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150 Years of Women at Berkeley Astronomy: Early Stars

Phoebe Waterman Haas

Phoebe Waterman Haas is one of the first two women to receive a Ph.D. in astronomy (1913) from UC Berkeley.
(Read more)

Anna Estelle Glancy

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(Read more)

Sophia Hazel Levy

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(Read more)

Priscilla Fairfield Bok

Priscilla Fairfield Bok is one of the first women to receive a Ph.D. in astronomy (1921) from UC Berkeley.
(Read more)

Jessica May Young

Jessica May Young is one of the first women to receive a Ph.D. in astronomy (1920) from UC Berkeley.
(Read more)

Edith Cummings

Edith Cummings received a Ph.D. in astronomy from UC Berkeley in 1923.
(Read more)

Mary Lea Heger Shane

Mary Lea Heger Shane received a Ph.D. in astronomy from UC Berkeley in 1925.
(Read more)

Maud Worcester

Maud Worcester received a Ph.D. in astronomy from UC Berkeley in 1930.
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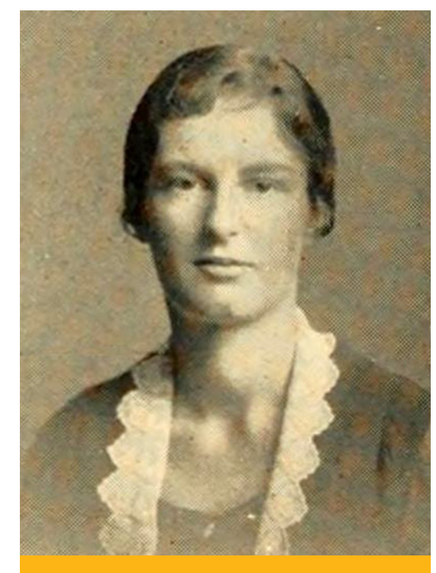

Lois Tripp Slocum

Lois Tripp Slocum received a Ph.D. in astronomy from UC Berkeley in 1930.
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Charlotte Moore Sitterly

Charlotte Moore Sitterly received a Ph.D. in astronomy from UC Berkeley in 1931.
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Phyllis Hayford

Phyllis Hayford received a Ph.D. in astronomy from UC Berkeley in 1932.
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Katherine Prescott

Katherine Prescott received a Ph.D. in astronomy from UC Berkeley in 1933.
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Dorothy Nell Davis

Dorothy Nell Davis received a Ph.D. in astronomy from UC Berkeley in 1937.
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Cecile Trumpler Weaver

Cecile Trumpler Weaver graduated in astronomy 1939.

(Read more)

Martha “Patty” Stahr

Martha Stahr received a Ph.D. in astronomy from UC Berkeley in 1946.
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Elizabeth Leonard Scott

Elizabeth Leonard Scott received a Ph.D. in astronomy from UC Berkeley in 1949.
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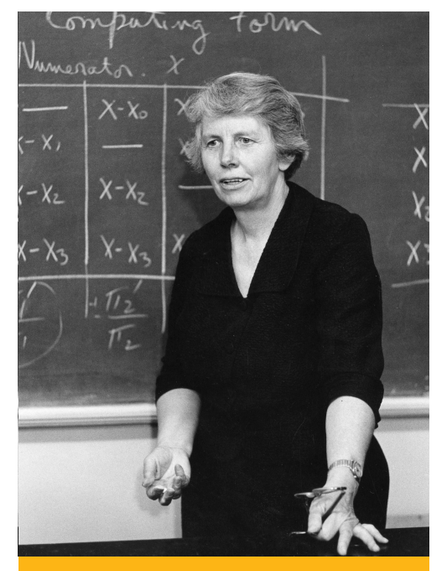

Helen Pillans

Helen Pillans received a Ph.D. in astronomy from UC Berkeley in 1952.
(Read more)

Jill Tarter

Jill Tarter received a Ph.D. in astronomy from UC Berkeley in 1975.
(Read more)

Imke de Pater

Imke de Pater was the first woman appointed to the Faculty in the Department of Astronomy. She has a joint appointment with EPS.
(Read more)

150 Years of Women at Berkeley

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Statement on Collegiality

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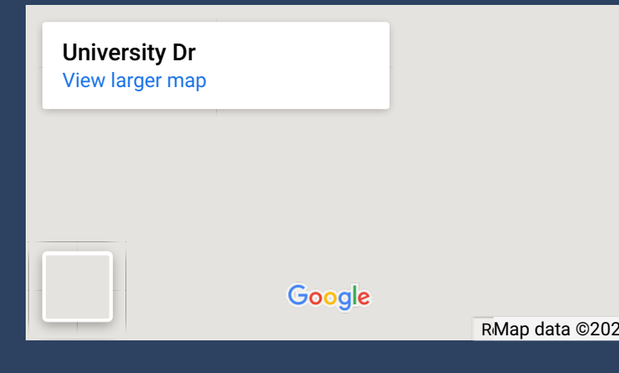

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Phoebe Waterman Haas (1882-1967)

Phoebe Waterman Haas Smithsonian National Air and Space Museum (NASM 9A12030)

Phoebe Waterman Haas was one of the two women who earned the first doctoral degrees in astronomy on the same day in 1913 and each matriculated at Berkeley from women's colleges where they were taught by women faculty. Waterman was the daughter of a US Army cavalry officer. While visiting her father in 1900 in Cuba, she was excited to observe a partial solar eclipse. Waterman studied astronomy at Vassar College where she earned a BS and an MS in astronomy in 1905 and 1906. She wrote her MS thesis on "The Definitive Orbit of Comet 1880." Waterman studied with Professor Caroline Furness, a Columbia PhD, who became her lifelong mentor. Before being accepted to Berkeley's graduate program, Waterman worked as for two years a *computer* at the Mount Wilson Laboratory, near Pasadena, supervised by acclaimed astronomers like George Ellery Hale and J. C. Kapteyn. She chafed at her assigned tasks of classification of photographic plates and reduction of stellar spectra and found little chance for independent work.

Realizing she needed advanced training to achieve her ambition to make her own observations, she applied for graduate study at Berkeley. Once enrolled, she commented about the difference between Vassar and Berkeley, and the new experience of competing with men. Waterman wrote to Furness: "... they give a woman the same work as the men. I am getting used to the different standard a little—for it surely is a different one, and quite a different thing from measuring up against women." Armin Otto Leuschner, who built Berkeley's astronomy program, described Waterman as "one of the most unusually well-equipped women we have ever had at Berkeley. She is brilliant, quick and accurate and disposes of her work with promptness and accuracy." [1] She wrote a PhD thesis on "The Visual Region of the Spectrum of the Brighter Class A Stars." Waterman is believed to be the first woman astronomer to conduct her own telescopic research instead of relying on the observation logbooks of others. Alongside her fellow students, she conducted research at the Lick Observatory; records of her observations appear in the Lick Observatory Archives. [2] After graduation, Phoebe Waterman and her roommate, Estelle Glancy, accepted positions at the Argentine National Observatory in Cordoba, an outpost of the Lick Observatory, directed by the American Charles Perrine. Fate intervened; during the voyage to Argentina. Waterman fell in love with an American businessman, Otto Haas. Once in Cordoba, she found the work to be routine and boring, and soon returned home to marry Haas. Like Berkeley mathematician Emma Lehmer, she gave up an independent career as a promising astronomer to marry and raise a family. Nonetheless, Haas bought a telescope in 1927 and recommenced observational astronomy for several years. When her two sons were older, she tried to reenter the field but reported she was discouraged by Berkeley faculty. At the suggestion of her Vassar mentor, Caroline Furness, Haas volunteered to observe variable stars for the American Association of Variable Star Observers at Harvard Observatory (AAVSO). As a citizen scientist Haas continued involvement in astronomy through her scientific observations and calculations. Haas submitted 338 observations to AAVSO between 1928 and 1933. In 1941 she wrote "Someday I hope I can join in again.... There is nothing I enjoy more than an evening out with my telescope, the thrill of finding a faint prick of light where last time I looked, I could see nothing, then seeing that point brighten. I'll be at it again yet!" [3]

Although Haas sustained her passion for astronomy as an observer and volunteer computer, she never attained a professional position. In 1945, after World War II, Phoebe and Otto Haas founded the Phoebe Waterman Foundation to help children who had lost fathers in the war, and to support educational institutions. Her grandson, Thomas Haas, donated $6 million in 2013 to support science education through the Phoebe Waterman Haas Public Observatory at the National Air and Space Museum. As a result, Phoebe Waterman Haas is far better known than her classmate Estelle Glancy.

From *Celestial Observers: Sixteen Berkeley Women Doctoral Graduates in Astronomy 1913-1952*
By Sheila Humphreys

[1] These quotes are drawn from Smithsonian National Air and Space Museum, "Introducing the Phoebe Waterman Haas Public Observatory," July 16, 2013. https://www.airspacemag.com/space/womans-fight-for-the-stars-180969500/
[2] Records of Berkeley student observations and calculations, including those of Berkeley students Waterman, Glancy, Levy, Fairfield, Young and Taylor are archived at the Lick Observatory Archives: http://collections.ucolick.org/archives_on_line/search_ms.html
[3] Thomas R. Williams. "Phoebe Haas- An AAVSO Volunteer" Journal of American Association of Variable Star Observers, vol. 20, 1991, 18-22.

