Ordinary Meeting, 2005 March 30

held at The Geological Society, Burlington House, Piccadilly, London W1

Tom Boles, President

Ron Johnson, Nick Hewitt and Nick James, Secretaries

Mr Boles opened the fifth Ordinary Meeting of the 115th Session, and invited Dr Nick Hewitt to read the minutes of the previous meeting. These met the approval of members, and were duly signed. Mr Ron Johnson, Business Secretary, reported that three gifts had been received: *Mary Somerville*, by Dr Allan Chapman, and Sir Patrick Moore's Autobiography, both donated by Mr A.J. Kinder, and *Big Ben, The Bell, The Clock*, by Mr P. MacDonald, donated by its author. Members applauded the donors. The President reported that fifteen new members were proposed for election, and put to members the election of those 49 who had been proposed at the previous meeting. This being accepted, they were declared elected, and the President invited any newcomers to introduce themselves after the meeting.

In the absence of the Papers Secretary, Mrs Hazel McGee announced the approval of five papers for Journal publication:

The Discovery of the Correct Birth Date for Selenographer Thomas Gwyn Empy Elyer, by ??? Garfinkle
The 2004 Transit of Venus from the Open University Observatory, by ??? Cooper
Predicting Astronomical Seeing in the UK, by Damian Peach
The Sky at Night Goes South, by Damian Peach
Lunar Domes: A Generic Classification of the Dome near Valentine located at 10.26°E and 31.89°N, by ??? Lena

The President announced that the next Ordinary Meeting would be held at 14:30 on April 23, when the main speaker would be Omar Almaini of the University of Nottingham, speaking on *Quasars, Black Holes and Galaxy Formation*. In other news, he extended his warmest congratulations to Mr Guy Hurst, former President, who had received the Royal Astronomical Society's 2005 *Award for Services to Astronomy* in recognition of his work within the amateur astronomical community, both administrative and observational. Mr Hurst's work in forging and strengthening ProAm collaborations had received particular commendation, he added.

Moving onto administrative matters, he reported with regret that Ms Anne Davies had departed the Office, and a presentation was made in recognition of her services to the Association. He was pleased to announce that effective March 23, a new Manager, Ms Jean Felles, had filled the vacancy.

He then introduced the evening's first speaker, Dr Simon Green, Senior Lecturer in Planetary and Space Science at the Open University, and a specialist in the study of asteroids and comets. It was noted that Dr Green's work in searching plates from the *IRAS* infrared telescope had yielded no less than six comet discoveries. On this occasion, he would be speaking about the results of the recent descent of the *Huygens* probe into the atmosphere of Saturn's Moon *Titan*.

Titan Revealed – First Results from Huygens

Huygens, Dr Green opened by explaining, was a European-built landing probe, which had descended into the atmosphere of Saturn's moon *Titan* on January 14. It had been carried there by NASA's *Cassini* spacecraft, which remained in orbit, on an ongoing mission to study Saturn's entire system, including the rings, moons and magnetosphere. He added that, weighing five tonnes at launch, standing 6.7 m tall, and having a $3bn price tag, Cassini was something of a dinosaur; it was very unlikely that NASA would send another similarly sized craft to the outer planets again. Indeed, it seemed likely that it had survived NASA's budget cuts of the early 1990s, to which CRAF, for example, had fallen victim, only because of their agreement with ESA to fly Huygens.

A 2.7-m-diameter disc-shaped entry vehicle weighing 318 kg, Huygens had been selected by ESA as its first 'Medium Mission' in 1989; Cassini had been on NASA's drawing boards since the early 1980s. Both had finally been launched from Cape Canaveral on 1997 October 15 aboard a *Titan IVB* rocket with *Centaur* upper stage. Their interplanetary trajectory had taken them through two gravitational slingshots from Venus, one from the Earth, and then finally one by Jupiter, before arriving at Saturn on 2004 July 1.

