choosing between one of two admissible hypotheses, and is essential to an adequate background of the subject. In addition, the reader is occasionally left without further guidance; thus, on page 15 it is stated that the measure of skewness a_3 "can be zero without the distribution's being symmetrical," and a similar caution is given in connection with a_4 as a measure of peakedness. However, the reader is given no hints on the nature of these exceptions, to enable him to judge whether they are "pathological" or not, nor is he told where such exceptions are discussed in the literature. Explicit citation in the text of especially pertinent references given at the end of the chapter would be very helpful in numerous instances, as would also the referencing of such material in the index under author and subject.

This reviewer obtained the impression, as he read along, that he was being "talked down to." Instead of a feeling of being guided through new vistas by an enthusiastic statistician engaged in a bit of proselyting, or the feeling of being "shown the way" to a new "religion" by a penetrating thinker with wide experience, he felt that the narrator was condescending to tell him a few of the things regarded as commonplace by those "in the know."

As a textbook for a first course in mathematical statistics, its mathematical level is likely to render it unsatisfying to students of mathematics, and its atmosphere of noncontact with practical applications may limit its effectiveness among practical workers who seek on-the-job guidance. There is, however, at present no other book of comparable size that provides such a broad introduction to statistical inference.

CHURCHILL EISENHART

National Bureau of Standards

Theory of servomechanisms. Hubert M. James, Nathaniel B. Nichols, and Ralph S. Phillips. (Eds.) (Massachusetts Institute of Technology Radiation Laboratory Series.) New York-Toronto-London: McGraw-Hill, 1947. Pp. xiv + 375. (Illustrated.) $5.00.

In the first four chapters of this volume one finds a short history of servo design technique, some performance specifications, and a brief introduction to the mathematics used in the analysis of servo systems. The servo is likened to a linear filter and is characterized by either of the following: (a) its weighting function, (b) its frequency response, (c) its transfer function. Servo elements and networks are described, and Nyquist Criterion of stability is introduced. The fifth chapter deals with filters subjected to pulsed data, their transfer functions, and their stability. Pulsed servos and their characteristics are discussed in this chapter.

The last three chapters are concerned with the mathematics of statistics and statistical methods applied to control. A new design technique based on the minimum root mean square error in the presence of extraneous noises and inputs is described and applied.

There is correlation between the various chapters, and the sequence of topics discussed is well chosen. Illustrative examples and diagrams are presented throughout.

The 8 chapters of this book, written by 10 members of the Radiation Laboratory, constitute a valuable contribution to the science of servomechanisms.

E. M. SABBAGH

Purdue University

Methods of algebraic geometry. (Vol. I.) W. V. D. Hodge and D. Pedoe. Cambridge, Engl.: at the Univ. Press; New York: Macmillan, 1947. Pp. viii + 440. $6.50.

The volume before us, which, it is announced, will be followed shortly by a second volume devoted to the theory of algebraic varieties and to the study of certain loci which arise in many geometric problems, is divided into two books. Book I is devoted to Algebraic Preliminaries, and Book II, to Projective Space. As the title implies, no attempt has been made to build up a body of geometric theorems. Though the projective group is necessarily fundamental, no discussion of its invariants is given except as these may appear incidentally in reductions to canonical forms. The polar operator is mentioned, but its invariance is not stressed. Yet the necessarily restricted choice of material is excellent, and the volume is a very welcome addition to the literature in this field.

In Book I the four chapters deal, respectively, with integral domains, rings, fields, and factorization; with linear algebra, matrices, and determinants; with algebraic dependence, field extensions, and their effect on factorization; and with algebraic equations, including Hilbert's "basis" and "zero" theorems and the theory of resultants. In the second half of this book, from the point at which determinants are introduced, the basic field is assumed to be commutative. Fields with characteristic are considered only incidentally, and algebraically closed fields are employed only as circumstances demand.

In Book II, Chapters V and VI, respectively, give an algebraic and a synthetic definition of a "projective space." In these two chapters a noncommutative field is basic and commutativity is shown to be a consequence of the validity of the Pappus theorem. Essentially, the objective here is to show that the projective spaces obtained by either approach are identical. The remaining three chapters, based entirely on commutative fields, deal with Grassmann coordinates, with collineations, and with correlations including polarities and null systems. The customary reduction of pencils of such forms to canonical forms is exhaustively treated.

Much of the presentation is preliminary to Chapter VI, in which the projective space is obtained axiomatically. This particular chapter, almost one-fifth of the entire volume, seems somewhat foreign to the general purpose. Even the authors appear to share this feeling to some extent, for, in a footnote to the chapter heading, we read that "this chapter is almost completely independent of the rest of the book, and may be omitted at a first reading." Much greater unity might have been attained by omitting this chapter and using only commutative ground fields. Noncommutativity might well have been restricted to operations, such as permutations and matrix multipli-

cation, which implicitly involve it. Yet this is a matter of taste, and doubtless many readers will welcome the comparative approach.

