OBITUARY

# Professor Margaret Burbidge obituary

## Trailblazing astronomer hailed as ‘Lady Stardust’ who became the first woman director of the Royal Greenwich Observatory

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Margaret Burbidge showed how heavier elements are produced from lighter ones in stars

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In August 1944 Margaret Burbidge, then a young astronomer driven by a thirst for knowledge that would later define her, was studying for her PhD thesis. Her subject was a star called Gamma Cassiopeiae and she was not going to allow the Second World War to stand in her way.

Each evening she would travel from the family home close to Hampstead Heath to the University of London Observatory at Mill Hill Park and open up the telescope named after its donor, JG Wilson. She would then spend hours sitting in the cramped and cold space below it, alone with her view of the stars.

At that time the Luftwaffe was sending doodlebug flying bombs across the Channel to terrorise the capital but Burbidge ignored the danger. On the night of August 3, her log

notes that shortly before 10pm, just after she had opened up the telescope, a flying bomb exploded so close to the observatory that the reverberations from the impact shifted the star out of the telescope's field of vision.
Undeterred she started her observations again a few minutes later only for another doodlebug to explode, this time farther away. Although the star was temporarily lost again she quickly recovered it and completed her observations. "Those nights, standing or sitting on the ladder in the dome of the Wilson reflector . . . fulfilled my dreams," Burbidge recalled many years later.

The woman who would go on to become one of the most prominent astronomers of the 20th century and a trailblazer in a field that in the early years of her career was an exclusively male preserve, traced her love of the stars back to an even earlier childhood memory.

When she was four her parents took her and her sister on a ferry to France for their summer holidays. The young Burbidge began to feel seasick during the night-time crossing. To help her feel better she was lifted up so she could look out of a porthole on an upper bunk. With her view unaffected by light pollution, she saw the twinkling mass of stars above for the first time and was hooked from that moment on.

The possessor of a brilliant inquiring mind, Burbidge went on to build a glittering career in astronomy. She became the first woman director of the Royal Greenwich Observatory in 1972 and in 1983 was elected president of the American Association for the Advancement of Science. She was also involved in planning the Hubble Space Telescope, which was launched into low Earth orbit in 1990 and continues to function today.

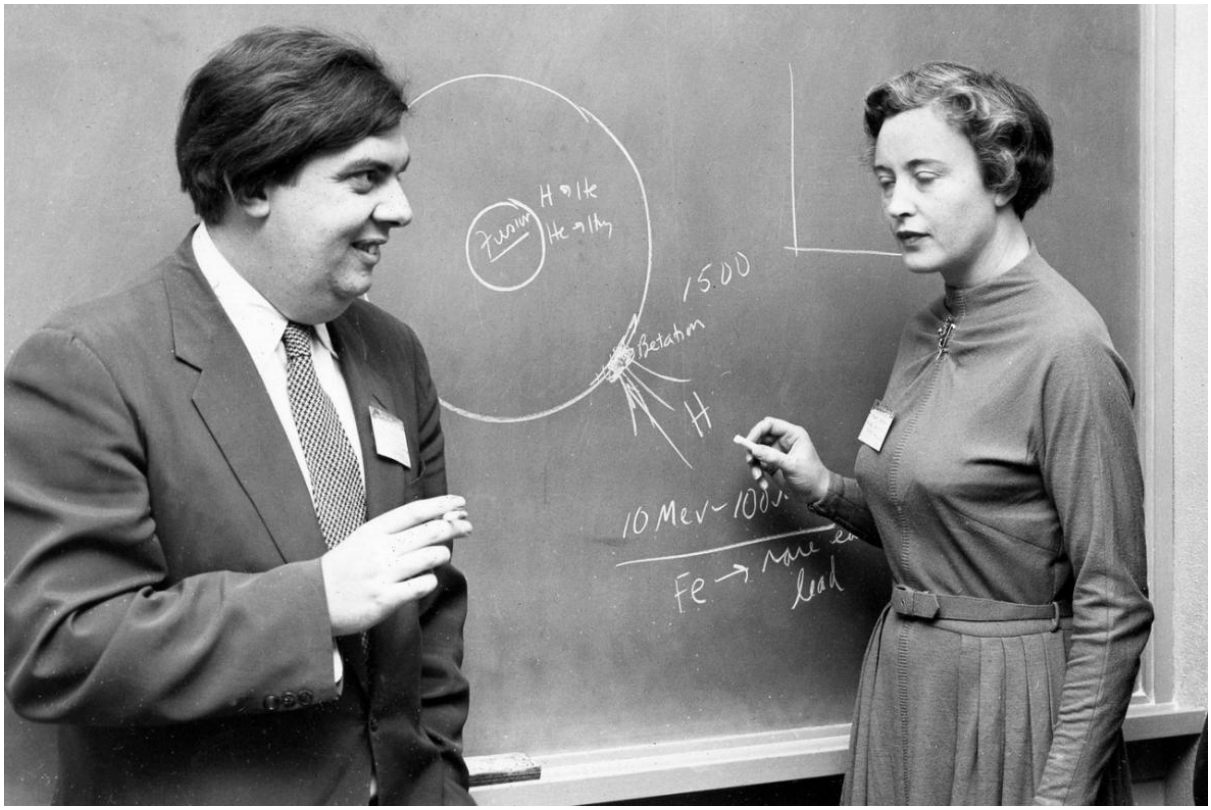
In the academic field Burbidge is best known for co-authoring a landmark paper on astronomy with Fred Hoyle, William Fowler and her husband, Geoffrey Burbidge. Known as "$B^2FH$" after the initials of the writers and published in *Reviews of Modern Physics*, it described how all the heavier chemical elements in nature, and hence our bodies, are created from hydrogen in the stars.

