Improving muscular effort

R.C. Woledge

Handbook of Physiology: Section 10, Skeletal Muscle.
Edited by Lee D. Peachey, Richard H. Adrian and Stephen R. Geiger.
American Physiological Society (distributed by Williams & Wilkins): 1983. Pp.688. $145, £139.

THE American Physiological Society started to publish the series *Handbook of Physiology* 25 years ago. It was introduced with the following words:

The original literature of physiology has become so vast and is growing so rapidly that the retrieval, correlation and evaluation of knowledge has become with each passing year a more complex and pressing problem. Compounding the difficulties has been the inevitable trend towards fragmentation into smaller and smaller compartments, both of knowledge and of research skills. This trend . . . must be accompanied by the development of mechanisms for convenient and reliable reintegration in order that knowledge shall not be lost and research effort wasted.

Since then the problems have not diminished, and the publication in this series, for the first time, of a volume devoted to skeletal muscle has been eagerly awaited. To what extent can the editors and authors solve the immense problems of "reintegrating" this highly fragmented field, and present us with a "critical and comprehensive account of the physiological knowledge and concepts"? Inevitably the effort has to be made by a large team — in this case of 29 authors — and the resulting volume shows all the virtues and faults common to such works.

The advantage that stands out above all is the undoubted authority of each contributor within his field, and the corresponding confidence and enthusiasm with which they survey their chosen areas. Nearly all the chapters are strong, stimulating reviews. My particular favourites are those by Haselgrove (on X-ray diffraction studies), B. Eisenberg (quantitative ultrastructure), Gonzales-Serratos (inward spread of activation), Kushmerick (energetics) and by Peachey and Franzini-Armstrong (structure and function of membrane systems). All of these and many others succeed in providing a historical perspective and at the same time conveying something of the continuing excitement of developing areas; they are comprehensive and detailed but seldom boring.

The main fault of the book stems from the fact that the editors appear to have allowed their contributors undue freedom in choosing what they will cover. The consequence is that there are some substantial areas of overlap and some surprising — and serious — omissions.

For example, although 180 pages are devoted to the structure of muscle, I could find no discussion of the lengths of the thick and thin protein filaments which make up the myofibrils. This question is crucial because the interpretation of the relation observed between muscle length and the force it produces requires a knowledge of these lengths. Worse still, the interpretation that *is* given uses filament lengths that have long been known to be somewhat wrong.

There is also no detailed discussion of the way in which actin activates the splitting of ATP, although the subject is touched on in two chapters, one of which deals in considerable and fascinating detail with the splitting of ATP by myosin alone. But a knowledge of what actin does is surely essential to bring together the biochemical study of myosin as an ATPase with the physiological study of energy transduction in muscle. A further criticism is that although the longest chapter in the book is devoted to the mechanism of calcium transport by the sarcoplasmic reticulum, no author has made it his business to discuss the process of relaxation in muscle and the extent to which calcium transport and other processes contribute to and explain the dynamics of relaxation.

The weakest section of the whole book is undoubtedly the chapter on the mechanics and theories of contraction. It is much shorter than other contributions dealing with topics of corresponding importance and therefore lacks the detail and the authoritative tone which should be exhibited here; this chapter seems to belong in an altogether more modest textbook. It is particularly unfortunate that such a lack-lustre performance is apparent at what should be the core of a well-balanced treatment of muscle physiology.

Yet, overall, there can be no doubt that the volume as a whole is a great success. It should become a standard work of reference which will indeed help to ensure that "knowledge shall not be lost and research effort wasted". □

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Meteoric principles

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Physics of Meteoric Phenomena.
By V.A. Bronshten.
Reidel: 1983. Pp.356. Dfl.185, $74, £46.95.

METEORS, commonly known as shooting or falling stars, are produced when small interplanetary dust particles hit the Earth's upper atmosphere and burn out in it. Incident velocities range from 11 to 74 km s^{-1}. The causative particles have masses between 10^{-6} and 10^{8} g. Beneath the lower limit the resulting ionization and excitation is under our detection threshold — these particles are retarded before massive ablation sets in and then drift down to the Earth's surface. The upper limit is somewhat arbitrary, being governed by the fact that on average only one 10^{8} g meteoroid hits the Earth each year. Also a 10^{8} g meteoroid encounters about its own mass of air during its atmospheric traverse. Larger bodies punch through the atmosphere like bullets and form craters in the Earth's surface.

The simplistic approach to meteor physics relates the observables, such as luminosity as a function of distance along the trail, beginning height and end height, deceleration, time of occurrence and spectra to the fundamental properties of the incoming particle — mass, velocity, density, composition and orbit. But nature is far from simple. Meteoroids are loose conglomerates — fragile dust balls which fragment in flight — and the relationship between their loss of kinetic energy and their physical parameters is complex. Large meteoroids, below heights of 80 km, are surrounded by shock waves and analysis of their motion has to be tackled by gas-dynamical approaches. No longer are individual molecular impacts solely responsible for the melting and ablation of the meteoroid. Convective transfer, radiation and electronic heat conduction have to be taken into consideration.

Monographs on meteoritic phenomena are rare, the last two to be published being *The Physical Theory of Meteors and Meteoric Matter in the Solar System*, by B. Yu Levin (Izdatel'stv. Akad. Nauk. SSSR, 1956) and *Physics of Meteor Flight in the Atmosphere* by E.J. Opik (Interscience, 1958). Obviously the subject needs bringing up to date and V.A. Bronshten has done just that. He has assumed that the reader starts off with a good grasp of physics and applied mathematics but little knowledge of meteor science. This he builds up from first principles.

The Russian version of the book came out in June 1980 and the English translation was completed two years later, the hiatus being bridged by the addition of a short ten-page appendix. Bronshten covers the subject in commendable detail, and after developing the fundamental equations deals with the heating of the meteoroid, its ablation by vaporization, the spraying away of the molten layers and the formation of a shock wave. He then considers the luminosity and spectra of meteors, and how the curve of growth method leads to an understanding of chemical composition. Finally, there is treatment of meteor ionization, mass and density determinations, and the problems induced by fragmentation.

Bronshten's monograph is clearly written and well translated. It is a worthy addition to the few volumes on this rather specialized subject. □

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