and explained to the extent that a working theoretical framework exists. True, many details remain to be filled in, but none that fit the description given.

The statement, ". . . Implantation of energetic ions changes the structure of crystal layers under bombardment . . ." is factual as far as it goes. The hundreds of Frenkel pairs (*associated* vacancies and interstitials) created near the end of the range of the stopped ion are indeed a "change of structure," but an easily rectified one. Heat treatment (annealing) at temperatures well below those required to diffuse measurably substitutional ions removes the evidence, electrical, physical and chemical, of these defects. The stronger interatomic forces of materials characterized by high energy gaps will raise the annealing temperatures of, for example, implanted silicon carbide or aluminum phosphide, but there is no reason to conclude *per se* that the structural change is irreversible in a practical sense.

The aphoristic ". . . Sputtering and back diffusion limit maximum impurity concentration . . . although . . . arbitrarily high impurity concentration would seem to be attainable . . ." suggests that the author has relied on the significant, but nevertheless early, ion implantation efforts of J. O. McCaldin at North American Aviation Science Center and D. B. Medved at Electro-Optical Systems, both of whom implanted heated silicon targets with "low" energy (less than 30 keV) alkali ions. The sputtering effects in their work were pronounced indeed. It is a well known experimental fact that sputtering yield is a function of ion energy and for most ion–target combinations reaches a broad maximum below 40 keV. The sputtering yield then drops for increasing energies to become insignificant for practical purposes above 80 keV. The column I elements are known to be interstitial diffusants, and any back diffusion observed was more likely due to a choice of ion and target temperature (400°C to 500°C). These effects are of no consequence in numerous later experiments performed with energetic columns III and V ions and *cold* targets, ranging in temperature from 77°K to 300°K. Impurity concentrations exceeding thermal solubility limits *are* attainable, as evidenced by the recently published results given by Ogden J. Marsh and coworkers (*Appl. Phys. Letters* **11**, 92, 1967).

Finally, ". . . particle currents of many presently available heavy-ion beams in the relevant energy range of about 30–500 keV can barely hold their own in the number of impacts per unit time and area with residual gas molecules in a conventional vacuum . . ." hardly does justice to a rapidly developing accelerator technology in which microampere current levels of finely focused isotopically pure beams are available for all the elements of practical interest in the energy range given. The gaseous species encountered by ions in their flight are not "dirt" impurities in the sense that their incorporation will influence electrical properties of implanted layers to any significant extent. Nitrogen may ultimately offend in this respect, however, since experimenters have shown conclusively that it produces doping effects when it is accelerated and implanted.

CLAUD M. KELLETT
NASA Electronics Research Center
Cambridge, Mass.

Who "defects"?

I object to the use of the word "defected" in two personal news notes on page 107 of the December PHYSICS TODAY. This is a jargon word of the cold war that implies an adverse political judgment on the individuals involved. The American Institute of Physics should favor the free international movement of scientists and should not speak disparagingly of those who have been forced to relocate because of adverse political conditions.

The verb "defect" is not defined in the jargon meaning by the Oxford English Dictionary, but it does define "defector" as "one who falls away; a seceder or deserter," which certainly carried a derogatory implication. Were Albert Einstein, Leo Szilard, James Franck and Enrico Fermi defectors?

E. U. CONDON
University of Colorado

The meaning we had in mind appears in our unabridged *Webster's Third New International Dictionary*: "to desert a cause or party, esp. in order to espouse another."

THE EDITORS □