

EDMUND HALLEY AND ECLIPSES



Edmund Halley

We are all familiar with Edmund Halley (1656-1742). He was responsible for predicting the return of the comet that carries his name, and he was a friend and supporter of Isaac Newton. It was Halley, probably the most important person in Newton's life, who persuaded him to publish his great mathematical and astronomical book *Principia*. Unfortunately, these few achievements are almost trivial among Halley's great scientific achievements. He is often referred to as "a genius in eclipse". If Halley had lived at a different time from Newton, his reputation might be as one of the country's greatest scientists.

The theory of eclipses was one of his great projects. After studying historical eclipse records, he discovered the Saros, which is the period of 18 years plus ten or eleven days over which eclipses recur. He did not

realise that the Babylonians and Greeks knew about it much earlier. The *Proceedings of The Royal Society* noted "Halley shewed a Paper wherein he had computed the Eclipses of the Moon in several series, and said that he found that he could very well represent them all; much nearer than they were observed by several observers." His claim to be more accurate than people who had actually seen the events was due to the Saros being more accurate than clocks at that time.

Halley had a real understanding of the theory of orbits laid out in the *Principia* and realised the power of Newton's theories. He calculated that the path of a total solar eclipse would pass across southern England and Wales in 1715, the first over London since 1140. Computing a detailed path for the totality, he wrote to a wide variety of potential observers, asking them to time the eclipse. A map was printed



Halley's Map

and distributed showing the anticipated path of totality. Fortunately examples of this map still exist. Halley held a position within the Church of England and many rectors and the like provided him with detailed observations. He observed the eclipse from London with other members of the Royal Society. Flamsteed observed the eclipse from Greenwich but refused to supply observations because of his ongoing dispute with Halley and Newton.

He received dozens of reports from the widely scattered observers, some less than a mile apart, and he produced a new map of the path of totality. It turned out that his predictions were out by approximately three miles on the north limit and twenty miles along the south limit. Halley suspected the errors were mainly due to an imprecise figure for the Astronomical Unit (the Earth - Sun distance) and the lunar diameter. He went on to propose using timings of the Transit of Venus as a method to calculate the Astronomical Unit accurately. This resulted in the 1769 worldwide observations of the Transit and subsequent difficulties in calculating the distance due to the Black Drop Effect.

Halley's results have been re-examined in recent years. These show that there has been no measurable change in the Sun's size in the last 300 years. The accuracy of Halley's two maps is impressive today. In 1925 when the path of totality passed across Manhattan in New York City, precise measurements resulted from placing observers on each street intersection. The results showed unprecedented accuracy and confirmed the results of Halley's work. One curiosity associated with the 1715 eclipse was the date, 22 April. After moving across England the path of totality grazed the edge of Brittany where it was already 3 May, as England still used the Julian calendar while France had moved to the Gregorian calendar. England changed over to the Gregorian in 1752.

In 1693 alone, Halley presented papers to The Royal Society on the position of the Tropics, the pressure in a diving bell, how the length of the shortest day varies with

latitude, how deformed fingers are inherited in some families, mortality rates and annuities, how crabs and lobsters re-grow amputated claws and a hydrographic survey of the Sussex coast. From 1703 he was Savilian Professor of Geometry at Oxford and Astronomer Royal from 1720. He really was “a genius in eclipse.”

Mark Butterworth

DARK SKY SCOTLAND - 2007 AUTUMN SEASON

The Dark Sky Scotland programme, started earlier this year, is a collaboration between the Royal Observatory Edinburgh, Careers Scotland, The Forestry Commission and a number of other bodies, and is aimed at stimulating interest in science and astronomy through the use of one of Scotland's greatest natural resources - some of the darkest skies in Europe !

We are all affected by light pollution and it is a great shame that many people these days (especially youngsters) miss out on seeing the beauty of the night sky from a truly dark site. Here in the central belt the proliferation of skyglow is as bad as in any built-up area of the UK, but fortunately it is only necessary to travel a short distance to find much darker skies. This is where the Forestry Commission comes in. As one of the largest land-owners in Scotland, they have some wonderful dark sites like the David Marshall Lodge which are not too remote, easily accessible, and with good indoor facilities (including the all-important toilets and hot drinks !).

A typical Dark Skies weekend consists of a mix of daytime activities and night time viewing. Indoor activities include training workshops for teachers, an inflatable planetarium (great fun - you crawl through a tunnel to find yourself under the night sky !), very impressive (and quite messy!) comet-making demonstrations and much more. When night falls, the action moves outdoors and we get a chance to show people around the Universe - weather permitting of course! All events are open to the public, and it is a great opportunity to get people of all ages interested in astronomy. We are already starting to see some real benefits for the Society, in the form of increased membership enquiries and a bigger take-up for the evening classes.

