is a conscious decision to underscore the remarkable successes and space-weather contributions of the joint effort by the European Space Agency and NASA in launching the *Solar and Heliospheric Observatory* satellite, or *SOHO*.

The technical level of the articles is highly variable, with no sense of progression from one topic to the next. Four pages of acronyms and abbreviations are provided up front to assist the reader, but the proliferation of jargon and the contributors' propensity to refer to all manner of effects, phenomena, organizations, and objects by unintelligible sequences of capitalized initials is eventually annoying. That said, I did find most of the articles to be comprehensive, clear, and engaging. But the contributions that disappointed me the most were those on topics in which I have the strongest research background and working knowledge. Those articles often failed to provide the deep physical insights that help to catalyze the reader's comprehension and understanding. In light of that realization, I began to wonder just how accurate my glowing positive assessments of the other articles might be.

The above observations bring me to the question of precisely what niche the book fills. With the expensive price tag of $200 for the smart-looking hardback edition, the book will not reach graduate students, who would most benefit from its sweeping overview of the subject. Neither will it appeal to working space scientists and space-weather forecasters, who will find the treatments a little too superficial and lacking in critical technical detail: There are already several specialized monographs and conference proceedings that will better serve the needs of the experts. In addition, the technical detail and jargon make the book a difficult read for physical scientists interested in expanding their interdisciplinary horizons and for the science policy analyst wishing to come up to speed on how space weather will affect our technologically sophisticated global economy.

Although *Space Weather* tries unsuccessfully to fill the vast middle ground between popularizations and specialized technical treatments of the subject, its extensive reference lists at the end of each chapter are extremely valuable. I believe the book functions best by sitting on the library reference shelf where it can be readily consulted as needed.

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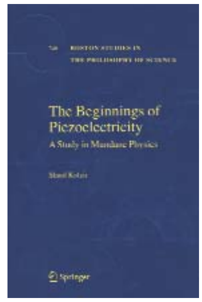
The Beginnings of Piezoelectricity

A Study in Mundane Physics

Shaul Katzir
Springer, Dordrecht, the Netherlands, 2006. $149.00 (273 pp.). ISBN 978-1-4020-4669-8



Even though Shaul Katzir's *The Beginnings of Piezoelectricity: A Study in Mundane Physics* is published as part of the Boston Studies in the Philosophy of Science series, it will also interest applied scientists and engineers working on modern aspects of piezoelectricity and electromechanical transduction in materials. The field is still very active and has produced many important devices such as ultrasonic transducers, frequency generators for clock control, and precise small-scale movement stages. Advancements have reopened some of the fundamental questions discussed in the book: the preparation and optimization, over the last few decades, of polar piezoelectric polymers and of piezoelectrets and ferroelectrets from nonpolar polymers; the recent attention to space-charge and fatigue effects in piezoelectric crystals and ceramics; and the ongoing development of techniques for examining the dynamics of fast structural changes in condensed matter.

As a historian and philosopher of science at Bar-Ilan University in Israel, Katzir is mainly interested in the development of scientific methods and thoughts at the end of the 19th century. He subscribes to the traditional view of piezoelectricity as a phenomenon restricted to crystals that do not have a center of symmetry; therefore, he assumes that Woldemar Voigt's classical theory based on crystalline symmetry is comprehensive. According to Katzir's view, the experimental and theoretical treatment of piezoelectricity was essentially complete around 1900. As a consequence, the author must consider earlier and later works on mechano-electrical (mechanical to electrical) or electromechanical (electrical to mechanical) transduction effects in various materials as only loosely connected to piezoelectricity. Hence he concludes that the seminal experiments of brothers Jacques and Pierre Curie represent the discovery of piezoelectricity. That conclusion is correct, but the role of previous contributions to the field should not be underestimated.

Katzir's book demonstrates how the works of leading British, French, and German physicists contributed to piezoelectricity research during the last two decades of the 19th century. Those scientists' names are still well known today. Among them are the Curie brothers, Voigt, Lord Kelvin, Wilhelm Röntgen, August Kundt, and Friedrich Pockels. The author shows how innovative experiments, new and refined theoretical concepts, and precise measurements led to the quick and relatively complete exploration and explanation of piezoelectricity in crystals. By drawing extensively on the original publications, the author tells an intriguing story of a rapid scientific development that was not yet driven by the potential for commercial applications but instead by the desire to understand the causes of observed phenomena. He also shows how several national and local schools and scientific traditions, such as the style of performing experiments, strongly influenced and shaped the course of the early exploration of piezoelectricity.

