUATOR: Appendix IV Vapor Pressure of Liquid Mercury

CRITICAL EVALUATION:

The vapor pressure of mercury has been measured by many workers. The experimental data have been evaluated a number of times. We present here data from three evaluations. Two of the evaluations were done in the early 1970's and one was done in 1951.

Douglas, Ball, and Ginnings compared values from 14 laboratories with the vapor pressure equation they developed from thermodynamic data in 1951. Their equation for the vapor pressure of mercury was obtained by equating the Gibbs energies of saturated liquid and vapor using the best available thermodynamic data at that time. They took into account the effect of gas imperfections and temperature scale. The equation, which contains over 20 constants is difficult to use. Vapor pressure values from the equation are tabulated at 20 degree intervals from near the triple point to 500°C in their paper. These values are given on the next page.

Douglas, Ball, and Ginnings give a simpler equation for practical use that reproduces the vapor pressure of the full equation between 100 and 500°C to within 0.01 percent. The equation is

$$\begin{aligned}\log\,(p/\text{mmHg}) = {} & 11.257555 - 3339.202/(\theta/\text{K}) - 1.153092 \log(\theta/\text{K}) \\ & + 2.95697 \times 10^{-4}(\theta/\text{K}) - 7.4588 \times 10^{-8}(\theta/\text{K})^2 \\ & - 1.5605 \times 10^{-11}(\theta/\text{K})^3 + 3.600 \exp(-5360/(\theta/\text{K})),\end{aligned}$$

where θ is the temperature on the 1948 International Practical Temperature Scale, related at the thermodynamic scale by

$$\begin{aligned}(T/\text{K}) - (\theta/\text{K}) = {} & 0.6381 - 4.809 \times 10^{-3}(\theta/\text{K}) + 1.1096 \times 10^{-5}(\theta/\text{K})^2 \\ & - 7.481 \times 10^{-9}(\theta/\text{K})^3.\end{aligned}$$

Unfortunately these equations are somewhat dated. However, they do represent a thorough careful evaluation, and they should not be ignored because they are related to the 1948 IPTS.

Ambrose and Sprake combined measurements of their own with earlier data and information from earlier evaluations to develop two equations for the vapor pressure of mercury. The first equation is a third order Chebyshev polynomial for the 400 to 686 K temperature interval. It is

$$\begin{aligned}(T/\text{K}) \log(p/\text{kPa}) = {} & 1313.8587/2 + 997.8311\, E_1(x) - 3.0387\, E_2(x) \\ & + 0.2965\, E_3(x)\end{aligned}$$

where

$$x = \{2(T/\text{K}) - (686 + 400)\}/(686 - 400)$$

and the Chebyshev polynomials are

$E_0(x) = 1$, $E_1(x) = x$, $E_2(x) = 2x^2 - 1$, $E_3(x) = 4x^3 - 3x$, and $E_4(x) = 8x^4 - 8x^2 + 1$.

They are related by the recurrence relation

$$E_{s+1}(x) = 2xE_s(x) - E_{s-1}(x).$$

Value from the equation are reproduced on the next page from 273.15 to 673.15 K. The second equation of Ambrose and Sprake is a fifth order Chebyshev polynomial for the 400 to 1765 K temperature interval. It was fitted to experimental data over the 400 to 772 K range and to the critical temperature and pressure. The equation is:

$$\begin{aligned}(T/\text{K}) \log(p/\text{kPa}) = {} & 8745.7706/2 + 4708.7980\, E_1(x) + 13.2829\, E_2(x) \\ & + 29.7025\, E_3(x) + 11.7077\, E_4(x) + 4.5180\, E_5(x)\end{aligned}$$

(continued on page 243)

COMPONENTS:

Mercury; Hg; [7439-97-6]

EVALUATOR:

Appendix IV

Vapor Pressure of Liquid Mercury

CRITICAL EVALUATION:

