High stakes at the frontier

D. H. Perkins

Nobel Dreams: Power, Deceit and the Ultimate Experiment. By Gary Taubes. *Random House:1987. Pp.261. $19.95.*

IT WAS inevitable that, sometime, a book would appear seeking to tell the inside story of the discovery of the charged W^+ and W^- and neutral Z^0 particles; these are the carriers of the so-called weak force which, together with electromagnetism, the strong nuclear force and gravity constitute the known fundamental interactions in nature. Their discovery provided crucial proof of the validity of a theory unifying the weak force with electromagnetism, and gained the 1984 Nobel Prize for two physicists, Carlo Rubbia and Simon van der Meer, at the international accelerator laboratory, CERN, near Geneva. The W and Z particles were created in head-on collisions of energetic protons with antiprotons circulating in opposite directions in a giant magnetic storage ring, 6km in circumference, located underground at CERN. Van der Meer's contribution was to accomplish the daunting task of making, storing and accelerating enough antiprotons that the W and Z particles, created in only 1 per billion collisions, might be detected in sufficient numbers. Rubbia's role was to conceive and push through the entire project, and to demonstrate the existence of the particles using a sophisticated 2,000-ton detector called UA1.

The book is almost entirely centred on Carlo Rubbia, a flamboyant and brilliant physicist, a man who drove himself and his co-workers mercilessly. It is based on Taubes's sojourn of some months in CERN and on numerous interviews with physicists in the field, both from Europe and the United States. It is a racy, revealing and very readable account of opportunism in big science, and of the frequently violent interactions between personalities and factions involved in a 150-strong international collaboration of the best brains in the business — people who were playing for high stakes, for the sort of scientific breakthrough that might come once in a lifetime.

High energy physics had been dominated by the United States since the end of the Second World War, at least until the mid-1970s. In Europe, the focus of such research was CERN, where the accelerators ran with the precision of Swiss watches. But time and again, the leaner and fitter American laboratories beat CERN to the draw. The discovery of the W and Z in 1983 marked a high point in the gradual shift of the balance towards Western Europe. The shock effect in the American science community was exemplified by the *New York Times* headline "Europe 3, US not even Z zero". It was a scientific triumph — and a desperately needed one — for CERN.

There were, in fact, two competing experiments running simultaneously at the CERN collider: UA1 and the more modest and somewhat less-well-instrumented UA2, which got comparable numbers of W and Z events but receives scant mention in Taubes's book. UA1 was a mammoth and ingenious experiment operated by gifted people, but it *was* only one experiment, and it could have been wrong. After all, Rubbia himself had previously taken part in more than one wrong experiment, and these mistakes had been highly visible and well publicized, because that was his style of operating. It is worth recording that the other major scientific success at CERN, the discovery of neutral currents in 1973 — and an essential step on the path to the collider project — had not been universally accepted at the time (and least of all in the higher echelons of CERN) because it had not been independently confirmed. Worse, a rival neutrino experiment at Fermilab, Chicago, had initially been in conflict with it (but turned out to have been wrong). Because Carlo Rubbia himself, in his role of professor at Harvard, had been a member of that ill-fated venture, he of all people would be the first to acknowledge the great debt he owed to UA2 for providing the much needed confirmation of the discovery of W and Z.

CERN

Carlo Rubbia — flamboyant and brilliant.

What comes through clearly in Taubes's book is that the scale and expense, and the consequences of success or failure in big science projects, place great pressures on the scientists at the sharp end to deliver the right goods at the right time, and are not always calculated to bring out the best characteristics of the human species. This is at odds with the one-time popular image of basic research carried out by tiny bands of dedicated people in back rooms, quietly beavering away in their selfless search for the ultimate truths of nature. Nevertheless, all of the people on the UA1 and UA2 experiments were there because they were driven by the physics. Personal ambitions, power and glory, politics and backbiting also came into it, and, of course, these things reveal the normal human strengths and weaknesses, make the headlines and sell popular accounts; but when the dust settles, they are forgotten and the solid scientific achievements remain.

Taubes also traces some of the developments in the CERN UA experiments since the W and Z were first observed, in particularly favourable modes of decay, into electrons and muons and neutrinos. They have not been found in more prolific decay modes, which we know must be there, because other physical processes obscure the signal. But that very "background" has turned out as a bonus in another way, giving important results — not originally foreseen — on the nature of the forces between quarks in the proton. This is not even mentioned in the book. Other new phenomena had also been predicted by theory — the existence of the top quark and of supersymmetric particles. Here the experimenters have not so far been successful, despite enormous efforts. Initial evidence for the existence of a new quark with 40 GeV mass has not been confirmed, and early indications for supersymmetric particles (the so-called monojets) have melted into the background. That is what research at the frontiers is all about. It is a cautionary tale. You try hard but you just can't win them all.

For all the human interest, the real message of Taubes's book is that it describes a triumph of modern technology and scientific ingenuity against enormous odds, one which enlarged and enriched our view of the material world. Not least, that and the Nobel award which followed were a tangible demonstration that a dozen European states could sink their differences and work together in a huge and complex enterprise towards a common scientific goal. □

D. H. Perkins is a Professor in the Department of Nuclear Physics, University of Oxford, Keble Road, Oxford OX1 3RH, UK.