The surface of Titan revealed

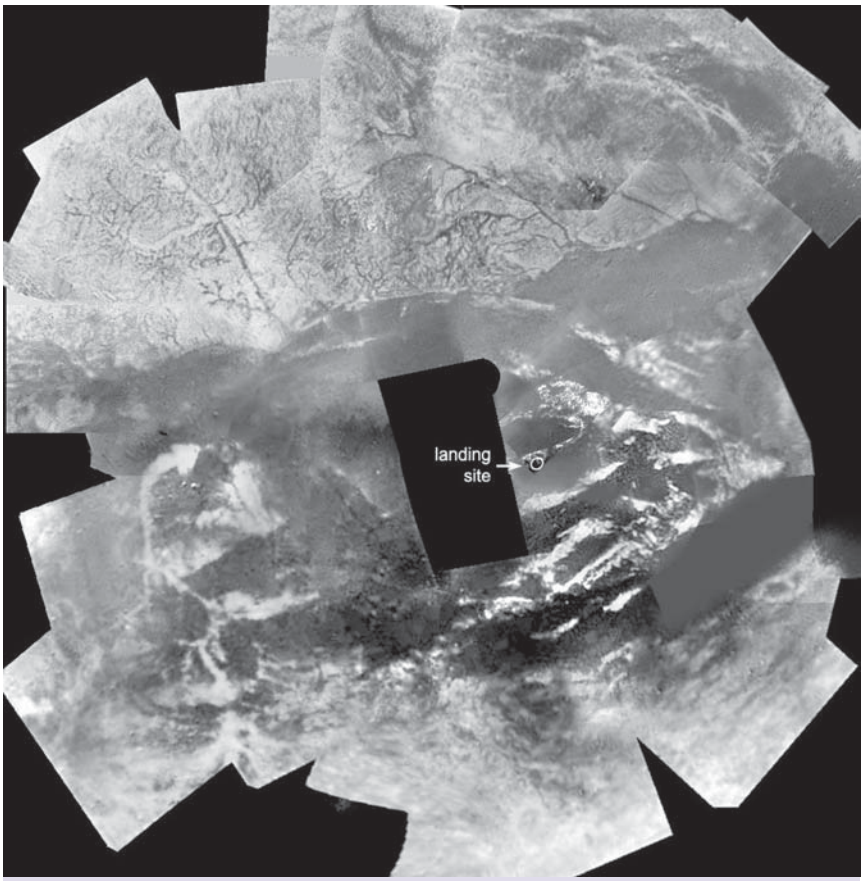
The landing of *Huygens* on Titan was a technical triumph – the first landing on any body so distant and so cold. It was also a scientific triumph, revealing the geography and climate of a totally alien world. And yet the rivers, seabeds, and mists of Titan were consistent with scientific predictions, and surprisingly reminiscent of the icy northern coastlines of Earth. The laws of physical geography apply the same on a world at –180°C where the flowing liquid is methane.

As *Huygens* emerged below the global smog layer, about 30km up, its cameras revealed two types of landscape, which appear to correspond to the bright and dark terrains discerned from orbit. The bright terrain was 'land', extensively criss-crossed by dark channels: innumerable streams merging into larger rivers. These open into the dark terrain, which is evidently the bed of a large channel or sea, marked with many bright bands and wedges which appear to be islands or shoals which liquid sometimes flows around. As *Huygens* descended, some strips close to the shore became brighter, suggestive of low-lying offshore mists.

After 2.5 hours' descent, *Huygens* landed in the dark seabed, but very close to the edge of a bright band. The view returned after landing shows the flat dark seabed littered with lighter 'stones': as these are all rounded and mostly of similar size (10–15cm across), they are evidently pebbles deposited by running liquid. These pebbles may comprise the bright bands seen from above. If so, *Huygens* contrived to land on the boundary of bright and dark terrain to within a metre or so, thus sampling both!

But the pebbles are not made of rock: their colours indicated that they are made of dirty water-ice, which is believed to be the 'bedrock' of Titan. The surface itself, according to the Open University's Surface Science Package, was perfect to cushion *Huygens*' landing: it had the consistency of mud or sand with a thin brittle crust; or, as the scientific team summed it up, créme brûlèe. In fact this was not a far-fetched analogy, as the mud appears to be a mixture of precipitated organic polymers, water ice, and methane – still soft in spite of being very well chilled to –180°C. As *Huygens* warmed it up, two instruments detected puffs of methane evaporating from it.

All this is a striking vindication of theories proposed after the *Voyager* missions, to explain how abundant methane existed in Titan's atmosphere, even though it was being decomposed by sunlight to produce hydrogen, ethane, and the orange smog of hydrocarbons. Given that the temperature was close to the boiling point of methane, scientists proposed that a reservoir of liquid methane existed, either in local lakes and rivers, or dissolved in large seas of ethane, or trapped in some muddy complex. With Hubble Space Telescope's infrared images in 1994, P. H. Smith and colleagues produced the first map of Titan's surface and proposed that a large bright area was an icy highland washed clean by methane rainfall (*Icarus* **119** p.336).



A preliminary mosaic of raw *Huygens* images, looking down on an area tens of km across. At top is the bright land with channels; another bright region at bottom has less distinct topography and/or haze. The dark band between the two seems to be a broad seabed with bright islands or gravel-banks. The raw images were produced by the Descent Imager–Spectral Radiometer (principal investigator Prof. Martin Tomasko), **http://www.lpl.arizona.edu/~kholso/** and are copyright to ESA, NASA, JPL, and the University of Arizona. The mosaic was assembled by an amateur internet group (Anthony Liekens, Jakub Friedl, Ricardo Nunes, and Daniel Crotty) **http://anthony.liekens.net/huygens_static.html** and further edited by John Rogers. This amateur mosaic does not attempt an absolutely correct map of terrain nor brightness; a fully calibrated map will be produced by the DISR team in due course.

