photographs are scientifically accurate and relevant.

Finally, I very much enjoyed the historical introduction to gravity. Having taught a course on the subject, I found his treatment very balanced and easy to read. I may use his book as a text for my undergraduate course on black holes.

Perhaps it is because Nicolson is not a working relativist that he has been able to give such a clear account. However, I am very impressed that an outsider would be aware of the subtleties in the field. For example, he has a very clear discussion of the fact that Seyferts (spiral radio galaxies) do not have double radio lobes, while elliptical radio galaxies do, which tells us that the gas content of galaxies (spirals have a lot, ellipticals very little) may be crucial in the formation of such lobes. This is an obvious point, but one that many researchers in the field would be hard pressed to put forth so succinctly.

My thanks to Nicolson. I took forward to his next book!

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Science Observed: Essays Out of My Mind

J. Bernstein
Basic Books, New York, 1982. $16.95

Physics—and science in general—is extraordinarily fortunate in having Jeremy Bernstein to interpret us to educated nonphysicists. I find great and continued pleasure in reading his clear and literate writing about us.

I have always felt that the profile by Jeremy Bernstein is the ultimate biography from the subject's point of view: respectful, clear, nearly impersonal. His wart-free portraits of the great scientists show them as they must wish to be seen. In this mixed collection of profiles, essays, capsule biographies and even a story, Bernstein takes several steps away from his too-generous portrayals and toward being a writer rather than an apologist: He reveals at least a few of his own emotions and his own "warts." There is, for instance, an account of Los Alamos of considerable power, especially in the description of his own immature attempt to dissuade Adlai Stevenson from supporting a test ban treaty; in another essay he discloses his own anger at a college president's stupidity at closing down a research reactor. The minor pieces are, in fact, unexpected and almost unalloyed sources of delight: the wonderfully accurate skewering of *The Tao of Physics* and its phony ilk, the revelation of what we all know about cranks but couldn't express as well, a concluding piece on artificial intelligence not in the manner of Douglas Hofstader but how he might have written with sufficient prodding and editing.

About half the book returns to Bernstein's more familiar turf, writing for *The New Yorker*: a long, expanded profile on Marvin Minsky introducing the artificial intelligence world; a shorter piece on Stanley Kubrick's *2001*, and chess (the only "padding" in the book, I felt, was the extra bit here about covering Fischer–Spassky for *Playboy*); and a profile type of piece on Harold Furth and plasma physics. With Minsky, as with the pieces on J. Robert Oppenheimer, Erwin Schrödinger, and plasma physics, one is still left looking for the warts and the clay feet, aspects which some of Minsky's colleagues in the computer world would have happily supplied. Scientists do compete, backbite, carry on personal feuds, ride hobbyhorses, bluff, puff themselves up, make egregious mistakes in judgment: Why do we never hear of these things except 300 years later (or in the only honest book I know about science, the *Double Helix*)? In the case of Minsky, one is left with far too positive a view of the scientific field itself; the notable failures, as in speech recognition, pattern recognition, linguistics, the game of Go, not to mention the simple economic mess of software glut, are not visible. In the case of Oppenheimer, why were the "wonderfully productive" years 1930–1940 so devoid of major achievements? Why has his handpicked faculty at the Institute of Advanced Study been so surprisingly sterile in the actual event? In the case of fusion, several real problems are glossed over, one explicitly: It is not at all true that tritium is harmless; quite the opposite. There has to be—and there is in all of these cases—a different side which Bernstein in his enthusiasm seldom probes. For the good of the our public images let this be a best-seller! For the good of informing the public about what scientists do, let Bernstein take a few more critical steps.

