TRANSIT

The May 2012 Newsletter of

NEXT TWO MEETINGS at Wynyard Planetarium

Friday 11 May 2012, *7.15 for 7.30 pm*
What's in a name?
Neil Haggath FRAS, *Meetings Sec., CaDAS*

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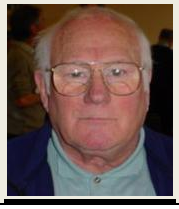
Friday 8 June 2012, *7.15 for 7.30 pm*
Presidential address (*topic TBA*)
Jack Youdale FRAS, *Hon. President, CaDAS*



Contents

Editorial

Rod Cuff

We offer a warm welcome this month to new members Peter Beattie, Malcolm Hutchinson and Jonathan Roberts, who we hope will get a lot of pleasure and information from future CaDAS meetings and *Transit*.

Included in this issue: Keith Johnson has been down to Sir Patrick's pad in Selsey recently, along with some other CaDAS members. He took some astrophotographs (suprise! ☺) while he was there, including a magnificent H-α image of the Sun.

Neil Haggath completes his informative two-part series on how our modern calendar got into the strange state that we find it today. So *that*'s why the financial year starts on 6 April …

Ray Worthy has another absorbing article for *Transit*, this time on the tides, building to an intriguing climax.

Many thanks to this month's contributors, and if you're not one, please consider writing in with an article, letter or idea. The deadline for *Transit*'s June edition is **Tuesday 29 May**.

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(01287 638154, mobile 07775 527530)

Letters

South African naked-eye astronomy

from Rob Peeling

I went on business to Jo'burg again just before Easter. This time we stayed in a hotel on the edge of the Randburg Golf Club. Despite the city lights, I was still able to see quite a bit in the area of sky stretching from α Centauri up through the Southern Cross into Carina.

NGC 4755, the Jewel Box cluster, was easy to find below and to the right of β Crucis. I didn't notice the **Coalsack**, however – difficult, with the light pollution. There was a very rich area above Crux in the sky. I noted various nebulae and clusters. **IC 2602, the Southern Pleiades**, was very bright and clear. The open cluster **IC 2944 (λ Centauri cluster)** is obvious and a naked-eye object (originally mistaken by me for ω Centauri, which is in a completely different place in the sky).

NGC 3532 is a large, faint but rich cluster and there was a large bright area that must have been the **Eta Carinae nebula, NGC 3372**. **Omega Cen** was a naked-eye object to the north of the Southern Cross. I found **47 Tucanae** in the murk low towards the horizon. It was shining clearly through – but there was no sign of the Small Magellanic Cloud through the light pollution.

. *All the best – Rob*

Greetings from Moonfish

from Dani Corredor

Thanks for adding me to the CaDAS distribution list, and for the free publicity in last month's issue! Seriously, thanks so much. It will take me a bit to read all the document (due to my level of English...) but I *will* do it :)

And of course, remember that if any of you need any telescope or accessory, get in touch to check whether I can get it. I will offer the same discount that I get from the Spanish dealers, ok? The unique problem could be the shipping costs, but I think that it would be cheaper to pay an EasyJet ticket to Ray[1] to take it in his suitcase! This discount is for ANY CaDAS member. It would be a pleasure to try to help all you with our common passion. :-D

Best wishes – Dani

OBSERVATION REPORTS AND PLANNING

Skylights – May 2012

Rob Peeling

The Moon

6 May	12 May	21 May	28 May
Full Moon	Last Quarter	New Moon	First Quarter

On the evening of 26 May the moon will occult the open cluster M67 in Cancer. With M44 nearby to the north or above, this may make a good opportunity for binoculars.

The planets

Venus will move rapidly westwards in May as the planet catches up with the Earth. Ultimately, on 6 June it will catch up with the Earth and lie exactly between the Sun and the Earth, leading to the much-heralded spectacle of the Transit of Venus. Let's hope it's a clear-skied morning, as the next transit will be in 2117 and so it's pretty unlikely that any of us will still be around then. As the planet orbits, it will appear to move closer to the Sun and will start to set earlier in the evening. It is around peak brightness at the start of the month, but will get larger and become a thinning crescent. As it approaches its closest position to the Earth (on 6 June), we see an increasing portion of its night side.

Figure 1. Venus Transit image from 2004. The striations were caused by cloud cover. Image Credit: Sylvie Beland.

[1] *[Ray Stapleton – see* Transit*, January 2010, for an explanation! – Ed.]*

Mars remains prominent to the south in the evening beneath the constellation of Leo, and moves steadily east as the Earth moves ahead. Because its distance from us is increasing, the planet's disk will reduce in size, making observation of any surface details harder.

Figure 2. Iapetus, taken during the Cassini mission. Image courtesy of NASA/JPL/Space Science Institute.

Saturn is past opposition and at its best this month. The rings are at an attractive semi-open angle now. Visual observers will find any surface cloud details on the planet hard to see. Try to spot the Cassini Division in the rings and see if there is any sign of either the shadow of the rings across the face of the planet or the planet's shadow on the rings as they pass behind. For me it is the endlessly varying positions and visibility of the moons that I never tire of. There are up to eight you might be able to spot. Titan is always visible, but the others seem to come and go, even Rhea, the next brightest. The others are Dione, Tethys, Mimas, Enceladus, Hyperion and finally Iapetus, which is normally only spotted to the west of the planet because of its weird division into light and dark halves.

Meteors

The **eta Aquarids** are active through to 20 May with a maximum on the 5th. These meteors are derived from the tail of Halley's Comet and the shower occurs as the Earth passes through the track of the comet's orbit around the Sun.

Deep sky

Virgo

Last month I described **Markarian's Chain**. There is another bit of sky nearby where you can play 'How many galaxies can I see at once?'. We start once more from **Vindemiatrix** or ε Virginis, which is a naked-eye star and hence easy to see in your finder. I like using Vindemiatrix as a starting point because I like the name and like imagining it as being the friend of Asterix the Gaul.

