The Ashen Light of Venus: A century of observations by McEwen and Moore

Richard McKim & Patrick Moore§

A report of the Mercury & Venus Section (Director: R. J. McKim)

This paper is a catalogue and analysis of the Ashen Light sightings from two remarkably long series of Venus observations held in the BAA Mercury & Venus Section archives spanning 1892 to 1999. The records comprise overlapping series of visual records by the first two Directors of the Section, Henry McEwen and Patrick Moore. The Ashen Light was seen during 25 of the 56 adequately-observed elongations. By analysing the results in terms of the eight-year 'cycle' of Venus elongations we demonstrate that the Ashen Light's visibility does not simply depend upon terrestrial viewing conditions: those elongations that permitted Venus to be viewed at reasonable altitude against a dark sky were not the only occasions when the Light was well seen. At times the phenomenon can become especially conspicuous, as in 1953 and 1956 (when it was visible semi-continuously for more than a month), and in 1895, 1935, 1940, 1957, 1980 and 1988 (where there were fewer good sightings). There also exist long intervals where, despite excellent conditions and observational coverage, the Ashen Light has remained remarkably obscure.

Introduction

The Ashen Light of Venus[1] has been widely reported since the 17th century, though since the dawn of the Space Age it has been fashionable in some quarters to simply dismiss it as being illusory.

In 1991 Lecacheux *et al*.[2] became the first group to image the nightside surface of Venus with a ground-based telescope in the 1.0μm near-infrared (IR) window. According to Taylor *et al.*,[3] over 95% of IR emission at 1.0μm is actually from the surface. In the early 1990s, *Galileo* Near-Infrared Mapping Spectrometer data showed that the planet's atmosphere was neither so uniform nor so opaque as had previously been thought. The sulphuric acid aerosols are not highly scattering at visible and near-IR wavelengths. In a recent popular review, Taylor[4] has written that 'it seems not unreasonable to expect a fully dark-adjusted observer to be able to see the glow from the surface of Venus under good viewing conditions.'

Is it possible that the red-hot faintly glowing surface of Venus, at a mean temperature of some 460°C, may in principle be dimly perceived at visual wavelengths on the nightside, where it would not be overwhelmed by emission from the brilliant sunlit disk of the planet? If so, its visibility might be modified by interposing Venusian clouds.[4] The historically observed warm tint and occasional speckled nature or partial visibility of this darkside phenomenon does not contradict this hypothesis. However, we must recall that there are other theories – airglow in particular[1] – to account for the origin of the phenomenon, and surely the last word has not yet been written on the matter.

As already implied, the brilliantly illuminated dayside of the planet presents a major obstacle to observation, and doubtless for that reason almost all records of the Ashen Light (hereinafter simply 'AL') have been made at phases below 0.5. An occulting bar helps in searching for, and in verifying the objective reality, of the AL. At the same time, given the faintness of the AL, searches must be conducted against a dark or twilight sky so that the AL stands out clearly against the foreground sky (which strongly scatters blue light during daylight hours). Thus it is generally necessary to view Venus when she is low down and affected by adverse seeing conditions. Since 2004, amateur astronomers such as Christophe Pellier have also taken 1-micron band CCD images showing the faintly glowing night side of Venus,[2] but in this paper we shall focus entirely upon the aspect at visible wavelengths.

The paper does, we feel, show that long continued visual observations of the Ashen Light are of great value. We are now quite certain that it is a real phenomenon and not simply a contrast effect as has been claimed. Therefore, we hope that the members of the Mercury & Venus Section will continue to observe the Light as energetically as possible. We are not yet entirely certain of its cause, but there is no doubt of its importance in any studies of Venus.

Observational materials

Richard Baum has recently catalogued the AL work of a past BAA Mercury & Venus Section stalwart, M. B. B. Heath.[5] Baum has also described how the phenomenon appears darker than the sky (mostly by pure illusion but perhaps partly by colour contrast) before sunset to lighter than the sky afterwards. Even longer series of records come from two other observers: Henry McEwen and Patrick Moore. McEwen was the first Director of the Section (founded 1895), and Moore its second. Each observed the planet continuously for over 50 years. The early reports of the Section are scattered throughout the volumes of the *Journal* since 1895, with further notes in the annual Council Reports; McEwen was very selective about what he published, and many of

§The second author (Moore) wishes to point out that although the paper draws heavily upon his observations, the actual paper itself was written by the first author.

his own records never appeared in print.[6] Upon assuming the Directorship in 1956, Moore inaugurated a series of comprehensive reports on each elongation, continued by his successors without a break until the 1990s.

McEwen observed Venus from 1892 till shortly before his death in 1955. However, his extant Venus diaries cover only 1892–1948. Moore kept personal records from 1935 onwards, and copied his best Venus drawings to the Section from 1949 onwards, till he was obliged to retire from active observing after 1999. The other Section records prior to 1955 were lost upon McEwen's death.[6] For this paper for reasons of convenience we have used Moore's original notebooks as a source, because although the Mercury & Venus archives exist from 1956 onwards, the records are mostly filed by date instead of by observer, making the location of the complete records of any individual a time-consuming task! Thus we used McEwen's diaries (having cross-checked against all his published work to fill some of the gaps in the record) and Moore's notebooks. McEwen used a 127mm (5-inch) Wray refractor for all his work and observed from the suburbs of Glasgow, Scotland. He owned a Hilger variable occulter, and this was sometimes used to test the objective reality of the AL by hiding the bright crescent. Moore used a variety of instruments, mostly a 76mm (3-inch) OG, and 216, 320 and 390mm (8.5-, 12.5- and 15-inch) Newtonian reflectors, almost entirely from southern England. In some of his work he was assisted by the use of an occulting bar.

