

# Reflections

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## President's Message

The year for NSAS is already halfway through, and it's been eventful so far. Some of you who do not attend meetings may have missed the 2<sup>nd</sup> edition of Reflections this year, as it was not published for the simple reason that there were so few contributions from the membership that it would have not been worthwhile. I'd like to remind everyone in the Society that Reflections is a journal for the members, but also *of* the members. There's no point in rehashing information that is available in the newspapers or the Web in Reflections, as these are available to most of our members.

Don't forget that the Geoff Welch Prize for best article submitted to Reflections is short listed by the Committee in September, and the winner is chosen by the membership at the September General Meeting so, if you haven't contributed this year, it's already too late!

On to other, happier, matters. The Society has had a busy and fruitful year so far, both in attracting new members and in running its various internal programs and outreach. The Theory Group has continued to attract new attendees and the last meeting had about 20 persons attending.

The New Astronomers Group (NAG) has been moving slowly through the art of observing over the year, and a number of new and existing members who have not been active in observing have been attending. The sad state of observing during the last year due to the La Nina weather pattern has continued to dog our scheduled observing program, but we've managed to continue the NAG on other subjects. Hopefully we are finally seeing the return of better skies, and this winter may allow us to run a more frequent observing program.

Also starting up this year has been Bob Roeth's "Fifth Tuesday" Mathematics and Astronomy programs. These have been well-attended by both the mathematically inclined and the rest of us and they promise

to be interesting in the future. The next program will be in August.

The guest speaker program this year has continued to run strongly and, at the moment, NSAS has guest speakers from the professional astrophysics community booked for the rest of the year, with a number of candidates selected for 2012. Our speakers so far have come from CSIRO, Macquarie, Sydney, and NSW Universities and they have talked to us on a wide range of subjects that form their areas of expertise.

As you know, we recently made a move in our meeting place from the Fr. Mac Pavilion to Regis Hall at St. Ignatius, which is big step up in our facilities and ability to host a large group. It's probably just as well, as the membership of the Society has slowly grown over this year towards the level that the Committee would like to see. In fact, we have gained 12 new members, at the loss of 3 members at the last renewal. So please introduce yourselves to our enthusiastic new members at the next opportunity.

On the outreach side NSAS has been somehow busy. After a quiet start to the year, we ran a primary school star program at Lindfield Public School in May, followed by the Parramatta Park star party and the Seaforth Public School event in June. The major outreach event for NSAS this year will be the star party we will run as a part of the Lane Cove Council Cameraygal Festival on September 3. This is a major event comparable to our parties for Willoughby Council and it will require broad support from the membership, so expect to be asked for help.

As you may remember, a survey of the membership at the last membership renewal indicated a strong desire for field trips this year and we made our first trip in late June to Parkes, where a 30-strong group of members and wives toured the Dish, and attended a joint observing session with

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the Central West Astronomical Society (see the more detailed article inside). Our intentions are to run another field trip, possibly to Coonabarabran and the AAO, later in the year.

We have also tried to start our arrangement with WSAAG at Linden Observatory this year, but they are equally frustrated with the observing conditions.

We've recently lost our Secretary, Anna Koeneman, who has resigned due to a broken (writing) wrist, after 3 years of support in this important area of Society documentation. She has left her position with the often chaotic paperwork now very neat and tidy. The Committee wishes to thank her for her loyal support. We will attempt to get by for the rest of the Society's year within the Committee but I'd like everyone to start thinking about the makeup of the Committee next year prior to the elections in October.

Due to my likely return to university next year, I will be stepping down as President to offer myself in a slightly less active position, so I'll be looking for a replacement.

I wish everyone a pleasant winter of astronomical interests, and hope to see more of you at the various meetings and observing sessions.

