COMPONENTS:	EVALUATOR:
(1) Methane; CH_4; [74-82-8] (2) Alkanols (alcohols)	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322 USA 1985, April

CRITICAL EVALUATION:

THE SOLUBILITY OF METHANE IN ALKANOLS AT METHANE PARTIAL PRESSURES UP TO 0.200 MPa (*ca.* 2 ATM).

Nine papers report solubility data on methane + alkanol systems over the C_1 to C_{12} range of alcohols. All of the workers have used volumetric methods. Except for 1-propanol all of the measurements were made in the 283-318 K temperature interval at pressures near 100 kPa. Komarenko and Manzhelii (ref 6) measured the solubility of methane in 1-propanol over the 173-243 K range at a methane partial pressure of 26.7 kPa (200 mmHg).

The results reported by Winkler (ref 3) and Friedel and Gorgeu (ref 1) are qualitative. The Winkler value is rejected, but the value of Friedel and Gorgeu appears useful. The work of McDaniel (ref 2) is poor. His results are 10 to 20 percent smaller than more modern results, and his temperature coefficients of solubility are sometimes of much larger magnitude than the more recent measurements.

Figure 1 shows the mole fraction solubility at 298.15 K and 0.1013 MPa methane partial pressure in the normal alcohols. The line was drawn to follow the results of Lannung and Gjaldbaek (ref 5), Ben-Naim and Yaacobi (ref 7), and Wilcock, Battino, Danforth and Wilhelm (ref 8); the three papers we judge to contain the most reliable data. The results reported by Makranczy, Rusz, and Balog-Megyery (ref 9) are larger than all other results and do not show the decrease in solubility as the alcohol becomes more polar that the other workers show. Although we do not have proof, we suspect the Makranczy *et al.* results are too large. The results of Boyer and Bircher (ref 4) show the effect of the increased polarity of the low molecular weight alcohols on the solubility, but their results also appear to be too large in the high carbon number alcohols. Their temperature coefficients of solubility show larger variations from alcohol to alcohol than do the results of others.

In evaluating ethane, propane, butane and 2-methylpropane solubility in alcohols Hayduk (ref 10) fitted the data to equations of the type

$$\ln x_1 = b_1 + b_2 \ln C_n$$

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) Alkanols (alcohols)

EVALUATOR:

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CRITICAL EVALUATION:

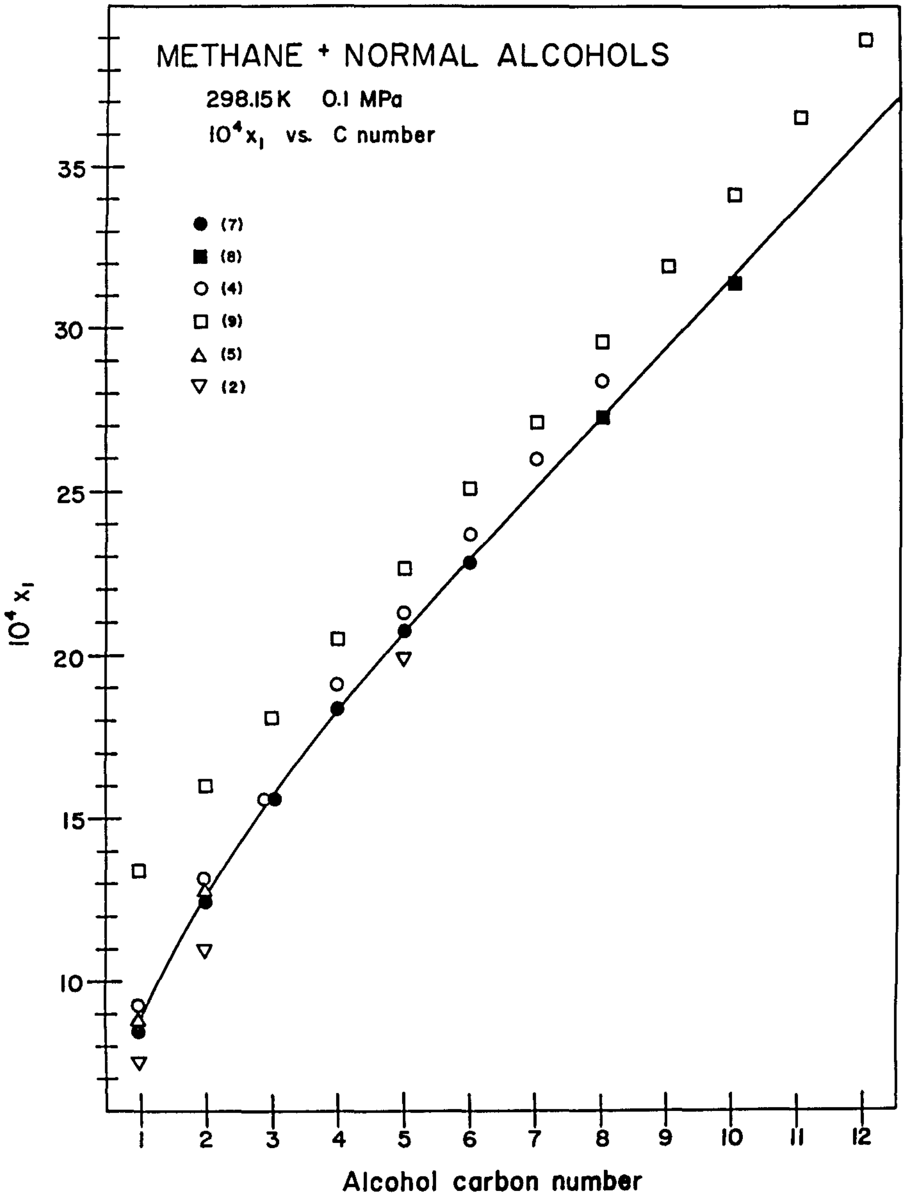

Figure 1. Methane + *n*-Alcohols. The methane mole fraction solubility at 298.15 K and 0.101 MPa *vs.* alcohol carbon number.

The equation $\ln x_1 = -7.0388 + 0.54046 \ln C_n$ or $x_1 = (8.7718 \times 10^{-4})\ C_n^{0.54046}$ reproduces the line of the above graph within one percent from $C_n = 1$ to 8. As the carbon number increases above 8 the equation values are smaller than the line values.

at 298.15 K where x_1 is the mole fraction solubility and C_n is the alcohol carbon number.

We have done the same for the methane solubility values of Lannung and Gjaldbaek, Ben-Naim and Yaacobi, and Wilcock *et al.* to obtain the equation

$$\ln x_1 = -7.0388 + 0.54046 \ln C_n \quad \text{with } r = 0.9987$$

and for all of the data on Figure 1 to obtain the equation

$$\ln x_1 = -7.0155 + 0.55673 \ln C_n \quad \text{with } r = 0.9728$$

The first equation reproduces the line of Figure 1 with an average deviation of one percent for C_n = 1 through 8, but by C_n = 12 the calculated value is 6.7 percent low. Thus, equations of this type empirically reproduce the changing solubility with carbon number quite well up to carbon number 8, but are unreliable and give results that are progressively too small as the carbon number increases beyond C_n = 8.

The individual systems are discussed below in more detail.

Methane + Methanol; CH_3OH; [67-56-11]

McDaniel (ref 2), Boyer and Bircher (ref 4), Lannung and Gjaldbaek (ref 5), Ben-Naim and Yaacobi (ref 7) and Makranczy, Rusz and Balog-Megyery (ref 9) report values of the solubility of methane in methanol. At 298.15 K the results of Lannung and Gjaldbaek and of Ben-Naim and Yaacobi accord within one percent. Their enthalpies and entropies of solution from the temperature coefficient of solubility agree within 8 and 2 percent, respectively. At 298.15 K the McDaniel value is 14 percent smaller, the Boyer and Bircher value 6 percent larger, and the Makranczy *et al.* value 55 percent larger than the average of the Lannung and Gjaldbaek and the Ben-Naim and Yaacobi values. The temperature coefficient of solubility of McDaniel gives an enthalpy of solution that is four times the magnitude of the other results.

The values of Lannung and Gjaldbaek and of Ben-Naim and Yaacobi were weighted twice, and the single value of Boyer and Bircher was weighted once in a linear regression to obtain the tentative equation for the mole fraction solubility of methane in methanol over the 283.15 to 308.15 K interval

$$\ln x_1 = -8.52458 + 4.40002/(T/100 \text{ K})$$

with a standard error about the regression line of 1.35×10^{-5}. From the constants of the equation the temperature independent thermodynamic

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changes for the transfer of one mole of methane from the gas at 0.1 MPa to the infinitely dilute solution are

$\Delta\bar{H}_1^0$/ kJ mol^{-1} = -3.66 and $\Delta\bar{S}_1^0$/ J K^{-1} mol^{-1} = -70.9

Smoothed values of the solubility are in Table 1.

Table 1. Solubility of Methane in Methanol. Tentative mole fraction solubility and partial molal Gibbs energy of solution as a function of temperature at a methane partial pressure of 0.1013 MPa.

