Sky-High 2010


Andromeda Galaxy - Messier 31

The 18th **annual guide** to astronomical phenomena visible from Ireland during the year ahead (naked-eye, binocular and beyond)

By John O'Neill and Liam Smyth

€ 5

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Foreword

We send greetings to all fellow astronomers and welcome them to this, the eighteenth edition of *Sky-High.*

We thank the following contributors for their articles: Patricia Carroll, John Flannery and James O'Connor. The remaining material was written by the editors John O'Neill and Liam Smyth. The Gallery has images and drawings by Society members. The times of sunrise etc. are from *SUNRISE* by J. O'Neill.

We are always glad to hear what you liked, or what you would like to have included in *Sky-High*. If we have slipped up on any matter of fact, let us know. We can put a correction in future issues. And if you have any problem with understanding the contents or would like more information on any topic, feel free to contact us at the Society e-mail address ias1937@hotmail.com. Any updates or errata for *Sky-High* will be posted at the Sky-High 2010 update page:
www.irishastrosoc.org/skyhigh/skyhigh.htm

Up-to-date news of IAS activities and links to sites of interest on the internet can be found on our website at **www.irishastrosoc.org**.

On the Society website is *Sky and Gallery* which highlights some celestial events featured in *Sky-High*. Also featured will be unpredicted events such as bright comets and bright supernovae.

Contents

Wishing you clear skies for 2010,
John O'Neill and Liam Smyth

The Irish Astronomical Society

The Irish Astronomical Society was founded in 1937. It caters for those of all ages and interests in astronomy and space.

You don't have to be an expert to be part of our dynamic club. Many of our members are taking their first steps in the hobby and you are sure to receive friendly advice from some of the more experienced amateur astronomers among us.

Activities include monthly meetings, receiving our bi-monthly newsletter *Orbit*, observing groups, e-mail alert notices of transient astronomical phenomena such as aurora, and outings to places of astronomical interest.

Members have joined expeditions to observe several total solar eclipses world wide. Also note, Sky-*High* is a free benefit of IAS membership.

The Society also has a well stocked library of books, journals and videos that members can borrow as well as access to a number of telescopes that can be loaned for a period.

A number of IAS members have made their own telescope, while others possess telescopes ranging in size to well above 50 cm aperture. Many are now experimenting with the latest technologies to hit the amateur community such as CCD cameras.

If you are considering purchasing a telescope then we'll point you in the right direction before you take the plunge and part with your hard-earned cash.

The *Dublin Sidewalk Astronomers* hold public star parties at regular intervals, usually in Sandymount, Dublin (see IAS website for details).

Your Night Sky Primer

As with any hobby, astronomy seems to have its own set of terminology designed to confuse. However, with a little patience you'll soon pick up the jargon and be well on the way to knowing your way around the sky.

The revolving heavens

We all know the Heavens don't revolve, it is the other way round, the Earth rotates on its axis. But it looks otherwise and it is easier to describe things as we see them for our immediate purpose. The fact that the Earth turns on its axis about every 24 hours causes the Sun to rise in the east and set in the west, and it is due south at noon. A similar situation applies to all the other heavenly bodies except that since they appear to move relative to the Sun they are not south every day at noon.

The stars appear to drift west in such a way that any particular star is due south four minutes earlier each day or night. If you multiply four minutes by 365 you get something close to 24 hours. So if a star is south at eight o'clock tonight, it will be south four minutes earlier tomorrow, and two hours earlier in a month. In six months it will be south at about eight in the morning. In a year it will again be south at eight in the evening. It follows that we see different constellations in different seasons, but over a year, we see all that portion of the heavens that can be seen from Ireland.

Star maps

You will need at least one star map. This could be a set of monthly charts such as are included in many books on astronomy. A Planisphere is very useful. They come in various sizes at equivalent cost. It allows you to show the constellations visible at any time of the night, any time in the year.

You could get away with using the monthly charts published in newspapers but there are a couple of drawbacks. Each chart is correct for only one time on a given night, say 10 p.m. If you are observing two hours later you would need the following month's chart. These charts also show the planets visible for a particular month, so they can be confusing unless you tippex them out. When learning the constellations check first from the monthly notes if there is a bright planet in the area.

Once you can find the constellations you will enjoy learning more about them.

A useful guide is the Collins Pocket Guide *Stars & Planets* (now in its 4th edition) which has constellation charts as well as all sky charts, along with sections on the stars and planets.

For more detailed studies, especially with binoculars or a small telescope you will need a more detailed map showing all stars to at least sixth magnitude. A more recent entry is the *Pocket Star Atlas* published by Sky Publishing for about €16. This shows stars to magnitude 7.6 and the positions of many deep-sky objects.

An idea of size or scale

If you have seen a picture of a total eclipse of the Sun you will have noticed that the black disk of the Moon just about covers the bright disk of The Sun. If you were to suspend a one Euro coin about two and a half metres in front of your eye, it would just about cover the Moon's disk.

The Sun is nearly 1.4 million km in diameter, the Moon is 3476 km and the one Euro coin is just over two centimetres in size. Yet they appear nearly equal. This is because they all seem to take up the same amount of the space in front of our eyes. We may say they have the same **angular diameter.** In this case it is about half a degree (½°).

Degrees are further divided into 60 **arcminutes** (60') with each arcminute made up of 60 **arcseconds** (60"). The scale allows us to measure angles in the sky or apparent size of a celestial object. For example, the Full Moon measures an average of half a degree, or 30 arcminutes, in diameter.

Your closed fist held at arms length is about ten degrees (10°). Your stretched out hand, i.e. from the tip of your thumb to the tip of your little finger, is about twenty degrees. Between four and five outstretched hands or twice as many closed fists will take you from the horizon to zenith. If you know the Plough you will find that its overall length is rather more than one outstretched hand - it is almost 25 degrees.

Some familiarity with angular measure is necessary to find your way easily about the sky.

Positioning in the sky

Starting at any landmark and going right around the horizon is three hundred and sixty degrees. The **azimuth** of an object is a measure of its position relative to the horizon as measured from true north which starts at 0° with due east being 90° and so on. Going from a point on the horizon straight up to the point overhead - the **zenith** - is ninety degrees and a measure of altitude.

Astronomers use a kind of celestial longitude and latitude called **right ascension** and **declination** to accurately plot the position of an object in the sky.

The basis for this system is the equator and the poles.

Right ascension is expressed in hours (h), minutes (m) and seconds (s) running eastward from 0 to 24 hours right round the equator. The zero point of right ascension is taken as the vernal equinox - the point where the Sun crosses the celestial equator, moving from south to north, in its course around the sky.

An object's declination is written in terms of how many degrees, minutes, and seconds north (+) or south (-) of the celestial equator it is.

Planetary data

The Earth is the third planet of the Solar System. Mercury and Venus are closer to the Sun while Mars, Jupiter, Saturn, Uranus, Neptune and Pluto are further out. The major planets are always to be found in the **zodiac** - a band centred on the ecliptic**.** The ecliptic is the sun's path on the celestial sphere. Mercury and Venus seem to swing from one side of the Sun to the other but as viewed from Earth they never get further away than the positions known as **greatest elongation.** The other planets can be anywhere in the zodiacal band.

The moment when Mercury or Venus are directly between the Earth and the Sun is known as **inferior conjunction.** They are at **superior conjunction** when they pass on the far side of the Sun. Obviously, the other planets outside our orbit can only pass through superior conjunction.

When outer planets are in **opposition** they are opposite the Sun to us and are on the celestial meridian (the southern part – from Ireland) at midnight.

The **celestial meridian** is an imaginary line that starts at the north point of the horizon, rises directly through the **North Celestial Pole** (NCP) to the zenith and then continues on down to the southern point of the horizon. The NCP is less than one degree from Polaris, the Pole Star.

Venus and Mercury show phases like the Moon. Mars can look **gibbous,** i.e. not quite full. Jupiter can show very slightly less than full at **quadrature** in amateur telescopes.

The outer planets exhibit a phenomenon known as **retrograding.** A consequence of them lying further from the Sun than us is that they orbit more slowly than the Earth. Therefore, at opposition, the Earth overtakes an outer planet causing its apparent movement against the stars to grind to a halt, move back to the right, halt, and then resume direct motion once again.

A note on time

Times throughout *Sky-High* are given, unless noted otherwise, in **Universal Time** (UT). This is the 24-hour system starting at mean midnight as measured at Greenwich. It is the same as Greenwich Mean Time GMT. UT is the same as Irish civil time, except when Summer Time is in use. To translate UT into Summer Time just add one hour.

Star magnitudes

The **magnitude** of a star refers to its brightness, not to its size. The scale of magnitudes is a logarithmic one. A difference of one magnitude is a difference of 2.512 times in brightness. A difference of five magnitudes is a difference of 100 times in brightness. The lower the magnitude number, the greater the brightness.

The stars in the Plough range from about magnitude 2 to magnitude 3.5. The faintest stars you can see with the naked eye on a really dark, moonless night, away from city lights, are magnitude 6 or slightly fainter. Binoculars show stars about two magnitudes fainter, while the most powerful telescopes in the world are able to show magnitudes about 20. Modern imaging techniques on such telescopes can reach below 25. The apparent brightness of a star depends on its true brightness and its distance. The term magnitude if not qualified, refers to apparent brightness.

The term **absolute magnitude** is the magnitude a star would show if it lay at a standard distance of 10 parsecs (the parsec is defined below).

Location

The times for certain events, such as occultations, apply for Dublin. For other parts of the country, you need to look a few minutes early.

Distance

The **Astronomical Unit** (AU) is a unit of distance of just under 150,000,000 km (the mean distance of the Earth from the Sun). It is convenient for solar system measurements.

For stellar measurements the **light-year** is used. It is the *distance* light travels in a vacuum in one year. It is about 63,000 AU.

A ***parsec*** is the distance a star must lie at to exhibit a parallax of one arc-second; it is equivalent to about 3.26 light years. Or another way of putting it, is that a parsec is the distance at which the radius of the Earth's orbit (1 AU) would subtend an angle of one second of arc.

Sky Diary 2010

January

1 Jupiter's moon Europa partially occults Io at 18:25 UT for 3 minutes. However, they are only at 14° altitude.

3/4 Quadrantid meteors at maximum (18 hrs). The bright waning gibbous moon interferes.

3 Earth at perihelion.

3/4 π Leonis (mag 4.9) occulted by the waning gibbous moon; reappearance at 01:34 UT.

4 Mercury at inferior conjunction.

5 Lunar (south edge; waning gibbous) grazing occultation of 62 Leonis (mag 5.9) at about 07:19 UT. The northern limit passes from Ardara, Co Donegal to Kilmuckridge, Co Wexford.

6 HIP 57791 in Virgo (mag 5.6) occulted by the gibbous moon; reappearance at 05:12 UT.

11 Venus at superior conjunction.

11 Rhea passes 14" N of Titan at about 3 hrs.

15 Annular Solar Eclipse visible from parts of east Africa and south and east Asia. Nothing of the event is visible from Ireland. See page 12 for details.

22 Saturn's moon Titan at eastern elongation.

27 Mercury at greatest elongation, 25° west.

28 δ Geminorum (mag 3.5) occulted by the bright full moon; disappearance at 18:46 UT.

29 Mars at opposition in Cancer, mag –1.3.

30 Nearest full moon of year (356,700 km) at 6 hrs. This occurs just 3 hours before the nearest lunar perigee of the year (356,600 km). As the moon sets that morning the moon should appear, as well as be, especially large (33.7').

31 Omicron Leonis (mag 3.5) occulted by the bright moon, just one day past full; reappearance at 05:22 UT.

February

7 Saturn's moon Titan at eastern elongation.

13 Furthest lunar apogee (406,500 km) of the year, but moon poorly positioned.

14 Neptune at conjunction.

16 Jupiter lies about ½° north of Venus, but both planets are very low after sunset.

16/17 4 Vesta passes 13' SW of γ Leonis (mag 2.2) at about 4 hrs.

17 Saturn's moon Iapetus at western elongation.

17 4 Vesta at opposition in Leo, mag 6.1

20 ε Arietis (mag 4.6) occulted by the first quarter moon; disappearance at 22:57 UT.

21 The first quarter moon passes ½° south of M45, the Pleiades star cluster, in the evening sky.

21 HIP 17776 in Taurus (mag 5.4) occulted by the first quarter moon; disappearance at 19:15 UT.

21 Lunar (north edge; first quarter) grazing occultation of HIP 17692 (mag 6.8) at about 19:17 UT. The northern limit passes from Crohy Head, Co Donegal to Carnlough Bay, Co Antrim. The star is on the southern outskirts of M45.

21 Lunar (north edge; first quarter) grazing occultation of 26 Tauri (mag 6.5) at about 20:08 UT. The northern limit passes from Tranarossan Bay, Co Donegal to Cushendun, Co Antrim. The star is on the SE outskirts of M45.

21 Lunar (north edge; first quarter) grazing occultation of HIP 17999 (mag 6.9) at about 21:09 UT. The northern limit passes from Cahersiveen, Co Kerry to Kinsale, Co Cork. The star is on the SE outskirts of M45.

22 Comet 81P/Wild comes to perihelion, 1.60 AU.

23 Saturn's moon Titan at eastern elongation.

28 Jupiter at solar conjunction.

March

9 λ Sagittarii (mag 2.9) occulted by the very low waning crescent moon; disappearance at the bright limb at 04:58 UT; reappearance in bright twilight at 06:10 UT.

10 Saturn's moon Titan at eastern elongation.

10 Mars at east stationary point.

14 Mercury at superior conjunction.

16 136472 Makemake at opposition in Coma Berenices, mag 16.9. It is now 52.2 AU from the sun. Apart from Pluto, this is the brightest Trans-Neptunian Object.

