Table III. Enthalpy of Solution of H<sub>2</sub>O in 9.93 m HCl at 40 °C

Sample wt, g	Cor temp rise, °C	-Enthalpy of soln, cal/sample	$-\Delta H_4,^a$ cal/mol	
10.020 05	0.3551	254.4	457	
11.010 88	0.3873	277.8	455	
12.054 48	0.4242	305.7	456	
13.021 93	0.4572	329.0	455	
15.028 65	0.5268	380.1	456	

<sup>a</sup>  $\Delta H_4 = -458 + 0.20w$ , w = 13.14493, std dev = 1,  $\Delta H_4 =$ -455

Table IV. Enthalpy of Solution of  $NH_4H_2PO_4$  in 9.93 m HCl + Stoichiometric H<sub>2</sub>O at 40 °C

Sample wt, g	Cor temp rise, °C	Enthalpy of soln, cal/sample	$\Delta H_{s}^{a}$ , cal/mol	
12.915 02	-0.8600	624.8	5565	
13.310 58	-0.8879	646.3	5585	
13.695 95	-0.9125	663.5	5572	
14.119 04	-0.9392	684,3	5575	
14.51473	-0.9650	703.6	5576	
a				

 $^{a}\Delta H_{s} = 5534 + 2.95w, w = 13.31608$ , std dev = 7,  $\Delta H_{s} =$ 5573.

equations of the enthalpies of solution as a function of sample weight, w, were fitted to the observed values by the "leastsquares" method. These equations were solved where w was the average weight of  $(NH_4)_5P_3O_{10}$ ·H<sub>2</sub>O or the stoichiometric amount of H<sub>3</sub>PO<sub>4</sub> · 16.26H<sub>2</sub>O, NH<sub>4</sub>H<sub>2</sub>PO<sub>4</sub>, or H<sub>2</sub>O corresponding to that weight. The equations along with the standard deviations and the values of  $\Delta H_2$ ,  $\Delta H_3$ ,  $\Delta H_4$ , and  $\Delta H_5$  for the specified values of walso are listed in Tables I-IV. Substitution of these calculated values of the enthalpies of solution in eq 6 gives  $-31592 \pm 66$  cal (standard deviation) for the enthalpy of reaction 1 at 40 °C. This value was adjusted by 242 cal to give --31350  $\pm$  66 cal for the enthalpy of reaction 1 at 25 °C according to the equation

$$\Delta H_1(25 \ ^\circ \mathrm{C}) = \Delta H_1(40 \ ^\circ \mathrm{C}) + \int_{40 \ ^\circ \mathrm{C}}^{25 \ ^\circ \mathrm{C}} \Delta C_P \ \mathrm{d}T$$
(7)

through use of polynomial equations for determining differences

between the heat capacities of the products and the reactants. The heat capacity equations were derived from the data of Osborne et al. for water (8), of Stephenson and Zettlemoyer for  $NH_4H_2PO_4$  (9), of Egan et al. for phosphoric acid solutions (2), and of Luff and Williard for  $(NH_4)_5P_3O_{10}H_2O$  (6).

The data of Egan and Luff (1) were used to determine  $\Delta H_8$ and  $\Delta H_9$ , the enthalpies of reactions 8 and 9 at 25 °C, as -436  $H_{3}PO_{4} \cdot 16.26H_{2}O + 84.24H_{2}O = H_{3}PO_{4} \cdot 100.5H_{2}O$ (8)

$$H_{3}PO_{4} \cdot 100H_{2}O + 0.5H_{2}O = H_{3}PO_{4} \cdot 100.5H_{2}O$$
 (9)

and -1 cal, respectively. Subtracting twice the difference between  $\Delta H_8$  and  $\Delta H_9$  from  $\Delta H_1$  at 25 °C gives  $\Delta H_{10}$ , the enthalpy of reaction 10 at 25 °C, as -30 480 cal.

$$(NH_4)_5 P_3 O_{10} \cdot H_2 O + 2(H_3 P O_4 \text{ in } 100 H_2 O) + H_2 O = 5NH_4 H_2 P O_4$$
 (10)

The standard enthalpies of formation of NH<sub>4</sub>H<sub>2</sub>PO<sub>4</sub>(c), H<sub>2</sub>O(I), and  $H_3PO_4$  in 100H<sub>2</sub>O are -345.38, -68.315, and -308.176 kcal/mol, respectively (7). Substituting these enthalpies of formation and the enthalpy of reaction 10 in the equation

$$\Delta H_{f}^{\circ}((\mathrm{NH}_{4})_{5}\mathrm{P}_{3}\mathrm{O}_{10}\cdot\mathrm{H}_{2}\mathrm{O}) = 5(\Delta H_{f}^{\circ}(\mathrm{NH}_{4}\mathrm{H}_{2}\mathrm{PO}_{4})) - 2(\Delta H_{f}^{\circ}(\mathrm{H}_{3}\mathrm{PO}_{4} \text{ in } 100\mathrm{H}_{2}\mathrm{O})) - \Delta H_{f}^{\circ}(\mathrm{H}_{2}\mathrm{O}) - \Delta H_{10} (11)$$

gives -1011.8 kcal/mol as the standard enthalpy of formation of (NH<sub>4</sub>)<sub>5</sub>P<sub>3</sub>O<sub>10</sub>•H<sub>2</sub>O.

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# **Pressure–Volume–Temperature Relationships** of Several Polar Liquids

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The specific volumes of liquid CCl<sub>2</sub>F<sub>2</sub>, CHClF<sub>2</sub>, CH<sub>3</sub>Cl, CH<sub>3</sub>I, CH<sub>3</sub>Br, C<sub>2</sub>H<sub>5</sub>Br, and CH<sub>3</sub>COOCH<sub>3</sub> have been measured at several temperatures from -20 to +40 °C and at pressures from the saturated vapor pressures to near 1600 atm with an accuracy better than 0.13%. The data were fitted to the Tait equation of state at each temperature with a maximum deviation of 0.2%.

An accurate knowledge of the specific volumes of polar liquids under high pressures is important in the interpretation of the polarity effect on the compressibility in connection with the elucidation of the internal structure problems of polar liquids.

Most studies of P-V-T relationships have been made on nonpolar liquids, and very few measurements are available on polar liquids. The purpose of the present work is, therefore, to obtain the specific volumes of polar liquids. The measurements were made at temperatures from -20 to +40 °C, and at pressures up to near 1600 atm.

