PETER GALISON. **How Experiments End.** Chicago: University of Chicago Press, 1987. Pp. xii+330. ISBN 0-226-27915-4. £11.95 (paper; also in hardback).

Until very recently the history of science has focused almost exclusively on theory, to the virtual neglect of experiment. Experimental results were adduced and in some cases, notably in the work of Galileo, questioned, but the general presumption was that experiment was a straightforward affair requiring or deserving little in the way of analysis. Paradoxically, attempts by sociologists of science to challenge the naïvety of this position have themselves done little to add to our knowledge of experiment. The presumption that experimental results provide some sort of objective knowledge has been challenged, and most effectively. But the demonstration that social as well as intellectual contexts and predispositions have been instrumental in the determination of experimental results has not been developed into an understanding of the process of experiment.

The past few years have at last seen a growth of interest in the experimental process, evidenced in particular in the philosophical work of Ian Hacking (*Representing and Intervening*, CUP, 1983), and in some of Galison's own papers. Galison's book, however, takes the subject an enormous step beyond anything published before.

The book is at once a history of experimental technique in physics, as this has evolved from the late nineteenth century to the present day, and an analysis of what is common to the process throughout that evolution. Of the three major historical chapters, one focuses on the work of Einstein and Haas on gyromagnetism. The experiments concerned, though carried out in the present century, were rooted in nineteenth century theory and practice and were traditional experiments based on macroscopic forces and effects. The second focuses on the cosmic ray scattering experiments carried out by two small groups of physicists working in America and Europe in the 1930s, and leading to the discovery of the muon. The third, covering over a hundred pages, focuses

on the large scale experiments on neutral current phenomena carried out in the early 1970s, again by one American and one European team. This time, however, the teams composed literally hundreds of scientists, and the equipment consisted of massive particle accelerators with complex detectors and computerized analysis of events.

The main theme running through these accounts is the experimental problem of separating the effects one is seeking from the background of other effects. As Galison shows, there are many ways of doing this (e.g., by calculation, by experimental filtering, by compensation), and so many ways of approaching the same experimental problem. Moreover, the process is not one with an absolute ending. In experiment one can never be absolutely sure, and even though at some point the experiment will be ended, a result having been determined to a certain level of satisfaction, that determination is relative. New evidence or theories can show up previously omitted possibilities, and different individuals will have different levels of satisfaction. Since experimental results are always published in a sanitized form without the details of the trials and tribulations which accompanied them, the results will often be more convincing to the audience than to the experimenter.

This absence of what may be thought of as the craft history of an experiment from the publication of its results has always been the case, but is particularly striking in the modern period. In the attempt to isolate a new particle or phenomenon, the elimination of alternative causes of what is observed can be a massive task requiring several separate teams, a host of experimental arrangements and a severe discipline. Many are the observations that would have been just what the scientists were looking for, if only the accelerator hadn't been switched off at the time. But none of this reaches publication. To assess the validity of the results presented, scientists therefore have to rely heavily on each other's craft reputations and on the consensus judgement of the team performing the experiment. This being the case, the process of ending an experiment, and of the acceptance of its results, is a thoroughly social one, and the argument that it is also an entirely social one is very tempting. As Galison points out, however, physicists do still publish results they had neither sought nor expected nor wished for. Complex though it now is, the experimental process remains in fact much as it has always been, and there is ample evidence for the assertion that the results are still in large measure based on physical rather than social fact.

This work is not definitive: it opens an area of discourse rather than closing it, and there is much in it that could be questioned. But given the cavalier way in which experiment has generally been treated in the past, whether by historians, philosophers or sociologists, the fact that there *is* much in the book to be questioned, and not just the usual array of dogmatic assertions, is one of its main strengths. Another is that it does genuinely communicate with each of the constituencies just mentioned. Galison does not agree much with the sociologists, but his analysis relates directly to their arguments. He is critical of a lot of philosophy of science, but he is well versed in it and again directs his analysis so as to contribute to it. Unlike many who work in either of these fields his historical research is thorough and extremely detailed. And, moreover, he knows his physics too! All in all, this is a book to be most highly recommended.

JOHN HENDRY
Cranfield Institute of Technology

F.G. GOSLING. **Before Freud: Neurasthenia and the American Medical Community, 1870–1910.** Urbana and Chicago: University of Illinois Press, 1987. Pp. xviii+192. ISBN 0-252-01406-5. $25.00.

During the final third of the nineteenth century, Americans grew more and more nervous, or that at least is what their doctors maintained. It was the price of progress. In 1869, New York neurologist George Beard coined the term 'neurasthenia' or nervous weakness to designate a host of somatic and mental complaints that increasingly plagued his patients: fatigue, insomnia, dyspepsia, headache, de-