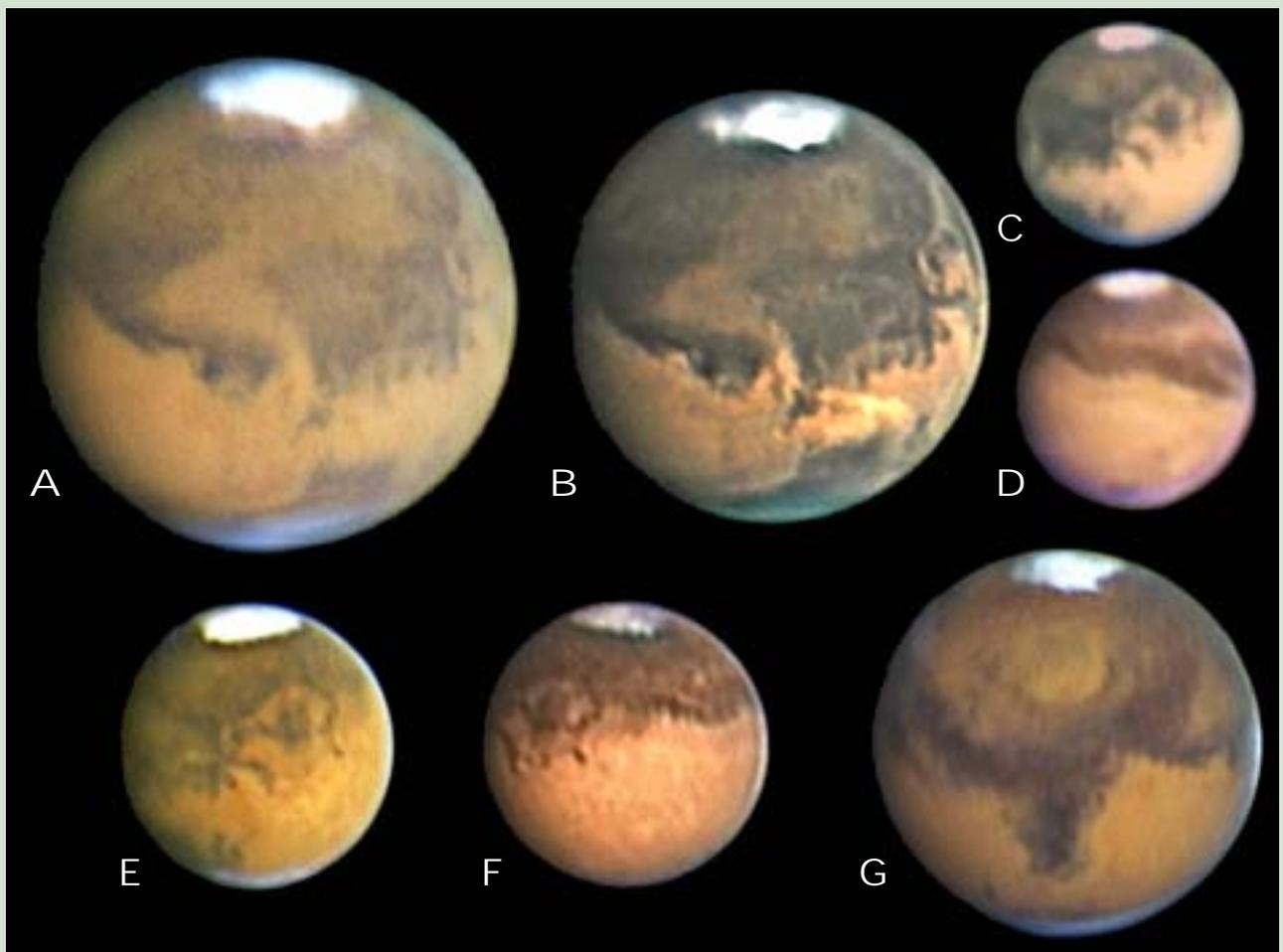


# CCD images of Mars in 2003



*Top:* a selection from the many thousands of excellent CCD images received by the Mars Section during the current perihelic opposition, forming part of Richard McKim's Mars report on pages 000–000. Most were produced by colour compositing of several hundred matched red, green and blue images by the observer. (The Director made minor changes to the contrast and brightness of some in order to obtain a satisfactory collage.) See page 000 for image details.  
*Bottom:* Grazing occultation of Mars by the Moon on 2003 July 17. A composite of images by several ALPO/IOTA observers including Andrew Chaikin and Don Parker (eastern Highlands County, Florida, USA); 279mm Schmidt–Cass., 08h 32m 55s, 27m 42s, 27m 15s, 25m 57s and 24m 28s (from left to right). Contributed by Jeff Beish.

