

# This Week's Citation Classic

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Hirth J P & Pound G M. *Condensation and evaporation—nucleation and growth kinetics*. England: Pergamon Press, 1963. 190 p. [Ohio State Univ., Columbus, OH and Carnegie Inst. Technol., Pittsburgh, PA]

The theories of homogeneous nucleation from the vapor and of heterogeneous nucleation onto a substrate are developed in terms of both quasi-equilibrium thermodynamical and statistical models. Crystal growth and evaporation kinetics are described in terms of absolute rate theory and in terms of motion of ledges under surface diffusion control. Experimental results are reviewed. [The SC<sup>®</sup> indicates that this book has been cited over 520 times since 1963.]

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"This book was an extension of my Ph.D. thesis research at the Carnegie Institute of Technology where Marshall Pound was my advisor. It was written during the period of my Fulbright post-doctorate fellowship at the University of Bristol with F.C. Frank and of subsequent service as an assistant professor at Carnegie Tech. The genesis of the book was an overlap of interests between Pound and myself at a time when the general field of crystal growth was just beginning to burgeon. He had worked in the area of nucleation in his own thesis with V. LaMer at Columbia University and was primarily responsible for the sections on homogeneous and heterogeneous nucleation. I had worked on sublimation and evaporation at Carnegie Tech and extended this work to the area of crystal growth while at Bristol, and so initiated the sections on crystal growth and dissolution. The effort involved was considerably more than we had antici-

pated, the book appearing about two years later than we first expected. I recall the anguish at the loss of a set of proofs at sea and empathetic exchanges with an editor that developed into an exchange of cartoons for some time. Also, we had expected to proof-read the manuscript in one day, but most of a day, mild losses of temper and recourse to spirits found only one-tenth of the material completed.

"The frequent citation of the work probably was because it completely covered the field through 1962 and because the area was just beginning a period of enormous growth. Early nucleation theory by M. Volmer,<sup>1</sup> primarily for homogeneous nucleation, was just being extended to liquid and solid transformations and to heterogeneous nucleation from the vapor to substrates by G.M. Pound,<sup>2</sup> and D. Turnbull and J.H. Hollomon.<sup>3</sup> F.C. Frank had just provided the basis for the modern view of crystal growth by his work on the effect of screw dislocations on growth and, later, on the ledge kinetics of crystal growth.<sup>4</sup> We included these ideas, together with our own on sublimation, and covered the entire field with a review of 539 references. Since then the literature has grown to tens of thousands of references and the pertinent journals *Surface Science*, *Journal of Crystal Growth*, and *Physics of Thin Films* have appeared. Our work is often cited to cover early work in the growth and evaporation field. Indeed, much of the treatment of nucleation is relevant today and is currently a topic of great interest in astronomy with regard to formation of interstellar dust. A more recent review is provided in *Crystal Growth*.<sup>5</sup>

1. Volmer M. *Kinetik der Phasenbildung*. Dresden and Leipzig: Steinkopff. 1939. 220 p.

2. Pound G M. Homogeneous nucleation theory. *Ind. Eng. Chem.* 44:1278-301, 1952.

3. Hollomon J H & Turnbull D. Nucleation. *Prog. Met. Phys.* 4:333-88, 1953.

4. Burton W K, Cabrera. N & Frank F C. The growth of crystals. *Phil. Trans Roy Soc London A* 243:299-358, 1950.

5. Parker R L, Chernov A A, Cullen G W & Mullin J B. *Crystal growth*. Amsterdam: North-Holland. 1977. 662 p.