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Forest Products and Wood Science Principles of Wood Science and Technology **Forest Products and Wood Science** *Forest Products and Wood Science* **Springer Handbook of Wood Science and Technology Wood Science and Technology** *Wood Variation* **Wood - The Internal Optimization of Trees** Spiral Grain and Wave Phenomena in Wood Formation Wood Microbiology Three-dimensional Structure of Wood Wood Structure and Environment **Wood Composites** *The Biology of Reaction Wood Research Developments in Wood Engineering and Technology Flow in Wood Genetics of Wood Production* **Springer Handbook of Wood Science and Technology Wood as Raw Material Handbook of Wood Chemistry and Wood Composites** *Juvenile Wood in Forest Trees* **Trees and Wood in Dendrochronology** *Principles of Wood*

Science and Technology Wood Science Journal of the Institute of Wood Science *Atlas of Macroscopic Wood Identification* Kiln-Drying of Lumber **Transport Processes in Wood** *Xylem Structure and the Ascent of Sap* **Methods in Lignin Chemistry** *Understanding Wood* **Science from Your Airplane Window Nanotechnology in Paper and Wood Engineering Wood Coatings** Biochemistry and Molecular Biology of Wood **Forest Products and Wood Science** *Science and Technology of Wood The Practice of Silviculture* **Nondestructive Characterization and Imaging of Wood Wood & Fire Safety**

The trend in forestry is toward shorter rotations and more complete utiliza tion of trees. The reasons are: (1) financial pressures to obtain rapid returns on the forestry investment made possible by an earlier harvest; (2) enforced harvest of young plantations to maintain a continuing supply of cellulose for mills where wood shortages are experienced; (3) thinning young plantations, both because they were planted too densely initially and because thinning is done where long rotation quality trees are the forestry goal; (4) more intensive utilization is being done using tops and small diameter trees; and (5) there is interest in using young (juvenile) wood for special products because of its unique characteristics and the development of new technologies. The largest present-day source of conifer juvenile wood is from thinnings of plantations

where millions of hectares of pine were planted too densely. Because of the better growth rate resulting from improved silviculture and good genetic stock, plantations will need to be thinned heavily. As a result of this trend, young wood makes up an increasingly larger proportion of the total conifer wood supply each year. Large amounts of juvenile wood from hard woods are also currently available, especially in the tropics and subtropics, because of the fast growth rate of the species used, which results in shorter rotations and ess~ntially all juvenile wood. Modern forest products research had its start hardly fifty years ago. Today we are in a position to apply the title "wood science" to the field of wood technology that is based on scientific investigation, theoretical as well as experimental. It is this research that fosters new uses for wood as a raw material and that creates the foundation for new industries for the manufacture of wood-base materials such as plywood, laminated products, particle and fiber board and sand wich construction. Wood technology in its broadest sense combines the disciplines of wood anatomy, biology, chemistry, physics and mechanical technology. It is through this interdisciplinary approach that progress has been made in wood seasoning, wood preservation methods, wood machining, surfacing and gluing, and in the many other processes applied in its utilization. In 1936 the senior author published a book entitled, "Technologie des Holzes", which was a first approach to a universal

reference book on wood technology. The first edition of Volume I of the Textbook of Wood Technology, co-authored by H. P. BROWN, A. J. P AN SHIN , and C. C. FORSAITH, was published in 1948. An indication of the rapid development of this field can be gained from the fact that the second edition of "Technologie des Holzes und der Holzwerkstoffe", completely revised, was needed by 1951. It contains 2233 pages compared with the 764 pages of the 1936 edition. The new edition of this book offers a fully revised and updated review of the forest products industry. This important text covers the full spectrum of the subject, basing itself in a thorough understanding of the anatomical and physical nature of wood and providing a special emphasis on its use as an industrial raw material. Forest and biomass researchers are provided with comprehensive coverage of all aspects of wood science and industry, ranging from tree growth and wood anatomy to a variety of economically important wood products. At present, no single book adequately covers a basic understanding of wood book satisfies the need for such a work. It describes drying in practice. This the fundamental basis of kiln-drying technology, to enable forest companies to imFrove their drying operations as high-quality timbers become scarcer and of yesteryear can no longer be tolerated. Adaptive the wasteful practices is no longer good enough. Innovations change based on past experience of the material being dried and the processes require a sound

