The VSS RASNZ Variable Star Charts: a Story of Co-Evolution

Alan Plummer
Linden Observatory, 105 Glossop Road, Linden, NSW 2778, Australia; info@alplummer.com.au

Mati Morel
6 Blakewell Road, Thornton, NSW 2322, Australia; mmorel7@bigpond.com

Received September 21, 2009; accepted October 7, 2009

Abstract The background and history of the *Charts for Southern Variables* of the Variable Star Section of the Royal Astronomical Society of New Zealand (VSS RASNZ) is presented. It is seen that while there are some common origins with the charts of the AAVSO, they have undergone their own unique and important development. After much effort the two organizations' chart resources are now compatible and complementary. Some more general but nonetheless important history of the VSS is also mentioned.

1. Introduction

1,302 charts with good sequences now exist for southern variables, courtesy of the Variable Star Section—now Variable Stars South—of the Royal Astronomical Society of New Zealand (VSS RASNZ). The charts have been published as *Charts for Southern Variables* in 27 Series between 1958 and 2008 (Table 1), with the earlier charts and sequences more recently revised.

We add a southern hemisphere perspective to the historical work done by Malatesta and Scovil (2005) which covers the early history of the AAVSO charts. The AAVSO certainly did—and do—offer charts for southern objects, but naturally their priority lies in the north. After much in common in the early years, it fell to those under the southern sky to do the labor needed. After many decades the two chart systems are now formally linked, with the southern comparison star sequences having being entered into the AAVSO's Variable Star Plotter (VSP). This current work is excerpted and expanded from a presentation to the 2009 Conference of the RASNZ held in Wellington, New Zealand (Morel and Plummer 2009).

2. The Variable Star Section

The Section was formed in 1927 by Frank Bateson, on his return from a four-year stay in Sydney, Australia, in response to requests from professional and amateur astronomers. At first it was a sub-section of the Southern Variable Star Section of the New South Wales Branch of the British Astronomical Association (now the Sydney City SkyWatchers). From June 30, 1928, the successful sub-

section became an observing section of the Astronomical Society of New Zealand (Bateson, 1958a), later to become the RASNZ.

It is worth noting some historically important decisions, the consequences of which still reverberate in astronomy today. In the early 1950s a decision was made by Bateson to concentrate less on Miras and to observe all dwarf novae brighter than magnitude 13.5 at maximum. This was at a time when there was very little professional interest in these objects (Bateson 1990). Look to any current text on cataclysmic variables and the fruits of this decision can be seen (see for instance Livio and Shaviv 1983 and Warner 1995).

The International Astronomical Union (IAU) 1956 Dublin session formally asked the VSS and the AAVSO to work more closely together. In 1957 the two directors met—the AAVSO's Margaret Mayall and Frank Bateson—whereupon it was agreed that VSS be freed from observing LPVs north of –20°. in order to concentrate on southern objects. This was with the important exception of U Gem stars and the like, because New Zealand filled an important longitude gap. Furthermore, the two organizations were asked to standardize charts and sequences (Bateson 1959). As will be seen below, this has only just been completed in the first years of the 21st century.

3. Charts and sequences

Every organization that starts its own series of charts has a precursor, drawing upon similar work done elsewhere. This is true of the VSS as much as the AAVSO. An early compiler of variable star charts around the year 1900 was Rev. Johann Georg Hagen, S.J. of Georgetown Observatory, Washington, DC. For a detailed account of his and other early advocates of variable star observing see Malatesta and Scovil (2005). These charts are now hard to locate; however, a set does exist in the State Library of New South Wales, Australia.

Hagen's charts are described, but not reproduced, in the pages of the *Astrophysical Journal* (Anon. 1897; Hagen 1898; Parkhurst 1907). A specimen chart, U Puppis, is available for download from the ADS Serials and Journals server, but the reproduction is poor and distorted. Shown in Figure 1 is the Hagen U Pup chart from his *Atlas Stellarum Variabilium,Series I* (Hagen 1899), reproduced from a copy in the AAVSO library. The original charts have a grid, printed in red, the purpose of which was that when viewed under red light at the telescope, the grid would vanish.

