

35, 1104 (1931)], who came to the same conclusion from cryoscopic and vapor pressure measurements. The absence of frequencies less than 800 wave numbers indicates that the concentration of higher polymers in a solution of this concentration must be small. The absence of a modified line in the 1675–1725 region for the trioxymethylene and the presence of a line corresponding to the C–O linkage may be due to the formation of a trimer in the manner suggested by Venkateswaren and Bhagavantam [*Proc. Roy. Soc. (London)*, **128**, 260 (1930)] for paraldehyde. The presence of only three frequencies below 900 wave numbers may indicate that the polymer consists of not more than three aldehyde units. Lines corresponding to C–H linkage for the trioxymethylene are very weak and as yet have not been definitely identified.

That strong continuous Raman spectra may be a property common to viscous liquids has received some substantiation from the Raman spectra of sodium silicate, orthophosphoric acid, potassium hydrogen phosphite and ethylene glycol solutions. The continuous spectra decrease on dilution and on temperature elevation. This behavior is similar to that observed with glycerin by Venkateswaren [*Indian Journal Phys.*, **3**, 105 (1928)]. This phenomenon may possibly owe its origin to intermolecular attraction, the continuous spectra arising from the probability of a large number of energy levels. The Raman spectrum of  $\alpha$ -chloronaphthalene consists of 16 lines and shows some similarities to that of chlorobenzene and naphthalene.

A detailed account of these experiments will be communicated later.

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#### THE IONIZATION CONSTANT OF ACETIC ACID

*Sir:*

We have obtained a precise value of the ionization constant of acetic acid at 25° from the results of new conductance measurements, made in this Laboratory, on acetic acid, hydrochloric acid, sodium chloride and sodium acetate at low concentrations (the lowest in each case being about 0.00003 *N*). The principles underlying the computations are essentially those which have been outlined by one of the undersigned [MacInnes, *This Journal*, **48**, 2068 (1926)]. The calculations take account of the change of the mobilities of the ions as required by the Debye–Hückel–Onsager theory and of the ion activities as predicted by the Debye–Hückel theory. The computations, which involve a short series of approximations, consist in estimating the proportion of ions at each acetic acid concentration by comparing the measured equivalent conductance with that

of completely dissociated acetic acid,  $\Lambda_e$ , at the same ion concentration. Values of  $\Lambda_e$  are found by using Kohlrausch's law of independent ion migration, which is valid at the low ion concentrations involved. Applying the mass action law to the resulting degrees of dissociation we find a series of "constants,"  $K'$ , which, to obtain the thermodynamic ionization  $K$ , must be multiplied by the product of the ionic activity coefficients,  $\gamma^2$ .

It is noteworthy that to obtain a true constant the activity coefficients required are exactly those given by the Debye-Hückel theory in its limiting form

$$-\log \gamma^2 = 2 \times 0.5065 \sqrt{C_i}$$

in which  $C_i$  is the ion concentration. The results for the more dilute solutions are given in Table I.

TABLE I  
RESULTS FOR THE MORE DILUTE SOLUTIONS

Concentration, equivalents per liter $\times 10^3$	Ion concn., $C_i$ $\times 10^3$	$K'$ $\times 10^3$	$\gamma^2$	$K$ $\times 10^3$
0.028014	0.015092	1.7626	0.9910	1.747
.15321	.044005	1.7733	.9846	1.746
.21844	.054096	1.7766	.9830	1.746
1.0283	.12714	1.7937	.9741	1.747
1.3638	.14779	1.7961	.9721	1.746
2.4139	.19992	1.8053	.9776	1.747
3.4407	.24069	1.8104	.9645	1.746
5.9115	.31895	1.8189	.9592	1.745
9.8421	.41517	1.8285	.9536	1.744

Although extraordinarily constant in the range given, at higher concentrations there is a decrease in the value of  $K$ . This variation is due to several effects which may for the present be lumped together as "effect of the medium." The bearing of this value of  $K$  on the  $PH$  scale will be discussed later and full accounts of these researches will shortly be submitted to THIS JOURNAL.

LABORATORIES OF  
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D. A. MACINNES  
THEODORE SHEDLOVSKY

#### THE DIRECT REACTION BETWEEN OXYGEN AND ETHYLENE

Sir:

The direct reaction between oxygen and ethylene is of general theoretical and technical interest. Study of the reaction in this Laboratory has shown that the slow non-explosive thermal reaction is complex. Two compounds have been found to be formed in the reaction whose presence has not been demonstrated before; these compounds are ethylene oxide and dioxy-