Issues and Strategies for the Future

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Abstract This talk summarizes five challenges facing the AAVSO in the near future.

1. Introduction

My talk primarily concerns organizational aspects of the AAVSO, rather than scientific, although what we do as an organization can affect the scientific outcome. What I say will be familiar to you because these are themes that have come up repeatedly at this meeting. There are many important topics, but I am limiting myself to five: relevance of observing programs, charts and sequences, recruitment and retention of young observers, accessibility of data, and cooperation. Each of these topics is both an issue and an opportunity.

2. Relevance of observing programs

You will not be surprised when I say that the research priorities of professional astronomers change with time. This is a reason both to add new stars to the amateur program and to continue with the same stars monitored for decades.

There are at least three good reasons for astronomers becoming more interested in a class of variables: new discoveries, new technology, and new theory. New discoveries, for example, Supernova 1987A, can provide opportunities for observatories with current technology that did not exist in the past. New technology can give us three avenues for advance—by allowing new kinds of variables, such as pulsars, to be discovered; by revealing unexpected aspects of known variables, such as soft X-ray emission from dwarf novae; and by giving the opportunity to test theories that previously were untestable. New theory also can enhance interest in previously boring sources by predicting observable phenomena.

Eventually though, the new discovery fades away, the new technology is exploited as far as it can go, and the latest theories are found to be untestable. At this stage, the study of a particular class of objects reaches stagnation, and professional astronomers move on to other projects. There is no sense in beating a dead horse.

I wanted to quantify the amount by which the priorities of professional astronomers change. To do this I surveyed the abstracts of papers published in five refereed journals in the first six months of 1970 (Böhme *et al.* 1970) and in the first six months of 1995 (Burkhardt *et al.* 1996). The journals were *Monthly Notices*, *Astronomy and Astrophysics* (regular and supplement), *Astrophysical Journal* (again both regular and supplement), *Astronomical Journal*, and *Publications of*

the Astronomical Society of the Pacific. Figure 1 shows the results of this survey.

There have been significant changes in the past twenty-five years in the kinds of science being done. The number of papers on cataclysmic variables, exotics, pre-main sequence variables, Miras, cool spotted stars, supernovae, and extragalactic variables has surged. Papers on Alpha CVn variables have actually decreased, but pulsating and eclipsing stars have shown little growth. Surprisingly to me, given that this is the golden age of extragalactic astronomy, the proportion of all papers devoted to variable stars was higher in 1995 (14%) than in 1970 (10%).

Clearly, to remain relevant, the amateur observing programs must also change.

New discoveries and new technology both give us exciting opportunities now to expand the observing programs of the AAVSO and other organizations. Hipparcos has provided a whole new zoo of variable stars! Will we find any new species in this zoo? We need follow-up observations to know for sure.

Use of CCDs opens up new ranges of variables to amateurs. The top of the line amateur systems—telescope, CCD, and computer—would have been the envy of many colleges and some universities twenty-five years ago. With them it is possible to observe fainter variables than visual observers could. This aspect makes it possible to get observations at minimum of large-amplitude variables, such as LPVs, cataclysmics, and RCB stars, where in the past all we could provide were upper limits. It also makes more quasar and BL Lac variables (e.g., Quirrenbach 1993) accessible to amateur monitoring. Furthermore, as with photoelectric photometry, CCD observing makes it possible to get good data on small-amplitude variables. This opens up classes of variables such as Ap stars, ZZ Ceti stars, and the pulsating aspect of RCB stars. Finally, again as with photoelectric photometry, CCD observing makes it possible to use filters, thus providing substantially more information by isolating critical wavelength intervals. How about narrow-band photometry of RV Tauri stars (Wing 1986) or Miras? The overhead times and reduction effort can be large for these kinds of studies (Szkody 1993; Walker 1994).

The combination of new discoveries and new technology available to some of us makes for exciting opportunities. Let's seize them by enlarging our observing programs. There is a lot of work for the organization to do to select new program stars and to develop charts and sequences for them, and for observers to add the new stars and new techniques to their repertoire.

But let's not abandon "old friends" when adding new. Professional astronomers are no more astrologers than amateurs are. We cannot predict what classes of stars will move back into the front lines of research in the next twenty-five years. Earlier in this meeting, Mr. Bateson pointed out that the persistent monitoring of dwarf novae by amateurs proved valuable once these variables became fashionable again. Only through consistent amateur attention can long-term behavior be addressed for classes of variables that fall out of vogue and then pop back in again.

