



# TRANSIT

The July/August 2012 Newsletter of



## NEXT MEETING at Wynyard Planetarium

Friday 14 September 2012, 7.15 for 7.30 pm

**Life in a cluster of galaxies**

**Professor Richard Bower, Durham University**



## Contents

|      |   |                      |
|------|---|----------------------|
| p.2  | Editorial                                 |                      |
| p.2  | Letter: <i>Re-reading rewards</i>         | <i>John Crowther</i> |
|      | <i>Observation reports &amp; planning</i> |                      |
| p.3  | Skylights – July 2012                     | <i>Rob Peeling</i>   |
| p.4  | Skylights – August 2012                   | <i>Rob Peeling</i>   |
| p.6  | More solar imaging                        | <i>Keith Johnson</i> |
| p.7  | Transit of Venus non-report!              | <i>Neil Haggath</i>  |
|      | <i>General articles</i>                   |                      |
| p.10 | The ultimate frustration                  | <i>Ray Worthy</i>    |
|      | <i>The Transit quiz</i>                   |                      |
| p.14 | Answers to June's quiz                    |                      |
| p.15 | The summer's quiz                         |                      |

## Editorial

*Rod Cuff*



Alas, as we all know, the **Transit of Venus** happened on 6 June, but might as well not have done as far as all of us who stayed in the UK were concerned. However, I understand five CaDAS members turned up at the Planetarium in hope and to help host those members of the public, if any, who might join them. To Ed's and everyone's surprise, about 40 people did so, and sat in the relative comfort of the Planetarium chairs to watch a live feed from Mauna Kea in Hawaii. Two CaDAS members went further afield, with very different results. You can read Neil Haggath's tale in this issue, and we're promised John McCue's in the next.

Rob Peeling exceeded his own standards by supplying *two* 'Skylights' articles, one each for July and August. I've rather reduced the impact of this by deciding to put out an issue three-quarters of the way through July, for which I apologise sincerely to Rob; but much of what he's written for July applies to August too, so I've left both articles in rather than trying to smash them together.

As stated in the June issue, September's *Transit* will be guest-edited by Andy Fleming, so please send material for it to Andy ([fleming5ln@btinternet.com](mailto:fleming5ln@btinternet.com)).

Many thanks, as ever, to this month's contributors.

*Rod Cuff*, [info@cadastro.org.uk](mailto:info@cadastro.org.uk) 1 Farndale Drive, Guisborough TS14 8JD  
(01287 638154, mobile 07775 527530)



## Letter

### Re-reading rewards

*from John Crowther*

There are two benefits gained when an article is read again. One is that information that may have been missed is then noticed. The other is that any former mistake can be corrected.

This applied to me when I looked again at Ray Worthy's article 'Tidal consequences' in the May 2012 issue. I think I was correct in writing that the Moon and Earth rotate around a centre of gravity that is below the surface of the Earth.

But Ray was definitely correct when he wrote that the tidal bulge opposite to the Moon or Sun is due to the spin of the Earth.

So does the slow monthly rotation of the common centre of gravity influence this at all?

*Best wishes – John*



# OBSERVATION REPORTS AND PLANNING

## Skylights – July 2012

*Rob Peeling*



### Hours of darkness

| <i>Date (all times BST)</i> | <i>Sunset</i> | <i>Astronomical twilight</i> | <i>Sunrise</i> |
|-----------------------------|---------------|------------------------------|----------------|
| 1 July                      | 21:41         | None                         | 04:46          |
| 31 July                     | 21:07         | 00:30 to 02:00               | 05:26          |

Full darkness (when the Sun is at least 18° below the horizon) isn't reached at all at our latitude in July. Astronomical twilight returns at the very end of the month.

### The Moon

|             | 4 July           | 11 July                   | 19 July         | 27 July              |     |
|-------------|------------------|---------------------------|-----------------|----------------------|-----|
|             | <b>Full Moon</b> | <b>Last Quarter</b>       | <b>New Moon</b> | <b>First Quarter</b> |     |
| <i>Rise</i> | 20:53            | 23:56 (10 <sup>th</sup> ) | 05:35           | 14:18                | BST |
| <i>Set</i>  | 04:30            | 14:14                     | 20:50           | 23:44                | BST |

### The planets

**Saturn** spends July to the north of Spica,  $\alpha$  Virginis. **Mars** starts the month near  $\beta$  Virginis, well to the south of Denebola, which marks the back end of Leo. During July, Mars will zip across Virgo to finish the month completing a nice bright grouping with Saturn and Spica, which you can catch low in the west just after sunset.

