On Conjecture and Proof

To the Editor:

It seems to me that the recent exchange of letters (*MRS Bulletin*, August 1997, p. 6), between R. Cahn and the authors H. Leamy and J. Wernick misses an important point. Namely, that conjecture and proof are different entities. In this year of the electron, this can be illustrated by the strong conjecture at the time of Faraday that electricity consists of discrete particles. This waited many decades for proof by Millikan.

There was an abundance of conjecture and indirect evidence for the existence of dislocations in crystals at the time of R. Cahn's studies of polygonization (1947). However, there was no irrefutable evidence, and only approximate quantitative evidence. Thus hard core critics dismissed it all as "piffle," while true believers were excited by every new development that promised a proof. For this novice graduate student it was an exciting time. Cahn's observations of polygonization, and of etchpits at the sub-boundaries substantially strengthened the conjecture, but since there was no proof of a one-to-one correspondence between etchpits and dislocations, most of the researchers of the time would not have concluded that dislocations were necessarily directly observed.

Soon (1949), a quantitative theory of grain boundaries in terms of dislocations was developed by W. Shockley and W.T. Read (*Phys. Rev.*, **75**, 1949, p. 692). It agreed quantitatively with experimental values of energies vs. mismatch angles, but was still indirect. J. Washburn and E.R. Parker (*J. Metals*, **4**, 1952, p. 1076) showed that applied stresses can move small-angle grain boundaries in zinc. This gave additional support to the conjecture that discrete dislocations exist in crystals, but did not provide a proof.

Then, Bill Pfann observed a long set of uniformly spaced etchpits in a specimen of Ge, and interested Linc Vogel in attempting to measure the presumed small mismatch-angle across the line of etchpits. Together with H.E. Corey and E.E. Thomas, Vogel did this with considerable precision, and found that the combination of germanium's crystallographic structure, the etch-pit spacing, and the mismatch angle agreed quantitatively with the dislocation theory of grain boundaries (*Phys. Rev.*, **90**, 1953, p. 489). Voila! Proof! No loose ends!

I remember vividly the excitement of seeing the Vogel et al. paper for the first time. Its beauty was its uniqueness. There were no longer any ifs, ands, or buts. Quantitative proof left no room for doubt. For me, this paper proved the conjecture for the first time.

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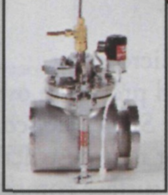

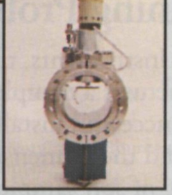

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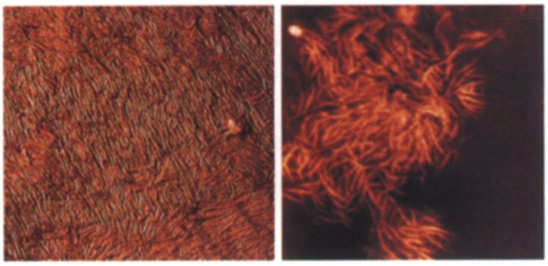

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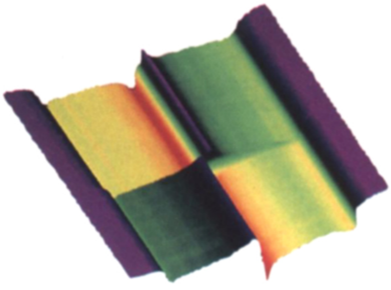

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