BOOK REVIEWS, continued

Dynamics of Fluids in Porous Media

Jacob Bear, who is a professor of Hydrology at the Technion-Israel Institute of Technology at Haifa, Israel, is well known to many soil physicists, particularly as a result of his work on hydrodynamic dispersion and on the flow of immiscible fluids in porous media. His book is intended for advanced graduate students, graduate students, and active researchers in a wide variety of disciplines. The author assumes a reasonable background in advanced calculus, complex variables, and differential equations. Some experience in fluid mechanics and/or transport phenomena would also be helpful. The treatment is restricted largely to inert, coarse-grained, porous media and linearly viscous fluids. The numerous exercises at the end of each chapter provide extensions of the theory and practice in actual calculations.

A general description of porous media and of physical parameters used to describe them is given in Chapters 1-3 (64 pages). In Chapter 4 (54 pages) the balances of mass and momentum are presented in a general context. In Chapters 5 and 6 (128 pages) the balances of momentum and mass of a homogeneous fluid are derived and discussed in great detail. In spite of the strong tradition in the literature, it would have been more natural to discuss the balance of mass before the balance of momentum. Chapters 7 and 8 provide an excellent introduction to the literature on flow to wells and on agricultural drainage. In Chapter 7 (114 pages), following a detailed discussion of initial and boundary conditions, various methods for solving Laplace's equation for movement of fluids in saturated porous media are presented. Chapter 8 (77 pages) deals with unconfined flow and the Dupuit-Forchheimer approximation. Chapter 9 (140 pages) deals with the flow of immiscible fluids. The movement of water in unsaturated soils is presented as a special case within this class of flows. This device clearly shows the similarities and differences between approaches in petroleum engineering and ground water hydrology on the one hand and in soil physics on the other hand, and should help put in perspective recent attempts to evaluate the effect of resistance to displacement of soil air. The section on unsaturated soils does not include any of the recent work on multidimensional flows. An excellent treatment of hydrodynamic dispersion is given in Chapter 10 (85 pages). Finally, in Chapter 11 (63 pages) one finds, following some general principles of scaling, a detailed discussion of sand box models and of viscous flow, electrical conduction, and membrane analogs.

In my opinion, the book has one major flaw: the author has been too liberal in treating different approaches, notations, and terminologies. A summary of general principles in continuum mechanics in section 4.4.2 is immediately followed by a summary of the elements of the thermodynamics of irreversible processes without any discussion of the relative merits of the two approaches. Equations involving vectors and second order tensors are presented virtually at random in either symbolic, or indicial, or component notation. It would be more economical to present all arguments of a general nature in either symbolic or indicial notation, and restrict the use of component notation to treatments of specific flow problems. In particular, the general aspects of anisotropic and deforming porous media could have been treated more concisely. In some cases alternative notations, terminologies, and derivations could have been relegated to appendices. Much of the confusion and repetition in the literature on the hydrodynamics of porous media arises from the diversity of the applications or of the background of researchers. I believe that writers of textbooks should do everything possible to bring order in this chaos.

In some sections, the author included quite a few errors and misleading statements. For example, on page 131, the surprising statement is made that for the inner product of a vector and its curl to be zero, either the vector or its curl must be zero. In section 7.1.10, it is assumed that at an interface between two isotropic porous media, the normal component and refraction of streamlines always coincide. In fact, one can show that such a coincidence is quite exceptional. Finally, soil physicists do not assume that the soil air is stagnant (cf. pages xix, 474, 487), but rather usually assume that the air pressure is uniform and constant.

In pointing out some of these shortcomings, I do not intend to discourage the use of this book by students, teachers, and researchers in soil physics. At present, it is the best source for teaching an advanced, interdisciplinary course on the theoretical aspects of the hydrodynamics of porous media. Any soil physicist who can afford it and who is seriously interested in bridging gaps with related disciplines should have a copy of this book. Of course, one will have to turn to other textbooks for treatments of physical-chemical aspects, heat transfer, aeration, detailed treatment of unsaturated soils, and general implications of the theory.—P. A. C. RAATS, Soil Scientist, Agricultural Research Service, USDA, and Associate Professor, Dept. of Soil Science, University of Wisconsin, Madison, Wis.

Soils of the Humid Tropics

The NAS Committee on Tropical Soils along with invited contributors "have sought to distinguish the specific problems in the use of (humid) tropical soils from the guiding generalizations of soil science that have wide global applications."

A "summary of present knowledge" is presented for the following topics: soil survey, soil microvariability, physical properties of soils, nitrogen and organic matter, phosphorus and sulfur, potassium, acidity and liming, micronutrients, silicon, fertilizers, soil management systems, soil testing, and soil fertility evaluation services. Derived from these discussions is a short chapter near the beginning of the book concerning research needs under the two broad categories of "Soil Inventory" and "Soil Management Systems."

An appendix contains summary reports of research for tropical Latin America, Malaysia, French-speaking Tropical Africa, Nigeria, Tanzania, Congo (Kinshasa), Central Africa, and Hawaii. Limited numbers of the complete reports are available on request from the authors.

Discussion is predominately limited to better-drained upland soils at elevations less than 1,000 m. Vertisols and flooded rice soils were excluded. Such precise definition had a commendable impact on the quality and application of the papers. The publication is extremely well edited and all presentations are exceptionally lucid. Most of the papers are critically referenced and appear to cover the literature through 1970.

This publication is long on fertility but short on microbiology. The reviewer feels that plant pathology problems increase tremendously in importance for humid tropical crop production. This aspect was dismissed by one short sentence near the end of the book.

Soils of the Humid Tropics represents a significant watershed in tropical soil literature. It is an excellent addition to the library of all agronomists and other scientists with an active interest in the tropics. Additionally it can be adapted easily for use in graduate-level tropical soils courses.—FRANK G. CALHOUN, Soil Science Dep., University of Florida, Gainesville, Fla.

New Slide Rule and Slide Chart Available
For further information, contact: Warren Wood, Qanta/Metric Corporation, 120 Industrial Way, San Carlos, California 94070.

A new pocket-size slide rule that relates X-ray critical absorption and emission energies to atomic numbers and their corresponding elements has been produced by Qanta/Metric Corporation, maker of automated energy dispersive X-ray analysis systems.

The new slide chart has readings for both K-Series and L-Series tables, including weighted averages. Tables are calculated in keV. A special slide scale for converting between keV and angstroms is also included. Copies are available on letterhead request.