of a photograph of a multicolored hologram image, but the reader is never given an explanation of the multicolor problem in holography. The highly mathematical presentation of chapters 3–5 should be supplemented by a chapter containing a good qualitative discussion of physical principles supported by illuminating ad hoc arguments. Chapter 8, dealing with applications, does not explain holographic interferometry despite its development into a first-rate tool in several technologies. These aspects of holography, not properly covered in the book under review, deserve inclusion in a unified treatment. If the book is to be as broad as its title implies, it is not sufficient to liberally sprinkle the text with references to the literature (the book does have a good reference list) in the hopes that the reader will pursue the subject to its source.

The book's unfortunate overemphasis on in-line holography (as against the off-axis holography with which E. N. Leith and J. Upatnieks in the early 1960's introduced holography to most of us) can cause confusion. While the in-line method is useful for pulsed-laser holographic imaging of small particles, I think most holographers work with the off-axis method. Thus it is confusing to see, time after time, in the first 85 pages of the book an enunciation of the need to process the photographic medium according to conditions desirable for Fraunhofer holograms (gamma = −2) with no mention of the fact that these conditions are not practiced with the off-axis method. Only on pages 86–87 is there the suggestion that negative holograms are sufficient and that operation on the linear portion of the amplitude transmission as opposed to exposure curve is desirable for off-axis holography. The consequence is to propound a rather unbalanced parochial view of holography.

The task of unifying the results in holography is admirable, necessary and not easy. Perhaps if DeVelis and Reynolds had delayed their start until holography is more completely unfolded or had updated the text as they did their reference list, they might have better presented the whole record.

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The reviewer is a physicist at Bell Telephone Laboratories and supervises a group in holography.

In the beginning . . .

THE ORIGIN AND EVOLUTION OF THE UNIVERSE. By Evry Schatzman. Trans. from French. 287 pp. Basic Books, New York, 1966. $8.50

by S. Fred Singer

A physicist who wants to enter into cosmogony faces the following problem: how to absorb as efficiently as possible the observational basis underlying the theory of the origin of the universe and of cosmology without having to become an astronomer. To meet this problem, the distinguished French astrophysicist, Evry Schatzman, has condensed astronomical phenomena and knowledge into a tightly written but easy-to-follow volume.

About one third of the book reviews the present state of knowledge, concentrating mainly on the properties of stars, on galactic structure and interstellar matter. Most of this is descriptive, concisely tabulated and well presented. The second third of the book deals with one of the author's specialities, the origin and evolution of stars and stellar systems. There is a good review of the internal structure of different types of stars and of the nuclear reactions in their interiors. Following this review, there is a concise account of the formation of stars, of stellar systems and of galaxies. The last part of the book is concerned mainly with extragalactic nebulas and cosmology. It starts with a brief discussion of Olber's paradox and a careful review of observational data on properties of galaxies and galactic clusters. Much attention is given to the red shift of spectral lines and to the many objections against interpreting them in terms of an expansion of the universe. A Doppler shift remains, however, the most reasonable interpretation.

There finally follows a very brief and quite painless account of cosmological theories. It is really more in the nature of a classification of cosmological models, but it serves as an orientation and useful overview.

It is at this point where the new results of the last two or three years are badly missed. Schatzman's book was originally published in 1957 but translated into English and brought up to date in 1965. Quasars, unfortunately, are not mentioned, and one would have to refer to recent review papers or books to amplify the discussion. (See, for example, S. P. Maron and A. G. W. Cameron, *Science* **157**, 1517, 1967; D. W. Sciama, *New Scientist* 29, 16, 1966; and a summary by Thornton Page, Smithsonian Astrophysical Observatory, "Conference on Observational Aspects of Cosmology;" as well as *Quasi-Stellar Objects* by G. and M. Burbidge, Freeman, San Francisco, 1967.) Of course it is not all settled whether quasars are at a "cosmological" distance, that is, whether the extreme red shifts ob-

served correspond to extremely fast radial-expansion velocities.

The book concludes with a rather sketchy review of theories of the origin of the solar system and an even briefer account of the origin of the chemical elements.

The style is direct, simple and quite attractive: Chapters are introduced by well written lead-ins and summaries. There are good tables and figures, a bibliography and two indices.

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S. Fred Singer, now deputy assistant secretary for scientific programs, Department of the Interior, is on leave from the University of Miami, where he organized, in December 1965, a symposium on observational aspects of cosmology.

