

Isolation Of Chlorophyll And Carotenoid Pigments From Spinach

Carotenoid Chemistry and Biochemistry covers the proceedings of the Sixth International Symposium on Carotenoids, held in Liverpool, United Kingdom on July 26-31, 1981. This symposium highlights the interest in biochemical and biological aspects of carotenes. This book is organized into 25 chapters including chapters on carotenoid chemistry, their structures, synthesis and physical methods, with emphasis on their stereochemistry. Other chapters deal with the chemistry of complexes between carotenoids or retinoids and protein, the novel blue carotenoproteins, and the visual pigments and the nutritionally important retinol-binding proteins. The discussions then shift to animal carotenoids, carotenoid metabolism and transformations, including interesting stereochemical findings. This book also reviews studies of carotenoids in photosynthesis, the industrial importance of carotenoids, medical aspects, particularly the use of carotenoids in treatment against skin photosensitivity and their possible role in protection against cancer. The remaining chapters examine the effects of chemicals on carotenoid biosynthesis and its relevance to herbicide design. This book will be of value to carotenoid scientists and researchers.

Chlorophyll a Fluorescence: A Signature of Photosynthesis highlights chlorophyll (Chl) a fluorescence as a convenient, non-invasive, highly sensitive, rapid and quantitative probe of oxygenic photosynthesis. Thirty-one chapters, authored by 58 international experts, provide a solid foundation of the basic theory, as well as of the application of the rich information contained in the Chl a fluorescence signal as it relates to photosynthesis and plant productivity. Although the primary

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photochemical reactions of photosynthesis are highly efficient, a small fraction of absorbed photons escapes as Chl fluorescence, and this fraction varies with metabolic state, providing a basis for monitoring quantitatively various processes of photosynthesis. The book explains the mechanisms with which plants defend themselves against environmental stresses (excessive light, extreme temperatures, drought, hyper-osmolarity, heavy metals and UV). It also includes discussion on fluorescence imaging of leaves and cells and the remote sensing of Chl fluorescence from terrestrial, airborne, and satellite bases. The book is intended for use by graduate students, beginning researchers and advanced undergraduates in the areas of integrative plant biology, cellular and molecular biology, plant biology, biochemistry, biophysics, plant physiology, global ecology and agriculture.

Carotenoids represent a large group of isoprenoid structures with many different structural characteristics and biological activities. They are the most important of the naturally occurring pigments and are responsible for the various colors of different fruits, vegetables, and plant parts. Marine carotenoids and their unique structures are responsible for the color of many fish, shellfish, and algae. However, while there have been many papers and reviews on carotenoids of terrestrial origin, there has been relatively little research conducted on the impact of marine carotenoids on human health. Recent research efforts have revealed that marine carotenoids have strong biological activity affecting human health and are candidates for nutraceuticals. This Topical Collection of Marine Drugs is dedicated to marine carotenoids, and will focus on the benefits of carotenoids for human beings. For a better understanding of the physiological effects of marine carotenoids, this collection should include the most recent developments in the

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presence, analysis, chemistry, and biochemistry of marine carotenoids.

"Carotenoids, Volume 2" is the first book to be devoted entirely to the chemical synthesis of carotenoids. The essential in-depth appreciation of the perspectives, principles and strategies of carotenoid synthesis is provided in the first chapter. Preparation of polyene synthons and carotenoid end groups, and the coupling reactions commonly used for carbon-carbon double bond formation, as well as the application of these methods and synthons for the synthesis of carotenoids, are then described in detail. The commercially important technical syntheses used for the large scale industrial production of carotenoids, and methods for the preparation of isotopically labelled carotenoids, in particular for biological and medical applications, are also covered. Following the practice established in Volume 1A, Worked Examples are presented. These describe in detail reliable and efficient procedures for key reactions and can be used to form the basis of practical exercises for students of organic chemistry. Tables of useful synthons and a list of natural carotenoids that have been prepared by total synthesis are included as appendices.

Written by leading experts in the area of carotenoid research, this book gives a comprehensive overview of a various topics in the field. The contributions review the basic hypotheses about how carotenoids function and give details regarding testing different molecular models using state-of-the-art experimental methodologies.

