The Scientific Imagination. Gerald Holton. Universities Press (India) Limited, 3-5-819 Hyderguda, Hyderabad 500 029. 1999. 382 pp. Price: Rs 475.

In 1930, Rabindranath Tagore met Albert Einstein at Kaputh in Germany. They had a brief discussion on the nature of reality. During this discussion Tagore, in an answer to a question by Einstein, commented, 'This world is a human world – the scientific view of it is also that of a scientific man. Therefore the world apart from us does not exist; it is a relative world, depending for its reality upon our consciousness'.

The strong part of Tagore's comment (the world apart from us does not exist) may not be acceptable to most scientists. But we can extract a milder version in the form – it is impossible to completely delink human consciousness from the scientific conception of the world. Few scientists are expected to disagree with this statement, particularly because, the human face behind science can be recovered.

It is true that in science, at least in hard sciences like physics, chemistry, biology, etc., attention is confined entirely to those parts of our perception which are fully shared by all human beings. It is a natural conclusion that this part of reality exists independent of human consciousness. One may also call it a definition of objective reality. No algorithm exists either to prove or disprove this statement. Most scientists believe in it. But it would be a blunder to forget that though science is objective, scientists are not. Being human beings, even when they are engaged in scientific work, almost all the subjective elements are active and play their roles. But nobody records them. By the culture that science has developed over the years, scientists exclude all subjective matters in their writings. The human face behind science comes out clearly when we go into the details behind each discovery, that is when we look not at the scientific achievements but at the working methods behind them. In his remarkable book, *Sleep Walkers*, Arthur Koestler writes: 'The progress in science is gradually regarded as kind of clean, rational advance along a straight ascending line; in fact it has followed a zig zag course, at times almost more bewildering than the evolution of political thought. This history of cosmic theories, in particular, may without exaggeration be called a history of collective obessions and controlled schizophrenias; and the manner in which some of the most important individual discoveries were arrived at remind me more of a sleep walker's performance than an electronic brain's'.

In the book under review, Gerald Holton discusses how scientific imagination functions in different individual scientists. In his own words, 'The chief aim of the book is to contribute concepts and methods that will increase our understanding of the imagination of scientists engaged in the act of doing science'. This book, in fact, is a continuation of his earlier work, *Thematic Origins of Scientific Thought: Kepler to Einstein*. To collect materials for such studies is a difficult task. Published scientific writings are of little help. One has to search the scientist's personal notebooks, where day to day progress is recorded. For example, when discussing Millikan, the author gives interesting details from Millikan's laboratory records, how he selected some results and rejected others, how he exercised his judgement to decide which results are in gross error, etc. Then there are private communications, correspondences and discussions with colleagues for which some sort of a record is available. In contemporary cases, interviews with the scientists provide important materials. The most significant part of this approach is what Holton calls 'thematic analysis'. Every scientist has preconceived notions or 'themata' about the nature of the solution he is expecting. Individual scientists start with their individual themata. For instance, Millikan in the University of Chicago and Ehrenhaft in Vienna started the measurement of electronic charge at about the same time (1909–1910). But they were motivated by antithetical themata. Millikan's conviction centred around atomicity of electricity and Ehrenhaft's themata was continuity of charge. This started the battle over the electron, which continued over many years. Ehrenhaft claimed that he observed charges as small as 1/1000 of the electronic charge. Holton collected considerable factual materials on this controversy and also analysed how the different scientific backgrounds of the two scientists led to the development of opposite themata in their minds. Both the scientists were competent and Ehrenhaft had the advantage of a more sophisticated laboratory. Still, Ehrenhaft's themata led to failure and Millikan's themata led him to success.

A detailed example of thematic analysis is given in the introduction, where the discovery of high temperature superconductivity by K. A. Müller and J. G. Bednorz in 1986, is discussed. When at the age of fifty, Müller decided to work on superconductivity, his choice of ceramic oxides with pervoskite structure appeared strange. Colleagues thought that he was crazy. In an interview with Holton, Müller was asked to elaborate on his remark that the pervoskite structure 'always worked for him'. Holton writes, '... he obliged us by sharing in some detail an aspect of his motivation that would ordinarily be kept private'. In answer to the question Müller said, '... the pervoskite structure was for me and still is a symbol of holiness'. Thus an observation with this structure played the role of a themata for Müller.

Apart from thematic analysis, the author has included discussions on several other topics related to science and society. Some of the topics are, 'Can science be measured?', 'On the psychology of scientists, and their social concerns', 'Lewis Mumford on science, technology, and life', and 'Frank E. Manuel's Isaac Newton'. All these topics are interesting in themselves. For example, Manuel's study of Newton based on Newton's writings on theology (nearly one million words, practically unpublished) is bound to evoke curiosity and interest. We are familiar with the Newton of *Principia*. In these two books by Manuel, the author looks at Newton from the other side, and the two images are so different! How to reconcile them into a single image is the puzzle.

My own feeling is, by introducing too many different topics, readability of the book has been affected. The author's preference for a pleonastic style of presentation added a problem for this reader. But there is no doubt, the book has a wealth of information and ideas and the problems discussed are hot problems for the present human society.

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