BOOK REVIEWS

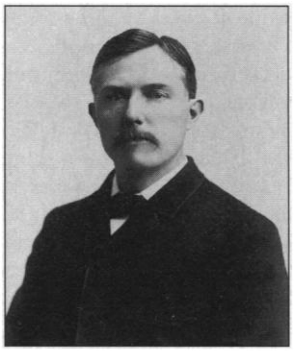
A Committed Observer

The Immortal Fire Within. The Life and Work of Edward Emerson Barnard. WILLIAM SHEEHAN. Cambridge University Press, New York, 1995. xiv, 429 pp., illus. $49.95 or £40.

The life of E. E. Barnard (1857–1923) straddled an era of revolutionary change in astronomy, especially in the application of photography and spectroscopy to the heavens. It was in photography that Barnard did his pioneering work, leaving a legacy of thousands of photographic plates, including the earliest wide-field images of the Milky Way. Given the impoverished circumstances of his early life, Barnard's achievements are remarkable, and with this biography William Sheehan has given us the first detailed account of Barnard's step-by-step journey toward scientific prominence.

E. E. Barnard pictured with view wagon operated in the 1870s by James W. Braid for Poole's Photographic Gallery, Nashville, Tennessee. Barnard was Braid's assistant in outdoor photography. [From *The Immortal Fire Within*; Special Collections, Vanderbilt University]

Barnard's life falls into three distinct eras: his early life and work in Nashville, Tennessee (1857–1887), his observations at the newly constructed Lick Observatory in California (1887–1895), and his culminating achievements at the Yerkes Observatory in Williams Bay, Wisconsin (1895–1923). In Nashville at the age of nine he went to work for a local photographer, and by 1877 (the year Asaph Hall discovered the moons of Mars with a 26-inch refractor) Barnard had purchased a 5-inch telescope. Also in that year Barnard took the opportunity to ask Simon Newcomb—president-elect of the AAAS and presiding officer at its meeting that year in Nashville—for his advice to an aspiring astronomer. A stern Newcomb counseled Barnard to abandon the telescope until he understood mathematics; luckily Barnard—who had no aptitude for higher mathematics—largely ignored Newcomb's advice, and by 1879 he began systematic observations with his small telescope. By the time he left Nashville eight years later, Barnard had nine comet discoveries to his credit, had brought astronomical acclaim to the fledgling Vanderbilt University (which had an observatory with a 6-inch refractor), and was well known among American astronomers. All of this he accomplished with very little formal training, utilizing only keen eyesight and determination that became legendary.



E. E. Barnard in 1893. [From *The Immortal Fire Within*; Mary Lea Shane Archives, Lick Observatory]

With this background, in 1887 Barnard landed a job at Lick Observatory, where the 36-inch refractor was nearing completion. His junior status left him largely to work on the 12-inch telescope, however, and increasingly he was at odds with Lick director E. S. Holden. Fully half of Sheehan's book is devoted to Barnard's eight years at Lick, and, with Donald Osterbrock's history of Lick Observatory and biography of Barnard's contemporary James E. Keeler, this period of Lick's history is now well understood. Barnard discovered more comets during his years in California, but more important, on 9 September 1892, a few months after he was given regular use of the larger telescope, he discovered a fifth moon of Jupiter (now known as Amalthea), which was to be the last of the visually discovered moons of the solar system. This discovery further added to Barnard's reputation for keen eyesight. So also did his observations of Mars; Barnard's conservative attitude toward the interpretation of observations prevented excesses such as Percival Lowell's claim to have found canals. Ironically, the same caution delayed for many years a correct interpretation of the results of Barnard's photographic work on the Milky Way, begun at Lick using a wide-field 6-inch "Willard lens."

Engaged as he was with visual and photographic techniques in astronomy, Barnard also worked in an era when reflectors would gradually supersede refractors. In 1895, the year he left Lick for Yerkes with its mammoth 40-inch refractor (still the largest in the world), Lick obtained a 36-inch reflector, and by 1900 Keeler demonstrated its superiority for photographing spiral nebulae (which many astronomers still believed to be planetary systems in formation). Barnard, however, remained firmly in the refractor tradition.

During his Yerkes years Barnard photographed every comet visible from Yerkes, producing some 1400 plates. He also discovered the nearby and fast-moving star that now bears his name. But most of all Barnard continued and consolidated his photographic work on the Milky Way, and after long consideration came to the conclusion that many of the "holes" and patterns evident in his photographs were actually dark obscuring nebulae viewed against the bright background of stars. Barnard's *Comet and Milky Way Photographs* (1913) and *Atlas of Selected Regions of the Milky Way* (1927) encapsulate his life work, and the catalog of dark nebulae contained in the latter was not superseded until the 1960s.

E. E. Barnard with the Bruce Photographic telescope. [From *The Immortal Fire Within*; Yerkes Observatory]

Sheehan, an amateur astronomer and psychiatrist, occasionally makes psychological judgments of Barnard that, though interesting, are unsatisfying because unprovable. But overall he has provided a well-written and meticulously researched biography that makes judicious use of voluminous archives. With its numerous photographs (including many of Barnard's own) it is a handsome and well-produced volume, marred only by a series of mismatches, in chapter 20, between footnote numbers and superscripts in the text.

After Barnard's death one of his Nashville friends spoke of "the immortal fire within" that drove Barnard ruthlessly to observe night after night in his effort to understand the universe, sometimes to the detriment of his personal health and safety. Although it is unlikely today that one could reach the top of any profession in science without formal training, this biography recounts an inspiring example of what one individual can accomplish with hard work and dedication, against all odds. It is a lesson that should not go unheeded by students or professionals; even in the era of big science.

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All About Mice

Mouse Genetics. Concepts and Applications. LEE M. SILVER. Oxford University Press, New York, 1995. xiv, 362 pp., illus. $49.95 or £40.

Mapping the human genome and identifying genes that contribute to susceptibility and resistance to disease are currently major preoccupations in biomedical science. The foundations for much of this sophisticated field of research were established in the mouse. Almost a hundred years ago, when it was recognized that laboratory mice developed tumors, attempts were made to use transplantable tumors as a means of inducing immunity to cancer. This led ultimately to a requirement for genetic uniformity in this species and the subsequent construction of inbred strains beginning in 1921. It soon became apparent that individual strains differed in their susceptibilities to cancer. Strains with a high incidence of mammary tumors (C3H) or leukemia (C58, AKR) stood in contrast to low–spontaneous-cancer strains (BALB/c, C57BL). The biological problems evolving from the transplantation of tumors in inbred strains opened a brilliant chapter in mammalian genetics with the discovery of the major histocompatibility locus. But quickly the progress in the mouse led to comparable work in humans and the mouse was relegated to a more parochial role in mammalian genetics.

Several important developments rekindled interest in the genetics of the mouse and made genetic findings more relevant to our understanding of human biology. Molecular geneticists discovered that many genes are highly conserved throughout evolution and that the order of genes in segments of chromosomes is conserved as well. Despite exceptions, "over 80% of the autosomes have now been matched up at the subchromosomal level." This linkage homology has made possible the transposition from one genome to another. Yet another series of observations opened additional ways in which to study human genes in mice. Construction of transgenic mice and gene targeting by homologous recombination to "knock out" the function of genes has created new strains of mice for studying mechanisms of gene action. The combination of these two methods can potentially produce mice that function with human genes.

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