loose soil in place and prevent it from filling your reservoir. The holding back of rainfall by vegetation and humus is wasteful of water.

The watershed of an undammed river is a different proposition, since it is desirable to delay the water as much as possible so that it will not rush to the ocean. In this case, it is the *delayed* water that interests us. The far greater portion of it that is evaporated by the vegetation is the price we gladly pay to insure a small but steady flow in the valley.

CHAPMAN GRANT

2970 Sixth Avenue, San Diego

Book Reviews

Microwave transmission circuits. (Massachusetts Institute of Technology Radiation Laboratory Series.) George L. Ragan. (Ed.) New York-Toronto-London: McGraw-Hill, 1948. Pp. xvii + 725. (Illustrated.) $8.50.

This is one of a set of 28 volumes forming the Radiation Laboratory Series, in which information previously available only in classified reports, or in many cases unpublished information, is recorded. Most of the material concerns techniques evolved during the war in the development of microwave radar.

The term *microwave* designates radio waves roughly in the range of wave lengths between 1 and 30 cm. As these wave lengths are of the same order as the dimensions of the various circuit components, new problems arise which are not present at lower frequencies. The wave aspects of electromagnetism become of increased importance, whereas the electric currents are of less importance and the concept of *voltage* is generally ambiguous.

In common with low-frequency circuits, the microwave systems can generally be divided into three parts, generators, receivers, and interconnecting elements. The book under discussion concerns itself solely with the interconnecting elements. In a microwave circuit these elements consist of transmission lines of various types and junctions between these transmission lines. Engineering problems connected with these circuit elements are extensively treated. Included are coaxial and wave guide transmission lines, both rigid and flexible. Power dividers, tuners, couplings, and switches may be mentioned as examples of transmission line junctions. There is a section on microwave filters and an introductory chapter on the theory of the transmission line.

Although 7 authors contributed to the book, it is well organized and has little overlap. It is reasonably complete. A description of the magic tee and its various uses, such as power divider, tuner, and line stretcher, seems, however, to be missing. The book is valuable largely because of the engineering data which it contains.

R. H. DICKE

Princeton University

Higher algebra: a sequel to "Higher algebra for schools." W. L. Ferrar. Oxford, Engl.: Clarendon Press; New York: Oxford Univ. Press, 1948. Pp. vii + 320. $5.00.

Although this book is a sequel to *Higher algebra for schools,* it is not written so that the earlier book is the only source of the needed preliminary knowledge. The material is planned for study in "top mathematical forms in schools and first year classes in universities." There are discussions of series, complex numbers, difference equations, theory of equations, partial fractions, inequalities, and continued fractions. There is no general discussion of convergence and divergence, the summing of finite and infinite series being stressed. A lucid introduction to complex numbers uses directed number, or vector, as the basic definition. Thus, Demoivre's theorem is readily obtained and is used in the next chapter to yield many trigonometric identities; bilinear transformations are another application of complex numbers. The relations between the coefficients of an equation and the symmetric functions of its roots, and the exact solutions of a cubic and a quartic, are the principal topics in the theory of equations. Several general inequalities are given, including Hölder's and Minkowski's.

The manipulation of algebraic expressions is a central feature, and in this respect the work has the same spirit as that classic treatise with the same title by Hall and Knight. The level of rigor can best be indicated by pointing out that convergence and continuity are not defined in a precise way, but intuitively: "A function $f(x)$ that changes its value gradually as x changes gradually is said to be continuous." Thus, many results cannot be proved rigorously, although, surprisingly enough, the word "proof" is used without qualification, e.g. in the "proof" (pp. 135–136) that if a polynomial $f(x)$ is positive for $x = a$ and negative for $x = b$, then $f(x) = 0$ has a root between a and b. The author makes it clear that he feels that precision in these matters may well wait: ". . . the intending mathematician must be prepared for a considerable refinement . . . ."; and yet he expects his readers to perform intricate and ingenious manipulation with some very difficult problems. But if students are not benumbed by these problems, they are surely ready for some critical mathematics. In addition to this criticism, the absence of determinants will restrict the usefulness of the book as a text on this continent. Most Canadian and American college students are, of course, not prepared for this material in their first year.

Only a few errors were noted. For example, multiplication by zero is never defined in the development of complex numbers; the fact that an algebraic equation of degree n in the complex field is solvable and has n roots is not even stated, let alone proved, but is used; and Theorem 38 is needed in proof of Theorem 37.

As a book in the celebrated English tradition of elementary mathematical texts, placing great emphasis upon, and replete with, manipulative problems, the volume is a success.

IVAN NIVEN

University of Oregon