
This book deals with the developments in physics in the 19th century and the early part of the 20th century. It is well known that the 19th century was a period when classical physics reached its glorious peak and the euphoria was there among many scientists of the time, who felt that science had reached a stage when all natural phenomena could be explained. As Anton Capri, the author mentions in the very first paragraph of the book, a senior scientist like Gustav Kirchoff advised the 17-year-old Max Planck in 1875 ‘Why do you want to come into physics? All is done and understood’. However, by the end of the 19th century, several clouds started appearing in the horizon of classical physics – the nature of the blackbody spectrum, the discrete spectral lines emitted by excited atoms and the constancy of the velocity of light violating the additive principle of velocities. In addition, three major discoveries – the discovery of X-rays, of radioactivity and the electron and its radiation properties just could not be fitted into the classical framework. There was also the dual nature of light – the corpuscular and wave-like aspects, which had been brushed under the carpet without any justification. It is in this confusing scenario of being unable to explain well-established experimental facts that the two major theories, quantum theory and the relativity theory made their appearance and brought about a complete transformation of all the classical concepts – space, time, matter, energy, causality and so on, and spelt in no uncertain terms, the downfall of classical physics. It is in this background of crisis which is so familiar to all physicists, but may not be so to other scientists and the general public, that this book has to be read.

To narrate the history, the author has adopted a format that is rarely followed by others, but has proved effective. He focuses attention on a variety of anecdotes concerning the scientists behind the developments than on the physical situations themselves. The specifics of the experimental and theoretical results become evident through the statements by the scientists, the reaction to the statements, and the conversation and discussions between the scientists that are elaborated.

The book starts by highlighting the role of scientists of the 19th century, who created the subjects of thermodynamics and statistical mechanics. Naturally the names of Kirchoff, Rumford, Gibbs, Carnot and Boltzmann stand out. Count Rumford arrived at the idea of the mechanical equivalent of heat through his personal experience of the heat generated while boring cannons for the Bavarian army. Sadi Carnot, who formulated the first and second laws of thermodynamics, is credited to be the first to measure the mechanical equivalent of heat by Max Planck.

Willard Gibbs is another scientist of this time about whom Max Planck says ‘Whose name not only in America, but in the whole world will be reckoned among the most renowned theoretical physicist of all times’. Such statements by Nobel Laureates bring out clearly the quality of the 19th-century scientists and their work. Boltzmann, another scientist of this time, is the one who created statistical mechanics single-handedly and unified the study of discrete atoms and molecules with thermodynamics. The controversy between Boltzmann and Zermelo reported by Capri is interesting and educative. Zermelo was a pure logician and held that any system eventually returns to its initial state. Boltzmann, on the other hand, had shown that any system ultimately comes to an equilibrium state. Both were right in a certain sense. Boltzmann stated ‘Zermelo’s proof although logically quite correct, was totally irrelevant for a physical system since the system would come to its initial state after a period longer than the age of the universe’.

It is a tragedy that Boltzmann, who advanced vigorously the atomic hypothesis and who genuinely felt that he had not received the kind of appreciation that should have been given to him, committed suicide.

Next, Capri moves on to narrate the events in the life of J. J. Thomson, who discovered the electron – the atom of electricity, very much smaller than the atom. Capri also points out that two other physicists, Stoney in 1891 and Wiechert in 1896, had preempted the discovery of Thomson. In January 1896, Wiechert had reported at the Konigsberg Physics Economics Society, that the mass of the particle in cathode ray tubes was between 1/200 and 1/1000 of a hydrogen ion. As Capri points out, at this stage itself Wiechert had said ‘so far as modern science is concerned, we have to abandon completely the idea that by going into the realm of small we reach the ultimate foundations of science’. The incident relating to the demonstration of the working of the X-ray tube to the Kaiser by Rontgen is quite fascinating. Strangely, Rontgen did not accept the discovery of the electron by Thompson and even went to the extent of forbidding the use of the word ‘electron’ in his laboratory! In 1896, Becquerel discovered radioactivity.

These discoveries together with the nature of the experimentally observed blackbody spectrum, the discrete spectral lines from atoms, and the results of the Michelson–Morley experiments on the velocity of light spelt disaster to the classical ideas held till the end of the 19th century and a new awakening in science had to come from a bunch of scientists, who were not so well known till then, except Max Planck. The others were Einstein, Niels Bohr, Rutherford to be joined later by Schrödinger, Heisenberg, Max Born and Dirac. The new awakening came with discarding the classical Newtonian concepts of space, time, matter, radiation, causality and replacing them with Einstein’s special and general theory of relativity, and the radical concept of quanta and quantum mechanics. Intuition and mathematical beauty of the solutions of equations became more relevant than reason and logic and of course, the final court of appeal, as started by Max Born, was the experimental result. A larger fraction of the book is concerned with narration on the role played by a variety of scientists who brought about this transformation in the very core of physics. Among these are mathematicians, theoretical physicists, experimental physicists and technologists.
Capri presents an excellent account of Einstein, both about his personal quantities and the path-breaking ideas of relativity and quantum mechanics. This account is rich with quotations by Einstein himself and also on him by his colleagues. There is an equally fascinating account of Max Planck, the originator of the quantum hypothesis, who was much older than Einstein. Planck was undoubtedly the most respected German scientist of the time, who tried to protect the interests of the Jewish scientists against the Nazi onslaught.

