atom. The practical side of the measurement of the fundamental constants (discussed in the book by K. F. Smith and by B. W. Petley) is today also geared to expressing everything in terms of atomic units.

The gravitational force obeys an inverse square law, just like electrostatics, and Gm_pm_e (where G is the gravitational constant and m_p and m_e are the proton and electron masses) is an analogue to e^2 for the hydrogen atom. The gravitational fine structure constant $\alpha_G = Gm_pm_e/\hbar c \sim 10^{-38}$ is very small, relevant if e were zero. The gravitational Bohr radius of the hydrogen atom not only is large ($a_{oG} \sim 10^{28}$ cm) but is close to the present-day value of R_U, the radius of the observable universe. R_U is changing with time because the universe is expanding, and Dirac (1937) raised the question whether the dimensionless constants of nature (especially α_G) might themselves be changing with time. So far all attempts at finding time variations of fundamental constants have turned out negative (as is discussed in a paper by R. D. Reasenberg and in one by B. E. J. Pagel), including an accurate demonstration of the constancy of the coupling for the nuclear force (from the bizarre occurrence of the Oklo natural reactor (J. M. Irvine). The importance of the large dimensionless numbers for many macroscopic phenomena is summarized in the book (M. J. Rees), and even biological evolution (B. Carter) and the human four-minute mile (W. H. Press and A. P. Lightman) are treated.

If the constants of nature are really constant are they also related? The hope for an affirmative answer provides the underpinning for much of fundamental particle theory of today (S. Weinberg, C. H. Llewellyn Smith, J. Ellis). The successes to date relate mainly to results of high energy experimental physics, which are very plentiful, so the theories still have quite a number of parameters in them. Grand unification including gravity is still the end of the rainbow, partly because the weakness of gravity translates into large masses: with the Planck mass M_{Pl} defined by $GM_{Pl}/\hbar c = 1$, $M_{Pl} \sim 10^{19}\ m_p$ is even larger than the grand unification mass ($\sim 10^{15}\ m_p$) where the various couplings (excluding gravity) approach each other. Thus it is not clear yet whether the empirical relation $ln(M_{Pl}/m_p) \sim (3\alpha)^{-1}$ can be derived from fundamental theory. I will dodge the question whether this book is entirely successful in explaining the state of the art in each subject to readers outside the field. So many specialized fields must be brought together that success in this may be impossible. However, even if one does not understand much of what one reads one is carried along by the sense of excitement, especially when it is understated (for example, the note added in proof on the discovery of the Z-particle, p. 46, which pretty well verifies what was predicted in the talk).

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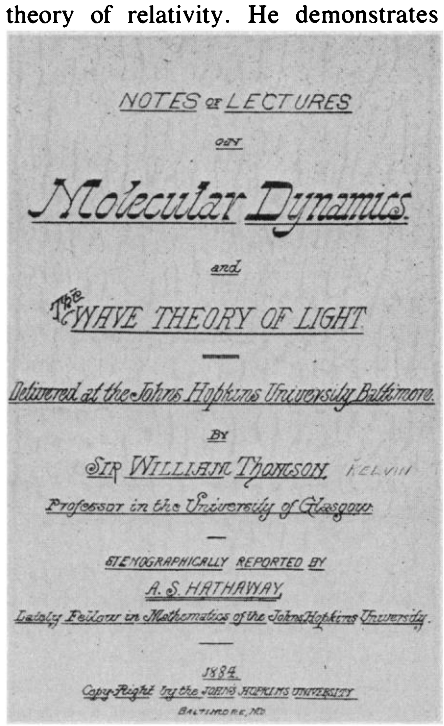
Mechanists and Deviationists

American Physics in Transition. A History of Conceptual Change in the Late Nineteenth Century. ALBERT E. MOYER. Tomash, Los Angeles, 1983. xx, 218 pp., illus. $30. The History of Modern Physics, 1800–1950, vol. 3.

In this book Albert Moyer examines the "prehistory" of the American reception of quantum theory and Einstein's theory of relativity. He demonstrates that in the decades preceding 1905 there existed in American physics a questioning of foundations and a search for alternatives to what was seen as a failing mechanistic world view, paralleling the ferment in European physics in the same period.



