

HARALD FRITZSCH

QUARKS

THE STUFF OF MATTER



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THE COSMIC CODE

Heinz R. Pagels

A lucid and exciting guide to the world of infinitesimal particles.

'The universe is a message written in code, a cosmic code', says the author in this introduction to the mysteries of the microcosmos. Quantum physics – the study of the infinitesimal particles called quanta that are the very stuff of material reality – is the Science that seeks to decipher this code. Already, it has made profound and startling discoveries which challenge our assumptions about the nature of reality.

Tracing the historical development of the Science, the author develops his overview of quantum physics and describes the bafflingly and seemingly lawless world of leptons, hadrons, gluons and quarks. These are the key to the cosmic code – holding out as they do enormous possibilities for social and cultural evolution, and a new understanding of the universe.

THE LIGHT FANTASTIC

Peter Mason

IN EARLIEST CIVILIZATIONS LIGHT WAS REGARDED AS A GOD

It was only after centuries of experimentation and controversy that the mystery of its nature was solved by Einstein. Written by a professor of physics for the interested layman. *The Light Fantastic* is the story of the trial and error that went into the invention of spectacles, X-rays, cameras, electric lighting, lasers, television and the many other brilliant inventions that we now take for granted.

Each new development opened up a different potential, from gas-lit cities to laser communication systems; a new world sprang into life at the end of a microscope, another at the end of a telescope. It is a fascinating story of a science that has transformed human life.

EINSTEIN'S UNIVERSE

Nigel Calder

The universe that Albert Einstein saw was an astonishing spectacle: a skyscape of curved lines, high speeds, black holes, light-cones and exploding stars.

Today we live in his universe – and often fail to understand it. Universally recognized for his ability to interpret scientific developments in a clear and understandable manner, Nigel Calder has here made Einstein's vision accessible. How can a black hole keep you young? Why does a falling person feel no force of gravity?: answering these and many other questions, Nigel Calder makes plain the debt that humanity owes to the man who revolutionized so completely our ideas of time and motion.

'A must' – *Irish Times*

'A valuable contribution to the de-mystification of relativity' – *Nature*

ON TIME

Michael Shallis

In our everyday lives we take it for granted that we get older and the surrounding universe ages with us.

Yet, since Einstein's discovery of relativity, science has known that when it reaches out to distant galaxies or inward to the core of an atom, this assumption does no good.

Michael Shallis' brilliant and lucid book takes us on a guided tour of this new, relativistic universe where time has become a central, but elusive, factor, and shows just how complicated our time-keeping will be if we ever travel to the stars; how black holes stop time in its tracks; how a final limit is placed on our probing of the universe by the relationship between time and light; and how – back on earth – in the high energy physics laboratories, the workaday definitions of time have dissolved into paradox.

GOD AND THE NEW PHYSICS

Paul Davies

How did the world begin – and how will it end?

What is life?

What is matter?

What is mind?

These questions are not new; what is new, argues Paul Davies, is that we may be on the verge of answering them. Here he explains, in clear, jargon-free language, how far the recent explosive discoveries of the new physics are revolutionizing our view of the world and, in particular, throwing light on many of the questions formerly posed by religion.

Science has come of age, Professor Davies believes, and can now offer a surer path to God than religion. In this important, exciting and highly readable book, he explains why.

'There is a wealth of interesting ideas here' – *The Times Literary Supplement*

'The author is an excellent writer. He not only explains with fluent simplicity some of the profoundest question of cosmology, but he is also well read in theology' – *Daily Telegraph*

SPACEWARPS

John Gribbin

Recent research into the relationship between space, time, and gravity has resulted in exciting discoveries. Based on the current interpretation of Einstein's theory of relativity and assessing the most up-to-date information, *Spacewarps* investigates the implications of bent space-time in the universe around us.

Often controversial and always entertaining John Gribbin explores the effects of spacewarps, boldly exploring black holes and white holes, quasars, pulsars, X-ray stars and even the increasing possibility of time-travel.

Spacewarps is a fascinating glimpse into the mysteries of the cosmos.


COMPUTER POWER AND HUMAN REASON

Joseph Weizenbaum

"This is the best book I have read on the impact of computers on society, and on technology and man's image of himself" - *Psychology Today*

Computer Power and Human Reason has fired enormous controversy and acclaim in America and is now published in the UK for the first time. Here Joseph Weizenbaum, one of the world's top computer scientists, provides us with an expert insider's critique of computers: what they can already do, what they cannot do and, most controversially, what they *should not* be used to do. Should we, for example, be working towards the use of computers as substitutes for doctors or psychotherapists?

Brilliantly and passionately argued, Professor Weizenbaum's book is unique in combining scientific and humanistic approaches to the many vital questions surrounding computers. It should be read by programmers, scientists and academics as well as by everyone interested or concerned about the impact of computers on ourselves and our future world.



PELICAN BOOKS

QUARKS

Harald Fritzsch was born in 1943 in Zwickau. He has been a Professor at the universities of Wuppertal and Berne and a visiting scientist at Caltech, Pasadena and CERN (European Nuclear Research Centre). He is now Professor of Theoretical Physics at the University of Munich and a Research Professor of Physics at the Max-Planck Institute for Physics in Munich.

Harald Fritzsch

QUARKS

The Stuff of Matter



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To Brigitte

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Foreword

Humankind has been obsessed with a concern for a world view since we have had records, and presumably long before then. The earliest puzzles concerned the cycle of day and night, the cycle of the seasons, and practical science that would diminish irrational human fears and ensure the bounty of nature. But less applied science was also prominent; and the dreamers among our remote ancestors studied the night sky and the infinite variety of matter in its natural environment, and invented models in their quest for an underlying coherence.

The belief that there is, in fact, a key to the functioning of the physical world, and that this key will yield to human thought, was given credence with the success of science beginning in the sixteenth century. The combination of natural philosophy and practical arts gradually accelerated progress, as science led to invention, and invention, in turn, gave increasingly more powerful tools to science.

Professor Fritzsche's book on the state of particle physics summarizes current thought on the subject; this current thought is the culmination of a series of episodic events in which violent intellectual revolution alternated with steady, undramatic advances along the entire front between comprehension and ignorance. This book is an attempt to describe, in layman's terms, the events of the past several decades. By 1940, physics had become comfortable with the revolutions taking place between 1920 and 1930 in relativity and quantum mechanics. The next development was the postwar application of new technology (with the blessings of impressed governments) to the construction of powerful instruments, particle accelerators. These are properly credited here with opening a rich domain of the microscopic universe to observation.

It is appropriate in this survey to concentrate on the evolution of ideas and experimental results. Underlying both theoretical and experimental happenings are a series of brilliant inventions in both the accelerator domain and the domain of particle detectors. Notable developments include the invention of the new accelerator principle, strong focusing, by Ernest D. Courant and Hartland S. Snyder in the early 1950s; this

