Muscle Physiology

Plasticity of Muscle. Proceedings of a symposium, Konstanz, Germany, Sept. 1979. DIRK PETTE, Ed. De Gruyter, Hawthorne, N.Y., 1980. xxvi, 626 pp., illus. $90.

For a long time the term "plasticity of muscle" was used to characterize its resistance to stretch. The essential condition for such plasticity is that actin and myosin filaments not be linked together, and this state requires the presence of adenosine triphosphate. The concept of plasticity is extended in the book under review, which deals with the ability of muscle to adapt to changed conditions. Thus, muscle shows plasticity in response to changes in the environment elicited by neuromuscular and metabolic interactions, diverse stimuli, or disease. Alternatively, plasticity may involve the antigenic properties of myosin or the effects of thyroid hormones on muscle.

Plasticity of Muscle is a collection of papers dedicated to the memory of Ernest Gutmann, a distinguished Czechoslovakian muscle physiologist. It is divided into seven sections covering the heterogeneity of metabolic and molecular properties of muscle fibers, the development and growth of muscle, the interaction of nerves and muscle, the influence of use on muscle, the effects of long-term stimulation on muscle, mechanisms of hypertrophy and atrophy, and the effects of thyroid hormones.

The properties of fast and slow muscles are discussed in the majority of the papers. Fast and slow myosins appear in sequence during myogenesis, and their subunit composition is modified following cross-innervation or cordotomy. Long-term electrical stimulation changes the fuel uptake and performance in fast skeletal muscle, induces changes in its enzymic activities, and alters the protein composition of the sarcoplasmic reticulum. Studies on fast and slow muscle fibers from patients with Duchenne dystrophy are especially valuable. Glycogen phosphorylase is severely affected in fast fibers, and β-hydroxyacyl coenzyme A dehydrogenase is severely affected in slow fibers.

It has been recognized for some time that the division of skeletal muscles into only two groups, fast and slow, is an oversimplification. Thus, fast muscle may be further divided into type A, which produces energy through oxidative metabolism and is resistant to fatigue, and type B, which produces energy mainly through glycogen breakdown and fatigues rapidly. This symposium reports a broad heterogeneity of muscle fibers when investigated by highly sensitive techniques, such as enzymology, microphotometry, and immunology. Homogeneity probably exists in fibers of one motor unit.

Several papers are devoted to elucidating the factors that determine fiber type. It seems likely that the control occurs at the gene level and that the expression of the genes responsible for the fast or slow muscle is regulated by fast or slow innervation, respectively. How long-term stimulation changes the muscle type and how the frequency of stimulation determines the nature of polypeptide synthesized in the muscle cell are still moot questions.

Many of the data presented at the symposium are already in the literature. Summary or conclusion is generally missing at the end of the papers. The book is recommended for general biology and medical school libraries.

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Enzymatic Transformations

Enzymatic Basis of Detoxication. WILLIAM B. JAKOBY, Ed. Academic Press, New York, 1980. In two volumes. Vol. 1. xvi, 416 pp. $43. Vol. 2. xiv, 370 pp. $38.50. Biochemical Pharmacology and Toxicology.

In recent years a great deal of interest has centered on mammalian enzyme systems that metabolize substances foreign to the body, such as drugs and pollutants. Many of these compounds are potential carcinogens. Some of the enzymatic transformations generate compounds that are more toxic to the organism than the parent compounds, whereas others render the compounds less toxic. In Jakoby's terms, the latter process is "detoxication." The study of the physiological significance of these enzymes has been aided by advances in enzymology, as well as in chemistry, genetics, pharmacology, and other fields, and an explosion of basic knowledge about them has occurred in the past ten years.

