

Preface:



era Rubin

Over many millennia, civilizations have been curious about the Universe in which they find themselves, so stories about origins were devised: how the Milky Way formed, why there are seasons, what causes the rising and the setting of the Sun and the stars. These stories were handed down throughout generations, and became an important part of science history. As tools and understanding progressed, questions were answered but new discoveries and new questions arose to take their places.

In recent times, the pace of science and technology has increased enormously. Before 1950 we lived in a Universe that we detected almost entirely with our eyes, or with substitute eyes, such as telescopes or cameras. These instruments were generally sensitive only to the wavelength region seen by the eye. But in the last fifty years or so, the pace of new astronomical discoveries has been enormous. Every decade or so, a new discovery has forced scientists to revise their understanding of the history and evolution of the Universe. Some of these phenomena were surprises, enabled by new technologies. Some advances came from using known technology, some from using new ideas, some from both.

Consider this increase in our knowledge of astronomy in only 50 years:

1950s: New detectors sensitive in the radio region of the spectrum returned images of stars and galaxies as seen by their emission of radio waves. Astronomers discovered radio galaxies, galaxies that emit more of their radiation at radio wavelengths than at optical wavelengths. Within a few decades or so, astronomers could detect and study galaxies also by their ultra-violet, infrared, x-ray, and gamma ray radiation.

1960s: Quasars were discovered, now understood as energetic cores of galaxies, many enormously distant from our Galaxy. They are also called quasistellar objects, due to their point-like nature.

1970s: Studies of rotation velocities for stars and gas in galaxies, some acquired from optical, some from radio observations, indicate that most of the matter in the Universe is dark. Now called dark matter, radiation is not one of its attributes. Most of the dark matter cannot be composed of conventional matter.

1980s: Distant galaxies appear to be expanding at velocities faster than predicted from simple cosmological models. Dark energy, an unknown energy, is invoked to explain the high velocities.

1990s: Astronomers increase the dust mass in spiral galaxies by ninety percent. The first extrasolar planets are also detected, planets orbiting nearby stars. The number of known extrasolar planets now numbers almost 250.

What discoveries will the next 50 years bring astronomers and the interested public? We can only guess how our view of the Universe will be altered. Earlier science history suggests an accelerating rate of discoveries. The work of David Block and Kenneth Freeman already forms an important part of this accelerating knowledge. As they describe in this book, their discovery that cold cosmic dust pervades space makes it necessary for astronomers to redesign their classification scheme for galaxies. They suggest that symmetry should be at the heart of a new classification scheme in the near-infrared. One look at the stunning images produced by astrophotographer David Malin in Chapter 11 is sufficient to convince any skeptic.

Along the way, this book takes the reader on a whirlwind tour of astronomical photographic history beginning with the world's first heliographs (one of these newly unveiled by David Block) to the present day difficulties of classifying galaxies. But the described route is not linear. Instead, the reader is exposed to nights at a telescope, travels to talk and to learn, biographies of early and recent scientists who have contributed to the path David and Ken follow. Their story is part of the history as they describe their work as

astronomers. And they write about their discoveries in a manner that makes it fun to read. David and Ken's book is unconventional. It mixes history, geography, physics, geometry, biography, art, poetry, plants and religion, with ground based and space photographs of galaxies. Some readers may question the discussion of religious beliefs, but this is their story.

Even to an astronomer who studies galaxies, the comparison of the early and even recent images with the newly processed ones can only be described as breathtaking. The authors correctly call these "the new view of galaxies." But some of the knowledge is old, only uncovered by the authors. The book contains extended quotes from the scientists themselves. Many of Sir John Herschel's drawings from the Cape of Good Hope concern the Magellanic Clouds observed by eye, and their details are unforgettable.

I congratulate the authors. As a tribute to them, I add a quote from Marcel Proust:

The real voyage of discovery consists not in seeking new landscapes but in having new eyes.

Vera C. Rubin is an observational astronomer who has studied the motions of gas and stars in galaxies and motions of galaxies in the Universe for seventy-five percent of her life. Her work was influential in discovering that most of the matter in the Universe is dark. She is a graduate of Vassar College, Cornell University, and Georgetown University; George Gamow (George Washington University) was her thesis professor. A staff member at the Department of Terrestrial Magnetism, Carnegie Institution of Washington since 1965, she is now a Senior Fellow. She is a member of the U.S. National Academy of Sciences and Pontifical Academy of Sciences. President Clinton awarded her the National Medal of Science in 1993. She received the Gold Medal of the Royal Astronomical Society (London) in 1996. The previous woman to receive this medal was Caroline Herschel in 1828. She has numerous honorary degrees, including Harvard, Princeton, Yale and Smith College. In 1994 she delivered the *Henry Norris Russell* Lectureship; previous recipients of this esteemed Lectureship have included Nobel laureates Enrico Fermi and Charles Townes. Vera is active in

encouraging and supporting women in science. Her husband (deceased January 2008) and their four children are Ph.D. scientists in physical chemistry, geophysics, astronomy, and mathematics.



Photograph by Philip Birmingham



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Shrouds of the Night

Masks of the Milky Way and Our Awesome New View of
Galaxies

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