McEwen did not observe every elongation of the planet, but intensively followed many of those occurring between 1892 and 1954; Moore covered all except two elongations between 1949 and 1999, though like McEwen he did not always manage to get observations close enough to inferior conjunction (hereinafter denoted 'IC') to usefully search for the AL.

In such delicate studies as that of the AL, individual differences of perception between observers become very significant. Therefore, although we shall sometimes refer to other observations by BAA members for comparison purposes, our primary aim has been to discuss the long-term studies by McEwen and Moore. Inspection of their work (represented by Figures 1–2) shows that neither observer suffered from decreasing sensitivity with time.

Table 1. Elongations of Venus 1892–1999

Evening (E) elongations	
Group I	**1892 1900 1908** 1916 **1924 1932 1940 1948 1956 1964 1972 1980 1988 1996**
Group II	**1893 1901 1909** 1917 **1925 1933** 1941 **1949 1957 1965 1973 1981 1989 1997**
Group III	**1895 1903 1911 1919 1927 1935 1943 1951 1959 1967 1975 1983 1991 1999**
Group IV	**1897** 1905 **1913 1921 1929 1937 1945 1953 1961 1969 1977 1985 1993**
Group V	1898 1906 1914 1922 1930 **1938 1946 1954 1962 1970 1978 1986 1994**
Morning (W) elongations	
Group VI	**1892 1900** 1908 1916 1924 1932 **1940 1948 1956 1964 1972 1980 1988 1996**
Group VII	1894 1902 **1910** 1918 1926 1934 1942 **1950 1958 1966** 1974 **1982 1990** 1998
Group VIII	**1895** 1903 1911 **1919 1927** 1935 1943 **1951 1959 1967 1975 1983 1991 1999**
Group IX	**1897** 1905 **1913** 1921 1929 **1937** 1945 **1953 1961 1969 1977 1985 1993**
Group X	1899 1907 1915 1923 1931 **1939** 1947 **1955 1963 1971** 1979 **1987 1995**

Elongations of Venus

Over a period of eight years, there is a 'cycle' of ten elongations (five E and five W and therefore also five ICs) after which Venus returns to very nearly the same point in the sky. Meeus[7] has discussed how the same geocentric phenomena are exhibited eight years later, but 2.5 days earlier. Thus the 1924 elongation (viewed and reported upon at

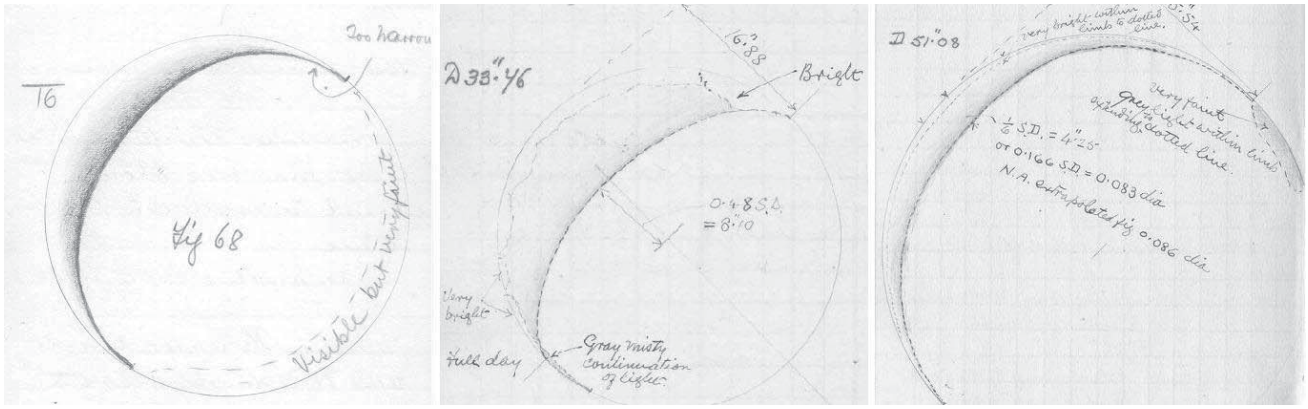

Figure 1. The Ashen Light observed by Henry McEwen with a 5-inch (127mm) OG (reproduced from his notebooks in the BAA Mercury & Venus Section archives). South is uppermost. From left to right:
A. 1902 January 26d 16h 30m, ×150. AL seen all over night side, brightest at opposite limb.
B. 1943 July 24d 18h 40m, ×135. AL associated only with N cusp.
C. 1948 June 8d 21h 25m, ×163. AL associated only with S cusp.

length by McEwen) was very similar to that of 1956 (the subject of Moore's first Section Report) and that of 1980 (studied by both the present authors).

