Explorationist's Guide

Electrical Methods in Geophysical Prospecting. GEORGE V. KELLER and FRANK C. FRISCHKNECHT. Pergamon, New York, 1966. 527 pp., illus. $18.50.

This book contains a great deal of useful information for the explorationist, and in today's market it represents good value indeed. It commences with a review of our present knowledge concerning the transmission of electricity through earth materials, and follows that with a brief discussion of electrical well-logging methods—in about sufficient detail, I would judge, for an exploration course aimed at geophysics and geology majors. Then comes the core material of the book, which is a thorough treatment of the theory relating to the resistivity, magnetotelluric and telluric current, electromagnetic induction, and induced polarization methods of geophysical prospecting, plus enough details of instrumental technique to give the inexperienced reader some feel for practical field problems. A notable feature of the book is the inclusion of many significant contributions made during recent years in these areas by Russian geophysicists.

There is no doubt about the need for a text of this kind. The nearest comparison that would be familiar to most geophysicists in Western countries would, I suppose, be the electrical section in Heiland's *Geophysical Exploration*, which is now over 25 years old, and some of the techniques described therein have long since fallen into disuse. *Electrical Methods* is authoritative and up-to-date, and much of the theory contained within its pages has appeared in the geophysical literature since the last edition of Heiland's book was published. It is also, in general, written for a more advanced audience than Heiland's. About two-thirds of the mathematical material can be handled by junior- or senior-year undergraduates, whereas the remaining third will probably be understood only by geophysicists having some graduate experience. Explorationists will profit from the sections on interpretation theory only after they have properly assimilated the fundamentals, which for the most part are given in sufficient detail that intensive outside reading will not be necessary.

The two best chapters, in my opinion, are those on electrical properties of earth materials and on induced polarization. Both are full of useful information not easily accessible (at least in so well-organized a form) elsewhere in Western geophysical literature; and both, coincidentally, relate to areas in which the authors have themselves made significant contributions. The mathematics in the chapter on telluric currents, which appears to be largely a translation from a Russian work, seemed rather murky by contrast; but this was probably due in part to my lack of familiarity with the subject. The remaining topics are handled carefully, but provide fewer numerical aids for interpretation than might have been hoped for from so specialized a book. There are several errors (probably typographical) in the text, as is perhaps not too surprising in a book containing over 600 numbered equations; but for the most part they are minor ones, unlikely to mislead any careful reader.

It is clear that geophysicists will need a strong academic background in the fundamentals of their science to take full advantage of this book; but for those who are willing to develop this background, it should help very substantially to increase their effectiveness in the field of interpretation. *Electrical Methods* is an important and useful addition to the literature of applied geophysics. In fact, no company or individual who engages in electrical exploration can afford to be without a copy.

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Functions

Lectures on Functional Equations and Their Applications. J. ACZEL. Translated from the German edition (Basel, 1961) by Scripta Technica. Hansjorg Oser, Translation Ed. Academic Press, New York, 1966. 532 pp., illus. $19.50.

This book, an updating of the original edition printed in German, is a welcome and important addition to the mathematical literature. The field of functional equations has mainly been dealt with by amateurs—that is, mathematicians who have developed certain special results cognate with applications to other areas.

Although clues to more general results are indicated, the author stays close to real or complex variables as basic variables for the functions involved. The number of variables and of participating functions is required to be finite. Examples of functional equations are:

$$f(x + y) = f(x) + f(y) \quad (1)$$

$$F[F(x,y),z] = F[x,F(y,x)]. \quad (2)$$

The first is called the *additivity* equation and the second the *associativity* equation. Considering Eq. 2 alone one sees that functional equations, if permitted, go deep into algebraic structure.

The restrictions placed by Aczel on his presentation allow him to start with J. d'Alembert, 1747, as having first given a treatment of functional equations. Euler, Cauchy, Legendre, and Gauss each dealt with certain functional equations. However, N. H. Abel gave the first known general attack on functional equations in a series of four papers published between 1823 and 1827.

The lack of a systematic theory unifying a major portion of what is now known about numerical functional equations lends a rather *ad hoc* appearance to the treatment. The importance of the particular equations considered is so great that one should not require extremes of generality. Anyone working with mathematical analysis would profit by study of this book. Young mathematicians looking for new worlds might well consider the loose ends proposed by Aczel as a place to start.

A most valuable feature of the book is the attempt to provide references to the literature. Although Aczel kindly does not say so, it is obvious that much redundancy exists in the literature, largely because there was no book like the present one to make it less excusable. There is a chronological bibliography by certain years from 1747 to 1965, as well as an author index and a subject index.

The arrangement of the material seems to result from variable classification systems. Thus, chapter 1 is headed "Equations which can be solved by simple substitution," chapter 2 is entitled "Values of the unknown function on a dense set," chapter 3, "Equations with several unknown functions," and chapter 4, "Reduction, general methods," and so on. In other words, sometimes the methods, sometimes the independent variables, and sometimes the forms of the equations are the dominant motive. This seemingly unnatural arrangement reflects the fact that the theory of functional equations has not yet congealed into the framework of tedious elegance.