understanding of drying. Newer techniques, such as the use of ultrahigh temperature sea soning and superheated steam under vacuum, require an even greater depth of physical understanding for these methods to be used effectively and economically. book provides a description of modern ideas about wood structure, This moisture movement and stress development, from which models of the drying process are developed to give the kiln operator important information about the course of drying under specified conditions, and thus a means is compared with practice wherever for rational process improvement. Theory possible. Wood as Raw Material: Source, Structure, Chemical Composition, Growth, Degradation and Identification focuses on the scientific advancements in general forestry. This book discusses the value of wood as a raw material as looked upon from biological, botanical, and technical perspective. Organized into 12 chapters, this book starts with an overview of the importance of forest trees as sources of wood. This text then examines the chemical composition and ultrastructure of wood. Other chapters explain the biological mechanisms of wood and bark formation by forest trees. This book discusses as well the certain fundamental relationships between tree growth and wood structure. The final chapter deals with wood identification in North America and European forest tree species. This book is a valuable resource for students engaged in the study of forest management, wood

science and technology, tree physiology, silviculture, forest soils, forest genetics, forest engineering, pulp and paper technology, forest and wood pathology, and other specialized areas. Foresters and technologists will also find this book useful. Inn this essential reference for woodworkers, the author explains everything from how trees grow to getting a sharp edge. Includes examples of problems and their solutions to help woodworkers through their own projects. Full-color photos and b&w illustrations. This atlas presents macroscopic descriptions, macro cross section pictures, general characteristics and identification keys of 335 wood species currently introduced in the European timber market from all over the world. Overall 292 different genera are represented and CITES-listed timbers are also included. Macroscopic descriptions are based on a recently proposed list of macroscopic features for wood identification. Macroscopic features and their codes are defined and illustrated in the atlas. Wood descriptions also include information about natural durability, physical and mechanical properties, end uses, environmental sustainability and possible related misleading commercial names. Furthermore, each genus is described in terms of number of species, geographical distribution and main commercial timbers, and details are given about to what extent timbers within the genus can be typically identified through macroscopic and microscopic analysis, if any. The atlas will be a valuable guide for all

agents in charge for timber verification, those involved in the European Timber Regulation enforcement and CITES inspections, as well as wood scientists, foresters, wood sellers, wood restorers, and any wood worker and wood passionate interested in a fast and reliable tool for wood identification. The science of dendrochronology has grown significantly in the past 20 years. In the 1950s and 1960s, interest in the subject was limited to only a handful of scientists who perceived in dendrochronology a "l'art pour l'art". Today, however, specialists from many different fields recognize and are pursuing the problems of dendrochronology. Tree-ring research has acquired a permanent role in the various sciences of archeology, history, geology, ecology, and climatology. The founders of dendrochronology themselves were of varied scientific backgrounds and interests. For example, A. E. Douglass in the United States was an astronomer, B. Huber in Germany a forest-biologist, and F. N. Shvedov in Russia a climatologist. Today the spectrum is even broader. Many den drochronologists are authorities in mathematics, archeology, history, forestry, botany, wood technology, ecology geography, geology, etc. It is, therefore, understandable that it has become almost impossible for one individual to encompass the entire field. Bitvinskas (1974), Fritts (1976), Schweingruber (1983), and Mitsutani (1990) have attempted, each guided by his own interests, to provide at least an overview of the field. Recently, individual

aspects have been presented by groups of authors in books edited by Fletscher (1978), Hughes et al. (1982), Jacoby and Hornbeck (1987) and Bradley and Jones (1992). It is very likely that in the future summaries covering each branch of dendrochronology will be published. The most up-to-date, comprehensive resource on silviculture that covers the range of topics and issues facing today's foresters and resource professionals The tenth edition of the classic work, The Practice of Silviculture: Applied Forest Ecology, includes the most current information and the results of research on the many issues that are relevant to forests and forestry. The text covers such timely topics as biofuels and intensive timber production, ecosystem and landscape scale management of public lands, ecosystem services, surface drinking water supplies, urban and community greenspace, forest carbon, fire and climate, and much more. In recent years, silvicultural systems have become more sophisticated and complex in application, particularly with a focus on multi-aged silviculture. There have been paradigm shifts toward managing for more complex structures and age-classes for integrated and complementary values including wildlife, water and open space recreation. Extensively revised and updated, this new edition covers a wide range of topics and challenges relevant to the forester or resource professional today. This full-color text offers the most expansive book on silviculture and: Includes a revised and expanded text with