But *Huygens* found no liquid on the surface at present. Judging by the mists and mellow mushiness, liquid has been present very recently, presumably running off the channelled bright lands from rain or melting snow. So how often does it flow? Titan, like Saturn, has a year that is 30 Earth years long, so perhaps there is a rainy season once or twice in that period. Indeed, in 1995 using the UK Infrared Telescope, Caitlin Griffiths and colleagues detected transient brightenings implying variable clouds some 15km above the surface (*Nature* **395**, 575). So if *Cassini* can keep going for many years to come, perhaps it will detect methane rainclouds forming and filling the methane seas.

Titan is advertised as being like the primitive Earth in deep freeze; so does *Huygens* tell us anything about our own origins? Certainly Titan is not pristine; now we see that it has vigorous chemical and geographical processes of its own. This demonstrates how such 'primordial' bodies can develop rich organic chemistry and dynamic cycles of activity, which may well have enriched the 'building blocks' well before the Earth itself formed.

John H. Rogers

From the President

This 'From the President' column was started several years ago by Dr Richard McKim when he was President. It was introduced to help the President communicate with our members and to keep them up to date with changes and things going on in your Association. In particular, it is a way to let you know which activities your elected Council and Officers are currently involved with.

You heard last year that we have been busy making plans to get our administrative systems upgraded and new applications installed. This is now very close to fruition. The Association has invested in a new system to aid the way that it provides membership services to you. The current system has been installed for many years and although it has enabled us to provide basic services to our members, it lacks much of the sophistication that modern management systems incorporate as standard. It also runs on a DOS-based platform and is well overdue to be upgraded to a Windows environment.

The new system, which is due to go live this month a few days after the Winchester weekend, has the potential to help us keep a closer track of members' needs and preferences. That complicated set of letters that you might have seen on the label on the front of your *Journal* encodes the interests that members registered with us when they completed their application forms. Since many of you have been BAA members for some time this code will almost certainly need reviewing and updating as interests have surely changed.

Although the new system is very powerful, the strategy is to install it very simply initially, so that it is configured to provide the basic services supplied by the old system. We will then gradually add enhancements to it until we have enabled all the features that we have identified as being useful to us. I am sure there are many members reading this who have had experience in getting new systems to work who will agree with this approach! The BAA's very small office and lack of a large corporate IT department sitting in the background to help dig us out of trouble makes this the logical and only way forward. One powerful feature will be a seamless integration with our accounting system, which is also being replaced. Our accountants and auditors are already excited by the prospect of producing month end and annual reports more easily and quickly. The integration should also help to eliminate some of the human error inherent in moving large amounts of data between systems.

The membership module will also interface fully with the BACS system for clearing Direct Debits and Gift Aid. This is perhaps a good time to emphasise again just how much less work is involved for everyone when members opt to pay their subscription by Direct Debit. The system handles this completely automatically for us and hugely reduces manual effort and therefore costs. Also subscriptions for those members who are kind enough to sign Gift Aid forms, will automatically have income tax recovered from the Inland Revenue at no cost to the members. This substantially benefits the Association. If you do not currently have a Direct Debit or a signed Gift Aid form lodged with us, we will soon be writing to you to ask that you consider doing this.

I wrote in an earlier column about some of the ways that the Council activities occur. In considering plans for the future two groups have met from time to time, these are the Way Forward Group and the Risk Assessment Group. The boundary between these two groups has become blurred in recent years with many of the agenda items being common to both. Indeed the membership of both groups is almost identical. They consist mainly of a core group of Council members, and any others who wish to participate on specific topics. This approach is usually very fertile in recognising the need for changes and future actions, but as you have heard me say before, it is finding volunteers to help with the actions that is the real

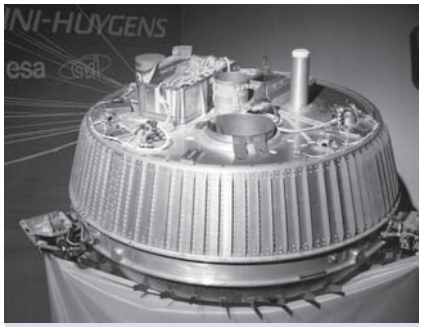
'Silent, upon a peak in Darien...'

'Then felt I like some watcher of the skies
When a new planet swims into his ken;
Or like stout Cortez when with eagle eyes
He stared at the Pacific – and all his men
Looked at each other with a wild surmise –
Silent, upon a peak in Darien.'

Professor David Southwood, Director of Science at the European Space Agency, had tears in his eyes as he quoted these words by John Keats to the assembled press at the European Space Operations Centre in Darmstadt, Germany, on January 15. The day before, ESA's *Huygens* probe had successfully landed on Titan, and via the *Cassini* mother ship returned data and images for 3½ hours until *Cassini* dropped below the probe's horizon. Thousands of scientists and engineers in nineteen countries over 25 years were involved with this immensely ambitious project; the success of the mission exceeded their wildest dreams.

The launch of *Cassini–Huygens* from Cape Canaveral, 1997 October 15. *All photos by Hazel McGee.*

Nick James and I have followed *Cassini* since its launch. Seven years ago we stood together on the beach at Cape Canaveral in Florida and cheered it on its way; last July we visited JPL in California and shared the excitement as the spacecraft executed a complex and perfectly planned manoeuvre to enter orbit around Saturn. Images and science from *Cassini* as it orbits Saturn and flies by its many moons have thrilled the world and will continue to do so for at least the next four years. But for Europeans in particular, and indeed for anyone whose sense of the adventure of space exploration is not completely drowned beneath the cynicism and banality of the modern world, the highlight of *Cassini*'s journey would be monitored from Darmstadt on 2005 January 14, when its hitch-hiking passenger *Huygens* would attempt to land on Titan.



