



THE INSTITUTE OF PAPER CHEMISTRY, APPLETON, WISCONSIN

Project 2236

Report One

A Quarterly Report

to

THE PIONEERING RESEARCH COMMITTEE
PIONEERING RESEARCH PROGRAM

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THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

THE MOLECULAR PROPERTIES OF NATURALLY OCCURRING POLYSACCHARIDES

THE EFFECT OF ION BINDING ON THE MOLECULAR PROPERTIES OF LOW
MOLECULAR WEIGHT POLYSACCHARIDES

This is the first quarterly report on Project 2236 established in co-operation with the Pioneering Research Committee for the purpose of investigating the molecular properties of naturally occurring polysaccharides. This report summarizes activity during the first quarter. The experimental details and significance of the work will be set forth in a later report when the data are more complete.

A series of cellodextrins have been obtained from Dr. N. S. Thompson of our staff and from Mr. W. Bliesner. We now have 0.1-g. quantities of cellobiose, cellotriose, cellotetraose, cellopentaose, cellohexaose and (40 mg.) of celloheptaose available.

The partial specific volumes of several of these oligosaccharides have been determined in water solution through use of a Springel bottle. Values for the partial specific volumes are given in Table I.

TABLE I

PARTIAL SPECIFIC VOLUMES OF THE CELLOBIOSE-CELLOPENTAOSE SUGARS
OF CELLULOSE AT 30.00°C.

| Sugar | Concentration, g./ml. | Partial Specific Volume, ml./g. |
|---------------|--------------------------|------------------------------------|
| Cellobiose | 0.010610 | 0.6148 |
| Cellotriose | 0.009635 | 0.6109 |
| " | 0.004844 | 0.6110 |
| Cellotetraose | 0.009970 | 0.6132 |
| Cellopentaose | 0.005149 | 0.6279 |

A limited number of centrifuge experiments have been carried out on cellobiose and cellopentaose using the Schlieren optical system. Sedimentation experiments were carried out using the technique of Van Holle and Baldwin (1). The experiments were carried out in the Spinco Model E ultracentrifuge with a double sector cell operated at a speed of 39,460 r.p.m. After correcting for nonideality, a value of 334.9 was obtained for the molecular weight of cellobiose compared with the accepted value of 342.3. A value of 831 was determined for molecular weight of cellopentaose and compares favorably with the known value of 828.72. It appears that the use of the Schlieren optical system will provide sufficient accuracy for our ion binding studies.

It is possible to determine diffusion coefficients from an analysis of the transient state of the system during approach to sedimentation equilibrium. We are still in the process of computing diffusion coefficients for cellobiose and cellopentaose.

A calibration cell was purchased and it is now possible to determine the optical constants of the Schlieren system with good accuracy so that we are able to calculate the specific refractive index increments from sedimentation velocity experiments.

Within the next report period we hope to complete our experiments on water solutions of the celloextrin series. The formal ion binding studies will start as soon as this work is completed.