British variable star associations, 1848–1908

John Toone

A summary version of this paper was presented at the joint meeting of the American Association of Variable Star Observers (AAVSO) and British Astronomical Association Variable Star Section (BAA VSS) held at Cambridge, UK, on 2008 April 11.

Introduction

The study of variable stars lagged some distance behind solar system, positional (double star) and deep sky research until the middle part of the 19th century. Then, following F. W. A. Argelander's pioneering work in the 1840s, there was a striking increase in variable star research, particularly in Europe. The transformation was to such an extent that in the second half of the 19th century there were three attempts at forming variable star associations within Great Britain. The first in 1863 was the ASOVS, which never got off the ground. The second in 1883 was the LAS VSS, which was successfully launched but had somewhat limited achievements. The third launched in 1890 was the BAA VSS which was eventually both a resounding and lasting success. This paper is an outline history of these three associations up to a position of one hundred years ago (1908).

Preamble to the Associations (1848–1862)

In 1833 Sir John Herschel published his *Treatise on Astronomy* as part of Lardner's *Cabinet Cyclopaedia*, which was intended as a comprehensive reference series covering all aspects of literature, science and art. Within *Treatise on Astronomy* Herschel (Figure 1) made the first appeal in the English language for amateur astronomers to observe variable stars: 'This 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. It holds out a sure promise of rich discovery, and is one in which astronomers in established observatories are almost of necessity precluded from taking a part by the nature of the observations required'.[1]

Figure 1. Sir John Frederick William Herschel (1792–1871). The author of *Treatise on Astronomy*, which contained the first appeal in the English language to observe variable stars.

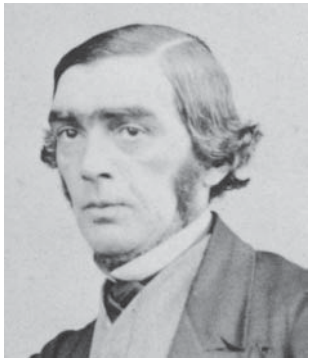


Figure 2. John Russell Hind (1823–1895). The leading discoverer of variable stars by 1850.

The above appeal was strikingly visionary and could be very much taken as a mission statement for a 20th century variable star association. Unfortunately it did not have any immediate impact on shifting the then prevailing emphasis of amateur astronomical research in Great Britain. Then following Argelander's similar appeal in 1844[2] and his well publicised work on variable stars at Bonn, Herschel repeated his appeal in 1849 in his widely acclaimed book *Outlines of Astronomy*. This time it appeared to have the desired effect, as it coincided with three English astronomers (soon to be joined by a fourth) taking up the challenge of discovering and systematically monitoring variable stars.

John Russell Hind (Figure 2) is better known for discovering asteroids and his work at the Nautical Almanac Office,[3] but his variable star discoveries were more than double his asteroid count and by 1850 he was the leading discoverer of variable stars worldwide.[4] Hind was born in Nottingham, the same city as Norman Robert Pogson (Figure 3) to whom he gave his first astronomical job at George Bishop's observatory in Regent's Park, London (where Hind was appointed director in 1844).[5] Pogson became famous for proposing the magnitude ratio scale of 2.512[6] and was Government Astronomer in Madras for 30 years.[7] Pogson discovered 14 variable stars including the first recurrent nova eruption of U Scorpii in 1863 (a remarkable observation considering its very brief appearance). Pogson's sister, Mary

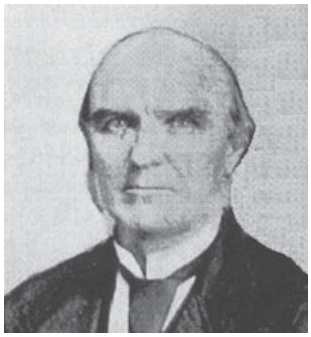


Figure 3. Norman Robert Pogson (1829–1891). The proposer of the standard magnitude scale and author of the ill-fated *Hartwell Variable Star Atlas.*

Anne, married Joseph Baxendell (Figure 4) of Manchester who discovered 16 variable stars (including Lambda Tauri) and monitored many red variables including Alpha Orionis for over 40 years.[8] These three astronomers were soon joined by George Knott (Figure 5) of London, who intensely monitored 23 variable stars for over 30 years and who developed a close working relationship with Baxendell.[9]

Prior to 1847 the pace of discovery of variable stars was very slow and only 22 were listed as definite variables. Then the rate of discovery suddenly quickened and by 1863 the number of known variables stood at 110. More than half of the discoveries (45) during this period were credited to Hind, Pogson and Baxendell (see Table 1).

Naturally the four astronomers were well known to each other and they began to collaborate in variable star research. One outstanding area of collaboration was with U Geminorum which was discovered by Hind in 1855.[10] Pogson reported major flickering in U Gem in 1856[11] and Baxendell reported lesser flickering some two years later.[12] This was regarded with scepticism by many astronomers at the time but flickering is now known to be an established characteristic in many dwarf novae and especially U Gem.

Knott undertook a 33-year observing programme of U Gem, monitoring it on 746 nights between 1860 and 1893.[13] Baxendell and Knott even notified each other of outbursts by telegraph, thus pioneering the idea of internet alert systems that would become widespread in the early 21st century. For 41 years (until SS Cygni was discovered in 1896) U Gem was thought to be a unique form of repeating nova, and knowledge of this important star would be much less if it were not for Hind's discovery and the early work of Pogson, Baxendell and Knott.

It was soon recognised by Pogson, Baxendell and Knott that accurate charts and sequences were absolutely necessary to undertake systematic work on variable stars. Pogson & Knott in particular, were skilled draughtsmen and they produced a good number of charts between 1853 and 1890. They adopted contrasting styles however, and this is the origin of the differing chart formats later adopted by the AAVSO and BAA VSS. Knott followed the convention of the day which was to assign letters to the comparison stars and list the magnitudes at the bottom of the chart (see Figure 6) which later became the BAA VSS format. Pogson on the other hand introduced a new system which labelled the comparison stars ten times their magnitude minus the decimal point directly on the chart (see Figure 7) which later became the format used by the AAVSO.[14]

Table 1. Variable star discoveries by Hind, Pogson & Baxendell, 1848–1863

These discoveries accounted for more than half the total discoveries worldwide.

Star	*Discoverer*	*Year*	*Star*	*Discoverer*	*Year*
S Cnc	Hind	1848	S Oph	Pogson	1854
R Cap	Hind	1848	U Gem	Hind	1855
Mu Cep	Hind	1848	S CMi	Hind	1856
R Gem	Hind	1848	R Lyr	Baxendell	1856
S Gem	Hind	1848	g Her	Baxendell	1857
T Gem	Hind	1848	U Cap	Pogson	1858
S Hya	Hind	1848	R Lib	Pogson	1858
V841 Oph	Hind	1848	R Sgr	Pogson	1858
R Ori	Hind	1848	X Boo	Baxendell	1859
R Peg	Hind	1848	R Sge	Baxendell	1859
λ Tau	Baxendell	1848	T Boo	Baxendell	1860
R Tau	Hind	1849	S Del	Baxendell	1860
T Cnc	Hind	1850	T Oph	Pogson	1860
R Psc	Hind	1850	S Sgr	Pogson	1860
T Hya	Hind	1851	T Ser	Baxendell	1860
S Psc	Hind	1851	T Tau	Hind	1861
R Cyg	Pogson	1852	S Vul	Baxendell	1862
S Vir	Hind	1852	S Aql	Baxendell	1863
R Cas	Pogson	1853	T Del	Baxendell	1863
R Oph	Pogson	1853	T Peg	Hind	1863
R UMa	Pogson	1853	T Sgr	Pogson	1863
S UMa	Pogson	1853	U Sco	Pogson	1863
T Cap	Hind	1854			

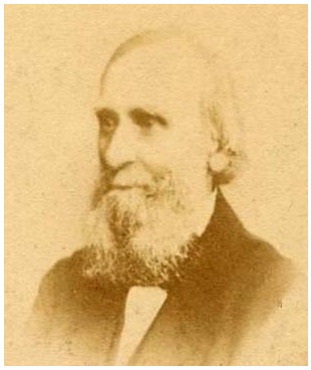


Figure 4. Joseph Baxendell (1815–1887). A dedicated variable star observer who attempted to launch the ASOVS in 1863, and was a Vice President of the LAS.

The Association for the Systematic Observation of Variable Stars (ASOVS), 1863

In 1863 Baxendell & Knott further collaborated in an attempt to set up the world's first variable star association. Hind was at the Nautical Almanac Office and Pogson had moved to India and neither directly participated in the project. This was a risky endeavour because all previous attempts (including most notably the Uranian Society of 1839 and the Leeds Astronomical Society of 1859) to form popular or practical astronomical observing associations had failed.[15] Undaunted, Baxendell and Knott proceeded and on 1863 January 9 the 'Association for the Systematic Observation of Variable Stars' (ASOVS) was announced in the *Monthly Notices* of the Royal Astronomical Society,[16] and this was followed by a similar announcement in the *Astronomical Register* on 1863 March 1.[17]

On 1863 March 5 Baxendell presented his outline proposals for the ASOVS to the annual meeting of the Mathematical & Physical Section of the Manchester Literary & Philosophical Society.[18] Baxendell contended that variable star research was important because all stars were known to have a similar constitution, including the Sun, and

Figure 5. George Knott (1835–1894). Together with Baxendell attempted to found the ASOVS and co-authored *On the Method of Observing Variable Stars*.

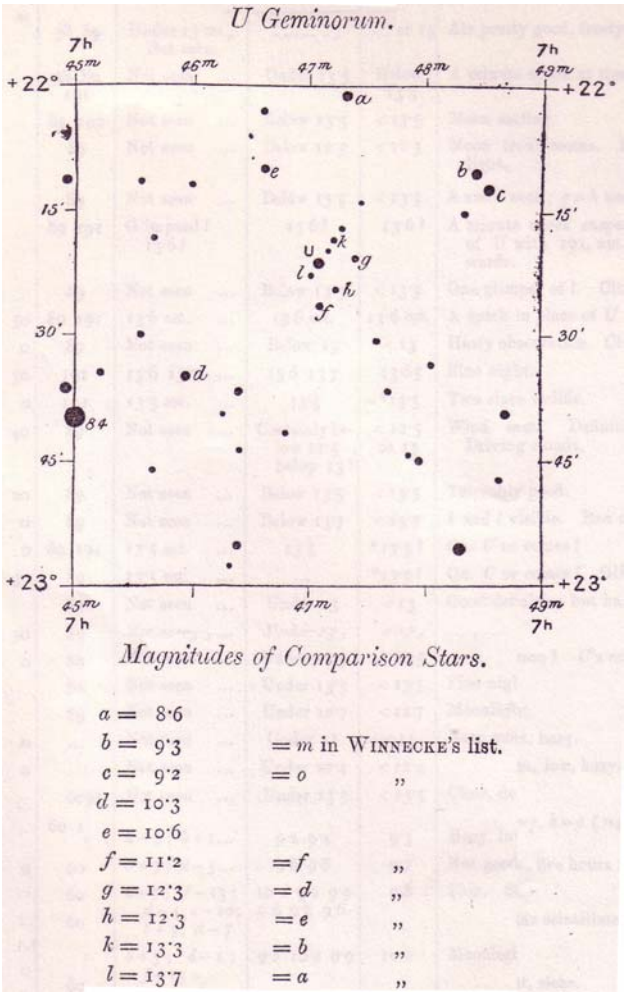


Figure 6. Chart for U Gem drawn by George Knott. The comparison stars were labelled with letters, the format later adopted by the BAAVSS.

