new junior-level course for students in the humanities and social sciences, I shall want to explore some of this territory. I think that I might be able to use some of these interviews as assigned readings prior to some discussions. But the interviews are generally too brief for any topic to have been explored much beyond its barest introduction, and far too often a potentially interesting line is abandoned too rapidly (for example, Salam, on the problem of basic science in a developing country).

For those who have followed the concurrence of science and public policy for some years and have some awareness of trends in research, this book will make occasional light reading, but I am afraid that for nonscientists much might be incomprehensible, not least because of the jargon and brevity of the editorial notes.

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The reviewer, who teaches at Washington University, has been active for several years in presenting scientific information to a wide audience through the St. Louis Committee for Nuclear Information.

Applied math reference

DISTRIBUTIONS AND THE BOUNDARY VALUES OF ANALYTIC FUNCTIONS. By E. J. Beltrami, M. R. Wohlers. 116 pp. Academic Press, New York, 1967. $6.50

by Garrison Sposito

This interesting little book describes the way in which analytic functions of a single variable whose boundary values are distributions, rather than square-integrable functions, may be dealt with rigorously. In particular, the class of functions analytic in a half plane and of polynomial growth at infinity are discussed at length and are shown to possess a relation with their boundary values comparable to that known for functions of the Hardy-Lebesgue class. The subject is relevant to physics because the so-called "vacuum expectation" values arising in the theory of quantized fields are distributional boundary values of analytic functions of polynominal growth at infinity.

The book is divided into three chapters, two of which are introductory. The first is a summary of the relevant parts of the theory of distributions. (As the discussion is somewhat abbreviated, the serious reader, unless he is an expert, should have at hand a good text on functional analysis.) Careful attention is paid here to the extension of the Fourier transform to tempered distributions. The second chapter discusses the Laplace transform in the same sense and offers the important distributional analog of the Paley-Wiener theorem. The last chapter is based largely upon the authors' research and deals with the generalization of the Cauchy integral to include the representation of analytic functions having distributional boundary values. Such work has great practical significance in that it would evidently widen the class of functions that can be considered in the solutions of the Dirichlet and modified Hilbert problems. (The latter, of course, includes the Wiener-Hopf technique.) At the end of the book are two short appendices on the representation of positive-real matrices and the extension of the results of the third chapter to functions of several variables.

Distributions and the Boundary Values of Analytic Functions can be recommended as a useful addition to the libraries of the interested applied mathematician and the quantum-field theorist, especially if the memorable little tome by Streater and Wightman is already upon the shelf.

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The reviewer, an assistant professor of physics at Sonoma State College, Rohnert Park, California, is interested in quantum statistical mechanics and mathematical physics.

Modern numerical techniques

REVIEW OF MATHEMATICAL METHODS FOR DIGITAL COMPUTERS, Vol. 2. A. Ralston, H. S. Wilf, eds. 287 pp. Wiley, New York, 1967. $11.95

by George H. Weiss

If one wants to learn the elements of numerical analysis, this volume is not a suitable introduction. However, if one wants a summary of selected modern numerical techniques together with a flow-chart and in some cases, a FORTRAN program, this volume together with the first of this series will fit the bill in admirable fashion. Some of the topics taken up are the solution of ill-conditioned linear equations, numerical single and multiple quadrature, spline functions, the solution of polynominal and transcendental equations, random-number generators and rational Chebyshev approximation. Although this is not for the general reader, it is a must for those in computer installations.

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Warmly recommended thermometry

THE MEASUREMENT OF TEMPERATURE. By J. A. Hall. 96 pp. Barnes & Noble, New York, 1966. Paper $3.75

by Martin E. Straumanis

The author states in the "Preface" that this book has been written to replace two books, published in 1953 by the Institute of Physics Monographs for Students entitled *Fundamentals of Thermometry* and *Practical Thermometry* because they were out of print and in many respects, out-of-date. The present book of the well known author contains, of course, the matter of the earlier volumes in a considerably revised form and new developments in the field of temperature measurement.

The book starts with the temperature scales (absolute and thermodynamic), with the discussion concerning the absolute zero point (-273.15 ± 0.01°C) and with the International Practical Scale of Temperature. Thereby the distinction between reproducibility (precision) and accuracy of the measurements is emphasized. For instance, although the melting point of gold can be reproduced with a resistance thermometer within ± 0.01 °C, the accuracy of this point, comparing the results of various investigators, is only ± 0.5 °C, because of systematic errors.

The next chapters deal with the

electrical resistance thermometry, thermocouples, optical and radiation pyrometry, and expansion thermometers. In each of these chapters the respective measuring instruments are described in sufficient detail, the measuring procedures are given (including the basic equations) and the possible errors as well as the reduction of errors are discussed.