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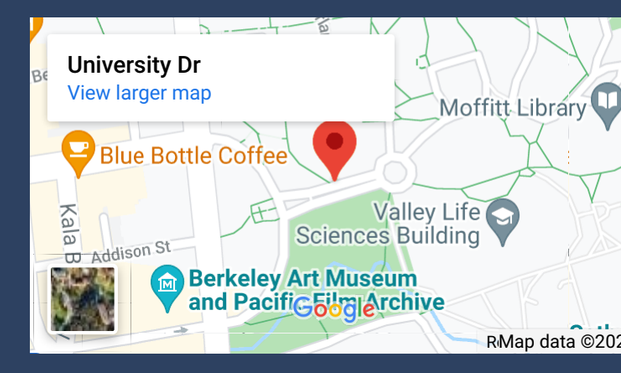


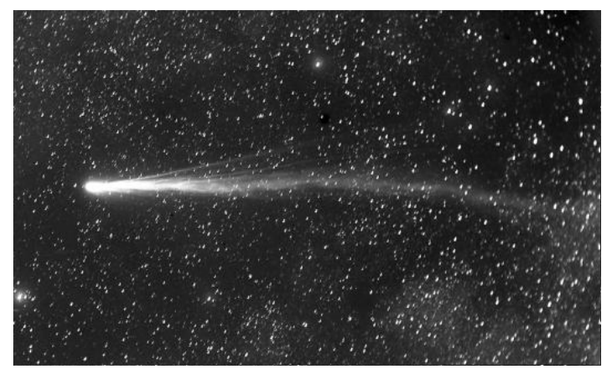
Anna Estelle Glancy (1883-1975)

Estelle Glancy earned a BA in astronomy at Wellesley College in 1905. Wellesley, like Vassar, had a strong astronomy program. Glancy received her PhD in astronomy from UC Berkeley the same day as her roommate, Phoebe Waterman, in 1913. Graduate study at Berkeley was serendipitous. When she failed to find a job, Glancy explained: "After an idle period of nearly a year and no success in selling my poor talents at an eastern observatory, I launched a far distant appeal to the Berkeley Astronomical Department ...I was invited to come as a computer provided I would also work toward a PhD degree; a thought which would never have entered my mind."[1] She arrived in 1906 shortly before the San Francisco earthquake and fire.

Estelle Glancy
Carl Zeiss Vision International GmbH

S. Einarsson, E.A. Fath, W.F.Meyer, Estelle Glancy, Sarah Morgan, Alice Joy at UC Berkeley in 1908 (The Blues Chaser Vol. 1, UC Berkeley Astronomy Department)

Glancy's research advisor, Armin Leuschner, called her "brilliant, industrious and accurate." Like Waterman, she was a fellow at the Lick Observatory, where a record of her observer's notebooks and instrument logbooks are archived.[2] According to Lick archivist Tony Misch, Estelle Glancy is considered the first woman to do her own research at Lick. Her groundbreaking achievement "was the splendid series of glass-plate photographs she made from Mt. Hamilton of comet Morehouse in 1908 using the Crocker telescope."[3] After earning her PhD, Glancy could not find a position as an astronomer in the United States, so she traveled with Phoebe Waterman to accept a position as an assistant astronomer with the Argentine National Observatory. She was considered by W.W. Campbell for the position of director of the southern observing station in Santiago, Chile, but as one recommender wrote "Too bad A. E. Glancy has not Alfred instead of Anna as her first name."[4] Glancy remained for four years but with the onset of World War I she returned to her native New England. Still finding no position in astronomy, Glancy decided to migrate from astronomy to optics and "start from scratch." She spent the rest of her career as a successful geometric research optician at American Optical Company in Southbridge, Massachusetts. Like other female employees, she first functioned there as a computer. "I had no illusions about the difficulty of transfer from Astronomy to Optics but knew also that there was no better background than computing in astronomical problems. So I elected to start once more from scratch. Trigonometry, calculus, the art of computing and something, which is best called insight, which developed under the inspired teaching of Professor Leuschner, was my stock in trade. In exchange, the new job could give me association with top-flight leaders and a chance to grow...."



Comet Morehouse (aka 1908c) photographed by A. Estelle Glancy from Mount Hamilton using the Willard lens on the Crocker Telescope, November 14, 1908; scan from the original glass-plate negative, courtesy of UCO/Lick Observatory

Her boss at American Optical for 33 years was a former astronomer, Dr. E. D. Tillyer, widely known as a leading lens designer. During WWI American Optical was requisitioned to fill large military orders for lenses, which were calculated by Glancy. In her role as a geometric optician, she worked on numerous lens designs and was responsible for performing the complex mathematical calculations involved in ophthalmic optics.

"When the war ended, I began the long and repetitious calculations on which the Tillyer spectacle lens is based. In principle, this lens aims to give marginal vision as nearly like vision through the center of the lens as possible. The larger part of ten years was occupied in this major project which no other company than the American Optical Company was ready to undertake."

A decade of mathematical calculations was essential to the Tillyer corrected curve lens, to which Estelle Glancy's name should have been appended. Glancy was awarded a patent in 1923 for her design of the first progressive lens for eyeglasses, an impactful innovation to correct for near and distant vision as an alternative to bifocal and trifocal lenses. She also designed lenses for microscopes, cameras and military optics. Between 1929 and 1945 Glancy received thirteen patents for her innovations. Glancy was the first among her Berkeley women peers to find employment in industry, but she continued to write astronomy papers with her advisor Armin Leuschner.[5] As of 1950, Glancy was the sole woman lens designer in the world. In retirement she cited her progressive deafness as a factor in her success. "The forced aloneness which deafness imposes was compensated in part by freedom from distraction and the ability to concentrate." She modestly concludes the account of her career: "Opportunity knocked at my door...."

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By Sheila Humphreys

[1] All the quotes by Estelle Glancy are taken from her autobiographical account in: Dick Whitney. "Estelle Glancy: 1918-1951" Optics and Photonics News. Vol. 28, 3, 40-47.
[2] Records of Lick Observatory faculty and student observations and calculations, including those of Waterman and Glancy, are archived at the Lick Observatory archives: http://collections.ucolick.org/archives_on_line/search_ms.html
[3] Personal communication, Tony Misch, Director, Lick Observatory Historical Collections Project, June 27, 2021.
[4] John Langford. American Astronomers. Chicago: 1997, 292.
[5] Paul Herget. "Armin Leuschner: A Biographical Memoir". Washington DC: National Academy of Science, 1978.

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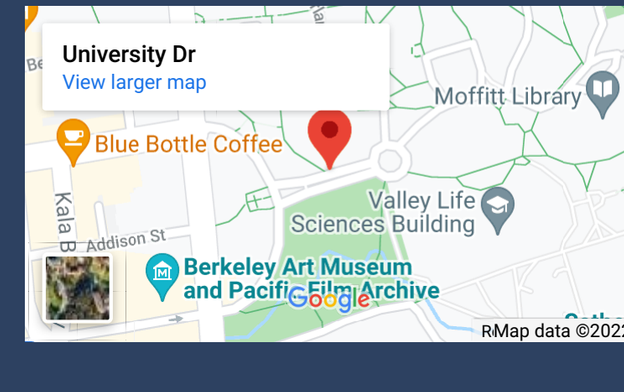

Sophia Levy

Dept. of Mathematics, UC Berkeley

Sophia Levy (1888–1963) was the daughter of California pioneers. Levy developed an interest in astronomy as an undergraduate at Berkeley, where she earned a BS in 1910 and PhD in 1920. For the bulk of her career, however, Levy belonged to the faculty in mathematics at Berkeley., While pursuing graduate study she was hired as an astronomy assistant from 1910-1914. After that she worked in two administrative posts, assistant to the dean of the Graduate Division and Secretary to the California State Board of Education for the Commission of Credentials. She was appointed as astronomy instructor in 1921. Levy contributed many papers in theoretical astronomy. Because of her ability in mathematical analysis, she was hired as an instructor in mathematics at Berkeley in 1923. Eventually Levy rose to full professor of mathematics in 1949, twenty-six years later. During World War II, Levy directed the mathematics instruction for the Army Specialized Training Program at Berkeley.[1] She taught courses on antiaircraft gunnery and even published a text, Introductory Artillery Mathematics and Antiaircraft Mathematics.[2]Levy was deeply committed to improving the quality of mathematics instruction at the secondary school level, and assumed leadership roles in the training of math teachers and prospective teachers. She advised the state of California on math curriculum for the California Committee for the Study of Education in California public schools. She served as chair and sectional governor of the recently organized Northern California Section of the Mathematical Association of America. In 1941, the Northern California and Southern California Sections established a Joint Committee on Mathematical Education under her chairmanship "to study means of strengthening the program of mathematics in schools and colleges." Levy developed a summer session for math teachers to meet state requirements and published articles The Mathematics Teacher on the teaching of mathematics in the schools.[3]

Levy chose to defer her marriage to a colleague in the math department (John McDonald) until he retired in 1944 because, under nepotism rules, one of the two would have had to resign from the faculty had they married. Nepotism rules, which were not dropped until the 1970s, often had the effect of inhibiting women's careers. Such is the case of Phoebe Waterman. The first women to earn PhDs in astronomy at Berkeley were undergraduates at women's colleges, Vassar and Wellesley, where women students avoided comparisons with men.

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[1] Louis E. Keefer, The Army Specialized Training Program in World War II, http://www.pierce-evans.org/ASTP%20in%20WWII.htm.
[2] Sophia Hazel Levy, Introductory Artillery Mathematics and Antiaircraft Mathematics (Berkeley: University of California, 1943).
[3] V.F. Lenzen, S.Einarsson and G. Evans. In Memoriam. Sophia Levy McDonald. University of California, April 1965.

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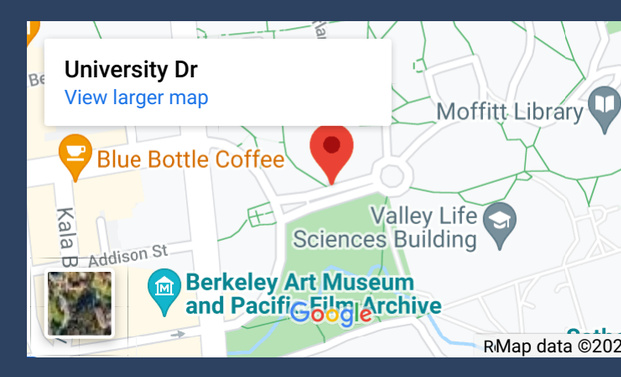

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Priscilla Fairfield (Bok) (1896-1975)

Courtesy of Monterey Institute for Research in Astronomy

Priscilla Fairfield's career in astronomy is intimately linked with that of her husband, Bart Bok. The daughter of a Unitarian minister, she grew up outside of Boston and was fascinated by the sun as a child. She worked throughout college to pay her tuition at Boston University. It is said that she bribed a nightwatchman to allow her to use the telescope on the roof. At the age of twenty, Fairfield wrote an article on her observations for Popular Astronomy. She enrolled for a doctorate in astronomy at Berkeley, where she was one of the last students of Professor William W. Campbell, Director of the Lick Observatory, and a future president of the University of California. She finished her degree in 1921 and accepted a position as assistant professor of astronomy at Smith College for a salary of $1800. Known in the Smith course catalogue as "Miss Fairfield," she taught Introduction to Astronomy and Astronomy 11, which required 3 to 4 hours of observing weekly. General Electric had rejected her job application because she revealed her aspiration to be an astronomer. In her nine years at Smith, Priscilla Fairfield advanced to the rank of associate professor.