Whilst the main events are planned and co-ordinated by the Royal Observatory, participation from local astronomical societies is strongly encouraged. We have already had one very successful event at Aberfoyle in March this year, organised in conjunction with Dark Sky partners Careers Scotland and the Glasgow Science Centre, and we have been asked to participate in the next event as part of the Mushroom Festival on the evening of 20 October. Everyone is welcome to come along and take part, so let's hope for clear skies!

Dan Hillier from the ROE very kindly agreed to be their Society's first speaker of the year, and gave an overview of the Dark Skies programme at our first meeting

in September, before heading off to Ullapool to catch up on the DSS event taking place there that weekend.

Further Dark Skies Events will be taking part all over Scotland :

12-13 October Forest of Ae & Caerlaverock (Dumfries)
20 October Abriachan Community Woodlands (Loch Ness)
20 October Mushroom Festival (David Marshall Lodge, Aberfoyle)
26-27 October Tweed Valley Forest Festival (Peebles)
26-27 October Anagach Community Woodlands (Grantown-on-Spey)
16-17 November Sunart Woodlands (Ardnamurchan)
23-24 November Cromarty (Black Isle)

Some of these are of course pretty remote, but more events are being planned for the first quarter of 2008 - including some, we hope, a bit closer to home!

Further details of all of the events can be found at the Dark Sky website:
<http://www.darkskscotland.org.uk/>

Alan Cayless

DARK SKY SCOTLAND - SMITH LECTURE 14 OCTOBER 2007

Dan Hillier of the Royal Observatory Edinburgh gave an inspirational talk, not about campaigning for dark skies, but about using the dark skies with which Scotland is particularly well blessed due to the terrain and low population densities, (not because of the clouds!).

The ROE Dark Sky project takes astronomical observation into the community at venues all over Scotland. Armed with professional astronomers, telescopes and mobile planetariums, "Dark Sky" can always deliver an astronomical experience where ever they go.

The talk resonated with the energetic members of SAS who for years have given memorable astronomical experiences to many of Stirlingshire's local communities. From the start and for nearly two decades, founder member and now President of the society Dr. Ken MacKay, organised and manned these valuable events.

Chris Davis.

A MULTIPLE GALAXY COLLISION

One of the biggest galaxy collisions ever observed has been seen by NASA's Spitzer Space Telescope and the WIYN Telescope. Four large galaxies have begun to tangle and will ultimately merge into a single giant galaxy ten times as massive as our the Milky Way. In the process the multiple collision is ejecting billions of stars, some of which will end up remote from any other galaxy.

DA

THE MYSTERIES OF GRAVITY

Part 4 - Gravitational Waves, Quantum Gravity and Unification

After publishing his theory of general relativity, Einstein continued to investigate the possible consequences arising from it. One of these was the theory's implied existence of gravitational waves. According to Newtonian gravitation, the gravitational interaction between two bodies is instantaneous, but relativity limits the transmission of any interactions to the speed of light. If two bodies are interacting gravitationally and one of them suddenly changes shape so that the pattern of its gravitational force field changes, relativity requires this change to be transmitted as a wave across its gravitational field at the finite speed of light, so that the other body would not sense the change instantaneously. Also, the emission of gravity waves would carry away energy from their source, just as light waves carry energy away from a light source.

A simple system which changes its gravitational field, and so should emit gravitational waves, is a massive dumbbell rotating about the axis perpendicular to its handle. An astronomical example of this is a binary pulsar. A pulsar is a rapidly rotating neutron star, typically of about the same mass as the Sun but compressed into a sphere about 20 km in diameter. It possesses an immensely intense magnetic field which produces forces that strip ions and electrons from its surface and accelerates them to near the speed of light, causing them to emit radiation which is beamed out into space from the star's two magnetic poles. Because the magnetic poles are not aligned with the star's rotational axis, the two beams sweep the sky, and if one of these happens to hit the Earth, we detect the pulsar by the rapid regular pulses of radio and other electromagnetic radiation which we receive from it in this way. Much information about the pulsar can be gleaned from this.

