Magnetic Susceptibilities of Nitric Acid Solutions.

WE have determined the magnetic susceptibilities of HNO_3 solutions for over thirteen concentrations between 4 and 65%, employing a modified form of the Quincke method with photographic recording arrangement, developed by one of us.[1] The advantage of the photographic method lies in the fact that it enables simultaneous and nearly instantaneous records to be obtained for both the standard and comparison liquids, thus eliminating errors due to non-prevalence of identical conditions.

The susceptibility-concentration curve, as shown in the figure, indicates marked departure from the linear relation. As each point on the curve represents the average of a number of readings which agree to within 0·1%, it is believed that these departures from linearity are genuine. The best line drawn through the points cuts the susceptibility axis at a point corresponding to the value of $-0{\cdot}668 \times 10^{-6}$ for water in solution, which is lower than that for water in the pure state ($-0{\cdot}72 \times 10^{-6}$). The gram-ionic

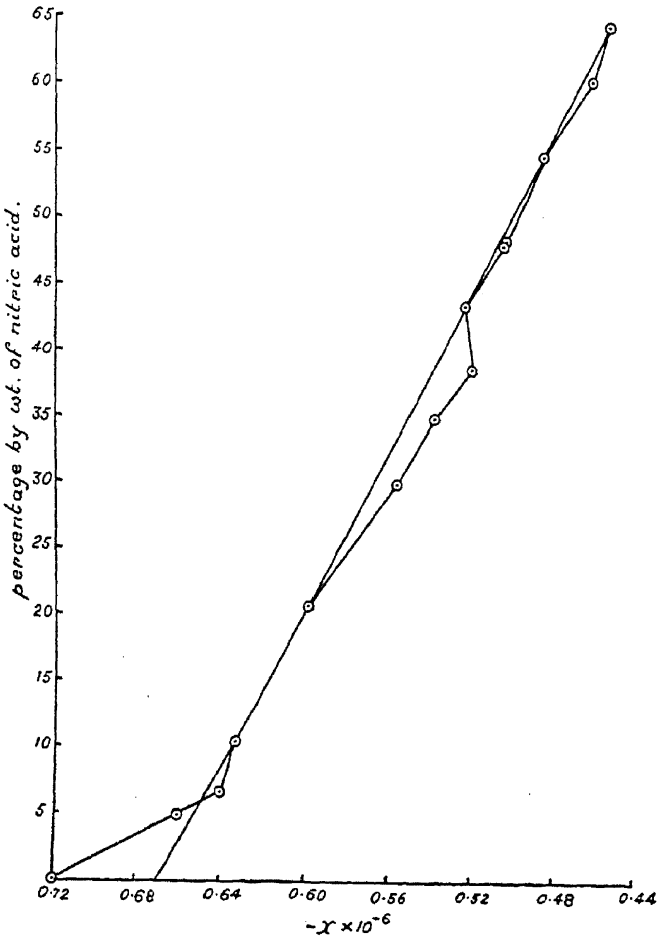

Fig. 1.

susceptibility of the NO_3 ion is found to be $-20{\cdot}83 \times 10^{-6}$ which agrees with the value of $-20{\cdot}1 \times 10^{-6}$ as given by Kido[2] but differs considerably from the value of -38×10^{-6} as calculated by Pauling.[3]

The curve shows four definite minima, corresponding to the compositions, $HNO_3 + 50\ H_2O$, $HNO_3 + 6\ H_2O$, $HNO_3 + 4\ H_2O$, and $2\ HNO_3 + 5\ H_2O$. Although the first minimum cannot be easily accounted for, the other three departures may be attributed to the formation of definite molecular complexes. The existence of such complexes or hydrates has also been indicated by other physico-chemical data, such as freezing point determinations, conductivity, etc. It may be pointed out that the deviations in the case of the last two hydrates are considerably less than those in the first two. This may be explained on the assumption that water which is known to exist in the form of associated molecules is depolymerised at higher concentrations and that the increase in susceptibility resulting from this depolymerisation partly compensates for the decrease, due to the formation of hydrates. Fuller details will be published elsewhere.

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[1] *Indian J. Phys.*, 1931, **6**, 421.
[2] *Sci. Rep. Tohoku Univ.*, 1932. **21**, 149.
[3] *Proc. Roy. Soc.*, 1927, **114**, 181.

