BOOKS

The Galaxies In Their Glory; A Thirty-Year Labor of Love

The Carnegie Atlas of Galaxies, Volumes 1 and 2

Allan Sandage and John Bedke
The Carnegie Institution, Washington, D.C., 1994. 731 pp. $92.00 hc ISBN 0-87279-667-1

Reviewed by Sidney van den Bergh

A picture is worth a thousand words. This saying expresses the fact that human beings absorb most information about the world around them from visual images. It is therefore not surprising that our understanding of the realm of galaxies has been strongly influenced by published collections of galaxy photographs. Prior to 1950 the publicly available sample of galaxy images was strongly biased towards pretty, long-armed, high-luminosity spirals and galaxies in rich clusters.

The publication of the Palomar Sky Survey (*National Geographic Society–Palomar Observatory Sky Atlas*, 1954-1958) provided the first unbiased census of galaxies. Inspection of that survey showed that: (1) both the morphology and the mean surface brightness of spiral and irregular galaxies depend on their luminosity; (2) the structure and morphology of galaxies may be modified by their environment; (3) most galaxies in the universe are located in small clusters (like our local group), whereas isolated galaxies and objects in rich clusters are less common; and (4) gravitational interactions between spiral galaxies are more common than had previously been appreciated. Two major shortcomings of the Palomar Sky Survey were that the galaxy images were reproduced at a rather small scale (the typical resolution was two arcseconds), and that the bright central regions of most galaxies were burned out on the images.

The *Carnegie Atlas of Galaxies* overcomes many of these shortcomings by providing large-scale images of 94% of the 1246 brightest galaxies in the sky. A large fraction of the beautiful photographs reproduced in the atlas were obtained by Allen Sandage during a 30-year labor of love using the largest telescopes at the Palomar and Las Campanas Observatories. Most of the images in *The Carnegie Atlas* were obtained with large reflecting telescopes that produced large-scale images having resolutions of one arcsecond or better. The outstanding quality of this atlas owes a great deal to Sandage's perseverance and to his and John Bedke's attention to detail.

It is still too early to say how the publication of this atlas will affect ideas on galaxy morphology and classification. After spending a few weeks studying the images in it, I have the impression that the presence or absence of a nucleus in a galaxy may turn out to be a major factor in determining the morphology of its outer regions. Future generations of astronomers will no doubt learn a great deal by trying to fit this enormous collection of galaxy images into a coherent evolutionary classification scheme.

GALAXY IN PROFILE. Galaxy NGC 5746, the brighter member of a pair in the constellation Virgo. For the bulge light to be visible both above and below the near-side dust lane, the line of sight must be within only a few degrees of edge-on. (From *The Carnegie Atlas of Galaxies*, with permission.)

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Quantum Optics

Daniel F. Walls and Gerard J. Milburn
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Quantum optics has entered a new era. Until the mid-1970s it was sufficient in this field to describe the interaction of light with matter by treating the matter—the atoms—quantum mechanically and the light as a classical wave. In the past 20 years, however, many new effects have surfaced in which the quantization of the radiation field is essential to an understanding of the phenomenon.

For example, Leonard Mandel's group at the University of Rochester, studying the resonance fluorescence from an atom, confirmed the earlier calculations by Howard Carmichael and Daniel Walls showing that light emitted by a driven atom is antibunched. In this circumstance, light shows its granular structure, that is, its quantum nature, by arriving not in bunches but in a more regulated manner.

Another quantum effect elucidated during the last 20 years is the phenomenon of squeezing. Here the fluctuations of the light field are suppressed in one variable at the expense of enhanced fluctuations in the conjugate variable. In the mid-1980s, various groups developed new light sources that emit such squeezed light, which is of ultimate importance in the context of gravitational-wave detection and communication science.

Daniel Walls and his quantum-optics school in New Zealand have always been at the forefront of this hunt for the quantum nature of light; his name is associated with many of the phenomena that define the field. In *Quantum Optics*, Walls, together with Gerard Milburn, has now summarized the contributions of the New Zealand school. The book acknowledges the new era in quantum optics