Joint meeting of the BAA and the Society for the History of Astronomy

held on Saturday, 2007 April 21 at the Birmingham and Midland Institute, Margaret Street, Birmingham

Dr Richard Miles, BAA President, opened the meeting at 10:00 am with 79 people in attendance. He thanked the SHA for making the joint meeting possible and introduced the first speaker, Peter Grego, to talk on 'Lunar and Planetary Observing: learning from our legacy'. Peter traced the importance of telescopic visual observation of solar system objects from the earliest times of Galileo and Thomas Harriott through to the present day. In turn, he discussed observing the Sun, Mercury, Venus, the Earth itself, and finally his favourite, the Moon.

He explained how solar observation was possible via eyepiece projection, and that Harriott's drawings of sunspots made soon after the invention of the telescope were particularly accurate but that mysteriously he never published his work, unlike his successor Christopher Scheiner, who postulated in the 1630s that sunspots were satellites in transit across the bright disk of the Sun. The key to understanding lay in attention to detail and faithfully reproducing fleeting views of fine telescopic detail. As telescopes improved in performance, so did the quality of drawings made along with a better understanding of the underlying physical phenomena. By the mid-19th century, observers began to record the orientation of the solar disk and Carrington discovered the gradual drift of sunspots towards lower solar latitudes as each solar cycle progressed. Peter pointed out that although we are now in Carrington cycle number 23 and photography and CCD imaging has largely taken over, drawings continue to be made at the Mt Wilson Observatory to maintain an unbroken historical record. Indeed, many amateur astronomers continue to gain much enjoyment and satisfaction from making accurate drawings of the Sun, faithfully recording detail seen in the process.

The first drawings of Mercury of which Peter is aware, appear to be those made in the late 17th century by G. D. Cassini at the Paris Observatory. However little progress was achieved for over two centuries before Percival Lowell made a map of the planet depicting linear structures, contrasting with those of Schiaparelli and later Antoniadi. For a long time, it was thought that Mercury's rotation was locked to its orbital period but this was largely illusory due to a stroboscopic selection effect.

Peter pointed out that like Mercury, Venus also presented problems for the visual observer since we now know that clouds in the planet's atmosphere obscure any view of the surface, making it impossible to determine the rotation rate. The unusual telescopic appearance of Venus was known from early times. In particular, Johann Schröter noticed that the time when dichotomy is reached (i.e. when the planet appears to be 50% illuminated) occurred early during evening apparitions and late during morning apparitions. We now know that the 'Schröter effect' is a consequence of the planet's thick atmosphere. Visual observers have on many occasions recorded irregularities along the terminator and towards the poles or cusps.

The Grade II Listed building of the Birmingham & Midland Institute. *Photo: Stuart Williams*

Peter then suggested that terrestrial field studies are a form of observation, but in this case of the Earth itself. Most crucially, he explained that field sketches can concentrate on important geological features to make them clear, unlike a photograph, which records details indiscriminately. John Ruskin's work depicting the true nature of the Alpine peaks is an example of this.

Last but not least, Peter turned to the subject of the Moon, the appearance of which was first drawn with the aid of a telescope by Thomas Harriott, most notably in his sketch dated 1609 July 17. By 1651, Riccioli had produced a map of the Moon and had introduced a system of nomenclature. Excellent drawings were made of lunar features during these early years; for example Peter showed that of the crater Albategnius by Robert Hooke, as depicted in his book *Micrographia* in 1665. Peter then listed the reasons why visually recording lunar features is still worthwhile, including a) not all of the nearside has been mapped; b) even where it has been mapped detailed visual observation can reveal new features as in the case of Graham Wheatley's drawing of the floor of the crater Ptolemaeus; c) it provides a good way to learn the names of the various lunar features; and d) improving one's drawing skills.

Finally, Peter showed how modern technology can be utilised by the visual observer. One example being that a CCD image taken by the observer can be printed out and used as a model on which to record visual detail, and another that a Personal Digital Assistant (PDA) can be used in place of paper to make records at the telescope.