Best Regards,



Bob Fuller

# Calendar

- General Meetings:** July 19<sup>th</sup> Guest Speaker: Baerbel Koribalski (CSIRO); the Wallaby project  
August 16<sup>th</sup> Guest Speaker: Daniel Yardley (Sydney Uni); gravitational wave detection  
September 20<sup>th</sup> Guest Speaker: David Free (Macquarie Uni); subject TBA
- Theory Group Meetings:** July 12<sup>th</sup> - August 9<sup>th</sup> - September 13<sup>th</sup>
- NAG Meetings:** July 26<sup>th</sup> - August 23<sup>th</sup> - September 27<sup>th</sup>
- Observing Nights:** Consult NSAS' web site at <http://nsas.org.au/observing/>
- Deadline:** Please send your contributions to the October issue of Reflections in time to reach the editor **before September 15<sup>th</sup>** to [nsas.editor@ozemail.com.au](mailto:nsas.editor@ozemail.com.au)

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## ISS and Space Shuttle Sighting

On May 21<sup>ST</sup> 2011, the Space Shuttle Endeavour had already joined and was linked to the International Space Station.

Both are passing over Sydney and more closely over Gosford and the HKG village where I reside at a very high angle, up to 66 degrees high as it closes on the star Spica in Virgo, on Saturn, the Southern Cross and the prominent 2 pointers.

In fact there is quite a bunch of craft all together in this pass as they are followed by the Soviet Soyuz TMA 20 and the Soyuz TMA 21, these are transport modules that transport goods to the ISS and are kept nearby for disposal of waste when the ISS is filled.

Its interesting to also note that the sewage from the ISS is also disposed this way and who knows, the next time you see a 'Falling Star' and make a wish, well it could just be one of these craft burning up that waste in our atmosphere.

We do not want to pollute space, just Earth's atmosphere. But no problem, in the reentry the craft do burn up with the heat generated in the fiery descent

There is also a 3<sup>rd</sup> extra craft in this bunch, called the ATV Johannes Kepler 2. At this stage I am not too sure of its function with the others. \*

The whole of this pass starts at 5.45pm and it is due to rise over 10 degrees in the NNW in the constellation of Gemini near the main stars Pollux and Castor at 5.47pm



*Endeavour and the ISS as seen from Soyuz TMA 20 supply ship. Credit NASA*

Progressing it reaches higher and higher in the northerly sky, past Leo and on to Virgo passing to our right of Saturn by 5.49pm. Remember it is quite fast as it is traveling at over 17,000 km per hour but is over 380 km distant so it is quite a steady track. Total visual transit will take up to 5 minutes.

By the time it gets near the small constellation of the Southern Cross it will be at its maximum height of 66 degrees and be positioned on our left of the Cross and the two Pointers.

It is due to continue towards the ESE and will enter the Earth's Shadow when it is only 18 degrees high at 5.50 pm, just after just reaching Scorpio

By this time the sky should be relatively dark but since the ISS and the Shuttle are now joined together the vision of the two should be very bright in the reflected evening sunlight as seen at that altitude of well over 380 km.

Report of this sighting:

On time and on course and quite brilliant.

I have never seen the ISS quite so bright as it soared overhead. Seemed to have quite a few points of light. Since it looked more like a Sydney bus with all its lights on, I rechecked my notes and timings and its trajectory, just in case I was watching a rather low flying Jumbo jet, albeit very silent with no sign of any navigation lights red or green. No it was the ISS and the space shuttle absolutely on the predicted course and on time!

This sighting was one of the best I have witnessed and it excelled in the fact the NNW to ESE direction was in fact the exact length of the HKG valley and it cleared all the trees except for the initial 2 minutes.

This spectacle was well worth the time taken to enjoy the view of this special event.

*Continued on page 8*

# A Quadruple Conjunction

Friday May 13<sup>th</sup>, 08:00 pm

I've missed the news on ABC1 but Jacqueline, my wife, watched them.

She asks me: "Do you know about the planets tonight, on the news they spoke about something happening tonight."

- Really? No I don't see what they were talking about.
- Nobody talked about it at your club? It seems to be something big and people are already preparing themselves for it all over the place.
- Well, no, nobody's mentioned anything but let me see..."

Ok, let's see what the 2011 Astronomy book says. But where is it?

Ah here it is.

S o o o ...  
M a y ...  
p l a n e t s ...  
h e r e w e  
a r e :

- *Mercury: the month opens with Mercury just below Venus with the close duo of Mars and Jupiter further below.*
- *Venus: Venus and Jupiter are 0.6° apart on the 12<sup>th</sup>, a magnificent sight!*

Okay, so there really seems to be something interesting happening tonight or rather tomorrow morning. So, let's fire up the computer and see what's going on with Stellarium...

