# DISCUSSION

*R. B. Adamson*[1]—To date, very little is known about the influence of stress on the growth phenomenon. One of your specimens, the composite specimen which was welded into a unit which bowed under the influence of differential growth, developed a stress during irradiation. Is any difference in the results between that specimen and those irradiated in the stress-free condition? Have you considered the possible effects of irradiation enhanced creep or stress influenced growth on your experiment?

*J. E. Harbottle (author's closure)*—One of the reasons for having two types of specimen was to examine the effect of stress on the growth strain. No difference was detected in the results from the stressed and the unstressed specimens. The stress developed in the bow specimens is very small and would be unlikely to produce measureable *thermal* creep. The highest temperature at which bow specimens were used was 80 C so the possibility of significant thermal creep is discounted. The stresses are so low that the creep due to *growth* in a polycrystal (radiation enhanced creep) is only a small fraction of the stress-free growth strain.

I have not considered the effect of stress on the growth rate of a single crystal of Zircaloy 2. The experiments of Buckley[2] on uranium single crystals indicate that stress does not effect their growth rate, but as there are other differences in the growth behavior of the two materials, this observation does not apply necessarily to Zircaloy 2.

*A. L. Bement*[3]—Both G. R. Piercy and F. A. Nichols have been critical of your past interpretations of growth in Zircaloy 2. G. R. Piercy's[4] criticism pertained to the difficulty of explaining the in-pile creep data of Fidleris[4] from the value of the growth coefficient, $G$, previously reported by Hesketh[4] (assumed constant with neutron fluence). F. A. Nichols'[5] criticism pertained to your assumption that Roberts–Cottrell yield creep, which would not be expected to exhibit a reversal in creep strain upon annealing, is controlling. Do the results reported in this paper reconcile these criticisms?

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[2] Buckley, S. N., "Uranium and Graphite," Institute of Metals Spring Meeting, London, 1962.

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[4] See *Journal of Nuclear Materials*, JNUMA, Vol. 26, 1968.

[5] See *Journal of Nuclear Materials*, JNUMA, Vol. 26, 1968.



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*J. E. Harbottle (author's closure)*—In a manuscript freely commended by one editor of the *Journal of Nuclear Materials* and firmly rejected by another, R. V. Hesketh has replied to the criticisms of Piercy and of Nichols. There is no difficulty in explaining the in-pile creep data of Fidleris. The initially high value of $G$ explains why steady irradiation creep can be distinguished after about 600 h instead of after about 8000 h, as one would expect if $G$ were to be nearly unity from the beginning of irradiation [*5*]. There is a confusion in Nichols' work between steady creep and transient creep. The transient probably is not negligible in the relaxation data of the Bettis group. Nichols' criticism rests upon these data.