T/K	$10^4 x_1$	$\Delta\bar{G}_1^0$/kJ mol^{-1}
283.15	9.39	16.410
288.15	9.14	16.765
293.15	8.91	17.119
298.15	8.68	17.473
303.15	8.48	17.828
308.15	8.28	18.182

Methane + Ethanol; CH_3CH_2OH; [64-17-5]

The same five papers (ref 2,4,5,7,9) report the solubility of methane in ethanol. Again McDaniel's values are the smallest by about 14 percent, but his enthalpy of solution value agrees with the other workers. His values are doubtful. The single value of Makranczy *et al.* at 298.15 K is 26 percent the largest. It is classed as doubtful.

The values of Lannung and Gjaldbaek, Ben-Naim and Yaacobi, and Boyer and Bircher agree within about 3 percent of 298.15 K. Their values are classed as tentative. Their results were combined in a linear regression to obtain the tentative equation for the mole fraction solubility of methane in ethanol of a partial pressure of 0.1013 MPa over the 283.15 to 308.15 K interval

$\ln x_1 = -8.11131 + 4.31444 /(T/100\ \mathrm{K})$

with a standard error about the regression line of 1.44 x 10^{-5}.

From the constants of the equation the temperature independent thermodynamic changes for the transfer of one mole of methane from the gas at

0.1013 MPa to the infinitely dilute solution are

$\Delta\overline{H}_1^0$/kJ mol^{-1} = -3.59 and $\Delta\overline{S}_1^0$/J K^{-1} mol^{-1} = -67.4

Smoothed values of the solubility are in Table 2.

Table 2. The solubility of Methane in Ethanol. Tentative values of the mole fraction solubility and partial molar Gibbs energy of solution as a function of temperature at a methane partial pressure of 0.1013 MPa.

T/K	$10^4 x_1$	$\Delta\overline{G}_1^0$/kJ mol^{-1}
283.15	13.8	15.508
288.15	13.4	15.846
293.15	13.1	16.183
298.15	12.8	16.520
303.15	12.5	16.857
308.15	12.2	17.194

Methane + 1-Propanol; CH_3CH_2OH; [71-23-8]

Boyer and Bircher (ref 4), Ben-Naim and Yaacobi (ref 7), and Makranczy *et al.* (ref 9) report the solubility of methane in 1-propanol in the room temperature region. Komarenko and Manzhelii (ref 6) measured the solubility of methane at a partial pressure of 26.7 kPa (200 mmHg) over the 173.15 to 243.15 K interval.

Boyer and Bircher, and Ben-Naim and Yaacobi report the same mole fraction solubility at 298.15 K. Makranczy *et al.* report a value that is 16 percent larger. The value was not used.

The data are fit by linear regressions to three equations. First, the data of Komarenko and Manzhelii were calculated for a methane partial pressure of 0.1013 MPa assuming Henry's law is obeyed, and the equation for the temperature interval of 173.15 to 243.15 K obtained

$$\ln x_1 = -5.67059 + 3.23393/(T/100\ K) - 2.047 \ln(T/100K)$$

with a standard error about the regression line of 5.43 x 10^{-5}.

Second, the data of Boyer and Bircher, and Ben-Naim and Yaacobi were combined to obtain an equation for the mole fraction solubility over the 283.15 to 308.15 K interval

$$\ln x_1 = -8.05738 + 4.77195\ /(T/100\ K)$$

with a standard error about the regression line of 1.26 x 10^{-5}.

Third, the three data sets were combined in a linear regression to

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obtain the equation for the mole fraction solubility over the 173.15 to 308.15 K interval at a methane partial pressure of 0.1013 MPa.

$$\ln x_1 = -15.5019 + 14.8315/(T/100\text{K}) + 3.7230 \ln (T/100\ \text{K})$$

with a standard error about the regression line of 1.01×10^{-4}.

Smoothed data from the three equations are in Table 3.

Table 3. The Solubility of Methane in 1-Propanol. Tentative values of the mole fraction solubility as a function of temperature at a methane partial pressure of 0.1013 MPa from three equations.

	$10^4 x_1$ from equations for temperature interval		
T/K	173-243 K	283-308 K	173-308 K
173.15	72.5		75.0
183.15	58.4		57.9
193.15	47.8		46.4
203.15	39.7		38.4
213.15	33.4		32.6
223.15	28.4		28.3
233.15	24.4		25.1
243.15	21.1		22.6
253.15			20.6
263.15			19.0
273.15			17.8
283.15		17.1	16.8
288.15		16.6	16.4
293.15		16.1	16.0
298.15		15.7	15.6
303.15		15.3	15.3
308.15		14.9	15.0

The thermodynamic changes for the transfer of one mole of methane from the gas at 0.1013 MPa to the infinitely dilute solution calculated from the three equations follow Table 3. The equation for the data of Komarenko and Mazhelii gives enthalpy changes that become more negative as the temperature increases. The more usual trend is for ΔH to become less negative as T increases as is seen in the third equation that combines the three data sets.

The thermodynamic changes calculated from the constants of the fitted equations are

	173-243 K			283-308 K		173-308 K		
T/K	ΔH	ΔS	ΔC_p	ΔH	ΔS	ΔH	ΔS	ΔC_p
183	-5.81	-74.5	-17.0	-	-	-6.66	-79.2	31.0
233	-6.66	-78.6	-17.0	-	-	-5.11	-71.7	31.0
288	-	-	-	-3.97	-67.0	-3.41	-65.2	31.0
298	-	-	-	-3.97	-67.0	-3.10	-64.1	31.0

Units: kJ mol^{-1} and J K^{-1} mol^{-1}.

Methane + 2-Propanol; $CH_3CHOHCH_3$; [67-63-0]

Only McDaniel (ref 2) reports the solubility of methane in 2-propanol. At 298.15 K the mole fraction solubility in 2-propanol is about 8 percent smaller than in 1-propanol. This is contrary to most of our experience that gases of this molecular weight are more soluble in the branched than the unbranched carbon solvent. Since McDaniel's solubility values are usually too small it is reasonable to assume these values are too small. The enthalpy of solution compares well with those of other workers, indicating the temperature coefficient of solubility may be correct.

The data are classed as tentative, but it is suspected they are at least 10 percent too small. A linear regression gives the equation for the 293.15 to 313.15 K interval at a methane partial pressure of 0.1013 MPa

$$\ln x_1 = -7.99145 + 4.31546/(T/100\ \text{K})$$

with a standard error about the regression line of 4.55×10^{-6}.

From the constants of the equation the temperature independent thermodynamic changes for the transfer of one mole of methane from the gas at 0.1013 MPa to the infinitely dilute solution are

$$\Delta\bar{H}_1^0/\text{k J mol}^{-1} = -3.59 \text{ and } \Delta\bar{S}_1^0/\text{J K}^{-1}\ \text{mol}^{-1} = -66.4$$

Smoothed solubility values are in Table 4.

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CRITICAL EVALUATION:

Table 4. The Solubility of Methane in 2-Propanol. Tentative values of the mole fraction solubility and partial molal Gibbs energy as a function of temperature at a methane partial pressure of 0.1013 MPa.

T/K	$10^4 x_1$	$\Delta\overline{G}_1^0$/k J mol^{-1}
293.15	14.7	15.889
298.15	14.4	16.222
303.15	14.0	16.554
308.15	13.7	16.887
313.15	13.4	17.219

Methane + 1-Butanol; C_4H_9OH; [71-36-3]

Boyer and Bircher (ref 4), and Ben-Naim and Yaacobi (ref 7) report solubility values that agree within 4 percent at 298.15 K and within 5 percent at 303.15 K. Makranczy *et al.* report a single value which is 10 percent larger than the average of the other two at 298.15 K.

The solubilities of Boyer and Bircher and of Ben-Naim and Yaacobi were combined in a linear regression to obtain the equation for the mole fraction solubility over the 283.15 to 308.15 K interval at 0.1013 MPa

$$\ln x_1 = -7.76446 + 4.41862/(T/100\ \mathrm{K})$$

with a standard error about the regression line of 3.75 x 10^{-5}.

From the constants of the equation the temperature independent thermodynamic changes for the transfer of one mole of methane from the gas at 0.1013 MPa pressure to the infinitely dilute solution are

$$\Delta\overline{H}_1^0/\mathrm{kJ\ mol^{-1}} = -3.67 \text{ and } \Delta\overline{S}_1^0/\mathrm{J\ K^{-1}\ mol^{-1}} = -64.6$$

Smoothed values of the solubility are in Table 5.

Table 5. Solubility of Methane in 1-Butanol. Tentative values of the mole fraction solubility and the partial molar Gibbs energy of solution as a function of temperature at a methane partial pressure of 0.1013 MPa.

T/K	$10^4 x_1$	$\Delta \bar{G}_1^0$/kJ mol^{-1}
283.15	20.2	14.605
288.15	19.7	14.928
293.15	19.2	15.251
298.15	18.7	15.574
303.15	18.2	15.896
308.15	17.8	16.219

Methane + 2-Methyl-1-propanol; $CH_3CH(CH_3)CH_2OH$: [78-83-1]

Only Winkler's (ref 3) qualitative measurement, which corresponds to a mole fraction solubility of 13 x 10^{-4}, is available for the system. The value appears to be much too small and is rejected.