In 1928 Fairfield traveled to Leiden, The Netherlands, to attend the International Astronomical Society meeting. There she met Bart Bok, a Dutch astronomy graduate student ten years her junior, who was assigned as her host. Bok fell in love immediately. After a year of correspondence, Bok interrupted his own doctoral research in Holland and moved to Harvard. Three days after his arrival, Fairfield and Bok were married. Theirs was a felicitous union, personally and professionally. While Bok rose to full professor at Harvard, Priscilla Bok continued collaborating with him in their research without pay or title for forty years. She stayed home to raise their two children but continued to do research. Women astronomers, mostly faculty at women's colleges, gathered at intervals through the 1940s, and Fairfield's name appears regularly as a participant on the rosters of the meetings.

In his oral history, Bart Bok says, "My wife Priscilla did a lot of work at Harvard and didn't even want a job." [1] Their scientific achievements are completely entwined. In the Royal Astronomical Society obituary for Bok, the author states "...it is difficult and pointless to separate his achievements from hers." [2]

The Boks jointly wrote many journal articles on stellar magnitudes, star clusters, and the structure of the Milky Way. The textbook they published in 1941, The Milky Way, was immensely popular and was revised and republished in five subsequent editions and many languages. [3] As galactic astronomy rapidly evolved, they continuously revised the text. The Boks were interested in sharing their discoveries with the public and were called the "salesmen of the Milky Way" by the Boston Globe.

After twenty-five years at Harvard, the Boks left for Australia where Bok was named Director of the Mount Strombo Observatory in Canberra. He installed a new telescope there and a field observatory and initiated a graduate program in astronomy. He had little time for research, but Priscilla Bok devoted herself to nocturnal observations to determine stellar positions, and data analysis during the day. After nine years, the Boks made a final move to Arizona, where Bart directed the Steward Observatory from 1966-1970. Priscilla Bok died in 1975 [4]

The Priscilla asteroid (2137, a Main-belt asteroid), named for her, was discovered on August 24, 1936 by K. E. Reinmuth at Heidelberg, Germany. The Priscilla Fairfield Bok Prize, established in 1966 at the Australian National University, is awarded annually to a third-year female science student. In recognition of their dedication to the public understanding of science, other awards in the name of both Bart and Priscilla Bok have been established by the American Astronomical Society and the Astronomical Society of the Pacific, given at the Intel International Science and Engineering Fair. A recent book entitled Women of the Moon: Tales of Science, Love, Sorrow and Courage (2019) devotes a chapter to the marriage and achievements of Priscilla Bok but adds little to what is already known. [5]

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[1] Oral History Interview with Bart Jan Bok, May 15-19, and June 14, 1978. American Institute of Physics, 1978. Bart Bok's academic career, with references joint work with Priscilla Bok, are included.
[2] Bart Bok Obituary. http://articles.adsabs.harvard.edu/cgi-bin/nph-iarticle_query?bibcode=1987QJRAS..28..539L&db_key=AST&page_ind=0&data_type=GIF&type=SCREEN_VIEW&classic=YES
[3] Bart J. Bok and Priscilla F. Bok. *The Milky Way*. Harvard University Press: 1941; 5th edition 1981.
[4] For a full account of Bart Bok's academic career, with references to joint work with Priscilla Bok, see his oral history: Oral History Interview with Bart Jan Bok, May 15-19, and June 14, 1978. American Institute of Physics, 1978. See also:
[5] Daniel R. Altschuler and Fernando Ballesteros. *The Women of the Moon: Tales of Science, Love, Sorrow and Courage*. J. Ballesteros. Oxford University Press, 2020.

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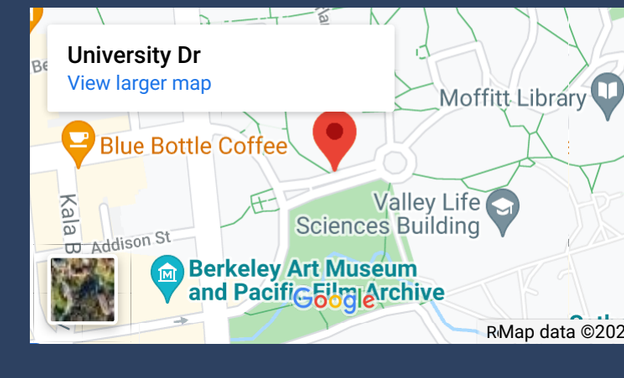

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Jessica May Young (Stephens) (1893-1961)

Washington University

Jessica May Young grew up in St. Louis, Missouri, and earned a bachelor's in 1914 and master's degree in 1915 in astronomy and physics at Washington University. She wrote an MS thesis "On the Cause of the non-appearance of certain periodic comets on their predicted returns." Young enrolled at UC Berkeley to pursue a PhD in astronomy, which she earned in 1920, with a thesis on "The Galactic Rotation Effect in Open Clusters,"about the orbits of comets and binary stars. The fourth woman to earn an astronomy doctorate at Berkeley, Young briefly taught physics and astronomy at College of St. Teresa in Minnesota and at Northwestern University. Returning to Missouri, she was hired as Instructor of Math and Astronomy at her alma mater. Sometimes known as "Mrs. Stephens" after her marriage to Eugene Stephens, a colleague in the math department, Stephens made frequent trips from St. Louis back to Lick Observatory for study and research. In 1923 she was advanced to Assistant Professor of Mathematics and Astronomy, the level at which she remained until she became the first woman in astronomy promoted to Associate Professor in 1952, 32 years after her first appointment. Stephens enjoyed a robust and successful teaching career at Washington

Jessica Young in 1918 (The Blues Chaser Vol. 1, UC Berkeley Astronomy Department)

University archives reveal that Stephens promoted appreciation for astronomy through public lectures during the 1940s and occasionally wrote general interest articles for the St. Louis Post Dispatch. In April 1940, for example, Stephens issued a bulletin announcing the spectacular visibility of Venus, Saturn, and Mars. The St. Louis papers reported that Stephens accompanied her students to the campus observatory to view eclipses of the moon in 1942 and 1947. The Business and Professional Women's Club of St. Louis honored Jessica Stephens in 1952 as one of eight outstanding women "Rampart Builders". Dr. Stephens retired as Associate Professor Emerita in 1958. To mark her retirement, Washington University hosted a "Tea in honor of Mrs. Stephens." She accepted one last teaching post in astronomy at North Carolina Agricultural and Mechanical College.

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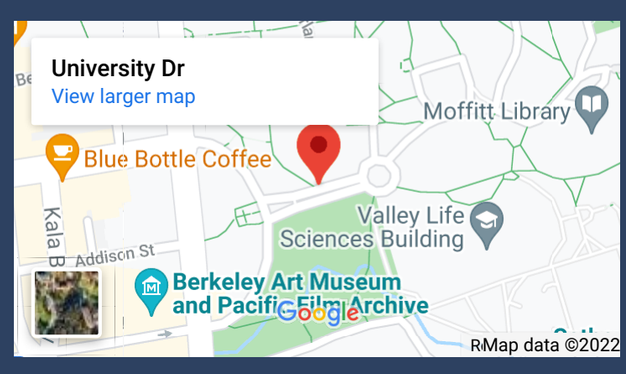

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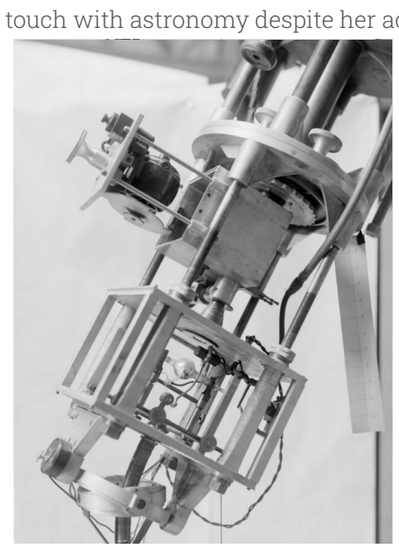
Edith Eleanor Cummings (Taylor) (1894-1979)

Savitar Yearbook 1916, University of Missouri

Edith Cummings was born in Beatrice, Nebraska and attended the University of Missouri. In that era, the University of Missouri had a strong astronomy department. She graduated Phi Beta Kappa in 1915 with a bachelor's and with a master's degree in astronomy in 1917. Recognized as a gifted student. Cummings conducted research with Professor Robert Horace Baker. She wrote a master's thesis entitled "The eclipsing binary TV cassiopeiae," which was published in the Laws Observatory journal in 1918. In recognition of the distinction of her thesis, Cummings was awarded the Laws Astronomy Medal in 1916. Professor Baker hired her as his research assistant from 1915-17 and they co-authored several publications. Baker wrote in his recommendation letter for graduate school: "As an undergraduate Miss Cummings was the most promising student I have had...while unfortunately she is not a man, I believe she is hampered by her sex less than any aspirant I have known. In our extrafocal work she has done a man's share. She has unlimited energy, health and strength to accompany it. She intends to make astronomy her life's work."[1] Cummings earned her PhD in astronomy from Berkeley in 1923. During her graduate years at Lick Observatory, she co-authored at least two publications with her contemporary Priscilla Fairfield.[2] Cummings built a photoelectric photometer, an instrument deemed highly innovative, used to measure the intensity of starlight work. This was an unusual achievement for a woman. Her doctoral thesis was entitled "The Photoelectric Photometer of the Lick Observatory and Some Results Obtained with it." This research was published in 1924 in the Lick Observatory Bulletin.[3] In 1922 Edith Cummings married William Halvor Taylor, a physics graduate of Ripon College, and gave birth to a daughter the following year. She moved to Wisconsin with her husband who worked for the Bureau of Standards; they later divorced. After several years Edith Cummings Taylor appears to have lost touch with astronomy despite her accomplishments and her vow to make astronomy her life's work.[4]



Photometer made by Edith Cummings for the 12-inch refracting telescope (© Regents of the University of California. Courtesy Special Collections, University Library, University of California Santa Cruz. Lick Observatory Photographs)

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[1] Charles Peterson. An informal history of the Astronomy Department. University of Missouri, 1981.
[2] https://ui.adsabs.harvard.edu/abs/1920PASP...32Q..67C/abstract
[3] Shane, M. L, & Calciano, E. S. (1969). Mary Lea Heger Shane: The Lick Observatory
[4] Peterson, op. cit., 64.

