inductive, deductive or whatever is much more complex even than philosophers of science generally allow" (p. 343).

In effect, theirs is an argument for a return to fundamentals. If archeology is to be scientific, the archeologist must first be able to describe accurately and classify objectively the material remains that are his or her primary data (p. 5). The need for accurate description justifies the emphasis on quantification and the need for objective classification the use of mathematical techniques.

The themes of description and classification provide the framework for Doran and Hodson's discussion of data analysis techniques. They cover a series of univariate and multivariate procedures that have been tried on archeological data, ranging from the traditional scattergram plots and histograms to numerical taxonomy in the form of *k*-means cluster analysis, principal component analysis, discriminant analysis, and a relatively new technique, constellation analysis. The presentation is at a general level, emphasizing the goals and assumptions of the various procedures. Doran and Hodson also provide examples of application of the several techniques to the same data sets to give the reader a sense of the kind of results that can be expected. The amount of technical detail, though insufficient for a manual of procedures, is appropriate for giving the statistically naive reader a sense of the utility and limitations of the procedures. Examples from the literature are also given illustrating the misuse of statistical techniques.

Unfortunately, in their exuberance to show the inappropriateness of much of the statistical work in archeology, Doran and Hodson sometimes end up guilty of the same oversimplification for which they chide their colleagues. For example, they properly argue against first converting metric variables to nominal ones and then proceeding to search for types at the level of nominal variables with chi-square tests of significance. But the fact that the chi-square test was introduced to determine the existence of types in data as defined by the nonrandom association of nominal variables (strictly speaking) is lost, and the authors' alternative procedure for discovering types, the *k*-means clustering algorithm, does not address that issue.

And chide their colleagues they do: For example, they refer to Sackett's "misguided results" (p. 171); express "doubts about [Hill's] understanding of exactly what a significance test is" (p. 341); state that Binford's "method intended to simplify data has resulted in greater and unnecessary complication" (p. 205) and that it is "unfortunate that Spaulding's formulation [of a type] has had such an influence in New World Archaeology" (p. 168); and write, with reference to Clarke, "Alas, it is so much easier to make theoretical play with exciting, if imprecise, general concepts than to get down to actual mathematics or to solid and detailed practical application!" (p. 339). While such comments may be ego-bruising, they are primarily arguments "for archaeological procedures and reasoning to be made more systematic, more exhaustive and more objective" (p. 346), certainly one of the avowed goals of the new archeology.

Mathematical techniques are seen by Doran and Hodson not as a solution to all of the methodological and interpretative problems of the archeologists but as adding "new diversity and colour to what is already one of the most varied, attractive and significant areas of human investigation" (p. 347).

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Photoreactions

Concepts of Inorganic Photochemistry. ARTHUR W. ADAMSON and PAUL D. FLEISCHAUER, Eds. Wiley-Interscience, New York, 1975. xvi, 440 pp., illus. $22.50.

Although the photosensitivity of transition metal coordination compounds has been known for over a hundred years, systematic investigation of the photoreactions did not begin until the 1950's. The investigations can be conveniently differentiated into two types: synthetic and mechanistic. The synthetic studies, devoted to producing new compounds, have been dominated by work on metal carbonyl and organometallic compounds. The high photosensitivity and the diversity of the photoproducts of these compounds have combined to make synthetic photochemistry an extremely active field. The growth of mechanistic studies, on the other hand, paralleled the advances in characterization of excited states, particularly by ligand field theory and molecular orbital theory. Mechanistic studies are generally concerned with the primary photochemical step, the photophysical processes competing with the photochemical change, and the relationships between molecular excited states and photoreactivity. To facilitate such studies, the inorganic systems generally chosen are thermally stable transition metal complexes with classical ligands for which detailed spectroscopic analyses can be made.

Concepts of Inorganic Photochemistry is primarily concerned with the mechanistic aspects of transition metal photochemistry. The feature that distinguishes this book from the continually appearing review articles and the existing monograph on the subject (Balzani and Carassiti, *Photochemistry of Coordination Compounds*) is the intention, stated in the preface, of critically organizing "the idea as well as the data content" of the field. In keeping with this goal, the first two chapters provide a pedagogically useful survey of the important photophysical and spectroscopic background of inorganic systems. The background helps to unify the book and in addition clearly reveals the differences and similarities between inorganic and organic systems. The remaining chapters cover solution photochemistry of metals classified according to the type of metal (first-row transition metals, heavy metals), the type of ligand (carbonyl, diketonate), and a type of excited state (charge transfer), and in addition treat aspects of solid state photochemistry and solution photochemistry of nonmetallic inorganic ions. Topics omitted from the book include the photographic process, photoelectric and photogalvanic effects, and experimental technique. Omission of the last is consistent with the level of the book. Knowledge of the fundamentals of photochemistry and of specific techniques such as flash photolysis is assumed.

The primary theme running through the majority of the chapters is that interaction of metal coordination compounds with light causes replacement of coordinated ligands by molecules in the surrounding medium. The chapter on first-row transition elements summarizes the ligand photosubstitution arising from internal *d-d* transitions in cobalt (III) and chromium (III) complexes. The mechanistic aspects of charge-transfer excited state chemistry are less well studied and understood. A thermodynamic model is discussed that, although it is nonstandard and still untested, may provide focus to future studies. The spectroscopy of the heavy metals and the carbonyl complexes is currently being extensively investigated. The chapter on the former is primarily a summary of data collected up to 1974, while that on the latter is an evaluation of the knowledge gained from the numerous synthetic and the few mechanistic studies. The details of the behavior in solution of photogenerated nonmetallic fragments are summarized in a chapter that deserves the attention of everyone studying solution photochemistry. The final half of the last chapter (entitled "Photochromism and chemiluminescence") discusses the intriguing speculation that a molecule in an excited state may be regarded as an "unstable isomer" of the ground state.

