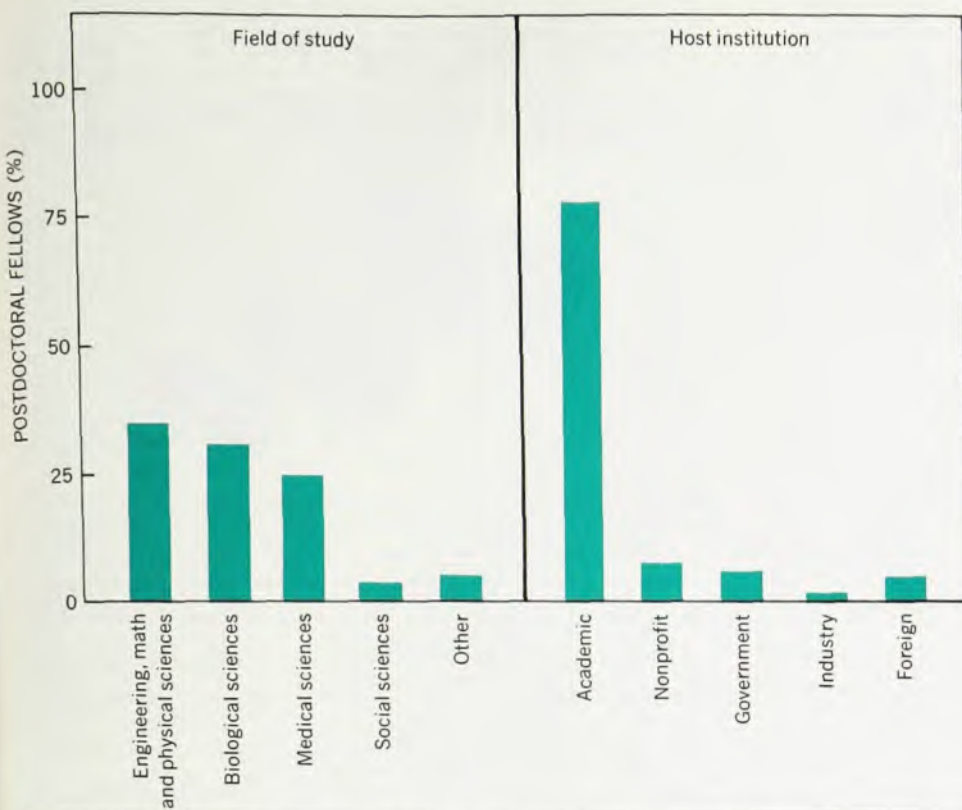




Distribution of US postdoctoral fellows. (From the book reviewed on this page.)

in those chapters is the large fraction of postdoctorals who are foreigners. Adding the postdoctorals in engineering, mathematics and the physical sciences together, we find that foreigners make up 56% of that group. For the postdoctorals in the life sciences this fraction is 41%, and it is only 22% in the social sciences. The distribution of fellowships by postdoctoral field is 35% for engineering, mathematics and the physical sciences, 56% for the life sciences, 4% for the social sciences and only 2% for the arts and humanities.

The third major aspect of this book is the effects of postdoctoral education on the host institution. The discussions naturally center around the university, because that institution not only produces all postdoctorals, but also employs the great majority of them. Tables and diagrams offer detailed information on the interaction between scholars and mentors and their influence on students, faculty and administration of a university. Academic institutions are divided into groups labeled "leading," "major," "established" and "developing," and tables show for selected graduate departments the activities, background, space requirements, and ratios among faculty, postdoctorals and students. But universities are not the only host institutions; nonacademic hosts such as industry and nonprofit organizations make their contributions and receive attention in this book.

Since the purpose of the book is to explain and evaluate postdoctoral educa-

tion, it has conclusions and recommendations. The fundamental conclusion is that postdoctoral education is a sound development which resulted from expansion of graduate education. In view of how crucially important the relationship is between the postdoctoral appointee and his mentor, more freedom in choosing a mentor is one of the recommendations. Another recommendation is that the duration of appointment should be determined by the fellow's progress toward independence and excellence in research. A difficulty that should be corrected is that of indirect support; it prevents patrons and administrators from recognizing the contributions of postdoctorals. However, better manpower planning can alleviate most of the difficulties, and this book can supply the necessary data needed for better planning.

The Invisible University is well written; it takes a narrow topic and explores all major aspects of it. Unlike many education and manpower books, *The Invisible University* singles out physics in many of its tables and graphs instead of just showing physical sciences as a group. All comparisons are pertinent, and the author is careful to discuss all sides of a given situation. Because a special study was conducted to obtain most of the material for this book, it should be said that the author is always careful not to read too much into the results of a survey.

Susanne D. Ellis

American Institute of Physics

Elementary Radiation Physics

By G. S. Hurst, J. E. Turner

166 pp. Wiley, New York, 1970. \$7.95

This book contains five chapters of very elementary introductory material on the interaction between x rays, gamma rays and neutrons with matter. These are followed by two chapters on measuring absorbed energy and dosimetry with three final chapters on biological effects, x-ray technology and a small selection of applications.