Methane + 1-Pentanol; $CH_3(CH_2)_3CH_2OH$; [71-41-0]

McDaniel (ref 2), Boyer and Bircher (ref 4), Ben-Naim and Yaacobi (ref 7), and Makranczy *et al.* (ref 9) report solubility values for the methane + 1-pentanol system. At 298.15 K the four solubility values show a range of about 13 percent.

All values are classed as tentative and all values were combined in a linear regression to obtain the equation for the mole fraction solubility over the 283.15 to 303.15 K interval at 0.1013 MPa pressure.

$$\ln x_1 = -7.42305 + 3.7397/(T/100\ \mathrm{K})$$

with a standard error about the regression line of 9.30 x 10^{-5}.

The thermodynamic changes for the transfer of one mole of methane from the gas at 0.1013 MPa to the infinitely dilute solution are

$$\Delta \bar{H}_1^0/\mathrm{kJ\ mol^{-1}} = -3.11 \text{ and } \Delta \bar{S}_1^0/\mathrm{J\ K^{-1}\ mol^{-1}} = -61.7$$

Smoothed solubility data are in Table 6.

COMPONENTS:	EVALUATOR:
(1) Methane; CH_4; [74-82-8] (2) Alkanols (alcohols)	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA USA 1985, April

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Table 6. Solubility of Methane in 1-Pentanol. Tentative values of the mole fraction solubility and partial molar Gibbs energy of solution as a function of temperature at a methane partial pressure of 0.1013 MPa.

T/K	$10^4 x_1$	$\Delta\bar{G}_1^0$/kJ mol^{-1}
283.15	22.4	14.366
288.15	21.9	14.675
293.15	21.4	14.983
298.15	20.9	15.292
303.15	20.5	15.600
308.15	20.1	15.909

Methane + 3-Methyl-1-butanol; $CH_3CH(CH_3)CH_2CH_2OH$; [123-51-3]

Friedel and Gorgeu (ref 1) report an absorption experiment at 285.7 K and 0.1013 MPa. The mole fraction solubility calculated from their measurement is 23 x 10^{-4} which is of similar magnitude to the solubility of methane in 1-propanol at that temperature. The value is classed as tentative.

Methane + 1-Hexanol; $CH_3(CH_2)_4CH_2OH$; [111-27-3]

Ben-Naim and Yaacobi (ref 7) report the solubility of methane in 1-hexanol at five degree intervals from 283.15 to 303.15 K. Boyer and Bircher (ref 4) and Makranczy *et al.* report single solubility values at 298.15 K which are 4 and 10 percent larger, respectively, than the Ben-Naim and Yaacobi value. All values are classed as tentative, but only the Ben-Naim and Yaacobi values were used in the linear regression to obtain the equation for the mole fraction solubility over the 283.15 to 303.15 K interval at 0.1013 MPa.

$$\ln x_1 = -7.84121 + 5.24282/(T/100\ \mathrm{K})$$

with a standard error about the regression line of 5.00 x 10^{-6}.

The thermodynamic changes for the transfer of one mole of methane from the gas at 0.1013 MPa to the infinitely dilute solution are

$\Delta\bar{H}_1^0$/k J mol^{-1} = -4.36 and $\Delta\bar{S}_1^0$J K^{-1} mol^{-1} = -65.2

The smoothed solubility data are in Table 7.

Table 7. The Solubility of Methane in 1-Hexanol. Tentative values of the mole fraction solubility and the partial molar Gibbs energy of solution as a function of temperature at a methane partial pressure of 0.1013 MPa.

T/K	$10^4 x_1$	$\Delta\bar{G}_1^0$/k J mol^{-1}
283.15	25.0	14.101
288.15	24.3	14.427
293.15	23.5	14.753
298.15	22.8	15.079
303.15	22.2	15.405

Methane + 1-Heptanol; $CH_3(CH_2)_5CH_2OH$; [111-70-6]

Two solubility values are reported for this system. Boyer and Bircher (ref 4) report a mole fraction solubility of 26.0 x 10^{-4} at 298.15 K and Makranczy *et al.* (ref 9) report a value of 27.1 x 10^{-4} at 298.15 K. The values are classed as tentative.

Methane + 1-Octanol; $CH_3(CH_2)_6CH_2OH$: [111-87-5]

Wilcock, Battino, Danforth, and Wilhelm (ref 8) report solubilities at three temperatures, Boyer and Bircher (ref 4) at two temperatures, and Makranczy *et al.* (ref 9) at one temperature for the system. At 298.15 K Boyer and Bircher's value is 4 percent larger,and the value of Makranczy *et al.* is 8.5 percent larger than the value of Wilcock *et al.* All of the data are classed as tentative, but only the solubilities reported by Wilcock *et al.* and Boyer and Bircher were used in the linear regression to obtain the equation for the mole fraction solubility over the 283.15 to 313.15 interval at 0.1013 MPa.

$$\ln x_1 = -7.43754 + 4.60763/(T/100\ \mathrm{K})$$

with a standard error about the regression line of 6.38 x 10^{-5}.

The thermodynamic changes for the transfer of one mole of methane from the gas at 0.1013 MPa to the infinitely dilute solution are

$\Delta\bar{H}_1^0$/kJ mol^{-1} = -3.83 and $\Delta\bar{S}_1^0$/j K^{-1} mol^{-1} = -61.8

The smoothed solubility values are in Table 8.

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) Alkanols (alcohols)

EVALUATOR:

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1985, April

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Table 8. The Solubility of Methane in 1-Octanol. Tentative values of the mole fraction solubility and the partial molar Gibbs energy of solution as a function of temperature at a methane partial pressure of 0.1013 MPa.

T/K	$10^4 x_1$	$\Delta \bar{G}_1^0$/kJ mol^{-1}
283.15	29.97	13.679
288.15	29.13	13.988
293.15	28.35	14.297
298.15	27.61	14.606
303.15	26.92	14.915
308.15	26.26	15.224
313.15	25.64	15.534

Methane + 1-Nonanol; $CH_3(CH_2)_7CH_2OH$; [143-08-8]

Makranczy, Rusz, and Balog-Megyery (ref 9) report a solubility which gives a mole fraction of 31.9 x 10^{-4} at 298.15 K and 0.1013 MPa. The value is classed as tentative.

Methane + 1-Decanol; $CH_3(CH_2)_8CH_2OH$; [112-30-1]

Wilcock *et al.* (ref 8) and Makranczy *et al.* (ref 9) report solubility values at three and one temperatures, respectively. At 298.15 K the Makranczy value is the larger by 9 percent. All data are classed as tentative, but we prefer the data of Wilcock *et al.* which are used in the linear regression to obtain the equation for the mole fraction solubility over the 283.15 to 313.15 K interval at a pressure of 0.1013 MPa.

$$\ln x_1 = -7.2511 + 4.4321/(T/100\ \mathrm{K})$$

with a standard error about the regression line of 3.46 x 10^{-5}.

The thermodynamic changes for the transfer of one mole of methane from the gas at 0.1013 MPa to the infinitely dilute solution are

$$\Delta \bar{H}_1^0/\mathrm{kJ\ mol^{-1}} = -3.68 \text{ and } \Delta \bar{S}_1^0/\mathrm{J\ K^{-1}\ mol^{-1}} = -60.3$$

Smoothed solubility values are in Table 9.

Table 9. The Solubility of Methane in 1-Decanol. Tentative values of the mole fraction solubility and partial molar Gibbs energy of solution as a function of temperature at a methane partial pressure of 0.1013 MPa.

T/K	$10^4 x_1$	$\Delta\bar{G}_1^0$/kJ mol^{-1}
283.15	33.94	13.386
288.15	33.03	13.687
293.15	32.17	13.989
298.15	31.37	14.290
303.15	30.61	14.591
308.15	29.89	14.893
313.15	29.21	15.194

Methane + 1-Undecanol; $CH_3(CH_2)_9CH_2OH$; [112-42-5]

Methane + 1-Dodecanol; $CH_3(CH_2)_{10}CH_2OH$; [112-53-8]

Makranczy, Rusz and Balog-Megyery (ref 9) report solubility values that correspond to a mole fraction of 36.5 x 10^{-4} and 38.9 x 10^{-4}, respectively, for the two systems at 298.15 K and a methane partial pressure at 0.1013 MPa. Both values are classed as tentative; however, it is the judgement of the evaluator the values may be 8-10 percent too large.

Alcohols and alkanes as solvents for methane show interesting trends when the enthalpy and entropy changes for the transfer of one mole of methane from the gas at 0.1013 MPa to the infinitely dilute solution are compared. The average enthalpy change is -3.72 ± 0.33 for all or -3.71 ± 0.14 kJ mol^{-1} when the values for the C_5 and C_6 alcohols are omitted. The values compare with average enthalpy changes of -4.06 ± 0.52 for all or -4.05 ± 0.14 kJ mol^{-1} when values for the C_7 and C_{16} alkanes are omitted. Thus, there is no significant change in $\Delta\bar{H}_1^0$ with carbon number for either alcohols or alkanes. The 0.34 kJ mol^{-1} more exothermic average $\Delta\bar{H}_1^0$ for alkanes than alcohols falls just at the limit of the uncertainty of the two averages, and may not be significant.

