Early Women Chemists of the Northeast[1]

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ABSTRACT

Few women chemists in the early part of the twentieth century followed what would be considered traditional courses in chemistry or biochemistry. The lives and careers of women from the Northeast who followed different pathways to success are discussed.

The women from Mt. Holyoke are considered, including Emma Perry Carr, Mary Lura Sherrill, and Lucy Pickett who formed one of the early research groups in order to achieve success and recognition for their work. Other women who followed a variety of routes included Pauline Beery Mack at Penn State, Mary Petermann at Sloan Kettering, Mary Caldwell at Columbia, and Helen Dyer at NIH. Katherine B. Blodgett, the first woman to get a Ph.D. in Physics at Cambridge and whose lifetime was spent working on physical chemical problems at General Electric is also discussed.

Contributions and accomplishments of several other women chemists from the Northeast, who were also recipients of the Garvan Medal, are discussed.

In the early part of this century, chemistry was basically a man's discipline. It was not a field in which women were expected or allowed to excel. A few very talented women, however, struggled to become successful chemists and biochemists, and won. Their advances have opened the way for the aspiring women chemists of today. These women, coming from different backgrounds, discovered very different routes to success and recognition. Although talented women were working nationwide, some of the greatest advances were made in the Northeast.

One of the most successful of the early research groups was that formed by the women of Mt. Holyoke, including Emma Perry Carr, Mary Lura Sherrill, and Lucy W. Pickett.

Emma Perry Carr received most of her undergraduate and graduate instruction at the University of Chicago and graduated in 1905 with a B.S. in Chemistry. She earned her Ph.D five years later and immediately began a long teaching career at Mt. Holyoke College, including 33 years as chairman of the Chemistry Department. During these years, her emphasis on group research gained for her department, as well as herself, a reputation of excellence among women's schools.[2]

Her research was concentrated in the field of physical chemistry. The research that earned for her in 1937 the first Garvan Medal ever awarded was her study of the electronic spectra of aliphatic hydrocarbons through the use of absorption studies in the far ultraviolet. After her first work appeared in 1929, she gained the support of the National Research Council and the Rockefeller Foundation. The research group that she put together, utilizing the work of other professors and a long progression of students, became one of the best models of this type of group research. Even more significant is the fact that it was achieved at an institution concentrating on undergraduate study. The work of the Mt. Holyoke research group contributed to a better theoretical basis of the energy relationships involved in ethylenic unsaturation. Her advances were later applied by petroleum chemists.[3]

Dr. Carr received many honors for her work, including four honorary degrees. The Northeastern Section of the American Chemical Society recognized her exemplary teaching career with the James Flack Norris Award in 1957. She was an active member of Phi Beta Kappa, Sigma Xi, an honorary member of Sigma Delta Epsilon and Iota Sigma Pi, and many other professional organizations. She was also a delegate to the International Chemical Union in 1925, 1926, and 1936. Dr. Carr remained active in Mt. Holyoke's program long after her retirement. She died in 1972 at the age of 92.[3]

Mary Lura Sherrill was a colleague of Dr. Carr at Mt. Holyoke and in the research group there. She received her B.A. and M.A. at Randolph–Macon Women's College in 1909 and immediately began teaching there. In 1918, she went to the Woman's College of the University of North Carolina and in 1920, she became a chemist at the Edgewood Arsenal for the Chemical Warfare Service. Finally, in 1921, she embarked on her long teaching career at Mt. Holyoke College where she remained for 34 years. She participated in the group research which studied ultraviolet absorption spectra of unsaturated hydrocarbons. This work required a high standard of sample purity. The accuracy of her work was later upheld by spectra prepared by the American Petroleum Institute.[3]

World War II was Mary Lura Sherrill's next opportunity to gain recognition for her work. Supported by the Office of Research and Development, she and her students initiated research on new antimalarial drugs. The synthesis of aminobenzothiazole derivatives became more important in the 1970's during research aimed at the drug-resistant malarias of Southeast Asia. This type of group research which involved faculty colleagues, and especially students, was typical of Mary Lura Sherrill's career. Among her many honors were the James Flack Norris Award for outstanding achievement in the teaching of