She also studied how galaxies rotate, enabling her to work out their masses, and carried out extensive work in the field of quasars, objects that emit vast quantities of radiation with a large red-shift (an indication of distance). She was a strong believer that quasars were not extremely distant objects, as would be consistent with the big bang theory of the origins of the universe, but were much closer to us. Her conclusion, which she shared with her husband but few others, was based on the observation that certain quasars appeared to be related to galaxies with much smaller red-shifts, calling into question the use of red-shifts as an indication of distance.

Burbidge, the “Lady Stardust” of astronomy, never shrank from speaking her mind and became a champion of the rights of women in science. When she was made director of the Royal Greenwich Observatory, the post did not come with the traditional honorary title of astronomer royal, which was conferred on the radio astronomer Sir Martin Ryle. Burbidge saw this omission, the first time it had happened in 300 years, as a blatant instance of discrimination against women in the astronomical community.

In 1972 she refused the Annie J Cannon prize from the American Astronomical Society (AAS) because it was an award for women only, something she regarded as another facet of the same discriminatory mindset. In 1984 the AAS awarded her its highest honour regardless of gender, the Henry Norris Russell lectureship.

Eleanor Margaret Peachey was born in 1919 in Manchester, the eldest of two daughters of Marjorie and Stanley Peachey. A distant relative on her mother’s side was the physicist, astronomer and mathematician Sir James Jeans. Her father was a chemistry lecturer at the Manchester School of Technology where her mother had also studied chemistry. In 1921 the family settled in Hampstead in north London when her father moved into industry, having patented several lucrative chemical processes.



Burbidge posed as an assistant to her husband, Geoffrey, to evade one observatory's ban on women using telescopes

Burbidge attended Heysham School, a private institution in Hampstead where she excelled at maths and became a voracious reader, quickly racing ahead of her peers. An early passion was numbers, especially large ones, and on the way to school she and her mother would work out complex calculations in their heads for fun. "It used to give me enormous fascination to get a piece of paper and to write '1' followed by 32 or 64 'zeros' or 120 or whatever number of zeros, and just contemplate that large number," she recalled in a 1978 interview.

After attending Francis Holland Church of England School, near Regent's Park in London, and being held back until she was 17, Burbidge studied astronomy and mathematics at University College London, graduating in 1939. The following year she began war work at the University of London Observatory (ULO) making rangefinders, among other tasks, as well as maintaining the equipment. There she completed her PhD research, studying the radiation emitted by "B" stars, in particular Gamma Cassiopeiae. She rose to become acting director at the ULO, but after spotting an advert for Carnegie Fellowships at Mount Wilson Observatory in California, she applied for the position. A

blunt reply followed: the vacancy was not open to women because only men were allowed to use the telescopes there.

“The letter of denial opened my eyes to a new and somewhat frightening situation: new, because I had never before experienced gender-based discrimination,” she later wrote.

In 1947 she met the theoretical astrophysicist Geoffrey Burbidge who went on to become a hugely influential figure in postwar astronomy and a noted critic of the big bang theory. The couple married the following year and became lifelong scientific collaborators. They left England for America in 1951 where Margaret took up a position at the University of Chicago, working at the Yerkes Observatory in Wisconsin. While there she began investigating the properties and structure of spiral galaxies under the American astronomer Bill Morgan, who discovered the spiral structure of the Milky Way.

Together with her husband, who was based at Harvard, Burbidge also continued to work on B stars. They began developing their ideas about the origin of the elements and their abundance in stars, sparked by Fred Hoyle’s early work. “The elements,” Burbidge explained in her autobiography, “were not formed in some primordial series of events at the origin of the universe, but were built up out of hydrogen in successive generations of evolving stars.” It was during a brief return to England in the mid-1950s that the Burbidges, together with Fowler and Hoyle, began work on $B^2FH$.
Returning to America, Burbidge took up a series of appointments at prestigious institutions. After a long campaign, she was officially allowed to use the Mount Wilson Observatory, having spent several years sneaking in as her husband’s “assistant” when the Burbidges had to stay in an unheated cabin on the mountain, away from a dormitory housing other male astronomers. The couple continued their work investigating the origin of the elements.

Burbidge returned to England in 1972 to take up the directorship at Greenwich. But after disagreements over moving the Isaac Newton Telescope to a site more suitable than the

marshlands of Herstmonceux in East Sussex, among other issues, she resigned and the family moved back to San Diego.

Burbidge went on to become a US citizen and from 1979 to 1988 was the first director of the Center for Astronomy and Space Sciences at the University of California San Diego. Among many accolades and awards, she was elected a fellow of the Royal Society in 1964 and in 1978 was the first female astronomer to be elected to the US National Academy of Sciences. In 1983 she was awarded the US National Medal of Science. Alongside her husband she was awarded the gold medal of the Royal Astronomical Society in 2005. An asteroid discovered in 1960 — No 4590 — is named after her.

Geoffrey Burbidge died in 2010, aged 84. Their daughter, Sarah, chose not to follow a scientific path, becoming a lawyer. She lives in San Francisco.

Burbidge spoke in an understated way and exuded a quiet sense of efficiency. She was an inspiration to the many young astronomers who heard her lectures, while at home she was a great cook who put on feasts on high days and holidays. In California she would do the driving for her husband in the couple's family car, an old Jaguar.

Her calm demeanour disguised a committed and rigorous academic mind. "It was the classic iron fist under her velvet glove," remarked Joe Miller, director of the Keck Observatory in Hawaii, which she frequented in her seventies. "She knew what she knew and believed strongly, and she would stick to her principles."

**Professor Margaret Burbidge, astronomer and astrophysicist, was born on August 12, 1919. She died following a fall on April 5, 2020, aged 100**