

## Molluscs Mollusca Gastropoda Bivalvia From The Upper

The nervous system is particularly fascinating for many biologists because it controls animal characteristics such as movement, behavior, and coordinated thinking. Invertebrate neurobiology has traditionally been studied in specific model organisms, whilst knowledge of the broad diversity of nervous system architecture and its evolution among metazoan animals has received less attention. This is the first major reference work in the field for 50 years, bringing together many leading evolutionary neurobiologists to review the most recent research on the structure of invertebrate nervous systems and provide a comprehensive and authoritative overview for a new generation of researchers. Presented in full colour throughout, *Structure and Evolution of Invertebrate Nervous Systems* synthesizes and illustrates the numerous new findings that have been made possible with light and electron microscopy. These include the recent introduction of new molecular and optical techniques such as immunohistochemical staining of neuron-specific antigens and fluorescence in-situ-hybridization, combined with visualization by confocal laser scanning microscopy. New approaches to analysing the structure of the nervous system are also included such as micro-computational tomography, cryo-soft X-ray tomography, and various 3-D visualization techniques. The book follows a systematic and phylogenetic structure, covering a broad range of taxa, interspersed with chapters focusing on selected topics in nervous system functioning which are presented as research highlights and perspectives. This comprehensive reference work will be an essential companion for graduate students and researchers alike in the fields of metazoan neurobiology, morphology, zoology, phylogeny and evolution.

Taphonomic bias is a pervasive feature of the fossil record. A pressing concern, however, is the extent to which taphonomic processes have varied through the ages. It is one thing to work with a biased data set and quite another to work with a bias that has changed with time. This book includes work from both new and established researchers who are using laboratory, field and data-base techniques to characterise and quantify the temporal and spatial variation in taphonomic bias. It may not provide all the answers but it will at least shed light on the right questions.

*Physiology of Mollusca, Volume II* focuses on the physiology of mollusks, as well as feeding, digestion, mechanics of the heart, metabolism, and pigmentation. The selection first offers information on feeding and digestion, including Amphineura, Gastropoda, Bivalvia, anatomy of the gut, movement of food, and digestive diverticula. The text then elaborates on feeding and digestion in cephalopods and heart, circulation, and blood cells. Discussions focus on food and feeding, mechanics of heart and circulation, control of the heart, cardioregulatory substances, and blood cells. The publication considers respiration, molluscan hemoglobin and myoglobin, and molluscan hemocyanins. The text then examines the pigmentation of mollusks, carbohydrate and nitrogen metabolism, physiology of the nervous system, and sense organs. Topics include indole pigments, sugar and polysaccharides, metabolism of nitrogenous compounds, terminal products of nitrogen metabolism in mollusks, and synaptic transmission. The selection is a dependable reference for readers interested in the physiology of mollusks.

This multi-author, six-volume work summarizes our current knowledge on the developmental biology of all major invertebrate animal phyla. The main aspects of cleavage, embryogenesis, organogenesis and gene expression are discussed in an evolutionary framework. Each chapter presents an in-depth yet concise overview of both classical and recent literature, supplemented by numerous color illustrations and micrographs of a given animal group. The largely taxon-based chapters are supplemented by essays on topical aspects relevant to modern-day EvoDevo research such as regeneration, embryos in the fossil record, homology in the age of genomics and the role of EvoDevo in the context of reconstructing evolutionary and phylogenetic scenarios. A list of open questions at the end of each chapter may serve as a source of inspiration for the next generation of EvoDevo scientists. *Evolutionary Developmental Biology of Invertebrates* is a must-have for any scientist, teacher or student interested in developmental and evolutionary biology as well as in general invertebrate zoology. This volume covers the animals that have a ciliated larva in their lifecycle (often grouped together as the Lophotrochozoa), as well as the Gnathifera and the Gastrotricha. The interrelationships of these taxa are poorly resolved and a broadly accepted, clade-defining autapomorphy has yet to be defined. Spiral cleavage is sometimes assumed to be the ancestral mode of cleavage of this grouping and therefore the clade is referred to as Spiralia by some authors, although others prefer to extend the term Lophotrochozoa to this entire assemblage. Aside from the taxon-based chapters, this volume includes a chapter that highlights similarities and differences in the processes that underlie regeneration and ontogeny, using the Platyhelminthes as a case study.