Chemistry, awarded by the Northeastern Section of the American Chemical Society in 1957, and the Garvan Medal, awarded by the ACS in 1947. She died in 1968 at the age of 80.[3]

Lucy W. Pickett was the third member of the Mt. Holyoke research group. She received her A.B. and M.A. from Mt. Holyoke College in 1925 and 1927 and received her doctorate from the University of Illinois in 1930. She immediately began teaching at Mt. Holyoke where she remained until 1968 when she was designated an emeritus professor. She served six years as chairman of the Chemistry Department.[4]

Dr. Pickett worked with Dr. Carr and Dr. Sherrill on vacuum ultraviolet techniques of analyzing simple organic compounds, a process that has become important in the petroleum industry. Dr. Pickett received the Garvan Medal for her work on far ultraviolet spectroscopy in 1957.[4]

The Mt. Holyoke research proved that group research was a very efficient use of the scarce resources of time and money. By working together, these women were able to gain recognition for their research and advances, as well as continue and further their teaching careers. Together they made Mt. Holyoke an outstanding research institution in Chemistry.

Pauline Beery Mack gained recognition for her outstanding work in the field of nutrition. She received her undergraduate training at Missouri State University where she also received her first research experience. She then went on to get a master's at Columbia University in 1919 and her doctorate in 1932 at Pennsylvania State University where she began her career in education. During her first 15 years, she taught elementary chemistry courses for home economics majors. Her goal was a research/teaching position in physical chemistry but because she was a woman, most universities would not even consider that. In this period, her reputation for teaching excellence grew.[5]

Dr. Mack's main research centered on the calcium chemistry of bone. In 1927, she began research that she would continue for 23 years on a method of measuring the density of calcium in the bone structure of living subjects through the use of x-rays. She then used this process to study the retention of calcium in the human body and in other animals. In 1940, Dr. Mack was made the first director of the newly formed Ellen H. Richards Institute, a departmental research group named for the first woman graduate in chemistry from the Massachusetts Institute of Technology. This institute studied the chemistry of nutrition, textiles, and household materials. The Pennsylvania Mass Studies in Human Nutrition, begun in 1935 and supported by the state of Pennsylvania since 1936, is said to be the longest running research project in nutrition.[5]

Pauline Beery Mack became Dean of the College of Household Arts and Sciences of the Texas State College for Women in 1952 and Director of its Nelda C. Stark Research Foundation in 1966. She was a member of many professional societies, including Iota Sigma Pi, in which she served as National President; the American Chemical Society, from which she received the Garvan Medal in 1950; and Phi Beta Kappa Associates. She also received the "Silver Snoopy" from the American Astronauts in 1970. She died in 1974.[5]

Mary Locke Petermann received recognition as the first woman member of the Sloan–Kettering Institute for Cancer Research. She received her undergraduate training at Smith College, graduating in 1929. Her doctoral degree was earned at the University of Wisconsin in 1939, where she then became the first woman chemist on the staff of the University of Wisconsin. During World War II, under the auspices of the National Defense Research Council's Committee on Medical Research, she researched the properties of human serum albumin and discovered methods of purifying it for use as a substitute for blood. She also found a method for the purification of immunoglobulins which is now a treatment for mumps. In 1945, Dr. Petermann began work at Sloan–Kettering in New York in nucleoprotein research.[6] She became the first to isolate, characterize, and measure

the ribosome. For a short time, they were even called "Petermann particles" before they were formally named. Using ultracentrifugal analysis and electrophoretic analysis, she showed that the ribosomes of normal and abnormal mammalian tissues differed in some ways.[7] In 1966, Dr. Petermann became a full Professor of Biochemistry at Sloan-Kettering Institute Graduate School of Medical Sciences at Cornell University where she worked until her retirement in 1973.[6]

Dr. Petermann received the Garvan Medal in 1966 for her work in cellular chemistry. She also received the Alfred P. Sloan Award in Cancer Research in 1964 for her work linking ribosomes to cancer. In 1974, Dr. Petermann formed the Memorial Sloan-Kettering Organization for Professional Women. She died in 1975 at the age of 67.[6]

