COMPONENTS:	EVALUATOR:
1. Phosphine; PH_3; [7803-51-2] 2. Organic liquids.	P. G. T. Fogg, School of Chemistry, Polytechnic of North London, Holloway, London N7 8DB United Kingdom. August 1983

CRITICAL EVALUATION:

Data obtained by Palmer *et al* (1) and by Devyatykh *et al* (2) have been discussed in detail by Gerrard (3). Mole fraction solubilities calculated from measurements by Palmer *et al.* fall into a consistent pattern with a lower solubility in hydrogen bonded solvents compared with other solvents. There is also an increase in mole fraction solubility with increase in chain length in the case of straight chain alkanes. Solubilities are in the order:

in benzene < in cyclohexene < in cyclohexane

and

in benzene < in toluene < in xylene.

The variation of solubility in nitrobenzene, with change in temperature, was measured by both Palmer *et al.* and by Devyatykh *et al.* The ratio $vol._{PH_3}/vol._{solvent}$ for a temperature of 295.2 K has been estimated by the compiler from data given by Devyatykh *et al.* to be 8.4. This may be compared with the value of 3.06 given by Palmer *et al.* for a pressure of 1 atm. There is a similar discrepancy between the solubility in liquid paraffin calculated from the data of Devyatykh *et al* and that measured by Palmer.

There is also a marked difference between the solubility of phosphine in didecyl phthalate calculated from data given by Devyatykh and that in dibutyl phthalate measured by Palmer. Expressed as $vol._{PH_3}/vol._{solvent}$ at 295.7 K the former gives 22.2 and the latter 3.23. If it could be assumed that Devyatykh's data could be extrapolated to a partial pressure of phosphine of 1 atm, the corresponding mole fraction solubility at 295.7 K for didecyl phthalate would be about 0.3 compared with the value of 0.0342 given by Palmer for dibutyl phthalate at this temperature.

Solubilities measured with conventional apparatus by Palmer *et al.* are likely to be reliable. Solubilities for a partial pressure of 1 atm calculated from distribution constants determined by gas chromatography by Devyatykh *et al.* are likely to be unreliable. They may, perhaps, be used to estimate relative solubilities in the solvents which were studied but such estimates may not be precise.

The solubility in cyclohexanol at 299.2 K was measured by Cauquil (4) using very simple apparatus. The mole fraction solubility at a partial pressure of 1 atm, calculated from the Ostwald coefficient reported by this author, is close to values for other polar solvents reported by Palmer *et al.* The value for cyclohexanol may therefore be accepted as a tentative value in the absence of other data for this solvent.

The solubility in trifluoroacetic acid was measured by Fujioka and Cady (5) who also used very simple apparatus. They calculated the Ostwald coefficient to be 15.9 from measurements at 653 mmHg and 299.2 K. This corresponds to a mole fraction solubility of 0.040 at this pressure and about 0.046 at 760 mmHg. These measurements are in sharp contrast to those of Palmer *et al.* who reported an Ostwald coefficient of 2.46 at 760 mmHg and 293.2 K for 95.3% trifluoroacetic acid and a value of 2.64 at 760 mmHg and 294.7 K for a 96.8% sample. Unfortunately the purity of the acid used by Fujioka and Cady was not stated and direct comparison of the two sets of work may not be justified.

(cont.)

COMPONENTS:	EVALUATOR:
1. Phosphine; PH_3; [7803-51-2] 2. Organic liquids.	P. G. T. Fogg, School of Chemistry, Polytechnic of North London, Holloway, London N7 8DB United Kingdom. August 1983

CRITICAL EVALUATION:

References:

1. Palmer, M. G.; Lessels, R.W.M.; Childs, A. F.; McCoubrey, J. C.
Albright & Wilson (Mfg.) Ltd., Technical Note No. 60, 1963.
(Quoted by Gerrard, W. *Gas Solubilities - Widespread Applications*,
Pergamon Press, Oxford, 1980.)