3. Charts and sequences

The second topic we must consider is charts and sequences. Lazlo Kiss's report (Kiss 2006), showing how two good observers observed light curves of V482 Cygni with low internal scatter, but a magnitude apart, was dramatic evidence of the problem. What more can I say? These differences put fear into the hearts of astronomers studying long-term behavior and analyzing multi-periodic phenomena.

Maybe such discrepancies are not a major problem for stars that are well-observed and smoothly varying, and for observers who have contributed regularly year after year. After all, if the researcher can identify the biases, she or he may be able to calibrate them. But to increase the value of all amateur visual data on all stars, whether well-observed or not, whether smoothly varying or eruptive, it is necessary to provide consistent and accurate sequences.

Michel Grenon proposed a solution during this conference (Grenon 2006). Stars with Tycho photometry could be used as bright sequence members. A campaign by our CCD observers, using the Tycho stars as secondary standards, would extend the sequences to as faint as the visual observers need. This effort would be called Project 2001 and would set a goal of releasing a library of all new charts by January 1, 2001. The AAVSO would set up a working group with international membership to address the issues involved in creating and distributing these new charts.

This is a serious and significant proposal. The AAVSO must make an effort to implement it. Sequences have been an issue since the beginning of time. With this effort, we can put the issue permanently behind us. If we don't make the change, then observers fifty years from now will still be puzzled by charts that don't match the sky, and researchers will still wonder about strange glitches in the light curves of variables. Even if all-sky CCD surveys might make visual magnitude estimates obsolete as a research tool in twenty-five years, accurate calibration of the charts is needed to free the historical database of error.

There are major issues and hurdles to overcome to make Project 2001 a reality, not the least of which is finding the manpower to implement it. Other serious issues include correcting for the bandpass differences between the Johnson *V* and the dark-adapted eye, the likelihood that not all observers will switch to the new sequences, and the discontinuity in light curves that will be created when new sequences are substituted for old. To address these last two issues, it will be necessary to create a historical database of sequences and charts, and to document in the variable star database the version of the sequence used for the observation.

4. Recruitment and retention of young observers

My third topic, attracting and retaining young observers, is more issue than opportunity. In 1993 John Bortle called the AAVSO's attention to the fact that more and more of our observations are coming from fewer and fewer observers who are getting older and older. The obvious conclusion is that in a year not too

far in the future we will have one observer who contributes an incredible number of observations and then the next year we go out of business.

Hungary may be an exception here. Mr. Kiss has reported that they attract a lot of young observers with summer camps and newsletter reports. He also notes the problem that eventually these young astronomers start a family and stop observing when they no longer have the free time. That is understandable and natural. It is important that the organization remember these former observers and invite them to start over again in twenty years when they are more established financially and when their children are beginning to leave home.

You might ask whether there is really a problem. In twenty years, won't all visual observing be made obsolete by a network of automatic telescopes? Perhaps, although I think it would be a shame if our only view of the sky is through a computer monitor. Furthermore, even if visual observing is obsolete, we need to identify the future owners and operators of the telescopes and detector systems that will comprise such a network.

I have no magic answer to the aging-observer problem, but here are some of the steps that the AAVSO has been taking that might result in increased numbers of young observers. First, Janet Mattei, John Percy, and a few others have worked to expose school children to good astronomy. One program for doing this is *Hands-On Astrophysics*, an educational curriculum which was described here in the session on astronomy education (Mattei and Percy 2006). Another AAVSO program, "Partnership in Astronomy," involves having amateurs work with individual schools (Motta 2006).

A second initiative that the AAVSO has taken to better retain new members is a program that matches inexperienced observers with older members who can give them advice and encouragement. This mentoring program is run by Dan Kaiser.

An e-mail discussion group (aavso-discussion@mira.aavso.org) was set up by Doug Welch. This service enables our on-line members to develop a feeling of community and to have an opportunity to have questions answered.

AAVSO Headquarters has gone on-line, too, with a web site to snare surfing observers.

Finally, recognizing observers with certificates when they achieve milestone numbers of observations provides recognition and encouragement for the young observers to persevere.

None of these initiatives is sufficient, and we will continue to search for new ways to nourish our observers.