In Table 1 we group all the 136 elongations in terms of the 8-year cycle, covering 1892 (E)–1999 (W). The year given is that during which Venus is at greatest elongation, not necessarily that in which it passes inferior conjunction. In **bold** type we have indicated those elongations for which there exists any observational data in the McEwen–Moore collection; in addition, underlining indicates that observational data were adequately close to inferior conjunction for our purposes. Actual AL sightings will be dealt with later.

The declination at IC varies considerably during the 8-year cycle (as well as showing a slow change with time).[7] The following modern figures are adequate to account for the relative quality (and number) of the observations at successive elongations.[8] The latitude of the centre of the disk as viewed from Earth does not vary much; thus during 2004 it varied over the extreme range ±2.6°.[9] We also note from radar studies of the rotation rate of the planet's surface that the same face of Venus is always presented to the Earth at every IC.

IC date	*Group*	*Declination*
1996 June 10	I/VI	+21°
1998 January 16	II/VII	−16°
1999 August 20	III/VIII	+ 5°
2001 March 30	IV/IX	+11°
2002 October 31	V/X	−19°

From the declination data we can see that the IC in 1924, 72 (or 9×8) years before 1996, also occurred under favourable viewing conditions in the UK, with a high N. declination, but that of 1978, 24 (or 3×8) years prior to 2002, would have been observed under much more difficult conditions.

In total, 56 elongations of the136 that occurred in the period 1892–1999 were adequately observed for the purpose of this paper.

The observations

These are given *in extenso* in Appendices I and II.

Discussion

In order to roughly compare the frequency of the AL sightings we have adopted a simple alphabetical scale, the letter being indicated in brackets after the elongation:

A: Two or more really definite sightings of the AL (whether visible in its entirety or not)
B: At least one definite sighting of the AL
C: One or more uncertain sightings

Very vaguely suspected cases of the AL have been listed in the Appendices, but have not been included below. We give in Table 2 the subsets of elongations in which the AL was searched for by McEwen and Moore. The right-hand column lists those elongations which yielded positive sightings.

Overall there were 56 elongations in which effective searches could be made, and at 25 elongations the AL was detected. Comparing E with W elongations, it is most likely that the lower positive frequency of AL for the morning elongations is a simple consequence of the smaller number of observations made. (On the other hand, it is not impossible that the AL really is more frequent during evening elongations, when the evening nocturnal hemisphere is displayed, if its visibility is related to the time of Venusian night.) The greatest number of sightings is in the (decreasing) order I, IV, III, II, V, as might have been expected from the declination data. Yet the visibility within each group varies considerably – and irregularly – with time. Statistically, it is not surprising that there were no positive records from Group V: only two elongations were sufficiently well observed near IC. The same comment applies to several of the series of morning elongations. Further notes upon particular groups of elongations now follow.

Group I

1956 E: There were very many sightings in the summer of 1956.[10] This is confirmed by the independent evidence of the whole BAA Mercury & Venus Section, whose positive records extended from April 22 up to IC (June 22).

Table 2. Records of the Ashen Light, 1892–1999

Evening (E) elongations

Elongations in which AL searches were made	*Positive records and ratings*
Group I	
1892 1900 1924 1932 1940 1948 1956 1964	1924(C) 1940(A) 1948(B) 1956(A)
1972 1980 1988 1996	1972(C) 1980(A) 1988(A)
Group II	
1893 1901 1909 1949 1957 1965 1973 1989	1901(B) 1909(C) 1957(A)
Group III	
1895 1903 1919 1927 1935 1943 1959 1967 1975	1895(B) 1919(B) 1935(A) 1943(B)
Group IV	
1897 1913 1921 1937 1953 1961 1969 1977 1985	1897(B) 1953(A) 1961(C) 1969(B)
1993	1977(B) 1985(C) 1993(C)
Group V	
1962 1994	–

In summary, a total of 21 positive E. elongations of the 41 possible (a 51% incidence rate).

Morning (W) elongations

Elongations in which AL searches were made	*Positive records and ratings*
Group VI	
1940 1956 1980	–
Group VII	
(no entries)	–
Group VIII	
1895 1927 1951 1959 1967 1975 1983 1991	1895(A) 1967(B)
Group IX	
(no entries)	–
Group X	
1939 1955 1971 1995	1939(B) 1955(C)

In summary, a total of 4 positive W. elongations out of 15 possible (27%).