*The Mollusca, Volume 5: Physiology, Part 2* focuses on the biochemistry and physiology of mollusks. The selection first elaborates on the feeding biology of gastropods and feeding and digestion in Bivalvia and cephalopods. Discussions focus on feeding, digestion, feeding and digestive rhythms, feeding behavior, ontogeny of gastropod feeding biology, and feeding mechanisms. The text then examines the circulatory systems of gastropods and bivalves and circulation in cephalopods, including blood vessels and extracellular space, chemical control of the circulation, fluid mechanics of the circulation, and nature and anatomy of the circulatory system. The text takes a look at ionic regulation and water balance, excretion, and molluscan immunobiology. Topics include internal defenses of gastropods, bivalves, cephalopods, and Polyplacophorans, Monoplacophora, Cephalopoda, and Scaphopoda. The selection is a vital reference for researchers interested in the biochemistry and physiology of mollusks.

*Physiology of Mollusca* Academic Press

U.S. mariculture production of bivalve molluscs—those cultivated in the marine environment—has roughly doubled over the last 25 years. Although mariculture operations may expand the production of seafood without additional exploitation of wild populations, they still depend upon and affect natural ecosystems and ecosystem services. Every additional animal has an incremental effect arising from food extraction and waste excretion. Increasing domestic seafood production in the United States in an environmentally and socially responsible way will likely require the use of policy tools, such as best management practices (BMPs) and performance standards. BMPs represent one approach to protecting against undesirable consequences of mariculture. An alternative approach to voluntary or mandatory BMPs is the establishment of performance standards for mariculture. Variability in environmental conditions makes it difficult to develop BMPs that are sufficiently flexible and adaptable to protect ecosystem integrity across a broad range of locations and conditions. An alternative that measures performance in sustaining key indicators of ecosystem state and function may be more effective. Because BMPs address mariculture methods rather than monitoring actual ecosystem responses, they do not guarantee that detrimental ecosystem impacts will be controlled or that unacceptable impact will be avoided. *Ecosystem Concepts for Sustainable Bivalve Mariculture* finds that while performance standards can be applied

for some broad ecosystem indicators, BMPs may be more appropriate for addressing parameters that change from site to site, such as the species being cultured, different culture methods, and various environmental conditions. This book takes an in-depth look at the environmental, social, and economic issues to present recommendations for sustainable bivalve mariculture. This book is the bible of bioluminescence and a must-read not only for the students but for those who work in various fields relating to bioluminescence. It summarizes current structural information on all known bioluminescent systems in nature, from well-studied ones to those that have been seldom investigated. This book remains an important source of chemical knowledge on bioluminescence and, since the second edition's publication in 2012, has been revised to include major developments in two systems: earthworm *Fridericia* and higher fungi whose luciferins have been elucidated and synthesized. These two new luciferins represent an essential addition to seven previously known, with fully rewritten sections covering this new subject matter.

Genomics in Aquaculture is a concise, must-have reference that describes current advances within the field of genomics and their applications to aquaculture. Written in an accessible manner for anyone—non-specialists to experts alike—this book provides in-depth coverage of genomics spanning from genome sequencing, to transcriptomics and proteomics. It provides, for ease of learning, examples from key species most relevant to current intensive aquaculture practice. Its coverage of minority species that have a specific biological interest (e.g., Pleuronectiformes) makes this book useful for countries that are developing such species. It is a robust, practical resource that covers foundational, functional, and applied aspects of genomics in aquaculture, presenting the most current information in a field of research that is rapidly growing. Provides the latest scientific methods and technologies to maximize efficiencies for healthy fish production, with summary tables for quick reference Offers an extended glossary of technical and methodological terms to help readers better understand key biological concepts Describes state-of-the-art technologies, such as transcriptomics and epigenomics, currently under development for future perspective of the field Covers minority species that have a specific biological interest (e.g., Pleuronectiformes), making the book useful to countries developing such species

Listing of all species in collection to 1981; includes collections from Beaufort Sea and Baffin Island and Labrador coasts.

The Mollusca

Mollusks have been important to humans since our earliest days. Initially, when humans were primarily interested in what they could eat or use, mollusks were important as food, ornaments, and materials for tools. Over the centuries, as human knowledge branched out and individuals started to study the world around them, mollusks were important subjects for learning how things worked. In this volume, the editors and contributors have brought together a broad range of topics within the field of malacology. It is our expectation that these topics will be of interest and use to amateur and professional malacologists.

