

# *Stargazey Pie!*

*A slice of Highlands astronomical life!*

**Tues 3<sup>rd</sup> February 2009**

## **Introduction**

Despite the threat of bad weather looming over us all, the attendance at February's meeting was amazing! The timing turned out to be just right, as it was not until Wednesday/Thursday that the snow really began to hit. Why the big turnout? Probably because another solar system talk by Pauline Macrae was promised, along with breakout and discussion groups, refreshments, raffle prizes, and of course the arrival of the year's batch of lunar postcards. There was plenty more interesting stuff listed in the notices:

- **AGM.** Notice of this year's AGM was given. It will take place at the April meeting, Tues 7<sup>th</sup> at 7.30pm.
- **HAS Office Bearers.** All positions are up for election in April 2009. The Society actively encourages keen members to seek nomination for these positions and also positions on the Committee. Changes are being made to the way the Committee operates so that the work is less onerous and more fun for individuals to help out running the Society. If you would like to help out at events etc, but not actually join the committee, there is still a place for you – just contact Maarten for details.
- **Website.** As you will now be aware, our new website is up and running! It can still be accessed via the same URL: [www.spacegazer.com](http://www.spacegazer.com). It is hoped that a discussion forum will be added sometime soon.
- **Member Recruitment Incentive Scheme.** Details of the proposed member recruitment incentive scheme are still being worked out. Once it's all sorted out we will be told how we can benefit financially from encouraging new members into the Society.
- **HAS Seeing Stars article.** "The Bull ready to Lock Horns" has been written by Pauline Macrae and is in Fri 6<sup>th</sup>'s edition of the Inverness Courier. It is also available to read on the website here: <http://www.spacegazer.com/index.asp?pageid=119696>
- **General Astro News Articles.** John Gilmour has contributed two pieces, on Comet Lunin and general astronomy this month, which will be put on our website for your enjoyment.
- **IYA 2009: "4000 years of Astronomy in the Highlands".** This is the title of a mini festival that we propose to run in March in conjunction with NTS at Culloden, as part of the International Year of Astronomy 2009. Financial assistance for running the event has been awarded by Highland 2007 legacy fund. Events include a series of talks, observing events at the new observatory (including a Messier Half Marathon), visits to local schools and a lecture or two on the subject of Ethno-Archeological Astronomy, by Howie Firth!
- **IYA 2009 Webcasts (HAS & SIGMA).** Eric Walker is webcasting from his home observatory throughout the year. So far we have been treated to views of Venus, the Orion Nebula, various star groupings and some interesting shots of the Moon. His webcasts can be accessed at

<http://www.ustream.tv/channel/the-cosmos-cam> and you can view highlights from his previous efforts too. Or, email him directly to find out when the next live transmission will take place.

Eric is not alone: Pete Sherman of SIGMA is also sending real-time astronomical images out over cyberspace, and his webcasts can be found at <http://ustream.tv/channel/the-night-sky>

- **HAS Messier Challenge Update.** Please let a Committee member know if you are approaching completion of one of the Messier lists or whether you need help to find any of them.
- **Lunar Postcards.** Yes, that mightiest and most useful of astronomical accessories is once again available to Highlands Astronomical Society members! Not the TeleVue 35mm Panoptic, nor the Equinox 120mm Apo, but the yearly Lunar Phase postcard! Get yours for only £1 each and benefit from complete knowledge of the lunar phases throughout the whole of 2009 being at your fingertips.
- **Observing Sessions:** Observing sessions will take place at the JSL Observatory at Culloden as follows:

<b>Public + Members:</b>	Fri 20 <sup>th</sup> Feb 20:00h – 23:00h	(Pauline Macrae)
<b>Members Only:</b>	Sat 21 <sup>st</sup> Feb 20:00h – 23:00h	(Maarten de Vries)
<b>Public + Members:</b>	Fri 27 <sup>th</sup> Feb 20:00h – 23:00h	(Rhona Fraser)
<b>Members Only:</b>	Sat 28 <sup>th</sup> Feb 20:00h – 23:00h	(Lynn Robinson)

*Please check website for the most up to date information regarding these sessions*

There is now a gate at the entrance to the car park and this is locked from about 7:30pm each night. This has made a marked improvement to the security situation and should prevent cars driving around the car park as well as those looking to cause trouble. However it requires strict time management to allow ingress/egress. Please contact your duty observer to clarify access times and procedures.

