



Bruce Medalist Profiles

Edward Emerson Barnard: The Fourteenth Bruce Medalist

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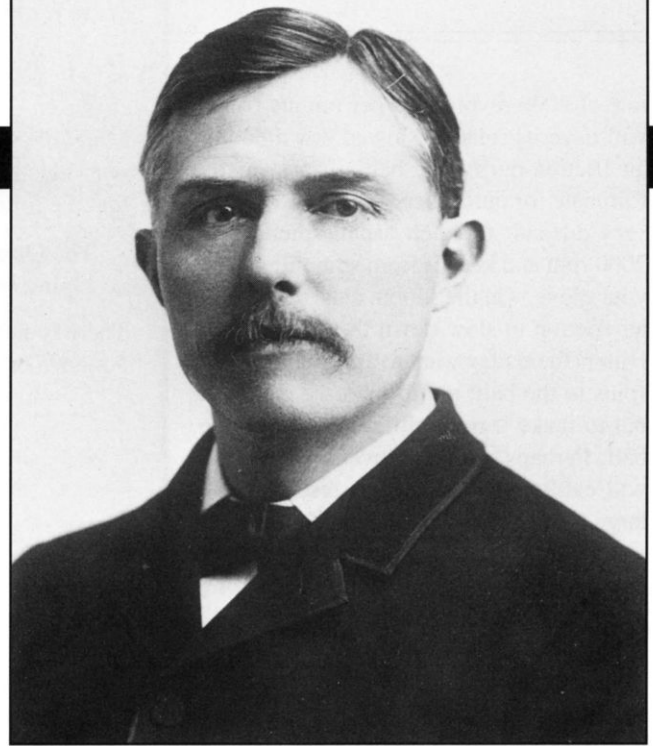
Imagine a contest to choose an ideal role model for amateur astronomers, say someone who rose from poor, self-taught amateur to the very top rank of professionals. The winner would probably be William Herschel, the 18th century musician from Hanover who became court astronomer to Britain's King George III after discovering the planet Uranus with his homemade telescope. Herschel went on to found stellar astronomy and make the first maps of the Milky Way.

Second place might well go to Edward E. Barnard. Like Herschel, he started in poverty, built his own first telescopes, and became known for both exceptional eyesight and an overpowering drive to observe the heavens. Both men won renown and gold medals for the discovery of unexpected objects in the solar system, and both made important studies of the Milky Way. Both concentrated on observations and avoided theory.

There were differences. Barnard's greatest accomplishments involved the use of photography, something unknown in Herschel's time (but which Herschel's son helped pioneer). Barnard worked alongside other professionals at two of the world's leading observatories, while Herschel observed at home, assisted only by his sister and hired laborers.

Barnard's father died before he was born, and his mother had a difficult time supporting her two sons. As a child in Nashville, Tennessee, Ed frequently swam the Cumberland River to retrieve rations lost by the armies as the American Civil War raged nearby. Although his mother taught him much, he received but two months of formal schooling, and, at age nine, he went to work to help support the family.

His job was in a photographic gallery, where an enormous enlarging camera called Jupiter was used to make prints or to make a temporary image for an artist to paint on. The photographer or artist worked inside the camera, while young Ed slowly turned it so as to keep its opening pointed toward the Sun. He was a human clock drive! Other boys had preceded him, but they had fallen asleep on the job. Ed not only stayed awake, but he showed curiosity and interest, and soon discovered on his own what astronomers call the *equation of time*: the Sun moves through the sky at varying rates, so that the time from one local noon (when the Sun is at its highest point) to the next is sometimes more and



Edward Emerson Barnard
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*(Photograph 1893,
courtesy of Mary Lea
Shane Archives, Lick
Observatory)*

sometimes less than twenty-four hours on the clock.

According to J. W. Braid, a photographer who worked in the gallery, "Edward soon became much interested in the properties of lenses. He often said he wished he could get one and fix it to use in looking at the moon and planets. One day when I was in the shop of Mr. Charles Schott I noticed an old ship's spyglass hanging on the wall. It had no lenses...I made an offer to buy it, and when I told him I wanted it for Ed Barnard he let me have it for two dollars...We....got an object glass of thirty-two inches focus which we fitted into the brass tube. We made an eyepiece out of the wreck of an old microscope, which gave a power of about thirty-eight. A simple altazimuth mounting was made. Barnard had a good tripod..."

"This simple telescope gave Barnard more pleasure than anything else in his whole life." He was about thirteen at the time.

Barnard stayed at the gallery for sev-

enteen years, supporting his mother, in her later years an invalid "with beclouded mind," and observing the sky from the roof at night. As a teenager he "loaned" some money to an acquaintance who as collateral left him a stolen astronomy book. At last he could learn the names of the stars and constellations whose positions in the sky he had already memorized.

