

Book Review

The Universe. Visions and Perspectives. *By N. Dadhich and A. Kembhavi (Eds.)* 360p., Kluwer Academic Publishers, 2000. EUR131.50 USD150.00 GBP95.00. ISBN 0-7923-6210-1.

Naresh Dadhich and Ajit Kembhavi have assembled a collection of essays on cosmology whose breadth and vitality mirror the career of Jayant Narlikar, the man they honor. Narlikar is most famous for his work on steady state cosmology, which began in the 1960's during the rebirth of interest in general relativity. Several of the essays are by his close associates in this endeavor—Halton Arp, Geoffrey Burbidge and Fred Hoyle.

In taking on this review, one of my most distinguished colleagues warned me that *festschrifts* typically contain material which, because of either style or substance, could not be published in standard journals. In accord with this tradition, the articles in this book are informal, quite often speculative and in some cases highly entertaining. This is especially true of the lead article "Observations and Theory," by Arp. He states that "the most predictable observation concerning theories is that they will probably turn out to be wrong," citing Ptolemy to phlogiston and implicating the more recent orthodoxy of the big bang "theory that the entire universe was created instantaneously out of nothing." According to the proponents of steady state cosmology, the big bang theory of the universe is inconsistent with observations that have been ignored because "there was no theory to 'explain' them." However, as Arp continues, since the formulation of the Hoyle-Narlikar theory of continuous creation of matter, "there has not even been this feeble excuse for abandoning empiricism." Is Arp (an adroit fencer) suggesting that steady state cosmology may fall on its own petard by offering an underlying theory?

Six essays, by Arp, Burbidge, Das, Hoyle and Narlikar himself, provide historically interesting recollections of the development of steady state cosmology. They present a brief introductory account for the young cosmologist who is

curious about what lies off the conventional path. General relativity is famous for its elegant geometrical treatments of black holes, cosmological models, singularity theorems—to name a few highlights. Steady state cosmology originated in another mode from the dirty world of observations. Violations of the Hubble law by anomalous luminosity-redshift measurements of radio galaxies suggested that big bang cosmology might be wrong. A steady state universe arose as an attractive alternative to an initial singularity. The first attempt to disprove the theory was based upon radio source counts, which at face value implied an expanding spacetime. However, Narlikar, working as a student of Hoyle, showed that the inclusion of evolutionary effects on radio luminosity could make these counts consistent with a stationary cosmos. The situation became more complicated with the discovery of quasars. The steady-state proponents argue that the numerous apparent associations of quasars with galaxies of different redshift are more than just chance line-of-sight projections. They propose that these anomalous quasar redshifts might arise, in some unexplained way, in a continuous creation of matter that feeds galaxy formation. Absent in these essays is the contrary argument that gravitational lensing can enhance the probability of an apparent association by creating an illusionary bridge between quasars at neighboring directions. (An essay by Chitre does explain how gravitational lensing can account for the apparent superluminal motions of VLBI components without abandoning the Hubble relationship between quasar distances and redshifts.) Also noticeably missing is a discussion of how the recent measurement of a positive acceleration of the universe fits into the steady-state picture.

The cleverness, creativity and expertise of the steady-staters is exemplified by their explanation of the microwave background radiation as the thermalization of energy released in the synthesis of the elements by purely galactic processes. This includes helium and all the light isotopes, which otherwise cannot be synthesized in stellar interiors and are used as evidence of the big bang. The essays on this subject project the excitement of a masterful episode in cosmology which mainstream astrophysics seems to have passed by. It appears inescapable that if steady-state cosmology is indeed correct then by the force of its own prediction there will emerge a new generation of proponents.

Additional articles (by D. Atkinson; P. M. Branoff and D. R. Brill) present quantum mechanical implications for steady state theory. Six other essays deal with other topics in cosmology: an epistemological discussion by G. Ellis that would be of interest to philosophers; some new spherically symmetric inhomogeneous solutions, presented by S. D. Maharaj; how addition of higher derivative terms to the gravitational action affects inflation, by B. C. Paul and S. Mukherjee; the case for considering a scale invariant, fractal cosmological matter distribution, by J.-C. Pecker; how anisotropy in the microwave background might be used to infer a nontrivial spatial topology, by T. Souradeep; and a nice discussion of unresolved

issues regarding the definition and properties of a black hole in a cosmological spacetime, by C. V. Vishveshwara.

Other than cosmology, the essays are scattered over a wide field ranging from the origins of bacteria in outer space (N. C. Wickramasinghe) to the implications of non-commutative spacetime geometry for elementary particle physics (K. C. Wali). The chief common denominator is the Indian heritage of the majority of authors, including many whom Narlikar has served well as mentor.

Two contributions come from the grand patriarchs who initiated the remarkable tradition of relativity in India. In "A fresh look at the singularity problem," A. K. Raychaudhuri analyzes what most others would call the Raychaudhuri equation to conclude that a nonsingular cosmology requires apparently unphysical properties (such as an energy density with vanishing spatial average or closed timelike curves) except for rotating cosmologies with closed spatial sections. P. C. Vaidya (with L. K. Patel) presents new exact solutions with pure radiation fields which generalize the famous "Vaidya solution."

Several excellent essays on quantum gravity come from the modern generation of relativists who have emerged from India. A. Ashtekar describes the program for nonperturbative quantization of gravity based upon a connection and triad as variables. Without giving technical details, he presents the basic principles for calculating the discrete spectra of such basic geometrical observables as surface area. S. D. Mathur gives a clear presentation of the quantum information paradox posed by the thermodynamic properties of black holes. T. Padmanabhan reviews the problems in quantizing gravity via the methods of conventional quantum field theory.

On an editorial level, the book is rife with misspelling, typographic errors and the uncovered tracks of cut and paste. The articles are presented in alphabetical order without any attempt to group them by subject, a practice shunned by the more elite publishers. But these editorial defects are not serious enough to obscure the content of the contributions.

Through library purchases, the recent plethora of festschrifts and conference proceedings has accomplished the almost impossible task of prying institutional funds for the support of pure science. Take advantage and browse through this book if you come across it in your library or spot a freebie on the shelves of a contributor, where I am sure it will find many a haven in fond tribute to a mentor and colleague.

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