Obituary

John Hedley Robinson (1905–1991)

By the death of J. Hedley Robinson, on 16 October 1991, the Association has lost one of its best-loved members. Though he had not been able to attend many meetings in recent years, his name was known to all observers, and all older members will remember him personally.

Hedley Robinson (to the best of my knowledge, he never used his first name) was born in Bristol, and educated privately at Redland Hill House School. On leaving school he joined the Midland Bank, and spent his entire career with them, finally retiring in 1965 – by which time he had become Second Officer at the Bank's branch at Dawlish. He had moved house to Teignmouth, where he set up a private observatory equipped with an excellent 10-inch reflector, and soon became known not only as a skilled observer but also as a first-class popularizer of astronomy.

His initial interest was in variable stars, and he made many thousands of estimates for the Variable Star Section, but later it is fair to say that he concentrated more on the Moon and planets. As an energetic member of the Lunar Section he was concerned particularly with TLP (Transient Lunar Phenomena) and was unquestionably one of the Section's most reliable workers; he also pioneered the use of filters in lunar and planetary observations. In 1965 he was appointed Director of the Mercury and Venus Section of the BAA, and continued in this post until retiring in 1980; it was appropriate that at this time he was awarded the Walter Goodacre Medal. He was an ideal Director, who 'led from the front' and was a constant source of help and encouragement to others. It is sad that he did not live to see the restoration of the Mercury and Venus Section as a separate entity!

J. Hedley Robinson (1905–1991). *(Photo: Avery's, Brighton).*

He was an extra-mural lecturer in astronomy for Bristol University before moving to Teignmouth, after which he became a lecturer to the WEA and gave courses at various places in Devon. He was a founder member of the highly successful Torbay Astronomical Society; he served a term as Chairman, after which he was elected a Life Member in 1973 and became Patron in 1989. He was also the founder-President of the Devonshire Astronomical Association.

Over the years he published many scientific papers as well as popular articles, and was the author of three books: *Astronomy Data Book* (1972), *Using the Telescope* (1978) and *God and the Universe* (1988). The last of these underlines the great part that religion played in his life. He became an accredited Methodist lay preacher in 1937, and conducted services in many local circuits for almost fifty years.

In 1932 he married. It was a very happy union, but, sadly, marred by the fact that his wife Mildred suffered ill-health for many years. Hedley gave up most of his outside activities to take care of her, which was absolutely typical of him – though until recently he was still able to spend a little time in his observatory, and also some hours with his model railway, built in the attic mainly by himself. He died after a brief final illness, aged 86.

Hedley was one of the few people about whom it would be impossible to say anything evil; he was absolutely incapable of any malicious or dishonorable act. He had many friends, and no enemies. He will be badly missed, and our sympathy goes out to his wife and family. (His son, Donald, is himself an active amateur astronomer). I am proud to have counted him as a friend for over half a century.

Patrick Moore

New members (cont.)

Gargani, Naum, 47b Hanover Gate Mansions, Park Road, London NW1 4SL

Giddings, Ian Craig, 95 Brentfield Circle, Ellon, Aberdeenshire AB41 9DB

Gillingwater, Richard Charles, 85 Brunel Road, Maidenhead, Berkshire SL6 2RT

Goode, Barry David, 50 Hough Hill, Swannington, Leicestershire LE6 4RE

Granger, Michel, 22 Place Mathias, Chalon-sur-Saone, 71100 France

Haynes, David John, 14 Cowslip Meadow, Woodmancote, Cheltenham, Gloucestershire GL52 4TT

Herbert, Glen Nigel, 62a Broad Street, Lyme Regis, Dorset DT7 3QF

Holderness, Richard Thomas, 5 Downley Avenue, Bradwell Common, Milton Keynes, Buckinghamshire MK13 8DB

Hopkins, Alan Leonard, 46 Chapel Road, Great Totham, Essex CM9 8DB

Howard, Patrick M. B., 9 Bexley Lane, Sidcup, Kent DA14 4JW

Hutchinson, Elizabeth, 218 Merton Road, Wimbledon, London SW19 1EQ

Irvine, David Bannerman, Vallance Farm, Cross Green, Hartest, Bury St. Edmunds, Suffolk IP29 4ED

Jardine, Herbert Donald, 46 Viceroy Close, Bristol Road, Edgbaston, Birmingham B5 7US

Jenkins, Paul Joseph Miller, 4 Speed Street, Dundee, DD2 1HR

King, Brian Jeremy, Flat G, 15 Summerhill Terrace, Newcastle-upon-Tyne, Tyne & Wear, NE4 6EB

Kirkup, Don, 30 Winslow Road,Wingrave, Aylesbury, Buckinghamshire HP22 4PS

Larcey, James Paul, 42 Woodfall Avenue, Barnet, Hertfordshire EN5 2HA

Learney, Lewis Philip, Bernina, New Domewood, Crawley Down, East Sussex RH10 3HE

Legge, Martin Alan, 19 Solent Close, Lymington, Hampshire SO41 9ST

Lloyd-Davies, Edward Justin, Halfacre, Harmers Hill, Newick, East Sussex BN8 4LJ

MacMahon, Stephen Hugh, 113 Atherstone Avenue, Peterborough, Cambridgeshire PE3 6UJ

