thalamus. Moreover, the chapter is chronologically garbled and the account of the disentwinement of hypothalamic from pituitary functions is difficult to follow.

The chapter on hypothalamic anatomy by Lammers and Lohman is authoritative and sound as far as it goes, but it does not go far enough. Intrinsic connectivities (internuclear relations) of the hypothalamus are discussed in a most fragmentary manner and chemical neuroanatomy is left to be picked up, mainly in fragments, in some of the later endocrine chapters. Discussion of the monoaminergic pathways in the hypothalamus would have served as a basis for interpreting the chapters on aminergic systems in relation to feeding behavior and some of the endocrine chapters. Perhaps most important, the morphology chapter enumerates connections instead of elucidating principles of organization, such as the basic patterns of connectivity between the limbic system and the hypothalamus. The chapter by Pilgrim on the histochemical differentiation of the hypothalamus includes excellent sections on the hypothalamo-neurohypophysial and tubero-infundibular systems. It also includes brief notes on the ontogenesis of acetylcholinesterase in the ventromedial-arcuate area, but there is no discussion of the "cholinergic" circuits that pass through the lateral hypothalamic area and also provide potential "cholinergic" pathways to the endocrine nuclei of the hypothalamus.

In the physiology section, the chapters by Guillemin, Dyer, and Ariëns Kappers *et al.* deserve comment. Guillemin's covers the hypothalamic-pituitary axis thoroughly and in detail, and one comes away with a broad view of the nature of the hypothalamic-endocrine linkages, especially in regard to releasing and inhibitory factors. Dyer's chapter on electrophysiology of the hypothalamus and its endocrinological implications is excellent, but not for this particular book. Perhaps because of the paucity of data available, the chapter simply pinpoints some of the technical problems encountered in electrophysiological analysis of the hypothalamus at the single cell level, gives examples of what electrophysiology can contribute to the understanding of neuroendocrine mechanisms, and outlines some strategy for further experiments. The lengthy chapter by Ariëns Kappers *et al.* argues that pineal "hormones" activate hypothalamic magno- and parvocellular neurosecretory systems, thereby influencing endocrine activity. The conclusion that the pineal organ may be "a regulator of regulators and center for general homeostasis *probably* exerting its effects primarily on the hypothalamus" seems considerably ahead of the evidence at this time. However, this chapter constitutes about as thorough and up-to-date a discussion of pineal "hormones" as one can get.

The eight chapters dealing with growth and parturition and sexual mechanisms stay almost strictly at an endocrine level without any substantive discussion of brain-hormone interactions.

Some of the behavioral chapters do by far the best job of enlarging on the theme of the conference. Wayner's chapter on the hypothalamus and adjunctive behavior is one of them. The finding that the lateral hypothalamus is involved in the control of spinal reflex and motor activity is significant and has not heretofore been given much attention. Slangen's chapter on the role of hypothalamic noradrenergic neurons in regulation of food intake is a well-balanced review of an important topic of active research. Slangen also summarizes evidence relating damage of the nigrostriatal tract to the phenomena of adipsia and aphagia and makes a refined fractionation of the lateral hypothalamic area which indicates, as has other work in the past, that there is no single lateral hypothalamic "syndrome," but rather a gradient of effects growing more drastic as the lesion extends more laterally. Slangen observes that lateralmost hypothalamic lesions destroy part of a system that is located *only* in the far-lateral hypothalamic area. When only a part of this system is damaged some degree of functional "recovery" may take place. This chapter emphasizes the nigrostriatal system, and it should be pointed out that traveling in parallel with this system are strionigral pathways and that both of these bundles are destroyed by far-lateral hypothalamic lesions. Jürgen's chapter dealing with the hypothalamus and behavioral patterns is well organized and integrates well with chapters on hypothalamic physiology. Jürgen concludes that the hypothalamus serves to modulate stimulus-response relationships by changing the probability of occurrence of specific behavioral patterns, in other words by changing the "motivation." This conclusion is speculative and is not supported by direct evidence. Introducing the concept of motivation only befouls already muddy waters. The final chapter, by deRuiter *et al.*, is a heroic attempt to build an adequate physiological model of behavior with emphasis on the central neural feeding mechanisms. The ethology is tried and true, but the chapter becomes deeply mired in motivation theory as an explanation of mechanism. As deRuiter *et al.* finally admit, no general theory of the behavioral functions of the hypothalamus can yet be constructed. Overall, however, the chapter is thought-provoking even though it pushes neuronal modeling to its extreme limits and even beyond.

