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Basinski Z S. Thermally activated glide in face-centred cubic metals and its application to the theory of strain hardening. *Phil. Mag.* 4:393-432, 1959.
[Division of Pure Physics, National Research Council, Ottawa, Canada]

Analysis of the temperature and strain rate dependence of the flow stress of fcc metals leads to a simple description of thermal activation of dislocations over obstacles, for which a unique force-distance relation is derived. Intersecting forest dislocations are identified as the obstacles responsible for hardening during the deformation. [The *SCI®* indicates that this paper has been cited in over 305 publications.]

Obstacles to Plastic Flow

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I had intended to become an industrial scientist, but a compulsory year of research, under the enthusiastic supervision of Dr. J.W. Christian, convinced me that searching for the unknown is very interesting. Joining the Massachusetts Institute of Technology's (MIT) Division of Industrial Co-operation as a fresh postdoctoral employee, I was handed a project involving rolling steels in a low-temperature mill. This did not appeal to me, and, fortunately, I was permitted to explore any chosen avenue. The Cryogenic Engineering Laboratory had unmatched low-temperature facilities; I wanted to work on low-temperature deformation, but there was no suitable tensometer. Inspired by the example of the head of the laboratory, Professor Samuel Collins, of building facilities as needed, I constructed a series of tensometers to fit the existing cryostat. The early work led to the discovery of adiabatic instability.[1] The first tensometer, which was hand-driven, forced me to realize how important was the rate of deformation, since, as normally cranked, the machine would produce wavy stress-strain curves. At about this time, papers by A.H. Cottrell and coworkers[2,3] appeared, showing the proportionality between the temperature-dependent and temperature-independent changes in flow stress. I decided to extend this work to very low temperatures and also to measure strain rate changes.

After joining Dr. Gerhard Herzberg's Division of Pure Physics at the National Research Council of Canada (NRC) in 1956, I built an improved tensometer; a rudimentary clutch produced a reasonably sharp stepwise change in speed. Systematic data on the strain rate and temperature dependence of the flow stress of pure metals, the foundation on which the thermodynamic analysis rested, were collected over a period of a couple of years. The term "strain-rate sensitivity," now in general use, was coined at that time.

There were then conflicting views concerning the fundamental mechanism of work hardening. The paper presented experimental data and reasoning that led to the conclusion that forest dislocations are the obstacles to plastic flow. This is now generally accepted, accounting for the heavy citation. Subsequent work on generalized plastic properties and structural studies[4,5] supported the idea of forest hardening. My interests in the fundamental understanding of the mechanical properties of matter have continued, more recently especially in the field of metal fatigue.

I have had ample opportunity for discussion with knowledgeable and inspired people along the way, which has not only been a pleasure, but also very helpful. I attribute much of the success of this work also to the excellent research atmosphere fostered at that time both at MIT and at NRC: One could take great care with experiments, and, unhindered, ponder over the meaning of the data, a luxury that is hard to find today.

In recognition of general research contributions, I was appointed an Officer of the Order of Canada.

1. **Basinski Z S.** The instability of plastic flow of metals at very low temperatures. *Proc. Roy. Soc. London Ser. A* 240:229-42, 1957. (Cited 155 times.)
2. **Cottrell A H & Stokes R J.** Effects of temperature on the plastic properties of aluminium crystals. *Proc. Roy. Soc. London Ser. A* 233:17-34, 1955. (Cited 220 times.)
3. **Adams M A & Cottrell A H.** Effect of temperature on the flow stress of work-hardened copper crystals. *Phil. Mag.* 46:1187-93, 1955. (Cited 80 times.)
4. **Basinski Z S & Basinski S J.** Dislocation distributions in deformed copper single crystals. *Phil. Mag.* 9:51-80, 1964. (Cited 155 times.)
5. **Jackson P J & Basinski Z S.** Latent hardening and the flow stress in copper single crystals. *Can. J. Phys.* 45:707-35, 1967. (Cited 100 times.)

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