Muscle Contraction

MCNEIL CURTIS

Regulatory Mechanisms of Striated Muscle Contraction Pergamon
Muscle contraction has been the focus of scientific investigation for more than two centuries, and major discoveries have changed the field over the years. Early in the twentieth century, Fenn (1924, 1923) showed that the total energy liberated during a contraction (heat + work) was increased when the muscle was allowed to shorten and perform work. The result implied that chemical reactions during contractions were load-dependent. The observation underlying the “Fenn effect” was taken to a greater extent when Hill (1938) published a pivotal study showing in details the relation between heat production and the amount of muscle shortening, providing investigators with the force-velocity relation for skeletal muscles. Subsequently, two papers paved the way for the current paradigm in the field of muscle contraction. Huxley and Niedergerke (1954), and Huxley and Hanson (1954) showed that the width of the A-bands did not change during muscle stretch or activation. Contraction, previously believed to be caused by shortening of muscle filaments, was associated with sliding of the thick and thin filaments. These studies were followed by the classic paper by Huxley (1957), in which he conceptualized for the first time the cross-bridge theory; filament sliding was driven by the cyclical interactions of myosin heads (cross-bridges) with actin. The original cross-bridge theory has been revised over the years but the basic features have remained mostly intact. It now influences studies performed with molecular motors responsible for tasks as diverse as muscle contraction, cell division and vesicle transport.

Peptides as Probes in Muscle Research Muscle Contraction
Smooth muscles line many internal organs and, in general, are involved in moving fluids and slurry around the body. They are controlled by the action of hormones, by nervous stimulation, and can be influenced by drugs. This 1997 book provides a review of our understanding of smooth muscle and integrates molecular, cellular and physiological information with tissue and anatomical studies. Well-known researchers have written chapters giving detailed reviews of our current knowledge of the biochemistry, pharmacology, physiology and anatomy of smooth muscle. In particular, they cover the seven most important areas of smooth muscle function including morphology, electrophysiology, mechanisms of electromechanical and pharmacomechanical coupling, calcium homeostasis, signal transduction, mechanics of contraction, and the contractile proteins. All those interested in muscular contraction will find this book worthwhile, whether they are biochemists, physiologists, or cell biologists.

Molecular Control Mechanisms in Striated Muscle Contraction CRC Press
This book includes a valuable and extensive bibliography with historical introduction on pages 3-44. It is a detailed study of the physiology of skeletal muscle.

The Structural Basis of Muscular Contraction Cambridge University Press
This book offers a comparative and interdisciplinary approach to excitation-contraction-coupling in smooth and striated mus cles, including the myocardium. It is an account of the path ways and mechanisms by which cellular calcium is handled and activates the contractile proteins. It also describes how these mechanisms are adapted in various kinds of muscle to meet specific functional requirements, such as speed or economy. This monograph then presents facts, ideas and theories and the evidence on which they are based, and ifit stimulates others and furthers research, it will have served its purpose. All of the chapters are self-contained and may be read in any order, but readers unfamiliar with muscle are recommended to start with the introductory chapter on excitation and contraction. During all the years of writing this book, I received enormous help from Isolde Berger who corrected, edited and transformed my innumerable notes and drafts into a readable manuscript; she also compiled the list of references and the Subject Index. I owe a great debt of gratitude to her and also to Claudia Zeugner, who prepared the figures with expertise and care. Then I would like to thank the Deutsche F orschungs gemeinschaft and the Fritz-Thyssen-Stiftung for supporting the work of my Department which has been reported in this monograph. A great many people contributed with helpful discussions.

Molecular Biology Springer Science & Business Media
This volume intends to provide a comprehensive overview on the mecha nisms of muscle contraction and non-muscle cell motility at the molecu lar and cellular level, not only for investigators in these fields but also for general readers interested in these topics. A most attractive feature of various living organisms in the animal and plant kingdoms is their ability to move. In spite of a great diversity in the structure and function of various motile systems, it has frequently been assumed since the nineteenth century that all kinds of "motility" are essentially the same. Based on this assumption, some investigators in the nineteenth century thought that the mechanisms of motility could better be studied on primitive non-muscle motile systems such as amoeboid movement, rath er than on highly specialized muscle cells. Contrary to their expectation, however, the basic mechanisms of motility have been revealed solely by investigations on vertebrate skeletal muscles, since a monumental discovery of Szent-Gyorgyi and his coworkers in the early 1940s that muscle contraction results from the interaction between two different contractile proteins, actin and myosin, coupled with ATP hydrolysis.