Scan westwards (right) from Vindemiatrix to find the 'rocket' asterism of four stars with **ρ Virginis** in the centre (incidentally, the tip of the rocket is a wide double, **27 Virginis**). Sweep to the north-east (across and to the left of the rocket's nose) with a low-power lens and **M59** and **M60** should come in view together. Look carefully to the south of M59 (the western one of the pair) and find the less bright but still obvious **NGC 4638**.

Now look carefully to the south-east along a line marked by M59 and down through NGC 4638, and using averted vision you should find **NGC 4660**. Check with a higher-power lens to see if you've found it.

Now move back to M60 and look close-by to the north-west, where you should find **NGC 4647**. Finally, extend the line linking NGC 4660, NGC 4638 and M59 upwards to the

north-east and try to see **NGC 4606**. This is the hardest galaxy of the (underlined) six, and you will probably only catch a slightly elongated flicker with averted vision. Having found them, go back to low power and see how many you can get in the field at the same time – probably five, with either NGC 4660 or NGC 4606 at the southern and northern extremes getting left out.

Go back to Asterix's friend and look north to the next fairly bright star. This should be **Diadem** or **α Comae**. Close by to the north-east in a low-power view, you should be able to see the bright globular cluster **M53**. It is bright enough to be visible in the finder.

Nearby to the south-east of M53 is another globular cluster, **NGC 5053**. This one is a real challenge. It is very faint and elusive despite being quite large. I find this a very tough object to see, and it is only really detectable with averted vision.

My final suggestion for the month is the interacting pair of galaxies **NGC 4490** and **NGC 4485**, an old favourite of mine. These lie just west of β Canes Venaticorum (Chara). NGC 4490, the **Cocoon Galaxy**, is fairly easy to pick up. Its companion NGC 4485 is shyer but will be seen under good conditions. There is a definite triangle of faint stars nearby to help confirm you have the right field.

Figure 3. Globular cluster M53 (though it probably won't look quite like that through your scope ...). Image from ESA/Hubble/NASA

Celebrations and imaging at Selsey

Keith Johnson

In October last year, a film crew from *The Sky at Night* visited my house, as part of putting together a show about various types of observing and imaging set-ups, ranging from very basic tripod-&-telescope to full-blown observatories. I had sent photos of the set-up in my garden to the series producer, Jane Fletcher, who replied that it was just what she wanted.

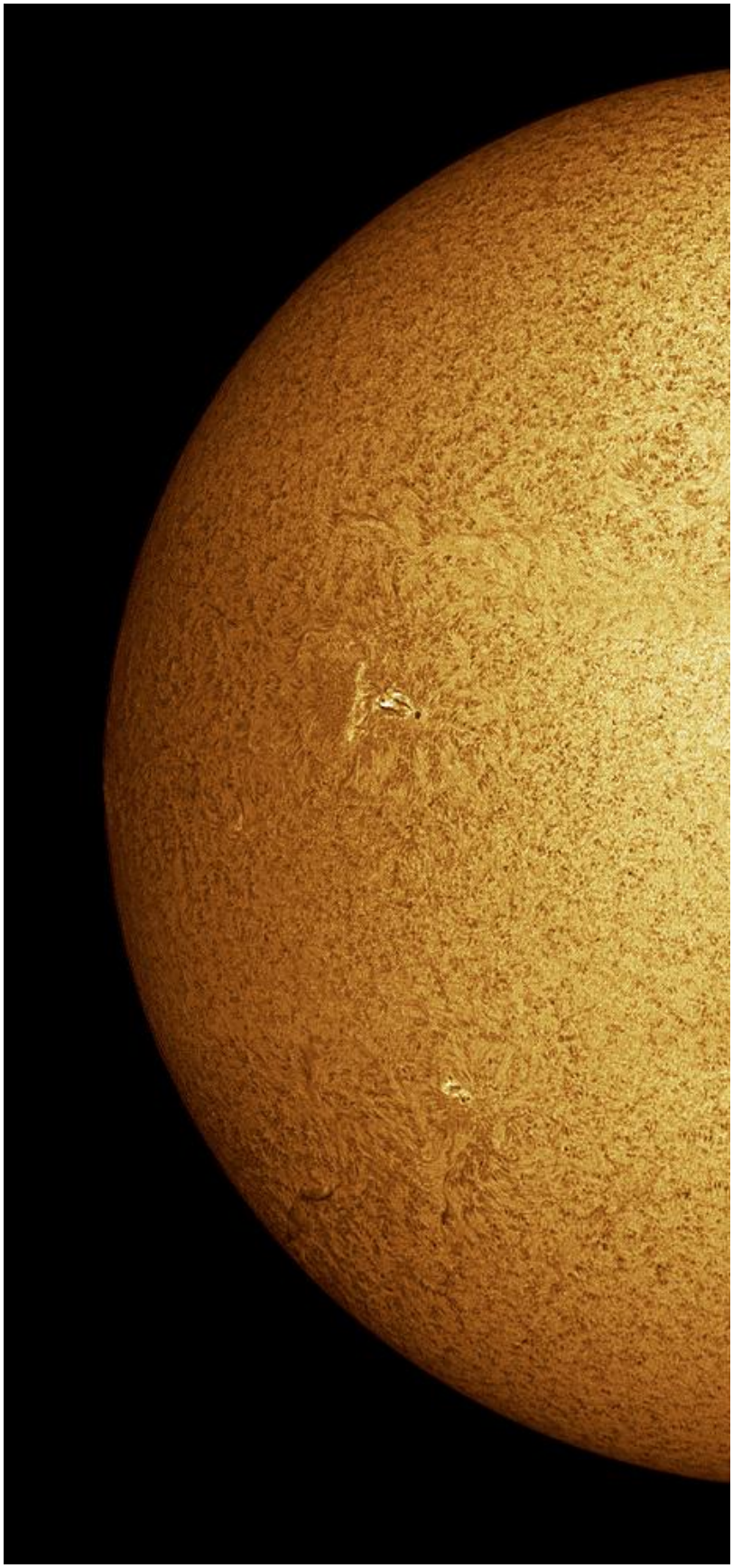
After they had gone to Jürgen's house to film his observatory and interview him, I arranged to meet up with the crew at Kielder Star Camp, where we carried on filming. That programme will be transmitted later on this year.

