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Section II: Women in Academic Disciplines - Physical and Mathematical Sciences

Title

150 years and counting: Co-education and the College of Chemistry

Permalink

<https://escholarship.org/uc/item/7bd8v001>

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Publication Date

2023-12-18

150 years and counting: Co-education and the College of Chemistry

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by Marge d'Wylde

"I have frequently been questioned, especially by women, of how I could reconcile family life with a scientific career. Well, it has not been easy; it required a great deal of decision and of self-sacrifice." Marie Curie, two-time Nobel Prize Winner in chemistry and physics. [1]



Co-ed lecture, South Hall 1898, image: Bancroft Library

The decision to allow women to attend the University of California at Berkeley (Berkeley) as a co-ed institution beginning in the 1870s is directly tied to changes in American and European politics, philosophy, and scientific access that had been radically reoriented during the "long 18th century" (1685-1815); commonly known as the Enlightenment.

During this period, an expanding international class of male scientists created a community of individuals linked by common interests and shared values, who presented their ideas in journals and through scientific organizations. By the late 17th Century, science academies blossomed in London, Paris, and Berlin. As the academies' research value grew, so did governmental interest in their output. Governments began to invest and shape these organizations and their memberships.

Social opinion about advanced education for women also coalesced at this time. During the Renaissance, noblewomen had been able to find niche areas of scientific study and research and held some academic appointments. By the age of Enlightenment, with a few notable exceptions, women were relegated to the position of lab assistants and illustrators. There was such a pent-up demand for scientific education by women that courtesans utilized the famous Paris salons to educate themselves about scientific topics through invited lecturers. They were even publishing journals on science topics to trade amongst themselves. Women were often in the majority at public lectures on scientific topics of the day.[2] and [3]

The rise of these scientific academies increased the professional and educational barriers for women into the 20th Century. Marie Curie, the first person to win two Nobel prizes, was rejected by the French Academy of Science in 1911 because she was a woman.[4]

At the same time in the U. S., women were summarily excluded from higher education until the 1830s when the first women's colleges were founded. The situation remained static until after the Civil War when interest in women's education began to increase and co-education got its start driven in large part by the need for more teachers to handle the increased immigrant population arriving from Europe. The suffragette movement, which also got its start after the War, added access to a college education to its high-profile list of grievances women petitioned for along with the vote.

To maintain control over the increased number of women in the workforce, marriage bars were established restricting women from marrying if they worked as teachers. It is no surprise the practice arose at the same time women began attending universities in larger numbers. Women worked around the law by hiding their marriages or taking their cases to court. These laws eventually went out of fashion but remained on the books in many states until the Civil Rights act of 1964 rendered them unconstitutional.[5]

By the 1880s, American and European universities were reluctantly opening their doors to co-education. The first woman to receive a B.S. in chemistry in the U.S. was Ellen Swallow in 1873. She was admitted to MIT by a special vote of the faculty in 1870. The record states, "it being understood that her admission did not establish a precedent for the general admission of females." She continued her studies at MIT and would have been awarded its first M.S. degree, but the institution balked at giving this distinction to a woman instead awarding the degree to Frederick Fox, Jr. in 1886. [6] and [7]



Berkeley senior co-eds wearing plugs, 1900; image: Bancroft Library

Twenty-one years elapsed before Fanny Rysan Mulford Hitchcock at the University of Pennsylvania and Charlotte Fitch Roberts at Yale received the first chemistry doctoral degrees in 1894.[8] Agnes Fay Morgan, Berkeley's first woman chemist, who did groundbreaking research in nutrition and biochemistry in the home economics department, received her doctoral degree in 1914 at the University of Chicago.[9]

Co-education at Berkeley

Berkeley is in the enviable position this year of celebrating 150 years of co-education. Women began officially registering in 1870 with the Regent's permission, although they had been auditing classes since 1868. [10] Eight* women enrolled that first year. Four years later,