These two volumes treat the individual enzymes. Although the term "detoxication" appears in the title, most investigators now realize that many of the enzymes treated here can have either beneficial or deleterious roles, depending upon the substrate involved and the model system that is being investigated. Many of them also exist in multiple forms that have different catalytic activities toward different substrates. Most of the enzymes discussed metabolize certain chemicals endogenous to the body as well as foreign chemicals. Whether the enzymes have developed to handle foreign or endogenous chemicals has not been clearly resolved in most cases.

The book begins with a short introduction by the editor on the general role of enzymes in reactions involving detoxication, which is distinguished from the more commonly utilized term "detoxification." Chapters dealing with pharmacokinetics, human genetics, enzyme induction, and comparative aspects of metabolism follow. The remainder of the text treats individual detoxication enzymes organized into several categories: mixed-function oxidases (cytochrome P-450, NADPH cytochrome P-450 reductase, and microsomal flavin-containing monooxygenase), other oxidation-reduction enzymes (alcohol dehydrogenase, aldehyde reductase, aldehyde oxidizing enzymes, ketone reductase, xanthine oxidase and aldehyde oxidase, superoxide dismutase, glutathione peroxidase, and monoamine oxidase), and enzymes involved in conjugation and hydrolic processes (glucuronidases, *N*- and *O*-methylases, glutathione *S*-transferases, enzymes involved in peptide bond and mercapturic acid formation, cysteine conjugate β-lyase, thio *S*-methyltransferase, acetylase, aryl hydroxyamic acid acyltransferase, sulfotransferase, thiotransferase, rhodanese, glyoxylase, epoxide hydrolase, and carboxylesterases and amidases). The scope of the work is thus very broad.

Most of the chapters cover the physiological roles of the enzymes as well as purification techniques, protein characterization, evidence for and against multiplicity, and other matters. The chapters vary in breadth, with some largely focused on an author's own work and others more comprehensive. Several, both on specific enzymes and general topics, are clearly excellent, among them that by Wislocki, Miwa, and Lu on the various reactions carried out by cytochrome P-450. There is a minimum of overlap between the papers, but a few are similar to others published by the same authors elsewhere.

The volumes present a nice marriage between pharmacology and biochemistry, and one can recommend them to workers in both fields as a reference. Most of the reviews cover the literature up to early 1979. With their overall breadth and readability, these volumes could also be used well by graduate-level

students in biochemistry, pharmacology, toxicology, or related fields. For seasoned investigators, as well as for students, this reviewer recommends this work highly.

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Tupaiidae

Comparative Biology and Evolutionary Relationships of Tree Shrews. W. PATRICK LUCKETT, Ed. Plenum, New York, 1980. xvi, 314 pp., illus. $39.50. Advances in Primatology.

The tree shrews, a close-knit family of squirrel-like mammals inhabiting South and Southeast Asia, were rescued from obscurity by LeGros Clark's studies (1924–1932) indicating phylogenetic association with the primates. This interpretation received support in Simpson's influential classification of the mammals (1945) incorporating the tree shrew family Tupaiidae in the order Primates—an allocation soon widely accepted. Over the past 15 years, however, suspicions have grown that tree shrews are not close relatives of primates after all, and the present consensus is that they constitute a separate order (Scandentia). The time is ripe for a comprehensive review of tree shrew affinities, and Luckett's edited volume substantially meets this need.

The reappraisal of tree shrew phylogenetic relationships has resulted partly from a flow of new data, often revealing significant differences between tree shrews and primates. There have also been many corrections of errors in earlier reports. More important, though, has been the revolution (to some extent inspired by Hennig) that has affected procedures used for phylogenetic reconstruction. It is now generally accepted that mere listing of apparent homologous characters does not suffice to reveal relationships. For any group considered one must distinguish between primitive (symplesiomorphic) homologies retained from the initial ancestral stock and derived (synapomorphic) homologies retained from any later stock. The overwhelming conclusion that emerges from this book is that reanalysis of the undoubted similarities between tree shrews and primates identifies most of the shared features as characters retained from the ancestral placental mammals, while the remainder probably involve convergence.