clear language and explanations Covers the many cutting-edge resource issues that are relevant to forests and forestry Contains boxes within each chapter to provide greater detail on particular silvicultural treatments and examples of their use Features a completely updated bibliography plus new photographs, tables and figures The Practice of Silviculture: Applied Forest Ecology, Tenth Edition is an invaluable resource for students and professionals in forestry and natural resource management. The international perspective of this wide-ranging handbook embraces temperate and tropical woods, as well as first-time coverage of uses of bark. This book deals with all the aspects of wood science and technology in India including structural timber; timber machine; wood anatomy; wood preservation; composite wood; pulp and paper; and identification of different woods. The primary aim of Wood Structure and Environment is to reveal the hidden ecological richness in stems and roots from trees, shrubs and herbs. The detailed, lucid text will inspire researchers to consider the anatomic microcosm of wood plants and use it as a retrospective source of information, solving problems related to ecophysiology, competition, site conditions, population biology, earth science, wood quality and even human history. Modern forest products research had its start hardly fifty years ago. Today we are in a position to apply the title "wood science" to the field of wood technology that is based on scientific investigation,

theoretical as well as experimental. It is this research that fosters new uses for wood as a raw material and that creates the foundation for new industries for the manufacture of wood-base materials such as plywood, laminated products, particle and fiber board and sand wich construction. Wood technology in its broadest sense combines the disciplines of wood anatomy, biology, chemistry, physics and mechanical technology. It is through this interdisciplinary approach that progress has been made in wood seasoning, wood preservation methods, wood machining, surfacing and gluing, and in the many other processes applied in its utilization. In 1936 the senior author published a book entitled, "Technologie des Holzes", which was a first approach to a universal reference book on wood technology. The first edition of Volume I of the Textbook of Wood Technology, co-authored by H. P. BROWN, A. J. P AN SHIN , and C. C. FORSAITH, was published in 1948. An indication of the rapid development of this field can be gained from the fact that the second edition of "Technologie des Holzes und der Holzwerkstoffe", completely revised, was needed by 1951. It contains 2233 pages compared with the 764 pages of the 1936 edition. Over the past years, a great deal has been learned about variation in wood prop erties. Genetic control is a major source of variation in most wood properties. Wood is controlled genetically both directly in the developmental or internal pro cesses of wood formation and indirectly

by the control of tree form and growth patterns. Emphasis in this book will be on the internal control of wood production by genetics although there will be two chapters dealing with the indirect genetic control of wood, which was covered in detail in the previous book by Zobel and van Buijtenen (1989). The literature on the genetics of wood is very variable, SO'lle quite superficial, on which little reliance can be placed, and some from well-designed and correctly executed research. When suitable, near the end of each chapter, there will be a summary with the authors' interpretation of the most important information in the chapter. The literature on the genetics of wood can be quite controversial. This is to be expected, since both the environment and its interaction with the genotype of the tree can have a major effect on wood properties, especially when trees of similar genotypes are grown under widely divergent conditions. Adding to the confusion, studies frequently have been designed and analyzed quite differently, resulting in conflicting assessments of results. This proceedings volume presents new scientific works of the research workers and experts from the field of Wood Science & Fire. It looks into the properties of various tree species across the continents affecting the fire-technical properties of wood and wood-based materials, its modifications, fire-retardant methods and other technological processes that have an impact on wood ignition and burning. The results of these

findings have a direct impact on Building Construction and Design describing the fire safety of wooden buildings, mainly large and multi-story ones. The results of these experiments and findings may be applied, or are directly implemented into Fire Science, Hazard Control, Building Safety which makes the application of wood and wood materials in buildings possible, while maintaining strict fire regulations. One part of the contributions focuses on the symbiosis of the material and the fire-fighting technologies. Wood burning has its own specific features, therefore, the fire protection technologies need to be updated regularly. It also includes the issue of the intervention of fire-fighting and rescue teams in the fires of wooden buildings. Presentations deal with the issue of forest fires influenced by the climate changes, relief, fuel models based on the type and the age of the forest stand. The first edition of this book was the first to provide an integrated description of sap ascension from an anatomical and functional point of view. The second edition opens with the three-dimensional aspects of wood anatomy. The cohesion-tension theory and new evidence are introduced in response to recent controversies over the mechanism of sap ascent in plants. The physiology, anatomy and biophysics of xylem dysfunction are discussed and new insights into hydraulic architecture are reviewed with special emphasis on physiological limits on maximum transpiration and how hydraulic architecture limits