President Daniel Coit Gilman (1872-1875) stated that Berkeley had more women who ranked high in scholarship than men. By 1900, women comprised 45% of the student body enrolled in both undergraduate and graduate programs with a total enrollment of 2,241. At the same time, most U.S. colleges and universities still either excluded women or enforced quotas to keep the numbers low. As of 2019, Berkeley's undergraduate enrollment included more than 16,000 female and 14,000 male students. [11] and [12]

Not everyone at Berkeley agreed with the co-ed policy. As women started to take classes, the common perception was that education interfered with women's roles as wives and mothers. A 1904 address by UC President Benjamin Ide Wheeler (1899-1919) to the Women's Associated Student Government of Berkeley captures this attitude:

"The public-school system of California knows of no difference between men and women, and the University is part of California's public-school system. But the women are not here to be like men. Womanhood is too good, too sacred, to change. Through education women should grow more-true, more-womanly. There is no object in trying to do what men do.... You are not here with the ambition to be school-teachers or old maids, but you are here for the preparation of marriage and motherhood." [13]

Despite this prevailing opinion, the ability of women to take any curriculum including agriculture, chemistry, engineering, and mechanical arts along with literature and classics, paved the way for women to move into the sciences.

The first women students in science

Rosa Leticia Scrivener Ph.B. 1874, Agri



Rosa Scrivener Robinson (1851-1914) was Berkeley's first female science graduate and was closely allied with chemistry. She received her Agriculture degree in 1874. Her senior thesis was entitled: "The Social Development in the San Joaquin Valley".

At that time, all students in the science curriculums were required to study chemistry in their junior and senior years which means Rosa did her chemistry class and lab with the College's first chemistry professor and dean, Willard B. Rising. Rising had arrived in 1872 fresh from his doctoral defense in Germany. She would have used laboratory instruments purchased by Robert Fischer, Berkeley's first chemistry lecturer, during an 1868 trip to Europe. She attended classes in the temporary Oakland campus as South Hall, as the chemistry department's first official home, was not completed until 1873.

Rosa's education and work experience were the topic of a 1901 San Francisco Chronicle article.[14] "It did not take Miss Scrivner [sic] long to avail [herself] of the legislation of October 2, 1870, by which the Board of Regents extended to women all the advantages enjoyed by

men.” The article goes on to describe the not always mild hazing that Rosa and her fellow women students received in their classes from the male students and faculty, who were not used to women in their midst and not particularly happy about the co-ed policy.

Rosa went on to teach in Stockton, Ca. remaining single during her time as a teacher. “...[she] stood faithfully by her post for many years. Finally, when on the verge of nervous prostration from overwork, she preempted land in the northern part of California. It was there she became Mrs. Robinson. She is now a woman of influence and great usefulness in her community.”

Rosa married widower John Robinson in 1891 after she acquired land for a farm from the Bureau of Land Management in Northern California’s Yolo County. She had one son with Robinson and raised an infant stepdaughter from his first marriage. She was accompanied by her mother and a niece. Although there are no details on the kinds of crops the Robinsons raised, Rosa’s degree was apparently an important asset as she was widely tapped as an agricultural advisor in the region.

Rosa believed her time at Berkeley served her well. She commented, “If every ‘co-ed’ were an equally ‘powerful, purposeful personality’ and made an equally good use of the results of college discipline there could be no opposition to co-education.”

The Bragg Sisters

Elizabeth Bragg (Ph.B. 1876, Civil Eng)



Elizabeth Bragg Cummings (1858-1929) and Adah Bragg Holmes (1862-1952) both studied science at Berkeley. Elizabeth received her Ph.B. in civil engineering (the first woman in the country to do so) in 1876. Adah followed as one of the first three women to receive a chemistry Ph.B. at Berkeley in 1881.

Elizabeth was highly gifted in mathematics. She was unhappy at her high school in San Francisco, so her father, Robert Bragg, moved her to the preparatory high school attached to Berkeley where she was required to study Latin in order to matriculate. After high school she went straight into the department of civil engineering. She took all the science track courses, including chemistry, and excelled in them all.

