The contribution by Howell Williams, "Geological observations on the ancient human footprints near Managua, Nicaragua," differs from the other papers in that it is a critical and definitive review of all the evidence to date bearing on the fascinating but complicated problem of deciding when the footprints were made. After the footprints came to the attention of the scientific world in the latter part of the 19th century, a controversy raged, with many taking the side of the archeologist Flint, who claimed that they "were at least 50,000 years old, and might be 200,000." After the present painstaking study of the geology of the region, and after taking into account such evidence from fossil remains and human artifacts as has been adduced, Williams is forced to the conclusion that the footprints are not less than 2000 and probably not more than 5000 years old.

REGINA FLANNERY HERZFELD
Department of Anthropology,
Catholic University of America

Theory of Functions of a Complex Variable. vol. I. C. Carathéodory. Trans. by F. Steinhardt. Chelsea Publ., New York, 1954. xii + 301 pp. Illus. $4.95.

The past few years have witnessed a good deal of activity in the translation of mathematical books and monographs into English. The list of outstanding books in the theory of functions of a complex variable available in English has been increased this last year by the monograph of Saks and Zygmund and now by the first volume of the *Theory of Functions,* by Carathéodory. It was with considerable excitement that the news of the original appearance of Carathéodory's *Funktionentheorie* was greeted by the mathematical public in 1950. The theory of analytic functions had been an ever-recurring theme in the research of Carathéodory. His contributions were many and significant. His monographs that had appeared hitherto (*Real Variable Theory, Calculus of Variations, Conformal Mapping*) were all of striking originality. The *Funktionentheorie,* from the time of its appearance, has had a warm reception, and its importance certainly justifies the pride that Carathéodory himself felt in his accomplishment.

The translation of this work by F. Steinhardt now renders it available to a large scientific public. In its present form it should be useful as a textbook in a course in the theory of functions of a complex variable and as a reference work in a scientific library. The first volume is elementary in scope and, of course, looks forward to the more sophisticated second volume.

The author has frankly omitted certain topics in the interest of not expanding the textbook unduly. From one point of view, the most serious omission is a systematic account of the theory of analytic continuation (however, the monodromy theorem is treated). Although the lacuna can be made up by reference to the masterful account of Saks and Zygmund, it would have been of great interest to see a treatment of this theme by Carathéodory. On the other hand, the treatment of the geometry of circles (unlike that of most books on the theory of functions of a complex variable) is extremely extensive. The justification for this elaborate treatment lies both in its pedagogic utility as an introduction to the theory of functions of a complex variable and in its value as an instrument of investigation. Other special features worthy of note are the systematic use of spherical distance (Ostrowski), the theory of normal families, and the early introduction of the Poisson integral.

An idea of the scope of the book may be had from the following summary of its contents.

> Part one: "Complex numbers from the algebraic point of view"; "Geometry of complex numbers"; "Euclidean, spherical, and non-Euclidean geometry." Part two: "Convergent sequences of numbers and continuous complex functions"; "Curves and regions"; "Contour integration." Part three: "Foundations of the theory"; "The maximum-modulus principle"; "The Poisson integral and harmonic functions"; "Meromorphic functions." Part four: "Continuous convergence"; "Normal families of meromorphic functions"; "Power series"; "Partial fraction decomposition and the calculus of residues." Part five: "The exponential and trigonometric functions"; "The logarithm and the general power function"; "The Bernoulli numbers and the gamma function."

MAURICE HEINS
Department of Mathematics, Brown University

Wave Motion and Vibration Theory. Proc. of Symposia in Applied Mathematics of the American Mathematical Society, vol. V. Albert E. Heins, Ed. McGraw-Hill, New York–London, 1954. v + 169 pp. Illus. $7.

This book contains a collection of 15 addresses on wave motion and vibration theory delivered at the fifth symposium on Applied Mathematics of the American Mathematical Society, held at Carnegie Institute of Technology, 16–17 June 1952. It reports the mathematical methods and the latest advances in many diverse fields of wave motion and vibration theory. These 15 papers can be grouped into approximately four broad categories:

Stability of fluid motions. C. C. Lin, "Hydrodynamic stability." A critical discussion of the linearized theory of stability of laminar parallel or nearly parallel flow is given. Many controversial points on this linearized theory are clarified. S. Chandrasekhar, "Examples of the instability of fluid motion in the presence of a magnetic field." The difference of effects of magnetic field on the thermal instability of a horizontal layer heated below and the rotational instability of viscous flow between rotating cylinders is discussed. Without magnetic fields, these two problems of instability are quite similar.

Hydrodynamic waves. P. R. Garabedian, "On free-surface flows." Researches on axially symmetric cavitational flow are reviewed. W. Bleakney, "Review of significant observations on the Mach reflection of shock waves." N. W. McLachlan, "On a nonlinear differential equation in hydraulics." The nonlinear differential equation that oc-

curs in connection with a hydroelectric power system is studied by the method of slowly varying amplitude and phase.