In the early morning just before the Sun rises, **Jupiter** will be visible above the Hyades.

**Venus** rises later and will move into the Hyades during the month. The asteroids **Ceres** and **Vesta** are also in this area through the month.

### Meteors

Towards the end of the month there are two separate meteor shower, the **Southern Delta Aquarids** and the **Alpha Capricornids**. Both are at maximum on 30 July. Some bright meteors are possible from these showers.

### Noctilucent clouds

Between mid-May and mid-August is the best time for observing noctilucent clouds (NLC). The reasons for and origins of these clouds are still mysterious. They are completely different from the tropospheric (weather) clouds found in the lower 10km of the Earth's atmosphere. Noctilucent clouds exist at a height of around 80km and seem to be made of ice crystals. They can only be noticed when the Sun is well below the horizon and therefore illuminates just these very high clouds, which is of course how they get their name. When they are

visible, the lower, normal clouds are dark to look at, which is how you tell the difference. Noctilucent clouds can be quite bright and are white or an attractive blue-white colour.



**NLC 27–28 July 2001, by Tom Eklund, Valkeakoski, Finland**

NLC forms are classified into four easily identified types.

**Type I: Veil** – A simple, structureless sheet, sometimes as background to other forms.

**Type II: Bands** – Lines or streaks, parallel or crossing at small angles.

**Type III: Waves** – Fine herring-bone structure like the sand ripples on a beach at low tide.

**Type IV: Whirls** – Large-scale looped or twisted structures.

The Noctilucent Cloud Observers’ homepage [www.kersland.plus.com](http://www.kersland.plus.com) contains plenty of information on how to record observations and the different types to be seen, together with photos to help you see what to look for.



## Skylights – August 2012

*Rob Peeling*

### Hours of darkness

| <i>Date (all times BST)</i> | <i>Sunset</i> | <i>Astronomical twilight</i> | <i>Sunrise</i> |
|-----------------------------|---------------|------------------------------|----------------|
| 1 August                    | 21:05         | 00:30 to 02:00               | 05:28          |
| 31 August                   | 20:01         | 22:14 to 04:04               | 06:19          |

The hours of astronomical twilight increase rapidly through August.

## The Moon

|             | 2 August         | 9 August                 | 17 August       | 24 August            | 31 August        |     |
|-------------|------------------|--------------------------|-----------------|----------------------|------------------|-----|
|             | <b>Full Moon</b> | <b>Last Quarter</b>      | <b>New Moon</b> | <b>First Quarter</b> | <b>Full Moon</b> |     |
| <i>Rise</i> | 20:42            | 22:45 (8 <sup>th</sup> ) | 05:48           | 14:57                | 19:28            | BST |
| <i>Set</i>  | 06:01            | 14:25                    | 19:55           | 23:10                | 06:16            | BST |

There are two full moons in August. By some accounts the one on the 31<sup>st</sup> is a Blue Moon. Officially, however, it is not a Blue Moon because there are only three full moons in the season between the summer solstice and the autumnal equinox. The definition of a Blue Moon in the *Maine Farmers' Almanac* is the third full moon within the same astronomical season. This next happens on 21 August 2013.

## The planets

**Saturn** and **Mars** remain close together, low in the west, at sunset. However, by the middle of the month they will be below the horizon before it gets dark enough to see them.

**Neptune** is in Aquarius and **Uranus** right on the boundary between Pisces and Cetus. They can be found in the early hours, with Neptune rising first.

**Jupiter** is in the vicinity of the Hyades when it rises very late into the night. **Venus** is speeding away from the Hyades back towards the Sun to pass behind it this time after the transit in June.

## Meteors

The **Perseids** are the highlight of the meteor observing year. The maximum is 12/13 August. Ed is holding a public observing session at the Planetarium for the maximum, from 21:00 on 12 August until 06:00 on the 13<sup>th</sup>. The meteors are associated with the [comet Smith–Tuttle](#).

## Deep sky

Here are two **planetary nebulae** that you may enjoy finding in the constellation of Ophiuchus. The first is **NGC 6572**, which lies south of 71 Oph. It is plotted in most star atlases, including *Norton's*. It is very bright for a planetary nebula and at first difficult to spot because it is very star-like in appearance. However, its colour is what gives it away. Suddenly you realise that you are looking at a bright green star, and that can't be right! Higher power or an OIII or UHC filter will show some nebulosity to confirm that it really is a planetary nebula. It deserves its nick-name of the **Emerald Eye Planetary**.