Her course focus was practical surveying. If she had remained at Berkeley for some graduate work, her professors would have recommended her for a position in the draughting rooms of the United States Coast Survey. She decided to teach instead.

According to Elizabeth, “The professors were kind enough to the girls when they stood well, but there was no consideration for them because they were girls. We were hustled along with the

boys. It is true that for the most part we were looked on as interlopers, but we went right along and attended to our work. My work was unusual, and possibly I had less friction than some of the other 'co-eds.' And then I was sort of a boy among boys, and so I managed to get along pretty comfortably.

"Oh, yes, we were looked upon as queer and forward for wanting to [be at] the University and we felt conspicuous, but the little things did not count, and I look back on those days as one of genuine pleasure." [15]

Elizabeth married fellow engineering student George Cummings (Ph.B. Civil Eng, 1881) in 1888 and stopped teaching. They had four sons named George, Robert, David, and Alan.

Adah Bragg (Ph.B. 1881, Chem)



Elizabeth's sister Adah was one of the first three women to graduate in chemistry in 1881. Her fellow students were Kate Sessions and Nellie Sell.

Adah taught after she left school until her marriage in 1891 to Henry Edmond Holmes. They had three children named Henry, Adah and Philbrook. Henry ran a carriage manufacturing business on Folsom Street in San Francisco.

Katherine Sessions (Ph.B. 1881, Chem)



Katherine (Kate) Sessions (1857-1940) had a strong interest in plants when she was a child and is best remembered as the "Mother of Balboa Park." However, it might be more accurate to designate her as the female "Johnny Appleseed" of San Diego.

She was instrumental in the planning and planting of Palm Canyon and the Aloe and Agave Garden. The plants and trees she introduced to the area are now found all over San Diego and beyond. Although San Diego's parks, streets, and gardens are now lush with many shrubs, trees, vines, and succulents from all over the world, at the time Kate arrived there, much of San Diego was empty land. She procured many new species of plants from growers worldwide and introduced those plants to the region. Blessed with a mild climate, San Diego proved to be a fertile growing area for many of these species.

Kate graduated from Berkeley with a degree in chemistry in 1881. She said of her experience, "although I was a university graduate, 30 years ago one got but little of botany and the other natural sciences at college. There were but three or four field days during the whole course. But I loved plants and trees, and I could always make things grow, so I wasn't afraid. I left my home and friends and went to work." [16]

She moved to San Diego in 1884 to teach but she didn't like the work. She started a plant nursery in 1892 initially with two partners, contracting with the city to plant 100 trees a year for 10 years in exchange for a nursery area in the northwest corner of what is now Balboa Park. She is said to have introduced the jacaranda, poinsettia, orchid tree, bougainvillea, bird of paradise, and many other exotic plants now common in regularly used in gardens.

Kate published numerous articles in magazines, newspapers, and journals, including California Garden. She also taught extensively throughout her career and was a founding member of the San Diego Floral Association. Sessions was the first woman awarded the American Genetic Association's Frank M. Meyer Medal. [17]

The College's first doctoral students



Lecture hall, UC Berkeley, 1950; image Bancroft Library

Advanced science degrees had become a requirement for chemistry professorships by the late 19th century. Ambitious male chemistry students went to Germany for one to three years to obtain doctorates or do postdocs. Many of the College's founders, including the College's first dean Willard Rising, received their advanced degrees in Germany and France. G. N. Lewis did his postdoc with Wilhelm Ostwald and Walther Nernst after completing his doctoral degree at Harvard.

Ironically, American women also first received doctoral degrees in Europe. In the 1880s, the only place a woman could obtain a chemistry doctorate was in Switzerland. The celebrated American chemist Rachel Lloyd was the first to receive her Ph.D. at the University of Zurich in 1886. She matriculated not because Zurich was more open minded, but simply because they needed to meet student quotas. [18]

Another irony of Rachel's chemistry experience was that her introduction to the profession was a result of spending time in her husband's lab. In an 1893 interview Rachael said of her early experience:

"The girl-wife dearly loved to perch herself, with some bit of sewing, in the deep window of her husband's laboratory, which was a part of their home, and, as she became familiar with the apparatus and watched the experiments with wondering eyes, she little dreamed that the same work would one day be hers in even more extended fields." [19]

Berkeley's first woman doctoral student was Milicent Shinn (1858-1940) who was a classic example of the brilliance required of young women of the day to be accepted into graduate programs. She finished her undergraduate degree in 1880, edited the journal *Overland Monthly* from 1882 to 1894, and went on to receive her Ph.D. in psychology in 1898; only the eleventh Ph.D. awarded at Berkeley.