Oh yes! That's look impressive and, for once, the action takes place in the East. We shall be able to see it from the balcony.

A quick look outside, clear skies and the forecast for tomorrow morning is good.

- Camera... checked
  - Tripod... checked
  - Binoculars... checked
  - Scope... checked, the small 4" Skywatcher will do
  - Alarm clock... checked
- Time to go to bed...

Saturday May 14<sup>th</sup>, 05:15am

Here goes the alarm clock, a quick look through the windows, perfect, the sky is clear and the stars are twinkling but it's pretty cold.

Let's get dressed and out to the balcony.

Ohhhh yesss... here they are!

Absolutely stunning, Venus, Jupiter and Mercury in a neat rectangular triangle with Mars a bit lower.

To the naked eye, Venus, Jupiter and Mercury look pretty much as bright but Mars is just a faint reddish dot.

Binoculars show the triangle in the same field of view and you can see the discs of Venus and Jupiter.

Done, now let's see what we can see through the scope.

Obviously, the field of view is too small to show more than one planet at a time.

Venus: it's noticeably gibbous, very bright, almost blinding and, as always, completely featureless.

Mercury: not much to see, appears like a minuscule quarter moon

Mars: I did not expect much and yes there not much to see with a small aperture scope, just a tiny brownish disc.

Jupiter: at last something worth looking at, 2 dark bands are clearly visible and its four main moons are neatly aligned, Callisto Ganymede and Io on one side and Europa on the other.



06:15am The Sun is not far from rising, the stars are disappearing and Mars is fading. It's time to pack up the gear and to get back inside to a warm cup of coffee.

Well, I'm no longer used to getting up that early but I'm glad I did not miss this show.

*Jean-Luc Gaubicher*

*Stellarium Screenshot of the Conjunction*

Now let's take some pictures.

I'll take a few bursts of 10 shots and I'll stack the best ones with RegiStax.



# Parkes Field Trip

After months of planning, 29 NSAS members and wives traveled to Parkes in the Central West of NSW for the first NSAS Field Trip in a number of years.

The main attraction for the trip was a tour of the CSIRO Parkes Radio telescope, or "The Dish" as it is popularly known. On the occasion of a visit to the Dish in February while on an Aboriginal astronomy field project, I was introduced to Dr. John Sarkissian, the Operations Scientist for the facility. John kindly gave me a personal tour of the telescope, which is something not available to the public, and I had a chance to talk to some of the radio astronomers while at work. The idea for a NSAS field trip was hatched and, as John is also the current President of the Central West Astronomical Society, we discussed some joint activities at the same time. Eventually, we came up with the dark end of June, Saturday the 25<sup>th</sup>, for the event.

Saturday night was a special observing night jointly held between CWAS and NSAS at their Cookamidgera site about 20km South of Parkes.

18 NSAS observers made their way by convoy to this very dark site, where the only light pollution was a small glow from Parkes to the North. As it was well dark when we arrived, most of us had a shock



"hamburger" it is often described as and many other galaxies were visible in the larger scopes.

As the evening wore on, the temperature dropped, and so did the dew and many of us were busy swapping eyepieces from pocket to scope and warming secondary mirrors dewing up from radiation.



when we stepped out of our vehicles, looked up and saw the Magellanic Clouds even before our eyes had dark-adapted!

About 10 PM, the dew suddenly stopped as the temperature dropped to around zero and some scopes actually started to ice up on the metal tubes! By 10 or 11 most of us were frozen and called it a night, dreaming of our warm beds back in the Parkview Motel in Parkes.

Everyone traveled independently to Parkes on Friday and most got together for dinner in Parkes that night.

The sky was spectacular, with the Milky Way visible from horizon to horizon and, for those interested, the Emu clearly visible in the dark lanes.

The next morning everyone got together in the motel parking lot to discuss the events of the weekend and organize for the trip back to Sydney.

Our large group split into two and each had a one-hour detailed tour of the telescope, which was working at the time as it is for 85% of the 24/7 workweek. Joris, a German radio astronomer, gave all of us a brief on his current pulsar project, while John gave us an insight into the history and operational aspects of the facility.



Those in the half not on the tour took advantage of the first-rate café at the Visitors Centre for their lunch. After the tour, a number of us watched the excellent films at the Centre.