Other procedural inadequacies in earlier assessments of tree shrew relationships included inadequate representation of different placental mammal groups, limitations both in the numbers of characters considered and in the depth of analysis (for example, omission of embryological information), neglect of variation within the Tupaiidae, and internal inconsistencies in proposed phylogenetic schemes. These inadequacies have been overcome to varying degrees in the contributions to Luckett's book, and the revision of tree shrew relationships thus represents a genuine advance in scientific knowledge rather than just a fashionable swing in opinion.

A useful historical introduction is provided by Luckett, and well-balanced accounts of cranial morphology (Novacek; Cartmill and MacPhee), central nervous organization (Campbell), and reproductive biology (Luckett) place in modern theoretical perspective many of the key characteristics originally thought to link tree shrews with primates. The treatments by Novacek and by Cartmill and MacPhee of orbital and basicranial characters overlap considerably, but it is encouraging that broadly similar conclusions emerge. Strangely, despite traditional reliance on dental morphology in mammalian phylogenetic reconstructions, no adequate case was ever made for significant dental resemblances between tree shrews and primates; and Butler's chapter on tree shrew dentition expertly shows that no case exists. One major drawback has been, and remains, the absence of convincing early fossil tree shrews. We now have some fragments documenting the presence of tree shrews in India some 10 million years ago, but unfortunately Jacobs's chapter predated the recent reports of the most substantial specimens by Vasishat, Chopra, and Kaul. Discussions of postcranial features by Szalay and Drawhorn and by Novacek are incomplete and do not rigorously distinguish primitive from derived conditions. Szalay and Drawhorn's analysis of the tarsus is weakened by reliance on unassociated fossil specimens and concomitant circularity. Worse, the only known associated European adapid postcranial skeleton (recently described by von Koenigswald) throws doubt upon the identification of isolated tarsal specimens as "*Adapis parisiensis*" and thus upon the entire analysis. All of these chapters on morphological criteria suffer from a lack of quantification and, in particular, from neglect of allometric effects—so further work remains to be done.

The relatively new approach of tree-building with the use of quantitative data from immunological cross-reactions and protein sequencing is covered in two chapters (Dene *et al.*; Cronin and Sarich). Such studies add a valuable new dimension to phylogenetic reconstruction, but immense problems are raised by gene duplication, by generation of numerous alternative trees with only marginal differences in "parsimony," and by use of antiserums produced in a mammal (rabbit) to assess mammalian evolutionary relationships. Further, molecular information has yet to be successfully integrated with classical morphological data.

The total evidence in this book discounts any close relationship between tree shrews and primates, but there is no clear consensus concerning relationships between mammal orders. Some authors favor a modification of Gregory's "Archonta" (primates; tree shrews; elephant shrews; bats; flying lemurs), whereas others see this group as united only by shared primitive placental mammal features. Resolution of mammal interordinal relationships must await a proper synthesis of available data from all sources, and the tree shrews will doubtless continue to serve as a suitable test case.

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A Study in Paleoecology

Lower Wenlock Faunal and Floral Dynamics. Vattenfallet Section, Gotland. VALDAR JAANUSSON, SVEN LAUFELD, and ROLAND SKOGLUND, Eds. Geological Survey of Sweden, Uppsala, 1979. 294 pp., illus. Paper, $19. Sveriges Geologiska Undersökning Series C NR 762.

This important advance in the study of paleoecology goes far beyond the rather superficial counts of fossils exposed on bedding planes that characterized many of the early efforts in the field. Merely suggesting the inadequacies of previous attempts, it provides a procedural model for future paleoecologic studies—a model that may save workers in the field much time, many mistakes of omission, and not a few of commission. The editors have coordinated a remarkable effort by 32 specialists from eight countries to provide an account of the paleontological dynamics of a single thin mid-Silurian section. They call this study "the first ever attempt to elucidate the succession of all fossil organisms during an interval