The other planetary nebula, **NGC 6309**, lies a little north of  $\eta$  (eta) Oph. This is quite a difficult object to find because the surrounding field is confused by the presence of a nearby double star and because it is low in the Teesside sky. The confusion is because the nebula itself is close to another star and so superficially appears to be another double. Careful inspection reveals one of the 'stars' to be the nebula, with its shape elongated towards the real star. This gives the appearance of an **Exclamation Mark**, which is one of several names for this object. It is also referred to as the **Box Nebula** and **Tempel 1** (after the discoverer).

Other objects worth looking out for are **M11**, the **Wild Duck cluster** in Scutum, which is easy in binoculars, and a very rich open cluster. I have never understood the Wild Duck name, though. I can't see anything that resembles the lines in a flying flock of ducks.



Further south from M11 are two famous nebulae, **M16**, the **Eagle Nebula**, and **M17**, the **Swan Nebula**. The star cluster associated with M16 is easy to see but the nebulosity itself is much more elusive. M17, however, is easy to see and does (to my eyes anyway) merit the Swan description.



## [More solar imaging](#)

With gaps in the cloud on 4 June, I managed to grab some data using the [Lunt 35mm solar scope](#), EQ6 Pro mount and DMK USB II mono camera. (I left the camera attached to the telescope to retain focus in readiness for the next day's Venus transit – but that was not to be ...)

The final image was a mosaic of sub-images from more than 20 AVIs (video sequences) each aligned and stacked in [AutoStakkert II](#). The sub-images were then combined into two separate mosaics in Adobe Photoshop CS2 – one for the prominences and the other for the disc. These two were then adjusted slightly using wavelets in [Registax v6](#) and finally transferred again into Photoshop, where false colour was applied and finally both images were layered together.

*Keith Johnson*





## Transit of Venus non-report!

or *The best-laid plans of mice and astronomers, Part 3*

Neil Haggath

So that's it, folks – the last chance in any of our lifetimes! I refer, of course, to the transit of Venus on 6 June. I gather Cleveland was completely clouded out, as was virtually the entire UK. Rob Peeling, in Reading, told me that he got a single break in the clouds for ten seconds – which seems to be about the best that anyone got!



As far as I'm aware, the only CaDAS member who actually managed to observe the event was John McCue, who travelled to Qatar in the Middle East. But among our members, I hold the dubious record of having travelled the furthest – about 6000 miles – to *not* see it!

In the hope of seeing the transit for most of its duration, I headed a long way east, to the fair Kingdom of Thailand. From there, the transit still began before sunrise, but I would, in theory, get to see all but about the first hour. To see it in its entirety, I would have had to go even further east – say, the Philippines, or Japan, or the east coast of Australia. But those places were beyond my budget, given that I'm planning a major trip to Australia in November for the next total eclipse. So while Thailand was far from ideal, it was a compromise between ideal and affordable.

Naturally, I wasn't going to travel all that way *just* for the transit; I was going to make a holiday of it. Nor was I sorry to be a few thousand miles away from all the Jubilee palaver... (The Queen has a way to go yet; [King Bhumibol Adulyadej](#) of Thailand, although one year younger, has now reigned for *66 years!*) My destination, in fact, was my favourite place in the Far East – the beautiful island of Phuket. I've now been there five times, and four in the last five years. That's because it has several attractions for me, namely:

- fabulous scuba diving, in warm and crystal clear water
- the [Patong Go-Kart Speedway](#), which is rated as one of the world's top five karting tracks
- and last, but not least, Yunet – a charming lady who works at the said Speedway, and who, for reasons best known to herself, thinks the world of me!

I flew to Phuket on 27–28 May – an overnight journey of 18 hours and three planes – arriving on the Monday afternoon. (I flew with KLM from Birmingham, via Amsterdam and Bangkok; I always avoid Heathrow if at all possible!) I spent ten nights there, returning the day after the transit. In fact, it was a very early morning departure on Thursday 7 June, getting me back to Birmingham in the late evening of the same day – in time to drive up to Cleveland for the CaDAS meeting on Friday. Well, I was *physically* present at the meeting, but my brain wasn't sure which continent it was on...

There was one major potential problem: in Thailand, as in most of South-East Asia, it was the start of the rainy season. But that usually means that it rains for an hour or two per day, not all the time. All the weather stats I read for Phuket said that the usual trend is cloudy overnight, dry with sunny spells in the morning and showers in the afternoon. (The word 'shower', as used in that part of the world, doesn't quite mean the same as it does here. When it does rain, it *rains!* 'Shower' is actually quite an apt word, because it's rather like

standing under one – you are soaked through to your undies in approximately ten seconds.) As the transit was going to take place in the morning – the local time (GMT+7) of sunrise was 06h10m, and last contact would be at 11h49m – it sounded as though I wouldn't have too much to worry about. Or so I thought...