17 Uranus at solar conjunction.

19 Mu Arietis (mag 5.7) occulted by the crescent moon; disappearance at 20:38 UT.

20 Vernal (or Spring) Equinox at 17:32 UT.

22 Comet 81P/Wild at perihelion, 1.60 AU.

22 Saturn at opposition in Virgo, magnitude +0.5.

23 Titan (mag 8.3), Tethys (mag 10.1) and Rhea (mag 9.6) in an almost north-south straight line just east of Saturn (1 hrs).

23 Titan (mag 8.3), Tethys (mag 10.1) and Dione (mag 10.3) in a north-south straight line just east of Saturn (4 hrs).

23 532 Herculina at opposition in Coma Berenices, mag 8.9.

25 Comet C/2009 O2 Catalina at perihelion, 0.71 AU.

26 Saturn's moon Titan at eastern elongation.

26 Xi Leonis (mag 5.0) occulted by the bright gibbous moon; disappearance at 20:49 UT.

27 Omicron Leonis (mag 3.5) occulted by the bright moon, just one day before it's full; disappearance at 01:52 UT.

28 Irish Summer Time starts at 1 hrs civil time (01.00 UT), clocks go forward one hour.

30 Mars at aphelion, 1.67 AU.

April

3 Venus (mag –3.9) and Mercury (mag –0.6) 3° apart in the evening twilight.

4 Easter Sunday.

7 Mercury at greatest elongation, 19° east in the evening sky. Best evening apparition of the year.

11 Saturn's moon Titan at eastern elongation.

12 9 Metis at opposition in Virgo, mag 9.5.

16 Mars lies about 1° north of M44 Praesepe star cluster.

19 HIP 30570 in Gemini (mag 6.0) occulted by the waxing crescent moon; disappearance at 22:41 UT.

22/23 Lyrid meteors at maximum (16 hrs). The just past last quarter moon interferes, apart from 45 minutes before dawn.

27 Saturn's moon Titan at eastern elongation.

28 Mercury at inferior conjunction.

30 Comet C/2009 K5 McNaught at perihelion, 1.42 AU.

30 Rhea lies just 9" N of Titan (23 hrs).

May

5 Eta Aquarid meteors at maximum (8 hrs). Although a fairly rich shower, the radiant is poorly placed.

6 Saturn's moon Iapetus at western elongation.

9 12 Victoria at opposition in Libra, mag 9.2. That evening it lies 10' NE of Iota^2 Librae.

9 Rhea lies just 3" S of Titan (23 hrs).

13 Saturn's moon Titan at eastern elongation.

16 6 Leonis (mag 5.1) occulted by the waning gibbous moon; reappearance at 01:53 UT.

18 2 Pallas at opposition in Serpens (Caput) on the border of Corona Borealis, mag 8.7.

26 Mercury at greatest elongation, 25° west.

28 Sigma Scorpii (mag 2.9) occulted by the low full moon; disappearance at 01:16 UT.

29 Saturn's moon Titan at eastern elongation.

June

5 Saturn's moon Tethys (mag 10.3) occults Dione (mag 10.5) from 23:27 UT for 8 minutes. Most of the disc of Dione will be covered at maximum.

6 Mars (mag 1.2) lies less than 1° north of Regulus (mag 1.4).

8 Uranus (mag 5.9) lies less than ½° north of Jupiter (mag –2.3).

17 Earliest sunrise of the year (at Dublin), 03:56 UT.

18 1 Ceres at opposition in Sagittarius, mag 7.0.

21 Summer Solstice at 11:28 UT, the night of 20/21 is the shortest of the year.

24 Latest sunset of the year (at Dublin), 20:57 UT.

25 Pluto at opposition in Sagittarius, magnitude 14.0. It is now 31.9 AU from the sun.

26 Partial Lunar Eclipse visible from Australia and the western Pacific. The maximum magnitude of 0.54 occurs at 11:38 UT. Nothing of the event is visible from Ireland.

28 Mercury at superior conjunction.

July

2 Comet C/2009 R1 McNaught at perihelion, 0.41 AU.

4 Comet 10P/Tempel at perihelion, 1.42 AU.

6 Earth at aphelion.

8 Despite not being visible from Ireland this is a notable event. δ Ophiuchi (mag 2.7) is occulted by asteroid 472 Roma (mag 13.5). The predicted path goes across mainland Europe crossing the holiday region of the Algarve in Portugal.

11 Total Solar Eclipse visible across the Pacific Ocean. Nothing of the event is visible from Ireland. See page 12 for details.

25 Saturn's moon Iapetus at western elongation.

30 Mars (mag 1.5) lies less than 2° south of Saturn (mag 1.1), very low in evening twilight.

August

6 Comet 2P/Encke comes to perihelion, 0.34 AU. This apparition is poorly placed from Ireland.

6 103 Tauri (mag 5.5) occulted by the waning crescent moon; reappearance at 01:17 UT. The moon is only 9° above the horizon at Dublin.

7 Mercury at greatest elongation, 27° east.

10 Venus (mag –4.3) forms, about this time, a triangle with Mars (mag 1.5) and Saturn (mag 1.1). The two fainter planets, about 100 times fainter than Venus, will be difficult in the bright twilit evening sky.

12/13 Perseid meteors at maximum (21 hrs), moon free.

15 Favourable lunar libration (of 10° on the N.E. limb).

18 Mars (mag 1.5) lies less than 2° north of Venus (mag –4.3), very low in evening twilight.

20 Neptune at opposition in Capricornus, mag 7.8.

20 Venus at greatest elongation, 46° east in the evening sky.

24 Furthest full moon of the year (408,200 km).

25 Jupiter's moon Callisto at eastern elongation.

31 Lunar (north edge; waning gibbous) grazing occultation of 47 Arietis (mag 5.8) at about 01:26 UT. The northern limit passes from Lispole, Co Kerry to Glynn, Co Antrim.

September

1 33 Tauri (mag 6.0) occulted by the last quarter moon; reappearance at 04:36 UT.

3 Mercury at inferior conjunction.

8 Nearest lunar perigee of the year (357,200 km).

15 8 Flora at opposition in Aquarius, mag 8.2.

16 39 Laetitia at opposition in Aquarius, mag 9.1.

19 Uranus (mag 5.7) lies less than 1° north of Jupiter (mag –2.9).

19 Mercury at greatest elongation, 18° west in the morning sky.

21 Jupiter at opposition in Pisces, mag –2.9.

21 Uranus at opposition in Pisces, mag 5.7. It then lies less then 1° north of Jupiter.

23 Autumnal Equinox at 03:09 UT.

28 6 Hebe at opposition in Cetus, mag 7.7.

28 Moon passes about 1.5° south of the Pleiades M45. Look before dawn.

30 121 Tauri (mag 5.4) occulted by the nearly last quarter moon; reappearance at 03:57 UT.

30 Mu Geminorum (mag 2.9) occulted by the last quarter moon; reappearance at 22:43 UT. The moon is only 6° high in Dublin.

October

1 Saturn at solar conjunction.

2 61 Geminorum (mag 5.9) occulted by the just past last quarter moon; reappearance at 01:15 UT.

7 Comet C/2007 Q3 Siding Spring at perihelion, 2.25 AU.

15 136199 Eris at opposition in Cetus, where it is magnitude is extremely faint at 18.7. It is now 96.6 AU from the sun.

17 Mercury at superior conjunction.

17 Omicron Ceti (Mira) predicted to be at maximum (about magnitude 3.4) about this date.

18 Kappa Aquarii (mag 5.0) occulted by the waxing gibbous moon; disappearance at 22:57 UT.

20 Kappa Piscium (mag 4.9) occulted by the waxing gibbous moon; disappearance at 02:29 UT.

20 Comet 103P/Hartley is nearest the earth, 0.12 AU.

21/22 Orionid meteors at maximum (17 hrs), the nearly full moon interferes.

24 Jupiter double shadow transit of Ganymede and Europa. The double event starts at 01:39 UT when the shadow of Europa enters the disc. The disc of Europa is also transiting at that time.

27 3 Geminorum (mag 5.8) occulted by the waning gibbous moon; reappearance at 22:57 UT.

28 Mu Geminorum (mag 2.9) occulted by the waning gibbous moon; reappearance at 05:47 UT.

28 Comet 103P/Hartley at perihelion, 1.06 AU.

29 56 Geminorum (mag 5.1) occulted by the waning gibbous moon; reappearance at 06:12 UT.

29 Venus at inferior conjunction.

30 Asteroid 2003 UV_{11} (mag 11.9) passes 5 lunar distances from the earth.

31 Irish Summer Time ends at 2 hrs civil time (01.00 UT), clocks go back one hour.

November

14 Lunar (south edge; just after first quarter) grazing occultation of HIP 110378 (mag 7.5) at about 21:36 UT. The southern limit passes from Roaringwater Bay, Co Cork to Wicklow Head, Co Wicklow.

16 19 Piscium (mag 5.0) occulted by the waxing gibbous moon; disappearance at 19:42 UT.

17/18 Leonid meteors at maximum (0 hrs), bright waxing gibbous moon interferes.

24 1 Geminorum (mag 4.3) occulted by the bright waning gibbous moon; reappearance at 03:56 UT.

December

1 Mercury at greatest elongation, 22° east.

8 16 Psyche at opposition in Taurus, mag 9.4.

13 Earliest sunset of the year (at Dublin), 16:06 UT.

13 Kappa Piscium (mag 4.9) occulted by the waxing gibbous moon; disappearance at 18:12 UT.

13/14 Geminid meteors at maximum (6 hrs), moon free during the morning.

20 Mercury at inferior conjunction.

21 Total Lunar Eclipse, visible very low in the dawn. See page 12 for details.

21 Mu Geminorum (mag 2.9) occulted by the full moon; reappearance at 18:41 UT. Not an easy observation with the glare from the bright moon.

21 Winter Solstice at 23:38 UT, shortest day of the year.

22/23 Ursid meteors at maximum, full moon interferes.

25 6 Leonis (mag 5.1) occulted by the waning gibbous moon; reappearance at 01:53 UT.

27 Pluto at solar conjunction.

29 20 Piscium (mag 5.5) just 4' SE from Jupiter, compare the star with the Galilean satellites.

30 Latest sunrise of the year (at Dublin), 08:40 UT.

Phases of the Moon for 2010

NEW				FIRST QUARTER				FULL				LAST QUARTER			
	d	h	m		d	h	m		d	h	m		d	h	m
								Dec	31	19	13	Jan	7	10	39
Jan	15	7	11	Jan	23	10	53	Jan	30	6	18	Feb	5	23	48
Feb	14	2	51	Feb	22	0	42	Feb	28	16	38	Mar	7	15	42
Mar	15	21	01	Mar	23	11	00	Mar	30	2	25	Apr	6	9	37
Apr	14	12	29	Apr	21	18	20	Apr	28	12	18	May	6	4	15
May	14	1	04	May	20	23	43	May	27	23	07	Jun	4	22	13
Jun	12	11	15	Jun	19	4	29	Jun	26	11	30	Jul	4	14	35
Jul	11	19	40	Jul	18	10	11	Jul	26	1	37	Aug	3	4	59
Aug	10	3	08	Aug	16	18	14	Aug	24	17	05	Sep	1	17	22
Sep	8	10	30	Sep	15	5	50	Sep	23	9	17	Oct	1	3	52
Oct	7	18	44	Oct	14	21	27	Oct	23	1	36	Oct	30	12	46
Nov	6	4	52	Nov	13	16	39	Nov	21	17	27	Nov	28	20	36
Dec	5	17	36	Dec	13	13	59	Dec	21	8	13	Dec	28	4	18

Sunrise and Sunset for 2010

				Nautical Twilight						Nautical Twilight	
Date		Sunrise	Sunset	Begin	End	Date		Sunrise	Sunset	Begin	End
Jan	**1**	8:40	16:17	7:13	17:45	**Jul**	**9**	4:08	20:51	1:57	23:01
Jan	**8**	8:37	16:26	7:11	17:52	**Jul**	**16**	4:17	20:44	2:14	22:45
Jan	**15**	8:32	16:37	7:08	18:01	**Jul**	**23**	4:27	20:35	2:33	22:27
Jan	**22**	8:24	16:49	7:02	18:12	**Jul**	**30**	4:37	20:24	2:52	22:08
Jan	**29**	8:14	17:02	6:54	18:23	**Aug**	**6**	4:49	20:11	3:11	21:49
Feb	**5**	8:03	17:16	6:44	18:35	**Aug**	**13**	5:01	19:57	3:28	21:30
Feb	**12**	7:49	17:30	6:32	18:47	**Aug**	**20**	5:13	19:42	3:45	21:10
Feb	**19**	7:35	17:44	6:19	19:00	**Aug**	**27**	5:26	19:26	4:01	20:50
Feb	**26**	7:20	17:57	6:04	19:12	**Sep**	**3**	5:38	19:10	4:16	20:30
Mar	**5**	7: 4	18:10	5:49	19:25	**Sep**	**10**	5:50	18:53	4:31	20:11
Mar	**12**	6:47	18:23	5:32	19:39	**Sep**	**17**	6:02	18:36	4:44	19:53
Mar	**19**	6:30	18:36	5:15	19:52	**Sep**	**24**	6:14	18:19	4:58	19:35
Mar	**26**	6:13	18:49	4:57	20:06	**Oct**	**1**	6:26	18:02	5:11	19:17
Apr	**2**	5:57	19:02	4:38	20:20	**Oct**	**8**	6:38	17:46	5:24	19:00
Apr	**9**	5:40	19:14	4:19	20:35	**Oct**	**15**	6:51	17:29	5:36	18:44
Apr	**16**	5:24	19:27	4:00	20:50	**Oct**	**22**	7:04	17:14	5:48	18:29
Apr	**23**	5:08	19:40	3:40	21:08	**Oct**	**29**	7:18	16:59	6:00	18:16
Apr	**30**	4:53	19:52	3:21	21:26	**Nov**	**5**	7:31	16:45	6:12	18:04
May	**7**	4:39	20:04	3:01	21:44	**Nov**	**12**	7:44	16:33	6:23	17:54
May	**14**	4:27	20:16	2:41	22:03	**Nov**	**19**	7:57	16:23	6:34	17:46
May	**21**	4:16	20:27	2:23	22:22	**Nov**	**26**	8:09	16:15	6:44	17:40
May	**28**	4:08	20:37	2:05	22:41	**Dec**	**3**	8:19	16:09	6:53	17:36
Jun	**4**	4:01	20:45	1:50	22:58	**Dec**	**10**	8:28	16:06	7:01	17:34
Jun	**11**	3:58	20:52	1:38	23:13	**Dec**	**17**	8:35	16:07	7:07	17:35
Jun	**18**	3:56	20:56	1:31	23:21	**Dec**	**24**	8:39	16:10	7:11	17:38
Jun	**25**	3:58	20:57	1:33	23:22	**Dec**	**31**	8:40	16:16	7:13	17:44
Jul	**2**	4:02	20:55	1:42	23:14						

The times (UT) in this table are for Dublin. On the west coast add about 12 minutes. North of Dublin, the days are a little longer in summer and shorter in winter. South of Dublin, the days are a little shorter in summer and longer in winter. At the equinoxes day and night are equal everywhere. The sky is dark enough for most astronomical observing at the end of nautical twilight (sun 12° below horizon). The end of civil twilight (sun 6° below horizon) occurs about midway between sunset and the end of nautical twilight.