#### Experimental Section

Materials. The origin and purity of samples are recorded as follows: CCl<sub>2</sub>F<sub>2</sub> and CHClF<sub>2</sub>, Daikin Kogyo Co., Ltd., Japan, 99.9%; CH<sub>3</sub>Cl, Matheson Gas Products, a Division of Will Ross, Inc., 99.5%; CH<sub>3</sub>I, Kokusan Kagaku Co., Ltd., Japan, 98.2%;

Table I.	Experimen	tal Specific	Volumes
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$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$			Specific volume, cm <sup>3</sup> /g				<b>P</b> ef of
$\begin{array}{c ccl_1F_1} & (P_{a}) & 0.85 \ 46 \ (1.5)^2 & 0.715 \ 92 \ (3.0)^2 & 0.722 \ 47 \ 0.728 \ 47 \ 47 \ 0.728 \ 47 \ 47 \ 0.728 \ 47 \ 47 \ 0.728 \ 47 \ 47 \ 0.728 \ 47 \ 47 \ 0.728 \ 47 \ 47 \ 0.728 \ 47 \ 47 \ 0.728 \ 47 \ 47 \ 47 \ 47 \ 47 \ 47 \ 47 \ 4$	Compound	Pressure, atm	-20.00 °C	0.00 °C	20.00 °C	40.00 °C	vol data
95.3         0.728 37         0.748 37         0.748 37         0.748 37           283.1         0.653 15         0.651 73         0.654 94         0.653 45         0.653 97           641.4         0.655 00         0.657 38         0.654 94         0.653 45         0.657 38           1021.9         0.660 75         0.619 56         0.632 67         0.645 40           1214.1         0.600 08         0.610 26         0.622 60         0.654 68           1387.2         0.358 61         0.979 71         0.626 81         0.617 87           140.5         0.592 90         0.603 53         0.617 83         0.617 87           35.4         0.959 73         0.712 85         0.603 73         0.617 87           35.4         0.959 73         0.712 85         0.715 83         0.617 87           35.4         0.959 73         0.712 86         0.749 70         0.728 97           35.4         0.959 73         0.712 85         0.759 50         0.722 34           1022.4         0.658 75         0.673 95         0.669 95         0.648 124           1126.5         0.651 73         0.669 95         0.649 124         0.748 35           1126.5         0.651 33         0.669 95	$CCl_2F_2$	$(P_{o})$	0.685 46 (1.5) <sup>a</sup>	0.715 92 (3.0) <sup>a</sup>	0.752 44 (5.6) <sup>a</sup>	0.798 02 (9.5) <sup>a</sup>	3
$ \begin{array}{c} 283.1 \\ 409.2 \\ 409.2 \\ 409.2 \\ 634.4 \\ 634.4 \\ 634.5 \\ 634.4 \\ 634.5 \\ 634.4 \\ 634.5 \\ 634.4 \\ 634.5 \\ 641.4 \\ 635.5 \\ 641.4 \\ 635.5 \\ 641.4 \\ 635.5 \\ 641.4 \\ 635.5 \\ 641.4 \\ 641.5 \\ 641.4 \\ 641.5 \\ 75.4$		95.3			0.728 37	0.761 82	
		283.1	0.652 73	0.671 72	0.694 67	0.718 19	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		469.5	0.639 15	0.654 94	0.673 12	0.692 97	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		654.9	0.625 81	0.640 73	0.656 61	0.674 10	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		841.4	0.616 40	0.629 08	0.643 10	0.658 06	
$ \begin{array}{c} 1214.1 \\ 120.0000 \\ 1507.2 \\ 15$		1027.9	0.607 75	0.619 66	0.632 67	0.645 40	
$ \begin{array}{c} 1400.3 \\ 1597.2 \\ 1400.3 \\ 1.222.4 \\ 0.232.5 \\ 0.42.4 \\ 0.742.74 (2.4)^a \\ 0.742.74 (2.4)^a \\ 0.742.35 (4.9)^a \\ 0.780.35 (4.9)^a \\ 0.775.45 \\ 0.$		1214.1	0.600 08	0.610 26	0.622.60	0.634 66	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		1400.5	0.592 90	0.003 30	0.014 27	0.020 00	
CHCL 1         CH 2 (14)         CH 3 (14) <thch (14)<="" 3="" th=""> <thch (14)<="" 3="" th=""> <thch< td=""><td>CHCIE</td><td>(P)</td><td>0.300.81 0.742.74 (2.4)<sup>a</sup></td><td>0.397 87</td><td>0.007 85</td><td>0.01707</td><td>8</td></thch<></thch></thch>	CHCIE	(P)	0.300.81 0.742.74 (2.4) <sup>a</sup>	0.397 87	0.007 85	0.01707	8
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	circii 2	95.4	0.74274(2.4)	0.700 33 (4.7)	0.820 40 (0.0)	0.847 02	0
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		283.1	0.709 79	0.735 19	0.762.02	0.794 50	
651.2         0.679 16         0.686 79         0.716 83         0.740 39           1022.4         0.658 75         0.675 96         0.690 51         0.706 68           1206.5         0.652 13         0.665 13         0.669 55         0.675 96           1390.7         0.643 33         0.666 13         0.669 55         0.669 20           147.47         0.636 38         0.649 07         0.659 98         0.673 90           128.31         0.966 55         0.995 96         1.029 6         1.064 4           68.6         0.950 16         0.975 24         1.004 3         1.035 2           65.12         0.936 60         0.929 61         1.039 2         0.992 89           1022.4         0.913 16         0.932 97         0.992 89         0.970 60           1206.5         0.904 79         0.922 12         0.942 26         0.950 14           1370.7         0.894 28         0.912 06         0.913 125         0.950 14           1206.5         0.949 77 0         0.427 92 (0.0) <sup>20</sup> 0.438 44 (0.4) <sup>20</sup> 0.449 90 (0.9) <sup>20</sup> 1206.5         0.991 77 (0.917 0         0.421 95         0.418 31         0.427 92 (0.0) <sup>20</sup> 1206.5         0.991 77 (0.917 0         0.430 60<		468.6	0.693 73	0.712.86	0.736 69	0.763 25	
