NORTHERN SYDNEY ASTRONOMICAL SOCIETY

Reflections

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President's Message

We're halfway through the year, and it has been a busy one for NSAS. Most of our programs are running to plan, and while I'd like to see a lot more participation from about half of our membership, I understand that people have busy lives these days and, in many cases, NSAS is just a small part of their commitments.

When the current Committee was elected last October, one of the aims agreed upon was to spend a bit less time on outreach and a bit more on developing activities for the membership.

I think the balance this year has been pretty good, although outreach activities are a constant. In that respect, since my last report, we have had a few activities that have gone ahead, including the Parramatta Park Star Party, where we contributed five scopes to a very large crowd on what turned out to be a good night for observing.

Probably the biggest event for the Society took place on the 6th of June, and that was the Transit of Venus.

We managed to put together about 7 solar-equipped scopes or viewing devices for a setup at the Fr. Mac Pavilion at St Ignatius on the morning, which dawned very ominous for any viewing at all. As it turned out, we were very fortunate to have a lot of breaks in the cloud, and probably averaged about 10 minutes viewing for every 15 minutes of cloud. There is a report with images in this issue of Reflections but the most encouraging thing about our program that day was that we were able to get about 200 of St Ignatius' students down to the observing that day, where they all were able to witness an event they may not see again in their lifetimes (although, who knows, some of them may make it another 107 years!)

In regards to observing, we've begun to see a slow breakup of the long run of bad observing weather in the last few months with some good nights.

We've also reorganised our Observing Officers, with 8 of us now bidding on a roster system, so that no one is too bogged down with this responsibility and one person is responsible for every planned night. We've also tried out a couple of new venues and found that Howson Oval in Turramurra may be a great new one without the trees that we are finding at North Turramurra Golf Club. As soon as we come up with a solution to the security lights at Howson Oval, we will start using it regularly

Because of the current activity in observing, we have put off the planned observing at Macquarie University Observatory until July.

Our first field trip for the year just took place in Canberra on the 16th of June and, while the weather didn't cooperate for observing, the group had very comprehensive tours of the NASA Deep Space Center at Tidbinbilla and of Mt Stromlo. A report is included in this issue. The Committee is awaiting some suggestions regarding another field trip this year.

Though we've had one or two new members each month, membership remains a concern for the Committee. We are currently in the mid-60's in number, which is on the low side of what we believe is comfortable. On that subject, Bruce Retallick, our Vice-president, has volunteered to set up a welcoming arrangement where all new members are personally welcomed to NSAS and provided with support for their interests in the Society.

We continue to get good speakers from the local professional astronomical community, and in June we had a first, our first web-based speaker, Tom Field from Rspec-Astro in Seattle who spoke about amateur spectroscopy. One speaker not to miss will be Dr Charlie Lineweaver from ANU, who will speak in September.

Finally, the Theory Group continues with smaller numbers, and I'd like to remind everyone who has thought about attending that you can come along any month and still get educated! The lectures, for the most part, do not require that you attended all the previous ones and every lecture will be interesting and add to your knowledge.

Hope to see you at a meeting or observing in the next few months.

Best Regards,

Bob Fuller

In this issue

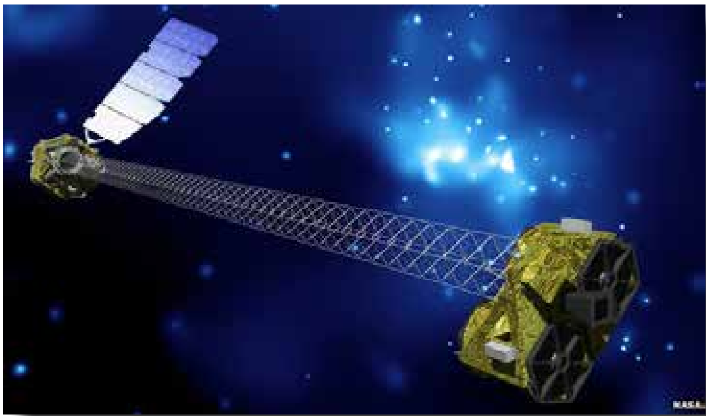
Calendar

General Meetings:	July 17th	Guest Speaker: Dr. Francesca Primas (ESO) - Chemical abundance and planet formation
	August 21st	Guest Speaker: Barnaby Norris (USYD) - Red giants and dust shells
	September 18th	Guest Speaker: Dr. Charlie Linewear (ANU) - Subject TBA
Theory Group Meetings:	July 10th	
	August 14th	
	September 11th	
NAG Meetings:	TBA	
Observing Nights:	Consult NSAS' web site at http://nsas.org.au/observing/	
Deadline:	Please send your contributions to the July issue of Reflections in time to reach the editor before September 15th to nsas.editor@ozemail.com.au	

