The History of AAVSO Charts, Part I: The 1880s Through the 1950s

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Abstract This article reviews the early history of AAVSO charts, including the inception and evolution of the charts, and the formation, challenges, and accomplishments of the Chart Committee, from the pre-AAVSO days of the 1880s through the 1950s.

1. Introduction

The American Association of Variable Star Observers (AAVSO) was founded in 1911 for the purpose of monitoring variable stars in a systematic way. Since much can be learned from the light output of a star, observers track the magnitude or apparent brightness of AAVSO program variable stars as a function of time. The AAVSO has archived over 12.5 million observations of variable stars since its founding. This work, however, could not be accomplished without a standardized set of sky maps that provide the observer with the necessary information needed to make one observer's variable star estimates compatible with those of another observer. Thus, AAVSO variable star charts are the shoulders on which countless observations stand.

AAVSO charts have historically been 8 × 10 inches in size. Although there have been modifications and improvements over the years, all charts contain a similar format: pertinent information about the variable star, such as Harvard Designation, variable name, magnitude range, and position are displayed in a chart heading at the top of the chart. This is followed by the body of the chart, which contains the star field in which each representative star "dot" or "disc" is drawn to scale by magnitude. The variable is denoted by an open circle, and selected stars of known constant magnitude used for estimating variable star brightness are numbered with their assigned magnitudes (minus a decimal point which could be confused for another star). The footer, displayed at the bottom of the chart, contains information such as the chart cartographer and the star field and comparison star sequence sources.

Furthermore, the star fields displayed in the bodies of AAVSO charts are drawn to different scales to facilitate observations with different size telescopes (Figure 1). They are therefore identified using a letter-code system which denotes the scale of

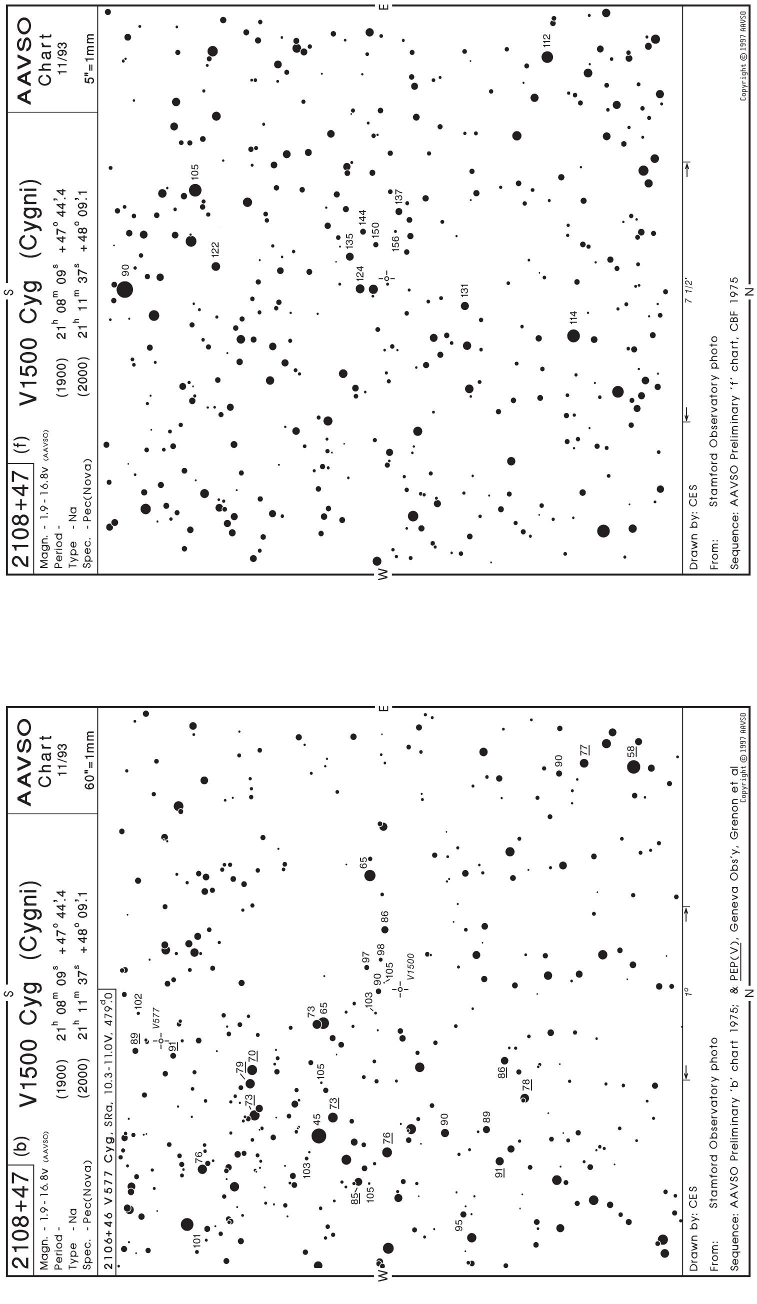

2108+47 (b) V1500 Cyg (Cygni)
AAVSO Chart 11/93
Magn. - 1.9 - 16.8v (AAVSO)
Period -
Type - Na
Spec. - Pec(Nova)
(1900) 21h 08m 09s +47° 44'.4
(2000) 21h 11m 37s +48° 09'.1
60"=1mm
2106+46 V577 Cyg, SRa, 10.3-11.0V, 479d.0
V577
V1500
S
N
E
W
1°
Drawn by: CES
From: Stamford Observatory photo
Sequence: AAVSO Preliminary 'b' chart 1975; & PEP(V), Geneva Obs'y, Grenon et al
Copyright © 1997 AAVSO
2108+47 (f) V1500 Cyg (Cygni)
AAVSO Chart 11/93
5"=1mm
7 1/2'
Drawn by: CES
From: Stamford Observatory photo
Sequence: AAVSO Preliminary 'f' chart, CBF 1975
Copyright © 1997 AAVSO

Figure 1. V1500 Cygni (Nova Cygni 1975), a fast nova/AM Herculis-type star, serves as an example of the present-day AAVSO variable star chart. In addition to showing the general format, the two charts shown ("b" scale on the left and "f" scale on the right) display the differences between scales. *All figures in this paper are from the AAVSO archives, except where indicated.*

the chart . Sequenced with letters "a" through "g," the charts range in scale from 5 arcmin/mm for the "a" scale to 2.5 arcsec/mm for the "g" scale. Hence, the smaller type scales, such as "a" and "b" show wider fields of view and brighter stars and are suited for binocular and finder use, or use with the smallest telescopes, while the larger scale charts of "d" through "g" show increasingly smaller fields of view and fainter stars for use with larger telescopes. Hence, each star may have charts(s) of one or more scales depending on the magnitude range of the variable. Additionally, more than one variable may be shown on a given chart.

