arts — often see the origins of this situation in the late nineteenth century. As science became more specialized, its practitioners more professionalized and its language more technical, it is often thought to have become separated from the rest of culture. *Science in the Nineteenth-Century Periodical* shows that this is not an accurate picture of what was going on, and must make us question whether it holds for the twentieth century either. True, there were increasing numbers of specialist science journals, but there were increasing numbers of specialist journals in every other field of endeavour too. It isn't true that the sciences disappeared from generalist publications in the late nineteenth century, nor that the science which did appear there was "mere popular science".

Men of science continued to be part of an intellectual community that debated the issues of the day in the highbrow journals. *Science in the Nineteenth-Century Periodical* reveals that some new areas of science were actually pioneered in generalist periodicals before they were picked up by the scientific community. For example, theories of infant development were being discussed in *The Cornhill Magazine* at a time when most men of science would have scorned to enter the female domain of the nursery.

The SciPer project is not just about the popularization of science. Studying the sciences over the whole range of the nineteenth-century periodical press allows us to witness crucial debates about the formation of disciplines. Sometimes the pages of periodicals reveal constructive interplay between experts in two fields that we would now consider quite remote. At times they reveal non-scientific intellectuals appropriating a scientific theory for an intriguingly different purpose. Occasionally, a new theory or approach is presented that will later be incorporated into science, such as the case of infant development. And sometimes experts or journalists explain science to audiences who might not understand all the technicalities — but that is only one small part of the discussion of science in those periodicals.

The rhetoric of 'popular science' or of the 'public understanding of science' is very much a concern of a world where we can see a clear demarcation between 'science' and 'non-science'. But in the nineteenth century, there was still an enviable mixing and cross-fertilization between seemingly disparate subjects, and there was no clear consensus on what counted as science — let alone on how a 'public' understanding might differ from any other sort of understanding. Consensus was eventually reached, not in the pages of the specialist scientific journals, but in the pages of the generalist periodical press. ■

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SciPer project
➧ **www.sciper.leeds.ac.uk**

Enrico Fermi (left) probed the structure of nuclear particles with the Chicago synchrocyclotron.

UNIV. CHICAGO VISUAL ARCHIVES

Fermi's legacy

Fermi Remembered
edited by James W. Cronin
University of Chicago Press: 2004. 296 pp. $45

Enrico Fermi: His Work and Legacy
edited by Carlo Bernardini & Luisa Bonolis
Springer: 2004. 380 pp. £30.50, $49.95, €39.95

Giulio Maltese

Enrico Fermi was one of the most influential physicists of the twentieth century. He was born in Rome in 1901, and became Italy's first professor of theoretical physics, aged just 25, at the University of Rome. He created some of the cornerstones of modern theoretical physics, such as the Fermi–Dirac statistics, which explain the quantum behaviour of electrons, protons and neutrons, and the theory of beta decay, a radioactive process in which certain nuclei emit electrons or positrons. He also discovered the artificial radioactivity caused by neutron bombardment, and was awarded a Nobel prize in 1938 for his discovery of the properties of slow neutrons.

That same year he fled Italy to escape the racial laws, which affected his wife Laura, and the poor research conditions. He accepted an appointment at Columbia University in New York, where he continued his research on neutrons. In 1942 he moved to the University of Chicago, where he achieved the first self-sustained nuclear reaction. Two years later he went to Los Alamos to help construct the first nuclear bomb.

On his return to Chicago after the war, he founded the most important school of physics in the world: many of its students were to be outstanding figures in physics in the second half of the century. He also came back to theoretical and experimental physics, achieving important feats in both fields, such as the idea of the compound pion — that pions are composed of a nucleon and an antinucleon — and the hint of the first pion-nucleon resonance, obtained with the Chicago synchrocyclotron, which came into operation in September 1951.

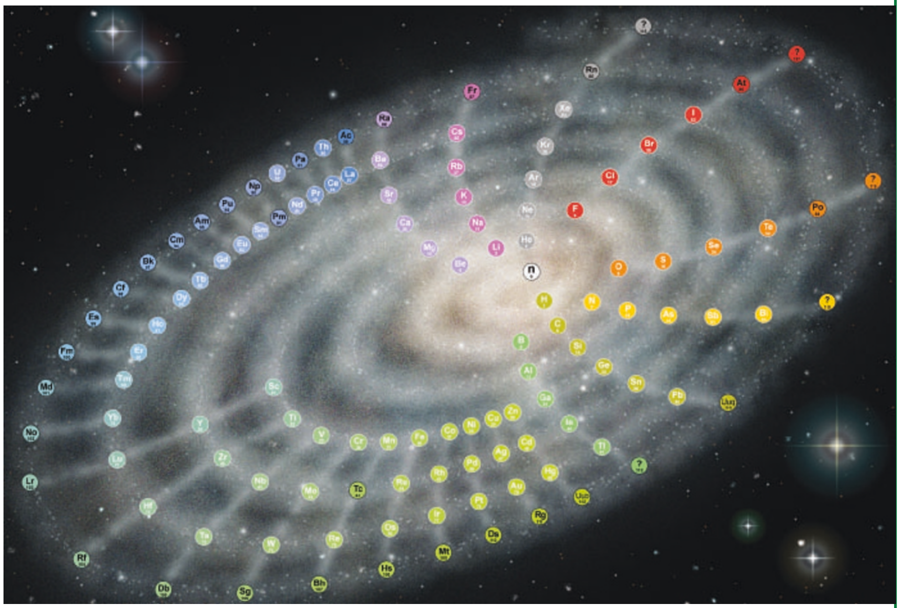
In 2001, to commemorate the centenary of his birth, celebrations were held in both Italy and Chicago. The University of Chicago organized a symposium, and this led to the book *Fermi Remembered*. The book contains recollections from some of Fermi's colleagues, a description of Fermi's impact on physics, and some well selected material from the Fermi archives in Chicago. It opens with a biographical sketch by Fermi's former student Emilio Segrè, first published in Fermi's *Collected Papers*. Also intriguing is the correspondence between Fermi and Leo Szilard in 1939 describing the genesis of some fundamental ideas about the chain reaction. Fermi's own account of those years is reprinted from *Collected Papers*. The book also includes letters and documents from the postwar years concerning scientific, political and personal topics, giving insights into Fermi's character and into his scientific