Use of this book as a textbook or a

starting point for research in inorganic photochemistry would require supplemental reading on experimental technique and elementary photochemical principles. Because of the extensive literature coverage, it provides a useful source for locating such material. Each chapter is self-contained. Overall, the book provides perspective on current experimental and theoretical activity, identifies areas in which further work is required, and suggests constructive solutions to existing problems.

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Characterization of Catalysts

Structure of Metallic Catalysts. J. R. ANDERSON. Academic Press, New York, 1975. x, 470 pp., illus. $33.75.

This book deals with the structure, particularly the surface structure, of catalysts in which a metallic component is a separate phase and with the chemistry of the preparation of such materials. Chemisorption and catalysis enter only as they relate to structure. As the author says, "This is not a book on catalytic reaction chemistry."

The great majority of metallic catalysts consist of tiny particles of metal (usually 10 to 100 angstroms in diameter) dispersed upon the surface of a porous, high-area support such as silica gel or alumina. Work on single crystallographic surfaces of single crystals is beginning to provide data and ideas that help to illuminate the nature of supported catalysts despite problems of discrepancy of scale and despite the fact that the surface areas of such single crystals are much too small to permit practical use. This book covers these materials as well as supported catalysts and metallic powders with and without textural promoters to reduce sintering, although most of it inevitably concerns supported catalysts.

The book appears at an opportune time because it is closely related to several subjects of major current interest. Even a single crystallographic surface may exhibit more than one type of catalytic site, and conventional catalysts will expose more than one type of crystallographic surface. In addition, the crystallites of supported catalysts may involve particles of different sizes that exhibit different types and concentrations of defects, and the catalysts may be influenced by the supports. The effect upon catalytic properties of all of these matters comes under the heading of structure sensitivity. This subject leads immediately into a second subject of current interest, the characterization of the size distribution, the morphology, and the nature of the defects in the set of tiny crystallites of metal in a supported catalyst. There is also considerable current interest in multimetallic or "alloy" catalysts, a subject well surveyed in this book.

The book contains chapters on support materials, massive metal catalysts, dispersed metal catalysts, and the structure and properties of small particles of metal, including their interaction with supports and their sintering. It also contains two chapters on methods of characterizing the physical nature of metallic catalysts. The first and longer describes the application of physisorption, chemisorption, transmission electron microscopy, and x-ray and magnetic methods to characterization of the texture, that is, determination of surface area, particle size and shape, and pore structure. The other chapter treats the characterization of surface composition and structure, primarily by the methods of surface chemical physics.

The book covers a coherent and important subject thoroughly and critically. I believe it will be frequently used and referred to.

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Hormonal Effects

Biochemical Actions of Hormones. Vol. 3. GERALD LITWACK, Ed. Academic Press, New York, 1975. xvi, 416 pp., illus. $36.

Four of the 11 papers in this volume provide views of the current status of our understanding of the mechanism by which steroid hormones produce their effects. Three concern applications of the techniques of genetics and cell culture to the study of hormone action. Other papers review recent developments in our understanding of the hormonal receptors in plasma membranes, the mechanism of action of thyroid hormones, and the structure of hypothalamic hormones and their function in regulating the pituitary. The final essay reviews the effects of the hormones that regulate the synthesis of specific proteins in the isolated perfused liver.

An excellent chapter by Hollenberg and Cuatrecasas reviews the many investigations of membrane-localized hormone receptors carried out in their laboratories. The recent advances resulting in the identification and purification of these receptors are summarized, the principles of ligand-membrane interactions are described, and some of the pitfalls of such studies are presented. The chapter deals primarily with the authors' studies of the receptors for insulin and glucagon, but touches on the binding of catecholamines. The review of the hypothalamic-hypophysiotropic hormones by Boss, Vale, and Grant provides an excellent and balanced survey of the contributions of the key laboratories working in this fascinating and fast-growing field. The unanswered question of how these peptides influence the secretion rate of particular pituitary hormones is presented in an interesting fashion. The contributions to endocrinology of the techniques of cell hybridization and studies of the genetic control of differentiated functions, especially the genetic control of hormonal induction, are reviewed in a thoughtful and stimulating chapter by Croce and Litwack. The review by Armelin of the present status of mammalian cell cultures in the study of hormonal and other mechanisms regulating growth emphasizes again that hormones are key extracellular regulators for cell proliferation and growth.

It is convenient to have in one place presentations of the approaches of three different groups investigating the mechanisms by which estrogens control the synthesis of macromolecules in their target cells. Parallel and complementary investigations of the effects of estrogens in the chick oviduct have been carried out in Shimke's laboratory at Stanford and in O'Malley's laboratory at Baylor, and their experiments and conclusions are summarized here. The discovery some years ago that under certain hormonal conditions the chick oviduct to a large extent synthesizes a single protein, ovalbumin, has provided a model system that has greatly facilitated the study of the mechanism of action of the hormone in this target tissue, permitting the isolation and identification of the messenger RNA for ovalbumin. Comparable studies in the rat uterus, which are more difficult because no single protein is produced in large amounts in response to the hormone, are reported by Katzenellenbogen and Gorski. The fourth chapter devoted to steroids, a review of the glucocorticoid receptor by Cake and Litwack, provides an overview of steroid receptors in general and discusses the tissue distribution and developmental changes in the glucocorticoid receptor in certain tissues. This chapter contains a valuable discussion of the techniques for identifying and quantifying steroid receptors.

All the subjects discussed in this book have been reviewed elsewhere by the same authors or by others. Furthermore, most chapters focus primarily on studies car-