I was then invited to *The Sky at Night*'s 55th-anniversary celebration party at Sir Patrick Moore's house in Selsey and, as I always do, asked Jane if I could bring someone along with me, which she very kindly agreed to. George Gargett and I arrived in Selsey on 26 April a day ahead of the party, owing to the long distance George had to drive us.

I've kept in contact with several people whom I met at my very first invitation to Sir Patrick's, and this time we managed to get lodgings at the same hotel. The south-facing rear garden there looked very suitable for imaging, so I decided to take some equipment with me. Jürgen had kindly loaned me his H-alpha filter, specially adapted to fit onto my 80mm Moonfish ED refractor, which also at one time had belonged to Jürgen. George and I set up the equipment (*below*) and I began capturing solar video sequences.

I also photographed the Moon later on – the results are shown on the next few pages.

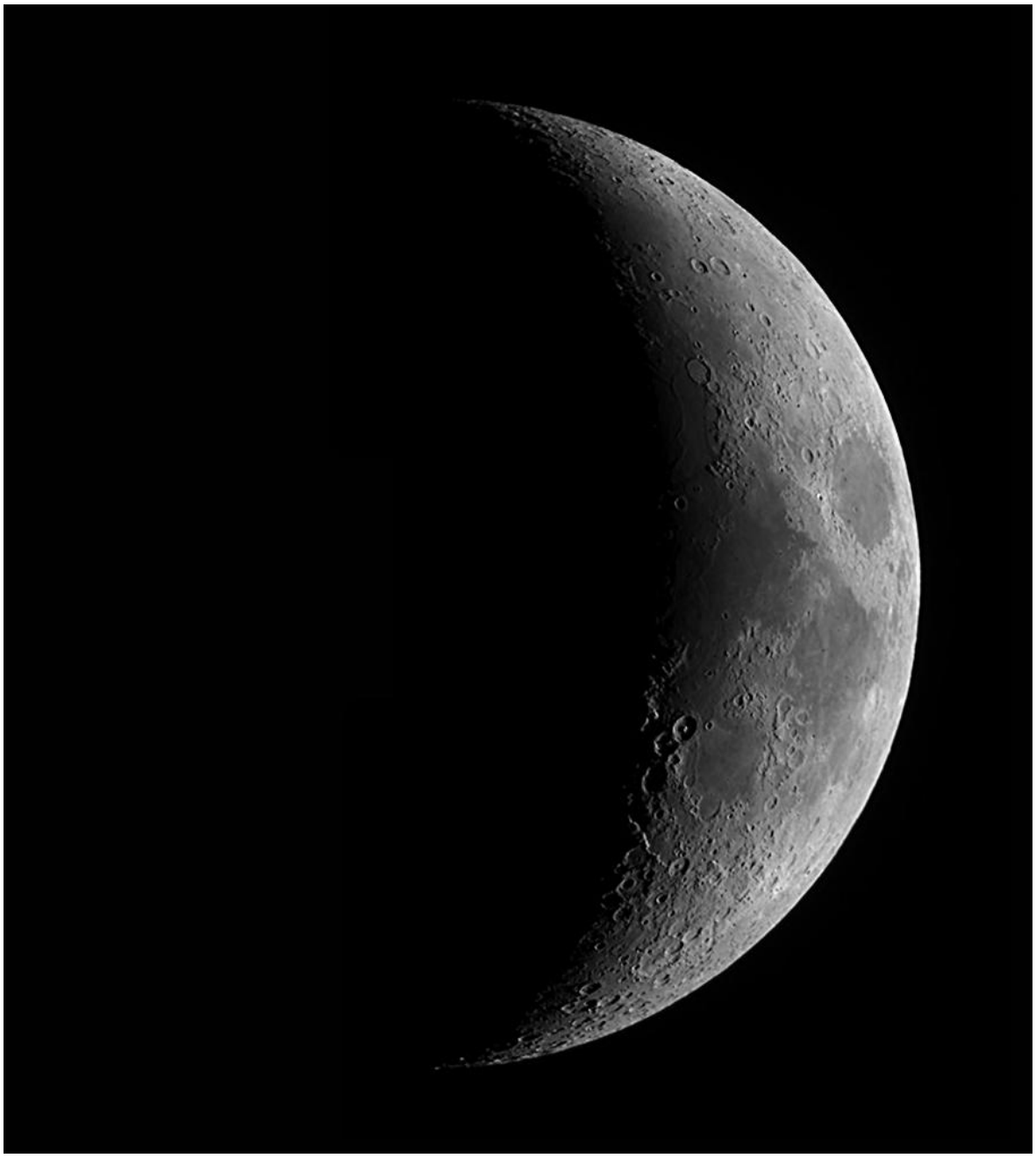
- HEQ5 Pro Mount
- 80mm ED refractor
- 40mm H-alpha SolarMax filter
- DMK USB2 camera



The Sun captured in hydrogen-alpha light using the equipment above, 26 April 2012, showing solar active region 1467.

