tains a few widely separated peaks of development which correspond to the primary sensory areas. Surrounding the peaks are successive belts showing progressively less development until old cortex is reached on the medial wall (hippocampus) and on the lateral wall (pyriform area). Sanides's interpretation is that two kinds of old cortex, pyriform and hippocampal, gave rise to neocortex, which further developed in successive waves, the process culminating in the primary sensory and motor areas. Most of the traditional association cortex can be classified as either one of the two main intermediate grades—proisocortex or periallocortex.

Obviously it is the neocortex that expands most in primate evolution; but it is one thing to say this in a general way and quite another to know precisely to what extent the neocortex and its various subdivisions have developed. We learn in chapters by Heinz Stephan, Orlando J. Andy, and Roland Bauchot that, for example, the neocortex of simians is 34 times the size of the hippocampus, while in the generalized living insectivores, such as hedgehog, the ratio is three to two. The significance of this inquiry depends not only on the authors' careful measurements of new and old brain structures in a variety of species but on the use of living insectivores to provide a base line for assessing evolutionary changes. Not all parts of the rhinencephalon, as this term was traditionally used, have the same fate in primate evolution. Certain olfactory centers in the strict sense are reduced in an ascending series; on the other hand, the septum and the hippocampus actually increase in size from insectivores to prosimians but then remain stable. These last changes are, of course, dwarfed by the increase in the size of the neocortex. Insight into the reasons why certain kinds of changes in the brain go together in certain lines of descent can ultimately be provided by a factor analysis, according to George Sacher. Sacher writes a provocative chapter, based on the raw measurements provided by Stephan and Andy, which should have far-reaching methodological implications.

As Le Gros Clark showed years ago, the enlarged occipital and temporal areas distinguish primates from other mammals, and these features can be observed even in fossil primates. A chapter by Leonard Radinsky reviews his own study of endocranial casts and confirms this picture. He also raises questions about the classification of certain fossil prosimians, which issue will be of greater interest to the specialist in taxonomy than to the general audience in comparative neurology. Of more general significance is the fact that the remarkable temporal areas (as measured from side to side) in certain fossil prosimians can also be attributed to the important role of vision in these species (just as the development of the occipital areas can be attributed to vision), a conclusion forecast by Le Gros Clark before present evidence was available showing that the temporal lobes receive visual impulses from the tectum relayed via the pulvinar and from the striate cortex via corticocortical chains. If *differential* development is the key to understanding primate brain evolution, the question arises whether *gross* brain size has any value whatsoever for assessing phyletic level or neural development. Harry Jerison believes that it has, and his conclusion is supported especially by comparisons between widely separated groups such as mammals and reptiles.

The remaining chapters are chiefly reviews of the literature. W. J. C. Verhaart, who has contributed much to our understanding of the pyramidal tract in primates, reviews this literature. Similarly, Lee R. Wolin and L. C. Massopust review the literature on the primate retina. Charles R. Noback and Lois K. Laemle describe visual pathways to the cortex. A chapter by Roland A. Giolli and Johannes Tigges on the primary optic pathways and nuclei of primates, in addition to reviewing the literature, contains many of their unpublished observations on the terminations of the optic tract.

This accounts for all the chapters in the book except the last. The chapter by Ralph Holloway seems to be chiefly methodological, the main point being that gross structural differences do not account for differences in species-specific behavior, such as the attractiveness between sexes of the same species. If this is regarded as a methodological criticism of the rest of the book it misses the point. The discovery of how the primate brain is altered by evolution, especially the instances of convergent evolution, challenges the psychologist to discover behavioral measures that reflect these trends. Needless to say, the behavioral tests must be common so that the various groups can be compared on the same scale, and the tests should not reflect eccentricities in sensory-motor ability. We need not be reminded that this line of inquiry will not answer all questions about brain-behavior relations, since functional differences, such as that exhibited by the two hemispheres in man or that produced by learning, are not reflected in gross structural differences. Holloway's difficulty in communicating may simply be rhetorical, since it may be useful to consider the limitations of a comparative approach in attempting to understand man's unique intellectual capacity.

To sum up, *The Primate Brain* is a collection of reviews unified by the editors' careful subdivision of the subject matter. The unity that the editors achieve by parceling the subject matter is not matched by an attempt to make the chapters uniform in style, rhetoric, purpose, or method. Some chapters present original data and offer original points of view, while others chiefly review the literature, and most fall between these extremes. I suppose it is pointless to lament that since Le Gros Clark's retirement there is no one person with sufficient breadth to cover all these topics; so, if a wide range of materials is to be presented in a single source—a laudable goal—then we have no alternative to the diversity found in this publication.

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Thermogenic Mechanisms

Brown Adipose Tissue. OLOV LINDBERG, Ed. Elsevier, New York, 1970. xiv, 338 pp., illus. $24.50.

The publication of this book is another indication of the recently awakened and broadened interest in brown adipose tissue. Long recognized, this intriguing tissue has had many roles assigned to it. Within the last ten years evidence has been steadily accumulating to indicate that one of its prime functions may be as a furnace which helps to maintain an animal's body temperature or restore it to normal values. In this monograph there are 13 chapters contributed by 22 investigators

from six countries. Most of these investigators, including the editor, have turned their attention to studies of this tissue within the last decade.