A mockup of the *Huygens* lander at the Space Operations Centre.

For those of us fortunate enough to be there, the drama began the night before, when a rumour circulated that radio telescopes on Earth were planning to listen directly for the transmissions from *Huygens*, without waiting for *Cassini* to relay ▸

challenge. Extra meetings are necessary because much time at Council meetings is taken up with routine matters that need to be addressed on a regular basis. Approving papers for publication in the *Journal* and electing new members are good examples.

I will describe the outline of a typical Council meeting in a future From the President. This might help remove some of the mystery and perhaps encourage members who would otherwise not consider standing for Council to do so, and so influence the future of our cherished Association.

We took the unusual step earlier this year of taking a slightly different approach as to how we use Council time. In March we wiped the Council agenda clean except for those items that could not be carried forward to the next meeting. The result was an opportunity to get all of Council involved in thinking about where we want to go and what we want to do rather than just the smaller subset normally involved in the Way Forward and Risk Assessment groups. This was quite a radical change from the norm. Having a large working group made up of the full Council along with willing Directors from the observing Sections is challenging, to say the least. Everyone must have his or her say and copious notes be taken of all the best ideas before they vanish forever. Fortunately some extra exchange of ideas and thoughts took place by email etc. before the meeting. This helped to facilitate the flow of ideas on the day. Was it a success? Time will tell. Once again it is not the number of good ideas generated that measures success but the number that are successfully implemented.

It is also now that time of the year when nominations come in for members of the BAA Council. Anyone interested in helping with the running of your organisation and who could attend Council meetings approximately eight times per year should come forward. Please contact me if you are unsure of the procedure.

I am also pleased to say that preparations are in hand for the unveiling of a plaque to George Alcock in Peterborough Cathedral on April 19 at 4.30 pm. The plaque is to commemorate his achievements in comet and nova discovery. The unveiling will be performed by the Astronomer Royal, Sir Martin Rees. Anyone interested is cordially invited to attend.

Tom Boles, *President*

▸ *Huygens – from previous page*

them to Earth as planned. This way we would receive confirmation that the probe was operating properly, and maybe even that it had reached the surface, long before the expected time. Sure enough, around 11.20 CET on January 14, the news came from the control centre: Greenbank in the USA had detected the transmissions, loud and clear! Project scientist and mission manager Jean–Pierre Lebreton brought over the trace with its telltale 'blip'. We knew for sure that *Huygens* had entered Titan's atmosphere, opened its main parachute and discarded the vital front heatshield. The signal sent from 1.2 billion km away at Titan and received at Greenbank after 67 minutes travelling at the speed of light was approximately the strength of a call from a mobile phone.

Huygens descended through Titan's atmosphere for 2¼ hours, during which it continuously relayed data to *Cassini* in orbit above. At 13.30 CET it turned on a lamp to illuminate the surface so the spectral radiometer could determine the surface composition, and at around 13.34, at a speed of approximately 5–6 metres per second the spacecraft touched the surface. The Surface Science Package led by Prof John Zarnecki of the Open University included a penetrometer, a rod which extended below the spacecraft and was the first part of it to make contact: Zarnecki said later that this instrument encountered some resistance on contact, then broke through what appeared to be a thin crust, to settle into a thick, slushy material with a consistency 'like crème brûlée'. John Rogers discusses the first results from the surface of Titan in his article on page 60.

Project scientist and mission manager Jean–Pierre Lebreton shows the trace from the radio telescope at Greenbank with the 'blip' from *Huygens*.

At JPL in July, John Zarnecki had told Nick James and I that if they managed three minutes' data from the surface they would be content. In fact *Huygens* continued transmitting to *Cassini* from the surface for over 70 minutes, until the orbiter passed below the probe's horizon. Earth's radio telescopes detected *Huygens*' carrier signal for a further two hours until the batteries finally died. One of the SSP scientists told me that the internal temperature of the probe remained at a constant 25°C throughout, despite no battery power being available for heating and the external temperature approaching –180°C; a credit to the quality of the spacecraft's insulation, and the reason why the batteries lasted so much longer than expected.

Meanwhile, the scientists and press at Darmstadt waited through the day for confirmation that *Cassini* had received and forwarded the vital data. In the early evening, at last it came, with jubilation in the control centre as the data began to be received, and a memorable press conference to confirm the good news. Later in the canteen after dinner we watched dumbfounded as the first, astonishing images were revealed. The following morning, hardened journalists packing the press room applauded David Southwood as he quoted Keats's poem, and introduced us to another world.

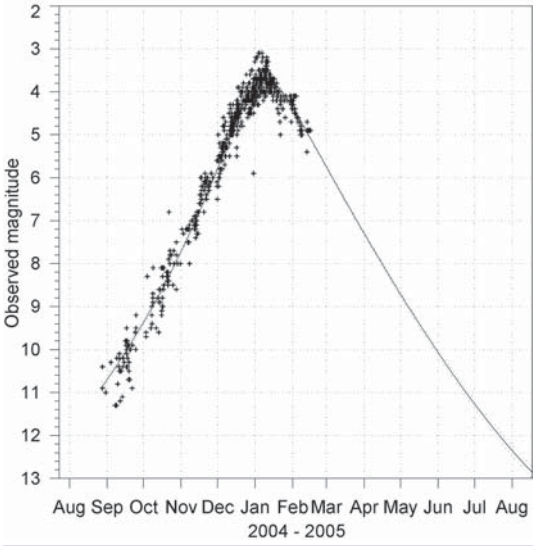
The European Space Operations Centre at Darmstadt, Germany.

