It was shown that at $p \rightarrow 0$ and $N_1 \ll N_2$

$$\log \frac{f_1}{N_1} = \log f_1^o + \frac{v_1}{4.58T} \left(\frac{\sqrt{a_1}}{v_1} - \frac{\sqrt{a_2}}{v_2} \right)^2_{p=0} = \log K \qquad (4)$$

where $\left(\frac{\sqrt{a_1}}{v_1} - \frac{\sqrt{a_2}}{v_2} \right)^2_{p=0}$ refers to zero pressure. The calculation carried out according to eqn. (3) shewed[10] that the value of $\left(\frac{\sqrt{a_1}}{v_1} - \frac{\sqrt{a_2}}{v_2} \right)^2$ increased with the pressure.

In the present communication we shall try to discuss the dependence of this quantity on the pressure and hence work out in addition the theory of regular solutions on the basis of concentrated solutions of gases in non-polar solvents at high pressures.

To this end we calculate, as in eqn. (2), the change of f_1 with pressure increase and substitute the molar volumes in Hildebrand's equation by the partial molar volumes.

Hence we obtain an equation expressing not only the dependence of $\log f_1/N_1$ value on the pressure but also on the concentration:-

$$\log \frac{f_1}{N_1} = \log f_1^o + \frac{\overline{v}_1}{4.58T} \left(\frac{N_2 \overline{v}_2}{N_1 \overline{v}_1 + N_2 \overline{v}_2} \right)^2 \left(\frac{a_1}{\overline{v}_1} - \frac{a_2}{\overline{v}_2} \right)^2_{p=0} + \frac{\overline{v}_1 (p-p_2^o)}{2.303 RT} \qquad (5)$$

924 Comparison between eqns. (3) and (5) leads to:-

$$\left(\frac{\sqrt{a_1}}{\overline{v}_1} - \frac{\sqrt{a_2}}{\overline{v}_2} \right)^2_p = \left(\frac{\sqrt{a_1}}{\overline{v}_1} - \frac{\sqrt{a_2}}{\overline{v}_2} \right)^2_{p=0} + \frac{1.982}{82.07} (p-p_2^o) \left(\frac{N_1 \overline{v}_1 + N_2 \overline{v}_2}{N_2 \overline{v}_2} \right)^2 \qquad (6)$$

The partial molar volume of the dissolved hydrogen was equated by us to the molar volume of liquid hydrogen at $p = 1$ atm. (as appears probable from the data of Table III). The same goes for the partial molar volume of the solvent. The hypothesis was also advanced of the independence of $\overline{v}_1$ and $\overline{v}_2$ of p and N. If the values of $\overline{v}_1$ and $\overline{v}_2$ are correctly chosen and the assumption is valid, it is evident that we obtain with graphical representation of the values calculated from experimental data of

$({}^{a_1}/\overline{v}_1 - {}^{a_2}/\overline{v}_2)^2_p$ against $(p-p_2^o) \left(\frac{N_1 \overline{v}_1 + N_2 \overline{v}_2}{N_2 v_2} \right)^2$ a straight line with the slope:-

$$\beta = 1.982/82.07 = 0.02415$$

From the intercept of this line with the ordinate, the Henry coefficient at p, $N_1 \rightarrow 0$ is calculated.

We tested the applicability of eqn. (5) with the data on the equilibrium H_2-CO[1] at 68.1°, 73.1° and 83.1°K up to 200-225 atm. and 40.1% hydrogen content, H_2-N_2[1] at 63.1°, 68.1° and 78.1°K up to 160-215 atm. and 37.9% H_2, H_2-CH_4[5] at 90.3° and 110°K up to 190-220 atm. and 15.6% H_2 and H_2-C_2H_4 at 188.1°K up to 50 atm. and 3.6% H_2.

In the following table are shown, by way of example, the data for the system H_2-N_2. The f_{H_2} value was calculated according to the Lewis-Randall rule and $f^o_{H_2}$ as in the previous paper.[10] The calculating of the fugacities was taken from Newton diagrams.[13]