# DISCUSSION

*S. D. Harkness*[1]—What are the implications of your work for the use of HVEM and other ion irradiations for investigating new alloys?

*F. A. Garner (authors' closure)*—Preconditioning provides a tool to investigate the swelling behavior of alloys whose void nucleation may be controlled by microstructures that can develop only in-reactor. The utility of this technique is limited by the availability of neutron-irradiated material, which will be in short supply or nonexistent for new alloys. As low fluence swelling data become available, investigators may wish to bombard preconditioned specimens to high fluences and compare the results with unconditioned irradiations.

*David Kramer*[2]—Is it possible to produce preconditioning with respect to void density by a two step irradiation where the first step at one temperature produces nucleation and the second step is done at the desired temperature of interest?

*F. A. Garner*—Such an experiment has been reported elsewhere[3] in pure nickel where low temperature electron irradiation not only nucleated voids at higher densities but also provided a stable dislocation network unobtainable at a high temperature. In the analysis of such an experiment one must be certain to factor in the change in denuded zone depth which will increase at the higher temperature.

*T. E. Michell*[4]—Do you think there is a denuded zone in thin foils for dislocations as well as for voids, and do the two denuded zones interact with one another?

*F. A. Garner*—Thomas and I have previously examined the dislocation structure in the void denuded zones (see Ref *10* of paper) and found that dislocations are not denuded to any measurable depth in stainless steels. I have no doubt, however, that there exists a gradient in the dislocation density near the surface. I would expect that the void denuded depth is dependent on the dislocation density, and that constitutes an interaction of some sort.

*I. S. Levy*[5]—Would preconditioning also be required for heavy ion bombardment simulations, which have a larger cascade effect than does the HVEM?

[1] Combustion Engineering, Windsor, Conn. 06095.
[2] Atomics International, Canoga Park, Calif. 91304.
[3] Makin, M. J., *Philosophical Magagine*, Vol. 25, March 1972, pp. 761–767.
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*F. A. Garner*—Preconditioning is not required for any simulation experiment but is merely a technique we will use to study the influence on swelling of the microstructure developed on time frames that cannot be duplicated in the HVEM. The evolution of the early microstructure is probably not so much related to the presence of displacement cascades as it is to the time, temperature, and flux history of the reactor.

*G. R. Odette*[6]—Have you monitored the dislocation structure evolution in the preconditioned material and compared it to the neutron case? This might have implications with respect to saturation mechanisms.

*F. A. Garner*—It is very difficult to monitor the evolution of dislocations in preconditioned irradiations. The neutron-produced dislocation densities are already very high; the foils must be thick enough to reduce the impact of surface effects and the observations are made at temperature. The net result is to preclude such observations.

*A. Taylor*[7]—Have you made any observations of denuding along grain boundaries in preconditioned electron irradiated specimens?

*F. A. Garner*—Denuded zones at grain boundaries are observed frequently in neutron irradiated steels. In electron irradiations, however, it is our practice to avoid grain boundaries.

*G. L. Kulcinski*[8]—Do you feel that the precipitate structure is stabilized in this preconditioning test? For example, do you think the lack of resolutioning of precipitates during HVEM studies will simulate neutron irradiation tests where possible resolutioning effects are taking place?

*F. A. Garner*—We cannot answer that question at present. There are other experiments in progress at our laboratory designed to determine the extent of cascade-induced resolution of precipitates. One of our objectives is to determine which simulation techniques have the better capabilities for providing representative simulations of the various aspects of material response to neutron irradiation.

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