Summary

In retrospect, how should we judge the contribution of the Storrs symposium? No unified view emerges: Metallurgists proposed mechanisms, mechanicians correlated data. And yet, there was a curious symbiosis; a sense that the microscopic and macroscopic points of view have begun to converge. Forbearance and mutual respect, if not collaboration, was the tone of the meeting.

Fracture mechanics, almost omitted from the initial program, was rediscovered in the creep range, holding out the promise of extending the advantages of the method to design, testing, and analysis of high-temperature structures. Extensions were demonstrated through modification of the crack growth law by an activation enthalpy term containing, unexpectedly, the stress intensity; also by correlating the crack growth with the range of strain intensity. Underlying this activity, the thought that fracture mechanics, through new concepts such as strain rate intensity and crack closure, may catalyze development of predictive techniques through its unique capability to blend metallurgical and mechanistic constructs.

The promulgators of the Coffin-Manson relationship continued to set the pace for most of us: undisputable evidence that the environment can be the dominant factor at elevated temperature (one is struck here by the similarities between oxidation-controlled fracture and stress-corrosion cracking) and a challenge to view the creep-fatigue interaction as four separate processes depending upon the nature of the strain cycle, that is, whether creep or plastic, or mixed, with one effecting the reversal of the other. Clearly, the limits of validity of these points of view must be probed, especially until they overlap; and the interactions that they illustrate should be interpreted in terms of microstructural mechanisms. The concept of strain range partitioning should be particularly amenable to interpretation by fracture mechanics and appears to offer a useful guide to the development of a model of crack-tip behavior.

Thermal ratchetting, a problem which has long affected designers of high-temperature equipment, has assumed new prominence as a nuclear design code consideration, requiring sophisticated nonlinear, time-dependent computation of strain. Inability to characterize materials under complex loading cycles has, apparently, given ratchetting special status—and its own jargon—among problems of constitutive behavior. Nowhere, perhaps, is the importance of microstructural modelling so evident. We were shown, for example, how relatively simple models can provide the theoretical framework (with considerable empirical sheathing) for describing time-dependent cyclic behavior with surprising realism. Such a model can predict the ratchetting of a structure as a matter of course with the aid of a suitable computerized stress analysis program. Strict empirical correlation without the benefit of a microstructural model would be impractical.

It might, in fairness, also be noted what was *not* featured in the Symposium, for example, time-dependent crack displacement observations or analysis. We must learn how creep affects the strain field of a crack in order to represent its effect on the rupture process. Models of cavity growth and coalescense, including sintering are required, especially at grain boundaries.

It is hoped that this symposium will serve as a useful point of departure.