

Transport is another sector where attention must be given to achieving greater efficiency. For instance, in Delhi, 4.2 million trips were made per day in 1988–1989 by 6000 buses and 1.4 million personal vehicles. By 2001, this is estimated to increase to about 11.4 million trips by 16,000 buses and 4 million personal vehicles. Average speed is expected to decrease from 20–30 kmph in 1988–1989 to 10–15 kmph in 2001. Considerable debate is now taking place on whether to build a metro system at a cost of over US \$3 billion. This illustrates the high cost to a developing country of achieving some semblance of transport efficiency and removing a major bottleneck to production as well as reducing the severe levels of pollution.

Science and the Quality of Life addresses the question from a purely Indian perspective. It includes 50 contributions from many of the top scientists and planners in India and covers a range of topics including planning and development, science and economics, science and social issues, science and human welfare, science, education and human development, and science and frontiers areas. This book is something of a rarity in that its publication coincides with the congress on which it is based – a reflection no doubt of the drive of its editor, the current President of the Indian Science Congress Association. Its importance stems from the fact that it gives a very wide ranging overview and analysis of the problems facing India as well as much on the state of Indian science. As such, it is an invaluable resource for anyone with more than a superficial interest in India.

Quite apart from the above comments, the book covers an extraordinary range of fore-front topics such as ocean resources, space technology, biotechnology, new materials, earthquake hazard assessment and information technology which give a very up-to-date picture of the state of Indian science. However, some key issues such as sustainable development of land use and pollution are not given the attention that we would have liked. In addition, one topic is not mentioned which we feel is very important for India, namely 'Total Quality Management'. It seems to us that, if India is to achieve the desired qualitative improvements in social and environmental indicators, then much greater emphasis, amounting to a re-

volution in the way things are done, needs to be placed on optimizing operations at all levels to reduce the sorts of inefficiencies and impacts that are discussed briefly in the preceding paragraphs. It is significant that technological innovation in India is much more developed in export-oriented industries than in those protected against imports emphasizing the competitive spur to innovation.

It is recognized that India cannot follow the path of material development followed by the so-called rich countries because it is clearly non-sustainable. Rather, population control, employment generation, alleviation of poverty and universalization of primary education are the main aims of the Eighth five-year plan. This book demonstrates with great and commendable frankness the scale and diversity of the problems that India faces. It is to be hoped that these can be successfully addressed over the coming decades to give the people of India the sort of quality of life that the founders of modern India envisaged but which is far from being universally achieved. The alternative of a society in which perhaps 750 million people are marginalized from the mainstream economy is one that must be avoided above all else.

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A Skeptical Biochemist. Joseph Fruton. Harvard University Press, Cambridge, Massachusetts, USA. 1992. pp. 330 US \$29.95.

In a recent issue of *Science*, a short but intriguing comment entitled 'Pasteur Notebooks Reveal Deception' appeared on page 1117. Historian Gerald Geison of Princeton University noted 'evidence of potential scientific misconduct and ethically dubious human experimentation' when he examined over a 100 note books of the distinguished scholar

Louis Pasteur. After identifying three distinct examples Geison concluded that 'Pasteur's research often failed to adhere to the scientific method' of his time.

Wouldn't such a note be sufficient to create skepticism among scientist? . . . Certainly YES!

Nevertheless, skepticism has played a vital role in scientific literature since 1661 (Robert Boyle, *The Sceptical Chymist*) and has maintained its significance even today.

Here is another shining projection of healthy skepticism for the scientist as well as the historian. A skeptical biochemist – Joseph Fruton reveals history with the touch of a historian and science with the confidence of a scientist. The result, a combination of an intellectually stimulating book which will delight, annoy or probably even confuse some readers. This reviewer was by all means delighted to read an honest yet critical review of biochemistry down the centuries. The book is not merely for historians but discusses the philosophy and history of science (especially the evolution of biochemistry) in a style almost unique in itself. It should be read not only by scientists or historians but would reap accolades when weaved carefully into school, undergraduate and graduate curriculum. This book contains a lot of opinions, some of which are Fruton's very own and some from his peers.

Fruton's first chapter on Biochemistry and Skepticism speaks about his polemic views of chemists and biologists. He states that 'chemists have been skeptical about chemical hypotheses offered by biologists who, in turn, have been skeptical about biological hypotheses offered by chemists. The resulting tensions have been transmitted through several generations to the present-day scientist who identify themselves as biochemists or molecular biologists'.

As Fruton's skepticism rolls along this magnificent book, and slowly unveils his reflections of the past 60 years, he skillfully illuminates the interplay between biology and chemistry, which seems to be the basis of his entire book.

The different characterizations of the term 'scientific method' have been entailed in another chapter where he quotes and discusses the ideas and philosophies of scholars like Peter Medawar, Justus von Liebig, Francis Bacon and a few other contributors such

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as Claude Bernard who then claimed to be the founder of Experimental Medicine (and was regarded by Fruton as an 'egocentric' of his time). Fruton greatly appreciates and acknowledges the role of 'journeymen' and their 'craftsmanship' (or laboratory assistants) and presents an interesting citation of Moses Kunitz. His comments on the current trends of 'scientific methods' can best be expressed in his own words:

Obviously, one of the reasons for the indifference of most of my scientific colleagues to the writings of present-day philosophers is that the present social climate of research in the biochemical sciences, with its intense competition in fashionable fields, hardly encourages a philosophical attitude among the people actively at work in these fields. A more important reason, in my opinion, is the enormous acceleration during this century of the growth of reliable knowledge in diverse areas of scientific inquiry with various methodologies whose character has been changing as a result of the interplay of theory and practice

However, Fruton has never shown a cavalier attitude towards the writings of his peers but these are his very own (skeptical) views on the scientific method:

In short, I doubt whether there is any such thing as the scientific method, independent of time and circumstance, but rather tend to believe that there are many such methodologies, all of which have emerged from the interplay of thought and action within separate areas of inquiry, and which have continued to change in response to challenges presented by new problems, or the restatement of old problems, within those individual areas

There are a few other interesting comments made by Fruton in his remaining chapters

- ... about Peter Medawar's opinion of the (fraudulent) scientific paper and journal,
- ... about the development of biochemistry more through techniques than ideas,
- ... about a few 'words of the tribe' such as protein, messenger, gene, enzyme, affinity, etc. which have helped in transforming the chemical language into more appropriate terms and an entire chapter which deals with many reflections on biochemical literature.

A Eugene Higgins Professor, Emeritus, of Biochemistry at Yale University, Joseph Fruton was the recipient of the John Frederick Lewis Award conferred by the American Philosophical Society in 1990. He has authored many books in the past, both on biochemistry as well as history and his writings have been widely praised by historians and scientists alike. Fruton has had the proud privilege of working for Max Bergmann (a distinguished organic chemist and the last principal assistant to Emil Fischer) and Leonidas Zervas at the Rockefeller Institute during 1930s after he received his doctorate from Columbia University.

This book is surely an outstanding masterpiece which reveals more than Fruton's sagacity... 'Makes compulsive reading'.

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