Still more problems

PROBLEMS AND SOLUTIONS IN MATHEMATICAL PHYSICS. By Y. Choquet-Bruhat. 314 pp. Trans. by C. Peltzer. Holden-Day, San Francisco, 1967. $9.00

by Gerald C. Pomraning

The expression that necessity is the mother of invention can, with some degree of truth, be applied to this book by Madame Choquet-Bruhat. For several years there has been a clear need for the inclusion of a significant number of nontrivial examples, with solutions worked out in detail, in textbooks on contemporary applied mathematics. The "invention" in this case is a book of over 300 pages devoted entirely to such examples. Since the book gives no pretense of supplying the underlying theory necessary to fully understand these examples, it is essential, for the student at least, that it be used in conjunction with a standard text. The book recommended in the preface for this purpose is *Linear Algebra and Analysis* by A. Lichnerowicz. Fortunately for the American student, this French text has been translated into English (Holden-Day).

The areas covered in this book through 72 examples of about four parts each are best summarized by listing the eight chapter headings. These are: (1) linear mappings: operations on matrices; (2) proper values and proper vectors: reduction of matrices; (3) scalar product and norm: Hermitian operators; (4) vector calculus: multiple integrals; (5) function spaces and operators; (6) series expansions of functions; (7) differential equations; (8) partial differential equations. This list shows that, as far as examples are concerned, this book goes beyond the material supplied in Courant and Hilbert, Morse and Feshbach, and other books of similar hue. Nevertheless there are areas not included that would have made the book more interesting and complete. Problems involving probabilities always cause difficulties for students (as well as others), and a few well chosen examples using symmetry principles would have brought this book to the forefront of modern mathematical physics. An obvious omission is a chapter on variational and perturbation methods. However all books have to be ended more or less arbitrarily, and the author cannot be seriously faulted for her choice of subject matter in this case.

The examples in the book range from a few very elementary problems to more difficult and interesting ones. An example of the former is the orthogonalization and normalization of the first few polynomials with respect to a given weight function in a given interval (construction of Laguerre polynomials). Fortunately the latter type of problem is in the majority. In all cases the problems are well stated and the solutions constructed in sufficient detail to be useful to the student. At times the author finds it necessary or convenient to introduce certain definitions. This is generally integrated smoothly into either the statement of the problem or the discussion of the solution. When a more detailed discussion is required, as in the case of unitary operators, the author retains the basic tenet of the book by stating as a problem: "Give the . . . properties . . . of a unitary operation . . ." The solution is the discussion needed to understand the examples which follow and involve various properties of this class of operators.

This book originally appeared in French, and the present translation into English is an excellent job. Only in very occasional instances would this reviewer suggest any changes in the translation, such as the use of "eigenvalue" rather than "proper value" and "Dirac delta function" instead of "Dirac measure . . . limit in the sense of distributions . . .". Since this book is intended for applied scientists, it would seem desirable to use their jargon in the translation. From the overall quality of the translation, however, it is probably true that this was not an oversight but rather a deliberate choice on the part of the translator.

The book has one major fault. It contains far more misprints than can be excused as inevitable in the publishing process. For the experienced reader this is more a nuisance than anything else, but many of these could cause considerable difficulty for the student. It is hoped that the book will be carefully edited before any reprinting, and that an erratum will be distributed with those already off the press. Aside from this criticism, the book is well done. Although it is intended primarily for students, it should be of more than passing interest to the practicing scientist, engineer and applied mathematician.

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The reviewer is a physicist with the General Dynamics Corporation.

Best suited for nuclear physics

INTRODUCTION TO THE QUANTUM THEORY OF SCATTERING. By Leonard S. Rodberg, Roy M. Thaler. 398 pp. Academic Press, New York, 1967. $11.50

by John L. Gammel

The most startling thing about this book is that it contains no references to the literature other than a statement in the preface that references may be found in the book by M. L. Goldberger and K. M. Watson[1] and the one by T. Wu and T. Ohmura.[2] The authors excuse themselves on the grounds that the treatment is self contained and highly personal. I believe that a better reason is that the authors are lazy. What is self contained or highly personal about the following? A differential equation, numbered 5.10 on page 64 of the text, is "readily identified as a hypergeometric equation whose regular solution is. . . ." The result shown in equation 5.13 for the asymptotic form of the hypergeometric function came from somewhere: where?

Having disposed of this disquieting point, I suppose that it is best to proceed by comparing this book with those of Goldberger and Watson,[1] Wu and Ohmura,[2] and the recent one of Roger G. Newton.[3] The book can even be compared with the first edition of the book by N. F. Mott and H. S. W. Massey.[4] There is a great deal else available in book form, a