search and a brief discussion of the controversy over the Whitehead Institute, there is little discussion of social context. Though the 1980s research scene was set by the constriction in federal funding and the proliferation of firms from academic biology laboratories, Weinberg's own involvement in a firm receives only passing mention and there is no discussion of its effect, either positive or negative, on his academic research group. We are left to speculate whether his increasing distance from his group, noted by Angier at that time, was connected to his commercial involvement or simply to temporary discouragement over research setbacks. Although her book is set in a later time period, Angier provides us with a "before" portrait of molecular biology, without the safety, ethical, and commercial issues of the 1970s and '80s.

Both authors combine internalistic and externalistic approaches, explaining the intellectual content of the science and the organization of group research. Ironically, the dynamics of research groups are often left out of laboratory studies conducted by social scientists, who, following the reductionist approach of many of the scientists they study, make the conduct of science the virtual equivalent of the output of instrumentation. By contrast, these books read like nonfiction novels. Their depictions of lab groups and gene clonings are the academic counterparts of Tom Wolfe's portrayal of esoteric enclaves of auto buffs or Truman Capote's account of a murder. Short of running celluloid past a camera lens, *Invisible Frontiers* and *Natural Obsessions* are as close as we are likely to come to a motion-picture double feature of post-war academic science in the United States.

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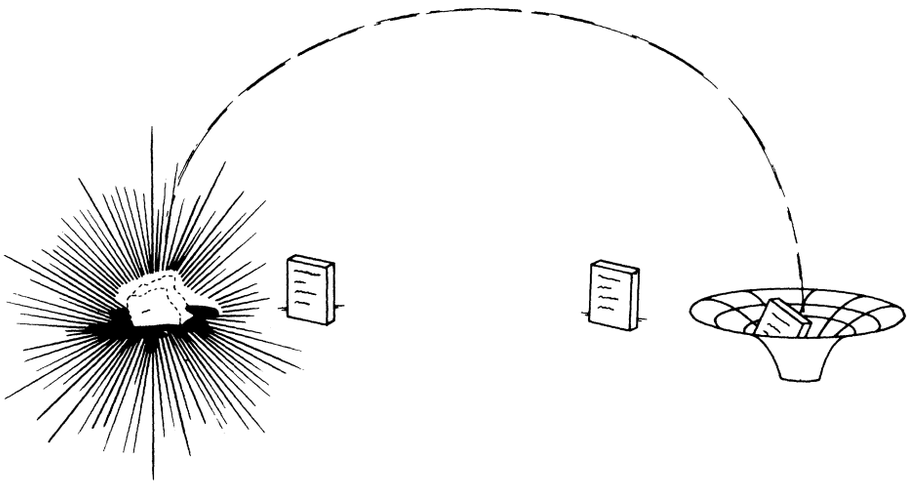
A Range of Physics

Between Quantum and Cosmos. Studies and Essays in Honor of John Archibald Wheeler. WOJCIECH HIBERT ZUREK, ALWYN VAN DER MERWE, and WARNER ALLEN MILLER, Eds. Princeton University Press, Princeton, NJ, 1988. xii, 623 pp., illus. $49.50. Reprinted from *Foundations of Physics*, vol. 16, nos. 2–7 (1986).

Between Quantum and Cosmos is a collection of papers assembled in honor of the 75th birthday of John Archibald Wheeler. Before commenting on the book proper, it seems appropriate to say a few words regarding Wheeler himself. In many ways he is a unique figure. Early in his career he made important contributions to nuclear physics and general quantum mechanics. Perhaps the single most outstanding contribution of these is the analysis of nuclear fission as a non-classical (that is, tunneling) hydrodynamic instability in the framework of the liquid drop model. From this work emerged not only a successful semiquantitative theory of fission but a paradigm of how classical reasoning could be used and refined to deal with deeply quantal phenomena. The use of semiclassical techniques has become a vast and thriving activity touching upon issues ranging from the description of nucleation in phase transitions to chemical reaction theory to soliton models of elementary particles. Arguably, Wheeler's fission work nucleated the subject and his subsequent work on diffractive scattering helped spur its rapid growth.