gas exchange, carbon gain and growth of plants. The text concludes with a description of xylem failure and pathology. The book highlights fascinating areas of current research with the aim to stimulate more work in the future. An up-to-date compilation of the theoretical background and practical procedures involved in lignin characterization. Whenever possible, the procedures are presented in sufficient detail to enable the reader to perform the analysis solely by following the step-by-step description. The advantages and limitations of individual methods are discussed and, more importantly, illustrated by typical analytical data in comparison to results obtained from other methods. This handbook serves the need of researchers and other professionals in academia, the pulp and paper industry as well as allied industries. It is equally useful for those with no previous experience in lignin or lignocellulosics. Here are two physicists looking over the fence of physics, getting thrilled by the life and growth of trees, taking an altogether different, exciting view of wood: trees produce wood for their own benefit. They do not live for the benefit of man who builds his world using wood as a raw material. Timber is revealed in a different light, and the reader is taught to stop thinking of it in terms of defective beams and boards. Wood only fails as a part of the living tree. To us, the tree and wood biologists, this new definition is a real, inspiring challenge, which is just what Kubler and Mattheck

intended it to be. Their answers may seem too simple or little logical to some of us; but the authors are not at a loss for sound and solid arguments. Their field studies prove the incredible, their hypotheses makes us want to get to the bottom of the un proven unbelievable. The authors' answers and arguments are bold and cour ageous. They arouse our curiosity and force us to fathom the facts. It seems as if Kubler and Mattheck wanted to trick us into believing that trees only live and react following mechanical rules and strategies. To tell the truth, that was what I first suspected the authors of: but I was wrong. This handbook provides an overview on wood science and technology of unparalleled comprehensiveness and international validity. It describes the fundamental wood biology, chemistry and physics, as well as structure-property relations of wood and wood-based materials. The different aspects and steps of wood processing are presented in detail from both a fundamental technological perspective and their realisation in industrial contexts. The discussed industrial processes extend beyond sawmilling and the manufacturing of adhesively bonded wood products to the processing of the various wood-based materials, including pulp and paper, natural fibre materials and aspects of bio-refinery. Core concepts of wood applications, quality and life cycle assessment of this important natural resource are presented. The book concludes with a useful compilation of fundamental material parameters and data as

well as a glossary of terms in accordance with the most important industry standards. Written and edited by a truly international team of experts from academia, research institutes and industry, thoroughly reviewed by external colleagues, this handbook is well-attuned to educational demands, as well as providing a summary of state-of-the-art research trends and industrial requirements. It is an invaluable resource for all professionals in research and development, and engineers in practise in the field of wood science and technology. Wood is the usual end product of a forestry operation. Because of its importance, numerous studies have been made relative to wood prop erties, the causes of wood variation, and how best to develop wood for desired products. There is voluminous literature related to these subjects, but it is neither well known nor appreciated by foresters because the publications are often not available or are not well understood by the forester or by those who use the wood. Frequently, the literature is confusing and contradictory, making it difficult for the nonspecialist to use what information is available. In order to produce and use wood efficiently, the variation pat terns within trees, among trees within species, and among species must be understood. This also requires some knowledge of the causes of variation and the effects of different wood properties upon utiliza tion. The information about variation patterns, their causes, and con trol and effect upon the product must be known by the