Hazel McGee

Comet Section

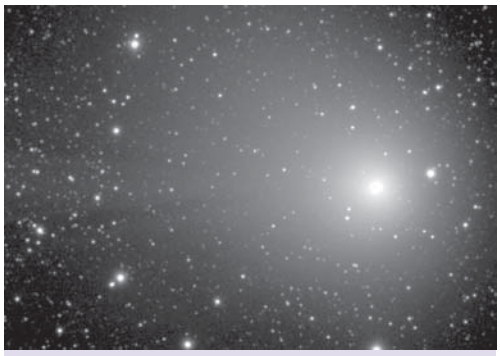
Comet Machholz (2004 Q2)

A naked eye comet has been visible in the evening sky since mid-December, and it should remain as a naked eye object into March. However, it hasn't been that spectacular and appeared much as a large globular cluster – there have been few naked eye reports of a tail. Discovered by American amateur astronomer Don Machholz on August 27, observing with a 0.15m f8 reflector ×30, it has the designation 2004 Q2, signifying that it was the second comet discovered in the second half of August. The first was also an amateur discovery, but this time by CCD observer Roy Tucker, and this has remained much fainter. Don spent nearly 1500 hours searching for his latest find, which is his tenth.



Light curve of Comet Machholz from 670 observations, 2004 August 28 to 2005 February 15.

2004 Q2 reached its closest point to the Sun outside the orbit of the Earth, but it conveniently did this when it was nearly at opposition, so we had a good view. Comets that remain more distant from the Sun than the Earth rarely have significant tails, and this one was no exception. Under dark skies a thin gas tail could be seen, with the dust tail at quite an angle to it, but the most spectacular views were from CCD images, particularly as it passed near to the Pleiades. (See the colour images on page 58.)



Comet Machholz imaged by Jeremy Shears, Cheshire, on 2005 January 29, 19:02 UT. 6 minute exp., Takahashi FS102 at f/8.

The comet first became visible to UK observers in November, and became readily observable in the evening sky in mid-December. It peaked at about mag 3.5 in early January and fortuitously passed close to the Pleiades during the dark, moonless period, which coincided with a spell of good weather in the UK. In March it passes just over 5° from the pole star, and will remain visible from the UK till mid-summer. The light curve is relatively straightforward, with no surprise brightenings or fadings. So far it has followed $m = 4.9 + 5 \log(\Delta) + 10.7 \log(r)$, which implies a little more rapid brightening than the average long period comet. The orbit suggests that it isn't on its first visit to the inner solar system, however it won't be back again for around 100,000 years.

Because of its brightness and favourable observing circumstances I expect comet Machholz to go zooming up the list of best observed comets, which is currently headed by Hale–Bopp, Ikeya–Zhang and Hyakutake. Comet 2001 Q4 (NEAT), which put on a good show last May is currently 7th, but I expect it to climb further as there are still many more observations to come in. Lots of observers are following comet Machholz, including James Abbott, Len Entwisle, David Frydman, Martin Gaiger, Mark Green, Alan Heath, Nick James, Cliff Meredith, Martin Mobberley, Neil Morrison, Gabriel Oksa, Roy Panther, Jeremy Shears and Alex Vincent. If you haven't seen it yet, you should be able to observe the comet with binoculars into May, and this provides an excellent opportunity to practise making magnitude estimates of a moderately bright comet.

Jonathan Shanklin, *Director*

Aurora Section

2004 November

The month was geomagnetically quite active. Our observers noted disturbed conditions on Nov 03, 04, 20, 21, 25 and 29. A complex of coronal mass ejections, possibly associated with solar flare activity on Nov 03 and 04, interacted with the Earth's magnetosphere to cause severe magnetic storms from 07 to 10, then dying down towards Nov 12. The interplanetary magnetic field north-south component Bz was mainly positive (north-seeking) on Nov 07 but fluctuating N to S, +40 to –45 nanoteslas on 08 to 10. The ACE satellite detected solar wind speeds rising to 900km/s declining to around 420 km/s on Nov 14. The planetary magnetic index reached a maximum value of 9 on Nov 08 and 10, and the daily planetary index Ap was 189, 120 and 181 on Nov 08, 09 and 10 respectively.

Around 20 British observers reported sighting aurora on the night of 07/08 in the time range 17:30 to 03:00 UT. Overhead coronal conditions were noted between 21:00 and 21:30 UT poleward of 56°N in the UK. Quiet bands were reported between 20:30 and 22:30 UT down to 52°N. Some observers were hampered by cloud. In this report, as usual when nothing is specifically mentioned, geographic latitudes are referred to.

A lesser aurora comprising glows, arcs, rays and patches followed on Nov 08/09 and was noted by some seven Scottish observers in the time range 17:30 to 21:40 UT.

On 09/10 some 28 British observers noted auroral conditions in the time range 17:30 to 21:40 UT. Overhead coronal conditions were observed between 19:30 and 20:30 poleward of 55°N. Glows, arcs and rays were seen down to 50°30′N.

On 10/11 there were only two British reports of active auroral events, from Carlisle and Leeds, but overseas reports were received from North Dakota, Nova Scotia and Australia. Jay Brausch at Glen Ullin, N. Dakota observed lesser aurorae on 03/04, 10/11, 16/17, 19/20 and 20/21 with more active events on 08/09 and 11/12. Aurorae on 07/08 and 09/10 were coronal covering most of the sky.

A new observer, Lars Poort, lives at Uummannaq, Greenland, at 70°41′N, which is north of the auroral oval which lies approximately above Kap Farvel on the southern tip of the island. Lars has sent in reports on the polar aurora. Active rayed bands were recorded on Nov 16/17, 21/22 and 24/25 while overhead coronal structures were noted on 23/24 and 25/26.

There was one isolated observation of a low elevation auroral glow and arc on Nov 12/13 at 21:00 UT from southern Scotland.

A British Airways pilot also reported observing low elevation auroral glows on 16/17 when flying east of Labrador.

