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Foremothers in STEM: Celebrating the work of Catholic sister scientists

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ABSTRACT

Some of the earliest and most influential women scientists in the U.S. have been Catholic sisters. Yet their stories and scientific contributions are not widely known. Why did these sisters pursue scientific study, in what ways did they contribute to science, and how did their experiences compare to that of other women scientists? Using archival data from women's religious communities to which they belonged and universities where they were employed, this qualitative multiple case study explored the occupational motivations, scientific contributions, and experiences of three U.S. Catholic sister scientists. Similarities between the experiences of sister scientists and other women scientists included mentoring, marginalization, and religious discrimination. What differed in the experiences of sister scientists was their financial obligation to and support from their religious communities, and their regard of science as worship. This article brings to light the significant scientific contributions of three Catholic sister scientists as a way to honor their previously overlooked work and to document their lived experiences for the benefit of other women in STEM and those considering a career in STEM.

KEYWORDS

Catholic sisters; women scientists; STEM; case study; nuns

Foremothers in STEM: Celebrating the work of Catholic sister scientists

Some of the most influential women scientists in the U.S. have been Catholic nuns, or sisters. In *Women Scientists in America* (1995), Rossiter identified 21 “notable nuns in science” (p. 209) for the 1950-1970 period, a time in which women scientists were essentially “invisible” (p. xiii) or “camouflaged” (p. xviii). As was typical for the time, most Catholic sisters with advanced science education were faculty in the science departments of Catholic women’s colleges. Often, they used their knowledge and experience to promote interest in science among their female students. As an example, Sister Mary Kenneth Keller, a member of the Sisters of Charity of the Blessed Virgin Mary in Dubuque, Iowa, and co-developer of the BASIC computer language, was the first woman in the U.S. to obtain a Ph.D. in the burgeoning field of computer science in 1965. That same year Keller accepted a position at Clarke College, a Catholic women’s college, and started one of the first computer science departments in the U.S. Her efforts to increase women’s interest in computer science included her policy of allowing working mothers to bring their young children with them to class (Cavanaugh, 2017; Clarke University, 2012). Yet, despite such important scientific contributions and influence in promoting science for girls and women, the work of U.S. Catholic sisters in science remains largely unknown.

While conducting a study of the contributions of Catholic sisters to U.S. public higher education, my attention was captured by sister scientists who had done exceptional work in their respective disciplines. However, I was able to find little written about their careers as scientists or their scientific contributions. Responding to calls for additional research on the lived experiences of women in STEM, the purpose of this qualitative multiple case study was to explore the career motivations and experiences of three U.S. Catholic sister scientists, as well as their contributions to science. The research questions that guided this study were:

RQ1: Why did the Catholic sisters choose careers as scientists?

RQ2: How did the Catholic sisters contribute to the field of science?

RQ3: How did the Catholic sisters’ experiences as women scientists compare to those of other women scientists?

Literature review

In order to address the continuing problem of women’s underrepresentation in STEM fields, Blackburn (2017) called for further research documenting the lived experiences of women in STEM. At the same time, authors advocate for acknowledging the historical contributions of women to science (Lee, 2013; Rossiter, 1993; Witter, 2019), and role model biographies that challenge typical STEM stereotypes have been shown to have a positive effect on both STEM and non-STEM undergraduate students’ interest in STEM fields (Shin, Levy & London, 2016). As author and illustrator Rachel Ignatofsky noted, she was compelled to

create a book featuring 50 pioneering female scientists when she “realized women aren’t just underrepresented in STEM, itself – the stories about their contributions don’t get much play either” (Franz, 2017). This absence of women scientists’ stories led me to frame this study using muted group theory (Ardner, 1978, 2005), which “attempts to represent nondominant or marginalized groups whose voices and experiences are often overlooked or silenced” (Boylorn, 2013, p. 7). Catholic sisters, along with women scientists, have been marginalized, particularly in the last century. Thus, muted group theory is especially well suited to support this study which focuses on women who are members of both groups.