Smooth Muscle Contraction; Its Regulatory Mechanisms CRC Press
Molecular Biology: Elementary Processes of Nerve Conduction and Muscle Contraction focuses on the underlying elementary processes of muscular contraction and nerve impulse conduction. This book explores the fundamental concepts and notions in molecular biology. Organized into 11 chapters, this book starts with an overview of the double array model of striated muscle. This text then discusses the structural changes at the molecular level, which occur as a consequence or an accompaniment of the chemical reactions that occur during contraction. Other chapters explain the process by which molecular changes are summated to produce macroscopic shortenings. This book discusses as well the molecular complementarity and chemistry of acetylcholinesterase, which provides significant information for the understanding of nervous activity. The final chapter deals with the structure of guanidinium ion, which consists of three equivalent NH2 groups arranged with a planar trigonal symmetry around the central carbon atom. Physicists, chemists, and biologists will find this book useful.

Skeletal Muscle Springer
This volume covers the entire spectrum of research on troponin and related muscle proteins, including pathophysiological and clinical aspects. It details recent advances in work on the genetic disorders of cardiac troponin and ryanodine receptor proteins. Many color figures illustrate the three-dimensional structures of the proteins involved in the muscle functions. The book will help readers understand characteristic features of the regulatory mechanisms of striated muscle contraction and their disorders at the molecular level.

Mysteries in Muscle Contraction Springer Science & Business Media
Muscle ContractionSpringer Science & Business Media

Muscle Contraction and Cell Motility Springer Science & Business Media
There has been a lot of debate concerning the nature of the molecular mechanism that produces filament sliding and muscle shortening. This book presents the different kinds of structural and mechanical evidence in favour of the swinging of myosin heads on actin during the contractile cycle.

Regulation of Smooth Muscle Contraction Springer Science & Business Media
Provides readers with a detailed understanding of the different facets of muscle physiology. Examines motoneuron and muscle structure and function. It is intended for those need to know about skeletal muscle--from undergraduate and graduate students gaining advanced knowledge in kinesiology to physiotherapists, physiatrists, and other professionals whose work demands understanding of muscle form and function.