The second speaker was Anthony Kinder, Director of the BAA Historical Section. His talk on, 'Why History', struck an immediate chord with SHA principles. Anthony said that all that was needed was an interest in recording history. In the UK, astronomical observation goes back at least to the time of Stonehenge. He did not consider himself an astronomer and had little interest in astronomical objects in their own right, but he was interested in the history of astronomy and of astronomers.

Anthony has accumulated over 4,000 biographies of astronomers. His ongoing project is to collect biographical details of all members of the BAA since its foundation in 1890, and he welcomed any information from present and former BAA members.

Detail mattered in any historical research and previously unrecorded material, no matter how trivial, added valuable weight to previous studies and built up a truer picture of the subject. Individual quirks are of particular interest but are rarely recorded. For instance it is said the Astronomer Royal, George Airy, didn't get on with Edward Maunder because Maunder was a civil servant-astronomer and, unlike Airy, not classically trained in his subject.

Anthony considered libraries and historical archives as fundamentally important sources of biographical and historical material. They contain the most information, including original papers and written documents, and serendipity dictates that you find more than you look for. The Internet is of limited use as only already-known information is available, although genealogical records are invaluable (what you look for is what you find). The growing use of e-mail is considered a hindrance for future historical research, as original documents are unlikely to be saved.

The historian must preserve the past by recording objectively and accurately, and if necessary correct any popular inaccuracies. For instance, neither the Rev John Flamsteed nor Dr Edmund Halley were knighted. William Herschel was never Astronomer Royal; at best he was a royal pensioner. Robert Ball was British, not Irish. Anthony regarded the SHA's Sir Robert Ball Library as very important. A library of the history of astronomy needed to have astronomy books contemporary with the date of the historical and biographical material it contained, so that both could be referenced in mutual context. He praised the SHA survey of Britain and recommended that as intended in the very early days of the BAA, newspaper cuttings pertaining to regional astronomers and their interests should be collected and archived. This had never been done by the BAA nor had any early astronomical literature been collected in spite of many BAA Founder Members, like Huggins and Maunder, having had a keen interest in astronomical history.

BAA Historical Section Director Anthony Kinder. *(Stuart Williams)*

Records from different cultures helped a broader understanding of events such as historical supernovae and comets but astronomical books have also been published in many different languages and both modern and contemporary translations are a valuable source of historical information. Astronomy is an international subject and many cultures have a rich astronomical legacy that is part of their history.

Anthony Kinder's message was simple: the astronomical historian has a goldmine of information available that is still waiting to be studied.

The third speaker of the day was SHA councillor and founder member, Roger Jones, who gave a fascinating and well-illustrated presentation about the Victorian astronomer, writer and lecturer, Sir Robert Stawell Ball. The main theme of Roger's talk was Ball's well-attended public lectures on popular science and astronomy, that he gave throughout the UK and in America in the late 19th century.

Sir Robert Ball was involved with the Birmingham and Midland Institute for more than thirty years, lecturing here on many occasions during the late Victorian era and becoming its President in 1891. The SHA's reference library is dedicated to him as a fitting tribute to his involvement with the Institute. He is remembered for his many popular astronomy books such as *Starland* and especially his *Story of the Heavens*.

Born in Ireland in 1840, Robert Ball had a privileged upbringing, with private schooling in England before attending Dublin's Trinity College where he had a brilliant university career, gaining honours in mathematics and experimental physics and graduating in 1865. He had no formal astronomical training; his first practical experience came when he went to Birr Castle as tutor to the sons of the Earl of Rosse, where he also took charge of Rosse's 72-inch reflector, the 'Leviathan of Parsonstown'.

He spent several years as professor of Mathematics at Dublin's new Royal College of Science. In 1874, he was appointed to the Andrews Chair of Astronomy, at Trinity College, which carried with it the position of Royal Astronomer of Ireland, and a move to Dunsink Observatory.