While there are thousands of variable stars charted in the AAVSO observing program, there are many more charts in the AAVSO catalogue of variable star charts. With each star having charts of one or more scales, the catalogue of charts has grown to represent a collection of more than 4,000 charts over the past ninety-plus years. While this count represents those charts presently in circulation, countless charts have been retired when replaced by improved editions. Needless to say, unimaginable hours have been logged in decades of work by various hard-working and dedicated chart teams.

Figure 2. Director of HCO for forty-two years, E. C. Pickering, not only encouraged amateur astronomers, but also, with the aid of his staff, made visual photometric studies of 45,000 stars, guided the production of the *Henry Draper Catalogue*, and published the first all-sky photographic map, amongst other achievements.

With such an impressive library of active and archival charts today—and the automated production of customized charts coming with the online Variable Star Plotter developed by Clockwork Active Media Systems—one can't help but wonder how did the AAVSO charts begin and how have they evolved over the years?

2. The early years

In the late 1800s and early 1900s, Edward C. Pickering (Figure 2), Director of the Harvard College Observatory (HCO), was diligently working in the "neglected field" of variable star astronomy. Realizing the important contribution amateur astronomers could make to his work, Pickering petitioned for observers who could help with his research. In 1882, he wrote an article titled, "A Plan for Securing Observations of the Variable Stars" (Pickering 1882). In this publication, he suggested that volunteer amateur astronomers could contribute greatly to the field of variable star astronomy. The key to helping these observers, he knew, would be to provide them with reliable representations of the variable star field with standard sequences of comparison stars with assigned magnitudes. This type of chart would be infinitely easier to use than the cumbersome procedure involving step magnitude estimates, which was in use at the time. In 1891, Pickering (1891) issued his first set of sequences for comparison stars. Presented in pamphlet form and titled "Variable Stars of Long Period," the publication contained the approximate positions and sequences for seventeen long period variables (LPVs) north of +50 degrees.

As a follow-up to this endeavor, Wendell and Pickering (1900) published "Observations of Circumpolar Variable Stars During the Years 1889–1899" in the *Annals of the Astronomical Observatory of Harvard College*. With this article, the authors presented a wealth of information about the stars encompassed in their program, and included the finder charts labeled with lettered sequences and a table of comparison stars for the seventeen variable stars (Figure 3). Subsequent announcements presented in either the *Annals of the Harvard College Observatory* or the HCO *Circulars* told of the progress made in comparison star sequence work (see for example, Pickering 1901, 1906; Wendell and Pickering 1902; Campbell and Pickering 1908). In Pickering's 1901 HCO *Circular*, he described a method for observing variable stars: "A sequence of comparison stars is first selected as near the variable as possible, and each about half a magnitude brighter than the next in order, the brightest being somewhat brighter than the variable at maximum, and the faintest, fainter than the variable at minimum." Pickering further remarked that,

> The excellent charts of Father Hagen [Hagen's *Atlas Stellarum Variabilium*] are almost indispensable for observing the stars when fainter than ninth magnitude. When the variables are bright, the need has been felt here for charts on a smaller scale and covering a larger region. After various experiments, photographic enlargements [from Harvard College Observatory] have been made of portions of the admirable charts of the *Bonn[er] Durchmusterung*. A region 3 degree square, surrounding each variable, has been enlarged three times, thus giving a map on the standard scale of one minute of arc to one millimetre. (Pickering 1901)

Concluding his article, Pickering noted that the preparation of charts for over seventy variable star fields was underway (Pickering 1901).

Along with a handful of dedicated volunteers, Pickering continued to monitor variable stars with the newly issued charts. Pleased with the results thus far, in 1909 Pickering gave a lecture about variable stars at a meeting of the American Association for the Advancement of Science, held at HCO. An aspiring amateur astronomer in attendance at the lecture, William Tyler Olcott (Figure 4), was very impressed with Pickering's collection of variable star light curves and charts. Upon his return to his Connecticut home, Olcott enthusiastically wrote to Pickering offering his assistance. Pickering gladly welcomed Olcott as an observer. He directed one of his assistants, Leon Campbell, to visit Olcott at his Connecticut home and instruct