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News from the New South Wales Branch

Alan Yates, Senior Vice-President and London Liaison Officer of the NSW Branch, recently sent reports of some of the activities of the Branch, which are summarized here. In his covering letter Alan says, 'I am pleased to say the degree of enthusiasm for the BAA in New South Wales is on the increase and participation by the members and the support they give their committee is very exciting as we approach our 100 years of amateur astronomy. ... As you are aware, our Branch is small in numbers but our keenness and dedication to amateur astronomy is as strong as one could expect from Associations many times its size'.

Variable Stars (Coordinator F. Traynor). Observations have mostly been of large-amplitude long-period variables, such as R Cen, T Cen, and R Sct. Stars subject to unpredictable outbursts, such as η Car and T Ori, and suspected variables have been monitored. Col Bembrick has written a set of programs in BASIC for the input, reduction and presentation of variable star data. These are of use to both visual and photoelectric observers and include a module for period search, phase folding of data and curve smoothing.

Occultations (Coordinator C. S. Bembrick). Four members observed lunar occultations. The results have been forwarded to the RASNZ for processing. Nine events of Jupiter's satellites were timed by the Coordinator. A number of attempts were made to observe occultations by minor planets.

Instruments (Curator Janette West). An 18-inch reflector, built in the 1920s by the Hoskins family is being restored at Macquarie University in Sydney. When the work is complete it will be used jointly by the BAA and the University for photometry. A 12-inch Cassegrain reflector, bequeathed in 1981, has recently been returned from loan and it is planned to replace the mounting and tube before setting up the telescope permanently at the BAA observatory currently under construction. A number of other telescopes owned by the Branch are in use. A 5-inch refractor (the Wunderlich Telescope) is currently in storage and is available for use.

Planetary, Solar and Comet (Coordinator Derek McKay): A wide variety of observations have been undertaken. Three members have made regular solar observations throughout the year. Sketches of the solar disc and sunspot counts have been made. Sketches have been forwarded to the BAA in London and the sunspot count data to the Paderborn Public Observatory, Germany.

The *Bulletin* (Editor Ralph Buttigieg): In 1991 the magazine has been produced bimonthly and is now about 20–22 pages long.

Library (Librarian Greg Bradford): Given limited resources, the library has a policy of acquiring only expensive or hard-to-obtain books, though any requests are considered. Use of the library, which is open before and after each meeting, is increasing. There is now a computerized index to *Sky & Telescope*.

BAA *Winchester Weekend* 1991 March 22–24

'A' one might reasonably suppose would be 'for astronomy'. But starting an astro-alphabet at the beginning of the Winchester Weekend, Bob Mizon decided that it was 'for Andromeda'. Not all the alphabet Bob gave was quite so predictable and listeners calling out suggestions as each slide snapped onto the screen had such interesting problems to contend with as 'J' being 'for giant planet', and 'F' being for 'fuzzy object'. Did you know you need twenty seven slides to cover the alphabet thoroughly? Some unusual facts about each object shown were provided in a Michael Caine ('not a lot of people know that') manner, and the presentation was obviously a great 'S for Success' with the audience, a survey of whom showed they had come from as far afield as Jersey, Germany, Switzerland and The Netherlands.

Many observers imagine that planetary nebula are among the more difficult deep-sky objects for observers. Covering an observational history and some of the physics involved in professional studies of these objects, Nick Hewitt showed how both visual and photographic observations could be made with average sized amateur telescopes. His slide showing the useful work amateurs can do remained significantly blank, but he gave an exhaustive list of what to look for and note when making observations. The 'butterfly' theory of the evolution of these objects was discussed and interesting amateur photos showed that these objects could be captured, the problem being their small size and not necessarily their brightness.

Following Nick Hewitt, John Wall gave advice on building large telescopes, with the emphasis firmly on solid engineering. Many parts for larger instruments may be gleaned from scrap yards and John showed how, with an engineer's experience, they might be pressed into service.

At various breaks during the weekend, visitors wandered among the exhibits provided both by individuals, societies and traders. As usual it was only too easy to part with more money than one had anticipated for books (old and new), eyepieces and other telescope components. This integral part of the weekend remains ever popular with all present.

During the Saturday afternoon, Charles Wise looked back on 25 years of Winchester Weekends. This reflection was preceded by the award of the Winchester Clock prize to Rob Januszewski for some excellent slides taken from the centre of Birmingham with just such a device. Chaired by Ron Arbour, the afternoon continued with a lively debate on light pollution, a surprise to many probably being various tales from the audience of success in dealing with local authorities, British Rail etc.