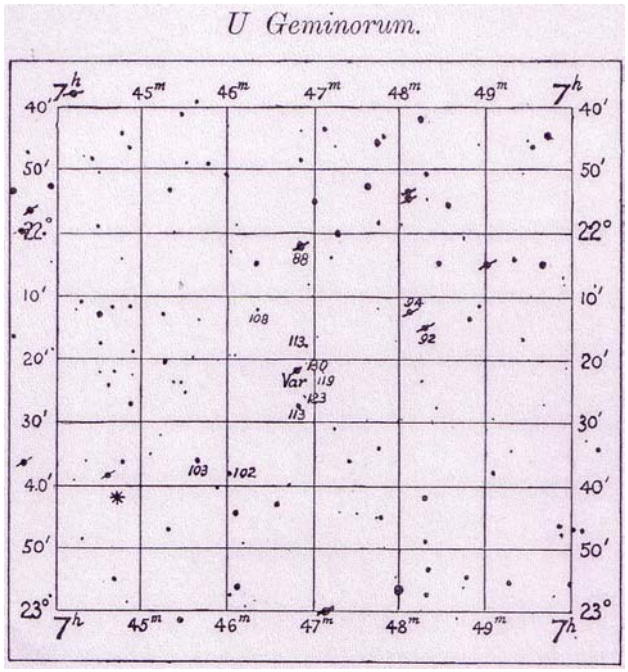


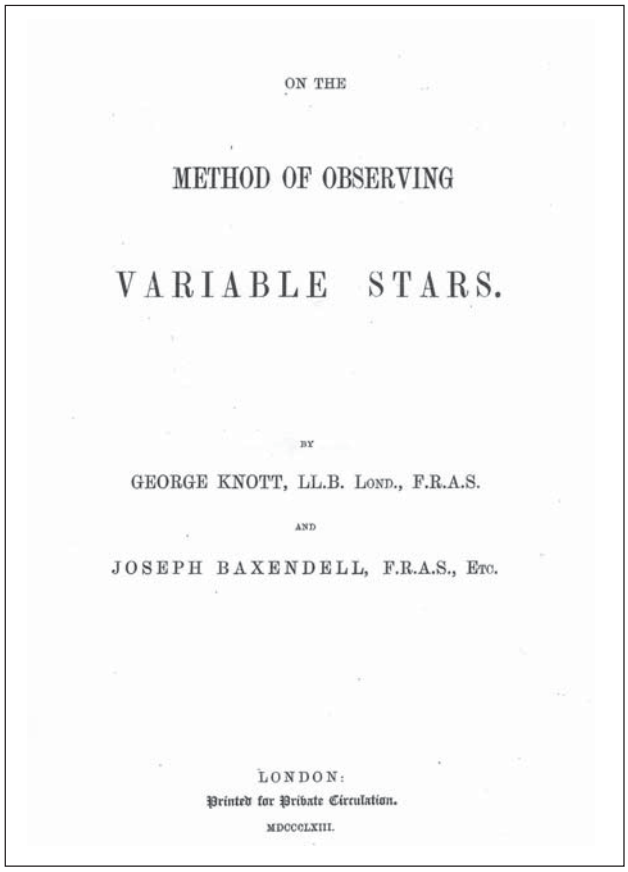
Figure 7. Chart for U Gem drawn by Norman Pogson. Pogson's format labelled the comparison stars with the magnitude omitting the decimal point, which was later adopted by the AAVSO.

that any small variation in the Sun could have implications for magnetic and meteorological science and also affect vegetable and animal life on the Earth. In the 1863 April edition of the *Astronomical Register* the editor, Sanford Gorton, made the following statement: 'We are glad to see the study of variable stars so energetically taken up in England since the departure of Mr. Pogson to Madras, and hope that the proposal of Mr. Baxendell (in conjunction with Mr. Knott) to organise an association for observing these objects on a well arranged system, will meet with a ready response.'[19] At the 1863 May 8 meeting of the Royal Astronomical Society Mr A. Brothers of Manchester (an acquaintance of Baxendell) exhibited his iris diaphragm, which was designed for magnitude determinations of stars, and said that it would prove useful to the members of the Variable Star Association.[20] Finally, the pamphlet *On the Method of Observing Variable Stars* (see Figure 8) written by Baxendell & Knott was published and circulated with the 1863 October edition of the *Astronomical Register*.[21]

On the Method of Observing Variable Stars was the first manual produced specifically for the observation of variable stars and the primary objective of Baxendell & Knott was to stimulate interest and rationalise the observation of variable stars through this publication and the ASOVS. All of the major points for the observation of variable stars were included in the *Method of Observing Variable Stars*, which became the prototype model for the visual observing manuals later produced by the various variable star associations during the 20th century. Some key points within this publication were:

- Standard charts including a lettered or numbered sequence of comparison stars shall be used for making all observations. It was intended that the *Hartwell Variable Star Atlas* (HVSA), which Pogson the author had already been working on for ten years, would be used for this purpose. The first part of five of the HVSA was expected to be published at the end of 1863.
- The method of making and reducing observations was described. The Pogson step method was recommended, where the differences between the variable and individual comparison stars were estimated in tenths of a magnitude.
- The systematic recording of observations within a logbook was encouraged. The detail to be recorded was date, name of star, instrument, power, light (magnitude) estimate, resulting (deduced) magnitude and remarks. Two methods of recording the magnitude estimate were given as examples.
- It was proposed that observers periodically submit their observations to headquarters for consolidation and evaluation (although there was no mention of where the headquarters was located).
- The drawing of lightcurves was advocated using cross ruled (graph) paper with a scale of half an inch to one magnitude and half an inch to ten days. Prior to this time (1863) there were few published examples of lightcurves.
- The analysis of observations and lightcurves was recommended including the determination of maximum and minimum dates (using Pogson's method of bisected chords) and the calculation of the mean period.

A fundamental recommendation was the adoption of Pogson's 1856 proposal of a light ratio of 2.512 (log R = 0.4) for stars that differ in brightness by one magnitude, to produce a standard magnitude scale. In 1863 there were several systems in use including most notably Herschel's


ON THE

METHOD OF OBSERVING

VARIABLE STARS.

BY

GEORGE KNOTT, LL.B. LOND., F.R.A.S.

AND

JOSEPH BAXENDELL, F.R.A.S., ETC.

LONDON:
Printed for Private Circulation.
MDCCCLXIII.

Figure 8. *On the Method of Observing Variable Stars* was published in 1863 and was the earliest observing manual specifically dedicated to the observation of variable stars.

(2.55 for naked eye & 2.00 for telescopic stars[22]) and Struve's (2.89 for naked eye and 4.00 for telescopic stars[23]). Baxendell advocated that one uniform scale be used for both naked eye and telescopic stars and that the generally accepted view that the light ratio of a star of 1st magnitude to one of the 6th is 100 to 1 (equivalent to Pogson's 2.512) should be adopted.

Unfortunately, despite all the publicity and the concerted efforts of Baxendell & Knott the ASOVS never got off the ground and there appears to be no surviving detailed account of why it failed. There is however, compelling evidence to support the following conjecture.

In the mid-19th century William Rutter Dawes was regarded as an eagle eyed visual observer and was a prominent figure in British astronomical circles. He concentrated his work primarily on double stars, using the finest refracting telescopes of the time manufactured by Merz & Mahler (Munich), Thomas Cooke (York) and Alvan Clark (Boston). By 1860 Dawes was probably the most skilled visual observer with a refracting telescope in the world and the expanding firms of Clark and Cooke regarded his praise as a warranty for their object glasses.[24]

Dawes and Knott corresponded frequently and it would appear that Dawes had been a mentor to Knott in the early stages of Knott's astronomical career, which was initially focused on double stars. In 1859 Knott purchased from Dawes a fine 7-inch Alvan Clark refractor which he never replaced, and it was Dawes in 1860 who proposed Knott to be elected a Fellow of the RAS. Dawes, however, did not share Knott's enthusiasm for variable stars and his efforts (with Baxendell) to form the ASOVS. On 1863 October 3 (just as subscribers to the *Astronomical Register* were receiving their October edition complete with *On the Method of Observing Variable Stars*) Dawes wrote to Knott: 'I am heartily glad that you have not relinquished double star measuring, for which, as you justly say, your O.G. is so admirably suited. Indeed, you will not wonder that, as I consider you to possess in a very high degree the essential qualities of an accurate observer of these objects, I have felt not a little jealous of such a telescope and such an observer being mainly employed on variable stars, on which, to say nothing of the observer, a vastly inferior telescope would do as well.'[25]

On 1863 October 6, 7 and 8 Dawes wrote further letters to Knott essentially disagreeing with the proposal for a standard light ratio of 2.512 and stating that Baxendell & Knott had misinterpreted some of the main points in Dawes' paper 'On the Photometric Determination of Magnitudes.' Dawes followed this up with a note in the 1863 November edition of the *Astronomical Register* where he claimed that Baxendell, Knott & Pogson were misguided in advocating a light ratio of 2.512. Dawes firmly believed that for telescopic stars his own work supported that of Struve whose recommended light ratio was 4.0.[26]

It would seem therefore that by 1863 November Dawes had seriously impaired progress towards the formation of the ASOVS and had probably weakened Baxendell's and Knott's resolve for continuing with the project. With criticism being levied by an astronomer of Dawes' stature it would have been very difficult to obtain the support from other astronomers that Baxendell & Knott were seeking. It is ironic however, that Pogson's light ratio proposal was later adopted by E. C. Pickering at Harvard College Observatory in 1879, C. Pritchard at Oxford in 1883 and G. Muller at Potsdam Astrophysical Observatory in 1894, and by the turn of the 20th century it was the accepted worldwide standard.[27]

If the controversy over the light ratio halted the progress of the ASOVS the non-appearance of the first part of the HVSA at the end of 1863 probably killed the whole concept stone dead. Without charts and sequences there was no prospect for systematic observations being undertaken, consolidated and analysed. Pogson had started to work on the HVSA as early as 1853, but it was still incomplete and remained unpublished at the time of his death in 1891. The 18 charts and 134 catalogues that comprised the unfinished HVSA were returned to Mary Anne Baxendell (Pogson's sister and widow of Joseph Baxendell) who following correspondence with Pickering sent them on to Harvard College Observatory where they remain to this day in storage.[28] The charts of the HVSA followed Pogson's format where the comparison stars were labelled ten times the magnitude minus the decimal point. Pickering at Harvard College Observatory and later the AAVSO adopted this system for variable star charts and sequences.[29]

Baxendell & Knott's vision in 1863 of an association undertaking systematic observations of variable stars to a standard photometric system was unfortunately decades ahead of its time, and it did not become a reality until E. E. Markwick effectively re-launched the BAA VSS in 1899 December.

The intervening years, 1864–1883

Baxendell and Knott continued to observe variable stars and from time to time they would issue reports to the Royal Astronomical Society. Neither made any further attempt to lead or coordinate any form of collaborative association, especially whilst the publication of the HVSA was stalled. Nor did they contribute to the short-lived 'Observing Astronomical Society', run in the main by William F. Denning in 1869–1871.[30] This society was formed for the purpose of aiding the spread of practical astronomy, but only survived as long as it did because of the support of the *Astronomical Register*, which published the society reports. However, as elderly gentlemen Baxendell and Knott did become part of the whirlwind association of the 1880s known as the Liverpool Astronomical Society (LAS).

The Revd Thomas Henry Espinell Compton Espin (Figure 9) was born in Birmingham and became one of the most accomplished amateur astronomers of the early 20th century.[31] Equipped with a 17-inch (432mm) Calver reflector and home made spectroscope, he observed every star (some 100,000) on Argelander's charts down to magnitude 9. The result of this survey was the cataloguing of 3,800 red stars, many nebulae and 30 new variable stars (including R CVn, EU Del and X Oph). Espin also undertook a systematic search for double stars brighter than mag 9.5, and this yielded a total of 2,575 measures of new double stars during the period 1899 to 1932. Much earlier however, in 1881 at the tender age of 23, Espin was responsible for founding the LAS.[32]

The LAS was an amateur society aimed at promoting astronomical research, organising & coordinating astronomical observations and communicating astronomical information. The Secretary, W. H. Davies, described its primary function as 'a kind of halfway resting place between the amateur public and the Royal Astronomical Society'.[33] By the 1880s amateur observational astronomy was ready for expansion and unification, and the LAS perfectly facilitated this. The society grew rapidly in size and reputation and quickly evolved from a local into a national and even international association. In 1887 the AGM was held at the RAS headquarters in London and by 1888 there were 641 members, with branches in Brazil and Australia.[34] Foreign associate members included Giovanni Schiaparelli, Otto Struve, Asaph Hall and S. W. Burnham. Another foreign associate member was Edwin F. Sawyer of Boston who in 1885 announced his discovery of T Vul in the *Journal* of the LAS (see Figure 10).[35] Baxendell (now located in nearby Southport) became a vice-president and started to report his variable star work to LAS meetings. Knott also reported his work to the LAS but did not attend the meetings, whilst Espin served as president in 1884–'85 and 1886–'87. It is also worth noting that the LAS was the first scientific society in Great Britain to grant ladies full membership.[36]

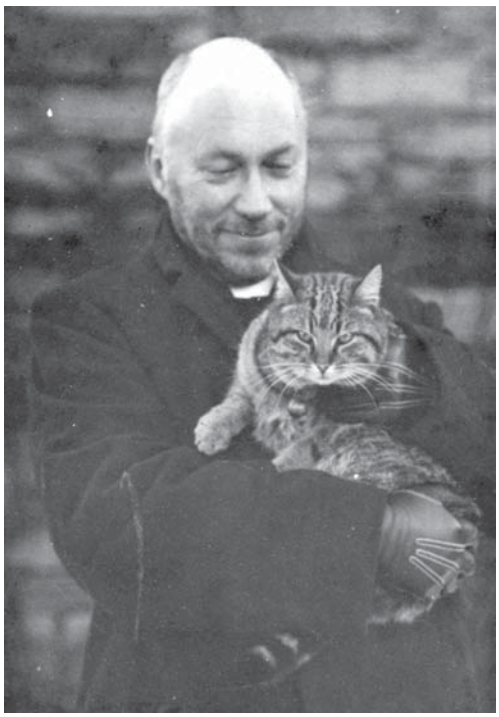


Figure 9. Revd Thomas Henry Espinell Compton Espin (1858–1934). Founder of the LAS and the first director of the LAS VSS in 1883–'84.

