9. ANDRUS, S. B., MEISSNER, G. F., and WHARTON. C. M. *Cancer*, **4**, 1015 (1951).
10. EICHWALD, E. J. *Cancer Research*, **8**, 273 (1948).
11. KEMLER, R. L., and GRAHAM, E. A. *Cancer*, **3**, 735 (1950).
12. HOVENIAN, M. S., and DEMING, C. L. *Surg., Gynecol., Obstet.*, **86**, 29 (1948).
13. BROWNING, H. C. *J. Natl. Cancer Inst.*, **8**, 173 (1948).
14. GREENE, H. S. N. *Cancer*, **5**, 24 (1952).

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Sedimentation and Flexibility of Sodium Thymonucleate Molecule

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In a previous communication (*1*) it was shown that the peculiar viscosity behavior of solutions of sodium thymonucleate at different concentrations and in the presence of different amounts of salts could be explained by the folding-unfolding of flexible high molecular chains in solution. It may be argued that if increasing extension of a chain molecule with increasing extent of dissociation of its sodium salt be responsible for higher reduced viscosity in dilute solution, then this effect will be reflected in all other properties of such solutions—namely, sedimentation, diffusion, etc.—where the movement of hydrodynamical volume of the dissolved units plays the deciding role. In fact, it has been found by Tennent and Vilbrandt (*2*) that the sedimentation constant (S) of sodium thymonucleate increases with diminishing concentration of the solute (Table 1).

TABLE 1

SEDIMENTATION CONSTANT OF SODIUM THYMONUCLEATE IN SOLUTION*

Conc (g/100 ml)	S	$1/S$	$d(1/S)/dC$ or K
0.290	6.4	0.156	0.26
.190	7.3	.136	.36
.100	9.4	.106	.46
.060	12.0	.083	0.58
.050	13.0	.076	—
.040	14.0	.071	0.66
0.025	17.0	0.058	0.90

* Results in the first two columns have been taken from Tennent and Vilbrandt's (2) data for sodium thymonucleate of 580,000 molecular weight.

This type of behavior has also been noted for various other high molecular weight substances for which Burgers (*3*) has deduced an equation

$$S = S_0(1 + KC)^{-1}$$
$$\text{or } S_0/S = 1 + KC \text{ (where } S_0 = S \text{ where } C = 0)$$

and found that for a large number of substances the plot of $1/S$ vs C curves is linear, the slope of which gives the value of K, which is taken as constant for a particular solvent-solute system. When Tennent and

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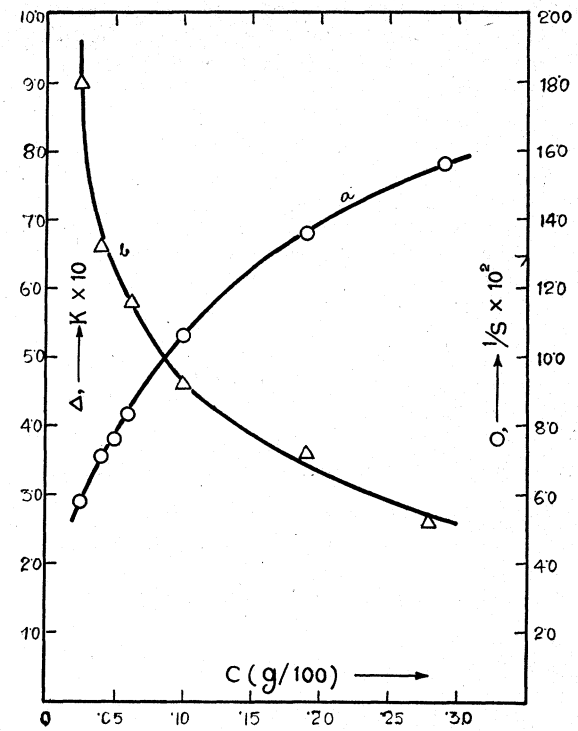

FIG. 1.

Vilbrandt's data were plotted as $1/S$ vs C (Fig. 1*a*) the graphs obtained were not linear, being strongly concave toward the C-axis. If K, in the above equation, instead of remaining constant, also varies with concentration, this type of behavior is expected, and in that case the value of K at each concentration may be obtained from the tangent drawn at the corresponding points in the curve in Fig. 1 *a*. The results are given in the last column of Table 1. When this value of K is plotted against the corresponding concentrations a curve (Fig. 1*b*) similar to $\eta sp/C$ vs C is obtained—i.e., a rapid rise in K value with dilution.

It has recently been shown by Newman and Eirich (*4*) from the sedimentation measurements of a solution of polystyrene in chloroform, toluene, and methyl ethyl ketone that $1/S$ vs C curves were more or less linear in all the three solvents, although the slope of each curve was different, in the order ${}^{K}\text{chloroform} > {}^{K}\text{toluene} > {}^{K}MEK$. Kirkwood and Riseman (*5*) have shown that the extent of stretching (E) of the polystyrene molecule in solution is in the order ${}^{E}\text{chloroform} > {}^{E}\text{toluene} > {}^{E}MEK$. From these results Newman and Eirich (*4*) concluded that the increase in K value in the sedimentation experiment is due to the increase in the extent of stretching of the polystyrene molecule in different solutions.

Taking the cue from these observations it may be concluded that the increase in K value with diminishing concentration of thymonucleate in solution is due to the increase in the extent of stretching of the flexible chain of thymonucleate molecule, a conclusion that has also been arrived at from completely inde-

pendent sets of measurements—namely, viscosity.