Saturday evening's Alf Curtis Memorial Lecture was introduced by the President, and given by Ben Mayer, a graphical designer by profession, from Los Angeles, California. The lecture was titled 'Noumena Transcend Phenomena' and Ben showed in the course of presenting sixty four slides and a video, how a lifetime of interest in astronomy had led him to choosing this particular legend for the Association's coat of arms. The talk roamed far and wide covering a life that had obviously been both full and rewarding. In particular Ben concentrated on the books he has written and upon a number of inventions he has made. The PROBLICOM blink comparator, a device using two slide projector's and a rotating shutter was well known to many in the audience as an ingenious way of ▶

▶ comparing the same star field photographed on two separate occasions to check for novae, asteroids etc. Slides showing other inventions followed but perhaps less well known to the British audience were some of Ben's inventions designed to ease the first steps in astronomy particularly for the young. A wire 'coathanger' was pressed into service as a cheap finding device and Ben went on to show various levels of sophistication this simple but effective apparatus gradually acquired. He concluded his talk with an impassioned plea for those present to give rather than to sell their skills and expertise to the next generation 'with love as an amateur'.

The evening concluded with the Colin Ronan producing rabbits from hats in the best Tommy Cooper tradition, possibly a feat every BAA President should be able to emulate!

Those awake early on the Sunday morning heard Richard Fleet discussing cataclysmic and other variables, pointing out along the way, that this was one study which need not necessarily be adversely affected by light pollution. He showed how it was possible to determine magnitudes from slides as well as the more traditional visual methods. The highlight of the weekend for some keen observers had occurred the previous evening in the car park outside the lecture theatre where TT Cra, an eruptive variable first discovered by Richard, was found to be in outburst at magnitude 13 compared with its usual value of 16. Observers were able to use the telescope which made the original discovery for this observation.

Colin Pither then gave a resumé of double star observing and, in particular, methods available to the amateur for the accurate measurement of position angle and separation. The diffraction grating micrometer is not a familiar piece of equipment with amateurs and Colin gave details of its construction and use, including the results of experiments using the 'interrupted' type he had developed himself.

Sunday afternoon, while heralding the end of the weekend, also allows members of the audience the chance to 'do their bit'. John Fletcher showed some excellent colour slides, pointing out he waited until after midnight to ensure as many house lights as possible were switched off! Bob Mizon showed a celestial coathanger in Vulpecula referring to Ben Mayer's talk the previous evening. Barry Moulang's slides of the deep-sky were augmented by shots of a 14-inch Cassegrain, an uncommon type of telescope in amateur hands at present. The March 1989 aurora was not forgotten with pictures from Dave Gavine, and Lee MacDonald showed how a small telescope can be used to take pictures of the Moon and still reveal craters $\frac{3}{4}$ kilometre in diameter. Filters and photography is always a much discussed subject and Bob Neville showed slides taken with a Jessop R2 filter, one not familiar to many present. Exposures of 30 minutes or so with a 135-mm lens at f/2.8 yielded enormously improved H alpha regions on colour film. Other contributors included Robert Mills making a sundial from an (empty) beer can, and John Wall giving a small presentation that might well have been titled 'an even bigger telescope'.

All in all the Silver Jubilee Weekend was the great success we have come to expect of an event organized by Alan Dowdell and Le Forbes, to whom the Association owes a great debt.

Don Miles

The BAA at Durham University Out-of-London Weekend, 1991 September 20–21

The 1991 Out-of-London Weekend at the University of Durham began on Friday September 20 with tours round the University Observatory and the University itself, kindly organized and conducted by members of the Astronomy Department. At a cheese and wine party in the evening, the BAA President, Mr Colin Ronan, said what a great pleasure it was to be back in Durham, and he looked forward to a very pleasant weekend.

On the morning of September 21, members convened in the Physics Department to hear an address by Dr Paula Chadwick on the subject of high-energy gamma ray astronomy. Introducing her, the Astronomer Royal, Professor Arnold Wolfendale, said the last time the BAA had met in Durham was in 1984, when Patrick Moore was President. On behalf of the BAA, President-elect Dr John Mason said that it was an honour to be here, and that all were looking forward to the address by Dr Chadwick, one of the world's leading experts in this field.

