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This Week's Citation Classic

Newhouse V L. *Applied superconductivity.* New York: Wiley, 1964. 285 p.
[General Electric Research Laboratory, Schenectady, NY]

This book is about the device applications of superconductivity and was the first to be written on the subject since its start with the appearance of high field superconducting magnets. It covers the physics of the superconductive devices known at that time, and about one third of it reviews my own work. This includes the thermal propagation effect, the current induced superconducting-to-normal transition of films, the electrostatic analogy for superconductors, and superconductive film switching and storage devices. [The *SCI*® indicates that this book has been cited over 65 times since 1964.]

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"This book was started in 1961, about halfway during the ten-year period I spent at the General Electric Research Laboratory, and was the first attempt to cover all existing and proposed (mostly proposed at the time!) applications of superconductivity. It seems to me now that, during this 'Golden Age of Superconductivity,' the subject went through a degree of growth which in its richness, magnitude, and speed has surely never been exceeded by any other science.

"The events which make up this saga may be said to have started with the publication in 1956 by Dudley Buck[1] of the current-controlled superconductive computer switching element which he named the 'cryotron.' The next year Bardeen, Cooper, and Schrieffer[2] announced their Nobel prizewinning theory of superconductivity, and the following six years saw in turn the development of (thin film) computer storage and switching elements, the discovery of the so-called Class II superconductors, of Giaever tunneling, of the superconducting flux quantum, and of methods of fabricating the very brittle, high critical field superconductors into usable solenoids capable of generating 10^5 Gauss. As a grand climax came the verification of Josephson tunneling!

"In view of the fact that this book was finished during the middle of this 'Golden Age of Superconductivity,' it is surprising to find that it should still be cited almost 20 years later. For a more recent review see my 1975 book.[3] A dip into the literature shows, however, that most of the more recent citations are not to the book as a review of the field, but are instead a shorthand way of referencing various parts of my own work, which are contained in the book. Of these, the most often cited is the thermal propagation effect, which my colleague John (Jack) W. Bremer and I discovered in 1958.[4]

"The origin of this discovery was the finding that the currents which caused superconducting films to undergo a superconducting-to-normal phase transition were much smaller than predicted by theory. The fact that the reported transitions were very sharp and showed hysteresis led me to suspect that they must be caused, not by the current directly, but by the Joule heat from a tiny ('weak') region of the superconductor, which by driving the adjacent regions normal through heat conduction, causes more Joule heat to be produced, leading finally to a runaway thermal transition. I still remember my excitement when Jack and I verified this hypothesis by creating a magnetically induced normal nucleus in a current carrying superconducting film, and then observed it propagate along the whole length of the film.

"During the rest of that year Bremer and I finished disentangling the confusion in the literature regarding the current induced superconducting-to-normal transitions of films and were finally able to achieve satisfactory agreement with theory. This work was reasonably succinctly described in the book and seems to be the reason for the fact that it is still cited."

1. **Buck D A.** The cryotron—a superconductive computer component. *Proc. IRE* **44**:482-93, 1956.
2. **Bardeen J, Cooper L N & Schrieffer J R.** Theory of superconductivity. *Phys. Rev.* **108**:1175-204, 1957.
3. **Newhouse V L,** ed. *Applied superconductivity.* New York: Academic Press, 1975. Vol. II. p. 387-700.
4. **Bremer J W & Newhouse V L.** Thermal propagation effect in thin superconducting films. *Phys. Rev. Lett.* 1:282-4, 1958.