NuStar ready to study high energy X-rays

NASA's Nuclear Spectroscopic Telescope Array, or NuSTAR, has successfully deployed its lengthy mast, giving it the ability to see the highest energy X-rays in our universe. The mission is one step closer to beginning its hunt for black holes hiding in our Milky Way and other galaxies.

"It's a real pleasure to know that the mast, an accomplished feat of engineering, is now in its final position," said Yunjin Kim, the NuSTAR project manager at NASA's Jet Propulsion Laboratory.



Artist's concept of NuSTAR on orbit. NuSTAR's 10-metre mast separates the optics modules (right) from the detectors in the focal plane (left). NuSTAR has two identical optics modules in order to increase sensitivity.
Image credit: NASA/JPL-Caltech

NuSTAR's mast allows the telescope to take crisp images of high-energy X-rays for the first time. It separates the telescope mirrors from the detectors, providing the distance needed to focus the X-rays. This is the first deployable mast ever used on a space telescope.

On June 21, nine days after launch, engineers at NuSTAR's mission control at UC Berkeley sent a signal to the spacecraft to start extending the 10-meter mast, a stable, rigid structure consisting of 56 cube-shaped units. Driven by a motor, the mast steadily inched out of a canister as each cube was assembled one by one. The process took about 26 minutes.

Once the verification of the pointing and motion capabilities of the satellite are carried out and the alignment of the mast fine-tuned, the team will instruct NuSTAR to take its "first light" and start calibrating the telescope.

Why did NuSTAR need such a long, arm-like structure?

The answer has to do with the fact that X-rays behave differently than the visible light we see with our eyes. Sunlight easily reflects off surfaces, giving us the ability to see the world around us in colour. X-rays, on the other hand, are not readily reflected: they either travel right through surfaces, as is the case with skin during medical X-rays, or they tend to be absorbed, by your bones for example. To focus X-rays onto the detectors at the back of a telescope, the light must hit mirrors at nearly parallel angles; if they were to hit head-on, they would be absorbed instead of reflected.

On NuSTAR, this is accomplished with two barrels of nested mirrors, each containing 133 shells, that reflect the X-rays to the back of the telescope. Because the reflecting angle is so shallow, the distance between the mirrors and the detectors must be long.

NuSTAR launched on an Orbital Science Corporation's Pegasus rocket, tucked inside a small canister.

This rocket isn't as expensive as its bigger cousins because it launches from the air, with the help of a carrier plane, the L-1011 "Stargazer," also from Orbital.

Source: NASA/JPL

NuSTAR was launched into a low-Earth, near-equatorial orbit on a Pegasus XL rocket from Kwajalein Atoll in the Marshall Islands. The Pegasus launch vehicle, built by Orbital Space Corporation, relies on a unique air-launch system with the rocket released at approximately 40,000 feet from the "Stargazer" L-1011 aircraft.
Image credit: NASA/JPL-Caltech

Observation Report: The Transit of Venus

Today, members of the society and a number of visitors met at St. Ignatius to view the transit of Venus across the sun, the last time this will be visible from Earth until 2117.

Theoretically we were ideally placed here in Sydney to view this event, with it occurring between about 8:15am to 2:45pm and the entire transit should have been visible to us. Unfortunately, the weather had other plans and we spent most of our time waiting for clouds to clear and covering up the scopes when the rain came through.

That said, we were still lucky enough to get enough breaks in the cloud to enable us to get some viewing in.

We had seven scopes in all, five with solar filters, one Coronado Solar Scope (Tim's) and a projection box (set up by Jean-Luc).
Another means of viewing the transit was using solar glasses.

Of course, we had a number of groups of students come by throughout the day to take a look at the transit in progress.

Unfortunately, the rain settled in just towards the time of the third contact and we were not able to see the fourth one.