The Planets in 2010

Mercury, the elusive innermost planet, can be seen (given a clear horizon) without too much difficulty if you look on the right day and time.

The planet has a moderate morning apparition in late January. Best visibility occurs around the 21st January, the planet's magnitude is then 0.0. You will need binoculars to make out the planet, 35 minutes before sunrise, only 5°up in the SE.

The best evening apparition of the year occurs in early April, best visibility occurs around the 2nd April when the planet's magnitude will be –0.7. The graph, below, shows Mercury's position in the sky relative to the horizon at the end of civil twilight (when the sun is 6° below the horizon). This occurs at about 35 minutes after sunset at this time of year. Mercury lies about 3-4° to the right of brilliant Venus (mag –3.9).

For its morning apparitions the planet will be seen in the second half of September. Best visibility occurs around September 23rd when the planet's magnitude will be –0.8. Look 10° up in the east 50 minutes before sunrise.

In the last few days of the year, the planet appears low in the SE before sunrise.

Venus, does not appear until March. The planet then appears low down in the twilit evening sky. Maximum height is reached in early May and by the time of greatest elongation on the 20th August the planet will be sinking ever lower into the bright dusk glow.

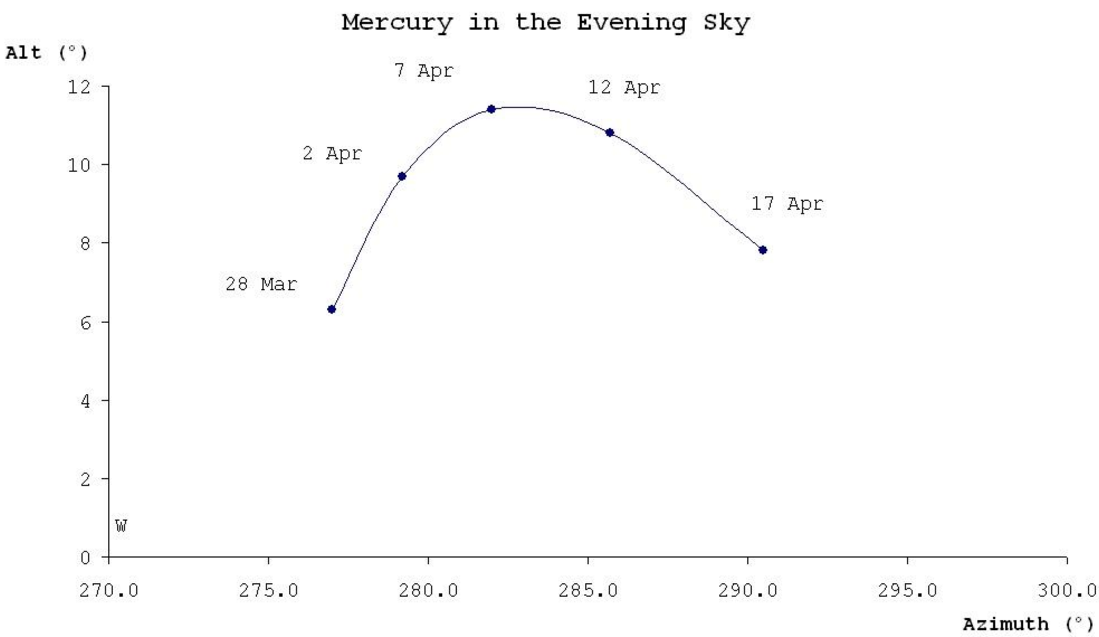
To compensate for the mediocre evening apparition, the planet vaults into the morning sky in mid-November. During December it is a glorious morning star (mag –4.6), in time for Christmas. The apparent diameter is 20". In a telescope the gibbous phase is visible.

Mars in well placed as the year opens. It is then high in the sky as it approaches opposition on 29th January. It then lies in Cancer.

However the planet is near the far point in its elliptical orbit. This means the planet will reach only 14.1" in apparent size. Still its stellar magnitude will be an impressive –1.2. Despite the small size, on nights of steady seeing when high in the sky, some detail on the disc may be made out.

The most prominent dark marking is the wedge shaped Syrtis Major. It is well placed for viewing on the part of Mars facing the earth, known as the Martian Central Meridian (CM), around midnight as the year opens. It appears 37 minutes later each night on the CM, as the Martian day is 37 minutes longer than the earth's day. See the table, on the next page, for some well places transits.

Jupiter comes to opposition on September 21st in Pisces at magnitude -2.9. This year it is better placed than in 2009 for telescopic viewing as the planet now reaches the celestial equator. Still even when on the meridian (due south) it reaches an altitude of only about 37°. This is not likely to produce great seeing so it will still be difficult enough to observe very fine detail on the planet.



The apparent equatorial diameter will be a generous 49.7", as the planet approaches perihelion in 2011.

Still, a good quality small telescope should show the dusky belts, the Great Red Spot (GRS) and Jupiter's four large (known as the *Galilean)* moons. The intensities of the dark belts varies over the years and there have been occasions when an entire belt has faded away. Particularly favourable transits of the GRS are tabulated below. In recent years the spot has been a pale salmon colour.

In the winter of 2009/10 it will be 400 years since Galileo discovered the moons named after him. In increasing distance from Jupiter they are Io, Europa, Ganymede and Callisto.

Saturn comes to opposition on 22nd March in Virgo. The magnitude then is only +0.5, as the rings are still nearly edge on towards the earth. The apparent diameter is then 19.5".

The tilt of the rings is +5° at the start of the year, but reduces to under +2° by May before reaching +10° by the end of the year. The plus sign means that the north side of the rings are on view.

Saturn's largest satellite Titan (mag 8.2) is readily seen in a small telescope. Some of the other main satellites may be seen in a moderate/large telescope: Rhea (9.6), Tethys (10.1), Iapetus (10.3), Dione (10.3), Enceladus (11.6) and Mimas (12.8). The opposition magnitudes are quoted. Faint and elusive Enceladus and Mimas are a little less difficult early this year as the glare from the rings will be minimal.

Iapetus is unusual is that it fades to 12th magnitude around eastern elongation, this is due to the fact one side of the moon is very dark. It is being coated with dust from (a newly discovered) distant ring of the parent planet. See the Diary for dates of visible western elongations, when the moon reaches 10th magnitude.

On 5th June Tethys occults Dione, see the Diary (page 6) for details.

Uranus comes to opposition on 21st September (at magnitude 5.7) in Pisces (SE of the circlet). At that time the planet is less than 1° north of Jupiter, a very convenient signpost! Uranus is now only 1° south of the equator, so it is much higher in the sky than it has been for many years.

On nights of good seeing, a small telescope will give a view of its small disc, only 3.7" in diameter. See chart on the opposite page for the path of planet .

Neptune comes to opposition on 20th August at magnitude 7.8. It lies in Capricornus (just on its border with Aquarius) at declination 13° south. It then lies about 1.3° NE of the 5.1 magnitude star μ Capricorni.

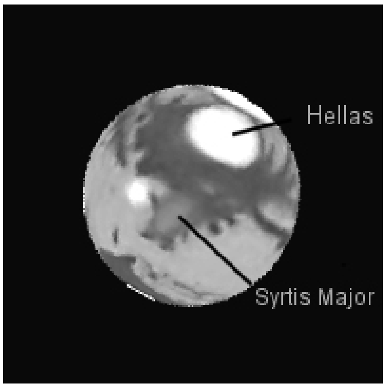
The small disc is 2.4" in diameter. So for most purposes, it looks just like a star. See chart on the opposite page for the path of planet .

In mid April, Neptune again reaches its discovery field (of 23rd September 1846) 1½° NW of Iota Aquarii. However, due to retrograde motion, the real anniversary of one circuit completion (a Neptunian year) does not happen until 2011.

Pluto appears as a faint stellar object of magnitude 14.2 in Sagittarius when it comes to opposition on 25th June. It now lies, 18° south of the equator, in the dense star field of the Small Sagittarius Star Cloud. This makes it all the more difficult to find.

Syrtis Major of Mars transit times

1/2	Jan	00:00
4/5	Jan	01:50
7/8	Jan	03:39
7/8	Feb	21:36
10/11	Feb	23:24
13/14	Feb	01:12