A binary pulsar designated *PSR 1913+16* was discovered in 1974. It consists of a pulsar with a close companion which is also thought to be a neutron star. The two stars are in orbit around one another with an average separation of only about the Sun's radius and an orbital period of only seven and a half hours, or 27,000 seconds. Moreover the pulsar rotates on its axis once every 0.059 seconds! This orbiting binary pulsar can be regarded as a rotating dumbbell where the two massive ends are held together by gravity, and so according to general relativity it should be emitting gravitational waves as its gravitational field constantly changes. Because *PSR 1913+16* is 16,000 light years away, any gravitational radiation from it is much too weak to be detected here on Earth. However, by emitting gravitational waves the binary system would lose energy and this would result in a decrease in its orbital period and a decrease in the two stars' separation. Although there would be an increase in the kinetic energy of the system because of the orbital speed-up, there would be a greater loss of gravitational potential energy as the two stars come closer together. Because the effects of gravitational radiation are so weak, it was

predicted that the rate at which the 27,000 second orbital period should be decreasing is only 75 millionths of a second per year. It took four years of exacting observation to confirm that this was actually happening, with a result within the limits of observational errors. Subsequently the rate of decrease of the orbital period has been measured at 76 ± 2 millionths of a second per year - an astonishing validation of the existence of gravity waves and so also of the theory of general relativity.

Gravity is by far the weakest force we know. For example, it is about a million million million million million (10^{36}) times weaker in attracting two protons together than the electric force which repels them away from each other. Electric charges can be positive or negative, and on the atomic scale and above they cancel each others' effects out, except where charged particles are involved. But there is only one type of gravity which is determined by a body's mass, so the effect is cumulative. Hence the motions of the planets, stars and galaxies are determined by very weak gravity and not by strong electric forces. The mass of a proton is about 10^{-24} gm, but there are 10^{57} of them in the Sun. It is the cumulative gravity of all these protons (and other particles) which keeps the Earth in orbit around the Sun.

Although gravity is such a weak force, its cumulative effect can be catastrophic for a massive star at the end of its active life. When a star has exhausted its thermonuclear fuel necessary to produce the heat and pressure to support it against its own gravity, gravity pulling inwards causes it to shrink, thereby further enhancing the gravitational effect. If the star is sufficiently massive, the collapse continues catastrophically and it becomes a black hole with a point spacetime 'singularity' of infinite curvature at its centre. Surrounding the singularity at a distance from it depending on its mass is its 'event horizon' from within which no light or information can escape, but its gravitational field beyond this still exists. The properties of black holes are fascinating, but that's another topic.

Faraday and Maxwell showed in the mid nineteenth century that electricity and magnetism are closely related forces and can be described by a unified electromagnetic field. This success motivated the search for a way of extending the unification of forces by merging the electromagnetic field with the gravitational field. In his later life Einstein worked on a unified field theory which attempted to unite gravitation and electromagnetism in a way which would embrace both, but he did not succeed. In his approach he tried to describe matter (and energy) geometrically in terms of distortions or vibrations of spacetime. Very little was known then about the internal structure of atomic nuclear matter, on which the future success of such unification would depend.

There are four different types of forces and force fields in the Universe - the electromagnetic, the strong nuclear, the weak nuclear and the gravitational. The strong and weak forces only operate on the sub-atomic scale. The strong force,

stronger than the electromagnetic, is what binds protons (and neutrons) together in an atomic nucleus even against the repulsion caused by their electric charges. It only operates over a very short range and cannot be detected outside the confines of the atomic nucleus. Protons and neutrons are subject to the strong force, but electrons are not. The strong force is responsible for one type of radioactive decay which releases great energy. It is what controls nuclear fusion in the cores of stars and liberates the energy of a nuclear bomb. The weak force is by far the weakest force except for gravity. It also is responsible for a type of radioactive decay - beta decay in which atomic nuclei emit high speed electrons. It is what makes a free neutron disintegrate into a proton, an electron and a neutrino. More spectacularly, it manifests itself in supernova explosions.

The modern approach to the unification of the four forces is based on quantum theory. Force fields act by exchanging so-called 'messenger' particles. Some of these are photons for the electromagnetic force, W and Z particles for the weak force, gluons for the strong force and gravitons for the gravitational force. All matter is made up of particles and so quantum theory provides a common way of linking forces and matter. At the ultra-microscopic sub-nuclear level forces and matter are intertwined - particles act on other particles by exchanging still more particles, so a unified theory of the forces should also encompass matter as well.

The first concrete step in unifying the four forces was taken in the late 1960s by Weinberg and Salam based on work by Glashow, for which they all received a Nobel Prize in 1979. It involved the application of quantum mechanics to the electromagnetic field. They developed a mathematical theory which showed electromagnetism and the weak force as two components of a single 'electroweak' force. This new theory made predictions which could be tested experimentally. One of these was the existence of a new form of electromagnetic field involving not photons but new Z particles. In 1983 these predicted Z particles were produced in the CERN high energy accelerator near Geneva - a striking confirmation of the success of this approach to force unification.

