errors in the text, however, although these are troublesome only in a few instances, where physical units are quoted incorrectly.

The subject of plant-water relationships lends itself to a combined ecological-physiological approach. It is rare to find a book which integrates these two subjects so well. The author is particularly well qualified to write about them, having contributed extensively to the literature of both fields.

The book is a major addition to earlier works which, though less biophysically based, are still important summaries of plant-water relations. There can be little doubt, however, that in the future we will see more of Slatyer's approach and, one hopes, will have an increasingly healthy combination of the two points of view.

JOHN S. BOYER
*Department of Botany,
University of Illinois, Urbana*

Motile Systems

Structure and Functions of Contractile Proteins. BORIS F. POGLAZOV. Translated from the Russian edition (Moscow, 1965) by Scripta Technica. Academic Press, New York, 1966. 339 pp., illus. $17.

The ability to produce controlled movements is one of the fundamental properties of living organisms. Even though a large number of apparently different motile systems have been described, ranging from the slow streaming of protoplasm to the high-frequency oscillations of insect flight muscle, it is reasonable to suppose that one is dealing with a class of phenomena exhibiting common features and evolutionary relationships. This book is probably the first attempt to provide a unified treatment of the broad area of motile systems. It deals primarily with the question, Is there a group of proteins with common properties which could be referred to as "contractile proteins"?

A translation of a 1965 Russian edition, the book covers the literature in detail up to the end of 1963. The translation is adequate but often awkward, and one gains the impression that the author's exact meaning has not always been conveyed.

The first third of the book is devoted to a review of the structure and chemistry of muscle. In view of the pioneering work of Engelhardt and Lyubimova on the adenosine triphosphatase activity of myosin, the volume of Russian work is surprisingly small. Except for the discussion of Poglazov's own studies on the role of sulfhydryl groups in polymerization of actin and in adenosine triphosphatase activity of myosin, the same ground has been covered by a number of reviews in English. A short chapter devoted to tropomyosin leaves the (mistaken) impression that invertebrate paramyosin and vertebrate tropomyosin are essentially the same protein. An important difference in emphasis occurs in the treatment of the mechanism of contraction. Although most British and American workers seem to regard the Huxley-Hanson sliding-filament model as at least the starting point for a discussion of contraction, here it is accorded the status of one hypothesis among a number of possibilities. Poglazov emphasizes the importance of the "α-spiral" in cross-β configuration as the basis of contraction in muscle and as the unifying principle which relates muscle contraction to other motile systems. The finding of the cross-β configuration in bacterial flagella by Astbury is taken as support for the general importance of this type of mechanism.

This point is amplified in a long chapter devoted to the "Motor apparatus of bacteriophage." The T2 caudal sheath has been extensively studied by Poglazov and collaborators. In brief, the sheath protein is believed to bear some resemblance to actin; and since adenosine triphosphatase activity is also present, a contractile protein system presumably functions in DNA injection. The mechanism involves a change in pitch of the helix formed by sheath protein. Similar suggestions have been made by Kozloff and co-workers, but Poglazov goes further in suggesting that the change involves an α to cross-β transformation and that the adenosine triphosphate is hydrolyzed by the sheath protein by a mechanism similar to the hydrolysis of bound nucleotide in the G to F transformation of actin. The phage system is described as a "monomolecular muscle." The hypothesis is certainly interesting and must await further characterization of the proteins, but the role of the cross-β configuration in muscle contraction would probably be disputed by most American and British workers.

A chapter is devoted to flagella and the mitotic apparatus. The author tends to regard bacterial and animal flagella as chemically similar systems, both related to actin and myosin. Unfortunately, much of our knowledge of the properties of animal cilia proteins was obtained after the preparation of this book. There may be some resemblance between actin and microtubule protein, but the thesis that a cilium is an actomyosin-like system is difficult to defend. Studies on the mitotic apparatus by Mazia and collaborators are adequately reviewed, but no important new evidence is added from Russian sources.

A discussion of the role of actomyosin-like proteins in protoplasmic streaming is presented, based on the work on slime mold (myxomyosin) and on a protein preparation obtained from *Nitella flexilis* by Vorob'eva and Poglazov (algomyosin). Here we are on firmer ground, since a pure protein has been obtained from slime mold by Oosawa and by my own laboratory which is essentially identical to actin. However, it should be emphasized that this is the only case so far in which a pure actin or myosin preparation has been obtained from a motile system other than muscle. Poglazov also describes crude preparations from a variety of organelles, cells, and tissues which are said to be actomyosin-like, in the sense that they exhibit adenosine triphosphatase activity and a decrease in viscosity with the addition of adenosine triphosphate. If these criteria are acceptable, then actomyosin-like proteins are found in most cells, including erythrocytes, and in mitochondria and chloroplasts. Furthermore, it is suggested by Poglazov that contractile systems could operate in permeability and active transport. One should also add that a contractile system, in reverse, could therefore function as the energy acceptor in oxidative phosphorylation in mitochondria and photophosphorylation in chloroplasts, and thus lead to the synthesis of adenosine triphosphate.

At present, the problem of energy conversion in any motile system has not been solved, and Poglazov's book provides us with a general survey of this interesting field. Perhaps the tendency to describe all systems as "actomyosin-like" is premature. It indicates our lack of satisfactory criteria for distinguishing "contractile proteins" except by analogy with the properties of actomyosin. The ciliary adenosine triphosphatase (synein) is not myosin-like, yet the cilium is an efficient motile system. On the other hand, the failure to confirm earlier reports of the presence of myosin in mitochondria and chloroplasts does not rule out a mechanical energy-conversion mechanism in these organelles.

