found in birds. D. Amadon produces figures of about 250 species for the African rain forests and 550 species for the Amazonian ones. The mammal faunas, by contrast, are much more comparable, although Amazonia has a particularly rich bat fauna (F. Bourlière). The Amazon aquatic system is also much richer than that of the Congo; it has some 1300 species of fish against 560 in the Congo (R. Roberts). The freshwater turtle fauna of the former is also twice as rich (R. F. Laurent).

How are these differences to be explained? Richards notes that evidence from lake sediments, pollen, and archeological records indicates that during, and since, the Tertiary Africa has been subject to a series of severe climatic oscillations. Again unlike those elsewhere, the African rain forests are characterized by a regular dry season. R. T. Moore also emphasizes the importance of the climatic oscillations, noting that R. E. Moreau postulated a long history of fragmentation and reduction in the case of these forests. Richards questions why, if Africa was subjected to a series of severe climatic shifts, Amazonia did not also suffer these. As yet little evidence has been developed one way or the other on this. Speciation patterns in contemporary Amazon birds and reptiles do, however, suggest temporary fragmentation of the rain forests during the Pleistocene, as is indicated by Haffer and by Vanzolini and Williams. (It is possible that the more central continental position of the Amazon forests and their greater extent could have been factors minimizing extinction in this biota. The Neotropical rain forest biota is, of course, also essentially a "double" one resulting from the late uniting of separate tropical North American and tropical South American ones, as Ernst Mayr has pointed out.)

The concluding chapters, on the ecology of aboriginal man and on the utilization of rain forest habitats, are interesting as much for what is not known as for what is known of these subjects. Interesting links are indicated between the food and cultural ecology of African pygmies and between Amazonian Indians and their habitats. On the other hand (to a biologist) it is depressing how purely descriptive and totally lacking in quantification this information is. One can but lament what a large proportion of anthropological work is limited to the cultural sphere and how different are the priorities of animal ecologists and anthropologists in data gathering. There is an urgent need for the initiation of a broad program to quantitatively investigate the ecology of primitive man relative to his natural environment before it is too late.

The chapters of H. Sioli and F. R. Fosberg are a sober warning against the dangers of misuse of the Amazonian rain forest habitats. In the seeming luxuriousness of the Amazon forests clearing and destructive agricultural practices continue at an undiminished rate. Humid tropical forest soils have only a low productive potential, however, owing to long-continued leaching and the rapid and complete decomposition of organic matter that occurs at their high temperatures. We still seem to be a long way from convincing politicians and the man in the street of this.

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Rare Earths and Magnetism

Magnetic Properties of Rare Earth Metals. R. J. ELLIOTT, Ed. Plenum, New York, 1972. x, 426 pp., illus. $28.

The rare earth metals occupy a unique and particularly interesting position in the study of magnetism and magnetic materials. Their magnetism originates from unpaired 4*f* electrons, which occupy localized atomic-like states even in metallic hosts, and the interaction between the spins occurs mainly via indirect processes involving the conduction electrons. Thus the electrons responsible for the magnetism and those involved in electrical transport are completely distinct. This separation, on the one hand, is responsible for the remarkable physical properties of rare earth metals, alloys, and compounds, and, on the other hand, simplifies considerably attempts at a microscopic understanding of these materials. By contrast, the transition metals, their alloys, and many of their compounds have proven remarkably intransigent to the most concerted attempts to understand their magnetic and transport properties.

This excellent book basically summarizes our experimental and theoretical knowledge of the rare earth metals and alloys up to 1971. It is composed of a set of review articles covering such subjects as the exotic magnetic structures exhibited by the rare earth metals, the concomitant bulk magnetic properties, the elementary magnetic excitations, transport properties, hyperfine interactions, band structures, indirect exchange, and crystal field effects. The authors are all scientists who have made important contributions to this area over the last decade. The articles are generally lucid, thorough, and authoritative. Indeed, my only serious criticism of the book is that there is rather little cross-referencing and that the basic physical ideas thus tend to be reintroduced in each chapter. This, however, seems to be a failing of many such edited books.

There are, of course, still many interesting and important properties of rare earths, particularly in metallic compounds, which to date have been explored only superficially and are poorly understood. Among these I might mention valence change effects, crystal fields, and anisotropic exchange interactions. Reliable empirical information on these has only appeared in the last three years.

This book should be an invaluable basic work for physicists and chemists who are interested in the properties of the rare earth metals and should in addition be useful for all workers concerned with magnetism and magnetic materials in general. Finally, the price of the book, though somewhat higher than I would have liked, is still within the reach of individuals who would like their own shelf copy.

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CMR Data and Methodology

Carbon-13 Nuclear Magnetic Resonance for Organic Chemists. GEORGE C. LEVY and GORDON L. NELSON. Wiley-Interscience, New York, 1972. xvi, 222 pp., illus. $9.95.

Carbon-13 NMR Spectroscopy. J. B. STOTHERS. Academic Press, New York, 1972. xii, 560 pp., illus. $24.

