atom is trapped and thus overlapping the deBroglie waves of atoms trapped in neighboring potential minima of that standing wave; consequently the atoms form a coherent state and the recoil momentum is no longer absorbed by the emitting atom alone but distributed over all. (At these low velocities the kinetic energy of an atom is less than the variation in its internal energy with position in the laser standing wave, so that the atom becomes trapped in one of the valleys in the figure.) Cohen-Tannoudji relates in a brief epilogue (1994) that creating extensive arrays of laser trapped and cooled atoms in coherent states and investigating their properties is the exciting program in which he is now engaged.

Paul Forman
National Museum of American History, Washington, DC 20560, USA

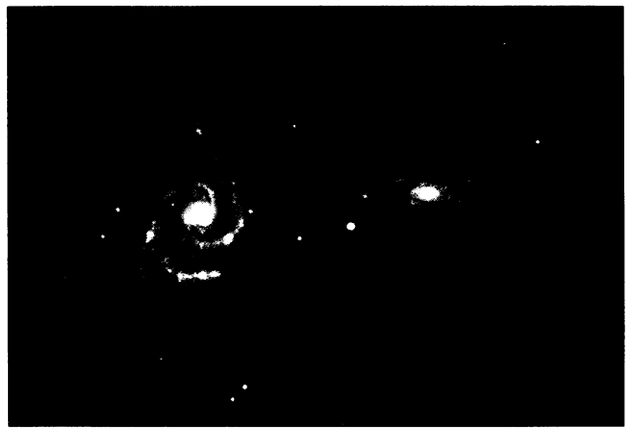
■

Galaxies

Carnegie Atlas of Galaxies. ALLAN SANDAGE and JOHN BEDKE. Carnegie Institution of Washington, Washington, DC, with the Flintridge Foundation, 1994. In two volumes. viii, 750 pp., illus. $95.

In 1936 Edwin Hubble wrote, "We know our immediate neighborhood rather intimately." "Immediate" and "intimate" are odd words to apply to a region a hundred million light years across. Now *The Carnegie Atlas of Galaxies* makes Hubble's statement seem eminently reasonable. The atlas is a work of art. Nowhere are the grandeur and aesthetic appeal of the cosmos more elegantly displayed. The images of the galaxies are mesmerizing—it is easy to spend hours paging through the two exquisite volumes.

The authors, Allan Sandage and John Bedke, describe the atlas as a guide to the classification and detailed properties of more than a thousand nearby galaxies. From the nearly featureless elliptical galaxies to spectacular spirals to the messes called irregulars, the verbal descriptions of the galaxies are clear and concise. The photographs are so cleanly reproduced that the salient features of any particular galaxy are obvious even to the uninitiated. The choices of contrast, scale, and positive or negative images masterfully enhance the clarity of the verbal descriptions. For the researcher, the atlas is an invaluable aid in developing research projects on nearby galaxies. Perhaps these volumes will inspire a solution to the nagging puzzle What causes the range of morphologies of galaxies?



NGC 5426/5427. Both these galaxies "have normal Sbc morphologies. They evidently form a physical pair. . .The only evidence for a close tidal encounter are the two thin straight strands of the multiple outer arms of NGC 5426 that overlap the outer thin spiral arms of NGC 5427, which are of the grand design." [From *Carnegie Atlas of Galaxies*]

The *Carnegie Atlas* is the culmination of an ambitious project with a distinguished pedigree. From 1919 to 1948 Hubble used the 60-inch and 100-inch telescope on Mount Wilson to photograph bright galaxies to explore and to define their "family traits." Hubble was unable to complete his atlas before his death in 1953. In 1961 Allan Sandage completed the now classic *Hubble Atlas of Galaxies*, which includes famous photographs of galaxies by Hubble and by Sandage himself. The *Carnegie Atlas* builds on (and includes) the *Hubble Atlas*. The photographs are a unique historical record of the exploration of the nearby universe—of people and of telescopes.

Taking the photographic plates at the telescope was only the crucial first step in the production of the new atlas. Many of the photographic plates are as large as 20 by 20 inches (51 by 51 centimeters), and a specially equipped lab is necessary to print the images for wide accessibility. John Bedke met the challenge of organizing and directing a photolab at the Space Telescope Science Institute where the extraordinary requirements of the atlas could be met. The crisp image of single spiral galaxy filling the 17 by 13½ inch printed page is simply awe-inspiring.

The authors write, "The intent is that volumes reach the hands of the young astronomers who will produce the coming spectacular developments in the next century." Perhaps this goal is too modest. Because of the generous subsidy provided by the Flintridge Foundation, the first printing is available for a small fraction of the commercial cost of such high-quality printing. The *Carnegie Atlas* should be in art museum shops along with other collections of famous photographs. For the professional or amateur astronomer the atlas is a must. Copies in high school libraries would inspire any imaginative young person, science-oriented or not. In fact, a brief, informal guide for young people (and their teachers) would be a valuable companion to the atlas.

Margaret Geller
Harvard-Smithsonian Center for Astrophysics, Cambridge, MA 02138, USA

NGC 1187. The inner-arm pattern of this galaxy "is composed of three high-surface-brightness grand design spirals. Each begins near the small central nucleus. . .The two principal arms of the inner triad pattern can be traced for about three-quarters of a revolution outward before they abruptly decrease in surface brightness." [From *Carnegie Atlas of Galaxies*]

■

Millennia of Star Study

The Norton History of Astronomy and Cosmology. JOHN NORTH. Norton, New York, 1995. xviii, 697 pp., illus. $35 or $C45; paper, $18.95.