Hagen's listings of magnitudes were not really sequences as they are understood today, but simply visual estimates for every field star, and none were ever published in the *Astrophysical Journal*. At this time it is not known whether or not these charts were used by the VSS, but more likely early southern observers used charts from the AAVSO or the British Astronomical Association.

Campbell and Pickering (1913) published useful comparison star sequences for ninety-two variable stars south of –30°, and some of the VSS charts were

made from Campbell and Pickering's photographs with these values marked on them. The AAVSO appears to have reproduced Campbell and Pickering's original charts for these southern stars. The weaknesses of these sequences are summarized by Bateson (1958a) as follows:

1. Sequences often not as bright as the target at maximum.
2. Sequences often not as faint as target at minimum.
3. Consecutive stars in the sequences sometimes differ in brightness by far more than desirable.
4. Many differences in assigned and "apparent" magnitudes, and occasional wrong identifications.
5. All sequences unreliable under 11th magnitude.

The *Cape Photographic Durchmusterung* (CPD; Gill and Kapteyn 1895–1900) survey was used to plot some basic charts, and another cause of problems was the fact that the film was blue sensitive, so that red stars disappeared below about 10th magnitude while blue stars of magnitude 11.0–11.5 were present.

While the use of the *Cordoba Durchmusterung* (CoD; Thome 1892–1932) would have been preferable for making charts for visual observers, this survey, in five parts, was long out of print for most parts. By 1965 Bateson had overcome this problem in collaboration with Ignas Stranson of Queensland, Australia. The latter had very skillfully constructed his own Schmidt camera, aperture 7-inch and focal length 434-mm, which he used to photograph many southern variable star fields between 1965 and 1972. His prints were used extensively to provide accurate detail on the charts down to 13.5v, from Series Three onwards.

For lack of good sequences many VSS program stars, particularly long period variables, had only lettered comparison stars. The old observations of these stars await a future date to be reduced to numerical values and entered into the VSS RASNZ data base.

In the period 1974–2004 one of us (MM) was focused on preparing charts for the VSS under Frank Bateson's direction. At first, the concept of an overall index or compilation of sequences such as now exists never really arose. As far back as 1966 Bateson stated "...After publication of all charts in this Series a separate publication will provide data on all comparison stars" (Bateson *et al.* 1966). There were some efforts made in 1994 after the *Guide Star Catalog* (Space Telescope Science Inst.1992) became available, however nothing of enduring value then materialized.

4. The beginning of modernization

In 2003 the AAVSO initiated their Comparison Star Database project. The aim was to document over 70,614 comparison stars on 4,128 charts, with the ultimate aim to have an updatable database which could be accessed by computer

and used to create charts, on demand, by their Variable Star Plotter (VSP) system (Malatesta *et al.* 2007). While the work of documenting the AAVSO charts was divided up among about a dozen members, they were not surprisingly most familiar with northern skies.

The progress of the AAVSO work was followed closely, and it appeared that the extensive southern charting work of the VSS RASNZ was barely on the radar. In June 2005 it was decided that if documenting the VSS charts were to be done at all, if would have to be done by someone intimately familiar with their creation. Thus began Project Snapshot.

5. Project Snapshot 2005–2007

The plan was simple: to document all visual comparison stars used or selected by observers and shown on published VSS charts. With the availability of several modern all-sky surveys with reliable *BV* data it appeared quite feasible to convert all of the existing VSS sequences to the international *BV* standard, to clear the backlog of letter-only sequences, and to update old visual magnitudes.

Starting with the very first charts issued by the VSS, each chart was compared with a GUIDE8® display on a PC, to obtain the most precise astrometric position of each lettered comparison star or magnitude on the chart. The *USNO-A2.0 Catalog* (Monet *et al.* 1992) was used to extend the on-screen display beyond magnitude 14–15 when required. Particular care was needed when comparing a precise computer display with paper charts which often used telescopic field sketches, made by hand and eye alone.

Figure 2 compares the original hand drawn VSS chart 1 with the new version. The old chart is perfectly good and served very well for decades. However, it can not be doubted that the revised chart 1 serves the observer better.

