

MOLECULAR AND ULTRAFINE STRUCTURE
OF
COTTON FIBRES

A thesis submitted by

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CONTENTS

ACKNOWLEDGEMENTS	viii
ABSTRACT	ix
LIST OF TABLES	xi
LIST OF FIGURES	xiii
LIST OF PLATES	xvi
 <u>CHAPTER 1</u>	
 <u>INTRODUCTION TO THE STRUCTURE OF COTTON CELLULOSE</u>	
1.1. GENERAL FEATURES OF COTTON	1
1.1.1. Origin and Physical Characteristics	1
1.1.2. Chemical Composition	3
1.1.3. Chain Length of Cellulose	3
1.2. THE MOLECULAR STRUCTURE OF CELLULOSE 1	5
1.2.1. Configurations of the Cellulose Molecule	5
1.2.2. Anomalies in the Meyer and Misch Model	6
1.2.3. Conformations of the Primary Alcohol Group	7
1.2.4. The (-50°) Screw Dyad Model for the Anhydrocello- biose Unit	9
1.2.5. The Helical Structure of Cellulose	11
1.2.5.1. Parameters for the Helical Structure	12
1.2.5.2. Discussion	15
1.3. CRYSTALLOGRAPHY OF CELLULOSE 1	16
1.3.1. Introduction	16
1.3.2. The Unit Cell of Native Cellulose	20
1.3.2.1. X-ray Diffraction Investigations	20
1.3.2.2. Electron Diffraction Studies	24
1.3.3. Summary	26

1.4. THE SUPRAMOLECULAR STRUCTURE OF COTTON CELLULOSE	26
1.4.1. Nomenclature of Structural Units	26
1.4.2. Dimensions of the Fibrillar Units	27
1.4.3. Theories of Fine Structure	31
1.4.3.1. Introduction	31
1.4.3.2. Extended Chain Structures	31
1.4.3.3. Folded Chain Structures	34
1.4.3.4. A Mechanism of Chain Folding in Cellulose	36
1.4.3.5. Discussion	38
1.4.4. Hydrogen Bonding and its Significance in the Structure of Cellulose	41
1.4.4.1. Introduction	41
1.4.4.2. The Hydrogen Bond	41
1.4.4.3. Some Proposed Schemes of Hydrogen Bonding for Cellulose I	43
1.4.4.4. Hydrogen Bonds and Mechanical Properties	47
1.5. THE MACROSTRUCTURE OF THE COTTON FIBRE	48
1.5.1. Introduction	48
1.5.2. General Morphology	48
1.5.3. The Fibre Surface	50
1.5.4. Cuticle and the Primary Wall	51
1.5.5. The Secondary Wall	53
1.5.6. The Tertiary Layer	56
1.5.7. The Lumen	56
1.5.8. Bilateral Structure of Cotton	57
1.5.9. Summary	58



CHAPTER 2

ELECTRON MICROSCOPE STUDIES OF PARTICLES FROM HYDROLYSED

COTTON - BRIGHT FIELD TRANSMISSION MICROSCOPY AND


ELECTRON DIFFRACTION

	60
2.1. INTRODUCTION	60
2.1.1. Cellulose Particles	60
2.1.2. Method of Examination	64
2.2. INTERPRETATION OF HIGH RESOLUTION ELECTRON MICROGRAPHS OF CELLULOSE PARTICLES	65
2.3. MATERIALS AND METHODS	67
2.3.1. Preparation of Samples	67
2.3.2. Electron Microscopy of Cellulose Particles	67
2.3.3. Measurement of Particle Dimensions	68
2.3.4. Electron Diffraction of Cellulose Particles	69
2.4. RESULTS	69
2.4.1. Bright Field-Transmission Electron Microscopy	69
2.4.2. Electron Diffraction of Cellulose Particles	73
2.5. DISCUSSION	75
2.5.1. Bright Field Transmission Electron Microscopy	75
2.5.2. Electron Diffraction	77

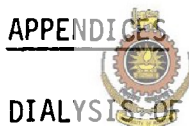
CHAPTER 3

X-RAY DIFFRACTION STUDIES

	81
3.1. INTRODUCTION	81
3.1.1. Unit Cell Parameters	81
3.1.2. Crystallite Size	83
3.1.3. Orientation	85

