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This Week's Citation Classic®

Jona F & Shirane G. *Ferroelectric crystals.* Oxford: Pergamon Press, 1962. 402 p.
[IBM Research Center, Yorktown Heights, NY and Westinghouse Research Laboratory, Pittsburgh, PA]

The book is a compilation of all ferroelectric crystals known in 1960 and their properties. The introductory chapter includes a presentation of the thermodynamics of crystals while the last chapter touches briefly on the then-new idea of lattice vibrations and soft modes as the origin of ferroelectricity. [The *SCI*® indicates that this book has been cited in over 1,145 publications.]

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The anomalous dielectric behavior of certain crystalline materials, known as ferroelectricity, constitutes an important sector of solid-state physics today and is actively studied in a large number of laboratories around the world.[1] The development of the field, however, was initially slow and erratic. The oldest ferroelectric crystal known, a double tartrate of sodium and potassium (called Seignette or Rochelle salt), used as a laxative in the seventeenth century, had been noted by the Curie brothers in 1880 for its abnormally large piezoelectric effect and in 1894 by Pockels for its large electro-optic effect. But its anomalous dielectric properties were discovered first in 1921 by Valasek[2] in Russia and remained unique and little-noticed until 1935, when Busch and Scherrer,[3] in Zurich, discovered similar properties in potassium dihydrogen phosphate. In the 1940s and 1950s, despite the discovery of a number of new ferroelectrics, the phenomenon was studied in only about half-a-dozen laboratories in Switzerland, Japan, and the US.

I was introduced to the ferroelectric phenomenon as a graduate student in Zurich by my adviser, Paul Scherrer, and continued working in the field after my doctorate, when I joined Ray Pepinsky's group at Penn State in the early 1950s. There, I met Gen Shirane, who had joined the Pepinsky group from the Tokyo Institute of Technology. Gen and I worked together on a number of ferroelectrics until 1957 when we both moved to the Westinghouse Research Laboratory in Pittsburgh. Two years later, we parted ways, when I went to the IBM Research Center in Yorktown Heights, but Gen remained at Westinghouse.

I had considered changing my field of research (and I did so, in fact, in 1960, soon after joining IBM), but shortly before leaving Pittsburgh I was asked by representatives of Pergamon Press to write a book on ferroelectricity together with Gen. Being young, eager, and not so wise, we accepted. We knew, however, that the effort of writing a book on so little-known an effect in solid-state physics would never produce financial gains. During the last few months in Pittsburgh, I wrote at night, working until three or four in the morning, occasionally drinking beer to quench my thirst. I remember this detail because Gen, who was doing the same at his home, told me that if the book royalties repaid us for the expense of the beer consumed during the writing, we should consider ourselves lucky. (They did, I guess, but barely.) Gen and I had decided that only one of us was going to do the final writing, in order to give the book a uniform style, and I was the one to do it. Thus, I rewrote the chapters that Gen had written and had the final typescript ready at the end of 1960, a few months after joining the IBM laboratory.

In a way, the book was already obsolete when it appeared in print in 1962 because the "soft-mode" theory that Bill Cochran had developed to give a general explanation of the ferroelectric phenomenon in all materials was published[4,5] just when Gen and I had finished our writing effort. Thus, our book presents the state of the art in the "pre-soft-mode" period of ferroelectricity, a feature of little interest *per se* and perhaps only of historical value. That the book has become a *Citation Classic* is, therefore, surprising. The reason for this fact, I suppose, lies in the value of the book as a reference for a large number of experimental (especially structural) data on a respectable number of ferroelectric crystals, as well as an introduction into the thermodynamics of the phenomenon.

1. Proceedings of the Japan-U.S. Seminar on Light-Scattering Studies of Structural Phase Transitions, June 1983, Bentenjima, Japan. (Whole issue.) *Ferroelectrics* 52(1/2/3), 1983. 263 p.
2. **Valasek J.** Note on the piezo-electric effect in Rochelle salt crystals. *Science* 65:235-6, 1927.
3. **Busch G & Scherrer P.** Kurze Originalmitteilungen. *Naturwissenschaften* 23:737, 1935.
4. **Cochran W.** Crystal stability and the theory of ferroelectricity. *Advan. Phys.* 9:387-423, 1960. (Cited 705 times.)
5. **Cochran W.** Crystal stability and the theory of ferroelectricity. Part II. Piezoelectric crystals. *Advan. Phys.* 10:401-20, 1961. (Cited 265 times.)

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