Although the weather could have been nicer to us, it could also have been much worse and I think it's fair to say that we all still had a great time.
Finally, our thanks go to St Ignatius for providing us with a hearty breakfast and lunch of sausages, bacon, eggs and fruit that were cooked by John Blanch, the Master Chef of the BBQ.

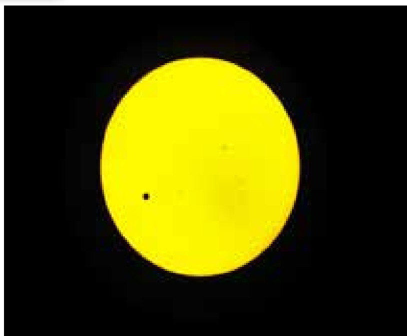
Chris Anderson

Pictures by Anna Koenneman, Chris Anderson and Jean-Luc Gaubicher

1

Transit viewed through Tim's Coronado Solarscope (1-note the prominences), through a scope with solar filter (2) and as eyepiece projected (3).

2



3

Reciprocals in Triplicate

A scientific calculator has a reciprocals button usually labelled X^{-1} which is a symbol for '1 over X', i.e. "1 divided by X". This implies that the biggest numbers have the smallest reciprocals and vice versa.
Division by zero is not defined so zero has no reciprocal and your calculator should give an error message. Otherwise, if you use the X^{-1} button twice in a row, you get back to where you began. In other words, the reciprocal of the reciprocal of a number is the original number.

Definitions may involve one or more reciprocals. The converging or diverging power of a single lens is stated in dioptres and is calculated as the reciprocal of the focal length measured in metres. A positive sign is allocated for a converging lens and a negative sign for a diverging lens. It follows that the reciprocal of the power in dioptres is the focal length in metres.

Examples using the definition, one for each sign:

a) A particular lens has a focal length of +1250 mm or +1.25 metres so its power is, numerically, the reciprocal of +1.25: i.e. +0.8 D. This lens alters the paths of rays in a parallel beam so that they actually pass through a point 1250 mm from and beyond the centre of the lens and from which they actually diverge.

b) Another lens with a power of –4 D is a diverging lens with a focal length of 0.25 m or 250mm. This means that a parallel beam of light will be altered by the lens so that it appears to have come from a single point 250 mm from the centre of the lens on the approach side.

The amount of bending of a light ray that is transmitted from one medium to another is determined by the Refractive Index for that change. This R.I. is actually the ratio of the light's speeds in the two media. It follows immediately that the R.I. for a change from medium A to medium B is the reciprocal of the R.I. for the opposite change B to A. e.g. the R.I. for the change from air to water equals the ratio of the speed of light in air to its speed in water which is very nearly 4/3. The R.I. for light travelling from water to air will be very nearly 3/4.

Some formulae derived for simple optical situations can be expressed in terms of reciprocals. The focal ratio of a telescope relates to the primary image-forming element of the system and is the ratio of the focal length to the effective aperture. A 'fast system' is one with a small focal ratio. For example, an F3 system is regarded as fast and an F8 system is slow.
The descriptive terms indicate the effect on the exposure times for photography through the telescope.

Astronomer like to have a pinpoint image of a star. If the wanted focus is not achieved, a circle of confusion is involved and, if the image is central in the field, there is a simple connection between the diameter of that circle and the distance from best focus:
Diameter = the product of the distance error and the reciprocal of the focal ratio.
This means that a faster system has a larger circle of confusion for the same distance from best focus so accurate focussing of a fast system is imperative.
Example: If the focussing error is 2 mm in an F3 system, the circle of confusion (replacing a point image) will have a diameter of 2mm x 1/3, i.e., 2/3 mm.
This diameter will be magnified by other lenses in an eyepiece or a camera system.
For an off-axis image, an additional problem, coma, may be present.

Formulae may contain several reciprocals.
If there are two reciprocals and nothing else, the formula can be simplified:
E.g. "1/x = 1/y " is equivalent to the simpler form "x = y" that has no reciprocals.
However, a similar statement for three reciprocals is false.
The truth of " 1/x + 1/y = 1/z" does not imply the truth of the statement "x + y = z" .
E.g. Look at this counter-example: "1/6 + 1/3 = 1/2" is true but 6 + 3 is obviously not 2.