2. Devyatykh, G. G.; Ezheleva, A. E.; Zorin, A. D.; Zueva, M. V.
Zh. Neorgan. Khim. 1963, *8*, 1307.
(*Russ. J. Inorg. Chem.* 1963, *8*, 678.)

3. Gerrard, W.
Solubility of Gases in Liquids, Plenum Press, New York, 1976.

4. Cauquil, G.
J. Chim. Phys. Phys. Chim. Biol. 1927, *24*, 53.

5. Fujioka, G.S.; Cady, G.H.
J. Amer. Chem. Soc. 1957, *79*, 2451.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Phosphine; PH_3; [7803-51-2] 2. Alkanes	Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C. *Albright & Wilson (Mfg.) Ltd., Technical Note No. 60,* 1963. Quoted by Gerrard, W., *"Gas Solubilities - Widespread Applications"*, 1980, Pergamon Press, Oxford.
VARIABLES:	PREPARED BY: P. G. T. Fogg

EXPERIMENTAL VALUES:

Solvent	T/K	Mole fraction x_{PH_3} (1 atm)	Ostwald Coefficient, L
Pentane; C_5H_{12}; [109-66-0]	294.65	0.0200	4.33
Hexane; C_6H_{14}; [110-54-3]	294.65	0.0354	6.79
Heptane; C_7H_{16}; [142-82-5]	294.65	0.0413	7.12
2,2,4-Trimethylpentane; C_8H_{18}; [540-84-1]	294.4	0.0400	6.19
Decane; $C_{10}H_{22}$; [124-18-5]	294.05	0.0432	5.73
Dodecane; $C_{12}H_{26}$; [112-40-3]	293.15	0.0469	5.35

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts and measurements made at room temperature.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam; phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.
2. C_5H_{12}; C_6H_{14}; C_7H_{16}; C_8H_{18}: pure materials supplied by Esso Petroleum Ltd; $C_{10}H_{22}$; $C_{12}H_{26}$: technical grade samples purified by distillation.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]
2. 2,6-Dimethyl-2-heptane; C_9H_{18}; [5557-98-2]

ORIGINAL MEASUREMENTS:

Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C. *Albright & Wilson (Mfg.) Ltd., Technical Note No. 60,* 1963. Quoted by Gerrard, W., *"Gas Solubilities - Widespread Applications"*, 1980, Pergamon Press, Oxford.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

T/K	Ostwald Coefficient, *L*
293.65	5.87

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts and measurements made at room temperature.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam, phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.
2. G.P.R. grade, distilled under reduced pressure (ca. 17 mmHg), to remove dissolved gases.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]
2. Alicyclic compounds

ORIGINAL MEASUREMENTS:

Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C. *Albright & Wilson (Mfg.) Ltd., Technical Note No. 60*, 1963. Quoted by Gerrard, W., *"Gas Solubilities - Widespread Applications"*, 1980, Pergamon Press, Oxford.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

Solvent	T/K	Mole fraction x_{PH_3} (1 atm)	Ostwald Coefficient, L
Cyclohexene; C_6H_{10}; [110-83-8]	294.15	0.0280	6.85
Cyclohexane; C_6H_{12}; [110-82-7]	291.65	0.0326	7.47
Undecafluoro(trifluoromethyl)-cyclohexane; C_7F_{14}; [355-02-2]	294.95		1.31
1,2,3,4-Tetrahydronaphthalene; $C_{10}H_{12}$; [119-64-2]	295.25	0.0291	5.34
2,6,6-Trimethylbicyclo[3.1.1]-hept-2-ene,(α-pinene); $C_{10}H_{16}$; [80-56-8]	292.65		19.5
Decahydronaphthalene; $C_{10}H_{18}$; [91-17-8]	295.35	0.0316	5.05

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts and measurements made at room temperature.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam, phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.
2. Cyclohexene Technical grade, purified by distillation. Other solvents "Analar" or G.P.R. grade, distilled under reduced pressure (ca. 17 mmHg) to remove dissolved gases.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]
2. Aromatic compounds