836.9         0.669         0.00         0.686 79         0.702 59         0.702 29           1206.5         0.653 75         0.675 96         0.690 51         0.706 68           1200.5         0.652 13         0.664 38         0.679 53         0.669 20           1574.7         0.636 38         0.649 07         0.659 58         0.664 24           167.0         0.977 21 (1.2°         10.075 74 (4.8)         1.12 26 (8.3)°           283.1         0.966 55         0.995 94         1.023 6         1.064 4           64.6         0.950 16         0.995 974         0.985 01         1.011 9           836.9         0.924 42         0.995 74         0.995 28         0.992 28           1022.4         0.913 16         0.932 12         0.942 26         0.962 66           1390.7         0.849 428         0.912 06         0.931 25         0.950 14           1457.4         0.886 42         0.910 10         9.92 064         0.939 62           1390.7         0.487 73 0.997 78         0.443 84 (0.40 40         0.442 95           468.6         0.405 26         0.413 30         0.421 95         0.436 64           1390.7         0.888 33         0.439 77         0.436 64         0.424 25		651.2	0.679 16	0.698 09	0.716 83	0.740 39	
1022.4         0.658 75         0.679 96         0.690 51         0.706 68           1390.7         0.643 33         0.656 13         0.669 58         0.649 50           1574.7         0.636 38         0.649 07         0.659 98         0.673 90           (P,)         0.99 72 (1.2) <sup>a</sup> 1.03 43 (2.5) <sup>a</sup> 1.07 75 (4.8) <sup>a</sup> 1.12 62 (8.3) <sup>a</sup> 651.2         0.995 66         0.975 74         0.983 01         1.011 9           836.9         0.924 42         0.945 16         0.956 27         0.992 89           1022.4         0.914 16         0.932 70         0.954 21         0.976 60           1206.5         0.904 79         0.922 12         0.943 26         0.963 67           1206.5         0.904 79         0.922 12         0.943 26         0.963 67           1206.5         0.904 77         0.418 31         0.427 60         0.439 90 (0.9) <sup>a</sup> 283.1         0.410 55         0.418 31         0.427 60         0.439 90 (0.9) <sup>a</sup> 283.1         0.410 55         0.418 31         0.427 60         0.439 90 (0.9) <sup>a</sup> 283.1         0.410 91         0.417 22         0.418 97         0.423 64           1574.2         0.351 27         0.355 27 </td <td></td> <td>836.9</td> <td>0.669 00</td> <td>0.686 79</td> <td>0.702 69</td> <td>0.722 34</td> <td></td>		836.9	0.669 00	0.686 79	0.702 69	0.722 34	
1206.5         0.652 13         0.664 38         0.679 53         0.684 24           1574.7         0.636 38         0.649 07         0.659 95         0.684 24           1574.7         0.636 38         0.649 07         0.659 98         0.673 90           283.1         0.966 55         0.995 96         1.023 6         1.064 4           283.1         0.966 55         0.995 96         1.023 6         1.064 4           651.2         0.936 60         0.975 24         1.004 3         1.033 2           651.2         0.994 42         0.945 16         0.968 27         0.992 89           1206.5         0.994 79         0.922 12         0.942 26         0.966 64           1206.5         0.994 79         0.922 12         0.942 26         0.962 64           1574.2         0.886 42         0.903 01         0.920 64         0.939 62           283.1         0.409 55         0.418 31         0.421 36         0.424 90 (0.9) <sup>a</sup> 283.1         0.409 55         0.418 31         0.421 36         0.424 90 (0.9) <sup>a</sup> 283.1         0.404 50         0.411 92         0.418 97           1022.4         0.329 75         0.404 72         0.414 17           11574.2		1022.4	0.658 75	0.675 96	0.690 51	0.706 68	
