

Recollections and Revisions

Pions to Quarks. Particle Physics in the 1950s. LAURIE M. BROWN, MAX DRESDEN, and LILLIAN HODDESON, Eds. Cambridge University Press, New York, 1989. xxxiii, 734 pp., illus. \$59.50. Based on a symposium, Batavia, IL, May 1985.

Like its predecessor *The Birth of Particle Physics*, this volume derives from a Fermilab symposium, but it is not a proceedings in which talks are reproduced more or less *viva voce*. There is evidence of careful editing (not least in the time elapsed between the symposium and the book), and it is stated that the editors have solicited additional papers for publication. They do not stipulate which they were, but one has the impression of a desire to achieve a balance with regard to some of the internal rivalries of the physics community.

In the first, 1980, Fermilab symposium, professional historians were invited to listen to and participate in discussions with the physicist protagonists of the historical events. The result of that encounter encouraged the organizer-editors to suggest that "in future symposia of this kind, historians as well as physicists be invited to present papers to the mixed group." This has been done here; about a third of the contributions are by historians, and they are appropriately mixed with those of the physicists. This has the effect of an immediate confrontation between the two professions. John Heilbron in his introductory contribution explores the analogies and differences between their concerns.

The volume is structured in ten parts, each but the first headed by a relevant quotation from Arthur Roberts's "Academic Songs," which recall very effectively the mood of the time. The first part contains, in addition to Heilbron's contribution and some remarks by C. N. Yang, a summary by the editors of the main events of the chosen period, from the birth of the pion in 1947 to the naming of the quark in 1963. The second part, a bridge to the first volume, contains two essays on research in particle physics by way of cosmic rays from 1947 to 1957, when the big accelerators finally took over the field.

Parts 3, 4, and 5 cover the experimental work on pions, nucleons, and strange particles, including the discovery of resonances, nucleon structure, and the antiproton. The account here of the development of the tools

of the trade, the particle accelerators and the new detectors that were used with them, is enlivened by a panel discussion, the only discussion reported in the book. The next three parts are concerned with weak reactions and parity violation as seen both by experimenters and by theoretical physicists; with the response of the "particle physics community" to its social and political milieu in the United States, Europe, and Japan and the establishment of national and international centers; and with the progression of the theory through semi-phenomenological models in the frame of quantum field theory from the S-matrix to quarks.

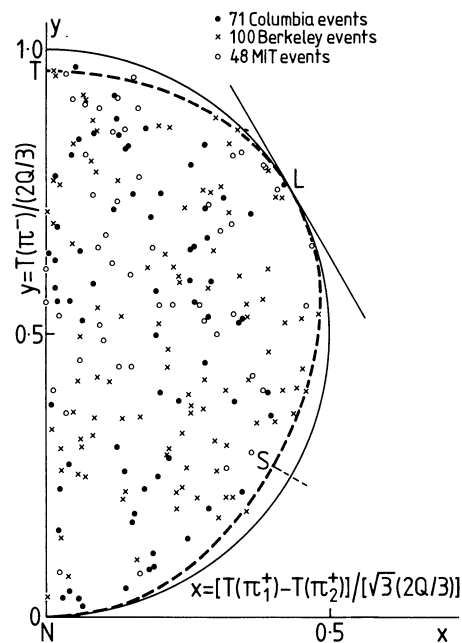
The book concludes with three "personal overviews." Robert Marshak documents the history of the period through the discussions at successive Rochester Conferences, and Silvan Schweber gives a historian's analysis and Murray Gell-Mann that of a theoretician.

The historians' contributions to the book reflect the various interests of their profession. Peter Galison and Allan Franklin explore methods and interactions within the community of experimental physicists, Galison in a study of the invention and development of bubble chambers and spark chambers and Franklin in an analysis of early (1928–30) evidence for parity violation and the reasons it was not recognized at the time. Hywel White and Daniel Sullivan in discussing weak interactions and Andy Pickering in his treatment of the role of dispersion relations explore the theoretical community. Robert Seidel on the other hand emphasizes the political context in his study of the interaction between the military, the Atomic Energy Commission, and the physicists in the funding, design, and location of the big American accelerators. Armin Hermann does the same with regard to the founding of CERN in the rather different political conditions of Europe. Both Helmut Rechenberg, incidentally to his chronicle of S-matrix theory, and Michiji Konuma in his study of the social aspects of Japanese physics investigate the problems of wartime isolation and postwar restrictions in the countries vanquished in World War II. Schweber assesses the contributions of external pressure, mostly by way of funding, and of the internal tradition of pragmatism proper to the Anglo-American community to the dominance of the major theoretical research programs in the '50s and to the

changing of the face of physics.