While the LAS was rapidly establishing itself in Great Britain, over in North America in late 1882 Edward Charles Pickering (Figure 11), the director of Harvard College Observatory, released his 'A Plan for securing Observations of the Variable Stars'.[37] This plan was essentially an appeal to amateurs, students and ladies of astronomy to direct their attention towards the study of variable stars. There was no proposal to form an association dedicated to observing them, because Pickering's strategy was for Harvard College Observatory to become the clearing house for all variable star observations. The plan included the following key points:

– An introduction to variable stars including a description of the five classes, which were: I) temporary stars, II) long period variables, III) minor irregular variables, IV) short period variables & V) Algol stars.

– Observers were encouraged to observe long period variables once or twice a month throughout their full range. Suspected variable stars were also to be observed to establish or disprove variability.

– Observations should be to a system that would permit all the observations to be reduced to the same absolute magnitude scale.

– The fractional method of estimating the variable was proposed. The variable was compared with a brighter and fainter comparison star and its brightness judged in tenths of the interval between the two comparison stars.

– Observations should be recorded on a standard form 10 inches by 8 inches with a margin of ½ inch for binding purposes. The detail required was outlined and the observer was instructed to begin with a new sheet each evening.

– Observations (on the standard form) were to be sent every month, 3 or 4 days before full Moon, to Harvard College Observatory.

Pickering stressed that this plan was not to be limited to observers in North America. He actively encouraged southern hemisphere and wide longitude observers and made the following statement directed specifically to European amateurs: 'It is hoped that among the many amateurs of Europe, and especially of England, may be found some ready to participate in this work'. Pickering followed up this appeal a few months later in the middle part of 1883 by undertaking a tour of Europe . The natural place to fully engage with the 'amateurs of Europe and especially of England' in 1883 was the LAS. Consequently, his last engagement on his European tour was an ad-

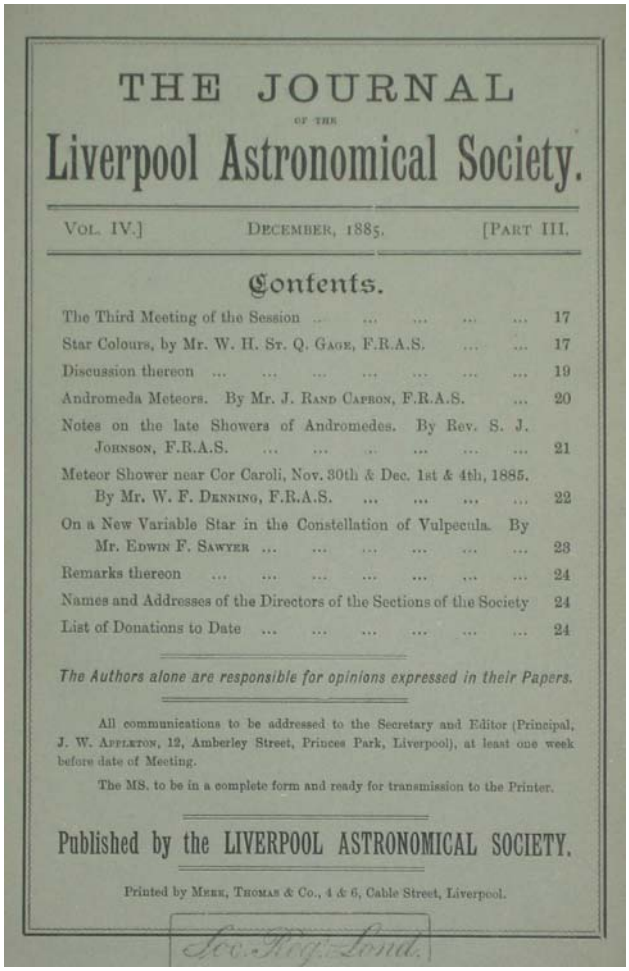


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Figure 10. The 1885 December *Journal of the LAS* included Edwin Sawyer's announcement of his discovery of T Vul.

dress to a meeting of the LAS on 1883 September 23. Pickering's opening remarks are recorded as follows: 'The encouragement of astronomy, which your Society has in view, is an important work, and it gives me great pleasure to address you. I would speak tonight more particularly about the work to be done in connection with stellar light and stellar variation'.[38] The fact that the director of Harvard College Observatory was prepared to address a society of amateur astronomers a long way from home and in such a complimentary style probably made a big impression on the members of the LAS.

The Liverpool Astronomical Society Variable Star Section (LAS VSS), 1883–1889

Within three months of Pickering's address, on 1883 December 17, the Liverpool Astronomical Society Variable Star Section (LAS VSS) was formed.[39] It is tempting to think that Pickering's address less than three months earlier was the inspiration for this, but on the very same date the LAS also announced the formation of Planetary, Lunar, Double Star and Coloured Star sections. Perhaps Pickering's real legacy in this respect was to ensure that variable stars were not to miss out when the LAS decided to form its specialist observing sections.

Specialist sections had been used before in the Literary & Philosophical Societies that existed in the major regional towns from the late 18th century onwards, and it is perhaps significant that an astronomical section had emerged within the Liverpool Literary & Philosophical Society in 1859.[40] However, the LAS was the first astronomical body to put them into practice to cover subdivisions of astronomical research. The concept of specialist observing sections is simple, effective and logical:

- The observer is given a choice of different areas of research in which to engage.
- The techniques employed for observing variable stars are very much different from those required for planets, meteors, double stars etc.
- Detailed information on the specialist area can be communicated only to those interested in receiving it.
- Sections can rely on the parent association to provide support for publishing the work of the section and for supplying new recruits.

The sectionalisation of an association is similar to how modern project computer files are structured and is consistent with how the logical Victorian mind was taught to think. It also proved to be the only method of ensuring that an association of variable star observers in Britain could be sustained in the 19th century.

The LAS published *Journals*, *Transactions* and *Proceedings*. The *Journals* were published six times a year just like the *Journal of the BAA* would be in later years, and contained short reports on the LAS VSS (see Figure 12). The *Transactions* were published every two years and contained the longer reports of the LAS VSS (see Figure 13). The *Proceedings* were published at varying intervals and contained details of the meetings undertaken by the LAS. Reports of the meetings of the LAS were also published in *The Observatory* alongside the reports of the meetings of the Royal Astronomical Society.

The LAS VSS was directed in its first year by Espin himself, who was then aged just twenty five. Then in late 1884 J. E. Gore took over the Directorship and retained it until 1889. The efficient post, telegraph and railway network of the 1880s allowed Section Directors to reside outside of Liverpool.[41] Gore was based in Ireland and rarely attended any of the Liverpool meetings. Instead he regularly sent papers to be read out at meetings. One of Gore's earliest papers was read at the meeting held on 1882 December 14 and was entitled 'The probable vari-

Figure 11. Edward Charles Pickering (1846–1919). The director of Harvard College Observatory during 1877–1919, he addressed the LAS in 1883 just prior to its forming a VSS.

REPORT OF THE VARIABLE STAR SECTION

UNDER THE DIRECTION OF J. E. GORE, F.R.A.S.

THE following is a summary of observations made by members of the section in the years 1886-1888.

Summary of observations made by Major Markwick, F.R.A.S., chiefly with binocular field-glass.

R Aquilæ. 1886, Nov. 8 to Dec. 14 this variable was invisible in binocular, and must have been below 8.5 mag. [Gore's observations confirm this.] According to Schönfelds Elements this star should have been at this time at a maximum! (6.4-7.4 mag.) Observations of this variable are very desirable. Schönfield's period is about 345 days. Chandler gives 352.3, with a shortening period.

Figure 12. The last report of the LAS VSS, for the years 1886–'88, published in the 1889 February *Journal of the LAS*.

ability of Beta Leonis'.[42] From examination of historical records Gore concluded that Beta Leonis was most likely to be a secular variable and had lost some of its former brightness.

In 1886 Gore wrote the following on the objectives of the LAS VSS:[43]

- Observation of bright variable stars with opera glasses or naked eye.
- Determination of periods and ranges of suspected variable stars not on regular variable lists.
- Detection of fluctuating light in any fresh star.

The published reports of the LAS VSS by Gore contained quite detailed summaries of the individual observers' work, but made no attempt to consolidate the observations. This is probably because the number of observers was small and they spread their efforts over many variables and suspect variables using different sequences. The only lightcurve published where more than one observer's data were plotted was for a long outburst of U Gem in 1885 April (see Figure 14) where Baxendell Junior, Espin and Knott provided the observations.[44] The active observers according to the reports published were: Baxendell (deceased in 1887), Baxendell Junior, Miss Elizabeth Brown, Espin, Gore, Knott and Markwick.

The LAS VSS can be regarded as the first successfully launched variable star association, but in terms of astronomical research it achieved very little and was only sustained because of the support of the parent society. However, on a positive note the LAS VSS provided the blueprint for the BAA VSS, which quickly evolved directly from the LAS VSS.

The demise of the LAS and the formation of the BAA, 1889–1890

The rapid expansion of the LAS to a society of international proportions was not welcomed in all quarters of Liverpool. Isaac Roberts during his presidential address on 1886 May 11 was critical of some Council members' work-rate, the low

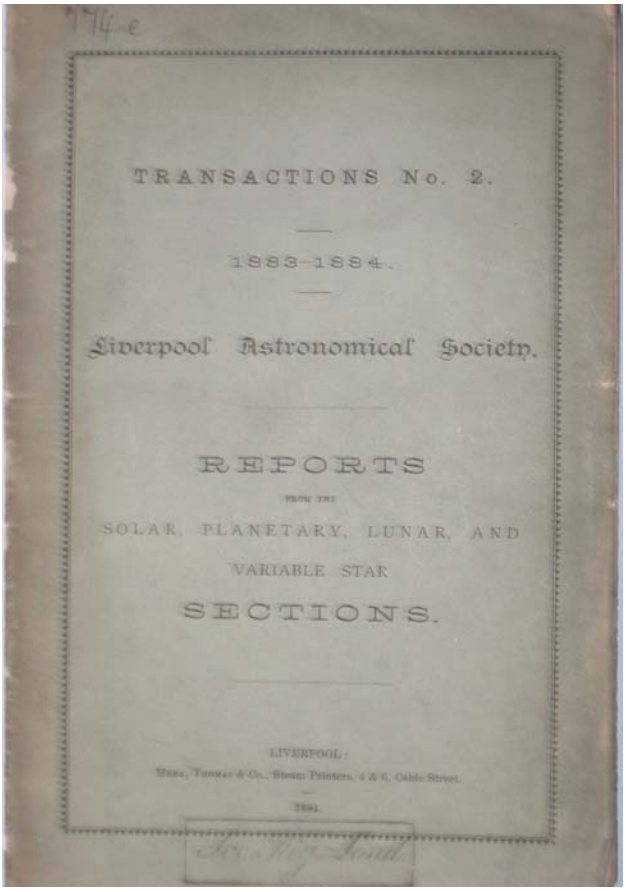


Figure 13. *Transactions* No 2 of the LAS contained the first report from the LAS VSS, for the years 1883–'84.

annual subscription of 5 shillings (the society was £8 in debt during session 1884–'85) and that many active workers were not residing in Liverpool. Roberts felt that the society should be primarily for Liverpool astronomers and considered that it had over-expanded.[45] This started a very public spat with Vice-President Davies who vigorously supported the existing format of the society and its national and international status. Davies contended that the voluntary contributions of remotely based persons such as Denning, Franks, Gore, Espin and Elger practically eliminated the need for paid local assistance.[46]

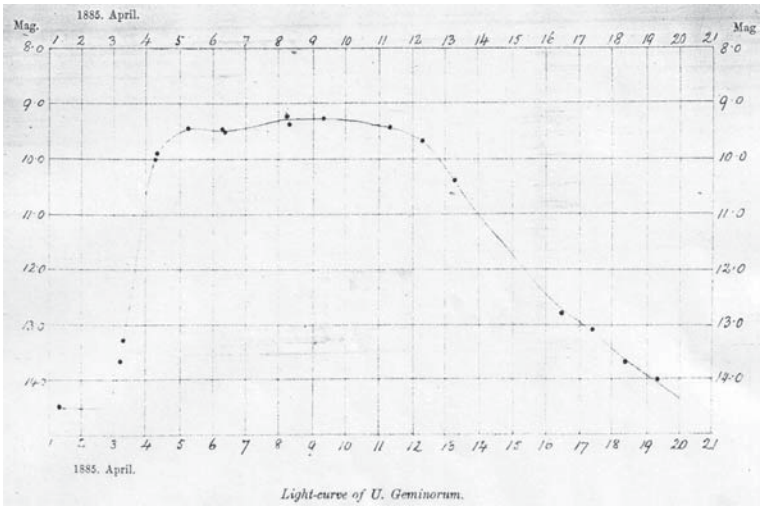


Figure 14. LAS VSS lightcurve of the 'long outburst' of U Gem in 1885 April.