Having been made aware of the temperature by the Friday night low, everyone had dressed warmly but when the CWAS observers introduced themselves their "freezer suits" (full

length insulated suits as used in cold stores) were the envy of us all. Scopes were rapidly set up and everyone set about looking at whatever interesting objects we could find in a sky so full of stars it was difficult to orient oneself. Galaxies were the flavour of the night, with everyone having a chance to see them. Centaurus A looked just like the



The trip generated a lot of enthusiasm amongst the participants, so the Committee will discuss another trip later in the year, possibly to Coonabarabran and the AAO.

*Bob Fuller*

*Photo credits: Alex Abbey (CWAS), Robyn Fuller, Peter & Yuki Nosworthy (NSAS)*

# Lindfield School Event

On May 14th, the society participated in an outreach event at Lindfield Public School.

We had been contacted by a teacher from the school, Nicky Jones, who said that her 5th grade class was scheduled to study space and astronomy during the term. She was hoping to hire a telescope or have someone come to the school to show the students some objects with a telescope during a sleepover at the school.

We agreed to support the event, and a couple of weeks

before, I went to the school to meet Ms. Jones and to assess the site. The proposed observing site was a balcony adjoining the 5th grade classroom. However this offered a limited view of the sky, particularly to the north and east. It would also require carrying our scopes up the stairs as there was no lift. After discussing these problems with Ms. Jones, we agreed to use the playground area instead.

The weather on the day looked a little dubious but, as evening approached, the sky looked better and by sunset there were only a few clouds about so we decided to go ahead.



(3)

The students began arriving for the sleepover at about 6pm and we began setting up our scopes in the playground at about 6.30pm while the students and a few parents watched. In addition to myself, we had four members supporting the event: Peter Korber, Gary Maas, Graham Nicholson and Josephine Lindquist. Between

us we had four scopes in a range of types and sizes.

The students began lining up at each of the scopes and took turns at the eyepieces. I was glad I had brought my stepladder as most of the

students needed it to reach the eyepiece of my scope.

For logistical reasons the date of the event coincided with a gibbous Moon. This, and the school's location on the Pacific Highway, made for a very bright sky. We therefore had to concentrate on just a few bright targets beginning with the Moon itself.

The rugged mountains and craters along the lunar terminator were an impressive sight and brought many exclamations of awe from the students as they took turns at the eyepiece. Some even said that they could see an alien on the Lunar surface!

At one point, pizzas arrived causing great excitement and a temporary pause in observing.

And not just the kids were excited!

Saturn was the only bright planet visible on the night and this naturally proved popular with everyone. Omega Centauri, the Jewel Box and a few other bright clusters were the only other objects bright enough to observe in the conditions.



(2)

We finished at about 8pm after a short but exciting session.

The students then presented us with gifts and some huge 'Thank You' cards that they had hand-made in a space theme.

Thanks to the students, parents and Nicky Jones for making it an enjoyable night for those of us who attended.

*Peter Nosworthy*



(4)

*Photos by the author:*

- (1) Gary and Peter
- (2) Nicky Jones - Teacher
- (3) Graham and Josephine
- (4) Cards presented to us by the students

# Paul's Corner

On the 7th July, the Moon will be waxing and in Virgo in the NW sky high above Leo and closely joined by Saturn.

Constellations on view in the North will be Leo, Hydra, Corvus, Coma Berenices will gain altitude during the night and would be a good subject for inspection from the star Denebola eastwards for the many Galaxies therein, do not overlook the Leo triplet first.

Much higher up we will come to Beta Librae ( $\beta$  Lib,  $\beta$  Librae), which is the brightest star in Libra.

It has the traditional name Zubeneschamali meaning the northern claw. Now try saying that quickly with a mouth full of sausage sizzle!

Better still also find Alpha Librae ( $\alpha$  Lib,  $\alpha$  Librae), which is the second brightest star in Libra despite its Bayer designation as alpha. It has the traditional name Zubenelgenubi. The name, from Arabic (al-zuban al-janūbiyy), means "southern claw" and was coined before Libra was recognized as distinct from Scorpius when Libra was added as the 12th constellation.

Below Beta Libra you will come across M5 described as the best globular cluster in the Northern skies. Have a look to see if you would agree. M5 was used as a prominent marker when some NSAS members went looking for Pluto, the then 9th planet, some years ago from our site at the NTGC.