tree grower, the tree breeder, and the tree harvester as well as by those who ultimately convert wood into a final, salable product. Wood Microbiology, Second Edition, presents the latest advances in wood decay and its prevention. Coverage includes classification of fungi and bacteria, factors affecting growth and survival, fungal metabolism, and wood chemistry. There are also chapters that focus on the anatomical aspects, chemical changes, and ultrastructural effects of wood decay. Additionally, this book discusses major issues associated with wood decay, detecting decay, and how to take protective action against it. This is a one-stop reference resource for wood scientists, wood processing and preserving professionals, foresters and forest pathologists, as well as students of forestry, and wood science and technology courses. It is authored by two leading experts with over 80 years of experience working with timber durability. Provides updated taxonomy and classification of decay groups Presents detailed descriptions of anatomical, chemical, and ultrastructural aspects of wood decay Includes discussions on major issues associated with decay, how to detect decay and preventative measures This book on the Nondestructive Characterization and Imaging of Wood by Professor Voichita Bucur is truly the most outstanding reference on the subject ever written. Since the origins of mankind, wood has played a key role in the history of humans and other living creatures, ranging from provision of life from

trees giving air, heat, light, and food to nourish their bodies to structures to protect them from the elements. Wood has also played a key role in one of the world's primary religions. Nondestructive diagnostics methods have long found application in medi cal practice for examination of the human body in order to detect life threatening abnormalities and permit diagnosis to extend life. Nondestructive testing has been used for many years to insure the safety of machinery, air craft, railroads, tunnels, buildings and many other structures. Therefore, it is timely for a treatise, like the present one, to be written describing how wood can be characterized without employing destructive test methods. Since wood is so valuable to mankind, it is important to know the latest methods to nondestructively characterize wood for all practical applications. The updated seventh edition of the classic text on wood science and forestry The seventh edition of Forest Products and Wood Science: An Introduction offers a fully revised and updated review of the forest products industry. This classic text contains a comprehensive review of the subject and presents a thorough understanding of the anatomical and physical nature of wood. The authors emphasize its use as an industrial raw material. Forest Products and Wood Science provides thorough coverage of all aspects of wood science and industry, ranging from tree growth and wood anatomy to a variety of economically important wood products, along with their applications and

performance. The text explores global raw materials, the increasing use of wood as a source of energy and chemicals and environmental implications of the use of wood. This edition features new material on structural composites, non-structural composites, durability and protection, pulp and paper, energy and chemicals, and global raw materials. This seventh edition of the classic work: Contains new information on a variety of topics including: structural composites, non-structural composites, durability and protection, pulp and paper, energy and chemicals and global raw materials Includes a fully revised text that meets the changing needs of the forestry, engineering, and wood science academics and professionals Presents material written by authors with broad experience in both the private and academic sectors Written for undergraduate students in forestry, natural resources, engineering, and wood science, as well as forest industry personnel, engineers, wood-based manufacturing and using professionals, the seventh edition of Forest Products and Wood Science updates the classic text that has become an indispensable resource. Describes dozens of interesting phenomena and occurrences readily observable during an airplane ride and relates them to the appropriate scientific principles. This book has a similar subject content to the author's previous Flow in Wood but with substantial updating due to the abundance of research in the wood science field since 1971. Several different concepts have been introduced,

particularly in regard to wood-moisture relation ships. The role of water potential in the equilibria between wood and its humid and moist environments is considered. Two theories are introduced to explain the nonisothermal transport of bound water in the steady and unsteady states. As in the former text, the wood-. structure relationship is emphasized . . The author is especially grateful to Dr. C. Skaar for his careful and critical review of much of the manuscript and for the productive dis cussions of many of the concepts. Dr. T. E. Timell, the series editor, rendered major assistance in the preparation of Chap. 2 and in his editing of the manuscript. The author wishes to thank Dr. W. A. Cote, Mr. A. C. Day, and Mr. J. J. McKeon for providing electron micro graphs, Mr. G. A. Snyder for his photography of much of the art work, Dr. C. H. de Zeeuw for his advice in the field of wood anatomy, and Ms. Mary M. Siau for her careful rendition of the art work. Apprecia tion is extended to Miss Judy A. Barton and Mrs. Stephanie V. Micale for their work in typing and checking the manuscript. Mr. J. A. Introduces wood as an industrial raw material and explains the physical and chemical nature of wood, important wood properties, and the nature of major wood products Nanotechnology in Paper and Wood Engineering: Fundamentals, Challenges and Applications describes recent advances made in the use of nanotechnology in the paper and pulp industry. Various types of nano-additives commonly used in the paper