3.2. MATERIALS AND METHODS	88
3.2.1. Sample Preparation	88
3.2.2. Photometric Methods	88
3.2.3. Diffractometric Methods	89
3.3. RESULTS	
3.3.1. Lattice Spacings	90
3.3.2. Unit Cell Parameters	92
3.3.3. Line Broadening	96
3.3.4. Orientation	98
3.4. DISCUSSION	98
3.4.1. Lattice Spacings and Unit Cell Parameters	98
3.4.2. Crystallite Size and Line Broadening	100
3.4.3. Orientation	101
 University of Moratuwa, Sri Lanka. Electronic Theses & Dissertations www.lib.mrt.ac.lk	
<u>CHAPTER</u>	
<u>ELECTRON DIFFRACTION</u>	105
4.1. INTRODUCTION	105
4.1.1. Brief Theory of Electron Diffraction	105
4.1.2. The Reciprocal Lattice and Ewald Sphere	109
4.1.3. Estimation of the Deviation of the Spherical Section from the Plane of the Diffraction Pattern	111
4.1.4. Relation between Camera Constant and Lattice Spacings.	112
4.1.5. Intensity Variations in Electron Diffraction Patterns.	113
4.1.6. Advantages and Limitations of Electron Diffraction	115
4.2. EXPERIMENTAL METHODS	
4.2.1. Sample Preparation	121

4.2.2.	Influence of the Electron Beam on Cellulose	122
4.2.3.	Recording of Electron Diffraction Patterns	123
4.3.	RESULTS	124
4.3.1.	Calibration of Instrument	124
4.3.2.	Lattice Spacings	126
4.4.	DISCUSSION	130
	<u>CHAPTER 5</u>	
	<u>SUMMARY AND GENERAL CONCLUSIONS</u>	134
5.1.	ULTRAFINE STRUCTURE OF THE COTTON FIBRE	134
5.2.	MOLECULAR STRUCTURE OF COTTON CELLULOSE	135
	<u>APPENDICES</u>	
I	DIALYSIS OF COLLOIDAL PARTICLES	137
II	PREPARATION OF SPECIMEN SUPPORTING FILMS	138
III	METAL SHADOW CASTING	140
IV	NEGATIVE STAINING	142
V	WIDE ANGLE X-RAY DIFFRACTION PROCEDURES AND ANALYSIS	144
	 LIST OF REFERENCES	 147



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ABSTRACT

Differences among native cottons which have been recognized in the textile industry for many years, and have formed the basis for cotton classification in commerce and ultimate utilization, include factors such as fibre length, fineness and spinnability. Recent, detailed investigations have established that, in addition, cotton types vary in their fundamental mechanical properties. The object of the present work has been to ascertain whether the variation in fibre properties are due to differences which exist at the ultrafine and molecular levels of the structure. Furthermore, with the advent of man-made fibres, modifications of the properties of natural fibres has become a compelling requirement, for their survival in the competitive world markets, and for this reason a detailed study of the structure of the cotton fibre has particular relevance.



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The ultrafine and molecular structure of several varieties of cottons have been examined by means of transmission electron microscopy and X-ray and electron diffraction techniques.

It has been possible to establish that there are no significant differences in: (i) the size of the particles (obtained after hydrolysis) whose dimensions may be taken to represent the combined crystalline and para-crystalline regions, and (ii) the crystal structure (cellulose I), between different cotton types. X-ray studies have shown that differences in the orientation of the 'crystallites' have an effect on the mechanical properties of the fibre. Thus, the evidence leads to the conclusion that variation in fibre properties are due to differences at higher (fibrillar) levels of structural organization.

Electron diffraction results have conclusively shown the inadequacies of the widely accepted model for the fundamental structural unit of crystalline cellulose I (unit cell), proposed by Meyer and Misch on the basis of X-ray diffraction studies. A possible unit cell to fit the observed data, from electron (and X-ray) diffraction, has been postulated, even though a detailed elaboration of a unit cell for cellulose I was outside the scope of this work.

The present study has laid the foundations for further investigations into the structure of cotton fibres at the fibrillar level and a more rigorous study of the unit cell of native cellulose by means of electron diffraction.



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LIST OF TABLES

Table No.		Page
1	Crystallographic Data for Cellobiose	12
2	Unit Cell Parameters for Cellulose Modifications	16
3	Parameters for Some of the Proposed Unit Cells of Native Cellulose	22
4	Dimensions of the Cellulose Elementary Fibril	29
5	Dimensions of the Cellulose Microfibril	30
6	Hydrogen Bonds in Cellobiose	43
7	Effect of Concentration of Sulphuric Acid on the Length of Isolated Particles	69
8	Analysis of Variance	70
9	Effect of Sulphuric Acid Concentration on the Width of Isolated Particles	71
10	Mean Particle Length Between Varieties	72
11	Mean Particle Width Between Varieties	72
12	Lattice Spacings for Hydrolysed Particles	74
13	Interplanar Spacings for Graphite	78
14	Paratropic Reflections	91
15	Diatropic Reflections	91
16	Interplanar Spacings for Native Cotton Cellulose	92
17	Unit Cell Parameters for Native Cotton Cellulose	95
18	Volume of Unit Cell and Density	96
19	Experimental Half-Height Width of 002 Intensity Profile	96