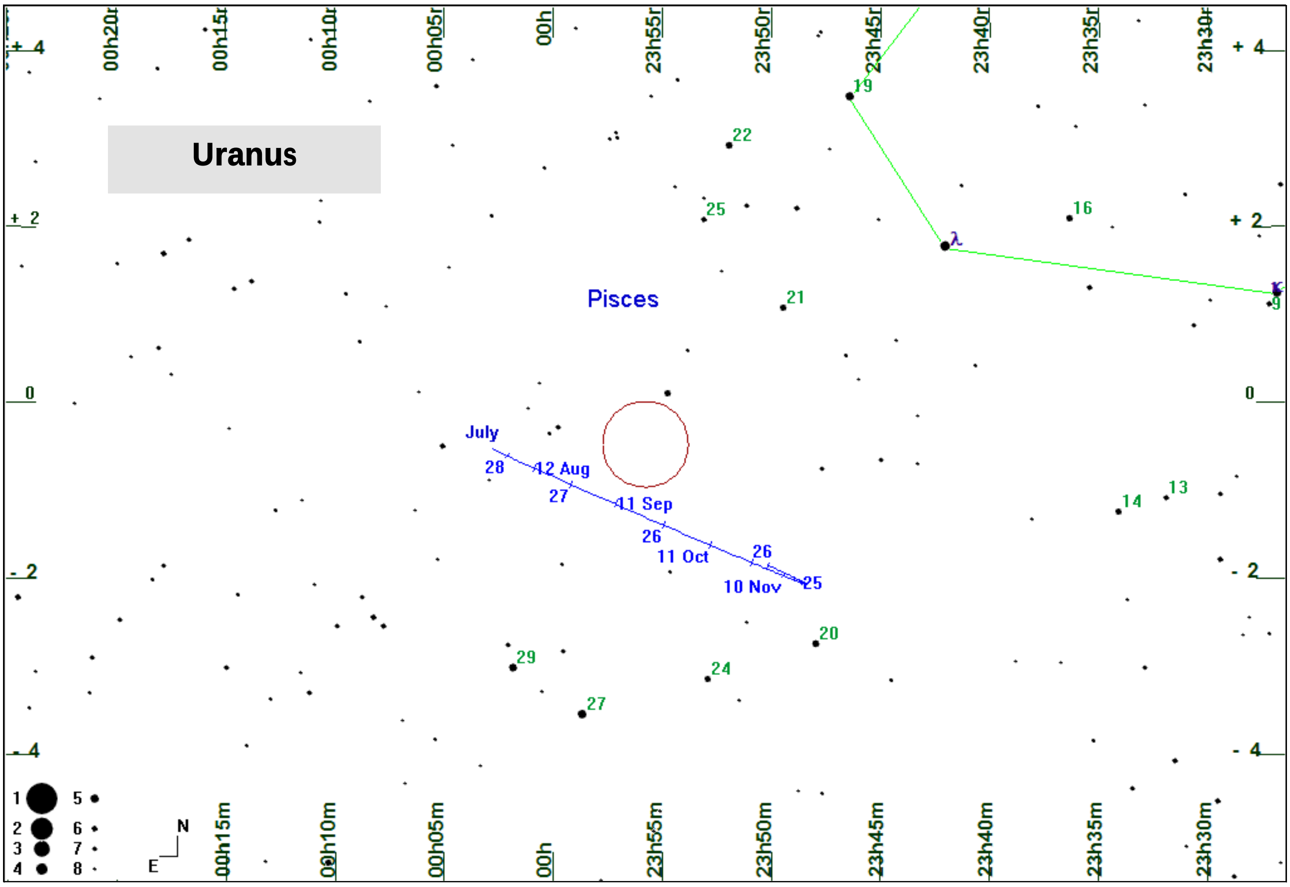


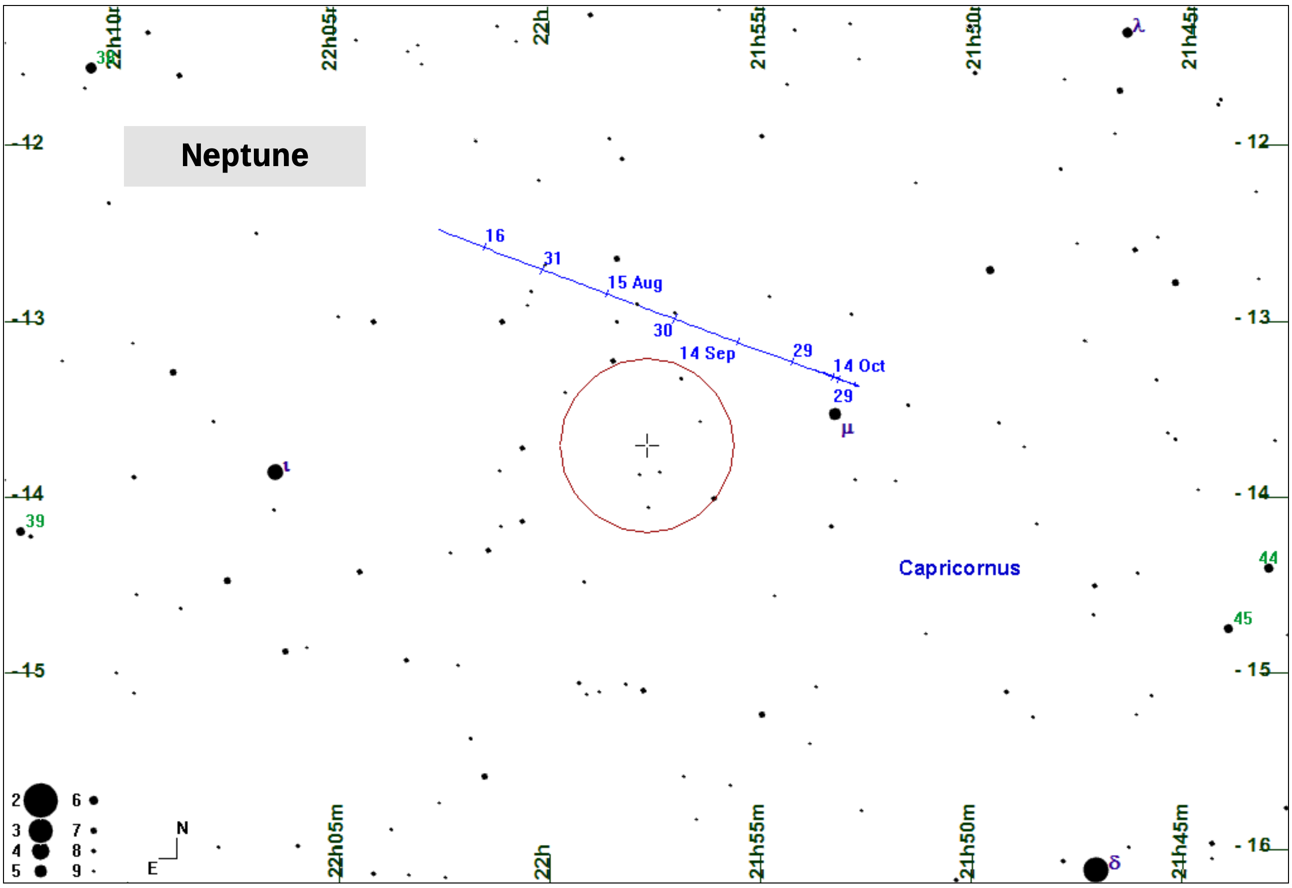
(graphic from *Mars Previewer II)*

Jupiter's Great Red Spot transit times

4/5	Aug	00:40
16/17	Aug	00:32
21/22	Aug	23:39
28/29	Aug	00:24
2/3	Sep	23:31
7/8	Sep	22:38
14/15	Sep	23:23
26/27	Sep	23:15
1/2	Oct	22:22
13/14	Oct	22:15
18/19	Oct	21:22
25/26	Oct	22:08
4/5	Nov	20:24
20/21	Dec	18:32

The GRS is assumed to lie at longitude 138° (Jovian System II), as it was in late 2009. The GRS may drift in longitude as the year goes on, any update will be posted on the *Sky-High Update* web page (see page 27 for the address).





The circles are 1° in diameter.
(charts generated using *Guide8*)

Eclipses in 2010

Annular Solar Eclipse 15th January

An Annular Eclipse of the Sun is visible principally across Kenya, Sri Lanka and China on 15th January. The maximum magnitude is 0.92. Greatest eclipse occurs at 07:06 UT.

The partial phase is visible from parts of eastern Africa and nearly all of Asia. Nothing of the event is visible from Ireland.

Total Solar Eclipse 11th July

A Total Eclipse of the Sun is visible across the Pacific Ocean on 11th July.

The path of the eclipse crosses French Polynesia, Easter Island and ends in southern Patagonia. The weather prospects are reasonable in the mid Pacific, particularly if one has mobility. The maximum duration of 5m 20s occurs about midway between French Polynesia and Easter Island. Greatest eclipse occurs at 19:33 UT.

The partial phase is visible from a wide area of the Pacific and southern South America. Nothing of the event is visible from Ireland.

Total Lunar Eclipse 21st December

A total lunar eclipse occurs during dawn on 21st December. The altitude of the moon will be just 3°(in Dublin) at mid-eclipse, the sky will be bright as it is just 20 minutes before sunrise. Times in the Table, below, are given in UT (h:m). The altitude is for Dublin, the moon will be a little higher in the west and south of the country. 'BH' means below horizon.

The diagram below shows the passage of the moon through the earth's shadow. It also shows the meaning of the various contact times as given in the table.

Try some photography, particularly if you have a digital camera. Place the camera on a tripod, focus on infinity, zoom in and range through different exposures. You can either expose for the umbra or the uneclipsed part.

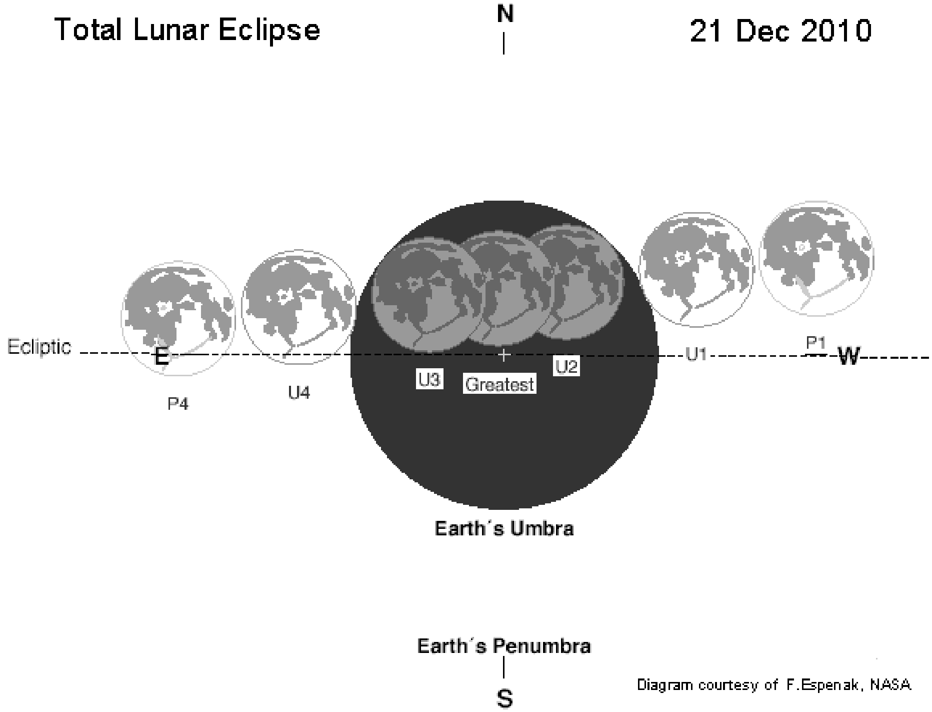
Total Lunar Eclipse 21 December

		time	alt.
Penumbral Phase Starts :	P1	05:29	25
Partial Phase Starts:	U1	06:33	16
Total Phase Starts:	U2	07:41	7
Mid Eclipse:	Greatest	08:18	3
Total phase Ends:	U3	08:53	BH
Partial Phase Ends:	U4	10:01	BH
Penumbral Phase Ends:	P4	11:05	BH

Right:

The diagram shows the path of the moon through the shadow of the earth in the sky on the 21st December .

The time marked 'U2' will be the best time to see the moon completely immersed in the full shadow (known as the umbra), later the moon will be virtually on the horizon.



Comets in 2010

C/2007 Q3 Siding Spring

The comet was at perihelion on 7th October 2009. By January it should still be a 10th magnitude object in Bootes. About 29th January it passes about 1° SE of the 3.2 mag star γ Bootis. It was discovered at Siding Spring Observatory in 2007.

81P/Wild

This is a favourable return of this periodic comet. It may reach about 9th or 10th magnitude from early February to early May in Virgo. On 30th January it passes ¾° north of the 4.4 mag star θ Virginis.

The comet was discovered by Paul Wild at Zimmerwald, Switzerland in 1978. In 2004 NASA's *Stardust* spacecraft made a close fly-by and parachuted back samples (taken from the dust tail) in a capsule to earth in 2006.

The current period is 6.4 years.

Comet C/2009 O2 Catalina

This comet should appear as 9th magnitude object in the morning sky during the spring. It is best seen before perihelion, which occurs on 25th March. The comet thereafter rapidly sinks into the dawn glow and becomes lost from view by the end of the month.

On the night of 13/14th March it passes less than ½° SE of 4.1 mag star 1 Lacertae. On the morning of 20th March it approaches very near to 4.3 mag star Iota Andromedae, by the time the sky gets too bright it will lie about 20' W.

This comet was discovered in 2009 during the course of the Catalina Sky Survey in Arizona, USA.

Comet C/2009 K5 McNaught

This faint (9th or 10th magnitude) comet should be well placed for viewing from March to Mid-May. Perihelion occurs on 30th April. The comet is then moving north from Vulpecula through Cygnus and into Cepheus.

It lies about 1° west of Eta Cephei on 26th April and passes about 7° from the pole about 19th May.

This comet was discovered in 2009 by Robert McNaught at Siding Spring, Australia.

Comet C/2009 R1 McNaught

Another of Rob McNaught's dicoveries. During May, as the comet moves north, it should brighten rapidly, reaching 8th magnitude by the end of the month.

The comet is nearest the earth on 15th June and will be best seen about this time, perhaps at 6th magnitude, rather low in the brightening dawn sky. During that morning it passes just ½° SE of 3.0 mag star δ Persei. In the bright twilight sky on the morning of the 21st June the bright star (mag 0.2) Capella will act as a guide, the comet being less than 2° above the star.

Although it will continue to brighten, the comet will also move in towards the sun and by the end of June it will be lost from view. Perihelion occurs on 2nd July at just 0.40 AU.

Comet 10P/Tempel

This comet will be best placed after perihelion (which occurs on 4th July) from late July to early September. It will then reach magnitude 9 or 10, low down in the morning sky before dawn. On 4th August it passes ¼° above Eta Ceti (mag 3.4).

This periodic comet was discovered by William Tempel at Milan in 1873. Its current period is 5.4 years.

103P/Hartley

This comet has a very favourable return in the autumn and is predicted to become an easy binocular object.

The comet will pass only 0.12 AU from the Earth on October 20th. The comet is then predicted to peak in brightness at perhaps 6th magnitude or brighter. Perihelion (1.06 AU) occurs on 28th October. With full moon on the 23rd October the comet is best seen earlier in the month. During November it fades rapidly.

It will pass very near the 3.7 mag star Eta Persei on 10th October. See charts on next page.

The comet was discovered by Malcolm Hartley (at Siding Spring, Australia) in 1986. Its current period is 6.47 years.

It is possible that the comet could produce a meteor shower during November. Different calculations give the dates of November 17th (by Ridley) and November 2nd (by McNaught). The radiant will be in the northern Aquila to Vulpecula region of the sky. However, when the comet was last at a favourable return in 1997 no meteors were seen.

The *Deep Impact* probe, which visited comet 9P/Tempel in 2005, is scheduled to fly pass the comet on 4th November. This *Deep Impact* extended mission is dubbed EPOXI by NASA.

Bottom: The track of Comet **P/103 Hartley** from the beginning of October to late November as it moves south-eastwards from Cassiopeia to Monoceros. The tick marks show dates at intervals of one day (at 0 hrs UT). Stars to magnitude 5 are shown.