The LAS continued unabated until 1889 when a financial crisis suddenly engulfed the entire operation. Roberts' earlier warnings about the low subscription and over-expansion seemed to run true, with the society seriously in debt and large sums of money owed to the printers. Almost simultaneously to the financial crisis the key personnel managing the society were lost: President Revd S. J. Perry died, the Secretary W. E. Rowlands fell ill and the Treasurer W. H. Davies (Roberts' arch opponent) resigned.[47] The LAS imploded with political infighting (largely between local and remote members) running amok.

Prior to its becoming operationally paralysed the LAS had demonstrated a successful formula for fulfilling the demands of amateur astronomers nationwide, and it was not inconceivable to many in 1890 that with competent financial management it could have been a sustained success. Accordingly when William Henry Monck in 1890 July advocated the formation of a national amateur astronomers' association based in London, formatted largely along the lines of the LAS, he received a ready and positive response. Monck proposed that the outline objective of the association be:[48]

- To meet the wishes and requirements of those who find the subscription of the Royal Astronomical Society too high, or its papers too advanced; or who are, as in the case of ladies, practically excluded from becoming Fellows.
- To afford a means of direction and organisation to the work of observation for amateur astronomers.

Within a month Edward Walter Maunder confirmed that such an association was in the process of being formed and by September it was already signing up members.[49] Draft rules of the association were set up and Rule II defined the association's objectives as: 'The association of observers, especially the possessors of small telescopes, for mutual help, and their organisation in the work of astronomical observation. The circulation of current astronomical information. The encouragement of a popular interest in astronomy'.[50] The annual subscription was set at half-a-guinea (Monck's suggestion) with a five shilling entrance fee. Thus the entrance fee alone was equivalent to the annual subscription fee of the LAS, but it was evidently eminently affordable; 283 members were signed up by the time of the first meeting.[51] At the first meeting held on 1890 October 24 the principal business was the naming of the new association, confirmation of the President & Council, confirmation of the rules and the naming of the observing Sections & their nominated Directors. The association name chosen was the British Astronomical Association (BAA) and the Variable Star Section (VSS) was amongst the Sections officially announced, with J. E. Gore as Director.[52] The Sections announced were in fact virtually the same sections (and directors) that had existed within the LAS at the point of its collapse.

Figure 15. John Ellard Gore (1845–1910). Director of the LAS VSS in 1884–'89 and the first director of the BAA VSS in 1890–'99.

The BAA Variable Star Section (BAA VSS), 1890–1899

Following the founding of the BAA VSS on 1890 October 24 there was much work to be done by the Director to get it fully operational. According to BAA Rule 10 in 1890: 'It shall be the duty of each Director to furnish the Council with full particulars of the scheme of observations which he intends to undertake, to invite the co-operation of other Members in his work, to issue instructions, after approval by the Council, to such co-operating Members, to receive and discuss their observations, and to report to the Council at such intervals as they may direct'.[53] In simplified terms this meant: make proposals, sign up members, issue instructions, gather and collate observations and report to Council. To start this process Gore made the following proposal to the Council on 1890 October 31:[54]

- The observation of known variable stars which have for some cause been neglected by variable star observers.
- The observation of stars suspected on good grounds to be variable, and of suspicious objects met with in the course of the observations.
- A systematic search for variables of short period in selected portions of the short period zone (Pickering's).
- The supply to members of comparison stars and information respecting variable stars generally.

BAA President Captain William Noble lent his support to the VSS in his presidential address on 1890 November 26 by stating: 'What may be done in the way of observation of variable stars by the aid of a simple field glass, has been amply shown by Mr Gore and by Major Markwick. Here is a pursuit within the reach of any persevering observer, whose extremely modest equipment needs only patience for its adjunct'.[55]

So by the end of 1890 the BAA VSS was launched with a Director appointed. It was established with a strategy laid out which had been accepted by Council, and most importantly had been given Presidential endorsement.

John Ellard Gore (Figure 15) was born in Athlone, Ireland and graduated with a degree in electrical engineering at Dublin College in 1865. He worked on the Sirkend Canal Project in the Punjab, India from 1868 to 1877 and retired with a Government pension aged just thirty four in 1879. Whilst in India he developed an interest in astronomy and variable stars in particular. He was responsible for discovering EW CMa, W Cyg, S Sge, U Ori and X Her. He also independently discovered RT Cap, GK Per and Tau4 Ser. Besides being the LAS VSS Director from 1884 to 1889 and BAA VSS Director from 1890 to 1899, Gore was a prolific writer. Between 1877 and 1907 he published many papers and books. In 1884 he published a *Catalogue of Known Variable Stars* which had 190 entries, but the pace of discovery meant he was forced to produce an updated catalogue of 243 entries in 1888. His

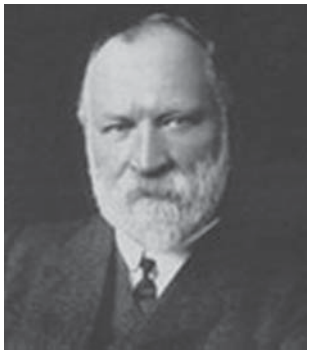


Figure 16. Alexander William Roberts (1857–1938). The leading observer of the BAA VSS in 1891–'92, who went on to make a world record 65,000 observations of variable stars from South Africa.

1894 book *The Worlds of Space* attracted criticism from H. G. Wells for not considering silicon-based life. He was also responsible for translating Camille Flammarion's *Popular Astronomy*. Gore's eyesight began to fail after 1901 and possibly contributed to his death in 1910 when he was run over by a horse car in Dublin.[56]

In 1891 Gore had recruited the following persons as members of the VSS: D. Booth, Miss E. Brown, T. R. Clapham, H. Corder, Lt. Col. E. E. Markwick, A. Mee, Lieut. P. P. Molesworth, A. W. Roberts (South Africa), W. Sang, Revd W. Swindlehurst (Australia) and Revd W. R. Waugh. So the VSS initially consisted of just twelve members (including Gore), who included two army officers, two Reverends, one lady and two individuals who were based in the colonies.[57]

Alexander William Roberts (Figure 16) was the most prominent observer among the initial members of the VSS in 1891. Roberts was born in Farr on the north coast of Scotland but migrated to South Africa in 1883 to teach 'natives' at the Lovedale Missionary Institution. After 1920 he got involved in politics and Prime Minister Jan Smuts appointed him as a senator to represent the interests of native Africans. Roberts established an observatory shortly after his arrival at Lovedale, and undertook parallax and proper motion measurements of Alpha and Beta Centauri.

Upon the establishment of the VSS Roberts turned his full attention towards variable stars and commenced work in earnest in April 1891. Taking note of Gore's recently issued instructions he set out to monitor poorly covered variables, suspect variables and to search for new variables. Roberts was favourably located for this work as the southern sky was still very much virgin territory for variable star surveys. Roberts' report to the VSS for 1891 stated that he made 1,019 observations of 27 variable stars on the 101 nights that were favourable for observing. He set out to estimate all stars brighter than magnitude 8 between 50° south to the south pole, and during this process he discovered six new variable stars. Roberts candidly said that the observations for April were excluded from his report because they were his first observations and he was not satisfied with their accuracy.[58] In his report for 1892 Roberts said that he made 2,402 observations of 36 variable stars on 161 nights, and discovered four new variable stars.[59]

Roberts' observations of variable stars were very accurate due mainly to his use of instruments that eliminated position angle error, and the fact that a single 'observation' consisted of four or five individual estimates. In 1896 Roberts calculated that the errors in his visual observations were ±0.04 magnitude, and contended that they were no less accurate or less valuable than those being made with the aid of visual photometers.[60] Roberts eventually went on to make 65,000 observations of variable stars, which at the time he ceased observing in 1920 was a world record.

In 1892 Gore proposed a nova search plan for the VSS.[61] The search for new or temporary stars was to be concentrated on the northern Milky Way, to which he had paid much attention whilst working in India in the 1870s. Sketch maps were prepared showing all stars in Heis Atlas to magnitude 6.7 and observers who agreed to take part were allotted a region to monitor. This was a good idea by Gore but there seemed to be no rigorous follow through and no discoveries were made. The nova search plan was effectively abandoned by 1897.

In his report for 1892–'93 (see Figure 17) Gore said that the work of the VSS had been chiefly directed to the new or temporary star search, the discovery of new variable stars and the observation of known variable stars.[62] The search for new stars had not produced any results but some 'false alarms' had been reported to the Director. The VSS now had nineteen members including Prof. Joan de Moraes Pereira in the Azores and Prof. O. F. Rigge of St Louis, USA. Summary reports of the observations from Henry Corder, Lt. Col. E. E. Markwick, Roberts and Pereira were published in the *Journal* and *Memoirs*. Gore's style of reporting for the BAA in 1893 was very similar to that for the LAS in 1889. Individual observers' data were reported separately because they were working independently, covering many stars and using (in some cases) different sequences.

In his report for 1894–'95 Gore said that the work of the VSS had continued to be directed towards searching for new or temporary stars in the Milky Way and the observation of

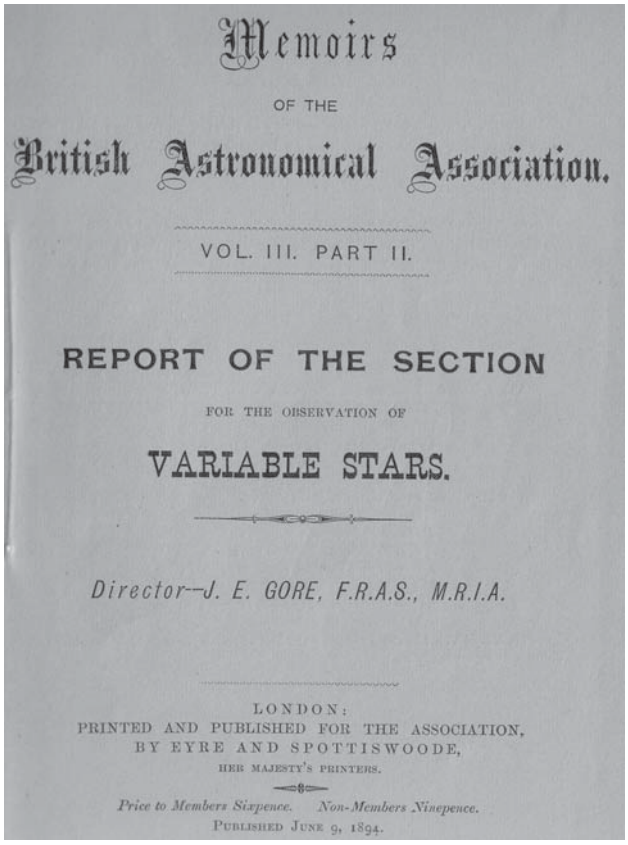

Memoirs
OF THE
British Astronomical Association.
VOL. III. PART II.
REPORT OF THE SECTION
FOR THE OBSERVATION OF
VARIABLE STARS.
Director—J. E. GORE, F.R.A.S., M.R.I.A.
LONDON:
PRINTED AND PUBLISHED FOR THE ASSOCIATION,
BY EYRE AND SPOTTISWOODE,
HER MAJESTY'S PRINTERS.
Price to Members Sixpence. Non-Members Ninepence.
PUBLISHED JUNE 9, 1894.

Figure 17. BAA VSS *Memoir* No 2 reported on the activities of the Section in 1892–'93.

selected known and suspected variable stars.[63] Gore remarked 'The search for new stars had not proved successful and considering the rarity of these remarkable objects, failure in such a search is not surprising.' Summary reports of the observations from Miss E. Brown, H. Corder, Lt. Col. Markwick, Pereira and J. T. Wood were included in Gore's report. For the first time however, Gore made a summary combining individual observers' data on long-period variables where maxima and minima could be identified, and compared them with the elements quoted within Chandler's *Catalogue of Variable Stars*.[64]

In October 1896 John Tebbutt tentatively proposed that the BAA New South Wales Branch in Australia form a Variable Star Section to cover far south variable stars such as R Car and T Cen.[65] Unfortunately this did not get going until 1922, but it was still the first southern hemisphere variable star association to be established. Its early work impressed a sixteen year old Frank Maine Bateson in 1925 when he was in Sydney and inspired him to set up the Variable Star Section of the New Zealand Astronomical Society in 1927.

In *Memoir* No 3 published on 1896 December 12 Gore requested that all observers adopt the fractional method of estimating variable stars, where the light interval between comparison stars is always taken as ten steps.[66] This was originally proposed by Pickering in 1882 in his 'A Plan for securing Observations of the Variable Stars.'

For 1896–'97 Gore produced a summary of the maxima and minima of long-period variables recorded by the observers (see Figure 18).[67] Despite this the VSS appeared to be in the doldrums after just seven years and the Director's report for 1897 was particularly uninspiring, reading as follows: 'The Director has very little to report and simply desires to state that the work of the Section has been continued during the past session on the same lines as in former years. Known and suspected variable stars have been regularly observed and the search for new or temporary stars along the course of the Milky Way continued'.[68]

To be concentrating two-thirds of the observing effort on suspected variable stars and novae searching was clearly a strategic mistake, as variable star observers (new ones in particular) like to be able to see the star and detect clear variation. The VSS was shrinking in size and the most prolific observers, Roberts and Pereira, started to submit their observational reports elsewhere. Gore was described as a 'grave quiet man' and so was perhaps not a natural leader, and after 13 years as Director of the LAS VSS and BAA VSS it seemed by 1897 that he was running out of ideas and enthusiasm. To be fair to Gore he was simply following the Council's remit to Section Directors: proposing a scheme of work, enlisting members to participate and reporting the results to Council. This permitted him time to concentrate largely on his extensive writing projects which continued unabated.