The entropy change is nearly constant for the alkanes at -57.0 ± 2.3 J K^{-1} mol^{-1} while the entropy change varies from -70.9 for methanol to -61.8 and -60.3 for 1-octanol and 1-decanol, respectively. As the alcohol carbon number increases the entropy change approaches to within about 3 J K^{-1} mol^{-1} of the hydrocarbon value.

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For the solubility of methane in water at 298.15 K the enthalpy and entropy changes are much more negative being -13.19 kJ mol^{-1} and -132.2 J K^{-1} mol^{-1}, respectively. Comparison of the water enthalpy values with the alkane and alkanol values suggests the methane molecule is located primarily in a hydrocarbon-like environment in both the hydrocarbon and alcohol solvents including even methanol and other small carbon number alcohols. Comparison of the entropy values suggests the methanol is intermediate between water and hydrocarbon but nearer the hydrocarbon as an ordered solution. By about carbon number eight the alcohol and hydrocarbon entropy difference is only about 3 J K^{-1} mol^{-1} with the methane about twice as soluble in the hydrocarbon as the alcohol.

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9. Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
10. Hayduk W. *ETHANE, Solubility Series* 1982, *9*, 166-7; *PROPANE, BUTANE, 2-METHYLPROPANE, Solubility Series* 1985, *24*, 331-4.

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) Methanol; CH_3OH; [67-56-1]

ORIGINAL MEASUREMENTS:

McDaniel, A. S.

J. Phys. Chem. 1911, *15*, 587-610.

VARIABLES:

T/K = 295.25 - 322.95
p_1/kPa = 101.3 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature t/°C	Temperature T/K	Mol Fraction 10^3x_1	Bunsen Coefficient[a] α	Ostwald Coefficient[b] L/cm³ cm⁻³
22.1	295.25	0.746	0.4102	0.4436
25.0	298.15	0.737	0.4059	0.4431[c]
30.2	303.35	0.704	0.3883	0.4278
40.0	313.15	0.635	0.3436	0.3938
49.8	322.95	0.426	0.2278	0.2695

[a] Bunsen coefficient, α/cm³(STP) cm⁻³ atm⁻¹.

[b] Listed as absorption coefficient in the original paper. Interpreted to be equivalent to Ostwald coefficient by compiler.

[c] Ostwald coefficient (absorption coefficient) estimated as 298.15 K value by author.

[d] Mole fraction and Bunsen coefficient values calculated by compiler assuming ideal gas behavior.

EVALUATOR'S COMMENT: McDaniel's data should be used with caution. His values are often 20 percent or more too small when compared with more reliable data.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is all glass. It consists of a gas buret connected to a contacting vessel. The solvent is degassed by boiling under reduced pressure. Gas pressure or volume is adjusted using mercury displacement. Equilibration is achieved at atm pressure by hand shaking, and incrementally adding gas to the contacting chamber. Solubility measured by obtaining total uptake of gas by known volume of the solvent.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Prepared by reaction of methyl iodide with zinc-copper. Passed through water and sulfuric acid.

(2) Methanol. Source not given, purity stated to be 99 per cent.

ESTIMATED ERROR:

$\delta L/L \geq -0.20$ (compiler)

REFERENCES:

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) Methanol; CH_3OH; [67-56-1]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330 - 1331.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction 10^4x_1	Bunsen Coefficient[1] α	Ostwald Coefficient $L/cm^3\ cm^{-3}$
298.15	9.19	0.506	0.552 ± 0.004

[1] $\alpha/cm^3(STP)\ cm^{-3}\ atm^{-1}$

The Bunsen coefficient was calculated by the compiler.

The mole fraction solubility was taken from Boyer's thesis (1).

Boyer's thesis gives the equations:

$$\log x_1 = -3.062 + 0.565 \log C \quad \text{for } 298.15 \text{ K}$$
$$\log x_1 = -3.091 + 0.579 \log C \quad \text{for } 308.15 \text{ K}$$

where C is the number of normal alcohol carbon atoms. Most of the mole fraction solubility values given in the paper were calculated from the equation at 298.15 K.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors.

The total pressure of the gas and the solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (2) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

1. Methane. Phillips Petroleum Co. Stated to be 99.9 mol per cent.
2. Methanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$
$\delta L/cm^3 = \pm 0.003$

REFERENCES:

1. Boyer, F. L., Ph.D. thesis, 1959 Vanderbilt Univ., Nashville, TN
2. Peters, J. P.; Van Slyke, D. D. *Quantitative Clinical Chemistry* Baltimore, MD, 1932, Volume II.

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) Methanol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Lannung, A.; Gjaldabek, J. C.

Acta Chem. Scand. 1960, *14*, 1124 - 1128.

VARIABLES:

$T/K = 291.15 - 310.15$
$p_1/kPa = 101.325$ (1 atm)

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction 10^4x_1	Bunsen Coefficient $\alpha/cm^3(STP)cm^{-3}atm^{-1}$	Ostwald Coefficient L/cm^3cm^{-3}
291.15	9.01	0.500	0.533
291.15	9.01	0.500	0.533
298.15	8.71	0.479	0.523
310.15	8.10	0.440	0.500
310.15	8.30	0.451	0.512

Smoothed Data: For use between 291.15 and 310.15 K.

$$\ln x_1 = -8.5538 + 4.4905/(T/100\ K)$$

The standard error about the regression line is 8.23×10^{-6}.

T/K	Mol Fraction 10^4x_1
298.15	8.69
308.15	8.28

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb containing degassed solvent and the gas was placed in an air thermostat and shaken until equilibrium (1).

The absorbed volume of gas is calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent is determined by the weight of displaced mercury.

The values are at 101.325 kPa (1 atm) pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Generated from magnesium methyl iodide. Purified by fractional distillation. Specific gravity corresponds with mol wt 16.08.

(2) Methanol. B.A.S.F. Distilled over magnesium.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$\delta x_1/x_1 = \pm 0.015$

REFERENCES:

1. Lannung, A. *J. Am. Chem. Soc.* 1930, *52*, 68.

COMPONENTS:

1. Methane; CH_4; [74-82-8]
2. Methanol; CH_4O; [67-56-1]

ORIGINAL MEASUREMENTS:

Ben-Naim, A.; Yaacobi, M.

J. Phys. Chem. 1974, *78*, 175-8

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient,* L	Mole fraction+ at partial pressure of 101.3 kPa, x_{CH_4}
283.15	0.5437	0.000935
288.15	0.5364	0.000912
293.15	0.5278	0.000888
298.15	0.5180	0.000862
303.15	0.5070	0.000834

* Smoothed values obtained from the equation.

$$kT \ln L = -2{,}604.5 + 18.546\ (T/K) - 0.03729\ (T/K)^2 \text{ cal mol}^{-1}$$

where k is in units of cal $\text{mol}^{-1}\text{K}^{-1}$

\+ calculated by compiler assuming the ideal gas law for methane.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that described by Ben-Naim and Baer (1) and Wen and Hung (2). It consists of three main parts, a dissolution cell of 300 to 600 cm^3 capacity, a gas volume measuring column, and a manometer. The solvent is degassed in the dissolution cell, the gas is introduced and dissolved while the liquid is kept stirred by a magnetic stirrer immersed in the water bath. Dissolution of the gas results in the change in the height of a column of mercury which is measured by a cathetometer.

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.97 mol per cent.
2. AR grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{CH_4} = \pm 2\%$ (estimated by compiler).

REFERENCES:

1. Ben-Naim, A.; Baer, S. *Trans. Faraday. Soc.* 1963, *59*, 2735.
2. Wen, W.-Y. Hung J.H. *J. Phys. Chem.* 1970, *74*, 170.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Methane; CH_4; [74-82-8] 3. Methanol; CH_4O; [67-56-1]	Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
VARIABLES:	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P^+/kPa	Ostwald coefficient	Mole fraction of methane*, x_{CH_4}
298.15	101.3	0.808	0.001343

* calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref. (1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta x_{CH_4} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) Ethanol; C_2H_5OH; [64-17-5]

ORIGINAL MEASUREMENTS:

McDaniel, A. S.

J. Phys. Chem. 1911, *15*, 587-610.

VARIABLES:

T/K = 295.35 - 313.15
p_1/kPa = 101.3

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mol Fraction	Bunsen Coefficient[a]	Ostwald Coefficient[b]
t/°C	T/K	$10^3 x_1$	α	L/cm³ cm⁻³
22.2	295.35	1.116	0.4282	0.4628
25.0	298.15	1.096	0.4197	0.4581[c]
30.1	303.25	1.064	0.4051	0.4503
40.0	313.15	0.998	0.3771	0.4323

[a] Bunsen coefficient, α/cm³(STP) cm⁻³ atm⁻¹.

