

Applied Geophysics

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Book Reviews

Applied Geophysics

W. M. Telford, L. P. Geldart, R. E. Sheriff
and D. A. Keys
Macmillan Company of Canada,
860 p. 1976.
\$67.00 (hardcover only)

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The book is good, the price is obscene. But I suppose more is expected of a reviewer than that especially as the free review copy could be regarded as a substantial fee for service.

To answer the first two questions usually asked. The book will be of most benefit to senior undergraduate students (with at least a second year mathematics course under their belt) and graduate students, although there is also enough descriptive material for it to be useful to more junior students, particularly those enrolled in a Geophysics rather than a Geological programme. The book should replace the classic, comprehensive but now outdated textbooks by Jakosky and by Heiland. It is pleasant to see some Canadian continuity with the older text book "Applied Geophysics" by Eve and Keys with D. A. Keys as one of the authors of this textbook.

It is hardly a criticism to point out that the book, over 800 pages, is very long for if it were made much shorter one would complain that it was incomplete. However, some minor saving of space could perhaps be achieved if there was less discussion of instruments which are really of only historical interest. For instance, in the chapter of Magnetic Methods several pages are devoted to a discussion of mechanical balance type

magnetometers, both the Schmidt balance and the torsion models, which are now obsolete. Again, in the chapter on Gravity Methods a few pages are devoted to a discussion of Eotvos torsion balance which, although it produces far more information per station than the present gravimeters, was rendered obsolete because it was so difficult and time consuming to use. However, in this latter instance the discussion did cause the present reviewer to reflect that perhaps with modern technology, and because of the unique information given by the instrument, one should reconsider the possibility of designing a torsion balance that would be easy to use.

The problem of writing a textbook which will be useful to a broad range of earth scientists is the same as that which faces any lecturer who has to teach a mixed class of students; some of the students have considerable mathematics and physics in their background and some have virtually none. The form of this text represents a valid solution to the problem, with much qualitative discussion interspersed by excursions in depth at a number of points.

One mild general criticism might be cited here. Even the hardliners in the oil, gas and mining industries will have to go metric at some stage, and not too far away in the future, so it is a pity that with a book that is bound to be widely read the opportunity was not seized to lead the way; for example, mixed units (milligals ft⁻¹) are used in Chapter 2.

After a short introductory chapter the authors lead off with a chapter on gravity methods approximately 100 pages long. The coverage is full with material on anomalies due to bodies of simple geometrical shapes, use of characteristic curves, a surprisingly brief mention of the use of second

vertical derivatives, and discussion of various types of instruments. There is some sloppiness in the statement of some problems, e.g., for Figure 2.23 the profiles are presumably taken along the surface trace of the vertical plane containing the thin rods. On page 15 the constants used are for the old International Gravity Formula 1930 (based on the International Ellipsoid 1924) even though the new Geodetic Reference System 1967 has now been internationally agreed.

The third chapter, again about 100 pages long, discusses magnetic methods with a mix of coverage about the same as for the previous chapter. As with that chapter it is marred by one or two erroneous or confusing statements. For example, on the first page, paragraph three, surely the main reason why magnetic maps appear to be more complex than gravity maps is that magnetic susceptibilities of common rock forming minerals covers such a huge range (several orders of magnitude) whereas densities do not. If densities covered the same range the gravity map would look just as complex (or give as much local detail, depending on your point of view) as magnetic maps.

The fourth chapter on seismic methods is over 200 pages long and is one of the most complete accounts that I have seen. Not only does it cover the basic theory reduction and interpretation procedures and problems (including convolution-deconvolution, and time-term techniques), but includes an account of the various types of energy sources, and methods of energy input that are used on land and over water.

The short chapter 5 "Electrical Properties of Rocks" serves as an introduction to the next four chapters dealing with the various methods which depend upon electrical conductivity variations in rocks.

Chapter 6 deals with the application of spontaneous polarization and magnetotelluric methods; the latter is somewhat out of place since although it can give valuable indications of gross crustal structure it is of little use as an exploration method.

Chapter 7 covers electromagnetic methods with good descriptions of airborne electromagnetic methods as well as ground methods. It is good to see the correct equation for the polarization ellipse on page 513 since although the incorrect expression given in Grant and West is due to an obvious typographical error (as is the expression for the angle between the major axis of the ellipse and the reference) the error has been propagated in a number of papers. There appears to be some confusion as to which field component is measured in the Sundberg and Turam methods.

Chapter 8 deals with various resistivity methods. A fairly full account of *interpretation procedures is given but a surprising omission is the curve matching procedure used for multi-layer cases using families of curves such as those produced by Orellana and Mooney. The cumulative resistivity method (Moore's Method) of interpretation is briefly discussed but with no discussion of its theoretical validity.*

The chapter on induced polarization, chapter 9, is the last of the group on electrical methods and justifiably omits mention of the presently purely experimental approach to MIP methods.

Chapter 10 is on radioactivity methods and, in spite of its shortness, covers the basic principles fairly well.

Chapter 11 deals with geophysical well-logging. The chapter is obviously an expanded form of the relevant entries in Sheriff's invaluable "Encyclopedic Dictionary of Exploration Geophysics". This chapter is particularly useful to the students since all other general texts on exploration methods known to this reviewer either completely ignore well-logging methods or dismiss them in a very few pages.

The final chapter consists of a series of problems where the student can analyse sets of data and discover for *himself the circumstances under which using more than one geophysical technique can significantly reduce the number of possible solutions to a given geological structure.*

Each chapter is followed by a set of problems designed to bring out the essential features, and especially the possible ambiguities, of interpretation dealt within the chapter. Each chapter is very fully referenced with an indication in the list of references being given as to whether the reference deals primarily with theoretical, field or instrumental aspects.

Most of the erroneous and confusing statements in the book, some of which have been given as examples, are the sort of thing a lecturer frequently makes and either corrects on the spot or ignores if the point is minor. However, in a textbook they are more important; many students are too modest and uncritical and assume that if a point is confusing the fault lies with them rather than with the lecturer or textbook.

In spite of these comments the book contains fewer points with which one can carp than most; it is in general very well written with generous illustrations throughout and presents the topic as a nice blend of the theoretical (quantitative), interpretational (quantitative and qualitative) and instrumental aspects of the subject. The book should prove of considerable use to students and faculty. Even the professional geophysicist who has lost touch with some of the topics he no longer specializes in will find the book useful; as for the professional geologist - well, he could, when he feels the geophysicists are trying to pull the wool over his eyes, quietly take the book from his shelf and get enough background in a hour's reading to at least make the geophysicists sweat a little at a few pertinent questions.

But we have to get back to the subject of the price of the book. Although in these inflated days the cost per page is probably not significantly greater than many other textbooks, the faculty member has to ask himself whether he can reasonably recommend such an expensive textbook as a required text for his students (he will also ask if he can afford it for himself). For a student in an Honours Geophysics programme the situation might not be too bad since if he bought it when entering the third year of a four year programme, the book could

certainly serve as basic reading for the last two years of his undergraduate programme and would be useful in the first year of a graduate programme or as a general text during his professional geophysics life.

The book is thoroughly recommended for libraries and wealthy individuals.

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Note

We regret the following mistakes which occurred in Volume 3, Number 3: On page 251 it should read "Reviewed by R. W. Macqueen". Page 251, column 2, line 10 should read "The last chapter on relationships among the three types of stratigraphic units is only three pages in length, and could well have been expanded to provide examples, useful for students. The text . . ." (Ed.).