The physicists' reaction to the presence of historians in their midst can be seen first of all in the style of their talks. Following the historians' declaration of the fallibility of personal memory there is a general tendency to increased rigor and documentation. Though some ignore the problem and others retreat into pure scholasticism, most share Valentine Telegdi's attitude that although reminiscences "can be misleading... chronological presentation devoid of personal reminiscences" contributes no more than a standard textbook—fortunately, for we thus have, for instance, four personal accounts in the section on accelerator design and construction that give a clear idea of the differences among the various institutions and individuals involved in attitude toward these problems. Also one finds many different pictures of the motives and methods of the physicist, from that of Robert Hofstadter, the highly individual experimentalist, to that of Luis Alvarez, the wielder of group power.

The historians' preoccupation with the influence of national interest on the shaping of science policy is generally countered by emphasis on the international spirit of the physics community. Little mention is made



"A plot of 219 τ^+ decay events found," as of mid-1956, "in nuclear emulsion exposed to stopping K^+ beams from the Bevatron." A conference held a year earlier, at which 93 τ^+ decay events identified through the emulsion method were reported, compared to 17 identified through cosmic-ray cloud-chamber experiments, "marked essentially the end of significant cosmic-ray contributions to τ^+ decay studies." This plot, after J. Orear *et al.*, *Phys. Rev.* **102**, 1676 (1956), "illustrate[s] the rapidity of the change." [From R. H. Dalitz's contribution to *Pions to Quarks*]

of dissidence, apart from Jack Steinberger's reference to refusal to sign a loyalty oath and the editors' comment on the unpopularity of the government decision on the 12.5 GeV zero-gradient synchrotron and allusion to "other Cold War decisions that alienated some physicists from the government." There should be scope for historical study of such themes.

In the face of history, there appears also a widespread desire to remedy past wrongs, to acknowledge unquoted sources, recall the role of little-recognized innovators such as Hartmut Kallmann, or acknowledge the contribution of humbler colleagues, as Alvarez does in the case of the discoverers of the strange resonances. When acknowledgment is not forthcoming, there are those who make their own claims, either by implication or directly, like Oreste Piccioni and E. C. G. Sudarshan.

The historians have paid considerable attention to the encouragement of phenomenological theory at the cost of axiomatic quantum field theory but little to the age-old contrast between experimenters and theoreticians. Abdus Salam, quoting Oppenheimer, refers to the experimenter's "desire to spite the theorist." The '50s was a period in which the experimenter was still dominant. Not only did the richness of the data pouring out of the machines keep the theorists calculating busily, unexpected discoveries obliged them to think hard too. There is much nostalgia in the experimenters' contributions for this aspect of the good old days.

The clarification of these various tensions is in part due to the editors' careful contrapositioning of texts and in part is to be found by an attentive reader in odd phrases. It is perhaps in the apparently minor details that the richness of this volume as a source book for the history of particle physics lies.

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Lost Heroes

Women of Science. Righting the Record. G. KASS-SIMON and PATRICIA FARNES, Eds. Indiana University Press, Bloomington, 1990. xvii, 398 pp. \$39.95.

There now exists a considerable amount of published material on women in science, and to make a substantial contribution to this field a new book must integrate its material with the new scholarship, provide an expanded reference source, or offer a unique approach to the subject. This collection of essays recounting the contributions of women to ten different scientific disci-

plines takes an approach that is problematic in several respects. Kass-Simon writes that "since the method of evaluating a scientist's work has traditionally been by peer review, it . . . seemed essential that such an investigation be carried out by trained women scientists," and for the most part these essays were written by practitioners of the disciplines. Kass-Simon further reports that a major aim of the volume was to search for "the lost and buried women heroes of science." Yet an expert in a discipline is not necessarily qualified to write its history, and with the perspective that "in one sense history is the recounting of heroes' deeds," such a search may be too much concerned with assigning proprietorship over an idea or apparatus at the expense of historical context. Perhaps part of the problem lies with the appropriateness of the essay format for the purpose of calling attention to "forgotten women." Such information might have been better presented in a reference-book format.