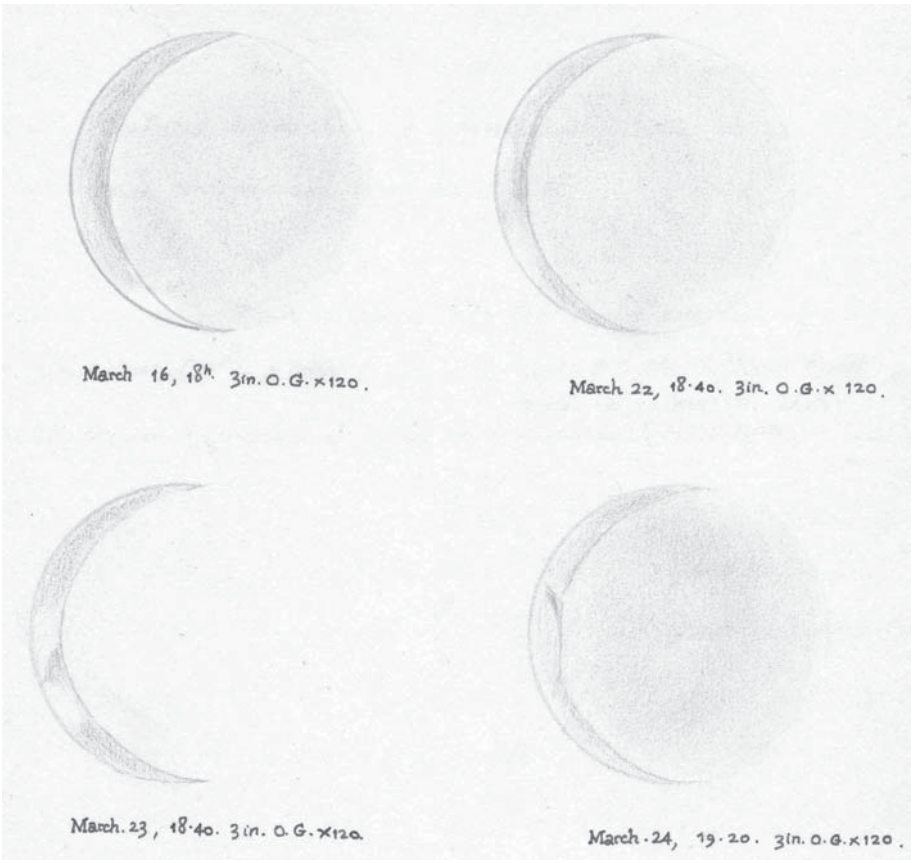

Figure 2. The Ashen Light observed by Patrick Moore in 1953 March with a 3-inch (76mm) OG, ×120 (reproduced from his observational notebook). South is uppermost. The AL was visible on March 16, 22 and 24, but not on March 23. Note also the terminator indentations on the last date.

Group II

1957 E: There were several sightings at this evening elongation according to the whole BAA Mercury & Venus Section, though the phenomenon lasted for a shorter time than in 1956 (the fortnight from December 29 onwards, from the work of the whole Section).[10]

Group III

1935 E: McEwen's positive sightings of the AL were mostly taken prior to the commencement of the intensive French observing campaign organised by D. Barbier (1935 August 15 – October 1), whose AL results were quite negative.[11]

Group IV

1953 E: See Figure 2. There were very many sightings in the spring of 1953, and if we include the work of other observers, more than at any other elongation. This is confirmed by the independent evidence of R. M. Baum (personal communication), M. B. B. Heath,[5] and members of the Association of Lunar & Planetary Observers in the USA. In an early reference to filter work, Moore has written how in 1953 April: '...a most interesting observation was made by Clyde Tombaugh and C. C. Post in America. Using a red filter, they saw that the 'dark' regions were shining with a reddish glow against the narrow, brilliant crescent.'[12]

Groups VIII and X

Though there were only two positive elongations in each group, there were definite AL sightings, including the strong appearance in 1895 October.

Within those groups where the AL was more frequently seen there is no constant frequency of sightings over time, which would be expected to be the case if the phenomenon were constantly visible (and if its visibility depended only upon getting a good view of the planet against a dark sky). Taking Group I, the paucity of sightings in 1900 E contrasts (for example) with the relatively large number in 1940 E and 1956 E. There is obviously no relationship with solar activity, and indeed this had already been established by Hedley Robinson in his analysis of BAA Venus work for 1956–1972.[10] Robinson also concluded – correctly – that neither was there any 8-year periodicity in the AL sightings.

Sometimes the AL is visible for many days in succession, as in 1940, 1953, 1956 and 1957. At other times, despite excellent observing conditions, it remains elusive. In terms of best visibility, a phase near 0.2 (or phase angle[13] 127°) seems more successful than 0.1 (phase angle 143°): glare is more of a problem with the higher phase, but more importantly the planet is at a higher altitude on a darker sky. Indeed, some of the records were even made at an observed phase above 0.4 (corresponding to a phase angle of 102°).

The AL does not always extend over the entire invisible hemisphere. This was Moore's experience in 1969 E. Often too the AL appears lightest at the limb opposite the bright crescent: *vide* McEwen, 1895 W, 1901 E (Figure 1A), etc. Occasionally, as in McEwen's remarkable observation from 1948 E (Figure 1C), the AL is associated exclusively with the immediate vicinity of one or other cusp (on that case the S. one). On that occasion one is tempted to suggest that the thickening of the point of that cusp that he had observed a few days beforehand may have been a precursor: an indication of unusual atmospheric upheaval near the S. pole? McEwen's other unusual observation concerned the area near the N. cusp in 1943 July (Figure 1B), and so did one by Moore in 1967 October. We know of just a few other unusual sightings of details within the AL by BAA observers: as noted in a review by Baum,[1] the Light appeared patchy to D. Graham in 1988 and to D. Gray in 1999, whilst the late V. A. Firsoff has illustrated several of his personal observations (from the 1950s), which are of interest and relevance here.[14,15] A drawing from 1932 showing much structure in the dark hemisphere was published in a French journal by R. Cheveau.[16]