Mary Letitia Caldwell has been recognized for her work in carbohydrate enzymology. She received her A.B. from Western College for Women in 1913 and her A.M. and Ph.D. from Columbia University in 1919 and 1921 respectively. She began a teaching career at Columbia in 1922 that continued until her death in 1972.[3]

Dr. Caldwell began her research on malt amylase in 1918—research that was to take her a lifetime. She used group research, including the work of many graduate students, which was paid for by foundation and industrial grants. Enzymology has been changed radically by her research. Many of her techniques are now standard practice in universities and industry. She studied the properties and reactions of highly purified amylases, becoming the first to prepare crystalline pancreatic amylase. The research group also showed that amylases were proteins, and identified what triggered their activity. Finally, they demonstrated that all alpha-amylases do not have the same action mechanism. Mary Caldwell received the Garvan Medal in 1960 for her outstanding contributions in the field of enzymology.[3]

In reality, Dr. Caldwell had two careers. One was her research; the other was her dedication to the administrative duties of the Chemistry Department at Columbia. She served for over thirty years as an adviser in charge of assigning teaching assistants and guiding graduate admissions and research. At the same time, Dr. Caldwell served as secretary of the department and as a financial adviser to graduate students.[8]

Katherine Burr Blodgett earned her B.S. from Bryn Mawr in 1917 and her M.S. from the University of Chicago in 1918. In 1926, she became the first woman to receive a Ph.D. in Physics from Cambridge. She began her research career as the first woman at General Electric research laboratories in 1918. She got this position with the help of friends in GE and the labor shortage caused by World War I. She assisted Dr. Irving Langmuir in his work on monomolecular films. This group research, including several other prominent chemists at GE, resulted in the production of "invisible" glass in 1938, a product now standard in all cameras and optical equipment.[9] Successive one-molecule thick layers of transparent soap are applied to a lens in order to cut down on reflection. She then devised a method and a gauge to measure the thickness to one microinch of films based on color comparisons. Other research included the improvement of tungsten filaments in electric lights, ridding airplane wings of ice, and developing a new smoke screen during the second World War.[10]

Katherine Blodgett received the American Association of University Women Achievement Award in 1945 and the Garvan Medal in 1951 for her work with monomolecular films. She died at the age of 81 in 1979.[10]

Gertrude B. Elion made advances in Biochemistry and Pharmacology. She received her A.B. at Hunter College in 1937 and her M.S. at New York University. After a few years of shifting from company to company in menial jobs, she found her place at the Burroughs Wellcome Research Laboratories in New York in 1944. The wartime manpower shortage was the boost that she needed to land a good research job.

At Burroughs Wellcome, she synthesized Allopurinol (Zyloprim) which reduces the formation of uric acid. This drug is effective against gout and other diseases.

Azathioprine (Imuran), another of her drugs, is an immunosuppressant used in organ transplants. In fact, it was utilized in the first human heart transplant. She also synthesized 6-mercaptopurine which is used to treat children with leukemia. She was the recipient of the Garvan Medal in 1968 for her advances in pharmacology and chemotherapy.[11]

Sarah Ratner received her A.B. and M.A. at Cornell University in 1924 and 1927 and her Ph.D. at Columbia University in 1937. She began teaching at Long Island College of Medicine in 1926. In 1930, she moved to Columbia University's College of Physicians and Surgeons. She went to New York University's College of Medicine in 1946 where she was appointed adjunct associate professor of biochemistry in 1954. That same year, she joined the Public Health Research Institute of New York City.[12]

Dr. Ratner's research in the area of amino acids metabolism has gained recognition for her as well as her colleagues. Her first work studied the reaction of cysteine and formaldehyde. Later she applied isotopes to research in amino acid metabolism. In 1945, she initiated research in the utilization of enzymes in this process. This was a great step toward the eventual discovery of the mechanism of urea synthesis. As part of this research, she helped to study a children's mental deficiency associated with one of these enzymes.[12]

Dr. Ratner received the Carl Neuberg Medal of the Society of European Chemists in 1959. She was also the recipient of the Garvan Medal in 1961 for her research on the effect of enzymes on protein production.[12]