Her dissertation, "Notes on the Development of a Child", was published in three installments between 1893 and 1899 and was based on observations of her niece over two years. In 1900, she published a popular version of her findings entitled *The Biography of a Baby*. Her writing received widespread acclaim, and for years her dissertation was considered the foundational text for developmental psychology classes. Even Wilhelm Preyer, her only predecessor in such a comprehensive record, was impressed, and called for the work to be translated into German.

However, Milicent did not practice psychology. Instead, she returned home to care for her aging parents and her brothers' families. She never married.[20]

By the time Willard Rising retired in 1908, only four Ph.D. degrees had been awarded from the College. In 1912, Gilbert Newton Lewis arrived from MIT to serve as dean and build the graduate and research programs. When he left 29 years later in 1941, the number of undergraduate degrees per year had risen to approximately 60, and 250 chemistry Ph.D. degrees had been awarded. Three of those Ph.D.s went to Marjorie Young (Vold) and Maxine Young in 1936, and Helen Louise West (Nutting) in 1937.[21] These women were all contemporaries of the world-renowned chemist Glenn T. Seaborg who received his Ph.D. in 1937.

It would take two World Wars to open Berkeley to women chemistry doctoral students. By the 1930s, the U.S. was heavily embroiled in war research. World War I had cut off ties with German scientists leaving the U.S. with a dearth of chemists to do advanced laboratory research. As World War II ramped up, doctoral programs, including Berkeley, began accepting

women. These first female graduates went on to work in the war effort alongside their male counterparts.

Marjorie Jean Young Vold (Ph.D. 1936, Chem)



Marjorie Jean Young (1913 – 1991) was born in Ottawa, Ontario. She moved to the United States in 1918 and became a U.S. citizen in 1921. She came from a family of scientists dating back to 1895. Her father and grandfather both worked at the Lick Observatory in Oakland as astronomers.[22]

Marjorie was a Berkeley Medalist, colloid chemist, distinguished professor, author, and researcher. Her time at Berkeley was marked by an exceptional educational career. She earned her B.S. in 1934 graduating Phi Beta Kappa. She was the first woman chemistry student to receive the University Medal and was valedictorian that year. She earned her Ph.D. in 1936 at the age of 23 focused on thermodynamic chemistry. Her thesis entitled “The Kinetics and Mechanism of the Reactions between Phenyl-Halogen-Acetic Acids and Halide Ions” was written under the mentorship of Axel Ragnar Olsen [23].

The year she graduated she married fellow student Robert Vold (Ph.D. '35, Chem). They had three children, Mary, Robert, and Wylde, all born during World War II. Marjorie and Robert did a four-year postdoc at Stanford University in the lab of James William McBain who spearheaded major advances in colloid chemistry, introducing thermodynamic descriptions to the previously small and qualitative field. During World War II, she worked as an industrial chemist for Union Oil Company.

Her career was largely devoted to research in collaboration with Robert. Internationally recognized in the chemistry community for their contributions to colloid science, the Volds established the renowned Center for Surface and Colloid Chemistry at the University of Southern California where they both taught and researched. In 1964, Marjorie and Robert published *Colloidal Chemistry*, a popular reference textbook.

She received a Guggenheim Fellowship to teach in the Netherlands in 1953, the only woman chemist to earn that honor between 1940 and 1970. In 1957, she was the first woman to address the Indian Institute of Science in Bangalore, India. She was named one of the Los Angeles Times “Women of the Year” in 1966 and was awarded the Garvan Medal by the American Chemical Society in 1967 for her pioneering work in computer models of colloids.