This stimulated the search for further unification of what had now been reduced to three fundamental forces. The next step was taken by Glashow and Georgi in 1973 when they published a 'grand unified theory' (GUT) in which the new electroweak force was merged with the strong force to form what is called a 'grand unified force', leaving just gravity out on its own. Other alternative GUTs have since been developed, all based on the same essential foundation of what is called gauge symmetry. However the direct verification of any of these experimentally is not technologically possible because of the ultra high energies necessary to do it. Indirectly, GUTs predict that protons are not completely stable but decay extremely slowly, and that magnetic monopoles - isolated N and S pole particles - can exist. Attempts to detect either of these have so far been inconclusive.

Gravity is the odd one out in all this. The other forces can be represented by force

fields extending through space and time, but in general relativity gravity is a *property* of space and time, being a curvature or warp in the geometry of spacetime - just distorted emptiness, as it has been called. General relativity and the quantum theory used successfully in the interpretation of the other forces seemed for a long time to be incompatible. The quantum description of general relativity gravity in terms of quantum graviton messenger particles runs into insurmountable mathematical difficulties (strings of infinities in the graviton equations). In recent years a new theory called 'supergravity' is being developed to overcome this. Supergravity differs from gravity in that it uses several other particles besides the graviton to transmit the gravitational force. But importantly it also provides at last a framework for the total unification of all the forces into a single 'superforce'. However, there is a long way to go before all the problems in its formulation are solved, and if and when they eventually are solved there appears to be no way this theory can be subjected to experimental verification.

This approach to unification and the progress it is making involves the necessary existence of further dimensions of space beyond the three in which we live. In 1921, not long after Einstein announced general relativity to the world, Kaluza, a Polish physicist, tried to extend Einstein's work to include electromagnetism in the geometrical formulation of force fields. He found that this was not mathematically possible within Einstein's spacetime where time is the fourth dimension, but was possible if an additional space dimension is added. In five dimensional spacetime electromagnetism becomes a form of gravity in the added fourth space dimension. His theory combined gravity and electromagnetism in a single geometrical formulation of both force fields. In this, light becomes a ripple in the fourth space dimension and electrically charged particles in electric and magnetic fields move because they are being subjected to the geometrical distortions of gravity in this extra dimension. Mathematically, Einstein's gravitational field in five spacetime dimensions is exactly and completely equivalent to gravity plus electromagnetism in four spacetime dimensions. But where is the fourth space dimension? In 1926 Klein, a Swedish physicist, proposed an answer. It is 'rolled up' to a very small size which cannot be detected. What we regard as a point in familiar three dimensional space is in fact a tiny circle going round in the fourth space dimension. He was able to calculate the circumference of these circles from the electron's electric charge and the strength of the gravitational forces between particles. It came out to 10^{-32} cm, or about 10^{-20} the size of an atomic nucleus - far too small to be detected.

This Kaluza-Klein theory was little more than a mathematical curiosity for more than fifty years. Then in the late 1970s its possible relevance to the new GUTs and supergravity ideas was realised and it was applied to these. As in the original theory, forces were brought into the unification by grafting on more space dimensions to spacetime. To unify the three remaining forces required several additional space dimensions to be added. Ever higher gauge symmetry considerations lead to a theory in which there must be *seven* extra space

dimensions, making a total of ten space dimensions and one time dimension - a spacetime of eleven altogether! Since they cannot be detected, the seven extra space dimensions must all be 'rolled up' very small in some way. In eleven dimensional Kaluza-Klein supergravity, not only gravity but all the forces of nature are treated as manifestations of the geometrical structure of spacetime. Normal gravity is still Einstein's curvature in the familiar four spacetime dimensions, but the other forces become curvatures in the unseen higher dimensions of spacetime. What would Einstein think of this!

The road which started reputedly with the apple falling on Newton's head has come a long way in the search to unravel the mysteries of gravity, which now is shown to be closely related to all the other forces as well. Is the end in sight with the postulated supergravity as the single superforce? Who knows!

Derek Allen

JENA - HOME OF AN OPTICAL LEGEND

Anyone interested in optical instruments, especially cameras, binoculars and telescopes, will be familiar with the name Carl Zeiss. The optical company, founded in the valley town of Jena in former East Germany, has always been synonymous with the very highest quality in lenses and optical instrumentation.

On a recent trip to Jena I was able to learn a little bit about the long and varied history and fortunes of the company set up in Jena in 1846 by 30-year old Carl Zeiss. Working initially as a one-man band, Zeiss started by building and repairing all sorts of optical equipment such as luges, lenses and microscopes.