Another slight problem is that the main resort town of Patong Beach, where I was staying, is on the west coast of the island, with hills to the east – not too good for observing the sunrise! So my initial idea was that on the day, I would make a very early start and transport myself and my equipment (by taxi) to somewhere on the east side with a good horizon. An obvious place would have been Chalong Marina, from which all the dive boats sail.

I planned to photograph the transit with my DSLR and a 300-mm zoom lens, with a mylar filter. I also took my [Solarscope](#) – by which I don't mean an expensive H $\alpha$  telescope, but an ultra-cheap, ultra-low-tech projection device. It is in fact a small camera obscura, which uses a 40mm lens and a small mirror to project an image onto a screen

inside a big cardboard box. With the optical components removed – and protected with bubble wrap! – the whole thing folds flat for carrying in a suitcase. With that and my camera tripod, my luggage was somewhat over the airline weight limit...

When I arrived in Patong on the Monday afternoon, my initial thoughts were something unprintable; it was, to put it mildly, chucking it down! In fact, before I left the UK, Yunet had told me that it had been raining almost non-stop for a couple of days. But the hotel staff told me that the forecast said it was going to improve from the next day – and it proved right.

For the next few days, the weather behaved mainly as per the stats. In the mornings, it usually began overcast, but the clouds broke up by about 07h30m, with at least intermittent sunshine for the next few hours. The evenings were rather wet, but I didn't care about that. On a couple of occasions, there was in fact a bit of rain during the morning, but only for about half an hour. The probability of seeing the transit unimpeded looked like being slim to zero, but I thought it was better than evens that I would at least get *some* clear views, and hopefully long enough breaks to take a few images.

Because of those morning showers, I abandoned the idea of travelling anywhere on the day. I had found that at my hotel, by about 45 minutes after sunrise, the Sun rose into view above the buildings and hills – and that period was usually cloudy anyway. So I decided to sacrifice those 45 minutes, and settle for observing from the hotel – so that if it did start to rain, I could get my equipment under cover, *fast!*

During the next week, I had two highly enjoyable days of diving, and one day showing off my lunatic driving skills at the Kart Speedway. One advantage of going out of season is that the





dive boats are relatively quiet. On my first trip, there were only about a dozen divers on the boat, most of them were Russians. As the only English-speaking guest, I had a 'one to one' with my own personal guide! And what's more, my guide was a very nice guy – and a fellow Yorkshireman, no less – whom I already knew from my previous two visits, and regarded as a mate. As I have no astronomical images to show you, I'll show you this handsome fellow...



And then Yunet and I had a fun day out, experiencing the delights of traditional local transport...



Then came the Fateful Day... The previous evening, things were looking ominous, as it ever so slightly chucked it down for a couple of hours, then continued to drizzle overnight. At about 4 a.m., there was a 'shower' of such intensity that the noise of it woke me up! But by the time I got up at 06h00m, the rain had actually stopped – though it was still 100% cloud. I grabbed a quick bite of breakfast, and had my equipment set up at the poolside by 06h50m, ready for when the Sun came into view – if it ever did...

But it didn't. At about 07h30m, it began to rain again, and I quickly got my equipment back under cover in my room. And that was it; from then on, it rained... and rained... and rained... For a little while, I held out hope that this was just another 'shower' and that it might still clear up again. Some hope – it got steadily worse, and within the next couple of hours, the 'shower' had developed into a full-blown typhoon! I stubbornly waited around all morning, with my equipment still set up in the room, just in case – but it was a lost cause. [Sod's Law](#) had struck again. And there was no chance of getting to another location at the last minute, as I think the entire island was getting it just the same.

Even with all my previous experience of how it rains in South-East Asia, this beggared belief. It was absolutely torrential, with water standing an inch deep on the roads and pavements – and it went on for *13 hours*! I was thoroughly hacked off... and very wet.

Meanwhile, just a few hundred miles away in Bangkok, they were blessed with a clear sky. Soon after the transit had ended, I saw the news on Thai TV, with pictures of crowds of people in the capital, watching through eclipse glasses. At any given location, it was simply pot luck.

That evening, I had to pack for the flight home; I had to pack soggy clothes and shoes in my case, as it was impossible to get anything dry!