Marjorie overcame many personal setbacks during her career. She was diagnosed with multiple sclerosis in 1958 and became confined to a wheelchair. She wrote her final scientific paper, “Micellization Process with Emphasis on Premicelles,” at the age of 78. The paper was published posthumously in 1992.

Maxine Barton Bardsley Young (Ph.D. 1936, Chem)



Maxine Barton Bardsley (1906 – 1999) was born in Beaver, Utah. In her high school yearbook, she was described as “scientific, with an interest in swimming, basket, and baseball, the chemistry club, and was a scholarship award recipient.” Her father, Edward Bardsley, was a miner and President of the Mammoth Copper Mine.

It’s not clear what brought Maxine to Berkeley. She did her undergraduate and graduate work at the College receiving her A.B. in 1929, M.S. in 1931, and her Ph.D. in 1935. Her graduate field of study was radiation and atomic structures. E.D. Eastman was her faculty advisor while she worked on her dissertation entitled “Electromotive Force of Calomel Thermocells and the Partial Molal Entropy of Chloride Ion.”

Maxine met her husband, fellow chemist Herbert Alexander Young (Ph.D. 1932, Chem) at Berkeley. Herbert received his Ph.D. in physical and inorganic chemistry. They were married in 1929 and had one son named John in 1938. Herbert stayed at Berkeley as a lecturer while Maxine finished her Ph.D. He began as an assistant professor at UC Davis (then the University Farm) in 1934 and was an assistant chemist in the experiment station. Maxine worked as a researcher.



Women employees of the Manhattan Project operate calutron control panels at Y-12, in a US government photo by Ed Westcott.

As the U.S. moved into World War II, Berkeley scientists became responsible for overseeing the Manhattan Project which was responsible for the atom bomb. A number of Berkeley trained chemists were enlisted by renowned physicist Ernest Lawrence to join the war effort. The Youngs moved to Oak Ridge, Tennessee where Herbert headed up the Y-12 project to produce enriched uranium for the atomic bomb project.

There's no apparent documentation that states what Maxine did at Oak Ridge. However, as a professional chemist, with a background in radiation and atomic structure, she was likely a highly valued resource and worked as a researcher.

After the war, the couple returned to Davis where Herbert became a full professor, and eventually Dean of the College of Chemistry at UC Davis. Maxine resumed her work as a researcher at the University.

Women join chemical engineering



John Prausnitz's lab group in downtown Berkeley late 1970s. Ellen Pawlikowski is in the front row (center); Georgie Scheuerman is in the second row (left). Photo courtesy Georgie Scheuerman.

"I found that the College of Chemistry had a welcoming atmosphere. The faculty, staff and students all worked to make students feel respected. This doesn't mean being a student at Berkeley was easy. But I was part of an academic community that valued and actively included all its members." Georgie Scheuerman

The chemical engineering program (known today as Chemical and Biomolecular Engineering) was formed in 1947 at Berkeley, although it did not get a permanent home in the College of Chemistry until 1957.

Marie Lavering (née Johnson) was the first woman to receive her chemical engineering B. S. in 1950. She went on to teach chemistry and physics in a Bay Area high school. During the early- to mid-1970s the proportion of women in the department grew substantially. By 1977, the undergraduate class contained 13% women.[24] It was at this time that the first women doctoral students entered the program.

Georgianna (Georgie) Scheuerman (née Lobien), Gail Greenwald (née Green) and Sadie Salim were the first three women to receive doctoral degrees in 1980. They were followed by Ellen Pawlikowski (née Prusinski) in 1981. Georgie and Ellen did their doctoral research in the lab of John Prausnitz and were Fannie and John Hertz Foundation Fellows.

Both women arrived at Berkeley with chemical engineering undergraduate degrees from the New Jersey Institute of Technology (NJIT). Ellen states, "Georgie and I both did our undergraduate work at the same school. She graduated two years ahead of me with my husband, Paul. They were friends. Both Georgie and I were valedictorians. When I came to look at the program at Berkeley, she was already doing research in thermodynamics in John Prausnitz's lab which is what I wanted to study. She met me and showed me around."