Turning to Huygens' eventual destination, Titan, Dr Green explained that, at 5150 km across, it was larger than both the Moon and Mercury, and that it was the only planetary satellite in the solar system with an atmosphere. It had been discovered telescopically by Christiaan Huygens in 1655, after whom the present probe had been named. However, little had been known about it before this mission: its atmosphere appeared to be composed mostly of nitrogen, with methane and traces of other hydrocarbons, but the surface below was obscured by photochemical haze at 200-km altitude. *Voyager* had suggested that on the surface, the temperature was ~ -175°C, the pressure

~1.5 times that on Earth, and the gravity one-seventh of terrestrial.

The scientific interest of Titan, he explained, stemmed partly from the belief that it had formed from the same primordial material as the Earth: its atmospheric chemistry might resemble a deep-frozen, preserved copy of that from which life on Earth had developed. It was known that its atmospheric methane could be broken apart by cosmic rays, yielding a reactive ionised form, which would readily polymerise to form hydrocarbons. These in turn were the building blocks for more complex organic molecules. But here lay a puzzle: the estimated lifetime of its atmospheric methane was only one million years – within this time, the bulk of it would become dehydrogenated. The liberated hydrogen atoms would rise up buoyantly through the atmosphere and escape, making the process irreversible. Why then was methane still seen today; was some reservoir continuously replenishing it? As a final curiosity, the surface temperature and pressure lay close to methane's triple point, allowing it to transmute readily between solid, liquid and gaseous forms, potentially driving unusual weather systems and erosion.

Dr Green recalled that Huygens had originally been planned purely as an atmospheric probe; a landing science package had only been added after considerable debate, motivated perhaps by the memory of the 1978 *Pioneer Venus Multiprobe* mission, one of whose atmospheric probes had continued to function after touching down, provoking embarrassing criticism of the lack of measurements planned for this eventuality.

Upon arrival in the Saturn system, Cassini-Huygens had been carefully aimed to pass northward through the gap between the outer F and G rings. This was perhaps the riskiest moment of the entire mission: whilst this gap was believed to be comparatively void of ring particles, a single collision could have destroyed the craft. To minimise the danger, it had rotated such that its high-gain antenna, its most resilient part, faced the direction of travel during this passage. Then, after a 20-minute orbital insertion burn by Cassini's engine, skimming a mere 20,000 km above Saturn's cloud-tops, it had returned southward through the same gap on the opposite side of the planet, never again to venture so dangerously close to it during its four-year mission.

Originally, it had been planned that Huygens would be released during Cassini's first orbit. The motivation for this was two-fold. Firstly, every orbit carried a small risk of a devastating impact with a ring particle, making it desirable to perform high-priority science as early as possible. Additionally, every manoeuvre by Cassini used more of its valuable fuel reserve while Huygens remained aboard.

However, Dr Green explained that an embarrassing problem, discovered mid-flight, had forced this to change. Huygens was to beam its data back to Cassini, to be later relayed to Earth. The problem was that as its speed changed upon entry into Titan's atmosphere, its radio signal would be redshifted. Cassini's antenna had a wide frequency response to account for this, but engineers had overlooked the effect of the redshift on the data rate, rendering the antenna quite unable to synchronise to Huygens' transmission. This could not be rectified by software patch, and so the geometry of the mission had had to be changed to place Huygens' entry path into Titan's atmosphere perpendicular to its line of sight to Cassini, to minimise the effect.

This was found to be possible if Huygens' release was delayed until Cassini's third orbit; the speaker personally felt that this arrangement had actually been preferable to the original plan. Giving a preview of what was to come, Cassini had imaged Titan from a distance of 338,958 km on July 3, prior to Huygens' release, though this had been too late for any change of landing site. Imaging at infrared wavelengths, sensitive to the presence of water and complex organic material, it had revealed features appearing remarkably like oceans of hydrocarbons.

Turning briefly to Cassini, the speaker displayed a gallery of its finest images, revealing Saturn's weather systems, and the cratered surfaces of its moons, in astounding detail. During its four-year, 74-orbit, mission, it would have close approaches with seven of the 35 known moons. His personal interest lay primarily in the dust in Saturn's system, and so he showed some images of its rings, many taken in the midst of its close encounter with them during orbital insertion. Fine filamentary and wave-like structures had been identified in several of them, caused by gravitational interactions with the moons.