Science in culture

A galaxy of elements

It's still the periodic table — but with a twist.

Martin Kemp



P. J. STEWART/WWW.BORNDIGITAL.CO.UK

When Dmitri Mendeleev unveiled his periodic table of the elements in 1869, his motives in part embraced what can broadly be described as aesthetic impulses. He sought to define the elusive "unity of matter" through the blending of experimental rigour with pythagorean harmonics (see *Nature* **393,** 527; 1998). If we recognize that a fundamental instinct for the beauty of implicit order has fired the endeavours of pioneering scientists over the ages, we should also acknowledge the role of aesthetically engaging images in drawing non-professionals into the wonder of scientific understanding.

The new 'galactic' version of the periodical table, devised by Philip Stewart of the Department of Plant Sciences at the University of Oxford, UK, is designed to achieve precisely this latter goal. Stewart is by no means the first to transform Mendeleev's rectangular table into a spiral: his scheme stands in a long tradition of alternative configurations, both flat and three-dimensional.

The primary order of the elements is their linear array according to increasing atomic weight (or the positive charge of the nucleus). The secondary relationships in the various schemes have been paraded in various ways, according to the different priorities, interests, needs and intuitions of those who have devised them. Their graphic rendering reflects, with varying degrees of success, the way their designers envisaged the audience: young or old, naive or knowledgeable.

As a boy, Stewart was inspired by a mural at the Exhibition of Science in South Kensington, London, during the Festival of Britain in 1951 — as indeed were others who were later to enter the world of science. The mural, produced by the artist Edgar Longman, depicted the periodic table as a multicoloured, elliptical spiral of box-like sections.

The ellipse as an iconic configuration in modern science has its own history. Before Johannes Kepler's definition in the early seventeenth century of the elliptical tracks of the planets, the circle or sphere was the shape that ruled supreme in defining the most perfect of cosmic orders. It is interesting (and unexplained) that, at the same time, ellipses and ovals gained prominence in Baroque ecclesiastic architecture in place of the circles, crosses and polygons favoured in the Renaissance.

Modern astronomy has ensured that we now readily recognize the thrilling dynamism of galaxies in any elliptical array of bright bodies. Stewart's new periodic table links the elements in their primary sequence with the dust of multitudinous stars. The spokes, curved by the pull of a notional attractor to the upper right, are composed of wisps of interstellar cloud. Such overtly starry allusions stand in a subtle balance with the genuine chemical advantages in the relative positioning of the elements and their associations. For example, hydrogen sits "comfortably" above carbon, Stewart explains. Lutetium and lawrencium, which cause problems for the conventional periodic table, can be seen here both as the last of the lanthanides and as the first of the next block of transition metals. The placing of neutronium, 'element 0', at the very heart of the galaxy is particularly elegant.

At a time when stunning images of Titan, Saturn's largest moon, from the probe Huygens are being shown on our television screens, with the black-and-white images artificially rendered in colour, it is appropriate to acknowledge the key role played by beauty in engaging a wide range of spectators with science. Engagement is a necessary prelude to communication. As Stewart says: "Science needs the emotions as well the intellect. Young people must have enthusiasm to sustain them in the study of difficult subjects."

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and teaching activities from 1945 to 1954.

There are several articles written by Fermi's research colleagues and by students "who were in that magic environment at the Institute for Nuclear Studies during the Fermi years". The book ends with an essay by James Cronin evaluating the predictions on the future of particle physics that Fermi made in a speech in 1954 to mark his retirement as president of the American Physical Society. This book will interest both specialist and general readers, as it provides valuable archive material and sketches of Fermi's life, as well as personal reminiscences from his former students and collaborators.

As part of the Italian celebrations of Fermi's centenary, a book was produced as a resource for physics teachers in secondary schools to introduce their students to Fermi's science. *Enrico Fermi: His Work and Legacy* is an English translation of this book. It includes commemorative essays by Edoardo Amaldi, one of Fermi's Italian disciples, and by Fermi's colleagues and friends Enrico Persico and Franco Rasetti. There are a further 14 essays on several fields of physics that benefited from Fermi's work, including statistical mechanics, quantum electrodynamics, nonlinear systems and particle physics.

The book concludes with a chronological essay by Luisa Bonolis on Fermi's work. Some articles, such as those on the development of nuclear physics, on Fermi's legacy in particle physics, on weak interactions and on nonlinear systems, provide interesting accounts of subsequent developments in these fields. These reveal the importance of Fermi's contributions in preparing the ground for future work.

It is not only physics teachers who will enjoy this book, but also physicists and science historians who want to know more about why Fermi's work is at the core of so many modern views of physics. ■

Giulio Maltese is a physicist and a historian of physics based in Rome. He wrote Enrico Fermi in America: A Scientific Biography *(Zanichelli, 2003).*