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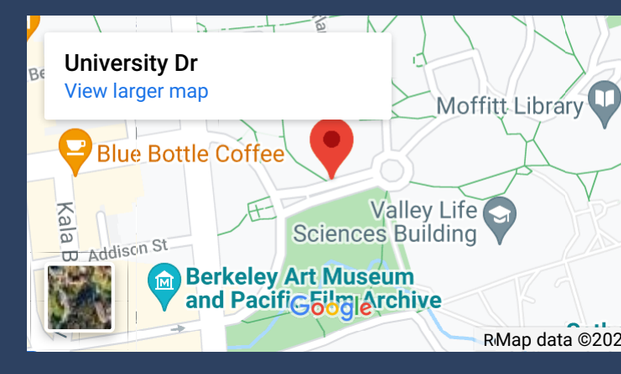

Mary Lea Heger (Shane) (1897-1977)

Courtesy of Bancroft Library, UC Berkeley

Mary Lea Heger grew up in Belvedere, across the bay from San Francisco. She majored in astronomy at Berkeley as an undergraduate, class of 1919 and received her PhD in Astronomy in 1924. As an undergraduate, Heger enjoyed the small classes and friendliness of the astronomy professors. During her senior year she was hired as a teaching assistant to instruct celestial navigation to naval officers. In her oral history Heger states that her pursuit of an astronomy doctorate was accidental. While aiming to obtain some observatory experience at Lick, she discovered that an idea she had while an undergraduate "just panned out...and became a ready-made thesis." "I don't think I meant to take a PhD when I went up" to Mount Hamilton in 1919. [1] Unlike the usual progression from coursework to research, she conducted observations at Mount Hamilton during her first year in the doctoral program. Describing her research problem as "irresistible" she said, "It was as though the thesis came and said, 'Take me'." Heger is credited with a major discovery: observing and researching the Diffuse Interstellar Bands 5780 Å and 5797 Å fifteen years before her contemporary P.W. Merrill, a fellow Berkeley PhD astronomer who spent his career at Mt. Wilson. She was one of the first people to detect sodium atoms in interstellar space and in doing so initiated "a substantial field of research." [2]

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Mary Lea Heger married her fellow grad student Donald Shane in 1920, just after Donald finished his PhD. The significance of Heger's doctoral research makes one wonder what she would have accomplished, had she not given up her research career in astronomy to raise children and support her husband's work. Their son Whitney Shane was born in 1928 and graduated from Berkeley in 1951. An observational astronomer whose career was in the Netherlands, Whitney Shane conducted research in structure and dynamics of galaxies. While Donald Shane served as the Director of the Lick Observatory from 1945-58, Mary Shane acted as the "scientific hostess" of the observatory community, welcoming astronomers from all over the world, apparently with grace and generosity. Shane describes the liveliness and warmth of the Lick community in her oral history, the life on Mount Hamilton, which included square dances, hikes and picnics, and preparing Christmas dinners for families of staff and faculty on the mountain. The children of faculty and staff attended a one-room school there. During the Second World War, Shane accompanied her husband to Los Alamos, where she worked as a computer in theoretical physics and he worked on the Manhattan Project. Toward the end of her husband's tenure at Lick, Mary Shane discovered dilapidated boxes in the attic of the Observatory which contained correspondence, handwritten scientific copy books, albums, and other memorabilia, which motivated her to spend five years organizing what became a historic archive of the Lick Observatory. "Under her leadership and with her active participation, a group of dedicated volunteers identified, classified, and catalogued thousands of letters, clippings, and photographs. Letters from almost every notable American astronomer since Simon Newcomb, as well as from many European scientists, can be found in the Shane Archives." [3] The Mary Heger Shane Archives, which were renamed in her honor in 1983, preserve an invaluable record of Lick Observatory. [4]

From *Celestial Observers: Sixteen Berkeley Women Doctoral Graduates in Astronomy 1913-1952*
By Sheila Humphreys

[1] Shane, M. L, & Calciano, E. S. (1969). *Mary Lea Heger Shane: The Lick Observatory.*
[2] Tony Misch pointed out the impact of Heger's research, documented in this article: Benjamin McCall and Elizabeth Griffin. "On the Discovery of Diffuse Interstellar Bands," 2013. https://royalsocietypublishing.org/doi/full/10.1098/rspa.2012.0604
[3] S. Vasilevskis and D. E. OsterBrock. *Charles Donald Shane: A Biographical Memoir.* National Academy of Sciences Washington D.C., 1989.
[4] https://www.ucolick.org/main/explore/archive.html

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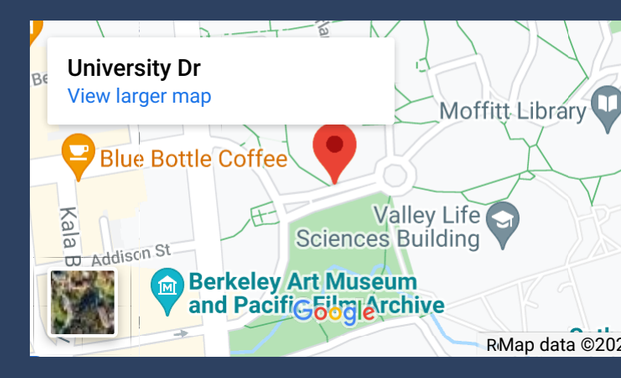

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Maud Worcester (Makemson) (1891-1977)

Vassar College Encyclopedia

Maud Worcester followed a circuitous route from teaching to journalism to an academic career in astronomy. After attending Girls Latin School in Boston, she studied Greek and Latin for one year at Radcliffe College. Following a brief stint of teaching, she moved to Pasadena, California with her family. Soon afterwards, Maud Worcester married Thomas Makemson and had three children. After divorcing her husband in 1919, she got a job in Arizona as a journalist. There she witnessed the great aurora in May 1921, which sparked her interest in astronomy. Showing unshakeable determination, Makemson enrolled in correspondence courses in trigonometry and astronomy from UCLA and then took science classes in summer school. Finally, she gained admission to UCLA and earned a bachelor's degree in 1925 at the age of thirty-four. Six years later she received her PhD from Berkeley in astronomy in 1930.

Makemson was appointed to the Vassar College faculty as an assistant astronomy professor in 1932 and was promoted to full professor in 1944. In 1936, she succeeded Caroline Furness as the fourth woman to direct the Vassar Observatory after Maria Mitchell, a somewhat controversial appointment. She was viewed as a "mature" for her rank of assistant professor. Makemson directed the observatory until 1957. She was a mentor to Vera Rubin, Vassar class of 1948, who became an eminent astronomer and made critical discoveries about dark matter. Rubin said of her professor, "She was a very thorough teacher, demanding high quality in return." With her students, Makemson computed the orbits of twelve minor planets, and named one "Maria Mitchell" and another "Vassar."

Maud Makemson's research and publications about primitive astronomy and mythology reflect her broad interests in languages and anthropology. During sabbatical leaves from Vassar and while on a Guggenheim Fellowship, she conducted research in Mexico and published The Astronomical Tables of the Maya (1943). Then in 1954 she wrote an article "Astronomy in Primitive Religion" in which she discussed the worship of celestial bodies in Mesopotamia, China, Egypt, Greece, and Rome.[1] She spent a year in Japan and Punjab on a Fulbright Teaching Fellowship in 1953-54.

After retiring from Vassar in 1957 Makemson taught at UCLA and co-authored Introduction to Astrodynamics, the first text of its kind, with Robert Baker of UCLA.[2] Makemson's final contributions focused on space research. She moved to Applied Research Laboratories of General Dynamics in Texas as a consultant to NASA on lunar exploration in 1964-65. She found a way to enable astronauts to determine their positions on the moon while they had no access to radar or radio. When Makemson began her research on "Determination of Selenographic Positions," she did not realize its usefulness. "When I developed an approximate method for determining selenographic latitude and longitude from star altitudes observed from the Moon's surface, the practical need for such a method seemed most remote. Now, in 1970, a method for finding accurate positions on the lunar surface is... an essential factor in every selenodetic survey." [3]

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[1] Maud M. Makemson. "Astronomy in Primitive Religion" Journal of Bible and Religion, Vol. 22, 3.July 1954.
[2] Robert M.L. Baker and Maud W. Makemson. Introduction to Astrodynamics. New York: Academic Press, 1960.
[3] Maud W. Makemson. "Determination of Selenographic Positions." The Moon, Vol.2, 3, February 1971.