Images of the A ring showed density waves, not dissimilar to the spiral arms of galaxies, while those of the E ring showed, in unprecedented detail, how the moons *Prometheus* and *Pandora* on either side *shepherded* it, carving its sharp edges. Chemical analyses of the F ring had shown similarities with the moon *Enceladus* within it, supporting ideas that it had formed from the debris of meteoritic impacts. Studies of the grain sizes had revealed a trend of increasingly large particles going outward through the ring system; this might yield interesting insights into its origin, especially when combined with *Voyager* data to probe its evolution over the intervening two decades.

Returning to Huygens, Dr Green explained that it had been only a three-hour mission. Released from Cassini on 2004 December 25, it had cruised through space with no systems active except a wake-up timer, which had reawakened it on January 14, fifteen minutes prior to its impact with Titan's upper atmosphere, at an estimated altitude of 1,270 km, and speed of 6 km/s. After passing through its peak deceleration, and then opening a pilot chute, its main parachute had opened at an altitude of 160-180 km, slowing its descent to 80 m/s. A spring had released its heat-shield shortly thereafter, revealing the instruments beneath, and allowing the scientific work to begin.

After 15 minutes, its descent having slowed to 40 m/s, a smaller stabiliser parachute had replaced its main parachute, the motive here being simply to get it to the surface within its operational lifetime. After accelerating briefly to 100 m/s, the thickening atmosphere had slowed it to a leisurely 5 m/s before impact with the surface. The mission design lifetime was 153 minutes: 2.5 hours for the probe to descend through the atmosphere, and only three minutes of guaranteed operational time after touchdown – just enough to establish the nature of the surface upon which it had landed. In the event, it had returned data from the surface for 1 hour, 9 minutes and 36 seconds, terminated only when Cassini sank beneath its horizon and could no longer receive its telemetry.

Turning to Huygens' armoury of instruments, the speaker discussed the *Huygens Atmospheric Structure Instrument* (HASI) first, which had monitored Titan's atmospheric pressure, temperature, and density throughout the descent, as well as the gas' electrical properties. Among its most notable discoveries announced so far was that Titan was thought to be free of lightening.

Chemical analysis of the atmosphere had been undertaken by the *Gas Chromatograph Mass Spectrometer* (GCMS) experiment, looking especially for the presence of noble gases and organic species. Early results suggested that Titan's noble gases had been significantly depleted compared to those of other solar system bodies. The significance of this lay in the physical similarity of argon to nitrogen: if Titan's primordial argon had escaped, so too should its nitrogen, suggesting its present nitrogen to have formed later; the photodissociation of ammonia was one possible source.

A study of aerosol particles had been conducted by the *Aerosol Collector and Pyrolyser* (ACP), which had shared the GCMS's mass spectrograph. Its results were yet to be announced.

Perhaps the most eye-catching returns were from the *Descent Imager and Spectral Radiometer* (DISR), which had operated seven cameras. Some pointed downwards, capturing images of the surface below; others pointed sideways, capturing the horizon; others upwards, imaging the scattering of light around the Sun, from which information could be gleaned about the atmospheric density of aerosol particles. Dr Green remarked upon the challenge that DISR's engineers had faced: Titan's thick atmosphere absorbed 90% of the Sun's light and, together with its remoteness from the Sun, rendered it a very gloomy environment, 1,000 times darker than the Earth. In its descent, Huygens had been moving at high speed and spinning at 7 rpm, making long exposures impossible, while Titan's haziness had presented still further problems.

The speaker showed mosaics of DISR's images where it had been possible to match them together. He urged that these were only preliminary results: the full processing of images taken in such difficult conditions would take many months. Surface features and relief had come into view at an altitude of 20 km, he reported, discrediting previous theories that Titan's surface was a global ocean.