ORIGINAL MEASUREMENTS:

Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C. *Albright & Wilson (Mfg.) Ltd., Technical Note No. 60*, 1963.
Quoted by Gerrard, W., *"Gas Solubilities - Widespread Applications"*, 1980, Pergamon Press, Oxford.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

Solvent	T/K	Mole fraction x_{PH_3} (1 atm)	Ostwald Coefficient, L
Benzene; C_6H_6; [71-43-2]	295.15	0.0260	7.26
Benzenamine; C_6H_7N; [62-53-3]	295.15	0.0105	2.80
Dimethylbenzene; C_8H_{10}; [1330-20-7]	294.65	0.0320	6.52
(1-Methylethyl)benzene; C_9H_{12}; [98-82-8]	294.65	0.0316	5.68
1,2-Benzenedicarboxylic acid, dibutyl ester; $C_{16}H_{22}O_4$; [119-64-2]	295.65	0.0342	3.23
Hexafluorobenzene 98.5%; C_6F_6; [392-56-3]	295.4		4.36

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts and measurements made at room temperature.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam, phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.
2. C_6H_6; C_6H_7N; C_8H_{10}: "Analar" or G.P.R. grade; distilled under reduced pressure (ca. 17 mmHg) to remove dissolved gases; C_9H_{12}; $C_{16}H_{22}O_4$: technical grade, purified by distillation.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]

2. Methylbenzene; C_7H_8; [108-88-3]

ORIGINAL MEASUREMENTS:

Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C. *Albright & Wilson (Mfg.) Ltd., Technical Note No. 60*, 1963. Quoted by Gerrard, W., *"Gas Solubilities - Widespread Applications"*, 1980, Pergamon Press, Oxford.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

T/K	Mole fraction x_{PH_3} (1 atm)	Ostwald Coefficient, L
293.85	0.0290	-
295.15	0.0304	7.15
313.4	0.0194	-
334.95	0.0129	-

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts for measurements at room temperature (293.85 K). Temperatures were thermostatically controlled for other measurements.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam, phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]
2. Cyclohexanol; $C_6H_{12}O$; [108-93-0]

ORIGINAL MEASUREMENTS:

Cauquil, G.

J. Chim. Phys. Phys. Chim. Biol. 1927, *24*, 53-55.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

T/K	p_{PH_3}/mmHg	Ostwald Coefficient, L	Mole fraction* x_{PH_3} (1 atm.)
299.2	766	2.856	0.01226

760 mmHg = 1 atm = 1.013×10^5 Pa.

* Value of x_{PH_3} (1 atm) has been calculated by the compiler using densities of cyclohexanol at 293.2 K and 303.2 K given in refs. (1) and (2), respectively, and values of van der Waals constants for phosphine given in ref. (1).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A measured volume of cyclohexanol was put into contact with a measured volume of phosphine in a graduated tube over mercury. The final volume of gas and the temperature and pressure were measured when equilibrium had been reached. The author considered that no allowance for the vapor pressure of cyclohexanol at the temperature of measurement was necessary.

SOURCE AND PURITY OF MATERIALS:

2. All dissolved air was removed by boiling; b.p. 334.1 K (766 mmHg).

ESTIMATED ERROR:

REFERENCES:

1. *Handbook of Chemistry and Physics*, (61st edition), C.R.C. Press, Cleveland, Ohio, 1980.
2. Timmermans, J. *Physico-Chemical Constants of Pure Organic Compounds*, Vol. II, Elsevier, London, 1965.

