ous disciplines involved in the exploitation of such new tools as artificial satellites for geodesy.

The book is not a textbook, with respect to either the theoretical or the engineering aspects of satellite tracking. However, the articles will serve as an excellent status report for knowledgeable readers in the various fields. Those who can follow both the highly theoretical contributions that cover gravitational mechanics and the articles on complex measuring and data evaluation systems will be rewarded with a knowledge of a factual cross section of the status of satellite geodesy at the time of the symposium.

Part 1 deals with the dynamics of satellite motion, and it concentrates on unusual cases, such as resonance, giving evidence that the basic problems associated with the mechanics of gravitational motion are largely solved.

Part 2 deals with satellite tracking and is concerned almost exclusively with the photogrammetric techniques of interpolating satellite imagery into the star background. The described techniques either result from astronomical observational methods or are applications of measuring techniques developed for the precision tracking of missiles and rockets.

Among the several aspects of the data evaluation problem discussed in part 3 are the basic problems of terrestrial and celestial reference frames, the accuracy of star catalogs, and the precise measurement of time. It is evident from the contents that, in the general area of error propagation, there remain quite a few problems which must be solved before valid geodetic information can be obtained.

The contents of part 4, on geometric methods, anticipate the interest in a geometric solution to the problem of a geodetic world-wide reference system, which, in the meantime, has attracted much attention. Part 5 is devoted to numerical results. Parts 6 and 7 deal with some tangential topics and comparisons between satellite geodesy and other (classical) methods. Geophysical implications are mentioned. Part 8 is a summary and a review of the main papers and topics of discussion.

That the financial assistance of UNESCO made the publication of this timely and interesting symposium possible should not go unmentioned.

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Geological Sciences Today

The Earth Sciences: Problems and Progress in Current Research. Thomas W. Donnelly, Ed. Published for William Marsh Rice University by University of Chicago Press, Chicago, Ill., 1963. viii + 195 pp. Illus. $6.

This handsome, well-printed book consists of six papers, first presented (in November 1962) at a symposium entitled "Frontiers of Geology" as part of the semicentennial celebrations of Rice University. It follows a pattern now common in offering essays on a wide variety of topics, and one wonders what the hard-pressed geologist who even rips his journals apart to eliminate unwanted material will do with the current spate of heterogeneous books. No doubt some of this material will also appear in journals, but the problem of keeping up with work first published in books of this character is becoming acute. Diversity is, of course, a striking feature of the present state of the geological sciences, and the difficulty of fitting together the six papers in this book merely exemplifies the obstacles in the way of a future synthesis. To comment intelligently and critically on each of the papers would require a most unusual breadth of competence, to which I lay no claim.

The first paper (38 pages), "Variation of density in the Earth and the melting curve in the mantle," is by Sydney P. Clark, Jr. This chapter summarizes the older work on density distributions and adds some new computations intended to establish limits of variation consistent with present knowledge. The new data obtainable from satellite orbits, high-pressure mineralogy, shock-wave equations of state, velocity measurements, and other sources are discussed and used to establish the broad chemical outlines of the constitution of the earth. Melting curves are of importance as setting upper limits for the temperatures of the mantle, and lower limits for the temperature of the liquid core. The uncertainties of these estimates are brought out, and the chapter concludes with a list of important unanswered questions. Like the other papers in this volume, the chapter includes a valuable bibliography of recent work.

The paper (18 pages) by John A. O'Keefe, "Two avenues from astronomy to geology," discusses the recent advances in knowledge of the earth's external gravitational field obtained from the perturbations of orbits of artificial satellites and the problem of the origin of tektites. Harmonics of the external potential up to the ninth degree have been evaluated, and although the uncertainties of some of these are still relatively large, it is now clear that the earth's figure departs from one of fluid equilibrium; even the second degree harmonic, usually described in terms of the "flattening," is appreciably different from the value that it would have for a fluid Earth of the same mass, moment of inertia, and angular velocity. O'Keefe discusses the bearing of these results on the theory of mantle convection. On his other theme, O'Keefe traces tektites to the moon, and then, because "Every attempt to find a decisive chemical or nuclear difference between tektites and terrestrial rocks has failed," suggests a return with variations to the Darwinian hypothesis of the separation of the moon from a primitive Earth-Moon system.

W. S. Fyfe contributes a chapter (24 pages) entitled "Experiment and the crust of the Earth: Problems and approaches." Fyfe points out the slowness with which classical thermodynamics and electrochemistry have made their way into the geological sciences; even today, much that is "new" in petrology and geochemistry had its origins nearly a century ago. Some of the newer geochemical fields are reviewed—the use of the electron microprobe, the study of phase transitions, solid and aqueous solutions, and reaction rates. A more profound study of physics and chemistry by the future students of geology is recommended.

The next paper (22 pages) is "Fundamental problems in dynamic structural geology" by Fred A. Donath. Much of this is devoted to experimental work on rock deformation, especially to the factors of anisotropy and ductility and to methods of judging the local deformations in the field from distorted pebbles or fossils. The difficulties and ambiguities of model studies are emphasized.