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Foundations of Optical Waveguides

G. H. Owyang
245 pp. Elsevier, New York, 1981. $45.00

This book presents a treatise on the wave propagation in planar and cylindrical waveguides from the field point of view. Gilbert H. Owyang, a professor of electrical engineering at the Worcester Polytechnic Institute, points out in his preface, "this text is the result of notes developed for undergraduate and

graduate courses in optical waveguides—including classes for practical engineers," and "it is intended to serve readers with some background in electromagnetic theory." After a survey of the background material on electromagnetic theory and its application to wave propagation, Owyang analyzes (in rectangular coordinates) the behavior of guided and radiation modes for the transverse electric and transverse magnetic waves in slab dielectric waveguides. He then discusses the properties of eigenvalues and eigenfunctions as related to the solutions of homogeneous second-order partial differential equations with homogeneous boundary conditions, analyzes the nonhomogeneous problems and then examines the solution of nonhomogeneous equations using Green's function techniques. The second half of the book concentrates on more practical problems—dielectric slab waveguides, cylindrical waveguides—and includes discussions of two methods of approximation and of inhomogeneous cylindrical waveguides with radial variation in the dielectric constant.

On the whole, the book does present a systematic treatment on both the slab and cylindrical optical waveguides, thus fulfilling its objective of providing a foundation on the subject. On the other hand, there are a number of areas in which improvements could be made. First, the chapter on the methods of approximation treats only very briefly—on nine pages—the perturbation and WKB methods. This chapter could have been expanded to include such other methods as the staircase approximation, the variational method and the linearly-polarized-field approximation, which are as important as the perturbation and WKB methods. Second, in discussing the dispersion characteristics, Owyang makes no distinction between chromatic dispersion and modal dispersion. As a consequence, he fails to compare the magnitudes of modal dispersion for step-index and graded-index waveguides and fails to consider the differences in chromatic dispersion for different excitation sources, notably laser diodes and light-emitting diodes. It is not clear what he means by saying that "especially *useful* in optical-fiber communications are the effects of dispersion." Third, the book would be more suitable as a textbook if selected exercises or problems had been included for each chapter. It would also be more useful for graduate students if references to the more important research papers had been given, particularly in the area of inhomogeneous cylindrical waveguides.

In summary, this book could be used as a reference for a university course on optical waveguides. On the other hand, its relatively high price makes it difficult for every student to own a copy. Furthermore, an engineer wishing to design a practical optical-fiber communication system may not find the book very useful because it does not provide information on systems design. For example, the book does not analyze the problems of coupling between two fibers or between a fiber and a light source (or a photodetector).

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A Lie Group: Rotations in Quantum Mechanics

J.-M. Normand
486 pp. North-Holland, New York, 1980.
$61.00

The use of Racah–Wigner angular momentum techniques to analyze rotational symmetry is now a familiar discipline used in essentially all branches of quantum physics; there is no lack of textbooks and monographs developing the subject to suit any taste. The present monograph is distinguished by two features:

- It uses the quantal rotation group as a simple and intuitive example to illustrate the general properties of (linear) representations of compact Lie groups
- It exploits the methods, and particularly the viewpoints, of the French school of mathematics, with its emphasis on intrinsic (coordinate-free) concepts, clarity and rigor

The book accomplishes these aims rather well, but it must be admitted that a less mathematically oriented physicist reader may find the presentation heavy going at times. Basic mathematical details (vector spaces, algebras, groups, . . .) are relegated to eight long appendices; this does not make the text read any more easily. Normand takes great care to distinguish intrinsically defined objects; the pace is detailed but slow (only in Chapter 5 do we find the angular momentum commutation relations for the first time). This very precision becomes a difficulty, especially in Chapter 10 (on representations in various functional vector spaces) through a most unwieldy notation.

The viewpoint Normand has chosen is less successful when it comes to such constructs as tensor operators and the algebraic properties of the 3-*j* and 6-*j* symbols. This difficulty is only to be expected since these topics have not been fully categorized in the mathematics literature. It is also no surprise that the applications to quantum mechanics are quite limited in scope. The literature citations are rather haphazard (and incomplete); Normand has the unhappy tendency to cite tertiary (even unpublished) sources for well-