Electrical circuits may require the use of formulae containing three reciprocals:

- $1/R = 1/R_1 + 1/R_2$ gives the resistance of two resistors in parallel. [$R = R_1 + R_2$ is only OK in series.]
- $1/C = 1/C_1 + 1/C_2$ for two capacitors in series. [$C = C_1 + C_2$ is only OK in parallel.]

Both of these formulae can be extended for more elements in the same configuration.

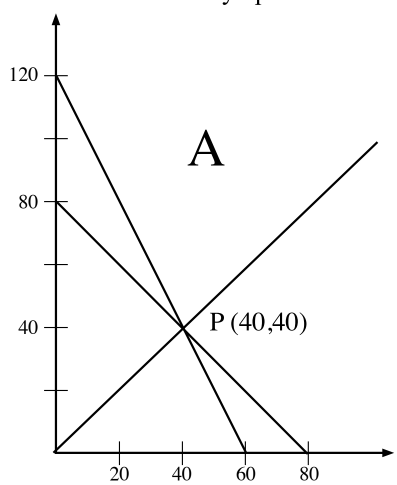
Closer to the interests of amateur astronomers is the formula connecting the focal length f of a convex lens or a concave mirror with the distances u and v respectively from the lens or mirror to the object source and to the resulting image:
$1/f = 1/u + 1/v$
Sometimes, f , s_1 and s_2 are used.

Examples:

a) Calculate the focal length of a convex lens that forms an image 120 cm behind the lens when the object source is 60 cm in front of the lens. We substitute u = 60 and v = 120 and get:
$1/f = 1/60 + 1/120$.
Typical calculator sequence:
{60, X^{-1}, +, 120, X^{-1}, =, X^{-1}, =}
Answer: The focal length is 40 cm.

b) For the same lens (i.e. f=40), where is the image of an object placed 80 cm in front of the lens?
Substituting into the formula again:
$1/40 = 1/80 + 1/v$
so $1/40 – 1/80 = 1/v$.
Typical calculator sequence
{40 , X^{-1}, - , 80, X^{-1} , =, X^{-1}, = }
Answer: The image is 80 cm behind the lens.

'But, you might ask, what do I do if I do not have that kind of calculator?' or, 'I have a calculator like that but the batteries are flat and I hate manual arithmetic' or some other story...
A graphical method was indicated and used in the Q&M Physics Notes produced by the (then) Technical Branch of NSW Dept of Education in 1953, in the days before electronic calculators.
Take a sheet of plain graph paper and mark two axes – for the distances from the lens - meeting at the bottom left of the ruled area. Put suitable numbers evenly spaced along the axes and draw one line from the origin at 45 degrees to both axes. See graph A.



Join 60 on one axis to 120 on the other axis. Read off the answer 40 cm, at P where this join cuts the 45 degree line. [The intersection has equal co-ordinates 40 and 40.]
Now, join 80 on one axis to P on the oblique line and continue to the other axis. Read off the answer, 80 cm, on the latter axis.
You do not need to know why this graph method works but it can be explained using algebraic geometry. The important features to keep in mind for this graphical method are:

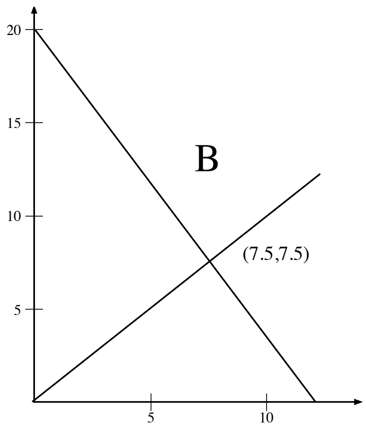
1. In each 'determination', the point P is the spot on the 45 degree line for

EVERY combination of u and v for ONE focal length. {For another ‘f’, you need a new P.}
2. In each ‘determination’, because of the algebraic symmetry in the basic formula, you may choose either axis for the object distance but the focal distance is always on the oblique line.

This writer has recognised that the graphical method for optics can be applied to a number of other situations whose mathematics is described by triple reciprocal equations:

If you are a ‘sparky’ and one of your electrical circuits satisfies the conditions mentioned above, you can combine two resistances in parallel or two capacitors in series in the same graphical way.