1390.7         0.643 33         0.656 13         0.669 55         0.664 92           1574.7         0.636 38         0.649 07         0.659 98         0.673 90           CH <sub>3</sub> Cl         (P <sub>1</sub> )         0.99 72 (1.2 <sup>a</sup> )         1.03 43 (2.5 <sup>a</sup> )         1.07 75 (4.8) <sup>a</sup> 1.12 62 (8.3) <sup>a</sup> 468.6         0.950 16         0.976 24         1.004 3         1.035 2           651.2         0.936 60         0.959 74         0.985 01         1.011 9           836.9         0.924 42         0.945 16         0.956 27         0.992 89           1206.5         0.904 79         0.922 12         0.942 26         0.960 66           1206.5         0.904 79         0.922 12         0.942 26         0.960 66           1206.5         0.904 79         0.922 02         0.942 26         0.960 66           283.1         0.404 52         0.913 01         0.422 60         0.436 40 (0.4) <sup>a</sup> 283.1         0.405 26         0.418 31         0.427 60         0.436 90 (0.9) <sup>a</sup> 283.1         0.394 33         0.404 80         0.411 192         0.418 97           1206.5         0.391 78         0.404 80         0.411 192         0.418 97           1202.4         0.392 77		1206.5	0.652 13	0.664 38	0.679 53	0.695 00	
$ \begin{array}{c} {\rm CH}_{3} ({\rm C}, {\rm G}, {\rm $		1390.7	0.643 33	0.656 13	0.669 55	0.684 24	
$ \begin{array}{c c} CH_{3}Cl & (P_{3}) & 0.99\ 72\ (1.2)^{a} & 1.03\ 43\ (2.5)^{a} & 1.07\ 75\ (4.8)^{a} & 1.12\ 62\ (8.3)^{a} \\ & 468.6 & 0.950\ 16 & 0.975\ 24 & 1.029\ 6 & 1.064\ 4 \\ & 468.6 & 0.950\ 16 & 0.975\ 24 & 1.004\ 3 & 1.035\ 2 \\ & 651.2 & 0.936\ 60 & 0.959\ 74 & 0.985\ 01 & 1.011\ 9 \\ & 1.022\ 4 & 0.913\ 16 & 0.932\ 97 & 0.954\ 21 & 0.976\ 60 \\ & 1200.2 & 0.904\ 79 & 0.922\ 12 & 0.942\ 25 & 0.950\ 14 \\ & 1574.2 & 0.886\ 42 & 0.903\ 01 & 0.931\ 25 & 0.950\ 14 \\ & 1574.2 & 0.886\ 42 & 0.903\ 01 & 0.220\ 64 & 0.939\ 90\ (0.9)^{a} \\ & 283.1 & 0.409\ 55 & 0.418\ 31 & 0.427\ 60 & 0.436\ 64 \\ & 468.6 & 0.405\ 25 & 0.418\ 31 & 0.427\ 60 & 0.436\ 64 \\ & 468.6 & 0.405\ 25 & 0.418\ 31 & 0.427\ 60 & 0.448\ 90\ (0.9)^{a} \\ & 468.6 & 0.405\ 25 & 0.418\ 31 & 0.427\ 60 & 0.418\ 97 \\ & 1200.2 & 0.394\ 33 & 0.400\ 91 & 0.477 & 0.410\ 7 \\ & 1200.5 & 0.391\ 27 & 0.397\ 59 & 0.403\ 77 & 0.410\ 7 \\ & 1200.5 & 0.391\ 27 & 0.397\ 59 & 0.403\ 77 & 0.410\ 07 \\ & 1300.7 & 0.388\ 33 & 0.394\ 22 & 0.400\ 44 & 0.400\ 44 \\ & 1.61\ 9 & 0.422\ 86 \\ & 1574.2 & 0.385\ 59 & 0.391\ 28 & 0.397\ 72 & 0.402\ 86 \\ & CH_{3}Br & (P_{3}) & 0.547\ 66 & 0.557\ 71\ 0.545\ 53 & 0.557\ 63 & 0.579\ 49 \\ & 651.2 & 0.534\ 07 & 0.552\ 71\ 0.555\ 50\ 10 & 0.557\ 40 \\ & 1202.4 & 0.323\ 25 & 0.533\ 01 & 0.557\ 63 & 0.579\ 49 \\ & 651.2 & 0.514\ 0.522\ 74\ 0.535\ 50\ 0.557\ 63 & 0.557\ 94 \\ & 1202.4 & 0.524\ 84 & 0.538\ 89 & 0.550\ 10 & 0.561\ 48 \\ & 1202.4 & 0.524\ 84 & 0.538\ 89 & 0.550\ 10 & 0.561\ 48 \\ & 1202.4 & 0.524\ 84 & 0.538\ 89 & 0.550\ 10 & 0.561\ 48 \\ & 1202.4 & 0.524\ 84 & 0.538\ 89 & 0.550\ 10 & 0.561\ 48 \\ & 1202.4 & 0.524\ 814\ 0.653\ 73 & 0.669\ 213 & 0.652\ 30\ 0.775\ 41\ (1.1)^{a} \\ & 188 & 0.629\ 67\ 13 & 0.663\ 73 & 0.665\ 71\ 0.557\ 71\ 0.565\ 51\ 0.557\ 71\ 0.557\ 51\ 0.55$		1574.7	0.636 38	0.649 07	0.659 98	0.673 90	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	CH3C1	$(P_{o})$	0.99 72 (1.2) <sup>a</sup>	1.03 43 (2.5) <sup>a</sup>	1.07 75 (4.8) <sup>a</sup>	$1.12\ 62\ (8.3)^a$	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		283.1	0.966 55	0.995 96	1.029 6	1.064 4	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		468.6	0.950 16	0.976 24	1.004 3	1.035 2	
		651.2	0.936 60	0.959 74	0.985 01	1.011 9	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		836.9	0.924 42	0.945 16	0.968 27	0.992 89	
$ \begin{array}{c} 1206.3 \\ 1390.7 \\ 1390.7 \\ 1390.7 \\ 0.894 28 \\ 0.912 106 \\ 0.931 25 \\ 0.930 12 \\ 0.930 26 \\ 0.931 25 \\ 0.930 12 \\ 0.930 61 \\ 0.930 62 \\ 0.930 61 \\ 0.930 62 \\ 0.930 61 \\$		1022.4	0.913 16	0.932 97	0.954 21	0.976 60	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		1206.5	0.904 79	0.922 12	0.942 26	0.962 66	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		1590.7	0.894 28	0.912.06	0.931 25	0.950 14	
$ \begin{array}{c} Ch_{3} \mathbf{r} & (\mathbf{r}_{3}) & (0.41) + (0.1) & (0.42) + (0.418 + 31) & (0.42) + (0.47) + (0.474 + 50) & (0$	СНІ	(P)	0.00042 0.41773(0.1) <sup>a</sup>	0.903.01 0.427.02 (0.2) <sup>a</sup>	0.920.04 0.438.44 (0.4) <sup>a</sup>	0.939.02	