In short, despite the title of the volume neither the special properties of the hypothalamus nor its function as one of the most important *integrative* centers of the brain receives adequate coverage either in formal presentations or in the appended discussions. We still await a volume that provides an adequate synthesis of integrative hypothalamic activity.

PETER J. MORGANE
Worcester Foundation for Experimental Biology, Shrewsbury, Massachusetts

Molecular Genetics

Mechanisms of Genetic Recombination. V. V. KUSHEV. Translated from the Russian edition (Leningrad, 1971) by Basil Haigh. Consultants Bureau (Plenum), New York, 1974. xii, 254 pp., illus. $25. Studies in Soviet Science.

The knowledge that genic material is DNA almost everywhere provides the hope that the processes of recombination will be similar in all creatures. Certain features of recombination are so widespread that they can be labeled "fundamental." Crossing-over occurs when DNA duplexes are broken and rejoined. Rejoining involves formation of a "splice." When the two participating chromosomes differ in the region of the splice, a "heteroduplex" results. Heteroduplexes can also arise by the replacement of a single-strand stretch of polynucleotide on one chromosome by the homologous stretch donated by the other in a process which does not result in crossing-over. Enzymes sometimes recognize heteroduplex base mismatches and act upon them to restore proper Watson-Crick structure. This mismatch correction is a source of gene conversion. Chromosomes contain nucleotide sequences which promote the events leading to gene conversion (localized

violations of the rule of equality of allele recovery in meiotic tetrads) and crossing-over (the process of simultaneous production of complementary recombinant types for genetic markers located further apart than the length of the splices).

If these facts were all we had, a survey of the field would be easy to write; on the other hand, it wouldn't really be needed. The true state of things is that there is a vast body of information bearing on the "fundamental" processes described above which, in its details, varies from creature to creature, from locus to locus, from site to site within a gene, and from mutant to mutant at or near a given site. The outside observer can only throw up his hands and wait for the experts to proclaim a party line. But there aren't any experts. One student of recombination may know fungi (or at least one or two fungi, or at least one or two loci in one fungus) but will be at sea when it comes to T4 recombination. The lambda expert is likely to shun *Sordaria* literature (out of self-defense). The professional model builder often defends his model as if it were a deduction, forgetting that it is a guess the abundance of whose parameters (increased as need be) thwarts the very tests which might raise it to a higher level. Perhaps a lucid survey could be forthcoming from a highly intelligent being from outer space on the basis of a dispassionate and exhaustive reading of the pertinent literature. Or perhaps such an effort would be doomed to failure by the technical flaws and cryptic assumptions in the original literature itself.

Kushev has tried hard, and those planning a similar effort may profit from his attempt. Other readers will not. Kushev has understood a lot, but misunderstood too much. He has said many things well, but misstated too many others. He has touched on almost all the important observations, but his descriptions of many of them are so brief as to be unintelligible. He has been translated into light, pleasant English which (I suspect) has introduced occasional flaws in meaning. Kushev has capped his effort by presenting a comprehensive model ("directed correction") for recombination. His model, a variant of Holliday's (*Genet. Res.* **5**, 282 [1964]), adds a novel parameter with the assumption that mismatch correction operates by special rules on those heteroduplexes whose formation did not involve crossing-over of the flanking markers. This assumption derives from a presumption about the molecular basis for the difference in efficiency of transformation by different markers in *Pneumococcus*. I confess to being unable to judge whether the arguments offered in support of the theory of directed correction are compelling, and the theory may be valuable even if the germinal observations on *Pneumococcus* should prove to have a different explanation (see G. Tiraby and M. S. Fox, *Proc. Natl. Acad. Sci. U.S.A.* **70**, 3541 [1973]).

