

CONTENTS

	PAGE
PREFACE.....	v
CHAPTER I. THE WOOD TISSUE.....	1
I. The General Structure of Wood.....	1
II. The Morphological Elements of Wood.....	4
III. The Arrangement and Volume of the Wood Elements.....	7
IV. The Growth of Wood.....	11
V. The Physiological Functions of the Wood Cells.....	17
VI. The Morphology of the Fibers.....	20
VII. Compression and Tension Wood.....	24
REFERENCES.....	27
CHAPTER II. THE PHYSICAL PROPERTIES OF WOOD.....	28
I. The Specific Gravity.....	28
II. The Water Content.....	31
A. Water Content of the Wood of Living Trees.....	31
B. Water Content of Air-Dried Wood.....	32
III. The Relation between Specific Gravity and Water Content.....	34
REFERENCES.....	36
CHAPTER III. THE WOOD COMPONENTS AND THEIR CHEMICAL PROPERTIES.....	37
I. The Components of the Woody Substance.....	37
A. History.....	37
II. Cellulose.....	41
A. The Structure of Cellulose.....	41
B. Changes Occurring in Cellulose by Swelling, Chemical and Enzymatic Attack, Heat, and Mechanical Treatment.....	77
1. Hydrate Cellulose.....	77
2. Hydrocellulose.....	78
3. Oxycellulose.....	81
4. Degradation of Cellulose by Mineral Acids.....	86
5. Cellulose and Alkalies.....	102
6. The Degradation of Cellulose by Heating in the Presence of Water.....	103
7. The Degradation of Cellulose by Dry Distillation.....	106
8. The Enzymatic Degradation of Cellulose.....	109
9. The Strength of Fibers; Degradation by Mechanical Means.....	116
C. Cotton Cellulose and Wood Cellulose.....	118
D. The Determination of Cellulose in Wood.....	124
III. Wood Polyoses and Polyuronic Acids.....	134
A. Nomenclature.....	134
B. The Individual Wood Polyoses, Their Properties and Their Occurrence in Different Woods.....	137
1. Pentosan.....	137
2. Araban.....	142
3. Mannan.....	144
4. Glucan.....	148
5. Galactan.....	151
6. Fructan.....	153
7. Pectin.....	153
8. The Occurrence of Polyoses in Different Woods, their Dissolution and Determination.....	156
REFERENCES TO SECTIONS I, II, AND III (pp. 37—161).....	162
IV. Lignin.....	181
A. Introduction. Color Reactions of Wood.....	181
B. Properties of Native Lignin.....	193
1. Lignin, Extractable with Organic Solvents.....	193
2. Firmly-Bound Native Lignin.....	196

	PAGE
3. Reactions of Native Lignin with Sulfite.....	196
4. Reactions of Native Lignin with Hydrogen Sulfide and with Alkali Sulfides.....	212
5. Reactions of Native Lignin with Alcohols, Mercaptans, and Phenols.....	213
6. Reactions of Native Lignin with Halogens.....	214
7. Reactions of Native Lignin with Hydrogen Halides.....	214
8. Oxidation of Native Lignin.....	214
C. Lignin Preparations.....	215
1. Lignosulfonic Acid.....	215
a. Dissolution of Lignosulfonic Acid.....	215
b. The Properties of Dissolved Lignosulfonic Acid.....	218
2. Lignin Preparations Obtained by the Action of Alcohols, Phenols, and Various Organic Acids, Amines, and Hydrazine on Wood or Isolated Lignin.....	237
a. Alcoholysis of Wood. Alcohol Lignins.....	237
b. Phenol Lignins.....	246
c. Acetic Acid and Formic Acid Lignins.....	247
d. Thioglycolic Acid Lignin.....	252
e. Amines and Hydrazine.....	254
3. Alkali Lignin.....	255
4. Lignins Prepared by Extraction of Wood with Hydrotropic Solutions.....	261
5. Hydrol Lignin.....	262
6. Lignins Obtained by the Action of Mineral Acids.....	263
a. Sulfuric Acid.....	263
b. Hydrochloric Acid.....	264
7. Cuproxam Lignin.....	276
8. Periodate Lignin.....	278
D. The Degradation of Lignin.....	279
1. By Alkali.....	279
2. By Oxidation.....	280
3. By Hydrogenation.....	281
4. By Destructive Distillation.....	282
E. Summary of the Chemical Properties of Lignin.....	282
1. Elementary Composition and Functional Groups.....	282
2. Formation of Formaldehyde—The Absence of Methyleneedioxy Groups.....	290
F. Physical Properties.....	292
1. Light Absorption.....	292
2. Index of Refraction.....	294
3. Molecular Weight.....	295
G. Occurrence and Distribution of Lignin in Wood.....	297
H. The Constitution of Lignin, Biosynthesis of Lignin, Lignification.....	306
I. The Determination of Lignin.....	324
1. Isolation with Strong Acids.....	324
a. Sulfuric Acid.....	324
b. Hydrochloric Acid.....	327
c. Hydrogen Fluoride.....	328
d. Mixtures of Strong Acids.....	328
e. Hot, Dilute Mineral Acids.....	329
2. Indirect Methods for Determining Lignin.....	329
V. Minor Components of Wood.....	332
A. Resin, Terpenes , and Fat.....	332
B. Phenols, Tannins, Coloring Matter and Nitrogen-Containing Substances.....	343
C. Inorganic Components.....	347
D. Other Wood Components.....	349
VI. Analyses of Wood.....	350
VII. Physical Structure and Chemical Composition of the Fiber Wall.....	358
REFERENCES TO SECTIONS IV, V, VI, AND VII (pp. 181—366).....	367
CHAPTER IV. THE DECOMPOSITION OF WOOD BY ACIDS. WOOD SACCHARIFICATION.....	390