With the almost explosive growth of high-resolution carbon-13 magnetic resonance (CMR) spectroscopy in recent months there could be no better time for the publication of books in this field by Stothers and by Levy and Nelson. CMR has been long in reaching maturity owing to the problems of detecting a magnetic isotope of relatively low natural abundance (1.1 percent) and less than favorable magnetogyric ratio

(the detectability of ^{13}C nuclei is about 63-fold less than that of ^{1}H nuclei at the same magnetic field). Both books review the methods that have been used to overcome these two rather serious limitations. In each case the authors have done an admirable job of avoiding overly sophisticated treatment of the field, and neophytes approaching the subject for the first time will find these works easy to read. The book by Levy and Nelson is more concise and is a slightly broader introduction to the subject in that it incorporates some of the recent relaxation research. It presents a brief outline of nuclear spin relaxation processes and a discussion of experimental methods for measuring such parameters. Stothers's book does not contain more than cursory statements concerning ^{13}C relaxation processes. This is somewhat understandable, for this book is pretty much limited to research published before the end of 1970 and relaxation data appeared primarily after that date. Up to 1971, Stothers has been so thorough in his review of CMR that future workers will now only rarely need to penetrate the original literature appearing before that date. As a compendium, which any serious worker using CMR techniques should have at his fingertips, the Stothers monograph is a valuable contribution. I expect that it will provide useful source material for many years to come for two reasons. First, the book contains an extensive tabulation of essentially all of the significant data collected in the few laboratories using CMR methods during the 1960's. Second, these data have been converted to the standard (tetramethylsilane) and conventions currently used by most workers for referencing spectra. This unification will do much to eliminate the confusion confronting workers using the early literature and to facilitate the development of routine CMR analytical techniques.

Both books are written in a clear and crisp style. They parallel one another in much of their organization. All the authors are recognized workers in the field, and their overview of the subject is balanced. Both books do a good job of covering the significant developments in the field, except as indicated above, and I have noted no serious omissions. CMR spectroscopy has developed into a powerful tool for structural identification in organic chemistry, the principal field for which these two books were written, and both monographs develop this theme. Parametric contributions to CMR chemical shifts are highly reproducible and faithfully represent a given structural feature. Organic chemists are provided with these substituent parameters in both books, and the methods of applying them are clearly treated in both. The discussion of spin-spin coupling involving the carbon-13 isotope is a bit perfunctory in both, but this probably reflects more the state of knowledge than any limitation on the part of the authors. Neither book provides more than an introductory treatment of the theoretical foundations of CMR, but then this limitation is mollified in both cases by the accurate application of concepts having their foundation in theory. Although Levy and Nelson treat briefly the importance of CMR in biological studies, both books would have been put to press before some of the recent results of biological importance were available. All serious CMR workers should have the Stothers book, and Levy and Nelson is recommended for those wishing a good but less detailed exposure to CMR.

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Tidal Mathematics

The Analysis of Tides. GABRIEL GODIN. University of Toronto Press, Buffalo, N.Y., 1972. xxii, 264 pp., illus. $25.

I am glad to say that Godin has in this book reached his goal completely. In fact he covers all the subject defined by the book's title with no digressions to other fields.

The work is very well planned. It contains an introductory part covering the main topics pertaining to the genesis of the tidal phenomenon and a whole chapter presenting mathematical tools necessary to a good understanding of tidal analysis based on modern scientific concepts. This chapter will be very useful to those interested in any kind of time-series analysis.

All the classic methods of harmonic analysis based on linear combination of ordinates are treated as special applications of the Fourier transform theory. Thus the reader will have a grasp of all these methods and will find himself able to devise more suitable linear combinations to solve his own problem. However, Godin is a very wise adviser when by way of warning he states his very humorous and apt "Principle of Conservation of Difficulty" in connection with the linear combination of ordinates.

The accuracy of the results obtained through the harmonic analysis is studied in detail, including the problem of noise in the separation of constituents with close frequencies. A criterion is established by which to choose the constituents which can be obtained directly from the analysis. Such a criterion is based on the least-squares analysis, also treated in full, but it can be used as a guide whatever method is chosen.

The development of the harmonic analysis of tidal streams is quite good. The algebra is lightened by the use of a vectorial treatment in the complex plane. Here the author points out the need of analyzing the fragmentary records by the least-squares method, since lengthy continuous-stream records are difficult to obtain in practice.

A complete study is presented of the refined nodal factors and angles in terms of longitudes of lunar node and perigee, and a useful algorithm is given by which to compute them.

It may also be mentioned that the delicate problem of inference of harmonic constants is studied in detail. Some results of the technique used by the author here show that he has a large experience on the subject. He provides the reader with a complete understanding of what can be expected from that technique.

The problem of analysis in shallow waters is covered according to Doodson's and Horn's points of view. Their approaches are fully discussed in the text. A summary of the hydrodynamics necessary to understand the origin of the shallow water constituents precedes the theoretical developments.

The book contains a complete development of the Munk-Cartwright method of tidal prediction and analysis which will be easy to follow for the reader well acquainted with the subject covered in the chapter on basic mathematics. Some knowledge of spherical harmonics is necessary. Philosophical advantages of the method and a very sound discussion of the results are provided.

Finally an account is given of several very important points in practical tidal analysis, including the choice of a type of analysis and the error to be expected. Here the reader finds a summary of the Zetler-Cummings technique