of astronomy that is far too abbreviated for my tastes. My opinion of the book was at its nadir when I reached chapter 4. Then things began to look up. The remainder of the book is a well written, thorough survey of astronomy. Though most of the chapters do not depart significantly from the presentations of the other detailed texts such as Abell and Wyatt, neither do they omit any important material. Chapter 16 on space exploration is unusual, though I found the description of the rocket principle wordy and turbid. Chapter 18 on exobiology is a welcome addition to the astronomy curriculum. Unfortunately, 15 pages cannot do more than scratch the surface of a fascinating topic.

I do have some specific criticisms of the text. The chapters on the sun and on stellar atmospheres make a great deal of the concept of a reversing layer in the discussion of spectral-line formation. This concept has not been used by workers in the field in recent years. After reading chapter 24, "The Nucleus of the Atom," and chapter 25, "Sources of Stellar Energy," I found myself plunged into a chapter on variable stars that contains only a brief reference to stellar evolution so that the point of the two chapters was lost. The student needs more discussion of stellar evolution at a point where chapters 24 and 25 are still fresh in mind. By deferring much of the discussion to the last chapter of the book, the authors had to include many forward references throughout the intervening material.

Among the particularly good sections, I would count the discussion of photometry in chapter 6; the treatment of visual double stars in chapter 21; the overall, very logical presentation on the physical properties of stars in chapters 19 through 22; and, the very complete discussion of cosmology in chapter 34. Several important formulas, such as the equation relating absolute magnitude, apparent magnitude and parallax, are given as nomograms (figure 19-7), which should be very helpful to the students.

On the whole, the book is well illustrated with excellent photographs and informative line drawings. Unhappily, while the text has been fairly well proofread, the figure captions contain numerous misprints and the cross referencing to figures and tables is frequently in error. Just as a few examples: In figure 27-7, "Supernova in Spiral Galaxy NGC3389," there are two or three points of light that, to my eye, could be the supernova, which should have been indicated by an arrow on the figure. A more serious error occurs in section 31-8. The text refers to the far-infrared spectral-energy distribution curve of the galactic nucleus as figure 31-15. It turns out that figure 31-15 is a photograph of NGC 4303, and the illustration of the spectral energy-distribution curve is not included in the book. A similar problem occurs in references to tables. In article 32-8 is a discussion of a table of the Local Group of galaxies, which is alleged to be Table 32-2. In fact, Table 32-2 is a table of the colors of various types of galaxies and there is no table of the Local Group in the book. In the very next paragraph, a reference to Table 32-3 is likewise confused.

While I do not think a new undergraduate astronomy text at this level fills a pressing need in view of the excellent books already available, I feel this book has a few innovations which make it worth considering.

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Collected Scientific Papers of Meghnad Saha

S. Chatterjee, *ed.*
414 pp. Sree Saraswaty Press, Calcutta, India, 1970. $18.00

This book belongs in every physics or astronomy department's library. It is a useful collection of 88 of Saha's papers reprinted from European and American journals, and also from some less accessible Indian publications. But the reader who sees only a library copy will probably miss the concise summary of Saha's life and work that appears on the dust jacket and reminds us that:

"The name of Professor Meghnad Saha would always remain associated with the theory of thermal ionization and its application to the interpretation of stellar spectra in terms of the physical conditions prevailing in the stellar atmospheres. The theory had all the simplicity and inevitableness which usually characterize a fundamental and epochal contribution. It was almost a direct consequence of the recognition that the laws of thermodynamics and the kinetic theory of gases can be extended to a gas of free electrons. Apart from astrophysics, the theory later found numerous other important applications, such as, to mention some of them, in the study of the ionosphere, conductivity of flames, electric arcs and explosion phenomena. Saha's researches in astrophysics and physics extended over a wide range of subjects. At one time or the other he worked on stellar spectra, thermal ionization, selective radiation pressure, spectroscopy, molecular dissociation, propagation of radio waves in the ionosphere, solar corona, radio emission from the sun, beta radioactivity, and the age of the rocks . . ." (This is reprinted from D. S. Kothari's obituary in the *Biographical Memoirs of the Fellows of the Royal Society of London.*)

M. N. Saha (as he usually signed his name to scientific papers) was born at Sheoratali, a village near Dacca (now in East Pakistan) on 6 October 1893. The biographical Foreword by D. M. Bose in this book tells us nothing about his parents except that they were too poor to finance his education, so that he had to win scholarships to pay his expenses all the way through school and college. He gained the DSc degree at Calcutta University in 1919, and on 4 March 1920 he sent to the *Philosophical Magazine* his fundamental paper "Ionization in the solar chromosphere." In this paper

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he derived what is now called the "Saha equation" for the equilibrium concentrations of atoms, ions and electrons, relating them to temperature, pressure and ionization constant. The equation may be viewed as a generalization of the mass-action law for chemical reactions to ionization reactions; the key step was the incorporation of Planck's constant (as a measure of the size of an elementary cell in phase space) through the Sackur-Tetrode formula for the "chemical constant." This was one of the more successful applications of the "old" quantum theory to statistical mechanics; it is interesting to note that the "new" quantum statistical mechanics began with a paper by S. N. Bose, one of Saha's colleagues at Calcutta. Saha was primarily interested in the application of his equation to the interpretation of solar and stellar spectra, and it has indeed been one of the most important tools of astrophysics during the past 50 years; it has also found increasing usefulness in laboratory plasma physics.

Among a large number of papers on the subjects mentioned in the quotation above, we find also some interesting writings on the inclusion of radiation in the Gibbs phase rule (1925), magnetic monopoles and the masses of proton and neutron (1936) and the possibility of existence of molecules in interstellar space

(1937). Many of Saha's articles have historical introductions that relate them to the mainstream of Western science, but only occasionally to the intellectual heritage of Eastern civilization (for example the Hindu time-scale mentioned on page 358). He was one of those Indians who had completely assimilated the European tradition of natural philosophy and was able to make significant contributions to it.

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Kinetic Theory of Vehicular Traffic

By I. Prigogine, R. Herman
100 pp. American Elsevier, New York, 1971. $12.50

This book will provide interesting reading for anyone who enjoys statistical physics and wants to believe that the techniques he has mastered can be directly applied to problems of public policy. Unfortunately, the reader's hope that transportation policy issues will be addressed here is not fulfilled, for the book describes an imaginary world invented by the authors.

Search, if you will, for a highway approximating the ideal road of this book —a road without entrances or exits, without cross streets, without traffic lights, without even a single drunken driver. When you find it, you will see that it presents no problems for the policy maker, and your interest in it will probably wane. But Ilya Prigogine and Robert Herman have become fascinated by this road and have spent a decade conducting a comprehensive program of research about its traffic patterns. Their book summarizes the results in such careful detail that the reader may find himself interested, despite his knowledge that real problems are not being addressed.

Most of the authors' arguments begin with the theory and proceed from there to observations. There is little here that appears to have been derived from experience. After a while, the reader may begin to imagine, although he knows it is not the case, that Prigogine and Herman have never wondered about their own experiences while driving. There is no feeling that the authors have ever marvelled at a traffic jam that suddenly evaporated without giving a hint of its cause, or that they have ever concentrated on the accelerator, trying to sense what stimuli were causing them to change speed.

The Prigogine-Herman theory is based on analogy with the kinetic