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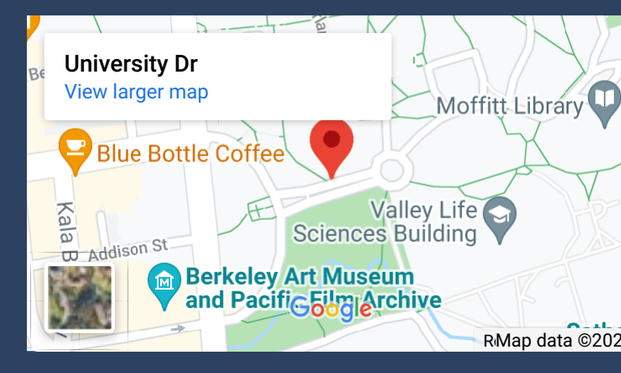
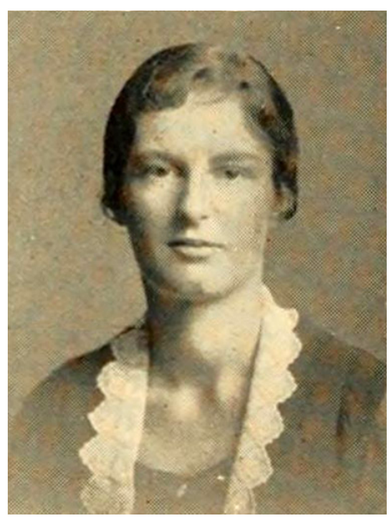


Lois Tripp Slocum (1899-1951)



Smith College Class Book 1921

Lois Slocum was born in New Bedford, Massachusetts to a family of seafaring ancestors. She was the niece of Frederick Slocum, a professor of astronomy at Brown University, whom she knew and visited several times as a student. Slocum graduated from Smith College in 1921 in astronomy and earned a master's degree there in 1924. As a graduate student at Berkeley, Slocum studied the Milky Way galaxy and dark nebulae. She received her doctorate in astronomy in 1930, supervised by Professor Robert J. Trumpler. Her thesis was a study of the colors of faint stars in a section of the Milky Way. Lois Slocum was strongly interested in teaching astronomy. She taught briefly at Wellesley but spent a full decade at Smith, where she was an instructor and assistant professor of astronomy from 1932-43. While teaching at Smith, Slocum continued to publish in astronomical journals. During World War II, she contributed to the war effort at Harvard's secret Radio Research Laboratory. In 1944 she was appointed professor of astronomy at Wilson College, a college for women in Chambersburg, Pennsylvania, where she remained for the rest of her career. Slocum was an active member of the American Association of Variable Star Observers. Her career was cut short by her early death at the age of 52. Her family established an annual Lois T. Slocum Memorial Lecture at Wilson College. Astronomer Bart Bok (husband of Berkeley alumna Priscilla Fairfield Bok) gave the first lecture in 1952 on "The Depths of the Milky Way." Bok said, "She was one of the first to demonstrate both the potential power of the color attack and the great difficulties that lay ahead."[1] Bok praised the significance of Lois Slocum's research and dedication to teaching until the very end of her life and said that she would have been pleased by his chosen topic, the subject of her own research.

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[1] Bart J. Bok. "The depths of the Milky Way." *Popular Astronomy*, Vol. 59, 501 ff.

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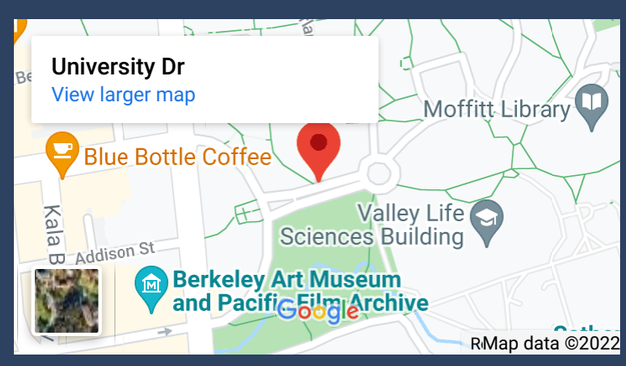

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Charlotte Moore Sitterly

Charlotte Emma Moore (Sitterly) (1898–1990) earned a PhD in astronomy from Berkeley in 1931. Although Berkeley is proud to claim her as an alumna, Charlotte Moore spent most of her career at Princeton. Following graduation from Swarthmore College in 1920 as a math major and with no prior experience, Moore was employed as a computer to process astronomical data. Moore's job was to calculate the positions of celestial bodies for a prominent astronomer, Henry Norris Russell, at the Princeton Astronomical Observatory. In 1925 Moore started a study of the solar spectrum. She spent two years in California working at the Mount Wilson telescope but found she was given more responsibility at Princeton with Russell. "But at that time there were not too many chances for any woman, no more chance there for a woman than there was at Princeton and I felt that I had more opportunity to get into general astrophysics with Dr. Russell than I did being channeled out there as a computer. There was little opportunity to broaden or advance." Moore attended graduate lectures at Princeton, but she was unable to enroll for graduate study there because Princeton did not accept women at that time. "Princeton wouldn't have anything to do with women under any circumstances. I could get no credit there whatever. There was no way." While Russell was on a two-year trip to Europe, Moore came west to Berkeley, where she completed her PhD with a thesis on sunspot spectra in 1931.

AIP Emilio Segrè Visual Archives, Gift of Michael A. Duncan

While working on her PhD, she continued researching spectroscopy and collected and analyzed data about the spectra of chemical elements and molecules. After obtaining her degree, Moore returned to Princeton to continue to work as a researcher with Russell until his death. In 1937, Moore presented a paper at the American Astronomical Society announcing her discovery of three new elements in the sun. After an evening of stargazing, she accepted a proposal of marriage to a Princeton colleague, astronomer Bancroft Sitterly. Moore continued to publish under her maiden name; she coauthored The Masses of the Stars with Russell in 1940. She spent the rest of her career as head of spectroscopy at the National Bureau of Standards in Washington, DC, in charge of an atomic energy levels program. One of her foundational contributions was the compilation of tables of atomic spectra, a lasting contribution to astronomy. She described her work modestly in a 1961 interview: "It isn't glamorous, but the work itself carries you along on its own interest."

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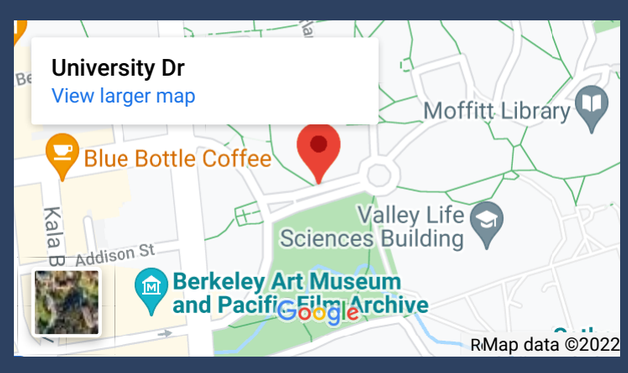

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Phyllis Hayford (Hutchings) (1904-1965)

Whitman College Archive

Phyllis Hayford was the youngest of four children of Professor John Hayford, a geodetic astronomer, who was Director of Engineering at Northwestern from 1909-1925. Each of Phyllis's three older brothers earned engineering degrees, and she followed suit. She graduated Phi Beta Kappa in civil engineering in 1926 from Northwestern University, and then worked for two years as a computer at Lick Observatory. Hayford enrolled at Berkeley in the astronomy doctoral program in 1928 and earned the PhD in 1932.

Phyllis Hayford ca. 1927 at Lick Observatory (© Regents of the University of California. Courtesy Special Collections, University Library, University of California Santa Cruz. Lick Observatory Photographs)

As a Lick Fellow at Mount Hamilton, she conducted research at Lick Observatory for six years through 1937, according to the observatory logs.[1] In 1934 she married a Berkeley math grad student, William Lawrence Hutchings, who earned his PhD in 1935. Facing a two-body problem to secure academic positions, the Hutchings found jobs at Rollins College in Winter Park, Florida, where Phyllis taught astronomy and her husband taught math until 1943. An article in the college newspaper in 1937 reports a public speech she gave about observatories of the West.[2] The couple was then appointed in the astronomy and math departments respectively at Whitman College, in Walla Walla, Washington. Phyllis Hutchings was listed in American Men of Science in 1949, with research interests of galactic rotation, orbit computation, asteroids and comets. Unexpectedly Phyllis Hutchings died at the age of 61. Hutchings's dedication to teaching was praised by Whitman's president Louis B. Perry, who called her "one of those rare individuals with tremendous loyalty to her institution and above all to her students. Without question she was among the most beloved members of the faculty at Whitman College and will leave a gap in the hearts of her colleagues and students which will never be filled."[3]

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[1] Phyllis Hayford. Reduction Book, No. 4 , *Measuring Book No. 2, Eros Plates.*, 9 November 1934–14 May 1937
http://collections.ucolick.org/archives_on_line/about.html
[2] *Sandspur*, Rollins College Vol. 42 No. 24, April 7, 1937.
[3] Walla Walla Union-Bulletin, July, 1965

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Katherine Prescott (Kaster) (1901-unknown)

"A Co-ed Comet Calculator" (Photo: Oakland Tribune, December 1927)

The daughter of a physician, Katherine Prescott grew up in a prosperous family in Boston. She earned an undergraduate degree in both astronomy and physics from Berkeley in 1923. On the basis of undergraduate research she was elected to Sigma Xi, a scientific research honors society. As a graduate student in astronomy, Prescott was named a Fellow at Lick Observatory. The Oakland Tribune published an article "A Co-ed Comet Calculator" about Prescott and a fellow student who plotted the path of an oncoming comet in 1927. Prescott wrote her dissertation "On the motions of perijove of the fifth satellite of Jupiter" and earned the doctorate in 1933. While in graduate school she married Howard B. Kaster, a Berkeley alumnus of the class of 1922 with a BA in astronomy. As a grad student, Kaster wrote at least one research paper with her husband, Howard Kaster: "The Orbit of a Comet a 1925" published by the Astronomical Society of the Pacific.[1] Claiming cruelty, Katherine Kaster sued for divorce in 1934 after six years of marriage. The Oakland Tribune reported that Howard Kaster "began to complain about her cooking."[2] Katherine Kaster continued to publish in astronomy journals through the 1940s. Lick Observatory, where she was employed as a Research Fellow in Astronomy, records her activity there from 1924 -1937. Scant biographical information is available about Katherine Prescott's professional life after 1940. From a very promising early career, she seems to have disappeared from astronomy. In 1942, Prescott published a short history of two coastal islands in Maine, associated with the Prescott family: *Cousins and Littlejohn's Islands, 1645- 1893.*

Katherine Prescott 1922 in The Blues Chaser Vol. 1, UC Berkeley Astronomy Department

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By Sheila Humphreys

[1] Howard B. Kaster and Katherine Prescott. "The Orbit of a Comet a 1925". Astronomical Society of the Pacific, Vol. 37. No 217, June 1925, 145-147.
[2] Oakland Tribune, At some point in the 1930s, Howard Kaster was a Naval officer and faculty member at the College of San Mateo, where he established a scholarship for students in the sciences.