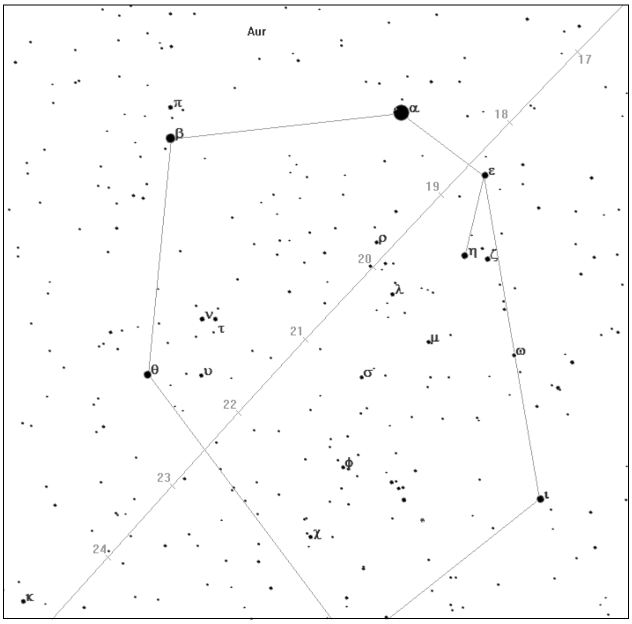
Right: Detail for Comet **P/103 Hartley** for around mid November (magnitude 8 limit). The figure of Auriga is shown for scale. North is up. (charts from *Guide8*)

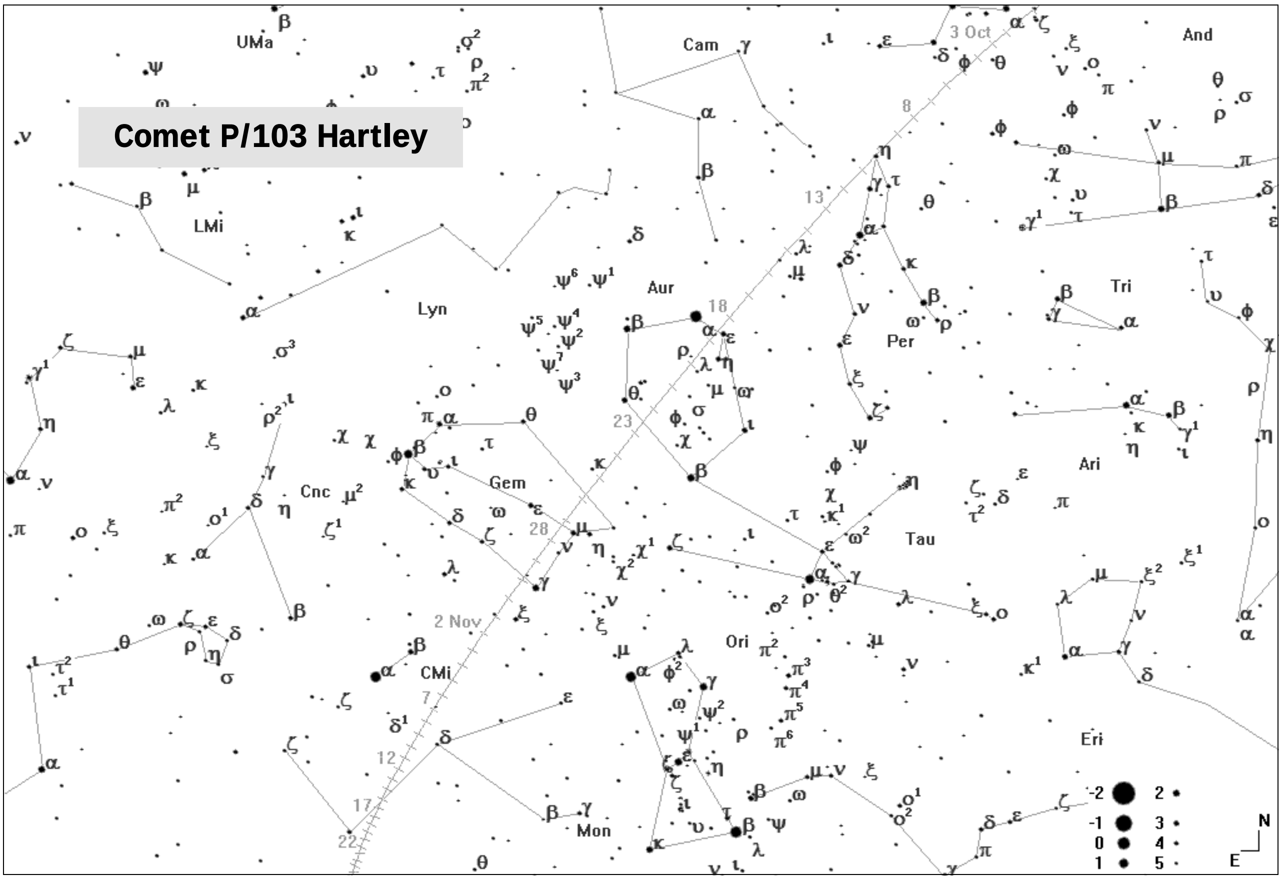
Comet Web Sites

BAA Comet Section:
www.ast.cam.ac.uk/~jds/

The Astronomer:
www.theastronomer.org

Cometography (by Gary Kronk):
http://cometography.com





Meteor Showers in 2010 by John Flannery

Meteors, or shooting stars, can be seen any night but during the year the Earth sweeps through dust trails laid down by comets as they circle the Sun. We then get a meteor shower. Some are rather weak with only a few meteors per hour seen while other displays delight amateur astronomers year after year with their greater numbers.

The **Quadrantids** in early January generally exhibit a short, sharp maximum and the peak is predicted for 19 hrs on the 3rd this year. Moonlight will prove a bit of a nuisance unfortunately so only the brighter shower members may be seen. The Quadrantid radiant lies in northern Boötes.

February and March tend to be characterised by low meteor rates with only the minor showers producing some activity. Things then pick up again when the **Lyrid** meteor shower peaks on April 22nd at 17 hrs. The sky is Moon-free for a couple of hours before dawn on April 23rd as the Lyrid radiant gains altitude. Occasional outbursts from the stream have previously been noted with the last in 1982.

The **eta Aquarids** peak on May 6th at 07 hrs but the radiant is low from here and only at a useful altitude in the pre-dawn hours. We are now at a time of year when the enduring twilight means observers can really only monitor showers using radio techniques.

The southern component of the **delta Aquarid** stream peaks on July 28th but is badly affected by Moonlight this year. The shower radiant clears the horizon after midnight and increases in altitude approaching dawn.

The dependable **Perseids** are predicted to peak at 23 hrs on August 12th and conditions are ideal with the 2 day old Moon setting just before 20 hrs 30 min.

The double peak noted a few years ago now seems to have merged into the traditional maximum but the International Meteor Organisation suggest the complexity of the Perseids means high rates may persist over a period of almost a full day.

The **Orionids** are October's best known shower and are associated with the well-known comet 1P/Halley. The radiant is near the raised club of Orion and rates tend to be good with many swift meteors. The maximum falls two days before Full Moon so conditions are not ideal this year.

Leonid rates have generally declined back to normal levels following the enhanced activity at the start of the century. The peak falls four days after First Quarter Moon but no outbursts are predicted to occur this year. The radiant in Leo rises at 23 hrs from here.

(Continued on page 18)

Principal Meteor Showers of 2010

Shower	Activity Period	Date of Max.	Moon's Age	ZHR
Quadrantids	01 Jan - 05 Jan	03 Jan	3 days after Full Moon	120
Lyrids	16 Apr - 25 Apr	22 Apr	1 day after First Quarter	18
η Aquarids	19 Apr - 28 May	06 May	Last Quarter Moon	60
δ Aquarids	12 Jul - 19 Aug	28 Jul	2 days after Full Moon	20
Perseids	17 Jul - 24 Aug	12 Aug	2 days after New Moon	110
Orionids	02 Oct - 07 Nov	21 Oct	2 days before Full Moon	20
S. Taurids	01 Oct - 25 Nov	05 Nov	1 day before New Moon	5
Leonids	14 Nov - 21 Nov	17 Nov	4 days after First Quarter	var.
Geminids	07 Dec - 17 Dec	14 Dec	1 day after First Quarter	120
Ursids	17 Dec - 26 Dec	22 Dec	1 day after Full Moon	5

The Zenithal Hourly Rate (ZHR) is a measure of the shower's activity. Its assumes a perfectly clear and transparent sky, the radiant overhead and no meteors missed. The ZHR in the table is the peak.

Asteroids in 2010

1 Ceres comes to opposition in June in Sagittarius. Even at best it will then be rather low in the sky. It passes over the Lagoon Nebula, Messier 8 at the end of May.

At 940 km in diameter Ceres is the largest asteroid, although the IAU has also classified it as a Dwarf Planet.

2 Pallas is at opposition on the borders of Serpens Caput and Corona Borealis in mid May, well north of the ecliptic. Although only magnitude 8.7 it should be readily seen in a small telescope.

4 Vesta is at opposition in February reaching mag 6.1. On 17th February it passes just 13’ SW of Gamma Leonis (mag 2.2).

7 Iris. Reaches mag 8.3 at the end of the year as it approaches opposition in January 2011. It passes 20’ N of 50 Cancri (mag 5.9) on Christmas Eve.

6 Hebe has an excellent opposition in mid September. It reaches magnitude 7.7, becoming an easy binocular object. During this time it is moving south in Cetus. See the Chart, below, to aid identification.

8 Flora comes to opposition in Aquarius during September. It then reaches mag 8.2. On the night of 7/8th September if you extend the line from Omega² to Omega¹ Aquarii westwards for 1¼° you will come to the asteroid.

532 Herculina will have an excellent opposition in March reaching magnitude 8.9. It is then moving north-west among the stars of Coma. In early March it passes just east of the Coma star cluster. On the night of 9/10th March it lies about 40' west of the star 12 Comae. On the night of 29/30th January the asteroid passes just 12' east and slightly south of the 10th magnitude galaxy M85.

Herculina is one of the few high numbered asteroids that can become visible in binoculars. It was found by Max Wolf at Heidelberg in 1904.

100 years ago…

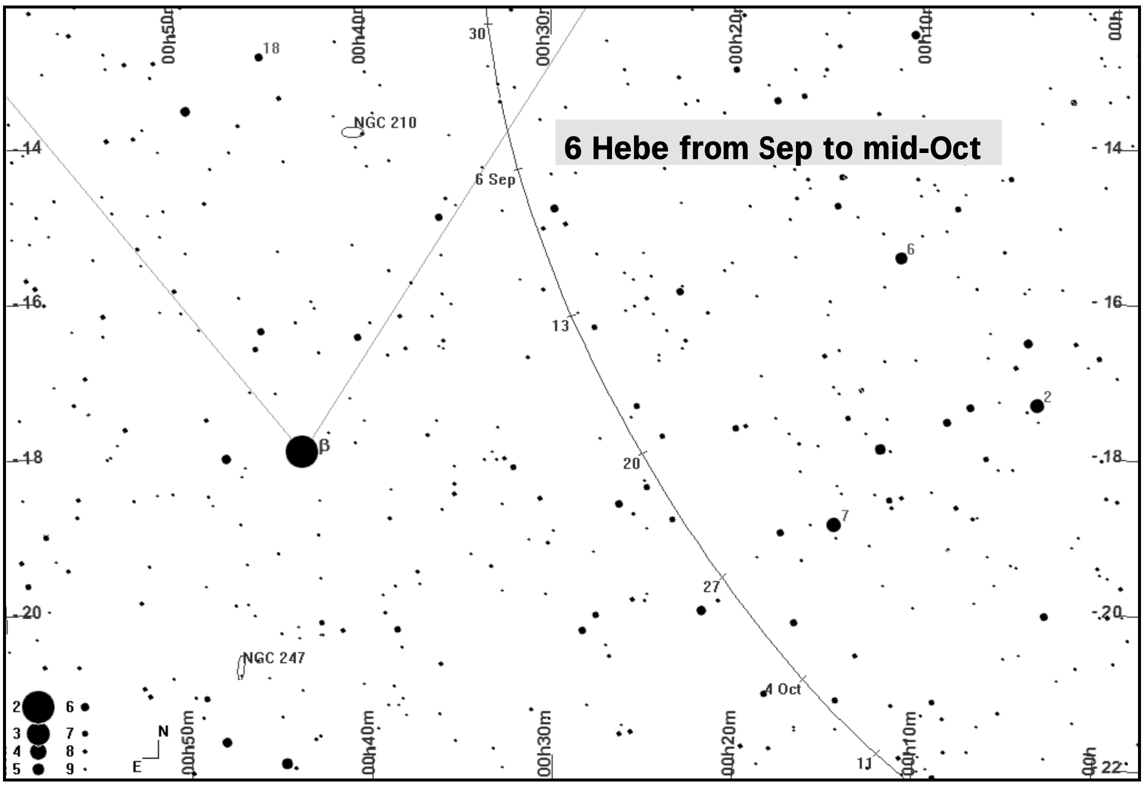
702 Alauda was discovered in July 1910. This year it will be best seen in January among the stars of Gemini.

It will then peak at mag 11.7. It passes 1.2° north of δ Geminorum on the night of 7/8th January.

Alauda was discovered by J. Helffrich at Heidelberg, Germany.

Charts of Brighter Asteroids (RASNZ):

http://www.rasnz.org.nz/Asteroids.htm



Variable Stars in 2010

Eclipsing Binaries

Algol or β Persei is the most famous Eclipsing Variable (EV) in the sky. Although it spends most of its time at constant light, every 2.8673 days a fainter star in the system eclipses a brighter one and their combined brightness (which is what you always see) drops from magnitude 2.1 to 3.4. From being almost as bright as Mirphak or α Persei (mag 1.8) Algol becomes fainter than γ Persei (mag 2.9) or δ Persei (mag 3.0). The complete eclipse lasts nearly 10 hours.

The dates and times of well placed minima of Algol are given in the table below.