	Ambrose and Sprake	Douglas, Ball, Ginnings	Vargaftik
t/°C	p/mmHg	p/mmHg	p/mmHg
-38.88		0.00219×10^{-3}	
-20		0.02336×10^{-3}	
0	0.197×10^{-3}	0.1996×10^{-3}	0.205×10^{-3}
10	0.515×10^{-3}		0.533×10^{-3}
20	1.258×10^{-3}	1.268×10^{-3}	1.30×10^{-3}
25	1.921×10^{-3}	1.935×10^{-3}	
30	2.893×10^{-3}		2.98×10^{-3}
40	6.304×10^{-3}	6.340×10^{-3}	6.47×10^{-3}
50	13.08×10^{-3}		13.4×10^{-3}
60	25.95×10^{-3}	26.048×10^{-3}	26.5×10^{-3}
70	49.44×10^{-3}		50.4×10^{-3}
80	90.75×10^{-3}	90.954×10^{-3}	92.4×10^{-3}
90	0.1610		0.164
100	0.2768	0.2771	0.281
110	0.4623		0.468
120	0.7517	0.75213	0.761
130	1.193		1.21
140	1.850	1.8499	1.87
150	2.808		2.83
160	4.180	4.1795	4.21
170	6.180		6.15
180	8.775	8.7734	8.83
190	12.40		12.48
200	17.27	17.27	17.37
210	23.72		23.83
220	32.14	32.15	32.28
230	43.02		43.19
240	56.90	56.93	57.11
250	74.45		74.70
260	96.41	96.70	96.70
270	123.6		124.0
280	157.4	157.23	157.5
290	197.8		198.3
300	247.1	247.41	247.6
310	306.2		306.9
320	376.7	377.27	377.4
330	460.2		461.0
340	558.4	559.22	559.3
350	673.2		674.3
360	806.8	808.00	807.9
370	961.3		962.7
380	1139.1	1140.65	1140.6
390	1342.8		1344.4
400	1575.0	1576.64	1576.9
420	2136.7	2137.76	
440	2848.2	2848.1	
460	3736.4	3733.8	
480	4829.8	4822.9	
500	6159.2	6145.4	

COMPONENTS:	EVALUATOR:
Mercury; Hg; [7439-97-6]	Appendix IV Vapor Pressure of Liquid Mercury

CRITICAL EVALUATION:

	Ambrose and Sprake	Vargaftik
t/°C	p/bar	p/bar
0	0.2632×10^{-6}	0.2728×10^{-6}
10	0.6869×10^{-6}	0.7101×10^{-6}
20	1.677×10^{-6}	1.7929×10^{-6}
25	2.562×10^{-6}	
30	3.857×10^{-6}	3.68×10^{-6}
40	8.405×10^{-6}	8.626×10^{-6}
50	17.44×10^{-6}	17.86×10^{-6}
60	34.60×10^{-6}	35.36×10^{-6}
70	65.91×10^{-6}	67.24×10^{-6}
80	0.121×10^{-3}	0.1232×10^{-3}
90	0.2146×10^{-3}	0.2182×10^{-3}
100	0.3690×10^{-3}	0.3745×10^{-3}
110	0.6163×10^{-3}	0.6247×10^{-3}
120	1.002×10^{-3}	1.015×10^{-3}
130	1.590×10^{-3}	1.608×10^{-3}
140	2.466×10^{-3}	2.491×10^{-3}
150	3.744×10^{-3}	3.778×10^{-3}
160	5.573×10^{-3}	5.618×10^{-3}
170	8.144×10^{-3}	8.204×10^{-3}
180	11.70×10^{-3}	11.78×10^{-3}
190	16.53×10^{-3}	16.64×10^{-3}
200	23.03×10^{-3}	23.15×10^{-3}
210	31.62×10^{-3}	31.77×10^{-3}
220	42.85×10^{-3}	43.04×10^{-3}
230	57.35×10^{-3}	57.58×10^{-3}
240	75.86×10^{-3}	76.14×10^{-3}
250	99.26×10^{-3}	99.59×10^{-3}
260	0.1285	0.12892
270	0.1648	0.16527
280	0.2094	0.20993
290	0.2637	0.26435
300	0.3294	0.33015
310	0.4083	0.40910
320	0.5022	0.50320
330	0.6135	0.61460
340	0.7444	0.74567
350	0.8975	0.89896
360	1.0756	1.0772
370	1.2816	1.2834
380	1.5187	1.5207
390	1.7903	1.7925
400	2.0999	2.1024
420	2.8487	2.852
440	3.797	3.801
460	4.982	4.986
480	6.439	6.446
500	8.212	8.222
520	10.341	10.358
540	12.872	12.901
560	15.851	15.899
580	19.324	19.403
600	23.34	23.46
620	27.94	28.14

