The Odd Quantum. Sam Treiman. Princeton University Press, 41, William Street, Princeton, NJ 08540, USA. 1999. 262 pp. Price: US$ 24.95.

Sam Treiman was Eugene Higgins Professor of Physics at Princeton University. Most of his professional life was devoted to research in elementary particle physics or, as it is sometimes known, 'high energy physics'. In the late 1950s, he published a result with M. L. Goldberger on charged pion decays (Goldberger–Treiman relation) for which he is well-known. This result provided one of the bricks which went into the construction of the cathedral of a 'Standard model of particle physics'. He had written a large number of research papers and a few books. All of these were rather technical. It was therefore, somewhat surprising to come across the present book *The Odd Quantum* by him. The genesis of the book is in a freshman one-semester seminar which Treiman gave at Princeton University to first year students. The seminar was entitled 'From Atoms to Quarks, Along the Quantum Trail'. I feel the seminar title gives a better idea of the topics covered in this volume but, I suppose the present title is more catchy.

There are a number of excellent books devoted to a fully non-mathematical popular treatment of the topics covered in the present book. My personal favourite is *The Cosmic Code* by Heinz Pagels. However, there is a limit to what even the best popular science writer can convey about new physics involving quantum mechanics without any mathematics. As Dirac said, 'a book on new physics, if not purely descriptive of experimental work, must be essentially mathematical'. Treiman decided therefore not to eschew mathematics completely, so as to be able to convey the real flavour of the subject but, at the same time, to be 'not overly technical'. The present text tries to fill this niche which falls between popular science books and technical texts.

The introductory chapter is devoted to an overview of conceptual changes brought about by a quantum revolution in the world view of classical physics. It covers the idea of quantization, intrinsic role of probability, the uncertainty principle and implications of identity of particles in quantum mechanics. The phenomenon of radioactivity, tunnelling through potential barriers (e.g. in alpha decay), antimatter and creation (as well as destruction) of matter are commented on to illustrate novel aspects of the quantum theory of matter. Also given here is a brief account of the beginning of the quantum theory. The 'Classical Background' of modern physics, viz. Newton's laws of dynamics together with his law of gravity and Maxwell–Faraday theory of electromagnetism, is covered next. It also includes a brief coverage of Einstein's special theory of relativity. The story of the development of the quantum theory is carried further in the next chapter.

Chapters 4–7 constitute the core of the book and deal with the principle and applications of quantum mechanics. After a discussion of the two-slit experiment, a mathematically elementary but clear presentation of the rules of quantum mechanics is given in chapter 4. This formation is then put to various applications involving a single particle, viz. free particle, particle in a box, the harmonic oscillator and electrons in the Coulomb field of the nucleus. Also included are Aharonov–Bohm effect and a qualitative discussion of alpha decay. Applications to a system of many identical particles are given in chapter 6. These include a discussion of Fermigas, an explanation of atomic structure and a brief discussion of Bose–Einstein condensation and lasers. (A minor caveat: the name of the founder of quantum statistics, Satyendranath Bose, is misspelt as Satendra Bose.) It is well known by now even to general public interested in science that while quantum mechanics is eminently successful in explaining physical phenomena, we do not understand what it means. An influential paper by Einstein, Podolsky and Rosen in 1935, uncovered a bizarre feature of quantum mechanics. The description provided by quantum mechanics is essentially nonlocal. More precisely, Einstein-locality is not obeyed. Bell's inequalities on correlation functions between spin components of two spin one-half particles, produced in a singlet state decay, have made it possible to carry out experimental tests of Einstein-nonlocality. The problem of measurement in quantum mechanics is a murky one. These and other foundational aspects of quantum mechanics are covered in chapter 7. The possibility of quantum computing has made this area of research even respectable now.

The last two chapters of the book are devoted to elementary particles. The first of this gives a brief description of what are the building blocks of nature in our presently accepted standard model of elementary particles. Also discussed are the symmetry aspects of our picture of the microscopic world. A description of the high energy processes, through which we have learnt what we know about elementary particles, is possible only through relativistic quantum mechanics. Unlike the non-relativistic case, the creation and annihilation of elementary particles, is an essential feature here. Quantum field theory and the resulting Feynmann diagrams provide the framework which has proved successful for a description of these phenomena. These are briefly described in the last chapter. This treatment could have been a little fuller.

Treiman passed away soon after writing this book last year. He was known as a good teacher at Princeton. A lifetime of experience in teaching and high energy physics research shines through the writing. He has kept his emphasis on correctly conveying the underlying concepts of quantum mechanics and elementary particle physics despite deliberately low level of mathematics of the presentation. I especially liked his overview and his treatment of identical particles and building blocks.

I strongly recommend the book to bright science undergraduates as well as to all those whose appetite about quantum mechanics and elementary particles has been whetted by popular science books and who can tolerate a few equations to get a deeper understanding.

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