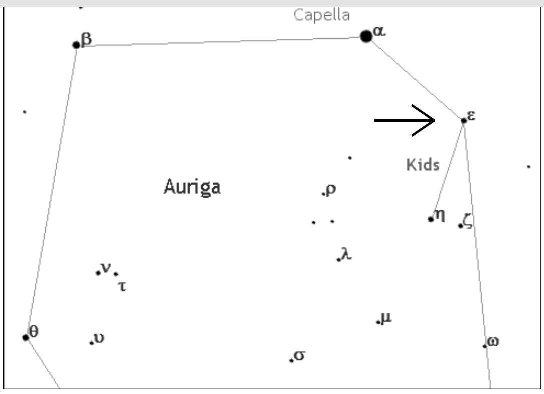
A few minima of some other notable EV's are also given given in the table. They are: circumpolar **RZ Cassiopeiae** (period 1.1952 days) goes from mag 6.2 to 7.7; winter object λ **Tauri** (period 3.9530 days) goes from mag 3.4 to 3.9 and summer object **U Sagittae** (Period 3.3806 days) which has a large drop from mag 6.6 to 9.2.

Epsilon Aurigae, the eclipsing binary star with the longest period (27.1 years), is now experiencing a very rare minimum, when it falls in magnitude from 2.9 to 3.8. See finder chart below which show ε as the northern most star in a small triangle (near Capella) known as the 'Kids'.

The eclipse started in August 2009. The primary star is due to be totally eclipsed by late December 2009, this will then last until the spring of 2011.

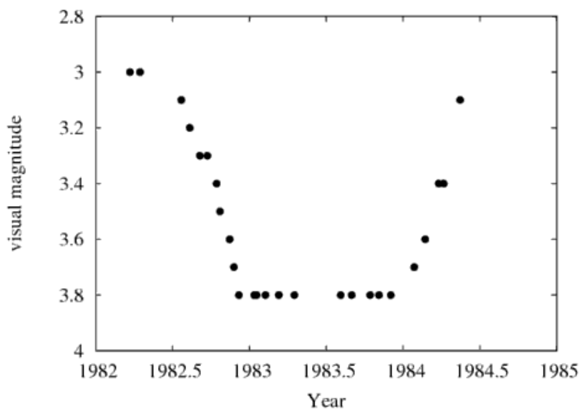
Epsilon Aurigae is the corner project of *Citizen Sky* (see web address next page), which contains much information on observing variable stars for beginners. Particularly check out the 10 Star Tutorial which has the AAVSO comparison chart.

Location of ε Aur in northern Auriga, 3½° SW of Capella



The AAVSO has a *Variable Star Plotter* (see web address next page) which can generate comparison charts for not only these but for any variable star in the sky.

Light curve of the previous eclipse of ε Aurigae



Eclipsing Binary Minima

β Persei (Algol)

Jan	1 19.2; 21 21.0
Feb	10 22.7; 13 19.6
Mar	5 21.3
Aug	22 1.4
Sep	13 23.9
Oct	6 22.4; 27 0.1; 29 20.9
Nov	18 22.6; 21 19.4
Dec	9 0.3; 11 21.1; 31 22.8

U Sagittae

Apr	11 2.1
Aug	4 0.6; 20 22.3
Sep	16 23.4
Oct	3 21.1
Nov	16 19.9

RZ Cassiopeiae

Jan	2 22.6
Feb	1 19.8
Mar	4 21.7
Apr	4 23.6; 10 23.0
May	6 1.4; 12 0.9
Aug	12 1.6; 24 0.5; 29 23.9
Sep	4 23.3; 16 22.1
Oct	4 20.4; 17 23.9; 29 22.8
Nov	4 22.2; 16 21.1
Dec	1 5.3; 17 2.9; 29 1.8

λ Tauri

Jan	29 0.2
Feb	1 23.0; 5 21.9
Oct	5 0.1; 8 23.9; 12 22.7
Dec	27 1.3; 31 0.1

Included here are just some of the better placed minima. All times are given in days and hours (UT) and are geocentric.

Long-Period Variables (LPV)

These intrinsic variable stars (mostly giant red stars) follow fairly regular cycles over a large range in brightness. The table, at right, gives predicted dates of the maxima for bright and well-placed LPV's during the year.

The maximum of Omicron Ceti (Mira) will be well placed in the Autumn sky again this year. Chi Cygni does not have a maximum this year.

For more information see the AAVSO LPV Section webpage (address at right).

Other variables

The variables above are the main (but not only) class of largely predictable variables.

Among the most exciting variables are a large class of unpredictable variables. Chief among these are the **cataclysmic variables** (CV) which flare up at irregular intervals. This interval can be weeks or months (or even years) for dwarf novae, decades for recurrent novae and thousands of years for novae. Most years we also have one or two supernovae in external galaxies readily visible in small to moderate backyard telescopes.

For more information on Cataclysmic Variables see the AAVSO CV Section webpage (address at right).

There is an active **Variable Star Observers Group** (VSOG) that associates variable star observers in Ireland and encourages variable star observing and their study.

See the web page (address at right).

Long-Period Variables in 2010

Star	Date of Max.	Mean Magnitude Range
R Lep	14 Jan	6.8– 9.6
T Cep	24 Jan	6.0-10.3
S Vir	14 Feb	7.0-12.7
U Ori	23 Feb	6.3-12.0
R Cas	21 Mar	7.0-12.6
R Aql	3 Jun	6.1-11.5
R Leo	21 Jul	5.8-10.0
R And	1 Oct	6.9-14.3
Omi Cet	17 Oct	3.4- 9.3

The **Date of Max.** is the predicted date of maximum based on AAVSO data as of early 2009. The **Mean Mag. Range** is based on the mean of the extremes. However, there can be quite a difference in dates and magnitudes for any particular cycle and that is part of the joy of observing them.

Variable Star Web sites

V.S.O.G.:
http://homepage.eircom.net/~vsn/vsog.htm

AAVSO:
www.aavso.org

AAVSO Variable Star Plotter:
http://www.aavso.org/observing/charts/vsp/

AAVSO CV Section:
http://sites.google.com/site/aavsocvsection/

AAVSO LPV Section
http://sites.google.com/site/aavsolpvsection/

BAA V.S.S.:
www.britastro.org/vss/

Citizen Sky:
www.citizensky.org

Citizen Sky 10 Star Tutorial:
www.aavso.org/aavso/10startutorial.pdf

Meteor Showers (continued from page 15)

The **Geminids** (maximum on the 14th at 11 hrs) are affected somewhat by the First Quarter Moon this year in the early part of the night. The Moon sets at 02 hrs though just when the Geminid radiant reaches its highest altitude. The shower remains at maximum for over 24 hours and can be considered even richer than the Perseids. The meteors are bright though few of them produce persistent trains. Computer modelling of the Geminid stream suggests their best is still to come in the latter part of the 21st century.

The other meteor shower for December is the poorly observed **Ursids** which peak this year on the 22nd at 20 hrs. Elevated rates have been noted as recently as 2007 so any results will prove valuable. The Ursid radiant is close to Kocab (beta Ursae Minoris) meaning they are visible all night. Conditions couldn't be worse though with maximum this year washed out by the Moon just 1 day after Full.

Irish Men (and Women) on the Moon

by Patricia Carroll

Everyone knows that (so far) the only humans to have set foot on the Moon have been American men, twelve in total. But hundreds of other people, some Irish among them, have been commemorated by having features on the Moon named after them. This tradition goes back to the time when telescopes were first used to observe Earth's satellite. Among those astronomers to name prominent lunar features, the foremost was Giovanni Riccioli in the 17th century. Additional contributions were made by Johannes Hevelius (17th century), Johann Schröter (18th century) and Wilhelm Beer with Johann Mädler (19th century), among others. However, over the centuries, many inconsistencies built up with lunar nomenclature. It wasn't regularised until the International Astronomical Union (IAU) standardised the names in the 1930s. A report called *Named Lunar Features,* which was published in 1935, gave a systematic listing of lunar names at that date. Any name given to a surface feature since then has had to be approved by the IAU.

In this article, the term *Irish* covers both those born in Ireland as well as those who were born abroad but worked in Ireland or had other Irish connections. Most of these people had science or engineering backgrounds; a few were explorers. The IAU has very strict rules as to who may be commemorated by a lunar crater or other feature. In this article only craters are considered. These vary considerably in their visibility from Earth with a modest telescope. Those in the first group are on the Earth facing hemisphere and are relatively easily seen; craters in the second group are in the libration zones around the limb of the moon and technically can be seen, but only with considerable difficulty; the third group consists of craters on the far side of the Moon.

In the descriptions that follow, the name of the crater is followed by its diameter and location, as well as the date approved by the IAU (if after 1935).

Earth-facing hemisphere:

Mare Imbrium/Mare Frigoris region

Birmingham (92 km; 61.5°N, 10.5°W): This crater lies just north of Mare Frigoris and due north of Plato. It is a very old crater with broken-down walls. ***John Birmingham*** (1816-1884) was a native of County Galway. He discovered a nova on May 12th 1866, which later became known as T Coronae Borealis. This was the first nova to be studied spectroscopically (by William Huggins). It is also a recurrent nova, erupting again in 1946.

Robinson (24 km; 59°N, 45.9°W): This crater is situated on the far side of Mare Frigoris from Sinus Iridum. ***Thomas Romney Robinson*** (1792-1882) was director of Armagh Observatory from 1823 until his death. He invented the cup anemometer in 1846.

South (104 km; 58°N, 50.8°W): This extremely old crater lies to the south-west of **Robinson**. ***James South*** (1785-1867) donated the 12 inch (30 cm) lens which is in the refractor in the "South dome" in Dunsink Observatory; the mounting was made by Grubb.

Sampson (1 km; 29.7°N, 16.5°W; approved 1976): This is a relatively small crater on the Mare Imbrium. It is just to the north-west of Timocharis. ***Ralph Allan Sampson*** (1866-1939) was born in Schull, Co. Cork and was appointed Astronomer Royal for Scotland in 1910.

Mare Serenitatis/Mare Tranquillitatis Region

Clerke (6 km; 21.7°N, 29.8°E; approved 1973) lies on the south-eastern rim of Mare Serenitatis, just to the south of Le Monnier and close to the Apollo 17 landing site. ***Agnes Clerke*** (1842-1907), who was from Skibbereen was a writer on astronomy. She synthesised the work of astronomers in the late 19^{th} and early 20^{th} centuries. Her works include *A Popular History of Astronomy during the Nineteenth Century*, *The System of the Stars* and *Problems in Astrophysics*.

Maclear (20 km; 10.5°N, 20.1°E; approved in 1961) is a flooded, old crater in north-western Mare Tranquillitatis. ***Thomas Maclear*** (1794-1879) who was born in Newtownstewart, Co. Tyrone, ran the observatory at the Cape of Good Hope for nearly 40 years from 1834.

Sabine (30 km; 1.4°N, 20.1°E) lies in south-western Mare Tranquillitatis. It forms a pair with Ritter and is situated close to the Apollo 11 landing site. ***Edward Sabine*** (1788-1883) who was born in Dublin, took part in scientific expeditions in the Polar Regions in the 1820s and 1830s. He was an expert on terrestrial magnetism.

Mare Nectaris/Mare Foecunditatis Region

Rosse (11 km; 17.9°S, 35°E) is quite a prominent crater, despite its size, due to its location on Mare Nectaris just to the north of Frascatorius. ***William Parsons, Third Earl of Rosse*** (1800-1867) constructed a 6 foot (1.8 m) telescope in the 1840s, which remained the biggest telescope in the world until the Hooker was built on Mount Wilson in 1917. With this telescope he discovered some "nebulae" were spiral. These were actually spiral galaxies outside the Milky Way, but this fact wasn't known until the early 20^{th} century.

Crozier (22 km; 13.5°S, 50.8°E) lies in southern Mare Foecunditatis in a region populated by other craters named after explorers. ***Francis Crozier*** (1796-1848?), who was born in Banbridge, Co. Down, was a British naval officer. He travelled with James Clark Ross in the Antarctic during the 1830s and early 1840s. In the mid 1840s, as second-in-command, he disappeared with John Franklin and more than 120 others during the ill-fated expedition of the Erebus and Terror to find the North-west Passage.

McClure (23 km; 15.3°S, 50.3°E) lies close to **Crozier** in Mare Foecunditatis. ***Robert McClure*** (1807-1873) was British naval officer. Originally from Wexford, he was involved in the search for the Franklin expedition. He was the first person to travel through the North-West passage, although part of the journey was by sledge. The passage was first traversed by boat by Roald Amundsen in the early 1900s.

Southern Highlands

Lindsay (32 km; 7°S, 13°E; approved in 1979) is situated to the east of Hipparchus and north of Abulfeda. It is just north-west of the Apollo 16 landing site. ***Eric Lindsay*** (1907-1974) became director of Armagh Observatory in 1937. He was involved in the setting up of the Armagh-Dunsink-Harvard (ADH) telescope in Bloemfontein, South Africa. In addition, Armagh Planetarium was established during his period as director.

Pentland (56 km; 64.6°S, 11.5°E) lies in the southern highlands near Curtius and Zach. ***Joseph Pentland*** (1797-1873) was an Irish geographer who undertook a survey of the Bolivian Andes.

Mallet (58 km; 45.4°S, 54.2°E) lies close to the Rheita Valley. ***Robert Mallet*** (1810-1881) was an engineer by profession. He was one of the pioneers of seismology and conducted experiments at Dalkey Quarry and Killiney beach to measure shockwaves through the earth as a result of explosions.

Libration Zones:

Boole (63 km; 63.7°N, 87.4°W; IAU approved 1964) lies on the north-west limb of the Moon. ***George Boole*** (1815-1864) was the first professor of mathematics at Queen's College Cork. He developed an algebraic way to represent logical statements which became known as "Boolean algebra" and which has become important in computer circuits.