Georgie comments, "John Prausnitz was the person to study thermodynamics with at the time. He had people from all over the world in his lab. The group looked at things differently because of the diversity of their backgrounds. Professor Prausnitz wanted his students to be well rounded scientists and engineers making it a wonderful place to do research."

John Prausnitz remembers when the women joined the lab. "It was quite unusual to have women in the group back then. They were the first in my lab. Ellen and Georgie were the ones who decided to work with me, not the other way around. I was very pleased to have them and welcomed them being there."

John knew they would be successful. He states, "Ellen was extremely efficient and very good in her people skills. She caught on to new concepts immediately. Georgie had both intellect and personality. It was very clear they would both do well professionally."

Ellen Pawlikowski (Ph.D. 1981, ChemE)



Ellen's summer intern supervisor, David Zudkevitch had recommended Berkeley and the Prausnitz lab when she decided to pursue her Ph.D. Ellen was in the ROTC program and could delay her active-duty service for only four years. The Chemical Engineering department had a rule that new graduate students did not select their research director until their second quarter at Berkeley. Ellen states, "I called and asked John if I could come to his lab and start work immediately. He said yes. It caused a little bit of a stir at the time. He was a really fascinating guy. I was amazed at how effective he was at getting people to do things, especially when he wasn't the subject expert."

Ellen married her husband Paul in the summer of 1980. They met in ROTC at NJIT. Paul was stationed at Mather Air Force Base while she did her research at Berkeley. Ellen joined ROTC during high school. She states, "I joined the program because I was curious. I was in high school at the end of the Vietnam War. I remember seeing pictures and was fascinated by the military. The only ROTC program at my school was Air Force and that's how I was introduced to my eventual career. It was really fortunate. At the time the Air Force had the highest tech and more opportunities for tech engineers particularly as a woman."

Ellen only planned to be in the service for four years but wound up staying because she liked being part of something that contributed to society in a larger way. She continues, "I wound up being a 'high priority' as they were figuring out how to incorporate more women into the Air Force. They were heavily recruiting engineers and so they were very interested in me."

That opportunity led to a forty-year career in the Air Force culminating with her becoming the third woman to achieve the rank of four-star General. She went from the manager of the service's airborne laser program, to its chief buyer of space technology, to ending her career as the head of Air Force Materiel Command before retiring. The command employs some 80,000 people and manages \$60 billion annually, providing the Air Force with advanced technology research and development.

In the fall of 2019, she joined the USC Viterbi School of Engineering faculty at USC as the Judge Widney Professor. She also serves on the board of directors for several companies including Raytheon.

Ellen states, "Looking back on my time at Berkeley I never felt ostracized while I was in John Prausnitz's lab. He got me to an area of research and then said that I would become a world expert. John taught me something fundamental as well. If John didn't know something, he would reach out to his network to get answers."

Georgieanna Scheuerman (Ph.D. 1980, ChemE)



Georgie states, “I entered college expecting to major in electrical engineering (EE). It was the ‘sexy’ major at the time. However, I discovered in my freshman physics class that electricity and electrical engineering just were not that interesting to me. And then I attended a presentation by the EE Honor Society and that clinched it. The president of the local Honor Society was so arrogant and “macho” that I turned my back on EE, deciding to major in chemical engineering in part because the faculty, staff, and students were much more welcoming. I also had found that I really enjoyed chemistry and the engineering that produces important chemicals at industrial scale.”

“As I was completing my graduate work at Berkeley, I decided that I wanted to go into industry and conduct research. There were many opportunities to do this for everyone graduating from the College at that time. I had the good fortune to get a job at Chevron Research Company in Richmond at Chevron’s Research Facility next to the refinery. Also, I met my husband Rick there.”

