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Cosmology and Controversy: The Historical Development of Two Theories of the Universe.
Helge Kragh

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quently happened to casual acquaintances of the Bandeliers. All too often the reader wonders who cares.

The authors never explore Bandelier's science in any detail. Occasionally they make a presentist judgment about Bandelier's work, noting, for example, that his fieldwork failed to meet modern standards or that he was a pioneer when he integrated fieldwork and archival research. They observe that Lewis Henry Morgan's idea that cultures inevitably evolve in a single pattern had a profound influence on Bandelier, but they never say how that viewpoint affected his thinking. Lange and Riley rarely discuss Bandelier's conclusions or the content of his publications. Instead, they numb the reader with still more detail about the scholar's itinerary—what he studied, not what he discovered. They maintain that Bandelier was interested in facts, not theory. That bias may explain their approach to Bandelier's science. It does not explain why a historian of science would be interested in this book.

The charisma Lange and Riley claim for Bandelier is never in evidence. Money was a struggle for Bandelier after family resources failed. Having constantly to seek support for his work, he often felt unappreciated and persecuted. The tale of his frequent complaints makes him difficult to like; the reader is hard put to see the positive side of Bandelier's personality in this account.

In short, this book leaves one wanting both more and less—more extensive analysis of Bandelier's role in the history of anthropology, less of the frustrating and uninteresting detail. The maps in the book are inadequate if the reader wants to keep up with Bandelier's wanderings. There are some editorial problems, the most glaring of which is the discrepancy between the spelling of Bandelier's name in the title of the book and on the dustcover. Lange and Riley have worked diligently to compile the information in this biography, but they have not done justice to Bandelier the scientist or the man.

VIRGINIA NOELKE

■ Twentieth Century

Helge Kragh. *Cosmology and Controversy: The Historical Development of Two Theories of the Universe.* xiv + 500 pp., figs., tables, bibl., index. Princeton, N.J.: Princeton University Press, 1996. \$35, £27.50.

In *Cosmology and Controversy* Helge Kragh has focused on one specific part of twentieth-century

cosmology, the rise and fall of the steady state model as an alternative to evolutionary (big bang, relativistic, Friedmann-Robertson-Walker) models. A steady state universe, as proposed by Hermann Bondi, Thomas Gold, and Fred Hoyle in 1948, is one that expands in accordance with Hubble's law but in which new matter is created at just the rate required to keep the density (and all other observable properties) the same at all times, at least when averaged over large enough volumes of space.

The story of the steady state theory has often been told within the astronomical community as an example of how science ought to work: someone puts forward a new idea; it is tested by comparison with additional observations or experiments; and it either survives or is ruled out. Kragh apparently agrees with this viewpoint, saying, "On the whole, the [big bang] theory was found superior to other views of the universe on epistemic grounds and not for other reasons" (p. 394)—other reasons being, for example, socio-cultural climate, social negotiation, or external authority. One can even claim for the story a sort of culture hero, Dennis Sciama, who, although an early, strong supporter of steady state, abandoned it on observational grounds, soon after the discovery of quasars, and said so publicly.

Astronomers of middle age and beyond will enjoy this book, at least to the extent that we all like reading about our friends. But I will perhaps not be unique among middle-aged (and beyond) astronomers in wondering whether the controversy deserves quite this much attention. Allan Sandage, in a wonderfully parochial remark, observes, "I think it's true that no one in Southern California ever took steady-state seriously" (quoted on p. 285). Nor, really, did scientists anywhere outside the University of Cambridge and its very immediate sphere of influence. The fact that Bondi, Gold, Hoyle, and the late Ray Lyttleton were extraordinarily good speakers and writers for the general public gave steady state a much larger constituency outside the astronomical community, including myself as a high school and undergraduate student (1958–1963 or thereabouts), than it ever had within it. (To this day, I continue to feel that it was a beautiful idea that just doesn't describe the universe we live in.)

Finally, of course, come all the reservations a scientist feels when reading material about his or her subject written by someone with a different background. Kragh truly seems not to understand or appreciate many of the issues. A very few examples must suffice.

