beam photoionization and photofragmentation, particularly by the absorption of multiple photons, a research area in which Bernstein and coworkers have made pioneering advances. But, on balance, the choice of material is first class, and the synthesis of this material into a readable account of this active research field is truly remarkable.

The Mathematical Experience

P. Davis, R. Hersh
440 pp. Birkhauser, Boston, 1981. $24.00

Mathematics Tomorrow

L. Steen
250 pp. Springer, New York, 1981. $18.00

When Gulliver in his travels visited the great academy of Lagado, he observed an unusually simple method for learning mathematics. The teacher merely wrote each theorem (with its proof) on a wafer, using as ink an extract from brain tissue. As the wafer was digested, the extract mounted to the student's brain, bearing the theorem with it. Unfortunately, even our most successful gene-splicers have not yet matched this accomplishment, and the study of mathematics remains as long and hard as ever. Consequently, there is always a need for books that give a general audience some understanding of mathematics, some feeling for what mathematicians do and how their work is related to the other arts and sciences. One such book is *Mathematics Today*, which came out in 1978 and is now available in paperback. It contains essays specially commissioned to present accessible recent work in mathematics and its applications, from scheduling problems to black holes, and it is worth recommending to anyone who missed it.

Mathematics Tomorrow is the bastard brother of *Mathematics Today*. It is another collection of essays, with the same editor and publisher, but (to put it plainly) without any mathematics. The first, 60-page, section is called "What is Mathematics?" but it contains mainly expressions of personal enthusiasm and recommendations for an undergraduate curriculum. In the longest section devoted to teaching, two separate authors from two-year colleges complain that they don't get enough respect. A section on "Issues of Equality" reminds us that women used to be kept away from mathematics and to some extent still are. The final section is called "Mathematics for Tomorrow," but it is devoted almost entirely to discussing which topics (all quite well-known today) should be taught to undergraduates.

Certainly some of the essays are attractive in themselves. Paul Halmos, in his usual felicitous style, contrasts the general attitudes that accompany work in pure mathematics and in applications. Peter Hilton complains with all too much reason that "mathematics avoidance" may be a healthy reaction to the dull, pointless, unrealistic drill that passes for mathematics in many elementary classrooms. Executives from Springer-Verlag and Birkhäuser suggest that publishers will soon be primarily editors: Electronic text transmission will make almost everything widely available, but many more people will read a book or article if it is included in the list of some respected "publisher." Others of the essays also contain some interesting ideas, but there is no common focus; at its worst the book seems like a set of background reports prepared for a faculty meeting.

The Mathematical Experience is a quite different book, reminiscent less of faculty meetings than of lunch-table monologs. The style is informal and enthusiastic, rather inclined to overstatement. The eight chapters share certain concerns and viewpoints, but are otherwise almost completely independent. Each consists of five to fifteen sections that again are only loosely related. There are brief expositions of actual mathematics, with topics chosen almost at random (these are mainly taken from earlier articles by the authors). There are snatches of history, especially on the interactions between mathematics and other cultural areas. There are odds and ends such as "mathematical eccentrics" and "how many theorems are published each year?" There are eight pages on astrology, with no mathematics at all. And there is quite a lot about the "philosophy" of mathematics.

The liveliness of the style entails a fair amount of stretching for effect. The section on mathematics and religion, for instance, ends with the sentence, "Can we conclude that mathematics is a form of religion, and in fact the true religion?" Few readers will be seriously tempted to suppose that the four pages of the section justify this conclusion (or any other conclusion). At another place, the authors point out that the prime numbers do not occur in any simple pattern, but we still know that the number of primes less than a large x will be asymptotic to $x/\ln(x)$. They add that this provides "a moral lesson on how individual eccentricities can exist side by side with law and order." (As the Dutchess said to Alice, everything's got a moral, if only you can find it.) But this sort of overwriting is usually easy to recognize and easy to discount.

There are, however, a couple of areas where readers who are not mathematicians should be on their guard. The authors' training and sympathy lie primarily in applied mathematics, and this leads them to express contempt regularly for what they tend to call "formal" mathematics. They use the term, however, to refer to a variety of things. Sometimes they mean the epistemological theory that the truth of mathematics lies in the structure of its proofs, regardless of its nominal subject. Sometimes they mean the use of a great many symbols instead of words. Sometimes they mean writing out all the details of an argument. Sometimes they mean leaving out examples. Sometimes they mean the use of axioms. Sometimes, indeed, they seem to mean most of mathematics. Now some of these quite different things may indeed be bad, but some are not, and there is no special connection between them. Readers should be wary of the authors' attempt to tar them all with the same brush.

The other problem area is "philosophy." The authors say that they have become as much interested in the philosophy of mathematics as in mathematics itself. But philosophy is notoriously coy, not nearly so easy to pick up as people first think. The authors criticize most current work on the philosophy of mathematics, for instance, on the grounds that it does not reflect how mathematics is discovered. But they never really explain why the truth of something *should* depend on how it is discovered. Sometimes they write as though mathematics were purely cultural, a matter of convention; at other times they think it is "reproducible." (Curiously, they never mention Noam Chomsky's ideas on innate linguistic capabilities, which seem to be the sort of idea they are reaching for.) Still, their confusion may serve to provoke thought—and the same is true of the rest of the book. As long as readers are not tempted to take the authors' word as law, they may well enjoy browsing through some of the many different topics discussed.

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Quantum Mechanics for Applied Physics and Engineering

A. T. Fromhold Jr
430 pp. Academic, New York, 1981. $34.50

This book has a promising title. It has long been a strong opinion of mine that applied physicists and electrical engineers should learn quantum mechanics, not only to acquire a broader understanding but also to learn the