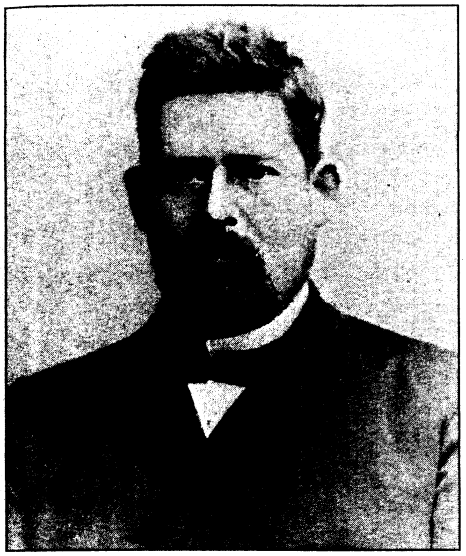
Bruce profile



Max Wolf

The Twenty-Fifth Bruce Medalist

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Minor planets (asteroids) have been much in the news lately, while clusters of galaxies and the structure of the interstellar medium are among the hottest topics of astronomical research. All three of these fields owe much to Max Wolf. Five years younger than Edward E. Barnard and five years older than George E. Hale, Wolf combined Hale's self-confidence and initiative with Barnard's persistence.

Wolf spent virtually his entire life in Heidelberg, the home, since 1386, of the university officially known as Ruperto Carola. Like Hale, he grew up in a comfortable home with a father who indulged him to the point of building a well-equipped private observatory next to the house. "I can't imagine becoming anything other than an astronomer—except maybe a physicist," he exclaimed at an early age. He discovered his first comet at twenty-one, and one year later published his observations of a nova in Andromeda. He received a thorough education in mathematics and physics, earning his Ph.D. at Heidelberg, where he began lecturing in astronomy, meteorology, and geophysics in 1890.

Meanwhile he continued research at his private observatory. Most professional astronomers who tried photography near the end of the 19th century continued using refractors of long focal length, adapting their methods only to the extent of moving plate holders from the eyepiece to where the shorter waves come to a focus. The field of view was so tiny that the international group working on the *Astrographic Catalogue* [see article on H.H. Turner, Jan/Feb 1994] needed enormous numbers of plates to cover the sky. (Reflectors were still considered toys used only by amateurs.) Wolf, like Barnard, used wide-angle lenses which could photograph a large section of the sky at once. After early experiments with smaller instruments, he acquired a photographic camera whose 6-inch doublet portrait lenses gave a huge field of 12°×8°. In 1890 he announced that he would use wide-field photography to search for asteroids, and he discovered eighteen in the next two years.

By 1893 Wolf was well-known for photography of meteors, comets, asteroids, and nebulae. He had discovered weak extensions of nebulosity in Orion, where he showed that the famous nebula is much larger than previously believed, Cygnus, where he discovered and named the North American Nebula and probed the giant supernova remnant known as the Veil Nebula, and Auriga. It was clear that under his leadership Heidelberg could play a role in astronomy commensurate with its illustrious history in physics and chemistry.

The Grand Duke of Baden, the State of Baden, and the City and University of Heidelberg agreed to pool their resources to build a new observatory on a 400-meter hill called the Königstuhl. Wolf was appointed to direct and supervise construction of the astrophysical half of the new observatory and was sent to America to visit observatories and learn their techniques. His correspondence with American philanthropist Catherine Wolfe Bruce [also the donor of the Bruce medal; see *Mercury* Jul/Aug 1986] produced a bonanza: With her $10,000, Wolf designed and ordered a double telescope with parallel 0.4-m (16-inch) lenses and a fast f/5 focal ratio. The wide field telescope, built in Pittsburgh by John Brashear, became the principal instrument of the new observatory upon its completion in 1900. A few years later Wolf received another large bequest, this time from a German lady, and acquired a 0.72-m (28-inch) reflector, primarily for spectroscopy.