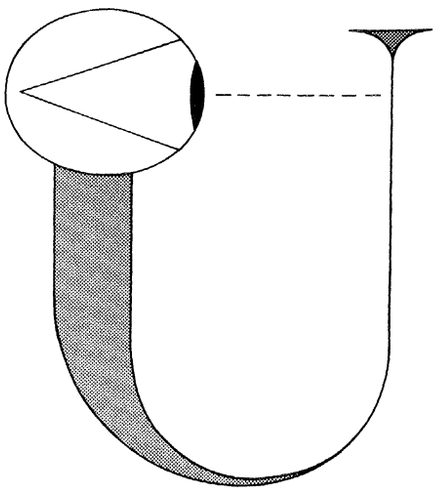


"The laws of physics are not chiseled on a slab of granite that stands from everlasting to everlasting. Those regularities had to come into being at the big bang and be obliterated in the gravitational collapse that takes place at the center of a black hole." [Reproduced from J. A. Wheeler, *Physics and Austerity: Law Without Law* (in Chinese; Anhui Science and Technology Publications, 1982), in *Between Quantum and Cosmos*]

After notable forays into the classical theory of radiation (with his student Richard Feynman), pioneering efforts in drawing out the general implications of causality in the measurable form of dispersion relations (with Toll), and classic contributions to the theory of mu-mesic atoms, Wheeler in the mid-'50s turned in quite a different, and at the time rather unfashionable, direction—that is, to general relativity. In this field, his influence has been enormous. It has arisen not so much from his technical contributions as from his insightful, charismatic formulation of problems and his inspired teaching. It is to him, for example, that we owe the term "black hole" and the remarkable phrase "black holes have no hair." Perhaps more than any other individual Wheeler converted what had become a backwater of physics to a vital, popular subject. He was aided in this, of course, by some remarkable empirical discoveries—quasars, pulsars, and the microwave background radiation. But Wheeler saw the developing rich possibilities for observational consequences of general relativity long before they were obvious. In recent years Wheeler's interest has tended more and more toward the issues involved in synthesizing general relativity with quantum mechanics. Several of the concepts he introduced, notably wormholes and the Wheeler-deWitt equation, occupy central positions in current work in the field. He has also written extensively on the philosophical implications of physics, especially regarding the nature of this last projected synthesis (whose outlines remain, at present, quite murky).

Wheeler has been led, in pondering the problems involved in reconciling the basic ideas of relativity and quantum mechanics, to striking speculations on the nature of time, measurement, and the very concept of physical law that are widely known and quoted. For example, "Quantum mechanics promotes the mere 'observer of reality' to the 'participator in the defining of reality.' It demolishes the view that the universe exists out there." This is not the place to discuss whether these speculations form a coherent system, or what their future may be. I will only remark that the importance of Wheeler's technical contributions to physics gives his statements a weight that, coming from another source, they would not have.

Now let us turn to the book at hand. It contains 40 papers on an extremely wide range of topics, reflecting the range of Wheeler's interests. Perhaps inevitably, the



"Existence viewed as a self-synthesizing system. The universe starts small (thin U at upper right), grows (loop of U), and in time gives rise (upper left) to observer-participancy—which in turn determines all we have the right to say about even the earliest days of the universe." [Adapted from C. M. Patton and J. A. Wheeler,"Is physics legislated by cosmogony?" in *Quantum Gravity*, C. J. Isham *et al.*, Eds. (Clarendon, 1975), for *Between Quantum and Cosmos*]

quality of the papers is uneven, and many are sketchy or of limited interest. However, I suspect that most physicists, as well as philosophers interested in the foundations of quantum mechanics, will find something to enjoy here. I will mention a few papers that I particularly liked. Glimm and Sharp contribute "An *S* matrix theory for classical nonlinear physics," which is a fascinating glimpse into a developing attempt to systematically classify shocks and their collisions. Dicke contributes a little gem, "On observing the absence of an atom," wherein the apparent paradox that by not observing an atom in a given part of a box (no interaction!) one has performed a measurement, and in particular taken the atom out of its ground state, is convincingly and instructively resolved. "Wedges I" by deWitt-Morette, Low, Schulman, and Shiekh is a beautiful discussion of exactly soluble diffraction problems and their use in deriving asymptotics more generally.

There is a very interesting cluster of contributions by Feynman, Geroch and Hartle, Landauer, and Bennett dealing with issues regarding the physical limits to computation (and vice versa) and the evolution of complexity. Feynman's contribution is a quite substantial discussion of quantum mechanical computers and, as always with Feynman, a delight to read. In their paper, Geroch and Hartle have performed a great service by formulating clear definitions of key concepts such as measurable and computable numbers and supply some instructive examples of their use.

