techniques of time-lapse microcinematography and electron microscopy. These could be valuable to persons contemplating using these tools.

This volume might be particularly useful to those persons who are heavily grounded in biology and biochemistry and who wish to bring themselves up to date in the areas covered. The contributors, A. S. Bajer, G. H. Czerlinski, E. D. Korn, H. D. Mayor and P. Mitchell, have all made important advances in their respective fields and have covered their subjects adequately and included substantial bibliographies.

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A Course in Vector Analysis

By L. G. Chambers
231 pp. Chapman and Hall, London, 1969. $7.25

Another little introduction to vectors might seem hardly necessary; but Llewelyn Chambers, senior lecturer in applied mathematics at the University College of North Wales, has written with particular empathy. His work emphasizes clear and concise explanations, rather than mathematical rigor. Thus products of vectors are discussed in terms of mechanical applications, and pseudovectors are simply described in terms of rotation. Theorems such as those of Stokes and Gauss are shown to be reasonable extensions of elementary cases rather than being strictly proved. Surprisingly, in view of other physical explanations, these theorems are little discussed in physical terms (although problems give applications).

Except for the omission of differential geometry, the content of the first five chapters is standard coverage of three-dimensional vectors. The sixth chapter concludes with "Miscellaneous Topics" that gives the book a modern cast, by briefly introducing abstract vector spaces and tensors, with considerable discussion of dyads. Although many readers would want more detail, there are sufficient exercises and worked examples to make the book attractive for self study.

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Fission Damage in Crystals

By Lewis T. Chadderton, Ian McC. Torrens
265 pp. Methuen, London, 1969. $13.50

This book describes numerous experiments carried on in the Surface Physics Laboratory of the late F. P. Bowden, professor at Cambridge University, and additional related work subsequently conducted by the authors in the US and in France. It is in a sense a continuation of the monograph *Radiation Damage in Crystals* (Methuen, 1965) written by L. T. Chadderton.

The present work is limited to the damage produced in single crystals by the passage of fission fragments. The closely related phenomena of radiation damage produced by fission neutrons is not included; however, the book cites auxiliary studies of damage produced by electron excitation as correlated with the effects of fission fragments. Several types of experimental investigation revealing the "spikes" and other changes produced in lattices are treated, including detailed studies by electron diffraction and field-ion microscopy.

A short but excellent chapter describes a study of the passage of a fission fragment directly through the tungsten tip of a field-ion microscope. The detailed examination of the "spike," as successive layers of the crystal tip are evaporated, adds considerable interest to the volume. The theoretical treatments are related primarily to the phenomena of "spike" formation in the passage of fission fragments through crystals and are sketched only in outline. However, there are many excellent electron-micrograph photographs and other photographic records. This book can be recommended for its highly specialized treatment, which relates almost exclusively to the specific research interest of the authors. Yet, it provides in no sense a general discussion of the subject, and it is deficient in that it does not relate to the experimental or theoretical work of other workers in this general field.

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Gas Laser Technology

By D. C. Sinclair, W. E. Bell
161 pp. Holt, Rinehart and Winston, New York, 1969. $7.00

Twenty-eight pages of this book are devoted to the choice of materials and design problems encountered in the actual construction of gas lasers. The remainder of the textual material discusses the theory of operating gas lasers. Thus the title is slightly misleading, if one interprets it to refer to the actual art of constructing a gas laser. Once one puts aside this bias the material presented is both useful and well done.

After an initial introduction to what constitutes a gas laser, the authors use a "semiclassical" approach to the theory

of laser operation. This theory treats the electromagnetic field in its classical (Maxwell) formalism; the gas is treated in its quantum-mechanical (Dirac) formalism. Using the rate-equation approximation, the discussion centers on the properties of the gain coefficient. An excellent discussion of plasma dispersion and line broadening completes this chapter.

The third chapter presents W. E. Lamb's theory of operation of a gas laser. Unfortunately, by changing notation, and inserting some (interesting) implications, the authors have not appreciably clarified this classic theory. For all its errors, the chapter in the *Quantum Electronics Proceedings* is still to be preferred from a pedagogical standpoint.

The discussion of mode structure reviews the basic physics of electromagnetic radiation confined in a cavity with losses present. This is perhaps the best section, as theory and diagrams work together to present a very clear understanding of a very complex subject. The discussion of longitudinal modes is not as detailed as that on transverse modes. Of particular interest is the section on general curved-mirror cavities.

The book concludes the theory, with a very limited discussion of the factors governing output power. Difficulties in obtaining good theoretical predictions are lightly glossed over. Not until the final chapter are the authors concerned with the technical details involved in actually constructing a gas laser. The summary of symbols at the beginning of this book and the appendixes at the end are useful for the reader.

The authors, presently employed by Spectra-Physics, Inc, have presented their material in a clear, concise manner. The graduate student who has completed quantum mechanics should have little difficulty with this book.

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Einstein Spaces

By A. Z. Petrov
411 pp. Pergamon, New York, 1969. $18.00

For years this book had to be consulted by researchers either in the original Russian or in a later German version. Now at last it has become available in English. It is a mine of unique information: A. Z. Petrov deliberately tried to limit himself to questions not treated elsewhere. For this and other reasons his book is not intended for one's first acquaintance with general relativity. Nor should the reader expect enlightenment on the more physical aspects of the theory. It is a book written by an excellent mathematician whose interest lies mainly in the formal mathematical structure of space–times. Certain aspects of this structure are here treated with encyclopedic thoroughness.

In a sense, all space–times of Minkowskian signature $(+ - - -)$ can be regarded as gravitational fields, generated, however, by energy and momentum distributions (obtainable directly from the metric by Einstein's field equations) that will be generally not very interesting and often downright unphysical (for example, with negative energy density). The special class of space–times corresponding to a vacuum have more chance of being physically significant. Here the sources must be sought in the mathematical singularities, if any. Gravitational waves are studied in such spaces. They are called "Einstein spaces" and are characterized by the constant proportionality of the metric with the Ricci tensor.

Petrov's title suggests that his book is concerned exclusively with such spaces. To this extent it is misleading: The title is evidently meant to encompass all space–times arising in relativity, and some of their generalizations. A more fitting title would be "New Methods in the General Theory of Relativity" —as this book was actually called in its later (1966) Russian edition. (Though purportedly a revised translation of the first Russian edition of 1961, the present version appears more akin to the 1966 Russian and 1964 German editions, neither of which, however, it fully coincides with.)

Petrov is probably best known for his 1954 work on the local algebraic classification of space–times by their Weyl tensor. Naturally, this famous "Petrov classification" is in the present book. After Felix Pirani introduced it to the Western world in 1956, it became an important item in the armory of modern researchers. Though Pirani's first attempt to correlate "Petrov degeneracy" directly with gravitational radiation turned out to be too optimistic, most subsequent work on gravity waves (and also on exact solutions of Einstein's field equations) at some stage made contact with Petrov's classification, especially through the powerful Goldberg–Sachs theorem, which geometrically characterizes Petrov degeneracy in the large.

But Petrov's book also contains another, and possibly even more important, classification of space–times, namely by the continuous groups of motions that they admit. The author proceeds along the lines that Bianchi introduced many years ago for the classification of positive-definite three-spaces using Lie-group theory. It is probably in this