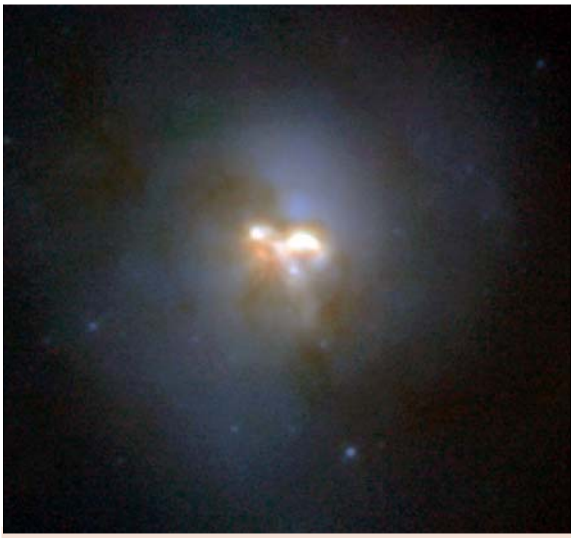
His first lecture to a paying audience was in 1869 at the Belfast Athenaeum and was entitled 'Some Recent Astronomical Discoveries'. He was offered a fee, but said he was happy just to recoup his expenses of 14 shillings. In later years, he was not so generous and commanded a substantial fee for his lectures. In 1874 he was invited to lecture on engineering at the Midland Institute of Birmingham and this led to his giving several public talks on mechanics and popular science, including astronomy, elsewhere in the Black Country. As Robert Ball became more widely known as a speaker and an author, he was invited to give talks throughout the UK. His oratory alone would have kept his audiences spellbound, but Ball was also an expert in the use of visual aids, particularly the magic lantern.

Roger Jones's talk reminded us that in the 19th century the average working man had limited access to public libraries, and lectures were a comparatively cheap and very popular source of scientific and cultural information for those that wanted to learn. Roger used numerous anecdotes to illustrate Ball's immense popularity.

In 1892, Robert Ball moved to England, to Cambridge University, replacing John Couch Adams as Lowndean Professor and Observatory Director. Once at Cambridge, he enjoyed something of a celebrity lifestyle. Browsing *The Times* archives, Roger found more than 300 entries about him. There were many Court Circular notices of his public appearances, including his attendance at the Westminster Abbey funerals of Gladstone and Tennyson. Hardly a week went by when he was not attending some meeting or other.

The total number of lectures Robert Ball gave is not known, but between 1874 and 1884 he gave 700, and he lectured continuously for the next 20 years. He probably lectured publicly more than 2,500 times. It is estimated that, not counting the many thousands of students and fellow scientists who heard him speak, at public venues he lectured to well over one million people. For 35 years, from 1874 to 1909, Sir Robert Ball virtually personified astronomy to the English-speaking world. He died on 1913 November 25, aged 73, and is buried in St Giles cemetery, Cambridge, a few hundred yards from the observatory and near his predecessor, John Couch Adams.

After the lunch break, Richard Miles opened the afternoon session with a lecture by Dr David Clements who spoke about the proposed 'Herschel Space Telescope'. This will be an orbiting observatory designed to explore the infrared universe. William Herschel discovered infrared radiation extending beyond the visible spectrum in 1800. Launch of the telescope on top of an Ariane-5 rocket is scheduled for end July 2008 and will be a cornerstone mission for the European Space Agency (ESA). The telescope will have a



Ultra-luminous infrared galaxy Arp 220 imaged by the NICMOS infrared camera on the Hubble Space Telescope. The cores of two colliding galaxies have provoked a burst of star formation in the nucleus. *NASA/STScI*

3.5-meter silicon carbide mirror (the largest that can be physically handled at present), which is large for even Earth-based observatories, and will operate in the far infrared (60–600 micron). UK establishments are involved in what will be the largest and most ambitious ESA mission to date.