By the time he was nineteen he had saved the equivalent of eight months' wages to buy a good 5-inch telescope. The next year the American Association for the Advancement of Science met in Nashville, and he got himself introduced to its president, the imposing Simon Newcomb.¹ When Barnard bashfully said that he would like to become an astronomer, Newcomb gruffly told him he would have to learn some mathematics first. As Newcomb wrote in his autobiography many years later, "I did not for a moment suppose that there was a reasonable probability of the young man doing anything better than amuse himself. At the same time, feeling it a duty to encourage him, I suggested that there was only one thing open to an astronomical observer situated as he was, and that was the discovery of comets. I had never even looked for a comet myself, and knew little about the methods of exploring the heavens for one, ... But I gave him the best directions I could."

Almost crushed, but grateful for the advice, Barnard scraped up the money to hire a mathematics tutor and began searching for comets. In 1881 he married the sister of two English artists who worked with him at the gallery. That year he found his first comet, but he did not know how to measure its position or report it, and no one else saw it. Seeking to learn how to make the necessary calculations, he contacted Olin H. Landreth, a man with some astronomical experience and the head of engineering at nearby Vanderbilt University. The ten-year-old university had an observatory and a six-inch telescope, but no astronomer. Landreth was "immediately impressed by

Barnard's boundless enthusiasm," and he arranged for the young man to enter the University in an unusual way: he would be both student and staff member with the title of Assistant Astronomer of the Vanderbilt Observatory. A married freshman of twenty-six was uncommon then, but as Assistant (and sole) Astronomer he had the use of the observatory and a small house on campus and a salary somewhat less than he had been earning as a photographic printer.

He studied mathematics, physics, English, French, and German by day and observed the sky by night. Sleep he considered a waste of time. In the next few years he built his own house with money earned by discovering comets. A wealthy patent medicine manufacturer had offered \$200 to any American who discovered a new comet, and Barnard managed to find one every time a mortgage payment was due. By 1887 he had properly reported seven, and his name was becoming known to astronomers.

Meanwhile he wrote flattering letters to Edward S. Holden, who was marking time as president of the University of California while waiting for the Lick Observatory to be completed so that he could become its first director.² Those letters paid off when Holden offered Barnard a job as one of the initial staff members at Lick, the first observatory to be placed on a mountain top (Mt. Hamilton) and the home of the world's then largest telescope (a 36-inch refractor). Barnard quit his job immediately, and he and his wife hurried to California, only to discover that the observatory was unfinished and still under the control of the trustees carrying out James Lick's will. Holden could not yet employ him. For several months Barnard, who had atrocious handwriting, copied documents for a San Francisco law firm (from human clock drive to human copy machine!), until the Lick trustees hired him to carry out an inventory of the equipment on the moun-

2. For more on Holden and the founding of the Lick Observatory, see *Eye on the Sky: Lick Observatory's First Century* by D.E. Osterbrock, J.R. Gustafson, and W.J.S. Unruh (U. of California Press, 1988). An excerpt appeared in the Mar/Apr 1988 issue of *Mercury*.

tain just before the observatory was turned over to the university.

As a junior member of the staff, Barnard was at first assigned time only on the smaller telescopes, while director Holden and senior astronomers James Edward Keeler and Sherburne W. Burnham used the 36-inch refractor. Barnard became increasingly upset as he found that Holden was using the greatest telescope in the world to take rather poor photographs of the Moon and frequently leaving the telescope idle after midnight.

According to Donald Osterbrock, Barnard was "a highly neurotic individual" who first came to Lick "looking for a father figure he could respect and emulate." When he found Holden inadequate for that role, he became one of the leaders in the battles which eventually involved nearly all the astronomers on Mt. Hamilton and which finally led to Holden's forced resignation in 1897.³ Barnard obtained time on the 36-inch refractor in 1892 by going over the director's head to the university trustees. Less than three months later, he detected Amalthea, the first satellite of Jupiter to be discovered since Galileo found the planet's four brightest moons in 1610. The discovery made him an international celebrity.

The press made much of his discoveries (he eventually found at least sixteen comets and the star with the largest proper motion known⁴), and he loved the adulation. Barnard fit the public image of an astronomer, an image which is still widespread today although far from the truth. He was a man with superior eyesight who actually *looked* through telescopes that looked like telescopes—enormous refractors with long tubes—and discovered new objects in the sky.

Yet to professionals, Barnard's most important work was in the field of his

1. For more on Newcomb see the first article in this series in the Jan/Feb 1990 issue of *Mercury*.

3. See "The Rise and Fall of Edward S. Holden: Part I," *Journal for the History of Astronomy*, volume 15 (1984), pages 81-127.

4. Barnard's star, at six light years away, is the nearest star other than the Sun visible from northern latitudes. It gallops across the sky at a whopping 10 arcseconds per year. Thus it moves the diameter of the full moon in just 180 years.

childhood labors—photography. His thousands of photographs of comets provided a rich resource for generations of researchers. As an example of his dedication, astronomer Robert Aitken recalled one occasion when Barnard took the afternoon stage down to San Jose to present an evening lecture while Comet Brooks was in the sky. Immediately after his lecture, “to make his series of photographs continuous, he hired a horse and light buggy and drove up the long 26-mile road to the mountain — a 5-hour journey — and went at once to the Crocker Dome to photograph the comet.”