Recently Fessler and Ogston (*6*) have shown that the $1/S$ vs C curve for sodium thymonucleate solution in presence of about 2% sodium chloride is linear, with positive slope over a considerable range of concentrations. This evidently follows from the statement made in the previous note (*1*) as to the complete suppression of dissociation of sodium thymonucleate molecules in the presence of excess of sodium chloride, with the consequent assumption of an average coiled-up structure by the thymonucleate molecules in solution.

References

1. Basu, S. *Nature*, **168**, 341 (1951).
2. Tennent, H. G., and Vilbrandt, C. F. *J. Am. Chem. Soc.*, **65**, 427 (1943).
3. Burgers. *Proc. Koninkl. Nederland. Akad. Wetenschap.*, **44**, 1045 (1941).
4. Newman, B., and Eirich, F. R. *J. Colloid Sci.*, **5**, 542 (1950).
5. Kirkwood, J. G., and Riseman, J. E. F. *J. Chem. Phys.*, **16**, 565 (1948).
6. Fessler, J. H., and Ogston, A. G. *Trans. Faraday Soc.*, **47**, 667 (1951).

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Variation in Coloring Rates of Tobacco[1]

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One of the more dramatic changes that take place during the flue-curing of tobacco is the transformation of the field-green leaf to the bright-orange or yellow tobacco of commerce. This color change comes about through the enzymatic destruction of chlorophyll and results in the unmasking of the yellow carotenoids that are already present. Under the conditions prevailing in the curing barn, coloring, as this phase of the process is called, is accomplished during the first 36–60 hr of the curing sequence, depending on weather conditions and the stalk positions harvested.

The progress of the development of the yellow color serves as the basis for advancing the temperature and ventilation schedule. The operator periodically examines the tobacco as it hangs in the curing barn. There in the half-light he estimates the average stage of the destruction of chlorophyll and adjusts the environment accordingly.

Because of the importance necessarily attached to this color transition as an indicator of curing progress, it seemed expedient to examine the changes in the reflectance spectra of tobacco leaves undergoing yellowing, with the ultimate aim of devising an instrument to replace the human eye for this critical evaluation. The reflectance spectra of tobacco during progressive yellowing are shown in Fig. 1. Fig. 2

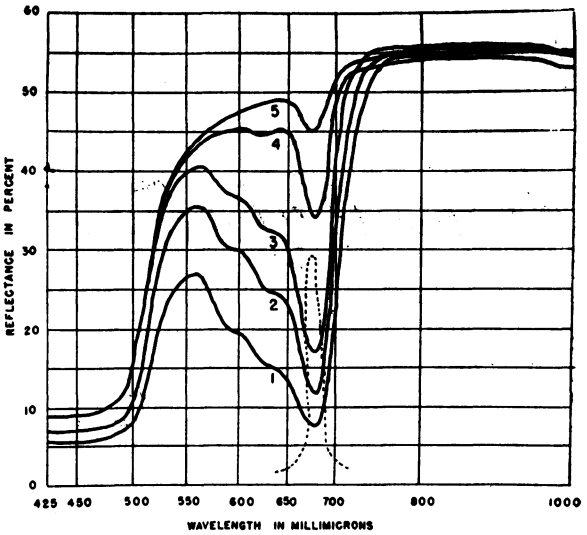

Fig. 1. Changes in the reflectance spectra of tobacco during the early stages of curing; Curve 1, mature leaf at priming; Curves 2, 3, 4, progressively yellower leaves; Curve 5, fully yellowed leaf. (Tracings made with a GE Recording Reflectometer, courtesy Sidney Blumenthal Company, Rocky Mount, N. C.) The broken curve gives the transmittancy characteristics of the filter used in the Yellowmeter.

shows the resulting portable reflectometer[3] being used to measure yellowness. This "Yellowmeter" registers increasing yellowness positively, whereas it actually measures the decreasing absorption of chlorophyll at 680 mμ wavelength. Light from 2 flashlight bulbs on either side of the instrument is reflected by the leaf in position under the lid and is received by a phototube. An electrometer circuit amplifies the phototube current so that it can be measured with a microammeter. An interference filter over the photocell transmits only the wavelengths in the red region

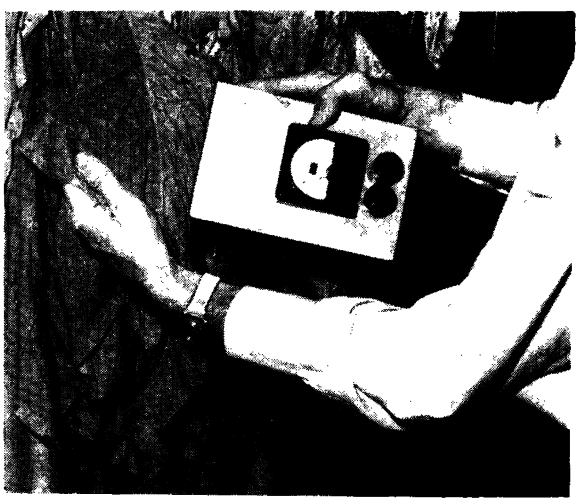

Fig. 2. Measuring reflectance of tobacco in the curing barn with the Yellowmeter.

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[3] Instrument developed cooperatively by North Carolina Agricultural Experiment Station and Division of Farm Electrification, U. S. Department of Agriculture.