To get in you will need access to a key, which session supervisors will have.

- During **Public Observing Sessions**, the gate will be open on the hour for 15mins to let people in and out of the car park, starting at 8.00pm with last admittance at 10.00pm. If people don't want to wait until the next opening of the gate (to get either in or out), they can leave their car in the dozen or so car park spaces outside the gate and walk to the observatory.
- **Chinese Solar Eclipse.** Rhona Fraser has information on how to arrange travel to this event. Bring your own oar.
- **2009: A Space Odyssey.** From Galileo to Hubble and Backyard Telescopes. Public lectures at Edinburgh Student Union Debating Hall on 18<sup>th</sup> April from 10:00 to 17:30. If you are interested in attending (cheap beer?) please contact Pauline, who is herself presenting a talk on the Dark Skies Scotland project.

### **Simon Steps Down**

Simon Urry has stepped down from the Committee, and so Maarten expressed the Society's thanks to Simon (who was absent due to the threat of bad weather) for all the grand work he has done in recent times. This included the arranging of the marquee on the opening day of the new observatory, and his help with the funding and organisation of the new observatory project. Unfortunately Simon would probably not have heard the applause from Thistle-Dhu on the Black Isle, but it will no doubt be repeated when he attends the next meeting.

In the meantime, that means there is another place to fill on the Committee...

## **Volunteers Wanted**

Representing the creative team behind the series of 'Seeing Stars' articles that are published monthly in the Inverness Courier, Rhona Fraser had an announcement to make. She asked for volunteers to join the team in writing new articles. This would spread the workload a little, and give a new 'flavour' to upcoming articles. Editing of the articles is done within the group before being submitted to the paper and the team can provide support and help along the way.

This could be a good way to get your name in the paper and open readers' eyes to any astronomical topic you wish to write about. Generally, articles published during the winter will focus on constellations or phenomena observable in the night sky, while during summer topics can include updates on space missions, technical advances, etc. If you are interested in giving it a go please contact me (Antony).

## **The Main Event**

*"Galilean Satellites" by Pauline Macrae*

Pauline is well known to many of the Society's members. She served as Chairwoman for 7 years before being let off for good behaviour. During that time she was instrumental in the development of two observatories – the new one and its predecessor – at Culloden battlefield. Pauline has a degree in Science studied at the Open University, one of the courses being astronomy, and is often involved in the Society's public activities and educational events. Her talks usually focus on solar system objects, and tonight's was no exception, being an update on the four main satellites of Jupiter: the Galilean Moons.

Pauline's talk was a collection of the latest images of the Jovian Moons along with a commentary listing the latest discoveries and theories associated with them. The commentary was delivered in heroic fashion as Pauline was suffering from a sore throat and cough, but was able to make it through the talk and never needed to resort to sign language.