Designed as the primary reference for the biotechnological use of macroalgae, this comprehensive handbook covers the entire value chain from the cultivation of algal biomass to harvesting and processing it, to product extraction and formulation. In addition to covering a wide range of product classes, from polysaccharides to terpenes and from enzymes

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to biofuels, it systematically discusses current and future applications of algae-derived products in pharmacology, medicine, cosmetics, food and agriculture. In doing so, it brings together the expertise of marine researchers, biotechnologists and process engineers for a one-stop resource on the biotechnology of marine macroalgae.

The Carotenoids book series provides an introduction to the fundamental chemistry, detailed accounts of the basic methods used in carotenoid research, and critical discussions of the biochemistry, functions and applications of carotenoids. Part 1 discusses the fundamental properties on which the biological functions and effects of carotenoids depend. Part 2 describes important natural functions of carotenoids in all kinds of living organisms.

To quantify antioxidants in natural sources, the application of chromatography techniques with different detectors followed by skillful sample preparation is necessary. *Analysis of Antioxidant-Rich Phytochemicals* is the first book that specifically covers and summarizes the details of sample preparation procedures and methods developed to identify and quantify various types of natural antioxidants in foods. Focusing on the principle of quantification methods for natural antioxidants, the book reviews and summarizes current methods used in the determination of antioxidant-rich phytochemicals in different sources. Chapter by chapter, the distinguished team of authors describes the various methods used for analysis of the different antioxidant-rich phytochemicals – phenolic acids; carotenoids; anthocyanins; ellagitannins, flavonols and flavones; catechins and procyanidins; flavanones; stilbenes; phytosterols; and tocopherols and tocotrienols. Going beyond extensive

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reviews of the scientific literature, the expert contributors call on their accumulated experience in sample extraction and analysis to outline procedures, identify potential problems in dealing with different samples, and offer trouble-shooting tips for the analysis. Analysis of Antioxidant-Rich Phytochemicals covers the important food applications and health-promoting functions of the major antioxidant phytochemicals, presents general analysis principles and procedures, and systematically reviews and summarizes the various analytical methods necessary for each type of natural antioxidant in different food sources.

Plants produce chemicals as part of their normal metabolic activities. These include primary metabolites found in all plants, such as sugars and fats, as well as secondary metabolites, which can have therapeutic effects in humans and be refined to produce drugs. Plants synthesize a bewildering variety of phytochemicals, but most are derivatives of a few biochemical motifs. Numerous herbal-derived substances have been evaluated for their therapeutic potential. These include alkaloids, coumarins, saponins, plant pigments and flavonoids. Flavonoids, carotenoids and anthocyanins are probably the best known of these substances due to their antioxidant properties.

Carotenoids: Structure and Function in the Human Body presents comprehensive coverage of carotenoids. The text covers the scientific literature and clinical significance of this organic pigment, with an emphasis on its therapeutic potential. The authors approach carotenoids from a range of perspectives, from their

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structural and physicochemical properties to their distribution in nature, interaction with the human metabolism, and use as a coloring agent in various products. The intake, metabolism and secretion of anthocyanins in the human body are covered in-depth, as are the biosynthetic pathways through which these compounds are synthesized in the natural system. Factors affecting stability and extraction are listed, and health-related uses and biological activities are covered in great detail. Present and future trends in carotenoid research are also presented. This book provides a solid background in carotenoids for researchers and professionals in food science, food technology, nutrition, biology, chemistry and medical sciences.

Set includes revised editions of some issues.

The Pigments from Microalgae Handbook presents the current state of knowledge on pigment production using microalgae-based processes, and covers both the scientific fundamentals of this technology and its practical applications. It addresses biology, chemistry, biochemistry, analysis and engineering aspects, as well as applications of natural pigments in photosynthetic organisms. The book also describes the analytical procedures associated with the characterization of pigments and the engineering aspects of microalgal pigment production. It considers the three major classes of pigments (chlorophylls, carotenoids and phycobiliproteins) produced and surveys the main commercial applications of these chemicals. The book offers a valuable source of information for industrial researchers and practitioners in industrial biotechnology,

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as it covers various engineering aspects of microalgal pigment production, such as bioreactors and bioprocesses, industrial extraction processes, and the bioeconomy of production including life-cycle assessment. The book will also be of interest to undergraduate and graduate students of biochemistry, food chemistry, and industrial microbiology.