Gertrude Erika Perlmann received her D.Sc. in chemistry and physics from the German University of Prague in 1936. In 1939, she came to the United States, joined the staff at Harvard Medical School, and in 1945 became a naturalized citizen. She joined the Rockefeller Institute in New York that same year where she remained until her death in 1974 at the age of 62.[13]

She used electrophoresis in several research projects on proteins. She was the first to link phosphate with the stabilization of protein structures, showing that the phosphate group in pepsin forms a diester in the polypeptide chain, creating a loop. She then thoroughly researched the structure of pepsin. She described its atomic arrangement, its use in digestion, and the structure and properties of pepsinogen when it is activated.[14]

She authored many publications on protein and enzyme chemistry. Dr. Perlmann received the Garvan Medal in 1965 for these studies on protein structures.[14]

Mary Engle Pennington was one of the first chemists to study the structures and reactions of perishable foods. She received her Ph.D. at the University of Pennsylvania in 1895. In 1898, she began teaching at Women's Medical College, specializing in bacteriology. She was consulted by doctors nationwide, and by the city of Philadelphia, on the care of perishable foods, including the refrigeration of milk. In 1908, Dr. Pennington helped to implement the Federal Food and Drug Act by setting up and directing a laboratory for the Department of Agriculture. This installation researched methods of ascertaining the quality of such perishables as eggs, poultry, and fish. This work led to many improvements in the food storage and transportation industries. Dr. Pennington was a U.S. delegate to the first three meetings of the International Congress of Refrigeration.[3]

In 1919, she became the manager of the research and development division of the American Balsa Company in New York. Finally, in 1923, she established her own office in New York City as a private consultant on the bacteriology of perishables. She maintained this office until her death in 1952. During World War II, she was called in by the War Shipping Administration. As Director of the Household Refrigeration Bureau of the National Association of Ice Industries, she did research on frozen foods.[3]

Mary Pennington was a member of numerous professional societies and the author of many publications. She was the recipient of the Garvan Medal in 1940.[3]

Helen M. Dyer has made startling advances in the field of cancer causation and nutrition. She earned her B.A. from Goucher

College in 1917 and her M.S. and Ph.D. from George Washington University in 1929 and 1935 respectively. Her first teaching experience was at the Mt. Holyoke College in 1919 and 1920 where she taught physiology. She then returned to Washington, D.C. and went to work at the Hygienic Laboratory in its department of Chemotherapy under Dr. Carl Voegtlin. After a few years, she left the laboratory to study at George Washington University where she began to teach in 1930. In 1942, she rejoined Dr. Voegtlin, then at the National Cancer Institute where she helped with the establishment of its chemotherapy program.[15]

Her research work has laid the groundwork for other research projects. She showed the relationship between vitamin B_6 and N-2-fluroenylacitamide in the production of abnormal tryptophan metabolites. This research led to various studies into the carcinogenic effects of this reaction. In 1938, Dr. Dyer made a breakthrough in biochemistry by synthesizing the ethyl analog of methionine expecting to find a methionine dietary substitute. Instead, she found that the analog is extremely toxic. This discovery added a new field in medical research and pharmacology. In 1949, Dr. Dyer collected and reduced a tremendous amount of literature into an index of tumor chemotherapy. More recently she has shown that there is an inverse relationship between the level of serum glutamic-oxalacetic transaminase (GOT) and the growth rate of liver tumors.[15]

The result of Dr. Helen Dyer's research has been over sixty publications. Today she is working as a consultant in the Washington D.C. area. She is a fellow of the AAAS, and a member of the ACS, Sigma Xi, Iota Sigma Pi, and other professional societies.[13]

The lives and careers of these women have inspired other talented women to enter a field that was once closed to them. Although their careers were very different, some similarities are apparent in their different paths to recognition. First, the influence of the two world wars on the supply of talented men and on the supply of good research jobs seems to have been a crucial factor in many of these women's "first break" and added new opportunities for others who already had distinguished themselves in chemistry. Among these women were Mary Petermann, Katherine Blodgett, Gertrude Elion, Gertrude Perlmann, and Mary Pennington. Another similarity is the use of group research. The women of Mt. Holyoke College are perhaps the best but not the only example.

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