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]
2. Petroleum ethers and liquid paraffin

ORIGINAL MEASUREMENTS:

Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C. *Albright & Wilson (Mfg.) Ltd., Technical Note No. 60,* 1963. Quoted by Gerrard, W., *"Gas Solubilities - Widespread Applications"*, 1980, Pergamon Press, Oxford.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

Solvent	T/K	Ostwald Coefficient, *L*
Liquid paraffin	292.35	4.86
40/60 Petroleum ether	292.15	4.36
60/80 " "	292.15	8.02
80/100 " "	296.15	6.42
100/120 " "	295.65	6.15
120/160 " "	293.9	6.14

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts and measurements made at room temperature.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam, phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.
2. Solvents were "Analar" or G.P.R. grade; distilled under reduced pressure (ca. 17 mmHg) to remove dissolved gases.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]
2. Aliphatic compounds containing oxygen.

ORIGINAL MEASUREMENTS:

Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C.
Albright & Wilson (Mfg.) Ltd., Technical Note No. 60, 1963.
Quoted by Gerrard, W., *"Gas Solubilities - Widespread Applications"*, 1980, Pergamon Press, Oxford.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

Solvent	T/K	Mole fraction x_{PH_3} (1 atm)	Ostwald Coefficient, L
Trifluoroacetic acid 95.3%; C_2HF_3O; [76-05-1]	293.15		2.46
Trifluoroacetic acid 96.8%; C_2HF_3O; [76-05-1]	294.65		2.64
Acetic acid; $C_2H_4O_2$; [64-19-7]	294.15	0.0075	3.19
1,2-Ethanediol; $C_2H_6O_2$; [107-21-1]	292.35	0.0033	1.45
2-Propanone; C_3H_6O; [67-64-1]	295.55	0.0132	4.45
1,2-Epoxypropene*; C_3H_6O; [75-56-9]	295.95	0.0088	3.06
Nitropropane*; $C_3H_7NO_2$; [25322-01-4]	294.4	0.0157	4.26
3-oxo-butanoic acid, ethyl ester*; $C_6H_{10}O_3$; [141-97-9]	294.95	0.0114	2.23

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts and measurements made at room temperature.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam, phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.
2. Compounds marked with * were technical grade and purified by distillation. Other solvents were "Analar" or G.P.R. grade distilled under reduced pressure (ca. 17 mmHg) to remove dissolved gases.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]
2. Tetrahydrofuran; C_4H_8O; [109-99-9]

ORIGINAL MEASUREMENTS:

Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C. *Albright & Wilson (Mfg.) Ltd., Technical Note No. 60*, 1963. Quoted by Gerrard, W., *"Gas Solubilities - Widespread Applications"*, 1980, Pergamon Press, Oxford.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

T/K	Mole fraction x_{PH_3} (1 atm)	Ostwald Coefficient, L
295.15	0.0245	7.49

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts and measurements made at room temperature.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam, phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.
2. "Analar" or G.P.R. grade, distilled under reduced pressure (ca. 17 mmHg) to remove dissolved gases.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Phosphine; PH_3; [7803-51-2] 2. Nitrobenzene; $C_6H_5NO_2$; [98-95-3]	Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C. *Albright & Wilson (Mfg.) Ltd., Technical Note No. 60*, 1963. Quoted by Gerrard, W., "*Gas Solubilities - Widespread Applications*", 1980, Pergamon Press, Oxford.
VARIABLES:	PREPARED BY: P. G. T. Fogg

EXPERIMENTAL VALUES:

T/K	Mole fraction x_{PH_3} (1 atm)	Ostwald Coefficient, L
293.65	0.0139	-
295.65	0.0127	3.06
313.25	0.0100	-

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts for measurements at room temperature (293.65 K). Temperatures were thermostatically controlled for other measurements.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam, phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]
2. Dinonylamine, (*N*-nonyl-1-nonanamine); $C_{18}H_{39}N$; [2044-21-5]

ORIGINAL MEASUREMENTS:

Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C. *Albright & Wilson (Mfg.) Ltd.*, *Technical Note No. 60*, 1963.
Quoted by Gerrard, W., *"Gas Solubilities - Widespread Applications"* 1980, Pergamon Press, Oxford.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