(1) The most obvious argument in favor of steady state, the short lifetime of a Friedmann-Robertson-Walker universe with a Hubble constant of 500 km/sec/Mpc, began to evaporate in 1951–1952. Kragh has correctly spotted a 1951 paper by Albert Behr suggesting a factor of two decrease in H (hence increase in lifetime) that appeared shortly before the well-known announcement by Walter Baade at the IAU General Assembly in Rome in 1952. But he merely calls Baade's suggestion "a similar but better argued conclusion" (p. 272). In fact Behr and Baade were looking at two entirely different pieces of physics, and the factors of two should be multiplied together.

(2) The Soviet focus on a cold big bang arose partly from a slight misinterpretation, by Yakov Zeldovich and others, of a 1961 paper by Ed Ohm (precursor of Arno Penzias and Robert Wilson) as allowing almost no extra, isotropic, microwave radiation beyond what our atmosphere must produce. In fact, the cosmic background is there, hidden in part of the calibration procedure. Kragh apparently misinterpreted the paper the same way, or possibly relied on secondary sources.

(3) Kragh has not done a very good job of describing (conceivably he does not appreciate) the enormous power radio source counts had in ruling out steady state, once a few sources had measured redshifts and the ones that had been counted added up to much of the total flux seen. Neither, admittedly, did Bondi, Gold, and Hoyle at the time. A critical contribution was Peter Scheuer's analysis of statistical brightness fluctuations across the sky, called $P(D)$ and presented at the 1958 Paris Symposium on Radio Astronomy and in a paper in the *Proceedings of the Cambridge Philosophical Society* (neither paper appears among Kragh's references).

(4) Finally, here is one statement I must contest: "Astrophysically important as the study of supermassive objects and energy production in quasars was, it was of no direct significance for cosmological models" (p. 333). This observation is, at least, misleading. Because the redshift distribution of quasars ruled out steady state if, and only if, the redshifts were cosmological (due to the expansion of the universe), the steady state and noncosmological-redshift communities have always been nearly identical, as the author recognizes. But they long used various supposed difficulties in quasar energetics, especially the inverse Compton problem, to argue that the quasars were much closer to us than indicated by their redshifts and the distribution therefore not

in contradiction with the predictions of the steady state model.

VIRGINIA TRIMBLE

Rudolf E. Peierls. *Atomic Histories.* (Masters of Modern Physics.) xviii + 377 pp., illus., index. Woodbury, N.Y.: American Institute of Physics Press, 1997. \$32.95.

This volume of selected nonscientific writings by the late Sir Rudolf Peierls (1907–1995) spans more than half a century, from his work as a young émigré theoretician in 1940 to the reflections of a perceptive elder statesman of physics in the 1990s. In keeping with the stated aims of the Masters of Modern Physics series, some of the essays in this collection provide "engaging sketches of friends and colleagues," while others "reflect on the social and political consequences of the scientific and technical enterprise." Clearly, Peierls was well suited for such reflection, by temperament and by circumstance. Together with Otto Robert Frisch, he wrote the famous memorandum that launched the British atomic bomb effort; he helped build the bomb in Los Alamos; and he remained a concerned observer of the aftermath. Peierls writes well, with clarity and care. The book has a sprinkling of lighthearted pieces, including an amusing "First Encounter with English Food," and a few that have little to say, but most of the essays are substantial. Nearly all have been published elsewhere; the advantage of this collection is the overview it provides of the man and his time.

The first half of the volume, "A Physicist's Portrait Gallery," consists primarily of biographical memoirs, obituary notices, and book reviews. Such a gallery tends to be an exhibit of Great Men in Physics: indeed, there are no women here and very few men who are not already quite well known. The "portraits" range from somewhat repetitive (three each for Niels Bohr and Paul Dirac) to conscientious (Wolfgang Pauli, James Chadwick, Max Planck) to superficial (Homi Bhabha) to dutiful (William George Penney, John Bell) to affectionate (Lev Landau, Bohr, Otto Frisch). Among the most interesting are four relatively long articles devoted to Werner Heisenberg, whose wartime work and behavior Peierls puzzles over with scrupulous fairness. Peierls is equally fascinated by Robert Oppenheimer, repeatedly returning to the man, his scientific leadership, and his security troubles after the war.

The section "Atomic Energy and Arms Control" is by far the most interesting part of this book. Here one sees the changes in Peierls as the