In 1889, Barnard mounted a second-hand six-inch portrait lens in a rough wooden box and strapped it onto a 6 and 1/2-inch telescope. Much later, astronomer Edwin B. Frost wrote, “Barnard’s long exposures with this instrument brought out the wonderful richness of the star clouds and other features of the Milky Way as they had never before been revealed. They thrilled him and his associates with their significance and beauty, and later the entire scientific world shared in this appreciation of them.”

Barnard himself noted, “In the photographs made with the six-inch portrait lens, besides myriads of stars, there are shown, for the first time, the vast and wonderful cloud forms, with all their remarkable structure of lanes, holes and black gaps and sprays of stars.”⁵ Those black gaps, which William Herschel had called “holes in the heavens,” remained on Barnard’s observing schedule for decades. Were they really voids, or were they evidence of dark matter obscuring the light from stars behind them? Astronomer Gerrit Verschuur has called this question “Barnard’s dilemma.”

In the early years Barnard took it for granted that the dark spots were holes; he was more interested in discovering new *visible* nebulosity. When he found star clusters next to bright nebulae he believed he was providing support for the theory that nebulae condense into stars. In some cases he was correct, but many of the objects called nebulae in Barnard’s time are now known to be external galaxies, systems of billions of stars far beyond the star clusters of the Milky Way.

Meanwhile Holden kept putting off

the publication of Barnard’s magnificent photographs, and the bitter quarrels between the two were affecting the latter’s health. In 1895 Barnard accepted an offer from George E. Hale to become a member of the initial staff at Yerkes Observatory, soon to surpass Lick as home of the largest telescope in the world. Again he arrived before the principal telescope was ready, but in Hale he found the leader he had sought. Letters from Barnard to Hale give the impression of a shy boy seeking a pat on the head from his father, despite the fact that Barnard was ten years older than Hale. Barnard happily spent the remainder of his life at Yerkes under Hale and his successor, Frost. The Barnards became known as the most popular hosts in the sometimes snow-bound community of Williams Bay.

Barnard was a major user of the Yerkes 40-inch refractor once it was completed in 1897, but he would observe every clear night with one telescope or another, no matter how frigid the weather. Frost exclaimed, “To him, a night at the great telescope was almost a rite — a sacred opportunity for a search for truth in celestial places.” It wasn’t all photography. Barnard made thousands of visual measurements of diameters of planets, asteroids, and star clusters, and of positions of stars and nebulae, using an instrument called a filar micrometer.

In 1897 (the same year she endowed the Bruce medal⁶), Catherine Wolfe Bruce provided the funds to construct a wide-field photographic telescope for Barnard’s use. With the Bruce telescope, he made superb photographs of the Milky Way and discovered a great many new nebulae, both light and dark. At Hale’s invitation, Barnard took the Bruce telescope to Mt. Wilson in 1905 to reach the southernmost portions of the Milky Way. Barnard spent most of his last years working on his photographic *Atlas of the Milky Way*, seeking the most perfect method of reproduction possible, and personally inspecting 35,000 prints, rejecting thousands which did not meet his exacting standards. (Finished after Barnard’s death by Frost and Barnard’s niece and assistant, Mary Calvert, the atlas was finally published in 1927).

Barnard’s views on the dark nebulae gradually changed. In 1913 he titled an

article, “Dark Regions in the Sky Suggesting an Obscuration of Light.” Later he made a direct comparison between some small cumulus clouds in the Earth’s atmosphere which temporarily blocked part of his view of the Milky Way and the permanent dark regions in the heavens, writing, “...there are dark opaque objects scattered here and there over the heavens...” He pointed out that the presumably large masses of the clouds would have to be taken into account in modeling the motions of stars.

His final view was expressed in 1919: “I did not at first believe in these dark obscuring masses. The proof was not conclusive. The increase of evidence, however, from my own photographs convinced me later, especially after investigating some of them visually, that many of these markings were not simply due to an actual want of stars, but were really obscuring bodies nearer to us than the distant stars... I think that there is sufficient proof now to make this certain.”

Barnard was not the only pioneer of wide-field photography. Max Wolf at Heidelberg was his friendly rival. Both received photographic telescopes through the generosity of Miss Bruce, and both explored the Milky Way. While Barnard specialized in comets, Wolf discovered asteroids on his photographs. The two visited and admired each other, and when Barnard’s wife died in 1921, Wolf named asteroid *Rhoda* in her memory.

Barnard compiled the first catalog of dark nebulae. Bart Bok, in his Bruce medal acceptance speech at the 1977 A.S.P. banquet, protested that some astronomers were using the term “Bok globules” for small, dark clouds that he had investigated as sites of star formation. “They should be called Barnard globules,” Bok declared. “He discovered them.”

Today there are probably more astronomers exploring the interstellar medium than observing stars. Barnard would be pleased to see new kinds of imagery — involving infrared and radio waves— revealing the star formation he had sought. ■

Note:

For further reading about Barnard, see *Interstellar Matters*, by Gerrit Verschuur (Springer Verlag, 1989).

5. *Publications of the Astronomical Society of the Pacific*, volume 2, pages 240-245 (1890).

6. See *Mercury*, Jul/Aug 1986.