Pluto was then claimed to be at its closest approach to earth for the next 315 years in its oval shaped orbit before exiting off stage to go way beyond Neptune's orbit.

Now, lets move to the East to see what is rising

I see the centre of our Milky Way rising with the tail of Scorpio, followed by Sagittarius and then Capricorn.

M7, Ptolemy's Cluster, is prominent and best seen with binoculars just below Shaula, the stinger of Scorpio.

To the left (North) you may sight M6, the Butterfly Cluster.

Turn left and you will find M8 and M20 angled away from each other. You are now in the middle of a mass of goodies awaiting your inspection.

At the centre of all those is Pluto that has returned but it is still very distant at over 31.055 AU and at 13th mag could be lost in the crowd. It maybe found by looking for M15, which is close by, but do not get confused by another good globular cluster, M22 that can, on a favorable night, be a good sight even in my small 4.5" Newtonian scope. It is very close to the Ecliptic line.

As a matter of interest, Gordon Stott, one our founder members, told me when I showed him one of the photos I had previously taken, that the star Sag 28 right on the Ecliptic line was occulted by Saturn, now many New Moons ago, and

was the very reason I took the image as part of a sequence of several to look for the dot that moved along over a period of several days, rather along the lines of Clyde Tombah searching for Pluto in 1930.

After that, it was relatively easy to trace the progress of Vesta with binoculars over the weeks. Not bad for a block of rock only 458 km radius.

This month Vesta is in Capricorn at its eastern end (lowest) very near the star HIP 106143 at 5.5 mag, see if you can find it again.

Watch the Milky Way if the sky is dark enough and see the Big Emu.

It was named by the Aborigines and it is placed below the Southern Cross, extending down as far as the top of Scorpio.

Look at the picture taken by me at my favorite dark Sky site.

Can you see an emu trotting up the slope? I can almost see some wings as well, a product of my imagination? or a fault in the film? I need to go back and check that out. If you go to Linden please double check and let me know.

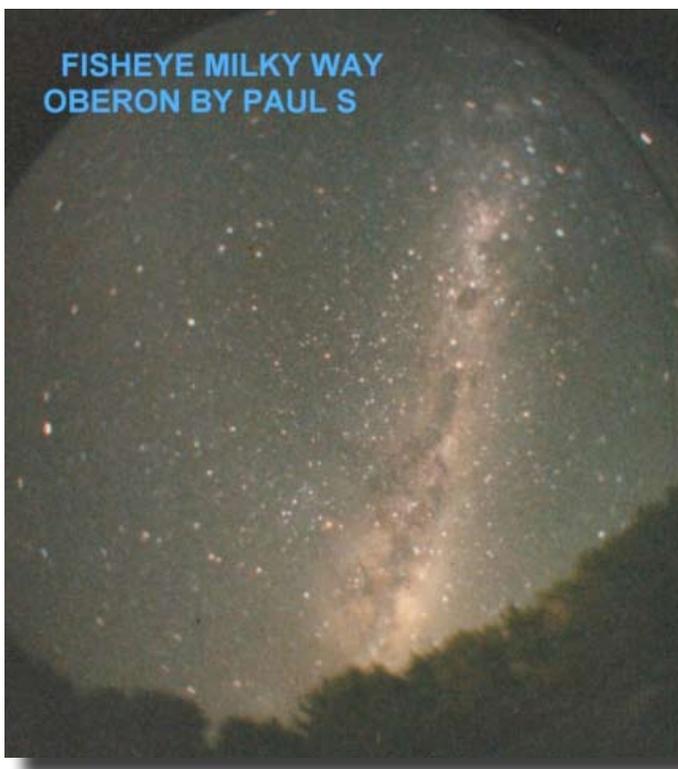
Sorry for the blobby stars , It was a fairly small sized fisheye lens I used, with a fixed f8 lens that I was kindly lent by an NSAS member to do a special project some years ago when chasing Comet Hyakutake.

The head is the coal sack just below the Southern Cross, not to be confused with the False Cross above.

This stands out very clearly in a dark sky and it's quite eerie to be watched by this looming up in the night sky.

No wonder that the aborigines gave it a name.

