# The opposition of Mars, 2005: Part II

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*A report of the Mars Section. Director: R. J. McKim*

In concluding this account of the 2005 opposition we discuss the seasonal activity of the white crystal clouds and polar regions. The Equatorial Cloud Band (ECB) formed near Ls= 45° in 2006, a typical result for telescopic visibility. White cloud activity was seasonally normal, though interrupted by the atmospheric warming caused by the S. hemisphere Regional dust storm which began in 2005 Oct. The *Arsia Mons* orographic cloud was well seen, and there was a short period of visibility of the 'W' cloud. No observations of surface 'flares' were reported, although the sub-Earth and subsolar latitudes coincided in early 2005 Nov. The start of the 2006 NPC recession was followed, while the complete 2005 SPC recession was measured. Compared with 2003, the 2005 SPC recession (as well as the seasonal separation of *Novus Mons*) was very slightly retarded prior to Ls≈ 250°.

## White clouds

This Report continues from Part I (published in the 2011 June *Journal*). [Numbering of figures, references and tables runs on consecutively from Part I.]

Near opposition the N. polar hood was an impressive bright, bluish-white feature, while the seasonal development of the white crystal clouds was typical, interrupted only by the Regional dust storm in 2005 Oct.

### *Equatorial Cloud Band (ECB)*

Gray's early sketch of 2004 Nov 22 (Ls= 118°; Figure 19, left) shows *Chryse* light at the CM, and (given the seasonal date) we can infer that the ECB was fully developed. Unfortunately there are no other visual data to hand, and none of the images during 2004 Nov–2005 Feb possess adequate resolution to confirm it. Certainly by 2005 Mar 20 (Akutsu, Ls= 179°) it was no longer present. (Typically the ECB season ends by Ls= 145°.)

On 2006 Apr 26 to Pellier (Ls= 45°) there was the first indication of complete ECB in the following martian year, when a belt of light cloud crossed the disk under CML= 276° (Figure 13). This result is typical, as Smith's THEMIS analysis[33] shows. Incomplete ECB was registered earlier as a westward extension of the *Xanthe* evening cloud on Apr 10 by Kidd, while on May 3 and 5 Akutsu and Minami confirmed the complete ECB: evening cloud over *Chryse* extended across the disk to join the *Tharsis* morning cloud. Around CML= 226° on May 3, McKim's drawing is suggestive of incomplete ECB. To McKim on 2006 Jun 3 (Part I, Figure 2L), the *Syrtis Major* appeared slightly faded, possibly by the effect of the ECB (Part I, Figure 2L), and likewise to Adamoli on Jul 11.

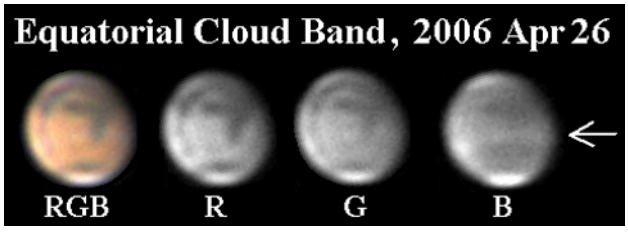


**Figure 13.** The new seasonal ECB at Ls= 45° on 2006 Apr 26d 19h 30m, CML= 276°, 210mm DK Cass., Lumenera LU 075M camera, *Pellier*. The ECB can be seen in blue-violet light (far right image) with D= 5".

Since the HST observations of 1995 and later work, it is known that the ECB pervades the N. late spring and summer seasons. Thus many of the bright a.m. and p.m. clouds are simply parts of a semi-continuous belt, enhanced by oblique lighting at limb or terminator: we no longer give routine details of equatorial white clouds.

### *Orographic clouds: Introduction*

Here we report on specific white clouds over *Alba Patera*, *Olympus Mons* (*'Nix Olympica'*), the *Tharsis Montes* (*Ascraeus Mons*, *Pavonis Mons* and *Arsia Mons*) and *Elysium Mons* (Figures 14–16; and Part I, Figures 4F, 5). The little white clouds over *Candor*, W. of *Noctis Lacus* (*Syria Planum*, *'Nox Lux'*) and *Arsia Mons* in the south and *Lunae Lacus* and *Ascraeus Mons* in the north can join to form the streaks of the martian 'W' cloud. (The western stroke of the 'W' crosses *Pavonis Mons*). It is essential to access the evening terminator, hence observations before opposition are best able to monitor such features.

### *Arsia Mons, Tharsis Montes, and Alba Patera*

See Figure 14. Early observations did not have sufficient resolution to show the *Tharsis Montes* orographic clouds, but unresolved *Tharsis* evening cloud featured on Ikemura's 2005 Feb 12 images, Minami's Mar 19–20 drawings, Morita's Apr 29 image, *etc*. Pellier's May 8 image was the first to show cloud specifically at *Arsia Mons*, and it was more distinctly caught by Bates on May 18, but was weakened on Wesley's Jun 1 image (Ls= 222°). Its seasonal activity then ceased, though its demise may have been hastened by the brief Regional dust storm of 2005 Jun (see Part I). McKim had a good view of the area on Jun 18 and no trace of cloud existed; indeed, no orographic cloud appeared there again until late July, although *Arsia Mons* itself continued to be visible as a dusky spot.

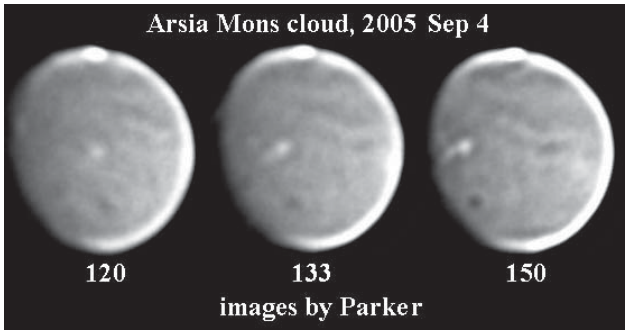


**Figure 14.** The *Arsia Mons* orographic cloud brightens, while the dusky spot marking the cloud-free *Olympus Mons* darkens, during the martian afternoon on 2005 Sep 4d. 450nm (BWHM= 116nm) B filter with 410mm refl. and ST9XE CCD camera, *Parker*. CM longitudes are shown.