Cover of William Thomson's "Baltimore Lectures." Thomson's use in these lectures of an analogy between the luminiferous ether and "Scottish shoemaker's wax" as a "commonplace, concrete 'illustration' to justify his assumption of an elastic ether points to the feature for which the . . . lectures are best known today: his insistence on mechanical models in explicating the molecular dynamics of light. . . . American misgivings about even Thomson's self-critical and circumspect mechanical outlook suggest that by the mid-1880s, physicists were not as uniformly and deeply committed to the atomo-mechanical viewpoint as Stallo contended." [From *American Physics in Transition*; Rare Book Department, University of Wisconsin Library]

Moyer begins with a careful analysis of J. B. Stallo's 1882 critique of the "metaphysical" commitment of contemporary physicists to an "atomo-mechanical" world view, that is, to the explanation of all physical phenomena in terms of particles or an ether obeying the laws of mechanics. Then, surveying the views of a dozen presumably representative American physical scientists active about 1880, and the transformations and realignments of these positions after 1895, Moyer finds a spectrum of opinion even among mechanists, both at the level of "content" (theories, hypotheses, and models) and at the level of "scientific ideologies" (philosophical stances, methodologies, and values). His "orthodox mechanists" Alfred M. Mayer and Amos Dolbear were born in the mid-1830's, "modest mechanist" John Trowbridge and "muted mechanist" Henry Rowland in the 1840's, and "practical" mechanists Albert Michelson and Edwin Hall in the 1850's. Moyer points out that the increasing complexity and subtlety of their positions reflected changing patterns of education and research in American physics. Yet four of his five "deviationists," spokesmen for nonmechanical outlooks that could have undermined the dominant "atomo-mechanical" position, were born in the same decade as his "orthodox mechanists," a coincidence of which he takes no notice. The potentially subversive views of these five included the operationalism of Simon Newcomb, the incipient pragmatism of Charles S. Peirce, the phenomenalistic "leanings" of Willard Gibbs, and the skepticism of Samuel Langley and Francis Nipher toward claims of scientific truth.

The section of the book delineating the philosophical and methodological positions of these physicists is its strongest part, providing essential support for Moyer's argument. A second strength of the book lies in the evidence it presents for the influence of European physicists in the United States. Moyer gives attention to the lecture tour of John Tyndall in 1873, the visits of Rayleigh, William Thomson, and others in 1884, the appearance of Helmholtz in Chicago in 1893, and the attendance at the 1904 St. Louis Congress of Arts and Sciences of a galaxy including Poincaré, Boltzmann, Ostwald, Langevin, and Rutherford.

Of the Europeans with whose influence he is concerned Moyer considers at length only Tyndall and William Thomson. A fuller examination of the diffusion in America of the views of Mach, Ostwald, Boltzmann, Lorentz, and Poincaré would have been useful, as would more attention to the journalistic activities of E. L. Youmans and Paul Carus in this regard. Conversely, the specifically American and more particularly local intellectual and cultural contexts are barely apparent, since Moyer scarcely begins to exploit the richness of recent historical work on late 19th-century American science and philosophy. Furthermore, though he makes the important point in the introduction that this period of conceptual transition coincides with the institutional and professional maturing of the American physics community, he neither explores the institutional context nor plumbs the depths of this "coincidence," simply inserting references to the work of others, especially *The Physicists* by Daniel Kevles. And his concentration on "physics" obscures the fact that much early interest in special relativity came from outside the physics community, from such physical chemists as G. N. Lewis and R. C. Tolman, authors of the first paper on relativity presented to the American Physical Society (1908), and from such mathematicians as R. D. Carmichael, author of the first treatise in English on special relativity (1913).

Since the youngest of Moyer's mechanists were about 50 in 1905, and his deviationists were older or already dead, one wishes that he had examined in as much detail the development of the views of a younger generation, a "generation of 1905," the one that was actually confronted with quantum theory and relativity. Moyer's younger generation consists only of the "progressive" members of the delegation of American physicists to the 1904 St. Louis Congress, and he treats their philosophical and methodological positions very briefly.

The task Moyer set himself was modest. The historical program of achieving a full understanding of the reception of such scientific innovations as quantum theory and relativity is an ambitious one, and its realization will continue to require the work of many hands. Moyer's study is an important component of the broader program. It enlarges our understanding of physics in the American context.

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Some Other Books of Interest

Chemical Ecology of Insects. WILLIAM J. BELL and RING T. CARDÉ, Eds. Sinauer, Sunderland, Mass., 1984. xvi, 524 pp., illus. $45; paper, $28.50.

The objective of the editors in compiling this volume was to "delineate the major concepts" of the discipline of insect chemical ecology. The opening section, Perceptual Mechanisms, consists of papers on contact chemoreception (E. Städler) and olfaction (H. Mustaparta). In the second section there are papers on odor dispersion (J. S. Elkinton and R. T. Cardé) and chemo-orientation in walking and flying insects (W. J. Bell; Cardé). Factors affecting choice of host plant (J. R. Miller and K. L. Strickler; J. M. Scriber) and parasitoid-host relationships (S. B. Vinson) are then discussed. The section Chemical Protection consists of papers on alarm pheromones in presocial insects (L. R. Nault and P. L. Phelan) and warning coloration and mimicry (J. E. Huheey). Under the heading Chemical-Mediated Spacing there are discussions of resource partitioning (R. J. Prokopy, B. D. Roitberg, and A. L. Averill), aggregation in bark beetles (M. C. Birch), and sexual communication (Cardé and T. C. Baker). The final group of papers is devoted to sociochemicals in bees (R. M. Duffield, J. W. Wheeler, and G. C. Eickwort), ants (J. W. S. Bradshaw and P. E. Howse), and termites (Howse). The volume has a brief subject index and a detailed table of contents.
—K.L.