5. Accessibility of data

A fourth topic for the future is the accessibility of the AAVSO's database.

Good science requires information flow. The AAVSO has struggled to improve the ease with which data can be made available to users.

The AAVSO has developed several ways of rapidly providing status information

via publication of raw observations. For critical events, phone calls and faxes coordinate the gathering of information and get the data out to the users immediately. The electronic "News Flash" was started in February 1996 to distribute current magnitudes for active variables, such as dwarf novae, RCB variables, and BL Lac objects. The monthly *Circular* provides thumbnail sketches of recent behavior for cataclysmic and irregular variables.

Making archival data available has been more difficult. The ultimate service is the delivery, on request, of evaluated data for analysis. These data are provided freely (though a small processing fee may be charged if large volumes of data are requested) to anyone who requests them. Evaluation is very time-consuming for the few experts at Headquarters, so it may seem as though the AAVSO is slow in responding to requests. In recent decades the AAVSO has entered all current and historical data into an on-line database and has developed on-line tools to aid in the evaluation process. Nonetheless, it is still a slow, labor-intensive process.

Many people would like to see all of the observations in the AAVSO's database available on a near-instantaneous basis on request, just as authorized users can link into a NASA archive, browse the catalogue, and order data sets that are delivered electronically within a matter of minutes or hours. This kind of service is needed in order for the AAVSO's archive to be fully utilized, and the AAVSO should make a goal of providing it.

Before we can do this, we must address a concern about the quality of unevaluated data in the archive. Readers of "The Birch Street Irregulars" article in *AAVSO Newsletter* Number 17 (Beck *et al.* 1996) will understand the apprehension that this issue raises. While NASA makes data from missions such as the HST and IUE available nearly instantaneously (after the one-year proprietary period has elapsed), the data from these missions is processed through standard pipelines and is evaluated by trained staff to reduce the risk that researchers will receive data that are not what they claim to be.

While most of the AAVSO's visual observations are of excellent quality (within the limitations of the charts and sequences), some are discrepant. Researchers, at least those who are not theoreticians, will identify these discrepant points, but they lack the information and experience to solve them. The discrepancies might be observational errors, but more often are data entry or specification problems. Such errors can be solved with access to the original report forms and with a knowledge of the kinds of errors that are likely.

AAVSO staff have the necessary skills to evaluate the data and to ensure that the researchers get what they expect. Unfortunately, it takes a lot of time to do this. Headquarters staff began to evaluate well-observed stars to post three-year light curves on the Website in October 1996. By May 1997, only three of the 88 constellations have been completed. At this rate, it will take about fifteen years to cover the sky. Since each light curve contains only three years of data, this gives some idea of the problem involved.

What can be done? Well, we could make data available electronically after

splitting them into three classes: Class A, fully evaluated; Class B, data with discrepant points flagged automatically; and Class C, raw and unevaluated. Users would have full access to Class A data, which consist of all data that have been evaluated in the past for researchers, monographs, etc. Class B data would be processed by software that simply flags discrepant points as suspect. If fewer than some selectable fraction of the data are flagged, these data would also be freely available. Users downloading these data would be required to register so that they could be notified of later updates. A user who found that the points flagged as discrepant were vital to the analysis could make a request to the AAVSO to evaluate the data set. Data that are not amenable to automatic flagging of discrepancies, such as observations of infrequently observed dwarf novae where all outburst observations would appear discrepant, would not be available as Class B.

6. Cooperation

Cooperation is a strategy for the past, present, and future. It is the basis on which the AAVSO was founded, but the AAVSO has no monopoly on it. At this meeting we have seen excellent examples of cooperation. I hope that we can continue the momentum started here throughout the coming year.

One major area for cooperation is between amateurs and professionals. The AAVSO has many professionals among its members, and will continue to recruit more. Amateurs and professionals share responsibilities as officers and Council members, with currently three professionals and three amateurs serving as officers, and three professional astronomers and five amateurs who are Council members. The spring meetings of the AAVSO in 1992 and 1993 were held in conjunction with the June meetings of the American Astronomical Society. AAVSO members will participate in a special session on amateur-professional cooperation at the American Astronomical Society meeting in June 1997. Last fall, we sponsored a half-day mini-conference on the 400th anniversary of the discovery of Mira. This attracted more professionals than we usually see at our meetings. We should continue having more mini-conferences on special topics. Finally, this meeting, while requiring a lot of work and expense, has brought amateurs and professionals together.