Smooth Muscle Contraction Springer Science & Business Media
Muscle contraction has been the focus of scientific investigation for more than two centuries, and major discoveries have changed the field over the years. Early in the twentieth century, Fenn (1924, 1923) showed that the total energy liberated during a contraction (heat + work) was increased when the muscle was allowed to shorten and perform work. The result implied that chemical reactions during contractions were load-dependent. The observation underlying the “Fenn effect” was taken to a greater extent when Hill (1938) published a pivotal study showing in details the relation between heat production and the amount of muscle shortening, providing investigators with the force-velocity relation for skeletal muscles. Subsequently, two papers paved the way for the current paradigm in the field of muscle contraction. Huxley and Niedergerke (1954), and Huxley and Hanson (1954) showed that the width of the A-bands did not change during muscle stretch or activation. Contraction, previously believed to be caused by shortening of muscle filaments, was associated with sliding of the thick and thin filaments. These studies were followed by the classic paper by Huxley (1957), in which he conceptualized for the first time the cross-bridge theory; filament sliding was driven by the cyclical interactions of myosin heads (cross-bridges) with actin. The original cross-bridge theory has been revised over the years but the basic features have remained mostly intact. It now influences studies performed with molecular motors responsible for tasks as diverse as muscle contraction, cell division and vesicle transport.
Nerve-Muscle Interaction Cambridge University Press
This book describes the evolution of ideas relating to the mechanism of muscular contraction since the discovery of sliding filaments in 1954. An amazing variety of experimental techniques have been employed to investigate the mechanism of muscular contraction and relaxation. Some background of these various techniques is presented in order to gain a fuller appreciation of their strengths and weaknesses. Controversies in the muscle field are discussed along with some missed opportunities and false trails. The pathway to ATP and the high energy phosphate bond will be discussed, as well as the discovery of myosin, contraction coupling and the emergence of cell and molecular biology in the muscle field. Numerous figures from original papers are also included for readers to see the data that led to important conclusions. This book is published on behalf of the American Physiological Society by Springer. Access to APS books published with Springer is free to APS members.
Muscle Contraction Springer Science & Business Media
This volume presents the proceedings of a muscle symposium, which was supported by the grant from the Fujihara Foundation of Science to be held as the Fourth Fujihara Seminar on October 28 - November 1, 2002, at Hakone, Japan. The Fujihara Seminar covers all fields of natural science, while only one proposal is granted every year. It is therefore a great honor for me to be able to organize this meeting. Before this symposium, I have organized muscle symposia five times, and published the proceedings: " Cross-bridge Mechanism in Muscle Contraction (University of Tokyo Press, 1978), "Contractile Mechanisms in Muscle" (plenum, 1984); "Molecular Mechanisms of Muscle Contraction" (plenum, 1988); "Mechanism of Myofllament Sliding in Muscle contraction" (plenum, 1993); "Mechanisms of Work Production and Work Absorption in Muscle" (plenum, 1998). As with these proceedings, this volume contains records of discussions made not only after each presentation but also during the periods of General Discussion, in order that general readers may properly evaluate each presentation and the up-to-date situation of this research field. It was my great pleasure to have Dr. Hugh Huxley, a principal discoverer of the sliding fllament mechanism in muscle contraction, in this meeting. On my request, Dr. Huxley kindly gave a special lecture on his monumental discovery of myofllament-lattice structure by X-ray diffraction of living skeletal muscle. I hope general readers to learn how a breakthrough in a specific research field can be achieved.
Muscle Contraction and Cell Motility Human Kinetics
In the second century, Galen recognized that nerve and muscle were functionally inseparable since contraction of muscle occurred only if the nerves supplying that muscle were intact. He therefore concluded that the shortening of a muscle was controlled by the central nervous sytem while the extension of a muscle could occur in the absence of innervation. Nerves, he thought, were the means of transport for animal spirits to the muscles; the way in which animal spirits may bring about contraction dominated the study of muscle physiology from that time until the historical discovery of Galvani that muscle could be stimulated electrically and that nerve and muscle were themselves a source of electrical energy. It is now well known that nerves conduct electrically and that transmission from nerve to striated muscle is mediated by the chemical which is liberated from nerve terminals onto the muscle membrane. In vertebrates this chemical is acetylcholine (ACh). Thus the concept of spirits that are released from nerves and control muscle contraction directly, is no longer tenable. Nevertheless the concept of 'substances' transported down nerv~s which directly control many aspects of muscle has not been abandoned, and has in fact been frequently reinvoked to account for the long-term regula tion of many characteristics of muscle (see review by Gutmann, 1976) and for the maintenance of its structural integrity.
Molecular Mechanisms in Muscular Contraction Springer Science & Business Media
The student of biolo,gical science in his final years as an undergraduate and his first years as a graduate is expected to gain some familiarity with current research at the frontiers of his discipline. New research work is published in a perplexing diversity of publications and is inevitably concerned with the minutiae of the subject. The sheer number of research journals and papers also causes confusion and difficulties of assimilation. Review articles usually presuppose a background knowledge of the field and are inevitably rather restricted in scope. There is thus a need for short but authoritative introductions to those areas of modern biological research which are either not dealt with in standard introductory textbooks or are not dealt with in sufficient detail to enable the student to go on from them to read scholarly reviews with profit. This series of books is designed to satisfy this need. The authors have been asked to produce a brief outline of their subject assuming that their readers will have read and remembered much of a standard introductory textbook of biology. This outline then sets out to provide by building on this basis, the conceptual framework within which modern research work is progressing and aims to give the reader an indication of the problems, both conceptual and practical, which must be overcome if progress is to be maintained.