Prior to 2001 quite a few VSS stars had photoelectric (p.e.) *V* sequences determined and published by a variety of authors. Nevertheless it was felt wise to check existing p.e. sequences against *All Sky Automatic Survey 3* (ASAS-3; Pojmański 2002) measures as any discrepant data could be identified and resolved. ASAS-3 has been extensively used in Project Snapshot.

It took about two years to go through 1,302 charts, compile the data, and type them all into EXCEL spreadsheets, of which there are now twenty-seven different volumes, corresponding to twenty-seven issues of *Charts for Southern Variables*. By mid-2007 Project Snapshot was essentially completed. One final task remained. At the suggestion of Arne Henden, Director of the AAVSO, between October 2008 and January 2009 the Snapshot files were converted into a format which could be loaded into the AAVSO's Variable Star Database, and hence be utilized for online plotting of charts via the VSP system.

The ASAS-3 magnitudes used in Project Snapshot are not the perfect solution, as ASAS-3 only delivers one color—*V*. One would prefer at least *B–V* as well, as there may unknowingly be very red stars in the sequences, a circumstance best

avoided. Until the AAVSO's mooted All-Sky Photometric Survey gets up and running in a year or two observers have to make the best of what's available. This new survey hopefully will return reliable data much fainter than the cutoff point of ASAS-3, 13.5V or so.

6. Conclusion

It is fitting that the VSS and AAVSO chart resources are now complementary and compatible. One might say that the vision of the 1956 IAU Dublin session was a long time being realized. As both organizations move into the future with the inevitable new astronomical discoveries and better measures, a close working relationship serves everyone well.

References

Anonymous. 1897, *Astrophys. J.*, **6**, 441.

Bateson, F. M. 1958a, *J. Roy. Astron. Soc. Canada*, **52**, 241.

Bateson, F. M. 1958b, *The Observation of Variable Stars*, privately printed, Rarotonga, Cook Islands.

Bateson, F. M. 1959, *J. Roy. Astron. Soc. Canada*, **53**, 1.

Bateson, F. M. 1990, *J. Amer. Assoc. Var. Star Obs.*, **19**, 156.

Bateson, F. M., Jones, A. F., and Stranson, I. 1966, *Charts for Southern Variables, Series 3*, Astronomical Research, Ltd., Tauranga, New Zealand.

Campbell, L., and Pickering, E. C. 1913, *Ann. Harvard Coll. Obs.*, **63**, 143.

Gill, D., and Kapteyn, J. C. 1895–1900, *Cape Photographic Durchmusterung, Ann. Cape Obs.*, **3** (1895, Part I: zones –18 to –37 degrees); **4** (1897, Part II: zones –38 to –52 degrees); **5** (1900, Part III: zones –53 to –89 degrees).

Hagen, J. G. 1898, *Astrophys. J.*, **8**, 160.

Hagen J. G. 1899, *Atlas Stellarum Variabilium, Series I*, F. L. Dames, Berlin.

Livio, M., and Shaviv, G., eds. 1983, *Cataclysmic Variables and Related Objects*, Proc. 72nd Colloq., Haifa, Israel, August 9–13, 1982, D. Reidel, Dordrecht.

Malatesta, K. H., and Scovil, C. E. 2005, *J. Amer. Assoc. Var. Star Obs.*, **34**, 81.

Malatesta, K. H., Simonsen, M. A., and Scovil, C. E. 2007, *J. Amer. Assoc. Var. Star Obs.*, **35**, 377.

Monet, D., *et al.* 1998, *USNO-A V2.0 Catalog of Astrometric Standards*, U.S. Naval Observatory, Flagstaff, AZ.

Morel, M., and Plummer, A. 2009, *South. Stars*, **48**, 19.

Parkhurst, J. A. 1907, *Astrophys. J.*, **25**, 361P.

Pojmański, G. 2002, *Acta Astron.*, **52**, 397.

Space Telescope Science Institute 1992, *The Guide Star Catalog*, Version 1.1, STScI, Baltimore.

Thome, J. M. 1892–1932 *Cordoba Durchmusterung, Resultados del Observatorio Nacional Argentino*, **16** (1892, Part I: –22 to –32 degrees), **17** (1894, Part II: –34 to –42 degrees), **18** (1900, Part III: –42 to –52 degrees), **21** (Part I) (1914, Part IV, –52 to –62 degrees), **21** (Part II) (1932, Parv V: –62 to –90 degrees).

