$$\Delta E = -\frac{8}{3}\frac{N\rho}{M}\frac{n^2e^2}{D_eL}$$

where D_e is an effective dielectric constant, N is Avogadro's number, M the molecular weight of the linear molecular unit of the structure and ρ is the density of the structure, regarded as a three-dimensional network with L the average distance between net points. Since electrostatic interactions between the charges of neighboring chain segments are neglected and other gross approximations have been employed in its derivation, Eq. (1) is intended to provide no more than an estimate of the order of magnitude of ΔE.

The elastic modulus of muscle[1] is of the order of magnitude 10^5 dynes/sq. cm. In order to produce a change of this order of magnitude by charging the structural units, we estimate from Eq. (1) a magnitude of n of the order of 100, with the rough assignments of value $\rho = 1$, $M = 10^6$, $L = 10^4$A, $D_e = 100$ to the other parameters. The values of L and M are those determined for the myosin or actomyosin molecule in solution, and D_e is assumed to be of the order of magnitude of the dielectric constant of water. The estimated number of charges would require phosphorylation sites situated at intervals of 100 Å. along the myosin or actomyosin molecule. This value is not inconsistent with the hydroxy amino acid content of myosin.

The observation of Needham[7] that the flow birefringence of myosin solutions is diminished by the addition of ATP seems at first to be in contradiction with our hypothesis. However, it seems that the effect was observed under conditions leading to the dissociation of actomyosin into actin and myosin, according to St. Gyorgi.[5]

We have deliberately avoided placing undue emphasis on hypothetical structural details of muscle and on the detailed analogy between the elastic properties of muscle and elastomers. The essential qualitative aspects of our suggestions, (a) change in the elastic modulus of the structure due to alteration of the electric charge of the structural unit, considered to be a polypeptide chain rich in hydroxy amino acid residues; (b) charging of the structural unit through phosphorylation of the hydroxyl groups by ATP, are to a large extent independent of assumed structural details.

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(7) J. Needham, Shih-Chang Shen, D. Needham and A. S. C. Lawrence, *Nature*, **147**, 766 (1941).

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Purification of N-Hydroxymethylphthalimide through a Molecular Compound with Pyridine

BY EUCLID J. SAKELLARIOS

In connection with the synthesis of N-alkylated phthalimides, we have prepared N-hydroxymethylphthalimide. This compound was first prepared by Sachs[1] by the hydrolysis of N-bromomethylphthalimide. It was later prepared by Sachs[2] from formaldehyde and phthalimide in sealed tubes and by Buc[3] from the same reactants at atmospheric pressure. The melting points reported by these authors were 141–142°, 139–140° and 137–141°, respectively. Buc also reported that the melting point is not improved by crystallization from ethanol.

We attempted to eliminate the impurities by adding about 1 g. of fuller's earth per 100 ml. of solution in Buc's procedure. This yielded a product melting at 144–145° which was, however, still not pure.

A product of high purity melting at 149.5° was finally obtained through an unstable, previously unreported complex formed from N-hydroxymethylphthalimide and one mole of pyridine.

Chloro-, bromo- and iodomethylphthalimides were prepared from the pure compound and the appropriate halogen acid. In all cases the products had higher melting points than those previously reported.

Procedure.—A solution obtained by warming 17.7 g. of N-hydroxymethylphthalimide[3] in 30 ml. of pure pyridine was filtered, if necessary, and left to crystallize. If crystallization did not occur, seed crystals were obtained by placing a few drops of the solution in a desiccator over sulfuric acid. As soon as the first crystals appeared, they were added to the solution. The new compound crystallized in long, bright needles which after cooling in an ice-bath were filtered with suction.

To determine the pyridine the crystals were dried briefly on a porous plate over calcium chloride. A weighed sample was then dried in vacuum over sulfuric acid. The crystals gradually lost their brightness and came to constant weight after twenty-four hours.

Anal. Calcd. for $C_6H_7O_3N \cdot C_5H_5N$: pyridine, 30.58. Found: pyridine, 30.68.

The residue melts at 148.5–149°. One crystallization from acetone brings the m. p. to 149.5°.

Anal. Calcd. for $C_8H_7O_3N$: N, 7.91. Found: N, 7.88.

The halogenomethylphthalimides were prepared essentially according to Gabriel,[4] heating at 50° for one hour after the crystals separated. The crystals were filtered, washed with the appropriate acid and then dried over sulfuric acid and potassium hydroxide. The results obtained are summarized in the table.

TABLE I

N-HALOMETHYLPHTHALIMIDES

Compound	Yield crude, %	Crystn. solvent	M. p., °C. Obs.	M. p., °C. Prev.[a]
Chloro-	93	Ethyl acetate	136.5	132–133[4]
Bromo-	91.1	Ethyl acetate	151.5	149–150[5]
Iodo-	92.3	Benzene–ethyl acet.	155.5	153[5]

[a] Best previously reported.

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(1) Sachs, *Ber.*, **31**, 1231 (1898).
(2) Sachs, *ibid.*, **31**, 3230 (1898).
(3) Buc, THIS JOURNAL, **69**, 254 (1947).
(4) Gabriel, *Ber.*, **41**, 242 (1908).
(5) Gabriel, *Ber.*, **31**, 1229 (1898).