From the work of Benson[41] we expect double peaks of activity for *Arsia Mons* around Ls= 250° and 330°: however, visibility is highly sensitive to dust-loading. The *Arsia Mons* orographic cloud returned weakly to telescopic visibility on Jul 22 (Peach) at Ls= 254°. By August it was stronger, and until late October appeared strikingly bright in the afternoon. On Aug 26 Pellier's blue image showed it in the form of a butterfly, due to its association with two adjacent clouds, and it took this form up until the October Regional dust storm. McKim on Sep 22 (Part I, Figure 2D) shows cloud at *Arsia* merged with a larger N–S area at the evening terminator. In Figure 14 we show Parker's Sep 4 series to illustrate the diurnal evolution of *Arsia Mons* and its 'butterfly cloud'. *Arsia Mons* showed up as a more and more dusky spot approaching the evening terminator, its orographic cloud lying to the west of the dusky caldera. The *Arsia Mons* cloud was still brilliant on Oct 21 (Lau and others), was fading on Oct 23–25 (Massey and Morita), and absent by Oct 27–29 (Massey and Pellier).

The opposition brightening of all three *Tharsis Montes* was evident during Nov 2–9. (See Part I, 'Region II'.)

The *Arsia Mons* cloud recovered partially on Nov 17 (though the 'butterfly' shape did not recur). It brightened in December and remained visible on some images until 2006 Mar 2 (Parker), and visually to Minami until Mar 5: recession of the evening terminator beyond the limb made further ground-based cloud sightings impossible.

The *Tharsis Montes* (*Arsia Mons*, *Pavonis Mons* and *Ascraeus Mons*) generally were easily visible as dark spots when near the morning terminator during 2006 Jan 20–24 (Peach, Pellier, Tyler), recalling earlier BAA observations of 1995–'99,[29–31] when they were also seen protruding through the low morning cloud layers. Peach's image of 2006 Feb 24 still shows them around local noon, appearing as dark spots, and not yet affected by orographic clouds.

Tyler caught *Alba Patera* as a small dark spot on the morning side, Jan 24, whilst that volcano (frosted?) had appeared as a small bright dot in the morning on Peach's fine Dec 17 R and B images. Pellier caught the light, ground-lit *Alba Patera* on Apr 5.

Evening cloud over *Tharsis* generally was reported by Minami as late as 2006 May 31.

### Olympus Mons

See Figure 15. The seasonal cycle of *Olympus Mons* is known to finish earlier than *Arsia's*. On Jun 25 it was beautifully seen (for the first time in the apparition) as a large dusky reddish patch upon an image by Bates. On Jul 22 Peach imaged it as a dusky spot. During August–October *Olympus Mons* darkened towards the sunset terminator: for comments upon the latter phenomenon, see Part I, under 'Region II'. On Aug 29 a fine image by Peach clearly located the entire network of the *Tharsis Montes* and *Olympus Mons* as dusky patches on the evening side. This network remained clear – though gradually fading – upon the best images until late September.

We have already seen (Part I) how the summit of *Olympus Mons* gave rise to an opposition brightening about a week

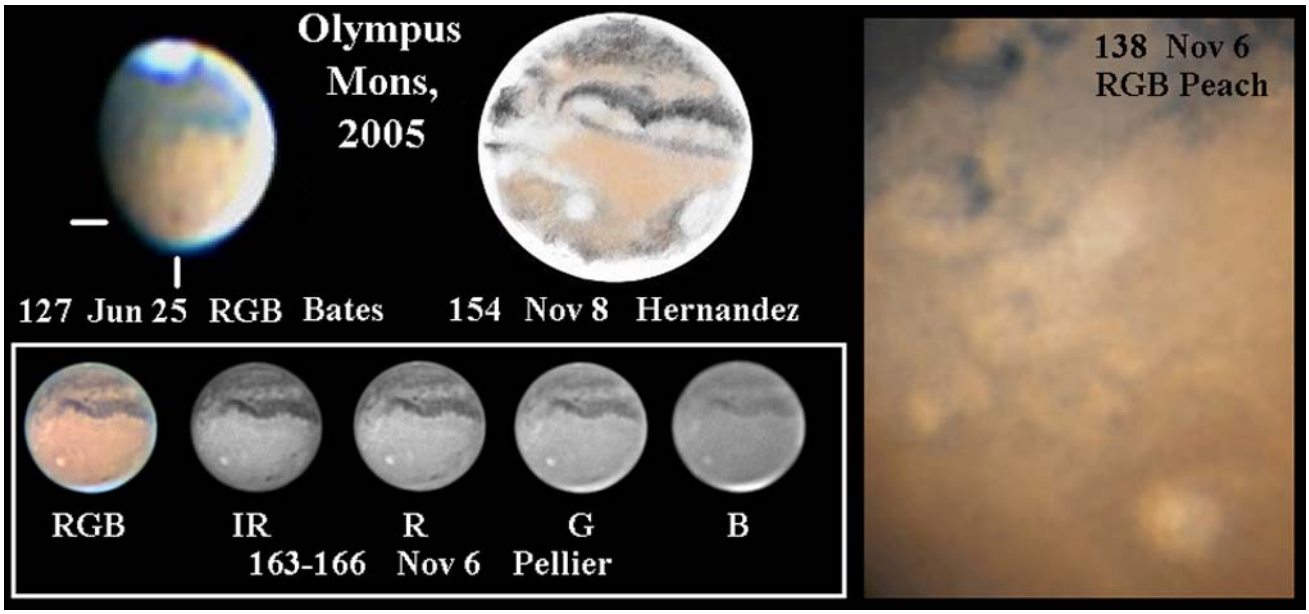


**Figure 15.** *Olympus Mons* in 2005 appears as a dusky spot on Jun 25, and exhibits opposition brightening in Nov. Drawing by Hernandez at ×388, INT+W30. Pellier's images with 210mm DK Cass. and Lumenera LU 075M; IR image at λ= 700+nm. An enlarged section of Peach's very high resolution image of Nov 6 (355mm SCT, Lumenera LU 075M) shows that the SE slope of *Olympus Mons* was the brightest part. Pellier's images also show the so-called 'Blue Clearing' at opposition. CM longitudes are shown.