Concepts of Biology is designed for the single-semester introduction to biology course for non-science majors, which for many students is their only college-level science course. As such, this course represents an important opportunity for students to develop the necessary knowledge, tools, and skills to make informed decisions as they continue with their lives. Rather than being mired down with facts and vocabulary, the typical non-science major student needs information presented in a way that is easy to read and understand. Even more importantly, the content should be meaningful. Students do much better when they understand why biology is relevant to their everyday lives. For these reasons, Concepts of Biology is grounded on an evolutionary basis and includes exciting features that highlight careers in the biological sciences and everyday applications of the concepts at hand. We also strive to show the interconnectedness of topics within this extremely broad discipline. In order to meet the needs of today's instructors and students, we maintain the overall organization and coverage found in most syllabi for this course. A strength of Concepts of Biology is that instructors can customize the book, adapting it to the approach that works best in their classroom. Concepts of Biology also includes an innovative art program that incorporates critical thinking and clicker questions to help students understand--and apply--key concepts.

Sperm Competition and Sexual Selection presents the intricate ways in which sperm compete to fertilize eggs and how this has prompted reinterpretations of breeding behavior. This book provides a theoretical framework for the study of sperm competition, which is a central part of sexual selection. It also discusses the roles of females and the relationships between paternal care in sperm competition. The chapters focusing on taxonomic development are diverse and cover all the major animal groups, both vertebrate and invertebrate, and plants. The final chapter provides an overview discussing the relationship between sperm competition and sexual selection in terms of both function and mechanism and how these translate into species fitness. This book will be of prime interest to behaviorists, ecologists and evolutionary biologists, suggesting new avenues of research and new ways of approaching old problems. The only up-to-date summary of a central and popular subject Well known editors and authors Provides a theoretical framework for the study of sperm competition Covers all major animal groups Includes a chapter on plants

Invertebrate Embryology and Reproduction deals with the practical and theoretical objectives of the descriptive embryology of invertebrates, along with discussions on reproduction in these groups of animals. It explains several morphological and anatomical expressions in the field and covers the embryology of invertebrate animals, starting from the Protozoa, to the Echinodermata, the Protochordate and Tunicates. These groups include economically important aquatic invertebrates, such as crustaceans, as well as medically important invertebrates and economic arthropods. Each chapter is preceded by the taxonomy of the discussed phylum and/or the species to enable the reader to locate the systematic position. Covers phylum definition, general characteristics, classification, reproduction, agametic reproduction, gametic reproduction, spawning, fertilization, development and embryogenesis Includes recent findings in the area, along with detailed figures and photos that illustrate important concepts Brings together difficult-to-obtain research data from the field, not only in Egyptian libraries, but globally, and previously only found through specialized references not widely available Clarifies descriptions with striking photos and electron microscopical studies of different species

Thorp and Covich's Freshwater Invertebrates: Keys to Palearctic Fauna, Fourth Edition, is part of a multivolume series covering inland water invertebrates of the world that began with Vol. I: Ecology and General Biology (2015), then Vol. II (2016) Keys to Nearctic Fauna, and finally in Vol. III (2018) Keys to Neotropical Hexapoda (insects and springtails). It now continues with identification keys for Palearctic invertebrates in Vol. IV. Two other volumes currently in development focus on general invertebrates of the Neotropical/Antarctic, and Australasian Bioregions. Other volumes in the early planning stages include Afrotropical and Oriental/Oceanic Bioregions. All volumes are designed for multiple uses and levels of expertise by professionals in universities, government agencies and private companies, as well as by graduate and undergraduate students. Provides identification keys for inland water (fresh to saline) invertebrates of the Palearctic Zoogeographic Region, from Iceland to Russia, and from the northern Pole region to Saharan Africa in the west, through the Middle East, and to the central China and Japan in the east Presents identification keys for aquatic invertebrates to the genus or species level for many groups and to family for Hexapoda, with the keys progressing from higher to lower

taxonomic levels Includes a general introduction and sections on limitations, terminology and morphology, material preparation and preservation and references

Entries examine a broad array of different species and behavior patterns, using techniques that range from molecular approaches to the study of behavior to analyses of individuals, populations, species, and ecosystems.