2004 December

Magnetic observers detected two particular periods of disturbance, on Dec 11 to 12 and 28 to 30. A general background of minor disturbance was noted on Dec 01 and from Dec 05 onwards, with quiet periods around 14, 19 and 24.

The winter period has been very cloudy and stormy in December and visual auroral observing from the British Isles was difficult. An aurora took place on 11/12 and was recorded as an active glow by three observers in Scotland, one in northern England and as an active glow and arc by Jay Brausch at Glen Ullin in North Dakota. Lars Poort north of the auroral oval in Greenland recorded a fragmentary pulsating corona of tall rays.

A further aurora appeared on 28/29 and was seen as glows, arcs and rays by three observers in Scotland. Brausch reported an aurora comprising a quiet arc followed by pulsating multiple patches.

Two observers in northern Scotland saw glows, arcs and rays on 06/07 and one observer noted glows and active arcs on 12/13. Brausch reported glows on 12/13 and 17/18 and on 13/14, 14/15 and 16/17 recorded glows, arcs and rays. Poort noted active aurorae including overhead coronal ray structures on Dec 29/30 and 30/31.

There were two isolated auroral reports from Cornwall. That of Dec 02/03 comprised a quiet glow to which was later added two rays. On 19/20 white and red glows were observed.

From 1999 to date 22 observations of the aurora have been received from North Cornwall. Of these, 9 were made when aurora was being observed by others to the north and the Earth's magnetic field was experiencing considerable disturbance. A further 5 Cornish auroral sightings were not confirmed by other observers in the UK, but the magnetic field at these times was at minor storm level. Three unconfirmed aurorae were related to highly disturbed but not stormy magnetic conditions, similar to two events which were confirmed.

It may be that with clear dark skies a skilled observer can detect auroral light at more southerly locations than might be thought. An inspection of Section records shows that on occasion aurora can appear to an experienced observer when not expected. The auroral apparition seen from Horncastle on 2003 September 13/14 and well authenticated there was a case in point, being associated with a minor pulse in a quiet magnetic field.

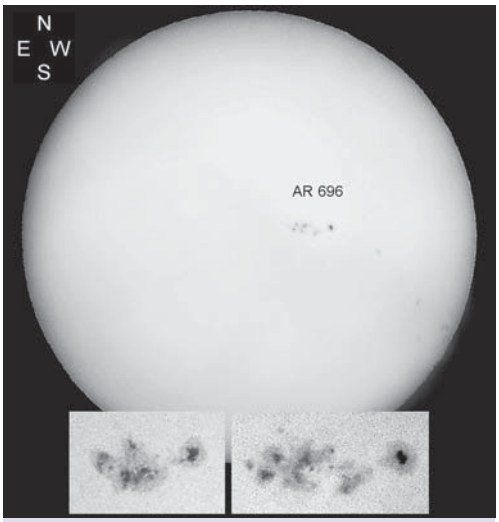
Ron Livesey, *Director*

Solar Section

2004 November

Despite the poor observing conditions in northern Europe, the Section was able to obtain data for every day during November.

The month opened with 5 active areas on the disk. The most striking was an E–W elongated Ekc group spanning some 13° of longitude containing 5 penumbral spots of mean position –15°/75°, covering an estimated area of 800 millionths and as such was a naked eye group. On Nov 3 it had crossed the CM and had lost the spots between the leader and follower groups. By Nov 4 it was of type Fkc with an area of some 520 millionths. The leading part of the group was an irregular penumbral spot while the following part comprised many small penumbral spots. It was last seen close to the W limb on Nov 9 as two spots. It survived its passage across the averted hemisphere and was seen again on Nov 25 as a single small penumbral spot at –15°/72°.



The solar disk on 2004 Nov 07, with insets showing the development of naked-eye group AR 696 between Nov 04 (left) and Nov 07. Peter Paice.

Also on the disk at the beginning of the month was another naked eye group at +9°/27°, spanning an area of some 620 millionths. It was a type Dko and comprised two penumbral spots and a smaller number of other spots. The follower spot was much larger than the leader and had many umbrae within it. When next seen on Nov 12 just a small Hsx spot was observed close to the W limb.

On November 11, a group began to develop right on the CM. On the next day it was a type Bxo at +5°/313°. By Nov 13 two small penumbral spots had appeared to make it a type Dsi and it showed signs of flare activity. Many other spots had also developed throughout the group. Larger penumbral spots had developed by Nov 14 while by Nov 16 the group was bipolar in form. It rotated off the disk by Nov 19.

Hydrogen-alpha

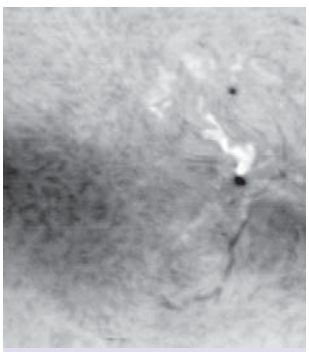
Prominence MDF = 4.9 (4 observers). An interactive hedgerow type was seen on Nov 4 on the W limb extending from –15° to –25°. On Nov 5, a small arch prominence was seen on the SW limb and two low arch prominences on the NW limb. On Nov 10 a low but unusually bright prominence was seen on the W limb, just to the south of the large spot group.

On Nov 11 there was a beautiful, large prominence complex at the E limb in the northern hemisphere, partly detached from the limb, resembling smoke blowing downwind from a chimney. On Nov 12 a group of arch prominences was seen on the W limb extending from +10° to –15°. The largest number of prominences was seen on Nov 14 but none was outstanding. A double low arch formation was seen on the E limb from +35° to +62°. One at +38° had a thin extension to the S towards a small prominence at +31°.

A filament was seen on Nov 1 in the SE quadrant extending southwards from a point just to the S of the equator at long. 140°. On Nov 3 it was seen approaching the W limb. It evidently gave rise to the prominences seen on Nov 4 described above.