A good feature for resistors and capacitors is that the scheme is easily extended to more than two components of the same type, just add extra reciprocals to the formula and modify the usage of the graph. An example for two resistors in parallel is solved by graph B which correctly combines two resistances of 12 ohms and 20 ohms to get the equivalent of 7.5 ohms. The same graph would combine



two capacities of 12 and 20 microfarads in series to make the equivalent of a single condenser with capacity 7.5 microfarads

Do you remember being expected to solve arithmetic problems like this:

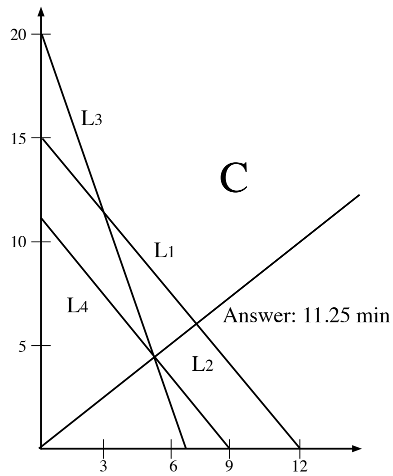
A tank can be filled from empty via one valve in twelve minutes or by another in twenty minutes. How long does it take to fill the tank from empty if both valves are turned on together? Note that the given numbers are the same as in Graph B which provides the answer, 7.5 minutes.

This graph method can be extended to more valves and some drains by adding reciprocals for valves and subtracting reciprocals for drains.

Examine Graph C to find how it solves this problem:

“There are three valves separately capable of filling a tank from empty in 12, 15 and 20 minutes and there is a drain capable of emptying the tank from full in 9 minutes, how long will it take to fill the tank from empty if the inlets and the outlet are all opened together?”

The formula needed for your calculator would become $1/T = 1/T_1 + 1/T_2 + 1/T_3 - 1/T_4$. Substituting 12, 15, 20, 9 in the right side provides the answer 11.25 minutes on completing the calculation.



Now, back to astronomy.

To determine Earth’s orbital period, we measure the time between two successive situations in which the same fixed star, at a great distance, is in conjunction with the Sun for an Earth-bound observer. Because of the involvement of the fixed star, the period is known by the full name ‘the sidereal period’ of Earth. No observer can carry out such measurements for other planets without being there at the two separate times so an indirect method of determining their sidereal periods is needed. To establish close approximations to these periods, a fairly easy method is possible on the basis of the assumption that all planets have uniform circular motion around the Sun. Pluto, the victim of re-definition of the term ‘planet’, had the most eccentric orbit of the Solar System, having e = 0.248, but its orbital minor axis is 96.876% of its major axis, not far from circular. For Mercury, the most eccentric survivor of the re-definition, the percentage is 97.86%.

We know from observational experience (or from Kepler’s Third Law) that both Mercury and Venus, our inferior planets, have shorter periods than Earth’s and our superior planets have longer periods than Earth’s. The observational key to the determination is the nearly regular repetition of the situation where Earth and another planet are in line with the nearest star, our Sun. The events to be anticipated are two successive inferior conjunctions of an inferior planet and two successive oppositions of a superior planet. The time interval between the two occurrences is called the Synodic Period of the inner planet as viewed from the outer one. The mathematical key is an equation with three reciprocals. In every comparison of two planets, the Sidereal Period of the inner planet is shorter than the Sidereal Period of the outer planet. The longest period involved is the Synodic Period of the inner planet as viewed from the outer planet. [This compels us to take the reciprocal of the shortest period as the SUM of the other reciprocals.] Using the third letter D for siDereal periods and N for syNodic periods and using subscripts I for the inner and O for outer planet, we have: {D involves a Distant star; N involves only a Near star.}

$1/D_I = 1/D_O + 1/N_{I//O}$, I/O indicates the inner planet as viewed from the outer planet.

E.g. for Venus viewed from Earth at two inferior conjunctions:

$$1/D_V = 1/D_E + 1/N_{V/E}$$

and for Mars viewed from Earth at two oppositions: $1/D_E = 1/D_M + 1/N_{M/E}$

Note that $N_{M/E}$ is both the time interval between successive inferior conjunctions of Earth as viewed from Mars and the interval between successive oppositions of Mars as viewed from Earth, the two descriptions of the one configuration being dependent merely on one’s point of view.