$C_{H_3}Br = \begin{pmatrix} 2.51 \\ 0.405 26 \\ 0.413 30 \\ 0.421 36 \\ 0.413 30 \\ 0.421 36 \\ 0.422 42 25 \\ 0.424 25 \\ 0.413 30 \\ 0.411 92 \\ 0.418 97 \\ 0.414 17 \\ 1022.4 \\ 0.394 33 \\ 0.400 91 \\ 0.407 72 \\ 0.414 17 \\ 1206.5 \\ 0.391 27 \\ 0.397 59 \\ 0.403 77 \\ 0.410 07 \\ 1390.7 \\ 0.388 33 \\ 0.394 22 \\ 0.400 44 \\ 0.406 40 \\ 0.406 40 \\ 0.577 47 \\ 0.99^2 2 \\ 0.400 44 \\ 0.406 40 \\ 0.402 86 \\ 0.590 70 \\ 468.6 \\ 0.540 28 \\ 0.522 70 \\ 0.555 40 \\ 0.575 40 \\ 0.595 92 (1.8)^a \\ 0.616 28 (3.3)^a \\ 283.1 \\ 0.547 66 \\ 0.560 73 \\ 0.575 50 \\ 0.575 40 \\ 0.590 70 \\ 468.6 \\ 0.540 28 \\ 0.522 70 \\ 0.555 61 \\ 0.579 49 \\ 0.575 40 \\ 0.590 70 \\ 468.6 \\ 0.540 28 \\ 0.522 71 \\ 0.545 53 \\ 0.575 40 \\ 0.597 40 \\ 0.597 40 \\ 0.595 40 \\ 0.575 40 \\ 0.590 70 \\ 0.561 48 \\ 0.022 4 \\ 0.523 25 \\ 0.533 01 \\ 0.543 53 \\ 0.575 40 \\ 0.597 40 \\ 0.597 40 \\ 0.535 51 \\ 0.577 40 \\ 0.597 40 \\ 0.535 51 \\ 0.577 41 \\ 0.592 48 \\ 0.522 71 \\ 0.533 21 \\ 0.533 01 \\ 0.543 66 \\ 0.554 41 \\ 0.527 71 \\ 0.537 77 \\ 0.547 34 \\ 0.522 74 \\ 0.533 216 \\ 0.533 36 \\ 0.554 40 \\ 0.533 36 \\ 0.552 49 \\ 0.533 36 \\ 0.754 41 \\ 0.595 \\ 0.581 \\ 0.622 34 \\ 0.633 73 \\ 0.669 71 \\ 0.668 52 \\ 0.669 71 \\ 0.668 59 \\ 0.661 83 \\ 0.671 1 \\ 0.685 95 \\ 0.620 10 \\ 0.633 46 \\ 0.661 83 \\ 0.671 1 \\ 0.685 95 \\ 0.620 10 \\ 0.633 46 \\ 0.661 83 \\ 0.671 1 \\ 0.685 95 \\ 0.621 1 \\ 0.685 95 \\ 0.621 1 \\ 0.633 44 \\ 0.615 81 \\ 0.622 34 \\ 0.633 14 \\ 0.633 73 \\ 0.669 71 \\ 0.668 59 \\ 0.661 83 \\ 0.671 1 \\ 0.685 95 \\ 0.620 10 \\ 0.633 44 \\ 0.631 40 \\ 0.621 49 \\ 0.613 79 \\ 0.623 53 \\ 0.634 47 \\ 0.685 95 \\ 0.621 1 \\ 0.634 47 \\ 0.615 80 \\ 0.621 69 \\ 0.621 49 \\ 0.613 79 \\ 0.623 53 \\ 0.634 47 \\ 0.638 44 \\ 0.593 74 \\ 0.608 29 \\ 0.616 80 \\ 0.627 49 \\ 0.613 40 \\ 0.621 69 \\ 0.621 69 \\ 0.621 49 \\ 0.613 79 \\ 0.623 53 \\ 0.634 47 \\ 0.608 29 \\ 0.616 80 \\ 0.621 49 \\ 0.613 40 \\ 0.621 69 \\ 0.621 69 \\ 0.621 69 \\ 0.621 69 \\ 0.621 69 \\ 0.621 69 \\ 0.621 69 \\ 0.621 69 \\ 0.602 12 \\ 0.698 5 \\ 0.987 0 \\ 0.608 1 \\ 0.028 1 \\ 0.028 1 \\ 0.028 1 \\ 0.028 1 \\ 0.028 1 \\ 0.028 1 \\ 0.028 1 \\ 0.028 1 \\ 0.028 1 \\ 0.048 1 \\ 0.028 1 \\ 0.048 1 \\ 0.048 1 \\ 0.048 1 \\ 0.048 1 \\ 0.048 1$	C11 <sub>3</sub> 1	2831	0.419 55	0.427 32 (0.2) 0.418 31	0.437 60	0.436 64	
$ \begin{array}{c} \mathbf{C}_{\mathbf{H}_3} \mathbf{B}_1 & \mathbf{C}_1 \mathbf{B}_2 & \mathbf{C}_1 \mathbf{A}_1 \mathbf{B}_2 & \mathbf{C}_1 \mathbf{A}_1 \mathbf{B}_2 \\ \mathbf{B}_1 \mathbf{C}_2 \mathbf{A}_1 & \mathbf{C}_2 \mathbf{A}_1 & \mathbf{C}_2 \mathbf{A}_1 \\ \mathbf{D}_2 \mathbf{C}_1 & \mathbf{C}_2 \mathbf{A}_1 & \mathbf{C}_2 \mathbf{A}_1 \\ \mathbf{D}_2 \mathbf{C}_1 & \mathbf{C}_2 \mathbf{A}_1 & \mathbf{C}_2 \mathbf{A}_1 \\ \mathbf{D}_2 \mathbf{C}_1 & \mathbf{C}_2 \mathbf{A}_1 & \mathbf{C}_2 \mathbf{A}_1 \\ \mathbf{D}_2 \mathbf{C}_1 & \mathbf{C}_2 \mathbf{A}_1 & \mathbf{C}_2 \mathbf{A}_1 \\ \mathbf{D}_2 \mathbf{C}_1 & \mathbf{C}_2 \mathbf{A}_2 & \mathbf{C}_2 \\ \mathbf{C}_1 \mathbf{B}_1 & \mathbf{C}_2 \mathbf{C}_2 & \mathbf{C}_2 \mathbf{C}_2 & \mathbf{C}_2 \mathbf{C}_2 \\ \mathbf{C}_1 \mathbf{B}_2 & \mathbf{C}_2 \mathbf{C}_2 & \mathbf{C}_2 \mathbf{C}_2 & \mathbf{C}_2 \mathbf{C}_2 \\ \mathbf{C}_1 \mathbf{B}_2 & \mathbf{C}_2 \mathbf{C}_2 & \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 \\ \mathbf{C}_1 \mathbf{B}_2 & \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 & \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 \\ \mathbf{C}_1 \mathbf{C}_2 \mathbf{C}_2 & \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 \\ \mathbf{C}_2 \mathbf{C}_3 \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 \mathbf{C}_2 \\ \mathbf{C}_3 \mathbf{C}_2 \\ \mathbf{C}_3 \mathbf{B}_2 & \mathbf{C}_2 $		468.6	0.405 26	0 413 30	0.421 36	0.429.96	
$ \begin{array}{c} 836.9 & 0.397\ 78 & 0.404\ 50 & 0.411\ 92 & 0.418\ 97 \\ 1022.4 & 0.394\ 33 & 0.400\ 91 & 0.407\ 72 & 0.414\ 17 \\ 1206.5 & 0.391\ 127 & 0.397\ 59 & 0.403\ 77 & 0.410\ 07 \\ 1390.7 & 0.388\ 33 & 0.394\ 22 & 0.400\ 44 & 0.406\ 40 \\ 1574.2 & 0.385\ 69 & 0.391\ 28 & 0.397\ 24 & 0.402\ 86 \\ CH_{_{9}}Br & (\mathcal{P}_{_{0}}) & 0.560\ 60\ (0.4)^a & 0.577\ 47\ (0.9)^a & 0.595\ 92\ (1.8)^a & 0.616\ 28\ (3.3)^a \\ 283.1 & 0.547\ 66 & 0.560\ 73 & 0.575\ 40 & 0.597\ 94 \\ 651.2 & 0.534\ 07 & 0.555\ 27 & 0.556\ 56\ 11 & 0.579\ 49 \\ 651.2 & 0.534\ 07 & 0.554\ 53 & 0.557\ 63 & 0.570\ 35 \\ 836.9 & 0.528\ 48 & 0.538\ 89 & 0.550\ 01 & 0.561\ 48 \\ 1206.5 & 0.519\ 00 & 0.527\ 71 & 0.537\ 77 & 0.547\ 34 \\ 1390.7 & 0.514\ 51 & 0.522\ 74 & 0.533\ 77 & 0.547\ 34 \\ 1390.7 & 0.514\ 51 & 0.522\ 74 & 0.537\ 