Diffraction and scattering problems. H. Levine, "Acoustic radiation pressure on a circular disk." W. Magnus, "Infinite matrices associated with a diffraction problem" (abstract only). A. E. Heins and H. Feshbach, "On the coupling of two half-planes." The authors are concerned with the effect of a plane wave incident upon two infinite half-planes of different acoustical materials joined along a straight line. G. F. Carrier and W. H. Munk, "On the diffusion of tides into permeable rock." The problem of water-level fluctuations in the irrigation wells is formulated mathematically by assuming the observed groundwater fluctuations to represent a diffusive transmission of the tidal disturbances through the porous volcanic structure. J. J. Stoker, "Some remarks on radiation conditions." The difficulty on the uniqueness of steady-state solution in unbounded domains may be avoided by formulating the problem as an appropriate initial value problem and then finding the solution of the steady state by limiting process in allowing time to tend to infinity. E. W. Montroll and J. M. Greenberg, "On the theory of scattering of plane waves by soft obstacles." An obstacle is considered to be soft if the wavelength of the wave inside the scatter does not differ much from that of the incident wave in the absence of the scatterer. Progress on this problem is reported.

Vibration theory. E. H. Lee, "Wave propagation in helical compression springs." A. Weinstein, "On the wave equation and the equation of Euler-Poisson." A general discussion of results on a class of hyperbolic partial differential equations which includes the classical wave equation as a special case is given. S. Lefschetz, "On the Lienard differential equation." R. J. Duffin and A. Schild, "The effect of small constraints on natural vibrations."

S. I. PAI

Institute for Fluid Dynamics and Applied Mathematics,
University of Maryland

Fatigue of Metals. ed. 3 of *La Fatigue des Metaux.* R. Cazaud. Trans. by A. J. Fenner. Philosophical Library, New York, 1953. 334 pp. Illus. + plates. $12.50.

This book is essentially an English translation of the author's 1948 edition of *La Fatigue des Metaux.* It discusses the characteristics of fatigue failures, theories of the mechanisms of fatigue in metals, fatigue testing machines, influence of various factors such as size, speed of test, overstress, understress, residual stress, notches, sharp shoulders, surface conditions, and corrosion. It includes a chapter on fatigue strength of structural joints and another on improving the fatigue strength of machine components.

The description of fatigue-testing machines is predominantly concerned with European practice, as would be expected. The few references to American testing machines are not representative of recent practice and do not reflect the fine work done in this field. The discussions of the effects of various factors are an interesting review and should serve as a valuable summary for engineers in general. The chapters on fatigue strength of structural joints and on improvement of fatigue strength of machine components should be of great value to designers in pointing up the practical application of the accumulated knowledge of fatigue of metals.

The book is well written and authoritative. However, it is not as modern as the date of publication (1953) would indicate. Practically all the data discussed were developed prior to 1948. Nevertheless, it is a valuable book for the practicing engineer to have on his bookshelf, for it will serve well as a ready reference on the subject.

R. R. MOORE

Drexel Hill, Pennsylvania

Statistical Analysis in Chemistry and the Chemical Industry. Carl A. Bennett and Norman L. Franklin. Wiley, New York; Chapman & Hall, London, 1954. xvi + 724 pp. Illus. $8.

Owing to the rapidly accelerating interest that has developed since 1947 in the use of modern statistical methods in the field of chemistry, the Committee on Applied Mathematical Statistics of the National Research Council and the Mathematics Branch of the Office of Naval Research have sponsored the preparation of this comprehensive book on applied mathematical statistics, with illustrative material from chemistry and the chemical industry. The authors were carefully chosen; one is a mathematical statistician with experience in chemistry, and the other is a chemist with knowledge of mathematical statistics. The sponsors and authors had the advice and cooperation of a host of statisticians and chemists of outstanding professional ability.

This remarkable planning and fine cooperation have resulted in a work of broad scope, as is indicated by its 11 chapter headings: "Introduction," "Descriptive statistics," "Probability and samples," "Mathematical machinery," "Statistical inference," "Relationship between variables," "Analysis of variance," "Design of experiments," "Analysis of counted data," "Control charts," and "Some tests of randomness."

The mathematics used is not beyond the ability of an engineering or chemistry graduate, thus placing the level between that of the standard textbooks of mathematical statistics and that of books dealing mainly with applications of statistical methods. The more theoretical topics are relegated to appendixes at the ends of several chapters. Many statistical techniques are presented and abundantly illustrated with appropriate examples from chemistry. Numerous tables make possible the numerical calculations involved in application of these techniques. However, there are no unsolved examples on which the student can test his knowledge.

Statistical Analysis can be studied with profit by physical scientists and engineers with some knowledge of statistics and by students of mathematical statistics interested in applications. However, it is doubtful whether the on-the-job chemist without formal