SOFTWARE

- Registax v6
- Adobe Photoshop CS2
- False colour added in Photoshop

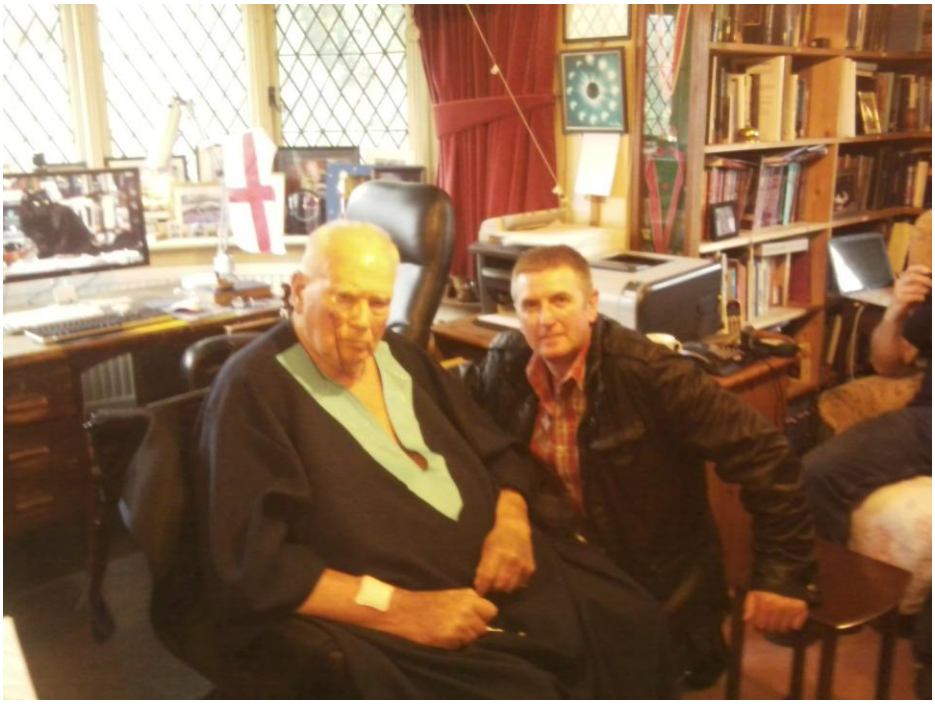


The party was being held on the 27th from 5 pm in a local pub called 'The Seal', about 5 minutes' walk from Patrick's home. We decided to arrive an hour early to get a seat – little did I know that only 50 guests were attending anyway!

Just after 5 pm some familiar faces started to arrive, along with friends I've met up with during previous Selsey visits. Soon after 5:30 pm Sir Patrick arrived, together with all the presenters.

After speeches by Chris Lintott (*below*) and Jane and finally a brief one from Patrick, everyone chatted and had a most enjoyable evening, which for some of us lasted into the early hours of the morning …

We arranged to visit Sir Patrick the next day. The photo below was taken shortly after I presented him with a book entitled *The Authenticated Meteoric Falls of the British Isles* by James D. Robinson, who is the brother of my brother-on-law.



We thanked Sir Patrick for once again allowing us into his home to meet him, then set off on our long journey home, feeling very privileged at being invited to *The Sky at Night*'s 55th-anniversary party and meeting the great man himself.

GENERAL ARTICLES

Leap years and calendar quirks – Part 2

Neil Haggath

Last month I told you how the Romans, with the combination of astronomers' logic and politicians' lack of it, gave us the clumsy calendar system we use today. This time, I'll tell you about how the Gregorian calendar improved on the Julian one, and why we have the peculiar rules for determining which years are leap years.

Everyone knows (I hope!) the basics of why we have leap years. The length of a year – the period of the Earth's orbit around the Sun – isn't a whole number of days; it's roughly 365¼ mean solar days. (A mean solar day is the period that we define as 24 hours, for normal timekeeping purposes – which is *not* the same as the Earth's rotation period.) So if we simply defined a calendar year as 365 days, it would move out of step with the cycle of the seasons, at the rate of a day every four years.

So we correct for this discrepancy, by adding an extra day to the calendar in every fourth year. This is done in February, because that was the last month of the Roman calendar; they simply added the extra day to the end of the year.

The Julian calendar, introduced by Julius Caesar, added a leap day every fourth year; if the year is divisible by four, then it's a leap year. But in reality, that doesn't quite work. The length of a year isn't exactly 365.25 days; it's actually very slightly less – 365.2421904 days, to an arbitrary number of decimal places! So by adding a day every four years, we're slightly *over*correcting, by an amount of 365.25 – 365.2421904 or 0.0078096 day per year.

Now that difference might seem trivial, but over a period of centuries it adds up. In fact, it adds up to just over three days in every 400 years (3 / 400 = 0.0075). So the Julian calendar was overcorrecting by that amount, and falling behind the seasons at the rate of three days per 400 years. By the 16th century, this discrepancy had added up to about 12 days. Something had to be done about it.

So in 1582, Pope Gregory XIII, acting on the advice of astronomer Christopher Clavius, further reformed the calendar to compensate for the overcorrection. (While this made perfect astronomical sense, it has to be said that the Pope's reason for doing it was primarily religious, to do with calculating the date of Easter.) Predictably, this 'counter-correction' is achieved by *removing* three leap days in every 400 years! Or to put it another way, we now have 97 leap years per 400 years, instead of 100.

This is done as follows. On top of the rule about every fourth year being a leap year, we now add a further rule; the last year of a century (i.e. if the year is divisible by 100) is *not* a leap year – unless the year is divisible by 400. So three out of four 'century years' are *not* leap years, but the fourth *is*. So 1600 was a leap year; 1700, 1800 and 1900 were not; 2000 was, and so on. This *almost* achieves the desired effect, of compensating for that surplus of 0.0078096 day per year. By removing three leap days per 400 years, we are in fact removing

0.0075 day per year; in effect, we are now assuming the length of a year to be (365.25 – 0.0075), or 365.2425 days – which is now pretty close to the true value of 365.2421904!

So the algorithm for determining which years are leap years can be stated as follows:

- If the year is divisible by 4, then it's a leap year;
- unless it's divisible by 100, in which case it *isn't* a leap year,
- unless it's divisible by 400, in which case it *is* a leap year.

It's not *that* difficult, really!

The rules used by Christian churches for calculating the date of Easter were established at the First Council of Nicaea in AD325. At that time, the vernal equinox occurred on 21 March. By 1582, owing to the overcorrection of the Julian calendar, the equinox fell ten days earlier on 11 March. When Pope Gregory introduced the new rules for leap years, it was also decided to restore the equinox to the date at which it had occurred in AD325. This was achieved by simply omitting ten days from the calendar; 4 October 1582 was followed by 15 October.

The Pope's declaration had authority only within the Catholic Church – but in Catholic countries, governments quickly adopted the new system, so that the civil calendar matched the religious one. But not all countries followed suit; in some predominantly Protestant countries, including England, governments stupidly rejected or ignored the change, simply *because* it originated from the Pope and the Catholic Church – despite the astronomical merits of the new system, and the fact that knowing when Easter occurred would be equally important to all churches!

This naturally led to a great deal of confusion, as different countries couldn't agree on what the date was. So over the next couple of centuries, most European countries gradually came into line and adopted the Gregorian calendar. It also spread to other parts of the world, via the overseas colonies of the European powers, and by the 19th century it had become the worldwide standard.