Ellison (36 km; 55.1°N, 107.5°W; IAU approved 1970) lies on the north-west limb beyond Boole. ***Mervyn Ellison*** (1909-1963), from Wexford, was primarily a solar observer and was director of Dunsink Observatory from 1958 until his death.

Maunder (55 km; 14.6°S, 93.8°W; IAU approved 1970) lies on the western limb of the Moon bordering Mare Orientale. ***Annie Maunder*** (1868-1947) was born Annie Russell in Strabane, Co. Tyrone and attended Cambridge University before women were allowed to graduate. She took a low paid job as a "computer" doing laborious calculations at Greenwich Observatory. Later she married Edward Maunder with whom she worked photographing and recording sunspots. He is also commemorated by this crater.

Shackleton (29 km; 89.9°S, 0.0°E; IAU approved 1994) is the lunar south polar crater. ***Ernest Shackleton*** (1874-1922) was born in Co. Kildare and lead three expeditions to the Antarctic. He came within 100 miles of the South Pole in 1909. In 1916 he and all his crew survived when his ship *The Endurance* sank in the Antarctic. Shackleton died in South Georgia and is buried there.

Hamilton (57 km; 42.8°S, 84.7°E; IAU approved 1964) lies on the south-east limb to the south-east of Furnerius. It is close to Mare Australe. ***William Rowan Hamilton*** (1805-1865), a mathematician, was appointed professor of astronomy at Dunsink while still an undergraduate at TCD. He predicted a phenomenon called conic refraction for which he was knighted when it was demonstrated to occur by Humphrey Lloyd. He is most famous for his discovery of quaternions.

Far Side:

Crommelin (94 km; 68.1°S, 146.9°W; IAU approved 1970) ***Andrew Crommelin*** (1865-1939) who was born in Antrim, was a comet specialist and calculated cometary orbits. He took part in Eddington's solar eclipse expedition to Brazil in 1919 which confirmed one of the predictions of Einstein's general theory of relativity.

Fitzgerald (110 km; 27.5°N, 171.7°W; IAU approved 1970) ***George Francis Fitzgerald*** (1851-1901) was professor of physics at TCD. After the unexpected results of the Michelson-Moray experiment he proposed the "Fitzgerald contraction" which retained the concept of the ether; this was independently suggested by Hendrick Lorentz and became known as the "Fitzgerald-Lorentz contraction". Einstein's theory of relativity later dispensed with the ether. With William Monck and Stephen Dixon he was the first to detect the light from a star electronically (Vega and Capella, along with the Moon, Venus and Jupiter) using a photo-cell in 1892. There is a plaque to commemorate this at 16 Earlsfort Terrace, Dublin where the experiment was conducted.

Schrödinger (312 km; 75.0°S, 132.4°E; IAU approved 1970) ***Erwin Schrödinger*** (1887-1961) an Austrian physicist, was invited to head the School of Theoretical Physics at the Dublin Institute for Advanced Studies in 1940. He remained there until 1956. He is renowned for his work on quantum mechanics.

Stoney (45 km; 55.3°S, 156.1°W; IAU approved 1970) ***George Stoney*** (1826-1911) was an uncle of George Francis Fitzgerald. He was born in Clareen Co. Offaly and became science professor at Queen's College Galway. He coined the term "electron" for the fundamental unit of negative charge.

And finally ...

On January 22nd 2009, the IAU approved the name **Gore** for a crater 9 km in diameter close to the lunar North Pole (86.2°N, 61.8°W). It commemorates ***John Ellard Gore*** (1845-1910) who was an amateur astronomer with observatories in Ballysadare, Co. Sligo and later in Dublin. He discovered the variability of several stars and made catalogues of variable stars and double stars. In addition, he was a founder member of the British Astronomical Association.

Pin Pointing the Image

by James O'Connor

Recently, in the course of a discussion that I watched on television, I noted one of the participants making the remark that each of the senses "with the exception of vision" involved some kind of contact with the object sensed. Apparently, he did not realise that there was no need to make this exception – it tended to weaken his own case – and the fact that he did so demonstrates the generally poor understanding of the phenomenon of vision and optics. "Contact" in the case of vision is every bit as great as it is in relation to the other four senses: we cannot see anything unless a particle (in practice, many of them) travels all the way from the object viewed, through the lens and other materials of the eyeball and impinges on the retina.

The particles in question are called photons. The usual way in which they are formed is when an electron forming part of an atom drops from a higher to a lower level within the atom. In so doing, it loses energy. However, energy can never be lost absolutely and so the energy lost to the electron is sent speeding off in the form of a particle. This particle, called, as we have said, a photon, has no rest mass and so can and does travel at the speed of light. It continues until some object gets in its way and absorbs it. The photon must then cease to exist but the comprised energy is not lost. It is delivered up to the object that has absorbed the photon. It is awe-inspiring to think that, when we view a galaxy at a distance of, say, a hundred million light years, we do so by means of photons that were formed in the galaxy by movements of electrons a hundred million years ago and that before registering themselves on our retinas they have been travelling relentlessly towards us for that enormously long period. Indeed, where the universe is concerned, a hundred million years is a relatively short period and photons are arriving daily that are much, much older than that.

Photons are amazing little entities. As far as they are concerned, time does not exist: they live in a kind of eternity. A photon may have been travelling for thousands of millions of years – say, from a distant galaxy – but it has not aged in the slightest by the time it arrives at the Earth and its existence ends. While photons have no rest mass – they cannot "rest" – they possess mass while in flight and are subject to gravitational forces.

They can also be refracted and reflected. Such events modify or otherwise change what the photon may enable us to see. For example, photons originating in the sun and reflected from the moon enable us to see not the sun but the moon. If photons are refracted (bent) they will cause objects to appear to be in a position other than that in which they are really located. The classic instance of this is where a stick appears bent at the surface of water.

But how exactly does a flood of photons coming from an object enable our eyes or a camera or a telescope to form an *image* of that object and not just a confused sensation of light? We get a sensation of this kind in relation to heat since our eyes are not sensitive to the infrared radiation involved in transmitting heat. For vision (or the operation of cameras, telescopes etc.) some way must be found of disentangling all that radiation and getting it to impart information about the details of its source.

As reflection is a simpler and more easily understood phenomenon than refraction, the phenomenon of the formation of images can probably be most easily understood by considering how a reflecting telescope forms an image. So let us say that we have a reflecting telescope and have pointed it at the moon. When we look through the eyepiece, we see an array of features – craters, plains, etc. open to our view. We now need to examine how exactly the telescope manages to disentangle all the photons being reflected from the moon so that those arriving from, say, a particular lunar peak are in one place and those arriving from another peak are in another.

The answer, or rather part of the answer, lies in the fact that the light (consisting of streams of photons) arriving from various parts of the moon does so from slightly different directions, depending on the location of the object that is receiving and reflecting the sunlight. To help us analyse what happens when the light strikes the mirror of our telescope, it is necessary to consider the mirror surface as consisting of a combination of a large number of tiny pinpoint reflecting surfaces. At this stage we will consider just one such pinpoint.

Light reaches this tiny area from all parts of the moon and, on reflection, is spread out in an expanding cone, the position of each light ray depending on the angle at which it struck the mirror – it being a law of reflection that the angle of reflection is always equal to the angle of incidence. Light from, say, the crater Tycho is reflected in one direction, light from Archimedes in a slightly different direction and so on. In this way, an image of the Moon is formed and we can see this image if we interpose a screen in the path of the reflected moonlight. It is easy to see that, as the light is reflected in the form of an expanding cone, the farther we place the screen back from the mirror, the larger, though fainter, will be the image.

However, if we rely on our single pinpoint, the amount of light available to form the image will be very small and the image correspondingly dim. We must, therefore, find a way of increasing the brightness of the image. The obvious way might seem to be the use of a larger reflecting area than just a pinpoint. But if we do this and our mirror is a flat mirror, the images resulting from reflections from different parts of our mirror will overlap; they will confuse each other and we end up with having no detectable image at all. Let us suppose that we have placed our screen at a point where the image of the moon formed by our first pinpoint image is 1 cm. in diameter. The image formed by another such pinpoint on the mirror located 1 cm. from the first will, naturally, be formed 1 cm. from the first image, so that the two images of the moon will merely touch externally instead of coinciding. Similarly, each point on our flat mirror will produce its own lunar image and these will overlap inextricably.

The answer to our dilemma lies in using a curved instead of a flat mirror. There is a particular curve which, and which alone, has the property of reflecting light reaching it from a distant object to a particular point. If we use a mirror shaped to this curve, we find that the overlapping of images mentioned above is compensated for exactly; the images formed by reflection from each point on the mirror will coincide to form a single image. Also, we are no longer dependent on the light reflected from a single point and our image is consequently much brighter. The same paraboloidal curve is used in radio antennae and (in reverse) for such things as searchlights and vehicle headlamps.

Lenses (including the lenses of our own eyes) form images in a similar manner, but the light is brought to a focus by refraction rather than by reflection.

Pinhole apertures should not be dismissed as having theoretical significance only. Good photographs have been obtained by their use and such photographs carry the advantage of focussing distant and nearby objects equally well. We are continually reminded of the formation of pinhole images when we see the circles of light mingling with the shade of a leafy tree. The circles are, in fact, pinhole images of the sun – the "pinholes" being the small interstices where the sun filters through the leaves. If we look at the images during a partial eclipse of the sun, we will see that the circles have changed to crescents, corresponding to the shape of the partially eclipsed sun.

Astronomy Satellites and Planetary Probes

Europe's **Rosetta** comet probe swung pass Earth on 13th November 2009 for the third and last time. This has finally increased its velocity to enable it to encounter comet 67P/Churyumov-Gerasimenko in 2014. On the way there it will fly-by at a distance of 3,000 km asteroid 21 Lutetia on 10th July. At 100 km in diameter, Lutetia will be the largest asteroid yet visited by an spacecraft.

NASA's **Deep Impact** probe, which visited comet 9P/Tempel in 2005, is scheduled to fly pass comet 103P/Hartley on 4th November. This extended mission is dubbed *EPOXI* by NASA.

The Japanese **Hayabusa** will tweak its return trajectory from April. If that manoeuvre is a success, then in June it will eject its return capsule to a landing in deserts of Australia. There *may* be *some* samples of asteroid 25143 Itokawa in the capsule.

NASA's **WISE** satellite is scheduled for launch in December 2009. It's mission is a sensitive wide-field survey of the sky in the mid Infra-Red part of the spectrum.

For Japan's **Venus Climate Orbiter** see page 26.

NASA's **Kepler** mission which was launched in mid 2009 continues to perform photometry on a selected region of the sky in Cygnus to search for exoplanets using the transit method. Any transiting planets will produce a tiny drop in the brightest of the parent star.

How Big is the Naked-Eye Universe ?
by Liam Smyth

He thought he saw a buffalo upon the chimney piece.
He looked again and found it was his sister's husband's niece.
"You'll leave this house at once", he said,
"Or I will call the police".

Lewis Carrol's Mad Gardener could see as far as the fireplace but at first not very clearly. But when he looked more carefully he discovered the (slightly) less improbable presence of his buttonhole relative.

We can see things without looking and look without seeing. To look at the Sun without proper eye protection is dangerous but even the most careful of us have seen the Sun many times. But if questioned after only one such inadvertent glance how would we describe what was seen? A blazing light, a bright disk, a ball of fire? Only after donning eye protection and having a proper look would we conclude the appearance was that of a disk.

Most of us have not only seen the Moon but have looked at it for some time with varying degrees of interest. Everyone would agree that the Full Moon is a yellowish disk with dark markings giving us the familiar "Man in the Moon". If asked had we seen the bright area in the Oceanus Procellarum surrounding the crater Copernicus, those who had not looked intently for it would probably answer in the negative. Those who knew of the feature and had looked for it would answer in the affirmative. Yet there is no doubt that all the observers with average eyesight had seen it, but not all noticed it.

There is probably a huge disparity between the number of people who have seen the planet Mercury and the number of those who know they have seen the planet Mercury. We are going to embark on a review in increasing distance of objects we can identify with the naked eye. But we cannot say we have reached the limit. Some people may have see even more distant objects but have not been aware of their identity and so have not reported their findings. Some may have seen without noticing.

From early times it was known that the heavenly bodies were not all at the same distance. For instance it was soon realised that the Moon was closer to us than the Sun or the known planets. It was also believed that the stars were the furthest away.

Sorting out the planets was a little more complicated than it might seem. We nowadays think of the distances of the planets in terms of their distances from the Sun. In order these are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. But at any given time, Mercury or Venus or Mars could be the planet closest to Earth. It depends on where they are in their orbits. They will all however be closer than Jupiter and the order of distance from both Earth and Sun, for Jupiter, Saturn, Uranus, Neptune is always preserved.

The mean distance of Saturn from the Sun is over nine Astronomical Units (A.U.) . The Unit is a measure of the mean distance of the Earth from the Sun. So Saturn is over one and a quarter billion kilometres away.

In these days of collapsing markets and banks, and NAMA, when billions of euros and pounds and trillions of dollars are being thrown around like snuff at a wake, one becomes somewhat unfazed by what we used to call astronomical proportions. However, suppose that, being under the legal alcohol limit, you climbed into your space travel compatible car (nuclear fusion powered, of course) and set off at a steady one hundred kilometres per hour, how long would it take you to reach Saturn? Well, you should pull a caravan full of the healthiest members of your extended family. It will be over fifteen hundred years before any of their seed or breed reach the destination. If a long lived St. Brendan had headed up in such a car instead of west in his boat, he would still have some centuries of driving ahead of him. And don't forget he'd be driving at the maximum speed allowed on our modern dual carriageways. Even so, he would not be even half way to the boundaries of the Solar System as defined by the planets, its most distant member being Neptune.