Oh, and just to add insult to injury... Between the flights there and back, the airline charged me a total of £150 in excess baggage charges for carrying my equipment, which I didn't get to use.

## GENERAL ARTICLES

### [The ultimate frustration](#)

*Ray Worthy*



If you've been a regular reader of my articles in this esteemed magazine, you will be aware that I cannot see very well. In this regard, I have experienced a great frustration only two days ago. (I am writing this on 2 June 2012.)

It so happens that I have been waiting several months for an operation to remove a cataract, so that once again I should be able to see the colours of the flowers in my garden. However, this was not to be. Two weeks before the operation date, I developed a persistent nose bleed. The blood flooded out and it got worse. There was nothing for it but to get my nostril cauterized. I arrived at the Eye Infirmary, but the anaesthetist would have nothing to do with me.

He told me, 'The use of the needle alone would increase your blood pressure and the nose would bleed again during the operation.'

He kicked me out to return six weeks later. So I am writing this with a feeling of great frustration hanging over me. I have to persuade myself that it is not the end of the world, and indeed it is not.

In my time as a teacher of astronomy, I have experienced many frustrations. Indeed, the very existence of our Wynyard Planetarium can be traced back to the frustrations caused by the cloud cover on the north-east coast. More spectacular was my visit to the Orkney Islands to view an annular eclipse of the Sun, scheduled to occur at dawn one May morning. It took me two or three days to get there, and then we had to get up at some unearthly hour to motor out to an open field sloping down to the eastern shore. As you will have already guessed, cloud cover prevented any view of the spectacular event. A local entrepreneur, having knowledge of the local climate, had set up a marquee and was selling whisky by the bucket load at four o'clock in the morning. He must have made quite a packet as a hundred frustrated astronomers drowned their sorrows.



When I realised that a transit of Venus was to occur this month, I couldn't resist the urge to write this present article about the unfortunate experience of a French astronomer called Guillaume Le Gentil in the 1760s. Please bear with me while I set the scene.

Over the years, the transits of Venus across the disc of the Sun occur in pairs about eight years apart. Then comes an interval of about a hundred years before the next pair. So you can see that each generation has but two chances of making a useful observation. The pair of transits in 1761 and 1769 had a special significance in astronomical history. There were two factors at work here. In the previous century, the appreciation of the laws of Kepler and Newton had enabled astronomers to work out the relative distances of the planetary orbits. Now, the technology of telescopes and reliable chronometers gave them the ability to fix the absolute distance from the Sun to the Earth.

Edmund Halley had developed the idea of timing the passage of Venus across the disc of the Sun, recorded by several observers distributed around the Earth's globe. These observations, when brought together and compared, could be used to establish the parallax of the planet. This would establish the actual scale of the Solar System. The [mathematics involved](#) is quite straightforward (so they tell me).

Unfortunately from Halley's viewpoint, the exercise could take place only when he was aged one hundred and four. Fortunately, his idea was taken up by the French Academy of Science, and over two hundred invitations to take part were issued to astronomers all over the world. The idea caught the attention of many national leaders and was taken up with enthusiasm by many nations.



In this exercise, it was important to get as long a base line as possible, and observations from the southern hemisphere would be especially valuable. This is why Captain Cook went to Tahiti in the Pacific. Cook had a go at only the second of the pair of transits, but Le Gentil intended to have a go at the first of the pair in 1761.



Guillaume Le Gentil (*left*) was a well-known astronomer, having been an acolyte of the famous Cassini. He was a respected member of the French Academy of Science, and some features of the heavens were named after him. Various [discoveries](#) of his became subsumed into the catalogue put together by Charles Messier. He must have been highly esteemed, because he was asked to head an expedition to Pondicherry in India to observe the 1761 transit of Venus, part of the world-wide collaboration.

In that era, of course, travel was by sailing ship and no timetable could be guaranteed. There was no Suez Canal, and the route took him around the Cape of Good Hope in South Africa. Politics entered the picture in that a war between Britain and France developed, which had its repercussions in the Indian sub-continent.

The transit was scheduled to occur on 6 June 1761, so, giving himself plenty of time, he set off from Brest in March 1760 – a 15-month cushion. He got as far as the Ile de France, now called Mauritius. At this point, he learned of a state of war (the [Seven Years War](#)) between Britain and France and he was warned to proceed with caution. This puzzles me, because scientific expeditions were not generally interfered with by warring navies. Indeed, when Cook sailed, he took with him a document that would prevent any possibly belligerent navy from interfering with his expedition.