*Paul Shallow*



he explained that, as the story goes, it had been used to measure the thickness of several rings of Saturn as it passed in front of that star.

I was also quite astonished that he was able to name a star so quickly just on a photograph!

In my image I also had Uranus, Neptune and Vesta, the third largest asteroid , which

## FOR SALE.

- Celestron "NextImage" CCD camera. New, never been used.  
Connects direct to USB port. Ideal for Solar System images: \$100
- Maksutov-Cassegrain telescope, 90mm, F=500mm, 1.25" eyepiece connection, erecting prism, wedge and screw tripod connections, carry bag included: \$200 ono

Contact Ray Harraway (02) 9712 7779

# Surprise: Dwarf Galaxy Harbours Supermassive Black Hole

The surprising discovery of a supermassive black hole in a small nearby galaxy has given astronomers a tantalizing look at how black holes and galaxies may have grown in the early history of the Universe.

Finding a black hole a million times more massive than the Sun in a star-forming dwarf galaxy is a strong indication that supermassive black holes formed before the build-up of galaxies, the astronomers said.

The galaxy, called Henize 2-10, 30 million light-years from Earth, has been studied for years, and is forming stars very rapidly. Irregularly shaped and about 3,000 light-years across (compared to 100,000 for our own Milky Way), it resembles what scientists think were some of the first galaxies to form in the early Universe.

“This galaxy gives us important clues about a very early phase of galaxy evolution that has not been observed before,” said Amy Reines, a Ph.D. candidate at the University of Virginia. Supermassive black holes lie at the cores of all “full-sized” galaxies. In the nearby Universe, there is a direct relationship -- a constant ratio -- between the masses of the black holes and that of the central “bulges” of the galaxies, leading them to conclude that the black holes and bulges affected each other’s growth.

Two years ago, an international team of astronomers found that black holes in young galaxies in the early Universe were more massive than this ratio would indicate. This, they said, was strong evidence that black holes developed before their surrounding galaxies.

“Now, we have found a dwarf galaxy with no bulge at all, yet it has a supermassive

black hole. This greatly strengthens the case for the black holes developing first, before the galaxy’s bulge is formed,” Reines said.

Reines, along with Gregory Sivakoff and Kelsey Johnson of the University of Virginia and the National Radio Astronomy Observatory (NRAO), and Crystal Brogan of the NRAO, observed Henize 2-10 with the National Science Foundation’s Very Large Array radio telescope and with the Hubble Space Telescope. They found

While central black holes of roughly the same mass as the one in Henize 2-10 have been found in other galaxies, those galaxies all have much more regular shapes. Henize 2-10 differs not only in its irregular shape and small size but also in its furious star formation, concentrated in numerous, very dense “super star clusters.”

“This galaxy probably resembles those in the very young Universe, when galaxies were just starting to form and were colliding frequently. All its properties, including the supermassive black hole, are giving us important new clues about how these black holes and galaxies formed at that time,” Johnson said.

The National Radio Astronomy Observatory is a facility of the National Science Foundation, operated under cooperative agreement by Associated Universities, Inc.

*Credit: Reines, et al., David Nidever, NRAO/AUI/NSF, NASA*



*The dwarf galaxy Henize 2-10, seen in visible light by the Hubble Space Telescope. The central, light-pink region shows an area of radio emission, seen with the Very Large Array. This area indicates the presence of a supermassive black hole drawing in material from its surroundings. This also is indicated by strong X-ray emission from this region detected by the Chandra X-Ray Observatory*

a region near the centre of the galaxy that strongly emits radio waves with characteristics of those emitted by super-fast “jets” of material spewed outward from areas close to a black hole.

They then searched images from the Chandra X-Ray Observatory that showed this same, radio-bright region to be strongly emitting energetic X-rays. This combination, they said, indicates an active, black-hole-powered, galactic nucleus.

“Not many dwarf galaxies are known to have massive black holes,” Sivakoff said.



The Binocular and Telescope Shop  
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# ISS and Space Shuttle Sighting

*Continued from page 2*

When you read these lines, Endeavour will be back home and there will only be one more STS trip to the ISS. That event is planned for the space shuttle Atlantis.

The launched date has been set for July 8th and this ultimate mission is planned to last 12 days.