Zeiss had previously studied in the University at Jena and very shrewdly realised that the chemistry and biology departments used a large number of optical instruments which would need frequent servicing and repairing. This gave him a ready-made market. In the very next year, Zeiss started manufacturing simple microscopes himself and soon started to introduce numerous improvements. For example, Zeiss designed a new focus mechanism which moved the optical tube, rather than the object table. This much better system was highly praised by the users, and his improvements very quickly gave Zeiss an edge over competitors like Chevalier and Plössl (of eyepiece fame).

Zeiss also found an ally in the University - the physicist Ernst Abbe, who from 1866 onwards worked with Zeiss to improve the design of microscope objectives. Abbe was an expert on the properties of glass and was able to make accurate measurements of refractive index and dispersion. By working together, Zeiss and Abbe were able to put the design of objective lenses on a firm scientific footing, based on accurate and precise measurement and calculation.

Zeiss quickly took on apprentices and staff. In these early years each instrument was hand-built by a single worker. Taking great pride in the quality of their work, the craftsman would sign each completed instrument with their own name.

With his developments and improvements in microscope design and technology, Zeiss started to feel the need for different types of glass to use in the designs of even better objectives and lenses. With each improvement came the requirement for glasses with ever-more closely specified and controlled properties.

This need was answered by the arrival of Otto Schott in Jena. Schott was a chemistry student who had taken a special interest in glasses. In 1879, Schott developed a new kind of glass containing lithium, and wrote to Ernst Abbe for assistance in measuring and characterising its properties.

After an exchange of scientific and technical correspondence, Schott came to Jena in 1882 and by 1884 had founded, together with Zeiss and Abbe, a "Glotechnisches Laboratorium" which would later turn into the Schott Jenaer Glaswerk. In addition to the technical and scientific partnerships with Zeiss and Abbe, Jena was an ideal place to found a glassworks because of the ready supply of raw materials (sand, and wood and coal for the furnaces) in the surrounding area.

By 1909 the works had over a thousand workers, and the optical instrument side was split off and set up as the Carl Zeiss foundation - an industrial undertaking run for the benefit of the workers and local people. The success of the joint glass and optical industries brought a lot of money into the area and much of this was put back into the local community. By the second World War, the Zeiss foundation and Schott glassworks employed over 30,000 people.

In the years after the War Jena found itself in communist East Germany, and Carl Zeiss was split into separate firms operating in East and West Germany. Much of the production and laboratory equipment and many workers were removed from Jena and taken away to Russia. The two sides of the firm developed independently for the next forty years, but were rapidly re-unified following the fall of the Berlin Wall in 1989. It is now once again possible to travel to Jena and to visit the places where all of this took place. The Schott Optisches Museum houses a wide selection of optical instruments from all eras, including microscopes, telescopes, lasers and ophthalmological equipment.

Among other things, Carl Zeiss have long been known as the maker of the finest planetarium projectors, and one of the highlights of our week was a trip to the Zeiss Planetarium opposite the University. This has always been used as a showcase for the latest Zeiss technology, and we were treated to a spectacular ride through the night sky.

For anyone interested in optical instruments and technology, I can't think of a better

place to visit !

Interesting Links:

Carl Zeiss <http://www.zeiss.de/en>

Zeiss Planetarium <http://www.planetarium-jena.de>

Scott [Glasshttp://www.schott.com/english/museum/index.html](http://www.schott.com/english/museum/index.html)

Optisches Museum <http://www.ernst-abbe-stiftung.de/struktur/optischesmuseum/ausstellung.htm>

Alan Cayless

THE NIGHT SKY - October, November, December 2007

<i>Date</i>	SUN		MOON			<i>Constellation</i>
	<i>Rises</i>	<i>Sets</i>	<i>Phase</i>	<i>Rises</i>	<i>Sets</i>	
3 Oct	07.21	18.46	LQ	22.29	16.42	Gemini
11 Oct	07.38	18.26	NM	08.05	17.58	Virgo
19 Oct	07.54	18.06	FQ	16.13	23.16	Capricornus
26 Oct	08.05	17.58	FM	17.17	08.47	Aries
1 Nov	07.22	16.35	LQ	22.13	14.28	Cancer
9 Nov	07.39	16.19	NM	07.29	15.25	Libra
17 Nov	07.56	16.04	FQ	13.43	22.54	Capricornus
24 Nov	08.10	15.54	FM	14.59	08.32	Taurus
1 Dec	08.22	15.46	LQ	#00.07	13.02	Leo
9 Dec	08.34	15.40	NM	09.09	14.35	Scorpius
17 Dec	08.43	15.40	FQ	12.13	23.34	Pisces
24 Dec	08.47	15.42	FM	15.38	09.56	Gemini
31 Dec	08.48	15.49	LQ	00.25	11.26	Virgo

Moon does not rise on 1 December - the time given is for 2 December.

