This Week's Citation Classic

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Kuhlmann-Wilsdorf D. A new theory of workhardening.
T. Met. Soc. AIME **224**: 1047-61, 1962.

The hardening which accompanies the plastic deformation of metals and all other crystalline materials is proposed to arise because the dislocations arrange themselves into gradually densifying networks, i.e. shorten in length, and therefore resist critical bowing-out, and hence further deformation, with increasing stress. [The *SCI*® indicates that this paper was cited 103 times in the period 1961-1977.]

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"Research into the mechanical properties of crystalline materials has run like a red thread through my professional career, although not to the exclusion of other interests, among them, properties of surfaces, radiation damage, melting and liquids, and science and religion. It began with "the bomb that changed my life." One of the few WW II bombs to fall on Gottingen blew out doors and windows in our department, thereby forcing the abandonment of my initial thesis research which required careful temperature control. As it was, I could subsequently make measurements down to freezing without artificial cooling, simply utilizing the ambient room temperature.

"Even at that time I considered that bomb a fateful lucky happening (fortunately none were injured or killed). It permitted me to switch to research on dislocations, that crystal defect which is widely taught now in undergraduate courses and is absolutely basic for our understanding of properties of solids, but which then was still quite conjectural. At that time there were only four persons in Germany fairly knowledgeable about dislocations, and I remember my conscious decision to reject all other hypotheses and to interpret my thesis research in terms of dislocations.

"Although the idea underlying the paper under discussion is most compelling and simple, and the phenomenon concerned, i.e. the hardening of most substances when they are bent, twisted, etc., is of enormous practical importance, it faced a rocky start. To begin with, the paper was under review for three months and still the editor had received no comments since reviewers either declined or reported themselves unable to judge the merit of the paper. At this stage, the editor asked my own opinion and accepted the paper on my recommendation.

"For a number of years after its appearance, the paper remained largely neglected in favor of the then prevailing view that work-hardening was caused by dislocation pile-ups. Somewhat ironically, I had introduced the pile-up concept in my earliest papers but, finding it wanting, abandoned it in 1952 before it was propagated by others. The 1962 theory, known as the "mesh-length theory," has been worked out in considerable detail in my subsequent papers. It is supported by much experimental evidence and is now becoming widely accepted."