METHODS

To address the research questions, I developed individual case studies of three sisters’ careers, looking for answers to how each became a scientist, what her scientific contributions were, and how her experiences compared to those of other women scientists. Each of the three sisters comprised a case: Sister Monica Asman (1920-2016), Sister Veronica Mary Maher (1931-2017), and Sister Miriam Michael Stimson (1913-2002). Data collection occurred from March 2018 to August 2019. Data which informed the study were found in ministry records, CVs, newspaper articles, newsletters, photographs, obituaries, and oral histories provided by archives of religious communities to which the sisters belonged. Additional data in the form of schedules of courses, catalogs, commencement programs, photographs, newsletters, and oral histories were obtained through archives or web sites of universities where the sisters worked. After a within-case analysis of each sister’s case, I compared the three cases looking for differences in a cross-case analysis (Merriam, 2001). Using concept coding (Saldaña, 2016) I reviewed the literature on women in science and compared my findings from the three cases to arrive at similarities and differences in their experiences.

RESULTS

Due to space limitations I will focus on the similarities and differences between the sister scientists and other women scientists rather than also discussing the cross-case analysis. The themes which emerged for similarities between the two groups were mentoring, marginalization, and religious discrimination. Differences appeared as themes of financial support and science as worship.

Career motivations

Of the three women, only Sr. Monica Asman’s records did not reveal a clear reason for her decision to pursue a career in science. It is likely, however, that similar to Sr. Veronica Mary, she was influenced by her religious community’s need for a science teacher, as she taught at schools staffed by her order, Sisters of St. Francis, from 1944 to 1962. Sr. Monica was one of eight women (all Catholic sisters) and 52 men to receive a Ph.D. from the University of Notre Dame in 1966. On receiving her doctorate in biology, Sr. Monica transitioned from primary and secondary education to higher education at Santa Clara University where she was an instructor of biology from 1966 to 1971. Sr. Monica concluded her career in science with a nearly twenty-year stint as a staff research geneticist at the University of California (U.C.) – Berkeley from 1968 to 1987 (Sisters of St. Francis Provincial Archive, n.d.).