MERCURY

	<i>Rises</i>	<i>Sets</i>	<i>Magnitude</i>	<i>Constellation</i>
3 Oct	10.14	18.56	0.15	Virgo
19 Oct	09.10	18.00	2.76	Virgo
1 Nov	05.46	04.48	0.68	Virgo
17 Nov	06.09	15.44	-0.73	Libra
1 Dec	07.31	15.22	-0.80	Libra
17 Dec	08.57	15.24	-1.16	Ophiuchus

VENUS

	<i>Rises</i>	<i>Sets</i>	<i>Magnitude</i>	<i>Constellation</i>
3 Oct	03.14	17.21	-4.52	Leo
19 Oct	03.20	16.55	-4.44	Leo
1 Nov	02.40	15.31	-4.36	Leo
17 Nov	03.16	14.58	-4.27	Virgo
1 Dec	03.54	14.29	-4.20	Virgo
17 Dec	04.43	14.00	-4.13	Libra

MARS

	<i>Rises</i>	<i>Sets</i>	<i>Magnitude</i>	<i>Constellation</i>
3 Oct	21.49	15.23	-0.11	Gemini
19 Oct	21.09	14.49	-0.37	Gemini
1 Nov	19.30	13.14	-0.63	Gemini
17 Nov	18.26	12.23	-0.98	Gemini
1 Dec	17.14	11.29	-1.29	Gemini
17 Dec	15.38	10.15	-1.58	Gemini

JUPITER

	<i>Rises</i>	<i>Sets</i>	<i>Magnitude</i>	<i>Constellation</i>
3 Oct	13.46	20.56	-1.98	Ophiuchus
19 Oct	12.57	20.02	-1.91	Ophiuchus
1 Nov	11.18	18.19	-1.87	Ophiuchus
17 Nov	10.32	17.28	-1.83	Ophiuchus
1 Dec	09.51	16.45	-1.81	Ophiuchus
17 Dec	09.05	15.57	-1.81	Sagittarius

SATURN

	<i>Rises</i>	<i>Sets</i>	<i>Magnitude</i>	<i>Constellation</i>
3 Oct	03.39	18.06	0.75	Leo
19 Oct	02.47	17.06	0.79	Leo
1 Nov	01.02	15.17	0.80	Leo
17 Nov	00.06	14.16	0.78	Leo
1 Dec	23.11	13.22	0.74	Leo
17 Dec	22.12	12.20	0.68	Leo

URANUS

	<i>Rises</i>	<i>Sets</i>	<i>Magnitude</i>	<i>Constellation</i>
	18.10	05.04	5.74	Aquarius
	17.07	03.54	5.76	Aquarius
	15.15	02.06	5.78	Aquarius
	14.12	01.01	5.80	Aquarius
	13.17	00.06	5.83	Aquarius
	12.14	23.01	5.86	Aquarius

CONJUNCTIONS, OPPOSITIONS AND ELONGATIONS

Date	Planet	
23 Oct	Mercury	Inferior conjunction
28 Oct	Venus	Greatest elongation W
8 Nov	Mercury	Greatest elongation W
17 Dec	Mercury	Superior conjunction
23 Dec	Jupiter	Conjunction
24 Dec	Mars	Inferior conjunction

COMETS (visible on 17 October, 16 November and 16 December)

	Date	RA	Dec	Transit	Magnitude
8P/Tuttle	17 Oct	12h43m	88	12.15	13.6
	16 Nov	17h06m	85	13.40	11.0
	16 Dec	00h13m	71	18.50	7.6
93P/Lovas	17 Oct	00h51m	27	00.09	13.0
	16 Nov	00h25m	26	20.58	12.8
	16 Dec	00h38m	23	19.27	13.0
29P/Schwassmann-Wachmann	17 Oct	06h30m	30	05.05	13.5
	16 Oct	06h27m	30	03.04	13.3
	16 Dec	06h14m	30	00.52	13.3

METEOR SHOWERS

	Radiant			
	Maximum	RA (Max)	Declination	
Orionids	20 Oct	06h24m	15	Fast meteors; favourable.
Taurids	3 Nov	03h44m	14	Slow meteors; sometimes abundant.
Leonids	18 Nov	10h08m	22	Very fast meteors; very favourable.
Puppids-Velids	9 Dec	09h00m	-48	Southern shower.
	26 Dec	09h20m	-65	
Geminids	14 Dec	07h32m	33	Slow meteors; very favourable.

NOTE

Times are BST until 27 October and GMT from 28 October, as viewed from Tullibody.

