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December 29, 1967

## REVIEWS

GEOHYDROLOGY; MECHANICS OF INCREMENTAL DEFORMATIONS;  
SAUDI ARABIA: PETROLEUM INDUSTRY; IRAN: PETROLEUM INDUSTRY;  
IRAQ: PETROLEUM INDUSTRY

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GEOHYDROLOGY by Roger J. M. de Wiest.

Published by John Wiley & Sons, Inc., New York, 1965, xv + 366 p., \$10.95

A bibliography of 345 entries, the detailed table of contents (five pages) divided into 8 chapters and subdivided into 90 topic headings, 2 fold-in plates, 186 line figures and photos, 2 appendices and a 6-page double-column index . . . this statistical review gives an indication of the careful and thorough treatment provided here for this subject. What is "geohydrology"? In the author's understanding, it is the science of groundwater hydrology as followed by civil engineers rather than geologists. A companion book, co-authored by de Wiest and Stanley Davis, discusses the opposite approach.

Much the longest chapter in the book deals with the elements of surface hydrology, such as the drainage basin, precipitation, evapo-transpiration, runoff, and case studies illustrating these factors. Other chapters include ground-water flow, theory of ground-water movement, steady state flow, the mechanics of well flow, multiple phase flow, and numerical and experimental methods in ground-water flow.

The opening chapter, a particularly delightful and informative history of hydrologic studies (although carried under many names in the five millenia discussed) is the perfect beginning to get and keep a student's interest. And this is the approach throughout the book; first and foremost it is a textbook to be used in teaching the science of the flow of ground-water to intermediate and advanced students. The mathematics, while rigorous, has been carefully selected for the level of the classes involved. As the author pointed out "in the derivation of the equation for the conserva-

tion of mass I make use of partial derivatives, but expertness in partial differentiation is neither required nor expected from the reader. Complex variables are not introduced. . . . Paragraphs containing more advanced material that may be skipped in a beginner's course are preceded by an ornamental line and set in reduced type."

This is an excellent book and well fulfills its purpose. It derives from material presented in lectures in N.S.F. sponsored SUMMER INSTITUTES, so has been carefully and thoughtfully threshed to separate and discard the chaff. The explanations are clear and sufficient, the proofs easily followed, and the teaching sequence logical. For the good of embryo civil and geological engineers, it is to be hoped that it achieves a wide acceptance.

MECHANICS OF INCREMENTAL DEFORMATIONS by Maurice A. Biot. Published by John Wiley & Sons, New York, 1965, xvii + 504 p., \$17.50

The sub-title of this book gives the key to the material covered much more clearly than does the title; it is "theory of elasticity and viscoelasticity of initially stressed solids and fluids, including thermo-dynamic foundations and applications to finite strain." The author's objective was to prepare a work intermediate between the formalistic approach of the mathematician and the pragmatic treatment usual with engineers. The result is a rigorous book characterized by the use of cartesian concepts but not requiring a knowledge of tensor calculus or other more specialized techniques. Since the theory is valid for non-elastic media, it has been found to be applicable to such problems as tectonic folding in geodynamics. Further extension of these methods has

proved applicable in geophysical studies, such as the problems of acoustic propagation in viscoelastic media under initial stress.

This is a book designed for the mathematician or the physicist, dealing with specific physical realities. It is a "method" book as well as a "theory" book, directed toward providing adequate tools with a sound mathematical foundation. As an example for the geologist, study was made of the elastic stability of anisotropic media; this would be of primary interest in analysing deformation in crustal layers. The assumption was made that a laminated medium obtained by superposition of alternating hard and soft thin adhering layers would relate these media to the normal sedimentary sequence. Then, within certain limits, this alternating sequence would behave like an elastic continuum with anisotropic properties although the individual layers (such as sandstones, shales, limestones, etc.) might be isotropic. Mathematical analysis first was made for this system assuming the materials to be incompressible and free of initial stress. Then a uniform strain without shear was considered. Finally the system was studied in regard to the deformation to be expected if it had been under initial stress; this would correspond to shear folding in crustal rocks. Not only is the mathematical treatment of this example rigorous and complete but the assumptions involved, the limitations of the assumptions, and the validity of the resulting approximations are discussed in detail.

While much of the book does not seem applicable to geological phenomena as customarily conceived, it provides a new view into systematic approaches to geological problems which may considerably broaden understanding of those problems and show this type of treatment is necessary after all.

**SAUDI ARABIA: PETROLEUM INDUSTRY** by Gordon Hensley Barrows. Published by International Petroleum Institute, Inc., New York, 1967, iv + 43 pp., \$5.50

This extremely detailed report on the economics of the petroleum industry of Saudi Arabia is one of a series covering the entire Middle East, with a similar study planned for each country of the area. Although a minimum of geological data is included (several structure maps and a generalized

cross-section), the historical background of the exploration for oil here will prove interesting to petroleum geologists. The constantly decreasing area of land under concession and the location of individual retained areas is most revealing in regard to production successes in this search.

The report, composed essentially of maps, tables, graphs, and similar inclusive methods of presentation, represents a compilation of data from many sources often difficult of access to the average reader. Such sources, usually credited, include the annual reports of the Arabian-American Oil Company, Oil and Gas Journal, ministry reports of the Saudi Arab government, Oil and Gas International, World Petroleum, Bulletin of the A.A.P.G., Middle East Economic Survey, United Nations monthly bulletin on Resources Statistics, reports of the International Monetary Fund, etc. These statistics, and their careful compilation, grouping, and assimilation, provide the value of this paperback, multilithed book.

**IRAN; PETROLEUM INDUSTRY** by Gordon Hensley Barrows. Published by International Petroleum Institute, New York, 1967, ii + 60 p., \$5.50

**IRAQ; PETROLEUM INDUSTRY** by Gordon Hensley Barrows. Published by International Petroleum Institute, New York, 1967, iii + 29 p., \$5.50.

These two fact-crammed pamphlets are recent additions to the IPI series covering the Middle Eastern oil industry. They follow the same general format as the report on Saudi Arabia previously reviewed; *i.e.*, introduction, history of exploration, generalized geology, concessions and legal ramifications, production, transportation, marketing, and a broad review of the place of oil in the life of the country.

Filled with maps, tables, charts, graphs, etc., the reports present a tremendous compilation of data gleaned from dozens of sources, many obscure and difficult of access to the general reader. Printed by multilith, most of the above have not been altered in the least from their original presentation but the minimum of text does an excellent job of tying the statistics into a single package. For geologists working in these areas, or simply interested in knowing what is going on throughout the world, these are invaluable.