For the first time, a procedure has been developed for the isolation of intact α - and β -carotene binding carotenoprotein from carrot chromoplasts. Initial attempts to isolate and purify this protein from spinach chloroplasts was unsuccessful because of contaminating chlorophyll and chlorophyll proteins. Though the attempts were unsuccessful for a carotene binding protein in spinach, a lutein isomer binding carotenoprotein was effectively isolated. The isolation method employed metal chelate affinity chromatography using immobilized copper ions. While suitable for this more polar carotenoid protein complex, this method was not utilizable for non-polar carotene binding proteins. Degradation of β -carotene occurred during chromatography, apparently catalyzed by the copper ions. The developed procedure for the isolation of the pure carotenoprotein from carrot chromoplast was quick and straightforward. Only French pressing, high speed centrifugation and gel filtration were needed to purify the protein. The major protein peak collected from the gel filtration column was also the major carotenoid peak. This peak corresponded to a molecular weight of approximately 2,000 kDal for the native protein. Isoelectric focusing indicated the presence of a single

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protein band with a pI of 3.6. Further substantiation that this was a single pure protein complex was demonstrated by SDS-PAGE where only a single 54 kDa protein band was detected. This indicates that the native complex of 2,000 kDa was comprised of seemingly identical 54 kDa subunits. Analysis of the carotenoprotein complex by reverse-phase HPLC demonstrated the protein to bind 1 mole of α -carotene and 2 moles of β -carotene for each mole of the subunit. The amino acid composition of the protein suggests that the protein contains a high percentage of α -helical conformation in combination with a probability of numerous reverse turns. Given this information and the high percentage of hydrophobic amino acids present, it may be hypothesized that the helical structure of the protein may form a hydrophobic cleft along the surface of the protein which would allow attachment of the carotenes. This hypothesis is consistent with the ease in which the carotene may be dissociated from the protein complex during the isolation procedures.

In the mid-1960's, scientists working on carotenoids throughout the World agreed to have periodic meetings for the purpose of discussing and disseminating scientific research results concerning all aspects of carotenoids. The meetings were also organized to act as teaching forums for students, and the major scientific results from each meeting were to result in a publication. Each meeting was planned to be International in scope, being held in different locations in the World, and organized by local, recognized carotenoid scientists. The first of the Carotenoid meetings was held in Trondheim, Norway in

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1966. Meetings then followed in Las Cruces, New Mexico (1969); Cluj, Roumania (1972); Berne, Switzerland (1975); Madison, Wisconsin (1978); Liverpool, England (1981); and Munich, Federal Republic of Germany (1984). In all of these meetings, the original purposes which stimulated the first meeting were accomplished: scientific discussion, student education and resulting scientific publication. The meetings and the information resulting from them have led to significant advances in carotenoid biochemistry, biology, and chemistry. This publication represents the contributions from a distinguished list of participants. We look forward to the future meetings in this series.

Handbook on Natural Pigments: Industrial Applications for Improving Food Colour is unique in its approach to the improvement of food colors. The book is written with industrial applications in mind, with each chapter focusing on a color solution for a specific commodity that will provide food scientists with a one-stop, comprehensive reference on how to improve the color of a particular food product. The first section of the book looks at the legal frameworks which underpin natural food colorings, also investigating the consumer expectations of food color. The second section of the book focuses on specific industrial applications of natural colorants with chapters covering the use of natural colorants in aqueous food products, cereal-based foods, and meat products, amongst many other topics. The various pigments which can be used to effectively color these commodities are presented with information on safety and testing included throughout. The final section

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in the book looks at recent developments and future perspectives in natural food colorings. There are chapters which cover the health benefits of natural pigments, the use of novel fruits and vegetables in pigments, and stable natural solutions for blue colorings. Presents recent advances in consumer demand and worldwide legislation regarding natural food colorants Discusses the use of natural food colorants for one specific product category per chapter rather than one pigment class per chapter – this makes the book extremely useable for industrialists working in a specific sector Contains a comprehensive array of product-specific coloration approaches, from using pigment-enriched feed additives to the direct addition of color formulations