Then comes the chapter on calibration of the instruments, where the triple point of water, the ice point, the boiling point of water and sulphur, the boiling point of oxygen, the freezing points of metals and the standard devices necessary for calibration are reviewed.

The last chapter deals with temperature measurement in practice and gives much useful advice, for instance that the temperature of the sensing element of a thermometer should be brought to the same temperature as that of the item of which the temperature is required, which is very often not at all easy. Also, that it is absurd to speak of measuring or controlling the temperature of a room, for instance to 0.2 °C. This is frequently disregarded, and not only by students. Finally, measurement of surface temperature and the thermometric lag are discussed.

At the end of each chapter there are references for further study and exercises in some chapters. The book concludes with an author and subject index. The small book is warmly recommended to all who are interested in temperature measurement.

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Not for pedestrians

LIE GROUPS FOR PHYSICISTS. By Robert Hermann. 193 pp. Benjamin, New York, 1966. $12.50

by Lawrence C. Biedenharn

The "mathematization" of theoretical physics—as for example in axiomatic field theory—is an inevitable (though not unanimously welcomed!) development; in elementary-particle physics the application of group-theoretic techniques follows this trend, and many texts, at various levels, have appeared on this theme in the past few years. The book by Robert Hermann, a mathematical physicist at Stanford, is rather different than this genre despite its title. For it assumes the reader to be already familiar with Lie groups, and aims instead at introducing to physicists the powerful, relatively recent, geometric techniques used by mathematicians in the theory of symmetric spaces.

The theory of symmetric spaces, as is true of most topics in Lie-group theory, was begun by Elie Cartan. The basic ideas, very briefly put, are these: the Lie algebra **G** belonging to a semisimple Lie group G can always be split by a *Cartan decomposition* into the subsets: $\mathbf{G} = \mathbf{K} + \mathbf{P}$, where $[\mathbf{K}, \mathbf{K}] \subset \mathbf{K}$; $[\mathbf{K}, \mathbf{P}] \subset \mathbf{P}$; $[\mathbf{P}, \mathbf{P}] \subset \mathbf{K}$. In addition, there always exists an automorphism s for which $s(\mathbf{K}) = \mathbf{K}$, $s(\mathbf{P}) \equiv -\mathbf{P}$.

Consider now the (finite) elements of G obtained from **P** by exponentiation; that is, $P = \exp \mathbf{P}$; this set of elements plays an additional role as a carrier space, called a *symmetric* space. For if $p \in P$ one has for *every* $g \in G$ an associated transformation in the space P: $p \rightarrow p' \equiv gps(g^{-1})$. This exhibits the Lie group G as a *transformation group* on the symmetric space P; one can show: (1) that P is a *homogenous* space (given p_1 and p_2, then there is a g such that $p_1 = gp_2$), (2) that the isotropy group at $g = e$ (the elements of G which leave e fixed) is $K = \exp \mathbf{K}$, and (3) that the elements $g \in P$ induce *transvections* (symmetries of the space P). Lie-group theory is in this way united with geometry.

The theory of homogeneous spaces is very natural to physics; for example, the Poincaré group has for its homogeneous space Minkowski space (identified here as the space of cosets of the Lorentz group).

The plan of Hermann's book may be sketched as follows: the first eight chapters treat standard Lie-group theory from Hermann's special point of view. Among the topics treated are: compact and noncompact Lie algebras, the Cartan decomposition, conjugacy of Cartan subalgebras, dual symmetric spaces, and the Iwasawa decomposition. The ideas and concepts treated here are very important—though even familiar results appear a bit forbidding in the "language" Hermann employs.

The next two chapters present the most important, and basically new, geometrical ideas with which Hermann is concerned: the concept of *vector bundles over homogeneous spaces.* This is the key point of the book and it is best to let Hermann speak here: ". . . many of the complications one finds in the physics literature, due, for example, to spin, are clarified in a vector-bundle context, and the theory can be strongly recommended to physicists as an appropriate mathematical language with which to understand the true nature of the relation between symmetries and fields. Certainly it can be quite dogmatically asserted that the machinery is absolutely necessary to organize the existing results on infinite-dimensional representations of noncompact groups in a semicoherent framework. (Unfortunately, even many mathematicians who work on this subject have only realized this in the last few years.)"

These concepts are applied in the final eight chapters, which alternate between mathematics (group-theoretic version of the Fourier transform, compactification of homogeneous spaces, representations of noncompact groups) and physics (contractions of Lie groups, groups in quantum mechanics and particle physics).

The task of making available to theoretical physicists the many fundamental and powerful ideas being developed by mathematicians is an essential and continuing one, and Hermann has much to offer. How well does he succeed in his task? Unfortunately not very well. He has set himself a large task, and covered much ground; of necessity many discussions are so condensed as to be indigestible—but this is only to be expected. Throughout, though, there are many valuable insights, clearly presented, as well as indications of currently unsolved problems.

The chief failure could, however,