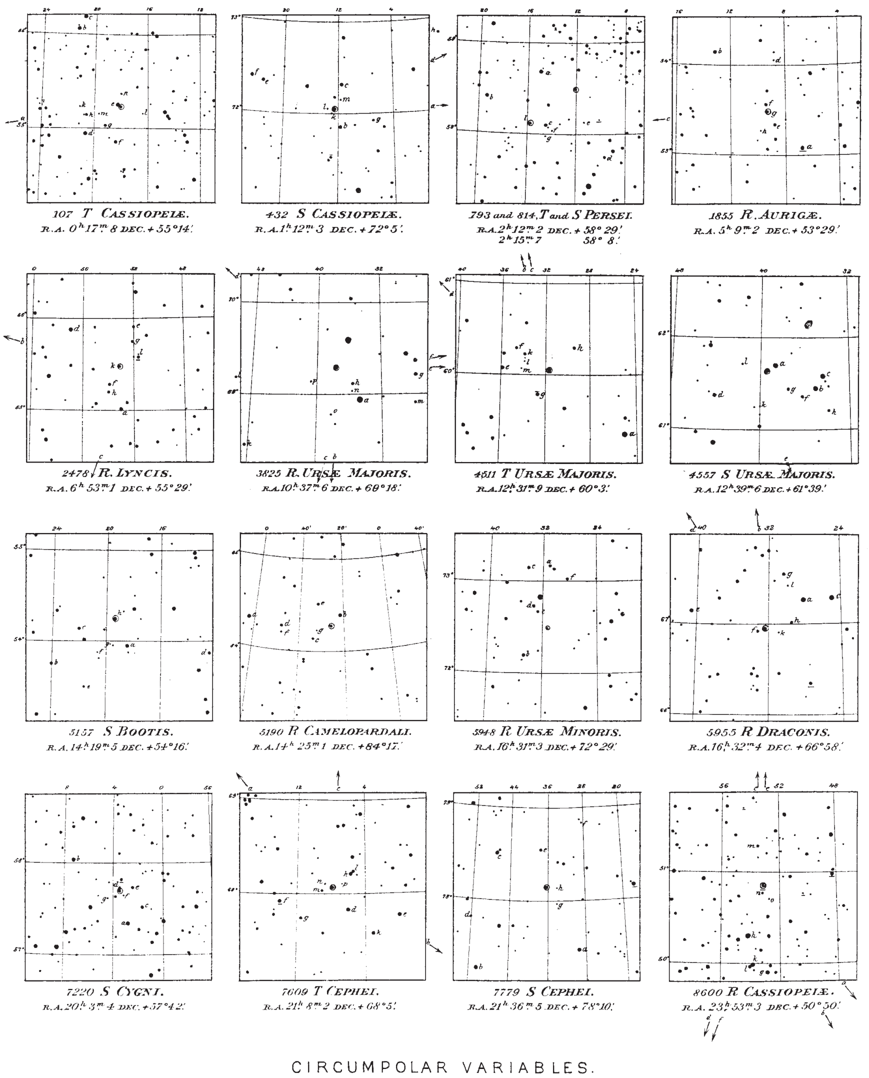

107 T Cassiopeiæ.
R.A. 0h 17m 8 Dec. + 55°14'.
432 S Cassiopeiæ.
R.A. 1h 12m 3 Dec. + 72° 5'.
793 and 814, T and S Persei.
R.A. 2h 12m 2 Dec. + 58° 29'.
2h 15m 7 58° 8'.
1855 R. Aurigæ.
R.A. 5h 9m 2 Dec. + 53°29'.
2478 R. Lyncis.
R.A. 6h 53m 1 Dec. + 55° 29'.
3825 R. Ursæ Majoris.
R.A. 10h 37m 6 Dec. + 69° 18'.
4511 T Ursæ Majoris.
R.A. 12h 31m 9 Dec. + 60° 3'.
4557 S Ursæ Majoris.
R.A. 12h 39m 6 Dec. + 61° 39'.
5157 S Bootis.
R.A. 14h 19m 5 Dec. + 54°16'.
5190 R Camelopardali.
R.A. 14h 25m 1 Dec. + 84°17'.
5948 R Ursæ Minoris.
R.A. 16h 31m 3 Dec. + 72° 29'.
5955 R Draconis.
R.A. 16h 32m 4 Dec. + 66°58'.
7220 S Cygni.
R.A. 20h 3m 4 Dec. + 57°42'.
7609 T Cephei.
R.A. 21h 8m 2 Dec. + 68°5'.
7779 S Cephei.
R.A. 21h 36m 5 Dec. + 78°10'.
8600 R Cassiopeiæ.
R.A. 23h 53m 3 Dec. + 50° 50'.
CIRCUMPOLAR VARIABLES.

Figure 3. E. C. Pickering's sixteen variable star charts (for seventeen variable stars) which set the stage for the future of AAVSO charts. *From Wendell and Pickering (1900).*

him in the fine art of variable star observing. This was the beginning of a long and fruitful relationship between Olcott and Campbell, as Campbell later became the Recorder of the AAVSO (a position now referred to as "Director"). Olcott's fascination flourished and just a couple of years later in 1911, he published "Variable Star Work for the Amateur With A Small Telescope" in *Popular Astronomy* (Olcott 1911), which featured variable star charts (Figure 5) along with instructions on how to make variable star estimates. In the article, Olcott stated, perhaps from his own experience, that "if the stars mentioned here are found and observed for a time, the fascination of the study will weave its spell, and the observer will be anxious to explore the heavens for new fields."

For the first few years, Olcott assumed the post as chart maker, tirelessly creating and supplying charts to members free of charge. The charts of the time were traced from Harvard maps, Hagen *Atlas* charts, and other various sources, and although they did not adhere to any specific fixed standards, they did supply the most accurate information, such as range and magnitude, that could be furnished by the HCO (Figure 6a). According to Brocchi *et al.* (1930), HCO supplied Olcott "with vast amounts of material from its seemingly unlimited store." In 1912, Dr. Edward Gray, Harold C. Bancroft, and E. L. Forsyth augmented this chart work by providing and distributing blueprint reproductions of the chart tracings (Figure 6b); they were soon aided in this by other enthusiastic members, including Alan Burbeck, Tilton C. H. Bouton, Alan P. C. Craig, Frederick C. Leonard, Charles Y. McAteer, and Giovanni B. Lacchini. In later years Leon Campbell also helped with advice and guidance, and with checking the charts (Olcott 1912, 1913; Brocchi *et al.* 1930).

Although charts were being produced, distributed, and readily used, they had maintained a somewhat unpolished appearance. With an increase in interest in the AAVSO, the efforts of the chart workers needed to be assessed and organized if chart productivity was to continue. It was thought that a specific plan of plotting charts would enable the chart makers to be much more productive, and would add to the uniformity and professional appearance of the charts.

3. The formation of the AAVSO Chart Committee

> At the annual meeting of the American Association of Variable Star Observers held at Harvard College Observatory in the fall of 1918, the writer [D. B. Pickering] suggested that an attempt be made to regulate, systematize and make more uniform, the charts used by the Association for variable star observation. The suggestion once adopted, a Chart Committee was formed and work immediately begun. (Brocchi *et al.* 1930)

The newly formed Chart Committee was placed under guidance of David B. Pickering (Figure 7, of no relation to Edward C. Pickering) who, with his enthusiasm and efficiency, put the chart making on a well-planned schedule (Campbell 1931).

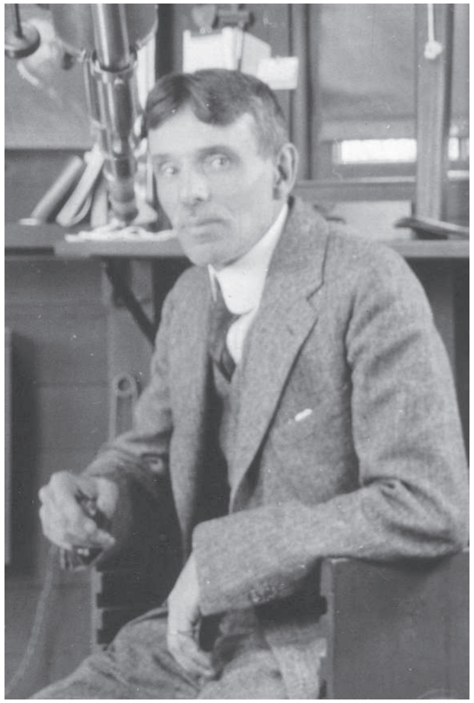


Figure 4. William Tyler Olcott in his observatory at Norwich, Connecticut. A lawyer by profession, Olcott authored many astronomical articles and books, including his popular classic guide, *Field Book of the Skies*. Olcott was the recipient of the AAVSO's third Merit Award in 1936.

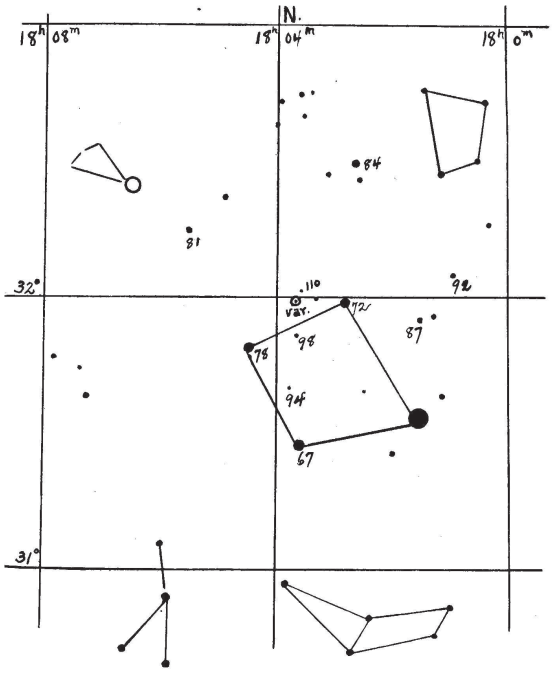

N.
18h 08m
18h 04m
18h 0m
32°
31°
84
81
110
var.
92
72
87
78
98
94
67
180531 T Herculis.

Figure 5. One of the early E. C. Pickering-based variable star charts that W. T. Olcott used in his 1911 *Popular Astronomy* article.