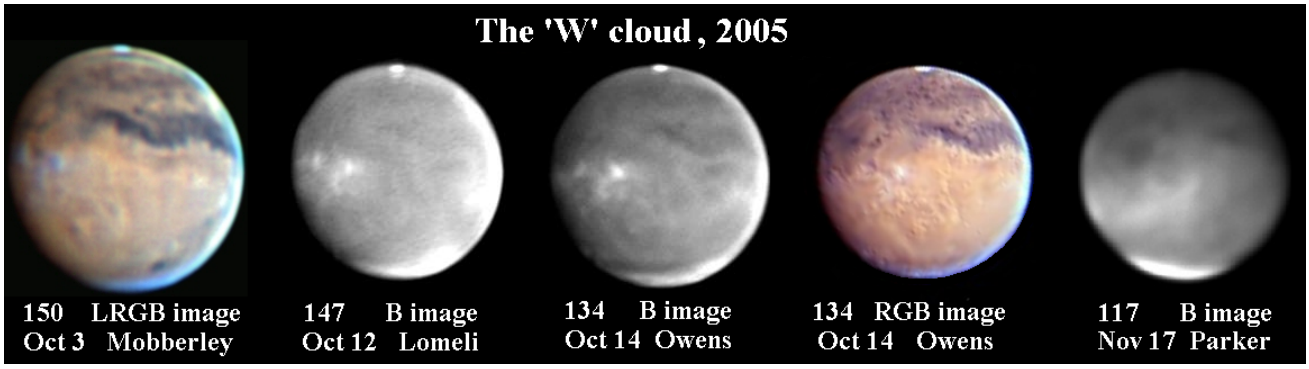


**Figure 16.** The 'W' cloud in 2005. CM longitudes are shown.

either side of the date of opposition (specifically, Oct 29–Nov 16). Series of images showed that it brightened at all wavelengths around opposition, during about Nov 2–9. (See also Part I, Figure 5. It is also shown in visual work, *e.g.*, Hernandez, Nov 8 (Figure 15) and McKim, Nov 6 (Part I, Figure 2G).) It was somewhat brighter in red and infrared: witness Pellier's images in Figure 15. Peach's superb image of Nov 6 (Figure 15) shows a still brighter patch at the summit within the opposition-brightened caldera. Part I also cited the 'opposition effect' at *Elysium Mons*.

*Olympus Mons* was again seen as a dusky reddish patch from Dec 10 (Peach, Pellier), remaining visible thereafter as a dark feature. Peach's image of 2006 Feb 24 still shows it around local noon, as a dark spot, not yet affected by orographic cloud. McKim saw a very faint whiteness at *Olympus Mons* near the CM on 2006 Jan 21, and Parker similarly near local noon on Mar 2. Peach (remarkably) was still able to image morning orographic cloud west of the caldera on Apr 7–11 (Ls= 36–38°; D= 5".5).

### The 'W' cloud

See Figure 16. On Oct 3 and 4 Mobberley, Pellier and Poupeau imaged discrete white clouds at *Nox Lux* and *Candor* east of the *Arsia Mons* orographic, as well as less bright clouds over *Pavonis Mons* and *Ascraeus Mons*: hence the visibility of the 'W' cloud had begun. The 'W' cloud was evident to several observers at least until Oct 18, for example to Lomelli and Owens, Oct 12–14. However, it never had time to become more prominent, for white cloud activity on the planet was interrupted for months by the large Regional dust storm (see Part I). Nevertheless, on Nov 17 Parker imaged the 'W' cloud faintly once more, (Figure 16) and it was partially and weakly imaged by Peach and Pellier in mid-December.

### The Syrtis Blue Cloud and the Isidis Regio/Libya diurnal cloud

The '*Syrtis* Blue Cloud' featured at the morning limb on Parker's Jul 22–24 images. *Syrtis Major* appeared bluish near the morning terminator (2005 Oct–Dec), again due to the presence of diurnal cloud. Morning cloud over *Isidis Regio/Libya* and a blue tint to the rising *Syrtis* featured in observations (for example) by Peach, Oct 27 and Sanchez, Nov 1. Minami found the *Syrtis* slightly greenish when observed from Lick on Oct 6–7 (suggesting an admixture of diffused dust).

The *Isidis Regio/Libya* cloud was well seen on the evening side until Oct 22, a few days after the start of the Regional dust storm, but it disappeared as the atmosphere warmed. Minami saw it weakly again on Nov 5, but it did not strongly reappear until 2006 Jan 26–27 (Akutsu). It was also visible later than this, being reported by Pellier on 2006 Apr 22–26, and by Minami, May 14. On 2005 Nov 19, CML= 352°, McKim found the *Syrtis* a beautiful bright blue colour at the evening limb, overlain by diurnal cloud which extended into *Aeria*. Views at nearly identical CML on Nov 16 showed the same evening cloud but the *Syrtis* then simply looked blue-black. Poupeau's images of 2006 Jan 31 show the *Syrtis* Blue cloud strongly at the evening limb.

## Blue-violet light phenomena

### The 'Blue Clearing'

The albedo contrast between dark areas and deserts tends towards zero at the violet end of the spectrum. Pellier[11] has convincingly shown that only near opposition do the relative intensities of the various features in blue-violet light match those in white light, so that the classical 'Blue Clearing' is recorded only then. (See Pellier's Nov 6 series in Figure 15.) Away from opposition the different surface properties of the albedo markings make some areas (those dark markings which are more reddish) relatively darker in blue-violet light, particularly *Claritas*, *'Valhalla'* and *Lunae Lacus*, whilst others such as *Solis Lacus* effectively vanish on account of their assuming the same albedo as their surroundings. It remains a fact, however, in the writer's long experience (and in considering all BAA data since 1979–'80) that the oppositions which favourably portray the planet's N. hemisphere exhibit a stronger classical BC than the rest. Such oppositions have the ECB present, and given that this band of white cloud avoids the main dark markings to the N. and S. with the exception of *Syrtis Major*, its presence will enhance the albedo difference between deserts and dark markings in blue-violet. Thus although the planet's surface properties will explain the basis of the BC effect,[11] the writer would contend that the ECB contrives to moderate its intensity. And of course atmospheric dust-loading will also be important.