Still with five months to spare, he set off to cross the Indian Ocean. Unfavourable monsoon winds caused his ship to tack from side to side and it was five weeks before he landed at a place called Mahe on the Indian coast. Here, he learned that the English had captured Pondicherry, so he returned to the Ile de France. He was still on board ship when the crucial date arrived, and, while he saw the event, the movement of the deck prevented any meaningful observations.

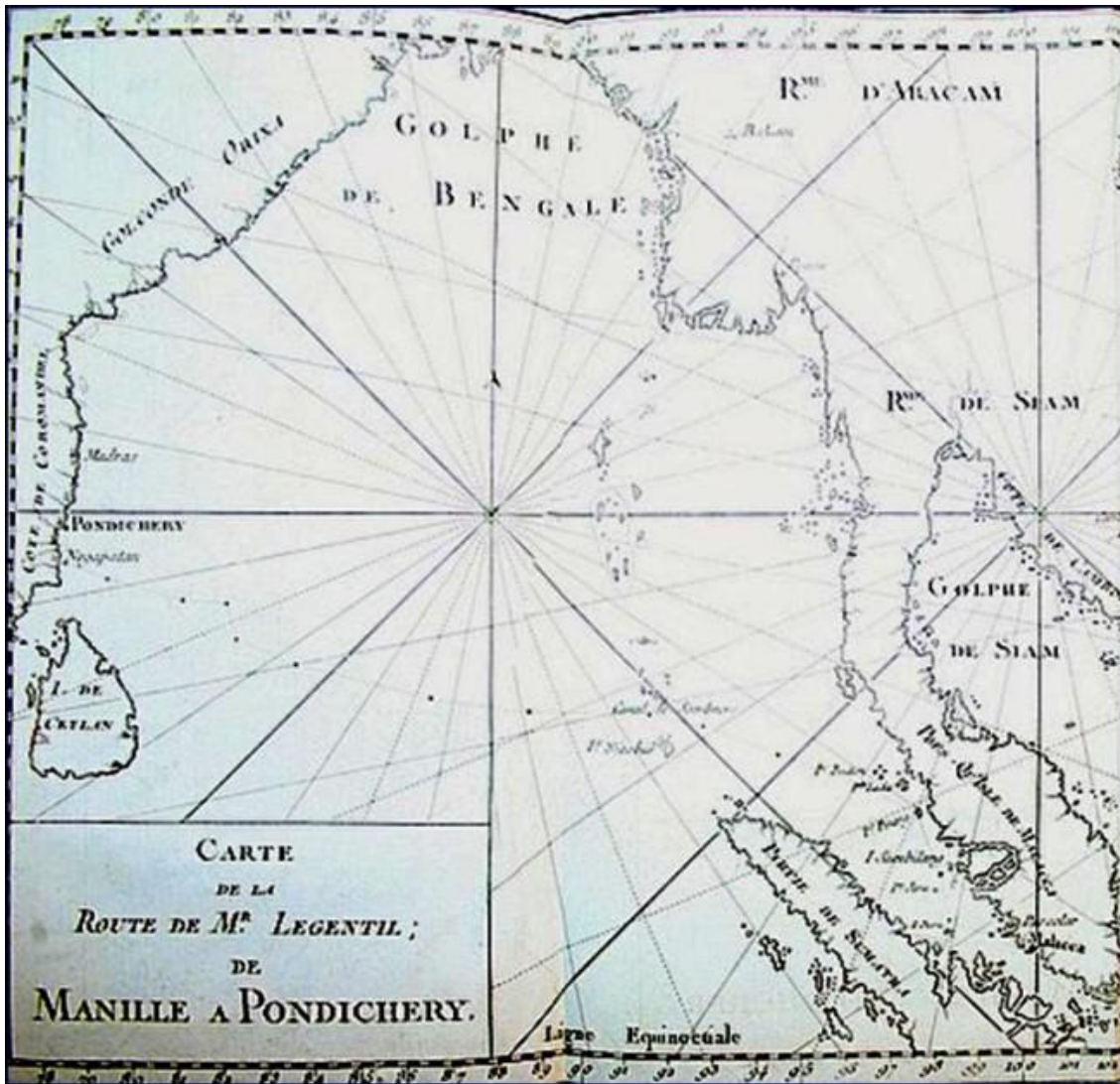
You can imagine his state of mind. In his understandable frustration, he made up his mind to stay in the Indian Ocean and Pacific region and carry out the duties of a more general scientific expedition: surveying, natural history and so on. He expressed his wish to hang around for the next eight years and have a go at the next transit.