High-Energy Gamma-Ray Astronomy

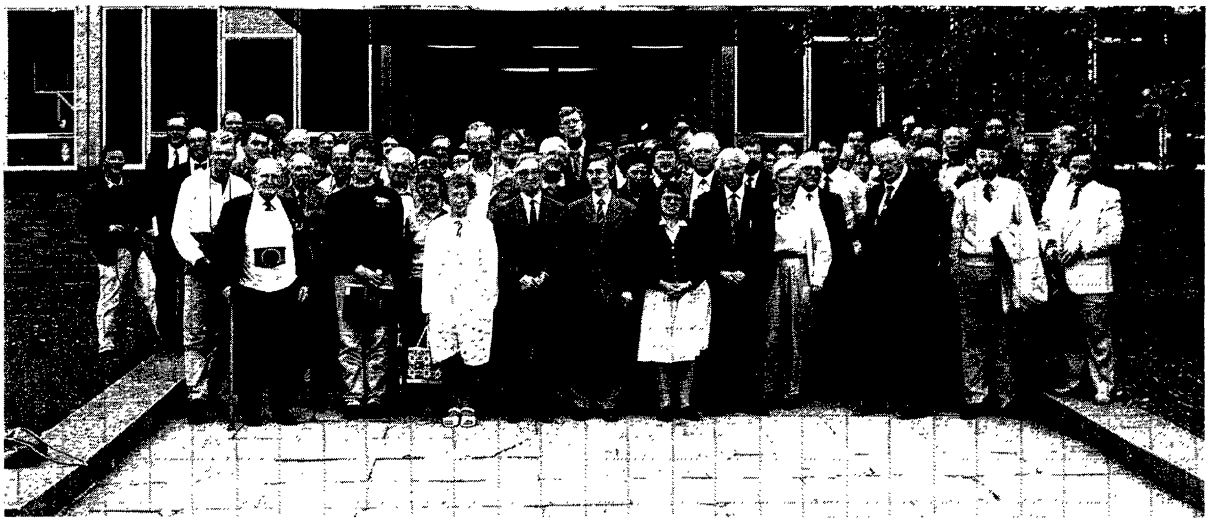
Dr Chadwick said that very high-energy gamma-ray astronomy is often regarded as slightly crazy, but it is also great fun! Gamma rays are more energetic than X-rays, so that direct studies from ground level are impossible; low-energy gamma rays can be studied from balloons to some extent, but the higher energy rays need satellites, such as GRO. Gamma rays are sparse, so that large detectors are essential – it is good going to record one gamma-ray per hour. Ideally, one needs to orbit two detectors of football-pitch size, but nature gives some help because, at 10^{11} GeV, the atmosphere itself becomes a gamma-ray detector.

Gamma rays come from space, hit the atmosphere, and produce cascades of particles, mainly other gamma rays, electrons and protons. In the lower atmosphere their velocity is greater than that of light in the same medium, and this produces flashes of blue light, known as Čerenkov radiation. What is needed is a 'light bucket' at ground level, and this is what is being planned at Durham.

Cosmic rays were first detected during balloon experiments by Viktor Hess in 1912. The ultimate aim is to find their origin, and this is the subject of much current research. Cosmic-ray primaries are mainly protons, electrons, and some stable nuclei. When broken up in the air they produce secondary rays, but these are electrically charged, and are thus so diverted by the Earth's magnetic field that their direction of motion cannot be found. Gamma rays, however, are produced by non-thermal processes, and are not charged. If one can detect gamma-rays from a discrete object, it is fairly safe to assume that one is also looking at a cosmic ray source.

A gamma-ray telescope consists of a mirror (i.e. a flux-collector), a detector (photomultiplier tubes), a good clock, and a recording system. However, Čerenkov radiation makes up only 1/10 000 of the total night sky illumination, and this means that Čerenkov detectors have noise problems. Moreover, cosmic-ray particles produce flashes of a similar type. Three detectors are used, each looking at a mirror, and an event is regarded as reliable only if it is recorded by all of them. Cosmic rays come in from all directions, but gamma rays do not (they exhibit *anisotropy*) and it is possible to detect clumps of Čerenkov radiation coming from discrete sources. With pulsars there is evident periodicity.

Dr Chadwick then outlined the history of gamma-ray telescopes, the first being built by Jelley and Galbraith in 1953 at Harwell. Durham entered the field in 1981 with an instrument set up at Dugway, Utah. Dr Chadwick is now using ▶



BAA members at the meeting at Durham University, 20–22 September 1991. *(Photo: David Tucker)*

▶ a 'Mark 4' version and described recent observing runs with it on the edge of the mountain near the William Herschel Telescope on La Palma.

Gamma-ray sources include pulsars, X-ray binaries, cataclysmic variables, and probably some types of galaxies. Among isolated pulsars the Crab Nebula is the archetype, and is continuously monitored from Jodrell Bank, so that it is always known where the main pulse should be. The gamma-ray pulse is very narrow, which is why an accurate clock is essential. Other gamma-ray sources were then described and Dr Chadwick remarked that, despite careful observation, no gamma rays had yet been detected associated with Supernova 1987A.

Many problems of gamma-ray astronomy remain, but considerable progress is being made, and this is an exciting new branch of modern astronomy.

Opening a discussion, Mr H. Regnart asked whether relativistic effects were involved in Čerenkov sources. Dr Chadwick said that this was correct. Dr Mason commented that it was encouraging to see such interesting research going on in Britain, particularly when tackled so enthusiastically.

Following an interval, the session reconvened, and Mr Colin Ronan introduced Dr Richard Stephenson.

The importance of historical astronomy

Dr Stephenson began by describing the observational records left by early civilizations in China, Korea, Japan and Babylon. There are cometary records, but very few observations of comets from Arab sources. Solar and lunar eclipses are described, and large numbers of occultations. Babylonian texts are found on clay tablets, and only about 5 or 10 per cent survive, of which 95% are in the British Museum.