The Ecology of Aquatic Insects. VINCENT H. RESH and DAVID M. ROSENBERG, Eds. Praeger, New York, 1984. xii, 625 pp. $35.

The principal goals of this book are "to present a contemporary overview of aquatic insect ecology" and "to highlight research needs and avenues of investigation . . . that currently seem most promising." An attempt has been made to avoid duplication of topics covered in other reviews, briefly surveyed in the editors' introduction. Among the 18 other contributions are two each on life histories (M. G. Butler; B. W. Sweeney) and predator-prey relations (B. L. Peckarsky; M. Healey). Other papers deal with behavioral adaptations (M. J. Wiley and S. L. Kohler), nutrient cycling (R. W. Merritt *et al.*), feeding (G. A. Namberti and J. W. Moore), secondary productivity (A. C. Benke), colonization (A. L. Sheldon), and effects of various properties of the habitat. One paper (J. D. Allan) discusses hypothesis testing in aquatic insect ecology, and several (T. Wiederholm; J. V. Ward; H. B. N. Hynes) are concerned with problems of pollution and habitat quality. The volume has author, taxonomic, and subject indexes. —K.L.

Periphyton of Freshwater Ecosystems. ROBERT G. WETZEL, Ed. Junk, The Hague, 1983 (U.S. distributor, Kluwer Boston, Hingham, Mass.). x, 346 pp., illus. $87.50. Developments in Hydrobiology, 17. From a workshop, Växjö, Sweden, Sept. 1982.

The word "periphyton," in the definition deemed best by the editor of this volume, refers to "a complex community of microbiota (algae, bacteria, fungi, animals, inorganic and organic detritus) that is attached to substrata" that may be "inorganic or organic, living or dead." The papers in the volume, most of which are reports of their authors' own studies, are arranged under six headings: Dynamics of Periphytic Communities (nine papers); Parameters Influencing Growth of Periphyton (ten papers); Productivity and Utilization of Periphyton (six papers); Periphyton/Substrata Interactions (four papers); Methodology (seven papers); and Periphyton and Pollution (five papers). The majority of the contributors are European; others are from North America, South Africa, Japan, and Australia. The volume concludes with recommendations for future research.—K.L.

Books Received

Antineoplastic, Immunogenic and Other Effects of the Tetrapeptide Tuftsin. A Natural Macrophage Activator. Victor A. Najjar and Mati Fridkin, Eds. New York Academy of Sciences, New York, 1983. viii, 273 pp., illus. Paper, $55. Annals of the New York Academy of Sciences, vol. 419. From a conference, Feb. 1983.

Appearances of the Dead. A Cultural History of Ghosts. R. C. Finucane. Prometheus, Buffalo, N.Y., 1984. viii, 232 pp. + plates. $18.95.

Arming the Heavens. The Hidden Military Agenda for Space, 1945–1995. Jack Manno. Dodd, Mead, New York, 1984. x, 245 pp. $13.95; paper, $7.95.

Aspects of Chemical Evolution. G. Nicolis, Ed. Interscience (Wiley), New York, 1984. xviii, 286 pp., illus. $50. Advances in Chemical Physics, vol. 55. From a conference, Washington, D.C., April 1980.

Atlas of Continental Displacement. 200 Million Years to the Present. H. G. Owen. Cambridge University Press, New York, 1984. x, 159 pp. $29.95. Cambridge Earth Science Series.

Atlas of Steroid Structure. Vol. 2. Jane F. Griffin, William L. Duax, and Charles M. Weeks, Eds. IFI/Plenum, New York, 1984. vi, 754 pp. $140.

Atmospheric Turbulence. Models and Methods for Engineering Applications. Hans A. Panofsky and John A. Dutton. Wiley-Interscience, New York, 1984. xx, 397 pp., illus. $49.95.

Automated Reasoning. Introduction and Applications. Larry Wos *et al.* Prentice-Hall, Englewood Cliffs, N.J., 1984. xiv, 482 pp., illus. $28.95.

Avoiding Inadvertent War. Crisis Management. Hilliard Roderick and Ulla Magnusson, Eds. Lyn-