Georgie worked in research and management at Chevron for 37 years with her home base at the Research Center in Richmond. She worked on projects throughout the U.S. and around the world. She was part of teams that created technology resulting in about 10 U.S. patents that landed her name on the inventor list. Her most important invention was a method for withdrawing a catalyst (particulate solid) from a packed bed. Berkeley is also fortunate to have her sit on the College of Chemistry advisory board.

Some of Georgie’s many projects at Chevron included hydroprocessing, catalyst development for hydroprocessing, fluid catalytic cracking, delayed coking and high throughput experimentation. Her first major project, “On-stream Catalyst Replacement,” was commercialized and is used today to convert heavy oils into useful lighter petroleum products.

She states, “While there have been some teachers, fellow students, and colleagues who I didn’t always enjoy working with, I was most fortunate to have experienced mostly respect and encouragement from my teachers and colleagues throughout my education and career, a career where women were often hard to find.

“This was true both during my time at Berkeley and in my career at Chevron. I have watched many organizational changes over time address the issue of diversity. Today I think we know more, and organizations are recognizing that not just diversity, but diversity and inclusion are essential. “Science is about research but also about relating; learning how to ask questions and study in other areas. I think John Prausnitz tried to do that with both thermodynamics and people. You need to look more broadly at the world.”

Women power up in the '90s



Friends and fellow graduate students celebrate a group birthday in 1994. Top row: Lisa Hernandez, Arti Prasad, Laura Smoliar, and Erica Kuo; Bottom row: Yi-Chyi Wu, Marcia Ziegeweid, and Nerine Cherepy. Photo courtesy Nerine Cherepy.

Laura Smoliar and Nerine Cherepy began their doctoral degrees at Berkeley in 1990. By that time, more than 240 women had received Ph.D.s from the College. Nationally, women were receiving 24% of the doctoral degrees in chemistry. Graduate funding for women was about the same as for men; women's salaries in academia and industry were approximately three-fourths of their male counterparts; about 12% of academic positions were held by women; and women made up about 7.5% of management positions in industry R&D research units.[25]

Laura and Nerine met on the bus between Stanford and Berkeley. They had been accepted into graduate school at both universities. Prospective students traveled to look at the Stanford program, and then visited the College of Chemistry. Laura states, "Nerine and I met on that bus. We remembered that when we showed up and saw each other again on campus for the first time."

Nerine continues, "When we started at Berkeley and saw each other in a class and it was like, 'hey remember me? I met you on the bus. Oh yeah.' We've been friends ever since."

Nerine Cherepy (Ph.D. 1996, Chem)



Nerine's science journey started as a youngster in the mountainous mining region of southern Arizona. She was fascinated by the gems and minerals she collected near her home. She did her undergraduate studies in chemistry at Arizona State University and in her junior year went to the Hautes Etudes d'Ingenieur in Lille, France. Nerine remarks, "It was very difficult and challenging being there, but I really loved it. I was surprised to find it was normal for the French to smoke in the chemistry lab at the time. I did an in-depth experimental chemistry research project that resulted in a published paper and it was then I realized I really enjoyed research."

When Nerine came to Berkeley, she entered the lab of Richard Mathies. She was interested in laser spectroscopy and wanted to study the energetics of photosynthesis. At the time, Mathies was doing Raman spectroscopy on biological and organic systems. Mathies' lab was a large enterprise. She received mentoring not just from Professor Mathies, but also from her fellow graduate students and the postdocs.

After finishing her Ph.D., she went on to a postdoctoral research appointment at UC Santa Cruz in the lab of Jin Z. Zhang. He was doing femtosecond spectroscopy which was then an exciting new laser application. Nerine states, "I did studies with Raman spectroscopy at Berkeley for my doctorate. We had figured out a way to get spectra that people had never gotten before. During my postdoc, I worked with a variety of new materials. A colleague and I found we could extract the dye from California blackberries and use that in a photoelectrical solar cell. No one had ever done that before. To this day it is my most highly cited publication."

She was given the opportunity to be a lecturer at Santa Cruz but found teaching a 350-student class a challenge. Nerine comments, "I asked my colleagues what I should do. They said that I was a really good researcher, had great ideas, and that they valued how I had helped them design and interpret their experiments.