The designer and builder of many instruments, Wolf helped Carl Pulfrich

Maximilian Franz Joseph Cornelius Wolf

21 June 1863 - 3 October 1932

1930 Bruce Medalist

(photograph 1894, courtesy Mary Lea Shane Archives, Lick Obser)

of the Zeiss Works to develop the stereocomparator, a device that allowed for fast "blinking" of two plates to discover the few objects that had moved between two photographs. Wolf named the first asteroid discovered by photography #323 Brucia, for Miss Bruce, and he called others after his city (#325 Heidelberga) and its university, (#353 Ruperto-Carola). Eventually, Wolf and his coworkers discovered 228 minor planets, and they photographed hundreds of others which were not observed long enough to obtain orbits, a prerequisite for the assignment of permanent numbers and names. Wolf noticed brightness fluctuations in some which he correctly attributed to rotation of nonspherical bodies. On 11 September 1909 Wolf won the race with Barnard and others to be the first to recover Comet Halley.

The discovery of minor planets eventually became routine, and Wolf realized that he would never discover them all. More important was his work on the structure of the Milky Way. Like Barnard he gradually became convinced that the dark nebulae were dust clouds obscuring the stars behind them rather than "holes in the heavens," as William Herschel had called them in the 18th century. With his strong mathematical background, Wolf went further, showing statistically that bright nebulae are associated with dark ones. He wrote: "There are often regions in the middle of the dense streams of nebulae which are almost completely empty. They look like jet-black 'holes' in the glowing foreground. Now, we always find a luminous mass (a compressed nebula), along with bright suns, close at hand to these 'holes.' ...We cannot think otherwise, but that the weakly shining matter has gathered together, and has compressed itself into suns, or else is in the process and is about to form new suns."

According to astronomer Otto Struve, "While Barnard was interested primarily in the peculiar shapes of cosmic clouds, Max Wolf ... was concerned with a different aspect of the problem. He invented a method of estimating the distance of a dark cloud from the apparent magnitudes of the foreground stars. When the nebula is not completely opaque, the stars showing through make it possible to derive an approximate value of the absorption of the cloud. Wolf's method was a simple one: He plotted the number of stars per unit area of sky against their mean apparent magnitudes (brightnesses) and compared plots made in transparent regions with plots made in the regions of dark nebulosities." While the method was not infallible, Wolf did convince astronomers that the dark areas were clouds, and, because stars were not reddened, that the clouds must be dust rather than gas.

Wolf published sixteen "Lists of Nebulae" containing about 6000 objects. At that time "nebulae" included two groups: "galactic," which were in the Milky Way, and "extragalactic," which shunned it. Most of the latter (now known to be external galaxies) exhibited a spiral shape. Further understanding required spectroscopy, which Wolf happily undertook as soon as he acquired the large reflector. He took long exposures: one of the Andromeda Nebula (M31) took 25 hours spread over 20 nights. As William Huggins had found decades earlier, galactic nebulae, including "planetaries" like the Ring, showed a few emission lines only, characteristic of a diffuse gas. Wolf showed that different regions of the Ring have different spectra, an effect now known to be due to temperature differences. In 1910 and 1911 Wolf became one of the first astronomers to obtain spectrograms of M31 which showed absorption lines. Like many others, he suspected that it was composed of numerous stars, with an average spectrum not too different from that of the Sun. He also discovered large clusters of galaxies, including the Coma cluster.

Wolf took his teaching responsibilities seriously. He was renowned for his clear lectures to undergraduates, and he devoted much time to introductory laboratory sessions. His student, August Kopff, declared that Wolf had described himself when he wrote in an obituary of Barnard: "It is a powerful passion that draws an observer to his work, and the satisfaction with instrumental resources so difficult to work with gives him the greatest pleasure..."

Informed that he would receive the Bruce medal, Wolf wrote:

I am sorry that the Board of Directors of the Astronomical Society of the Pacific has resolved to bestow upon *me* the Bruce Medal of the Society; because I am thoroughly convinced that I am not worthy of such a very high distinction.

The work which I have done was the work of a poor, simple workman. But your Medal is destined for an ingenious thinker—And the men who got it before, were and are great Astronomers, from what *I* am very far. Therefore I fear you will bring a discontinuity in your splendid Series, and therefore I should have preferred to be passed over by your board.

The Society did not agree, of course, but cherished his letter as a mark of a great astronomer and humble man.

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