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

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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

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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