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This Week's Citation Classic

Schoeck G. The activation energy of dislocation movement. *Phys. Status Solidi* **8**:499-507, 1965. [Instituto des Fisica, Centro Atomico Bariloche, and Institut für theoretische und angewandte Physik der Technischen Hochschule Stuttgart, FRG]

The paper makes an analysis of the thermodynamic state functions of a crystal containing a dislocation which moves through the lattice under the action of external and internal stresses and which overcomes localized obstacles in its path with the aid of thermal fluctuations. [The *SCI*® indicates that this paper has been cited over 160 times since 1965.]

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"After spending several years at research facilities and universities, first in the United States and then in Latin America, I accepted in 1964 a visiting professorship at the University of Stuttgart. The physics department there operates in very close scientific and personal contact with the Max Planck Institute for Metals Research. This was and still is one of the leading centres in studying defects in crystalline solids and I found the atmosphere very stimulating in every respect. For years I had been interested in the plastic deformation of metals which is accomplished by the movement of dislocations through the crystal. When a dislocation encounters some localized obstacle in its path it can overcome it with the aid of thermal activation. This means that local phase-coincidence of elastic lattice waves (or phonons) supplies the necessary energy. This is a problem of irreversible thermodynamics which is a very complex and complicated subject. Fortunately, in this case the problem reduces to one of steady state which under certain assumptions can be tackled with the methods of equilibrium thermodynamics. In stimulating discussions with Seeger, now director of the Max Planck Institute, and Schottky, now with IBM, we agreed that the treatments given previously were not complete and I tried to do something about it. The problem is that we have to consider a statistical event in a large ensemble. In changing the external variables such as temperature or applied stress we do not only influence the individual event but also change the ensemble average. Misconceptions arose and still arise when these two effects are not clearly separated.

"Therefore, I considered a very special case, but as it turned out later, the resulting equations apply under a much wider range of conditions. Actually, in performing an integration I replaced the correct integration limit by one which I thought had a more obvious physical interpretation. Maybe some of the citations of the paper result from the fact that people like to point out some error in somebody else's work.

"Coming back to the subject of thermodynamics I regret that in present teaching curricula it is not given enough consideration. Thermodynamics is one of the most fundamental sciences and allows one to make quite general predictions about the outcome of experiments or processes without knowing too much about details. Even at the present state of specialisation any physicist should master it and many errors and fruitless discussions could be avoided if everybody would."