

BOOKSHELF

From Nuclear Transmutation to Nuclear Fission, 1932–1939 by Per F Dahl, IOP Publishing, ISBN 0750308656, £55 (\$75/€75).

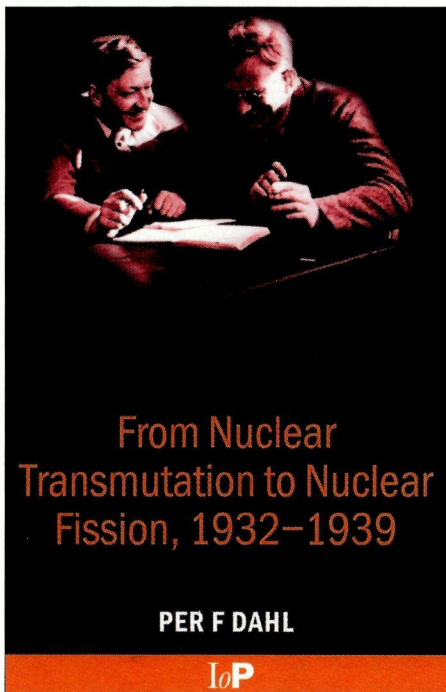
Per Dahl continues to be a careful and conscientious compiler of physics history. After *Flash of the Cathode Rays: A History of J J Thomson's Electron* (1997) and *Heavy Water and the Wartime Race for Nuclear Energy* (1999), his latest volume completes a trilogy published under the Institute of Physics imprint. The *Heavy Water* saga was compelling reading, but *Nuclear Transmutation* reverts to the solid scientific style of *Flash of the Cathode Rays*.

Nuclear Transmutation focuses on the competition between experimental teams in Europe and the US to furnish and exploit high-energy beams of subatomic particles in the quest to understand more about the atomic nucleus. Dahl, as in his other books, takes pains to place this central theme in a much broader context.

The period covered by the book links the twilight of the career of one physics giant named Ernest – Rutherford – with the emergence of another – Lawrence. The two main contenders in the competition were the Rutherford-inspired team of Cockcroft and Walton at Cambridge, and the group led by Lawrence at Berkeley. Their achievements and the subsequent award of the Nobel prize assured them a place in science history. Also prominent were the teams with Merle Tuve and Gregory Breit at the Carnegie Institution of Washington DC; Charles Lauritsen at Caltech; and Robert Van de Graaff at Princeton.

In the 1920s, the interior of the atomic nucleus was a complete mystery, but there was a widespread feeling that systematic studies using high-energy projectiles could reveal more about the nucleus. Each group developed its own technique to produce the necessary high voltages to accelerate projectile particles.

Many of Rutherford's physics achievements came before he arrived at Cambridge in 1919. The road ahead was to be more difficult, demanding inspired teamwork, Rutherford's dogged perseverance in his belief in the neutron, and the development and mastery of new techniques. However, Rutherford knew more than most about two complementary aspects of nuclear transformations: radioactive decay and reactions induced by radioactively emitted particles.



Rutherford's era in Cambridge also coincided with the development of modern quantum mechanics. While the majority of quantum mechanics applications focused on atomic physics, a deeper implication was seen by George Gamow. Radioactive particles tunnel, rather than leap, out of the nucleus. Gamow soon realized that if this were the case, energetic particles could also tunnel their way in.

At Cambridge, Gamow's new ideas immediately raised the research temperature. The payoff came in 1932 when Cockcroft and Walton "split the atom". This, along with Chadwick's discovery of the neutron the same year, was the high-water mark for Cambridge research, and soon the tide there began to ebb.