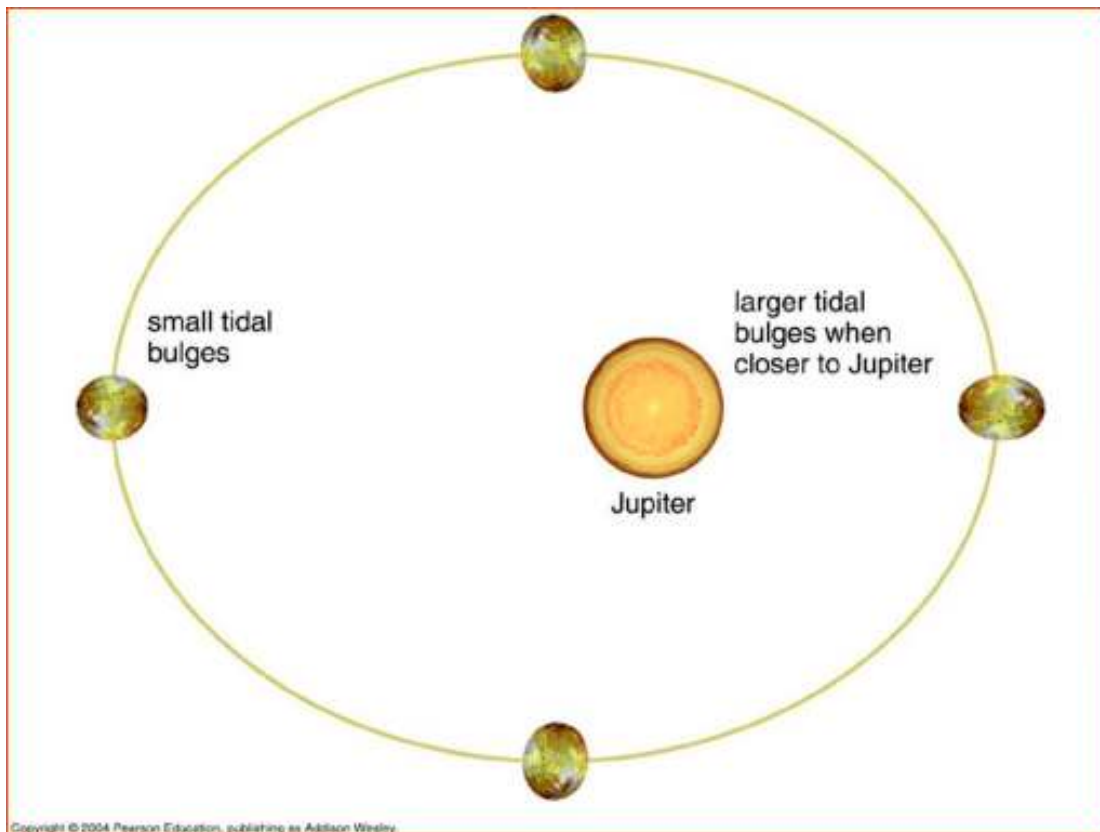
Pauline reminded us that the Galilean Moons were (for the majority of people) 'discovered' by Galileo in 1610. (If German astronomer Simon Marius had been quicker off the mark in publishing his observations, made five weeks prior to Galileo's, they might now be known as the 'Mariutian Moons'.) At that stage and for many hundreds of years after, their nature was unknown. It was supposed that they were simply inert lumps of rock. It was only with the arrival of the voyager space probes 30 years ago that their true natures were first revealed.

Each Moon was dealt with in order of increasing orbit. I'm sure you all know how to remember which Moon comes where in terms of orbit size? Try the mnemonic: "I Eat Green Cheese" and relate it to Io, Europa, Ganymede, Callisto. So Io was first.



*Io, Europa, Ganymede and Callisto*

Ground based observations of Io before Voyager arrived on the scene predicted that Io would be hot and volcanic, with these effects being caused by tidal heating. These predictions were correct, but what wasn't foreseen was that Io would turn out to be the most volcanically active body in the solar system. Jupiter's gravity distorts Io's shape from spherical to obloid, raising tides on its surface in the same way that our Moon raises tides on the Earth. Because the orbits of the three innermost moons are kept very slightly elliptical due to their orbital resonance, Io's interior is flexed, which creates friction and in turn produces heat. As a result the interior is partially molten, and this hot molten material is given plenty of opportunity to come venting onto the surface.



*Diagram showing the effects of Jupiter's gravity on Io*

The most common features on Io are calderas, formed when volcano tops collapse. These exist on Earth as well. Due to their angular shape, which suggests they are related to fractures and movement of the crust, they are given the name 'patera'. In photographs they appear black. Pauline showed several images of volcanic areas on Io, which illustrated how much lava erupts and how quickly the face of Io changes.

The pictures showed Io's surface as being similar to a particularly bad pizza. The large amount of yellow seems to come from an abundance of sulphur-rich material, which changes colour as it cools, or if it interacts with hot silicate lava. Sulphur is one of the most abundant elements in the solar system, but on Earth most of ours is locked up in the core, though some is found throughout the mantle and brought to the surface by volcanic activity. On Io such volcanism is much more common, hence the garish and ever-changing terrain.

Io's location means it is never going to be one of the solar system's beauty spots. Its volatile conditions and constant exposure to the deadly radiation emitted by Jupiter mean that Pauline's advertising slogan for future Io Holiday Tours is probably accurate: "See Io and Die"!