Sunspots were recorded only in China and Korea, though there were some later Arab observations; the Arabs believed that sunspots were due to transits of Mercury and Venus. There are recognizable descriptions of Halley's Comet and, from Alaska, of aurorae. In 1543 there were eight representations of aurorae in one year. It is, of course, dangerous to use old auroral observations for solar activity analysis, but the temptation is great. Meteors were also described, and occasional meteorites but, in Arab times, comets and meteors were believed to be atmospheric phenomena. There is also an account of a supernova seen in Lupus in 1006, but this must have been a Type I phenomenon, as no resultant pulsar has been found.

Eclipse records are studied to investigate tidal braking of the Earth's rotation, as are observations of other occultations. Comparing the actual time of an occultation or eclipse with the estimate which would be given if the slow-down of the Earth's spin were ignored, a significant discrepancy is found. For example, a total eclipse of the Sun seen in Babylon in 130 BC, 96 minutes after sunrise, was accurately described, but when computed back, it is found that neglecting the Earth's slowdown in rotation the track would have crossed Morocco, not Babylon. Since 136 BC the clock error has amounted to a full three hours. The day was then 40 milliseconds shorter than it is now.

The earliest total solar eclipse on record is that of 709 BC, seen in China, though there is a less reliable record from Syria in 1763 BC. From 800 BC eclipses can be dated with some accuracy; before that it is largely guesswork. Lunar eclipses were also recorded in Babylon, but only 5–10 percent of the observations survive, as they were made on clay tablets and the villagers tended to dig them up and use them as bricks! Curiously, the ancient Egyptians appear to have left no records of solar eclipses, despite modern computations showing many observable events occurring.

The Arabs made eclipse observations; IbnYunis, for example, explains how he observed an eclipse by reflection in water. It is interesting to note that there were no observations of the corona before the eclipse of AD 968, seen from Constantinople, when there is an account of a narrow band shining round the edge of the Moon's disc.

Halley's Comet has been recorded frequently and there are reliable records since 2134 BC. In AD 1066 it was seen from Baghdad until 27 April, reappearing after conjunction. The return of 837 was the closest on record, since the comet passed at only 3–4 times the distance of the Moon, and the orbit was considerably perturbed by the pull of the Earth, so that this must be taken into account in computing the theoretical dates of earlier returns. Neglecting this term, we can check the dates when the comet was seen; it would have been three days late in 1066. It is also notable that, in 1066, the comet was still under observation long after it should have faded to magnitude $7\frac{1}{2}$, so perhaps it was flaring, as it has done so unexpectedly in the immediate past.

The President thanked Dr Stephenson, and invited discussion. ▶

▶ Dr Patrick Moore said he was very surprised there were no records of the solar corona before 968 AD. This might indicate a prolonged solar minimum, of the same type as the Maunder Minimum of 1645–1715. There could be a way to check – naked eye sunspots have been recorded in past times; why not check these against the times of eclipses? If it could be shown that a major sunspot was in view near the time of an eclipse, it would indicate that the Sun was not undergoing a Maunder-type minimum. Dr Stephenson said this had not been investigated; it was a most valuable suggestion, and he would look into it.

Mr Andrew Elliott asked whether laser ranging could help in determining the Moon's tidal recession. Dr Stephenson said this was being done at the Jet Propulsion Laboratory, and it had been found that the lunar recession was 3.7 cm/yr. Going back 3000 years, we may assume that the rate of recession has remained constant.

Mr H. Regnart referred to the old observations of comets; did they give any indication of variation in the gravitational constant? Dr Stephenson said that he would like to say 'yes', but must in fact say 'no'. Dr Tom van Flandern had tried to estimate this from old occultation timings, and at first it had looked promising, but it now seems that the time over which observations have been reliably made is too short for any conclusions to be drawn.

The President thanked Dr Stephenson for a most interesting lecture, and adjourned the gathering for lunch. After lunch the BAA Ordinary Meeting took place. (A report appears on page 63 of this *Journal*.)

The final event of the day was an evening lecture given by the Astronomer Royal, Professor Arnold Wolfendale, who is also Head of Physics at Durham.

The 'new astronomies'

Professor Wolfendale described the history of astronomy at Durham, showing a picture of Temple Chevallier, the second Professor of Astronomy, who was also a registrar, Vicar of Ash, and an expert in Hebrew. One of his distinguished assistants was R. C. Carrington, who however left after two years because there was no money for improved research (he even offered to forego his own salary.) Carrington moved to Redhill in Surrey, where he founded a private observatory and discovered the differential rotation of the Sun.

Professor Wolfendale then discussed the possibility of identifying planets of other stars. This is difficult visually; a planet would be very faint, with a separation of only 1/10 arc second from its primary star, whereas the flawed Hubble Space Telescope can manage only $\frac{1}{2}$ arc sec. From Jodrell Bank, the detection of a planet moving round the neutron star PSR 1829-10 has been reported; it seems to be 1.25 million years old, with a mass 10 times that of the Earth, and in an orbit equivalent to that of Venus round the Sun. This is surprising; a pulsar, thought to be created by a supernova explosion, simply ought not to have a planet moving round it, and the explanation is as yet unknown.