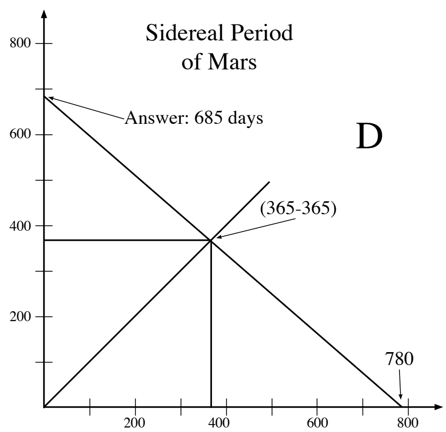
For working with Earth days as units, the graphical method for these periods requires a large sheet of very finely ruled graph paper to get the correct result. That is not suitable for our ‘Reflections’ but the calculator method is always available. Collins ‘Dictionary of Astronomy’ on p269 states that the average value for the Synodic Period of Mars is 2 years and 50 days and on page 509, the Sidereal Period of Earth is 365.26 days. Substituting in the latest formula above, we have:

$1/365.26 = 1/D_M + 1/780$

and hence $1/D_M = 1/365.26 - 1/780$

which provides $D_M = 686.94$.

Therefore D_M = Sidereal Period of Mars = 687 earth days to the nearest day.



Graph D suggests a value in the vicinity of 685 earth days.

Bob Roeth

<u>Caution</u>: As in all geometrical constructions, the accuracy of judging the exact intersection of pairs of lines will suffer if the angle between the lines is very small especially if the lines involved are not finely drawn.

Venus Transits: Past and Present

I had been thinking about the transit of Venus since last year: how it would look like, where it would be visible from, what would I need to be prepared, where could I get it, what did I want to do and what could I actually do...

Getting prepared! That made me think: who did see the transit for the first time, and when? Unlike other “noisy” celestial phenomena, like eclipses, meteors, comets and supernovae, the transit of inner planets (Mercury and Venus) might have passed unnoticed unless someone actually looked for it! The frequency of the phenomenon is so low and, without the technology we enjoy nowadays, to catch Venus in transit must have been a great achievement.
Excited I went to the web to do some research... and found out that EVERYONE was excited about it. Of course!! Many important discoveries were made during observations of the transit and expeditions made in relation to it. But, whose was the brain who first thought about it?

Johannes Kepler had such a brain: using data collected over the years by Tycho Brahe, he developed calculation tables for planetary motions and, armed with them, he predicted transits for both Mercury and Venus, although he didn’t live long enough to see any of them himself.

Actually, Venus was not the first planetary transit that was observed; it was Mercury’s, by Pierre Gassendi and 2 other astronomers on November 7, 1631, who used the calculations made by Kepler years before (1). Sadly, there’s no written evidence of anyone observing the transit of Venus supposed to have occurred on December 6 the same year.

The transits of Venus come in pairs every 120 years or so, and they are 8 years apart from each other: the next transit would occur in 1639.
A very young Englishman, Jeremiah Horrocks, found some inaccuracies in Kepler’s calculations and, making his own, he was the first man (at least registered in history) to see the transit of Venus on December 4, along with his friend William Crabtree (1).
Another of Horrocks’ remarkable achievements was to find out that the Moon’s orbit was affected by the Sun, long before Newton postulated his Gravitational Theory, and to build a planetary theory that was used for about 100 years... Not bad for a 20 year old baby! (2)

We, humans... we can’t just conform. Someone had to find some use for this phenomenon. And that was Edmond Halley. He came up with the idea of using parallax, with second and third contact of the transit as references, to measure the distance between Venus and Earth and to use that to calculate the distance between the Earth and the Sun(1). Clever! Aiming for this goal, astronomers taking part in this very ambitious project travelled to different parts of the world, in times of war, to take the measurements of the transit of June 6, 1761 that would finally give us the Astronomical Unit (AU).
However, due to the “drop effect”(4), discrepancies in measurements didn’t allow these campaigners to achieve their goal(3). It’s to be noticed, though, that while observing this transit, the Russian scientist Mikhail Lomonsov discovered and reported the thick atmosphere of Venus(3).
Tough scientists don’t give up! So they got prepared for the transit that would occur on June 3-4, 1769. These expeditions were quite fruitful, besides the successful observing of the transit. One of them, under the command of James Cook, resulted in the discovery of beautiful Australia and New Zealand(6). Other explorers did a lot of work studying flora, fauna, anthropology, etc, in areas of observation during the years prior the transit.(5)
However successful the observations, the drop effect still added inaccuracies to the data and the most accurate computation of the AU was about 2.5% larger than the actual one(5). Observers of the 1874 and 1882 Venus transits, despite the more advanced technologies available, such as cameras and bigger telescopes, couldn’t get rid of this optical effect and still got approximate data. The AU ended up being determined using other techniques.(5)