Europa is the next moon out, and where Io is fire, Europa is ice. Being further away from Jupiter, Europa is still subject to tidal heating, but not to the same degree as Io. The surface is criss-crossed by fracture lines and cracks, evidence of the shifting caused by tidal stresses. It is thought that below the icy crust is a subterranean (or sub-European) water ocean. Evidence for this came from the Voyager and Galileo space missions. Voyager showed that Europa had very few craters, so it had to be a young surface. Given

the age of the moon, the surface had to be recycled from somewhere, probably from within. Water seemed like a possible explanation, and Galileo provided further compelling evidence.

For example, there were ice flows near the equator, changes in Europa's magnetic field strength, strange scalloped shaped lines, domes and pits, and polar wander, all of which indicated a global ocean of salty water below the surface. The big question for Europa though is does that water ocean contain life? Finding out will be very difficult. The logistical problems of drilling through a deep ice crust to a sub-surface ocean millions of miles away will be tough ones to solve. Maybe one day though, as NASA is keen on sending a mission to Europa to explore the possibility of life.

Next out is Ganymede. Forming at its greater distance from Jupiter, Ganymede's composition is about 40% ice and 60% rock. This large percentage of ice in its makeup may be the reason why it is such a large body – larger than the planet Mercury.

Ganymede appears to be layered internally and it seems to have a small, partially molten iron core, giving rise to a magnetic field – the only satellite known to possess one. This suggests that it was hot enough at some point to melt and differentiate, leading scientists to believe that Ganymede was subject to tidal heating in the past, although no longer. The reasoning behind this is Ganymede's appearance: its surface is crossed with large expanses of dark and bright terrain.

The dark terrain is heavily cratered, suggesting an old surface perhaps in excess of 4 billion years. Long dark depressions known as furrows of about 5 to 10 km in width, tend to be arranged in concentric circles; these appear to be the remains of very ancient impact craters. Some of the dark terrain is quite jumbled, forming a patchwork of light and dark areas often with bright frost on high areas, yet the furrow floors remain dark. This dark material, which comprises about one third of the surface, contains clays and organic materials and may be the original material from which Ganymede is made.

The brighter areas seem to cut across the darker ones, and have fewer craters, suggesting this is younger material. The light areas are generally lower in altitude than the dark ones too, and can be smooth or criss-crossed by sets of parallel ridges and valleys. This may be evidence of water ice volcanism, where ice seeps up through cracks in the surface and flows out, covering the dark terrain as it goes. The bright grooved terrain is thought to be the result of a time when Ganymede's surface was ripped open as the moon expanded during the layering process. There is also evidence of salty water within Ganymede, though not in the quantity suspected in Europa. If there is a sub-Ganymedian 'ocean', it will probably be bounded below by high-density ice, and above by lower density ice.

Last of the Galilean Moons is Callisto. It looks quite normal, but is a bit of an enigma. Callisto completely lacks any volcanism, any ice flows, any mountains, but does have craters – lots of them! They're very old too, meaning that the surface has not changed much since its initial formation and bombardment. This moon is the most heavily cratered object in the solar system.

The surface does have a layer of fine dark material covering much of its area, with the brighter craters showing through it. The largest crater is known as Valhalla, and its extremities stretch nearly across one hemisphere of Callisto. For such a crater to have been formed it must have been one big lump of something that hit it. Was Callisto lucky to survive the impact?

It seems that the smaller craters, of sizes less than 1-km diameter, have disappeared. Maybe their edges eroded more quickly than expected, and the fine soot-like material coating the surface slipped into their depressions, masking them from scrutiny? However, there are many small knobs or bumps. These could be the remnants of the small craters, protruding above the layer of dark dust, like crater tombstones, although they are proving difficult for scientists to explain.

Being so far away from Jupiter, Callisto has never been subject to tidal heating, and yet it holds a surprise. It has been shown that a body of salty water exists just 100 km below the surface, and so far it is a complete mystery how it came to be there. A mystery worthy of investigation by future space missions we hope.