This book has informations about Phylum- Mollusca which has great potential in aquatic resources. To value these shall animals their classification anatomy and physiological aspects of various class/genus are described with important biological systems like digestive, respiratory, circulatory, excretory, sense organs and reproductive etc. The anatomy and physiology of animals pave the way for moluscan farming/value addition. The economic importance chapter can be exploited for scientific molluscan fisheries. Contents: Mollusca Classification, Bivalvia, Cephalopoda, Digestive System, Excretory System and Osmoregulation, Respiration, Blood, Body Cavity, Basic Roles of a Nervous System, Reproductive System, Economic Importance, Few Molluscs.

Molluscan Communities of the Florida Keys and Adjacent Areas: Their Ecology and Biodiversity is the first comprehensive overview of the ecology and biodiversity of the phylum Mollusca in the area of Florida extending from the Dry Tortugas and Ten Thousand Islands in the west to Palm Beach in the east. The book provides detailed analyses of molluscan faunas found in 20 different ecosystems, emphasizing the marine environments of the Florida Keys archipelago and its extensive coral reef tracts. Full-page color illustrations portray living animals, unique Keys environments, underwater ecosystems, and satellite images. More than 1,200 species of macromollusks—in 86 gastropod families and 54 bivalve families—are recorded from the study area, with color plates illustrating over 550 of the region's most ecologically important species. For the first time in any book on the malacology of the Florida Keys area, the 20 marine ecosystems and their associated molluscan assemblages are arranged by the CMECS (Coastal Marine Ecological Classification Standard) system. This system emphasizes the hierarchical relationships determined by substrate type, bathymetry, and water chemistry. Along with complete species lists for every molluscan assemblage, this handy guide introduces ten newly-discovered gastropods, including new species in the families Muricidae, Buccinidae, Nassariidae, Naticidae, Turritellidae, and Olividae. Two new bivalves in the families Pectinidae and Arcidae are also described in a special systematic appendix. This richly illustrated book is written for the professional scientific audience interested in mollusks, marine ecology, evolution, and taxonomy as well as malacologists, naturalists, and shell collectors. It is also an ideal synoptic field guide, showing where individual species of mollusks can be found and within which ecosystems they occur.

This book provides a comprehensive review of the ecology of freshwater bivalves and gastropods worldwide. It deals with the ecology of these species in its broadest sense, including diet, habitat and reproductive biology, emphasizing in particular the tremendous diversity of these freshwater invertebrates. Following on from these introductory themes, the author develops a life history model that unifies them, and serves as a basis for reviews of their population and community ecology, including treatments of competition, predation, parasitism and biogeography. Extensively referenced and providing a synthesis of work from the nineteenth century onwards, this book includes original analyses that seek to unify previous work into a coherent whole. It will appeal primarily to professional ecologists and evolutionary biologists, as well as to parasitologists.

Immunologists, perhaps understandably, most often concentrate on the human immune system, an anthropocentric focus that has resulted in a dearth of information about the immune function of all other species within the animal kingdom. However, knowledge of animal immune function could help not only to better understand human immunology, but perhaps more importantly, it could help to treat and avoid the blights that affect animals, which consequently affect humans. Take for example the mass death of honeybees in recent years – their demise, resulting in much less pollination, poses a serious threat to numerous crops, and thus the food supply. There is a similar disappearance of frogs internationally, signaling ecological problems, among them fungal infections. This book aims to fill this void by describing and discussing what is known about non-human immunology. It covers various major animal phyla, its chapters organized in a progression from the simplest unicellular organisms to the most complex vertebrates, mammals. Chapters are written by experts, covering the latest findings and new research being conducted about each phylum. Edwin L. Cooper is a Distinguished Professor in the Laboratory of Comparative Immunology, Department of Neurobiology at UCLA's David Geffen School of Medicine.

"Ponder and Lindberg provides a breathtaking overview of the evolutionary history of the Mollusca, effectively melding information from anatomy, ecology, genomics, and paleobiology to explore the depths of molluscan phylogeny. Its outstanding success is due to thoughtful planning, focused complementary contributions from 36 expert authors, and careful editing. This volume is a must for malacologists."—Bruce Runnegar, Department of Earth and Space Sciences, University of California, Los Angeles "Our understanding of the phylogeny and evolutionary history of the mollusca has been revolutionized over the past two decades through new molecular data and analysis, and reinvestigation of morphological characters. In this volume Ponder, Lindberg, and their colleagues do a wonderful job of integrating this work to provide new perspectives on the relationships of the major molluscan clades, their evolutionary dynamics, and their history. Particularly timely is the coverage of molluscan evo-devo and genomics."—Douglas H. Erwin, Curator of Paleozoic Invertebrates, National Museum of Natural History