T/K	Mole fraction x_{PH_3} (1 atm)	Ostwald Coefficient, L
294.4	0.0593	4.55

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts and measurements made at room temperature.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam, phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.
2. Technical grade purified by distillation.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Phosphine; PH_3; [7803-51-2] 2. Tetrachloromethane; CCl_4; [56-23-5] or 1,2-Dichloroethane; $C_2H_4Cl_2$; [107-06-2]	Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C. *Albright & Wilson (Mfg.) Ltd., Technical Note No. 60*, 1963. Quoted by Gerrard, W., *"Gas Solubilities - Widespread Applications"* 1980, Pergamon Press, Oxford.
VARIABLES:	PREPARED BY: P. G. T. Fogg

EXPERIMENTAL VALUES:

Solvent	T/K	Mole fraction x_{PH_3} (1 atm)	Ostwald Coefficient, L
Tetrachloromethane	293.65	0.0165	4.19
1,2-Dichloroethane	294.4	0.0176	5.48

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts and measurements made at room temperature.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam, phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.
2. Solvents were "Analar" or G.P.R. grade; distilled under reduced pressure (ca. 17 mmHg) to remove dissolved gases.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]

2. Carbon disulfide; CS_2; [75-15-0]

ORIGINAL MEASUREMENTS:

Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C. *Albright & Wilson (Mfg.) Ltd., Technical Note No. 60*, 1963. Quoted by Gerrard, W., *"Gas Solubilities - Widespread Applications"*, 1980, Pergamon Press, Oxford.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

T/K	Mole fraction x_{PH_3} (1 atm)	Ostwald Coefficient, L
294.15	0.0250	10.25

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts and measurements made at room temperature.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam, phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.

2. No details given.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]
2. Various Liquids.

ORIGINAL MEASUREMENTS:

Devyatykh, G.G.; Ezheleva, A.E.; Zorin, A.D.; Zueva, M.V.

Russ. J. Inorg. Chem. 1963, *8*, 678-682.

VARIABLES:

Temperature

PREPARED BY:

P.G.T. Fogg.

EXPERIMENTAL VALUES:

Solvent	Distribution constant $vol_{PH_3}/vol_{solvent}$	Heat of solution /kcal mol^{-1}
2-Furancarboxaldehyde, $C_5H_4O_2$; [98-01-1]	11.8	-3.4
1,2-Benzenedicarboxylic acid, didecyl ester, $C_{28}H_{46}O_4$; [84-77-5]	23.5	-4.0
Triethoxysilane, $C_6H_{16}O_3Si$; [998-30-1]	12.2	-5.4
Silicic acid, tetraethyl ester, $C_8H_{20}O_4Si$; [78-10-4]	12.45	-5.0
Silicone 702-DF	15.3	-3.6
Silicone VKZh-94B	25.3	-6.0

Temperature = 293.2 K.

Distribution constants were measured between 278.2 K and 323.2 K. The partial pressures of phosphine at which these measurements were made were not stated. The total pressure of phosphine and carrier gas was about 760 mmHg. in each case. Distribution constants were reported at one

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A chromatographic method was used. Temperatures were controlled to ±0.5K. The support phase consisted of Nichrome spirals. The carrier gas was either nitrogen or hydrogen. The volume, V_l, of the liquid phase was calculated from the weight of the column before and after filling with liquid and allowing to drain. The free volume, V_g, was equated with the retention volume for hydrogen gas. The distribution constant, K, was calculated from the James and Martin equation.

$$V_R = V_g + KV_l$$

where V_R is the retention volume for phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from phosphorus and aqueous alkali; purified by vacuum distillation; no impurities detected by chromatography.

   H_2 & N_2: passed through activated carbon and through molecular sieve.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]
2. Various liquids

ORIGINAL MEASUREMENTS:

Devyatykh, G.G.; Ezheleva, A.E.; Zorin, A.D.; Zueva, M.V.

Russ. J. Inorg. Chem. 1963, *8*, 678-682.

EXPERIMENTAL VALUES:

temperature only but heats of solution, said to have been calculated from the variation of distribution constants with temperature, were given.