On Nov 22 a long filament in the NE quadrant seemingly emanated from a spot at +13°/146° and extended northwards to just beyond the +40° parallel. I have no follow-up to it until Nov 28 when the long filament was seen in the NW quadrant in a similar position, though much more inclined veering in a NE direction towards the +40° parallel. A second smaller filament was further north, near to the solar limb. On Nov 29 both filaments were seen nearer to the W limb and the smaller most northerly connected to a prominence at +59° on the W limb.

On Nov 30 the lowermost part of the long filament was at the W limb and the first sign of promi-



Flare on 2004 Nov 30 imaged through cloud by Eric Strach.

BAA sunspot data, 2004 November–December

	November		December	
Day	*g*	*R*	*g*	*R*
1	5	92	44	3
2	4	69	42	3
3	4	81	42	3
4	4	66	31	3
5	3	66	41	3
6	4	72	22	2
7	2	79	11	1
8	3	58	19	2
9	2	47	8	1
10	2	35	11	1
11	3	42	16	1
12	3	47	23	1
13	3	53	21	1
14	4	61	20	1
15	3	57	6	0
16	3	47	14	1
17	4	52	24	2
18	4	43	27	2
19	3	36	17	1
20	3	36	15	1
21	2	30	23	1
22	3	35	25	1
23	2	29	20	1
24	4	43	25	1
25	3	39	17	1
26	3	41	15	1
27	4	51	15	1
28	3	35	21	1
29	3	36	17	1
30	3	35	21	1
31			31	1
MDFg	3.24 (41)		1.51 (50)	
Mean R	50.54 (34)		22.06 (42)	

North & south MDF of active areas g

	MDFNg	*MDFSg*
November	1.19	1.94 (27)
December	0.57	0.96 (33)

g = active areas (AAs)
MDF = mean daily frequency
R = relative sunspot number
The number of observers is given in brackets.

nences in the region +14° to +27° became apparent.

Eric Strach observed a flare on Nov 30 at 11:02. It was a gently curved brilliant jet emanating from the spot at –15°/72°. The attached image shows the flare through intervening cloud. The flare subsided two minutes later.

2004 December

Sunspot activity for 2004 December was very low with an MDF of only 1.51. This is the lowest recorded since mid-1997. On Dec 9 and 15, many observers recorded a blank disk.

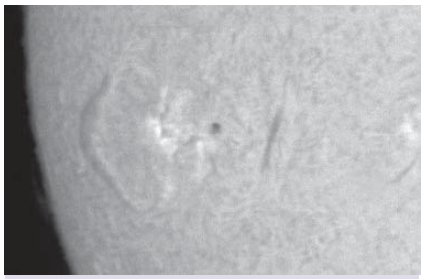
The month opened with 3 active areas on the disk, one at +10º/37º and two in the southern hemisphere of very similar longitudes: –06º/70º and –14º/72º. The southern groups crossed the CM on Dec 6.

On Dec 16 a pair of spots were seen at –12º/276º. By Dec 17 it was a type Eao with 5 spots in a line with a span of some 15º. Also on Dec 17, two groups rotated onto the disk, a fainter Cso group at +09º/148º (AR712) and a single penumbral spot Hax at –09º/128º (AR713). AR712 faded after Dec 18 while AR713 became active and expanded and developed a follower at +06º/111º which may be regarded as a separate area. By Dec 20 it covered an area of some 220 millionths. By Dec 23, the main penumbral spot had become asymmetrical with two smaller following penumbral spots. The total area of the group had reduced to 140 millionths. On Dec 25 the only penumbral spot was the leading one which became symmetrical again. On Dec 27 all following spots had disappeared to leave an Hsx spot. However by Dec 28, with the group nearing the W limb, two penumbral spots had appeared. Also on Dec 28 a new group appeared on the E limb at +05º/345º and became quite active right to the end of the month.

Hydrogen Alpha

In contrast to the low spot count, the prominence MDF of 5.26 (6 observers) was marginally up on last months value. The second half of the month was the most active.

Most prominences observed were small, however on Dec 19 a very active limb was observed with many different types seen. On the NE limb an extensive arching prominence extended from +15 to +40º NE. Fine strands of hydrogen were seen to extend high above the limb and loop down to the southernmost part of this eruptive prominence.



A spot group with preceding and following filaments, 2004 Dec 19, 11:38 UT. *Eric Strach.*

A mound prominence was seen on Dec 21 on the E limb at 57º to 64º. It first seemed solid, almost amorphous, but at an instance of excellent seeing (at 11:19 UT) its fine structure became apparent. On Dec 30, two further mound-type prominences were seen, one at +07ºto +11º, the larger one at +18º to +24º. The former had faded on the next day whilst the larger one remained almost unchanged.

With so many prominences on the E limb, it was no surprise to see several filaments on the disk, some of which were very long. One seen on the disk on Dec 21 at 11:59 UT was almost the length of half the solar radius.

Some shorter filaments were seen following sunspot groups on Dec 2 (AR708 and AR706). On Dec 19 AR713 sported a preceding filament as well as a follower at 11:38 UT.