Britain finally adopted the Gregorian calendar in 1752. By then, the discrepancy had increased to 11 days, so 11 days were omitted from the calendar; 2 September 1752 was followed by 14 September. We still have a remnant of this change in our calendar today, with the dates of the tax year. In the Middle Ages, 25 March – one of the traditional 'quarter days' – was regarded as New Year's Day. Shifting this date by 11 days gave us 5 April as the start of the tax year; it was moved so that people wouldn't be

Figure 4. Hogarth's painting of a protester on the Dover ferry, 14 September 1752, with a placard saying 'Give us back our Eleven Days!'.

charged tax for the 'missing' days! It was then moved by a further day in 1800, owing to the omission of a leap day in that year, but the same wasn't done in 1900 – so we still have 6 April as the start of the tax year.

All this naturally causes headaches for historians when indicating the dates of events during this 'transition' period. When historians refer to events in Britain between 1582 and 1752, they often resolve ambiguity by stating the dates in both 'Old Style' and 'New Style' – meaning, respectively, the date as observed in Britain and that observed in most of Europe.

While most of Europe had adopted the Gregorian calendar by the 19th century, a handful of countries stubbornly resisted it until the 20th. Russia, for example, didn't adopt it until after the Revolution in 1917, by which time its calendar was 13 days behind – which explains why the Soviet Union used to celebrate the anniversary of the 'October Revolution' on 7 November!

Finally, let's return to the maths. As I said earlier, the Gregorian calendar assumes the length of a year to be 365.2425 days, whereas the actual length is 365.2421904. So we still have a very small residual error, of 0.0003096 day per year. Over timescales of a few centuries, that's close enough, but it still adds up over a timescale of millennia! If we take the reciprocal of that small number, we see that it equates to one day in 3230 years – so, adding that number to AD325, the calendar will be exactly a day out of step again by AD3555! So sometime around or before that date, it will be necessary to omit another leap day. But so far, no rule has been established to operate on timescales longer than 400 years, the full 'cycle' of the Gregorian system.

Phil Plait, on the Bad Astronomy website, has made an interesting observation. If you multiply that residual error of 0.0003096 by 400, you get 0.12384 day; this is the amount by which the calendar is out of step after a 400-year cycle. Now this is pretty close to an eighth of a day (1/8 = 0.125) – so Plait suggests that a sensible next level of correction would be to omit a leap day after eight 400-year cycles, or 3200 years.

So perhaps our descendants, 12 centuries from now, will add another line to the algorithm that I stated earlier – 'unless it's divisible by 3200', and decide that the year 3200 will *not* be a leap year.

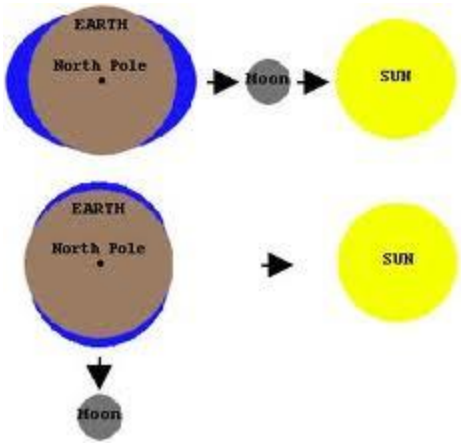
Tidal consequences

Ray Worthy

In my continual search for places in which to exercise away from the threat of traffic, I regularly find myself on the Hartlepool shoreline, where there is a smooth and traffic-free lane. Several times a week, I find myself watching the regular rise and fall of the sea. I do realise, that as a subscriber to this astronomical magazine, you must be reasonably cognisant of the causes of the tides. I ask you to be forbearing while I go over the reasoning, because there just might be a reader who requires reminding of the details.

The Earth and the Moon both have gravitational effects on each other. Just suppose that the Earth was not spinning with respect to the Moon. The liquid oceans would be free to form two bulges, one facing directly towards the Moon and another facing directly away from the Moon. However, as you know, the Earth *is* spinning and the oceanic liquid bulges are always

trying to stay on that Earth/Moon line. From the viewpoint of someone who is fixed on a shoreline, the sea is always exhibiting a twice-daily tide.



If the Moon created the only gravitational influence, all the high tides would rise to the same height, but the Moon factor is not the only one. The Sun's gravity has to be taken into account. The Sun causes its own liquid pair of bulges. Sometimes, when the Sun, Earth and Moon are in a straight line or nearly so, the bulges caused by the Sun are added to the bulges caused by the Moon, and the result is what is called a 'spring tide'. A fortnight later, when the Moon/Earth line is at right angles to the Sun/Earth line, the Sun's effect is subtracted from the height of the high tide and this is called a 'neap tide.' Stick with it. There will be further complications to discuss later in the article.

So far, I have mentioned only the tides in the liquid oceans, but it must be realised that the very rocks of the Earth are influenced by the same rhythm. When underground tunnellers and engineers were constructing the huge underground ring for the CERN installation, they made an interesting discovery. The internal navigation system used laser beams for accuracy. The constructors noticed that, at the accuracy level of wavelengths of light, the internal distances were following a twice-daily rhythm. One of the engineers was a spare-time sailor and kept his boat in the Gironde estuary, near Bordeaux. He confirmed that movement of the rocks underneath the Franco-Swiss border matched the tide table at Bordeaux on the Atlantic coast.

In the case of the moon Io, circling Jupiter with its huge gravitational influence, the tidal flexing of the moon causes such internal heating that volcanoes of molten sulphur erupt and regularly change the face of Io.