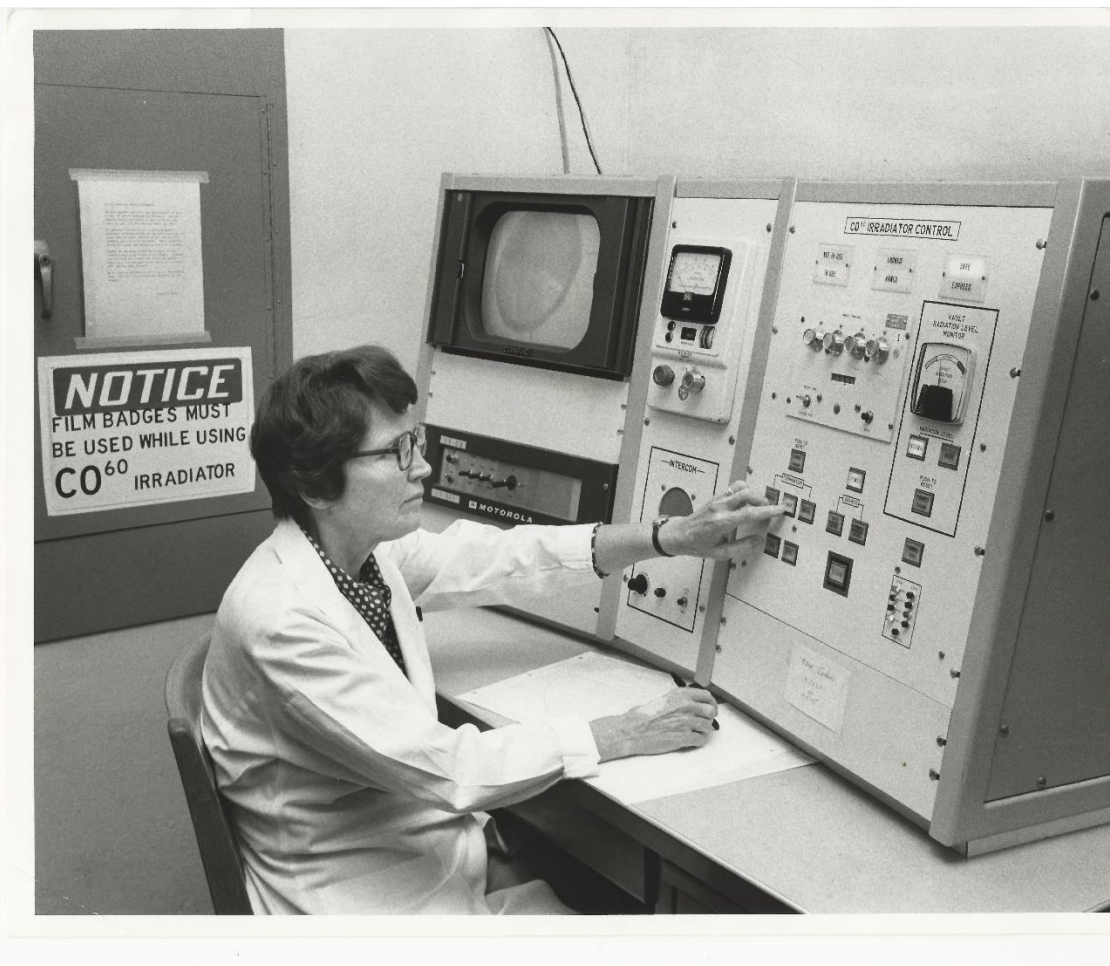


Fig. 1 U.C. Berkeley Lawrence Radiation Lab. Sr. Monica Asman, circa 1970s.

Sr. Veronica Mary Maher embarked on a career in science after the religious order she intended to enter, Sisters, Servants of the Immaculate Heart of Mary, asked her to major in science because it needed science teachers to staff its schools. After receiving her bachelor's degree in biology from Marygrove College, Sr. Veronica Mary taught general science, biology, and other courses for middle and high school students at Catholic schools in Monroe and Detroit, Michigan from 1951 to 1964. With a scholarship from the National Science Foundation, Sr. Veronica Mary attended the University of Michigan and earned a master's degree in biology in 1958. She was the only woman in the program, along with 30 male high school teachers. In 1968, Sr. Veronica Mary earned her Ph.D. from the University of Wisconsin in molecular biology, aided by a scholarship from the National Cancer Institute of the National Institutes of Health. Sr. Veronica Mary began work at Michigan State University in 1971 and remained there until 2009, immersed in cancer research, co-founding and co-directing the Carcinogenesis Laboratory, and serving as Professor of microbiology and molecular genetics, and biochemistry and molecular biology, Associate Dean for graduate students, and Director of medical

scientist training program in the College of Osteopathic Medicine (Sisters, Servants of the Immaculate Heart of Mary Archives, n.d.).



Fig 2 Sisters, Servants of the Immaculate Heart of Mary Archives. *Sr. Veronica Mary Maher.*

With an affinity for science from a young age, Sr. Miriam Michael Stimson originally intended to pursue a career in medicine. However, her experiences with the Dominican sister teachers at St. Joseph Academy, a Catholic girls' boarding school in Adrian, Michigan, led her to enter their order at the age of 19. Unlike the other sisters in this case study, Sr. Miriam Michael never taught at elementary or secondary school. Instead her order sent her to the Institutum Divi Thomae, a Catholic graduate school in Ohio, to prepare her to teach in their college. Sr. Miriam Michael earned a master's degree in physical organic chemistry in 1939 from the Institutum. She then returned to Siena Heights College in 1939 (previously St. Joseph College), as a member of the science faculty. Sr. Miriam Michael earned her Ph.D. in physical organic chemistry from the Institutum Divi Thomae in 1949. She spent the majority of her career (1939-1968; 1978-1998) at Siena Heights and was progressively promoted, holding the titles of Professor, Department chair, Director of graduate studies, and Professor emerita (Dominican Sisters Archive, n.d.; Tsuji, 2004).



Fig 3. Adrian Dominican Sisters Archive. *Sr. Miriam Michael Stimson, 1970.*

Scientific contributions

Sr. Monica was a world expert on mosquitos and her lifelong work was genetic alteration which she carried out by irradiating colonies of mosquitos. Working as a member of a research team at the University of California – Berkeley, Sr. Monica helped provide the first demonstration that genetics determine the susceptibility of mosquitos to a virus. Her work resulted in the creation of a strain of mosquitos incapable of carrying the virus that causes encephalitis, a disease which can be fatal to humans (BioScience, 1978). Sr. Monica’s research was funded by the National Institute of Allergy and Infectious Diseases and the U.S. Army Medical Research and Development Command. She produced over 50 publications in journals ranging from *California Agriculture* to the *Journal of Medical Entomology*. Sr. Veronica Mary demonstrated for the first time that chemical carcinogens could cause genetic changes in DNA. She was the first scientist in the world to discover the critical role DNA mutations played in causing cancer in humans (Marygrove

College, n.d.; Michigan State University, 2017). Sr. Veronica Mary was among the top five percent of researchers funded by the National Institutes of Health across a quarter century, from 1980 to 2005. Additionally, she was extraordinarily prolific during her career, publishing 148 peer reviewed papers, 73 monographs, reviews, and chapters, and serving as associate editor for 10 journals.