	PAGE
I. Introduction.....	390
II. Saccharification with Hot Dilute Acids.....	391
III. Saccharification with Concentrated Mineral Acids.....	400
A. Sulfuric Acid.....	400
B. Hydrochloric Acid.....	402
C. Other Procedures with Concentrated Acids.....	410
REFERENCES.....	411
CHAPTER V. THE PULPING OF WOOD WITH SOLUTIONS OF SULFUROUS ACID AND SULFITES.....	414
I. History of the Sulfite Process.....	414
II. The Theory of the Sulfite Pulping Process and its Practical Consequences..	415
A. The Chemistry of Sulfite Pulping.....	415
1. Sulfonation and Delignification.....	415
2. Stability of Cooking Acid.....	424
3. Sulfate Formation.....	426
4. Loosely Bound Sulfur Dioxide.....	429
5. Formation and Destruction of Sugar During the Sulfite Cook.....	430
6. Available Sulfite and Color Change in Cooking Liquor.....	434
B. Sulfite Pulping with Other Agents than Calcium Bisulfite.....	436
1. Pulping with Sulfur Dioxide.....	436
2. Magnesium, Sodium and Ammonium Salts.....	437
C. Behavior of Different Woods.....	438
1. Wood Character and Pulping.....	438
2. Sulfite Pulping of Pine and Other Woods.....	443
3. Sulfite Pulping of Hardwoods.....	448
D. Properties of Sulfite Pulp.....	449
1. Pulping Conditions and Pulp Properties.....	449
2. Reddening of Pulp.....	454
3. Fluorescence of Pulp.....	455
III. By-products of Sulfite Pulp Manufacture.....	456
A. Volatile By-products.....	456
B. Utilization of Waste Liquor.....	458
REFERENCES.....	467
CHAPTER VI. THE PULPING OF WOOD BY AQUEOUS ALKALIES.....	474
I. History of the Alkaline Pulping Process.....	474
II. The Chemistry of the Alkaline Pulping Processes.....	475
A. Main Components of the Black Liquor.....	475
B. Alkali Consumption and Reaction Velocity in Cooks with Caustic Soda	476
C. The Effect of the Sulfidity in Sulfate Cooks.....	477
1. Rate of Delignification and Pulp Strength.....	477
2. Formation of Thioglignin.....	482
D. Demethylation of Lignin and Formation of Low-Molecular Fission Products	487
E. Alkali Cooks with Addition of Other Sulfur Containing Reagents than Sodium Hydrosulfide.....	488
F. Effect of Prehydrolysis of Wood in Alkaline Pulping.....	489
G. Sulfate Cooks of Hardwoods.....	490
III. The By-products of the Alkaline Pulping Processes.....	490
REFERENCES.....	494
CHAPTER VII. OTHER METHODS OF PULPING.....	498
I. Semicheical Pulping.....	498
II. Pulping with Chlorine and Alkali.....	502
III. Pulping with Nitric Acid.....	503
REFERENCES.....	504
CHAPTER VIII. DELIGNIFICATION WITH BLEACHING AGENTS.....	506
I. Chlorination.....	508
II. Alkali Washing.....	516

	PAGE
III. Hypochlorite Bleaching.....	518
IV. Bleaching with Chlorine Dioxide and Chlorites.....	521
V. Bleaching and Pulp Characteristics.....	524
REFERENCES.....	528
CHAPTER IX. THE CHEMICAL PROCESS IN THE CARBONIZATION OF WOOD	531
REFERENCES.....	539
CHAPTER X. UTILIZATION OF WOOD BY CAUSTIC FUSION, PRESSURE	
HEATING WITH ALKALI AND DIGESTION WITH TARS	
OR PHENOLS.....	540
I. Caustic Fusion.....	540
II. Alkaline Pressure Heating.....	543
III. Digestion with Tars and Phenols.....	546
REFERENCES.....	547
CHAPTER XI. THE BEHAVIOR OF WOOD DURING STORAGE..	548
REFERENCES.....	552
CHAPTER XII. THE NATURAL DECOMPOSITION OF WOOD.....	553
REFERENCES.....	562
AUTHOR INDEX.....	565
SUBJECT INDEX.....	616