Star.	Maximum.		Minimum.		Observers.
	Date.	Mag.	Date.	Mag.	
Mira (o) Ceti	1896, Feb. 8	3·6	1896, Sept. 10?	—	Henry Corder.
,,	,, Dec. 28	3·8	—	—	J. T. Pope.
,,	1897, Jan. 1	4	—	—	Henry Corder.
,,	,, Nov. 25	3·3	—	—	,,
,,	,, ,, 30±	3·59	—	—	James T. Pope.
,,	,, Jan. 1	4·13	—	—	Miss M. A. Orr.
,,	,, Nov. 30	3·59	—	—	,,
,,	,, ,, 15-19	3·3	—	—	W. E. Besley.
R Draconis	1896, Feb. 7	7	1896, June 15	12	Henry Corder.
,,	,, Sept. 22	7·25	1897, Feb. 21	Invis. in 6½in.	,,
,,	—	—	,, Oct. 28	14	,,
S Coronæ	1896, Mar. 15	7.25	1896, Nov.	Invis.	,,

Figure 18. The BAA VSS long period variable report for 1896–'97.

Figure 19. Ernest Elliot Markwick (1853–1925). Director of the BAA VSS in 1900–'09 and president of the BAA in 1912–'14.

The BAA VSS, 1900–1908

In 1899 Gore retired as director of the VSS and was succeeded by Markwick (retired engineer replaced by an active army officer) who was anticipated to be a more natural and dynamic leader. Markwick's appointment notice read as follows: 'The Council desire to inform the Members of the Association that they have appointed Col. E. E. Markwick FRAS, Her Majesty's Gun Wharf, Devonport, Director of the Variable Star Section'.[69]

Ernest Elliot Markwick (Figure 19) was born in London and entered the army in 1872. He had a distinguished military career, and was mentioned in dispatches and promoted for services rendered during the Zulu and Boer conflicts in South Africa. He then became Chief Ordnance Officer at various stations before retiring in 1905 having attained the rank of Colonel. He came out of retirement during the Great War and was awarded the CBE (military) upon its conclusion in 1918. Markwick was a founder member of the BAA, served as President in 1912–1914 and was director of the VSS from 1899 December until 1909 December. In his early years Markwick monitored variable stars with a field glass and searched for new variables by dividing up the equatorial and southern regions of the sky into 5° segments, examining them with binoculars and comparing them to the *Uranometria Argentina*. Whilst stationed in Gibraltar he discovered two of the southern hemisphere's most celebrated variable stars, T Cen and RY Sgr. He also made independent discoveries of RR Sgr & S Scl, and suspected variation in RZ Ari, BD Cam, AR Cet, EG Cet, FS Com, BQ Gem, V640 Her & VY Leo, but could not claim confirmation because of their small ranges.[70]

Whilst Gore never devoted much effort to the consolidation of observations, analysis of consolidated results and expanding the efforts of the individual observers, this was the very cornerstone of

Markwick's strategy. Markwick's proposals for the VSS upon assuming command on 1899 December 27 were:

- The concentration of all observer efforts on a small programme covering well established and large range variables (with a view to future expansion).
- Adoption of Knott's standard step method.
- Charts issued with Harvard College Observatory (Pickering's) photometry.
- Standard form for reporting observations.
- Encouragement of observers to make continuous and systematic observations.
- Monthly submission of observations.
- Introduction of *Circulars* for rapid feedback.

Markwick knew that he was working with limited resources so he minimised the initial scope of work to just twelve variables. He basically adopted Baxendell's and Knott's proposals from 1863 (*On the Method of Observing Variable Stars*) and developed sequences from the best photometry available, which was from Harvard College Observatory. He also recognised the importance of rapid communication and like any good commanding officer who knew exactly how to motivate the troops, he issued the following appeal to the VSS members at the 1899 December 27 meeting of the BAA:[71]

'Now is the time to rally round our standard and start a series of observations which will bear fruit in the future in the shape of a great increase to our knowledge of the variables, for the work of observing these is essentially such as lends itself to co-operation, provided only the observations are carried out on the same system.'

In the 19th century observers were using many different sequences and even magnitude scales, but Markwick proposed standardisation; one sequence for each variable star, but ensuring that the observations were recorded in sufficient detail to rework them if the sequence was changed at a later date. Markwick's vision was the same as Baxendell & Knott but unlike his illustrious predecessors, he had the means to deliver and this marked the beginning of the VSS's systematic work of real scientific value.

The VSS programme on 1900 January 1 consisted of just 12 stars, which was roughly equal to the number of active observers. The stars were: U Cep, R CrB, X Her, R Leo, Beta Lyr, T Mon, Alpha Ori, U Ori, Beta Per, R UMa, S UMa & S Vir. The standard report form for observations required the following detail: date & time, sky condition, instrument, light estimate, remarks, deduced magnitude and observer code (e.g. Ma= Markwick).[72] The time, sky condition and observer code were new requirements but the other details were the same as that proposed by Baxendell & Knott back in 1863. Markwick himself drew and distributed charts for each of the programme stars that showed the naked eye and field glass views and included Revised Harvard Photometry sequences. The VSS members responded positively to Markwick's directions, charts and report forms and very soon good data were starting to accumulate. So much so in fact that Markwick felt able to announce towards the end of 1900 that the programme would be expanded from 12 to 46 stars.[73]

On 1901 January 16 Pickering issued Harvard College Observatory *Circular* No. 53 entitled 'Cooperation in Observing

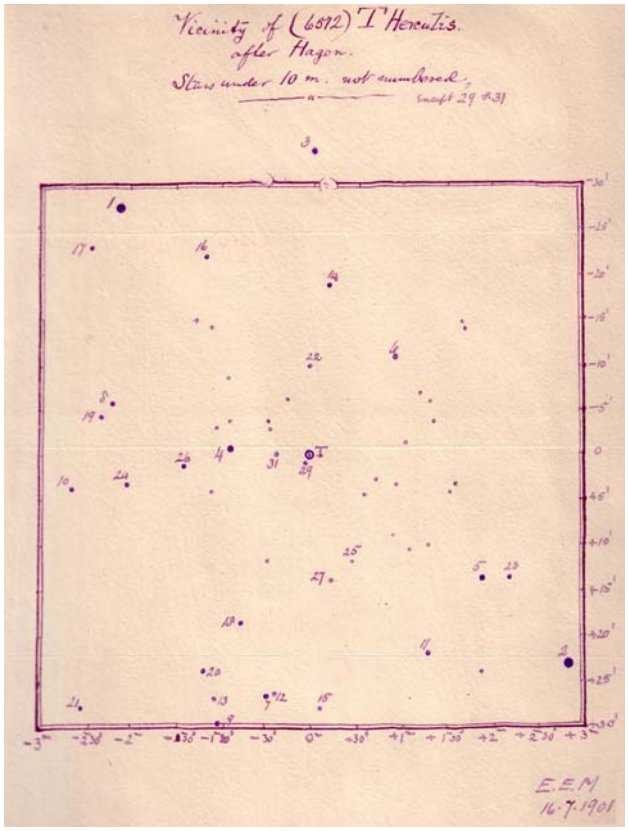


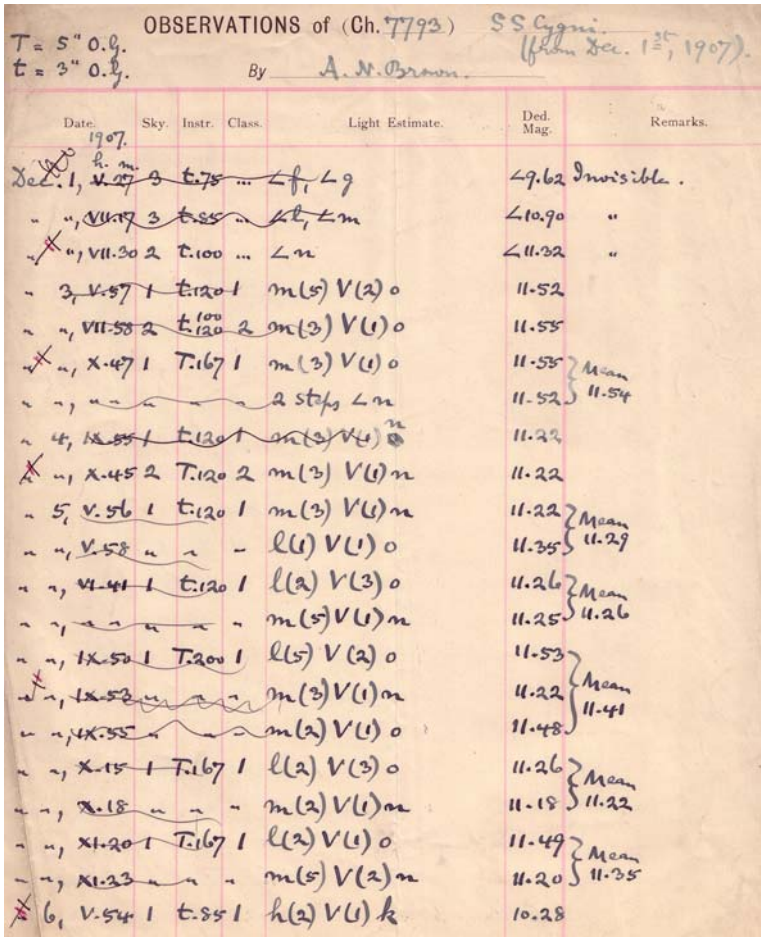
Figure 20. The BAA VSS chart for T Her drawn in 1901, which adopted the numbered sequence from the ASV.

Variable Stars.' It was an appeal for co-operation in observing 72 long-period variables, both systematically and in such a manner that they can be reduced to a uniform scale of magnitude. Markwick commented as follows: 'Prof. Pickering has just issued a circular from the Harvard College Observatory, drawing attention to the advantages to be derived from co-operation in observations of variable stars. I think we may say that we all entirely concur in his view; but I go a little further and say that we have forestalled him in the idea, as for over a year now the VSS of this Association has been engaged on observations of variable stars, all made on a uniform system, and so, easily comparable when reduced'.[74]

In 1901 Markwick issued hectograph reproduced charts for 18 long-period variables based on the recently published *Atlas Stellarum Variabilium* (ASV) by Johann Georg Hagen (see Figure 20). The sequences adopted were Revised Harvard Photometry for the brighter stars which had lettered references and Hagen's measures for the fainter stars, and adopted the number references from the ASV. These charts were intended to be used in conjunction with the ASV telescopic charts.[75]

Membership of the VSS was starting to recover and the active observers in 1901 were: W. E. Besley, C. L. Brook, J. W. L. Child, J. E. Gore, J. Kelly, A. King, E. E. Markwick, O. A. Le Beau, W. Oakes, Miss M. A. Orr, J. M. Peridier (France), P. M. Ryves, M. C. Sharp & W. M. Worssell.

In *Circular* No 32 issued in October 1901 Markwick instructed observers to make light estimates in steps of 0.1 magnitude or small fractions. The Pickering fractional method (adopted by the VSS in 1896) where the light interval between comparison stars was ten steps was abandoned be-


OBSERVATIONS of (Ch. 7793) SS Cygni (from Dec. 1st, 1907).

T = 5" 0.g.
t = 3" 0.g.

By A. W. Brown.