[b] Listed as absorption coefficient in the original paper. Interpreted to be equivalent to Ostwald coefficient by compiler.

[c] Ostwald coefficient (absorption coefficient) estimated as 298.15 K value by author.

[d] Mole fraction and Bunsen coefficient values calculated by compiler assuming ideal gas behavior.

EVALUATOR'S COMMENT: McDaniel's data should be used with caution. His values are often 20 percent or more too small when compared with more reliable data.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is all glass. It consists of a gas buret connected to a contacting vessel. The solvent is degassed by boiling under reduced pressure. Gas pressure or volume is adjusted using mercury displacement. Equilibration is achieved at atm pressure by hand shaking, and incrementally adding gas to the contacting chamber. Solubility measured by obtaining total uptake of gas by known volume of the solvent.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Prepared by reaction of methyl iodide with zinc-copper. Passed through water and sulfuric acid.

(2) Ethanol. Source not given. Purity stated to be 99.8 per cent.

ESTIMATED ERROR:

$\delta L/L \geq -0.20$

REFERENCES:

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) Ethanol; C_2H_5OH; [64-17-5]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330-1331.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction 10^4x_1	Bunsen Coefficient[1] α	Ostwald Coefficient L/cm^3 cm^{-3}
298.15	13.0	0.494	0.539 ± 0.003

[1] α/cm^3(STP) cm^{-3} atm^{-1}

The Bunsen coefficient was calculated by the compiler.

The mole fraction solubility was taken from Boyer's thesis (1).

See the methanol data sheet for the equations relating the mole fraction solubility and the number of normal alcohol carbon numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors.

The total pressure of the gas and the solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (2) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Phillips Petroleum Co. Stated to be 99.9 mol per cent.

(2) Ethanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = \pm\ 0.01$

$\delta L/cm^3 = \pm\ 0.003$

REFERENCES:

1. Boyer, F. L., Ph.D. thesis, 1959 Vanderbilt Univ., Nashville, TN

2. Peters, J. P.; Van Slyke, D. D. *Quantitative Clinical Chemistry* Baltimore, MD, 1932, Volume II.

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) Ethanol; C_2H_6O; [64-17-5]

ORIGINAL MEASUREMENTS:

Lannung, A.; Gjaldbaek, J. C.

Acta Chem. Scand. 1960, *14*, 1124 - 1128.

VARIABLES:

$T/K = 291.15 - 310.15$
$p_1/kPa = 101.325$ (1 atm)

PREPARED BY:

J. Chr. Gjaldbaek

EXPERIMENTAL VALUES:

T/K	Mol Fraction 10^3x_1	Bunsen Coefficient $\alpha/cm^3(STP)cm^{-3}atm^{-1}$	Ostwald Coefficient L/cm^3cm^{-3}
291.15	1.33	0.511	0.545
291.15	1.33	0.512	0.546
298.15	1.28	0.487	0.532
298.15	1.28	0.490	0.535
310.15	1.21	0.454	0.515
310.15	1.21	0.456	0.518

Smoothed Data: For use between 291.15 and 310.15 K.

$$\ln x_1 = -8.1618 + 4.4789/(T/100\ K)$$

The standard error about the regression line is 1.53×10^{-6}.

T/K	Mol Fraction 10^3x_1
298.15	1.28
308.15	1.22

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb containing degassed solvent and the gas was placed in an air thermostat and shaken until equilibrium (1).

The absorbed volume of gas is calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent is determined by the weight of displaced mercury.

The values are at 101.325 kPa (1 atm) pressure assuming Henry's law is obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Generated from magnesium methyl iodide. Purified by fractional distillation. Specific gravity corresponds with mol wt 16.08.

(2) Ethanol. Alcohol absolutus Ph. Dan. Distilled twice over quick lime.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$\delta x_1/x_1 = \pm 0.015$

REFERENCES:

1. Lannung, A. *J. Am. Chem. Soc.* 1930, *52*, 68.

COMPONENTS: 1. Methane; CH_4; [74-82-8] 2. Ethanol; C_2H_6O; [64-17-5]	ORIGINAL MEASUREMENTS: Ben-Naim, A.; Yaacobi, M. *J. Phys. Chem.* 1974, *78*, 175-8
VARIABLES: Temperature,	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient,* L	Mole fraction$^+$ at partial pressure of 101.3 kPa, x_{CH_4}
283.15	0.5567	0.00138
288.15	0.5468	0.00134
293.15	0.5370	0.00128
298.15	0.5272	0.00126
303.15	0.5175	0.00123

* Smoothed values obtained from the equation.

$kT \ln L = 255.3 + 2.636\ (T/K) - 0.01024\ (T/K)^2$ cal mol^{-1}
where k is in units of cal mol^{-1} K^{-1}

\+ calculated by compiler assuming the ideal gas law for methane.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that described by Ben-Naim and Baer (1) and Wen and Hung (2). It consists of three main parts, a dissolution cell of 300 to 600 cm^3 capacity, a gas volume measuring column, and a manometer. The solvent is degassed in the dissolution cell, the gas is introduced and dissolved while the liquid is kept stirred by a magnetic stirrer immersed in the water bath. Dissolution of the gas results in the change in the height of a column of mercury which is measured by a cathetometer.

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.97 mol per cent.
2. AR grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{CH_4} = \pm 2\%$
(estimated by compiler)

REFERENCES:

1. Ben-Naim, A.; Baer, S. *Trans. Faraday Soc.* 1963, *59*, 2735.
2. Wen, W.-Y.; Hung, J. H. *J. Phys. Chem.* 1970, *74*, 170

COMPONENTS:

1. Methane; CH_4; [74-82-8]
2. Ethanol; C_2H_6O; [64-17-5]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Rusz, L.;
Balog-Megyery, K.

Hung. J. Ind. Chem. 1979, *7*, 41-6

VARIABLES:

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/kPa	Ostwald coefficient	Mole fraction of methane*, x_{CH_4}
298.15	101.3	0.666	0.00160

* calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref. (1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta x_{CH_4} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos. G.
Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) 1-Propanol; C_3H_7OH; [71-23-8]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330 - 1331.

VARIABLES:

T/K: 298.15, 308.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $10^4 x_1$	Bunsen Coefficient[1] α	Ostwald Coefficient $L/cm^3\ cm^{-3}$
298.15	15.6	0.467	0.510 ± 0.004
308.15	15.1	0.449	0.506 ± 0.002

[1] $\alpha/cm^3(STP)\ cm^{-3}\ atm^{-1}$

The Bunsen coefficients were calculated by the compiler.

The mole fraction solubilities were taken from Boyer's thesis (1).

See the methanol data sheet for the equations relating the mole fraction solubility and the number of normal alcohol carbon numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors.

The total pressure of the gas and the solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (2) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Phillips Petroleum Co. Stated to be 99.9 mol per cent.

(2) 1-Propanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = \pm\ 0.01$

$\delta L/cm^3 = \pm\ 0.004$ (at 298.15)
$\pm\ 0.002$ (at 208.15)

REFERENCES:

1. Boyer, F. L., Ph.D. thesis, 1959 Vanderbilt Univ., Nashville, TN

2. Peters, J. P.; Van Slyke, D. D. *Quantitative Clinical Chemistry* Baltimore, MD, 1932, Volume II.

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) 1-Propanol; C_3H_8O; [71-23-8]

ORIGINAL MEASUREMENTS:

Komarenko, V. G.; Manzhelii, V. G.

Ukr. Fiz. Zh. (Ukr. Ed.) 1968, *13*, 387-391.

**Ukr. Phys. J. (Engl. Tranl.)* 1968, *13*, 273-276.

VARIABLES:

T/K = 173.15 - 243.15
p_1/kPa = 26.664 (200 mmHg)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mol Fraction	Mol Fraction
t/°C	T/K	p_1/mmHg = 200 10^3x_1	p_1/mmHg = 760 10^3x_1
-100	173.15	1.924	7.31
- 90	183.15	1.511	5.74
- 80	193.15	1.261	4.79
- 70	203.15	1.048	3.98
- 60	213.15	0.887	3.37
- 50	223.15	0.744	2.83
- 40	233.15	0.637	2.42
- 30	243.15	0.558	2.12

The compiler added the Kelvin temperatures.

The compiler calculated the mole fraction solubility values at 760 mmHg assuming Henry's law is obeyed.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solvent was degassed by vacuum. A thin layer of alcohol, cooled to 125-175 K, was kept for 20 h in a vacuum maintained at 10^{-3} mmHg.

The degassed liquid was sealed under vacuum in an ampule which was placed in the apparatus. The apparatus consisted of a manostat, a mercury compensator, and a solubility cell divided by a mercury seal. A gas pressure of 200 mmHg and the temperature were established. The foil ends of the ampule were pierced. The gas dissolved as the liquid flowed through a series of small cups. The amount of gas dissolved was measured by the rise in mercury level in the compensator.

Some measurements were made at 400 mmHg gas pressure. The results confirmed that Henry's law was obeyed.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Source not given. Purity by chromatographic method was 99.78 percent.