Conclusion

Many years of consistent records reveal that there is no obvious pattern in the observed frequency of the Ashen Light close to inferior conjunction. Sightings of the Light do not uniquely occur during those elongations when the planet is especially well-placed for observation. Its visibility must therefore depend upon conditions in the Venusian atmosphere rather than upon the altitude of Venus in terrestrial skies. Possibly there is variable emission from Venus' upper atmosphere. Or, if the AL is really a glow from the surface as Taylor has suggested,[4] it may be that on some occasions the Venusian clouds are thinner than at other times – or at least less absorbing in the red end of the visible spectrum – thus enabling observers to catch a glimpse of the Light.

In this age of CCD imaging, we would nevertheless strongly encourage observers to continue to observe Venus visually in order to maintain the historical record, so that direct comparisons may be made between the past and the present by means of that very useful tool, the Mark One Eyeball!

Addresses: RJM: Cherry Tree Cottage, 16 Upper Main Street, Upper Benefield, Peterborough PE8 5AN. [Rmckim5374@aol.com]
PAM: Farthings, 39 West Street, Selsey, West Sussex PO20 9AB.

Notes and references

1 R. M. Baum & D. L. Graham, 'Mercury and Venus', in R. J. McKim *(ed.)*, *Observer's Guide*, British Astronomical Association, 2006; R. J. McKim, 'Observing Venus', in J. Muirden *(ed.)*, *Sky Watcher's Handbook*, W. H. Freeman & Co., 1993; P. Moore, *Venus*, Cassell, 2002. The Ashen Light is specifically reviewed by R. M. Baum, *J. Brit. Astron. Assoc*., **110**, 325–329 (2000), and by C. T. Russell & J. L. Phillips, *Sky & Telesc.,* **79**, 108–111 (1990) and *Adv. Space Res*., **10** (no.5), 137–141 (1990) (the latter available at: **http://www-spc.igpp.ucla.edu/personnel/russell/papers/ashen/**).

2 J. Lecacheux *et al*., *Planet Space Sci*., **41**, 543–549 (1993). The first amateur images of the nightside IR emission were secured by C. Pellier in 2004: see R. J. McKim, *J. Brit. Astron. Assoc*., **114**, 241–2 (2004). Further successful results were reported in 2005–'06 (R. J. McKim, *ibid*., **116**, 168 (2006)).

3 F. W. Taylor, D. Crisp & B. Bézard, 'Near-infrared sounding of the lower atmosphere of Venus', in S. W. Bougher, D. M. Hunten & R. J. Phillips *(eds.)*, *Venus II*, University of Arizona Press, Tucson, 1997, pp 325–351

4 F. W. Taylor, 'The Ashen Light of Venus', in P. Moore *(ed.)*, *The 2004 Yearbook of Astronomy*, MacMillan, 2003

5 R. M. Baum, *J. Brit. Astron. Assoc*., **116**, 190–195 (2006). Baum has sent us a long list of his personal sightings of the AL (1951–1988), and we also draw attention to an historical AL catalogue by Baum listing the earliest records up until 1900: *J. Brit. Astron. Assoc.*, **67**, 242–250 (1957).

6 R. J. McKim, 'Henry McEwen of Glasgow: a forgotten astronomer? Part 1: Moray Firth to Mount Florida (1864–1916)', *ibid*., **115**, 13–24 (2005); 'Part 2: Cambuslang (1916–1955)'; *ibid.*, **115**, 87–97 (2005)

7 J. Meeus, 'The inferior conjunctions of Venus, 1960–2023', *ibid.*, **81**, 114–117 (1971)

8 Taken from the annual *Handbook* of the British Astronomical Association.

9 Taken from the *Astronomical Almanac*, 2004.

10 J. Hedley Robinson, 'Report on the Observation of the Planet Venus, 1956–1972', *Mem. Brit. Astron. Assoc*., **41** (1974). This report comments upon the many (objective) AL sightings in 1956 and 1957 compared with the paucity of reports thereafter. We also note that the 1970s advice within the Section to use the very dense Wratten 35 purple filter (based upon the supposition that the AL is an airglow akin to the terrestrial aurora) was likely to have hindered rather than helped its detection.

11 D. Barbier, *Bull. Soc. Astron. France*, **50**, 27–34 (1936). Cited and discussed by T. L. MacDonald in *J. Brit. Astron. Assoc*., **46**, 207–208 (1936).

12 P. A. Moore, *Guide to the Planets*, Eyre & Spottiswoode, 1955, page 61. The original source is: J. C. Bartlett, *J. Assoc. Lunar Planet. Obs.*, **8**, 57–68 (1954).

13 The phase angle i (the angle between the Earth and the Sun as seen from Venus) is calculated from the equation: Phase = 0.5 (1 + cos i).

14 V. A. Firsoff, *The Interior Planets*, Oliver & Boyd, 1968. See Plate 6 for his drawings showing irregular brightenings within the AL.