Dave Clements went on to explain some of the thinking behind the mission. By working in the far infrared, the observatory will measure the characteristics of matter that is only a few tens of degrees above absolute zero, which will contribute to our understanding of dark matter. Also the cosmological expansion of the universe shifts visible and even UV light well into the infrared. For example, the Herschel Observatory will be used to study the Hubble Deep Field. Other topics of interest are the formation of stars and planets, the structure of our own galaxy, and so-called 'starburst' galaxies. The unifying factors are interstellar grains and interplanetary dust particles. The telescope will see this dust directly in emission rather than by absorption in the visible spectrum. Starburst galaxies are formed by galaxies in collision and most star formation takes place within the dust, hidden completely from optical wavelengths.

Some galaxies termed ULIRGs or Ultra-Luminous Infrared Galaxies emit more than 99% of their energy in the infrared. These are particularly interesting in that they are likely to contain at their centre a supermassive black hole. Arp 220 is Dave Clement's favourite ULIRG, it being the nearest and comprising two galactic nuclei in collision separated by just a few hundred parsecs.

He showed a plot representing the cosmological background radiation and explained that the entire history of the universe is contained in the diagram if only we could understand it! How will the Herschel Space Telescope help to solve such problems in cosmology? It will do so by working at very long wavelengths with unprecedented angular resolution and sensitivity (the detectors will be cooled to 0.3 degrees above absolute zero) and by being situated about 1.5 million km from the Earth at the Lagrangian L2 point, behind a large sunshield so as to minimise interference from solar radiation.

After thanking Dr Clements for his future-looking talk, the BAA President introduced Drs Stephen Serjeant and Chris Pearson, who between them would describe the AKARI/ ASTRO-F space mission launched into space in 2006. Chris kicked off their double-act by explaining how the Japanese AKARI mission represented a continuation of a long line of successful space-borne infrared observatories starting in 1983 with IRAS, followed by IRTS in 1985, ISO in 1997 and finally Spitzer in 2003. The primary goal of AKARI is to map the entire sky in the 60–200 micron region, using a second IR camera to follow up looking at specific objects at shorter wavelengths in greater detail. The main mirror is some 67cm in diameter and the survey instrument has a 1° field of view. To date (2007 April) most of the sky has already been mapped and it is hoped that the entire sky will eventually be covered a second time before the coolant runs out.

To give an impression of the survey work, Dr Pearson compared the results with those of the IRAS survey. Whereas IRAS merely revealed the existence of IR sources, AKARI is able to show their actual nature. He demonstrated this by the example of images of the spiral galaxy M81 taken at six different wavelengths ranging from 3 to 24 microns. The spectra of ULIRGs have revealed their chemical compositions including water, carbon monoxide, carbon dioxide, silicate dust and hydrocarbons. Star-forming regions within our own galaxy show evidence of second generation and even third generation stars being created.

Dr Serjeant then took over the account by remarking how thrilling the whole enterprise has been in that it involves not just cataloguing objects but also researching into their origins – the so-called 'Pillars of Creation' within the Eagle Nebula being a prime example. AKARI has detected red giant stars within globular clusters shedding their outer envelopes of material. Of the extragalactic background light, for every three photons received, two have been absorbed by dust and re-emitted.

On the subject of the distant universe, AKARI is complementary in that it fills a gap between IRAS and Spitzer. One important question is the rate of star formation throughout the universe as a function of the redshift, z. At values of z of 5–10, light from the normally UV-bright star-forming regions is shifted well into the infrared and even towards the microwave region of the spectrum. Comparisons will be made between optical (e.g. the Sloan Digital Sky Survey or SDSS), AKARI and sub-millimeter surveys of the sky. Finally to round up, Stephen Serjeant mentioned the forthcoming PLANCK spacecraft and that a follow-up to AKARI is anticipated, a joint Japanese/European mission termed SPICA which will utilise extreme cooling of the detectors on board the craft.

Following the mid-afternoon tea break SHA Chairman, Gilbert Satterthwaite, introduced the final lecture. The speaker was SHA Honorary President, Dr Allan Chapman, who had of necessity arrived late having lectured the previous evening in Eastbourne. (Having been deprived of his life-sustaining cups of tea during his rail journey, Allan was presented with a full teapot by SHA member, Tony Cross, to refresh him during his talk.)