Warner, B. 1995, *Cataclysmic Variable Stars*, Cambridge Astrophysics Series, Cambridge Univ. Press, Cambridge and New York.

Table 1. Series comprising *Charts for Southern Variables*.

Chart Numbers	*Series Number*	*Compilers*	*Year Published*
1–12*	1*	F. M. Bateson, A. F. Jones	1958
13–43	2	F. M. Bateson, A. F. Jones	1960
44–100	3	F. M.Bateson, A. F.Jones, I. Stranson	1966
101–150	4	F. M.Bateson, A. F.Jones, I. Stranson	1967
151–200	5	F. M.Bateson, A. F.Jones, I. Stranson	1968
201–250	6	F. M.Bateson, A. F.Jones, I. Stranson	1970
251–300	7	F. M.Bateson, A. F.Jones, I. Stranson	1971
301–350	8	F. M.Bateson, M. Morel, R.Winnett	1976
351–400	9	F. M.Bateson, M. Morel, R.Winnett	1977
401–449	10	F. M.Bateson, M. Morel, R.Winnett	1979
450–500	11	F. M.Bateson, M. Morel, B.Sumner, R.Winnett	1979
501–551	12	F. M.Bateson, M. Morel, B.Sumner, R.Winnett	1980
552–600	13	F. M.Bateson, M. Morel, B.Sumner, R.Winnett	1981
601–649	14	F. M.Bateson, M. Morel, B.Sumner	1982
650–700	15	F. M.Bateson, M. Morel	1982
701–750	16	F. M.Bateson, M. Morel	1983
751–800	17	F. M.Bateson, M. Morel	1984
801–851	18	F. M.Bateson, M. Morel	1985
852–900	19	F. M.Bateson, M. Morel	1986
901–947	20	F. M.Bateson, M. Morel	1988
948–1002	21	F. M.Bateson, M. Morel	1990
1003–1053	22	F. M.Bateson, M. Morel	1990
1054–1104	23	F. M.Bateson, M. Morel	1992
1105–1154	24	F. M.Bateson, M. Morel	1995
1155–1203	25	F. M.Bateson, M. Morel	1997
1204–1251	26	F. M.Bateson, M. Morel, B. Sumner	1999
1252–1302	27	M. Morel	2008

**Note: The first twelve charts were not numbered. These were named "Series 1" some time after the publication of Series 2. The first twelve (unnumbered) were issued with a booklet to assist novice members of the VSS, titled* The Observation of Variable Stars *(Bateson, 1958b).*