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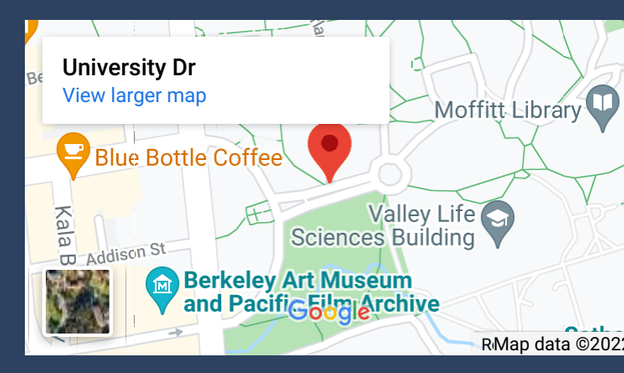

Dorothy Nell Davis (Locanthi) (1913-1999)

© Regents of the University of California. Courtesy Special Collections, University Library, University of California Santa Cruz. Lick Observatory Photographs

Born in East St. Louis, Missouri, Dorothy Davis was a precocious student. In high school she stood at 6'4" and broke a world track record for the standing broad jump. After finishing high school in three years, she entered Vassar in 1929 and majored in both physics and astronomy. Two of her Vassar professors were Caroline Furness, mentor to Phoebe Waterman, and alumna Maud Makemson. Davis was admitted to the graduate program in astronomy at UC Berkeley but could not afford to attend. Fortunately nearby Mills College in Oakland offered her a one-year teaching fellowship and the chance to earn a master's degree, for which she wrote a thesis on S-type stars. While teaching at Mills, she conducted research at the Lick Observatory, guided by Berkeley professor Donald Shane. The next year Davis received an assistantship from Berkeley and entered graduate school. She wrote her thesis on the spectrum of Antares and became an expert on molecular spectra. On completion of her PhD in astrophysics in 1937, Davis taught briefly between 1937-1939 at Vassar and at Smith. When she won an American Association of University Women Postdoctoral Fellowship, she was able to return to her real interest, which was research, at Mount Wilson Observatory. In 1940 she was invited to Princeton to assist astronomer Henry Norris Russell, in his work on the spectrum of ionized europium . During World War II, Davis contributed to the war effort by working on weapons programs and a rocket project at Caltech. In 1943 she married a Caltech student, Bart Locanthi, who was assigned to the same project. After the war, he took a job at Beckman Instruments to help support her husband through school. she interrupted her career at several points to rear children. When her first child was born in 1945, Locanthi dropped out for two years. With the birth of two more children, she stayed home for a decade. Locanthi held a series of half-time jobs at Caltech and Jet Propulsion Laboratory. In 1962, she returned to the labor force at Cal Tech, working on the derivation of stellar abundances. In 1972 she took a position at Jet Propulsion Lab in the planetary atmospheres section. She retired in 1985, but continued working, attending scientific meetings and presenting papers.[1]

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[1] Saul J. Adelman and Michael M. Dworetsky. "Dorothy N. Davis Locanthi" *Physics Today, Aprll 2000, 88.*

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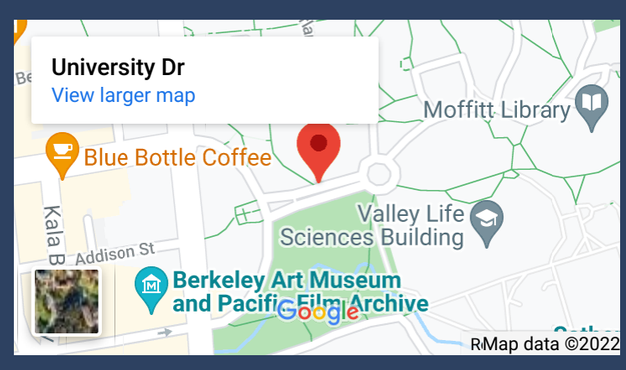

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Cecile Trumpler Weaver

with permission

Cecile Trumpler Weaver (1918-2020) graduated in 1939 with a degree in astrophysics from UC Berkeley. She was the daughter of Robert Trumpler, a faculty member in the Department of Astronomy at UC Berkeley. She was born in Pittsburgh (PA), and moved to Lick Observatory on Mt. Hamilton when she was 2 years old, when her father was appointed to the Berkeley Faculty. She attended the one-room school on Mt Hamilton until the 6th grade. She then lived for 2 years with her grandmother in Lausanne (Switzerland), her parents' home country, where she attended high school. She finished high school in Berkeley (University High, 1935), before enrolling at Cal, where she received her degree in Astrophysics (1939). While at Cal, she met and married fellow astronomy student Harold F. Weaver, who himself was later appointed to the Astronomy Faculty at UC Berkeley, after obtaining his Ph.D. under Robert Trumpler. While at Cal, Cecile calculated stellar orbits by hand.

Although Cecile did not continue in Astronomy, she always remained extremely interested in the field, while taking on a variety of other jobs during her long life. For example, after receiving one of the first Certificates of Religious Education from Starr King School for the Ministry, she became the religious education consultant for the Pacific Coast Unitarian Universalist Council. In 1968, Cecile earned a Masters in Social Welfare at UC Berkeley, and founded the Children's Center in Berkeley to help troubled families. In 1972 she started with the Towne House Creative Living Center in Oakland and became its first director, where she developed a program to help people with mental illness. She later developed similar programs throughout Alameda County. At age 70, Cecile volunteered at the UC Botanical Garden, where she stayed for 25 years, leading tours, scheduled volunteers, and was a carnivorous plant propagator. Meanwhile she began auditing classes at UC Berkeley in geology and planetary sciences, for which she received an (unofficial) "honorary" degree in geology. She was also active with the Chabot Science Center, organizing monthly enrichment lectures for the docents and supporters.

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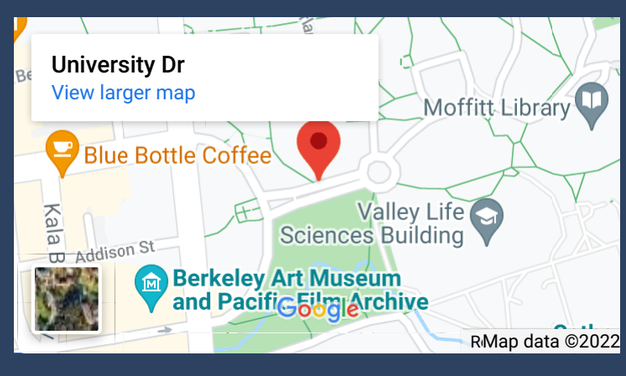

Martha "Patty" Stahr (Carpenter) (1920-2013)

Born in Bethlehem, PA, Martha "Patty" Stahr received a BA from Wellesley College in 1941, majoring in astronomy. Her lifetime interest in astronomy started through a junior high school science club. "I yearned for a telescope of my own,"[1] she recalled. While at Wellesley she built her own telescope with help from the Amateur Telescope Makers of Boston. Stahr earned an MS in 1943 with a master's thesis on the "A Method of Calculating Curves of Growth" and a PhD in astronomy from Berkeley in 1946. Advised by Robert J. Trumpler, she wrote a dissertation entitled "A Study of the Radial Velocities of Faint F and G Starts near the North Galactic Pole."

Papers of Martha Stahr Carpenter, "Martha Stahr Carpenter and Cornell University Radio Astronomy Equipment," NRAO Archives, accessed November 30, 2021, https://www.nrao.edu/archives/items/show/31605

Stahr made observations and measured radial velocities of F and G stars near the North Galactic Pole in an effort to investigate the gravitational force within the Milky Way Galaxy. Stahr also found and measured tilting of the central plane of the galaxy from pioneering radio-wave observations. She was active in the American Association of Variable Star Observers (AAVSO), and contributed 396 visual observations to the AAVSO between 1940 and 1950.

Patty Stahr 1943 in The Blues Chaser Vol. 1, UC Berkeley Astronomy Department

In graduate school Stahr spent 1944–1945 at Lick Observatory, where she used the spectrograph on the 36-inch refracting telescope. She recalled that students would ordinarily never have been allowed to use this instrument, but since it was during war years, "...most of the astronomers had left. There was a discussion as to whether a woman could handle the big telescope, [but] I just went up there. The man was there doing all he could to handle it, and it wasn't before long that I was doing it with him, so they were very glad that the telescope was kept in use, because it was more than one person could handle."[2]

Stahr's first job was teaching astronomy at Wellesley. She required her class in Practical Astronomy to contribute data to the AAVSO. In 1950 Stahr became the first woman faculty member appointed in the College of Arts and Sciences at Cornell University. In 1951 Martha Stahr married Jesse Thomas Carpenter, a labor economist who was 21 years her elder, and went by Carpenter afterwards. For several of her 18 years at Cornell, Carpenter was one of only two-full time astronomy professors. She collaborated with the School of Electrical Engineering project to observe radio waves from celestial objects, such as the sun and galactic center. Cornell established the first research program in radio astronomy at an American university. Carpenter was advisor to eminent astronomer Vera Rubin on her master's thesis.

In the 1950s and 60s Carpenter published the first-ever comprehensive bibliographies of literature in radio astronomy from all over the world, at a time when such information was not well known. In 1968 she and her husband moved to the University of Virginia to be closer to his family. At UVa she began as a part-time instructor and retired in1985 at the level of associate professor of astronomy. Her research encompassed many areas including variable stars, extraterrestrial radio noise and galactic structure. She served the AAVSO as president for several terms during a turbulent time for the organization, which had meant a great deal to her since college.

Carpenter is also the generous donor who made possible The Robert J. Trumpler Graduate Student Excellence Award at UC Berkeley to honor her advisor.

From *Celestial Observers: Sixteen Berkeley Women Doctoral Graduates in Astronomy 1913-1952*
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[1] The quotes and reminiscences of Patty Stahr are drawn from: Kristina Larsen. "Reminiscences on the Career of Martha Stahr Carpenter: Between a Rock and (Several) Hard Places." *JAAVSO Volume 40, 2012, 51*
[2] Larsen, ibid.