Significant developments in recent years have led to a deeper understanding of the role and function of carotenoids in photosynthesis. For the first time the biological, biochemical, and chemical aspects of the role of these pigments in photosynthesis are brought together in one comprehensive reference volume. Chapters focus on the photochemistry of carotenoids in light harvesting and photoprotection, the nature and distribution of carotenoids in photosynthetic organisms, their biosynthesis, the herbicidal inhibition of carotenogenesis and the 'xanthophyll cycle'. Throughout details are given of the various methodologies used. A detailed appendix provides physical data for the major compounds. Carotenoids in Photosynthesis is an invaluable reference source for all plant scientists.

Plant Growth and Regulation Alterations to Sustain

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Carotenoids — 5 is a collection of papers presented at the Fifth International Symposium on Carotenoids held in Madison, Wisconsin, on July 23-28, 1978. The symposium focuses on advances that have been made in understanding carotenoids, including their chemistry, biochemistry, and stereochemistry as well as biosynthesis and biological functions. Topics covered include the industrial applications of carotenoids; synthesis of polyenes via phosphonium ylids; biological functions of vitamin A in normal and transformed tissues; and enzymatic synthesis of carotenes. This volume is comprised of 18 chapters and begins with a review of carotenoid research undertaken over the years in the areas of separation, synthesis, and physical and chemical analysis and further significant advances that are to be expected in the future. The reader is then introduced to the development of the industrial manufacture of carotenoids and vitamin A by isolation and by synthesis, with special emphasis on the use of carotenoids as a preferred class of coloring matters for food and feed. The following chapters explore the progress in carotenoid characterization, chemistry, structures, chemical transformations, and stereochemistry; synthesis of optically active carotenoids and related compounds, carotenoid glycosylesters, and other carotenoids; and genetics and regulation of carotene biosynthesis. The final chapter describes a number of approaches to synthesis of canthaxanthin. This book will be a useful resource for chemists and biochemists.

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Featuring new experiments unique to this lab textbook, as well as new and revised essays and updated techniques, this Sixth Edition provides the up-to-date coverage students need to succeed in their coursework and future careers. From biofuels, green chemistry, and nanotechnology, the book's experiments, designed to utilize microscale glassware and equipment, demonstrate the relationship between organic chemistry and everyday life, with project-and biological or health science focused experiments. As they move through the book, students will experience traditional organic reactions and syntheses, the isolation of natural products, and molecular modeling. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

Carotenoids are an essential component of the human diet. Bioactive by nature, they are rich in antioxidants, promote vitamin A activity and lower the development of chronic illnesses. As such they are an area of growing interest to researchers and scientists who are working to design, develop and launch new functional food products, dietary supplements and other nutritional solutions. Carotenoids: Nutrition, Analysis and Technology is an up-to-date overview of the key areas of carotenoids in nutrition, therapy and technology. In the first section, the authors present a functional food perspective, outlining the therapeutic applications of the bioactive pigments. The second part is dedicated to the spectroscopic analysis of carotenoids, providing in-depth scientific methods and real research findings. In the final

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section, various technological applications of carotenoids are considered, including biotechnology and future prospects. Written by international experts in the field, this comprehensive book will be of interest to food scientists and researchers, nutritionists and health food companies. It will be of particular use to anyone involved in the spectroscopic analysis of carotenoids and other related bioactives.

Plant Growth and Regulation - Alterations to Sustain Unfavorable Conditions consists of five chapters written by scientists from different parts of the world, who are experts in their respective focuses of research. The topics cover the physical growth and physiological and genetic alterations in plants, particularly under environmental stress conditions. The storyline of this book starts from the plant community, followed by cellular and ultrastructural phenomena occurring within the plant in its interaction with the environment, and ends with elucidation of chloroplast's DNAs, their transfer to the nucleus, and the genetic engineering technology applicable for plant adaptation to changing environmental conditions. This book is aimed at attracting the attention of students, teachers, as well as scientists who have a similar focus of study or interest. It contains advanced studies in the respective chapters. Carotenoids were first studied as natural pigments, then as precursors of vitamin A, and then as bioactive compounds against chronic diseases. These compounds have been and continue to be the subject of intense research worldwide, now with an expanded scope. Food Carotenoids: Chemistry, Biology and Technology gathers