In conclusion, let me add that the book is attractively produced (although there are quite a few typos); especially nice touches are the face-to-face photographs of the infant and modern Wheeler, a selection of some of his memorable quotations, and reproductions of some characteristic striking graphics from his works.

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Some Other Books of Interest

Optical Effects Associated with Small Particles. P. W. BARBER and P. K. CHANG, Eds. World Scientific, Teaneck, NJ, 1988. xxii, 336 pp., illus. $75; paper, $35. Advanced Series in Applied Physics, vol. 1.

"The combined use of computers for calculation and lasers for experiments has continued to reward investigators with exciting new science and significant applications of optical diagnostic techniques for in-situ and real-time monitoring of aerosols and hydrosols in fields ranging from atmospheric science to combustion engineering and from oceanography to microbiology," write the editors of this volume. In particular, they identify the discovery in optical spectra of resonance peaks that are solely dependent on particle morphology as an important recent finding and note that the relevance of the "quantum size" effects of small particles to their optical properties is another important topic of research. Having observed that many findings in particle optics have been reported only briefly in rapid-communication journals, they have here asked active researchers in the field to provide "comprehensive reviews describing the fundamental approaches as well as the latest developments and discoveries in their respective research areas" in such a way as to be suitable for a wider audience. The opening paper is a review from a mathematical point of view of morphology-dependent resonances, a subject that the editors note figures in all the papers in the book, by S. C. Hill and R. E. Benner. In subsequent papers the use of levitation methods in the spectroscopy of single particles is discussed by S. Arnold, the absorption and fluorescence spectroscopy of aerosols by A. J. Campillo and H.-B. Lin, laser-induced droplet heating by R. L. Armstrong, and the applicability of bulk optical constants to small particles by D. R. Huffman. The papers, apparently printed from camera-ready copy supplied by their authors, are followed by an index. Volume 2 of the series this volume inaugurates (which is edited by S. Ramaseshan) will be devoted to computational light scattering.—**K.L.**

Chemistry of Nucleosides and Nucleotides. Vol. 1. LEROY B. TOWNSEND, Ed. Plenum, New York, 1988. xii, 394 pp., illus. $69.50.

This volume is the first to appear of what is to be a four-volume treatise intended for chemists in a variety of subfields and also for those whose interests are in the medical uses of nucleosides and nucleotides. It contains three chapters on subjects that have provided the basis for the development of the areas of research that will be dealt with in the future volumes: "Synthesis and reaction of pyrimidine nucleosides" (112 pages, 806 references) by Tohru Ueda, "Synthesis and properties of purine nucleosides and nucleotides" (169 pages, 672 references) by Prem C. Srivastava, Roland K. Robins, and Rich B. Meyer, Jr., and "Synthesis and properties of oligonucleotides" (84 pages, 490 references) by Morio Ikehara, Eiko Ohtsuka, Seeichi Uesugi, and Toshiki Tanaka. There is also a 25-page subject index.—**K.L.**

Advances in Lectin Research. Vol. 1. HARTMUT FRANZ, KEN-ICHI KASAI, JAN KOCOUREK, SJUR OLSNES, and LELAND M. SHANNON, Eds. Springer-Verlag, New York, 1988. 187 pp., illus., + plates. $57.

Both Irwin J. Goldstein and Hartmut Franz in the preface and the foreword to this first volume of a projected annual series note recent progress in research involving lectins, both as research tools and with regard to their biological functions, and predict further progress, particularly in biomedical uses. This series is intended to provide review articles that will reflect such progress. Franz notes that its initiation coincides with the centennial of Stillmark and Kobert's preparation (from the castor-oil plant *Ricinus communis L.*) of ricin, whose recognition as a hemagglutinin "represented the first step toward the creation of lectinology," and in the opening chapter he recounts and comments on the developments leading up to and following from this work. In chapter 2 Harold Rüdinger describes methods for the extraction, purification, and characterization of plant lectins and gives brief accounts of the isolation of lectins from some 100 plant species. In chapter 3 the structure and function of lectins, particularly concanavalin A, from their main source, the Leguminosae, are discussed, with several tables of comparative data, by Edilbert van