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# An Introduction to Hydrodynamics and Water Waves

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## Beach Processes and Sedimentation

By Paul D. Komar
*Prentice-Hall, Inc., 429 p., 1976.*
$29 95

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The study of coastal processes is bedeviled by the immensity of the existing literature including contributions from civil engineering, geography, geology, oceanography and applied mathematics. Within this mass of information, totally irreconcilable viewpoints are often fashionable simultaneously, each supported by equally irreconcilable observations. It is in the discussion of processes, hydrodynamic or sedimentary, that the differences between the disciplines are perhaps most obvious, the generally descriptive approach of the geologist and geographer contrasting strongly with the quantitative, predictive understanding required by the oceanographer or engineer. This difference is readily seen in the books currently available. There are several excellent volumes on coastal geomorphology which are primarily descriptive; there are a few texts on coastal engineering, all now rather dated, which provide good introductions to nearshore hydrodynamics but say very little about sedimentary processes.

This new book, based on a combination of physical oceanography and geology, fits very neatly into this gap providing an excellent introduction to the modern concepts in nearshore processes. The only existing book which makes a serious attempt to cover these topics is the 2nd edition of C. A. M. King's "Beaches and Coasts". This is very much more a survey of the subject, as it was in 1967 or so, concerned to present all the various ideas on any particular topic without very much critical comment. Komar's approach is much more personal, the development of a coherent picture of nearshore processes in the course of which alternative theories may get very short shift or be ignored entirely. Although this may annoy those whose favorite themes are neglected, the result is a very readable book, one that will be appreciated by both the professional earth scientist and the layman.

Following two short chapters, an introduction to the study of beaches and a brief review of coastal geomorphology, the bulk of the first part of the book deals with fluid motions, waves, tides, changing sea levels and nearshore currents. The second half of the book deals primarily with sedimentary processes, longshore transport, sedimentary budget, shoreline configuration and beach profiles. This is followed by a short chapter on coastal engineering structures and a rather lengthy final chapter covering a variety of sedimentological topics.

The treatment of the subjects is mathematical and, as far as possible, quantitative. The mathematics is not, however, emphasized and derivations of results are not generally included; instead the results are supported by an extensive list of references for each chapter. The book can be read 'around the mathematics' but the reader will find that some concepts which are now known to be central to our understanding of nearshore processes are most easily expressed in mathematical form. The obvious example is the concept of momentum flux due to the waves (radiation stress).

This book is essential reading for anyone interested in coastal processes. That it is written in a lively style with some very appropriate quotations and illustrations is an additional bonus. The book is basically designed for the graduate level, but for graduates from such diverse backgrounds that the general reader should have little difficulty in assimilating all but the most technical sections on wave theory.

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## An Introduction to Hydrodynamics and Water Waves

By Bernard Le Mehante
*Springer-Verlag New York Inc.,*
*324 p., 1976.*
$24 80

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Standard engineering textbooks on hydraulics or fluid mechanics generally deal very briefly, if at all, with the theory of water waves; the traditional emphasis is on topics such as pipe and channel flow, hydraulic machinery and practical aerodynamics. The aim of this new book is to introduce the more mathematical aspects of hydrodynamics to students who may have some practical experience but do not necessarily have a strong, mathematical background. Consequently, mathematical concepts and notation are introduced rather slowly, the emphasis being on a careful discussion of the fundamental physics. A natural result of stressing these basic, physical ideas is that the topics covered in the book tend to be those which do not depend heavily on empirical results.

The book is divided into three sections, the first of which "Establishing the basic equations that govern flow motion" is by far the most successful. The basic principles are clearly introduced, well supported by numerous illustrations. A particularly nice feature is the arrangement of the most important equations which includes the physical meaning of each term. This deliberate approach and the inclusion of rather extensive intermediate calculations gives a very orderly development of ideas but will quickly convince the general reader that this is primarily a textbook, not a book to casually dip into.

The second part of the book covers some further developments of the mathematical concepts in much the same vein. However the sections on the application of these ideas to actual problems tend to be very superficial with little discussion of the assumptions, and limitations, implicit in the solutions.

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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