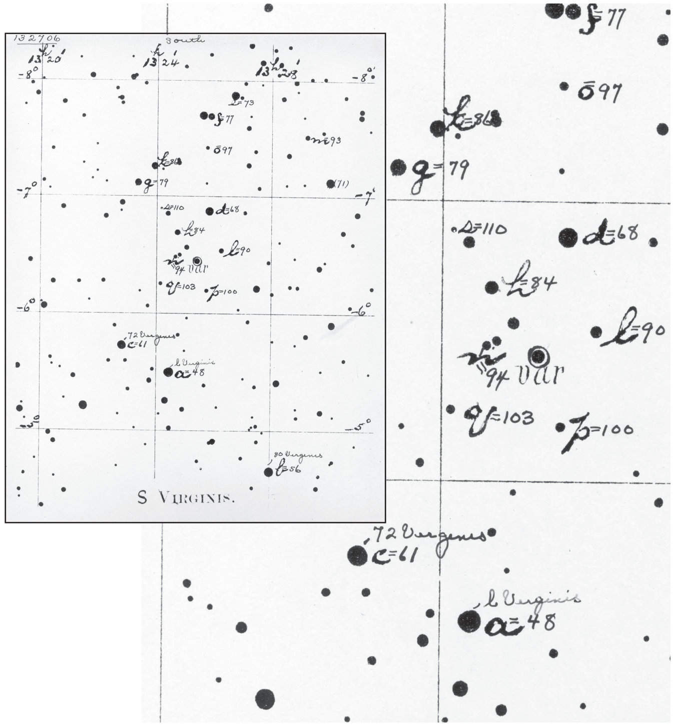

South
13 24
13 20
13 28
-8°
-7°
-6°
-5°
77
97
86
93
79
(71)
110
68
84
90
94 var
103
100
72 Virginis
c=61
l Virginis
a=48
80 Virginis
56
S VIRGINIS.

Figure 6a. One of the photographic charts provided by HCO in the early 1900s. W. T. Olcott made tracings from these and other types of charts for distribution to AAVSO observers. Compare this chart to his tracing of it at right (Figure 6b).

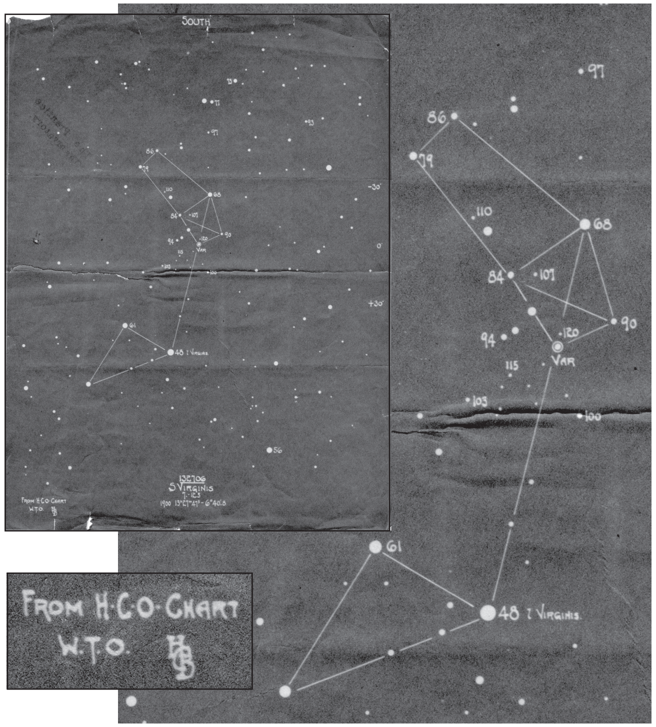

SOUTH
97
86
79
110
68
84
107
94
120
90
115
VAR
103
100
61
48 l Virginis
S VIRGINIS
FROM H.C.O. CHART
W.T.O.
HCB

Figure 6b. An early blueprint chart by Bancroft, from a tracing by Olcott. Note the initials "W.T.O." and the monogram "HCB" *(inset)* which appear in the lower left corner. This chart was probably made in 1912 or 1913. Compare to the HCO source chart (Figure 6a) at left.

Figure 7. Making a living as a jeweler in East Orange, New Jersey, David B. Pickering was the recipient of the AAVSO's fifth Merit Award in 1938.

The original Chart Committee consisted of John J. Crane, J. Ernest G. Yalden, and David B. Pickering as the Chairman (Brocchi *et al.* 1930). Like Olcott, the committee originally took on the responsibility of distributing charts in addition to their other duties, but the dissemination soon became too large a task. Therefore, in 1926, the position of Curator of Charts was developed and was first filled by William Francis Herschel Waterfield—a direct descendant of two famous Herschels: Sir William, his great-grandfather, and Sir John, his grandfather (Campbell 1931).

Leon Campbell supplied the newly formed Chart Committee with an extensive list of LPVs to plot. The selected stars, with exceptions, were limited to LPVs having a limited range of about three magnitudes or more and seen to be of ninth magnitude or brighter at maximum (Crane *et al.* 1920; Brocchi *et al.* 1930).

4. Standard issue

In an announcement issued on May 8, 1920 (Crane *et al.* 1920), the AAVSO Chart Committee advertised the first batch of its standardized AAVSO charts created, so far, for the region of Right Ascension from 08^h to 15^h, inclusive, and Declination +90° to –20°. In this statement, the committee also outlined its intent for the uniformity of the charts: (1) the size of the charts to be 8 × 10 inches; (2) the upper left corner placement of the Harvard designation; (3) the name, epoch, position, etc. at the top of the chart; (4) the variable's near or at central placement on the chart; (5) additional information in the bottom field; (6) the chart tracer's initials, trace source, and HCO approval date in the lower right corner; (7) the initials of the Association and type of chart in the lower left corner; (8) the cardinal field points identified; and (9) with exceptions, the South point would be at the top (Crane *et al.* 1920). Furthermore, they classified and described the letter-sequenced chart scale (Crane *et al.* 1920):

> *Chart a* Atlas reproduction of large area for use of beginners and those using Opera or Field Glass, or telescope of very small aperture. [Later defined to be 5 arcmin per millimeter.]
>
> *Chart b* Traced from HCO photographic enlargement of the *Bonn[er] Durchmusterung* chart. About 60 arcsec per mm. These show stars to about 11th magnitude and are best suited for telescopes of small aperture, 3 to 4 inches.
>
> *Chart c* Traced from HCO photographs of the sky. Originally about the same scale as Chart b, 60 arcsec per mm, they were later revised at an unknown date to be 40 arcsec per mm.
>
> *Chart d* Traced from HCO photograph. Scale 20 arcsec per mm. These show very faint stars and are more suitable for telescopes of medium aperture, 4 to 6 inches.
>
> *Chart e* Traced from HCO photograph. Scale 10 arcsec per mm. These charts are best suited for telescopes of large aperture.
>
> *Chart f* Traced from Yerkes photograph. About the same scale as Chart e, the scale was later revised at an unknown date to be 5 arcsec per mm.