The exposition is explicit and precise throughout. The results are obtained with a minimum of effort in notations, which in general are as convenient as the context permits. The very complete discussion of Grassmann coordinates in Chapter VII is a novel and welcome feature. The chapter on resultants and allied theorems is very effectively done, and the final chapter on correlations is unusually complete. Needless to say, the appearance of the second volume will be awaited with great interest.

ARTHUR B. COBLE

Haverford College

Integration in finite terms: Liouville's theory of elementary methods. Joseph Fels Ritt. New York: Columbia Univ. Press, 1948. Pp. vii + 100. $2.75.

Two general types of problems are discussed in this monograph, both of them closely related by the methods used: (1) When is the integral of an elementary function itself an elementary function? Here, a function is called elementary if it is constructed with a finite number of operations involving algebraic functions, exponentials, logarithms, trigonometric and inverse trigonometric functions. Of course, by Euler's relations, the trigonometric and inverse trigonometric functions can immediately be deleted from this list of basic expressions. (2) When can certain ordinary differential equations be solved by quadratures? That is, integration is now also considered an admissible elementary operation.

The study of these two types of problems was inaugurated by the great French mathematician, Joseph Liouville, who discussed such questions in 7 fundamental papers during the years 1833–41, developing quite new methods for this purpose. Only a few mathematicians continued Liouville's work; these include Chebyshev, Koenigsberger, Mordukhai-Boltovskoi, the author of this monograph, and, quite recently, Ostrowski.

In the present monograph the fascinating work of Liouville and his successors has been presented in a unified, rigorous and readable manner. The essential ideas have been stressed, and auxiliary information on analysis and algebra has been supplemented.

With regard to the first type of problems mentioned above, for example, the nonelementary character of Legendre's elliptic integrals of the first and second kinds, of the probability integral, of $\int \frac{e^x}{x}\,dx$, and of the (nonconstant) elliptic functions is proved. Among the second type of questions, Riccati and Bessel differential equations, algebraic differential equations of first order, and linear differential equations of second order are discussed. For instance, Bessel's differential equation cannot be solved by quadratures, except for special values of the parameter.

Mathematicians should certainly be indebted to the author for this very valuable monograph on such a beautiful part of analysis which, although often quoted, has been known so far only to a few specialists.

ARTHUR ROSENTHAL

Purdue University

Paramagnetic relaxation. C. J. Gorter. New York-London-Amsterdam-Brussels: Elsevier, 1947. Pp. vii + 127. (Illustrated.) $2.25.

This monograph is concerned with the frequency dependence of the magnetic susceptibility of paramagnetic salts. Prof. Gorter, now director of the Kamerlingh Onnes Laboratory at Leiden, was the first to explore this field and remains its leading experimental investigator. Most physicists and chemists are familiar with dielectric dispersion and absorption in polar substances. The magnetic analogue of this phenomenon, which we meet here, presents a much more complicated picture. The variables at the disposal of the experimenter are the temperature, the frequency of the oscillating magnetic field, and the intensity of a constant magnetic field applied to the specimen. (The important role of the last parameter has no analogue in dielectric relaxation.) The reader new to the field may find the wealth of experimental data assembled in Chapter III a bit bewildering, even after the succinct and illuminating review of static paramagnetism and the thermodynamics of a paramagnetic system contained in the first two chapters. The theoretical discussion of the phenomena observed is reserved for Chapter IV. On all but pedagogical grounds, the author's emphasis on the experimental results is certainly justified. Indeed, theory has by no means caught up to experiment in this field, despite the notable contributions of Van Vleck, in this country, and Casimir, Kronig, Broer, and others in Holland. The subject is very much alive, and Prof. Gorter's authoritative book, written during the dark days of the German occupation, represents a consolidation of ground gained in preparation for fresh assaults.

E. M. PURCELL

Harvard University

New developments in ferromagnetic materials, with introductory chapters on the statics and the dynamics of ferromagnetism. J. L. Snoek. New York-Amsterdam: Elsevier, 1947. Pp. viii + 136. $2.50.

This small book is intended to summarize the research on ferromagnetic materials carried out by Snoek and his co-workers during the war at the Phillips Laboratory in the Netherlands. This group was able to continue under the hazards and inconveniences that accompanied the German occupation and added a very interesting chapter to the subject of ferromagnetism.

Snoek has divided the monograph into three parts: I, Statics of Ferromagnetism; II, Dynamics of Ferromagnetism; III, Development of Ferromagnetic Materials. The first of these parts deals with new discoveries and new viewpoints concerning the properties of ferromagnetic materials under conditions in which