15 V. A. Firsoff, *Life Beyond the Earth*, Hutchinson & Co., 1963. See Plate 6a.

16 R. Cheveau, *Bull. Soc. Astron. France*, **47**, 13 (1933), reproduced in T. Arakawa, T. Osawa & T. Sato, *Planet Guidebook 1*, Japan Lunar & Planetary Observers Network [JALPON], Seibundo Shinkosha Publishing Co., Tokyo, Japan, 1981, page 102. The drawing is dated 1932 July 4.

Appendix I: Ashen Light (AL) records of Henry McEwen

In Appendix I we cite some (but not all) other AL reports by BAA members for the 1892 to 1948 epoch, whenever they or McEwen have given them. (Recall that the complete list of sightings by M. B. B. Heath has been published elsewhere by Baum.[5])

1892 E

First recorded observation 1892 April 1. June 8: McEwen recorded a portion of the unilluminated hemisphere apparently darker than the sky but dismissed it as an optical effect. Indeed, in this early work McEwen was still using the original simple eyepieces supplied with his Wray. Later he replaced them with good orthoscopics and monocentrics. There were no objective sightings of the AL this elongation.

1892 W

No observations close enough to IC.

1893 E

1894 January 28: Similar observation to 1892 June 8, again considered as an optical effect. Very few observations this elongation; no positive AL sightings.

1894 W

No observations made.

1895 E

July 4: McEwen's notebook oddly does not comment upon the AL but his letter to *English Mechanic* at the time concerning the observation gives a sketch (reproduced in McKim[6]) in which the AL occupies part of the S. hemisphere of the dark side. This is McEwen's only view of the AL this elongation, but according to Baum's historical catalogue[5] the phenomenon was clearly seen by several other astronomers.

1895 W

October 22: This would turn out to be McEwen's best AL sighting for many years (and one he would publish at the time). '...the dark side emitted a beautiful golden light. Very dark next middle of terminator and brightest all round the dark limb...' The inner, darker part was dull brown. McEwen placed the micrometer comb over the crescent but the AL was still visible. (See also his note in the *Journal*, **6**, 121–122 (1896).) October 27: AL similar to October 22 in terms of appearance and colour. October 28: 'Saw v. faint trace of dark limb at its broadest part, *i.e*., opposite the broadest part of crescent.'

1897 E

In a Section Report in the *Journal* (**7**, 382–383 (1897)) McEwen refers to his drawing of April 10 as showing a greyish shading visible

inside the crescent, but not the dark limb. The drawing is not included with the entry for April 10 in his notebook. The context is that of the AL, confirming a reported observation by T. H. Foulkes on April 2. McEwen made very few observations near IC.

1897 W

No observations close to IC.

(A break of a few years now appears, but there is no apparent gap in the notebook. There are several other gaps later, some very long, and we must conclude that McEwen recorded the missing data elsewhere. References to annual Council Reports often suggest that he did observe in many of the 'missing' years.)

1900 E

June 2: 'During the last two days I fancied that the dark part of Venus... was inclined to be visible as a darker portion than the sky...' But after careful observation on June 2 McEwen concluded the dark part actually was not visible. No record of AL this elongation.

1900 W

No obs. close to IC.

1901 E

1902 January 26: 'The dark portion of Venus was very faintly visible, the colour was greyish-yellow which was more prominent all round the limb.' The drawing (Figure 1A) shows illumination around the invisible limb. Of the bulk of the dark side McEwen wrote: 'It was slightly darker than the sky background caused probably by the different colour of this part.' (Also described by McEwen in the *Journal*, **12**, 386–387 (1902).) February 2: '...interior of crescent darker than sky...' No trace of the dark limb was seen this time, and one imagines that the effect was optical.

1903 E

Though no record exists in the notebooks (which have a gap between 1902 and 1908), McEwen (*Journal*, **13**, 372–373 (1903)) apparently made many observations and found no trace of the AL or darkside at least up to the end of 1903 August.

1905 E, 1905 W

McEwen apparently made many observations (*Journal*, **15**, 399 (1905)) but does not say whether or not he recorded the AL. (See comment, 1903 E.)

1908 E

Observations ceased while the planet was still gibbous.

1909 E

1910 January 29: '...suspected view of the dark part of disk, it appeared much smaller than the illuminated crescent, dull orange colour.' The air was unsteady. There were only two observations at this EE.

1911 E

Observations concluded at the gibbous phase, though we note for the sake of completeness that P. H. Hepburn suspected the dark part of the disk on September 2 and 7 (*Journal*, **22**, 100–101 (1911)).

1913 E

March 2: 'At times I thought that the dark part of the planet was visible especially towards the south limb. The occulting eyepiece was tried...on shutting out Venus no trace of the dark part was seen.' No observations closer to IC

1913 W

No observations close to IC

(There follows another long gap in the notebooks. In 1916 McEwen moved from Glasgow's Mount Florida area (where his view near IC was probably often restricted by rooftops) to the less built-up suburb of Cambuslang. From there he would enjoy better views. Council Reports mention observations being taken in this interval, but they are not relevant to this paper.)

