The authors intend their study to be a pictorial history of an idea—the localization of functions in the brain, detailed by the illustrations themselves. They contrast their approach with one in which pictures are merely used to clarify a written exposition. Their 158 illustrations, selected from a wide range of sources and thematically organized, are accompanied by brief commentaries and supplemented by a thorough bibliography. Although some of the drawings have been published previously, for the most part they have appeared in diverse periodicals and seldom with analyses in English.

The brain is a worthy subject for such a study. Along with the heart and the liver, it has been one of a trio of organs which have been central to medical theory since antiquity. From the time of Erasistratos to the present, it has retained (with some dissent) its dignified position as the seat of intelligence or of the soul. The changing ideas about the nature of mentality and its localization in the brain have left their traces in the drawings collected by Clarke and Dewhurst. The drawings show the ancient notion of soul as an ethereal substance contained within the ventricles and the rigid adherence to this notion in the "cell doctrine" of the Middle Ages. In the 17th and 18th centuries, attention began to shift gradually to the cortex. But only in the 19th century, partly through the influence of phrenology, were functions localized in the cerebral convolutions.

Glancing over the illustrations, especially the medieval drawings of cells or chambers in the brain, one cannot help asking what they were used for. Surely they were usually not portrayals of observed structures but conceptual representations of medical or philosophical ideas. Each of the cells, for example, was simply the place of a faculty of the soul, and the concept of cells had more to do with the division of mentality into units than it did with anatomy. Yet one need only read Vesalius's account of the ventricles to discover that naturalistic depiction of observed structure was a weapon in the overthrow of the cell doctrine in the Renaissance. Indeed, the relationship between the interest in structure and the interest in function is a continually emerging theme in this book. The accurate representation of a structure (with the consequent neglect of another) reflected sometimes the attention focused upon it by a theory of function, but sometimes the freedom to portray without preconceived notions. Medieval and early modern ideas discouraged interest in the convolutions, say the authors, but anatomists of the early 19th century, not "approaching function by way of morphology," concentrated upon the accurate representation of structure.

Once these issues have been raised, however, the authors give them scant attention. We do not learn how Galen could have forced the docile submission of medieval writers, or why anatomists began to examine the cortices in the 17th and 18th centuries, or how the anatomists of the early 19th century so easily escaped the oppression of functional theories. At one point, Gall's phrenology earns its place in history by focusing attention upon the convolutions through its doctrine of functional localization; at another, it secures itself by Gall's solid neuroanatomy in spite of flights into phrenological fantasy. However, structural and functional concern could not be separated in Gall, nor for that matter in Sir Charles Bell, the leading English anatomist of the early 19th century.

Part of the difficulty lies in pictorial history itself. As the authors concede with respect to modern ideas of localization, theoretical undertones are often beyond the reach of graphical portrayal. I think the problem goes deeper. The presumption that the theory underlying earlier drawings is simple and well understood, and that it is the detailed complexity of modern thought which eludes our graphical abilities, is misleading. It would be a mistake to equate the pictorial primitiveness of medieval illustrations with conceptual simplicity.

Pictures, like words, derive their complete meaning only from their use. They lend themselves to a variety of purposes and take on new significance in new contexts. A text written in pictures is commonly seen as a value-neutral exposition, assembled by the author yet standing independent and free of his bias. But the adaptability of illustrations can in fact obscure their proper interpretation and conceal an author's historiographical inclinations.

Clarke and Dewhurst have a definite historiographical commitment. From the frequency of expressions like "regression," "the next step," "inaccuracy," "crudity," and "advanced," it is clear that they view medical history as a progressive movement toward standards set in the present. In this case, the standard is a photographic portrayal of a living brain. But the drawings judged crude or transitional by the authors might be more profitably interpreted in terms of their intended use and contemporary technics. The sources for such an evaluation lie as much in the history of art and of culture as they do in the history of science and medicine. (One might begin with a look at the works of Herrlinger, E. H. Gombrich, and M. W. Evans.) It is unfortunate that the authors, in spite of their indebtedness to Herrlinger, fall back upon a more restricted view of the history of medicine.

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Antiviral Agents

Interferons and Interferon Inducers. N. B. FINTER, Ed. Second edition. North-Holland, Amsterdam, and Elsevier, New York, 1973. xx, 598 pp. $31. Frontiers of Biology, vol. 2.

This completely revised edition of the 1966 publication *Interferons* is an impressive compendium of information about the subject through 1971 (over 1500 references are included). Of particular use to researchers working directly with these antiviral substances, the volume also provides a valuable reference for researchers in related fields. The organization of the book is well thought out. The cross-indexing of subjects and authors is comprehensive, and the literature references are compiled in a single list.

Several recent developments are discussed in detail, and outdated concepts are revised. The point is well made that the term "species specificity" with regard to interferons is somewhat misleading and in need of qualification, since certain interferons have been found to be active in cells from heterologous species. It is suggested that this term be replaced by "characteristic species specificity," to indicate that most interferons do have specificities for the cells of particular animals and that when an interferon is active in cells of two different species it seldom has the same degree of activity in the two. Increased emphasis is also given in this book to the remarkable diversity of molecular size and electric charge among interferons, as a result of which progress in the study of their physicochemical nature will probably be slower

and more laborious than was thought originally. The chapters on the mechanism of formation and action of interferon likewise reflect the complexity of these processes.