Viewed from the orbit of Saturn the sky would look much as it does from Earth. To the naked eye Uranus would have become faintly visible but Neptune would still require optical aid. The Sun would appear as an extremely brilliant day-time star. Our voyagers would be shattered at the thought of how much longer it would take to reach Neptune. It would take more than twice as long again. Then they would be only starting the exploration of the trans-Neptunian regions of the solar domain. And what would they find there? To the naked eye, very little. The outer dwarf planets, Pluto, Eris and such would remain invisible. We don't know how many there are or how big they may be but aeons would pass travelling ever outward.

After ten million years just one light year would have been traversed. If our hypothetical extended family had survived they might be the only humans left. The earth bound human species might have become extinct, either through slow evolutionary changes or sudden disaster.

To our travellers the sky would look much as it had always done. The constellations would not have changed. Some faint starlike points might have emerged. After a further light year some of those might have disappeared to be replaced by new ones. These are the "brown dwarfs", more massive than planets, but not massive enough to become stars. They can, though, produce enough energy to become visible. Perhaps one of these might be the dreaded "Nemesis", destined to bring about the end of our race, but that's another story. After about fifty million of Earth's years our travellers would have travelled about the distance that separates us from the nearest star, just over four light years.

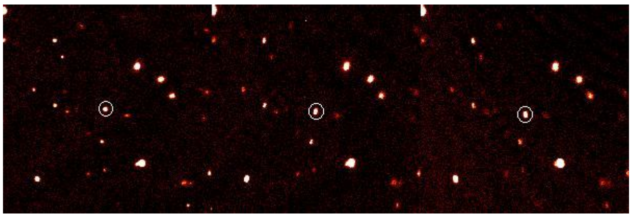
Even if our travellers had been offered Concorde rather than the 100 kph car it would take over two million years to get there. This span is many times longer than humans have trod the Earth. From now on, the only accessible, vaguely comprehensible, still mind-boggling, measure of distance is the light year, the distance light travels in one of our years, over sixty thousand times the distance from the Earth to the Sun.

When one had moved out by nearby stellar distances of five to twenty light years. the appearance of the sky would not have altered much. Depending on the direction of travel, some of the nearer bright stars such as Sirius and Alpha Centauri might show notable changes in relative brightness but the intrinsically brightest such as Deneb and Rigel would look the same as ever unless they themselves had changed. Our altered viewpoint would be insignificant. The different constellations would be immediately recognisable. Only at the remove of hundreds of light years would the sky begin to look different.

After moving thousands of light years the external galaxies such as Andromeda and Triangulum would appear as they do now. Even the Magellanic Clouds would not have altered much until we had moved some tens of thousands of light years. Those galaxies we can see with the naked eye from Earth, would probably remain the only ones we could see from anywhere within The Milky Way. I do not allow here for possible parallactic shifts of obscuring matter in space. So the span of our naked eye universe will remain unchanged to humans until they can travel out of our galaxy. This stands at about three million light years.

But perhaps entire galaxies are not the furthest objects. So-called "gamma-ray bursts" are thought to be cataclysmic events in very distant galaxies even beyond the reach of our biggest telescopes. Occasionally these bursts have become visible to the naked eye for very short periods. They are not predictable, seeing one is a matter of luck. If they are what astronomers think they are, they are way beyond anything we have so far considered. Are they from the early days of our universe after the Big Bang? Then the universe was smaller. Does that mean they may be nearer? Perhaps in different time. Who can tell? One clutches the brow. Perhaps our Mad Gardener had some inkling of this

He thought he saw a rattlesnake that lectured him in Greek.
He looked again and found it was the middle of next week.
" The one thing I regret" he said
"Is that it cannot speak".



Left: Three frames showing the discovery of Eris on 21st October 2003. They were taken with the 1.2m Schmidt telescope at Palomar Observatory, California.
(M.Brown, C.Trujillo and D.Rabinowitz)

Space Missions in 2010 by John Flannery

This year sees a focus on near-Earth activities with Japan's *Planet-C* Venus orbiter the only deep-space probe listed in the mission schedule for 2010. *Planet-C*, also known as *Venus Climate Orbiter* (VCO) is slated for launch in May and will arrive at cloud-shrouded Venus in December. From an equatorial orbit the spacecraft will image the surface with an infrared camera and look for evidence of current volcanism on the planet — there are strong hints that Venus has some active volcanoes but recent missions or Earth observations have been unable to verify this.

The planned retirement of the US space shuttle fleet following the five missions pencilled in for 2010 will almost certainly dominate the headlines. NASA will be in a bit of a quandary after this with no immediate successor to the shuttle on the horizon until the replacement vehicle *Orion* is ready in 2015. Even then *Orion*, part of the *Constellation* programme that also includes the *Ares* launch vehicle, may be at risk of being delayed indefinitely. At time of writing (early-October 2009) the current US administration is looking long and hard at NASA's budget for *Constellation*, considering it too expensive a project. A full-up boiler-plate test of *Ares X-1* is scheduled for mid-October 2009 but this may be the vehicle's only flight. If *Constellation* is shelved and the shuttle fleet pressed into service beyond 2010 then funds will need to be found to restart subcontractor companies who have already lain off highly technical staff in anticipation of the shuttle's retirement. The US space agency is certainly caught between the devil and the deep-blue sea with this one.

Cramming *ISS* modules and experiments currently awaiting launch into the last five missions has been a consequence of the planned cessation of shuttle flights. Two trips by *Discovery*, two by *Endeavour*, and one by *Atlantis* will ferry replacement Expedition crews to the *International Space Station* as well as the additional components for finalising construction of the permanent space outpost.

A number of Russian *Soyuz* missions will also enable the Expedition crews to be rotated and regular unmanned *Progress* craft visit the *ISS* to top up supplies. A second flight of Europe's unmanned *Automated Transfer Vehicle* (ATV) will take place in November. This complex spacecraft can dock automatically with the *ISS* where it remains for up to six months before detaching and burning up in the Earth's atmosphere. ESA are currently engaged in a major feasibility study on converting the *ATV* to a manned vehicle that could service the *ISS*.

So far, we've ignored the private space ventures. They've been quietly working away, somewhat out of the limelight, but are now ready to demonstrate their various transfer-to-orbit solutions. Chief amongst these is SpaceX which has developed a capsule called *Dragon* to re-supply the ISS and ultimately will ferry crew to and from the station. Two test flights are scheduled for the first half of 2010 before an actual resupply mission to the *ISS* slated for August.

Two other programmes to watch during the year will be *X-37B*, a reusable space plane that is a joint venture between the US Air Force and Boeing. A demonstration flight is planned for February 2010. Information is thin on the ground though about China's *Tiangong-1* ("Heavenly Palace"), their planned 7.7 tonne space station due to launch at the end of the year.

Table of Space Missions in 2010

Launch Date	Mission Name	Country /Agency	Mission Objectives
**/01/2010	Dragon-C1	SpaceX	Test flight
23/01/2010	Glory	NASA	Climatology
03/02/2010	STS-130	NASA	ISS assembly
**/02/2010	X-37B	USAF	Test flight
18/03/2010	STS-131	NASA	ISS assembly
02/04/2010	Expedition 23	Various	ISS crew rotation
14/05/2010	STS-132	NASA	ISS assembly
20/05/2010	Planet-C	JAXA	Venus orbiter
20/05/2010	IKAROS	JAXA	Solar sail test
30/05/2010	Expedition 24	Various	ISS crew rotation
**/06/2010	Dragon-C2	SpaceX	Test flight
29/07/2010	STS-134	NASA	ISS assembly
**/08/2010	Dragon-C3	SpaceX	ISS resupply
16/09/2010	STS-133	NASA	ISS assembly
29/09/2010	Expedition 24	Various	ISS crew addition
18/11/2010	ATV-2	ESA	ISS resupply
30/11/2010	Expedition 26	Various	ISS crew rotation
**/12/2010	Tiangong-1	CNSA	Chinese station

A tentative launch/encounter period is indicated with a double-asterisk (**) in the table's date column.

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(see www.irishastrosoc.org/mem.htm for details)

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Where non-members can get Sky-High 2010:

1. Available for sale in Eason's, O'Connell St, Dublin 1. (at the cover price).
2. By post to "Sky-High 2010", P.O. Box 2549, Dublin 14. Please add €1 to the cover price for p & p.
3. At our meetings in the early part of the year.

Useful Web Sites

IAS home page (with details of meetings and events):
www.irishastrosoc.org

Sky-High 2010 update:
www.irishastrosoc.org/skyhigh/skyhigh.htm

IAS Sky & Gallery:
www.irishastrosoc.org/obs.htm

AAVSO:
www.aavso.org

British Astronomical Association:
http://britastro.org

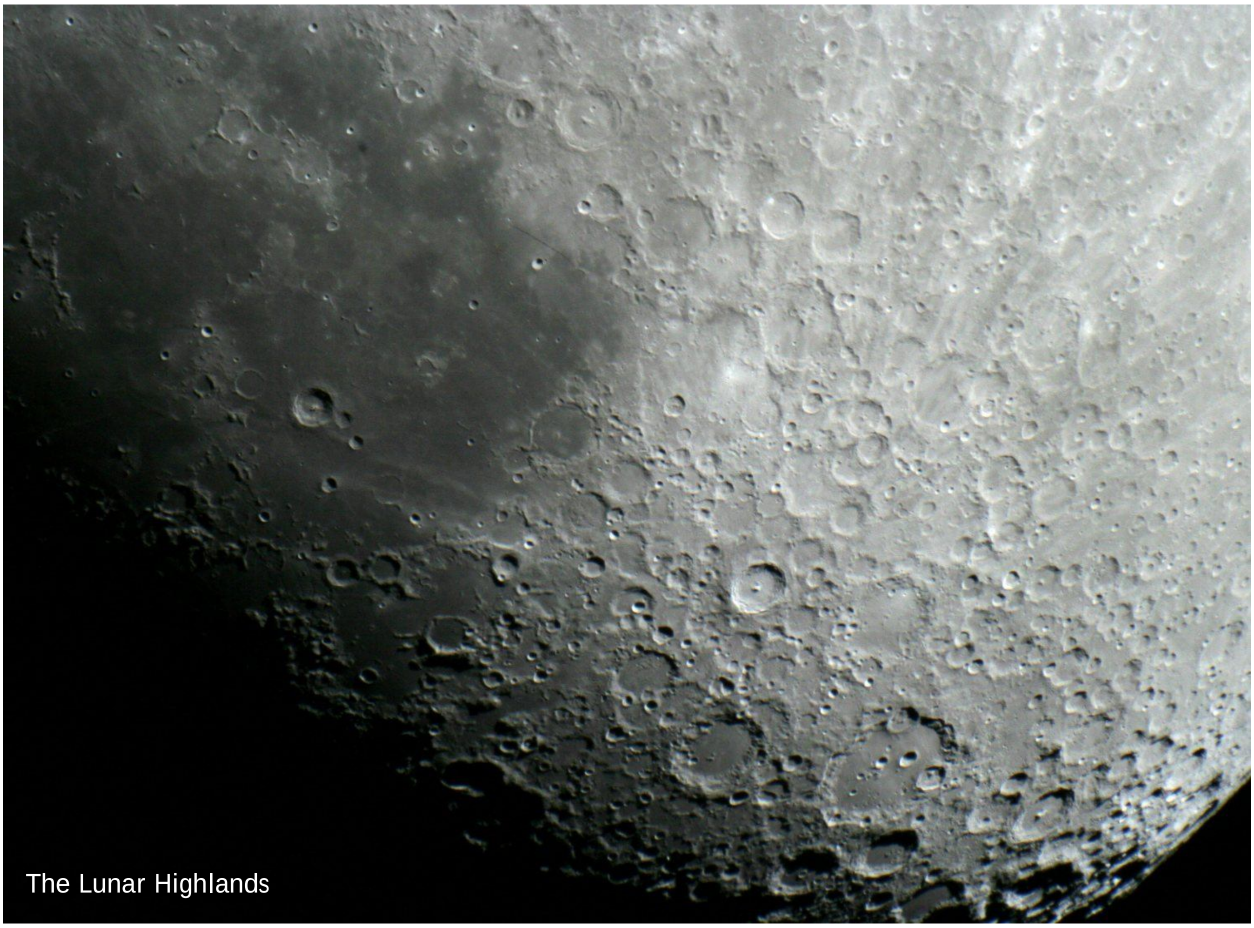
Ephemerides:
http://ssd.jpl.nasa.gov/horizons.cgi

Guide 8
www.projectpluto.com

Eclipse Details (F. Espenak):
http://sunearth.gsfc.nasa.gov/eclipse/eclipse.html

Eclipse Weather Prospects (J. Anderson):
http://home.cc.umanitoba.ca/~jander/

Gallery



The Lunar Highlands

Front Cover: Messier 31, the Andromeda Galaxy by John Murphy. 27-28th Nov 2008. DSLR with a camera lens. 45 minute exposure.

Inside Back Cover: The Lunar Highlands, by John O'Neill. 6th January 2009 with a 130 mm refractor. 1/60th second exposure.

1: Messier 45, the Pleiades Star Cluster by John Murphy. 28th December 2008. DSLR on a 20 cm reflector.

2: Drawing of active region 1024 on the solar surface in H-Alpha light by Deirdre Kelleghan. 6th July 2009. 40 mm telescope at 50x.

3: Messier 42, the Orion Nebula by John Murphy. 27th December 2008. DSLR on a 20 cm reflector.

4: Messier 51, the Whirlpool Galaxy by Liam Smyth. Exposures 12x20 seconds. May 2009 with a 23.5 cm SCT telescope.