

BOOKS

... Where Engine Grease Meets Up With Experimental Results ...

Image and Logic: A Material Culture of Microphysics

▶ Peter Galison
U. Chicago P., Chicago, 1997.
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Reviewed by W. K. H. Panofsky

Peter L. Galison's *Image and Logic* is an important but highly selective compilation of items within the history of elementary particle physics. It attempts to chart the evolution of particle physics in both its social and its substantive contexts. In the latter respect, it chooses to focus on the particle detectors used in conjunction with high-energy accelerators and colliders. As Galison defines his purpose in his preface: "I want to know . . . how pictures and counts get to be the bottom-line data in physics. . . . Historically, historiographically, philosophically, this book is a back-and-forth walk through physics to explore the site where engine grease meets up with experimental results and theoretical constructions." In the process, the technical evolution of accelerators and colliders on the one hand and the evolution of ideas on the other become adjuncts to case histories of specific detectors and detector systems whose technical principles and administrative arrangements he covers in detail.

In the category of "image" detectors, Galison deals with cloud chambers and bubble chambers and, to a more limited extent, nuclear emulsions. He traces the history of the bubble chamber from Donald Glaser's tabletop devices to Luis Alvarez's giant chamber built at Berkeley and then transferred to the Stanford Linear Accelerator Center. He also describes in detail the disastrous July 1965 explosion and fire at the Cambridge Electron Accelerator.

Galison designates as "logic" detectors the counter arrays, wire and spark chambers that result in electronic readouts. He then focuses on "hybrid"

detectors in which logic and image merge. In that latter category, he selects as primary examples SLAC's MARK I detector at the SPEAR storage ring and the Time Projection Chamber (TPC) at SLAC's PEP storage ring. The administrative shortcomings of the TPC projects are described in depth; however, the other side of the story—the generally successful construction of multimillion dollar detectors by many agencies, and, frequently, different countries—is not described.

Each case history is presented in elaborate and scholarly detail, and the author then draws social generalizations based on these examples. The reader may find it difficult to discern the extent to which such social conclusions depend on the particular example chosen. The case histories are imbedded in a recital of the evolution of physics and physicists during and after World War II and the consequent drastic transformation and expansion of the physics enterprise at the universities and the creation of the postwar national laboratories.

In citing the context of both the chosen case histories and the evolution of the conduct of high-energy physics, Galison deals in considerable detail with many topics that have been the subjects of major historical studies by other authors: There is a brief recital of the history of nuclear weapons and the postwar struggles over the policy dealing with the hydrogen bomb. There is a discussion of the basic concepts underlying quantum chromodynamics (QCD) but specifically related to the case history of the TPC. The author justifies this approach by dwelling on what he calls "trading zones" through which accelerator designers, technicians, engineers, experimentalists and theoretical physicists communicate in a relatively narrow context. Thus, the universality that permeates the work of the different participants in the physics enterprise tends to be underestimated.

Drawing broad conclusions from narrow case histories can lead to misinterpretation of the physical facts that lead to the choice of particular detectors for a particular application. One example: Since the expansion of a bubble chamber cannot be triggered once a particular class of events is

identified, it is difficult to identify rare events against a large background of competing processes. In the extensive discussion of the struggles by Alvarez to make the bubble chamber the preeminent tool in postwar particle physics, this fact is not recognized; Galison does not mention the hybrid bubble chamber in which an electronic adjunct decides when a picture shall be taken or not following expansion. He does provide a critical discussion of competing data-analysis systems for bubble-chamber photographs, focusing on the degree of human intervention, but his description of these methodologies implies much more discontinuity than really exists. The broad conclusions drawn from the Cambridge Electron Accelerator fire disregard the special circumstances at that laboratory, which impose limits on the ability of the laboratory's management to control its users.

There is considerable discussion of the evolution of the size of the detection instruments and of the collaborations that go with them, interpreted as a continuing quest for ever-growing expansion. However, Galison does not mention the accompanying contraction in the number of facilities operating at the frontier of the science. While the observations on the social dynamics of high-energy physics are meticulously documented and generally well interpreted, the author does not attempt to suggest a better way of advancing the field.

Let me summarize. This book indeed contains a scholarly and extremely valuable selective description of important episodes in the recent history of elementary particle physics. However, the broad conclusions drawn from these examples are of more limited significance than is perhaps the author's intent.

The Neutron and the Bomb: A Biography of Sir James Chadwick

▶ Andrew Brown
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James Chadwick is known to every physicist as the discoverer of the neutron. That discovery, in 1932, is often

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