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all the important information about these major compounds which impact both food quality and human health. It integrates in one volume various aspects of food carotenoids, such as: Structures and physicochemical properties Biosynthetic pathways and metabolism Analysis and composition of foods Stability and reactions during processing Commercial production as food colorants and precursors of aroma compounds Bioavailability and health benefits Having worked with carotenoids in various aspects for 44 years, Delia Rodriguez-Amaya is uniquely placed to pass on her wealth of knowledge in this field. This book will serve as solid background information for professionals in Food Science, Food Technology, Nutrition, Agriculture, Biology, Chemistry and Medical Sciences, whether in the academe, industry, governmental and non-governmental agencies.

The book "Progress in Carotenoid Research" presents an authoritative and comprehensive overview of the biology, biochemistry, and chemistry of carotenoids. Divided into 14 discrete parts, this book covers topics on basic science and applied technology of carotenoid molecules. This book provides an insight into future developments in each field and has an extensive bibliography. It will be an essential resource for researchers and academic and industry professionals in the natural pigment field.

Vitamins and related growth factors belong to the few chemicals with a positive appeal to most people; the name evokes health, vitality, fitness, strength . . . each one of us indeed needs his daily intake of vitamins, which should normally be provided via a balanced and varied diet. However, current food habits or preferences, or food

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processing and preservation methods do not always assure a sufficient natural daily vitamin supply, even for a healthy human being; this is all the more true for stressed or sick individuals. Although modern society is seldom confronted with the notorious avitaminoses of the past, they do still occur frequently in overpopulated and poverty- and famine-struck regions in many parts of the world. Apart from their in-vivo nutritional-physiological roles as growth factors for man, animals, plants and micro-organisms, vitamin compounds are now being introduced increasingly as food/feed additives, as medical-therapeutical agents, as health-aids, and also as technical aids. Indeed, today an impressive number of processed foods, feeds, cosmetics, pharmaceuticals and chemicals contain extra added vitamins or vitamin-related compounds, and single or multivitamin preparations are commonly taken or prescribed. These reflections do indicate that there is an extra need for vitamin supply, other than that provided from plant and animal food resources. Most added vitamins are indeed now prepared chemically and/or biotechnologically via fermentation/bioconversion processes. Similarly, other related growth factors, provitamins, vitamin-like compounds, i. e.

This third volume in the Developments in Paleoenvironmental Research series deals with the major terrestrial, algal, and siliceous indicators used in paleolimnology. Other volumes deal with the acquisition and archiving of lake sediment cores, chronological techniques, and large-scale basin analysis methods (Volume 1), physical and geochemical parameters and methods (Volume 2), zoological techniques (Volume 4), and statistical and data handling methods (Volume 5). These monographs will provide sufficient detail and breadth to be useful handbooks for both seasoned practitioners as well as newcomers to the area of paleolimnology. Although the chapters in these volumes target mainly lacustrine settings,

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many of the techniques described can also be readily applied to fluvial, glacial, marine, estuarine, and peatland environments.

Olive tree products provide a number of documented presentations of the production and quality of the two most important olive tree products: virgin olive oil and table olives. It is a source that familiarizes readers with recent approaches and innovations that can be introduced in the virgin olive oil extraction and stabilization technology and the preparation of table olives with emphasis on the presence of bioactive constituents. It also describes advances in the methods of checking authenticity and in the evaluation of attributes that may influence consumers' perceptions and preferences. Other topics discussed are squalene, a trove of metabolic actions, pigments, geographical indication, biotechnology in table olive preparation, and recovery of hydroxytyrosol from olive-milling wastes.

This book covers the state-of-the-art of microalgae physiology and biochemistry (and the several –omics). It serves as a key reference work for those working with microalgae, whether in the lab, the field, or for commercial applications. It is aimed at new entrants into the field (i.e. PhD students) as well as experienced practitioners. It has been over 40 years since the publication of a book on algal physiology. Apart from reviews and chapters no other comprehensive book on this topic has been published. Research on microalgae has expanded enormously since then, as has the commercial exploitation of microalgae. This volume thoroughly deals with the most critical physiological and biochemical processes governing algal growth and production.