(2) 1-Propanol. Purified and analyzed in the All-Union Sci. Res. Inst. for Single Crystals and High-Purity Substances. Purity 99.97 weight percent.

ESTIMATED ERROR:

δT/K = ± 0.05
δp_1/mmHg = ± 0.01
$\delta x_1/x_1$ = ± 0.005

REFERENCES:

COMPONENTS:

1. Methane; CH_4; [74-82-8]
2. 1-Propanol; C_3H_8O; [71-23-8]

ORIGINAL MEASUREMENTS:

Ben-Naim, A.; Yaacobi, M.

J. Phys. Chem. 1974, *78*, 175-8

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient,* L	Mole fraction+ at partial pressure of 101.3 kPa, x_{CH_4}
283.15	0.5417	0.00172
288.15	0.5282	0.00166
293.15	0.5174	0.00161
298.15	0.5090	0.00156
303.15	0.5029	0.00152

* Smoothed values obtained from the equation.

$kT \ln L = 4,378.1 - 29.028\ (T/K) + 0.04361\ (T/K)^2$ cal mol^{-1}
where k is in units of cal mol^{-1} K^{-1}

\+ calculated by compiler assuming the ideal gas law for methane.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that described by Ben-Naim and Baer (1) and Wen and Hung (2). It consists of three main parts, a dissolution cell of 300 to 600 cm^3 capacity, a gas volume measuring column, and a manometer. The solvent is degassed in the dissolution cell, the gas is introduced and dissolved while the liquid is kept stirred by a magnetic stirrer immersed in the water bath. Dissolution of the gas results in the change in the height of a column of mercury which is measured by a cathetometer.

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.97 mol per cent.
2. CP grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{CH_4} = \pm 2\%$
(estimated by compiler)

REFERENCES:

1. Ben-Naim, A.; Baer, S. *Trans. Faraday Soc.* 1963, *59*, 2735.

2. Wen, W.-Y.; Hung, J.H. *J. Phys. Chem.* 1970 , *74*, 170.

COMPONENTS:

1. Methane; CH_4; [74-82-8]
2. 1-Propanol; C_3H_8O; [71-23-8]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Rusz, L.; Balog-Megyery, K.

Hung. J. Ind. Chem. 1979, *7*, 41-6.

VARIABLES:

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/kPa	Ostwald coefficient	Mole fraction of methane*, x_{CH_4}
298.15	101.3	0.589	0.00181

* calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref. (1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta x_{CH_4} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.
Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) 2-Propanol or isopropyl alcohol; C_3H_7OH; [67-63-0]

ORIGINAL MEASUREMENTS:

McDaniel, A. S.

J. Phys. Chem. 1911, *15*, 587-610.

VARIABLES:

T/K = 294.65 - 313.15
p_1/kPa = 101.3 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mol Fraction	Bunsen Coefficient[a]	Ostwald Coefficient[b]
t/°C	T/K	$10^3 x_1$	α	$L/\text{cm}^3\ \text{cm}^{-3}$
21.5	294.65	1.46	0.4275	0.4620
25.0	298.15	1.44	0.4200	0.4585[c]
29.9	303.05	1.41	0.4081	0.4532
40.0	313.15	1.34	0.3837	0.4400

[a] Bunsen coefficient, $\alpha/\text{cm}^3(\text{STP})\ \text{cm}^{-3}\ \text{atm}^{-1}$.

[b] Listed as absorption coefficient in the original paper. Interpreted to be equivalent to Ostwald coefficient by compiler.

[c] Ostwald coefficient (absorption coefficient) estimated as 298.15 K value by author.

[d] Mole fraction and Bunsen coefficient values calculated by compiler assuming ideal gas behavior.

EVALUATOR'S COMMENT: McDeniel's data should be used with caution. His values are often 20 percent or more too small when compared with more reliable data.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is all glass. It consists of a gas buret connected to a contacting vessel. The solvent is degassed by boiling under reduced pressure. Gas pressure or volume is adjusted using mercury displacement. Equilibration is achieved at atm pressure by hand shaking, and incrementally adding gas to the contacting chamber. Solubility measured by obtaining total uptake of gas by known volume of the solvent.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Prepared by reaction of methyl iodide with zinc-copper. Passed through water and sulfuric acid.

(2) 2-Propanol. Source not given.

ESTIMATED ERROR:

$\delta L/L \geq -0.20$

REFERENCES:

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) 1-Butanol; C_4H_9OH; [71-36-3]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330 - 1331.

VARIABLES:

T/K: 298.15, 308.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $10^4 x_1$	Bunsen Coefficient[1] α	Ostwald Coefficient $L/cm^3\ cm^{-3}$
298.15	19.1	0.466	0.509 ± 0.002
308.15	18.2	0.443	0.500 ± 0.005

[1] $\alpha/cm^3(STP)\ cm^{-3}\ atm^{-1}$

The Bunsen coefficients were calculated by the compiler.

The mole fraction solubilities were taken from Boyer's thesis (1).

See the methanol data sheet for the equations relating the mole fraction solubility and the number of normal alcohol carbon numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors.

The total pressure of the gas and the solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (2) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Phillips Petroleum Co. Stated to be 99.9 mol per cent.

(2) 1-Butanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = \pm\ 0.01$

$\delta L/cm^3 = \pm\ 0.002$ (at 298.15)
$\pm\ 0.005$ (at 308.15)

REFERENCES:

1. Boyer, F. L., Ph.D. thesis, 1959 Vanderbilt Univ., Nashville, TN
2. Peters, J. P.; Van Slyke, D. D. *Quantitative Clinical Chemistry* Baltimore, MD, 1932, Volume II.

COMPONENTS: 1. Methane; CH_4; [74-82-8] 2. 1-Butanol; $C_4H_{10}O$; [71-36-3]	ORIGINAL MEASUREMENTS: Ben-Naim, A.; Yaacobi, M. *J. Phys. Chem.* 1974, *78*, 175-8
VARIABLES: Temperature,	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient,* L	Mole fraction+ at partial pressure of 101.3 kPa, x_{CH_4}
283.15	0.5194	0.00203
288.15	0.5115	0.00197
293.15	0.5016	0.00191
298.15	0.4898	0.00184
303.15	0.4765	0.00177

* Smoothed values obtained from the equation.

$kT \ln L = -4{,}090.4 + 29.065\ (T/K) - 0.05623\ (T/K)^2\ \text{cal mol}^{-1}$
where k is in units of cal mol^{-1} K^{-1}

\+ calculated by compiler assuming the ideal gas law for methane.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that described by Ben-Naim and Baer (1) and Wen and Hung (2). It consists of three main parts, a dissolution cell of 300 to 600 cm^3 capacity, a gas volume measuring column, and a manometer. The solvent is degassed in the dissolution cell, the gas is introduced and dissolved while the liquid is kept stirred by a magnetic stirrer immersed in the water bath. Dissolution of the gas results in the change in the height of a column of mercury which is measured by a cathetometer.

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.97 mol per cent.
2. AR grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{CH_4} = \pm 2\%$
(estimated by compiler).

REFERENCES:

1. Ben-Naim, A.; Baer, S. *Trans. Faraday Soc.* 1963, *59*, 2735.
2. Wen, W.-Y.; Hung, J.H. *J. Phys. Chem.* 1970, *74*, 170

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Methane; CH_4; [74-82-8] 2. 1-Butanol; $C_4H_{10}O$; [71-36-3]	Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6
VARIABLES:	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P/kPa	Ostwald coefficient	Mole fraction of methane *, x_{CH_4}
298.15	101.3	0.546	0.00205

* calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref. (1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

No details given

ESTIMATED ERROR:

$\delta x_{CH_4} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.
Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Methane; CH_4; [74-82-8] (2) 2-Methyl-1-propanol or isobutyl alcohol; $C_4H_{10}O$; [78-83-1]	Winkler, L. W. *Z. Angew. Chem.* 1916, *29, I,* 218-20.
VARIABLES:	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

The author states that the absorption coefficient of methane in isobutyl alcohol at room temperature in near 1/3. Compared to methane solubility values in other alcohols the value appears to be too small and is classed as doubtful. The small value may be due to water in the alcohol.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
No information.	No information.
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) 1-Pentanol or amyl alcohol; $C_5H_{11}OH$; [71-41-0]

ORIGINAL MEASUREMENTS:

McDaniel, A. S.

J. Phys. Chem. 1911, *15*, 587-610.

VARIABLES:

$T/K = 295.15 - 303.25$

$p_1/kPa = 101.3$ (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Mol Fraction	Bunsen Coefficient[a]	Ostwald Coefficient[b]
$t/°C$	T/K	10^3x_1	α	$L/cm^3\ cm^{-3}$
22.0	295.15	2.02	0.4196	0.4532
25.0	298.15	1.99	0.4123	0.4500[c]
30.1	303.25	1.95	0.4002	0.4444

[a] Bunsen coefficient, $\alpha/cm^3(STP)\ cm^{-3}\ atm^{-1}$.

[b] Listed as absorption coefficient in the original paper. Interpreted to be equivalent to Ostwald coefficient by compiler.