Date. 1907.	h. m.	Sky.	Instr.	Class.	Light Estimate.	Ded. Mag.	Remarks.
Dec. 1,	~~V.27~~	~~3~~	~~T.75~~	...	~~<f, <g~~	<9.62	Invisible.
"	~~VII.17~~	3	~~T.85~~	...	~~<l, <m~~	<10.90	"
"	VII.30	2	T.100	...	<n	<11.32	"
3,	V.57	1	T.120	1	m(5) V(2) o	11.52	
"	VII.58	2	T.~~100~~ 120	2	m(3) V(1) o	11.55	
"	X.47	1	T.167	1	m(3) V(1) o	11.55	Mean 11.54
"	"	"	"	"	2 steps <n	11.52	
4,	~~IX.55~~	1	~~T.120~~	1	~~m(3) V(1) n~~	11.22	
"	X.45	2	T.120	2	m(3) V(1) n	11.22	
5,	V.56	1	T.120	1	m(3) V(1) n	11.22	Mean 11.29
"	V.58	"	"	"	l(1) V(1) o	11.35	
"	VI.41	1	T.120	1	l(2) V(3) o	11.26	Mean 11.26
"	"	"	"	"	m(5) V(1) n	11.25	
"	IX.52	1	T.200	1	l(5) V(2) o	11.53	Mean 11.41
"	~~IX.53~~	"	"	"	m(3) V(1) n	11.22	
"	IX.55	"	"	"	m(2) V(1) o	11.48	
"	X.15	1	T.167	1	l(2) V(3) o	11.26	Mean 11.22
"	X.18	"	"	"	m(2) V(1) n	11.18	
"	XI.20	1	T.167	1	l(2) V(1) o	11.49	Mean 11.35
"	XI.23	"	"	"	m(5) V(2) n	11.20	
6,	V.54	1	T.85	1	h(2) V(1) k	10.28	

Figure 21. The BAA VSS observation report form introduced by Markwick in 1901 which remained in use (with the addition of a time column) until 1971.

cause it was known that the practical limit for most observers was a maximum of 5 or 6 steps. *Circular* 32 also introduced a revised report form (see Figure 21) which had an additional column headed 'Class' where the observer rated their observation. Class 1 was good, class 2 was doubtful and class 3 was unreliable.[76]

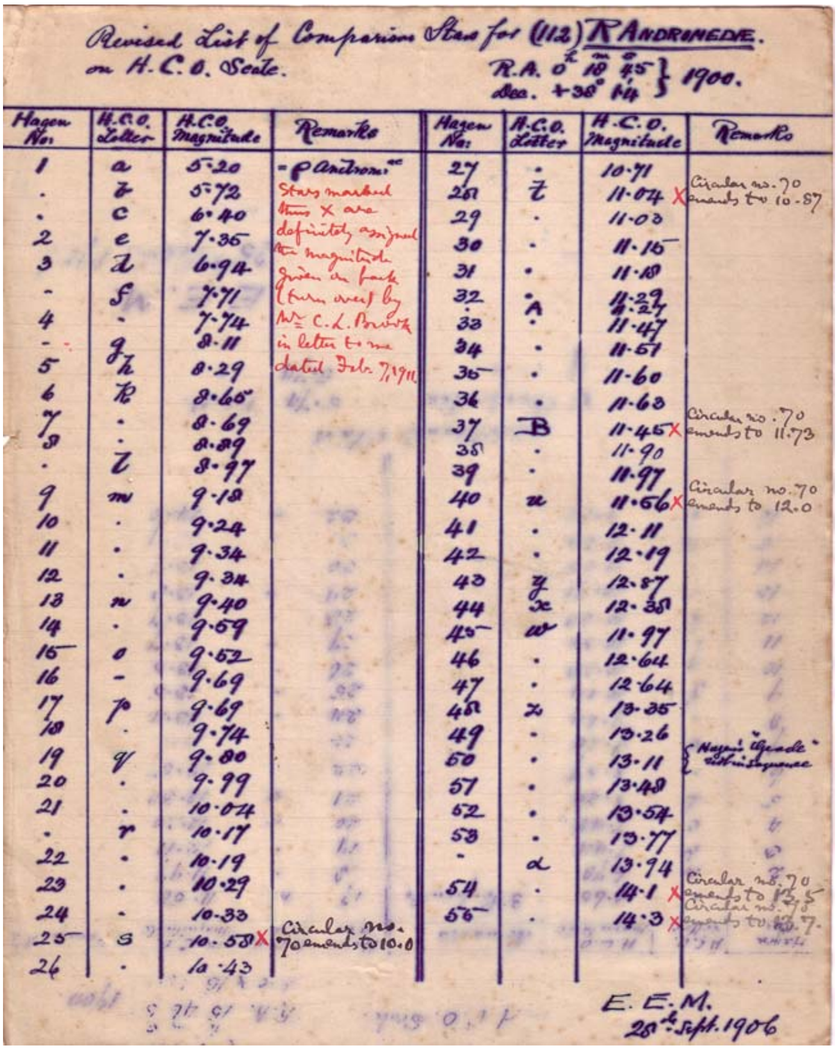
During the period 1900 to 1902 five interim reports appeared in the *Journal* of the BAA, 51 circulars were issued to VSS members and 7,450 observations were logged. A memoir on Nova Persei 1901 (GK Per) was issued in 1902.[77] The VSS was starting to appear to be the most active of the BAA observing Sections.

In *Circular* No 52 issued in January 1903 Markwick launched a nova search plan similar to that proposed by Gore in 1892, but with a little more in-depth organisation.[78] The northern Milky Way was divided into six sections which were allocated to specific observers, who were instructed to check down to 5th magnitude with the naked eye or if necessary binoculars. Each search was to be recorded with the date, time, state of sky and if it was a complete search. If the allocated section was not visible then the observer was permitted to check another section. Reports were to be sent to the Director every two months. In the period 1904 January to June there were 52 negative searches and the project was discontinued in 1906. The negative result was not too surprising considering that it took George Alcock thirteen years of meticulous searching to a fainter level before he discovered his first nova. The nova search project was not entirely fruitless though because during its course T. H. Astbury discovered the 5th magnitude cepheid RT Aur in 1905.[79]

Once the reorganisation of the VSS was fully established and running smoothly, in 1904 Markwick wrote an important paper in *Popular Astronomy* entitled 'The Observation of Variable Stars'.[80] It was directed at astronomers outside of the BAA and gave a summary account of why stars can be variable, outlining how amateurs could undertake useful observations with minimal instrumentation. Markwick emphasised that one good series of observations of a single variable star is worth much more than a large number of scattered sporadic observations of many stars. Markwick also stressed that if two or more observers combine their observations, the correctness of the results is vastly enhanced. Markwick took the perspective of the data analyst and always tried to encourage the observer to maximise the value of their observations to the analyst. Markwick's concluding statement was 'Such a method as is sketched out above is in vogue in the Variable Star Section of the British Astronomical Association, and a series of results of very great reliability have been the final outcome of the co-operation of less than a dozen workers'. This was Markwick's method of advertising the work of the VSS to the rest of the world. It probably did not go unnoticed in North America because it was in *Popular Astronomy* seven years later that the editor H. C. Wilson asked the question: 'Can we not have in America an association of observers with a Variable Star Section?'

Also in 1904 the VSS telescopic sequences for long period variables were switched from Hagen's ASV to Pickering's Harvard photometry. There were systematic differences between the Harvard and ASV magnitude scales that increased at the faint end. It meant that at magnitude 12 there was often a full magnitude difference between the two photometric systems. The change ensured that the VSS data would be directly comparable to the data of Harvard College Observatory and aligned with Pogson's light ratio scale previously adopted by the Observatory. The ASV numbers used for identifying comparison stars were however retained in the sequence and were included in the replacement charts drawn by Markwick and C. L. Brook.[81] Figure 22 shows a typical VSS sequence file from 1906 that contained the Harvard sequence and ASV comparison star identifiers.

In 1906 Brook proposed the reduced scatter experiment where five long-period variables were monitored by observers with 3-inch refractors and uniform magnifying eyepieces only.[82] The objective was to reduce the scatter between observers and detect minor irregularities in the lightcurve. This experiment was only partly successful because of the individual observers' differing responses to colour, but it did prove that different instrumentation and magnifying power had a significant effect on scatter. In 1910 January Brook succeeded Markwick as director of the VSS.



Revised List of Comparison Stars for (112) R ANDROMEDÆ. on H.C.O. Scale.

R.A. 0h 18m 45s } 1900.
Dec. +38° 14′ }

Hagen No.	H.C.O. Letter	H.C.O. Magnitude	Remarks
1	a	5·20	= ρ Androm.
.	b	5·72	Stars marked
.	c	6·40	thus X are
2	e	7·35	definitely assigned
3	d	6·94	the magnitude
-	f	7·71	given in fact
4	-	7·74	(turn over) by
-	g	8·11	Mr C. L. Brook
5	h	8·29	in letter to me
6	k	8·65	dated Feb. 7, 1911
7	.	8·69	
8	.	8·89	
.	l	8·97	
9	m	9·18	
10	.	9·24	
11	.	9·34	
12	.	9·34	
13	n	9·40	
14	.	9·59	
15	o	9·52	
16	-	9·69	
17	p	9·69	
18	.	9·74	
19	q	9·80	
20	.	9·99	
21	.	10·04	
.	r	10·17	
22	.	10·19	
23	.	10·29	
24	.	10·33	
25	s	10·58 X	Circular no. 70 amends to 10.0
26	.	10·43	

Hagen No.	H.C.O. Letter	H.C.O. Magnitude	Remarks
27	.	10·71	
28	t	11·04 X	Circular no. 70 amends to 10·87
29	.	11·03	
30	.	11·15	
31	.	11·18	
32	A	11·29 / 11·27	
33	.	11·47	
34	.	11·57	
35	.	11·60	
36	.	11·63	
37	B	11·45 X	Circular no. 70 amends to 11·73
38	.	11·90	
39	.	11·97	
40	u	11·66 X	Circular no. 70 amends to 12·0
41	.	12·11	
42	.	12·19	
43	y	12·87	
44	x	12·38	
45	w	11·97	
46	.	12·64	
47	.	12·64	
48	z	13·35	
49	.	13·26	Hagen's "Grade" within sequence
50	.	13·11	
51	.	13·48	
52	.	13·54	
53	.	13·77	
.	α	13·94	
54	.	14·1 X	Circular no. 70 amends to 13·5
55	.	14·3 X	Circular no. 70 amends to 13·7.

E. E. M.
28th Sept. 1906

Figure 22. The BAA VSS sequence file for R And in 1906, where ASV numbers are used to identify the comparison stars but Harvard photometry is adopted for the sequence.

In 1906 December the VSS recorded the second brightest maximum of the prototype long-period variable star Mira (see Figure 29 for lightcurve).[83] The mean maximum magnitude of six observers was reported as 2.0 but when the light estimates are re-reduced using modern *Hipparcos* photometry for the comparison stars, the actual average maximum recorded was 1.85. The only instance that this brightness level has been exceeded was in 1779 when the mean of William Herschel's and Pehr Wilhelm Wargentin's estimates equated to mag 1.1 using the *Hipparcos* photometric scale.

During the period 1903 to 1906 ten interim reports appeared in the *Journal of the BAA*, seven *Circulars* were issued to VSS members and two *Memoirs* were published. The programme was further expanded to include the irregular variables U Gem and SS Cyg and the first meeting of the VSS took place on 1906 December 10.[84] This period was very busy and was one of consolidation following the rapid growth of the preceding period.

4,168 observations were made of 27 long period variables (LPVs) by 15 observers in 1907, as shown in Figure 23.[85] Only three stars had fewer than 50 observations and the leading observer A. N. Brown observed two circumpolar stars on more than 100 nights. By 1907 sufficient data were being acquired to permit O–Cs (Observed–Calculated periods) to be calculated for LPVs. For 23 such stars 26 maxima and 22 minima were recorded, the periods calculated from the last two maxima observed and the O–C derived from Chandler's quoted periods.

In 1908 seven VSS observers accrued 747 observations of SS Cyg alone.[86] By taking away Stracham's 5 observations the average observer made 124 observations, which was most impressive and more than the leading AAVSO visual observer managed in 2007. The most prolific VSS observer of SS Cyg in 1908 was A. N. Brown who made 178 observations on 154 nights, which meant filling in 14 report forms. The observers from this period often made two observations per night if this particular variable was changing rapidly. The VSS light curve of SS Cyg in 1908 is shown in Figure 30 and represents a comprehensive record of what was an unusual period of activity for this dwarf nova.

In 1908 July the VSS produced a poster as part of the BAA display at the Franco-British Exhibition in London.[87] An introduction to the VSS was given explaining the work of the Section, the method of observing employed and a summary

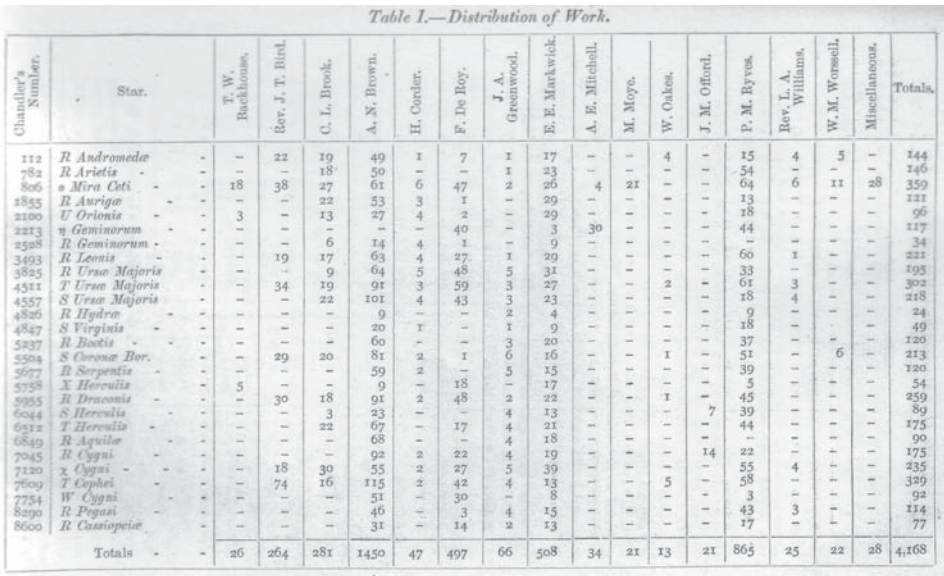


Table I.—Distribution of Work.