Professor Wolfendale then turned to the subject of the Sun. How stable is it and could the dinosaurs have been killed off by the effects of a gigantic solar flare? Astronomers are now looking at the way in which the Sun oscillates; there is certainly a 5-minute oscillation. It is also necessary to consider the problem of why the Sun seems to emit far fewer neutrinos than theoretically it ought to do.

Another absorbing problem relates to the origin of the universe. It is thought that space, time and matter were created together. Expansion began; in 700,000 years matter began to combine into atoms, so that it was decoupled from radiation. The Big Bang theory was strengthened in 1964 by the discovery of the 3°K microwave background radiation, but there should be 'clumpiness' in this, which is now being sought. Irregularities of the order of a few parts in a million are to be expected. In one direction the temperature is 1 part in 1000 above the mean, so we may be moving through the radiation at a velocity of 600 km/s but 'clumpiness' has not so far been detected. Unfortunately, cosmic rays hinder the search.

Professor Wolfendale ended with a quote from Sir William Herschel, which was adopted as the motto of the Royal Astronomical Society: 'Quicquid Nitet Notandum', or 'Whatever shines is to be noted'. Today, the shining is studied in all parts of the electromagnetic spectrum.

Dr Patrick Moore asked whether it had been considered that the problem of the planet orbiting a neutron star could be related to the fact that the orbital period was 186 days, or half the Earth's sidereal period; could there be any misinterpretation here? Professor Wolfendale said this seemed not to be the case, because other pulsars in the same direction did not show similar effects. It was, however, very strange that the orbit of the planet was circular; one would have expected it to be elliptical. Or perhaps the pulsar was not the result of a supernova explosion?

Mr H. Regnart asked the latest results on the problem of the masses of neutrinos. Professor Wolfendale said that, in theory, they should have zero mass but the paucity of solar neutrinos was curious; they might have slight mass of around 10 eV. This would mean that one type of neutrino could change into another and it might also solve the problem of the 'missing mass', which was one of the greatest enigmas in science today.

The President thanked Professor Wolfendale for his informative and entertaining address. The whole meeting had been particularly memorable and he repeated his thanks to those who had been involved in organizing it.

Patrick Moore

Aurora Section Meeting held at Centenary House, Leeds, on 1991 October 5

The meeting was held in Leeds by kind invitation of the Leeds Astronomical Society. Mr Paul Meeks, President of the Leeds Society, welcomed the 34 delegates then Mr Ron Livesey, the Director, took the chair and outlined the work of the Section since the International Geophysical Year (1957–58), including especially the new and interesting fields of magnetometry, radio aurorae and the detection of earth-currents. He played a tape by Doug Smillie, a radio observer of Wishaw, of aurora-distorted Morse reception.

Mr Neil Bone then described some of the recent big events such as March 13/14 1989 and March 24/25 1991. He showed spectacular slides of these from a variety of observers, pointing out some of the interesting structures. Mr Bone exploded the myth perpetuated by many elementary astronomy books, often from even earlier books, that aurorae are confined to the polar regions; observers in the south of England and beyond have been enjoying fine aurorae over the present peak of this solar cycle, and even the odd huge display, like February 8/9 1986, at solar minimum. It is just a case of going out and looking. ▶

Speakers at the Leeds Aurora Section Meeting. *Left to right:* Dr Les Woolliscroft, Dr Michael Hapgood, Ron Livesey, Neil Bone, Dr David Gavine, Alastair McBeath, Tom McEwan. *(Photo: Gina Bone)*

▶ Dr David Orr of York University then discussed aurorae in terms of the behaviour of the Sun's magnetic field and of the solar wind, which pours out a million tonnes of matter per second. At Earth distance this yields about 10 particles per cubic centimetre at typical speeds of 500 km s^{-1} rising to about 1000 km s^{-1} during high solar activity. Modelling the Earth's magnetosphere and bow shock, it is shown that the magnetic lines of force of the Earth and the solar wind interact to produce huge electric currents, which accelerate particles into the upper atmosphere, with re-connection of field lines in the magnetotail 'firing' the particles into the night side. When there is a predominantly southern component of the solar wind field the auroral oval becomes active, the arcs brighten and the westward surge begins as the aurora expands into mid-latitudes and breaks up into chaotic forms. Real data from the Dynamics Explorer satellite reveals all the stages. SAMNET is a network of seven magnetic observatories in Finland, Sweden, Faroes and Scotland which monitors activity at ground level. Ron Livesey here mentioned the brief and sudden 'flash' aurorae sometimes noticed by experienced observers, which appear not to be related to major magnetic disturbances, but they are of great interest to the Section.