It will serve our purpose to select the blue-violet filter data of Mobberley, Parker, Peach, Pellier and Tyler, which cover 2005 Apr 19–2006 Apr 26. BC order 1 was seen through-

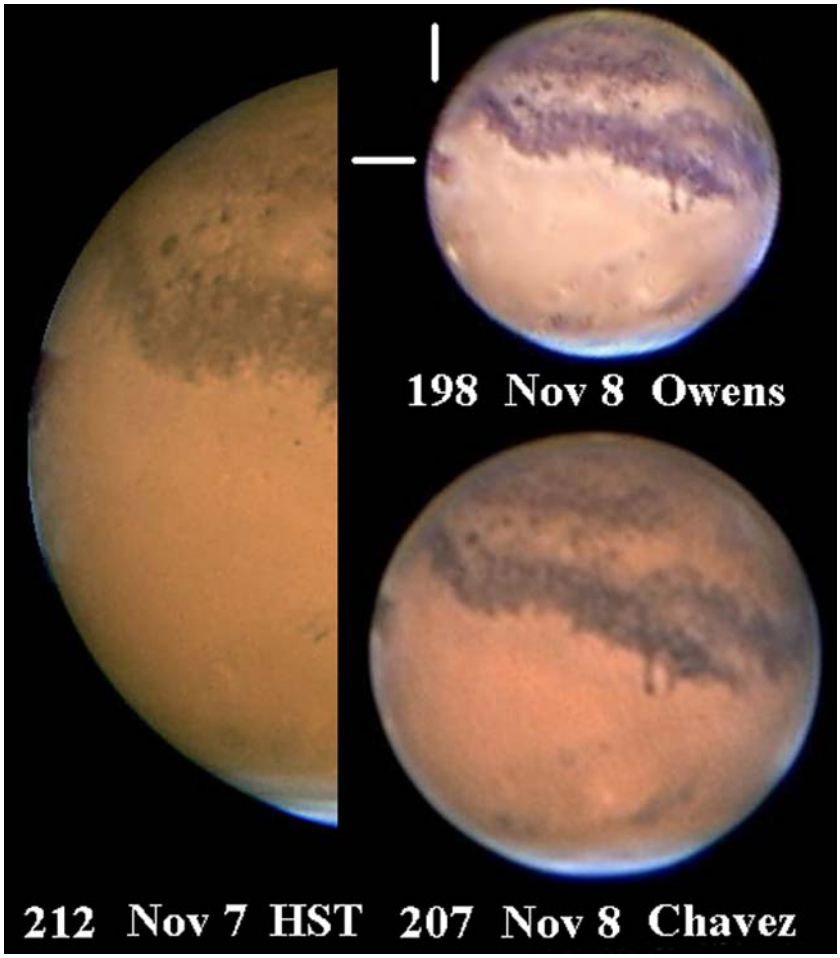


**Figure 17.** Showing an anomalous dark patch near *Arsia Mons*. Invisible in 2005 late Oct, it began to be visible on Nov 6, reaching maximum intensity on Nov 7–8. CM longitudes are shown.

out the whole period (with the occasional BC 0); order 2 was limited to most dates between early 2005 Aug and early 2006 Jan (with the occasional 1); order 3 was detected only during late 2005 Oct to mid-Nov (BC 2 sometimes intervening), with really intense albedo features detectable only 4–5 days either side of Nov 7. Wratten 47 filter data from Beish, Heath and McKim provide visual support for these conclusions, with McKim's rating of order 2 or 2+ being limited to Oct 29–Nov 24. However the foregoing images were sometimes made with slightly broader passband filters, and the classic BC effect is highly wavelength-dependent.

We shall not be analysing estimates of 'BC' in future reports, but other interesting blue-violet light phenomena will continue to receive attention.

### 'Violet holes'

For some decades the phenomenon coined the 'violet hole' has been recognised, where, due to exceptional transparency in violet light, there is a visible darkening of the ground. In 2003[8] this phenomenon was especially prevalent over the morning *Amazonis* at a certain season. In 2005 the same effect in that longitude was first caught by Flanagan on 2005 Nov 21 and 22, at similar CML to but seasonally later than 2003,[8] for the morning terminator can only be well seen after opposition. Flanagan, Mobberley and Parker showed a very dark spot within *Bosporos Gemmatus* at the a.m. terminator in blue on Nov 19–30, with morning clouds both N. and S.

A small violet hole, appearing reddish-brown in RGB images, was also caught preceding the E. end of the *Deucalionis Regio* dust cloud during late Oct–early Nov: see Part I.[40] Shortly afterwards, numerous observers found *Mare Serpentis* /E. *Sinus Sabaeus* conspicuously free from morning cloud and dark in blue light, Nov 20–Dec 7.

### Albedo anomaly at Arsia Mons

Some unusual observations were also made at the evening limb in early Nov, where a dusky patch some 10° in length existed at or very close to the setting *Arsia Mons*. The first sightings were by Walker on Nov 6 and Melka on Nov 7; the observations were confirmed on Nov 7 by the HST, then (for instance) by Chavez and Owens on Nov 8: see Figure 17. Minami[42] wrote of an earlier personal sighting on Oct 7 but otherwise there was no record before Nov 6. In each case the dark feature was seen in white light, but appeared more obvious in blue. At the time, orographic cloud was absent at *Arsia Mons*, so we suppose the atmosphere above it to have been particularly clear so that the evening terminator there (opposition: Nov 7) actually exhibited limb darkening. Within a day of opposition the evening terminator had given way to the evening limb, and already the effect was absent on Parker's image of Nov 9, CML= 196°, barely visible on Grafton's of Nov 10, CML= 206°, and not seen later. (See Part I, Figure 5E (for Nov 23, CML= 203°) for a 'normal' view of the area.)