A *Doppler Wind Experiment* (DWE) had hoped to record information about wind speeds, using the redshift of Huygens' communication signal, as measured by Cassini, to monitor its speed as Titan's winds buffeted it. The same redshift would also be monitored from terrestrial radio observatories, gaining additional measurements of Huygens' speed in a different direction. Dr Green explained that at the time of launch, measuring Huygens' radio signal – at 10 W, comparable in strength to a mobile telephone – from the Earth had not been feasible. It had since become comparatively easy, and so this latter experiment had been planned in flight.

In the event, the Cassini-based DWE experiment had failed. To minimise data loss, Huygens had been designed to transmit two data streams, labelled 'A' and 'B', which were largely duplicates. Channel A had failed due to a software fault on Cassini, and, while most experiments had lost only minimal data where engineers had taken advantage of the two channels to transmit more data, the DWE, measuring the redshift of A, had lost all. Whilst it would have been little consolation for those who had worked on the instrument, the terrestrial experiment had provided a rough indication of the winds which the DWE would have measured.

Dr Green added that Earth-based detection of Huygens' telemetry had been the first indication of the mission's success. Mission scientists had known, upon seeing its signal, that the probe was still intact, and had even known that it had touched down safely when its signal had continued after a sudden redshift change around the predicted landing time, indicating a jolt. But, unable to decode the radio data from such a distance, they had faced an agonising wait for that to be forwarded by Cassini. As Cassini had been unable to turn its main transmitter to the Earth until it had finished listening to Huygens, this had meant a delay of three hours, plus a further 67 minutes while its signal travelled to the Earth. To add to the tension, the data of the doomed channel 'A' had been broadcast ten minutes before that of 'B', telling of the failure of the former before the success of the latter.

Turning finally to his own specialist interest, the *Surface Science Package* (SSP), with which the Open University had been most actively involved, the speaker explained that, without knowing in advance whether it would land on liquid, mud or solid, its design had been quite a challenge. The result had been a collection of nine separate sensory subsystems; in all three scenarios, some would be useless, while others would make scientifically valuable measurements. The package had been generally tailored towards a liquid landing – eight out of the nine working in that case – because Titan's eccentric orbit around Saturn was more easily explainable if it had a global ocean. If Titan's primordial liquid content had frozen at some point, it would be expected that the resulting solid crust would have tidally deformed as it moved closer and farther from Saturn, dissipating Titan’s orbital energy and circularising its orbit within the age of the solar system.

In the event, Huygens had landed on solid ground, where four of the subsystems had been usable. Sonar ranging of the surface had started from an altitude of 100 m, producing a curious double-peaked echo, indicative of surface features on 10-m scales. Unfortunately this behaviour had ceased shortly before touchdown, and so the landing site might have been atypical. Estimates of the altitude dependence of the speed of sound, computed from the echo delay, suggested an increasing methane concentration close to the ground, supporting theories that it vented from Titan’s surface. However, early indications were that the shore-like features which DISR had imaged did not neighbour liquid reservoirs at the time of Huygens’ visit.

Another sensor had thrust a probe into Titan’s soil upon touchdown, measuring the required penetration force. It had detected a sharp spike of resistance upon initial contact with the surface, after which it had slid in rather more easily and with steady force. At first sight this suggested a surface composition not dissimilar to that of crème brûlée, though a bounce from a surface pebble was another possible explanation. Laboratory tests were under way, searching for materials which reproduced this profile using a duplicate of the probe, attached to a rig which accelerated it to an appropriate impact speed.

Other sensors, developed to measure the refractive index and physical density of surface liquid, proved useless. Further experiments, accelerometers and tilt-meters to measure any rocking motion of Huygens due to surface waves, also proved useless on the surface, but returned valuable data during descent; Dr Green noted that they had detected friction with Titan’s atmosphere from 1,400 km altitude. They had also detected an unexpected 7-rpm wobble in the craft’s motion at high altitude; this might be explained aerodynamically if its centre of mass had been displaced from its geometric centre, causing it to move as it rotated, but the motion had intensified upon the opening of the stabiliser parachute, and that remained unexplainable.

