abuse attributable to technology-bred insults such as insecticides, radiation, and noise. Sax seems to recognize this possible limitation in pointing out that a "judicially declared moratorium" has not been invoked in any cases in which there is a high degree of uncertainty as to the nature and extent of possible environmental injury. Similarly it is not clear that Sax's criticisms of the "administrative agency" are equally applicable to the purer form of regulatory agency such as the Food and Drug Administration, the Federal Power Commission, and state pollution control boards.

Nevertheless, it is difficult to quarrel with his general thesis. It is vitally important that administrative agencies be fully accountable to the public, and citizens' suits are an important means of achieving such accountability. Moreover, a highly useful purpose is served in subjecting environmental decisions made by experts, who typically have narrow experience and interests, to another forum, in which a fresh look will be given on a common-sense basis by an objective, detached judge. And beyond this, recognition that citizens have a "right," legally enforceable, to environmental quality seems to be an indispensable element in obtaining and maintaining environmental quality. Finally, Sax wisely does not argue that the courts should be the final arbiter of the balance between environmental rights and other considerations. He recognizes that in a democratic society this balance must be struck in the legislature, preferably with adequate inputs from the public, and that the role of litigation in the courts is primarily to vent public concern and to focus the issues for legislative consideration.

Sax's view that citizen-initiated litigation will improve the operation of the democratic process in resolving environmental issues is closely related to the broader question of technology assessment that is now being discussed. There seems to be broad agreement that some form of new governmental institution is required to assess technology in a manner which will appropriately identify, appraise, and balance pros and cons as a predicate for legislative action that will enable society to enjoy maximum benefits from technology with minimum costs and risks. Most of this discussion presupposes that the technology assessment function will be performed by one or more agencies staffed with appropriately interdisciplinary experts. Although a technology assessment board would not be the type of decision-making administrative agency that Sax criticizes, it would be subject to much the same criticism. Experts deeply immersed in technical problems have little basis for knowing what technological benefits the public wants and what price it is willing to pay for them. Assessment is therefore likely to boil down to what price the experts think should be exacted from the public in order that the public will have the benefits the experts think it should have.

It is easy to understand why environmental values, and human values generally, have so often in the past been sacrificed on the altar of progress. Whenever consideration is given to use of a technology or to some activity that will alter the environment, there are always strong vested interests, usually well-heeled, to articulate and advocate the benefits. Rarely, however, at least in the early stages, are many people to be found who are aware of the risks or who have sufficient interest or financial resources to articulate and argue the negative factors. Moreover, the benefits are usually obvious and immediate, whereas the risks tend to be speculative and more remote. It is to be expected that the authorities will give more weight to obvious, immediate benefits than to speculative and remote risks. This is another way of stating Sax's point that environmental values do not have a price put on them in the ordinary course of administrative decision-making.

Helpful though Sax's citizen-initiated litigation can be, use of the courts is a rather indirect and inefficient means of perfecting the democratic process for decision-making purposes. Some thought should be given to more directly improving the decisional processes of our legislatures and administrative agencies by assuring greater public participation and fuller consideration of environmental and human values at the time the decisions are first made. Although Sax does not dwell on this point, he does suggest at one point in his book that the essence of his thesis is "an enlargement of the adversary process." Lawyers generally think of the adversary process in terms of litigation in the courts. Much can be accomplished, however, by enlarging the adversary process within the forums of the administrative agencies and the legislatures as well. Perhaps we should think about creating governmental institutions whose sole role would be to represent environmental values vigorously in administrative agency proceedings. Such an agency might also play a major role in propagandizing environmental values and risks in the public arena and in our legislatures. The kind of adversary process which Sax views as indispensable would then come into play at a much earlier time. Such an approach, coupled with citizen-initiated litigation, would do much to enhance our ability to cope with the environmental crisis.

HAROLD P. GREEN
National Law Center,
George Washington University,
Washington, D.C.

Comparative Neurology

The Primate Brain. CHARLES R. NOBACK and WILLIAM MONTAGNA, Eds. Appleton-Century-Crofts, New York, 1970. xiv, 320 pp., illus. $18.75. Advances in Primatology, vol. 1.

Nothing excites our wonder and curiosity so much as the evolution of the mind of man. Hence our fascination with primates and especially the primate brain. For if the brain of primates does not hold all the secrets of man's mind, it provides, at the least, the starting point for the inquiry. The outstanding structural change in the brain as the primate scale is ascended from tree shrews and lemurs to apes and man is the increased differentiation of cortical architectonic areas—the number of areas increases as does the contrast between them. It is therefore remarkable that after an auspicious beginning architectonic analysis became discredited. Why? Suffice it to say that structural subdivision cannot stand by itself but requires support from some unifying functional principle; and the traditional principle that association areas of the higher primates constitute the most *specialized* part of the cortex serving "higher" integrative functions (which leaves simpler sensory processes to sensory areas) could not be supported. A welcome revitalization of cortical architectonics is achieved in this book in a chapter by Friedrich Sanides. According to Sanides, the cortex of man con-

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.

IRVING T. DIAMOND
Department of Psychology,
Duke University,
Durham, North Carolina

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