areas he chooses to emphasize—the Newtonian physics of celestial mechanics and the quantum physics of highly compressed matter—and his choice of applications do not lead the student close to current explanations of the exciting phenomena. Thus, for example, the topics of tidal dissipation and orbital resonance essential to understanding the energy sources of volcanism on Io are completely ignored. (Ironically, there is a reference to a post-flyby description of Io by geologists, but there is no reference to the pre-flyby prediction of Io's activity made by physicists, which won Stanton Peale and his colleagues the Cleveland Prize.)

The emphasis of the book is on the spherically symmetric structure of the planets, both terrestrial and major, rather than on their evolution or lateral heterogeneities. The level of technicality varies appreciably with the subject matter. Thus the discussion of seismology is rather easy reading, while the presentations of satellite orbit dynamics and the equilibrium of a rotating fluid are quite mathematical. Correlated with the technical level is the degree of referencing. Also variable is the amount of detail about each planet. For example, it is mentioned that the mean heat flow out of the earth is 0.06 W/m^2 (25% lower than current informed estimates), but there is no discussion of the 0.03–0.28 W/m^2 variations strongly correlated with tectonic setting. On the other hand, the only two measurements of heat flow out of the moon are precisely given (twice). There is no map of the earth's gravity field, despite the several pages on its determination from satellites and the accuracy with which it is now known, but there is a hideously wrong map of the farside gravity field of the moon from 1972, completely inconsistent with the spherical harmonic coefficients from 1977 on the facing page.

Aside from the occasional obsolescences like the above-mentioned, there are few errors of commission. In the chosen areas of emphasis, the presentation could be more heuristic. For example, the rate-of-precession of the node of an orbit is given first in a quoted equation and second as arising from the partial derivative of the gravitational potential with respect to the conjugate action variable, but there is allusion neither to Euler's equation nor to a vector diagram of why the equatorial bulge of a planet should lead to such precession.

The book lacks problems and guidance to the literature. For a physics-oriented introduction to the solid earth, the texts by Frank D. Stacey (Wiley) and George D. Garland (Saunders) are preferable. However, no really good books for the other planets exist and the interested student must go to review papers and symposium proceedings.

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Rainbows, Halos, and Glories

R. Greenler
204 pp. Cambridge U. P., New York, 1980. \$24.95

One of the most difficult tasks for undergraduate students is to bridge the gap between the abstract world of mathematical physics and the sensory world that they find around them. For them, defraction is understood through equations and seen in the darkened physics lab but would go unrecognized if seen in the sky while they were walking to class. For these undergraduates, and indeed for all those who enjoy observing and understanding their surroundings, Greenler's book should be mandatory reading.

Written without equations, and in the same conversational style as its primary antecedent, M. Minnaert's classic *Light and Colour in the Open Air*, Greenler's book largely restricts itself to the optics of the atmosphere. There are 32 pages of spectacular color photographs of the phenomena discussed. Scarcely a page appears without diagrams and more black and white shots, to make it very easy to relate theory and observations of nature.

The book has an acknowledged (and acceptable) unevenness of treatment, due to the author's particular interest in halos (the circles, arcs and spots of light resulting from reflection and refraction by ice crystals). Indeed, the three chapters on halos are the most fascinating portions of the book.

Greenler's book should find a valued place in the library of observers of nature, whether they be physicists or high school students.