To close, the speaker reminded members that the analysis of Huygens’ data legacy had only just begun: many new discoveries would emerge in coming months. Even then, their true significance might not be fully appreciated for years, until new questions were asked of them. Looking ahead, new insights would be provided when Cassini used radar to map the landing site. Its planned orbit would allow it to start this work on its eighth orbit, in 2005 October, though much of it would have to wait until 2007-8.

Following the applause for Dr Green’s full account of Huygens’ discoveries, the President regretted to announce that there was no time for questions, before inviting Mr Martin Mobberley to present his regular Sky Notes.

The March Sky

Mr Mobberley opened by commenting that the past few months had been exceptionally cloudy, and so the display of observations this month would be rather limited. Another consequence was that there were very few new supernova discoveries by UK amateurs to report, even though this was his first Sky Notes instalment since December. Tom Boles’ only discoveries in the intervening months had been a spate of four, all within a space of five days in January, when weather had permitted observation. Despite the slow progress of late, however, with his discoveries now numbering 86, it seemed his century could not be far away. In addition, Ron Arbour had made his fifteenth discovery, 2005au, on March 19.

There had been a spate of novae of late, though none had been readily UK-observable. The first had been Cygnus 2005 (V2361 Cygni), discovered from Kakegawa, Japan, at mag 9.7 on February 10 by Hideo Nishimura. Nick James had succeeded in imaging it from Chelmsford at 19h10 UT on February 12, when it had been setting at an altitude of only ~10° above his north-western horizon. Its light-curve had shown a rapid dimming and reddening, dropping below mag 17 by March 13, suggesting it to be of an interesting type, where a substantial dust cloud had formed around it at an early stage in its outburst.

On March 13, Liller had discovered another, Nova Norma 2005 (V382 Nor), from Chile. It had been mag 9.4 (red band) at discovery, though at declination –52°, not UK-observable. Also on March 13, variable star DO Draconis, an intermediate polar system, had been detected in outburst at mag 11.2. This followed several flares in recent years, most recently on 2004 January 23.

For those interested in observing supernovae, two old events remained readily CCD-observable: the first being 2004dj, discovered in NGC 2403 on 2004 July 31, which had been in a plateau phase at a little below mag 15 since November, and the other 2004et, discovered on 2004 September 27, now holding steadily at mag 13.0-13.5. A more recent event, 2005ay, discovered from Maine by Doug Rich on March 27, would be visible for at least a few more days.

The speaker summarised observations of the March 10 occultation of mag 7.7 star HIP59732 by mag 12.7 asteroid 209 Dido, though there had been cloud cover along most of its track through Europe. Having previously been touted as *the* occultation of 2005, there had only been three positive observations and timings in the event, all from northern Italy. Hence only three chords could be placed across the asteroid’s disk to constrain its shape. However, as some consolation, the speaker looked forward to the October 15 occultation of mag 1.4 Regulus by 35km-diameter asteroid Rhodepe, itself a faint mag 15.4, which, given the brightness of the star, would be naked-eye observable. Regrettably, its path did not cross the UK: observers would need to travel to Portugal, Spain, southern Italy, Greece or Turkey to see it. Given that the maximum duration would be 1.1 seconds, this seemed rather a long journey for a single second of excitement.

Moving onto the comet scene, Mr Mobberley reported that C/2004 Q2 (Machholz), fading at mag 7, remained the brightest comet in the sky, having peaked in excess of mag 4 shortly after its January 6 perihelion. C/2003 T4 (LINEAR), presently at mag 8 and close to its April 3 perihelion, had not performed as well as had been expected; Jonathan Shanklin described his observations as "disappointing". In summary, there were no particularly spectacular comets at present. However, looking back to January, Machholz had provided a very pleasing display, the speaker noting its passing around a degree to the west of the Pleiades in particular, when its tail had crossed the cluster's nebulosity, appearing briefly to merge with it. It was now within a few degrees of the celestial north pole and would descend in declination through April and May, entering Ursa Major on April 22, and then Canes Venatici on May 18.