Dahl recounts how another tide rose in the US. In the mid-1920s, the young Lawrence had been dabbling in nondescript research. He and Tuve were both born in 1901 in the same small South Dakota town. Tuve, working under the astute Gregory Breit, wisely urged Lawrence to concentrate instead on digging deep in a potentially rich new physics vein – beams of subnuclear particles. Lawrence took the idea and ran with it, going on to invent the cyclotron. Dahl explains how Lawrence, obsessed with cyclotron performance, initially missed out on several major physics discoveries in the early 1930s. However, Lawrence's powerful and versatile machines quickly overhauled the rest of the field, and he received

the Nobel accolade in 1939, while recognition for Cockcroft and Walton's pioneering achievement did not come until 1951. The lesson from Lawrence was that the development of big physics machines is not an end in itself, and must be complemented from the outset by physics insight and the provision of adequate detectors.

The history of accelerating subatomic particles has a curious Norwegian tradition. Both Lawrence and Tuve had Norwegian roots, as did Tuve's collaborators Lawrence Hafstad and Odd Dahl (who in the early 1950s initially led the team that developed CERN's first large accelerator). In Europe, accelerator pioneer Rolf Widerøe (whose work greatly influenced Lawrence) was also Norwegian. As Odd Dahl's son, Per Dahl is well qualified to document this story.

Towards the end of the 1930s, the physics spotlight turned away from artificially induced reactions to nuclear fission, again a transatlantic affair and with many of the earlier figures continuing to play key roles. Fission, a different kind of physics, is a closing parenthesis in the book.

Dahl contends that the early history of experimental nuclear physics was a race. It was surely more complicated than that. The history of science and technology is full of examples of different approaches to a common goal, where success and failure is not a simple binary outcome. In the quest to study the deep structure of matter using precisely controlled conditions, the Cambridge researchers got off to a flying start because of their unrivalled expertise in studying radioactive decays and nuclear transmutations. However, it was Lawrence who went on to set the industrial standard.

Gordon Fraser, CERN.

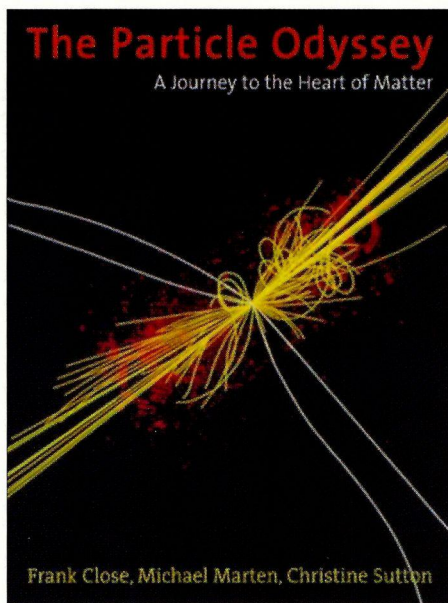
The Particle Odyssey by Frank Close, Michael Marten and Christine Sutton, Oxford University Press (2002), ISBN 0198504861, £29.95 (€48).

Fifteen years ago saw the publication of the most visually stunning, most accessible popular picture book on high-energy physics, *The Particle Explosion*. It resulted from a collaboration between theoretical physicist Frank Close, physicist and journalist Christine Sutton, and founder of the Science Photo Library Michael Marten. Theirs has proved a perfect partnership, bringing together clear explanation and story-telling; scientific

rigour and journalistic flair; and visual impact.

The Particle Odyssey is not simply the same book under a new name. Some 250 of the pictures are entirely new, as are great swathes of text. Clearly, a lot has happened in the past 15 years, not least the complete operational lifetime of LEP, the discovery of the top quark at Fermilab, and the first signs of neutrino oscillations. It is also interesting to note how book design has changed. After leafing through *Odyssey*, *Explosion* seems strangely dated. The new edition has whiter, glossier paper and crisper illustrations, some of them bled off the pages. Every page is eye-catching, and I suspect that considerably more text has been squeezed into the same 240 pages, mostly by greater column width.