Pauline's presentation included dozens of fantastic images, some taken by Voyager, but the majority by the Galileo probe, on their visit to the Jupiter system. The pictures included examples of all the geological features that were mentioned, and quite apart from the data that they contained, many were extremely beautiful to look at. These largest of Jovian moons are incredible planetary bodies, and are only just beginning to reveal hints as to their many hidden secrets. There is a lot more to learn about the Galilean Satellites, and we hope that once their hidden depths have been probed again, Pauline will return with another update on what we know about these mysterious moons.

## **Highland Skies – February 2000**

2009 is International Year of Astronomy. Think of it as a year dedicated to *sharing* astronomy with everyday people who might never have thought about it before, or who perhaps have never had the opportunity to look at, or find out about, astronomical objects in the sky. This will be reflected in many official Society activities. As you've already read, our mini festival in March is geared towards sharing our love of astronomy with school-children through visits by Society members to schools, and with members of the public who might like to enjoy their first views of the heavens through our equipment at Culloden.

We have already seen the delight that this openness can bring to people. We saw it in January when we looked at the faces of small children who had the chance to look through our 14" telescope at the new observatory. Their faces lit up, and, for a brief moment, they were lost for words! The adults were similarly impressed. Although some of them had previously read about the objects they were looking at, that had not prepared them for their first real look at them through a big high quality telescope.

Now February is a great month for visual astronomy. We have the fantastic constellation of Orion high above, with a complete collection of virtually every type of deep sky object contained within its borders. We also have Leo rising earlier and earlier every night, bringing with it a regal treasure-trove of galaxies that can be explored with telescopes of every size. In Leo's wake comes Saturn, the most beautiful of planets for the first time observer, even in its current state where the rings are nearly edge-on to us.

So, with all these treasures above, and in keeping with the ideal of IYA 2009, let's *share* all this wonder with people. Don't be limited to the Society's *official* IYA events. IYA is not just about clubs or societies; it's about spreading the knowledge, experience and love of astronomy to anyone who might be interested. When you're observing from your garden and your neighbour pops out to let the cat out, see if they'd like to take a look. If you're thinking of taking your telescope to a dark sky site for the night, consider asking a friend or workmate along to try it out. See if there are local people who may have a closet interest in 'star stuff' – maybe a friend of a friend has mentioned it?

Naturally, clubs and societies are probably the most efficient way of 'spreading the word', but not everyone is a club person. However, some people might really enjoy being asked along to have a look through a neighbour's telescope, or a chat about the sky in passing. You may gain from the process: if local residents appreciate what you are doing in your garden at night, you may find your local light pollution problem being addressed. Security lights may be toned down a bit – possibly in exchange for an occasional peep through the 'scope! Of course, all this may be fantasy and you may not achieve anything in the long term, but it probably doesn't hurt to try.

So as well as enjoying the wonderful views of galaxy groupings in Leo, dusky disc markings on the loveliest ringed gas giant and a plethora of emission and reflection nebulae in Orion's environs, remember you don't have to keep it all to yourself. It's good to share.

## **Collimation Day**

This only came up since the meeting, but I thought I'd drop it in here in case anyone was interested. At least two of our members need help collimating their Newtonian reflector telescopes. As we now have a warm, airy, convenient place to meet to do this sort of practical work (the new Observatory) I thought I'd arrange a 'Collimation Day' there this month. We're aiming for Sat 21<sup>st</sup> Feb, from about 11.00am onwards. Think of it as a practical workshop. Bring along your reflector if it's in need of collimation, or come along if you've discovered a super efficient way of collimating that you'd like to share with us, or if you just want some pointers. Although the aim is always the same (perfect alignment of the light path/mirrors) the methods used to achieve it can vary quite a bit. If you're interested in attending, contact me (Antony) directly.

### **Next Time**

The next meeting will take place at the Green House on Tues 3<sup>rd</sup> March at 7.30pm. The 'Youngstars' junior group will meet from 7.00pm to 7.30pm. Arthur Milnes will be talking about 'Powering Satellites and Spaceships', which sounds fascinating as always! Breakout groups will be organised too, and don't forget the tea and biscuits!

Feel free to visit our newly revamped website, where updates and news will be posted in the coming month.

Dark Skies,  
Antony