At this point in my narrative, I have to confess that I am not being the forensic historian that I should be and mention that the first time I heard of the Le Gentil story was when I was working in France in 1953. It was near a town called Ozoir-la-Ferrière where I was taking part in a forestry project. After dinner one evening, the conversation turned to the Pacific voyages of [Bougainville](#) and Cook. Le Gentil was mentioned but the emphasis was on the giggle factor. The story was told in the French language, in which I was not very proficient, and the company I was in used the story as a source of merriment. Later, a magazine article was produced containing material I have not seen elsewhere. I remember that, at this point in Le Gentil's story, when he decided to stay around the tropics for the next eight years, his wife



made it plain that she was not best pleased with his decision. It was not what she had signed up for when she married him.

Le Gentil did exactly what he said he would do. How he paid his expenses is not recorded. Perhaps his government gave him the go-ahead. That is not recorded either. At one time, he landed in Manila in the Spanish-held Philippines.



He planned to set up his observatory there, but fell foul of the local Spanish Governor and was told to leave. Some of his entourage stayed, though, which I think strange. He learned that peace had descended between Britain and France and that Pondicherry had reverted to being a French colony, so, once more, he set off for that port in India.

After the eight-year gap, he arrived in good time. His arrival was celebrated with a great feast and he successfully set up his observatory. The weather conditions were perfect for the month leading up to the crucial date. On that date, however (yes, you've guessed it), clouds obscured the sky for the period of the transit. As if to rub it in, the sky cleared within an hour of the transit ending.

What a calamity! What despair! The story next took a puzzling turn. For some reason or other, Le Gentil did not return home for another two years. During this time, he had not corresponded with his wife back in France. The French article that I mentioned above had it that Le Gentil had been detained by pirates, but I cannot find any support for this version in any report in the English language.

What is not in dispute is the fact that, when he finally arrived home, he found that his wife had given up on him and had him legally declared dead. She had a marvellous dowry, of course, and had married someone else. Furthermore, the rest of his family were engaged in disputing the ownership of his estate and assets. He had lost his place in the Academy of Sciences. His affairs were in such a hopeless array that the King had to step in to restore matters. His wife would not give up her new beau, so he married someone else.

So, the next time you pack your telescope and disappear out on to the moors to search for that ideal observation spot, just remember to keep in touch with your folks. You never know just what may happen.

## THE TRANSIT QUIZ

### Answers to June's quiz

1. What's the link between Apollo 11 and Amazon's founder, Jeff Bezos? **At the bottom of the Atlantic, a team led by Bezos has found, and plans to [recover](#), the five F-1 engines that powered the Saturn rocket that launched Apollo 11.**
2. What's the Astronomer Royal's salary? **£100 a year, fixed when Charles II appointed the first office holder, [John Flamsteed](#), in 1675.**
3. The Milky Way's principal disc is about 100,000 lightyears across. About how thick is it? **1000 lightyears – the disc is thus relatively very thin.**
4. NGC 6572 in Ophiucus is nicknamed the Blue Racquetball. What kind of object is it? **A small (18 arcsec), blue-green planetary nebula.**
5. Which planet has a satellite called Belinda? **Uranus. Tiny Belinda -- about 68 km in diameter – was discovered in 1986 by the Voyager 2 imaging team.**
6. The Tarantula Nebula (NGC 2070) is in the constellation of Doradus. What else is it in? **The Large Magellanic Cloud (see *right* – the arrow is indicating the fastest-rotating star yet known, which is in the Tarantula Nebula).**



7. Within our solar system, what is a Hirayama family? **A group of asteroids having closely similar orbital elements (and so probably having a common origin). More than a hundred families are known, some with hundreds of members.**
8. What two related solar system bodies did Asaph Hall discover in 1877? **Phobos (*below left*) and Deimos (*right*), the two moons of Mars.**

