

of the above values for the unpolarized interface, according to whether oxygen is or is not rigidly excluded from the water; the lower value is obtained in the presence of air, the higher value when oxygen is excluded. Confirmatory determinations have been made by the capillary rise method, using the apparatus of Bartell, Case and Brown, suitably modified. Working *in vacuo*, the figure obtained was 426 dynes/cm., and in equilibrium with either hydrogen or nitrogen at a pressure of one atmosphere, 427 dynes/cm., the temperature being 20° C. When air is admitted the value falls, and there are indications that the tension of a freshly exposed interface may have any value between 375 and 427 dynes/cm., according to the oxygen pressure over the system.

It is significant that the higher value found for the unpolarized surface is identical with that found by Gouy<sup>4</sup>, with cathodic polarization, at the maximum of the electrocapillary curve of pure water. This suggested that the effect of excluding oxygen consists simply in a lateral shift of the electrocapillary curve along the axis of polarization. This was confirmed by plotting the cathodic branch of the curve (the only one accessible to measurement under oxygen-free conditions) in the same apparatus under normal and under oxygen-free conditions. In the latter circumstances, the maximum of the curve was in fact found to lie slightly on the anodic side of zero polarization. It seems reasonable to suppose that the effect of dissolved oxygen is to produce mercury ions which are strongly adsorbed at the interface, and produce a lateral displacement of the cathodic branch of the electrocapillary curve in the same way as the so-called capillary active ions.

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<sup>1</sup> Landolt-Börnstein (fifth edition), 1, 243, quotes four determinations: 375, 372.4 and 370.1 at 20° C., 374 at 0° C. Bartell, Case and Brown, *J. Amer. Chem. Soc.*, 55, 2419 (1933). Glidden, *J. Amer. Chem. Soc.*, 57, 236 (1935).

<sup>2</sup> Burdon and Oliphant, *Trans. Farad. Soc.*, 23, 205 (1927).

<sup>3</sup> Brown, *J. Amer. Chem. Soc.*, 56, 2564 (1934).

<sup>4</sup> Gouy, *Ann. Phys.*, (9), 6, 5 (1916).

### Dependence upon State of the Dielectric Polarizations of Ammonia and its Three Methylated Derivatives

NEW measurements recently completed enable us to provide for the first time a set of data to show the dependence upon state of the dielectric polarizations of ammonia (NH<sub>3</sub>), methylamine (MeNH<sub>2</sub>), dimethylamine (Me<sub>2</sub>NH), and trimethylamine (Me<sub>3</sub>N). The essential results are tabulated below and illustrate the influence of the medium in dipole moment determinations<sup>1</sup>. The figures represent the total polarizations of these four substances calculated at 25° by the usual formulæ.

POLARIZATIONS OF AMMONIA AND ITS METHYL DERIVATIVES

State	NH <sub>3</sub>	MeNH <sub>2</sub>	Me <sub>2</sub> NH	Me <sub>3</sub> N
Gaseous, at zero pressure	49.6	44.9	36.6	28.6
Dissolved in benzene, at infinite dilution	46.5 <sup>2</sup>	55.4	50.3	35.2
Liquid	23.8 <sup>3</sup>	34.9	41.3	30.5

Full details of this work, and a discussion of its implications, will be published elsewhere later. For the present the relative magnitudes of the ratios  $P_{\text{gaseous}}/P_{\text{dissolved}}$  and  $P_{\text{gaseous}}/P_{\text{liquid}}$  may be noted. It will be seen that while ammonia conforms to the more common type of behaviour and has both these ratios

greater than unity, the reverse is the case for the di- and tri-methylamines, where the differences between the polarizations are greater than in other previously noted<sup>4</sup> examples of this kind of abnormal<sup>5</sup> solvent effect.

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<sup>1</sup> See Glasstone, *Ann. Rep. Chem. Soc.*, 33, 117 (1937).

<sup>2</sup> Kumler, *J. Amer. Chem. Soc.*, 53, 1049 (1936).

<sup>3</sup> Calculated from measurements by Grubb, Chittum and Hunt, *J. Amer. Chem. Soc.*, 53, 776 (1936).

<sup>4</sup> Le Fèvre and Russell, *J. Chem. Soc.*, 491 (1936).

<sup>5</sup> Le Fèvre, *NATURE*, 136, 181 (1935).

### The Polarographic Sero-Reaction for Cancer

IN a detailed communication<sup>1</sup>, I have described two polarographic sero-reactions concerning typical changes in human serum of individuals suffering from cancer, sarcoma, acute inflammations, fever, or some bile and liver disorders.

A re-investigation of the reaction I use has given rise to some erroneous remarks. Messrs. F. Bergh, O. M. Henriques and C. G. Wolffbrandt state in a letter in *NATURE*<sup>2</sup> that the great effect in the polarographic sero-reaction cannot be due to the presence of cystine compounds as the concentration of cystine had to be 100–1000 times greater than that generally found in serum. These investigators, however, have wrongly used a solution of cobaltamine (reagent for protein containing cystine) instead of the reagent for pure cystine, which is cobaltous chloride (divalent salt). When the latter proper reagent is used, a 1000 times smaller concentration of cystine causes the same effect as is shown in the last curve of these authors and is in complete agreement with the cystine content generally found in serum. (Their effect is obviously due to a trace of divalent cobalt in the trivalent salt solution used, brought in by the reduction with cysteine.)

As a result of this mistaken experiment, Messrs. Bergh, Henriques and Wolffbrandt ascribe the polarographic effect in the cancer reactions to "an additive expression of several substances". In answer to this suggestion, it should be emphasized that only such substances can be considered which cause the typical polarographic effect in the buffered cobalt solution and give an 'empty curve' in the absence of the cobalt reagent. This is the chief characteristic of the polarographic 'double wave' produced by proteins containing cystine or by their degradation products. Therefore, none of the chemically defined substances investigated by Messrs. Bergh, Henriques and Wolffbrandt can be taken into consideration except cystine or cysteine.

These authors also show that urine and water extract of yeast give in cobaltic solutions similar curves to the deproteinated serum. This is in accordance with facts already established<sup>3</sup> as well as with my interpretation of them, that the polarographic effect is to be ascribed to proteins or polypeptides containing cystine nuclei present in these biological fluids. Their finding that the substance responsible for the polarographic effect in urine passes slowly a 'Cellophane' membrane clearly indicates that the proteic substance in urine has a