The problems inherent in the assays used to measure interferon activity are discussed at length. An argument is made for calibrating laboratory reference interferons against national research standard interferons, so that potencies of all interferons from one animal species could be given in terms of a common "international unit" and results from different laboratories could be compared directly. This is undeniably the ideal goal. Unfortunately, the book does not deal with the question whether, with the current state of the art of interferon assays and without a rigorously defined reference unit, it might be better to report uncorrected titers with comparisons with national standards rather than merely corrected titers.

Considerable information is provided about interferon inducers, especially the nonviral inducers which have been receiving increased attention for potential clinical development. The synthetic polyribonucleotide inducers of antiviral resistance had not been discovered in 1966 when the previous edition was published; the antiviral, toxic, and other pharmacologic properties of this group of inducers are discussed extensively in the new one. The treatment of low-molecular-weight interferon inducers, such as tilorone, is also quite inclusive through the literature of 1971. The relationship of these nonviral inducers and interferon to growth of viruses and other agents (*Chlamydia*, Protozoa, *Rickettsia*, and bacteria) is covered in detail. Several contributors emphasize the pleiotropic effects of these nonviral inducers; the close relationship of inducers and interferon to the reticuloendothelial system and the immune system is noted. There is an excellent discussion of the relative advantages and disadvantages of the use of inducers and of exogenous interferon in treatment of viral diseases in humans.

Of particular value is the chapter on interferon, tumors, and tumor viruses. Here M. N. Oxman has attempted, with considerable success, to provide a critical review of available information concerning the interactions of interferons and inducers with tumor cells and with oncogenic viruses and the factors that must be considered in designing and evaluating experiments investigating these interactions. The general conclusion is that tumor viruses, like other viruses, vary in ability to induce interferon and in sensitivity to its action. The interferon system itself appears likely to be one of several host defenses that contribute to natural resistance to viral neoplasia, and interferon inducers or exogenous interferon preparations should be considered for controlled studies in selected cancer patients.

Research on interferon is still growing rapidly, and, as K. H. Fantes writes in one chapter, "new findings have often uncovered new difficulties instead of overcoming old ones." However, a volume of this nature provides the opportunity for reflecting on the overall progress that has been made over the last 16 years. The contributors have attempted, with varying degrees of success, to come to grips with the expanding and conflicting literature. At times the reader (particularly if he is not directly in the field) would benefit from greater attempts at clarification and evaluation of the available information. However, the volume is the most complete source available of general information about interferon. Finter and the other contributors can be assured that it will serve as a valuable reference.

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Parasites

The Coccidia. *Eimeria, Isospora, Toxoplasma,* and Related Genera. DATUS M. HAMMOND and PETER L. LONG, Eds. University Park Press, Baltimore, and Butterworths, London, 1973. x, 482 pp., illus. $24.50.

This book is concerned with members of the order Eucoccidiorida, which contains protozoan parasites of man and of domestic and wild animals and birds. From an economic standpoint this is an important group to the livestock industry, particularly cattle and poultry producers. Research in the past three years has confirmed the coccidian nature of the ubiquitous parasite *Toxoplasma gondii.* This parasite and *Isospora* species are pathogens of man.

The book contains 10 chapters, each by a well-known researcher who summarizes his own work and that of others in the field. The chapters cover history and taxonomy, host and site specificity, life cycles and development, ultrastructure, cytochemistry, and physiology and biochemistry of the Coccidia, as well as cultivation in avian embryos and cell cultures, pathology, pathogenicity, immunity, and techniques used for the study of Coccidia. One chapter deals with *Toxoplasma* and related organisms.

In the preface Datus Hammond states that the book is an attempt to provide an up-to-date coverage of the general aspects of the Coccidia and their relationships with their hosts. This objective has been well accomplished. Although most of the information has been published elsewhere, a comprehensive review of the biology of the Coccidia has not been attempted since 1934. To my knowledge this is the first time that a detailed history of the flux of the taxonomic status of the Coccidia has been written, and the chapter on techniques is also the first review of its subject. In the preface it is stated that no detailed consideration is given to chemotherapy because the subject could not be adequately covered in a single chapter. It is unfortunate that chemotherapy is not considered in an otherwise comprehensive review.

The book is well done in that errors or misstatements are rare. Figures are used throughout the book, and most of them are of high quality, especially the photomicrographs and electron micrographs. The book will prove useful not only to researchers dealing with Coccidia but to other biologists as well. I regret that such an excellent review of the literature on the Coccidia was not available when I began to work with this important group of parasites.

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Books Received

Abstract Algebra. A First Course. Larry Joel Goldstein. Prentice-Hall, Englewood Cliffs, N.J., 1973. xiv, 336 pp., illus. $11.95.

ACFAS. 41e Congrès. Résumés des Communications. Association Canadienne-Française pour l'Avancement des Sciences, Montreal, 1973. 160 pp., illus. Paper, C$1.50. Annales de l'ACFAS, vol. 40.

Acoustics. Historical and Philosophical Development. R. Bruce Lindsay, Ed. Dowden, Hutchinson and Ross, Stroudsburg, Pa., 1973. xiv, 466 pp., illus. $24. Benchmark Papers in Acoustics.

Advances in Heterocyclic Chemistry. Vol. 15. A. R. Katritzky and A. J. Boulton, Eds. Academic Press, New York, 1973. xxii, 350 pp., illus. $28.50.

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