The phenomenon was enhanced by the presence of adjacent evening cloud on the N. and S. sides, as shown clearly by the HST Nov 7 image (Figure 17).[18] Whatever the precise explanation, it is a rare phenomenon. The clearest sightings were limited to CML≈ 198–207°. On Walker's Nov 6 image the dusky spot is still inside the terminator at CML= 189°, while its *f.* part is barely discernable on images by Melka at 214° on Nov 7 and Chavez at 213° on Nov 8. Above the 10km contour line, the *Arsia Mons* caldera spans longitudes 117–124°, so any feature associated with it is necessarily lost beyond the terminator after CML= 214°, in perfect accord with the foregoing. Minami has given an extended account of current and previous sightings, suggesting the Föhn (Foehn) phenomenon as a possible explanation.[42]

## Martian flares

The best possibility of observing specular reflection occurred (according to the ephemeris) on 2005 Nov 8, when

De= Ds= –16°. OAA observers wanted to check for a repetition of the 1958 flare,[43] but clouds on Earth intervened; a watch on Nov 5 proved negative.

# Polar regions

## North polar region

### *NPC, 2004*

The planet was too distant for details of the NPC recession but Gray observed a tiny NPC on 2004 Nov 22 (Ls= 118°, D= 3.8", Figure 19). Images by Akutsu and Olivetti (2004 Nov 9–2005 Jan 1) did not resolve the NPC, but there is lightness on Olivetti's image of 2005 Jan 7. The mineralogical content of the NPC was observed by the OMEGA instrument aboard *Mars Express* during 2004 Sep–Nov.[44]

### *NPC to NPH transition*

The new NPH was still indefinite to Minami, 2005 Mar 19–31, and very vague on Morita's Mar 20 images, but whitish and clearly present to Minami from Apr 13, and to Peach (albeit weak at the CML presented) from Apr 19. Parker showed it bright, May 25. McKim found it weak on Jun 18, but brighter and more obvious from Jun 22. It was only consistently bright from August. As ever, the NPH was very well seen during N. winter, 2005 Aug–2006 Jan. Variability of the S. edge in latitude was strongest in Oct–Nov, according to measurements by Pellier.[11] The variation of the NPH over *Mare Acidalium* was noted in Part I. We specially illustrate the 'Dawes' slit' effect[45] in Figure 18.

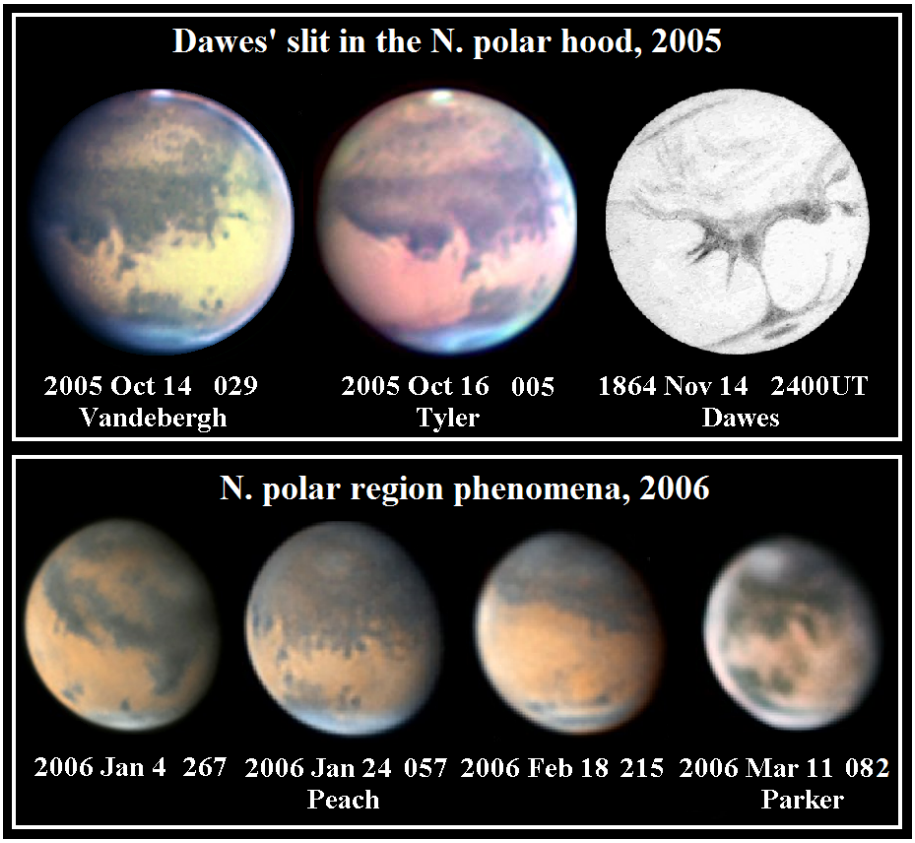


**Figure 18.** *Top row*: Illustrating the 'Dawes' slit' phenomenon (partial NPH transparency over *Mare Acidalium–Niliacus Lacus*). Images by R. Vandebergh with 254mm refl., ATK-1HS, IRGB; by D. B. V. Tyler with 279mm SCT, ATK-1HS, RGB; historical drawing by W. R. Dawes with 203mm OG, ×258. (Dawes noted: 'Patience required to obtain tolerably sharp views of the features.'[42])
*Bottom row*: The NPC and NPH in 2006. Images by D. A. Peach with 355mm SCT, Lumenera LU 075M, RGB: Jan 4 shows NPC; Jan 24 NPH; Feb 18 NPC + hood; later images show cap only; by Parker with 410mm refl., Lumenera LU 075M, RGB. CML data are shown.

Brilliant patches within the NPH were recorded from 2005 mid-Sep, and these were often associated with dust disturbances in the vicinity of *Chryse*. (See for example observations by the Director on Oct 20 (Part I, Figure 2F) and by Flanagan in NE *Mare Acidalium* on Oct 23 (Part I, Figure 8).) However, they existed at other longitudes too, and the Director for example frequently saw bright areas during Nov 6–Dec 14, and other data show a continuation into 2006 Jan. The patches were seen at all visible wavelengths, being strongest in blue.