The Temperature Coefficient of Susceptibility of Tetra Hydro-Naphthalene.

THE diamagnetic susceptibility of Tetra hydro-naphthalene has been studied at different temperatures, ranging from 23° C. to 25° C., using the Quincke method, with large magnetic fields. The electromagnet used was a large one of the Dubois type. In the experiments, currents used were within 7 amps. and the heating was not appreciable. Care was taken to maintain the current at a particular point. This was effected by having a travelling microscope focussed, on the pointer of an ammeter and any variation of the pointer was corrected by the adjustment of the current, by altering a resistance in parallel with the main circuit.

The tube was thoroughly cleaned first with benzene and then with sodium hydroxide, hot distilled water, and then concentrated nitric acid, and finally with hot distilled water.

The tetralene used in this investigation was kindly supplied in a pure state by Dr. M. Govinda Rau, of the Indian Institute of Science. The tube was filled with the liquid, evacuated and sealed. For observing the depression, a micro-meter eye-piece was used and the usual precautions taken.

The absolute value of susceptibility as determined from the mean of several readings is $-\cdot 688 \times 10^{-6}$. Values were taken at different field strengths and there was no variation with field strength, showing that there was no ferromagnetic impurity.

It is well known that this liquid is highly associated at ordinary temperatures and, therefore, it was thought interesting to study the effect of temperature on this compound. Nitro-benzene and other heavily associated organic liquids have been studied by Dr. Rao and Varadachari,[1] Bhatnagar[2] and Fahlenbrach[3] and the results are not concordant. Dr. Rao has found no change in the susceptibility value, while others find a decrease.

The boiling point of this liquid being 207·8° C., I studied the susceptibility of this liquid, in the range of temperature 23° C. to 70° C. At every temperature, the readings were taken several times and the mean taken as the correct value. It was found that there is no temperature effect on the susceptibility. This is in agreement with Dr. Rao's results that the break-up of association does not produce any change in the susceptibility.

In conclusion, I wish to record my grateful indebtedness to Prof. B. Venkatesachar for valuable guidance and suggestions. My thanks are due to Mr. Sibaiya for useful discussion and criticism.

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[1] *Proc. Ind. Acad. Sci.*, 1934, **1**, 78.
[2] *Ind. J. Phys.*, 1931, **6**, 207; *Phil. Mag.*, 1930, **10**, 101; 1930, **16**, 580.
[3] *Ann. der Phys.*, 1932, **13**, 270; 1932, **14**, 521.

Ageing of Surface of Solutions.

THE effect of age of a surface on its surface tension has been investigated by several workers. They have all employed either methods involving the contact angle or those in which the surface itself would be highly disturbed (*e.g.*, drop weight method). A critical study of available methods revealed that the surface pressure technique developed by Langmuir and Adam is most suitable for studying the phenomenon. This technique has been used in the present work.

A freshly formed surface of M/500 solution of benzopurpurin is shown to exhibit a regular fall of surface tension with time.

Simultaneous with the decrease in surface tension, it has been found that a surface film is produced at the ageing surface as can be detected by pushing the barrier towards the float. If an overcrowding of the surface is effected by pushing the barrier, the surface exhibits an *increase* of surface tension with time. The force-area relations of a five-minute old surface of M/5000 solution of the dyestuff are given in Table I.

TABLE I.

Area in sq. cm.	Surface Pressure in dynes/cm.
420	0
85	1
58	2
42	4
39	6
38	10

The film appears to be more or less of the condensed type. About one-sixth of the ten-minute old surface has been found to be occupied by the dyestuff molecules. The observed rate of accumulation of the solute molecules is far less than the calculated collision frequency, the two values differing by a factor of 10^9. The adsorption appears to be of the activated type. The rate of accumulation is more than doubled for a rise of temperature by 20° The high temperature coefficient of the rate of accumulation is in accordance with the hypothesis of activation. These studies have been helpful in obtaining the potential energy curves in the neighbourhood of the interface. This technique gives a semi-quantitative method of determining the efficiency of a substance as a foam producer.

The results obtained so far have opened out some new lines of investigation. A detailed account of the work will shortly be published elsewhere.

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