New Concepts in the Control of Muscle Contraction Springer Science & Business Media
Recent years have witnessed an explosion of knowledge lea- ding to a molecular understanding of the mechanisms of ac- tion of calcium on excitation and contraction coupling and its role in the regulation of contractility. This book highlights the most recent progress as well as providing a historial perspective of the field. It presents a concise and comprehensive overview of our current knowledge regar- ding calcium channels and regulatory proteins as well as in- tracellular calcium handling and the mechanisms underlying the activation of contractile proteins. It also describes how these basic mechanisms have been adapted in various types of muscle, especially in cardiac and smooth muscle.
The Kinetics of Muscle Contraction Springer Science & Business Media
This volume presents the entire proceedings of the symposium organized by one of us (H. S.) on November 11 to 15, 1991 at Hakone, Japan, under the title of "Mechanism of Myofllament Sliding in Muscle Contraction. " Among various kinds of energy transduction mechanisms in biological systems, the mechanism of muscle contraction has been studied most intensively and extensively over many years. Since the monumental discovery by the two Huxleys and coworkers that muscle contraction results from relative sliding between the thick and thin myofilaments, attention of muscle investigators has been focused on the question, what makes the fllaments slide past one another. In response to the above question, A. F. Huxley and Simmons put forward a contraction model in 1971, in which globular heads of myosin (cross-bridges) extending from the thick fllament first attach to actin on the thin fllament, and then change their angle of attachment to actin (power stroke) leading to force generation or myofilament sliding until they detach from the thin fllament. The rocking cross-bridge contraction model seemed to be entirely consistent with the kinetic scheme of actomyosin ATPase published by Lymn and Taylor at the same time, thus giving a strong impression to the people concerned that the muscle contraction mechanism would soon be sorted out. In his review lecture in 1974, however, A. F.
Mechanism of Myofilament Sliding in Muscle Contraction John Wiley & Sons
This book is an account of the centuries of experiment and speculation that have led to our understanding of how muscles work.
Molecular and Physiological Mechanisms of Muscle Contraction CRC Press
Sixth Annual Graduate Hospital Research Symposium
REGULATION OF SMOOTH MUSCLE PROGRESS IN SOLVING THE PUZZLE Every so often a scientific conference comes at a time when everyone has new and exciting information, when old "dogmas" do not seem to be as well established, and when speakers and participants alike are ready to challenge interpretations of old and new experimental data. This was such a conference. What turns on a smooth muscle cell? The precise answer to this question has eluded scientists for much longer than I have been involved in the field. We know that an increase in cytosolic calcium is necessary and we know that phosphorylation of the 20 kDa myosin light chain is an important step in the process. We do not know if other processes are necessary for the initiation and lor maintenance of a smooth muscle contraction nor do we know if other processes modulate the regulation of contraction. The goal of the symposium on which this volume is based was to explore the most current hypotheses for the answers to these questions. I believe that after reading the chapters included in this volume, you will agree that this goal was achieved. The importance of calcium and calmodulin dependent myosin light chain phosphoryla tion in the regulation of smooth muscle contraction was reinforced by many presentations. However, the status of myosin light chain phosphorylation as a simple calcium dependent switch came under serious suspicion.
Muscle Contraction Springer Science & Business Media
Understanding the molecular mechanism of muscle contraction started with the discovery that striated muscle is composed of interdigitating filaments which slide against each other. Sliding filaments and the working-stroke mechanism provide the framework for individual myosin motors to act in parallel, generating tension and loaded shortening with an efficient use of chemical energy. Our knowledge of this exquisitely structured molecular machine has exploded in the last four decades, thanks to a bewildering array of techniques for studying intact muscle, muscle fibres, myofibrils and single myosin molecules. After reviewing the mechanical and biochemical background, this monograph shows how old and new experimental discoveries can be modelled, interpreted and incorporated into a coherent mathematical theory of contractility at the molecular level. The theory is applied to steady-state and transient phenomena in muscle fibres, wing-beat oscillations in insect flight muscle, motility assays and single-molecule experiments with optical trapping. Such a synthesis addresses major issues, most notably whether a single myosin motor is driven by a working stroke or a ratchet mechanism, how the working stroke is coupled to phosphate release, and whether one cycle of attachment is driven by the hydrolysis of one molecule of ATP. Ways in which the theory can be extended are explored in appendices. A separate theory is required for the cooperative regulation of muscle by calcium via tropomyosin and troponin on actin filaments. The book reviews the evolution of models for actin-based regulation, culminating in a model motivated by cryo-EM studies where tropomyosin protomers are linked to form a continuous flexible chain. It also explores muscle behaviour as a function of calcium level, including emergent phenomena such as spontaneous oscillatory contractions and direct myosin regulation by its regulatory light chains. Contraction models can be extended to all levels of calcium-activation by embedding them in a cooperative theory of thin-filament regulation, and a method for achieving this grand synthesis is proposed. Dr. David Aitchison Smith is a theoretical physicist with thirty years of research experience in modelling muscle contractility, in collaboration with experimental groups in different laboratories.