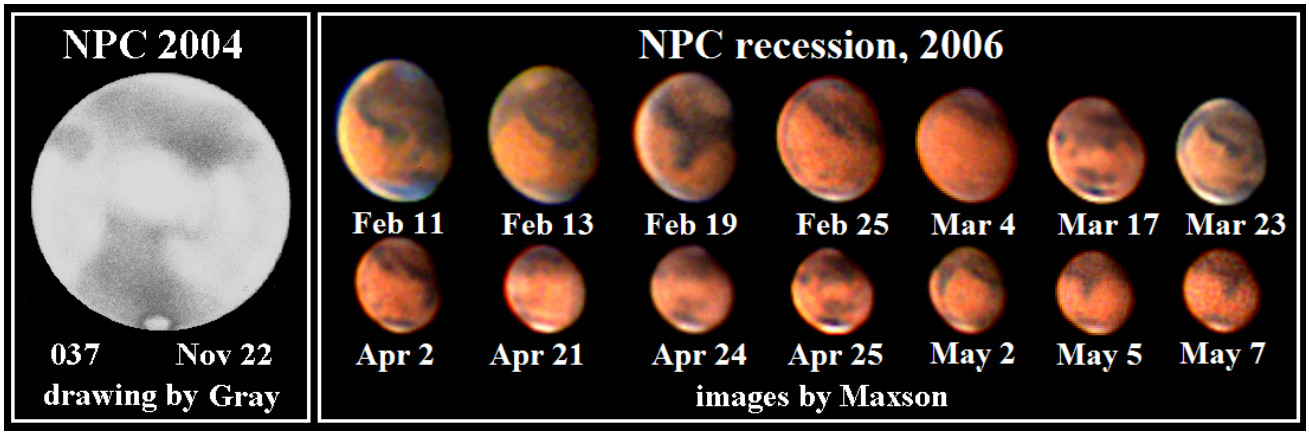


**Figure 19.** *Left*: Drawing showing the tiny summer NPC on 2004 Nov 22d, *Gray*. (D= 3.8").
*Right*: The NPC recession, 2006 Feb–May with 250mm SCT and Lumenera LU 075C, RGB images, *Maxson*. (D= 4".8 on May 7).

### NPH to NPC transition

The hood remained thick and extensive into 2006 Jan, but the new ground cap was noticeable in red light and in some RGB composites, the first case being Peach's Jan 4 image at Ls= 351°, where *Utopia* at the CM served as a marker point. But on the *Mare Sirenum* side on the same date, Go's image showed only polar hood. During this apparition the value of $D_e$ was unfavourable for watching the transition, although at first sight one thought the bright, sharp-edged NPR visible in 2006 Jan was the ground cap. In fact during much of that month the hood fringed the N. limb, but the NPC was more consistently observed from Jan 24 onwards. There were fewer records of the hood in February: just Akutsu, Feb 5 and Kumamori Feb 21 (over *Mare Acidalium*), whilst Peach imaged the cap clearly showing through the hood, Feb 17–20. See Figure 18 for selected images. On Feb 24 (CML= 128°) McKim found a bright NPC with a dusky S. border, then a strip of NPH south of that.

A significant hood, apparently a resurgence, was caught by Peach developing on Mar 3 and peaking on Mar 4 (in blue light) NW of *Mare Acidalium*: on Mar 5 the area looked normal (in white light) to the Director. After this, only the cap occupied the N. limb. We interpreted a somewhat similar event witnessed by Peach on 2006 Apr 17–21 as a local dust storm (see Part I), as the phenomenon was especially bright in red light, which the March event had not been.

### NPC recession, 2006

Due to unfavourable $D_e$, the NPC was not well observable till 2006 Mar. It was often observed visually by Adachi, Adamoli (until 2006 Jul 19), Hancock, McKim and Macsymowicz. Maxson's best Feb–May images are collected in Figure 19.

It was impossible to make good latitude measurements even from the best images due to the tiny disk diameter. However, the next two apparitions would yield useful NPC recession data for comparison with our results from 1980,[46] 1982,[47] 1995,[29] 1997[30] and 1999.[31]

## South polar region

Figure 20 illustrates the S. polar region and the cap fragmentation and decay.

### SPH to SPC transition

Pujic's 2005 Feb 15 and 22 images show a large S. polar hood; on Mar 4 the hood was a little better defined but there was no well-defined ground cap. On Mar 5 (Ls= 170°) and 6 Minami saw a S. polar cap, with *Depressiones Hellesponticae* on the latter date. Morita's Mar 5 red image suggests a cap, and on Mar 15 the cap was certainly imaged by Pujic, though a larger hood was still recorded in blue light by Morita on Mar 20. (*MGS* images showed the deposition sequence for the SPC, 2005 Feb–Apr.) The SPH dispersed seasonally later than in 2003.[8]

A mist was shown around the SPC in several observations, and the following appear to be records of white cloud, although dust activity was observed N. of the spring SPC (see Part I): Peach on Jul 22 (blue light) imaged white cloud there, as did Hill on several drawings, Aug 17–21.

### SPC fragmentation

The late winter/early spring cap was well caught in 2005 Feb–Mar by the Australian observers. By mid-April, Massey and Peach found the S. part of the cap darker. *Depressio Parva* was first seen as a dark spot by Bates on May 18, Pujic from May 23, *etc*., and others up to at least Jun 18. *Depressio Magna* was first evident upon Lazzarotti's May 28 image, whilst McKim saw it well on Jun 18. *Rima Australis* was recorded from May 16 until at least Jul 18.