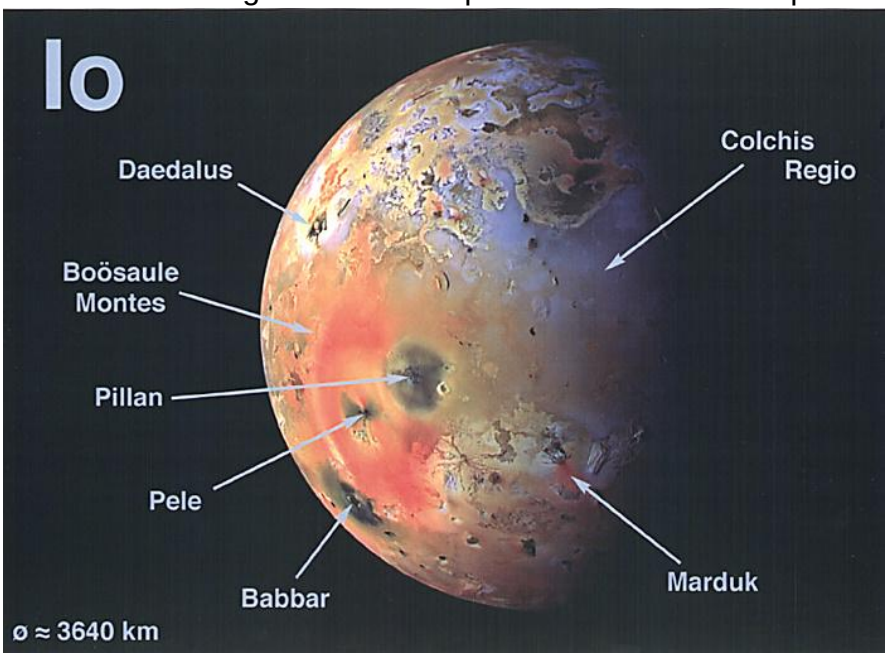


Figure 5. Volcanoes on Io.

However, let's get back to the more familiar terrestrial scene and bear in mind the title of this article. There was one tidal influence that changed the course of my life. It came about like this. In February 1953, there was a high tide far, far higher than normal. It was our misfortune that it was accompanied by storm-force winds that blew from the open Atlantic and bottled up the waters of the North Sea. This unfortunate combination resulted in great damage along our coast. Hartlepool lost its open-air swimming pool down by the Fish Sands. Staithes, the tiny fishing village on the Yorkshire coast, lost half of its sea-

front pub, the 'Cod and Lobster'. More seriously, further south where the shores of low-lying Essex and Holland were exposed to the surge, many people lost their lives in the floods.

'How did this affect you personally?', I hear you ask. It was like this. At that time, after serving as a soldier in Berlin and other devastated German cities, I was a fervent anti-war man and I became a local official of the United Nations Association. In a kind of 'hands across the sea' gesture, we resolved to organise an international work party to offer unskilled or skilled labour to help rebuild the houses of those who needed assistance. This effort was such a success that my summer holidays for the next few years found me in refugee camps in Austria, where displaced people were still living in ramshackle huts.

It was in this connection, on one occasion when I was down in Cambridge meeting some student volunteers, that I met Fred Hoyle.

Now we come to the part that is the raison d'être of this article. In the State University of Texas is a team of scientists who call themselves 'forensic astronomers', a description I have not encountered before. Their names are Olsen, Doescher and Sinnott. In March they published the results of some of their 'forensic' astronomy. Ten years or so ago, in an obscure science magazine (where have I heard that expression before?), a man named Fergus Wood produced an idea concerning tides and the icebergs coming south from Greenland. The forensic trio decided to check out Fergus Wood's idea.

The basis of it was that, at intervals of about 1400 years, there were highly exceptional tides that had grave consequences. What the trio began to consider was that there was an influence on the height of some spring tides caused by a factor not mentioned in the early part of this article.

What you have to take on board is the ellipticity of both the orbits of the Earth about the Sun and of the Moon about the Earth. If you traced the Earth's orbit, you would find that it is not circular but an ellipse, though only slightly so. The Sun occupies the place of one of the foci of the ellipse. This means that at one particular time of the year, the distance from the Earth to the Sun is at its minimum. The Earth reaches this point in its orbit on 3, 4 and 5 January. There is precious little difference in the distance during this passage. The natural consequence of this closest approach is that the tides at this time are affected. Because the close approach point is called the 'perigee', the respective tides are called 'perigeal' tides. You may have guessed by now where this is leading. There is a corresponding perigeal tide associated with the orbit of the Moon about the Earth. There is no whole-number relationship between the two orbits. This relationship is further complicated because the two orbits are not in the same ecliptic plane. If they were, there would be a solar eclipse and a lunar eclipse every month. The plane of the Moon's orbit is tilted at an angle of about 17° to the ecliptic.

This forensic team came up with the confirmation that, in the year 1912, the lunar perigee came within six minutes of the time of the full moon and this event came within a day of the solar perigee. The combination of these coincidences must have resulted in a high tide such as had not been seen for 1400 years or so.

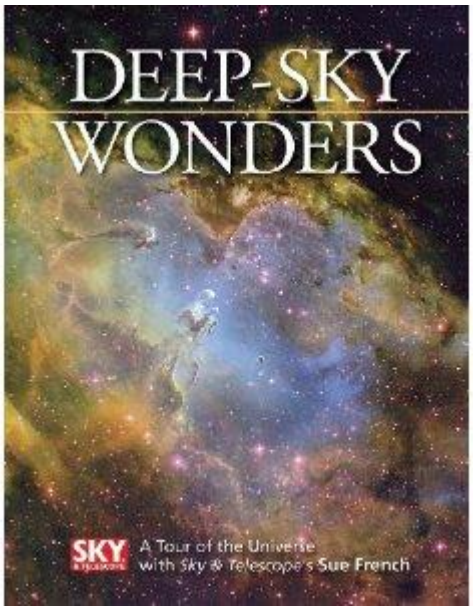
At this point, I ask you to take a flight on our modern magic carpet called 'Google Earth'.

Have a look near the west coast of Greenland somewhere around latitude of 76° north (*see above)*. There you will find several places where a large number of icebergs have calved from their respective glaciers and seem to be hanging around their calving positions as though reluctant to leave the company of their mothers. What is happening, of course, is that the bases of the icebergs have been caught up by the sea floor and have not been fully released to float away on the southerly current in the Labrador Sea. The trio point out that sometimes, on their way south, some icebergs get caught up on shelves along the coasts of Labrador and the Island of Newfoundland.