Dr Chapman spoke about the 'Astronomical Work of Robert Hooke'. Hooke was born at Freshwater, Isle of Wight in 1635. In 1662, he was elected by the Royal Society to the position of Curator of Experiments. Hooke enjoyed the social life of London and frequented the latest fashion, the coffee house. Tea and chocolate were also very popular drinks that aided intellectual discourse without inebriation, unlike alcoholic beverages. Hooke was probably addicted to strong Turkish coffee and frequently says that after nights out, he 'slept not'.

Hooke was first taught astronomical observation in 1657 by Dr Seth Ward at Oxford. Their friend, Dr John Wilkins at Wadham College, owned a telescope of 80-feet focal length. Hooke considered such instruments as 'artificial organs', to sharpen the senses.

Spectacles were common by 1610 and small lenses could be assembled into telescopes, but it was not until about 1650 that bigger lenses, from selected plate glass developed for larger, high-class luxury mirrors, could be manufactured commercially. Huygens and Cassini selected pieces of glass 3 to 7 inches in diameter from which big telescope lenses could be ground and polished. The longer the focal length of these lenses, the better the reduction of chromatic aberration, and long focal length also gave larger prime focus images of the planets. Allan suggested that by examining the planets in greater detail, under high magnification, the Copernican theory could perhaps be sup- ▶

ported. By the 1660s there was a race on to own and use big telescopes. In England, private individuals bought them; on the Continent, government-supported universities commissioned them.

Robert Hooke had a favourite lens of 36-feet focal length and three and a half inches in diameter. It was figured somewhat asymmetrically and he used it stopped down, but it gave excellent images. This long telescope was difficult to use but he mastered it to observe Jupiter in 1664 and again in 1666. In 1665, he left London to escape the plague. After September 1666, the Great Fire once again curtailed his observations. Hooke also used a telescope of 60-feet focal length (probably owned by Sir Paul Neile) from the quadrangle of Gresham College and rigged perhaps by seamen from the Greenwich shipyards to allow delicate alignment with astronomical targets.

Through the telescope, Jupiter appeared four times bigger than the full Moon, suggesting to Allan that Hooke had a two-degree virtual image with a magnification of about ×175. He drew six belts. He observed satellite shadow transits and was interested in permanent Jovian markings that suggested to him a rotation period of about 10 hours. More southerly European observers got better timings and saw more detail because for them the planet was higher in the sky. Hooke published his observations in the *Philosophical Transactions* of the Royal Society and elsewhere abroad via academic learned institutions, written in Latin.

Saturn was a puzzle planet; it had 'handles' or ansae. Why did they come and go? Huygens identified them as a thin, flat ring that nowhere touched the planet. Hooke pointed out the shadow of the planet on the ring and suggested that it could be used to determine the size of the planet. Mars also puzzled Hooke. It had a 'terminated and librated movement'. He thought the planet rolled and swayed, because surface detail was not always visible, perhaps obscured by dust storms.

1664 and 1667 presented him with two brilliant comets. He suggested that comets are bodies like planets, but which are 'corroded' by a solvent emitted by the Sun that caused the tail. He took a two-foot glass cylinder filled with nitric acid into which he suspended a wax ball encrusted in iron filings. The corrosive effect of the acid caused a vertical 'tail' of bubbles that exactly matched cometary tails. This was an example of experimental investigation typical of Hooke. He was a keen lunar observer and drew the crater Hipparchus showing exquisite topographical detail. He could probably resolve 3–4 arcseconds.

Concluding, Allan Chapman said that Hooke's involvement with the sciences, chemistry, physics, mechanics etc., indicated that 60% of his attention was devoted to astronomy.

This joint BAA/SHA meeting was brought to a close by Gilbert Satterthwaite and finally by Dr Richard Miles, who on behalf of the BAA thanked the SHA, the BMI and the members who had attended what had proven to be a fascinating day, which had covered a broad sweep of history through to futuristic space missions.

Kevin Kilburn & Richard Miles