

# Keeping the Legacy of Maria Mitchell and Dorrit Hoffleit

Vladimir Strel'nitski (Maria Mitchell Observatory)  
and  
Regina Jorgenson (Cambridge University)

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## 1. Introduction

### [Slide 1: Nantucket from a plane]

Nantucket Island, 30 miles off shore of Cape Code, was the birthplace of Maria Mitchell, the first American woman astronomer, and a person who was destined to play an outstanding role in the intellectual liberation of American women.

### [Slide 2: "Named after Maria Mitchell"]

A comet discovered by her, a crater on the Moon, an asteroid, a bust in the American Hall of Fame, a World War II military ship and even a modern train car in New York bear her name in stone and metal. The Maria Mitchell Association, a research-educational center created on Nantucket by the former students and the family of Maria Mitchell a little more than a hundred years ago keeps her memory alive and promotes her legacy of studying the world we live in and fostering the love for science in young generations, in particular, in young women, who were deprived of this intellectual joy and challenge for millennia.

### [Slide 3: Presentation title]

This presentation is about Maria Mitchell and her successors who have been struggling for the cause that is the focus of this conference.

## 2. Maria Mitchell

### [Slide 4: Mitchell's portrait and achievements]

Maria Mitchell was born in 1818 to a family of Quakers. Her multifaceted father, William Mitchell, was her first and only teacher, in particular, in Astronomy. The rest she learned from books, especially from those of great French luminaries in celestial mechanics. She was launched to fame by her discovery of a dim telescopic comet in

1847, a considerable achievement for her time, and one for which she was awarded a gold medal from the King of Denmark. She was invited to the newly created American Nautical Almanac to calculate the ephemerides of Venus and did this for two decades. For two decades she was a professor of Astronomy at the first Liberal Arts women's college in the U.S.A., the Vassar College. Among her students were such prominent women astronomers of the first quarter of the 20<sup>th</sup> c. as Mary Whitney, Margareta Palmer and, especially, Antonia Maury, the discoverer of the spectral signs of stellar luminosity classes and the author of pioneering works on spectral binaries.

Mitchell's major teaching principle was: LEARNING BY DOING. Instead of lecturing, she would assign doable though challenging research projects to her students. A live project and the prospect of making their own little discoveries, is a much stronger motivator for studies of the subject than the prospect of reporting the material on an exam, and this makes the learning much more efficient.

### **3. MMA, MMO, Dorrit Hoffleit, NSF REU program**

#### **[Slide 5: Hoffleit's portrait and achievements]**

This teaching principle was revitalized by the astronomers of the Maria Mitchell Association, in particular by Prof. Dorrit Hoffleit, the second director of the Maria Mitchell Observatory. In 1957, she succeeded in getting Federal funds for her program of teaching undergraduate women students astronomy via research at the MMO. After two decades of this experience, it became clear that the program had a considerable influence on the careers of young women. At least 20% of the 100 students Hoffleit mentored went on to obtain a PhD in astronomy. A recent study showed that Hoffleit's students accounted for approximately 8% of all the new American women PhDs in astronomy during those years – a considerable fraction for a single advisor at a small observatory!

#### **[Slide 6: Hoffleit's motto]**

It's the example of this successful program that prompted the National Science Foundation to launch in 1990 its now very popular Research Experiences for Undergraduates (REU) program that encompasses virtually all the branches of science funded by the NSF. The Maria Mitchell Association is a Permanent NSF REU Site in Astronomy.

### **4. The Current State of the Program**

By the end of the Hoffleit's 20-year program, the NSF started to insist that she take some male students as well. An NSF official allegedly told her: "Dr. Hoffleit, please take some men to your program. After all, giving this great opportunity to women only is also

discrimination!” And the good Dorrit (who had never been an enemy of men, I am witness to this), agreed. In her last two years, she took a couple of men.

**[Slide 7: Hoffleit and her “girls”]**

On this recent photo of Dorrit’s 99<sup>th</sup> birthday, you see some of her former “girls” and just one “boy” – John Briggs. Among the ladies there are prominent astronomers, including the former President of American Astronomical Society, Dr. Andrea Dupree.

**[Slide 8: Loines Observatory]**

One of the Hoffleit’s achievements while MMO director was the construction of a new observatory on Nantucket (besides the historical observatory on Vestal Street). This is how the Loines observatory looks in our days.