Figure 8 shows an HCO photograph that might have been used as the basis of a chart tracing.

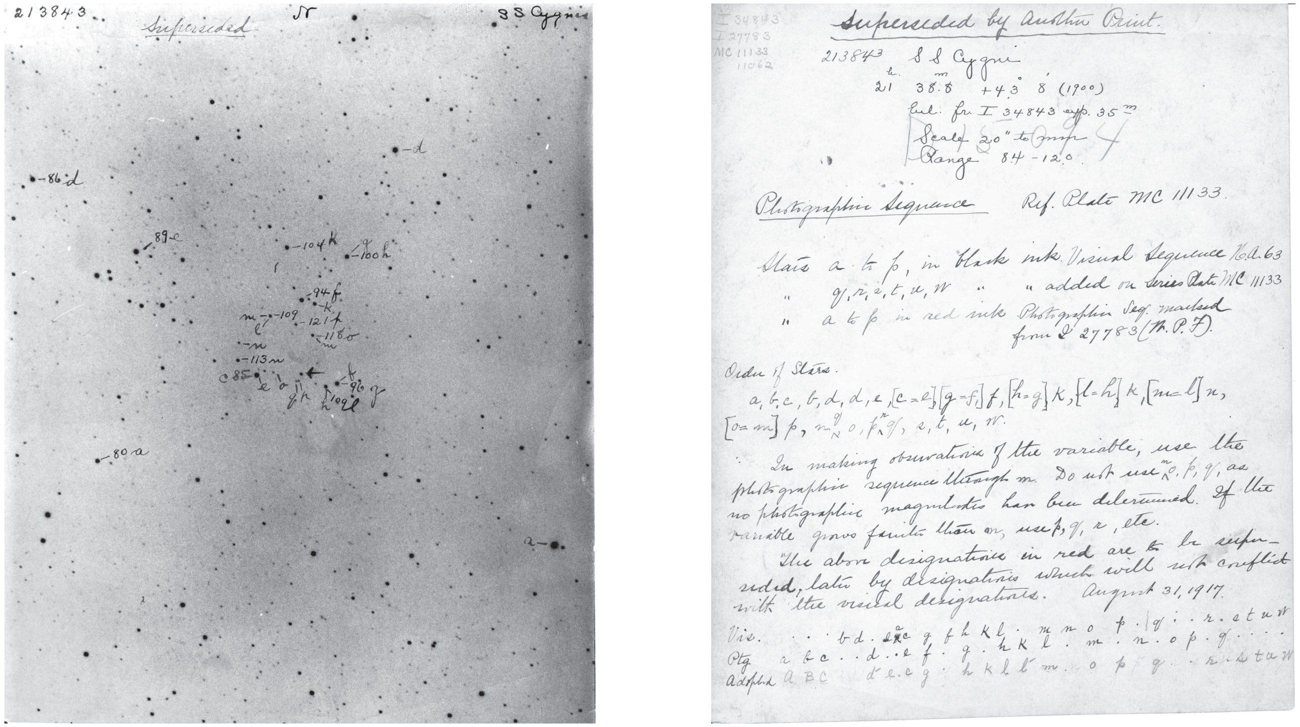
In addition to lettered-scale charts still in use today, there were the now obsolete numerically named chart scales (Crane *et al.* 1920):

> Charts 1 to 6. Traced from Hagen's *Atlas Stellarum Variabilium Series I, II, III, IV, V & VI,* with permission of Father Hagen. The field is either one degree or two degrees square and is divided into two parts. The inner square contains nearly all the stars which he could well observe with his telescope. The stars in the outer square are, with a few exceptions, to be found in the *Bonn[er] Durchmusterung*.

Undoubtedly as the result of D. B. Pickering's organization, the committee also proclaimed the development of a chart catalogue to be issued at a later date. A plan for future chart preparation was also given; the committee communicated that in order to facilitate work, the drafting of "a," "e," and "f" charts would be held off while more hours of Right Ascension were to be charted at the more popular "b," "c," and "d" scales. Stars south of –20° were to be done at a later date as well.

As if a secret mission were underway, the committee proudly announced that, "Through the courtesy of Harvard Observatory each chart will contain all the very latest intelligence procurable, much of which could not be otherwise obtained" (Crane *et al.* 1920).

In a follow-up announcement issued on February 1, 1921 (Crane *et al.* 1921), new charts for Right Ascension from 16^h to 20^h and Declination from +90° to –20°


213843
Superseded
SS Cygni
86 d
89 e
104 k
100 h
94 f
121 f
118 o
109
m
n
113 n
85 c
96 g
109 l
80 a
a
d

I 34843
I 27783
MC 11133
11062

Superseded by Author Print.

21384³ SS Cygni
21ʰ 38.8ᵐ +43° 8′ (1900)
Enl. fr. I 34843 exp. 35ᵐ
Scale 20″ to mm
Range 8.4 – 12.0

Photographic Sequence Ref. Plate MC 11133.

Stars a to p, in black ink Visual Sequence H.A. 63
" q, r, s, t, u, w " " added on Series Plate MC 11133
" a to p in red ink Photographic Seq. marked from I 27783 (M.P.F.).

Order of Stars.
a, b, c, b, d, d, e, [c = e], [g = f] f, [h = g] k, [l = h] k, [m = l] n,
[o = m] p, n o, p q, s, t, u, w.

In making observations of the variable, use the photographic sequence through m. Do not use n, o, p, q, as no photographic magnitudes have been determined. If the variable grows fainter than m, use p, q, r, etc.

The above designations in red are to be superseded, later by designations which will not conflict with the visual designations. August 31, 1917.