COMPONENTS: Mercury; Hg; [7439-97-6]	EVALUATOR: Appendix IV Vapor Pressure of Liquid Mercury

CRITICAL EVALUATION:

	Ambrose and Sprake	Vargaftik
t/°C	*p*/bar	*p*/bar
640	33.18	33.47
660	39.11	39.53
680	45.76	46.36
700	53.18	54.03
720	61.42	62.59
740	70.51	72.10
760	80.50	82.60
780	91.42	94.17
800	103.29	106.85
820	116.16	
840	130.06	
860	145.00	
880	161.03	
900	178.15	
950	225.9	
1000	281.2	
1050	344.2	
1100	415.8	
1150	496.7	
1200	588.3	
1250	692.4	
1300	812.0	
1350	950.8	
1400	1115	
1450	1312	
1490	1500	
1492 (ct)	1510	

COMPONENTS:	EVALUATOR:
Mercury; Hg; [7439-97-6]	Appendix IV Vapor Pressure of Liquid Mercury

CRITICAL EVALUATION:

with

$$x = \{2(T/K) - (400 + 1765)\}/(1765 - 400)$$

and the Chebyshev polynomials defined as stated previously. Values from the equation are given on the next two pages for temperatures from 683.15 to 1765 K.

The third set of values presented here are the vapor pressures from Vargaftik based on the evaluation of Vukalovich and Fokin. The table presents the vapor pressure in bars at 10 degree intervals from 0 to 800°C and in mmHg from 0 to 400°C.

Both Douglas, Ball and Ginnings and Ambrose and Sprake mention that the vapor pressures from the triple point to 400 K show poorer agreement than the values measured at higher temperatures. We make no recommendation that one data set is better than the other. The differences may reflect the overall uncertainty of the data on which they are based.

REFERENCES:

1. Douglas, T. B.; Ball, A. F.; Ginnings, D. C. *J. Res. National Bureau of Standards* 1951, *46*, 334 - 48.
2. Ambrose, D.; Sprake, C. H. S. *J. Chem. Thermodyn.* 1972, *4*, 603 - 20.
3. Vargaftik, N. B. *Tables on the thermophysical properties of liquids and gases*, Hemisphere Pub. Corp., Washington and London, 1975. (English translation of the 2nd Russian Edition, distributed by Halsted Press); *Chem. Abstr.* 1974, *80*, 137452v; 1976, *84*, 35655d.
4. Vukalovich, M. P.; Fokin, R. V. *Thermophysical properties of mercury*, Standards Press, 1971, 311 pp.; *Chem. Abstr.* 1973, *78*, 114619z.

COMPONENTS:	EVALUATOR:
Mercury; Hg; [7439-97-6]	Appendix V Second Virial Coefficient of Mercury Vapor

CRITICAL EVALUATION:

Douglas, Ball, and Ginnings evaluated graphically the second virial coefficient of mercury vapor at temperatures of 430, 530, 630, and 730 K. They took into account the molar dissociation energy of Hg_2.

The empirical equation

$$B_{11}/\text{cm}^3\ \text{mol}^{-1} = 56.4 - 43.82 \exp(655/(T/\text{K}))$$

represents the second virial coefficient, B_{11}, in the 373 to 773 K temperature range. Differentiation with respect to temperature gives

$$B'/\text{cm}^3\ \text{K}^{-1} = dB/dT = (655/(T/\text{K})^2)(56.4 - B).$$

Values of B and B' as a function of temperature are given below.

