Having very carefully obtained the mathematical tools to tackle these problems, the author seems content to run very quickly through the standard results without any serious physical discussion of how far a problem is satisfactorily solved. This reinforces the impression that this is a suitable approach for engineering undergraduates who already have some feel for these problems but not one the general reader is going to find very interesting.

The third section, on water waves, starts with a very useful summary chapter on the relationships between the various theoretical approaches to the study of water waves. The large, pull-out table showing the interrelationship between wave theories is a delight which will certainly be appreciated by those who have previously tried to find their way via the general literature. The later chapters are generally clearly presented but suffer somewhat from inverse presentation of the mathematics, for example the perturbation expansion of the wave equations is presented at the end of the chapter of finite amplitude waves instead of being an integral part of the development of linear theory, the first approximation. Two useful appendices are included, on wave statistics and similitude of scale models.

This book is a very nicely produced text on hydrodynamics for undergraduate engineers. The casual reader or the professional earth scientist will find very little of general interest, the discussion of the application of hydrodynamic theory to problems of concern to the geologist or oceanographer is minimal. However, for someone who is seriously interested in improving his background in hydrodynamics and is prepared to sit down and work through the text, this would be a very suitable book, the material is clearly presented and well argued without being too demanding mathematically.

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## Sedimentation Models and Quantitative Stratigraphy

By W. Schwarzacher
*Elsevier, Amsterdam,*
*Developments in Sedimentology,*
*v. 19, 382 p., 1975.*
US $47.95

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Students of sedimentary rocks have had a long history of exposure to mathematical concepts as is apparent from Krumbein and Pettijohn's manual published in 1938. As a group they have been more favourably inclined toward statistics than most other geologists. Perhaps the nature of sedimentary processes is such that it is easier to model them and stratigraphical facts may be more clear-cut. Surely Walther Schwarzacher's book shows that geomathematics has made much progress in this particular field. The book is solidly founded in mathematical statistics and uses standard notation.

Chapters 1 and 2 deal with sedimentary environments and time. The unit used for sedimentation rate is the Bubnoff (B) with B = micron/year = m/$10^6$ years. Deterministic models are discussed in Chapter 3 but the stochastic approach is adopted in the remainder of the book. Many readers will appreciate the clear exposition of Kolmogorov's model of bed formation in Chapter 4. Markov chains are the subject of Chapter 5, followed by a chapter on renewal processes and semi-Markov processes of which Schwarzacher has pioneered the sedimentological applications. The gamma distribution emerges as a serious candidate for bed-thickness distributions. Autoregressive processes and correlograms in Chapter 7 are complemented by the spectral approach in the next chapter. Stratigraphic trends and data smoothing are introduced in Chapter 9. The cycloid is one of several tools used. This is the curve described by a point on a rolling wheel. Sedimentary cyclicity has always been a controversial subject. The author adopts a nicely balanced point of view in his two chapters on cycles. Chapter 12 is on stratigraphical correlation and Chapter 13 on problems of three-dimensional stratigraphic analysis.

When stochastic models are introduced, Schwarzacher makes clear that the probabilities he is dealing with are physical or aleatory probabilities which do not refer to judgments but to the possible outcomes of real or conceptual experiments. The statement "Cox is probably a greater artist than de Wint" is an epistemological probability which refers to a judgment and cannot be tested by any experiment. Recently, the philosopher Ian Hacking has argued convincingly that probability emerged rather suddenly in the time of Pascal as a dual concept (aleatory and epistemological). Also, it developed from the "low" sciences such as medicine which had to deal in opinion as opposed to the "high" sciences such as physics which aimed at demonstrable knowledge. It must be conceded that most nontrivial geological problems are not completely solvable for lack of data. This calls for a probabilistic approach.

In some fields of applied geology, there is an increasing demand for quantitative answers, e.g., regarding the amounts of undiscovered oil or ore in a region. Many geologists are now adopting probabilistic procedures which consist of obtaining "best guesses" of numbers or they work with ranges of possible values. The aleatory approach in Schwarzacher's book may be less flexible but its devices tend to produce stable long-run frequencies which can be tested by experiment.

Although the price is high, this book should be read by students of sedimentary rocks, by all mathematically inclined geologists, and by statisticians interested in earth science.

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