This book is divided into four sections. The first section "Introduction" offers information on mollusc generalities. In addition, these organisms are important in areas of commercial significance such as aquaculture and fishing. Similarly, it was pointed out in the use of molluscs have uses in pollution studies and environmental processes among others. The second section "Social Aspects of Fisheries" considers aspects of molluscs gathering in tropical regions. The third section "Ecology" presents the results of long-term research concerning the study of variability of the size/mass

relationships in the mollusc *Rapana venosa* from the northwestern part of the Black Sea and near the eastern coast of Crimea (Sudak Gulf). The fourth section "Immune System" sheds light on the elements of the molluscan immune system and survival differences against *Vibrio vulnificus* and *Vibrio parahaemolyticus*. This book can be consulted by students, professors, and researchers in biological sciences and related areas.

More than 70% of the earth's surface is covered by water, making it an ideal and abundant resource for studying species diversity, faunal communities, and ecosystems. India's massive coastline (5,044 miles) means it plays a major role in housing these faunal communities. Of the 32 animal phyla, 15 are represented in India's marine ecosystem, covering more than 15,000 species. Marine and coastal ecosystems of India provide supporting services in the form of wide range of habitats. Major ecosystems such as estuaries, mangroves, coral reefs, lagoons, seaweeds and sea grasses serve as nurseries for both inshore and offshore fishes and others, many of which are supposed to be commercially exploited. *Marine Faunal Diversity in India* describes different marine faunal group ranges from sponges, corals, mollusks, crabs, fishes, reptiles, birds, marine mammals, mangrove fauna and tsunami impact on marine faunal diversity. The chapters, written by reputed experts in their respective fields, illustrate diversity and distribution of marine faunal communities. Key aspects of the ecology and conservation of this important ecosystem are also discussed. *Marine Faunal Diversity in India* provides marine biologists and related researchers with access to the latest research and field studies from this major region. Provides the latest field research on marine faunal diversity throughout the vast and species-rich Indian region Brings together expertise from top marine biology researchers in the country Covers a diverse array of aquatic environments, including coastal and island areas Discusses conservation ecology of marine faunal groups

Vinarski, Amy R. Wethington, Thomas Wilke

This up-to-date guidebook on freshwater invertebrates of the central European region is a richly illustrated work, providing an excellent source of systematic information on freshwater macroinvertebrates. Numerous colour photos and additional vector graphic figures allow readers to identify specific species at a higher taxonomic level (family). The book is supplemented by electronic material including pictures and short video sequences. *Freshwater Invertebrates in Central Europe – A Field Guide* is a must-have for all those interested in the freshwater animals of central Europe such as animal scientists and ecologists, as well as students attending classes on freshwater invertebrate.?

The third edition of *Ecology and Classification of North American Freshwater Invertebrates* continues the tradition of in-depth coverage of the biology, ecology, phylogeny, and identification of freshwater invertebrates from the USA and Canada. This text serves as an authoritative single source for a broad coverage of the anatomy, physiology, ecology, and phylogeny of all major groups of invertebrates in inland waters of North America, north of Mexico.

Crustaceans, due to the great diversity of their body organization, segmentation patterns, tagmatization, limb types, larval forms, cleavage, and gastrulation modes, are highly desirable for the study of questions at the interface of evolution and development. Modern interest in evolutionary developmental biology (evo-devo) rests on the molecular genetic approach and a variety of molecular techniques have proven fruitful when performed on crustaceans. *Evolutionary Developmental Biology of Crustacea* presents a comprehensive treatment of all aspects of the field, beginning with a discussion of the implications of the typological Bauplan and phylum concepts versus historical concepts such as ground pattern and monophylum for the formulation of conceptual questions in evo-devo. Following this, the authors present the results of Hox gene expression in various crustacean taxa, aspects of segment formation at the cellular and genetic levels, the formation of segmental structures such as neurons, ganglia, and limbs, and the role of morphological ontogenetic characters in resolving phylogenetic relationships. By covering so many general aspects of crustacean development, morphology, and evolution, *Evolutionary Developmental Biology of Crustacea* serves as an indispensable reference for developmental and evolutionary biologists investigating the role of genetics in evolution and development.

