Astrophysics: Stars and Galaxies. K. D. Abhyankar. Tata McGraw-Hill Publishing Co. Ltd, New Delhi. 1992. 543 pp. Price: Rs 300.

Until recently the pursuit of astronomy as an independent academic discipline in Indian universities was largely neglected. It may seem surprising but it is a fact that till the 1970s Osmania University, Hyderabad was the only one to have a fullfledged Department of Astronomy that offered degrees in the subject Today, there may be only a couple more universities with astronomical departments but there are a few others that offer astronomy/astrophysics as a special subject at the Master of Science level. The Joint Astronomy Programme of the Indian Institute of Science, exclusively a PhD programme, is just ten years old. On the other hand, some of the major research institutions in the country have had astronomy and astrophysics as important components of their research agenda. Major observational facilities have been set up in the country over the last three decades and a half with government funding and support. Several projects are nearing completion and many more are being planned. The young blood needed to sustain research at these various centres is usually drawn from the trained manpower provided by the Indian universities as graduates in physics, mathematics or engineering. Most of these research institutions have graduate programmes in astronomy recognized by various universities. They recruit students regularly and provide facilities and guidance for work eventually leading to the PhD degree. Teaching of astronomy and astrophysics is an important academic activity in these institutions. Over the last two decades the number of students learning astronomy at various levels has increased substantially and there has been a growing need for textbooks in the subject within easy access of Indian students With the declining value of the Indian rupee, textbooks published abroad but available in the Indian market have become prohibitively costly. A good Indian textbook on stars and galaxies thus seemed to be the need of the hour and we were waiting rather eagerly for the appearance of Abhyankar's book.

Abhyankar has been at the forefront of the movement of spreading astronomy education in the country. An optical astronomer of great distinction himself, he had his grooming in the subject in some of the best astronomical research centres in the world where he had the opportunity of working with some of the finest astronomers and astrophysicists. He was a Professor at the Department of Astronomy, Osmania University for the better part of the last three decades until his retirement in 1988. As a dedicated and compelling teacher he inspired generations of astronomy students, that came to Hyderabad, through his masterly expositions of stellar physics and other related fields. His credentials as an author of a text on astrophysics are not to be doubted. It was, therefore, quite disappointing to discover that the book he has written failed to fulfil our expectations. I find it flawed on many counts.

The text has covered a fairly wide ground starting with basic spherical astronomy moving on to the astrophysics of stars and nebulae and then to the structure of our Galaxy and finally to the large-scale structure of the Universe and Cosmology. Of a total of twenty chapters, approximately half are devoted exclusively to stars, there is a single chapter on nebulae and interstellar gas, three chapters on galactic structure and one each on external galaxies and cosmology. The last two chapters, one on astronomical instruments and the other on space astronomies do not really fit into the scheme and seem to have been added as an afterthought. All elementary and intermediate texts on astrophysics follow a standard pattern of organization of the material with a lot of importance given to the historical development of the subject. Abhyankar's book is no exception. A student of physics may not necessarily view this as the most exciting way of learning astronomy and it is unlikely that he will find in the style or the content much that holds his attention for long. While saying this I am aware that the task of making such a book attractive is by no means easy.

Before criticising the book for some of its major flaws, it will be worth enumerating a few of its virtues. The discussion on the fundamental parameters of stars, their masses and radii, distances and luminosities has been quite thorough. The atmospheres of stars have also been described at the right level. The chapter on the chemical compositions of stars is somewhat of a misnomer though, for the material merely describes the conventional curve-of-growth technique and line broadening mechanisms. In keeping with the pedagogical aims, a fair amount of mathematical detail has been provided wherever necessary. Teachers of elementary astrophysics courses will find their task made easy by using this book provided they are not misled by the errors and misprints. Exercises have been appended at the end of each chapter which the students may find useful to work out. Binary stars have been given their due importance as so much of the fundamental stellar astronomy we learn is by studying them.

Coming to the criticisms now, I shall limit myself to some of the major deficiencies particularly in the area of stellar astronomy since this seems to be the main thrust of the book. Much of the current excitement in stellar astronomy is found in the study of the late stages of stellar evolution and studies of star clusters. Observations in wavelength bands other than the optical and the use of charge coupled devices in the optical/near-infrared region have provided an enormous boost to this field. For some inexplicable reason Abhyankar has paid scant attention to these more active areas. Such crucial and important topics as massloss from evolved stars, evolution of massive stars to the supernova stage, the supernova phenomenon itself, the evolution of stars in clusters have all been practically left out of the discussion. Even the greatest event in astronomy in recent times -- the explosion of a massive blue star in the Large Magellanic Cloud as a naked-eye supernova, has been ignored. I shall not agree with the point of view that some of these are beyond the scope of a book of this kind. Much of this, in my opinion, involves rather basic physics and should be covered in books dealing with stars, no matter how elementary.

Even if we overlook these acts of omission, it is not possible to do the same to the errors and misrepresentations that make their appearance in almost all the chapters that I have read. In addition to the innumerable misprints and errors in the numerical values, the figures and the diagrams, there are several places where the discussion is very dated Chapter 10 may be cited as an example where the discussion of the late stages of stellar evolution and the origin of planetary nebulae are totally inconsistent with modern points of view It was also

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.