industry for modification of raw material to enhance final products are included, with other sections covering the imaging applications of nano-papers and nano-woods in pharmaceuticals, biocatalysis, photocatalysis and energy storage. This book is an important reference source for materials scientists and engineers who are looking to understand how nanotechnology is being used to create more efficient manufacturing processes in for the paper and wood industries. Provides information on nano-paper production and its applications Explains the major synthesis techniques and design concepts of cellulosic or wooden nanomaterials for industrial applications Assesses the major challenges of creating nanotechnology-based manufacturing systems for wood and paper engineering The degradable nature of high-performance, wood-based materials is an attractive advantage when considering environmental factors such as sustainability, recycling, and energy/resource conservation. The Handbook of Wood Chemistry and Wood Composites provides an excellent guide to the latest concepts and technologies in wood chemistry and bio-based composites. The book analyzes the chemical composition and physical properties of wood cellulose and its response to natural processes of degradation. It describes safe and effective chemical modifications to strengthen wood against biological, chemical, and mechanical degradation without using toxic, leachable, or corrosive chemicals. Expert researchers provide insightful

analyses of the types of chemical modifications applied to polymer cell walls in wood, emphasizing the mechanisms of reaction involved and resulting changes in performance properties. These include modifications that increase water repellency, fire retardancy, and resistance to ultraviolet light, heat, moisture, mold, and other biological organisms. The text also explores modifications that increase mechanical strength, such as lumen fill, monomer polymer penetration, and plasticization. The Handbook of Wood Chemistry and Wood Composites concludes with the latest applications, such as adhesives, geotextiles, and sorbents, and future trends in the use of wood-based composites in terms of sustainable agriculture, biodegradability and recycling, and economics. Incorporating over 30 years of teaching experience, the esteemed editor of this handbook is well-attuned to educational demands as well as industry standards and research trends. This handbook provides an overview on wood science and technology of unparalleled comprehensiveness and international validity. It describes the fundamental wood biology, chemistry and physics, as well as structure-property relations of wood and wood-based materials. The different aspects and steps of wood processing are presented in detail from both a fundamental technological perspective and their realisation in industrial contexts. The discussed industrial processes extend beyond sawmilling and the manufacturing of adhesively bonded

wood products to the processing of the various wood-based materials, including pulp and paper, natural fibre materials and aspects of bio-refinery. Core concepts of wood applications, quality and life cycle assessment of this important natural resource are presented. The book concludes with a useful compilation of fundamental material parameters and data as well as a glossary of terms in accordance with the most important industry standards. Written and edited by a truly international team of experts from academia, research institutes and industry, thoroughly reviewed by external colleagues, this handbook is well-attuned to educational demands, as well as providing a summary of state-of-the-art research trends and industrial requirements. It is an invaluable resource for all professionals in research and development, and engineers in practise in the field of wood science and technology. "This book examines the latest research advances and technological developments for wood material as an engineering product and the innovation it provides for environmental friendly materials"--Provided by publisher. Recent progress in enhancing and refining the performance and properties of wood composites by chemical and thermal modification and the application of smart multi-functional coatings have made them a particular area of interest for researchers. Wood Composites comprehensively reviews the whole field of wood composites, with particular focus on their materials, applications and

engineering and scientific advances, including solutions inspired biomimetrically by the structure of wood and wood composites. Part One covers the materials used for wood composites and examines wood microstructure, and wood processing and adhesives for wood composites. Part Two explores the many applications of wood composites, for example plywood, fibreboard, chipboard, glulam, cross-laminated timber, I-beams and wood-polymer composites. The final part investigates advances in wood composites and looks at the preservation and modification of wood composites, environmental impacts and legislative obligations, nano-coatings and plasma treatment, biomimetic composite materials, the integration of wood composites with other materials and carbonized and mineralized wood composites. Comprehensively reviews the entire field of wood composites in a single volume Examines recent progress in enhancing and refining the performance and properties of wood composites by chemical and thermal modification and the application of smart multi-functional coatings Explores the range of wood composites, including both new and traditional products This fourth edition is a major revision of a classic textbook continues its long tradition of being an introductory text designed to introduce students to wood as an industrial raw material. It is intended to help develop an understanding of the physical and chemical nature of wood, important wood properties and the nature of major wood