1919 E

July 20: 'Often thought that the dark part was visible but the air was never steady enough to obtain a continuous sight of this part.' On a diagram he wrote: 'This part very faintly visible at short intervals.' July 21, 29, 30: Similar to the above. Observations continued up to August 14 with no more sightings

1919 W

No observations close to IC.

1921 E, 1921 W

McEwen describes some of his work in the *Journal* (**31**, 366 (1921)) but the relevant notebook has a gap from 1919 to 1924. For 1921E McEwen evidently failed to record the AL, but seems to have gathered sufficient observations. (He mentions its visibility to H. MacPherson on March 2 and 25.)

1924 E

May 11: 'Thought that the dark part of Venus was visible; putting on the occulter...and shutting out the bright crescent showed that this part was not visible.' June 16: A specific comment that with occulter on a darker sky: '...no trace of the dark portion of Venus was visible.' June 20: McEwen spent much time with the occulter, but: '...no decided view of it was obtained. Sometimes an indefinite shading of a different tint from the surrounding sky was discernible between the horns of the crescent. This shading always vanished when looked directly at... Only once, in averted vision, was the whole outline of the planet visible as a slightly darker disk than the sky.' June 20 was the last record before (and very close to) IC; we will take it as a single weak appearance of the AL.

1925 E

No observations at crescent phase

1927 E

No AL sightings, though many observations near IC were taken. On the day of IC (September 10), however, C. S. Saxton (*Journal*, **38**, 64–66 (1927)) found the whole dark body of Venus lighter than the sky.

1927 W

As 1927 E.

1929 E

Observations ceased at a thick crescent on February 21, so did not continue close enough to IC. (Council Reports show that McEwen observed between 1929 and 1932; but the published material does not relate to this paper.)

1932 E

Despite continuing to thin crescent phase on June 16, no AL. (Cheveau observed the complete AL on July 4, five days following IC.[16])

1933 E

Observations continued only to gibbous phase.

1935 E

July 31: Diagram with partial AL at opposite limb and a note: 'Often saw glimmer here but could never hold it steadily.' (He does not say whether an occulter was used or not.) August 1: 'The whole of the invisible part appeared during instants; very faint and dusty yellow right into the terminator. Lighter along invisible limb.' August 14: 'Thought that the invisible part appeared a few times, doubtful however and the invisible limb was never defined or seen.' August 20: 'In best seeing thought whole invisible disk was outlined as a very faint arc.' [This however was presumably cusp extensions on very thin crescent, not AL.] August 27: On diagram, AL partly shown. 'Very faint light here but no outline of invisible limb seen.'

1937 E

AL not seen.

1937 W

Observations commenced at gibbous phase only.

1938 E

Observations stopped at dichotomy.

1939 W

1938 December 5: 'Night side fleeting. Speckled yellow contrasting with whity-blue sky.' Diagram shows that the AL extended not quite to opposite limb. 'The actual edge [of the night side]...was more defined than the interior... And at times showed an intermittent

yellowish line or edge.' (This was cited by McEwen in the *Journal*, **49**, 377–378 (1939); R. E. Pressman saw the AL on December 9.) December 18: On sketches the interior next to the crescent was noted [apparently] 'darker than sky'.

1940 E
McEwen's Venus logbook no. 22 stops on 1940 March 15, with the planet still slightly gibbous. Logbooks nos. 23 and 24 are missing. Logbook no. 25 begins on June 7 (a slender crescent). The AL was seen from June 8 onwards, so perhaps no critical observations were missed. June 8: '...glimpses of night side'. June 9: '...glimpses of the night side – watery brown – which eluded continuous seeing.' June 13: 'Faint flashes of indirect Ashen Light seen continuing a little beyond the south horn. A vague undefined darkening visible on the night side.' June 14: '… just a vague darkening within the crescent.' June16: 'Only fleeting undefinable darkenings visible within the crescent.' June 20 'Undefined traces of the night side appeared in shades of purple-brown.' 'Night side darker than sky background.'

1940 W
AL not seen.

1943 E
July 24: 'From tip of north cusp a narrow grey misty continuation of light following the invisible limb into the night side was observed.' See Figure 1B.

(McEwen did not observe the 1943 W elongation but remarks (*Journal*, **54**, SP4 (1944)) that M. B. B. Heath observed the Ashen Light on 1943 September 11, 17 and 22. McEwen's next diary entry is for 1946, yet he did observe the 1945 E and 1945 W elongations (*Journal*, **55**, 174–175 (1945), **56**, 154–155 (1946), and **57**, 139–143 (1947)).

1946 E
Observations continued only as far as the gibbous phase.

1948 E
May 29: Though not an AL record, the following should be noted before we describe the observation of June 8: 'A thickening of the south cusp was manifest... Instead of pointing, the tip appeared rounded off...' June 8: Describing the night side beyond the S. cusp: 'Very faint grey light within limb extending to dotted line.' '...Jim [his son, John McEwen] saw it without his attention being drawn to it.' See Figure 1C. This was the last observation of the elongation, and maybe McEwen's most intriguing sighting. In the Council Report (*Journal*, **58**, 238–239 (1948)) it is stated that this apparition of the AL extended to 24° beyond the S. cusp.