Sr. Miriam Michael was an internationally known pioneer in the field of infrared spectroscopy, a technique which reveals a chemical's structure. Her work in spectroscopy contributed to the discovery of the DNA double helix (Kean, 2012). Sr. Miriam Michael published 20 scholarly articles on spectroscopy between 1938 and 1954. In 1953 she was invited to lecture on her research at the Sorbonne, making her only the second woman ever invited to do so, the first being Marie Curie. Sr. Miriam Michael's research was supported by the American Cancer Society and the National Science Foundation.

Catholic sister scientists' experiences as compared to those of other women scientists

Mentoring.

As supported by the literature (Morton & Tobell, 2010; Reid, Smith, Iamsuk & Miller, 2016), Sr. Veronica Mary and Sr. Miriam Michael recognized the need to mentor girls and women to both encourage their participation and retention in STEM fields. Sr. Veronica Mary is credited with advancing the careers of numerous early career women scientists on several continents. Many of Sr. Miriam Michael's female students attested to her high standards as a science teacher, noting that she continued to mentor them even after graduation.

Marginalization.

The experience of marginalization of women scientists is not uncommon. This was the case with Sr. Monica when she was referred to in a news article as simply "a Roman Catholic nun," while her male colleagues' academic credentials were presented at the same time, and despite her having equivalent credentials. Neither Sr. Veronica Mary nor Sr. Miriam Michael were credited with significant scientific discoveries and may have been passed over for Nobel prizes, experiences shared by other women scientists (Lunnemann, Jensen & Jauffred, 2019; Rossiter, 1995).

Religious discrimination.

Sr. Monica was the target of jokes about nuns made by both her colleagues and the press. Sr. Miriam Michael acknowledged that the barriers she encountered as a woman in science were compounded by her being a sister. These experiences are confirmed by the literature which documents discrimination and perception of discrimination based on scientists' religious identity (Avraamidou, 2019; Jorgensen, 2019; Scheitle & Ecklund, 2018).

Financial support.

The unique financial interdependence that the sister scientists had with their religious communities was a difference not experienced by other women scientists. The sisters were typically educated and cared for in their retirement years through

the communities' financial resources. In return, during their working life sisters entrusted the majority of their salaries to the communities. Of Sr. Veronica Mary, her own biological sister wrote, "...all through her 33 years at Michigan State University, she lived very frugally. She sent her monthly salary check from Michigan State University to the [community's] business office and received a stipend for her living expenses" (Maher, 2012).

Science as worship.

Despite the intellectual tensions between science and religion, the work of sister scientists transcended mere facts and the material world. This was evident in the way others described their relationship to their work. According to Dr. Justin McCormick, research partner to Sr. Veronica Mary for over 40 years, "For Veronica, the laboratory was a sacred space, a kind of chapel where she worked out the mysteries of how the world was structured" (McCormick, 2017). Similarly, for Sr. Miriam Michael, research was described as "her avenue of worship, through which she could express herself as an Adrian Dominican sister in the search for truth" (Tsuji, 2004, p. 89).

DISCUSSION

Responding to the need for more documentation of the lived experiences of women in STEM, this multiple case study examined the career motivations, scientific contributions, and experiences of three U.S. Catholic sister scientists as compared to those of other women scientists documented in the literature. Findings revealed that many of the barriers experienced by women scientists, including marginalization and religious discrimination were also evident in the careers of the sister scientists. Both groups shared an understanding of the need for mentorship of women and girls in STEM, which the sister scientists enacted by mentoring high school and university female students over many decades. Experiences which were unique to the sister scientists and not found in the literature on women scientists were the mutually dependent financial relationships between the sisters and their religious communities, and the sisters' conception of science as a means of worship. This research presents the stories of individuals who do not conform to typical STEM professional stereotypes as a way to encourage girls and women to pursue careers in science. Notably, this study celebrates the work of U.S. Catholic sister scientists whose contributions to science have been overlooked. Given the influence that religion had on the sister scientists' careers, future research should focus on the intersection of religious identity and gender identity in STEM careers.

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