If it is assumed that distribution constants vary with temperature according to equations of the form :

$$\ln K = (-\Delta H/RT) + A$$

where K is the distribution constant for a temperature T, ΔH is the heat of solution of phosphine in the solvent and A is a constant for the solvent, then distribution constants at any temperature in the range 278.2 K to 323.2 K may be estimated from a value at 293.2 K and the corresponding value of the heat of solution. The equation for K may be written in the form :

$$K = \exp\,[A + (B/T)]$$

The following values of A and B have been calculated by the compiler:

Solvent	A	B/K
2-Furancarboxaldehyde	-3.371	1712
1,2-Benzenedicarboxylic acid, didecyl ester	-3.712	2014
Triethoxysilane	-6.772	2719
Silicic acid, tetraethyl ester	-6.065	2518
Silicone 702-DF	-3.455	1813
Silicone VKZh-94B	-7.073	3021

In the opinion of the compiler these distribution constants cannot be equated with Ostwald coefficients unless the assumption is made that equilibrium was established between gas and liquid phases under the conditions of the experiment.

In addition, possible adsorption of phosphine at the stationary phase-carrier gas interface may have lowered the accuracy of the results.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Phosphine; PH_3; [7803-51-2] 2. Various liquids	Devyatykh, G.G.; Ezheleva, A.E. Zorin, A.D.; Zueva, M.V. *Russ. J. Inorg. Chem.* 1963, *8*, 678-682.
VARIABLES:	PREPARED BY:
Temperature, pressure	P.G.T. Fogg.

EXPERIMENTAL VALUES:

Solvent	Pressure range /mmHg	Distribution constant $vol_{PH_3}/vol_{solvent}$	Heat of solution /kcal mol^{-1}
2-Ethoxyethanol, $C_4H_{10}O_2$; [110-80-5]	0.3-25.0	9.4	-0.95
1,1´-oxybis [2-chloro-ethane]; $C_4H_8Cl_2O$; [111-44-4]	0.05-19.0	20.0	-2.2
Nitrobenzene, $C_6H_5NO_2$; [98-95-3]	0.02-18.0	8.59	-1.56
Liquid paraffin	0.1 -43.0	15.9	-3.0
Silicone PFMS-4F	0.03-23.0	16.5	-2.3

Temperature = 293.2K   760 mmHg = 1 atm = 1.013×10^5 Pa.

Distribution constants were measured between 278.2 K and 323.2 K over a range of partial pressures of phosphine and a total pressure of about 760 mmHg. At a fixed temperature the distribution constants did not depart from the mean values by more than ±3%. These mean values were reported at one temperature only but heats of solution, said to have been calculated from the variation of distribution constants with temperature, were given. If it is assumed that distribution constants vary with temperature according to equations of the form :

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A chromatographic method was used. Temperatures were controlled to ± 0.5 K. The support phase consisted of Nichrome spirals. The carrier gas was either nitrogen or hydrogen. The volume, V_l , of the liquid phase was calculated from the weight of the column before and after filling with liquid and allowing to drain. The free volume, V_g, was equated with the retention volume for hydrogen gas. The distribution constant, K, was calculated from the James and Martin equation.

$$V_R = V_g + KV_l$$

where V_R is the retention volume for phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from phosphorus and aqueous alkali; purified by vacuum distillation; no impurities detected by chromatography.

   H_2 and N_2: passed through activated carbon and through molecular sieve.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Phosphine; PH_3; [7803-51-2] 2. Various liquids.	Devyatykh, G.G.; Ezheleva, A.E. Zorin, A.D.; Zueva, M.V. *Russ, J. Inorg. Chem.* 1963, *8*, 678-682.

