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# SYMPOSIUM ON STRESS-STRAIN-TIME-TEMPERATURE RELATIONSHIPS IN MATERIALS

## INTRODUCTION

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There are few applications for materials in which behavior under stress is not an important criterion, and service at ever higher temperatures is the order of the day. While a serious worker in a given materials field is always cognizant of the state of knowledge in his field, opportunities for interdisciplinary exchanges are all too infrequent. This, the Third Annual Symposium sponsored by the Society's Division of Materials Sciences, again brings together recognized experts from three major materials areas to discuss a subject of universal importance. To what extent is knowledge gained from studies of one material useful in understanding another? How much generalization is possible? What are the relative advantages of the several approaches to understanding materials—solid state or micromechanistic, phenomenological or macroanalytical, and ad hoc testing or simulated service? The state of our present ability to answer these questions is set forth by the four authors.

Professor B. J. Lazan, University of Minnesota, treats first the subject of idealized materials and shows how the known laws governing behavior of solids are complex and at present are limited in application to research studies, not to prediction of behavior of engineering materials. He advocates an approach based on analysis of behavior on a macro scale.

Professor W. D. Kingery, Massachusetts Institute of Technology, discusses the time-temperature behavior of ceramics. Materials of this class are diverse in their structure and no simple, broad generalizations apply.

Professor G. V. Smith of Cornell University examines both the micromechanistic and macroanalytical approaches to understanding of behavior of metals. Important practical problems of design of pressure vessels for high temperatures are being dealt with using the macroanalytical approach, and extrapolations in time based on mechanical equations of state are a useful aid in establishing design criteria. But Professor Smith emphasizes that ultimate understanding will come only with understanding of micromechanisms.

Dr. Thor L. Smith of Stanford Research Institute treats the subject from the point of view of the polymer physicist. Like ceramics, the polymers are a broad class of materials exhibiting a wide range of properties. An important aspect of polymers is their time-temperature equivalence which has been known

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for about 20 years. The quantitative application of the principle has been significant in development of our current knowledge of polymers.

Finally, each of the four papers is discussed in turn by four panelists, some suggesting different interpretations than those of the authors. But the authors have the final word.

This juxtaposition of experts in different materials fields made evident the need for a common terminology for stress-strain behavior that would facilitate communications across materials lines. While this desirable objective is not met in this volume, the seeds have been sown.

A paper on "Creep and Recovery of a Zirconium-Tin-Columbium Alloy" by J. D. Lubahn has been included in this volume because of its appropriateness to the subject of the symposium although it was actually presented on another occasion.

Those interested in this volume will also be interested in a subsequent volume scheduled for the Materials Science Series—"Symposium on Dynamic Behavior of Materials," a collection of the sixteen papers presented under joint auspices of the University of New Mexico and the ASTM Rocky Mountain District on September 27–28, 1962.