
Books

Rheology: Theory and Applications. Edited by Frederick R. Eirich. Vol. 1, 761 pp., \$20.00. Vol. 2, 591 pp., \$18.00. Academic Press Inc., New York, 1956 & 1958. *Reviewed by R. S. Marvin, National Bureau of Standards.*

Rheology is that branch of physics concerned with the properties of matter which determine its response to mechanical force. In basic rheological studies one seeks to determine which properties are dependent only on the material rather than on a particular experiment, to develop methods of measurement of such properties, and to determine the relationship of such properties to each other and to the structure of the material. In more applied studies one is interested in determining the applicability of a material, or a class of materials, to a particular use or in developing tests which are intended to check structure or composition against established criteria.

There is a further basic problem which complicates any review of the status of rheology today. Most of our thinking about material properties is based on the concepts of linear behavior developed in the classical theories of elasticity and hydrodynamics and most of our difficulties in understanding the properties of real materials are due to the fact that they refuse to confine their behavior to this linear region. Only recently have investigators begun to develop a strict mathematical treatment relating forces, deformations, and time, based on a minimum number of assumptions (such as continuity), and denying themselves the usual expedient of linearizing their equations. The transformation of this work from a field of mathematics to a branch of physics is only now beginning.

As is generally the case, those faced with applied rheological problems have been unable to await the solution of these basic questions in analysis, and have used various devices to extend essentially linear concepts to cover observed behavior. This has resulted, of course, in a wide divergence in viewpoint and many reflections of this are found in the treatise reviewed here.

In recent years the mathematical treatment of linear viscoelastic behavior, in which the ratio of stress to strain is a function of time but not of strain, has been applied in considerable detail to synthesize observations on several types of material, notably polymers and metals. Such work is well represented in the general chapters which form the whole of Volume 1 (1956) and are scattered through both Volumes 2 (1958) and 3 (in preparation). Both phenomenological treatments

and those relating properties to structure are discussed and the authors include a large percentage of those who are chiefly responsible for our present understanding of linear rheological phenomena.

The developments in nonlinear theories are represented by a chapter by Rivlin covering his theoretical and experimental work on equilibrium deformations in rubber, one by Oldroyd on non-Newtonian flow in Volume 1, and in Volume 2 a chapter by Jobling and Roberts dealing primarily with normal stress phenomena. This latter chapter is rather unsatisfactory, since it does not discuss the more recent theoretical work (which may indeed be too recent for inclusion here) and does not include an adequate account of the rather considerable disagreement regarding the interpretation of certain measurements in this field.

The balance of Volume 2 consists of chapters devoted to the rheological properties of materials of industrial importance plus one chapter by Gutenberg on the rheology of the earth's interior.

This is not a single unified text on rheology, nor did the editor intend it to be such. Largely by virtue of the subjects covered, a general reader will find Volume 1 of much greater value than Volume 2, though he could read with profit several of the chapters of Volume 2. Throughout both volumes extensive references are given and this alone will make the work of great value to those working in the field. The divergence in nomenclature is not so annoying as might be expected, partly because of the editor's insistence that each author include a rather complete list of the symbols and terms he employs.

Networks Synthesis, Vol. 1. By David F. Tuttle, Jr. 1175 pp. John Wiley & Sons, Inc., New York, 1958. \$23.50. *Reviewed by Louis Weinberg, Hughes Research Laboratories.*

Revolutions by their very nature are generally not quiet but explosive. Yet in the past decade what should be called a revolution has quietly transformed the character of the education of an electrical engineer. To cope with the research problems of today the engineer must be a cross between a physicist and a mathematician. Thus, to make room for the necessary physics and mathematic courses, much of the traditional engineering curriculum—like electrical machinery and strength of materials—is being dropped. One traditional course, however, is achieving new stature; this is a course in circuits or, more appropriately, network theory.

It is being increasingly recognized that a thorough course in network theory should be the core of a curriculum in electrical engineering. It is also being recognized, but more slowly, that network synthesis, rather than analysis alone, is an indispensable part of an engineer's training. Aside from their direct value, the perspective, techniques, and concepts taught in synthesis carry over into an engineer's attack on other problems. An engineer may never in his professional lifetime work out the Brune realization of a driving-point func-