The speaker noted that another of Machholz's discoveries, 141P/Machholz, was also presently observable at mag 13. In the coming month, it would pass westward into Taurus on April 4, before heading on into Orion on May 4. 62P/Tsuchinshan could be found looping around Coma Berenices, where it would remain until late May.

9P/Tempel 1 was given a final mention, since on 2005 July 4, NASA's *Deep Impact* mission would be impacting it with a 370-kg projectile, travelling at a velocity of 10.2 km/s (23,000 mph), before monitoring its subsequent activity and resultant cratering. Presently in northern Virgo at mag 12, it would head southward through May and June, passing ~7° to the east of Jupiter around June 7, and ~3° north-east of Spica on the date of impact. Regrettably, it would be beneath the UK horizon at the time of impact, 06h00 UT, which would also be in UK daytime. Throughout July, however, it would remain ~7° above the UK south-western horizon at the end of evening twilight, at around 22h30 UT. During this time, it might brighten dramatically, as a result of the blast's ejection of ice and dust debris, as well as the exposure of a large, fresh area of its surface to sunlight. Mark Kidger, among the bolder of amateur comet enthusiasts, had predicted a rapid brightening to mag 0, followed by a return to normal activity over a period of weeks; others made more modest predictions.

Mr Mobberley moved on to discuss lunar observation – rarely mentioned in Sky Notes, but the outstanding images he had seen in recent months seemed cause for an exception. He explained that the waxing phases of recent moons had been close to their most northerly possible declination of +28.5°, placing them high in the UK sky, where the seeing was good. He added that the Moon's declination oscillated about the equator with a 27.2-day period – the *anomalistic* month – and that the amplitude of this oscillation itself varied with an 18.6-year period. This amplitude was now close to its maximum, which would be attained in 2006 June, when the lunar declination would peak at ±28.5° each month. In March, the Moon had reached its northerly extreme around First Quarter. The same would be approximately true in coming months, on account of the closeness of its oscillation period to the 29.5-day *synodic* month (period between like syzygies).

The speaker explained that the 18.6-year cycle resulted from the 5.1° inclination of the Moon's orbital plane to that of the ecliptic, around which it precessed with the aforementioned period due to solar tidal forces. When it was inclined in the same direction as the Earth's equatorial plane, the Moon's declination would oscillate with minimal 23.5 – 5 = 18.5° half-amplitude each month. In 2006 June, however, the plane's inclination would be in the opposite direction, giving rise to a maximal 23.5 + 5 = 28.5° oscillation.

In addition, the speaker added that he had been monitoring wind speeds at a range of altitudes in the Earth's atmosphere[1] recently – low speeds usually yielding good seeing conditions – and had noted a period of exceptional stability around March 18/19, coincident with the Moon reaching its high-altitude First Quarter. He proceeded to show a series of exceptionally clear images captured by Jamie Cooper and Damian Peach on that night. Looking ahead, he added that in the forthcoming month, the Moon would once again be highest around the time of its reaching First Quarter.

Moving onto planetary imaging, he reported that Jupiter now transited at around midnight. In recent months, Dave Tyler and Damian Peach had been producing some spectacular images, but perhaps the most notable that he had seen were those by Zac Pujic in Brisbane, Australia – a name which he confessed to not having come across before. He remarked that Pujic's March 4 images were so sharp that at a quick glance they could easily be mistaken for HST images. With Jupiter now in the southern hemisphere, and quite low in the UK sky, Mr Peach had been optimising his imaging techniques for low-altitudes. He used infrared (I), red (R) and blue (B) filters, omitting to image in green (G) light to maximise the integration time in the other colours. He later synthesised a G image by co-adding the R and B frames. The luminance of the final image was set to the sum of the R and I images, while its colouration was taken from the RGB frames. This technique, termed *LRGB*, produced pleasing results, as images taken in the infrared typically seemed sharper than those taken in visible bands.