The general thesis that motile systems have some properties in common is a valuable one, but so little is known about their comparative chemistry that restrictive definitions should be avoided. Even the term contractile proteins carries mechanistic implications. In my opinion, the older term "mechanochemical systems" is preferable, because it focuses attention on the central problem—the conversion of chemical bond energy, usually in the form of adenosine triphosphate, into mechanical energy. The ability of a protein system to do mechanical work at the expense of chemical energy is the most satisfactory criterion to use in defining such systems. It is difficult to apply, since the system must be obtained in an asymmetric form, but the uncritical use of the viscosity response of a crude protein extract can lead to needless confusion. Furthermore, some of the systems described, such as the Na-K dependent adenosine triphosphatase, are probably not like actomyosin and should not be included as mechanochemical systems. In this case chemical energy is used to do work against an electrochemical gradient. Presumably protein systems are capable of carrying out several kinds of energy conversions, the mechanochemical type being an important, but not the only, example.

EDWIN W. TAYLOR
Department of Biophysics, University of Chicago, Chicago

Some Biological Mechanisms of Behavior

Progress in Physiological Psychology. Vol. 1. ELIOT STELLAR and JAMES M. SPRAGUE, Eds. Academic Press, New York, 1966. 299 pp., illus. $9.50.

Frontiers in Physiological Psychology. ROGER W. RUSSELL, Ed. Academic Press, New York, 1966. 277 pp., illus. $8.50.

It is just 100 years since Wilhelm Wundt inaugurated a new formal discipline by changing the title of his course at Heidelberg to "Physiological Psychology." The new field—devoted to the study of biological mechanisms of such aspects of behavior as attention, perception, learning, and memory—made slow progress for many decades. Techniques were lacking to record or influence directly processes taking place deep within the body, and especially within the brain. With the development of such techniques in the last quarter century, physiological psychology has spurted ahead.

Textbook writers have recently been trying to catch up with the rapidly expanding field. Whereas there was only one textbook of physiological psychology in wide use a few years ago, half a dozen have appeared in 1966 and 1967. So diverse are the problems and techniques and so rapid is the progress that writing textbooks in this field is unusually difficult and is almost bound to be a thankless task; even the most successful textbooks are doomed to be soon out of date. One attempt to provide continuing up-to-date coverage of this field is found in certain chapters of the *Annual Review of Psychology* and the *Annual Review of Physiology*.

An attempt devoted exclusively to this field was inaugurated in 1966—*Progress in Physiological Psychology*. The plan of the editors is to present each year six to eight papers, some being brief, authoritative accounts of the current state of a special field, others presenting new and unpublished investigations, and still others providing critical and speculative evaluations of concepts in the field. As new topics are covered in succeeding years, it is hoped that the whole breadth and depth of physiological psychology will be represented. Only the field of sensory mechanisms will be excluded, since this is being covered by the series *Contributions to Sensory Physiology* (also published by Academic Press), edited by W. D. Neff, but perceptual mechanisms will be included. Authors will come from other biological sciences as well as from psychology.

The six topics of volume 1 indicate some of the scope intended for this series: electrophysiological correlates of transaction and storage of information in brain tissue; concepts of attention and experimental approaches to attention through electrophysiology; effects of sensory deprivation on brain and on behavior; the anatomical locus of reinforcement of behavior; physiology of thirst; and functions of the limbic system of the brain in initiating and suppressing behavior. Three authors are physiologists and three are psychologists. Such a distribution of topics and authors should help to foster communication among members of the various disciplines that contribute to physiological psychology. Each of the present authors is well known for research in the area that he treats, and each goes beyond a simple review to comment and speculate on problems and concepts. The standard of exposition is high, carefully chosen references are given for each chapter, and indices of names and topics are provided. Volume 2 of this series is now in preparation.

Almost as if to start the foregoing series off with two volumes, R. W. Russell has edited *Frontiers in Physiological Psychology*. The treatment of topics is rather similar, and a few of its seven chapters even overlap somewhat (but not extensively) those in *Progress in Physiological Psychology*. A rather different topic, biochemical substrates of behavior, is covered in an excellent review by the editor. Both volumes can be recommended as providing authoritative accounts of main areas in current physiological psychology.

In the years to come the series begun by Stellar and Sprague should continue to provide a valuable source for both students and investigators. It should also provide a record of advances and, one hopes, a stimulus to further progress.

MARK R. ROSENZWEIG
Department of Psychology, University of California, Berkeley

Books Received

Advances in Astronomy and Astrophysics. Vol. 5. Zdeněk Kopal, Ed. Academic Press, New York, 1967. xii + 355 pp., illus. $16.

Advances in Mathematics. Vol. 2, fasc. 1. Topological planes. Helmut R. Salzmann. Academic Press, New York, 1967. 60 pp., illus. Paper, $3.95.

Advances in Morphogenesis. Vol. 6. M. Abercrombie and Jean Brachet, Eds. Academic Press, New York, 1967. viii + 331 pp., illus. $15.

Advances in Protein Chemistry. Vol. 22. C. B. Anfinsen, Jr., M. L. Anson, John T. Edsall, and Frederic M. Richards, Eds. Academic Press, New York, 1967. xviii + 443 pp., illus. $18.50.

Amphibians and Reptiles of Great Smoky Mountains National Park. James E Huheey and Arthur Stupka. Photographs by Isabelle Hunt Conant. Published with the cooperation of the Great Smoky Mountains Natural History Association, University of Tennessee Press, Knoxville, 1967. xii + 98 pp. $3.

(*Continued on page 1238*)