commercial spectrophotometers employ such an arrangement. The discussion of the effect of sample fluorescence on absorption spectra is confusing. The author makes the rather ambiguous statement that the fluorescence ". . . will appear in the absorption spectrum . . ." (p. 3031). He also states that, if one wishes to record a fluorescence spectrum, the source of excitation should ". . . be placed as close to the detector as possible . . . ," but such placement is contrary to good design principles. In the discussion of ways to correct absorption spectra for fluorescence artifacts, no mention is made of the obvious, and the best, technique of using two monochromators.

Probably the most serious technical errors in the volume are in chapter 59, "Fluorimetry." The author implies (on p. 3058) that fluorescence and phosphorescence are often confused at room temperature when, in fact, almost no compounds phosphoresce at room temperature. In the discussion of Fig. 59.1 it is implied that the quantum yield of fluorescence depends on the ratio of energy lost by internal conversion to the lowest excited singlet state, to the energy emitted as fluorescence. For most molecules the quantum yield is independent of the state to which it was initially excited, but is governed by the relative rates of spontaneous emission from the vibrationally unexcited lowest singlet state and competing processes. In Fig. 59.1 two lines are said to represent phosphorescence emission, whereas one (line 5) represents phosphorescence and the other (line 6) a radiationless transition from the lowest triplet state to the ground state. On page 3061 the lifetime of an excited singlet state is given as 10^{-12} sec, but 10^{-9} to 10^{-7} is more accurate. The statement is made that, at liquid nitrogen temperature, the decay rates of emission are increased (p. 3062). Actually, the rate of emission is relatively independent of temperature, but the rates of competing processes are reduced at 77°K, relative to room temperature, so that an excited state may come closer to its intrinsic lifetime which generally is *longer* than that observed at room temperature. The discussion of filter fluorometers (p. 3070 *et seq.*) fails to include two of the most popular filter fluorometers, the Farrand and Turner instruments. Finally, of the 157 references cited for chapter 59, only four are more recent than 1958.

Although there are some excellent chapters in this volume which will allow it to serve as a valuable reference work for some areas of analytical chemistry, the volume as a whole is not up to the high standards established by volumes 1 and 2 of part 1 of the *Treatise*.

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Cal Tech Lecture Notes

Mathematical Methods of Physics. Jon Mathews and **R. L. Walker.** Benjamin, New York, 1964. xii + 475 pp. Illus. $12.50.

There is no reason to deplore the proliferation of textbooks for the 1-year course on mathematical methods which is commonly taught to beginning graduate students, since the content and the level of sophistication of this course vary greatly from school to school. Unlike some other graduate courses in physics, this course cannot follow a uniform pattern. It must be related to the background of students and to their anticipated needs as they prepare for particular areas of research.

In the long chain of books on mathematical methods, the classic work of Courant and Hilbert stands at one extreme as a most comprehensive, systematic, and mathematically satisfying treatise. The volume reviewed here occupies the other extreme. It is designed to teach almost entirely by precept and example, as mathematical problems from contemporary physics are posed and methods for their solution developed. The emphasis throughout is on expeditious manipulation and speedy acquistion of mathematical skill for work in physics.

In the interest of getting things done, Mathews and Walker have gone as far as possible in the direction of teaching the tools of the trade. Remarkably, they have not sacrificed precision in the process, but there is no pretense of mathematical rigor, and most proofs are omitted. The result is occasionally incongruous. For instance, some secondary, although admittedly useful, theorems about group characters are derived, but several "very important theorems about group representations," including Schur's lemma, on which these derivations depend, are stated without proof. In lecturing, this kind of compromise is necessary and proper; however, I consider it the purpose of a useful textbook (and not only of a reference work, as the authors suggest) to supply the material in reasonably comprehensive form, including essential proofs.

The book by Mathews and Walker, then, is not so much a textbook as an excellent set of lecture notes, intended to tell us how the course is taught at California Institute of Technology. When we examine it in this light, the reservations evaporate. The choice of material is sensible. In addition to the standard topics on ordinary and partial differential equations, linear vector spaces and matrices, Green's functions and integral equations, and special functions and tensor analysis, it includes some calculus of variations, a chapter on numerical methods, another on probability and statistics, and an introduction to groups, already mentioned. The pace of the course is merciless, but for those who work the numerous problems and abandon themselves to the pragmatic spirit of the book, the study is bound to be rewarding.

The suitability of *Mathematical Methods of Physics* for use in a graduate course will depend on the taste and outlook of the instructor. If he likes to teach the course his own way, but wants to refer his students for detail and elaboration to a systematic textbook, other treatments are preferable; on the other hand, if he is interested in "following" a book, the Cal Tech course, carefully worked up as it is, can be highly recommended. But whether he wants to assign the book to his students or not, the instructor will find it a refreshing source of ideas and examples from which to draw for his pedagogic equipment.

The range of topics which the book treats in comparatively short space is truly astonishing. From the WKB connection formulas to dispersion relations, from the Wiener-Hopf method to the central limit theorem, from a graphical representation of the Fredholm solution to SU(3), there is a wealth of mathematical techniques, all of it of current interest in physics.

