

MASS LAW STUDIES, I

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When salts are precipitated by alcohol the exponent in the Mass Law formula is independent of the temperature so far as is yet known. There have been no experiments made to show whether this is or is not true when both the two non-miscible substances are liquids at the temperature of the experiment. For this reason I have determined the conditions of equilibrium for benzene, water and ethyl alcohol at three temperatures. The benzene used was dried over sodium and subjected to fractional distillation; the alcohol was treated with copper sulfate; the water was the distilled water of the laboratory. In all cases five cubic centimeters of alcohol were taken. The experiments were made in test tubes, one, two, three, four and five cubic centimeters of benzene being added to the five cubic centimeters of alcohol and water run until the

TABLE I
Temperature 20°
 $x^{1.85}y = C \log C = 0.775$

y found	y calc.	x found	x calc.	$\log C$
5.00		1.08	1.10	0.761
4.00		1.25	1.24	0.778
3.00		1.47	1.45	0.786
2.00		1.80	1.80	0.773
1.65	1.65	2.00	2.00	0.774
1.00	1.02	2.60	2.63	0.768
0.77	0.78	3.00		0.768
0.46	0.46	4.00		0.778
0.31	0.30	5.00		0.784

solutions were saturated. To obtain the remaining data two, three, four and five cubic centimeters of water were added to the alcohol and benzene run in to saturation. The temperatures were kept con-

stant by means of a Reichert gas regulator. The data are given in Tables I-III. In the formula x denotes cubic centimeters of water,

TABLE II

Temperature 25°

$$x^{1.85}y = C \quad \log C = 0.812$$

y found	y calc.	x found	x calc.	$\log C$
5.00		1.15	1.15	0.811
4.00		1.31	1.30	0.818
3.00		1.51	1.52	0.807
2.00		1.90	1.89	0.815
1.75	1.80	2.00	2.03	0.800
1.00	1.00	2.75	2.75	0.812
0.85	0.85	3.00		0.811
0.50	0.50	4.00		0.814
0.32	0.33	5.00		0.798

y cubic centimeters of benzene in five cubic centimeters of alcohol. Under the heading «calc» are the values required by the formula for the «found» values of the other components, C being given. In

TABLE III

Temperature 35°

$$x^{1.85}y = C \quad \log C = 0.890$$

y found	y calc.	x found	x calc.	$\log C$
5.00		1.26	1.27	0.884
4.00		1.43	1.43	0.887
3.00		1.68	1.68	0.894
2.15	2.15	2.00	2.00	0.889
2.00	1.97	2.10	2.08	0.882
1.03	1.02	3.00		0.895
0.62	0.60	4.00		0.907
0.42	0.39	5.00		0.916

the fifth column are the values obtained by substituting the experimental data in the formula and solving for $\log C$.

The experiments at the three temperatures can be represented

by a single equation, in which the exponent is independent of the temperature and only the equilibrium constant changes. It is not safe to generalize from this one experiment and to conclude that the exponent is independent of the temperature with all pairs of non-miscible liquids; but it makes such a conclusion not impossible. In the application of the Mass Law to chemical reactions it is well known that the exponents do not change with the temperature. If the same relation should be shown to hold for physical reactions, it would simplify the task of determining the significance of the exponential term.

Professor Bancroft has published a series of measurements for the system, benzene, water and alcohol, at 20° . His results could be expressed by the general formula $x^n y = C$; but he found that $n = 1.60$ while my measurements are best represented on the assumption that $n = 1.85$. There is also a great difference in the absolute solubilities, my alcohol apparently having a much greater solvent power than his. The cause of this discrepancy will be the subject of further investigation.

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