After lunch Mr Alastair McBeath spoke on radio aurorae. A dense concentration of ionization in the E-layer at 100–120 km gives a very low resistance which helps to produce two massive electrojets, one eastwards, the other westwards, circulating and meeting in the auroral oval. These give two auroral peaks, one (east) at about 1800 UT, the other (west) around midnight; the former is the stronger and is more easily detected. The degree of reception of auroral reflections depends on geography and on the conditions within the E-layer. To amateurs, 144 MHz has been the most popular band to study radio aurorae, but there is increasing interest at 50 MHz.

Dr David Gavine (Assistant Director) reported that noctilucent clouds (NLC) had been of lower frequency in 1990 and 1991 than in 1988 and 1989, and displays had been faint and weak. He showed slides of major NLCs of the 'good' years to describe the various structures for observers to report, and two extraordinary photographs of simultaneous aurora and NLC from Canadian observers in 1987. This unusual phenomenon was seen and photographed on July 13/14 this year in Britain. The general trend of NLC appears to indicate an increase with dips during years of high auroral activity. Although the Section has taken over the handling of NLC data, and the observers of both our Association and the Junior Astronomical Society are first class, the response from professional observers and from the rest of Europe (except some expert individuals in Denmark) is disappointing and more observers are needed to make a more complete network. There have also been problems with inexperienced observers reporting spurious effects such as twilit cirrus near the zenith – one person in the Tropics was adamant that he saw NLC every night!

Mr Tom McEwan, Director of the Aurora Section of the Junior Astronomical Society, then described the work of his observers, from the organization of the programmes to the publication of the results in the Society's Journal *Popular Astronomy* and the Newsletters. The Section is particularly noted for the enthusiasm of its members and for their photographic expertise: several slides of recent big displays were shown, to the admiration of all. Mr Chris Walker (Cleveland) and Mr Ken Tyson (Cumbria) showed spectacular slides of the auroral storms of October 1/2 and March 24/25 1991 respectively, and Mr David Pettitt (Assistant Director – Magnetometry) showed the fluxgate magnetometer trace of the night of October 1/2.

Dr Michael Hapgood (Rutherford-Appleton Laboratory) has been investigating the possibilities of predicting geomagnetic storms by statistical methods. The magnetic index Ap is a linear scale of worldwide magnetic activity, Kp is a logarithmic scale, Ap is the daily figure averaged from the 3-hourly a_p indices, and is supplied by Boulder (Colorado) and Göttingen (Germany), Boulder classify storms as 'severe' with Kp over 7 and Ap over 100, but Dr Hapgood examines the frequency of storms of Ap 30 and above, comparing sunspot numbers and the 27-day solar rotation period. On this basis 11% of days are 'storm' days on average, and all the peaks of storm fre-

Ron Livesey (Aurora Section Director, left) with Dr J. H. Archenhold at Leeds. *(Photo: D. Gavine)*

quency are found on the declining solar maximum curve. For Cycle 22 it appears that 1991–94 could be a period of storm peak. Storms can, however, be random in behaviour. The mean duration for active periods over Ap = 30 can be from 1 to 250 days with a mean of 2 days. Dr Hapgood described the coronal holes which are responsible for many of the quieter aurorae during sunspot decline and minimum. Mass ejection of material from the Sun, which may be responsible for some aurorae, is now being investigated by scintillation of radio sources caused by diffraction of the beam through bubbles of solar ejecta.

Dr Les Wolliscroft (Sheffield University) described the work to be carried out by the future satellites SOHO (a solar and heliospheric observatory to investigate solar oscillations and the corona) and CLUSTER, a group of four craft near the Earth to study the magnetosphere, the physics of space plasma, plasma waves and the fine structure of the solar wind. This will help in predicting storm activity and enhance further our knowledge of the aurora, both spatially and temporally. He then described the Cassini mission to Saturn and Titan via Jupiter which will investigate the magnetospheres of the planets and their behaviour as plasma sources and sinks. Sheffield University's role in the mission is in data compression.

Finally the Director thanked all the participants and the Leeds Astronomical Society for their hospitality, and urged everyone to keep watching for the aurora.

David Gavine

New members (cont.)

Marshall, Robert Jonathan, 32 Court Farm Road, Hove, East Sussex BN3 7QR

McAndrew, Stephen, 270 Cabramatta Road, Cabramatta, NSW 2166, Australia

McKenzie, Colin Marshall, 5 Hope Street, Springview, Wigan WN3 4TT

McKenzie, Don, 72 Lamb Street, Lilyfield, NSW 2040, Australia

McMenemey, James Desmond Scott, 9 Moultrie Road, Rugby, Warwickshire CV21 3BD

Napier, Lorna Anne, Old School House, Clachan, by Tarbert, Argyll PA29 6XL

O'Regan, Joe, 164 Salmon Street, Kingsbury, London NW9 8NX

Olver, Susan Margaret, 'Siena', 7 Copse Way, Wrecclesham, Farnham, Surrey GU10 4QL