Temperature t/°C	T/K	2nd Virial Coefficient B_{11}/cm³ mol⁻¹	Temperature Coefficient (dB/dT)/cm³ K⁻¹ mol⁻¹
100	373.15	-197	1.19
120	393.15	-175	0.98
140	413.15	-158	0.82
160	433.15	-142	0.69
180	453.15	-130	0.59
200	473.15	-118	0.51
220	493.15	-109	0.45
240	513.15	-101	0.39
260	533.15	-93	0.34
280	553.15	-87	0.31
300	573.15	-81	0.27
320	593.15	-76	0.25
340	613.15	-71	0.22
356.58	629.73 (bp)	-68	0.20
360	633.15	-67	0.20
380	653.15	-63	0.18
400	673.15	-60	0.17
420	693.15	-56	0.15
440	713.15	-53	0.14
460	733.15	-51	0.13
480	753.15	-48	0.12
500	773.15	-46	0.11

Mixed second virial coefficients, B_{12}, have been obtained from the solubility of mercury in compressed gases for mercury + argon, + propane, + butane, + methanol, and + acetone. The values are given in the evaluation of the solubility of mercury in compressed gases.

REFERENCES:

Douglas, T. B.; Ball, A. F.; Ginnings, D. C. *J. Res. Nat. Bur. Stand.* 1951, *46*, 334 - 48.

COMPONENTS:

Mercury; Hg; [7439-97-6]

EVALUATOR:

Appendix VI

Mercury Enthalpy of Vaporization and Molar Volume at Saturation Pressures

CRITICAL EVALUATION:

The values below were calculated from data in Vargaftik (see references 3 and 4 in Appendixes III and IV).

$t/°\mathrm{C}$	Enthalpy of Vaporization $\Delta H/\mathrm{kJ\ mol^{-1}}$	Molar Volume $V/\mathrm{cm^3\ mol^{-1}}$
0	61.544	14.755
10	61.471	14.781
20	61.399	14.808
30	61.327	14.835
40	61.256	14.862
50	61.185	14.889
60	61.115	14.916
70	61.047	14.943
80	60.978	14.970
90	60.910	14.997
100	60.842	15.024
110	60.775	15.051
120	60.709	15.078
130	60.643	15.105
140	60.577	15.133
150	60.512	15.160
160	60.447	15.188
170	60.382	15.215
180	60.317	15.243
190	60.252	15.270
200	60.188	15.298
220	60.060	15.354
240	59.931	15.410
260	59.802	15.467
280	59.672	15.524
300	59.540	15.582
320	59.406	15.640
340	59.269	15.699
360	59.129	15.758
380	58.985	15.818
400	58.836	15.879
440	58.521	16.003
480	58.178	16.130
520	57.801	16.260
560	57.384	16.395
600	56.921	16.535
640	56.408	16.680
680	55.839	16.830
720	55.210	16.985
760	54.516	17.150
800	53.755	17.315

Several values of the mercury cohesion parameter calculated from the values above as

$$\delta/\mathrm{MPa}^{1/2} = ((\Delta H - RT)/V)^{1/2} \text{ are:}$$

Temperature $t/°\mathrm{C}$	T/K	Cohesion Parameter $\delta/\mathrm{MPa}^{1/2}$
0	273.15	63.4
25	298.15	63.1
50	323.15	62.7
100	373.15	62.0
150	423.15	61.3
200	473.15	60.6

SYSTEM INDEX

Pages preceded by E refer to evaluation texts whereas thoose not not preceded by E refer to compiled tables. Compounds are listed as in Chemical Abstracts. For example, toluene is listed as benzene, methyl- and tetramethylammonium bromide as methanamine, N,N,N-trimethyl-, bromide.

REGISTRY NUMBER INDEX

Page numbers preceded by E refer to evaluation texts whereas those not preceded by E refer to compiled tables.

AUTHOR INDEX

Page numbers preceded by E refer to evaluation texts whereas those not preceded by E refer to compiled tables.