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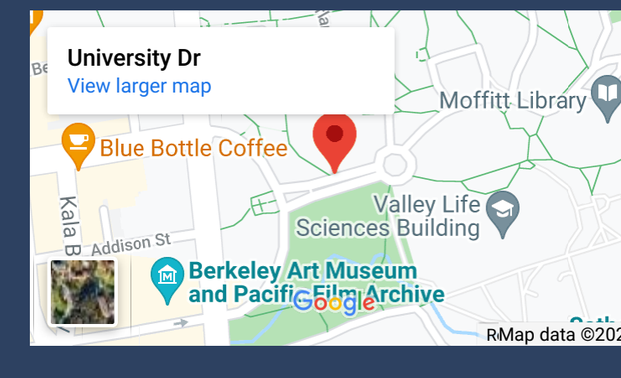

Elizabeth Leonard Scott (1917–1988)

During the late 1940s and early 1950s Berkeley granted doctoral degrees in astronomy and mathematics to several women whose studies were significantly interrupted by World War II. Among them were Elizabeth Leonard Scott, Evelyn Fix, and Julia Robinson. Elizabeth Scott, known as Betty, grew up in Oakland and graduated from Berkeley in 1939 with a bachelor's degree in astronomy. Her family moved to Berkeley specifically so that their children would attend UC Berkeley, with free tuition. At the age of twenty-two Scott wrote her first research publication, about comets. Scott was recruited by Professor Jersey Neyman to help with the war effort in his Statistics Lab. Scott went on to earn a PhD in astronomy from Berkeley in 1949. Advised by Robert Trumpler, she wrote a thesis in two parts. Part I was on "Contribution to the Problem of Selective Identifiability of Spectroscopic Binaries" and Part II was on "Note on Consistent Estimates of the Linear Structural Relation Between Two Variables."

Dept. of Statistics, UC Berkeley

In 2017 a former student, Professor Amanda Golbeck (biostatistics), wrote an extensive biography of Scott: *Equivalence: Elizabeth L. Scott at Berkeley*.[1] Scott's maternal aunt astronomer Phoebe Waterman Haas (profiled above) was undoubtedly an influence. Thirty-five years older than Scott, Haas saw her niece periodically at summertime family gatherings near Annapolis, Maryland. Scott was aware that Waterman was a pioneer whose marriage deterred a professional career in astronomy but who had resolutely continued her work as a variable-star observer. Scott was reluctant to credit her aunt directly: "It is very hard for me to say how much she influenced my going into Astronomy. Certainly, indirectly but not much directly." Golbeck questions why Scott may not have wished to acknowledge Waterman's influence. Scott acknowledged that she sometimes discussed astronomy with her aunt, but not until she was studying astronomy as a Berkeley undergraduate: "My mother's oldest sister had a doctorate in astronomy, but I knew her only as a friendly aunt whose children we played with. She was no longer active in astronomy.... We never talked about astronomy before I was in college, but I did know that astronomy existed and that there were women astronomers."[2]

Mildred Pierce and Betty Scott 1943 in The Blues Chaser Vol. 1, UC Berkeley Astronomy Department

Scott realized that because of discrimination, since women were barred from the use of certain large telescopes, she would have more research opportunities as a mathematician and statistician than as an astronomer. She explained her reasoning: "Well, it is not too often that you can actually put your finger on a discrimination, and you know that you really can prove that it was there. There was no secret about it. Women were not allowed to use the big telescopes at Mt. Wilson, the 60-inch and 100-inch. Women were not on the staff. There are no women on the staff at the Mount Wilson and Palomar Observatories. ... It was just forbidden. That went on for many years."[3] She was appointed assistant professor of mathematics in 1951 and left to join the newly formed Statistics Department at Berkeley in 1955-56. She served as chair of Statistics from 1968-73. However, Scott never abandoned her interest in astronomy, and between 1949-1964 she published over 30 additional papers in astronomy. Scott applied statistics to solve research questions in astronomy.

In 1957, Scott identified a bias in the observation of galaxy clusters, realizing that distant clusters could only be found if they contained brighter-than-normal galaxies, as well as a large number of galaxies. She submitted a formula to correct for what became known as the *Scott effect*. Scott's earlier papers focused on the use of statistical tools to answer important questions in that field, followed by a shift to work using astronomy as the motivation for and application of statistical ideas.

"This series of papers centered on the premise that the universe and its elements were products of random processes. Later papers extended the ideas about distribution of galaxies to more than two regions in space, regions that may or may not be disjoint, as well as extensions to many other statistical properties."[4]

Scott also worked in other areas of statistics. She wrote over 20 papers on cloud seeding, analyzing weather modification research particularly rain stimulation in the 1960s and 1970s. Another focus was the relationship of ozone depletion and skin cancer, research undertaken with an interdisciplinary team.

In the 1970s, Elizabeth Scott carried out rigorous studies on salary disparities between men and women faculty at UC Berkeley and nationwide. With anthropologist Elizabeth Colson, Scott co- chaired a subcommittee of the Berkeley Academic Senate, which published a comprehensive 78-page study of the status of women faculty and graduate students in academia at Berkeley.[5] This extremely consequential report examined not only salary and benefits but also hiring, rates of promotion and tenure, research opportunities and committee appointments, and propelled the drive to hire women in the 1970s. "Considerable disparities in treatment were documented and Scott promptly turned her attention to finding remedies. What Scott was doing here was unique. While most faculty women spent their time simply turning out evidence that they were paid less than their male counterparts were, Scott was collaborating in studies, employing multiple regressions that soon were used by universities in making salary adjustments and came to be widely accepted as evidence in lawsuits. Her work on this topic earned Scott a reputation as Berkeley pioneer in applying statistical methods to research on the status of academic women."[6] The Elizabeth L. Scott Award was established in 1992 to recognize Scott's lifelong efforts to advance the careers of women in academia. Scott's legacy at Berkeley lives on: Berkeley Statistics Professor Bin Yu won the Scott Award in 2018, as did her biographer Amanda Golbeck in 2012.[7] During the 150W celebration of women Elizabeth Scott has been the subject of a talk by her biographer, Professor Amanda Goleck and profiles in the departments of Statistics, Mathematics, and Computer Science Society webpages.

From *Celestial Observers: Sixteen Berkeley Women Doctoral Graduates in Astronomy 1913-1952*
By Sheila Humphreys

[1] Amanda L. Golbeck. *Equivalence: Elizabeth L. Scott at Berkeley* Boca Raton, FL: Chapman Hall, 2017. Golbeck drew on 120 boxes of Scott's papers which are stored by UC's Bancroft Library, but to date are not accessible to scholars because they have never been processed.
[2] Golbeck, idem. 88-91.
[3] An Interview with Elizabeth Scott, "Oral History, the Women's Faculty Club of the University of California, Berkeley, 1919– 1982, Regional Oral History Office, Bancroft Library, University of California, Berkeley, 1983, 149.
[4] David Blackwell, Elizabeth Colson, Susan Ervin-Tripp, Lucien Le Cam, Erich Lehmann, Laura Nader. In Memoriam. Elizabeth Scott. 1988
[5] E. Scott, S. Ervin-Tripp, and E. Colson. *Report of the Subcommittee on the Status of Academic Women on the Berkeley Campus* (Berkeley: University of California, Berkeley, May 1970).
[6] Francesca Webb and Edmund Robertson, "Elizabeth Leonard Scott," School of Mathematics and Statistics, University of St. Andrews, Scotland, August 2007, http://www-groups.dcs.st- and.ac.uk/history/Biographies/Scott_Elizabeth.html.
[7] https://community.amstat.org/copss/awards/scott

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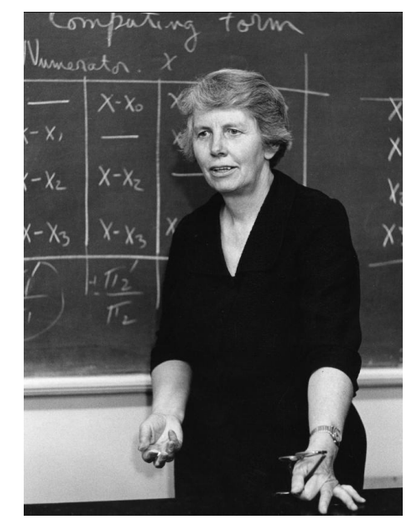

Photo: Ted Streshinsky (with permission)

Helen Pillans (1909 -1984) was a visionary scientist who foresaw the need for college women to study computer science, and acted on that conviction. She and her mother moved to Hawaii after her father died when she was 8, and Helen became fascinated by the stars in the night sky. At age 13, Pillans asked her mother what the sun was, and was shocked to find that she did not know. She attended the University High School in Oakland and graduated from the Anna Head School for Girls. She earned a bachelor's in 1932 and a master's degree in astronomy in 1933 from the University of Chicago. As was typical of women with advanced degrees in science, Pillans was hired by three colleges for women. At Hollins College, she was an instructor in physics and astronomy from 1936-42. Mount Holyoke, where she taught astronomy from 1942-1947, had a strong astronomy program led by women, thanks to the Williston Observatory built in 1881. Thirteen years after earning her master's degree, Pillans returned to California to enter the astronomy PhD program at Berkeley in 1947 and was awarded her doctorate in 1952. While a graduate student, she published articles in 1944, 1947, and 1947 on "Occultation of Stars by the Moon" with her Mount Holyoke collaborator, astronomer Alice H. Farnsworth, who directed the Williston Observatory.

Helen Pillans spent the rest of her career at Mills College from 1957 until her retirement in 1974. At Mills Pillans taught physics and mathematics during the academic year, and astronomy during January term. She spent seven summers as Visiting Associate Professor of Astronomy at UC Berkeley from 1964-. Despite a full teaching load, Pillans continued to write scientific papers through the 1950s for the Astrophysical Journal and Publications of the Astronomical Society of the Pacific. She rose to full professor at Mills, where she was known for her innovative views on education, brilliant teaching, and rapport with students. In 1959 Pillans wrote "Elementary Astronomy" co-authored with Berkeley colleague Professor Otto Struve and astronomer Beverly Lynds, a 1955 Berkeley PhD. This book was intended as general background in astronomy for students studying physical science without mathematical training, and deemed very easy to read and very thorough. Professor Pillans was enthusiastic about engaging the public and lectured widely on astronomy.

"Computers are revolutionizing our whole society and changing our approach to science."

Helen Pillans was ahead of her time in realizing the power of computers. She used one for her dissertation research. In her 1965 article, "A Computer at Mills College?" Pillans explains to Mills alumnae in the evolution of computing in higher education since 1950 and its ubiquitous applications. Calling computers "tools to amplify our intellect," Pillans introduced computing into both science and math courses but also fine arts. She was instrumental in obtaining a National Science Foundation grant in 1968 for Mills to join the regional educational computing network at Stanford. Pillans maintained memberships in the American Association of Variable Star Observers, Sigma Xi, and the Astronomical Society of the Pacific. Always looking ahead, Helen Pillans supported the race to reach the moon which she predicted. "Someday," she said in 1964, "I certainly would like to go to the moon."