*Novus Mons* (the brighter patch within the *Novissima*

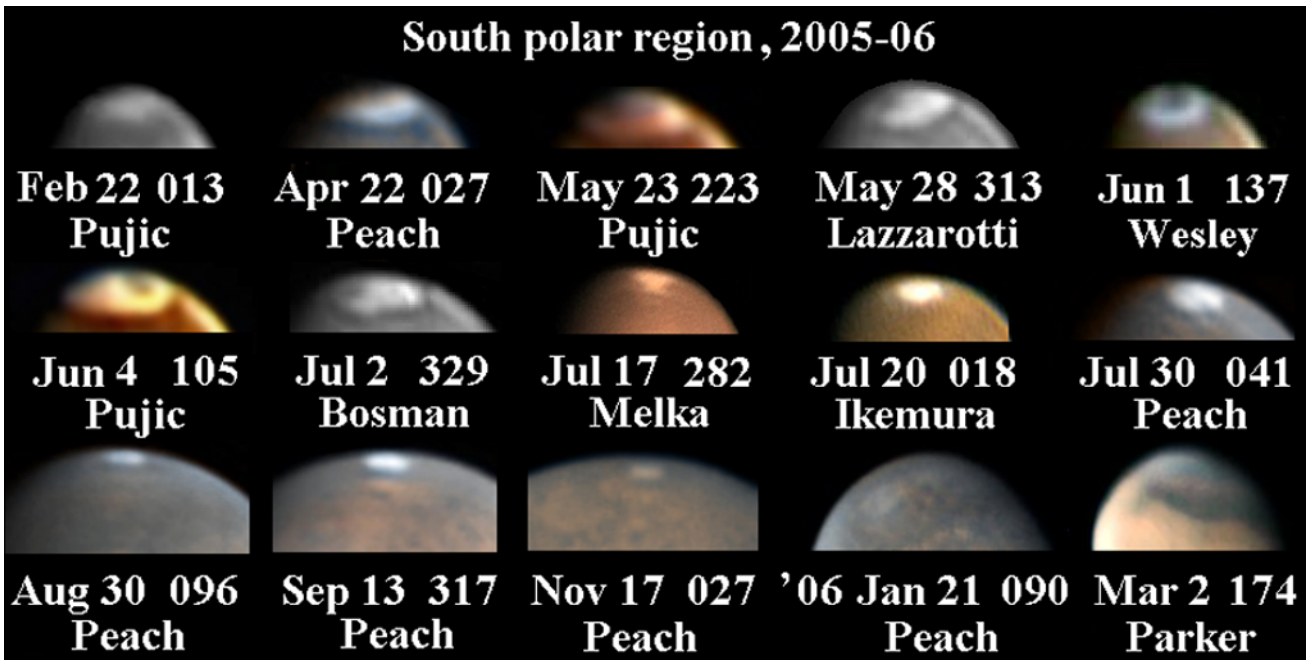


**Figure 20.** The S. polar region, 2005–'06. Note the shrinkage and fragmentation of the cap. CML data are shown.

**Table 2. SPC latitude measurements, 2005**

| *Mean Ls on images (°)* | *Latitude of N. edge of cap (°)* | *No. of measures* |
|---|---|---|
| 178 (*e.g.*, 176–180°) | 53.4 | 2 |
| 183 | 53.6 | 1 |
| 188 | 55.4 | 2 |
| 193 | 56.7 | 11 |
| 198 | 58.3 | 11 |
| 203 | 58.3 | 16 |
| 208 | 58.8 | 12 |
| 213 | 61.4 | 9 |
| 218 | 63.4 | 22 |
| 223 | 65.6 | 11 |
| 228 | 67.1 | 21 |
| 233 | 67.0 | 26 |
| 238 | 68.7 | 40 |
| 243 | 70.1 | 22 |
| 248 | 74.8 | 43 |
| 253 | 80.8 | 28 |
| 258 | 81.4 | 28 |
| 263 | 81.5 | 56 |
| 268 | 81.6 | 71 |
| 273 | 82.4 | 64 |
| 278 | 84.0 | 72 |
| 283 | 84.3 | 85 |
| 288 | 84.9 | 95 |
| 293 | 84.8 | 90 |
| 298 | 85.7 | 52 |
| 303 | 86.2 | 71 |
| 308 | 86.0 | 117 |
| 313 | 87.0 | 123 |
| 318 | 87.3 | 45 |
| 323 | 87.2 | 47 |
| 328 | 87.2 | 34 |
| 333 | 87.6 | 19 |
| 338 | 87.6 | 12 |
| 343 | 87.4 | 8 |
| 348 | 88.3 | 2 |
| | *Total* | 1,368 |

*Thyle* peninsula) became apparent about May 23. It was projecting from the edge of the cap and/or partly separated from it to Bosman (Jun 27, Jul 2), Pellier (Jul 3), Kowollik (Jul 4, 9) and Phillips (Jul 9). It is probable that Bosman caught its complete detachment on Jul 2 (Ls= 241°), and there is no doubt that Owens (Jul 8; Ls= 245°), Melka (Jul 10) and several others succeeded very soon afterwards. The large disk in 2003[8] had enabled detection of precise separation at Ls= 238°. *Novus Mons* was a white streak until Aug 19, and a mere bright point on Aug 20 (Grafton, Owens). Figure 21 shows the separation of *Novus Mons* as well as other polar phenomena. (*MGS* images tend to show the continuation of a narrow filament of ice from cap to outlier beyond Ls≈ 260°, but for the purpose of historical comparisons we deal only with ground-based work.)

That a white remnant at *Novus Mons* existed until Aug 20 (Ls= 272°) agrees well with 2003[8] (Ls= 270°), but given the excellence of the data for the two years, the evidence suggests that not only did it separate a few degrees later in Ls, but also that it persisted a few degrees longer.

Early in 2005 August airborne dust was drawn out into an arc following the newly detached *Novus Mons*, as discussed in Part I. This depressed area was still lightish after Aug 20 until at least Oct 17, due to dust fallout (see Part I). Minami wrote that it appeared lightish yet with no atmospheric dust on the Sep 13 *MGS* images. This apparent continuation of the already sublimed *Novus Mons* was first witnessed in 2003,[8] so that settled dust surely accounts for those earlier observations too. We illustrate in Figure 20 for Sep 13 a 'remnant' at the location of *Novus Mons*.

Of the other features, Parker reported *Rima Angusta* on Jun 17, and on Jul 1 McKim caught *Argenteus Mons* projecting slightly at the N. edge of the cap. Bosman's images of Jun 27 and Jul 2 show *Argenteus Mons* brightly, and numerous data show *Rima Angusta* prominently bordering it on Jul 30–Aug 8. *Argenteus Mons* gradually shrank during August. Parker imaged *Thyles Mons* at the cap edge on Jul 2. It was also recorded by Teichert (Jul 15), and in poor seeing by Tyler (Jul 18) and Peach (Jul 21): by Jul 29 (Parker) it was no longer to be seen.

The asymmetry of the cap was very evident from July. As in past years, a polar rift south of *Solis Lacus* was observable, dividing the cap into two unequal portions. It was followed from late Aug till late Nov, but by December the cap was just a tiny ellipse, last imaged on Dec 31 (Peach). By 2005 late Oct the Regional storm had settled dust upon the cap remnant, making it dull.