The main images reveal a remarkable amount of fine detail in the dark areas as well as recent large-scale changes as described in the article. The Phobos development is well shown in **C**, **E** and **F**. Novus Mons can be seen to be detached from the S. polar cap in **A**, **B** and **G**, as well as other details. The bluish, asymmetric N. polar hood partly hides northern Mare Acidalium in **A**. Image **B** shows a bright yellow dust storm evolving in the Chryse desert. **A**, **B** and **G** show the broadening and darkening of Mare Serpentis following the Hellas July dust storm. **E** and **F** show fine details in the Tharsis and Amazonis deserts, including the locations of the great volcanoes. **G** shows complex details around Syrtis Major, and **D** illustrates the continuing small size of Trivium Charontis, bordering Elysium. *RJM*



## Mars Section

## Mars in 2003: third interim report

## General

During the past few months the Director has been deluged with observations – mostly in the form of emailed CCD images – requiring much time on a daily basis to sort, file and classify. We reproduce a few drawings and images in monochrome in the following account. A gallery of colour CCD images is illustrated and described on the inside front cover of this issue, with caption details below.

Mars was at opposition on August 28, right on martian perihelion ( $L_s = 250^\circ$ ,  $D = 25.1$  arcsec) and was marginally closer to Earth on August 27. The large apparent diameter allowed even those observers with smaller telescopes to obtain excellent results. Observing from near Paris, Crussaïre obtained remarkable images with his 102mm fluorite OG (Figure 2). Even more detail can be seen visually with a large aperture under a high enough magnification, but to draw it accurately is truly difficult. Judging from the bias towards imaging in the obser-

vations this year, it seems that many visual observers have been discouraged. But they should continue to send in their work, for their contributions have not diminished in value. Visual observations of martian clouds, sudden changes and delicate colourations continue to be of great value, in addition of course to high resolution drawings.

During August the writer changed his routine to staying up late rather than rising in the early hours, and continued to enjoy some good views from rural Northamptonshire, despite the slight southward change in Mars' declination. One of his best views was obtained on August 20 against a slightly hazy sky (Figure 1). More of his detailed drawings will be published later. A deep red filter will help to show fine details in the dark areas, and will eliminate any nuisance due to atmospheric dispersion. Martin Mobberley was also pleasantly surprised by the state of the seeing at his observatory on the previous night – his best planetary viewing for many years – and made good



**Figure 1.** Drawing by Richard McKim with 410mm Dall–Kirkham Cass.  $\times 410$  with W25 red filter. 2003 August 20, 23h 25m, CML=  $23^\circ$ . Hellas light on the evening terminator; Argyre dull near the CM. Intricate fine detail seen, the observer remarking upon the coarse mottling of the dark areas of Margaritifer Sinus, Mare Erythraeum and environs. Note the small dark 'oases' in southern Chryse–Xanthe.

## Details of images on the inside front cover

## Top row:

**A:** Maurice Valimberti (Melbourne, Australia), 355mm Schmidt–Cass., Philips ToUcam Webcam, August 9d 15h 26 m, CML=  $4^\circ$ .

**B:** Ed Grafton (Houston, Texas), 355mm Schmidt–Cass., ST5 CCD, July 30d 09h 29m, CML=  $6^\circ$ .

**C:** Martin Mobberley (Cockfield, UK), 300mm Schmidt–Cass., Philips ToUcam, August 20d 01h 42m, CML=  $65^\circ$ .

**D:** Chris Proctor (Torquay, UK), 500mm refl. stopped down to 200mm., Starlight Ex-

press MX5c CCD, August 8d 02h 34m, CML=  $184^\circ$ .

## Middle row:

**E:** T. Ikemura (Nagoya, Japan), 310mm refl., Philips ToUcam, August 2d 15h 27m, CML=  $67^\circ$ .

**F:** Ferruccio Zannotti (Forca Canapine (PG), Italy), 235mm Schmidt–Cass., Philips ToUcam, August 11d 00h 20m, CML=  $125^\circ$ .

**G:** Tan Wei Leong (Singapore), 250mm Dall–Kirkham Cass., Philips ToUcam, August 20d 17h 21m, CML=  $294^\circ$ .

use of it (inside front cover). Unfortunately the English weather immediately prior to opposition did not cooperate.