**[Slide 9: The 24” telescope]**

Recently, using a generous grant from the NSF, we installed a new 24” Ritchey-Chretien telescope in the big dome of the Observatory. Equipped with the modern CCD photometer, it serves as one of the major sources of observational information for our student projects. We also use a radio telescope on Kitt Peak and other major national astronomical facilities for the program.

**[Slide 10: MMA campus and astronomy students]**

As you can see on this slide, our REU students feel pretty well at the MMO! During the past 13 years, we have elaborated a firm principle of “mixed but women dominated environment.” We invite for the program 4 women and 2 men every summer. This proportion has proven to be optimal for our goal of encouraging young girls to free their talents for prominent scientific careers.

One of the authors of this presentation (Regina Jorgenson) was a 1997 MMO REU student (she is the leftmost student on the “old” black-and-white photo here). After her REU summer and graduation, she was invited by the Director (Vladimir Strel'nitski) to work as his assistant for 2 years, then she went to the graduate school in astronomy at UCSD, defended her PhD in 2008 and is now a postdoc at the Institute of Astronomy, Cambridge University. In Regina’s words, “I cannot emphasize enough how important the summer spent at the MMO was for me and my career. It was the first opportunity to experience scientific research in a friendly, non-intimidating environment. While I did not fully realize it then, I know now what a unique and important experience it was -- to be treated as a colleague, rather than “just” a student, with the possibility and expectation to make important contributions and to have insights of my own.”

One of the problems that surfaced during these years is a lack of self-confidence in some very capable, talented young women. A special psychological support was crucial in such

cases. We could cite here several examples of a dramatic change in life of capable but timid young women after they have participated in our program.

The statistics confirm the efficiency of our principles. But before showing that, let us remind the audience some statistics at a larger scale.

**[Slide 11: Percentage of female astronomers representing their countries at the IAU]**

We gathered some statistics on percentage of women in the IAU back in 1998 and recently in 2010. The results for 1998 were published and discussed in STATUS. We were ready to see these frustratingly low numbers, rarely surpassing 10-15%, but we were highly surprised to discover a strong difference between the Romanic-speaking and Germanic-speaking countries, on the one hand, and between the western and post-communist countries, on the other. As you see on this histogram, in 1998, the average for the Germanic-speaking countries was lower than for the Romanic-speaking countries by a factor of  $>3$ , and the post-communist countries were better than the western countries, taken together, by a factor slightly less than 2. The real causes of these differences are still unknown. By now, the situation seems to have considerably (by a factor  $>2$ ) improved for the Germanic-speaking countries. We want to believe that the MMA has had some part in this improvement and here is the proof.

**[Slide 12: Percentage of those MMO REU students who become PhD]**

You see on this slide that the percentage of MMO REU students who eventually go to graduate school and achieve their PhD in astronomy *or other sciences* has increased from the time of Dorrit Hoffleit by a factor of 2 to 3. What is more important, this percentage is now practically equal for our female and male students, being around 60% for both.

**[Slide 13: Percentage of those who become PhD in ASTRONOMY]**

And this histogram shows that the percentage of MMO REU alumnae/i who eventually become PhD in ASTRONOMY, which was two times lower for women than for men in Hoffleit's time, is now reversed and almost two times higher for women.

**[Slide 14: Percentage of national PhD in ASTRONOMY that went through MMO REU program]**

And it is probably worth mentioning that the tiny MMO REU program is still the launching pad for about 5% of all the new American women PhD in Astronomy.

**[Slide 15: Presidential Award]**

Finally, we cannot hide our pride of having been chosen by the U.S. President for the 2008 Presidential Award for Excellence in Science, Mathematics and Engineering

Mentoring. It was given to the Maria Mitchell Association for its REU program in Astronomy – for encouraging women’s careers in Astronomy, in particular.

**[Slide 16: Conclusions]**

**Conclusions**

- Maria Mitchell’s teaching principle of learning by doing is alive and well and helps to ignite a stable interest in pursuing a scientific career – for young talented women in particular.
- Dorrit Hoffleit was the inspiration for the now highly popular U.S. National Science Foundation Research Experiences for Undergraduates (REU) Program.
- The mixed but female-dominated environment for undergraduate research practiced at the Maria Mitchell Observatory has proven to be optimal for developing the often lacking self-confidence in young women embarking on scientific research careers.