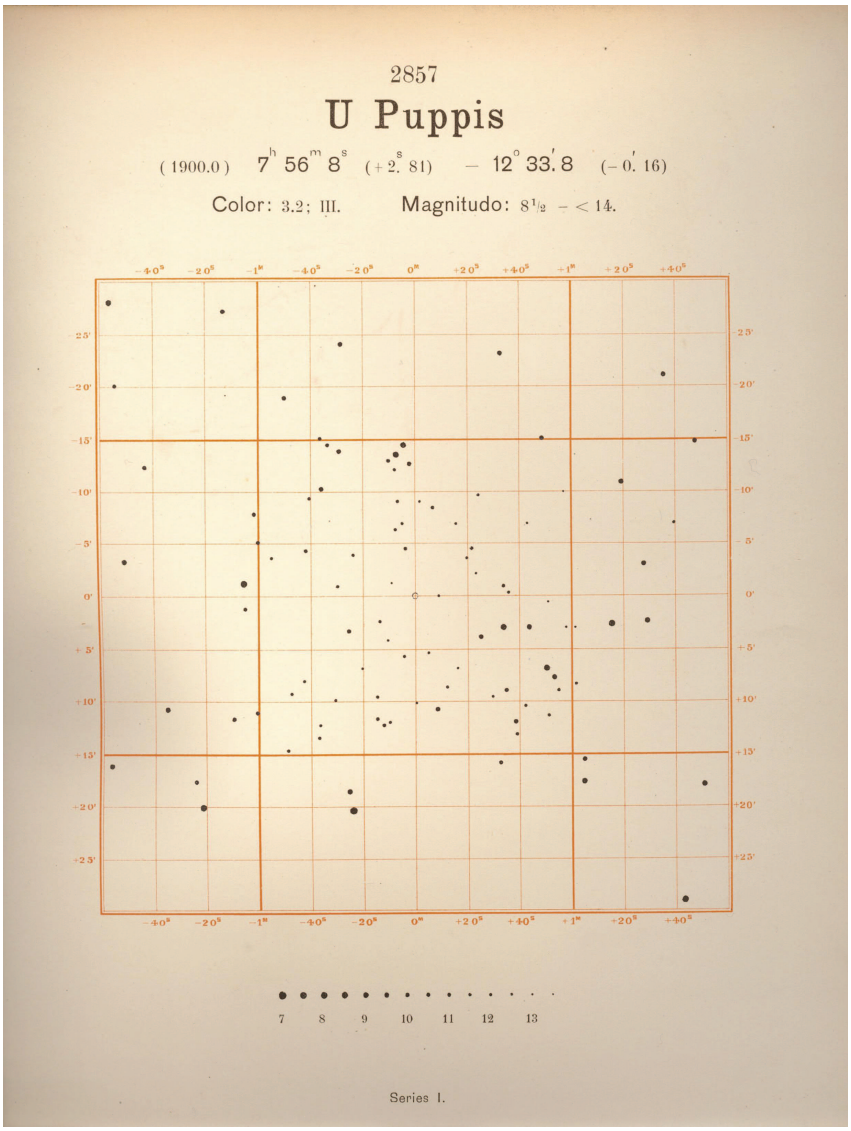

Figure 1. Chart for U Pup from *Atlas Stellarum Variabilium*, Series I (Hagen 1899).

