Janet Mattei's Contributions to Education and Outreach

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1. Introduction

I vividly remember meeting Janet for the first time. We were standing on a Winnipeg city bus, on a tour which was part of the 1974 General Assembly of the Royal Astronomical Society of Canada (RASC). That General Assembly was a joint meeting with the AAVSO. Janet had become Director of the AAVSO less than a year earlier; I had just become Vice-President of the RASC. We were young professional astronomers, former schoolteachers, who had just assumed leadership positions in two remarkable sister organizations.

Others will comment on the dramatic changes and expansion that the AAVSO underwent during Janet's 30-year directorship: its new observing programs, the three-fold increase in observations submitted, the 25-fold increase in the observations requested, the computerization, the Journal and the website, the growing internationalization and stature of the AAVSO, and the new headquarters building. Here, I shall comment only on some of the highlights of Janet's contributions to education and outreach. These were as varied as the many parts of the "astronomical education community," and the many facets of the AAVSO. They were, of course, aided by Janet's team at Headquarters but, given her participatory management style and her passion for education, her stamp was on every one.

2. Graduate education

We sometimes forget that graduate studies are an important part of astronomy education, and of the training of future astronomers. Janet's first annual report (Mattei 1974) lists four requests for data by graduate students who needed data for their theses. At least one of them is now a famous variable star astronomer. Based on those statistics, there must be dozens of graduate students who have benefitted from this no-hassle source of data, unaffected by the vagaries of weather, or of telescope time allocation committees.

3. Variable star data for student projects

Janet's first annual report (Mattei 1974) also states the following: "We have received about 400 requests for information about the AAVSO this year. Quite a number of these come from high schools and colleges that want to set up an

observing program, and are interested in variable star data." It's safe to say that almost every university, college, and school with an astronomical observing program for its students has benefitted from the AAVSO.

And then there are individual student research projects. Janet's reports always included a breakdown of the requests for AAVSO data and services, and one "slice of the pie" was for education, including student projects. As a former teacher, Janet was aware that hands-on projects, as opposed to "cookbook" activities, were an effective way to motivate and teach science and math to students at all levels. Her first formal pie chart was in 1986–1987 (Mattei 1987), and 5% of 148, or about 7 requests, was specifically for educational purposes. By 1994–1995, the proportion had increased to 26% of 373, or almost 100. After that, a significant fraction of the requests may well have been satisfied by *Hands-On Astrophysics*, or by on-line AAVSO data.

Some of these requests were from schoolteachers, others were from college and university instructors such as myself. I have personally supervised individual research projects by 111 undergraduate and senior high school students in the last 20 years, and over half of them have used AAVSO data. It's not unreasonable to assume that there are thousands of students, around the world, whose projects have also been made possible by AAVSO data, services, and information. But this includes only students whose teachers have made explicit requests for data. Nowadays, data are freely available on the AAVSO website.

Furthermore, the AAVSO website contains information and software which is especially useful to students who are studying variable stars, or working with variable star data. It's the first place that I send students for this purpose. I particularly appreciate the "Variable Star of the Season" pages which the AAVSO staff have created. They are an excellent way for students to become intimately familiar with specific examples of the different types of variables.

Some students, of course, actually worked at AAVSO Headquarters as research assistants under Janet's mentorship and guidance, especially in the summer, and some of them have gone on to brilliant careers in astronomy. And for many years, a lengthy parade of summer undergraduate research students from the Maria Mitchell Observatory appeared each fall, to present the results of their research to our annual meeting.

4. Lectures and workshops for teachers

It's not surprising that Janet willingly gave lectures and workshops to teachers, almost from the start of her AAVSO career, though her early annual reports don't list her presentations explicitly. She had been a teacher; she appreciated the support that teachers need and deserve; she knew that astronomy was of great interest to students, but not something that teachers had much background in. Initially, her presentations were on general astronomy. Later, these workshops emphasized variable stars, and their connections to the curriculum.

5. An education initiative in astronomy

Janet was one of 17 participants in an important but little-known workshop held in Washington on February 23–24, 1990. The participant list was a "who's who" of astronomy education in the U.S. at that time. The background to the workshop was the perceived crisis in science education and literacy in the U.S., and the desire of both the government and the astronomy community to help deal with that crisis. Previously, astronomy education had focussed on educating astronomers. Now, citizens needed to be better prepared to confront economic and societal issues such as environment, resources, and health. Astronomy has always had a special appeal for students, and could be a vehicle for improving students' awareness, understanding, and appreciation of science and technology.

The workshop report, entitled *An Education Initiative in Astronomy* (Brown 1990), identified opportunities for astronomy to contribute to education, and objectives and strategies which might be used. It made several recommendations—the first of which was to declare "an education initiative in astronomy." The result, thanks to the availability of increasing funds for education from NSF and NASA, was a wave of impressive astronomy education projects and programs.

6. "Partnership in Astronomy"

"Partnership in Astronomy" was an early AAVSO outreach program for grade-school children. It was described in detail at this symposium by Mario Motta, who was a key participant [*see p. 157 of this issue*]. The project was "hatched" in 1990, about the same time as *Hands-On Astrophysics*. It addressed the same issues as *An Education Initiative in Astronomy*, through personal connections between amateur astronomers and local schoolteachers. Specifically, it built on their expertise in constructing and using telescopes, as well as their general passion for astronomy. Although Janet always referred to herself as a professional astronomer, she was deeply connected to the amateur community—and, of course, to teachers.

