SYMPOSIUM ON BASIC MECHANISMS OF FATIGUE

INTRODUCTION

By T. J. Dolan[1]

What is "basic" in mechanisms of fatigue often depends upon the viewpoint of the individual who is observing the mechanism. To some of us a visual observation is pretty basic. To others a microscopic observation is a little more fundamental and to still others some hypothetical concepts of the behavior at a non-visible or sub-microscopic level is felt to be basic. Most of these various areas of observational levels are touched upon in the papers of this symposium in discussing movements of dislocations, in interpreting microscopic observations, and in terms of the visual or large-scale phenomena.

This is something of a departure, since ASTM publications in general have been primarily interested in how to standardize test methods and apply the results to an actual design. The emphasis has been on obtaining quantitative answers to the question: "What is the fatigue limit of the material?" But within the past few years there has been a strong expression of opinion that we need to know more about what "basically" affects fatigue performance. Many infer that we do not have adequate theories of fatigue, that we do not understand the mechanism and cannot predict quantitative behavior of the material. If one examines the field more closely he will find that we know a great deal about fatigue failure and the basic mechanisms of fatigue; much more than we know about brittle fracture, and perhaps much more than materials engineers know about creep. One of the reasons that it is rather difficult to evolve an exact design on a quantitative basis is because of the statistical nature of the phenomena. We can predict performance on the average for a large number of like components, or predict failure in a certain percentage of cases, but to set an exact limit for fatigue life or fatigue strength of a given member is impossible.

The papers in this symposium clarify some of the mechanisms leading to fatigue damage and help to emphasize the statistical nature of the material behavior under cyclic loadings.

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