EXPERIMENTAL VALUES:

$$\ln K = (-\Delta H/RT) + A$$

where K is the distribution constant for a temperature T, ΔH is the heat of solution of phosphine in the solvent and A is a constant for the solvent, then distribution constants at any temperature in the range 278.2 K to 323.2 K may be estimated from a value at 293.2K and the corresponding value of the heat of solution. The equation for K may be written in the form:

$$K = \exp\,[A + (B/T)]$$

The following values of A and B have been calculated by the compiler:

Solvent	A	B/K
2-Ethoxyethanol	0.609	478
1,1´-oxybis [2-chloroethane]	-0.782	1108
Nitrobenzene	-0.528	785
Liquid paraffin	-2.386	1511
Silicone PFMS-4F	-1.147	1158

In the opinion of the compiler these distribution constants cannot be equated with Ostwald coefficients unless the assumption is made that equilibrium was established between gas and liquid phases under the conditions of the experiment.

In addition,possible adsorption of phosphine at the stationary phase-carrier gas interface may have lowered the accurary of the results.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Phosphine; PH_3; [7803-51-2] 2. Carbon disulfide; CS_2; [75-15-0] 3. Phosphorus; P_4; [7723-14-0]	Palmer, M. G.; Lessels, R. W. M.; Childs, A. F.; McCoubrey, J. C. *Albright & Wilson (Mfg.) Ltd., Technical Note No. 60*, 1963. Quoted by Gerrard, W., *"Gas Solubilities - Widespread Applications"*, 1980, Pergamon Press, Oxford.
VARIABLES:	PREPARED BY:
	P. G. T. Fogg

EXPERIMENTAL VALUES:

T/K	Percentage by weight of CS_2	Percentage by weight of P_4	Ostwald Coefficient, L
294.15	88.69	11.31	6.25

Measurements were made at a total pressure equal to barometric pressure (unspecified) and solubility values were adjusted to a partial pressure of phosphine of 101.325 kPa (1 atm) using Henry's law.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas saturated with solvent vapor was passed into a glass absorption vessel connected to a gas burette. A measured volume of liquid was introduced into the vessel and stirred with a magnetic stirrer. A measured volume of gas was added from a gas burette to restore the total pressure in the absorption vessel to its original value which was apparently equal to barometric pressure. The procedure was repeated several times and the mean value of the solubility was taken. The apparatus was shielded from draughts and measurements made at room temperature.

In calculating the solubility of the gas, account was taken of the partial vapor pressure of the solvent and the partial pressure of hydrogen present as an impurity in the phosphine.

SOURCE AND PURITY OF MATERIALS:

1. Prepared from zinc amalgam, phosphorus and dilute phosphoric acid; contained 2.5% hydrogen as impurity; dried with conc. H_3PO_4 and with P_2O_5.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Phosphine; PH_3; [7803-51-2]

2. Trifluoroacetic acid; $C_2HF_3O_2$; [76-05-1]

ORIGINAL MEASUREMENTS:

Fujioka, G. S.; Cady, G. H.
J. Amer. Chem. Soc.
1957, *79*, 2451-2454.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

T/K	p_{PH_3}/mmHg	Ostwald Coefficient L	Mole fraction* x_{PH_3}
299.2	653	15.9	0.040

760 mmHg = 1 atm
1 atm = 1.013×10^5 Pa

* Calculated by the compiler using the density of trifluoroacetic acid at 25°C given in ref. (1).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

This solubility measurement was carried out during investigations of inorganic reactions in anhydrous trifluoroacetic acid. Phosphine was confined over mercury in a gas measuring tube and a measured sample of trifluoroacetic acid was added above the mercury by a hypodermic syringe. The apparatus was shaken for several hours until the new volume of gas was constant. The amount of gas absorbed was calculated from the change in volume of the gas phase. In the calculation of the partial pressure of phosphine the total pressure was corrected to allow for the partial pressure of trifluoroacetic acid but details of the correction were not given.

SOURCE AND PURITY OF MATERIALS:

1. No details given.

2. Supplied by Minnesota Mining and Manufacturing Co. and used without further purification.

ESTIMATED ERROR:

REFERENCES:

1. *Encyclopedia of Chemical Technology*, 3rd ed. Vol. 10, Wiley, New York, 1980.