Although the style is exceedingly informal ("This is OK for large x"), much care has gone into the writing and into checking the equations. The printing is unusually good, and the figures are very clear.

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Bacterial and Phage Genetics

The Genetics of Bacteria and Their Viruses. Studies in basic genetics and molecular biology. William Hayes. Wiley, New York, 1964. xii + 740 pp. Illus. $13.75.

There are several qualities that one looks for in a new book in one's own area of scientific interest. One hopes for a complete and well-balanced scope of subject matter, a logical organization, a lucid style of writing, carefully chosen illustrations that really help one to understand the written text, and a thorough bibliography. More often than not one is disappointed, but in Hayes's book all of these qualities are present to a degree that is nothing short of miraculous.

The book is a truly complete account of bacterial and phage genetics, and no pains have been spared to insure a logical development of the subject. The first 20 pages review the general principles of inheritance and Mendel's laws; following these Hayes provides clear explanations of recombination analysis and biochemical genetics. Next, he goes carefully into fine structure analysis: the concept of the allele is developed historically, and the new tools of analysis are dealt with—complementation tests, deletion mapping, and three factor crosses. Each method is discussed from the theoretical and from the practical point of view. In a set of background chapters, Hayes takes up the subject of mutation in bacteria and the current concepts of gene action: the genetic code, protein synthesis, the nature of spontaneous and induced mutation, and the nature of recombination.

The second half of the book is devoted to bacterial and bacteriophage genetics. Discussion of lysogeny and phage chromosome structure precedes detailed accounts of transformation, transduction, and conjugation. The last two chapters deal with two highly active fields—genetic regulation and episomes. In every chapter the author gives both the historical development of the subject and the most recent experimental results.

A very attractive feature of the book is the use of two-color diagrams whenever the complexity of the material warrants it. Finally, the bibliography of almost 1000 references covers the literature through 1962 and, for some areas, into 1963. The bibliography, which is alphabetical by author, gives full titles as well as references to the pages in the text where the work is cited.

All in all, this book constitutes a milestone in the genetics literature, and it will certainly be the standard teaching and reference work for some years to come.

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Soil Fauna of South America

Biologie de l'Amérique Australe. *Études sur la Faune du Sol.* vols. 1 and 2. Delamare Deboutteville and Eduardo Rapoport, Eds. Éditions du Centre National de la Recherche Scientifique, Paris. vol. 1, 657 pp., 1962; vol. 2, 399 pp., 1963. Illus. $16.60.

These volumes on the soil fauna of South America are two of a three-volume treatise sponsored by the Centre National de la Recherche Scientifique of France and the Consejo Nacional de Investigaciones Cientificas y Tecnicas of Argentina. The national research centers of the two countries are collaborating in publishing what is designed to be an ecological and biogeographic monographic study, but the first two volumes are appropriately systematic. In addition to the contributions of the editors, one from France and one from Argentina, there are 31 articles, mostly by French authorities, which consist primarily of descriptions of species and identifications mainly of Argentine and Chilean faunas. Much of the fieldwork was performed during the period February to April 1959 by six scientists. A special effort has been made to explore the fine national parks of Argentina, and it is hoped that this survey will be completed before their faunas have been modified by civilization.

A five-page introduction, which points out the uniqueness of southern South America and its interest to the world, precedes 32 pages of descriptions of the areas studied in these volumes. Five maps of the entire continent show its hydrography and meteorologic conditions. Other maps deal with that part which is south of the Tropic of Capricorn and with collecting areas in Argentina. The famous pampas and the Patagonian steppe make up much of this region, but between them there is a large area of "monte," or xerophilous bush, that has carried some tropical elements of the fauna far south to the Atlantic coast in the 41° to 44°S latitude area. Then there is the great Andean spine, with its special biota, which runs down into Tierra del Fuego and the Islas Malvinas (Falkland Islands).

The third volume is expected to summarize the data and provide more factual materials bearing on the prevailing hypotheses, such as Wegenerian continental drift and Antarctic pathways or extensions from the north, which will account for the derivation of the fauna and its relationships to others.

The first six articles are on Thecamoebae, Pauropoda, Symphyla, Acarina, and Pseudoscorpionidea, illustrating the ambitious nature of the project in dealing with all types of invertebrates. Copepods, palpigrades, nematodes, isopods, and syncarids are later described, but the bulk of the two volumes deals with Insecta and especially Coleoptera. It is remarkable that a major part of the animal species of any region of the world always seems to be beetles, and an explanation would be welcome. One Coleoptera study (by R. Jeannel) considers a relationship between South American and Australian members by way of Antarctica when the latter had a more favorable climate or even closer physical relations. It will be interesting to see in the later volume if there are similar relationships suggested which involve the Collembola that are now becoming well known in Antarctica. A handsome colored plate by the French editor shows some of the Collembola.

In view of the numbers of specialists who have contributed to the project, the editors have chosen to publish the articles together and in a common format, and this seems a wise choice. An alternative was to have them scattered in