The present account is a continuation of that published in the last issue of the *Journal*. All the BAA reports published during the present apparition can be assessed on the Section's website (<http://www.britastro.org/mars>). This report covers early to late spring in the martian southern hemisphere, encompassing the period 2003 July 1 ( $L_s = 213^\circ$ ,  $D$  (disk diameter) = 16.7 arcsec, tilt =  $-21^\circ S$ ) to August 31 ( $L_s = 251^\circ$ ,  $D = 25.0$  arcsec, tilt =  $-18^\circ S$ ), considering all work received at the time of writing (August 31).

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**Figure 2.** CCD image by Daniel Crussaire, 102mm OG, Philips Vesta Pro Webcam, Champigny-sur-Marne, France. 2003 August 19, 01h 51m, CML= 76° (Originally submitted as a colour composite.) Remarkably fine detail of the regions of Solis Lacus, Valles Marineris, etc. The smallest details are not perfectly resolved at this aperture and are recorded as slightly enlarged oases, etc.

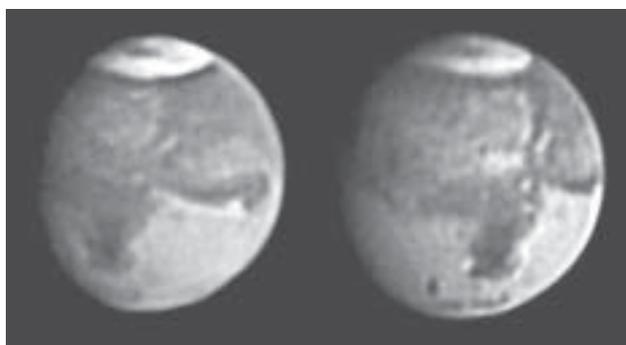
### Surface features

There have never been so many fine images of the surface of Mars obtained during one apparition. These reveal the surface in great detail. Recent images show a minor extension of, and a further dark nucleus in, the Aetheria secular darkening on the W. side of the Elysium shield. There have been several surface feature changes as a result of the regional dust storm which began in Hellas in early July (see next section).

### Atmospheric activity

#### Regional dust storm in Hellas

BAA electronic *Circular* No.109 (July 1) contained the following announcement by the Director: ‘Visual and CCD observations for July 1 reveal considerable albedo changes since the previous day in the areas of Iapigia, Hellas and environs. Several small discrete dust clouds have been observed. Dr D. C. Parker reports as follows in an email dated July 1: ‘Significant changes have occurred over the past 24 hours: 1. Mare Tyrrhenum, Syrtis Minor, and Crocea-Oenotria have lightened considerably, appearing to be covered by a thin whitish cloud... These features were dark and ‘normal’ on June 30 ...and throughout June. 2. Bright ochre spots [were] rimming Hellas and obscuring



**Figure 3.** Red-light CCD images by Ed Grafton, 355mm Schmidt–Cass., ST5, Texas, USA. *Left:* 2003 June 28, 09h 25m, CML= 302°. *Right:* 2003 July 2, 09h 43m, CML= 268°. On the right-hand figure the initial dust clouds of the Hellas regional storm can be seen around the great basin, especially at the northern periphery over Iapigia.

Deltoton-Iapygia... Little detail noted on the floor of Hellas.’

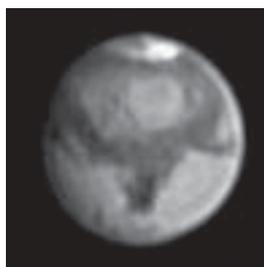
This activity was due to a rather typical regional dust storm, and its emergence from northern Hellas/Iapigia can be seen in the comparative CCD images by Grafton (Figure 3). A further report appeared in BAA *Circular* No. 791 (July 10): ‘Over the next few days the dust storm expanded to the east over part of Mare Tyrrhenum and Ausonia and Eridania, with dust veiling Hesperia and Cimmerium. Some dust obscured the southern part of Syrtis Major. The SPC has not been affected. Dust also expanded to the west, into Noachis, and some dust cut across the E. end of Sinus Sabaeus. In the last few decades, very similar events have occurred (for example) in 1971, 1986 and 1988... Illustrations of the storm (CCD images by Don Parker)... were sent to the BBC for their Website at the request of Dr David Whitehouse, and the resulting page... may be viewed at <http://news.bbc.co.uk/1/hi/sci/tech/3051548.stm>’

In the event, after one week, the storm began to subside without spreading beyond the above limits. By mid-July Hellas showed an absence both of bright clouds as well as the subtle floor details that had been visible earlier (Figure 4). But a new development on the surface could also be seen to have occurred on the western border of the disturbance: Mare Serpentis was greatly broadened, and the E. end of Deucalionis Regio was seen to have darkened, due to dust removal from the surface. (Figure 4 and inside front cover).

