

is blurred in Reichenbach's account both by his implication that light geometry was relativistic *prior* to Einstein's 1905 analysis, and by his explicit assertion that the revolutionary contribution of Einstein's special theory of relativity consisted in asserting that light geometry and matter geometry are identical (see pp. 14, 76). Though it is true that the subject matter of physical optics, in its Maxwellian form, is in an *objective sense* Lorentz-invariant prior to Einstein's analysis, that is, that Maxwell's equations are invariant under Lorentz transformations for space and time parameters, it is not the case that such Lorentz invariance is guaranteed by straightforward inductive generalization based on the results of the Michelson-Morley interferometer experiment of 1887. In papers published in 1899 and 1904, Lorentz was able to accommodate the Michelson results in the context of his "absolute" theory by means of his asymmetrically interpreted contraction effect together with his then experimentally sanctioned *approximation* to complete Lorentz (actually Poincaré and Einstein) invariance. Thus Reichenbach's exposition here does not distinguish sharply between the Lorentz absolute theory and Einstein's relativistic theory, though Reichenbach does do so, as regards the different contraction effects, in his 1928 monograph. It seems again that Reichenbach's epistemological analysis of 1924 must defer to his later work for historical fidelity as well as for logical adequacy.

As a final related epistemological point, I might note that Reichenbach cites as the experimental support for his axiomatization of relativity only an inductive generalization of the Michelson experiment (see p. 93), though he does indicate that a test of the transverse Doppler effect, later observed by H. Ives and reported by the editor in the notes, would be of import as well. The characterization of the relation between theory and experiment which Reichenbach has given obscures the historical fact of the variety and wealth of the evidential base of the Einstein special theory, discussed, for example, in M. Laue's 1911 text *Das Relativitätsprinzip*. Laue mentions, among others, the aberration experiments of Airy, Fizeau, and Rayleigh and Brace, the electrical experiments of Röntgen, Eichenwald, Wilson, Trouton and Noble, and Trouton and Rankine, and the high-velocity electron experiments of Kaufmann and Bucherer. Though

there may be some gain in elegance in erecting the theory of relativity on the narrowest experimental base possible, it is doubtful in the light of the remarks above whether Reichenbach has succeeded in doing so, and further it is also unfortunately likely that he has misrepresented the extent of the contact between theory and experiments in this case.

In sum, this book, if read in conjunction with the author's later work,

should be of considerable value to students of the philosophy of space and time, particularly to those working in the Reichenbachian-Grünbaumian tradition, as well as to those philosophers who are oriented toward the articulation of the formal structures of scientific theories.

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## Hypothalamic Structure and Function

**The Hypothalamus.** WEBB HAYMAKER, EVELYN ANDERSON, and WALLE J. H. NAUTA, Eds. Thomas, Springfield, Ill., 1969. xvi, 808 pp., illus. \$45.

This massive compendium, like the work with the same title that was published in 1940 under the aegis of the Association for Research in Nervous and Mental Diseases, brings together specific monographs by a number of the outstanding leaders in more recent investigations of the hypothalamus. The result, the first attempt at a comprehensive treatment of this subject in nearly three decades, is a monumental and beautiful book, fit to take its place beside the older volume.

The editors, who are also contributors, have selected the authors with care. As in the earlier work (edited by Fulton, Ranson, and Frantz), the topics covered are diverse; practically all major areas of investigative effort are ably represented in the 18 chapters. An instructive short chapter by Evelyn Anderson sets the tone by exposing some of the (sometimes tragicomic) processes through which scientific "truth" has been arrived at in the past, revealing both impediments to progress designed by nature and those marshaled by the all-too-human psyches of investigators whom later generations have come to view as paragons of scientific objectivity.

This is followed by a group of seven chapters which deal primarily with various morphological aspects of the hypothalamus and its components, as well as with the anatomy of related parts of the central nervous system. The subjects covered range from ontogeny through gross and comparative anatomy and vascular architectonics to nuclear organization and the synaptic connections that form the basis of most interneuronal information transfer. Included here is a superbly written chap-

ter by the late John D. Green on the hypothalamo-pituitary linkages through which the nervous system can adjust pituitary function in response to exteroceptive and interoceptive stimuli.

Green's chapter leads logically into a set of five chapters dealing with a subject on which the earlier book had only tantalizing prophecies to offer—the neural control of pituitary function. The 1940 book had two chapters (by C. M. C. Brooks and U. U. Uotila) suggesting that the pituitary stalk might have some necessary role in maintaining gonadal, thyroid, and adrenal function. The present volume contains four substantial chapters (by A. V. Nalbandov and J. Graber, G. W. Harris and R. George, C. H. Sawyer, and the late Leon Desclin) in which the mass of newer information on anterior lobe function is skillfully and selectively reviewed, as well as a lucid and well-proportioned chapter on the neurohypophysis (by M. Pickford). These chapters present a nice balance among various points of view. Some sections fairly pulse with the energetic arraying of evidence that the adenohypophysis is "under the control" of the hypothalamus. Others—without denying what is known in support of this relatively recent view (that the adenohypophysis, like an autonomic neuron perhaps, exists but to execute orders from the brain)—gently raise firm caveats: "The 'control' is not universal, here are some exceptions. Now, what is the true picture?"

