BOOK REVIEWS, continued

Small Watershed Experiments, An Appraisal of Concepts and Research Developments

The author presents his appraisal of concepts, research develop-ment, fundamental problems of, and alternatives to small watershed experiments. In doing so, he reviewed and included an extensive bibliography of publications related to the field of small watershed experiments. Because of the relaxed definitions of small and watershed experiment, the bibliography does not constitute a complete coverage of published work. It nonetheless presents an interesting appraisal and a useful bibliography for the student of small watershed experiments.

In the Introduction, a watershed is defined but the problem of defining small is sidestepped. An upper limit of 100 miles is generally used to insure inclusion of most relevant work, but this limit is not strictly adhered to in subsequent discussions. Watershed experiment is likewise a troublesome term to define. The most common alternative was small watershed experimentation which was the main criteria used to qualify studies as watershed experiments. This definition allowed inclusion of studies by third persons where the streamflow and rainfall data were collected by others, such as agency surveys and environmental data services. While this is possibly desirable, these unrestricted definitions allow an almost limitless number of investigations to be included as small watershed experiments.

Chapter 2 deals with the objectives of watershed experiments. These range from water, evapotranspiration, and energy balance investigations; nutrient balance and water quality investigations; rainfall-runoff studies; to urban and snow hydrology; and water resource and planning. Each type of study is illustrated by several examples and a brief description of experiments. Examples were often chosen at random and "may not always represent the 'best' or the most successful experiments." Consequently, the same work is often repeated in more than one discussion. Greater care in selecting examples could have eliminated some repetition and strengthened the chapter. However, studies involving forest, agriculture, urban, and mixed-cover conditions were all discussed. The section on terrestrial influences was the most detailed, perhaps reflecting both the author's interest in water balance studies and the volume of information available on the subject.

Chapter 3 is devoted to problems associated with watershed experimentation. The advantages of watershed experimentation are not considered since Dr. Ward presumed these to be self-evident. The major problems listed are lack of control, representativeness of experimental watersheds, problems of data accuracy and data manipulation, and high cost of watershed experiments. Alternatives to watershed experiments and complementary techniques are discussed in Chapter 4. Plot studies and physical, analog, and mathematical models are given as the principal alternatives to small watershed experiments. The discussion of complementary or alternative techniques revolves around the use of physical units other than the watershed, mainly plot studies and investigations of basic processes such as evaporation, transpiration, and moisture flow through soils.

In the final chapter, Dr. Ward concludes that, notwithstanding their deficiencies, small watershed experiments still at the turn of the century have served man's needs very well and that they are appropriate for a wide range of investigations. He believes that the small watershed provides the proof needed to verify results obtained from other approaches and these alternative approaches are no replacement for the small watershed experiment. He recognizes, however, that problems will most likely be solved by research in which small watershed experiments, plot studies, model development, and basic research all progress interdependently toward the answers.—J. E. DOUGLAS, Principal Hydrologist, Southeastern Forest Experiment Station, Forest Service, USDA, Asheville, N.C.

Fundamentals of Transport Phenomena in Porous Media
Proceedings of the First and Second International Symposia

The Proceedings of both symposia were published at about the same time although the first symposium took place in 1969 at Haifa and the second in 1972 at Guelph. The second symposium attracted more participants and covered more areas of research. However, some of the most important topics were discussed in both places; sometimes by the same scientists. The simultaneous publication of these proceedings showed the continued interest and the progress made recently in the understanding of the fundamentals of soil physics. Due to the wide variety of backgrounds among the participants, it is not possible to discuss every single contribution. The review below outlines some of the general topics that were covered and will undoubtedly continue to be scrutinized in future symposia.

Microscopic Description and Modeling—Regarding transport phenomena in porous media were related to the microscopic structure of the medium; but the pore geometry is so complex that only a partial description has been obtained so far. In addition, relations between microscopic and macroscopic properties were presented on the basis of a simplified analysis or an idealized medium.

Dispersion—Numerous papers on mathematical and numerical models as well as experimental results were discussed by many authors but there is obviously room for more research. The particularly lucid lecture by J. P. Heller discussed in detail the effects of diffusion and heterogeneity on dispersion.

Coupling—The formal description of the possible interactions between the various transport phenomena, based either on continuum mechanics or irreversible thermodynamics, has reached a high degree of sophistication. G. H. Bolt and P. H. Groenewalt clarified many of the general concepts, e.g., Onsager's relations, by looking at particular models in great detail. It is no detraction to their excellent work to note the need for more experi-mentation in this field.

Swelling and Non-Darcian soils—Numerous experimental re-sults of great interest were presented in this section, describing the often intriguing behavior of these soils.

This completes the list of the main subjects discussed in both symposia. Others were mostly covered in one symposium only. For instance the importance of hydrodynamic stability is increasingly recognized. In the first symposium, C. Thirriot and S. Bories discussed very thoroughly and with beautiful pictures the formation of Rayleigh-Bénard cells in a porous medium. On the other hand the fundamental problem of water movement in anisotropic, heterogeneous, or layered soils was extensively studied in the second symposium only.

Being concerned with "fundamentals," most papers reported laboratory experiments and theoretical investigations. However, it is clear that soil physics must prove its usefulness in the field and that its direct application to hydrological problems will increase in the future. Some of the difficulties encountered in the "real world" were touched upon in a few papers of the second symposium. W. R. Gardner for instance discussed "those problems which the soiler frequently attempts to elimi-nate," e.g. biological and bacterial activity. A. S. Rogowski was concerned with another important aspect of large scale prob-lems, namely the precision with which the soil properties have to be known.

The main merit of these proceedings is that they give a clear picture of the present trend of the research in soil physics. This alone makes their reading a must for scientists interested in that research area.—J.-Y. PARLANGE, Mathematician, The Connecti- cut Agricultural Experiment Station, New Haven, Connecticut.