Compiled by Alex Houston

SAS IN THE NEWS

The Community Newsletter for Doune and Deanston *The Bridge*, published the following comprehensive article about particular residents of Doune - the Cooper family. Douglas Cooper is one of our Society's most active members. *The Bridge* kindly gave us permission to reproduce here the full text of the excellent article by Juliet McCracken.

CD

PEOPLE WE MEET - STARGAZER EXTRAORDINARY

The Aurora Borealis, flaring in curtains of multicoloured light over the Wood of Doune; the statue of Colonel Stirling silhouetted against a blue dawn backdrop of smoky ice crystals; it's seldom that any of us get to view our familiar locality in the gorgeous, other-worldly settings recorded through the telescope of local astronomer, photographer and night owl, Douglas Cooper.

When most of us are putting away our cameras at the end of the day, on clear nights Douglas is bound to be rigging up one of his, ready to capture images from the spectacular display which the Universe spreads nightly overhead. Taken through a telescope, his most beautiful photographs are truly dazzling : the lunar eclipse on 3 March when refracted light from the Sun turned the Moon briefly into a huge coral-coloured Chinese lantern : the dance of the Pleiades : the whirl of light that is the Andromeda galaxy, hurtling towards our Milky Way : some of these have achieved the distinction of appearing on a NASA website.

Originally from Rothesay, Douglas and his wife Maureen have lived in the Wood of Doune for 26 years. A consultant engineer to the water industry, currently working for one of the main UK companies in this field, Douglas is at present much involved with flooding issues. Dr Maureen Cooper, formerly a lecturer in chemistry at Stirling University, was until recently director of the Scottish Resource Centre for Women in Science and Technology at Napier University. They have two daughters: 20-year old Christine is, at the time of writing, playing the double base to standing ovations at an Edinburgh Fringe production.

With degrees in maths and physics from both Glasgow and the Open University, Douglas first became star-struck in 1994, the result of a keen interest in theoretical physics. Researching the mathematics of solar flares led to the purchase of his first serious telescope: "I discovered that the Universe was a wonderful thing to look at, never mind to try to speculate on."

"It always amazes me that people don't look up more often", Douglas tells *The Bridge* : displays of the Northern Lights over these parts are set to strengthen as the Sun moves into a stronger phase of activity. The shifting shadows on the lunar surface; the moons of Jupiter whose orbit round their planet got Galileo into so much trouble; the Orion Nebula, birthplace of new stars; the Perseid meteor shower which, every 12 August sees the Earth crashing through a comet-tail of shooting stars: "These are there for all to see".

Currently secretary of the Scottish Astronomers Group, an amalgamation of some dozen local societies, Douglas is one of Scotland's leading astro-photographers and a regular on the national lecture circuit. He is also a tutor at Glasgow University's Department of Adult and Continuing Education. He was for many years chairman of the Stirling Astronomical Society, founded when Halley's Comet visited these parts in 1986. The Society meets monthly in the Smith Institute.

October to April sees a series of evening classes for novices in astronomy run at the Stirling Highland Hotel Observatory - at least half the attendees are women - by Douglas and his colleague Alan Cayless, current chairman of the Stirling Astronomical Society: "No maths, not too much theory, just fun", promises the former. Ring him on 841803 for details. The venue is much envied by fellow astronomers for its splendid rotating Victorian observatory, complete with wooden-barrelled reflector telescope some 3m long. Douglas was one of the team which, during the 1990s, helped restore the telescope to its former glory. Members of the public will be able to visit the observatory during Stirling's Heritage Days weekend, on Saturday 15 and Sunday 16 September, 10-12 and 2-4.

The current surge of interest in astronomy can partly be explained by improvements in digital camera technology and high tech computerised equipment, reckons Douglas. "The internet is a wonderful place for astronomy". Today anyone from a primary school pupil to a professor can book time on a robotic telescope and photograph galaxies from the other side of the world.

The amateur astronomer is every bit as capable of making important discoveries as a professional, says Douglas. Indeed, given the size of the Universe, the latter often rely on the former. Douglas's enthusiasm has taken him to Turkey to watch a solar eclipse and to Egypt to see the transit of Venus. A new ambition is to see the night sky in the Southern Hemisphere, ideally from Australia or Namibia.

Astronomy puts our place in the Universe into perspective. There must be life out there somewhere : how can we possibly be the only ones?"