Vis. . . . b d . a c g f h k l . m n o p . q . . r . s t u w
Ptg a b c . . d . . e f . g . h k l . m . n . o p . q . . . .
Adopted a B C d d′ e . c g h k l l′ m . n o p p′ q . . r s s t u w

Figure 8. A marked copy of an HCO photograph shows the comparison star sequence on one side, while notes about the variable star and its sequence were often written on the back side. The photographic plates used to create AAVSO charts are believed to have been taken mainly with the 16-inch f/5.25 Metcalf Doublet refracting telescope, located at HCO until the early 1930s and later at Oak Ridge Observatory in Harvard, Massachusetts.

were made available. In addition, many improvements to the format of the charts were introduced, including: a square at the center of the chart encompassing the variable, where all stars present in the original HCO photograph to magnitude ~14 could be seen, while outside of the box were shown down to a magnitude of ~11, and multiple headings were displayed when more than one variable appeared in the field. Additionally, in this announcement the committee began encouraging donations for the once gratis charts that had become so popular with its ever-expanding community:

> Subscriptions for the chart fund-for purposes of furnishing new and better charts in exchange for old and inferior ones, without charge to the individual members-which were solicited in May, 1920, have exceeded the amount requested...the demand for the new charts far exceeds our first estimate, and the Committee will at all times be glad to receive additional contributions to this fund. (Crane *et al.* 1921)

5. The calm before the storm

The Chart Committee continued to grow and prosper, and as it did it acquired more members: "In 1921, Dean Potter and Arthur C. Perry were appointed to the Committee" (Brocchi *et al.* 1930). Additionally in the 1920s, a good portion of the charts were being drawn by Dalmiro F. Brocchi, an AAVSO member and observer from Seattle, Washington, who had taken charge of chart making. Ultimately, over a reign of thirty years, Brocchi produced over eight hundred charts at a drafting time of ten to twenty hours per chart! (Hamilton 1948a) As an AAVSO member and observer, and an excellent draftsman by profession (he worked for the Great Northern Railroad), Brocchi was a perfect fit for the position. In the words of D. B. Pickering, "D. F. Brocchi joined the Chart Committee in 1922 and his superior draftsmanship set a high standard for his fellow Committeemen to follow" (Brocchi *et al.* 1930). Then,

> In 1929, G[iovanni] B. Lacchini, one of the master observers of our Association, was appointed to the Committee in recognition of his signal service in checking the chart work at the telescope. Both Lacchini and Brocchi, using instruments of thirteen and twelve inches aperture respectively, have recently done splendid work in effecting chart improvements through detection of discrepancies while making direct and careful comparisons of charts with the sky. (Brocchi *et al.* 1930; Figures 9 and 10)

Brocchi's draftsmanship combined with the best photometry of the time set the standard of professionalism seen in AAVSO charts. While the original tracings were all done on special heavy linen drafting cloth, mass production of the charts, often called the "blueprint" or "standard" charts ("standard" would later refer to a chart whose sequence was no longer subject to change, in contrast to"preliminary"

Figure 9. Dalmiro F. Brocchi of Seattle, Washington, was recognized with the AAVSO's sixth Merit Award in 1942.

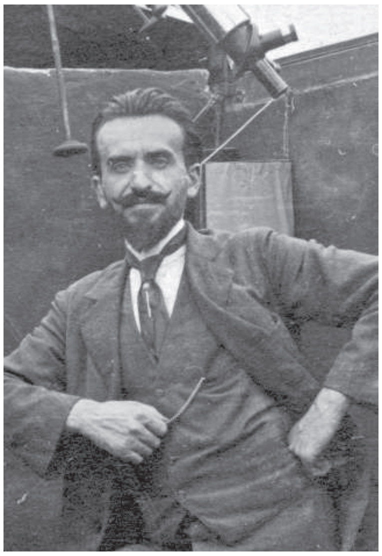
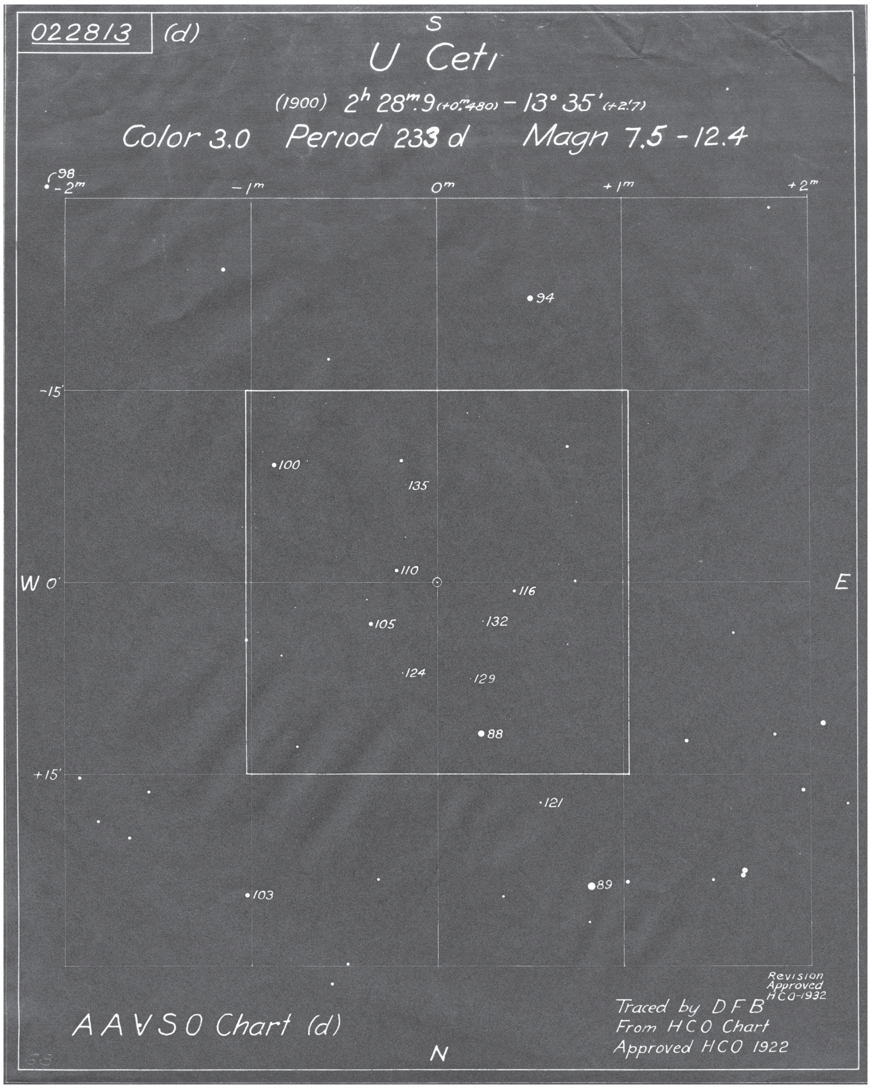


Figure 10. The first international member of the AAVSO, Giovanni B. Lacchini of Faenza, Italy.

charts), was done by the blueprinting process—an inexpensive way of making copies (Figure 11). The procedure involved making a print in white on a blue background. The "copies" were produced on large rolls of paper, from which individual charts would be cut for distribution. Thus, the early AAVSO charts had blue backgrounds with white stars. Members visiting Headquarters were often given a pair of scissors and were asked to cut charts from the large rolls received from the blueprinter. Many observers liked the blueprint charts because they could shine their red flashlight through the back of the charts, producing muted white stars against the dark background.