Once the date and time of its arrival at the ISS are determined, more news of its

planned likelihood of arriving in our local skies will be advised, prior to the event, for your benefit and enjoyment.

*Paul Shallow*

\* Ed: The Johannes Kepler ATV, or Automated Transfer Vehicle 002, was an unmanned cargo resupply spacecraft launched by the European Space Agency. The spacecraft was launched on 17 February 2011 on a mission to supply the International Space Station (ISS) with 7,000 kg of propellant, air and dry cargo. Johannes Kepler had a total mass of over 20,000 kg and is the heaviest payload ever launched by the ESA. A Reentry Breakup Recorder was placed aboard before the ATV's separation on 20 June 2011. It deorbited on the following day with its remains impacting the Pacific Ocean.

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## The Calendar - Book Review

This book, by David Ewing Duncan caught my eye and I borrowed it from the NSAS Library after a general meeting. I have read it twice, so decided to do a review for members who may like to have a look at it.

This book describes “The 5000-year struggle to align the clock and the Heavens”

Do you know what a ‘femtosecond’ is? Not very long! But we can measure that now.

Time may mean “Wet” and “Dry”  
Time may mean “Harvesting Time” when the cuckoo sings, “Low sex drive” when “Wine tastes best and goats are fattest.”

Man needs to know when taxes are due, or the appropriate time to make a sacrifice to appease an angry god. Mayans, Egyptians, Chinese and Cro-Magnons, all needed to know just when important (to them) events needed to happen. So they made their calendars. This book tells many fascinating stories of the struggles and the countless attempts that have been made.

Caesar, Greek philosophers, Persians, Indians, Druids, Arabs, Turks and indeed all men, had their concepts of how to measure all these variables to suit their important needs. Paper was first made in Baghdad in 794 CE; calendars could then be printed. Muslims needed to pray 5 times a day, so they needed time to be measured. Their month began 2 days after the new moon.

829: they thought the Earth was round and they could measure its diameter; algebra was invented.

1079: Omar Khayyam, who was a Persian mathematician and astronomer, worked out a solar calendar.

1126: Earth rotates but its orbit varies.

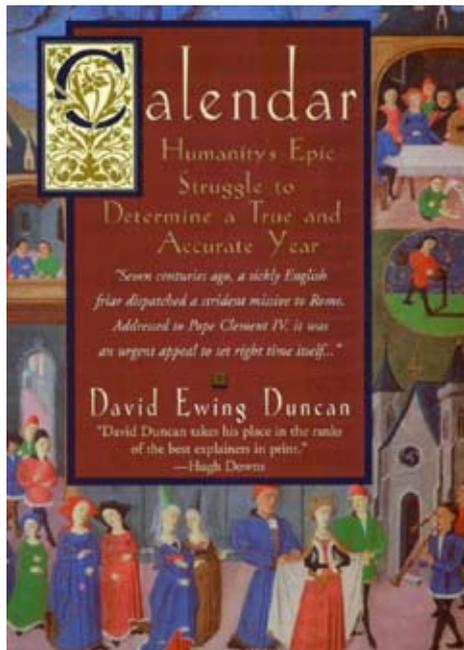
1582: Pope Gregory issued a papal bull implementing his calendar, which was widely accepted by 1752. Till then ‘Time belonged to God’ and it was sacrilege to meddle with it.

much later in during the 11<sup>th</sup> century in China and 13<sup>th</sup> century in Europe.

Cesium clocks now rule our time and, being a nanosecond out every now and again, Earth is not regular enough to keep up with cesium time.

Bell towers struck on the hour;  
I hope this works.

*Lydia Bell*



Trading grew and times and dates for deliveries became essential.

1924: Greece adopts the Gregorian calendar but China waits until 1949 to do so.

Clocks: early in history were water clocks and sundials; mechanical clocks came

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## Editorial

Yes, it's unfortunate but we missed one issue of Reflections due to a lack of contribution.

But, as you can see, this installment is a bumper one, so much so that this editorial had to be relegated to the last page and reduced to its bare essentials.

What I like about this issue, and what I would like to see more in the future, is that most of the articles are what you can call personal essays, which, as pointed out by our President in his message, is what it's all about.

Well, I hope you enjoyed reading this installment as much as I enjoyed putting it up together.

Cheerio,

*Jean-Luc Gaubicher*