[c] Ostwald coefficient (absorption coefficient) estimated as 298.15 K value by author.

[d] Mole fraction and Bunsen coefficient values calculated by compiler assuming ideal gas behavior.

EVALUATOR'S COMMENT: McDaniel's data should be used with caution. His values are often 20 percent or more too small when compared with more reliable data.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is all glass. It consists of a gas buret connected to a contacting vessel. The solvent is degassed by boiling under reduced pressure. Gas pressure or volume is adjusted using mercury displacement. Equilibration is achieved at atm pressure by hand shaking, and incrementally adding gas to the contacting chamber. Solubility measured by obtaining total uptake of gas by known volume of the solvent.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Prepared by reaction of methyl iodide with zinc-copper. Passed through water and sulfuric acid.

(2) 1-Pentanol. Source not given.

ESTIMATED ERROR:

$\delta L/L \geq -0.20$

REFERENCES:

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) 1-Pentanol; $C_5H_{11}OH$; [71-41-0]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330 - 1331.

VARIABLES:

T/K: 298.15, 308.15

P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $10^4 x_1$	Bunsen Coefficient[1] α	Ostwald Coefficient $L/cm^3\ cm^{-3}$
298.15	21.5	0.442	0.483 ± 0.005
308.15	21.1	0.429	0.484 ± 0.010

[1] $\alpha/cm^3(STP)\ cm^{-3}\ atm^{-1}$

The Bunsen coefficients were calculated by the compiler.

The mole fraction solubilities were taken from Boyer's thesis (1).

See the methanol data sheet for the equations relating the mole fraction solubility and the number of normal alcohol carbon numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors.

The total pressure of the gas and the solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (2) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Phillips Petroleum Co. Stated to be 99.9 mol per cent.

(2) 1-Pentanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = \pm\ 0.01$

$\delta L/cm^3 = \pm\ 0.005$ (at 298.15)

$\pm\ 0.010$ (at 308.15)

REFERENCES:

1. Boyer, F. L., Ph.D. thesis, 1959 Vanderbilt Univ., Nashville, TN

2. Peters, J. P.; Van Slyke, D. D. *Quantitative Clinical Chemistry* Baltimore, MD, 1932, Volume II.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Methane; CH_4; [74-82-8] 2. 1-Pentanol; $C_5H_{12}O$; [71-41-0]	Ben-Naim, A.; Yaacobi, M. *J. Phys. Chem.* 1974, *78*, 175-8.
VARIABLES: Temperature	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient,* L	Mole fraction+ at partial pressure of 101.3 kPa, x_{CH_4}
283.15	0.4925	0.00227
288.15	0.4843	0.00220
293.15	0.4760	0.00214
298.15	0.4676	0.00207
303.15	0.4592	0.00202

* Smoothed values obtained from the equation

$kT \ln L = -390.8 + 3.230\ (T/K) - 0.01150\ (T/K)^2$ cal mol^{-1}
where k is in units of cal mol^{-1} K^{-1}

\+ calculated by compiler assuming the ideal gas law for methane.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that described by Ben-Naim and Baer (1) and Wen and Hung (2). It consists of three main parts, a dissolution cell of 300 to 600 cm^3 capacity, a gas volume measuring column, and a manometer. The solvent is degassed in the dissolution cell, the gas is introduced and dissolved whicle the liquid is kept stirred by a magnetic stirrer immersed in the water bath. Dissolution of the gas results in the change in the height of a column of mercury which is measured by a cathetometer.

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.9 mol per cent.
2. AR grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{CH_4} = \pm 2\%$
(estimated by compiler).

REFERENCES:

1. Ben-Naim, A.; Baer, S. *Trans. Faraday Soc.* 1963, *59*, 2735.
2. Wen, W.-Y.; Hung, J.H. *J. Phys. Chem.* 1970, *74*, 170

COMPONENTS:

1. Methane; CH_4; [74-82-8]
2. 1-Pentanol; $C_5H_{12}O$; [71-41-0]
   or
   1-Hexanol; $C_6H_{14}O$; [111-27-3]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Rusz, L.;
Balog-Megyery, K.

Hung. J. Ind. Chem. 1979, *7*, 41-6

VARIABLES:

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/kPa	Ostwald coefficient	Mole fraction of methane *, x_{CH_4}
		1-Pentanol	
298.15	101.3	0.513	0.00227
		1-Hexanol	
298.15	101.3	0.491	0.00251

* calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref. (1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

No details given

ESTIMATED ERROR:

$\delta x_{CH_4} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G.
   Veszpremi Vegyip. Egy. Kozl. 1957, *1*, 55.
   Chem. Abstr. 1961, *55*, 3175h

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) 3-Methyl-1-butanol; $C_5H_{12}O$; [123-51-3]

ORIGINAL MEASUREMENTS:

Friedel, C.; Gorgeu, A.

Compt. rendu 1908, *127*, 590-4.

VARIABLES:

T/K = 285.7
p/kPa = 101.3

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Temperature		Pressure	Solubility Volume Methane/ Volume Alcohol
$t/^{0}C$	T/K	p/m	
12.5	285.7	0.760	0.5

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

In the original paper the alcohol was named simply amyl alcohol. However, the boiling point corresponds to the alcohol later named primary isoamyl alcohol or 3-methyl-1-butanol

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Prepared by authors by the decomposition of dimethyl mercury.

(2) 3-Methyl-1-butanol. Prepared by the authors. Boiling point 130-132 ^{0}C.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Methane; CH_4; [74-82-8] (2) 1-Hexanol; $C_6H_{13}OH$; [111-27-3]	Boyer, F. L.; Bircher, L. J. *J. Phys. Chem.* 1960, *64*, 1330 - 1331.

VARIABLES:	PREPARED BY:
T/K: 298.15 P/kPa: 101.325 (1 atm)	M. E. Derrick H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction 10^4x_1	Bunsen Coefficient[1] α	Ostwald Coefficient $L/cm^3\ cm^{-3}$
298.15	23.7	0.425	0.464 ± 0.002

[1] $\alpha/cm^3(STP)\ cm^{-3}\ atm^{-1}$

The Bunsen coefficient was calculated by the compiler.

The mole fraction solubility was taken from Boyer's thesis (1).

See the methanol data sheet for the equations relating the mole fraction solubility and the number of normal alcohol carbon numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors.

The total pressure of the gas and the solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (2) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Phillips Petroleum Co. Stated to be 99.9 mol per cent.

(2) 1-Hexanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$

$\delta L/cm^3 = \pm 0.002$

REFERENCES:

1. Boyer, F. L., Ph.D. thesis, 1959 Vanderbilt Univ., Nashville, TN

2. Peters, J. P.; Van Slyke, D. D. *Quantitative Clinical Chemistry* Baltimore, MD, 1932, Volume II.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Methane; CH_4; [74-82-8] 2. 1-Hexanol; $C_6H_{14}O$; [111-27-3]	Ben-Naim, A.; Yaacobi, M. *J. Phys. Chem.* 1974, *78*, 175-8
VARIABLES: Temperature	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	Ostwald coefficient,* L	Mole fraction+ at partial pressure of 101.3 kPa, x_{CH_4}
283.15	0.4727	0.00251
288.15	0.4622	0.00242
293.15	0.4535	0.00235
298.15	0.4663	0.00228
303.15	0.4404	0.00222

* Smoothed values obtained from the equation.

$kT \ln L = 3.087.6 - 20.591\ (T/K) + 0.02895\ (T/K)^2$ cal mol^{-1}
where k is in units of cal mol^{-1} K^{-1}

\+ calculated by compiler assuming the ideal gas law for methane.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was similar to that described by Ben-Naim and Baer (1) and Wen and Hung (2). It consists of three main parts, a dissolution cell of 300 to 600 cm^3 capacity, a gas volume measuring column, and a manometer. The solvent is degassed in the dissolution cell, the gas is introduced and dissolved while the liquid is kept stirred by a magnetic stirrer immersed in the water bath. Dissolution of the gas results in the change in the height of a column of mercury which is measured by a cathetometer.

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.97 mol per cent.
2. AR grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{CH_4} = \pm 2\%$
(estimated by compiler)

REFERENCES:

1. Ben-Naim, A.; Baer, S. *Trans. Faraday Soc.* 1963, *59*, 2735.
2. Wen, W.-Y.; Hung, J.H. *J. Phys. Chem.* 1970, *74*, 170.

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) 1-Heptanol; $C_7H_{15}OH$; [111-70-6]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330 - 1331.

VARIABLES:

T/K: 298.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction $10^4 x_1$	Bunsen Coefficient[1] α	Ostwald Coefficient $L/cm^3\ cm^{-3}$
298.15	26.0	0.410	0.448 ± 0.004

[1] $\alpha/cm^3(STP)\ cm^{-3}\ atm^{-1}$

The Bunsen coefficient was calculated by the compiler.

The mole fraction solubility was taken from Boyer's thesis (1).

See the methanol data sheet for the equations relating the mole fraction solubility and the number of normal alcohol carbon numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors.