Of course, cooperation between different international and national organizations also is important. The stars belong to no one country, and we all would be much poorer if we could only know about those variables that were overhead when it is night at our Headquarters. Meetings like this one, like in one in Brussels in 1990, and like the celebration at the dedication of the AAVSO's Headquarters building in 1986, provide a very necessary opportunity for members and leaders of the various organizations to exchange ideas and talk about concerns. The Internet has made world-wide written communication much more rapid and responsive. Perhaps we can establish a special e-mail distribution group for the organizations to allow them to keep in touch on a regular basis.

Finally, Janet Mattei is the AAVSO's ambassador to the world, with contacts in

both the amateur and professional communities. The personal touch is very important for promoting cooperation. I hope she can keep it up for a long time to come.

7. Summary

During this week we have seen a number of the paths that we can follow to the future. They all require that we change in some way or another, and that of course requires resolution and effort. Nonetheless, there is one thing that I hope will never change about variable star observing: that it will remain fun to do and rewarding to you.

8. Addendum, 2006

The five topics discussed in this paper represent key areas where the AAVSO excels and where it must continue to excel to serve its members and observers, to attract new observers, and to deliver relevant, high quality astronomical data to researchers. I am pleased that the AAVSO has made progress in all five areas since the Sion meeting. Tremendous progress has especially been made in data accessibility. However, I think that the AAVSO will never be able to say, "We have achieved everything possible." For many of us, the joy of variable star observing is not about reaching a destination, but about the journey. For the organization, the rewards come from steady progress towards goals of better science and better service even as new technology and new astronomical discoveries cause the location of those goals to move.

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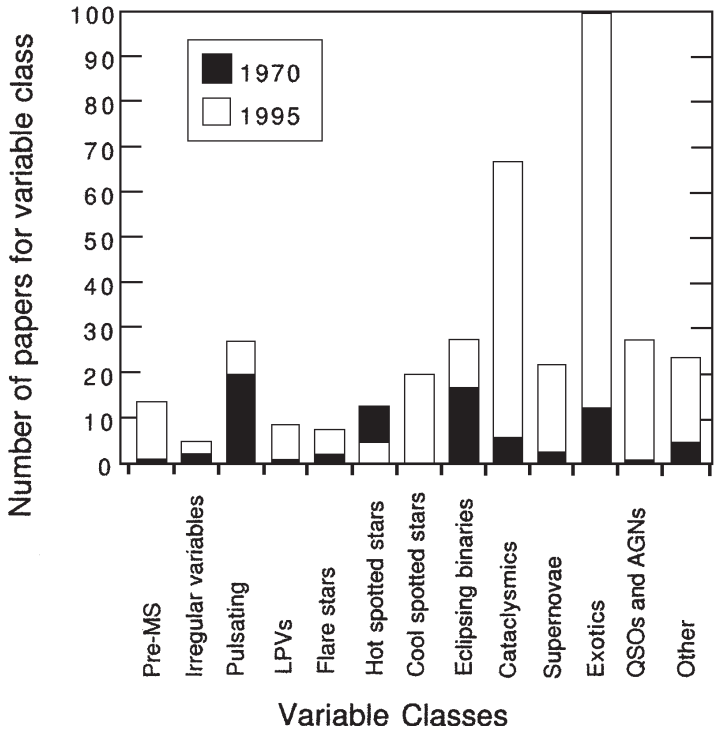

Figure 1. Comparison of numbers of papers on variables published in 1970 with those published twenty-five years later in 1995. Classes summed here include Pre-MS (FU Ori, T Tau, Ae/Be); Irregular variables (S Dor, RCB,...); pulsating (Bet Cep, Del Cep, Del Sct, RR Lyr, RV Tau, and ZZ Cet); LPVs (Mira, SR), flare stars (UV Cet); hot spotted stars (Alp CVn); cool spotted stars (RS CVn, BY Dra, solar cycle); eclipsing binaries (eclipsing, Algol, Bet Lyr, W UMa); cataclysmics (novae, DN, nova-like, AM Her, symbiotic); supernovae; exotics (neutron stars, pulsars, X-ray binaries, bursters); QSOs and AGNs (and BL Lac); and other (all else).