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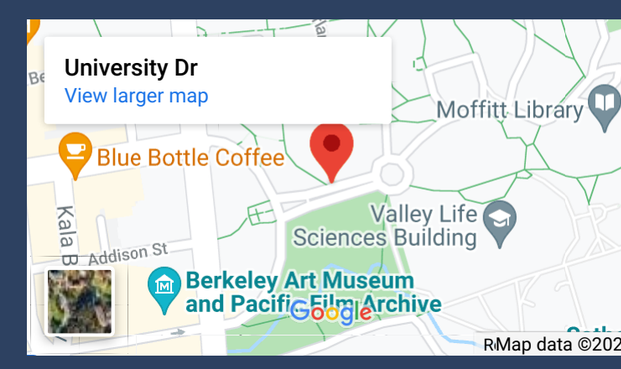

Jill Tarter

SETI Institute

Jill Tarter received her Bachelor of Engineering Physics Degree with Distinction from Cornell University and her Master's Degree and a Ph.D. in Astronomy from the University of California, Berkeley. She served as Project Scientist for NASA's SETI program, the High Resolution Microwave Survey, and has conducted numerous observational programs at radio observatories worldwide. Since the termination of funding for NASA's SETI program in 1993, she has served in a leadership role to secure private funding to continue the exploratory science. Currently, she serves on the management board for the Allen Telescope Array, an innovative array of 350 (when fully realized) 6-m antennas at the Hat Creek Radio Observatory, it will simultaneously survey the radio universe for known and unexpected sources of astrophysical emissions, and speed up the search for radio emissions from other distant technologies by orders of magnitude.

Tarter's work has brought her wide recognition in the scientific community, including the Lifetime Achievement Award from Women in Aerospace, two Public Service Medals from NASA, Chabot Observatory's Person of the Year award (1997), Women of Achievement Award in the Science and Technology category by the Women's Fund and the San Jose Mercury News (1998), and the Tesla Award of Technology at the Telluride Tech Festival (2001). She was elected an AAAS Fellow in 2002 and a California Academy of Sciences Fellow in 2003; she later served as President of the latter. In 2004 Time Magazine named her one of the Time 100 most influential people in the world, and in 2005 Tarter was awarded the Carl Sagan Prize for Science Popularization at Wonderfest, the biannual San Francisco Bay Area Festival of Science.

Tarter is deeply involved in the education of future citizens and scientists. In addition to her scientific leadership at NASA and SETI Institute, Tarter was the Principal Investigator for two curriculum development projects funded by NSF, NASA, and others. The first, the Life in the Universe series, created 6 science teaching guides for grades 3-9 (published 1994-96). Her second project, Voyages Through Time, is an integrated high school science curriculum on the fundamental theme of evolution in six modules: Cosmic Evolution, Planetary Evolution, Origin of Life, Evolution of Life, Hominid Evolution and Evolution of Technology (published 2003). Tarter is a frequent speaker for science teacher meetings and at museums and science centers, bringing her commitment to science and education to both teachers and the public. Many people are now familiar with her work as portrayed by Jodie Foster in the movie Contact.

Biography courtesy of https://www.seti.org/our-scientists/jill-tarter

For another description of her illustrious SETI career see:
https://www.americanscientist.org/article/first-person-jill-tarter

Thoughts by Jill Tarter on her time as a Berkeley grad student:

"Compared to my experiences at Cornell, where I did my undergraduate work as the only female in my entering class of 300 engineers, Berkeley was a breath of fresh air. But then again, not always fresh. My graduate class had three women, and one in the class before us. Arriving on campus, us newbies were invited to the Astronomy Department Chairman's office for an official welcome. The first thing he said to us was "You women are so lucky that all the smart men have been drafted into the Vietnam war." I don't remember anything else he said after that. When we were finally dismissed, we went out to the hallway and shared our anger and disappointment at that start. Having other women as confidants and friends made it much easier than Cornell at least.

When I entered grad school, I was married with a 15 month-old daughter. My first year, I was supported as a TA. Commuting from Danville to Berkeley and trying to pose as the perfect wife and mother in my non-university persona, took its toll on my graduate school commitments. The faculty told me that since I had a husband with a good job I really didn't need the money as much as other grad students, and didn't continue the appointment. I got a job programming a (very primitive by today's standards) computer to operate an optical telescope at Leuschner Observatory. It had an eleven instruction set, and no 'language'; so it had to be programmed in octal, setting all the ones and zeroes. I got good at it, and I liked it.

At the time we didn't know about dark energy or dark matter, but observations were hinting that we had a 'missing mass' problem in our Milky Way Galaxy. My advisor suggested that maybe this mass was hidden in very low mass stars that never managed to fuse H to He, so for the first part of my thesis I attempted to model such objects. Quoting none other than Edmond Land – "Brown is not a color." – I dubbed these faint wannabe stars Brown Dwarfs. It took another 25 years, and a lot of telescope development, to observe the first one, even though they are, in fact, quite abundant.

I was a grad student for a long time. Near the end, I accepted an NRC postdoc at NASA Ames and tried to wrap up my theoretical thesis now titled "The Interaction of Gas and Galaxies Within Galaxy Clusters". One of the terms of that NRC postdoc was that you had to begin it within one year of accepting the position – having already had your thesis turned into the university. My advisor kept having new ideas about the thesis, so he still hadn't signed it near the NRC deadline (the rest of the committee had signed). The very same professor who had insulted us entering female grad students, discovered me in the hallway in my dejected state. Upon hearing why I was so upset, he marched with me to the office of my advisor, and instructed him to SIGN!, which he did. A week later I went off to NASA Ames. "

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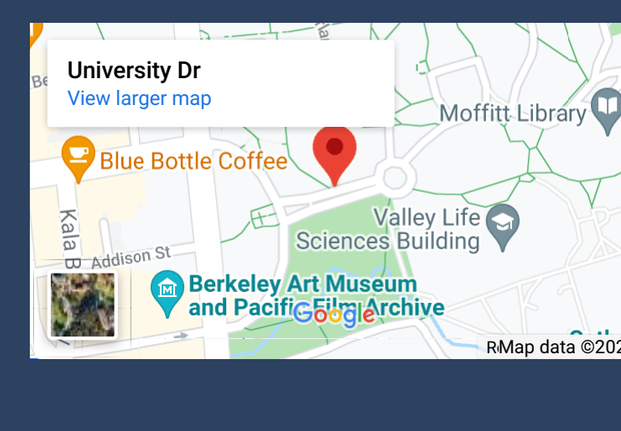

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Imke de Pater

Imke de Pater was the first woman appointed on the Astronomy Faculty, where she quickly advanced through the ranks from Assistant to Full Professor, and finally to "Above Scale," a rank that is reserved for only the top scientists. She has a joint appointment in the Department of Earth and Planetary Science. She served as the chair of the Department of Astronomy from 2010–2015, while she oversaw the building of our present "new" Campbell Hall. At present she is Professor Emerita and Professor of the Graduate School.

She is a planetary astronomer, using telescopes across the electromagnetic spectrum. For her Ph.D. thesis, she used the Westerbork Synthesis Radio Telescope (the premier interferometer at the time, mid-1970s) to map Jupiter's synchrotron radiation in novel ways. Not only did she pioneer the "parallel" dipole configuration on the telescope, she also found ways to create maps at all rotational aspects of the planet, despite the fact that Jupiter rotates in 10 hours, and a full (12-hr) synthesis is usually required to map a radio source. The circularly polarized maps made at the time are today still the best of its kind. She then developed a detailed model to simulate the data, which gave insight into both the magnetic field configuration and the spatial distribution of the radiating electrons. Her work was honored in 1984 with the URSI John Howard Dellinger Gold Medal (usually reserved for senior scientists).

She authored two classic textbooks with Jack Lissauer ("Planetary Sciences", and "Fundamental Planetary Science: Physics, Chemistry and Habitability", with Cambridge University Press); the first book received the Chambliss Writing Award from the American Astronomical Society.

We asked Professor de Pater to reflect on her time at Berkeley and her current research.

"I was appointed to the faculty in July 1983. At the time some faculty members wondered what I would do when "I would run out of planets," a notion that is unthinkable in this era when thousands upon thousands of exoplanets are being discovered. Although I was the only woman on the faculty for 19 years, I never gave this much thought; I always felt very welcome and supported, in particular in the then Radio Astronomy Lab. My time as Chair of the Department, however, was a most challenging period, probably not too surprising in a male-dominated environment.

My research is focused on bodies in our Solar System, using observations at radio, infrared and visible wavelengths. My Ph.D. thesis was focused on radio observations and models of Jupiter's synchrotron radiation.

Some highlights include:

- The impact of comet Shoemaker-Levy 9 with Jupiter in 1994, where I led a worldwide campaign using radio telescopes from all over the world. Simultaneously we also observed at infrared wavelengths with the first 10-m Keck telescope, which had just come on-line the year before. Here we saw in real time a fireball rising up above Jupiter's limb, triggered by the impact.
- We mapped the entire atmosphere of Jupiter at short radio wavelengths, "peering" through the clouds after the Very Large Array had been upgraded. These maps took us all by surprise, as they were as detailed as images of Jupiter from the Hubble Space Telescope, i.e., we saw for the first time Jupiter's Great Red Spot also at short radio wavelengths, providing unique information about its physical conditions, and of numerous smaller storm systems. (see, e.g., https://news.berkeley.edu/2016/06/02/new-radio-map-of-jupiter-reveals-whats-beneath-colorful-clouds/)
- One of my dreams, imaging an active volcano on Io at even shorter radio wavelengths, was finally possible with the Atacama Large (sub)Millimeter Array in Chile. We observed Io essentially moving through Jupiter's shadow. These images revealed a complex system of volcanoes that were spewing out sulfur dioxide gas at high velocities, and that interacted with Io's cold atmosphere when it came back out of Jupiter's shadow. (e.g., https://news.berkeley.edu/2020/10/21/active-volcanoes-feed-ios-sulfurous-atmosphere/)"

You can read more about Professor de Pater's recent research on the Astronomy website news page .

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