There were other changes, too. The aspect of the southeast part of Mare Tyrrhenum was altered somewhat, being invaded in several places by bright matter from the Ausonia side due to dust newly settled on the martian surface. Such developments – witnessed in considerably more detail this apparition than in the past – are typical results of storms having occurred in these longitudes.

#### Other smaller scale dust storm activity

At least four dust storm events of brief duration and extent have appeared over portions of Valles Marineris (see image E, inside front cover) and in Chryse (image B). The latter events were located within the Chryse Planitia basin. The first began on July 1, dust expanding to veil parts of Nilokeras and streaking across southern Mare Acidalium. The second began in late July. All were typical storms, reminiscent of several past events. Full details will feature in the final Section Report. Together with the Hellas event these storms caused a small amount of suspended dust to be distributed over large regions of the planet.



**Figure 4.** Red-light image by Damian Peach, 203mm refl., Philips ToUcam Webcam. July 28, 02h 23m, CML= 281°. Fine details around Syrtis Major. The Mare Serpentis region is much broader and darker than it was before the regional Hellas dust storm. Hellas shows less floor detail than it did before the storm.

Although not detectable directly, the suspended dust could be seen to tinge the morning limb (over a wide range of longitude) a distinct yellow colour until mid-August. Furthermore, white cloud activity was very low throughout July.

#### Will there be a great dust storm in 2003?

Although crystal ball gazing may be frowned upon in some quarters, the Director will briefly indulge, even though (as will be seen) our ability to make dust storm predictions based upon past records is not much better than guessing future London weather by observing a piece of seaweed nailed to the door of Burlington House. It is often written that in perihelic oppositions, any great storm is preceded by a regional event. This is generally true, at least in those oppositions when the great storm does not occur close to the start of southern spring. The converse, however, does not necessarily follow. Some perihelic oppositions proceed with a string of local and regional events only. Thus in 1988 there were significantly large regional storms at Ls= 212° (starting in Hellas) and Ls= 313° (Thaumasia) but no great storm.

Selecting only those oppositions displaying a planet-encircling storm well observed from Earth we have 1909, 1924, 1956, 1971, 1973, 1975 and 2001. The events of 1909 and 2001 began unusually early, just after the start of southern spring. The start of the encircling storm in 1975 was fairly well documented, but the period immediately beforehand was hard to observe due to the tiny disk diameter. We are left with three adequately observed years,



1924, 1971 and 1973, in which there were significantly large regional events observed in advance of encircling storms (see table).

Thus the interval in Ls between the last significant regional event in the S. hemisphere and the start of the encircling storm is  $47 \pm 10^\circ$  in Ls. The writer's experience is that significant time is needed between the larger events for dust to settle, and for the atmospheric opacity to drop to a level at which dust-raising may again proceed.

The 2003 July Hellas regional storm described began at Ls =  $213^\circ$ . Extrapolating from the 1924–'73 data suggests a plausible terrestrial date range of August 28 (Ls =  $250^\circ$ ) to September 27 (Ls =  $269^\circ$ ) during which a planet-encircling event *might* begin. This range is of course a very reasonable one to predict, because Ls =  $250^\circ$  corresponds to perihelion and the later limit corresponds with the summer solstice for the S. hemisphere, which will be reached on September 29 (Ls =  $270^\circ$ ).

This is not, however, a serious prediction. We must remember that our sample available for forecasting is not very large, and that in any case history teaches us that the chance of a planet-encircling storm following a large regional event is only about 32%, or about one in three (see R. J. McKim, *Mem. Brit. Astron. Assoc.*, **44** (1999)). All we can really say is that *if* there is to be a great storm, it will begin before Ls =  $360^\circ$ .