products. Wood-based materials discussed include solid wood products, structural and non-structural panel products, paper and fiber products, and how wood properties affect the use and performance of these products. Related issues examined include the use of wood for energy, environmental implications of wood-based materials, and the global wood supply. Divided into four parts: Part I introduces the growth and structure of hardwoods and softwoods, chemical and structural characteristics of wood and bark and inherent variability. Part 2 deals with the physical properties of wood, relating these properties to the chemical and structural characteristics covered in Part I. Part 3 discusses the principal major wood-based products, the basic manufacturing processes associated with each, and how raw material selection affects product properties. Part 4 focuses on the global raw material picture, use of wood as an energy source, and environmental implications of the use of wood. It is widely recognized that spiral grain in trees severely reduces the value of sawn timber through warping and loss of strength, and that it also causes problems for other wood uses as diverse as transmission poles or plywood. Yet, paradoxically, there are highly valued grain patterns including wavy and interlocked grain, whose origins in the cambium invite direct comparison with those of spiral grain, so that many authorities believe them to be related phenomena. In recent years this concept has prompted extensive research into the anatomy, genetics, and

physiology of all such grain patterns in wood. As a result it has become apparent that tree cambia provide excellent systems through which to study the origins of stem polarity and the complex processes of morphogenetic control in plants. Beside these and other pressing topics for research, the book examines methods of measuring grain deviations, and considers their influence on wood properties, on the economics of timber production, and on wood manufacturing. Progress in wood chemistry has been related mainly to chemical wood pulping and bleaching and chemical utilization of wood and wood extractives. Meth ods of wood analysis were developed by Schorger (proximate analysis in 1917) and Dore (summative analysis in 1919), and standard methods based on Schorger's method, e.g., TAPPI standards (Technical Association of the Pulp and Paper Industry), have been widely used for chemical analysis of woods in many countries. Thus it is generally known that wood is composed of about 50% cellulose, 20-35% of lignin, 15-25% of hemicelluloses, and variable amounts of extractives. Chemical characterization and efficient utilization of these wood components have been studied in laboratories of wood chemistry and technology in universities and government institutions. In the last decade, biochemistry and molecular biology of microorganisms, animals, and plants have greatly progressed. At the same time wood has been recognized as a unique renewable ecomaterial produced

by trees using solar energy. In addition, many desirable properties of wood and wood components as biomaterial that affects physiology and psychology in humans have recently attracted attention. Discover the current trends in industrial wood coatings! The comprehensive standard work from Jorge Prieto and Jürgen Kiene focuses on interior and exterior coatings for wood and wood-based materials. It compares classic solvent-borne wood coatings with modern UV-curing systems and water-borne coating systems. Moreover, guide formulations and actual procedures for coatings are shown in detail. Summarized: this book provides a comprehensive overview, with practical solutions and support for everyone who deals with industrial wood coatings. The book is a fundamental reference source on reaction wood for wood scientists and technologists, plant biologists, silviculturists, forest ecologists, and anyone involved in the growing of trees and the processing of wood. It brings together our current understanding of all aspects of reaction wood, and is the first book to discuss both compression wood and tension wood. Trees produce reaction wood to maintain the vertical orientation of their stems and the optimum angle of each branch. They achieve this by laying down fibre cell walls in which differences in physical and chemical structure from those of normal fibres are expressed as differential stresses across the stem or branch. This process, while of obvious value for the survival of the tree, causes

serious problems for the utilisation of timber. Timber derived from trees containing significant amounts of reaction wood is subject to dimensional instability on drying, causing twisting, bending and splitting. It is also difficult to work as timber, and for the pulp and paper industry the cost of removing the increased amount of lignin in compression wood is substantial. This has both practical and economic consequences for industry. Understanding the factors controlling reaction wood formation and its effect on wood structure is therefore fundamental to our understanding of the adaptation of trees to their environment and to the sustainable use of wood. The topics covered include: -Morphology, anatomy and ultrastructure of reaction wood -Cell-wall polymers in reaction wood and their biosynthesis -Changes in tree proteomes during reaction wood formation -The biomechanical action and biological functions of reaction wood - Physical and mechanical properties of reaction wood from the scale of cell walls to planks -The detection and characterisation of compression wood -Effects of reaction wood on the performance of wood and wood-based products - Commercial implications of reaction wood and the influence of forest management on its formation