Almost a half-century after the Dutch astronomer Antoine Pannekoek published the last widely disseminated single-author general history of astronomy (translated into En-

glish as *A History of Astronomy* in 1961), appears this bold new attempt to summarize five millennia of the science of the heavens. The decades since Pannekoek's volume have seen not only astonishing advances in astronomy but also the rise of the discipline of the history of science. In this new history of astronomy the author does much more than bring us up to date on trends through the launch of the Space Telescope; he also draws on 50 years of historical research to illuminate astronomy from antiquity to the present. The book appears as part of the Norton (Fontana in the United Kingdom) History of Science, a series whose express purpose is to bring the specialized interpretations and conclusions of history of science to a wider audience, specifically students and the educated general reader. Volumes on environmental science, chemistry, and technology have already been published, with six more volumes promised. None could be more challenging to write than this volume, which attempts to cover 5000 years of history and render it intelligible to a wide audience. Nevertheless, North succeeds to a considerable extent.

Unlike Pannekoek, North is a historian of science rather than an astronomer, but he is well schooled in the technical aspects of his subject. A professor of the history of the exact sciences at the University of Gröningen, past president of the history of astronomy Commission of the International Astronomical Union, and a prolific author whose scholarship in the history of astronomy has ranged broadly, North is well suited to the task. He proceeds chronologically, and on the crucial question of balance has chosen to devote half of the book to the period before Copernicus, a quarter to the four centuries from Copernicus through the 19th century, and the remainder to the 20th century. He not only treats the classical Western tradition but also includes chapters (albeit sometimes brief) on ancient Egypt, Mesopotamia, China and Japan, Pre-Columbian America, India and Persia, and Islam. At each end of the chronological spectrum are developments hardly dreamed of in Pannekoek's day, from archeoastronomy to the opening of the electromagnetic spectrum and the surprises of space astronomy.

For a synthetic volume such as this, many choices must be made, and not everyone will be happy with North's approach. Social historians, for example, will not be entirely pleased, for North has chosen to concentrate on the content of astronomy rather than on issues of patronage, politics, and the "social construction" of knowledge, even though all of these aspects occasionally appear. One might conceive a history proceeding thematically rather than chronologically, so that the developments internal to positional astronomy, descriptive astronomy, and cosmology could be better seen and the relationships among the three made clear. And others would undoubtedly have given different emphasis to different eras. But these alternatives serve only to highlight North's achievement: he has made his choices and consummated them, and the result is a lively history of astronomy that does credit to the approach chosen and lays the foundation for others who may wish to take other approaches from the diverse fields of history of science and science studies.

North has avoided what he calls "the clutter of footnotes," which may be an appropriate decision for the intended audience but which a century hence may also render the book less useful than, for example, Agnes Clerke's fully annotated *Popular History of Astronomy During the Nineteenth Century* (1908) is today. This is somewhat compensated by an extensive bibliographic essay that will point readers toward the modern scholarship. The illustrations, though not always of good quality, serve their purpose and allow the volume to sell at an affordable price. In other respects the book is well produced, and I found only one amusing error—a caption that referred to the "Fraunhofer reactor" rather than the "Fraunhofer refractor."

We may still look forward to much more specialized research in history of astronomy and to the volumes of the multiauthored *General History of Astronomy* slowly emerging from Cambridge University Press. But such a synthetic history as North's comes along only once a generation or two in its subject. This one will serve its purpose admirably.

"A Philosopher Giving a Lecture at the Orrery." Painting by Joseph Wright of Derby, 1734–1797. [From the dust jacket of *The Norton History of Astronomy and Cosmology*; Derby Museum and Art Gallery]

Steven J. Dick
U.S. Naval Observatory, Washington, DC 20392–5420, USA

Rites of Revitalization

Tombs for the Living. Andean Mortuary Practices. TOM D. DILLEHAY, Ed. Dumbarton Oaks Research Library and Collection, Washington, DC, 1995. viii, 425 pp., illus. $28. From a symposium, Washington, DC, Oct. 1991.

In the Andes ancestors—the dead—have been an important, even structuring, concern of society. *Tombs for the Living* is an effort to illuminate the nature of past and present Andean societies by bringing archeological, ethnohistorical, and ethnographic perspectives to bear on mortuary data from them. All the contributors have adequate, sometimes excellent databases. What varies is their success in postulating meaningful questions that mortuary data can help answer and in applying a fruitful theoretical perspective to the data. The contributions by Buikstra, Dillehay, Drennan, Rivera, and Salomon integrate sophisticated theory and empirical data so well they should interest all archeologists and other scholars concerned with mortuary questions.

Salomon's insightful reconstruction and discussion of late pre-Hispanic highland mortuary practices and beliefs offers probably the closest rapprochement archeologists will ever have with the *huacas*, *mallquis*, and *llactas* that formed the basis of Andean mortuary cults. The paper is particularly interesting for the insight it provides on ordinary, folk-level, shared practices—what was probably (in contrast to the state, or elite or priestly pattern typically picked up by archeologists who still favor excavations in monumental sites) the essence of Andean mortuary behavior. In contrast to Rowe, who sees culture normatively as a monolithic corpus of beliefs and behavior, Salomon presents a subtler reading of the ancestor