inevitable subjectivity in selecting entries "of the first importance." The frequency of misspellings does not shore up one's confidence, either.

In spite of these reservations, however, I learned from the book and found upon working through it that the arrangement of material could be quite useful as an entrée to the British literature. I discovered a number of important references that were new to me. The author first presents a chronological list of 659 references on British geology dating from A.D. 1538 to 1969. Familiar ones are there, but at least a few significant items are not (Lord Kelvin's challenges to the Lyellian school, for example). A second section lists 86 "Major Themes" with a short discussion of the development of each and citations of appropriate references found in the first section. These summaries seem rather uneven, and many readers might question the particular list presented. Why not a theme on textbooks in sedimentology or in geophysics, for there are separate ones for textbooks in paleontology and in igneous petrology? But a more significant example of imbalance is provided by comparing a half-page theme on the genesis of sedimentary rocks containing no reference either to Hugh Miller's or to H. C. Sorby's writings (both men are cited elsewhere) with a theme labeled "The Malvern Hills." The latter is a one-and-one-half-page discourse on local details of the field relations of rocks and their interpretation over the years. About one-third of the themes are broadly topical ("Experimental geology," "The Ice Age," "Internal structures of rock-bodies: slaty cleavage," "Concealed geology," and so on). The other two-thirds are more geographic in nature ("The Lake District," "The geology of Scotland," and so on). Appendix A lists 79 secondary sources, each of which is identified conveniently with one or more of the Major Themes. Appendix B lists alphabetically all authors cited, with cross-referencing to the first section of the book. For many authors a sentence or two of biographical material is added, which will be helpful. Finally, appendix C contains an index of geographic, stratigraphic, and fossil names used in parts 1 and 2.

Challinor has digested an immense volume of literature into compact form that can be very useful for two groups of workers. First are those lacking any familiarity with the history of British geology; this includes many practicing geologists outside the United Kingdom. The second group of beneficiaries includes anyone seeking an introduction to the history of geologic studies of specific areas or rocks within Britain. Because much of the origin of modern geology is rooted in British rocks, this group is potentially quite large. The author has done the greatest service for this latter group.

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An Overview

Trends in General Systems Theory. GEORGE J. KLIR, Ed. Wiley-Interscience, New York, 1972. x, 462 pp., illus. $19.95.

The developing family of ideas and concepts which fall roughly under the rubric of systems theory amounts to a profound revolution in science—a revolution which will transform human thought as deeply as did the earlier ones of Galileo and Newton. The volume under review represents an attempt to provide an overview of these ideas, as they appear from present perspectives.

Unlike earlier scientific revolutions, the ideas of systems theory have not arisen within a single discipline. On the contrary, systems concepts have simultaneously arisen from a host of inter- and intradisciplinary specialties; from mathematics, computer sciences, control theory, biology, linguistics, and many of the human sciences. This diversity makes the subject multiply difficult; if the virtue of systems concepts is that they provide new and fruitful modes of unification binding together apparently unrelated sciences, the corresponding defect of that virtue is that the concepts must, at present, be extracted from a multiplicity of specialized literatures, each with its own jargon and emphasis. Moreover, it is in the nature of organized systems that they present themselves differently to different observers; the parable of the blind men and the elephant is really a parable about systems.

The volume under review seeks to circumvent these difficulties; its cumulative thrust is to exhibit what it is about systems and organizations that transcends the mass of specific structural details which inevitably accompanies any individual system, and which allows systems of utterly diverse structures to be studied in the same light. In a sense, the overall spirit and intentions are much like that of axiomatization in mathematics; once the group axioms, for example, are laid down, then immediately a host of specific mathematical structures, whatever the nature of their elements, can be seen as representations or realizations of a common abstract system. In this way, a theorem about abstract groups simultaneously reaches into all branches of mathematics and allows information from any one part of mathematics to be transferred into all the other parts. In the same way, the study of the essence of organization and control, which is the concern of systems theory, touches every branch of science and enables us to formulate laws and principles which illuminate many apparently unrelated fields.

At the present time, systems theory is in an exceedingly exciting, dynamical phase of growth. No book can hope fully to capture this dynamism; at best it can offer us a snapshot exhibiting how the field appears at a particular instant of time. Indeed, the volume under review offers us a series of such snapshots, each taken from a rather different angle. But just as with an ordinary photograph, each such snapshot inevitably involves distortions of perspective and leaves even very large and important structures hidden behind smaller but more proximate ones. The multiplicity of snapshots helps correct for such problems, but cannot in the present nature of things eliminate them. Thus anyone involved with systems will inevitably have some quarrels over choice and emphasis of materials. To specify a few of mine: (i) biology and linguistics, which have introduced a host of profound ideas into systems theory, are rather badly scouted; (ii) in several long discussions of systems analogies, the mechano-optical analogy of Hamilton (which until now is by far the most important) is not even mentioned; (iii) the final chapter, on extended topology, though most interesting in itself, is only minimally related to the main thrust of the book; (iv) problems of systems epistemology and alternate modes of system description are hardly touched on.

Nevertheless, there is much to praise in this book. The bibliographies alone are of enormous value in a subject as far flung as systems theory. The individual contributions are in the main well chosen, with many truly excellent expository discussions (particularly by Löfgren, Rapoport, Weinberg, and von

Bertalanffy) and provocative formulations of basic ideas and concepts. And even though, as indicated above, some very important ideas about systems may not be adequately discussed (and some unimportant ones overstressed), most of the main currents in system-theoretic thought are in fact represented.