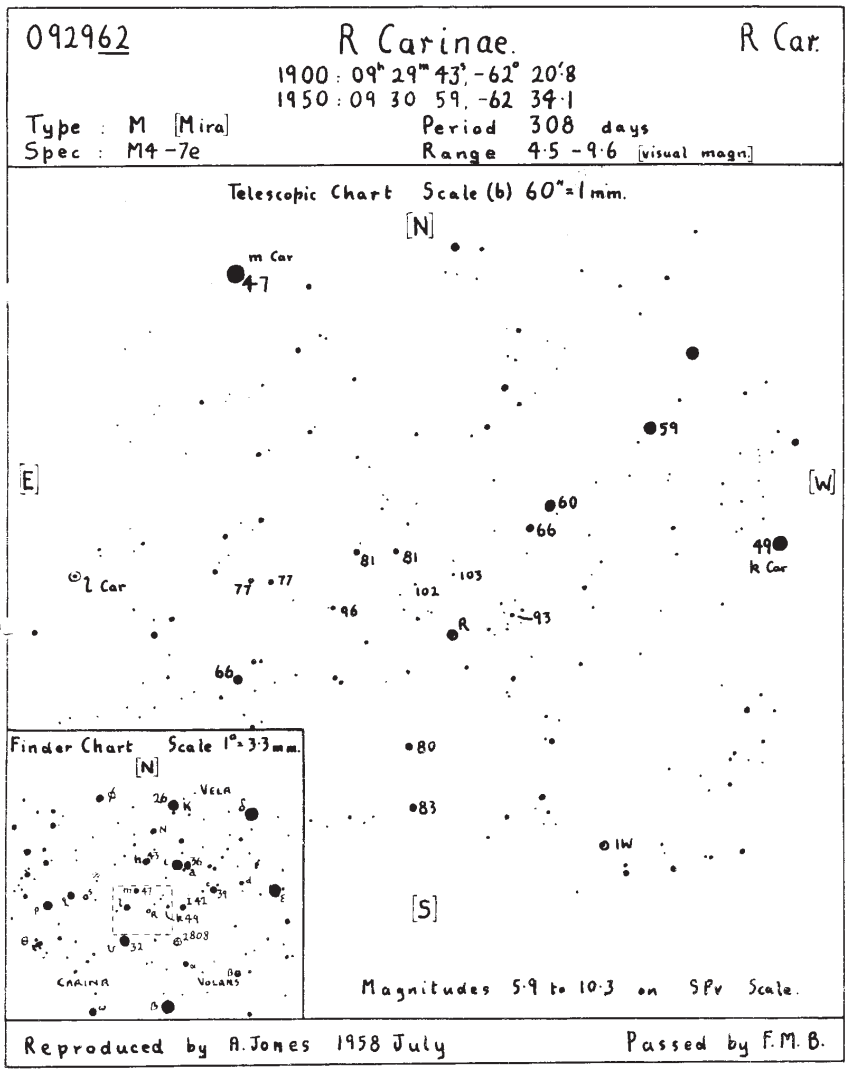

Figure 2a. The original VSS Chart 1 for R Car.

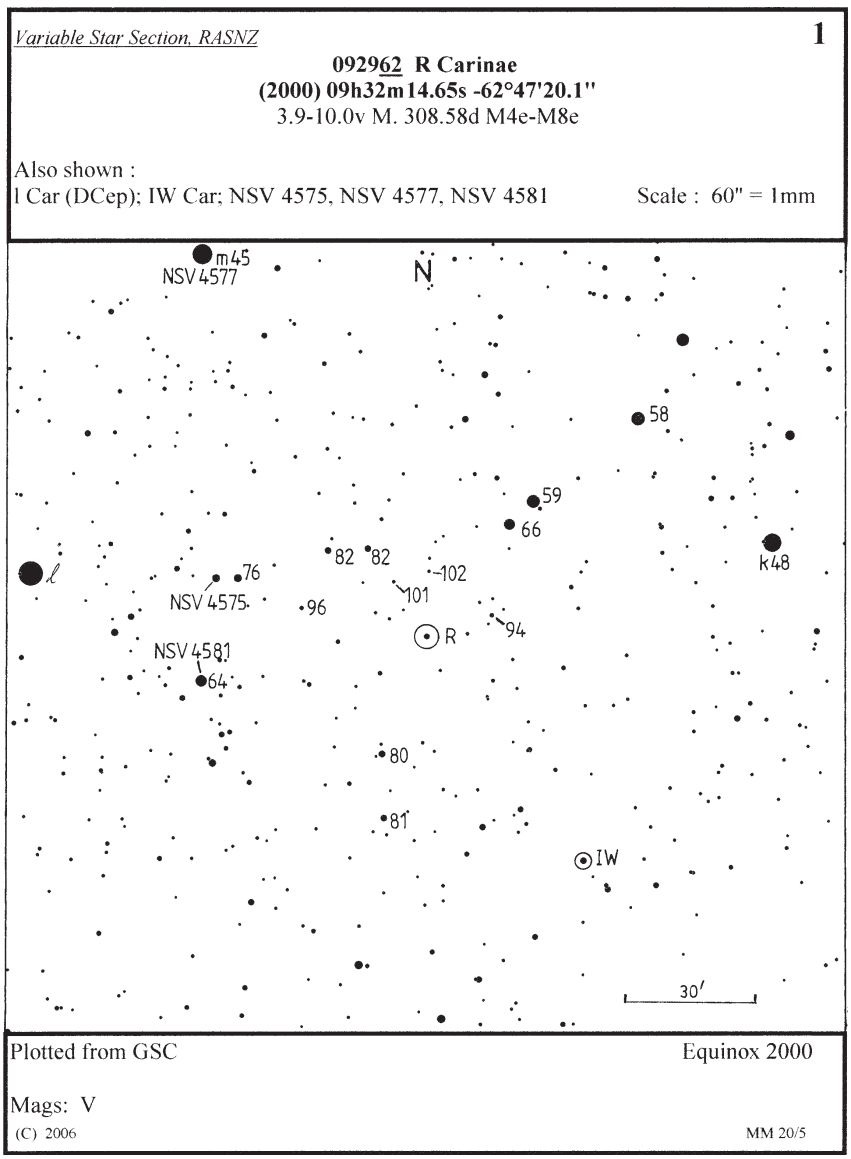

Figure 2b. The revised VSS Chart 1 for R Car.