day data, R. G. Hipkin concludes that the best value for this is about 4 percent per 100 million years, a figure that is in poor agreement with many of the paleontologic data and that is also probably too high to be explained merely by tidal friction. A lower value is also indicated by P. M. Muller and F. R. Stephenson in the longest article of the book, in which they review all the astronomical observations from 1375 B.C. onward; they conclude that for 3000 years the acceleration rate in day length due to all causes (both tidal and nontidal components) has been a constant 2.5 milliseconds per century.

Several authors examine ways in which the speed of the earth's rotation can be altered. The variety of methods indicates how much ferment there is in the field. P. S. Wesson investigates the consequences of a changing *G* (Newtonian constant of gravity) vis-à-vis global expansion on the order of several hundred kilometers, and favors the latter. K. M. Creer believes the consequences are geophysically reasonable and significant for changes in the depth of the transitional zone of the mantle, as well as for differences between the oblateness of the geoid and the hydrostatic figure, with fluctuations on a 100-million-year time scale. In yet another approach, J. A. Jacobs and K. D. Aldridge examine coupling of the core to the mantle in conjunction with Urey's idea of 1952 that changes in day length may be linked to changes in the moment of inertia related to the rate of core growth (and Runcorn's corollary of 1962 that this involves changes in the number of convection cells). O. H. Weinstein and J. Keeney discuss Hubble's law and "a cosmological drag force," and J. Gribbin focuses on the 11-year sunspot cycle and solar tides. D. H. Tarling's solution to the problem of "excess deceleration" is to deny the existence of deep oceans in the past, and thereby to increase lunar tidal torque.

It seems that, in general, even low-frequency geophysics may be no better off than this high-frequency paleontology, and that adequate paleontological data would greatly help in distinguishing among at least some of the possible mechanisms of the earth's deceleration (*5*). Indeed, as Hipkin concludes,

> Now that palaeontology has confirmed that past changes in the lengths of day and month are of the same order of magnitude as the original geophysical predictions, the role of the geophysicist can only be the reactionary one of interpreting the data given him. Its reliability is a problem for the biologists.

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Molecular Rearrangements

Isotopes in Organic Chemistry. Vol. 1, Isotopes in Molecular Rearrangements. E. BUNCEL and C. C. LEE, Eds. Elsevier, New York, 1975. xvi, 302 pp., illus. $41.75.

The current revival in tracer studies, after a period of commonplace use and then a decline, is due principally to the sophistication of nuclear magnetic resonance techniques. The editors announce that this volume is the first of a series that will also include volumes on the use of isotopes in hydrogen-transfer processes, aromatic systems, and elucidation of structure and on the use of carbon-13 and isotopic sulfur in organic chemistry. The intent of the series is to bring together information from areas of organic chemistry that have in common the use of isotopes.

Only a 26-page chapter is devoted to deuterium labeling in carbonium-ion rearrangements. Its author, Deno, writes, "No great effort has been made to secure complete coverage since many deuterium studies were auxillary [sic] to other work and are of import for their bearing on mechanistic problems rather than for illustrating techniques in deuterium labeling." He describes as "ingenious" a double-labeling experiment that is now commonplace. That method is at least as old as the work of Bloch and Rittenberg, whose double-labeling experiment, reported in 1945, showed that a metabolic acetylation reaction does not involve loss of carbon-bound deuterium. Deno's treatment of protonated cyclopropanes (pages 3 and 4) leaves the reader confused by the statement that kinetic isotope effects are of the secondary type and can be neglected, since his chart (page 4) shows the making and breaking of deuterium bonds, for which a primary isotope effect is expected. The "mechanisms" he presents on page 4 are shown, surprisingly, as nonreversible carbonium-ion rearrangements.

If this chapter seems short, the chapter by Hunter on carbanion rearrangements seems unduly long, because investigators have found little use for isotopes in the study of carbanions. Consequently, some sections of the chapter contain only the barest reference to a labeled compound. The chapter does, however, provide a good and profusely illustrated up-to-date, critical review of carbanion chemistry, and it includes an excellent appendix that lists, according to type, the specific compounds referenced in the chapter.

A once-popular book on molecular rearrangements contained a chapter by Rhoads on "no mechanism" pathways. Dolbier describes some of these inscrutable reactions in a chapter that relates secondary deuterium isotope effects to pericyclic reactions and includes cycloadditions, sigmatropic rearrangements, ene reactions, and retroene reactions. His discussion of the [2 + 2] cycloaddition reaction describes only the transition state proposed by Baldwin and Kapecki and offers no comment on the later (1969 to 1971) evidence by Huisgen, Dreiding, Brook, Ghosez, and their co-workers that the reaction proceeds through a crosswise transition state.

The remainder of the book is devoted to a review, by Holmes, of the use of isotopic labeling in the determination of mass spectral fragmentation mechanisms and another, by Swenton, of the use of deuterium in organic photochemical rearrangements. Swenton emphasizes that deuterium substitution is useful not only for establishing gross molecular change but also for synthesizing specifically deuterated molecules in reactions whose course is often profoundly altered by deuterium substitution in either reactant or solvent.

The references in this volume contain several errors. Running heads would have aided the reader. In spite of being a little ragged in a few places, the book is a good beginning in what should be a worthwhile series.

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Applications of Spectroscopy

Nuclear Magnetic Resonance in Biochemistry. Principles and Applications. THOMAS L. JAMES. Academic Press, New York, 1975. xiv, 414 pp., illus. $26.50.

Nuclear magnetic resonance (NMR) spectroscopy has developed over the past 30 years into a very powerful and versatile technique in the study of molecular structures, kinetics, interactions, and mechanisms. In the last half decade or so, remarkable advances in instrument design, particularly the advent of fast Fourier transform and pulse methods, have tremendously improved the sensitivity of