Considerations of hypothalamic function in the earlier book were dominated by analyses of those processes the physiologists of the time could assess: regulation of temperature, food and water intake and water balance, motor activity, sleep. Investigations of these processes have multiplied and, blessed by the advent of electronic technology, waxed increasingly sophisticated. Yes-

teryear's primitive notions of hypothalamic "centers" for these functions, revealed by the groping accounts in the 1940 book, form interesting contrasts with current (still groping) accounts of these exquisitely complex control systems. The reviewers (R. D. Myers, J. A. F. Stevencon, and W. P. Koella) have approached their awesome task with due perspective, perspective generated, to a large extent, by the "giant-step" recognition over the preceding decades of the importance of the "limbic system" and "reticular core" in the functioning of the nervous system as a whole. These reviews have managed, at least, to cover the conceptual span between this enlarged concept of brain-cord integration and the delicate and difficult studies which are emerging from the micro (micro-manipulation, electrode, pipette) world of single neuron function. They have done more. The authors, by defining trends, have attempted to preview the decades that will succeed their writing. These chapters thus forcefully lead the reader to wonder about the shape of future concepts.

The final chapter in this book (by P. MacLean) is a carefully didactic analysis of emotion and of the parts played by the hypothalamus, limbic system, and other phylogenetically original brain components in what is now called, vaguely enough, "affect." The book thus tries to span the conceptions of the hypothalamus (as a key component of the dominant system of the body) from its origin in primitive forms to its roles in determining the specific behavior patterns that distinguish human personalities. If it does not succeed in explaining these roles, it at least succeeds in stimulating thought about them.

The various subjects reviewed in this volume have, of course, for the most part been reviewed elsewhere, by the same and other authors, and more recently (the latest reference I noted was 1966, and several chapters referred to nothing after 1963). Thus, despite the inclusion of 115 pages of references, the book can serve as little more than an initial source for students attempting to review the literature up to the early 1960's. What the volume does offer, particularly in conjunction with the 1940 compendium on which it was modeled, is an overall picture of developments in this field during roughly a quarter of a century.

The editors deserve special credit for allowing the authors to present their

views with minimal restriction, so that not only the facts but the motivating philosophies of the authors are clearly discernible. Young investigators seeking to research the development of current concepts will find these chapters, and the book as a whole, invaluable. Older readers, whose familiarity with at least some of the subjects may go beyond what is written here about them, may gain new insights into a subject in which new insights are sorely needed.

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## Subcellular Systems

**Lysosomes in Biology and Pathology.** J. T. DINGLE and HONOR B. FELL, Eds. North-Holland, Amsterdam, and Interscience (Wiley), New York, 1969. Vol. 1, xxiv, 544 pp., illus., \$31; vol. 2, xxiv, 668 pp., illus., \$37. *Frontiers of Biology*, vols. 14A and 14B.

Since the early definition of the lysosome as a "new group of subcellular particles" by de Duve, the concept has undergone rapid evolution. Lysosomes and their enzymes have been recognized as belonging to a complex system which involves most, if not all, subcellular compartments. In the past decade, evidence of the participation of lysosomal enzymes in a broad range of cellular physiological processes and of their role in the pathology of the cell has accumulated at an impressive rate. Numerous review articles by de Duve and associates and other investigators have kept the scientific community amply informed of progress in the field. However, a comprehensive survey of the present knowledge of the subject has been needed. This book greatly contributes to the filling of the need.

The series of articles included in these two extensive volumes close the gap between the brilliant speculations on lysosomal properties begun as early as 1959 by de Duve and what is currently recognized as valuable and established information. This book also heralds the end of the oversimplified concept of lysosomes as "suicidal bags" or waste-disposal entities and characterizes them as a complex system of paramount importance in cellular physiology and pathology. Some of the biological processes in which a role for lysosomal enzymes had been tentatively postulated are now definitely docu-

mented in this book, which contains, for example, significant chapters on the participation of acid hydrolases in bone resorption, thyroid-hormone function, neuroendocrine secretion, physiological involution of temporarily hypertrophied structures, and the disposal of transient structures during metamorphosis or in tissue remodeling.

The numerous compounds that exert pharmacological control over lysosomal properties, and their mechanisms of action, receive comprehensive treatment in several chapters. Attention has also been directed to the possible involvement of lysosomes in plant and insect physiology, but the potentials of these systems have scarcely been investigated.

In the field of pathology, various articles in this book compile impressive evidence on the involvement of lysosomal hydrolases in defensive mechanisms against bacterial infection and in the pathogenesis of numerous storage diseases related to genetic alteration of lysosomal enzymes. Discussions of the possible role of these enzymes in viral infection, in the degradation of extracellular structures such as occurs in arthritis, in teratogenesis, and in muscular dystrophy certainly point to new approaches in understanding their underlying pathogenic mechanisms. The chapter on lysosomes and cancer, although highly speculative, undoubtedly represents a fresh approach toward understanding the process of carcinogenesis. This is particularly true of the section examining the possible role of lysosomal hydrolases in significant DNA alterations.

The chapter dealing with the participation of lysosomal enzymes in various types of immunological reactions points to the potentials of this line of research in the elucidation of some crucial aspects of the immune process.

The tantalizing question of whether the enhancement of lysosomal activities in the cell is a primary factor in cellular injury or simply reflects a secondary biochemical change related to tissue alteration is carefully analyzed, but remains unresolved and subject to future investigation. The deep concern with possible control mechanisms of lysosomal function in physiology and pathology clearly expressed by several contributors to this work may very well elucidate this important question in the near future.

The various chapters dealing extensively with methods for the investigation of lysosomes reveal the progress of the