

Editorial

Citizen Science

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Citizen science, according to the Oxford English Dictionary, is: “Scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions.” It’s a new name for an old activity, but it’s exactly what AAVSO observer/researchers do.

Long ago, there wasn’t much distinction between professionals and amateurs. Much of science was done by well-educated, well-to-do generalists, but that began to change in the 19th century, as science became more professionalized. AAVSO citizen science goes back to the words of John Herschel who, in 1833 said “this (variable star observation) is a branch of practical astronomy which has been too little followed up, and it is precisely that in which amateurs of the science, provided with only good eyes, or moderate instruments, might employ their time to excellent advantage.” Friedrich Argelander in 1844, said “Could we be aided in this matter (variable star observing) by the cooperation of a goodly number of amateurs, we would perhaps in a few years be able to discover laws in these apparent irregularities, and then in a short time accomplish more than in all the 60 years which have passed since their discovery.” The Variable Star Section of the British Astronomical Association appeared in 1890, and the AAVSO in 1911—building on the work of previous US amateurs.

The growth and maturation of citizen science

A generation or two ago, articles on citizen science would highlight ornithology (especially the work of the Audubon Society and the Cornell Lab of Ornithology), the work of the AAVSO, and perhaps a few more examples. Now, projects listed in *wikipedia* are so numerous that the AAVSO is mentioned only in passing. The well-known *Zooniverse* site (zooniverse.org/projects) contains 91 projects in the arts and sciences, including 18 in astronomy/space. The US Government website (citizenscience.gov) lists 439 projects, including 22 in astronomy/space. According to studies mentioned in *wikipedia*, the monetary value of the voluntary work in some of these projects is estimated to exceed an average of \$200,000 each. I wonder what is the monetary value of AAVSO observers’ work?

Technology has helped. AAVSO data are freely available on-line. There is software to analyze the data: think *vSTAR*. Our website provides charts, manuals, and connections to mentors and courses. There is email, and social media. Many

observers have photometers and CCDs. On cloudy nights, our idle computers can be used by SETI@home (though I don’t consider that as true citizen science, because the human brain is not engaged).

Technology can increase our opportunities for citizen science in other ways. My student Lucas Fenaux and I have just published (Percy and Fenaux 2019) a critique of the automated analysis and classification of tens of thousands of pulsating red giants in the massive All-Sky Automated Survey for Supernovae (ASAS-SN: www.astronomy.ohio-state.edu/~assassin/index.shtml), and showed that the majority of the automated analyses and classifications are incorrect or incomplete. There is still a place for the power and experience of the human brain! ASAS-SN provides great opportunities for analysis and research by students and knowledgeable amateur astronomers, as well as by professionals.

One characteristic of a mature field of endeavor is that it grows infrastructure. I remember amateur astronomy’s photoelectric photometry “revolution” in the 1980s. Previously, photoelectric photometry was done by electronics hobbyists, generally with unique equipment that they had built themselves. With the availability of off-the-shelf photometers came an organization (International Amateur-Professional Photoelectric Photometry, IAPPP) and its conferences, journal, and books.

Citizen science has spawned organizations in many countries; the US-based Citizen Science Association (citizenscience.org) has conferences, and a journal. Its interests lean towards nature and the environment. These organizations stress the need to establish goals and objectives, to adopt “best practices” which avoid bias and error, and to educate their members, evaluate their work, and provide feedback so their members’ work is even more effective. Could the AAVSO do that more effectively?

The European Citizen Science Association has drawn up a statement of ethics—“Ten Principles of Citizen Science.” Such statements of ethics and values have been drawn up for *professional* scientists by their institutions and organizations. A link to AAVSO’s policy statements is clearly presented at the bottom of its home page, but the addition of an explicit values statement would be useful and appropriate.

And what about diversity? In North America, amateur astronomy seems to be the preserve of well-to-do graying white males like me. Is this generally true of citizen science? What can be done to attract a more diverse population?

Citizen science and the classroom

Modern school science curricula encourage students to *do* science, not just hear and read about it. Numerous citizen science projects can appeal to students, including astronomy projects and especially environmental projects. The AAVSO's *Hands-On Astrophysics* project (now called *Variable Star Astronomy*: www.aavso.org/education/vsa), was designed to enable students to develop and integrate their skills in science, math, and computing through variable star observation and analysis, motivated by the excitement of doing real science, with real data. At the post-secondary level, there's an increasing emphasis on "Work-Integrated Learning." This can be achieved in various ways including by volunteering in citizen-science projects. Perhaps by making citizen science part of the formal education system, we can start to increase diversity among citizen scientists in general.

Alternate definitions of citizen science

Two things have expanded my concept of citizen science. One was supervising the senior thesis of a very creative undergraduate student who was majoring in both astronomy and in the humanities and social sciences. She reminded me of the social dimensions of the term—it can help bridge the gap between science and society, scientists and non-scientists, and help the latter to have more "ownership" of science. She has decided to pursue this in her graduate studies.

The other thing was reading the entry on citizen science in *wikipedia*. It includes multiple definitions of the term, and a long and diverse list of citizen science projects. It emphasizes engagement with the *application* of science to society. Many citizen scientists (such as AAVSO observers) do science as a personal hobby or pastime but, in fields more directly connected to societal needs, it is important for citizen scientists to be concerned about the societal implications of their work—and often to take action.

The importance of citizen science today

Our planet is facing major environmental challenges. Climate is changing, and this and other human factors are leading to significant declines in thousands of species—among many other changes. A recent program on Ontario's excellent public TV channel (TVO 2019) dealt with the precipitous decline in the number and diversity of insects in our environment, and the ecological implications of this. One of the most important and widely-publicized studies showed that there had been a 78 percent drop-off in insect populations in dozens of *nature reserves* in Germany. The bulk of the work had been done by primarily-amateur members of the Entomological Society Krefeld. Similar studies of birds, butterflies, and other insects are being carried out. In April 2019, three one-hour episodes of *Nature*—"American Spring LIVE"—on the US Public Broadcasting System highlighted many opportunities for citizen scientists, both in school and among the general public.

More than ever, the world needs evidence-based policy making, in a wide variety of fields from environment, to health and medicine, to energy, population, and hunger. That, in turn, requires evidence and data. Citizens can help to collect that evidence and data. At the same time, the alternate definitions of citizen science must kick in. Non-scientists (and scientists) must engage with policy-makers in both evidence-gathering and decision-making, at the municipal, state/provincial, and national levels. Both must engage with the democratic process, while the democratic process still exists. The world can no longer afford politicians who govern by gut reaction, personal bias, and "fake news."

References

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