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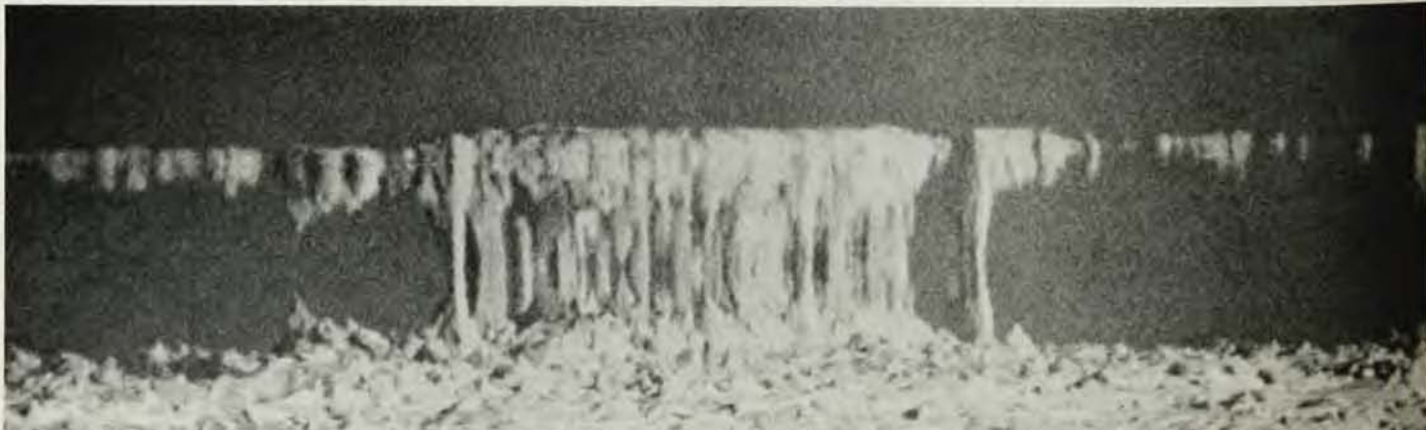
Surprises in Theoretical Physics

R. Peierls
168 pp. Princeton U.P., Princeton, N.J., 1979. \$15.00 cloth, \$3.95 paper

P. Ehrenfest has said "physics is simple but subtle." It is these qualities that come out so splendidly in this book. Every physicist will read this book with pleasure and delight. Most of the "surprises" are intellectual delicacies that will be savored by anybody who has a good training and experience in physics. The book is by no means directed only at theorists. Teachers of physics and graduate students will get a better feeling for the depths and subtleties of their field, aspects which all too often are neglected in present-day teaching and thinking.

The author states in the Preface that the book is based on lectures that presented instances "in which a plausible expectation is not borne out by a more careful analysis." Actually most of the 32 examples do more than that: The more careful analysis not only proves the expectations wrong but leads to a much better understanding of the phys-



A variation of the fata morgana, a kind of mirage that usually entails multiple vertical images. This example, produced when a layer of warm air overlayed the colder air above the ice, was photographed by R. Greenler and appears in *Rainbows, Halos, and Glories*.

ics. They support Niels Bohr's definition of an expert: a person who has made the largest number of mistakes in a given field.

The book is proof of the author's deep and wide understanding of our science. The examples are taken from almost every field of physics: atomic physics, statistical mechanics, the physics of transport processes, solid-state physics, nuclear physics and relativity. Moreover a large number of those insights come from his own work or from work his students performed under his guidance. Peierls is one of that decreasing group of physicists without prefixes such as "particle," "nuclear" or "condensed matter." There should be more of them. It is noteworthy that he left out particle physics—certainly not because of his lack of knowledge, but perhaps because he thought that in this field everything is a surprise.

There are a few items to criticize, however. Some of his examples are formal, mathematical ones; others—most of them, fortunately—deal with physical insight. Perhaps it would have helped if the reader were informed of this difference. Furthermore the book is limited by being a transcript of lectures; quite often the argument stops—probably because the hour was over—when it is about to become most fascinating. In many instances, one would have wished to get more of Peierls' wisdom. He certainly has more to say about some of his examples than we find in the book. A minor detail is the occasional presence of sloppy proofreading: The Euler equations were supposed to exemplify a nonlinear situation, but the omission of a velocity makes them appear linear; the Saha expression for the degree of ionization of a gas has two errors in it. All this is not very important. It is the style that counts. In this respect the book is a marvel. It shows us how to approach problems in physics and how to get at their depth in the most direct, elegant and penetrating way. It is not for beginners; this is a book for the connoisseur.

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Techniques and Applications of Path Integration

L. S. Schulman
359 pp., Wiley, New York, 1981. $31.95

How far has path integral quantization developed since Richard Feynman invented it as a graduate student 40 years ago? The acceptance and the recognition of path integration as a major concept and technique for quantum