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ELECTRONS AND ELECTRODES
(Book review)

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Electrons and Electrodes

Tunneling Phenomena in Solids. Lectures presented at a NATO Advanced Study Institute, Risö, Denmark, June 1967. ELIAS BURSTEIN and STIG LUNDQVIST, Eds. Plenum, New York, 1969. x + 582 pp., illus. $35.

The tunneling of electrons or other particles through a potential barrier is a purely quantum-mechanical phenomenon having no classical analogy. Research on tunneling, however, does have a classical analogy: cooking. In most cases the skill of the chef is more important than the quality of the ingredients—every chef has his own secret recipes—and the final result frequently ends up in the garbage. It was with great anticipation that I received this volume, hoping it would be the badly needed "cookbook" of the field. Alas, it is not, although it does contain some interesting recipes.

A glance at the table of contents of this volume suggests that the material covered is as diverse as the title would suggest; topics listed range from atomic tunneling in solids to quantum interferometry using Josephson junctions. Upon more careful examination one discovers that, except for a cursory article or two, most of the book deals with electronic tunneling between two electrodes. The first half contains sections on general tunneling theory and on semiconductor Schottky and *p-n* diodes, with several chapters devoted to phonon-assisted tunneling. The second half is devoted primarily to metal-insulator-metal junctions, with the preponderance of the authors discussing superconducting tunneling of one type or another. There is also an excellent section of related papers, both experimental and theoretical, on the Josephson effect. The organization of material, however, serves to emphasize the diversity of the subject matter rather than its underlying unity.

This is the only published compendium of the developments of the field (up to 1967) in which the developments are described by the original researchers. Many of the chapters present valuable insights, experimental techniques, and a variety of warnings against repeating the mistakes of others. For these reasons alone, this book should be on the shelves of those who are either considering working in the field or seeking applications of tunneling junctions and devices to other problems.

The casual reader, however, who approaches this volume for the purpose of obtaining an overall view of a rather diversified field with a multitude of both potential and realized technological applications may experience some difficulty in trying to put things in perspective. Although some attempt has been made to collect similar topics into adjacent chapters, the arrangement is rather haphazard and lacking in logical continuity. In addition, as with so many symposium volumes, many topics are discussed but each segment tends to be too narrow and specialized. There is no general review article to tie the subjects together. Reference lists have been left to the individual authors to provide, and the result is a narrow and subjective selection with a great deal of overlap.

There are at present only two other books dealing with electronic tunneling, one of them restricted to superconducting junctions. Duke's *Tunneling in Solids*, a supplement to the classic Seitz and Turnbull series *Solid State Physics*, presents the entire subject of tunneling between two electrodes in a systematic, well-organized, and thorough manner while emphasizing the spectroscopic aspects and applications. It is somewhat more theoretical and up-to-date and contains a fanatically comprehensive list of references, but often lacks the particular flavor imparted by an author who is reviewing his own work. Those who are interested primarily in superconducting tunneling or the Josephson effect should also consult the several relevant sections of Parks's *Treatise on Superconductivity*, in which a more cohesive treatment of these specialized topics is presented in much greater depth.

In summary, this book, though flawed, is a unique introduction to tunneling phenomena for those who are unfamiliar with recent developments and an interesting bit of memorabilia for those who have been contributing in past years. For those who are currently engaged in research, however, Duke or Parks will be indispensable; Burstein and Lundqvist probably will not be. If you cannot afford all three books, shop carefully before purchasing; the value of each depends on the knowledge of the user.

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