Rhoderick clearly points out that the experimental situation is beset by problems associated with the metallurgical nature of the interface, the existence of chemical contamination, the presence of interface states, and oxide layers that may be present between the metal and semiconductor. The theoretical situation is also far from adequate because most efforts are directed at explaining ideal Schottky diodes, and even here the analytic problems are formidable. Treatments of real contacts seem to be far off. Despite this state of affairs, Rhoderick's assessment, with which I concur, is that "... we have a reasonably good working picture of metal–semiconductor contacts that serves as a basis for interpreting experimental results and also enables us to 'design' contacts to a limited extent to obtain particular electrical characteristics."

The text contains an account of the theory of Schottky-barrier capacitance, including the effects of deep levels in the semiconductor and nonuniform doping profiles. A discussion of how to form "practical" contacts, and an excellent appendix comparing Schottky diodes and p–n junctions, round out the text.

The book is excellent as an in-depth introduction to the field from both the theoretical and experimental points of view. Graduate students, undergraduates and researchers will find the book quite valuable.

ALLEN ROTHWARF
Institute of Energy Conversion
University of Delaware
Wilmington

General Relativity from A to B

R. Geroch
225 pp. Univ. of Chicago, Chicago, 1978. $11.95

Many books for non-specialists treat a subject from "A to Z" and try to give answers to all the questions one either has been "afraid to ask" or has not thought to ask. Frequently one ends up with a collection of facts, but with little understanding. By the title of his book, *General Relativity from A to B*, Robert Geroch, a professor of physics and mathematics at the University of Chicago, signals that he does not intend to be all inclusive. Rather, he set himself the modest task of having his readers understand the revolution in thinking that was required by Albert Einstein's theory.

The whole discussion focusses on what is meant by a "space–time," a subject to which Geroch himself has contributed. He moves quickly from an absolute space and an absolute time to the Galilean view, where only time remains absolute. From the observation that the orbits of double stars are elliptical, one concludes that the velocity of light is independent of the speed of its source. From measurements, one finds that it is also independent of the speed of the observer. From the observation that muons produced in the upper atmosphere reach the Earth, one deduces that elapsed time may depend on the speed of the clock. These deductions are incompatible with the Galilean view.

In what is the most difficult step in the book, Geroch defines the *interval* between nearby events and assumes it to be an invariant for all observers. Armed with this definition, he uses example after example to develop the modern notions of a relativistic space–time in which neither space nor time is absolute. The culmination is a beautiful chapter in which Geroch describes the essential features of a black hole. He draws on astrophysical evidence to support the existence of black holes, but properly cautions that the identifications are tentative.

All of this is done with a minimum of mathematics, although some knowledge of analytical geometry is helpful. Simple examples are used: observers moving in space–time and signals being exchanged between them. Geroch makes the basic arguments and explanations in terms of space–time diagrams. Over 100 such elementary line drawings appear in this book of 225 pages. The language is simple; the structure, direct. Throughout, the discussion is punctuated with comments that illuminate the nature of physics: What is real? What is true? What is an explanation? Where does observation enter? Why is prediction important?

This beautiful little book is certainly suitable for anyone who has had an introductory course in physics and even for some who have not. Moreover, it contains enough substance so that a modern physicist may find that he can learn something—perhaps only that a difficult topic can be presented to a general audience. The whole succeeds so well because Geroch believes that "physics is a human activity . . ." and wants to share some of its joys with others.

The layout of the book is good and the publisher has clearly reproduced the diagrams. With a little more care by the editor, however, about a half-dozen split infinitives could easily have been eliminated.