Chandler's Number.	Star.	T. W. Backhouse.	Rev. J. T. Bird.	C. L. Brook.	A. N. Brown.	H. Corder.	F. De Roy.	J. A. Greenwood.	E. E. Markwick.	A. E. Mitchell.	M. Moye.	W. Oakes.	J. M. Offord.	P. M. Ryves.	Rev. L. A. Williams.	W. M. Worssell.	Miscellaneous.	Totals.
112	R Andromedæ	–	22	19	49	1	7	1	17	–	–	4	–	15	4	5	–	144
782	R Arietis	–	–	18	50	–	–	1	23	–	–	–	–	54	–	–	–	146
806	o Mira Ceti	18	38	27	61	6	47	2	26	4	21	–	–	64	6	11	28	359
1855	R Aurigæ	–	–	22	53	3	1	–	29	–	–	–	–	13	–	–	–	121
2100	U Orionis	3	–	13	27	4	2	–	29	–	–	–	–	18	–	–	–	96
2213	η Geminorum	–	–	–	–	–	40	–	3	30	–	–	–	44	–	–	–	117
2528	R Geminorum	–	–	6	14	4	1	–	9	–	–	–	–	–	–	–	–	34
3493	R Leonis	–	19	17	63	4	27	1	29	–	–	–	–	60	1	–	–	221
3825	R Ursæ Majoris	–	–	9	64	5	48	5	31	–	–	–	–	33	–	–	–	195
4511	T Ursæ Majoris	–	34	19	91	3	59	3	27	–	–	2	–	61	3	–	–	302
4557	S Ursæ Majoris	–	–	22	101	4	43	3	23	–	–	–	–	18	4	–	–	218
4826	R Hydræ	–	–	–	9	–	–	2	4	–	–	–	–	9	–	–	–	24
4847	S Virginis	–	–	–	20	1	–	1	9	–	–	–	–	18	–		–	49
5237	R Bootis	–	–	–	60	–	–	3	20	–	–	–	–	37	–	–	–	120
5504	S Coronæ Bor.	–	29	20	81	2	1	6	16	–	–	1	–	51	–	6	–	213
5677	R Serpentis	–	–	–	59	2	–	5	15	–	–	–	–	39	–	–	–	120
5758	X Herculis	5	–	–	9	–	18	–	17	–	–	–	–	5	–	–	–	54
5955	R Draconis	–	30	18	91	2	48	2	22	–	–	1	–	45	–	–	–	259
6044	S Herculis	–	–	3	23	–	–	4	13	–	–	–	7	39	–	–	–	89
6512	T Herculis	–	–	22	67	–	17	4	21	–	–	–	–	44	–	–	–	175
6849	R Aquilæ	–	–	–	68	–	–	4	18	–	–	–	–	–	–	–	–	90
7045	R Cygni	–	–	–	92	2	22	4	19	–	–	–	14	22	–	–	–	175
7120	χ Cygni	–	18	30	55	2	27	5	39	–	–	–	–	55	4	–	–	235
7609	T Cephei	–	74	16	115	2	42	4	13	–	–	5	–	58	–	–	–	329
7754	W Cygni	–	–	–	51	–	30	–	8	–	–	–	–	3	–	–	–	92
8290	R Pegasi	–	–	–	46	–	3	4	15	–	–	–	–	43	3	–	–	114
8600	R Cassiopeiæ	–	–	–	31	–	14	2	13	–	–	–	–	17	–	–	–	77
	Totals	26	264	281	1450	47	497	66	508	34	21	13	21	865	25	22	28	4,168

Figure 23. The BAA VSS observer summary for long period variables in 1907.

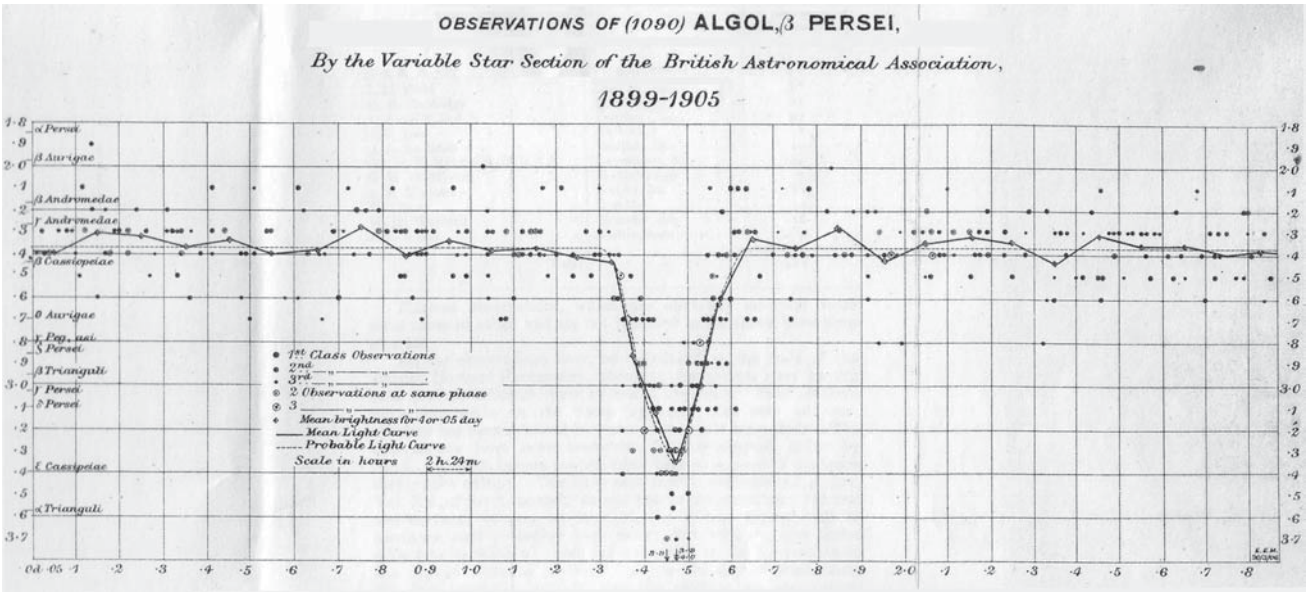


Figure 24. BAA VSS folded lightcurve of Beta Per (Algol) in 1899–1905. The comparison stars used are marked within the vertical magnitude scale.

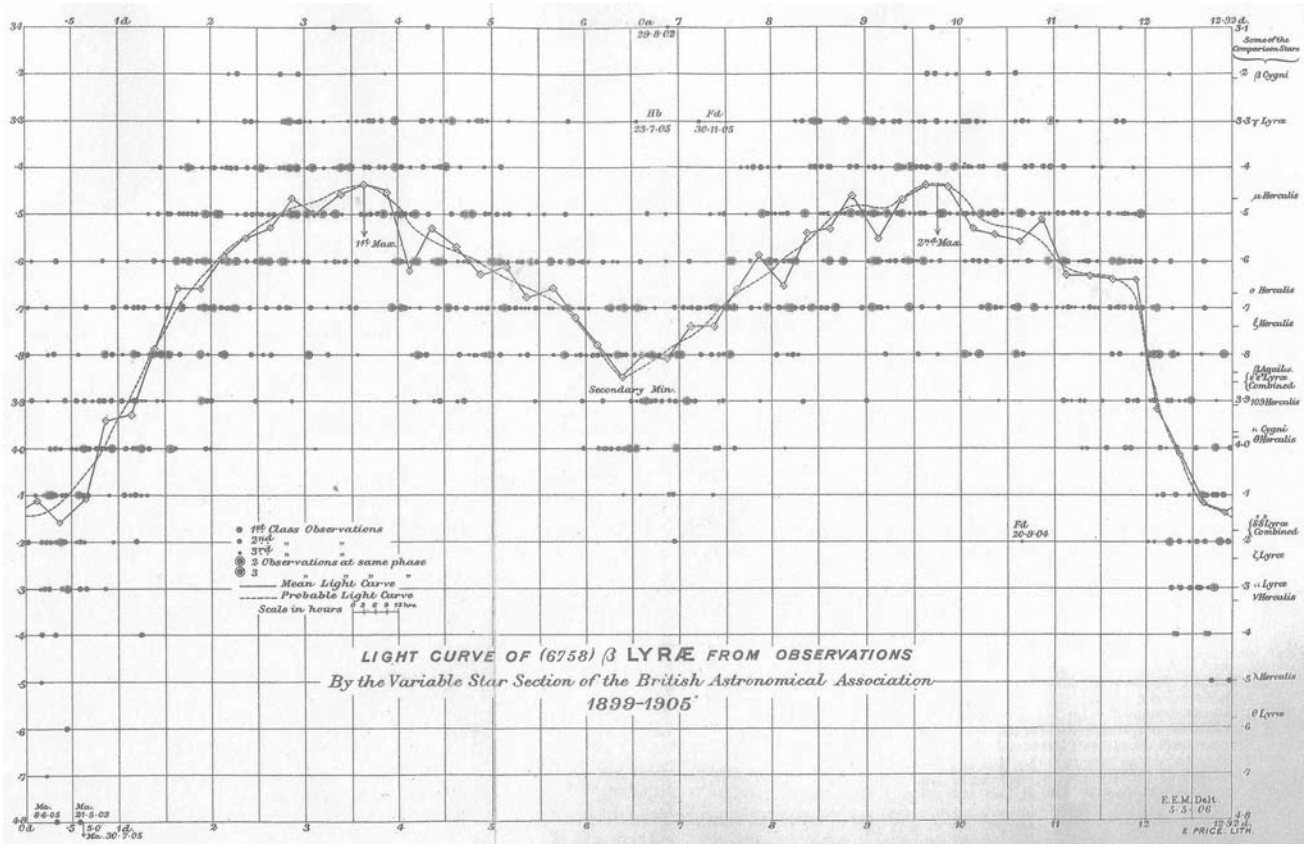


Figure 25. BAA VSS folded lightcurve of Beta Lyr in 1899–1905.

of the stars under observation. Blueprint lightcurves were shown covering R Aur, R Boo, S CrB, Chi Cyg, R Sct & T UMa in 1906 and R Aql, SS Cyg, R Dra, S Her & T Her in 1907. The emphasis was on what could be achieved in co-operation between variable star observers. One person at the Exhibition who showed particular interest in the lightcurves was Annie J. Cannon, who was renowned for her work at Harvard on stellar classification and for discovering variable stars from photographic plates.

During the period 1907 to 1908 nine interim reports appeared in the *Journal of the BAA* and the programme was further expanded to 50 stars. In 1908 the programme consisted of 5 Algol, 9 short-period, 27 long-period and 9 irregular variable stars. This programme was to remain largely in place for the following thirty years, ensuring excellent coverage for the stars selected. During the years 1900 to 1909 (Markwick's Directorship) the overall numbers of observations reported (of programme stars) by the VSS were:[88]

Algol type	2,080
Short period	6,870
Long period	21,690
Irregular	7,860

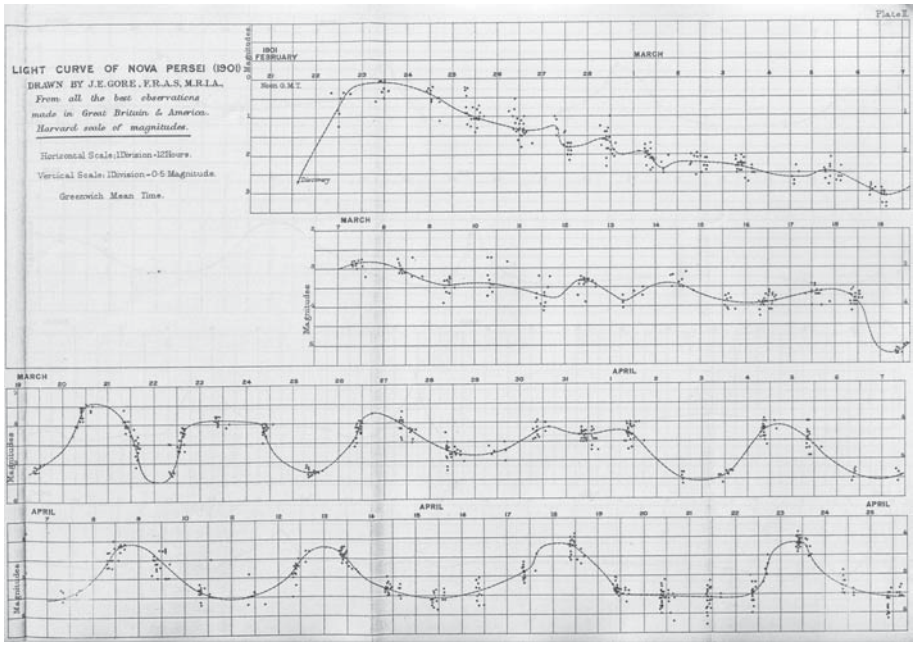


Figure 26. BAA VSS lightcurve of Nova Per (GK Per) in 1901. Multiple observations were made on every night for over two months as the nova declined and oscillations developed.