The total pressure of the gas and the solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (2) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Phillips Petroleum Co. Stated to be 99.9 mol per cent.

(2) 1-Heptanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = \pm\ 0.01$

$\delta L/cm^3 = \pm\ 0.004$

REFERENCES:

1. Boyer, F. L., Ph.D. thesis, 1959 Vanderbilt Univ., Nashville, TN

2. Peters, J. P.; Van Slyke, D. D. *Quantitative Clinical Chemistry* Baltimore, MD, 1932, Volume II.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Methane; CH_4; [74-82-8] 2. 1-Heptanol; $C_7H_{16}O$; [111-70-6] or 1-Octanol; $C_8H_{18}O$; [111-87-5]	Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
VARIABLES:	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P/kPa	Ostwald coefficient	Mole fraction of methane*, x_{CH_4}
		1-Heptanol	
298.15	101.3	0.469	0.00271
		1-Octanol	
298.15	101.3	0.633^+ (0.458)	0.00408^+ (0.00296)

+ appears to be an error in original table, probable value given in parentheses.

* calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref. (1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$$\delta x_{CH_4} = \pm 3\%$$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B. Sipos, G. *Veszpremi Vegyip. Egy. Kozl.* 1957, *1*, 55. *Chem. Abstr.* 1961, *55*, 3175h

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) 1-Octanol; $C_8H_{17}OH$; [111-87-5]

ORIGINAL MEASUREMENTS:

Boyer, F. L.; Bircher, L. J.

J. Phys. Chem. 1960, *64*, 1330 - 1331.

VARIABLES:

T/K: 298.15, 308.15
P/kPa: 101.325 (1 atm)

PREPARED BY:

M. E. Derrick
H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction 10^4x_1	Bunsen Coefficient[1] α	Ostwald Coefficient $L/cm^3\ cm^{-3}$
298.15	28.4	0.399	0.436 ± 0.004
308.15	26.4	0.372	0.420 ± 0.005

[1] $\alpha/cm^3(STP)\ cm^{-3}\ atm^{-1}$

The Bunsen coefficients were calculated by the compiler.

The mole fraction solubilities were taken from Boyer's thesis (1).

See the methanol data sheet for the equations relating the mole fraction solubility and the number of normal alcohol carbon numbers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A commercial Van Slyke blood gas apparatus (E. H. Sargent Co.) was modified by the authors.

The total pressure of the gas and the solvent vapor in the solution chamber was adjusted to a pressure of one atm. The pressure was maintained at one atm during the solution process. The saturated solution was transferred to a bulb below the lower stopcock of the extraction vessel and sealed off. The gas and solvent vapor were then brought to volume over mercury. See (2) for details of the extraction procedure.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Phillips Petroleum Co. Stated to be 99.9 mol per cent.

(2) 1-Octanol. Source not given. Treated by standard methods to remove aldehydes and ketones, then dried and distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$

$\delta L/cm^3 = \pm 0.004$ (at 298.15)
± 0.005 (at 308.15)

REFERENCES:

1. Boyer, F. L., Ph.D. thesis, 1959 Vanderbilt Univ., Nashville, TN

2. Peters, J. P.; Van Slyke, D. D. *Quantitative Clinical Chemistry* Baltimore, MD, 1932, Volume II.

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) 1-Octanol; $C_8H_{17}OH$; [111-87-5]

ORIGINAL MEASUREMENTS:

Wilcock, R. J.; Battino, R.; Danforth, W. F.; Wilhelm, E.

J. Chem. Thermodyn. 1978, *10*, 817 - 822.

VARIABLES:

T/K: 283.23 - 313.46

p/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction 10^3x_1	Bunsen Coefficient α/cm^3 (STP) cm^{-3} atm^{-1}	Ostwald Coefficient L/cm^3 cm^{-3}
283.23	2.992	0.4292	0.4450
298.08	2.687	0.3807	0.4154
313.46	2.548	0.3562	0.4088

The Bunsen coefficients were calculated by the compiler.

It is assumed that the gas is ideal and that Henry's law is obeyed.

Smoothed Data: For use between 283.15 to 313.15 K

$$\ln x_1 = -7.4910 + 4.7335/(T/100K)$$

The standard error about the regression line is 5.46×10^{-5}.

T/K	Mol Fraction 10^3x_1
283.15	2.970
293.15	2.805
298.15	2.730
303.15	2.660
313.15	2.530

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Matheson Co., Inc. Minimum mole per cent purity stated to be 99.97.

(2) 1-Octanol. Eastman Organic Chemicals. Distilled, density at 298.15 K, ρ/g cm^{-3} 0.8247.

ESTIMATED ERROR:

δT/K = 0.02

δP/mmHg = 0.5

$\delta x_1/x_1$ = 0.01

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Methane; CH_4; [74-82-8] 2. 1-Nonanol; $C_9H_{20}O$; [143-08-8] or 1-Decanol; $C_{10}H_{22}O$; [112-30-1]	Makranczy, J.; Rusz, L.; Balog-Megyery, K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6.
VARIABLES:	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P/kPa	Ostwald coefficient	Mole fraction of methane *, x_{CH_4}
		1-Nonanol	
298.15	101.3	0.448	0.00319
		1-Decanol	
298.15	101.3	0.437	0.00341

* calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref. (1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

No details given

ESTIMATED ERROR:

$\delta x_{CH_4} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos. G.
Veszpremi Vegyip Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h

COMPONENTS:

(1) Methane; CH_4; [74-82-8]

(2) 1-Decanol; $C_{10}H_{21}OH$; [112-30-1]

ORIGINAL MEASUREMENTS:

Wilcock, R. J.; Battino, R.; Danforth, W. F.; Wilhelm, E.

J. Chem. Thermodyn. 1978, *10*, 817 - 822.

VARIABLES:

T/K: 284.04 - 313.37
p/kPa: 101.325 (1 atm)

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	Mol Fraction 10^3x_1	Bunsen Coefficient α/cm^3 (STP) cm^{-3} atm^{-1}	Ostwald Coefficient L/cm^3 cm^{-3}
284.04	3.362	0.3984	0.4143
298.08	3.166	0.3709	0.4048
313.37	2.905	0.3361	0.3856

The Bunsen coefficients were calculated by the compiler.

It is assumed that the gas is ideal and that Henry's law is obeyed.

Smoothed Data: For use between 283.15 to 313.15 K

$$\ln x_1 = -7.2511 + 4.4321/(T/100K)$$

The standard error about the regression line is 3.46×10^{-5}.

T/K	Mol Fraction 10^3x_1
283.15	3.394
293.15	3.217
298.15	3.137
303.15	3.061
313.15	2.921

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility apparatus is based on the design of Morrison and Billett (1) and the version used is described by Battino, Evans, and Danforth (2). The degassing apparatus is that described by Battino, Banzhof, Bogan, and Wilhelm (3).

Degassing. Up to 500 cm^3 of solvent is placed in a flask of such size that the liquid is about 4 cm deep. The liquid is rapidly stirred, and vacuum is intermittently applied through a liquid N_2 trap until the permanent gas residual pressure drops to 5 microns.

Solubility Determination. The degassed solvent is passed in a thin film down a glass helical tube containing solute gas plus the solvent vapor at a total pressure of one atm. The volume of gas absorbed is found by difference between the initial and final volumes in the buret system. The solvent is collected in a tared flask and weighed.

SOURCE AND PURITY OF MATERIALS:

(1) Methane. Matheson Co., Inc. Minimum mole percent purity stated to be 99.97.

(2) 1-Decanol. Eastman Organic Chemicals. Distilled, density at 298.15 K, ρ/g cm^{-3} 0.8206.

ESTIMATED ERROR:

$\delta T/K = 0.02$
$\delta P/\text{mmHg} = 0.5$
$\delta x_1/x_1 = 0.01$

REFERENCES:

1. Morrison, T. J.; Billett, F. *J. Chem. Soc.* 1948, 2033.
2. Battino, R.; Evans, F. D.; Danforth, W. F. *J. Am. Oil Chem. Soc.* 1968, *45*, 830.
3. Battino, R.; Banzhof, M.; Bogan, M.; Wilhelm, E. *Anal. Chem.* 1971, *43*, 806.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Methane; CH_4; [64-82-8] 2. 1-Undecanol; $C_{11}H_{24}O$; [112-42-5] or 1-Dodecanol; $C_{12}H_{26}O$; [112-53-8]	Makranczy, J.; Rusz, L.; Balog-Megyery. K. *Hung. J. Ind. Chem.* 1979, *7*, 41-6
VARIABLES:	PREPARED BY: C.L. Young

EXPERIMENTAL VALUES:

T/K	P/kPa	Ostwald coefficient	Mole fraction of methane *, x_{CH_4}
		1-Undecanol	
298.15	101.3	0.431	0.00365
		1-Dodecanol	
298.15	101.3	0.426	0.00389

* calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref. (1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta x_{CH_4} = \pm 3\%$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos. G.
Veszpremi. Vegyip. Egy. Kozl. 1957, *1*, 55.
Chem. Abstr. 1961, *55*, 3175h