COMMUNICATIONS TO THE EDITOR

SYNTHETIC ELECTRICAL ANALOG OF PROTEINS[1]

Sir:

Despite many specific chemical differences, most proteins possess a pattern of similarity in their electrical behavior; best known, perhaps, are the existence of the isoelectric point, with reversal of electrophoretic mobility at lower and higher values of *p*H, and the electro-viscous effect. It was suggested[2] that a synthetic polyampholyte might duplicate these properties. This result has been obtained experimentally.

An equimolar mixture of 2-vinylpyridine and methacrylic acid was copolymerized (four hours at 70° with 0.04% azo-bis-isobutyronitrile). The copolymer (25% conversion), precipitated twice from methanol with 1:2 methyl ethyl ketone and benzene, analyzed to 62 mole % vinylpyridine. We thus have a linear polymer which contains on the average three (weakly basic) pyridine groups to two (weakly acidic) carboxyl groups on every ten carbon atoms of the chain. The intrinsic viscosity in dimethylformamide is 0.10, corresponding to a molecular weight of the order of 10,000.

The copolymer is insoluble in water in the range $3.8 < p\mathrm{H} < 6.8$, but becomes soluble outside this range. On the addition of acid, the viscosity initially rises as pyridine nitrogens are converted to pyridinium ions; on the addition of alkali, the viscosity also rises as neutral carboxyl groups are converted to negatively charged carboxyl ions. The viscosity increase is caused by intramolecular coulomb repulsion[3] between the ions on the polymer chain. With excess acid or alkali, the viscosity again decreases, as has been observed for other polyelectrolytes.

Finally, electrophoretic mobilities at 0° were measured, using a Perkin–Elmer Tiselius apparatus. One per cent. solutions of the copolymer were made up in glycine–hydrochloric acid and diethylbarbituric acid–sodium hydroxide buffers, and dialyzed against the buffers; the ionic strength of the buffers was 0.10. The *p*H and specific conductance of the dialyzates are given in the table. Cell currents were 6.1–8.6 milamp. at 6.2–4.4 volts/cm. Both ascending and descending boundaries were photographed.

*p*H	$10^3 \kappa$	$10^5 u$ (asc.)	$10^5 u$ (desc.)
2.23	6.357	....	10.9
2.97	5.427	13.3	10.9
8.22	3.225	−10.7	−8.5
8.80	3.234	−10.7	−8.5

As seen in the table the mobility u (sq. cm./volt sec.) is of the same order as that of proteins and the expected reversal of sign appears in the range of *p*H where the copolymer is insoluble. We thus have a synthetic material which electrically is closely analogous to proteins.

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[1] Office of Naval Research, Projects NR 054-022 and NR 054–002.

[2] R. M. Fuoss and G. I. Cathers, *J. Polymer Sci.*, **2**, 12 (1947).

[3] R. M. Fuoss and U. P. Strauss, *Ann. N. Y. Acad. Sci.*, **51**, 836 (1949).

REANALYSIS OF THE ELECTRON DIFFRACTION DATA ON $Be(BH_4)_2$ AND $Al(BH_4)_3$

Sir:

In a recent Note to THIS JOURNAL (**72**, 622 (1950)) on the reanalysis of electron diffraction data for $Be(BH_4)_2$ and $Al(BH_4)_3$, I regrettably failed to list the workers in this field who had suggested that *unsymmetrical* hydrogen bridge structures (γ) be considered as possible alternatives to the structures originally proposed (α). As was indicated in the above note, the results of X-ray diffraction work on crystals of $LiBH_4$, $NaBH_4$ and $U(BH_4)_4$ naturally led to the γ type configurations. This form of bridge was also suggested to me by Dr. W. C. Price, as a consequence of his infrared absorption studies, and independently by D. F. Stedman who based his deductions on a very interesting although unconventional theory of atom models. On the basis of this theory Dr. Stedman was led, in particular, to the γL model for $Al(BH_4)_3$.

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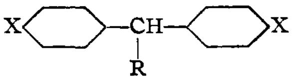
THE INSECTICIDAL ACTIVITY OF 1,1-DIANISYLNEOPENTANE

Sir:

A consideration of the stereochemistry of the insecticide DDT, 1,1,1-trichloro-2,2-bis-(*p*-chlorophenyl)-ethane (I), suggested that it would be of interest to synthesize and test a 1,1-diarylneopentane. In such compounds, models indicate that definite steric hindrance exists. In consequence, the phenyl groups should tend to approach coplanarity.



I, X = Cl; R = CCl_3
II, X = OCH_3; R = $C(CH_3)_3$
III, X = OCH_3; R = CCl_3