JOSHUA N. GOLDBERG
Department of Physics
Syracuse University
Syracuse, New York

Physics of Thin Films

L. Eckertova
254 pp. Plenum, New York, 1977. $27.50

Thin film is at present a field experiencing a fast progress in basic understanding as

well as in application. The driving force of the progress comes from the need for thin-film technology by the electronics industry. The demand for a faster speed and denser packing in microelectronics has now prompted many scientists to study the fabrication of submicron thin-film structures and their unique properties. How to examine these structures has also provided the thrust to develop microanalytical techniques for greater sensitivity and multiple analytical capabilities. The recent formation of a "Thin Film Microstructure Science and Technology" subcommittee in the National Science Foundation is an indication of the significant progress in the thin-film field.

Thin film covers a wide range of disciplines and applications (materials science, electronics, surface science and solid-state physics), and shows a strong interplay between science and technology, as illustrated by the example of thin-film contacts to semiconductors.

In such a fast developing and vast field, it is crucial to be able to grasp the basic phenomena and fundamental principles. With this viewpoint, I welcome the publication of *Physics of Thin Films* by Ludmila Eckertová of Charles University, Czechoslovakia. The book is of medium size (254 pages). We should congratulate Eckertová for attempting to emphasize physics in the thin-film field; nevertheless her accomplishment is unsatisfactory.

The outline of the book is conventional. It starts with film preparation and formation, then thickness and microstructure measurements, followed by properties of thin films (mainly mechanical and electrical) and finally application of thin films. Among the various topics, I found the sections on thin-film nucleation and transport properties more informative than the rest. For example, Eckertová points out on page 31 that deposition variables such as residual-gas pressure, evaporation rate, and temperature and structure of the substrate are important in producing films with reproducible properties. She gives detailed discussions on how each of these variables affect thin-film structure and composition. In general, thin-film properties are strongly affected by microstructure, and hence the transport property of thin films is more complicated than that of bulk specimens because of microstructure dependence. Eckertová discusses the correlations to surface scattering, thickness, grain size, and discontinuous films.

On the other hand, the book contains a very limited treatment of some current topics on thin films, and no mention at all of interfacial reaction and diffusion in thin films, which are at present very active areas. Also, Eckertová makes no mention of Rutherford backscattering technique, which can be used to measure film thickness, especially the intermetallic layers in thin-film reactions, although she has devoted a chapter to a discussion of thickness and deposition-rate measurement methods.

Overall, I feel Eckertová has not given enough attention to the unique structure–property correlations in thin films, which is needed in order to bring out the science from the field or to bring more physics into it. Finally, the book contains many printing errors; I found at least ten.

KING-NING TU
IBM Thomas J. Watson Research Center
Yorktown Heights, New York

Detection of Optical and Infrared Radiation

R. H. Kingston
140 pp. Springer-Verlag, New York, 1978.
$18.80

The field concerned with the detection of optical and infrared radiation has grown rapidly during the past decade. Advances have been spurred on by considerable success of applications in a variety of diversified fields encompassing research areas in astronomy and medicine, military applications such as reconnaisance and communications, and commercial applications ranging from nondestructive testing to weather forecasting and a search for natural resonances. Despite these broad ranges of applications, one finds few courses in academic institutions devoted to the field. Much of the training is obtained "on the job" or in concentrated minicourses, usually of one-week duration, at institutions such as the University of Michigan or the University of California at Santa Barbara.

While a number of books have been written in the field, most are reference books not especially suitable as texts. Robert H. Kingston wrote his recent text with the student in mind. At the beginning of each chapter, he states clearly what he intends to accomplish and why. At the end of each chapter, selected problems give the reader an indication as to whether he has digested some of the material studied. The book is well written, brief and to the point. Derivations are clear and references are adequate. It is quite apparent that the text has been tried out in a course, before Kingston wrote it in final form.

Contrary to expectations, as one sees the title, Kingston gives no lengthy discussion of various types of infrared detectors and their characteristics. He points out that there are sufficient books on that subject already (see, for example, *Optical and Infrared Detectors* edited by R. J. Keyes and reviewed in PHYSICS TODAY, October 1978, page 64). Kingston instead treats "the fundamen-