Juliet McCracken

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STIRLING ASTRONOMICAL SOCIETY MEETINGS

Regular Society Meetings are held from September through to May. Lecture Meetings mostly take place on the second Friday of the month in the Smith Museum Lecture Room, Dumbarton Road, Stirling from 7.30 pm to 9.30 pm. Details of the lecture programme are available from the Secretary and are posted on the Society website. They are also usually announced here in *Mercury* and in the *Stirling Observer*. These Meetings are free, and anyone with an interest in astronomy is welcome to attend, whether a member of the Society or not.

Members' Evenings are informal discussion meetings on various topics which are usually held on the last Friday of the month at the Mayfield Community Centre, St. Ninians, Stirling, from 7.30 pm to 9.30 pm.

At suitable times and with suitable weather conditions, arrangements are made for groups of members to meet for observation sessions at the SAS Observatory at the Stirling Highland Hotel, and at other locations as well. People interested should contact the Secretary.

The Society runs a series of Evening Classes on Astronomy in Stirling. These are suitable for beginners and are open to anyone over 11 years old. Classes take place on the first Thursday of the month at the Highland Hotel, 7:00 to 9:00 pm, starting in October, and can involve using the SAS Observatory telescope when weather permits. Please contact the Secretary or the SAS website for further details.

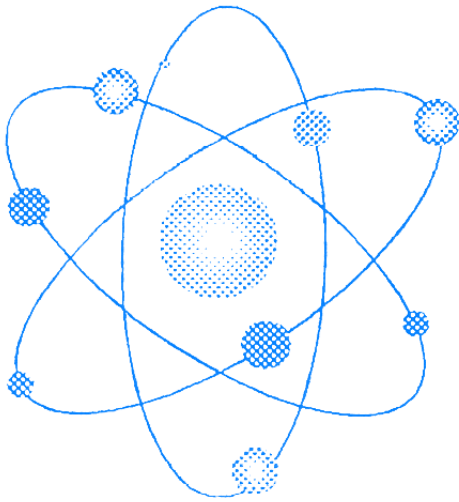
The forthcoming dates for the Lecture Meetings for the 2007-2008 Society Session are:

2007

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| 12 October | Speaker : Prof Alan Heavens, Institute for Astronomy,
University of Edinburgh |
| | Title : The future's bright, but it might not be Orange |
| 9 November | AGM and two short talks |
| 14 December | Speaker : <i>To be confirmed</i> |

2008

- | | |
|-------------|---|
| 11 January | Speaker : David Gavine |
| | Title : Life and works of Thomas Dick |
| 15 February | Speaker : Mark Butterworth |
| | Title : A history of observing sunspots |
| 14 March | Speaker : <i>To be confirmed</i> |
| 11 April | Speaker : <i>To be confirmed</i> |
| 9 May | Speaker : <i>To be confirmed</i> |
-



Stirling Astronomical Society

OFFICERS AND COMMITTEE FOR 2007

<i>President</i>	Ken Mackay
<i>Chairman</i>	Alan Cayless
<i>Secretary</i>	John Moffat
<i>Treasurer</i>	(vacant)
<i>Membership Secretary</i>	Bert Mackenzie
<i>Director of Observations</i>	Alex Houston
<i>Committee Member</i>	Terry Aitchison

For information about Stirling Astronomical Society, membership and activities, please contact the Secretary:

E-mail: johnmoffat@in-aberfoyle.demon.co.uk

or visit the SAS website :

www.stirlingastronomicalsociety.org.uk

Thanks to all contributors. Please think about pieces, articles and images for the next January issue. Items describing events or the activities of the Society, or of individual members or groups of members, are especially welcome. Advanced notification of future events and activities can be included, particularly as *Mercury* can now be accessed on the web.

Please give or send your contributions to (or first discuss them with) in the first instance to the new editor, or to me :

Derek Allen

1, Ogilvie Road
Stirling, FK8 2HJ

Tel: 01786 472771

E-mail: sasmercury@talktalk.net

Copy can be in clear handwriting, typescript, images for scanning, e-mail attachments, or on floppy disk or CD. Contributions should normally not be more than about 750 to 1000 words in length. Please try to have material ready by the beginning of December for the January 2008 issue of *Mercury*.

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I'M SORRY, BUT THIS IS MY LAST *MERCURY*

A year ago I said to the Society at the AGM and then in the January *Mercury* that I would like help with *Mercury* with a view to passing on responsibility for it altogether to someone else after one or two more issues. I have since had help from various members in several ways for which I am grateful, but no-one has yet offered to take over as editor. However, I have now reached the point where I really am no longer in a position to carry on as editor - a role I have undertaken for seven years and 28 issues. So this is my last *Mercury*. It is for the Society to decide on the future of *Mercury* and to find a new editor, so that I can hand over effectively and assist the new editor at first if needed. I now look forward to being just a contributor to *Mercury*.

Derek Allen