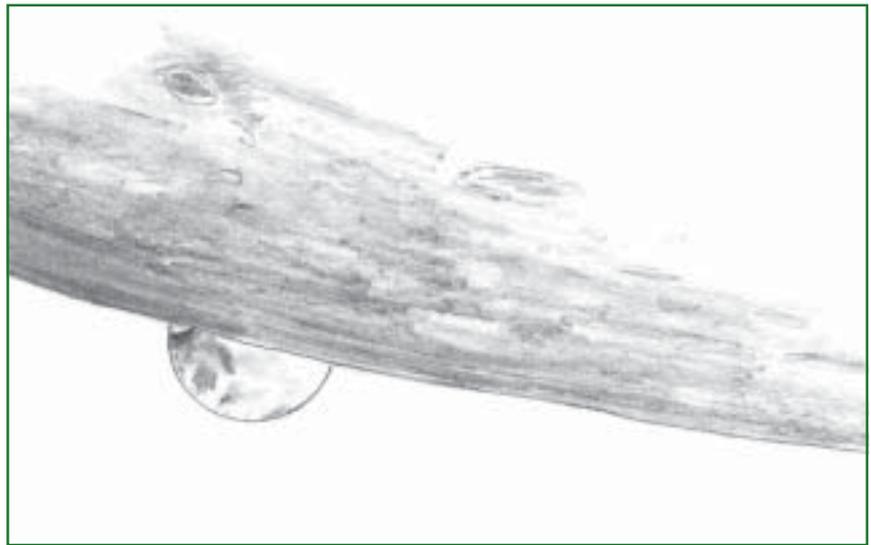


**Figure 5.** Image by Clay Sherrod, 410mm Schmidt–Cass., Philips ToUcam, Arkansas, USA. August 19, 07h 37m, CML =  $160^\circ$ . (Originally submitted as a colour composite.) Note the bright orographic evening cloud near Phoenicis Lacus and another fainter one to the north over Olympus Mons (Nix Olympica).

#### White clouds

Throughout July there was little sign of crystal clouds, the Hellas dust having warmed the planet's atmosphere. But as dust fall-out continued into August, coupled with the release of volatiles from the SPC, white cloud activity began to appear. The NPH also returned to prominence.

White evening clouds appeared over the Tharsis volcanoes and Olympus Mons. Most prominent was the little cloud near Phoenicis Lacus (Figure 5). Morning clouds of a bluish tint were recorded over the rising



**Figure 6.** Grazing occultation of Mars by the Moon, 2003 July 17, 08h 32m. Sketch by Jeff Beish, 152mm refl.  $\times 185$ , Florida, USA. (More images on inside front cover.)

Syrtyx Major in August, and both morning and evening clouds were noticed over Aeria.

#### Polar regions

By August, the retreat of the SPC had noticeably quickened, and changes in the contour of the cap could be seen in observations a mere few days apart. The dark surroundings of the cap persisted through July and August. As the cap retreated its well-known axial asymmetry developed, and the bright patches formerly within the cap became projections or outliers. Thus Novus Mons became separated from the cap in accord with the usual seasonal cycle, and Argenteus and Thyles Mons (Figure 5) appeared as outstandingly bright areas near the cap periphery (see cover images). High resolution observations revealed smaller, unnamed, bright spots, fine rifts and darker patches within the SPC, and such observations are certainly the most detailed ever obtained from Earth. There will be plenty of material to discuss the cap recession when a detailed analysis is made later.

The north polar hood was quite prominent again in August. As in past years it was

highly asymmetric about the rotational pole and tended to be displaced to a higher latitude in the longitude of Mare Acidaliu (a region of high thermal inertia).

#### Grazing occultation

This event (July 17) was not observable from the UK. Reports came from Parker and Beish (inside front cover and Figure 6), and from J. Phillips, all observing from the USA. The dark limb partly cut across the martian disk.

#### The martian satellites

Phobos and Deimos were both imaged on August 23 by T. Akutsu with a 32cm Newtonian, and N. Biver reported seeing them on several occasions with a 400mm aperture.

#### The next report

Our next report (scheduled for the December *Journal*) will deal with the post-opposition observations of September and October. Any material for consideration must reach the Director by the last week of October. The arrival of ESA's *Mars Express* (carrying *Beagle 2*) at Mars in late December/early 2004 January is awaited with much interest. This mission is expected to map the distribution of water and to measure the thickness of the polar deposits as well as studying the martian ionosphere.

**Richard McKim, Director**

#### Pre-perihelic martian dust storms

Terrestrial date of start of regional storm	Ls	Terrestrial date of start of planet-encircling storm	Ls	Ls interval(s)
1924 June 11 (Hellas)	200			
1924 October 8 (Hellas)	274			
1971 July 10 (Hellas)	213	1924 Dec 9 (Hellas)	311	74, 37
1973 July 16 (Hellas)	244	1971 Sep 22 (Hellas)	260	47
		1973 Oct 13 (Thaumasia)	300	56