The contention in the trio's paper is that, on this particular date in January 1912, the high tide, such as had not been seen in over a thousand years, floated off icebergs, not in their normal trickle, but in one concerted release. These bergs then took their leisurely time to float south on the Labrador current and be out in the Atlantic in four months, just in time to meet that unsinkable ship, the *RMS Titanic*.

Book review: *Deep-sky Wonders: A Tour of the Universe*

Rob Peeling



Author: Sue French

Hardcover: 320 pages

Publisher: Firefly Books Ltd (24 Nov 2011)

ISBN-10: 1554077931

ISBN-13: 978-1554077939

Sue French is a long-standing columnist with *Sky and Telescope* magazine. She writes sky tours that Dave Blenkinsop often used to quote to me. This book is basically a (large) collection of her recommended tours. She includes objects of all sorts, from double and variable stars through to quasars. She also covers the whole range from easy-to-find to downright-difficult. The tours are arranged by month and season.

Sue has an easy-to-read style and carefully explains what she herself has seen of each object with different-sized telescopes from her home in New York state. This makes it a good guide book for pretty well anybody.

You will see far more in an observing session if you have a plan beforehand of what you want to do. Sue French has done the planning for you. Set up your telescope, pick one of her tours and enjoy. I'm very glad I bought this!

The porridge is 'just right'

John Crowther

At the beginning of October 2011, the national TV news featured a new telescope built on the top of a mountain in the Atacama Desert in Northern Chile. It sits on a very dry, very clear, very high place with no vegetation, although there is a scattering of old, yet new-looking snow. Visitors must take a medical and become acclimatised to stay there for any length of time. The new telescope is the VLA, a 'Very Large Array' of steerable radio dishes (*see Figure* ***Error! Reference source not found.***), which are still being added to. They must also work with an optical telescope, for a colour-enhanced photograph of two galaxies colliding was

Figure 6. Part of the Very Large Array (VLA) in the Atacama Desert, Chile.

Credit: Dave Finley, AUI, NRAO, NSF

shown on the news. This isn't a collision as we might imagine it, for usually only the tenuous gas between the stars meets, and changes its temperature and colour. Galaxies, the largest objects in the Universe, are made up of stars light years apart. The star lights from ours (the Milky Way Galaxy) blend and blur together as the street lights of Hartlepool do when viewed from Hinderwell, Brotton or Saltburn.

Certain questions enter our minds. Are there any thinking creatures out there? Are they thinking similar thoughts as their telescopes point in our direction? If we are not alone, is it planned for their and for our good that time and distance must forever separate us? Whether we read science fiction or not, we know that the cost of manned space travel is prohibitive. This has stopped the only nation able to take that small step to the Moon from repeating it. Most records, once broken, are repeated and improved upon, but not that jump onto the lunar surface.

So where has my title come from? The Goldilocks effect is shown by the Earth being in just the right orbit. It's not too hot and it's not too cold. It has gravity that is just right for keeping an atmosphere which sustains life.

Just as we are in the right orbit in the Solar System, so it is in the outer reaches of our galaxy. For at our galaxy's centre there is a large black hole, which holds the slowly spinning system together yet periodically pulls in and destroys nearby stars; but our Sun is safe in this respect. The whole of the Universe seems to be finely tuned and balanced. To those who believe in a caring Creator, this strengthens their faith; but to others it's a matter of luck and chance.

THE TRANSIT QUIZ

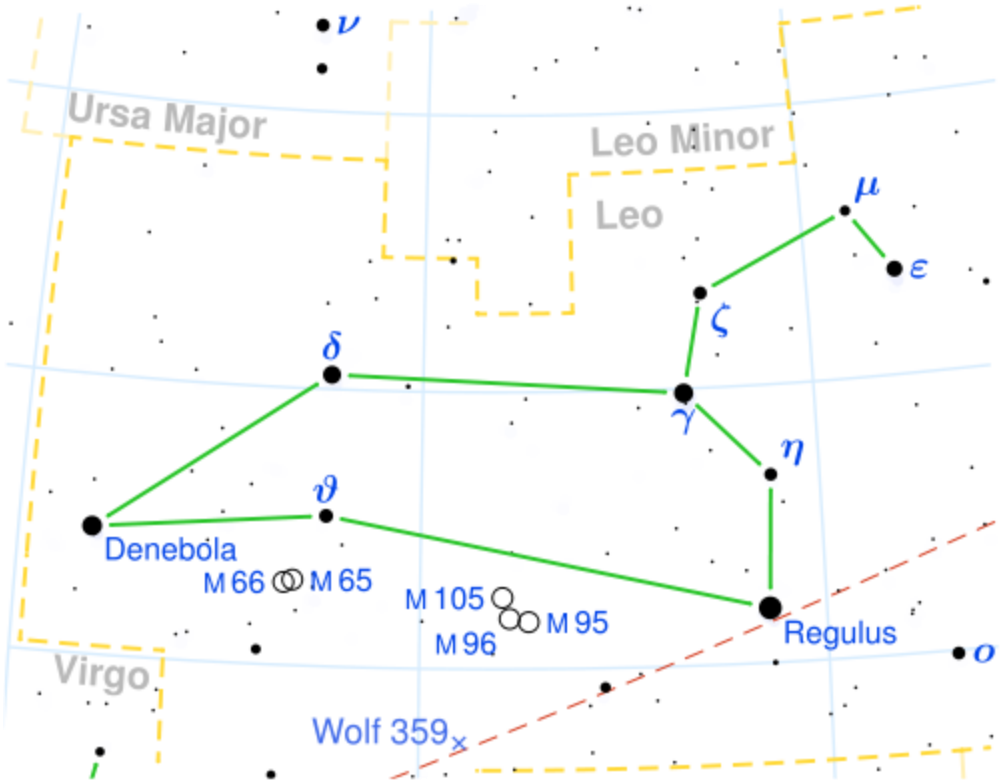
Answers to April's quiz

1. What's the connection between M16, IC 5070 and M97? **They're all nebulae with popular names derived from birds – Eagle, Pelican and Owl.**

2. And what about the connection between M40, M109 and M97? **They're all Messier objects in Ursa Major.**

3. And Albireo (β Cyg), Almach (γ And) and Rasalgethi (α Her)? **Well-known colour-contrast double stars: respectively orange and green/blue, orange and greenish, red and green.**