The volume also seems to suffer from a lack of editorial direction. The editors do not address the question of criteria for inclusion, and the contributors use their own implicit criteria. The lack of an operational definition of science is especially apparent in Martha Moore Trescott's chapter on engineering and Farnes's on medicine.

The scope of the essays also varies. Some authors deliberately limit their coverage, others consider a broad sweep of time and geography, and some provide a combination of the broad and the narrow. Kass-Simon, for example, in dealing with developmental biology, genetics, and physiology stresses 19th- and 20th-century Americans but in her consideration of natural history goes back to the contributions of Hildegard of Bingen. Some authors consider living scientists and others include some oral history. For example, Cynthia Irwin-Williams (archeology) interviewed three living American archeologists, although she does not integrate the interviews into the rest of her essay. The question of how to deal with well-known material is a problem in the essay on physics by L. M. Jones, who rehashes biographical material on Marie Curie without adding any new information. However, by selecting women who have contributed to a variety of aspects of physics Jones supports her contention that there is no such thing as "women's physics."

At a more specific level, defects such as crediting Antony van Leeuwenhoek with the invention of the microscope, ignoring Leibniz's contribution to the invention of the calculus, and substituting question marks for easy-to-locate death dates should not have occurred.

The essays by Michele L. Aldrich on geology, Pamela Mack on astronomy, Judy Green and Jeanne LaDuke on mathematics, and Jane Miller on chemistry do a good job of organizing and integrating materials. The authors clearly are aware of current literature and have set their subjects in a social and institutional context. Their essays reflect their understanding of historical problems. Maureen Julian's essay on crystallography is an especially valuable source for the names of women crystallographers and their connections with parent laboratories. Irwin-Williams makes a convincing case in her discussion of the "expedition mentality" as one reason for the exclusion of women in archeology.

In spite of obvious problems, the volume serves a valid purpose. Some new research is included (although in most cases still undigested), names of persons warranting future research are provided, and some (but not all by any means) of the essays integrate their material with recent scholarship.

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Reprints of Books Previously Reviewed

American Genesis. A Century of Invention and Technological Enthusiasm, 1870-1970. Thomas P. Hughes, Penguin, New York, 1990. Paper, \$10.95. Reviewed 244, 830 (1989).

The Analysis of Starlight. One Hundred and Fifty Years of Astronomical Spectroscopy. J. B. Hearnshaw. Cambridge University Press, New York, 1990. Paper, \$34.50. Reviewed 237, 783 (1987).

Reminiscences About a Great Physicist. Paul Adrien Maurice Dirac. Behram N. Kursunoglu and Eugene P. Wigner, Eds. Cambridge University Press, New York, 1990. Paper, \$27.95. Reviewed 241, 1239 (1988).

Studying Animal Behavior. Autobiographies of the Founders. Donald A. Dewsbury, Ed. University of Chicago Press, Chicago, 1989. Paper, \$19.95. (Originally entitled *Leaders in the Study of Animal Behavior: Autobiographical Perspectives*) Reviewed 235, 598 (1987).

Books Received

Aspects of Internalization. Roy Schafer. International Universities Press, Madison, CT, 1990. xxiv, 254 pp. Paper, \$19.95. Reprint, 1968 ed.

Atomic Rivals. Bertrand Goldschmidt. Rutgers University Press, New Brunswick, NJ, 1990. xviii, 372 pp., + plates. \$39.95. Translated from the French edition (1987) by George M. Temmer.

Attitudes. D. W. Rajecki. 2nd ed. Sinauer, Sunderland, MA, 1990. xii, 522 pp., illus. Paper, \$24.95.

Between Science and Technology. Andries Sarlemijn and Peter Kroes, Eds. North-Holland (Elsevier), New York, 1990. viii, 214 pp., illus. \$48.75. North-Holland Delta Series. From a conference, Eindhoven, The Netherlands, June 1989.

Biochemistry of Breast Cyst Fluid. Correlation with Breast Cancer Risk. Alberto Angeli et al., Eds. New York Academy of Sciences, New York, 1990. viii, 296 pp., illus. Paper, \$74. Annals of the New York Academy of Sciences, vol. 586. From a workshop, New York, Dec. 1988.

Divergent/Passive Margin Basins. J. D. Edwards and P. A. Santogrossi, Eds. American Association of