reappear throughout these presentations. One is the importance of good descriptive methods. This was emphasized by L. J. Savage and W. J. Dixon, among others. A second is the importance of communication (including teaching) to the statistical profession. The preface is a good essay on the communications theme as it emerged at the symposium. One noteworthy remark on the subject (made by Tukey: "I think the term 'service course' is a term native to mathematicians, and I think in view of the earlier discussions at the session, maybe statisticians might stop using it, slowly. Are we interested in getting the world to think at least a little like a statistician some of the time? I think we are. And if so, then doing this ought to be one of our main businesses, not just a 'service course.'" A third theme was the relation between computing and statistics; included were questions of university organization, the impact of computing on the development of new theory—and on old theory (for example, some theory has become obsolete because there is no longer a need to design experiments amenable to simple computations)—and of course data analysis.

The latter half of the book contains seven technical papers. In the first five of these the authors appeal to theory (often developed largely by themselves) which appears in other publications, and the papers included in the volume are essentially expository accounts of the methods, showing data and their analysis. The papers are interesting, well presented, and accessible to the nonspecialist statistician. Discussants' contributions are varied and worthwhile, presenting both theoretical and practical points, as the composition of the conference justified. Often questions that have occurred to the reader are aired by them. Moreover, the discussion is lifelike; I could practically hear the tone of voice of some of the discussants personally known to me.

The sixth paper, "Measurement in the social sciences" by G. A. Barnard, is interesting indeed. Barnard proposes that where a social science problem can be represented by some complex mathematical entity such as a diagram or a matrix, the statistician should not rush to reduce it to one or a few numerical indices. The complex mathematical entity has an important descriptive, conceptual role of its own. He gives interpretations of likelihood functions, and shows how from a single graph of the scoring functions of two samples light can be thrown on what are conventionally regarded as problems of testing, estimation, and combining of samples. He argues persuasively that where there is no theoretical basis for preferring some one particular scale of measurement, that fact should not cause the statistician to turn immediately to nonparametric methods. Barnard proposes, rather, than transformations of the data and linear methods applied to them will frequently lead to deeper insights.

The conference brought together a varied and high-powered group of participants whose symposium has resulted in an interesting—and varied—book.

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Uses of Spectrometers

Mass Spectrometry in Science and Technology. F. A. WHITE. Wiley, New York, 1968. xvi + 352 pp., illus. $14.95.

The stated objective of this book, which is intended for nonspecialists and for students with interdisciplinary interests, is "to make a serious appraisal of the mass spectrometer's present and potential relevance to a large number of professional fields." The author succeeds well. Interesting applications of mass spectrometry to chemistry, physics, nuclear geology and cosmology, the space sciences, materials science, biology and medicine, and ecology and environmental science are described and possible extensions or new studies are suggested.

In the first third of the book, in which the principles and some of the instrumentation of mass spectrometry are briefly presented, the reader is introduced to the bases for the physical or analytical applications of the mass spectrometer that are detailed in the remainder. The exposition of the instruments is for the most part succinct. No mention is made of the monopole instrument, but the author's cascade analyzer and the ion-beam microprobe are included, as are most other important or commercially available instruments. The very beautiful applications of the Syrotron instrument to the study of ion-molecule reactions should have been given at least brief mention.

A few distracting errors are noted; these occur largely in the early chapters. For example, on page 7 $y/z^2 \propto m/e$ and not the inverse; and at least 11 instances of the incorrect use of "specie" in place of "species" were detected. Only a few typographic errors are to be found; the statement that U^{234} and $_6K^{39}$ have the same charge-to-mass ratios (p. 312) is probably the most serious.

The omission of reference to the important work of Biemann, McLafferty, and others in the determination of amino acid sequences of peptides (p. 329) is regrettable. This book is a source of much information, but the subject index is too brief.

Although some repetition of principles occurs as the various applications are presented, the most insistent is the advocacy of stable-isotope dilution. Eight substantial reasons for using stable isotopes rather than radioisotopes, particularly in the life sciences, are enumerated in chapter 14 (of course, limitations are imposed by the naturally monoisotopic elements Be, F, Na, Al, P, I, and so on), and a final invitation to consider the exploitation of stable-isotope labeling with associated mass spectrometric analysis is made in the closing paragraphs of the book.

The author draws heavily upon his own contributions to illustrate the wide variety of applications he discusses. Particularly timely and cogent is his appeal that mass spectrometrists give more consideration to ecological studies.

Strong and fascinating arguments for isotope coding of materials are presented. The approach is not unreasonable and may well be economically feasible now or very soon. It is suggested that industry may wish to lead the way and initiate promptly a careful examination of the implementation of this important suggestion.

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Sun, Planets, and Comets

Mysteries of the Solar System. R. A. LYTTLETON. Clarendon (Oxford University Press), New York, 1968. x + 261 pp., illus. $7.

Seven essays, expanded from a series of lectures given at Brandeis University in 1965, cover topics studied by the author during 30 years at Cambridge University and several astronomical centers in the United States, including the Jet Propulsion Laboratory. The informal style makes easy reading of Lyttleton's mathematical studies of the

origin of the solar system, the interiors of the earth and other planets, the nature of comets, and the tektites (a queer type of meteorite).

A quantity of observational data are presented in tabular form and interpreted in terms of various theories of origin. Lyttleton states the case well for his theory whereby the sun collected material for comets and planets by gravitational accretion as it moved through clouds of interstellar dust. Each of the essays is a coherent summary of data and ideas bearing on one unsolved problem—a "case-history" illustration of the scientific method.

