

Quasars, Redshifts and Controversies. Halton Arp. 198 pp. Interstellar Media, Berkeley, CA, 1987. Price: \$19.95. (Reviewed by Jayant Narlikar.)

My first introduction to astronomy was in the late fifties through Fred Hoyle's classic book, *The Frontiers of Astronomy*. Two things about astronomy struck me as a math undergraduate at Cambridge, one positively and one negatively. The positive aspect was that laboratory physics is able to explain many astronomical phenomena succinctly, the most impressive achievement being the understanding of stellar structure and evolution. The negative aspect was the extent of imprecision allowed in the subject, in particular, the inability of the astronomer to gauge extragalactic distances.

Hoyle described the controversy at the turn of the century concerning the distances of nebulae, how at an international conference the view championed by R. A. Proctor that the nebulae are extragalactic was outvoted by a majority who firmly believed them to be part of our galaxy. Some two decades later, the minority view turned out to be correct.

Distance measurement continues to be the bane of astronomy even today. What is the value of Hubble's constant? In your search for the truth, you may find yourself pulled in two directions by opposite camps, one advocating $H_0 \cong 100$ and the other $H_0 \cong 50$, in units of $\text{km s}^{-1} \text{Mpc}^{-1}$. Imagine a similar situation in laboratory physics, where two experimental groups quote values of $\hbar$ differing by as much as factor 2, but with formal errors no more than 15%! (Hubble himself obtained a value of 530 for his constant, back in 1929.)

This uncertainty about the true value of Hubble's constant may turn out to be the thin end of a very thick wedge if even a fraction of what Halton C. (Chip) Arp describes in his book *Quasars, Redshifts and Controversies* is correct. For Arp, in this book, questions the very basis of modern cosmology, namely, the universal validity of Hubble's law.

Hubble's law gives a unique relation between the redshift and distance of any extragalactic object. The standard cosmological models (Big Bang, inflation, and all that) require it to be so. Almost entirely, the extragalactic observing programs of the world's major facilities take all this for granted. The theoretical brain power (ranging from whiz kids of graduate schools to distinguished opinion makers) devoted to the study of the very early universe and high-energy astrophysics is unprecedented, more so now because of inputs from particle physicists. So, to question

Hubble's law at this stage requires a great deal of courage and self-confidence.

Chip Arp has both in plenty. He is recognized, even by his opponents in the controversy, to be a highly competent observer. His noncontroversial work on galaxies and peculiar objects is the byword and often cited. Had he continued this work only, today he would be the head of a major observatory and chairing committees dishing out grants to others.

He chose not to do so. In the mid-60s he began to deviate from the straight and narrow path. His work on peculiar galaxies had probably equipped him to spot the unusual. Over the last two decades he has been following his hunches and instincts and discovering anomalous evidence relating to galaxies and quasars. He has paid the price: denial of observing time, lack of research funds, no graduate students (who would want to risk his or her future career?), etc.

This book gives a highly readable account of Arp's fight with the Establishment along with the disturbing results he has been steadily accumulating during the latter part of his career. There are several photographs showing anomalous configurations of quasars and galaxies, of galaxies and galaxies, and of quasars and quasars.

The bulk of the evidence is of the following kind. If the redshift is a measure of distance, then two objects that are physical neighbors must have the same redshift. In Arp's photographs, the near neighbors have highly discrepant redshifts. The controversies begin with his claim that objects found with small angular separation are real neighbors. Could they not, in fact, be far apart but happen to be projected in nearly the same direction?

This is where statistics are brought in by both sides to substantiate their claims. Arp, however, goes further; he points to alignments, filamentary connections, and equalities or periodicities of redshifts. None of these could be present if the apparent nearness is from projection only.

The evidence presented in this book is of mixed quality, and not exhaustive in this context. For example, the evidence for a nonlinear Hubble law pointed out by I. E. Segal and the evidence for the lack of a magnitude-redshift relation for quasars are missing. A more striking omission (in view of the author's own involvement in obtaining it) is the evidence of aligned triplets of quasars with discrepant redshifts.

Nevertheless, this book should be read by the younger generation of astronomers as well as the educated layman, for it presents an account that is rarely found in nontechni-

cal books and almost never in standard (recommended) texts for students. Chapter 10, "The Sociology of the Controversy," graphically describes the author's own encounter with the Establishment. The reader may well come away with the impression that in terms of intolerance of new ideas the scientific community of today is no different from the contemporaries of Copernicus and Galileo.

The author describes a double-bind situation that blocks new theories and new observations. The conventional theoretician believes that "there is no need to modify conventional theories because there are no valid observations which contradict them." The conformist observer facing anomalous data, however, argues that "the observations cannot be accepted because there is no theory to explain them."

The book indeed raises many pertinent questions: To

what extent can we give a hearing to new ideas? How do we distinguish between a genuine case and a host of cranky notions floating around? Paradoxically, these questions have become more difficult to answer honestly today than they were a few decades ago. For the "big money-big science" culture of modern times forces a young scientist to be conformist rather than original in order to survive and prosper. It is because this book provokes the reader to think about these issues that its value extends beyond the very interesting astronomy it describes.

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