1948 W
No observations close to IC.

(Further elongations to 1954: all later diaries are missing, and McEwen's final Council Reports fail to provide further useful details other than the fact that he continued to observe.)

Appendix II: Ashen Light (AL) records of Patrick Moore

As in Appendix I we have sometimes referred to other BAA data.

1948 E, 1948 W
No observations close to IC.

1949 E
No AL seen.

1950 W, 1951 E
No observations close to IC.

1951 W
No AL seen.

1953 E
The AL appeared prominently, lighter than the sky. See Figure 2. The complete unilluminated hemisphere was seen on all of the dates the AL was recorded: March 16 (Moore's first-ever view of it), 22, 24, 27 and 31. (See also Moore's paper in the *Journal*, **63**, 260–263 (1953).)

1953 W, 1954 E
No observations close to IC.

1955 W
1954 December 18: 'Ashen Light suspected – violet, lighting half the night side...'

1956 E
AL again prominent and visible over several weeks, brighter than sky. May 14: 'The Light covered all the disk and was considerably brighter than the sky.' May 15, 16: Some suspicions of the AL, but Moore felt it to be an effect of poor seeing. May 18, 19: AL lighter than the sky, full disk. May 20: 'The Ashen Light, distinctly brighter than the sky, was extremely prominent.' May 21: '...Ashen Light obvious, complete and much lighter than the sky.' May 22: The AL was clearly visible in red and orange filters and less obviously in yellow light. It was not seen with green or blue filters. June 1: AL 'strongly suspected.' June 4: AL 'distinctly seen over the whole disk.' June 5: AL again brighter than sky.

1956 W
No AL.

1957 E
AL recorded 1957 December 29, 1958 January 3, 5, 6, 7. 1958 January 3: With an occulting bar, Moore '...had the best view of the Ashen Light in my experience. It covered the whole circle, with a sharply defined edge, and appeared to be of a slightly brownish cast.' January 5: Similar comments, ditto. January 6: AL suspected only. January 7: 'The full circle of the Ashen Light could be seen, but no colour tonight – grey, not brownish.'

1958 W
No observations close to IC.

1959 E, 1959 W
No AL seen despite intensive observations.

1961 E
1961 March 26: The AL was suspected: '...a slightly different hue from the sky; mottled – the full circle.'

1961 W
No observations close to IC.

1962 E
Highly uncertain AL view October 22, regarded as an illusion.

1963 W
No observations close to IC.

1964 E
AL not seen.

1964 W
No observations close to IC.

1965 E
AL not seen.

1966 W
Few observations close to IC.

1967 E
AL not seen.

1967 W
October 22: 'From the N. cusp there was an extension, and distinct signs of the Ashen Light in the area.'

1969 E
March 6: A distinct AL, though it did not extend to the opposite limb. March 8, 28: Partial AL suspected.

1969 W, 1970 E
No observations close to IC.

1971 W
No AL.

1972 E
May 12: AL very vaguely suspected. May 27: AL 'strongly suspected, covering the area up to 10° on the far side of the cusps.'

1972 W
No observations close to IC.

1973 E, 1975 E
AL not seen. (No observations during 1974 W elongation.) McKim also failed to see the AL during 1975 E, despite excellent opportunities.

1975 W
AL not seen, but few observations close to IC.

1977 E
March 12: AL 'seen with fair certainty – much brighter than the background.' March 17: AL suspected.

1977 W, 1978 E, 1979 W
No observations close to IC.

1980 E
May 26: Partial view of AL: '...seen when the crescent was hidden by an occulting bar (curved): smaller than the full radius, grey, out to ~53% with a sharp edge.' May 27: Moore had his best-ever view of the AL, when it was conspicuously brighter than the sky, full circle, and striking either with or without an occulting bar. Visible in white, red, yellow and green light. It also had a sharp edge slightly brighter than the interior. Other BAA members provided further AL sightings on other dates at this elongation.

1980 W
No AL.

1981 E, 1982 W, 1983 E
No observations close to IC. (During 1982 W, using a 320mm OG, McKim (independently confirmed by a co-observer) suspected the AL on 1982 February 8, 06.50 UT, but in unsteady seeing (white light and W15 yellow). The AL seemed grey, covered just over half the unilluminated hemisphere and seemed to blend into the sky (*Journal*, **96**, 212–216 (1986).))

1983 W
No AL seen, but few observations near IC.

1985 E
AL suspected March 1, 17 and strongly suspected March 6.

1985 W, 1986 E, 1987 W
No observations close to IC.

1988 E
May 1, 10: Strong impression of the AL (and confirmed with occulting bar, May 10). May 4, 5: Suspicion of the AL.

1988 W
No observations close to IC.

1989 E
December 22 and 1989 January 2: AL suspected, but conditions poor and both observations dismissed as illusory.

1990 W, 1991 E
No observations close to IC.

1991 W
AL not seen, though few observations near IC.

1993 E
February 27, 28: AL suspected but conditions poor.

1993 W
No observations close to IC.

1994 E
AL not seen, but few observations near IC.

1995 W, 1996 E
AL not visible.

1996 W, 1997 E, 1999 E, 1999 W
No observations close to IC. 1998 W not observed. Last recorded observation 1999 December 19.

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