Nova Per 1901	1,440
Total:	39,940

Examples of lightcurves derived from the above observations are shown in Figures 24 to 31.

The observations were published in the *Memoirs* of the BAA which were the permanent records of the work of the VSS (see Figure 32). The data were listed by star then date order for easy reference, and included the full light estimate details so that the observations could be re-reduced if any of the sequences changed in the future (which inevitably they did, often more than once). To have the observations presented in this way was of major assistance during the computerisation of the VSS data which commenced in 1992 and was still ongoing in 2008.

Markwick deserves full credit for transforming the VSS from a minor club style reporting forum into a robust association of variable star observers, with a clear strategy and applying the most professional and exacting standards of the time. By 1908 the VSS had fully matured into the prototype model for future successful and sustainable variable star associations.

Whilst addressing the 1921 February 23 meeting of the BAA the eminent American Prof Henry Norris Russell spoke of the role that variable stars were playing in the study of stellar evolution, and commenced his address with the following words: 'I am very glad indeed to be at one of the meetings of the BAA. We owe a debt to the Association for its services to, and for the widespread interest it has aroused in astronomy, for its pioneering work, and for its direction of amateurs into certain fields of research. I will take one Section as an example, that of Variable Stars. The AAVSO, now closely associated with the American Astronomical Society, follows the lines laid down by Markwick and Brook. Amateurs with telescopes of moderate size have taken under their charge this branch of observation, and have given more information year by year than even professionals have done'.[89] These words by a professional astronomer of international repute accurately summed up the long term legacy of the BAA VSS, which had in effect led the way for amateur collaboration in variable star data acquisition.[90]

Summary

In 1848 the few individuals observing variable stars in Great Britain worked independently, but following Herschel's repeated appeal in 1849, collaboration between observers commenced on a tentative basis. In 1863 Baxendell & Knott

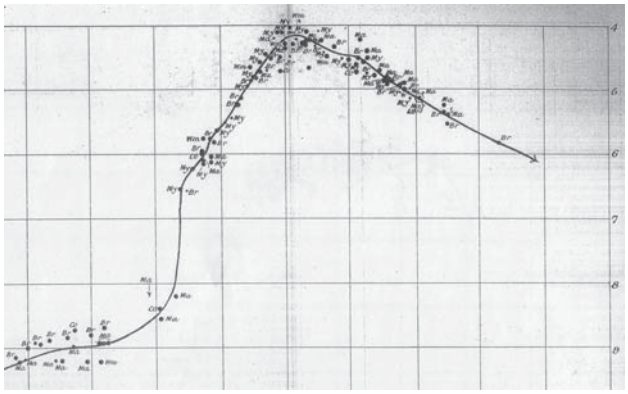


Figure 27. BAA VSS lightcurve of the bright maximum of Chi Cyg in 1904. The plotted observations are marked with the observer codes.

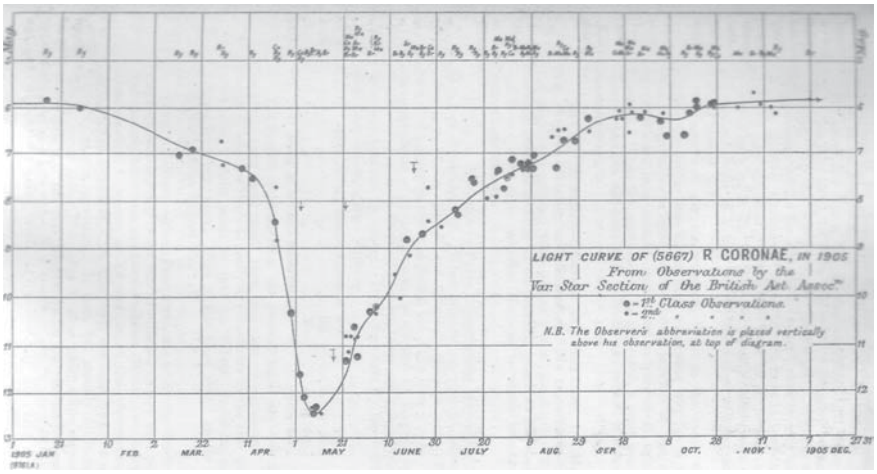


Figure 28. BAA VSS lightcurve of R CrB in 1905. This showed a typical deep fade and recovery that was accomplished within a year.

pressed for that collaboration to progress to a higher and more formal level through the ASOVS, but they encountered criticism and obtained only limited support. Pickering's encouragement together with Baxendell's and Espin's influence probably ensured that the LAS VSS was formed in 1883. Gore ran the LAS VSS and BAA VSS along very similar lines, simply collating and reporting observations, until 1898. Then Markwick rapidly transformed the BAA VSS into the model effective variable star association that was fully mature by 1908.

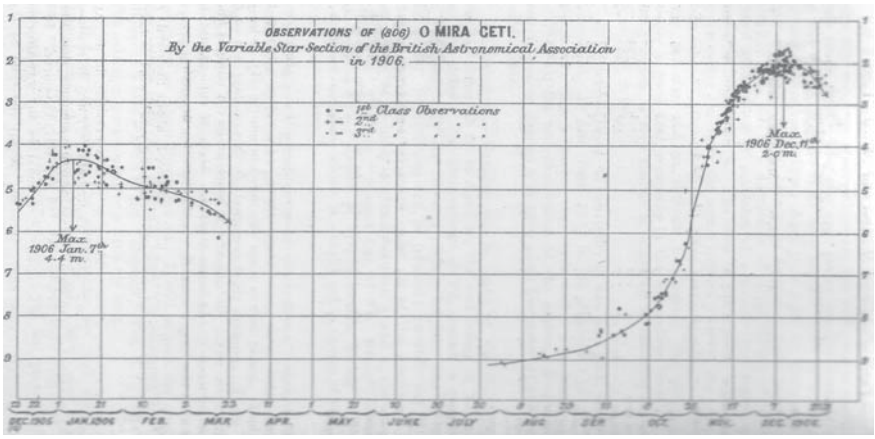


Figure 29. BAA VSS lightcurve of Omicron Cet (Mira) in 1906. Up to 2008 the 1906 December maximum was the second brightest recorded since regular monitoring began in the 17th century.

The formation and establishment of variable star associations was a perilous endeavour in the 19th century and they were only sustainable in the form of sections within large astronomical associations. The concept of an association dedicated to systematically observing variable stars to a uniform photometric scale which Baxendell & Knott proposed in 1863 was not achieved until 1900, because adequate photometry was not available. The almost simultaneous publication of the revised Harvard College Observatory photometry and ASV sequences changed the situation at the start of the 20th century and the BAA VSS under Markwick's direction took full advantage.

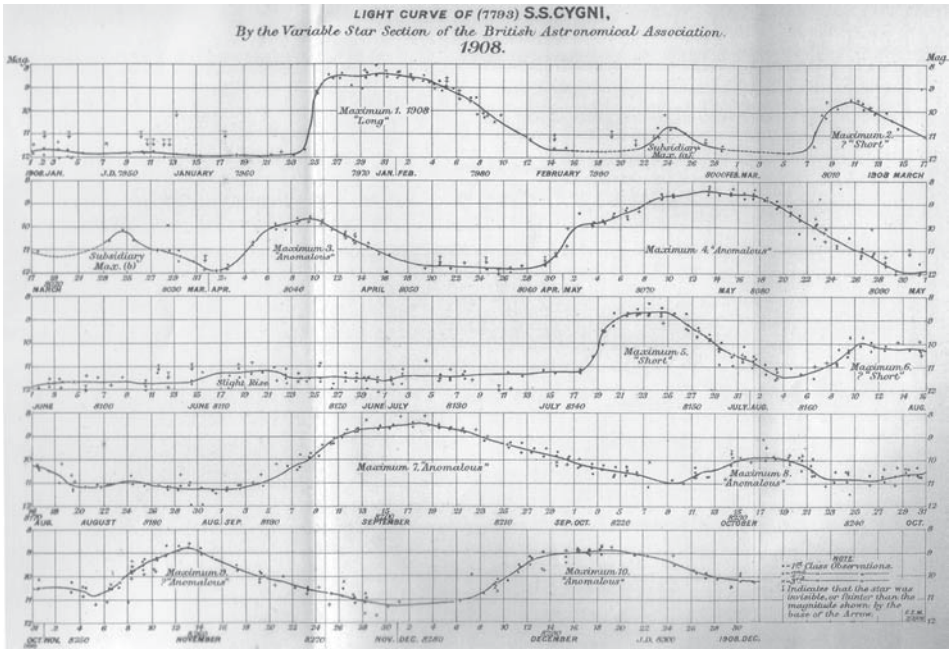


Figure 30. BAA VSS lightcurve of SS Cyg in 1908. Multiple anomalous maxima were recorded during what was an extended period of unusual activity.

The following thirty years (1909 to 1939) were the golden period for work undertaken by the BAA VSS when intense systematic observations were made of the programme stars selected by Markwick. It was also the time when variable star associations formed around the world, generally along national lines. These associations had the advantage that a model format was readily available to them, thanks to the pioneering efforts made in Britain during the 60-year period 1848 to1908.

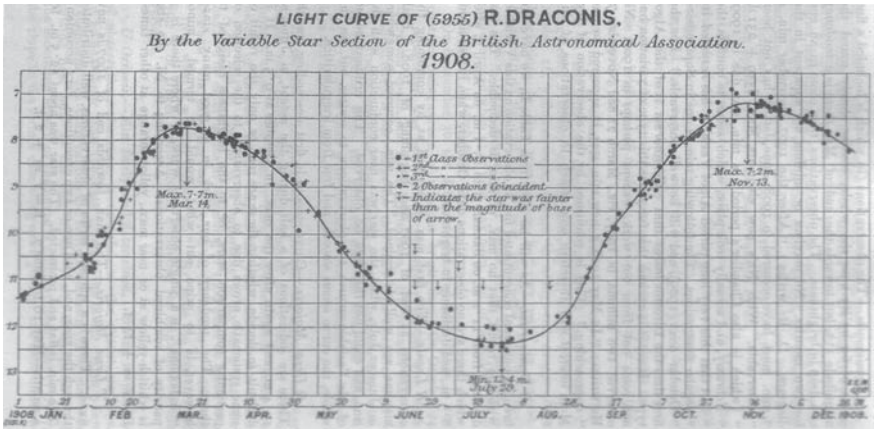


Figure 31. BAA VSS lightcurve of R Dra in 1908. The limited scatter in this lightcurve was due to a small group of observers concentrating their efforts on this circumpolar LPV.

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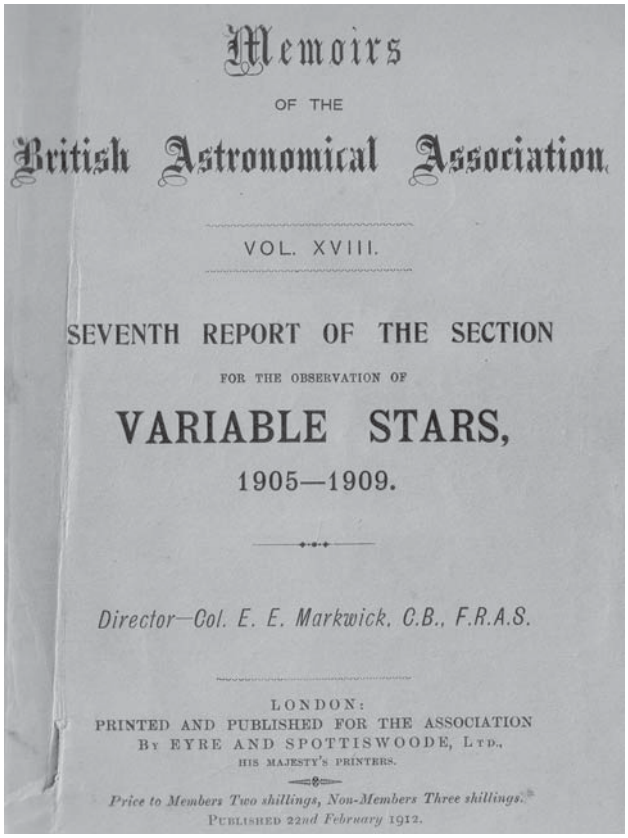
Memoirs
OF THE
British Astronomical Association
VOL. XVIII.
SEVENTH REPORT OF THE SECTION
FOR THE OBSERVATION OF
VARIABLE STARS,
1905—1909.
Director—Col. E. E. Markwick, C.B., F.R.A.S.
LONDON:
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Figure 32. BAA VSS *Memoir* No 7 published in full all observations of long period variables during 1905–'09.

BAA; Bob Marriott, BAA; Wayne Orchiston, James Cook University; Elizabeth Waagen, AAVSO; Tom Williams, AAVSO. Extensive use was also made of the NASA Astrophysics Data System.

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