During this time, chart activity was alive and fruitful. Within five years (as of 1923), the circle of sky from the North Pole to –20° had been charted, for a total of 393 charts for 285 variable stars. Charts were in high demand, so much so that observers were asked to return superfluous charts that were not being used for redistribution. And not only was the listing of charts growing by leaps and bounds, but ideas were brewing for the publication of an atlas. In the 1925 Chart Committee report given by Chairman D. B. Pickering, it was announced that the AAVSO charts were in demand by American and foreign observatories alike and were highly praised by professional astronomers because of their accuracy and utility (Waldo 1925). "And with this equipment, the Committee temporarily rested from its labors" (Brocchi *et al.* 1930).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Color 3.0 Period 233 d Magn 7.5 - 12.4
98
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0m
+1m
+2m
94
-15′
100
135
W 0′
110
116
E
105
132
124
129
88
+15′
121
89
103
Revision Approved HCO-1932
AAVSO Chart (d)
N
Traced by D F B
From H C O Chart
Approved HCO 1922

Figure 11. A Brocchi-drafted blueprint chart.

6. The uphill battle begins

"Then...things began to happen," according to D. B. Pickering, "Clouds were gathering in the offing that threatened the committee's serenity" (Pickering 1932). With the various scales traced for all stars on the HCO observing list, it was thought that "the work of the committee would be completed and that the future would be one glorious holiday, during which we would continue to print and distribute charts from the initial tracings" (Pickering 1932). The truth of the matter, though, was that "[the chart business] proved to be a Herculean task, far beyond the anticipations of the original committee" (Campbell 1931). For by 1928 it was found that the new charts fell short of the growing needs of the observers. A review of the charts revealed that many of the fields were in need of better distribution of comparison stars, more required additional scales, and although charts were cleaner than the original charts, many still needed retracing. Also, the fields south of –20° were yet to be produced. In addition, new photographic charts became available at Harvard that should be used to replace the tracings that had been made from Hagen's *Atlas*. With this, the Committee entered an era of "reconstruction and extension." "The committee realized then and there that their work not only had just begun, but that it would never be finished" (Pickering 1932).

As an important milestone in the recognition of the AAVSO by the professional astronomical community, the chart committee announced (Pickering and Sawyer 1928) that the revisions to take place would be accompanied by the introduction of new faint comparison stars as determined by Professor Samuel Alfred Mitchell, Director of the Leander McCormick Observatory in Virginia, and his assistants. Mitchell, who had been monitoring Nova Persei 1901 after it "was placed under observation at the Leander McCormick Observatory for the purpose of determining the fluctuations in brightness..." used the telescope "during the hours near midnight [when] the telescope is available for other lines of research" (Mitchell and Alden 1926). During this time, the team monitored about two hundred long period variables that at minimum showed magnitudes fainter than thirteen. In addition, determination of magnitudes for comparison stars was a prime project, such that "Not only have the magnitudes of the comparison stars adopted by Harvard been determined, but the sequences have been extended, when necessary, to stars fainter than fifteenth magnitude" (Mitchell and Alden 1926). With this, Mitchell and company proved to be a valuable asset to the chart committee and, with the aid of their 26-inch refractor and excellent photometer, worked on revising existing sequences and developing deeper comparison star sequences where needed.

The chart committee also began, for the first time, to work on "e" scale charts. Additionally, the committee went forward with its plan to replace poor charts, plot stars in the Declination range of –20° to –30°, and plot new variables from HCO, the latter of which took priority over other duties (Brocchi *et al.* 1930). The new and revised charts produced displayed headings that gave new values for ranges and magnitude as published in the *Harvard Annals* (Townley *et al.* 1928).

The ambitious work of the committee and Professor Mitchell yielded a batch of 153 revised charts in early December 1928, with January 1, 1929, as the date on which new charts were to be adopted. Specific directions on how to obtain the new charts were outlined in a letter titled "Important Notice to Members" published on November 6, 1928, in which D. B. Pickering continues, "deviation from this plan may result in untold confusion" (Pickering and Sawyer 1928).

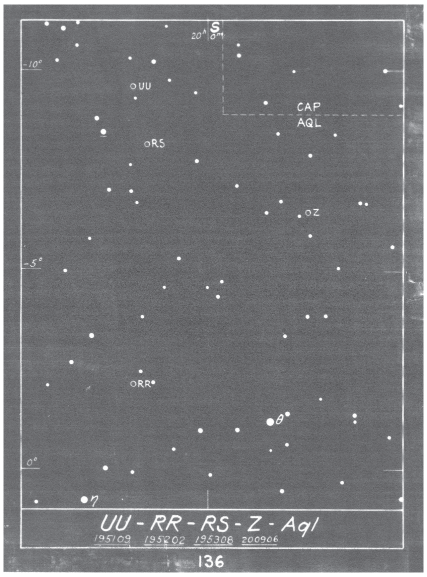

Figure 12. One of Brocchi's popular finder charts.

7. Changing of the guard

The Chart Committee was now well aware of the ongoing maintenance and other tasks at hand and continued to forge forward. In 1930 the awaited chart catalogue was prepared and issued by Brocchi, Lacchini, and D. B. Pickering, listing all of the charts available within the AAVSO observing program, which at the time included charts for 346 variable stars (Brocchi *et al.* 1930). In addition, a now elusive type of chart was produced: the "R"-type charts, where the sequences given had been determined in red light. About a dozen in number, the "R" charts were distributed with suitable red screens to a select list of observers to obtain "light curves visually in red light for comparison with ordinary visual observations" (Campbell 1935). (The effort was later dropped due to poor response and hence, few observations.) The *AAVSO Atlas*, drafted by Brocchi, was made available for the price of $1.50 for an unbound copy and $2.25 for a bound copy. This atlas covered the entire sky to magnitude 6.05 and showed the locations of the AAVSO variables, but excluded comparison star values. Furthermore, the once free-of-charge charts, whether first issue charts or replacements, were now to come at a fee (Brocchi 1936). Also, through "the inspiration and work of Mr. D. F. Brocchi" 164 finder charts covering fields of all Association variables were made available (Figure 12). Each being 4 × 5 inches in size, with a scale of 360 arcsec per mm, showing a field of over 12° in declination, and stars as faint as eighth magnitude, these charts would prove to be an extra resource for the observers (Pickering 1931).

In the Chart Committee report given in 1933 (Pickering 1933; see also Shapley 1933 and Nijland 1936), D. B. Pickering, proudly announced that:

> Every member of our organization will be gratified to learn that a special meeting of representatives of Variable Star Organizations was

> held at Cambridge in September, 1932, during the congress of the International Astronomical Union. The meeting was at the suggestion of Professor Mitchell. For the first time in history, an agreement was reached whereby the Harvard Scale of Magnitude for comparison stars was adopted internationally. This was an epochal achievement. Since that time Professor Mitchell has undertaken to supply the British and French Associations with the positions and values of all the faint comparison stars which have been added to our sequences since the work of revision began.