77 & 0.547\ 34 \\ 1390.7 & 0.514\ 51 & 0.522\ 74 & 0.532\ 669\ 71 & 0.535\ 36\ (0.541\ 33 \\ 1574.2 & 0.510\ 57 & 0.518\ 28 & 0.526\ 49 & 0.535\ 36\ (0.541\ 33 \\ 1574.2 & 0.510\ 57 & 0.664\ 382 & 0.667\ 718 & 0.667\ 91 \\ 968 & 0.609\ 25 & 0.620\ 10 & 0.630\ 46 & 0.665\ 91 \\ 744 & 0.663\ 87 & 0.613\ 88 & 0.627\ 13 & 0.638\ 50 & 0.661\ 83 \\ 968 & 0.609\ 25 & 0.620\ 10 & 0.630\ 46 & 0.642\ 49 \\ 1161 & 0.694\ 42 & 0.603\ 00 & 0.611\ 34 & 0.621\ 69 \\ 744 & 0.698\ 74 & 0.608\ 29 & 0.616\ 80 & 0.627\ 49 \\ 1547 & 0.594\ 42 & 0.603\ 00 & 0.611\ 34 & 0.621\ 69 \\ 744 & 0.698\ 5 & 0.998\ 5 & 1.020\ 4 & 1.043\ 2 \\ 744 & 0.998\ 5 & 0.998\ 5 & 1.020\ 4 & 1.043\ 2 \\ 744 & 0.968\ 5 & 0.998\ 5 & 1.020\ 4 & 1.043\ 2 \\ 744 & 0.968\ 5 & 0.998\ 5 & 1.020\ 4 & 1.043\ 2 \\ 744 & 0.968\ 5 & 0.998\ 5 & 1.020\ 4 & 1.043\ 2 \\ 744 & 0.968\ 5 & 0.998\ 5 & 1.020\ 4 & 1.043\ 2 \\ 744 & 0.968\ 5 & 0.998\ 5 & 1.020\ 4 & 1.043\ 2 \\ 744 & 0.968\ 5 & 0.988\ 0 & 1.008\ 1 & 1.028\ 2 \\ 744 & 0.968\ 5 & 0.988\ 0 & 1.008\ 1 & 1.028\ 2 \\ 744 & 0.968\ 5 & 0.988\ 0 & 1.008\ 1 & 1.028\ 2 \\ 744 & 0.968\ 5 & 0.988\ 0 & 1.008\ 1 & 1.028\ 2 \\ 744 & 0.968\ 5 & 0.988\ 0 & 1.008\ 1 & 1.028\ 2 \\ 744 & 0.996\ 5 & 0.988\ 0 & 1.008\ 1 & 1.008\ 1 & 1.004\ 5 \\ 744 & 0.996\ 5 & 0.988\ 0 & 1.008\ 1 & $		651.2	0.401 36	0.408 84	0.416 19	0.424 25	
$ \begin{array}{c} 1022.4 \\ 1022.4 \\ 1206.5 \\ 1390.7 \\ 1390.7 \\ 1390.7 \\ 0.388 \\ 33 \\ 0.391 \\ 22 \\ 0.397 \\ 59 \\ 0.403 \\ 77 \\ 0.400 \\ 40 \\ 40 \\ 40 \\ 40 \\ 40 \\ 40 \\$		836.9	0.397 78	0.404 50	0.411 92	0.418 97	
$ \begin{array}{c} 1206.5 \\ 1390.7 \\ 1390.7 \\ 1574.2 \\ 0.388 33 \\ 0.394 22 \\ 0.400 44 \\ 0.400 44 \\ 0.406 40 \\ 0.597 24 \\ 0.400 286 \\ 0.402 86 \\ 0.400 286 \\ 0.397 24 \\ 0.400 286 \\ 0.402 86 \\ 0.402 86 \\ 0.597 24 \\ 0.402 86 \\ 0.402 86 \\ 0.597 24 \\ 0.402 86 \\ 0.590 70 \\ 0.550 01 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.570 35 \\ 0.571 30 \\ 0.571 30 \\ 0.571 30 \\ 0.571 30 \\ 0.571 30 \\ 0.574 34 \\ 0.522 71 \\ 0.531 30 \\ 0.554 01 \\ 0.541 33 \\ 0.526 49 \\ 0.535 36 \\ 0.535 36 \\ 0.551 28 \\ 0.520 40 \\ 0.551 28 \\ 0.520 40 \\ 0.551 28 \\ 0.572 95 \\ 581 \\ 0.622 34 \\ 0.634 79 \\ 0.647 26 \\ 0.661 83 \\ 0.72 95 \\ 581 \\ 0.622 34 \\ 0.634 79 \\ 0.647 26 \\ 0.661 83 \\ 0.72 95 \\ 581 \\ 0.622 34 \\ 0.631 79 \\ 0.638 40 \\ 0.661 24 \\ 0.631 79 \\ 0.638 40 \\ 0.661 24 \\ 0.631 79 \\ 0.638 50 \\ 0.651 28 \\ 0.660 12 \\ 0.661 83 \\ 0.72 95 \\ 581 \\ 0.521 \\ 0.5$		1022.4	0.394 33	0.400 91	0.407 72	0.414 17	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		1206.5	0.391 27	0.397 59	0.403 77	0.410 07	
$ \begin{array}{c} {\rm CH}_3 {\rm Br} & (P_o) & 0.385  69 & 0.391  28 & 0.397  24 & 0.402  86 \\ {\rm CH}_3 {\rm Br} & (P_o) & 0.560  60  (0.4)^a & 0.577  47  (0.9)^a & 0.595  92  (1.8)^a & 0.616  28  (3.3)^a \\ 283.1 & 0.547  66 & 0.560  73 & 0.575  50 & 0.599  70 \\ 468.6 & 0.540  28 & 0.552  70 & 0.565  61 & 0.579  49 \\ 651.2 & 0.534  07 & 0.545  53 & 0.557  63 & 0.570  35 \\ 836.9 & 0.528  48 & 0.538  89 & 0.550  01 & 0.561  48 \\ 1022.4 & 0.523  25 & 0.533  01 & 0.543  66 & 0.554  01 \\ 1206.5 & 0.519  00 & 0.527  71 & 0.537  77 & 0.547  34 \\ 1390.7 & 0.514  51 & 0.522  74 & 0.532  16 & 0.541  33 \\ 1574.2 & 0.510  57 & 0.518  28 & 0.526  49 & 0.535  36 \\ {\rm C}_2 {\rm H}_9 {\rm Br} & (P_o) & 0.648  45  (0.1)^a & 0.666  43  (0.2)^a & 0.685  23  (0.5)^a & 0.705  41  (1.1)^a \\ 190 & 0.638  14 & 0.653  73 & 0.669  71 & 0.688  59  55 \\ 388 & 0.629  67 & 0.643  82 & 0.657  38 & 0.672  95 \\ 581 & 0.622  34 & 0.634  79 & 0.647  26 & 0.661  83 \\ 774 & 0.615  88 & 0.627  13 & 0.638  50 & 0.651  28 \\ 968 & 0.609  25 & 0.620  10 & 0.630  46 & 0.642  49 \\ 1161 & 0.604  19 & 0.613  79 & 0.623  53 & 0.631  47 \\ 13547 & 0.594  42 & 0.603  00 & 0.611  34 & 0.621  69 \\ 774 & 0.615  88 & 0.627  13 & 0.618  80 & 0.627  49 \\ 1547 & 0.594  42 & 0.603  00 & 0.611  34 & 0.621  69 \\ 774 & 0.968  5 & 0.998  5 & 1.020  4 & 1.043  2 \\ 774 & 0.968  5 & 0.998  5 & 1.020  4 & 1.043  2 \\ 774 & 0.968  5 & 0.998  5 & 1.020  4 & 1.043  2 \\ 774 & 0.968  5 & 0.998  5 & 1.020  4 & 1.043  2 \\ 774 & 0.968  5 & 0.998  5 & 1.020  4 & 1.043  2 \\ 774 & 0.968  5 & 0.998  5 & 1.020  4 & 1.043  2 \\ 774 & 0.968  5 & 0.998  8 & 0 & 1.008  1 & 1.028  2 \\ 768 & 0.9597  7 & 0.979  1 & 0.997  1 & 1.015  1 \\ 161 & 0.952  0 & 0.969  6 & 0.987  0 & 1.004  6 \\ 1354 & 0.944  6 & 0.961  2 & 0.978  1 & 0.994  9 \\ 1547 & 0.337  7 & 0.954  4 & 0.970  3 & 0.986  1 \\ \end{array}$		1390.7	0.388 33	0.394 22	0.400 44	0.406 40	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		1574.2	0.385 69	0.391 28	0.397 24	0.402 86	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	CH 3Br	$(P_0)$	0.560 60 (0.4) <sup>a</sup>	0.577 47 (0.9) <sup>a</sup>	0.595 92 (1.8) <sup>a</sup>	0.616 28 (3.3) <sup>a</sup>	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		283.1	0.547 66	0.560 73	0.575 40	0.590 70	