The monograph is not a compilation of papers presented at a symposium. There is, however, considerable overlap of coverage and unequal quality among the chapters. In some cases one will find a useful and comprehensive survey of the literature, and such chapters provide an excellent reference source for workers in the field. In this regard it is perhaps regrettable that only four of the 13 chapters provide the full titles of papers cited.

The main concern in the monograph is with the various morphological and biochemical attributes of brown adipose tissue which endow it with the potential to play a thermogenic role. Among the points covered that support such a role the following may be cited. First, the distribution of this tissue in various species; it is most abundant (3 to 7 percent of body weight) in hibernators and in neonates, especially those that are born lacking the fur coat that insulates the adult. Second, the tissue possesses a rich vascular network and is extremely rich in mitochondria—attributes that are necessary to permit the extremely high oxygen uptake of which the tissue is capable. Third, it has a rich sympathetic innervation and a high norepinephrine content which can serve to trigger the ignition of the oil burner to produce heat. Studies in vitro and in vivo support the role of catecholamines as stimulators of oxygen consumption. Fourth, biochemical evidence indicates that the tissue's fat stores (50 percent of wet weight) serve as fuel. Production of fatty acids and glycerol accompanies the stimulation of oxygen consumption by catecholamines. Presumably this involves the release of cyclic adenosine monophosphate and the activation of the tissue's lipase.

Still not resolved to everyone's satisfaction, however, is the question how this tissue generates heat. Increased oxygen consumption in nearly all tissues is geared to a demand for adenosine triphosphate as a source of energy rather than primarily to the generation of heat. Does brown adipose tissue fail to generate ATP when stimulated to respire rapidly, or does it possess some mechanism that permits ATP or some high energy precursor to be used rapidly and wastefully so as to achieve heat production? The present views on this question are well presented in this treatise along with the current biochemical information that must be taken into consideration in reaching a final answer to it.

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Zootoxicology

Poisonous and Venomous Marine Animals of the World. Vols. 2 and 3, Vertebrates. BRUCE W. HALSTEAD, with sections on chemistry by Donovan A. Courville. Government Printing Office, Washington, D.C., 1967–70. Vol. 2, xxxii, 1070 pp., illus.; vol. 3, xxvi, 1006 pp., illus. $50 for the set of three volumes.

The publication of the third volume on marine zootoxicology brings to a close this rather massive contribution (some 3100 pages in all), which first began publication in 1965 with the appearance of the volume on invertebrates. The three volumes, published jointly by the United States Air Force, Army, and Navy, are a first and greatly needed attempt to bring together all important information on dangerous marine animals. (The first volume was reviewed in *Science*, 12 May 1967.)

The second volume deals with poisonous fishes (those that produce biotoxication when ingested but have no specific poisonous glandular organ). The third volume includes venomous fishes, as well as fishes with specific poisonous glandular organs unassociated with venom apparatus (ichthyocrinotoxic fishes), poisonous sea turtles, venomous sea snakes, and poisonous mammals. A glossary, a general index, and finally addenda and errata for the three volumes are appended in volume 3. The organisms discussed are arranged more or less according to their phylogenetic relationships, and each is treated in a rather standard format usually including information, when available, on the history of research, the biology of the dangerous organism, the morphology and microscopic anatomy of the tissue and organs involved in the mechanism of intoxication, and the clinical symptoms, treatment, prevention, and pathology of intoxication. Comments on or sometimes rather thorough discussions of the toxicological, pharmacological, and chemical aspects of the poisons are also included.

The volumes are well illustrated, an attempt being made to illustrate all poisonous marine animals known. To achieve this Halstead has had to rely on extensive use of illustrations from ichthyological literature as well as many excellent to poor color photographs from a variety of sources. The resulting illustrations vary in quality and in some cases will be difficult for a physician or toxicologist to use as a means of identification. The physician and toxicologist should also be aware that the scientific names used for many of the fishes will be subject to future changes. Taxonomic problems in tropical marine shore fishes, including the majority of the fishes covered in this book, have only begun to receive adequate treatment in recent years.

The major purpose of these volumes, to summarize modern knowledge on poisonous and venomous marine animals, is amply accomplished, and the severe limitations of our knowledge of this area of biology and medicine are well shown. In reading through this work one is impressed with how little as well as with how much is known about the subject. The books will long remain a valuable source of information for all concerned with tropical marine biology and medicine.

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Hazardous Agents

Chemical Mutagens. Environmental Effects on Biological Systems. L. FISHBEIN, W. G. FLAMM, and H. L. FALK. Academic Press, New York, 1970. xiv, 364 pp., illus. $18.50. Environmental Science.

Microbial geneticists and molecular biologists have employed chemical mutagens for several decades as tools for the elucidation of basic genetic structure and function. In contrast with x-irradiation, the genetic hazards of which have long been appreciated, there has only recently been a realization that there are potential public health hazards due to chemical mutagens. This awareness has fortunately been paralleled by the recent development of practical, sensitive, and relevant methods for detecting and measuring effects of chemical mutagens in vivo and in vitro in mammalian systems and by microbial and other ancillary nonmammalian systems.

Chemical Mutagens takes a broadly