Mike Beales, *Director*

RAS award for Guy Hurst

As this *Journal* went to press, we were delighted to hear that a former President of the BAA, Guy M. Hurst, has been awarded the prestigious Award for Services to Astronomy presented by the Royal Astronomical Society. The citation reads as follows:

> In all senses, Guy Hurst has been a leading member of the amateur astronomical community for over 30 years. Guy established the UK Supernova Patrol in 1976, encouraging amateurs to search for these objects. His outstanding skills as a coordinator ensure that amateur discoveries of supernovae, novae and comets are rapidly verified and reported to the international community, resulting in a huge benefit to both professionals and amateurs alike. He has also been the editor of *The Astronomer* magazine for 30 years, providing a major forum for amateur astronomers involved in detailed astronomical work. Guy, being more than 'just' the editor of a magazine, takes direct interest in the observations that are reported, and has devoted significant effort and a considerable amount of his own time to the promotion and organisation of the amateur community.
>
> Serving as President of the British Astronomical Association from 2001–2003, he remains Vice-President, and continues to conduct and promote active observing of the night (and daytime) sky. It is widely recognised that the work of active amateur astronomers is of considerable value to professionals, and it is fitting that Guy Hurst's work in bringing together the communities should be recognised with the Award for Services to Astronomy.

Our congratulations to Guy on receiving this very well-deserved award.

Mercury & Venus Section

Section Committee

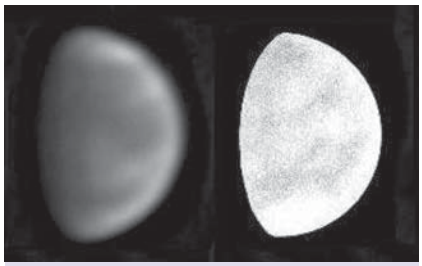
A new Section Committee has been formed. Its members are: Richard Baum, Keith Blaxall, Dr Richard Bowen, Edward Ellis, Mario Frassati, Alan Heath and Martin Taylor. We thank Peter Macdonald for his previous work in the role of Transit Coordinator.

Venus: Western elongation 2004

As reported in the last issue of the *Journal*, Venus was rather extensively imaged in the ultraviolet by numerous observers during the current W. elongation. This made it possible to make many comparisons with contemporaneous visual data, and the Director offers the illustrations given here to demonstrate that good visual observations are still of great value to the Section. Note the good accord between the drawing by Fisher and the CCD image by Akutsu, though in this instance an exact comparison is not possible due to the 11-hour time difference.

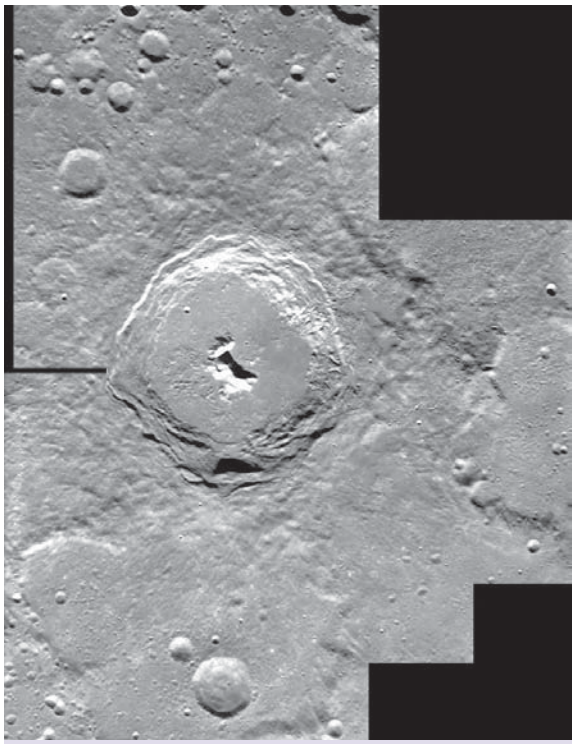
With the assistance of Alan Heath, the Director has started to analyse all the data for the E. and W. elongations of 2004. Any unreported data, especially for the morning elongation, will be most welcome.

Richard McKim, *Director*



Comparison of a CCD image with a drawing of the same date, 2004 October 6.
Left: UV (340nm) CCD image by Tomio Akutsu, 320mm refl., 21h 01m UT.
Right: drawing with Wratten 80A blue filter (slightly enhanced for publication) by David Fisher, 09h 44m UT, 216mm refl., ×153 & ×230. The observer made a similar drawing with the W23A red filter. The shading near the N. cusp was the darkest feature, and the northern cuspidal area was brighter than the southern.

Extended mission for SMART-1



A mosaic view of Pythagoras crater composed of images taken by the AMIE camera during two successive orbits on 2004 December 29 & 30 from an altitude of ~4000km. Pythagoras is a 120km diameter complex lunar crater characterised by a relatively flat crater floor, a central peak and terraced walls, which reach a height of 5000m. *ESA/Space Exploration Institute.*

On 2005 February 10 the ESA Science Programme Committee unanimously endorsed a proposed one-year extension for SMART-1, pushing back the mission end date from August 2005 to August 2006. SMART-1 became a satellite of the Moon on 2004 November 16 (see page 5 of the February *Journal*). Since then, its indefatigable ion-engine has fired for as long as 17 hours in one sustained 'burn' to stabilise the orbit. The prescribed orbit is polar with a perilune (closest approach to the Moon) of 300 kilometres over the lunar south pole and an apolune (most distant part of orbit) of 3,000 kilometres over the north pole. SMART-1 should achieve this orbit at the end of February. The first lunar orbit took days with a perilune of over 5,000km, and the original 'nominal' apolune was 10,000km.

Even after thousands of hours' running, the ion-engine (a mighty midget, not a great deal larger than a big fist) still has some xenon gas left to stabilise the orbit again later this year. This is needed because the orientation, then, would allow the Sun's gravity to perturb its otherwise smooth progress. This was the reason for the original, 'nominal' end to the mission, but the engine's success and the very careful monitoring and use by the Ground Control team has achieved the saving in fuel and got the probe to the Moon two months earlier than the 'nominal' schedule.