Then in 1934, after nearly twenty years of "interesting service" D. B. Pickering announced that he would be retiring from the position of Chairman of the Chart Committee. "The revision of the charts, as originally planned, has covered a period of six years and is now practically completed. The work has proved a delightful occupation....The chart work has reached but one mile-stone in progress. There is much to be done. It is time now for another to carry on" (Pickering 1934). D. B. Pickering had seen the chart program progress through some difficult years. Together with the devoted chart team, D. B. Pickering had worked to revise, perfect, and set the standard for AAVSO charts.

With the resignation of D. B. Pickering, the reconstructed chart committee consisted of Dalmiro F. Brocchi as the Chairman, Helen Sawyer Hogg as the Curator, who soon relinquished of the duty to Ferdinand Hartmann, and Dr. Samuel A. Mitchell and Harold B. Webb as committee members. Brocchi was reluctant about the prospect of being the Chairman, stating, "I would greatly appreciate the honor and [would] be willing to do the work to the best of my ability, but I would appreciate still more effort made to induce somebody else to accept the position" (Brocchi 1934); yet he assumed the position with zeal and urged observers to report any problems with the charts to the chart committee for revision:

> Observers are urgently requested to report to the chart committee suggestions for the revision of charts, and in particular any difficulty they may experience in locating fields with the assistance of finder charts. Owing to the magnitude of the task and pressure of other work when these charts are made, advantage was taken of the fact that the work could be abbreviated by using DM [*Durchmusterung* Catalogue] magnitudes, with the result, however, that in some of the charts conformity to the appearance of the sky is not of the best. Later a method was developed, whereby these charts can be replaced at the same rapid rate using Harvard magnitudes, resulting in decidedly improved agreement between charts and sky. (Brocchi 1936)

In 1937, Chairman Brocchi announced that the extensive program of revision undertaken by Dr. Mitchell had been brought to completion (Brocchi 1937).

8. The Chart Committee soldiers on

It seemed that nothing could stop the AAVSO observers from their hunger to observe. With World War II raging over the globe, the then Chart Curator, Ferdinand Hartmann, indicated in his fall 1944 report that even though a war was in progress the demand for variable star charts remained high (Smiley 1944). During the era, the task of fine-tuning the charts continued, while corrections of errors were of priority. Work also began in an effort to revise the chart headings from 1900 to 1950 positions. Preparation of charts for one hundred southern variables, as taken from photographs taken at Harvard's South American station, also moved forward (Seely 1951).

The 1940s also brought a number of changes to the Chart Committee. Harold B. Webb (author of the popular *Webbs* [sic] *Atlas of the Stars*) assumed the position of Committee Chair from the ailing Brocchi. Brocchi, however, had the privilege of being declared honorary Chairman for all of his hard work and dedication devoted to years of AAVSO chart business (Hamilton 1948b). In addition, he was elected as "Patron of the Association." In a letter to Brocchi from Campbell, it was a "token of appreciation of [his] many efforts and evidences of generosity in connection with the work of the preparation of the AAVSO charts" (Campbell 1947). The Chart Curator position was changing as well, as it shifted from Ferdinand Hartmann to Richard Hamilton (great-great grandson of Alexander Hamilton, the first Secretary of the United States Treasury), who was later appointed to the Committee Chairmanship in the 1950s.

Since the charts drawn thus far had been typically for stars that the Harvard Observatory had photos and sequence information with which to work, Roy A. Seely forged ahead on a series of stars that were observable but had not yet been plotted by the chart team. Seely began drafting such chart tracings utilizing sketches furnished by AAVSO member and observer Edward Oravec, AAVSO Headquarters photographs, and *Skalnate* and Hagen *Atlas* charts (Hamilton 1957). Several charts made specifically for binocular use were prepared by Seely from Oravec's sketches, and proved to be highly popular (Hamilton 1955).

In 1954, the AAVSO received a letter from the President of IAU Commission 27 (the commission on variable stars), Professor Boris V. Kukarkin, expressing the importance of monitoring LPVs of eleventh magnitude or greater, as well as U Geminorum- and Z Camelopardalis-type variable stars. The proposed LPVs alone that met this criteria added two hundred variable stars to the charting queue. Professor Kukarkin emphasized the continued need to determine all the dates of maxima and minima of the brighter members of the Mira Ceti class, including newly discovered variables. It was stated that the goal "can certainly be accomplished by such a powerful organization...known throughout the world by its variable star observations" (Mayall 1954).

The 1950s seemed to bring a fresh interest in variable star observing. In a number of Chart Committee reports, it is noted that, "correspondence with observers, both here and abroad, has been more active than in any recent year; especially has the 'younger set' of observers shown increased interest and activity" (Hamilton 1954); "especially has this [correspondence] been true with the large number of energetic young observers" (Hamilton 1955); "chart orders and correspondence have been the largest in numbers in the ten years of the present curator's office" (Hamilton 1958); and "there has been, however, an increasing number of orders for "d" and "e" charts from observers equipped with telescopes large enough to observe minima of variables" (Hamilton 1957). In addition, much-deserved recognition by the professional astronomical community increased as complete sets of charts were ordered by astronomers at some of the most prestigious observatories, including Kitt Peak National Observatory and the National Radio Astronomy Observatory (Mayall 1960). By the close of the 1950s and the start of the 1960s, activity with chart distribution had increased so much that the duty of distributing charts was transferred to AAVSO Headquarters "for reasons of economy and for greater ease in handling" since the counts had amounted to the sending out of over 10,000 charts per year (Mayall 1962).

9. Discussion

Our chart forefathers have clearly left an indelible mark on the face of the AAVSO charts. With Edward C. Pickering as the catalyst, William Tyler Olcott, along with Leon Campbell and others, promoted and helped make the variable star charts more accessible to the amateur. Through the organization of inaugural Chart Committee Chairman David B. Pickering, the AAVSO charting process became a more streamlined and uniform task, while the presentation of the chart was perfected by Dalmiro F. Brocchi and company.

The lessons learned and standards set have trickled through generations of chart makers. Heeding the needs of the observers, they have diligently created, revised, expanded, and perfected, even if just for the moment, the charts so crucial to the vitality of variable star observing. The AAVSO charts are a testament to the dedication and determination of a group of people with a common love for variable stars.

In part two of this paper, we will chronicle further challenges and achievements of the AAVSO chart team beyond the 1950s.

10. Acknowledgements

We would like to extend our sincere thanks to AAVSO staff member Michael Saladyga for his excellent organization and preservation of the AAVSO archives and for his help in providing us with the extensive archival literature necessary to put this history together. Our heartfelt thanks also goes to Janet Mattei, who tirelessly shared her knowledge and always offered her support and encouragement. We also wish to express our gratitude to all of the chart makers, observers, and Headquarters staff, past and present, who have helped to make the AAVSO charts the high quality variable star maps that they are today.

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