The personal tragedy that clouded the last years of Planck is poignantly related in the book. He died in 1947. As a mark of appreciation, appropriately the Kaiser Wilhelm Gessellschaft was renamed as Max Planck Gessellschaft in 1948.

Capri then passes on to the next line of stalwarts in physics of the first decade of the 20th century – Rutherford and Bohr. Rutherford came to England all the way from Australia and did the most important work of identifying the nucleus inside the atom. He came to the laboratory of Thomson in Cambridge, which acquired the reputation of producing several Nobel Laureates. Capri has given a nice account of what happened in this laboratory and on the scientists that gathered there. Some of the remarks made by the scientists in this wonderful atmosphere are delightful to read. About a pompous government official Rutherford was heard saying ‘That man is like a Euclidean point. He has position without magnitude’. One of the strangest statements attributed to Rutherford, the discoverer of the nucleus is A. Anyone who expects a source of power from the transformation of those atoms is talking moonshine. There is a lot to read about the colourful personality of Bohr and his atomic theory, and the reactions among scientists. At the University of Göttingen, where later quantum mechanics was developed, Bohr’s theory was not initially accepted. The quantum mechanical theory of the atom and the interpretation of quantum mechanics developed by Bohr, Heisenberg, Schrödinger, Pauli and Dirac became highly contentious despite the remarkable success of the theory in explaining observations. The book naturally shifts to a discussion of the physics and the personalities involved in this extended debate which lasted for more than 30 years. The book is full of statements and quotations from these scientists. It also portrays the differences in their approach to scientific explanation itself. Though they were all trying to find answers to the same problems confronting physics, their personal reactions and views were diverse.

Through many of the quotations from the masters like Einstein, Schrödinger, Heisenberg, Bohr, Pauli, Max Born, Dirac and others, the author portrays the very different, perhaps illogical way that these two branches of science relativity and quantum mechanics progressed. While the mathematical tools they used helped in making predictions that were verified by experiments, it was realized that the interpretation of the concepts and parameters used for the purpose was not logically deducible.

I have desisted from reproducing too many quotations from the book, since I thought it more appropriate that these are read from the book itself in their proper context. While many of the quotations are available in some of the earlier books, the virtue of the present one is that all of them are in one place and easy to find. Of course, there are many in this book which are not there in the others.

While reading the book, I was reminded of several earlier ones which have a similar approach, but are different in extent and details. A few that come to mind readily are the two volumes of Bell entitled _Men of Mathematics_, published more than fifty years ago, which deal with the lives of eminent mathematicians of the past. There is another book entitled _The Second Creation_ by Crease and Mann, which covers a similar theme, but is more concerned with the developments in physics after the Second World War years. More recently, there are the books by Abraham Pais _Subtle is the Lord_ and _Niels Bohr’s Time_, which are based on Pais’s own involvement in theoretical physics and his interactions with the masters, and are at higher professional level. While this book will be enjoyed most by those who are familiar with modern physics, it will certainly constitute delightful reading for students as well as discriminating public interested in modern science.

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Writing a book about the history of chemistry, especially for high-school students, and that too in about one hundred pages is a difficult task. However, the effort by the author is laudable and a first step towards making students aware of the rich history of chemistry. I liked reading this book, and the illustrations by Madhu vani Anantharaj are nicely done.

The account of very early attempts to sort out the nature of matter by Anaxagoras, Democritus, Aristotle and others provides a nice backdrop for the rest of the book. It was interesting to know the contributions by Indian, Chinese and Muslim scholars – something that I was unaware of and, upon reading the book, searched the internet for more information. The vivid, and at times hilarious, description of alchemy ends by making an important point. Although alchemy was a failure, the attempts to convert various things to gold led to the development of useful tools and processes. Several names that one comes across in the book are now forgotten and certainly not mentioned in our high-school chemistry textbooks. Thus, the beautifully illustrated book on the art of distillation by Hieronymus (in AD 1500!) and Johann Glauber (of the Glauber’s salt fame) being the first to produce hydrochloric acid (not mentioned in the book though) are important examples of systematic scientific practices. I particularly liked the bit about Boyle being a member of the ‘invisible college’, which later on led to the formation of the now well-known Royal Society. Many such historical tidbits are present...