

INSTANT CHARTS

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Abstract

The history of AAVSO variable star charts is detailed, with particular emphasis on the Preliminary Charts program. A new method of chart construction by photography is described.

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In the AAVSO publication *Variable Comments*, William Tyler Olcott (1936) wrote of the first few years of the existence of the AAVSO, "The Association was greatly hampered at the start by the lack of charts. Harvard Observatory had only a very limited number available for distribution to new members of the rapidly growing Association who were clamoring for material to work with. The writer during his six years of active work as an observer, Secretary, Editor of the monthly reports, and general practitioner to ailing fledglings who "couldn't find SS Cygni nohow," made seven thousand tracings from the enlargements of the [Bonner] Durchmusterung [BD] charts and from photographic charts, for distribution to the observers.

In 1931, *Variable Comments* (Campbell) reported, "About ten years ago a chart committee under the able guidance of David B. Pickering...was chosen to put the chart problem on a well planned basis. Different types of charts to meet the varied requirements of different observers with small and large telescopes were designed, a very definite system of star discs was adopted, and much needed information added to the charts to facilitate their use. This proved a herculean task, far beyond the anticipation of the original committee...." The committee did an excellent job, and gave us the "Blueprint" or "Standard" AAVSO charts distributed by AAVSO Headquarters. At that time the only inexpensive means of making many copies for distribution was by the blueprinting process, so originals were drafted on tracing cloth and copies were blue with white stars. Visitors to Headquarters were quite likely to be asked to cut out and trim charts from large blueprint rolls.

The different types of charts are designated by letters, starting with "a" for the charts with the largest area of coverage. These charts are suitable for naked eye or binocular observing, and cover a field 15x15 degrees, at a scale of 5'/mm, showing stars down to magnitude 7.5. Later, a few "aa" and "ab" charts were produced for bright variables, showing stars somewhat fainter than those on the "a" charts, and generally drawn to a scale of 8'/mm. Type "b" charts cover an area 3x3 degrees, to a scale of 1'/mm (or 1 degree = 60mm). They show stars down to about 11th magnitude, and are suitable for observing with wide field telescopes or small telescopes--to about three inches in diameter. They are also useful as finder charts in locating variables for observation with larger telescopes. Most of the "b" charts were drawn by enlarging the BD to the proper scale, and tracing it.

The type "c" charts have a scale of 40"/mm, covering a field 2x2 degrees, and show fainter comparison stars. They are suitable for use with telescopes in the 3 to 6 inch range. The rest of the chart types each have a scale one half that of the previous type. That is, each would be a 2x enlargement. Type "d" charts are drawn to a scale of 20"/mm and cover a field 1x1 degree. They show comparison stars to a

limit well into 14th magnitude, and in some cases fainter. Usually if fainter comparison stars are needed, further enlargement is needed, so type "e" charts are at a scale of 10"/mm, and type "f" charts are at a scale of 5"/mm. The system can be continued as crowding of fields or faint comparison stars require.

The "a," "aa," and "ab" charts are printed with north up, for visual and binocular use. The others are inverted, with south up, for telescope use. Recently a number of charts have been made with the fields reversed left-for-right, for use with telescopes using a diagonal mirror, and therefore having a "reverted" image.

Most of the Standard charts distributed by Headquarters were drawn by Donald F. Brocchi of Seattle, Washington, who was an observer with an appreciation of the needs and problems of those who would be using the charts. His excellent draftsmanship is reflected in the many charts still in use. Typically, charts were drawn only for those stars for which Harvard Observatory had photos and sequence material with which to work. For this reason many stars which could have been visually observed were not charted. A few of these were charted in the 1950's by Roy A. Seely of New York City. In the mid-1960's a large volume of material from Flower Observatory of the University of Pennsylvania became available. This material represented work done on variable star field charts and comparison star sequences by Dr. Charles P. Olivier and his assistants. Clinton B. Ford undertook to turn this material into AAVSO-format charts. These were pencil-traced originals, subject to correction from observations or later published data, with copies for distribution made on an office copier. The original tracings were made by laboriously tracing photographs enlarged to the proper scale. This work was the start of the current Preliminary Charts program.

Wayne M. Lowder contributed much to the program from his extensive library research, including the Russian literature which he taught himself to read for the purpose. As the program continued, many other contributors volunteered or were enlisted, so that the list now includes 54 people or groups.

In 1967 the 22-inch telescope at Stamford (Conn.) Observatory became operational photographically, and I joined the work of the Preliminary Chart program by taking photos and, somewhat later, drawing charts. This telescope is ideally suited to the work since its large photographic field, much like that of a Schmidt Camera, is 3x5 degrees. The telescope can also be used visually at f/15 with a different secondary, and in spite of rather badly polluted skies we typically reach nearly 16th magnitude.

In the years since the start of the Preliminary Chart program over 1160 charts have been drawn for about 960 variables, and the numbers grow weekly. These charts are listed in the Catalog of Preliminary Pencil-Traced AAVSO Format Charts, which is distributed by Clint Ford. About 40 of these charts were drafted into "final" form by R. Newton Mayall and added to the catalog of standard charts issued by AAVSO Headquarters. Recently, member John I. Riggs has been enlisted to draft more of the Preliminary Charts into final form. All of the "finalized" charts will be dropped from the next (Eighth) edition of the Preliminary Charts catalog, and will be distributed only from Headquarters.