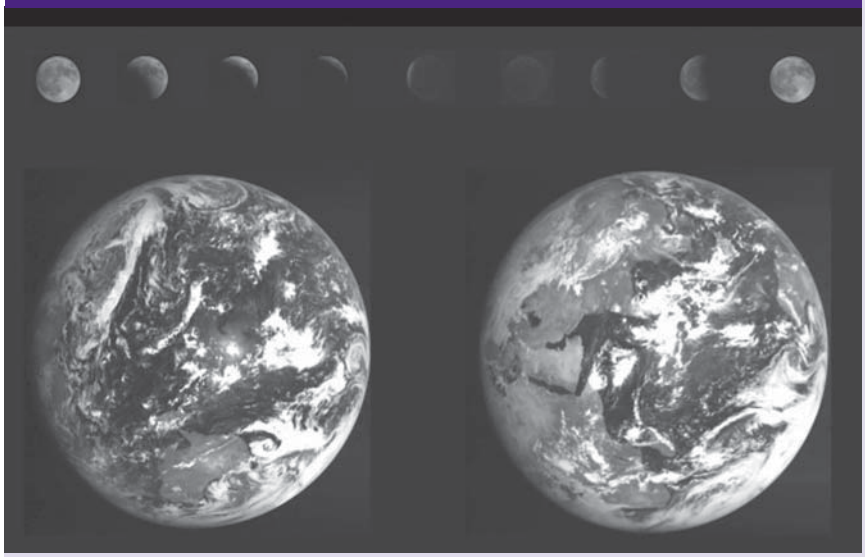
So far the pictures are non-scientific 'publicity' images and I've chosen the Pythagoras crater and the total lunar eclipse from space as two of the best. There are others, so see for yourself at:
http://www.esa.int/export/SPECIALS/SMART-1/SEMJHDO3E4E_0.html, or http://sci.esa.int/science-e/www/area/index.cfm?fareaid=10.

The extension to SMART-1's mission enables it to undertake a more thorough survey of the lunar surface and take advantage of different illumination conditions. One instrument (XSM) observes the Sun's X-rays directly and, thus, calibrates the D-CIXS X-ray spectrometer which observes them reflected from the Moon's surface. The first reflected X-ray detections occurred in January and I am very keen to learn what they revealed. A noble spectroscope (SIR) will be carrying out infrared surveys of the lunar ground, whenever conditions are favourable. The friendly camera AMIE (Advanced Moon Micro-imager Experiment) is scheduled to produce colour surveys of at least one third of the Moon by the end of April. If the Pythagoras picture is anything to go by, we are in for a real treat.

The extension is in two separate parts, each of six months, because the orientation of the orbit to the Moon and the Sun differs so much. Also, solar activity is increasing and there may be some solar flares, with consequent high intensity illumination of the lunar surface to gladden the hearts of the D-CIXS team. I have a personal hope that SMART-1 will find something exciting related to transient lunar phenomena, which have become almost respectable in the last few years.

Roger O'Brien

A lunar eclipse from space



This photo-montage shows a series of images taken with the AMIE camera on board SMART-1 during the second total lunar eclipse the craft witnessed from space. This eclipse took place on 2004 October 28. At that time, SMART-1 was about 290,000km away from Earth and at its farthest planned distance from the Moon of about 660,000km. From its vantage point, SMART-1 could see and photograph, for the first time ever, both the Earth and Moon during a lunar eclipse.

The images of the Moon are shown here in a temporal sequence, from left to right. They were taken with the AMIE camera, in visible light, between 1:14 UTC and 4:44 UTC. The 'totality' phase, in the middle of the sequence when the Moon is completely inside the Earth's shadow, lasted about an hour from 2:23 UTC and 3:24 UTC. The images of the Earth were taken just before and after the eclipse. The apparent relative size of the Earth and Moon, as shown in this picture, is exactly as seen by SMART-1. The relative distance between the two bodies, however, is not to scale. In fact, the Earth and Moon were farther apart than the field of view of AMIE and could not simultaneously fit within a single image. For this reason, a sequence of images was taken instead. In reality, the physical size of the Earth is about 3.7 times larger than that of the Moon; their diameters are about 12,800km and 3,500km, respectively. As SMART-1 was farther away from the Moon than from Earth, the difference appears exaggerated. *ESA/Space-X*

Campaign for Dark Skies

The Co-op takes the lead against light pollution

On February 9, I presented the BAA's Good Lighting Award to the Co-operative Group for their move to transform the uplighters on their retail stores into downlighters, thereby ensuring that light is directed where it's needed, not up into the sky. Since astronomy is on the schools' science curriculum, that can only be good news - at present, most schoolchildren have never seen the Milky Way.

The photograph was taken outside the Co-op store in Chard, Somerset, the store which first attracted my attention with its long uplighter, and which prompted me to ask the staff at their Head Office in Manchester, if they would reverse the uplighter to remedy the environmentally-unfriendly lighting. My request was dealt with handsomely by Mr Darren Thomas, Retail Stores Planning Manager.

Mr Thomas said that the Co-op was honoured to receive the award: 'The Co-op Group is an ethical company, so when Mrs Griffiths contacted us about our lights, we took her comments seriously. Light pollution wasn't anything we'd ever considered before because we are usually dictated to by local councils. We didn't even realise that we had been causing so much light pollution.

'Now, I'm happy to say, only 65 of our 1,800 stores have upward facing lights, the rest have already been replaced. We are pleased to be linked to a campaign that is doing so much good for the environment.'

I believe this shows the biggest problem that we have in our quest to reduce light pollution, namely that so many people are not aware. We only had to ask!

Joy Griffiths, *CfDS Local Officer*

After the award presentation to Chard Co-op. *Front, left:* Robert Garland, Chard Store Manager; *right:* Clive Netherway, Area Manager; *Standing, left to right:* Darren Thomas, Retail Store Planning Manager, based in Manchester; Joy Griffiths, BAA CfDS Local Officer; Dorothy Graham, Area Co-op Committee Manager. *Photo courtesy The Co-operative Group Ltd.*