7. *Hands-On Astrophysics*

Hands-On Astrophysics (HOA) was certainly the most complex project ever undertaken by the AAVSO, and may well have been the largest. This can be seen from the two-page acknowledgement list, found at the beginning of the HOA manual (Mattei, Percy, and Young 1997). It included the whole "orchestra" of AAVSO staff, plus professional and amateur astronomers, teachers and other educators, and other creators of the data, software, photos, slides, videos, charts, website, and the comprehensive teachers' and student's manual. The contributions of Michael Saladyga and Donna Young stand out, but many others contributed significantly.

The purpose of HOA was to develop and integrate students' science, math, and computing skills, motivating them by the excitement of doing real science with real data—both AAVSO data and, ideally, their own data. Key descriptors of HOA are

"interdisciplinary," "hands-on," "interesting and fascinating," "scientific process," "real science," "nothing artificial," and "supports the national standards for science and math education." HOA includes, in addition to the 600-page manual, computer software, over 600,000 variable star observations, 45 variable star charts, slides and prints of variable star fields for indoor practice, and a three-part video.

The first step in the HOA project was to obtain funding from the National Science Foundation (NSF), and this is where Janet's diplomacy and other "people skills" came to the fore. She consulted extensively with NSF, dealt with the challenge of writing a new and complex proposal, addressed the sometimes-conflicting comments from the reviewers, and successfully landed the biggest fish that the AAVSO had ever caught. We were especially grateful to our patient and helpful contact at NSF, Gerhard Salinger.

Then the work began. We had $303,943 from NSF, but that didn't include the in-kind contributions that we and our staff and colleagues were to make over several years. I could go on for many pages about HOA alone, but there are two representative recollections—a pedagogical one and a personal one. The personal one was spending 19 hours, one cold Easter Sunday, in a video editing suite in Toronto with Janet, Mike Saladyga, and our videographer Todd Hallam, creating the HOA videos from miles of tape. The pedagogical one was the several weeks of observations of δ Cephei made by the two dozen teachers at the first HOA workshop. The teachers made and submitted their observations before the workshop, so they could then work with them when they came to AAVSO Headquarters for the workshop. Comparing their observations with those of others was a real thrill. So was combining the observations, not only determining the period of δ Cephei, but detecting its evolution by the (O−C) method. It illustrated something that Janet always emphasized: every AAVSO observation has a person attached to it. Science is a human endeavor.

Earlier this month (Clery 2004), there was a review article on robotic telescopes in astronomy education, in the influential journal *Science*. It asks whether learning with robotic telescopes is mainly inspirational, or whether schoolchildren can do real science. An interviewee states that "Most teachers are not interested" (in doing science), but HOA provides a teacher-friendly tool for doing real science with any telescope, including remote, robotic ones. The future of HOA remains bright.

8. HOA around the world

In the 1980s and 1990s, the AAVSO had become more and more international, in part because Janet was an international type of person, so Janet attended variable star meetings, literally around the globe. She made special connections in Latin America, and also in South Africa. Since HOA was near the top of her interest and priority list in the 1990s, she frequently gave lectures, demonstrations, and workshops on HOA, as did I as co-director of the project. We were both active in the International Astronomical Union (IAU), and the IAU had begun partnering

with the United Nations Office of Outer Space Affairs, and its annual workshops on basic space science. We presented HOA at meetings in Germany and in Jordan, and in Vienna at UNISPACE III—the third UN conference on the exploration and peaceful uses of outer space (Percy and Mattei 1999). HOA is now part of the curriculum and resources of the UN regional centres for basic space science around the world (UN 2003).

Janet also continued and expanded her workshops for teachers in the U.S. using HOA, despite her increasingly busy schedule. The most recent and satisfying of these was the week that she spent, each year, at the University of Hawaii's TOPS (Toward Other Planetary Systems) programs for teachers. For a week, she and the teachers could engage in the hands-on, eyes-on study of variable stars, with all the personal connections that Janet was so good at making. Some aspects of these workshops were recently described by Kadooka, Meech, and Bedient (2002) in the *Journal of the AAVSO*; they were also eloquently described at the memorial symposium [*see p. 170 of this issue*].

9. Citizen science

The last of Janet's contributions that I shall highlight is one that might not be so obvious. That's because there is a misconception that education ceases upon leaving school. That is certainly not true in the workplace; we all need our ongoing "professional development." But education is more than job training—it is enrichment of the mind. And that doesn't cease on leaving school either. Learning should be lifelong. Indeed, some of the most enthusiastic learners in my experience have been older people.

Janet's public lectures have enriched thousands of minds, all over the world. But there's more than that. Janet, through her leadership of the AAVSO, her founding chairship of the American Astronomical Society's Working Group on Professional-Amateur Collaboration, and her service in many other organizations, has promoted and developed amateur astronomy and enriched the minds and lives of amateur astronomers all over the world. To mention just one example: she contributed a section to the Royal Astronomical Society of Canada's annual *Observer's Handbook*, which is used by thousands of amateur astronomers and students around the world. And it was in the *Journal of the RASC* that Janet initially reported on the behavior of variable stars, based on AAVSO observations, through her "Variable Star Notes" column. The AAVSO also contributed monthly information about variable stars to *Sky & Telescope*—the "bible" of amateur astronomy.

It is said, by noted science educator Derek Hodson (2001), that "students should learn science, learn about science, and learn to do science." This is certainly true for the members of the AAVSO and its sister organizations around the world. Their members learn the "facts" of variable star astronomy from the AAVSO's meetings, journal, website, and from the personal communications which Janet made so freely and well. They learn about variable star astronomy from these same sources, and

from AAVSO people, and from our esteemed historians such as Dorrit Hoffleit and Thomas R. Williams. They learn to do variable star astronomy from these same sources yet again, but especially from the eloquent and persuasive feedback and encouragement which Janet gave so well. Truly, Janet helped to create and mentor a world-wide community of citizen-scientists of all ages.

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