Finally, the latest couple of transits of Venus has taken place in 2004 and 2012, in the midst of the present flourishing space age. Thanks to Internet and more advanced technologies, the whole world was able to observe both events, live or delayed.
In addition to enjoying the experience of observing such event, most amateur astronomers were trying to make their own calculations of the AU, while scientists were busy studying the so annoying drop effect and, more interestingly, standardizing a spectroscopic technique to detect and study the atmosphere of extra-solar planets from space(7)!

NSAS made its own contribution on the last transit, on June 6, 2012 at St. Ignatius College. Despite rain, cold and wind, we were able to show the event to a couple of hundreds of people and, we hope, were successful in planting in the hungry minds of some kids the seed for the passionate appreciation of the universe we all share.

Irene Justiniano

References:
1.-http://www.skyandtelescope.com/observing/highlights/Transits-of-Venus-in-History-1631-1716-156303125.html
2.-http://www-history.mcs.st-and.ac.uk/Biographies/Horrocks.html
3.-http://www.skyandtelescope.com/community/skyblog/observingblog/Transits-of-Venus-in-History-1761-156333085.html
4.-The drop effect is an optical illusion observed when two dark objects get closer having a bright background behind http://www.skyandtelescope.com/observing/highlights/What-is-the-Black-Drop-Effect-155863705.html
5.-http://www.skyandtelescope.com/community/skyblog/observingblog/Transits-of-Venus-in-History-1769-today-156348395.html
6.- The Astronomical Society of Australia (2003). Factsheet No.15 Transit of Venus 8 June 2004.
7.-http://www.nasa.gov/mission_pages/hubble/science/transit-mirror.html

I feel very fortunate of living in this era in which I could take a lovely picture of the Goddess of Love passing by in front of Inti, the Sun God. This photo was taken holding manually my camera to the 25mm eyepiece of my scope, a 6” dobsonian with Baader solar filter.

Canberra Field Trip

The first NSAS Field Trip for 2012 was planned for Canberra on the weekend of 16-17 June. In the end, 27 members and partners/family made it to Canberra. Most of us drove down Friday night and stayed at various places, including Queanbeyan, and a few drove down on Saturday in time for the Mt. Stromlo tour.

The weekend was a typical Canberra winter overcast and cold with a bit of drizzle on the Saturday. The first event was a tour of the NSAS Deep Space Communications Center at Tidbinbilla, southwest of Canberra. It was my first visit there and, due to its remote location, a bit of a navigation challenge, even with GPS, but everyone made it in the end.

Our guide was Glen Nagle, the director of outreach and history at CDSCC, who gave us a fantastic tour of the entire facility over 3 ½ hours and really let us see the workings of a dedicated group of Aussies who are practically the mentors for the rest of the NSAS Deep Space network in Spain and California. I think all of us, notwithstanding the miserable weather outside, came away with a feeling of great respect for the work of this group who make possible the amazing planetary-exploration things we see on television and the Web. Without them, the achievements in this field simply would not have happened.

After a break for lunch, we re-assembled at the Visitors Centre at Mt. Stromlo, also to the southwest of Canberra. Due to the firestorm of January 2003, most of the working observatories on Mt. Stromlo were destroyed but, since then, some astronomical activities have slowly been re-established by ANU that operates the facility. A retired ANU outreach and history specialist, Ross Gould, kindly arranged to give us a tour of the historic remains of the site. While a walk around the summit is pretty saddening, with just the foundations of most of the observatories remaining and all of the major telescopes destroyed, the history of Mt. Stromlo as a centre for astronomy is nevertheless extremely interesting.
Ross took us to such observatories as the Oddie Telescope, which was the first on the mountain, and concluded with the observatory that housed the Great Melbourne Telescope that was mostly destroyed but is being re-birthed in Melbourne. The history of astronomy at Mt. Stromlo is, to a large degree, the history of astronomy in Australia and shows the foundation of the current astronomy capabilities in this country.