Saturn, now in Gemini, transited at 6.30pm, and Mr Peach had recommended observing as early in the evening as possible, even in twilight, to get the steadiest possible image as it sank towards the horizon. The speaker remarked upon the exceptional images taken by several members on the night of its opposition, January 13, in which the rings shone which extraordinary brilliance. He explained that this was a remarkable example of the *Opposition Effect*. Normally, the Sun's rays illuminated the small particles composing the rings at an angle to our line of sight, causing some of those exposed to our view to be shadowed by other particles, reducing their overall unresolved brightness. However, at opposition, on March 13, our line of sight had drawn within 5' of the direction of the Sun's rays. In this orientation, virtually all of the particles in view had been sunlit, and thus the rings had briefly appeared considerably brighter than usual.

Mars was presently unobservable, rising with Capricornus in dawn twilight, but would soon be visible earlier in the night, becoming an easy target by August.

To close, the speaker mentioned the forthcoming total solar eclipse of April 8, when totality would last a maximum of 42 seconds. It would be a *hybrid* eclipse – a rare type of total eclipse which reduced to an annular event at the two geographical ends of its path. He explained that this behaviour arose in consequence of the Earth's curvature. Total eclipses were seen when the Earth passed within the Moon's umbral shadow, and annular eclipses when the Moon was in a more distant part of its orbit, where its angular size was less than that of the Sun, and, as a result, the Earth passed behind its umbra, the vertex of that cone-shaped shadowed volume of space falling short of its surface. Hybrid eclipses were an intermediate case, where the curvature of the Earth's surface caused the umbra's vertex to fall beneath it at the centre of the eclipse path, and above it at either end. On April 8, the path of totality would be confined to the southern Pacific Ocean, not crossing land at any point, though annularity would be visible from Venezuela, Colombia and Panama.

Hybrid eclipses, the speaker explained, were around eight times more rare than total solar eclipses; the last such events had taken place on 1986 October 3, when totality had been shorter than a second, and 1987 March 29, when it had lasted 8 seconds. The next would be on 2013 November 3, when totality would last 99 seconds.

Following the applause for Mr Mobberley's talk, the President welcomed the evening's final speaker, Mr Bob Marriott.

BAA Instrument Number 1

Mr Marriott explained that since taking over the post of Curator of Instruments 14 years previously, he had been striving to recover the large number of items which were lost from the Association's instrument collection – those which had apparently been loaned out to members, but never returned. At a recent count he had recovered 38 of them, but still some frustrating omissions had remained, one particularly notable example being the first item ever to have entered the collection, a 31 mm-square specular metal diffraction grating. It had been presented to the Association in the year of its foundation, 1890, as a gift from John Brashear, a prominent American instrument-maker at John Hopkins University, who, upon touring Europe, had been especially impressed by the amateurs whom he had met in the UK. An inscription engraved upon the grating's surface recorded that it had been engineered on Rowland's famous ruling engine in the workshops of John Hopkins University, famed for its then-unprecedented exactitude.

The speaker reported that it had last been seen in 1952, when it had been loaned out to a member, of whom no trace could now be found. To his excitement, however, he had received an unexpected telephone call in 2004 September, from a member apparently wishing to return it. A subsequent trip to Worthing had proved fruitful: in addition to recovering the grating, which he held up for members to see, he had also received a Stevenson spectroscope for the collection.

Mr Marriott then recounted those members who had used the instrument before its loss, noting that many were notable figures in the annals of the Association. He was surprised that no observations made with the instrument seemed to survive, however. He remarked upon how regrettable it seemed that there were now so few amateurs making spectroscopic observations, given that the equipment was now so readily available, and how active the Association's members had been in such work in its early history, particularly in the early 20th century, when cellulose gratings had first appeared.

Following the applause for Mr Marriott's account, the President congratulated him on his tireless efforts to recover such historic instruments from the Association's past. The meeting was then adjourned until 2:30pm on April 23, at the English Heritage Lecture Theatre.

Dominic Ford

References

[1] http://weather.unisys.com/aviation/6panel/avn_300_6panel_eur.html