Table No.		Page
20	Crystallite-Size and Lattice-Distortion Parameters	97
21	Orientation of Native Cottons	98
22	Properties of the Cotton Varieties	102
23	Percentage Extent of Variation of Fibre Properties with Semi-Azimuthal Spread of 002 Reflection for Six Native Cotton Types	103
24	Wavelengths Corresponding to Voltages Encountered in Electron Diffraction	107
25	Calibration Curve Using Thallium Chloride	126
26	Equatorial and Meridional Lattice Spacings for (cotton) Cellulose I	127
27	'd' Spacings and Corresponding Projections (H) on Zero Layer Plane in Reciprocal Space	128
28	Reflections Indexed on Super Unit Cell	130
29	Reflections Not Fitting Meyer and Misch Unit Cell	132
30	Crystallographic Data for Silver	145
31	Data for Regression Analysis	146



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LIST OF FIGURES

Figure	Page
1.1 Stereochemistry of the Cellulose Chain	4
1.2 Cellobiose Group - Haworth Conformation	5
1.3 Staggered 'Chair' Conformation of Glucopyranose Rings	6
1.4 Models of the (1→4)-β-Linked Glucopyranose Units Showing Possible Conformations of the CH ₂ OH Group	8
1.5 Zero Position of Screw Dyad	9
1.6 (-90°) Screw Dyad	10
1.7 (-50°) Lateral Projection of Screw Dyad	11
1.8 Combining of Monomeric Units	13
1.9 Projection of the Helical Repeat on the Basal Plane	14
1.10 Interrelation of Some of the Unit Cells Proposed for Native Cellulose	21
1.11 Structural Models for the Elementary Fibril of Cellulose	32
1.12 Two Phase Fibrillar Concept and Modifications	34
1.13 Folded Chain Structure of Cellulose	35
1.14 Potential Energy Curve Versus Bond Rotation for Cellulose	36
1.15 Chain Folding in Cellulose	37
1.16 Structural Studies Based on Molecular Distribution Analysis	39
1.17 The Structure of one Asymmetric Unit of Cellobiose Viewed Down the c-Axis	43
1.18 Hydrogen Bonds in Cellulose I Unit Cell	45

Figure		Page
1.19	(002) Planar Hydrogen Bonding Schemes for Cellulose I	46
1.20	Schematic Representation of Components of Cotton Fibre	49
1.21	Transverse Sections of Cotton Fibre	54
1.22	Convolutions and Reversals of the Cotton Fibre	55
1.23	Bilateral Structure of Cotton	57
1.24	Longitudinal View of Swollen Cotton Fibre	59
2.1	Mean Particle Length V's Concentration of Sulphuric Acid	69
2.2	Distribution of Particle Length Within a Variety of Cotton at Varying Acid Concentrations	70
2.3	Distribution of Particle Length Between Varieties for a Fixed Acid Concentration	73
3.1	Azimuthal Scan of 002 Arc and X-ray Orientation Angle	87
3.2	X-ray Orientation Angle V's Fibre Strength for Native Cotton Fibres	102
3.3	X-ray Orientation Angle V's Elongation at Break for Native Cotton Fibres	103
4.1	Reciprocal Lattice and Ewald's Sphere	110
4.2	The Basic Geometry of Diffraction	111
4.3	Intensity Distributions in Reciprocal Space for Various Crystal Shapes	113
4.4	Distortions of the First and Second Kinds	114
4.5	Changes in Half-Height Width in Cellulose I Electron Diffraction	122
4.6	Rate of Decay of the Extent in Lateral Order	123



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Figure		Page
4.7	Calibration Curve Using Thallium Chloride	126
4.8	Monoclinic Reciprocal Lattice	127
4.9	<i>(hol)</i> - Projection of Reciprocal Lattice	130
5.1	The Fine Structure of Native Cotton Cellulose (a), and Possible Modes of Aggregation, (b) and (c)	135
5.2	Idealized Cross-Section of Elementary Fibril with Parallel Arrangement of Molecular Chains	136
A-1	Distribution of Negative Staining Material	142
A-2	Negative Staining and Distribution of Intensity	143



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LIST OF PLATES

Plate		Page
2.1	Particles from Native Cotton After Hydrolysis	68
2.2	Electron Diffraction Patterns of Particles	75
2.3	Micrograph Showing 'Kinked' Particles	77
4.1	Effect of the Electron Beam on the Crystal Structure of Cellulose I	121
4.2	Effect of Radiation Damage on the Transmission Image of Native Cellulose Fibrils (Dobb)	124
4.3	Electron Diffraction Pattern of Native Cotton Cellulose	128



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