While there may be some investment in observation on Mt. Stromlo, the major focus these days are the rebuilt instrument laboratories of ANU: they are one of the leaders in the development of astronomical instruments and have supplied many major instruments to current large telescopes.

The original plan for the weekend was to have a joint observing night with Canberra Astronomical Society at one of their member's properties at a dark site south of Canberra but the rain during the week led to this being changed to possible observing from Mt. Stromlo, which was eventually cancelled due to the solid overcast. At this point, everyone headed for their (warm) motel room or otherwise and either continued to explore Canberra on the Sunday or headed home.

Bob Fuller

Pictures by Yuko (Tidbinbilla) and Peter Nosworthy (Mt. Stromlo)

That's it, "Alea iacta est" as they used to say.
The following article by Lydia Bell is the last eligible entry for this year Geoff Welch Literary Competition.
If you haven't sent any contribution since last September, you have lost the chance of being a winner this year.

Why, it has not been easy but, thanks to a bit of coercion, we have been able to publish all 4 quarterly issues of Reflections.

I wish to take this opportunity to express my thanks to all who have contributed and to encourage those who haven't to consider doing so.

The next issue is due out in October so think about it. I'm sure there are plenty of subjects you are passionate about so don't be shy, share them with us.

Cheers,

Jean-Luc Gaubicher

Tektites

Ages ago, 7770,000 years ago to be precise, a chunk of rock, the size of a small town, hit the Earth at a very low angle to the horizon, 4,000km north of Australia.
I had picked up an "Australian Geographic" magazine in a Caravan Park laundry and read an article entitled "The day it rained glass"; I was so thrilled, I hadn't found out anything about tektites for many years.
"The huge meteorite ploughed through the earth at several kilometres per second, ejecting jets of vapour and molten rock from the point of contact. The molten rock and vapour were shot back into the atmosphere and solidified as glass tektites. Then, and for hours, the sky was alight as thousands of tektites rained back down across the continent. More than 100,000 tektites have been found and there are thousands more out there".

Tektites are molten objects formed from material from our planet. The high silica content and fast cooling has caused the glassy nature. Erosion then created the pitting.

Tektite shapes, sizes and colours vary: sizes range from dust to tens of kilograms and thercan be shaped likee lenses, tear-drops, saucers, loaves, buttons and dumbbells, including the flanged ones that are the rarest. For these to have formed, semi-solid blobs would have to have rotated to form the dumbbell, then a secondary melting would produce the flange as it travelled through the atmosphere.

There are four areas on Earth where tektites have been found.

- South East Asia and Australia
- Central Europe
- Ivory Coast in Africa
- North America

Tektite particles have also been found in sediments dredged from the Atlantic and Indian oceans.

Many years ago, I was given one by a station owner when I mentioned them to her and I purchased another one from a museum; I've forgotten which one.
Today, I handle them still in wonder but with much more knowledge.

Lydia Bell

Tektites of various shapes.
Picture Credit: Wikimedia Commons - Brocken Inaglory - Dante Alighieri - H. Raab

The larger tektite (5 cm) is the one give to me from KYBO Station, near the Trans line in WA
The smaller one(0.5 cm) was purchased from a Museum

Have you synchronised your watch?

Following a decision by the International Earth Rotation And Reference Systems Service (IERS), 1 leap second was introduced on June 30, 23h 59m 59s.
Leap seconds are used to adjust the time scale UTC to the apparent motion of the Sun.
UTC being the Coordinated Universal Time and UT1 being the time as determined by the rotation of the Earth, leap seconds are introduced in such a way that UT1-UTC stays smaller than 0.9s in absolute value.

The decision to introduce a leap second in UTC to meet this condition is the responsibility of the IERS.
It is necessary to do so occasionally as Earth does not rotate at a constant speed: due to the unpredictable nature of Earth's movement, leap seconds ensure that on average the Sun remains overhead at noon.

Reference: International Earth Rotation And Reference Systems Service http://www.iers.org/IERS/EN/IERSHome/home.html

NIST-F1 Cesium Fountain Atomic Clock built by the US National Institute of Standards and Technology.
Its uncertainty is about 3 x 10^{-16}, which means it would neither gain nor lose a second in more than 100 million years!
www.nist.gov

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