Sherby O D & Burke P M. Mechanical behavior of crystalline solids at elevated temperature. *Prog. Mater. Sci.* 13:325-90, 1967.
[Department of Materials Science, Stanford University, Stanford, CA]

It is now possible to predict quantitatively the steady-state creep rate of most polycrystalline metals and nonmetals, as well as solid solutions, at temperatures above one-half the absolute melting temperatures. It is clearly established that the creep rate is controlled by the rate of atom mobility. [The *SCI*® indicates that this paper has been cited in over 365 publications, making it the most-cited paper from this journal.]

Oleg D. Sherby
Department of Materials Science
and Engineering
Stanford University
Stanford, CA 94305-2205

March 11, 1987

An unusual aspect of the paper by Peter Burke and me is that it was published more rapidly than any other paper I have submitted for publication. On August 17, 1967, it was sent unsolicited to the editors of *Progress in Materials Science*. The paper was accepted on August 29, 1967, by W. Hume-Rothery, who stated, "I like the manuscript very much and am therefore sending it to Pergamon...." The paper was in print by early 1968.

The manuscript presented an overview of the mechanical behavior of crystalline solids at elevated temperatures, which probably made it attractive reading. It was, however, a strongly personalized view on the factors influencing the deformation of polycrystalline materials, and it centered on the premise that plastic flow was determined by a diffusion-controlled dislocation-creep process. The view had its origin in the experimental observation by Orr, Dorn, and me[1] that the activation energy for creep was equal to the activation energy for lattice self-diffusion and in the work of Weertman,[2] who theorized that dislocation climb was the rate-controlling process in steady-state plastic flow. The Sherby-Burke overview gave quantitative relations for predicting the creep behavior of polycrystalline materials and presented the variables that could be manipulated to enhance the creep resistance of materials (elastic constants, subgrains, stacking fault energy, and second-phase particles). The paper also addressed, for the first time, new concepts on the creep behavior of solid-solution alloys; it was shown that these alloys could be categorized into two types: Class I and Class II solid solutions, each having very distinctive and unique creep characteristics.

The publicity surrounding the paper led to my selection as a keynote speaker at a 1969 Gordon Conference on creep plasticity held in Issaquah Heights, Washington. Michael Ashby also attended, and his in-depth introduction to this field at the conference was a major factor in his development of deformation mechanism maps.[3]

Although our view on diffusion-controlled dislocation creep is widely accepted, there are objections to it, such as the particularly thorough one presented by Poirier[4] in 1978. A rebuttal by Weertman and me,[5] published in 1979, hypothesized that diffusion-controlled dislocation creep must control steady-state plastic flow of polycrystalline aggregates at all temperatures, even near the absolute zero.

The philosophies described and quantified in the paper by Burke and me form the principal bases for my recent election to the National Academy of Engineering (1979) and my receipt of the Gold Medal of the American Society for Metals (1985).

1. **Sherby O D, Orr R L & Dorn J E.** Creep correlations of metals at elevated temperatures. *Trans. AIME* 200:71-80, 1954.
2. **Weertman J.** Steady-state creep through dislocation climb. *J. Appl. Phys.* 28:362-4, 1957. (Cited 325 times.) [See also: **Weertman J.** Citation Classic. Commentary on *J. Appl. Phys.* 28:362-4, 1957. (Thackray A, ed.) *Contemporary classics in engineering and applied science.* Philadelphia: ISI Press, 1986. p. 208.]
3. **Frost H J & Ashby M F.** *Deformation-mechanism maps: the plasticity and creep of metals and ceramics.* Oxford: Pergamon Press, 1982. 161 p.
4. **Poirier J P.** Is power-law creep diffusion controlled? *Acta Met.* 26:629-37, 1978.
5. **Sherby O D & Weertman J.** Diffusion-controlled dislocation creep: a defense. *Acta Met.* 27:387-400, 1979.

 CC/ET+AS 2-8