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Interesting Molecule

Treatise on Collagen. Vol. 1, Chemistry of Collagen. G. N. RAMACHANDRAN, Ed. (xiv + 556 pp., illus. $22.50). Vols. 2 and 3, Biology of Collagen, Parts A and B. BERNARD S. GOULD, Ed. (vol. 2, xviii + 434 pp., illus. $17.50; vol. 3, xvi + 488 pp., illus. $18.50). Academic Press, New York, 1967–68.

In this *Treatise on Collagen* the editors have put together a comprehensive summary of the chemistry, structure, synthesis, metabolism, and biology of collagen. The chemistry is covered in one volume edited by Ramachandran, and the less readily delimited field of the biology of collagen is covered in the two volumes edited by Gould. The volumes are well produced and not unduly ponderous, and the electron micrographs are satisfactorily reproduced. The contributors to the treatise have done significant work in the field, and the result is an up-to-date review of most of the research (but not clinical) topics directly pertinent to collagen. As a compilation of results, references, and opinions, the treatise should be indispensable to any collagen worker and a most valuable source for students.

The adequacy of a treatise intended to be comprehensive must be measured by the scope of the review articles and the criticism their authors bring to bear on the findings in the literature. Ramachandran and Gould's selection of authors can hardly be criticized. The lengths of the chapters differ considerably; O'Dell covers the "Immunology of collagen and related materials" adequately in 10 pages; Glimcher and Krane describe the "Organization and structure of bone, and the mechanism of calcification" in 170 pages, a length that could well have justified a separate publication. Some of the authors betray a distressingly parochial view of the literature, and among these some recite their work and opinions in ways that are already familiar to workers in the field. The combination of such articles can confuse the student, but the intrusion of personal prejudice is probably inevitable when the authors are outstanding and opinionated workers in the field, and the value of the compilation of data this treatise contains outweighs this criticism.

It is to be regretted that the editors did not take a firmer hand to eliminate the considerable overlap in discussion in many of the articles, particularly those on the chemistry of collagen, and also that they did not do more to encourage a uniformity of vocabulary. The cost of books is too high to permit the repeated description of the triple-helix structure of collagen, and Ramachandran himself is culpable in that he includes in his chapter "Structure of collagen on the molecular level" previews of much of the later contents of that same volume. With regard to nomenclature, in three succeeding chapters the macromolecules from which collagen fibrils are built are referred to as "tropocollagen" by Alan Hodge, "soluble collagen" by Karl Piez, and "collagen molecules" by Peter von Hippel. Although there are arguments for and against each of these terms, the editors could have done service to the collagen field and avoided confusing newcomers to it had they insisted upon a common usage.

It is difficult to delimit the studies pertinent to the "biology of collagen," but it is to be regretted that a chapter on osteolathyrism was not included. Much of the present outstanding work on inter- and intramolecular cross-linking derives from studies on lathyritic animals, and the subject has progressed so rapidly that a revision of the chapter written by Tanzer in 1965 for the *International Review of Connective Tissue Research* would have been valuable.

The vigor of the present research on collagen is apparent from the fact that more than half the references cited in many chapters have been published since 1960, and the breadth of the studies described in this treatise belies Jim Watson's premature dismissal of collagen as an "uninteresting molecule." It is clear from these studies that collagen is a representative of long-lived biological macromolecules that in the extracellular milieu are extensively modified and manipulated by homeostatic mechanisms, the investigation of which has only just begun.

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Books Received

Alvan Clark and Sons. Artists in Optics. Deborah Jean Warner. Smithsonian Institution Press, Washington, D.C., 1968 (available from the Superintendent of Documents, Washington, D.C.). vi + 122 pp., illus. $1.75. U.S. National Museum Bulletin 274.

Animal Mechanics. R. McNeill Alexander. University of Washington Press, Seattle, 1969. xiv + 348 pp., illus. $9.50. Biology Series.

Annual Review of Entomology. Vol. 14. Ray F. Smith and Thomas E. Miller, Eds. Annual Reviews, Palo Alto, Calif., 1969. x + 480 pp., illus. $8.50.

Approaches to a Philosophical Biology. Marjorie Grene. Basic Books, New York, 1969. x + 302 pp. $6.95.

Aspects of Form. A Symposium on Form in Nature and Art. Lancelot Law Whyte, Ed. Elsevier, New York, 1968. xxii + 254 pp. illus. $8.50. Reprint, with a new preface, of the 1951 edition.

Atherosclerosis: Recent Advances. A conference, New York, 1966. Henry Haimovici, Ed. New York Academy of Sciences, New York, 1968. Illus. Paper, $16.50. *Annals of the New York Academy of Sciences*, vol. 149, article 2, pp. 585–1068.

Bioelectronics. A Study in Cellular Regulations, Defense, and Cancer. Albert Szent-Györgyi. Academic Press, New York, 1968. x + 90 pp., illus. $4.95.

The Biological Basis of Medicine. E. Edward Bittar and Neville Bittar, Eds. Academic Press, New York, 1968. Vol. 1, xvi + 590 pp., illus., $19.50; vol. 2, xvi + 578 pp., illus., $21.

The Biology of Euglena. Dennis E. Buetow, Ed. Vol. 1, General Biology and Ultrastructure. Academic Press, New York, 1968. xii + 364 pp., illus. $19.

Bird Song. Acoustics and Physiology. Crawford H. Greenewalt. Smithsonian Institution Press, Washington, D.C., 1968 (distributor, Random House, New York). viii + 196 pp., illus. $12.50.

Calculations of Analytical Chemistry. Leicester F. Hamilton, Stephen G. Simpson, and David W. Ellis. McGraw-Hill, New York, ed. 7, 1969. xiv + 514 pp., illus. $8.50.

Catalytic Conversion of Hydrocarbons. J. E. Germain. Academic Press, New York, 1969. xii + 324 pp., illus. $12.

(*Continued on page 218*)