BOOK REVIEWS

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Fermilab: Physics, the Frontier, and Megascience. Lillian Hoddeson, Adrienne W. Kolb, and Catherine Westfall. 512 pp. The University of Chicago Press, IL, 2008. Price: $45.00 (cloth) ISBN 978-0-226-34623-6. (Gabor Domokos, Reviewer.)

This is a serious scholarly work, complete with notes and references. I am sure that it will be appreciated by historians of science dealing with the modern history of physics in the United States.

In addition, those of us who are not professionals in the history of physics will enjoy the lively style of the book and the authors' description of the drama that culminated in the construction and operation of the largest particle physics laboratory in this country. Very sensibly, the authors paint a detailed backdrop, starting in the late 1950s and leading up to the planning and construction of the National Accelerator Laboratory, now known as *Fermilab*. And drama there was. Not only did physicists disagree on the scope of such a laboratory (regional? national?), but also, politics, as always, was involved, since it was clear to everyone concerned that the construction would require large sums of money. There was a controversy then, as there is today, about the role of "big science" in the nation's life. In addition, there was a very serious scientific debate about how best to construct a large accelerator in order to satisfy the growing needs of particle physics.

Edwin MacMillan of Berkeley, CA was the main proponent of the new accelerator and he insisted that it should be built in Berkeley. After all, that was the place where the technology of modern accelerators was born in the form of E.O. Lawrence's cyclotron. (Today the name of the laboratory celebrates that event—it is the Lawrence Berkeley Laboratory.) There were, however, competitors: Brookhaven and the Midwestern Universities Research Association. It is fascinating to follow the story of how the new accelerator ended up in the Midwest—in a suburb of Chicago. Its first director, Robert Wilson (1914–2000), was a very interesting person, full of new ideas regarding accelerators and almost anything else—truly a renaissance man. Among other things, he was actively interested in architecture: he designed the original high-rise building at the laboratory in the shape of the accelerator magnet he invented. It was at Wilson's insistence that the new laboratory was made accessible to all qualified particle physicists and was named *National* Accelerator Laboratory (NAL). (It was later renamed Fermi National Accelerator Laboratory, or *Fermilab for short*, the name it bears today.)

I found it interesting to read about Wilson's distrust of computers. Apparently he believed that computations should be carried out by physicists at their home institutions. I don't know whether this was a prophetic insight or a limitation. In any case, the World Wide Web is based precisely on the idea of spreading computing tasks to the home institutions of particle physicists, so Bob Wilson would be happy to see his ideas realized.

Wilson was followed as director by Leon Lederman. While Wilson was, in a sense, a builder, Lederman brought with him the spirit of research. (He shared the Nobel prize in 1988.) Under his directorship, NAL continued along the direction originally set by Wilson and became the laboratory where the fundamental interactions have been explored at the highest energies. It may be appropriate to interpret a quote from Leon as his *credo*:

> *"The life of a physicist is filled with anxiety, pain, hardship, tension, attacks of hopelessness, depression and discouragement."* However, "*…the supreme pleasures of physics, especially experiencing rare 'epiphanies', made the research worth all the pain"* (p. 227).

An important aspect of Lederman's directorship was his insistence on communicating the excitement of physics to the general public. Physics is an integral part of our culture. Furthermore, particle physicists are, ultimately, on the payroll of the taxpayers, who have a right to know what they get for their money. The Fermilab outreach effort initiated by Lederman has been highly successful and has served as a model for many similar efforts elsewhere.

I am very firmly convinced that the seeds of the success of Fermilab as described in the later chapters of the book were sown by its first two directors. Its TEVATRON accelerator is today the tool for the exploration of fundamental interactions at the highest energies, at least until the new machine at the European laboratory (CERN) starts taking data.

Overall, I am pleased to praise the authors for the accuracy of their work. I have only a few complaints.

Evidence for neutral currents. In the early seventies, there were some doubts about the existence of neutral weak currents. Carlo Rubbia's group repeatedly claimed that there was evidence for their existence and then had to retract the claim. (It must be remembered that physics progresses at the margins of what is known, and that in any experiment a large amount of data is needed before a result is definitely confirmed.) It is, however, inaccurate to state that the discovery of charm "*explained the absence of neutral currents*" (p. 167). What charm helped to explain was the absence of flavor-changing neutral currents which would, for example, enable a neutral gauge boson to decay into an electron and a muon.

The magnetic moment of the muon. Contrary to the authors' claim (p. 231), Lederman's experiment on (g-2) at CERN did not measure the spin of the muon. That was already known to be $\frac{1}{2}$ in units of the reduced Planck constant. Rather, the measurement established that the electromagnetic interactions of the muon are the same as those of the electron. (Soon after the muon was discovered, I.I. Rabi supposedly asked: "Who ordered that?" We still do not have a good answer to Rabi's tongue-in-cheek question.)

Mangled Italian. The quote from Gilberto Bernardini on p. 228 is not really in Italian. As Lederman tells the story, early in a joint experiment, when Gilberto succeeded in finding the

first hint of a positive signal, he went wild, yelling: "Mamma mia! Regardo incredibilo. Primo secourso…" Actually Gilberto spoke a very beautiful Italian. I suspect that Leon managed to misquote him in their very real enthusiasm over their success. I cannot blame the authors for the misquote.

In the end, I find that there are not many inaccuracies in this book. I am convinced that it will make a useful reference not only for historians of physics, but also for practicing particle physicists—we should learn from our past successes and mistakes. And to the rest of the physics community it tells a good tale.

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BOOKS RECEIVED

Atmospheric Thermodynamics: Elementary Physics and Chemistry. Gerald R. North and Tatiana L. Erukhimova. 278 pp. Cambridge U. P., New York, 2009. Price: $70.00 (hardcover) ISBN 978-0-521-89963-5.