"I interviewed with several companies but couldn't find a good match. I got lucky with Lawrence Livermore Lab. They were happy to hire me, and I've worked on all kinds of research projects related to light, optical materials and energy conversion. I've had the job assignment of 'Research Scientist' ever since."

She joined Lawrence Livermore National Laboratory in 1998. Since 2005, she has worked on the development of new light-emitting materials including single crystals; transparent ceramics and

plastics for various uses in ionizing radiation detection; and new imaging screens and lighting phosphors. To date, she is an inventor on 18 awarded patents and has published 146 papers.

Laura Smoliar (Ph.D. 1995, Chem)



Laura was born and raised in New York City. Her mother Barbara worked for Nobel Laureate Rosalyn Yalow who had established a radioisotope laboratory at the VA Hospital in the Bronx. Laura's introduction to science began when she would visit her mother and play in the lab while she was at work.

Laura did her undergraduate degree at Columbia College where she studied with Brian Bent who was a student of Gabor Somorjai. Laura decided to do her doctoral work at Berkeley but was conflicted about whether she should work for Gabor Somorjai or Nobel Laureate Yuan T. Lee. She was interested in working with molecular beam surface scattering and her work straddled both of their research areas. Somorjai settled it for her by telling her to work with Lee but that he would be available as well to mentor her.

Laura states, "Yuan wasn't around very much. He was always traveling. You have to remember this was before the internet and email. His big thing was the fax machine. Before he went on one of his trips, I would visit him and he would give me his itinerary, including hotels, and their fax numbers. If you sent him a fax, he would respond within 24 hours. I think he got his best work done on airplanes."

Lee returned to his home country of Taiwan to serve as President of Academia Sinica in 1994. Laura spent her last year of graduate school working with Lee in Taiwan and then did a postdoc as an Academia Sinica Fellow. She says, "My experience in Taiwan changed the course of my career, and I have worked collaboratively with companies and institutes in Asia ever since."

Laura started her career working for several companies in Silicon Valley. She founded her first startup in 2005 getting experience in licensing technology and raising financing. She sold it and started a second firm with her husband, electrical engineer Mark Arbore. After they sold the firm in 2013, Laura joined up with fellow doctoral student Ted Hou (Ph.D., 1995, Chem), who had also studied with Y.T. Lee, to form Global Innovation Foundry. In 2017, working with the College of Chemistry, they started the Berkeley Catalyst Fund, a venture capital fund aimed at commercializing research from the College, Berkeley Lab, and UCSF and structured to financially benefit the college.

Laura and Nerine's friendship has continued in interesting ways throughout their careers. Laura comments, "At one point I had a small company that did a lot of work with Japanese clients. A client showed me a picture of a group of people one day and said they were trying to get access to some particular technology from Livermore. I looked at the picture and thought 'Wow, that's

Nerine.’ They looked at me and said, ‘Do you know Nerine?’ They thought Nerine was a goddess. I told them she was my graduate school roommate. They asked me to arrange a meeting with her. We ended up doing a complicated license deal with Livermore to get them access to the technology. I think it was not long after the Fukushima Daiichi nuclear disaster.”

Laura continues, “I think it was hard to find jobs when Nerine and I came out of the university. The economy wasn’t great. Also, the workplace was very different. It has radically changed since then. For instance, many people go into startups now. That option wasn’t available when we looked for work.”

Nerine agrees. “I think the roles of men and women in the workplace have benefited from a greater open mindedness that is starting to emerge. There’s more acceptance of a woman as a creative force behind a team today. I think it’s quite an improvement.”

It will be very interesting to see what the landscape for women in science looks like 150 years from now.

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* The online version of this article has been updated to correct the initial enrollment numbers for women based on The Centennial Record of the University of California, 1868-1968.

<https://pages.github.berkeley.edu/OPA/our-berkeley/enroll-history.html>

This article was originally published here:

<https://catalyst.berkeley.edu/2020/05/27/150-years-and-counting/>