$ {                                   $		468.6	0.540 28	0.552 70	0.565 61	0.579 49	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		651.2	0.534 07	0.545 53	0.557 63	0.570 35	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		836.9	0.528 48	0.538 89	0.550 01	0.561 48	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		1022.4	0.52325	0.533 01	0.543 66	0.554 01	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		1200.5	0.519 00	0.527 71	0.537 17	0.54/ 54	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		1574 2	0.514 51	0.522 74	0.532 10	0.341 33	
$C_{11,01} = (1,0) = (1,0,0,0) = (1,0,0,0) = (1,0,0,0) = (1,0,0,0) = (1,0,0,0) = (1,0,0,0) = (1,0,0,0) = (1,0,0,0) = (1,0,0,0) = (1,0,0,0) = (1,0,0,0) = (1,0,0,0,0) = (1,0,0,0,0) = (1,0,0,0,0) = (1,0,0,0,0) = (1,0,0,0,0,0) = (1,0,0,0,0,0,0) = (1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0$	CHB	(P)	0.51057 0.648.45 (0.1) <sup>a</sup>	$0.510\ 20$	0.520 45	0.333350 0.705 41 (1.1) <sup>a</sup>	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	0,11,521	194	0.638.14	0.653 73	0.669 71	0.685 95	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		388	0.629 67	0.643 82	0.657 38	0.672 95	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		581	0.622 34	0.634 79	0.647 26	0.661 83	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		774	0.615 88	0.627 13	0.638 50	0.651 28	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		968	0.609 25	0.620 10	0.630 46	0.642 49	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		1161	0.604 19	0.613 79	0.623 53	0.634 47	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		1354	0.598 74	0.608 29	0.616 80	0.627 49	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	<b></b>	1547	0.594 42	0.603 00	0.611 34	0.621 69	
1941.002 81.025 91.052 11.079 53880.990 11.011 51.035 01.060 05810.978 50.998 51.020 41.043 27740.968 50.988 01.008 11.028 29680.959 70.979 10.997 11.015 111610.952 00.969 60.987 01.004 613540.944 60.961 20.978 10.994 915470.937 70.954 40.970 30.986 1	CH3COOCH3	$(P_0)$	$1.0175(0.0_3)^a$	$1.0430(0.1)^{a}$	$1.072.7(0.2)^a$	$1.105\ 6\ (0.5)^a$	
388       0.990 1       1.011 5       1.035 0       1.060 0         581       0.978 5       0.998 5       1.020 4       1.043 2         774       0.968 5       0.988 0       1.008 1       1.028 2         968       0.959 7       0.979 1       0.997 1       1.015 1         1161       0.952 0       0.969 6       0.987 0       1.004 6         1354       0.944 6       0.961 2       0.978 1       0.994 9         1547       0.937 7       0.954 4       0.970 3       0.986 1		194	1.002 8	1.025 9	1.052 1	1.0795	
581         0.9785         0.985         1.0204         1.0432           774         0.9685         0.9880         1.0081         1.0232           968         0.9597         0.9791         0.9971         1.0151           1161         0.9520         0.9696         0.9870         1.0046           1354         0.9446         0.9612         0.9781         0.9949           1547         0.9377         0.9544         0.9703         0.9861		388	0.990 1	1.011 5	1.035 0	1.060 0	
968       0.959 7       0.979 1       0.997 1       1.018 1         1161       0.952 0       0.969 6       0.987 0       1.004 6         1354       0.944 6       0.961 2       0.978 1       0.994 9         1547       0.937 7       0.954 4       0.970 3       0.986 1		581 774	0.9/83	0.998 0	1.020 4	1.0432	
1161         0.957 f         0.979 f         0.977 f         1.013 f           1161         0.952 0         0.969 6         0.987 0         1.004 6           1354         0.944 6         0.961 2         0.978 1         0.994 9           1547         0.937 7         0.954 4         0.970 3         0.986 1		068	0.908 3	0.900 0	1.008 1	1.020 2	
1354         0.944 6         0.961 2         0.978 1         0.994 9           1547         0.937 7         0.954 4         0.970 3         0.986 1		1161	0.952.0	0.969.6	0.987 0	1 004 6	
1547 0.937 7 0.954 4 0.970 3 0.986 1		1354	0.944 6	0.961 2	0.978 1	0.994 9	
		1547	0.937 7	0.954 4	0.970 3	0.986 1	