Carbon Nanotube Science: Synthesis, Properties and Applications. Peter J. F. Harris. 312 pp. Cambridge U. P., New York, 2009. Price: $90.00 (hardcover) ISBN 978-0-521-82895-6.

Digital Image Processing for Medical Applications. Geoff Dougherty. 459 pp. Cambridge U. P., New York, 2009. Price: $89.00 (hardcover) ISBN 978-0-521-86085-7.

Discovering the Expanding Universe. Harry Nussbaumer and Lydia Bieri. 243 pp. Cambridge U. P., New York, 2009. Price: $59.00 (hardcover) ISBN 978-0-521-51484-2.

Dynamics of Self-Organized and Self-Assembled Structures. Rashmi C. Desai and Raymond Capral. 342 pp. Cambridge U. P., New York, 2009. Price: $80.00 (hardcover) ISBN 978-0-521-88361-0.

Excitations in Organic Solids. Vladimir M. Agranovich. 512 pp. Oxford U. P., New York, 2009. Price: $130.00 (hardcover) ISBN 978-0-19-923441-7.

Finding the Big Bang. P. James E. Peebles, Lyman A. Page, Jr. and R. Bruce Partridge. 587 pp. Cambridge U. P., New York, 2009. Price: $80.00 (hardcover) ISBN 978-0-521-51982-3.

Mind and Nature: Selected Writings on Philosophy, Mathematics, and Physics. Hermann Weyl. 272 pp. Princeton U. P. 2009. Price: $35.00 (cloth) ISBN 978-0-691-13545-6.

The Monster Group and Majorana Involutions. A. A. Ivanov. 265 pp. Cambridge U. P., New York, 2009. Price: $99.00 (hardcover) ISBN 978-0-521-88994-0.

Optical Imaging and Spectroscopy. David J. Brady. 528 pp. John Wiley & Sons, Hoboken, NJ, 2009. Price: $119.00 (cloth) ISBN 978-0-470-04823-9.

Philosophy of Mathematics and Natural Science. Hermann Weyl. 336 pp. Princeton U. P. 2009. Price: $35.00 (paper) ISBN 978-0-691-14120-6.

Quantum Gods: Creation, Chaos, and the Search for Cosmic Consciousness. Victor J. Stenger. 292 pp. Prometheus Books, Amherst, NY, 2009. Price: $26.98 (hardcover) ISBN 978-1-59102-713-3.

Quantum mechanics. Gennaro Auletta, Mauro Fortunato, and Giorgio Parisi. 755 pp. Cambridge U. P., New York, 2009. Price: $90.00 (hardcover) ISBN 978-0-521-86963-8.

Quantum Statistical Mechanics. William C. Schieve and Lawrence P. Horwitz. 428 pp. Cambridge U. P., New York, 2009. Price: $85.00 (hardcover) ISBN 978-0-521-84146-7.

Sub-Riemannian Geometry: General Theory and Examples. Ovidio Cailin and Der-Chen Chang. 383 pp. Cambridge U. P., New York, 2009. Price: $99.00 (hardcover) ISBN 978-0-521-89730-3.

Viscoelastic Materials. Roderic Lakes. 479 pp. Cambridge U. P., New York, 2009. Price: $126.00 (hardcover) ISBN 978-0-521-88568-3.

Waves in Metamaterials. L. Solymar and E. Shamonina. 401 pp. Oxford U. P., New York, 2009. Price: $95.00 (hardcover) ISBN 978-0-19-921533-1.

Why Does $E=mc^2$?: (And Why Should We Care?). Brian Cox and Jeff Forshaw. 254 pp. Da Capo Press, Cambridge, MA, 2009. Price: $24.00 (hardcover) ISBN 978-0-306-81758-8.

INDEX TO ADVERTISERS

Preview â€” Fermilab by Lillian Hoddeson. Fermilab: Physics, the Frontier, and Megascience. by. Lillian HoddesonÂ Fermi National Accelerator Laboratory, located in the western suburbs of Chicago, has stood at the frontier of high-energy physics for forty years. Fermilab is the first history of this laboratory and of its powerful accelerators told from the point of view of the people who built and used them for scientific discovery. Focusing on the first two decades of research at Fermi Fermi National Accelerator Laboratory, located in the western suburbs of Chicago, has stood at the frontier of high-energy physics for forty years. Lillian hoddeson, adrienne w. kolb, a n D cat h e r I n e w e s t fa L L. The University of Chicago Press. Chicago and London.Â In approaching megascience along the colliding-beams track, Fermilab built two mammoth detectors to analyze the collisions, first CDF, the Colliding Detector at Fermilab, and then DZero, named for its location on the Main Ring. Growing up in the shadow of CDF, DZero was given fewer resources, but it in time grew comparable in scale to CDF. Larger than many earlier laboratories, the experiments at CDF and DZero bore fruit in their 1995 codiscovery of the â€œtop quark,â€ arguably the outstanding achievement of American megascience. Fermilab: Physics, the Frontier and Megascience Lillian Hoddeson, Adrienne W Kolb and Catherine Westfall 2008 University of Chicago Press Â£31.00/$40.00 hb 512pp. Monument to megascience. Fermilab, the scientific research facility, has for the past 37 years transformed a 10-square-mile patch of the Illinois prairie into the frontier of high-energy particle physics. Fermilab , the book, is the first written history of this unique place, covering both the birth of the Fermi National Accelerator Laboratory and its journey to its current position as a world centre of â€œmegascienceâ€. Yet Fermilab is far from being a dry historical account.