somewhat shocking to read that George Gamow and not Hans Bethe discovered the p–p reaction.

The list of errors and misprints is unusually long, and most unfortunate in a textbook! Given the urgent need for such a book it is my sincere wish that Abhyankar soon revises the book to increase its usefulness.

I am also unhappy with the rather poor quality of the production and the price which is unusually high for students. The pictures do no justice to the excellent photographs from which they have been reproduced. Will Abhyankar consider replacing the drab black and white photographs of the present edition by colour photographs in the next? Of course, the publishers may then price it even higher which will be disastrous.

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India and the Quality of Life. Qasim, S. Z., ed. The Offsetters, New Delhi, 1993. 620 pp. Price: Rs 600.

Science and the Quality of Life was chosen as the theme for the 80th Indian Science Congress held in Goa in January 1993. So what is it about India that is of interest? India with its size and diversity, seems like a paradox. On the one hand, many indicators show substantial improvements in human well being since independence. Relative to 1951, life expectancy has increased from 32 to 58, the literacy rate from 17 to 57%, per capita income has doubled in real terms, the number of hospitals has increased fourfold, etc. On the other hand, the population has increased from 362 to 844 million, of which about 240 million people (or 28% of the population) still live in poverty (82% in the rural areas and 18% in the urban areas). Poverty is, of course, a relative word and it is worth emphasizing that a significant proportion of the population (perhaps some of the 51 million who live in slums, the 2 million who are homeless, the 35 million mentally ill or the large number of alcoholics and drug addicts) live in conditions of such squalor that most Europeans, if they had to endure them, would, in our opinion, be dead within a year. These statistics are better appreciated when it is realized that India has a bimodal income distribution with the rich and the poor but no broad spectrum in between. India presently has a per capita GDP of US $350 which is 8% of the world average of US $ 4200 and puts it in the category of low-income economies. Nevertheless, its GDP is about US $295 billion compared to a value of US $850 billion for Britain.

The population statistics are of particular interest. In fact, the birth rate has decreased from 40 to 30 per thousand of population since 1951 but the death rate has decreased from 27 to 10 per thousand of the population. It is therefore the lowering of the death rate which has contributed most to the 233% increase in population since 1951, although the influx of economic refugees from countries such as Bangladesh has played a role.

Nonetheless, it is the population increase which is the major factor behind the negative indices of the quality of life in India. Sometimes, it is possible to get a glimpse of what life in India would be like with a lower population. In Delhi on 25 February, the day of the banned BJP rally, during which Delhi had a massive police presence and most people stayed at home, Delhi was transformed from a city choked with traffic and pollution (population 9.5 million, 2 million vehicles emitting 1400 tonnes of pollution daily, atmospheric SO_2, CO and suspended particulate matter contents regularly exceeding acceptable values) to one of the broad, uncrowded boulevards. The transformation was amazing.

In fact, as pointed out by the Maud Pember Reeves in her book *Round about a Pound a Week* about poverty in Edwardian England, poverty itself leads to economic inefficiency. Take energy.

In 1987, commercial energy consumption (coal, oil, gas, hydropower) in India amounted to 158 million tonnes of oil equivalent (a 5.8 fold increase from 1953) but non-commercial energy (fuelwood, dung cake, agricultural waste) amounted to 115 million tonnes of oil equivalent (a 1.8 fold increase on 1953). Therefore, whilst the percentage of commercial energy used had increased from 34% to 58% from 1953 to 1987, the non-commercial energy (i.e. biomass) still remains a large percentage (42%) of energy consumption and its use is increasing. The inefficiencies in this situation are emphasized by the fact that the end-use efficiency of traditional fuels in the household sector is 8% compared to 18% for coal and 45% for kerosene. The inefficient burning of biomass fuels presents a health hazard because of smoke production and it produces much higher CO_2 emissions than coal or kerosene (1 tonne of fuel wood produces 2.25 as much CO_2 as the equivalent amount of coal and 5.6 times as much as the equivalent amount of kerosene). Most importantly, since the use of biomass for fuel is well above the sustainable yield, it amounts to mining both the forests (with its resultant impact on the ecosystems and soils) and soil nutrients (dung). In fact, about 13,000 km^2 of forest are cleared each year for agriculture and energy production so that the forest cover has decreased from 45% of the land area 50 years ago to 12% now. Such facts emphasize the crucial importance of a policy of increased energy efficiency on the quality of life and testifies to a major point of this book that the environmental crisis, the development crisis and the energy crisis are one. Sustainable development, population stabilization and environmental protection therefore need to be balanced to achieve a better quality of life for both the present and the future.

The same conclusion can be drawn for other sectors. Take water which is the limiting factor in grain production. India has enormous water resources as a consequence of the monsoons and is rated as one of the wettest countries in the world. However, its uneven spread both seasonally and across the country results in large surface runoffs and problems of both drought and floods. Nonetheless, India remains a profligate, inefficient user of water. For instance, 2.1×10^9 litres of water per day are produced in Delhi, the largest per capita availability in any major Indian city. However, 15–20% of this production is lost due to leakage, taps left open, and horticultural use and water-borne diseases occur frequently in various parts of the city. Similarly, the Indian paper industry uses more than twice as much water for the same output as the US industry. In addition, there remain 150,000 villages in India with a per capita water availability of less than 40 litres per day. Much greater attention therefore needs to be paid in future to the efficient use of water resources by industry, agriculture and the domestic consumer.

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 in 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 revolution 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 Leibig, Francis Bacon and a few other contributors such