### SPC quantitative recession

This was analysed in the manner of 2003, using 1,368 (mostly) red images by 64 observers for 2005 Mar 15–Dec 31 (Table 2). After mid-Jul the measurements were of E–W cap diameter, but latitude at the CM was measured before then (due to the strong phase). The resulting curve (Figure 21) accords extremely well with 2003. Compared with the 2003 recession, the 2005 cap was systematically fractionally larger (at the same Ls value) until around Ls= 250°; hence recession was marginally delayed in 2005. This accords with the very slightly later seasonal separation of *Novus Mons*, noted earlier. The rest of the recession curves match nearly perfectly. As usual we cite historical sources[48–50] for reliably observed previous years.

The average diameter of the summer cap remnant was 5.4° over the period Ls= 311–345°.

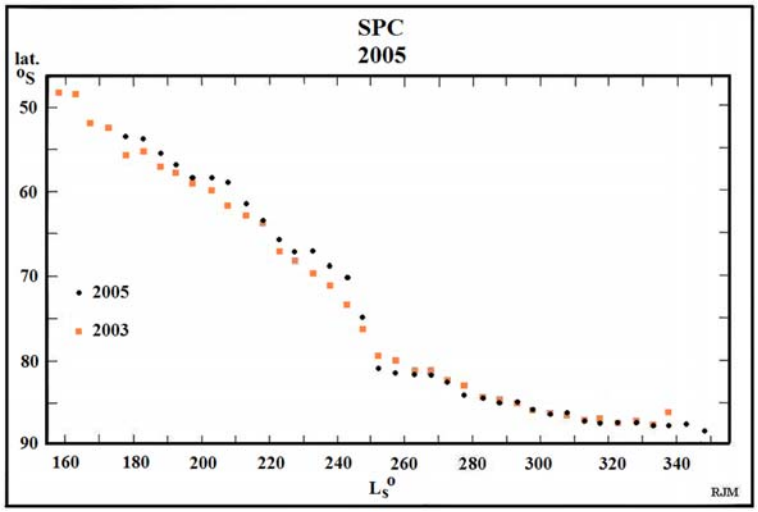


**Figure 21.** SPC recession curve, 2005, with 2003 added for comparison.

### SPC to SPH transition

Cloud at the morning terminator following the SPC was evident on images by Peach on Oct 10. This disappeared during the October Regional dust storm (see Part I); following the incidence of some circumpolar dusty hazes, such clouds were again recorded from Nov 16 onwards, traceable into December, when they intensified. Parker on Dec 5 noted 'a.m. limb haze merging with SPC': a typical remark. Buda on Dec 10 showed the cap very clearly, separated from the morning cloud over *Argyre*, but McKim saw the haze north of and circumpolar to the SPC next day. On Dec 14, McKim and Parker found the tiny SPC ill-defined due to overlying cloud. On Dec 17–31 Peach showed a small SPH overlying the SPC in blue light, *etc*. The SPC was minute, dull and of very low contrast in his Dec 31 image. Now the visibility of the eccentrically-placed cap itself depended heavily upon CML.

On 2006 Jan 6–11 a small dull hood overlying the cap was reported by Akutsu, McKim and Siegel, but it was not yet extensive or bright. McKim on Jan 21–25 recorded the hood brighter, now bluish-white: together with white evening *Argyre* cloud it formed a pair of lobes at the S. limb. Pellier on Jan 24 found the SPH conspicuous when close to the terminator, with separate *Argyre* morning cloud: typical results. By mid-Jan the *Argyre* cloud persisted through the day, still separate from the hood. In Feb–Mar the SPH extended to lower latitudes, sometimes – but not always – merging with the *Argyre* cloud: witness the images of Lomeli, Feb 8, *etc*. *Argyre* was generally brighter than the hood. On Feb 11 Parker showed the SPH down to S. *Noachis*, and the hood sometimes joined with diurnal cloud in *Hellas*. By Mar 4–6 Parker and Peach found the SPH larger, with *Argyre* as a bright extension, the latter also prominent in green light. To McKim on Mar 5 (CML= 50°, Part I, Figure 2K) the SPH was brilliant, and irradiated beyond the terminator.

The final parts of Figure 21 show large isolated polar clouds in 2006 Jan followed by the uniform S. polar hood as it appeared in 2006 Mar. After 2006 Mar the value of $D_e$ favoured the observation of the NPR rather than the SPR, but Minami could still make out the SPH on May 21.

It is of interest to compare the most reliable BAA data about the final visibility of the SPC remnant before being hidden by polar clouds. Given the high quality of the data (especially 1988–2005) it seems clear that the seasonal date for the onset of polar cloud really can vary, and is very likely related to the degree of atmospheric dust-loading.

| *Year of opposition* | *SPC visible until* | *Ls* |
|---|---|---|
| 1958[3] | 1959 Jan 2 | 354° |
| 1988[51] | 1989 Mar 2 | 006° |
| 1990[5] | 1991 Jan 12 | 003° |
| 2001[43] | 2002 Mar 28 | 349° |
| 2003[8] | 2004 Jan 27 | 340° |
| 2005 | 2005 Dec 31 | 349° |

### Cascades

No observations of these S. polar phenomena[8] were reported this year: the disk diameter at the appropriate season was simply too small for critical inspection.

**Figure 22.** *L to r:* Mars (1000×1/30s exposures), Phobos and Deimos (120×2–4s), 2005 Oct 27d 23h 00m, DMK21BF04 camera, *Dierick*.

## Martian satellites

Phobos and Deimos were again observed visually by Biver, were seen by Hancock at Flagstaff, and imaged by Dierick, Ikemura and Maxson.

## Lunar occultation

On 2006 Jul 27, Mars was occulted by the Moon at dusk. Adamoli noted: 'Just after 19.00UT I followed its emersion from the slender crescent, only minutes before both were occulted by a tree. At ×60 and ×240, in a bright sky, Mars was a slightly orange blob, not dissimilar in surface brightness to the Moon (in the first moments of emersion it appeared as a projection from the Moon's limb, not dissimilar to a lunar mountain...).'

### Erratum in 2003 report

In our 2003 Section Report, Part 2,[8] in Table 3, for Ls= 321° read Ls= 323°.

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