The change of title is perhaps revealing too. Back in the 1980s, just after the discovery of the W and Z bosons, it seemed that there had been an explosion of particles, almost more than theory could accommodate. Since then, I suspect, to those patiently wading through the terabytes of data, it has been more like an



odyssey to try and catch the last remaining particles within experimental range. It has been interesting to watch high-energy physics as a journalist for the past 15 years. It is not

easy to find a news peg in an incremental advance. A few thousand more data points do not make a story; a surprise or a race between laboratories does. As a result, I think I reported the discovery of the top quark three or possibly four times before its final confirmation! On the other hand, it is frustrating when a laboratory won't issue a public announcement even when you know the data are accumulating. This book recounts most of the trials and tribulations from the physicists' point of view, and, by telling many of the stories in their historical sequence, it gives us some very readable tales.

I recommend this book to everyone, whether they have read *The Particle Explosion* already or not; and whether they are complete novices or professional physicists. If you don't know the stories, it's a new adventure. If you do, it's a model of story-telling. And whoever said picture books were only for children? My only hope is that there will be enough new physics for another version in 15 years' time.
Martin Redfern, BBC Radio Science Unit.

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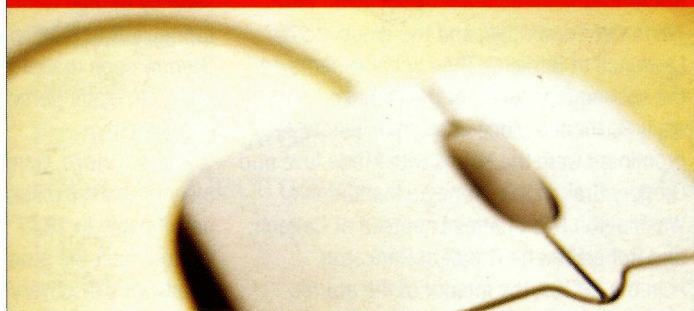
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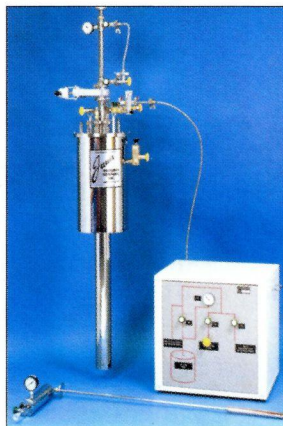
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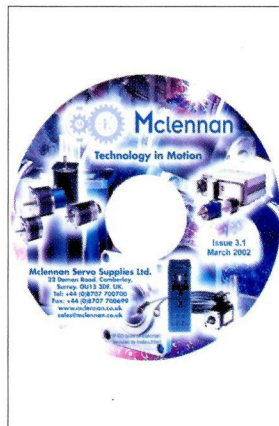
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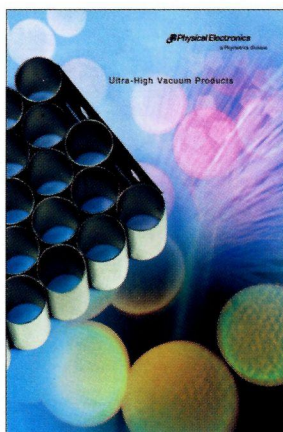
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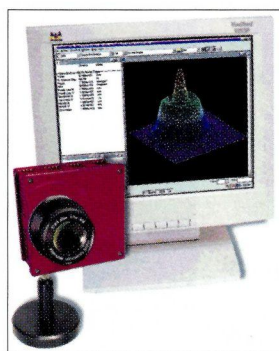
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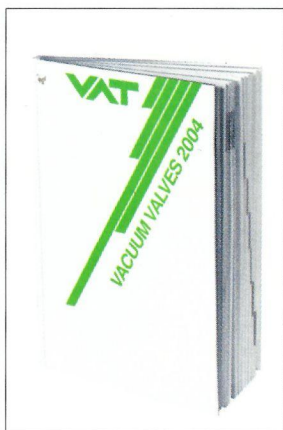


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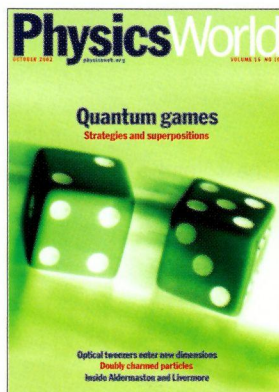


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