Natural products are sought after by the food, pharmaceutical and cosmetics industries, and research continues into their potential for new applications. Extraction of natural products in an economic and environmentally-friendly way is of high

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importance to all industries involved. This book presents a holistic and in-depth view of the techniques available for extracting natural products, with modern and more environmentally-benign methods, such as ultrasound and supercritical fluids discussed alongside conventional methods. Examples and case studies are presented, along with the decision-making process needed to determine the most appropriate method. Where appropriate, scale-up and process integration is discussed. Relevant to researchers in academia and industry, and students aiming for either career path, Natural Product Extraction presents a handy digest of the current trends and latest developments in the field with concepts of Green Chemistry in mind.

The marine environment covers 70% of the earth's surface and accounts for 98% of the potentially habitable space. The bioactives from marine microorganisms include antibiotic compounds, polysaccharides, inhibitors, enzymes, peptides, and pigments. These are used in various fields of biology that range from nutraceuticals to cosmeceuticals. Recent scientific investigations have revealed that marine microbial compounds exhibit various beneficial biological effects, such as anti-inflammatory, anti-cancer, anti-HIV, anti-hypertensive, and anti-diabetic. *Marine Microorganisms: Extraction and Analysis of Bioactive Compounds* sheds light on the extraction, clean-up, and detection methods of major compounds from marine organisms. The book includes information on the different classes of marine microorganisms and the different bioactives that can be extracted from bacteria, fungi and microalgae. Divided into 7 chapters, the book covers bioactive marine natural products, such as marine microbes, seaweeds, and marine sponges as potential sources of drug discovery, and focuses on analysis methods of the biocomponents from marine microorganisms. A useful reference tool for researchers and students, this

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book provides current knowledge about isolation and analysis methods of the bioactives and provides insight into the various bioactives of marine microbes toward nutraceutical and pharmaceutical development.

Featuring new experiments, a new essay, and new coverage of nanotechnology, this organic chemistry laboratory textbook offers a comprehensive treatment of laboratory techniques including small-scale and some microscale methods that use standard-scale (macroscale) glassware and equipment. The book is organized based on essays and topics of current interest and covers a large number of traditional organic reactions and syntheses, as well as experiments with a biological or health science focus. Seven introductory technique-based experiments, thirteen project-based experiments, and sections on green chemistry and biofuels spark students' interest and engage them in the learning process. Instructors may choose to offer Cengage Learning's optional Premium Website, which contains videos on basic organic laboratory techniques. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

The aim and scope of this book is to highlight the sources, isolation, characterization and applications of bioactive compounds from the marine environment and to discuss how marine bioactive compounds represent a major market application in food and other industries. It discusses sustainable marine resources of macroalgal origin and gives examples of bioactive compounds isolated from these and other resources, including marine by-product and fisheries waste streams. In addition, it looks at the importance of correct taxonomic characterization.

Pigments act as tracers to elucidate the fate of phytoplankton in the world's oceans and are often associated with important biogeochemical cycles related to carbon dynamics in the

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oceans. They are increasingly used in in situ and remote-sensing applications, detecting algal biomass and major taxa through changes in water colour. This book is a follow-up to the 1997 volume *Phytoplankton Pigments in Oceanography* (UNESCO Press). Since then, there have been many advances concerning phytoplankton pigments. This book includes recent discoveries on several new algal classes particularly for the picoplankton, and on new pigments. It also includes many advances in methodologies, including liquid chromatography-mass spectrometry (LC-MS) and developments and updates on the mathematical methods used to exploit pigment information and extract the composition of phytoplankton communities. The book is invaluable primarily as a reference for students, researchers and professionals in aquatic science, biogeochemistry and remote sensing.

The first dedicated new work since 1991, this book reviews recent progress and current studies in the chemistry, metabolism and spectroscopy of chlorophylls, bacteriochlorophylls and their protein complexes. Also discussed is progress on the applications of chlorophylls as photosensitizers in photodynamic therapy of cancerous tumours, and as molecular probes in biochemistry, medicine, plant physiology, ecology and geochemistry. Each section offers an introductory overview followed by concise, focused and fully-referenced chapters written by experts.

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