S. S. Wilks contributes a 32-page paper, "Statistical inference in geology." For a statistician "who knows virtually no geology," Wilks has nevertheless acquainted himself with much of the recent statistical work of a geological flavor. Statistical procedures have long flourished in many branches of geophysics, Jeffreys in particular having made judicious use of, and many original

contributions to, the theory of adjustment of observations and of statistical inference, and it might have been well to take a quick look at this substantially developed field. Most of Wilks' discussion deals with the problems of precision, sampling, randomization, and the analysis of variance, as applied to chemical analysis or size distributions.

The longest chapter (58 pages), "Biologic problems relating to the composition and diagenesis of sediments," is by Heinz A. Lowenstam. The emphasis is on the chemical and mineralogical composition of marine organisms, as originally deposited and as transformed by later reactions. A large amount of information is presented, clearly of great importance for the history of the oceans and for the interpretation of the sedimentary record. It appears, however, that the large amount of work so far accomplished has chiefly served to unsettle the views of the past, without as yet leading to a satisfactory new synthesis.

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Methods and Techniques

Treatise on Analytical Chemistry. I. M. Kolthoff and Philip J. Elving, Eds. pt. 1, *Theory and Practice*: vol. 4, sect. D-1, *Magnetic Field Methods of Analysis*; sect. D-2, *Electrical Methods of Analysis.* Charles N. Reilley and others. Interscience (Wiley), New York, 1963. xxvi + 955 pp. Illus. $25.

Modern analytical chemistry is a field in the process of rapid development and expansion. To answer the needs of organic chemists, biochemists, biologists, and others who must apply analytical techniques and keep informed of developments in this field, several series—including one devoted to organic analysis, one on physical methods of analysis, and two treatises on analytical chemistry—are being published, and a very extensive handbook on analytical methods has just appeared. The aim of the treatise that includes the volume under review is "to present a concise, critical, comprehensive and systematic, but not exhaustive, treatment" of analytical chemistry. Few editors would embark on such an undertaking, and only those with the qualifications of Kolthoff and Elving, and their assistants, could be so successful.

This volume is the fourth of part 1, which deals with the theoretical principles and techniques of various analytical methods (part 2, an element-by-element survey of analytical methods, is being published simultaneously). In volume 4 (of part 1) magnetic field methods, including magnetic susceptibility measurements, magnetic resonance methods, mass spectrometry, and ion-scattering methods, are discussed in the first third of the book, and a review of electrical methods of analysis, including potentiometry, polarography, voltammetry, chronopotentiometry, coulometric methods, conductometry, and oscillometry, occupies the remainder. The chapters are uniformly good, and all of the authors are acknowledged authorities in their respective fields. Each chapter presents a clear description of the method under consideration, starting with elementary principles and leading up to the current status of the technique; complete references to the literature are given for those seeking more details. The content of every chapter is excellent, but a few deserve special mention. The two introductory chapters on electrochemical methods, by Reilley and Murray, who also served as editorial assistants for this volume, provide an excellent overall survey, classification, and correlation of these techniques. The chapters by Adams (on voltammetry at electrodes with fixed surfaces) and Shain (on stripping analysis) contain much material not previously reviewed. The lack of any extensive discussion of alternating current and square wave polarography, cyclic voltammetry, rotating disk electrodes, and adsorption and double layer effects in electrode reactions was my only disappointment with the editorial content of this volume, and this may be only a reflection of the time lag between submission of the individual chapters and eventual publication.

A few editorial policies deserve comment. If this volume had been divided into two separate ones, the part on electrical methods would have made an excellent textbook for a course in modern electroanalytical chemistry. But it is hard to ask a student to pay $25 for the present volume and then inform him that somewhat more than one-third of the text will not be used in the course. I still prefer to have the references placed at the bottom of the page, within the text, rather than at the end of the chapter. It is frustrating, especially when reading review chapters such as these, to hunt continually for references at the end of the chapter to determine whether (21) represents a new article or just a well-known monograph. The index, something lacking in previous volumes in this series, is especially welcome. All in all, while there has not been a deficiency of good books about these methods, this volume, as part of a treatise, does represent a good introduction to this portion of modern analytical chemistry.

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Techniques and Applications

Thin-Layer Chromatography. James M. Bobbitt. Chapman and Hall, London; Reinhold, New York, 1963. xii + 208 pp. Illus. $8.50.

Thin-Layer Chromatography. Kurt Randerath. Translated by D. D. Libman. Verlag Chemie, Weinheim, Germany; Academic Press, New York, 1963. xiv + 250 pp. Illus. $8.

Both of these books emphasize the practical aspects of thin-layer chromatography, and to that extent they cover largely the same material. Thus, in each case, absorbants, layer preparation, sample application, development, and visualization are discussed. In addition, quantitative and preparative thin-layer chromatography are considered. In both books such general descriptions of techniques are followed by more or less detailed treatments of specific applications.

The appearance of such similar books at almost the same time invites comparison. Bobbitt, in general, employs an informal, almost conversational style. Randerath, on the other hand, makes use of a more conventional textbook style. The two books are actually very similar with respect to general arrangement and subject matter. Randerath employs running references at the bottom of each page,