<sup>a</sup> Saturated vapor pressure.

CH<sub>3</sub>Br and C<sub>2</sub>H<sub>5</sub>Br, Tokyo Kasei Kogyo Co., Ltd., Japan, 99.8 and 99%, respectively; CH<sub>3</sub>COOCH<sub>3</sub>, Nakarai Chemicals, Ltd., Japan, 97.0%. These samples were subjected to further purification by distillation before use, and the reagent grade mercury was purified by a modified automatic mercury washer (*1*).

**Apparatus and Method.** The method used in this study was similar to one presented earlier (10), but the volume changes of liquids at high pressures were measured by a modified glass piezometer as shown in Figure 1. The glass piezometer used previously had the fault that air may be introduced into the piezometer during the removal of it from a vacuum line. The



Figure 1. Glass piezometers: A, joint in vacuum line; B, screw; C, spring; D, O-ring; E, float; F, glass indicator; G, pressure vessel; H, mercury.

joint of this piezometer was modified for sampling in vacuo. I in Figure 1 indicates the piezometer under its connection with the vacuum line. As the piezometer filled with the liquid is removed from the line, the float (E) and the screw (B) are raised by the action of spring (C), and at last the float is tightly contacted with the O-ring (D) as shown in Figure 1, II. The specific volumes of liquids at high pressures are determined in a similar manner reported earlier after removing the screw and the spring from the float (see III in Figure 1). The saturated liquid volumes except for CCI<sub>2</sub>F<sub>2</sub> and CHCIF<sub>2</sub> were determined directly using the same piezometer placed in the thermostat by the usual method.

The volume data for H<sub>2</sub>O at 25 °C and up to 1000 atm show agreement with the data of the literature (9) within the limits of accuracy of measurement (0.06%).

## **Result and Discussion**

The specific volumes at four temperatures, -20, 0, 20, and 40 °C, were determined from the saturated vapor pressures to near 1600 atm. The specific volumes for seven liquids are presented in Table I. The maximum deviation from the smooth curves is  $0.13\,\%$  over the whole range of measurements. There are sources of P-V-T data for CHClF<sub>2</sub> (13), CH<sub>3</sub>Cl (7), CH<sub>3</sub>I (5), and  $C_2H_5Br$  (2, 4, 12), but the direct comparison of the present results with those is impossible because temperatures and pressures differ.

Many P-V-T data for liquids have been represented by the Tait equation (6), which may be written in the form

$$V_P = V_0(1 - C \ln [(B + P)/(B + P_0)])$$

The Tait parameters B and C were computed for each isotherm by a least-squares method fit to the P-V-T data and listed in

Table II. Tait Parameters, B and C

				, a	Max
<b>c</b> , <b>m</b>	°c n	,	AV	' dev,"	dev,
Compound T,	С В,	atm	<u> </u>	%	%
$CCl_{2}F_{2}$ -2	0.00	394 0	.0888	0.07	0.19
• •	0.00	285		0.07	0.17
2	0.00	197		0.04	0.10
4	0.00	125		0.08 -	-0.20
CHClF <sub>2</sub> -2	0.00	460 0	.0963	0.10	0.17
-	0.00	325	(	0.12 -	-0.21
2	0.00	214		0.08 -	-0.19
4	0.00	126		0.06	0.13
CH₃Cl −2	0.00	791 0	.1014	0.03 -	-0.13
	0.00	626		0.02	0.05
2	0.00	485		0.05 -	-0.12
4	0.00	368		0.04 -	-0.09
CH <sub>3</sub> I –2	0.00 1	.275 0	.0953	0.02	0.05
	0.00 1	.085		0.03 -	-0.05
2	0.00	936		0.03	±0.05
4	0.00	786		0.02 -	-0.04
CH <sub>3</sub> Br –2	0.00 1	020 0	.0956	0.02	0.04
	0.00	822	1	0.03 -	-0.08
2	0.00	670		0.05 -	-0.13
4	0.00	536		0.07 -	-0.16
$C_2H_sBr = -2$	0.00 1	085 0	.0942	0.03	0.05
	0.00	887		0.01 -	-0.05
2	0.00	722		0.02 -	-0.05
4	0.00	610		0.06 -	-0.18
CH <sub>3</sub> COOCH <sub>3</sub> -2	0.00 1	1063 0	.0874	0.02 -	-0.04
	0.00	938		0.03	0.07
2	0.00	779		0.02	±0.02
4	0.00	631		0.03	±0.07

<sup>a</sup> Average deviation =  $\sum_{n=1}^{n} \frac{(|(V_{calcd} - V_{exptl})/V_{exptl}| \times 100)/n}{V_{calcd}}$ .  $N_{calcd}$ ,  $V_{exptl}$  = specific volumes calculated by the Tait equation with parameters B and C in Table II and experimental values, respectively.

Table II. The specific volume at the saturated vapor pressure,  $P_0$ , was chosen as  $V_0$  in this evaluation. It has previously been reported (11) that the C value for NH3 became constant in the lower temperatures and decreased in the neighborhood of the critical temperature. The C values for other liquids, as well as NH<sub>3</sub>, were regarded as constant at experimental temperatures far from the critical temperature. Also, the average and the maximum deviation of the calculated values by the equation against the experimental data are indicated in Table II.

# Glossary

- B, C Tait equation parameters
- Р pressure, atm
- $P_0$ saturated vapor pressure, atm
- $V_0, V_P$ specific volumes at pressures, Po and P atm, respectively, cm<sup>3</sup>/g

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