Of the three main theoretical approaches to piezoelectricity—the phenomenology of thermodynamic systems, the microscopic mechanisms of atomic and molecular interactions, and the structural symmetry of crystals—the last one is clearly preferred in the book. The author's choice is appropriate from a historical point of view; but because researchers today have much better access to microscopic and nanoscopic phenomena, a modern perspective would probably put more emphasis on the first and especially the second approach.

Katzir developed his book from his 2001 PhD dissertation. Its origin is evident from the many footnotes that sometimes contain essential thoughts. The book also contains several errors of fact and instances of poor editing, which are stumbling blocks that reduce the reader's enjoyment. Examples include y and z instead of γ and Z_z or an equal sign instead of a multiplication sign (page 172); misstated scientific terms, such as "convention" instead of "convection" (pages 48 and 109) or "bond charge" instead of "bound charge" (page 166); wrong German spelling and grammar, such as "Lehere" instead of "Lehre" in several instances or "Piezoelektricität" instead of "piezoelektrische" (page 207). One factual inaccuracy is footnote 85 on page 182: The similarities between electrical and magnetic phenomena were already known to the ancient Greek writer Thales and Elizabethan physician William Gilbert. And contrary to footnote 50 on page 211, the "Deutsche Mark," or DM, was introduced only after World War II. Careful copyediting by the publisher could have eliminated most of those problems.

Such shortcomings need to be repaired in a second edition of the book. Some of the extensive summaries of references should probably be replaced by verbatim quotes from the well-written original papers, along with good translations. Nevertheless, even the present first edition of *The Beginnings of Piezoelectricity* is a useful and thought-provoking study of an often-neglected but exciting seminal field of materials physics.

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Spinning Flight

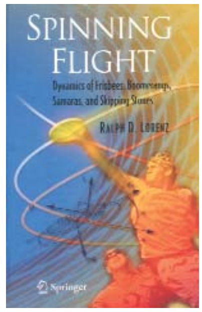
Dynamics of Frisbees, Boomerangs, Samaras, and Skipping Stones

Ralph D. Lorenz
Springer, New York, 2006. $49.95 (346 pp.). ISBN 978-0387-30779-4

Consider the following natural phenomena: The seed of a sugar maple tree spins as it falls to the ground, autorotating in the wind to achieve more time in the air and hence a longer horizontal distance from the tree. A spinning stone skips over the surface of water.

Similar movements can be seen every day in our society. A cylinder spins about its axis in a fluid flow and experiences an aerodynamic force perpendicular to both the flow and the axis; that mechanism has actually been used to propel ships. A baseball spinning to create a similar aerodynamic force results in a curved pitch. The same thing happens when a golfer hooks or slices a golf shot. Some gun barrels are rifled, or grooved, to impart spin to the bullets. A Frisbee is a spinning disk especially designed to achieve long distances through the air. A boomerang spins in such a way that the aerodynamic force on it leads to circular flight that allows it to return to its owner. And artificial satellites, along with everything else in space—stars, planets, comets, asteroids, and so forth—spin in space.

All examples given here are covered in Ralph D. Lorenz's *Spinning Flight: Dynamics of Frisbees, Boomerangs, Samaras, and Skipping Stones*. To my knowledge, Lorenz's work is the first in which the dynamics of spinning bodies have been treated under a single cover. Some of Lorenz's examples are esoteric, but all, unified by aspects of spin, have been cleverly put together in a very readable book. The author emphasizes the physical aspects of each situation, with only a minimum of mathematics and formulas. That characteristic is the value of the book, which is not a contribution to the scholarly state of the art but rather a smooth survey of the dynamics of spinning bodies taken as a whole. In that regard, it appears to be complete. Topics in its 14 chapters cover the map, and include the aerodynamics of balls, airbags, tumbleweeds, spinning aircraft, Frisbees, and samara seeds.



Spinning Flight reflects the author's research. Lorenz, who now works at the Johns Hopkins University Applied Physics Laboratory in Maryland, holds a degree in aerospace engineering. His former position was with the lunar and planetary laboratory at the University of Arizona in Tucson, where he worked