4. What are M65, M66 and NGC 3627 collectively known as? **The Leo Trio.**

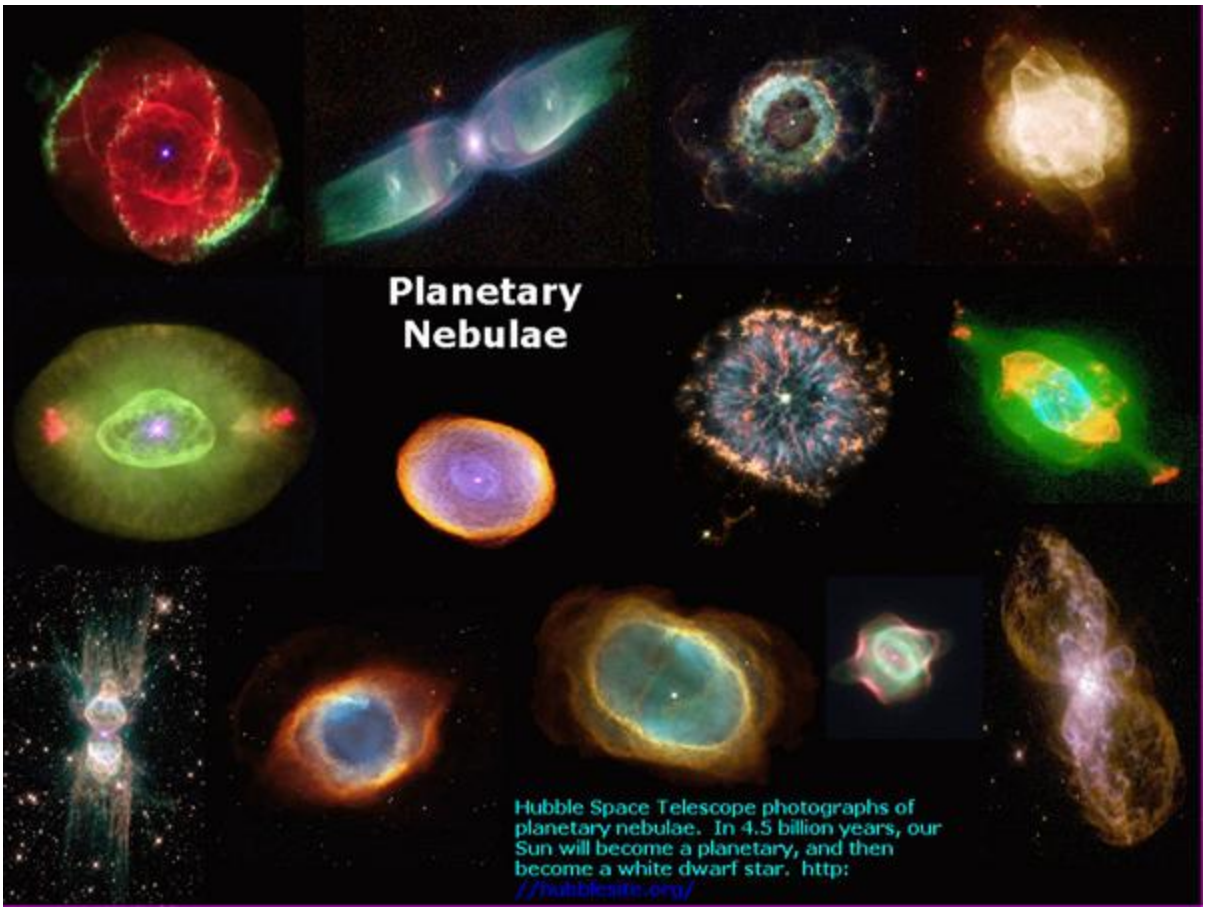


5. When Jupiter is at its closest to us, how many light-minutes/hours away is it?

   (a) 3 mins (b) 33 mins (c) 3 hrs (d) 333 mins **Answer: (b)**

6. Which astronomer does this describe, and what are his enduring legacies? His father was the Danish Minister for War and the Navy; he worked for Lord Rosse and directed the Armagh Observatory; and he produced a 15-volume edition of the works of Tycho Brahe. **JLE Dreyer (1852–1926), the compiler of the *New General Catalogue of Nebulae and Clusters of Stars* and its two supplementary *Index Catalogues* – better known by their initials NGC and IC, and still in use today.**

7. An O III filter excludes other than what kind of light? And what objects can be particularly well viewed through it? **Light from doubly ionised oxygen. O I is un-ionised oxygen, O II is singly ionised, and so on. An O III filter strongly enhances the contrast when observing planetary nebulae.**



8. In a typical diffuse nebula, how much space would a kilogram of dust grains occupy?

   (a) 1 cubic km (b) 1000 cubic km (c) a million cubic km (d) a cubic light-year
   Answer: (c)

9. What are Bok globules? **Compact dark nebulae, catalogued by the Dutch-American astronomer Bart J. Bok (1906–83).**

10. Where in our Galaxy would you be most likely to find OB associations, and what are they? **In the Galaxy's spiral arms. They are collections of highly luminous, massive (and hence young) stars of spectral types O and B, formed as relatively short-lived structures by the passage of pressure waves that create the spiral arms.**

May's quiz

1. Why have some astronomers recently been looking at the Moon to detect signs of life on Earth?

2. Who was the first Professor of Radio Astronomy at Cambridge?

3. Who proposed the 'dirty snowball' theory of comets?

4. Before 1977, we thought Saturn was the only ringed planet. We now know that Uranus and Neptune have rings too. How many?

5. Herschel, Planck, WMAP, H2L2 and the James Webb Space Telescope: what did/do/will these space telescopes have in common?

6. And what about the Pioneer, Voyager, Galileo and Juno missions?

7. What's the next in this series: 185, 1054, 1572, 1604, ….?

8. Which astronomer became a member of the House of Lords in 2005?

9. What's the largest telescope open for public viewing in the UK?

10. Oceanus Procellarum (Ocean of Storms) is the largest lava plain on the Moon at 811,000 sq. miles. The second largest is one of the 'Maria' – which one?