It is the result of experience with the health-physics group at Oak Ridge, and it has the strengths and limitations of that experience. The illustrative material tends to come from the AEC laboratories, and much of the revolution in biology of the past ten years is not mentioned, even though a significant quotation from D. E. Lea clearly suggests that the relation between radiation and molecular biology is basic and exciting.

As a teacher of the effect of radiation on living systems I welcome the book. Inevitably biologists work in this field and it is almost impossible to induce them to read the standard works on radiation. This material can be used by them, and the book, therefore, should be on the shelves of every biology department library. My guess is that, in fact, it will be found (and not read) in physics departments. However, that is life.

I regret that the chapter on the interactions of charged particles with matter is so sketchy. Ferrin has treated this subject so beautifully and simply that one would think it would be standard material everywhere. It is not, and it is not here.

I was startled to find no references for more advanced reading and, as this is not in keeping with the authors' approach, I wondered why. There are, however, a great many problems.

Ernest C. Pollard

Pennsylvania State University

Nonlocal Variations and Local Invariance of Fields

By Dominic G. B. Edelen

197 pp. American Elsevier, New York, 1969. \$14.50

Dominic Edelen's book is intended to provide a "graduate text" also of interest to field-theoretic physicists, engineers in theoretical mechanics, control engineers, and so on, dealing with "techniques and methods in the field of nonlocal variational mechanics." This is indeed an accurate assessment of the potential audience. Despite the advanced level of the material the treatment is essentially applied in character.

The monograph deals with variational problems in which the Lagrangian

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"function" contains a functional. This leads to Euler-Lagrange equations that are integro-differential and hence non-local in character. There is some discussion of constraints. Edelen indicates that "The basic techniques are obtained from appropriate extensions of the classical variational methods." A substantial portion of the work is devoted to the transformation properties of functional equations. The groundwork for this is a chapter on geometric objects and Lie derivatives, which would seem to have been strongly influenced by J. A. Schouten's "Ricci Calculus."

The treatment is devoted explicitly to relative extrema; no discussion of maxima, minima or problems generally requiring utilization of the second variation is included. Such topics as existence theorems and fields of extremals are also excluded. These exclusions are in proper accord with the aim of the book. There is, however, one topic that might well have been included: the class of problems developed by considering variations of domain boundaries. This would appear to be well within the scope of the work.

It has been stated that the book is self-contained. This is accurate, but the material is not accessible without a good working knowledge of "the classical variational methods" on which the work is founded. A solid mathematical background is also necessary.

Very commonly, advanced texts suffer from an absence of problems. This is not the case here; the author has provided problems for each of the four chapters. There are also a number of examples and problems to illustrate the techniques. Unfortunately, these all deal with local fields and not the non-local variety for which the book is intended. Perhaps these will be included in a later edition.

If the implication of both jacket and preface are accepted, the book is probably the outgrowth of a set of lecture notes. Being such, it has the strengths and faults of such an origin. One of the greatest of the strengths is that much of the material has been battle tested. There are also hazards. The amount of material that can be presented intelligently in a one- or even two-semester course is quite limited and without expansion is almost certainly too meager in scope for other than the narrowest of monographs. Considerable augmentation is generally necessary. Edelen's treatment is somewhat austere and reflects more than is desirable the genesis of the book.

There is yet another hazard. If one starts deliberately to collect material for a book it is routinely simple to keep track of sources; the bibliography is automatically prepared as the work proceeds. In the preparation of lecture notes there is no such compulsion.

Later if the notes are to be converted into a book the exceeding tediousness of tracking down citations often results in an absence of bibliography and an apology by the author. This book unfortunately falls into the latter category.

The term "unfortunately" is deliberately chosen. In a book at the undergraduate level a bibliography may well be an expensive luxury. At the graduate level, or if intended for an audience whose interest in the work is of a research character, it is a necessity. In any case, it affords the author the opportunity of being gracious to his sources.

Despite the several *caveats* the book should prove useful to the intended audience.

Alexander Harvey
Queens College, New York

Cosmic Ray Physics: Nuclear and Astrophysical Aspects

By S. Hayakawa

774 pp. Interscience, New York, 1969.
\$39.50

Cosmic Ray Physics deals primarily with nuclear and astrophysical aspects; it does not cover in any detail the geophysical, geomagnetic or interplanetary features of the subject. But, by confining his attention to a portion of the cosmic ray problem, Satio Hayakawa is able to develop the topics in considerable depth. Following a historical survey, there are two chapters that deal with particle interactions at high energies and at very high energies. Then follows a chapter that describes cosmic rays in the atmosphere and underground, followed by a description of extensive air showers, the highest-energy phenomenon in the cosmic radiation. Finally, there is a chapter on the origin of cosmic rays.

What distinguishes this book from many others is the considerable detail of treatment and the many excellent tables and appendices. It combines many of the aspects of a textbook, a treatise and a handbook, and, in this respect, is a most useful base for the beginning graduate student as well as for the researcher who may come from other branches of physics or from astronomy.

The characteristic aspect of the book is its high competence. This is understandable when one realizes that Hayakawa has personally contributed to so many different topics of cosmic radiation. The book is in the tradition of L. Janossy or D. J. Montgomery, but up-to-date, essentially to 1966. Thus quarks and quasars are absent, but we have particle "strangeness," isospin, supernovae and galactic x rays.

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