In considering the production of a new chart we need to ask, "Why do we need a chart of this star?" Considerations are: is it bright enough to be observed with current instruments? Is the range large enough? Is there something unusual that makes its study desirable? Has there been a request for chart/study by astronomers? In the case I have chosen for illustration, the star appeared on a list of requested

observations of dwarf novae in AAVSO Alert Notice No. 67. 2020+16 CM Delphini was listed, with the indication that it was not in our program, which means essentially that there is no AAVSO chart for it. Having decided to chart the star, the first step is to look it up in the General Catalogue of Variable Stars (Kukarkin et al. 1969), copy the data, and apply precession to 1950 and 2000. (CM Del is a dwarf nova, and has a range of photographic magnitude 13.4 to 15.3.) Among the data are usually two references, one of which may contain a finder chart. If these are available they can save a lot of time and effort in identifying the variable. If no chart has been published, a comparison of two or more photos will sometimes identify the star. A check of my photo files in this case showed that I had a photo taken with an astrograph, but no photo with the 22-inch telescope.

The star must be plotted on a convenient atlas, and the photo-plate compared with the atlas and the finder chart, if any. In this case no identification was possible due to the small scale of the photo and the unknown scale of the finder chart. The next step was the enlargement of the proper area of the photo to the scale of a "d" chart. Once this was done it became possible to recognize the field, with some of its stars just at the limit of the photo. Most of the difficulty in recognizing the field is due to the finder charts. Typically, they include only a very small area of sky, are made from blue-sensitive plates and therefore do not match my visual plates, and have no identifiable bright star on them. Often they do not indicate which direction is north.

Once the variable is identified the production of a chart can go forward. First, a copy-film positive is made by enlarging the plate onto Kodalith Ortho Film, Type 3, or its equivalent, which can be handled in red darkroom light like enlarging paper. From this film-positive a print to the desired scale is made, producing black stars on a white background. This saves tracing all those star discs with the inherent chance for error in disc scale or position. A xerox copy of this enlargement is pasted onto the chart-blank to form the original chart. A copy of this then becomes the master chart from which distribution copies are made. This is the "Instant Chart" process.

In the case of a nova, it must be plotted with care on an atlas, and a new photo taken. If a previous photo of the same area is available, it makes for positive identification of the new star. In a case such as CM Del, where I do not have a photo with the 22-inch telescope, I will take one at the earliest opportunity. Meanwhile I observe the star to check for possible outbursts, as a photo while the star is in outburst would be more valuable. In extreme cases a chart could be made by photographing the area from the True Visual Magnitude Photographic Star Atlas by Christos Papadopoulos.

In making photo-reversal charts it is necessary to use a photo taken with a camera or telescope with a focal length such that the stellar images will show a large gradation of sizes on the final chart. So far my experience indicates that for "c" or "d" charts a focal length from 20 to 30 inches is appropriate. For "e" or "f" charts a focal length of 80 to 100 inches would be about right. Too long a focal length means the star images will be too small even when enlarged, and the gradation of disc sizes is not apparent. It is possible to control the image size and limiting magnitude somewhat in making the copy-film positive and the subsequent print. In making xerox copies of the final print it must be noted that some office copiers shrink or distort the copy somewhat, and this must be avoided.

Once a standard-format chart is made, a comparison-star sequence is needed. A check of available catalogs of photoelectric star magnitudes may help, but typically such magnitudes are only for relatively bright stars. Rarely do any of these fall on the new chart

itself. With luck, some of them may fall on the photo-plate. This is most likely to be true of the astrograph plates which cover a field 11 degrees square. I keep a file of photoelectric photometry (PEP) sources in the literature, including many standard areas which have been measured to magnitude 17 or 18. It is great good fortune to find one of these, or some other AAVSO chart, on the photo-plate. Once some known magnitudes have been identified on the plate, they can be measured on an iris-densitometer, and comparison stars in the new field established. If a new plate must be taken before a star can be charted, it should include any nearby areas of known magnitudes. Alternatively, a photoelectric photometer can be used at the telescope to measure comparison stars directly.

Despite all our recent charting efforts, now covering a period of nearly twenty years, there are still many stars uncharted which could be visually observed. We need to ask ourselves not only the questions mentioned above, but also, will charting a lot more stars overload the available observers? So far we have a limited group of observers, and it grows only slowly. We also have limited facilities for collecting and publishing the data. The stars charted to date represent a good cross-section of all types of variable stars. It is to be hoped that the data derived from the observation of these stars will be broad enough to serve those who use them.

REFERENCES

- Campbell, L. 1931, *Variable Comments II*, 11, 49.
- Kukarkin, B. V. et al. 1969, *General Catalogue of Variable Stars*, 3rd ed., Moscow.
- Olcott, W. T. 1936, *Variable Comments III*, 9, 38.
- Papadopoulos, C. and Scovil, C. E. 1980, *True Visual Magnitude Photographic Star Atlas*, Pergamon Press, Oxford.