This book has been written with two main purposes in mind, page. At the same time animals show immense variation the first being to give a general review of the entire animal and none is truly typical. Some idea of the immense variety kingdom, and the second to give more detailed functional of animals is given in the diversity sections, with a synopsis accounts of the anatomy of a representative of each major of the classification of each major phylum. animal group. It is intended to be used by those who are Zoology has a language of its own, which appears highly interested in animals and does not start with the assumption complicated but in most cases can, in fact, be derived simply of any great zoological knowledge. It is hoped that it will from either Latin or Greek. Translations and derivations prove particularly helpful to those studying biology or have been given of a selection of zoological terms; these zoology at 'A' level, or in the early stages of a university should be regarded as examples. The interested zoologist course. may find the use of a Greek and Latin dictionary rewarding.

Molluscs comprise the second largest phylum of animals (after arthropods), occurring in virtually all habitats. Some are commercially important, a few are pests and some carry diseases, while many non-marine molluscs are threatened by human impacts which have resulted in more extinctions than all tetrapod vertebrates combined. This book and its companion volume provide the first comprehensive account of the Mollusca in decades. Illustrated with hundreds of colour figures, it reviews molluscan biology, genomics, anatomy, physiology, fossil history, phylogeny and classification. This volume includes general chapters drawn from extensive and diverse literature on the anatomy and physiology of their structure, movement, reproduction, feeding, digestion, excretion, respiration, nervous system and sense organs. Other chapters review the natural history (including ecology) of molluscs, their interactions with humans, and assess research on the group. Key features of both volumes: up to date treatment with an extensive bibliography; thoroughly examines the current understanding of molluscan anatomy, physiology and development; reviews fossil history and phylogenetics; overviews ecology and economic values; and summarises research activity and suggests future directions for investigation. Winston F Ponder was a Principal Research Scientist at The Australian Museum in Sydney where he is currently a Research Fellow. He has published extensively over the last 55 years on the systematics, evolution, biology and conservation of marine and freshwater molluscs, as well as supervised post graduate students and run university courses. David R. Lindberg is former Chair of the Department of Integrative Biology, Director of the Museum of Paleontology, and Chair of the Berkeley Natural History Museums, all at the University of California. He has conducted research on the evolutionary history of marine organisms and their habitats on the rocky shores of the Pacific Rim for more than 40 years. The numerous elegant and interpretive illustrations were produced by Juliet Ponder.

The book is divided into two sections and represents the current trend of research in aquatic bioresource. In the section "Biology, Ecology

and Physiological Chemistry", high-impact articles are contributed on reproduction, population genetics, evolution, biodiversity, biology and ecology of different aquatic faunas. Physiological chemistry of lipid, bioactive pharmaceuticals and chemical ecological aspects of aquatic organisms were discussed. In the section entitled "Conservation and Sustainable Management", authors highlighted conservation- and management-related issues of various bioresources in different regions of the earth. The book mentions the biological, ecological, physiological and genetic significance of aquatic organisms with resource potential. The authors stressed on rational utilisation and management of bioresource ensuring minimal damage of the aquatic ecosystem. This book would provide a direction towards sustainable ecological management of bioresource.

This volume reviews the most important advances that have taken place in the interpretation of the structure and function of molluscan systems. A detailed treatment of each organ system is presented with particular emphasis on skin, shell, muscle, and excretory systems, and luminescences. Emphasis is given to recent research and the current status of each topic.

Various kinds of mineralization have been found in many biological systems. Investigations made at a microscopical level using various sophisticated analytical methods and using principles developed in different fields have clarified their mechanisms very much. Sometimes, very similar phenomena have been found in the mineralized tissues of completely different biological systems. Compilation and comparative investigations of such findings obtained from the many specimens systematically collected contribute a great deal to an understanding of the crucial mechanisms and significance of biomineralization which originated in very primitive organisms and remain in advanced ones. Previously, the functional significance of mineralized tissues was considered mainly from an anatomical point of view based upon their morphological and structural features. However, the recent advance of investigations has made it possible to interpret the functional significance of biomineralization not only from local and mechanical points of view, but also from a systemic and phylogenetic point of view. It is also well-known that biomineralization has contributed in various ways to geological and oceanographical conditions of the environment in which the organisms were living. During this process, the mechanisms of biomineralization may have evolved to maintain harmony between organisms and their environments.

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