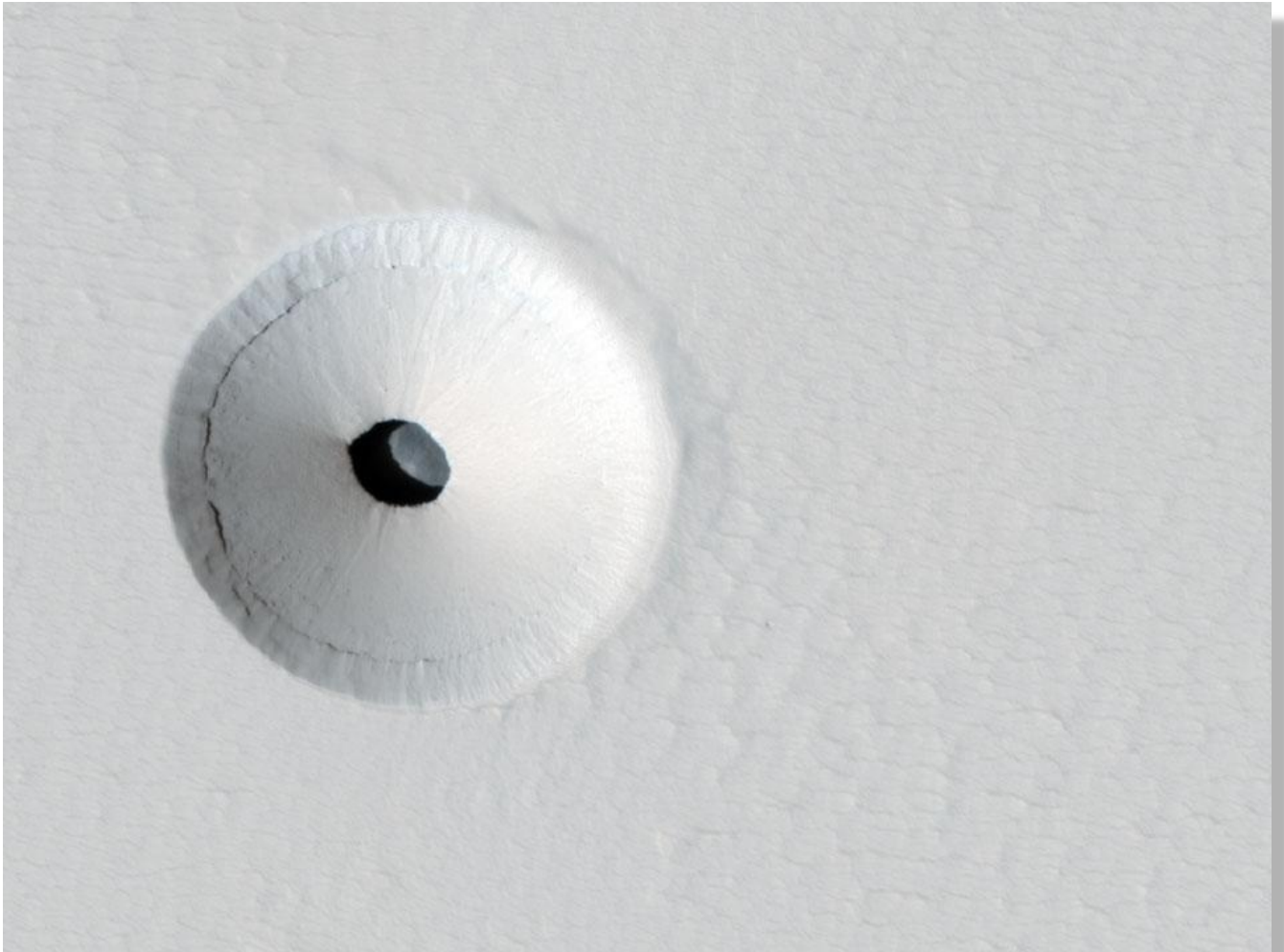


9. It has the greatest annual proper motion of any naked-eye star, and was also the first to have its parallax measured, in 1838. What is it? **It's 61 Cygni, which consists of two orange (K5 and K7) stars with a combined apparent magnitude of 4.8.**
10. Which observatory is 80 km north-east of San Diego? **Mount Palomar.**

### The summer's quiz

1. The Plough, the Christmas Tree cluster, the Square of Pegasus and the Teapot are examples of what?
2. Perseus, Norma, 3-KPC, Outer, Crux–Scutum – some of the names given to what?
3. What did NASA's Interstellar Boundary Explorer (IBEX) recently find out about the 'bow shock' where the heliosphere meets the interstellar medium?
4. The European Space Agency's next large science mission, due for launch in 2011, is JUICE. What does the acronym stand for?
5. 'Vega is within half a degree of Birmingham.' What?!
6. Historically speaking, what's the claim to fame of Kirch's Comet (1680)?

7. What's the connection between these three activities: the Milky Way Project, Planet Hunters and Solar Stormwatch?
8. Which familiar constellation has  $\alpha$  and  $\beta$  stars called Shedir and Chaph?
9. Which first-magnitude star is nearest to the celestial equator?
10. Where is this object and what is it?



*Image credit: NASA, JPL, U. Arizona*