In sum, I feel that this volume should be required reading for anyone interested in the natural and human sciences, in philosophy, or in human thought in general. It should be read by each individual through the eyes of his own discipline; the reader should examine each concept, seeking specific instances and examples within his field. He should then compare his own examples with those given in the book (which will generally involve other disciplines) to see how the general concepts provide a link which transcends disciplinary boundaries while simultaneously enriching all of them. It is to be hoped that many readers will be impelled to do more than this; that they will look further within their own specialties for new modes of thought, which will ultimately broaden their own insights, systems theory itself, and thus ultimately all of science.

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Hormonal Action

Steroid Protein Interactions. U. WESTPHAL. Springer-Verlag, New York, 1971. xiv, 568 pp., illus. $24.90.

This monograph describes the studies conducted on steroid-protein interaction by the author and his co-workers during two decades. The author does a creditable job of relating his studies to those of others. Blood components are given principal emphasis, tissue receptor proteins being covered by another volume in the series.

The concept of a dissociable protein-ligand complex is examined from the viewpoint that a substance must be in solution to exert an effect and that protein interaction is the connecting link to the site of action. Though basic concepts involved in the binding of ligands to proteins were elucidated with the use of dyes and drugs many years in advance of the identification of the first steroidal hormones, awareness of the relationship of protein binding to the biological action of the latter is a recent phenomenon. In fact, plasma steroids frequently are still determined without regard to whether they are free or bound.

A great strength of the volume lies in the fact that the author draws on his considerable experience to point out the many problems in technique which frequently are not dealt with in research reports—the importance of clean glassware, pure solvents, double-distilled deionized water, chelating agents, and an inert atmosphere and the potentially deleterious effects of excess light and elevated temperature. There is an excellent discussion of the pitfalls to be avoided in the use of radioisotopes for measuring steroid-protein interactions.

Discussions relating to experimental conditions and interpretation of data offer an explanation for the wide variations in the number of binding sites that have been reported for some proteins; the factors responsible for the variations include differences in the purity of the preparations, the presence of polymeric forms, and the influence of lipids and heavy metals.

The various methods used for studying steroid-protein interactions are discussed and evaluated. Gel equilibrium and equilibrium dialysis have, generally, found the most successful application; ultrafiltration is rapid, but its application can be limited owing to absorption by the membrane and the concentration of protein in the filtrans. The change in spectral characteristics of free and bound steroids has been developed into a useful tool in Westphal's laboratory. There is a valuable description and assessment of the procedures employed for the isolation and characterization of corticosteroid-binding globulin (CBG) from mammalian plasma.

The relationship between steroid structure and the extent of protein binding is examined in detail, as is competition of ligands for binding sites. The significance of these phenomena is discussed in relation to the effect of the binding of one steroid on the freeing of another for biological action.

It is of interest to note the endocrinological differences that exist among species. Thus, there is a high-affinity estradiol-binding protein in plasma of cow, frog, and fish but not of rat, rabbit, dog, and duck. Differences in CBG binding in rat, rabbit, guinea pig, and man are apparent. For example, the guinea pig has one protein for binding cortisol and another for binding progesterone, whereas in the rat the two steroids compete for the same protein. The CBG of rabbit plasma binds polar steroids more strongly than nonpolar ones; this is contrary to the polarity rule which obtains for the few other mammalian species investigated. Rabbit CBG is much more stable in the absence of corticosteroid than is human CBG. The ready polymerization of human CBG compared with rat CBG is also worthy of note.

Westphal examines the status of current knowledge to pinpoint problems that could profitably be investigated. We learn that consideration of protein-steroid interaction in relation to the thyroid-adrenal axis is highly desirable. Studies in the author's laboratory have contributed significantly to our knowledge of pituitary-adrenal-thyroid interrelationships as reflected by steroid-protein interactions. In this regard it is pointed out that androgens depress the plasma levels of thyroid-binding and corticosteroid-binding globulin; in view of the similarities in these proteins, it would be interesting to search for some kind of mechanism to explain the effect. Testosterone depresses the levels of CBG, but the mechanism is still to be elucidated. The effect of steroids on the production of CBG is well known, but though the thyroid has been implicated a direct action on the site of CBG production cannot be excluded; there is evidence implicating the liver, but further investigation is justified. Sialic acid in human CBG, testosterone-binding β-globulin, and α_1-acid glycoprotein can be removed without adverse effect on activity. This raises the question of whether this moiety has another role to play, possibly one involving the receptor in the target cells.

What's in a name? Just as the use of trivial names for poorly characterized or impure sterols hampered progress, the author suggests that the naming of the α-globulin as "corticosteroid-binding globulin" and "transcortin" may have had the effect of blinding investigators to the implications of Daughaday's early report that progesterone was strongly bound to the protein.

The small quantities of steroid-binding proteins in plasma have hampered investigations. Greater specificity in isolation procedures, such as that achieved by affinity chromatography, offers hope to the author that this limitation can be overcome.

For related subjects beyond the scope of the book (such as tissue-protein interactions), the reader is given adequate references to appropriate sources of information.