FRANKLIN W. STAHL
Institute of Molecular Biology, University of Oregon, Eugene

Radio Astronomy

Galactic and Extra-Galactic Radio Astronomy. GERRIT L. VERSCHUUR, KENNETH I. KELLERMAN, and VIRGINIA VAN BRUNT, Eds. Springer-Verlag, New York, 1974. xii, 402 pp., illus. $37.80.

Radio astronomers have lamented the lack of a comprehensive resume of the observational and interpretational products of radio astronomy. At last we have it, to the extent possible in such a fast-moving field. In this book the editors' goal was "to take over where most textbooks on radio astronomy leave off" and to provide "a discussion of what is actually known from the research done." The book is this and considerably more, in that a great deal of basic theory and even information on observational techniques is included because of the individual contributors' evident compulsion for completeness. I consider this to the good, since it allows the book to stand almost alone.

There are chapters by various contributors on all aspects of radio astronomy outside the solar system, from the now familiar supernova remnants, spiral structure derived from neutral hydrogen motions, and H II regions, to the more recently discovered pulsars, radio stars, and interstellar molecules. The inevitable variations in style and level of presentation occur as the script moves from one author to another, but all the chapters are good and some are outstanding. I particularly like the chapter on aperture synthesis, which is a particularly clear description of this key technique; the chapter on interstellar molecules, a subject on which some thorough discussion and an attempt to sort it all out have long been needed; and the beautiful chapter on cosmology, which casts this esoteric subject in a form that allows one to see the universe despite the trees.

More careful editing might have been in order: we find in at least two places almost identical reviews of the basics of synchrotron radiation, radiative transfer, and Faraday rotation, even with different notation. Yet the important phenomenon of synchrotron self-absorption is kept a dark secret until p. 342, and the important figure 13.10 described in the text surely isn't the printed figure 13.10, but maybe it is part of 13.11. All this does not hurt significantly; if we were to ask for any important change, it would be the addition of the beautiful results from the Westerbork instrument, results perhaps too recent to meet the publishing schedule.

This book is just what is needed as a textbook for graduate radio astronomy courses. It is a tragedy that the price is prohibitive for graduate students.

F. D. DRAKE
National Astronomy and Ionosphere Center, Cornell University, Ithaca, New York

Books Received

Advances in Microwaves. Vol. 8. Leo Young and H. Sobol, Eds. Academic Press, New York, 1974. xiv, 408 pp., illus. $35.

Bronchial Carcinoma. Thomas W. Shields with sections by Roy E. Ritts, Jr. Thomas, Springfield, Ill., 1974. xii, 182 pp., illus. $12.75. American Lecture Series, No. 942.

Cadmium in the Environment. Lars Friberg, Magnus Piscator, Gunnar F. Nordberg, and Tord Kjellström. CRC Press (Chemical Rubber Co.), Cleveland, ed. 2, 1974. xii, 248 pp., illus. $29.95.

Complex Stochastic Processes. An Introduction to Theory and Application. Kenneth S. Miller. Addison-Wesley, Reading, Mass., 1974. xiv, 238 pp. Cloth, $16.50; paper, $9.50.

Developmental Aspects of Carcinogenesis and Immunity. Proceedings of a symposium, Manhattan, Kans., June 1973. Thomas J. King, Ed. Academic Press, New York, 1974. xvi, 218 pp., illus. $8.95.

Electronic Circuits and Applications. Stephen D. Senturia and Bruce D. Wedlock. Wiley, New York, 1975. xii, 624 pp., illus. $16.95.

Electronic Measuring Instruments. Comparison Catalogue. Prepared by Erich Terner and Team. Služba Vyzkumu, Prague, Czechoslovakia, ed. 5, 1973. Variously paged, illus. $36.

Fourier Series. N. W. Gowar and J. E. Baker. Chatto and Windus, London, and Collins, Glasgow, 1974 (U.S. distributor, Crane, Russak, New York). x, 140 pp., illus. $31.50.

(Continued on page 480)