Plastow, John, 32 Cyril Mansion, Prince of Wales Drive, London SW17 4HP

Rae, James Thomas, 10 Windmill Rise, Bury St Edmunds, Suffolk IP33 3LP

Ramesh, Sangaralingam, 68 Westmount Road, Eltham, London SE9 1JE

Reynolds, Jonathan Owen, 7 Hill Side, Cheddington, Leighton Buzzard, Bedfordshire LU7 0SP

Robertson, Jacqueline Marion, 12 Greville Place, London NW6 5JH

Rocklin, David Samuel, Tamarisk, Hardings Lane, Ilkley, West Yorkshire LS29 0BB

Rose, Mark Phillip, 2/27 Station Road, Fowey, Cornwall PL23 1DT

Scott, Naomi Jane, Nordraflur, Biggins, Papa Stour, Shetland ZE2 9PW

Scott, Paul Stearn, Three Elms, Common Gate Road, Chorleywood, Rickmansworth, Hertfordshire WD3 5JR

Shakesby, Stephen, 11 Arrow Drive, Jarrow, Tyne & Wear NE32 4AL

Sheldon, Kenneth, Whitehaven, Maytree Road, Lower Moor Pershore, Worcestershire WR10 2NY

Silvester, David James, The Old Vicarage, Hatherleigh, Devon

Smith, Zoe, 53 Rochester Drive, Westcliffe-on-Sea, Essex SS0 0NJ

Snell, Robert Leslie, 36 Greenleaf Road, Walthamstow, London E17 6QQ

Stevens, Paul, 60 Poplars Close, Mardy, Abergavenny, Gwent NP7 6LY

Sumbler, Michael Geoffrey, 196 Meilton Road, Stanton-on-the-Wolds, Keyworth, Nottinghamshire WG12 5BQ

Swann, John, Suite 31, Victoria House, 22–26 Main Street, P.O. Box 569, Gibraltar

Sweatman, Jeanne Audrey, 30 Alderside Walk, Englefield Green, Egham, Surrey TW20 0LY

Taylor, Lockhart, Rogarth, 16 East Fortune Holdings, Athelstaneford, East Lothian EH39 5LJ

Thomas, Richard David, 2 Woodlands Road, Astley, Tyldesley, Manchester M29 7BH

Thompson, Frederick Wallace, 109 Beltoy Road, Carrickfergus, Northern Ireland BT38 9DA

Turchi, Via Ciro Menotti 7, I-41012 Carpi (Modena), Italy

Valencia Reyes, Jose Ignacio, Calle La Rosa 74 alto, 38001 Santa Cruz de Tenerife, Canary Islands

Wakefield, Nigel Bruce, 90 Withies Park, Midsomer Norton, Bath, Avon BA3 2PB

Wardorf, Robert, 24 Jubilee Court, Newton Road, Bury St. Edmunds, Suffolk IP33 2DD

West, Simon, 28 Falstone Avenue, South Shields, Tyne & Wear NE34 6SB

White, Geoffrey John, Dartway, The Level, Dittisham, Devon TQ6 0ES

Williams, Kevin Terence, 27 Dan-y-Graig Road, Melincrythan, Neath, West Glamorgan SA11 1UB

Wynne, Alexander, 1 Sandy Lane, Lydiate, Merseyside L31 4DL

Zanut, Stefano, Via Silvio Pellico 12, 33170 Pordenone, Italy

Chelmsford Astronomers, Mr B. Clark, 5 Borda Close, Chelmsford, Essex CM1 4JY

Durham Astronomical Society, Mr A. Rayner, 6 Strathmore, Great Lumley, Chester-le-Street, Co. Durham DH3 4LY

Elected 1992 January 4

Duhig, Terence Thomas, 2 Silver Chalet, Silvercrest Road, Silverstrand, Clearwater Bay NT, Hong Kong

Gomez, Jeremy, 54b St. John's Avenue, Harlesden, London NW10 4EE

Green, Elizabeth Lucy, 4 Templecroft, Ashford, Middlesex TW15 1TJ

Holloway, Peter Richard, 33 Worley Road, St. Albans, Hertfordshire AL3 5NR

Maile, Alan Gerald, 48 Lickhill Road North, Stourport-on-Severn, Worcestershire DY13 8RP

Parton, Cyril, 6 St. Mawes Way, Windle, St. Helens, Merseyside WA10 6EE

Porter, David William, 23 Littlebrook, Manor Way, Dartford, Kent DA1 5DX

Sharp, Andrew, 66 Edencourt Road, Streatham, London SW16 6QP

Smith, Ian Simon, 23 Fairway Green, Bilston, West Midlands WV14 6DE

Smith, Philip James Edward, Rose Cottage, 2 Butts Lane, Tibthorpe, Driffield, East Yorkshire YO25 9LE

Sutton, Andrew Gerrard, 'Saint Ronan's', 2 Kensington South, Bishop Auckland, County Durham DL14 6JA

Vallender, Richard William, Ground Floor (left), 14 St. Michael's Square, Gloucester, Gloucestershire GL1 1HX

Herschel Astronomical Society, Mr A. Dagnall, 61 Clewer Park, Windsor, Berkshire SL4 5HD