ASTRONOMICAL SOCIETY

Reflections

Journal of the Northern Sydney Astronomical Society Inc.

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President's Message

Hello all Members and Prospective Members

Following the success of this year's New Astronomers Group course that takes place every fourth Tuesday of the month and is now in full swing, NSAS membership has increased to one hundred, perhaps the highest level in our history.
What this means for us is that we have a platform to build on and secure our activities and operations for some years to come.
And in saying this I am referring to both our long-standing members and to our new members, all can contribute and we always need more help on the ground.

Accordingly, one of the actions of the Committee at the moment is the preparation of a survey (yes, I know, not another survey?! but stay with me for a moment) which will be designed to find out more about our membership.
In order to maintain your interest, we need to know what you, the members, want from NSAS; how experienced you are in matters astronomical; where your interests lie (e.g. observations / telescope activity or cosmology); what types of topics you would prefer from our speakers and at what level should they be pitched.

Of particular interest to us is to learn about our members who are simply interested, who maybe have no expertise, no telescope, no technical knowledge, just pure interest. I suspect we have more than a few and we need to ensure we look after them as they dabble in some preliminary astronomy.
So, when the survey is launched, I ask that all members take some time and respond, especially our new members.
The more we know about your interests and knowledge, the better we will be able to respond, for the benefit of us all.

In addition to membership, the Committee is also making good progress on several other matters that were identified as aims for the year and which generally relate to practice and procedure.

The consequence of this will be the preparation of several papers, one being related to our new members, as mentioned above, and another to the way we approach and manage our outreach activities – such as how many events can we manage, what is our capacity to undertake Outreach and who among our members is willing and able to take on the tasks; this information will become available from the survey.
I take this opportunity also to mention that whereas Irene had taken on the role of coordinator of Outreach events, her time is now increasingly family-oriented and we will therefore need somebody else to take this role on. It's not the management of the night or event, it's simply ensuring that there is a "project manager" for each event. Volunteers please?

"Formalised" procedures are generally regarded as a pain, but we are a very different organisation from when we started out some decades ago and the level of responsibility we now have is far higher in so many ways than in the past.
Developing at least a basic level of procedures is an acknowledgement and an addressing of risks and undoubtedly leads to improved efficiency in the way we do things.

For the moment the Theory Group remains in recess, pending resolution of its direction and, similarly, the Mathematics Group is also in recess while Bob Roeth remains out of action with illness. We wish Bob, one of NSAS' original members and an ongoing prominent one, all the best in his recovery.

Our speakers this year have continued to be of particularly high standard, thanks to Bob Fuller and his contacts, especially Helen Sim at CSIRO.
When the bar has been set at such a high level it must be hard to know where to go next. So they went to the top! Hence our speaker at the July monthly meeting will be Nobel Prize winner, Prof. Brian Schmidt.
Bob will circulate details of Brian's topic later but please note there will be no meeting or coffee break. Rather, we will go straight to our speaker and commence at 8pm, so we should all be seated well before 8.
While the night is simply a variation of our monthly meeting, family and friends being welcome, it will nevertheless be an epic occasion in the history of NSAS.
For August, Bob and Helen are running their fingers over the list of other Nobel Laureates. Can't let the standards slip! Maybe Hawking?

Also in August, on the 13th to be precise, there will be a speaker at Regis Hall organised by CSIRO direct: Phil Plait, of the Bad Astronomy Blog. Keep your eyes and ears open for him. More to come.

Final point, please review Reflections articles over the current twelve months, as voting for the Geoff Welch prize(s) for contributed articles will take place at the September General Meeting.

See you soon, please wear your name tags at meetings and say hello to our new members and visitors.

Bruce Retallick

In this issue

Calendar

General Meetings:	July 16th	Speaker: Dr. Brian Schmidt - Type 1a Supernovae
	August 20th	Speaker: Kate Chow - TBA
	September 17th	Speaker: TBA
Theory Group Meetings:	TBA	
NAG Meetings:	July 23rd	No Meeting
	August 27th	Collimation, maintenance and care of your telescope
	September 24th	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	

Fire in the Hole

Will an astronaut who falls into a black hole be stretched like a rubber band or burned to a crisp?
Spaghetti or roast?

In March 2012, Joseph Polchinski began to ponder what would happen to an astronaut who dived into a black hole. Obviously, he would die. But how?

The accepted speculation is that he wouldn't feel anything special, even when his fall took him through the black hole's event horizon. But eventually, after hours, days or even weeks if the black hole was big enough, he would begin to notice that gravity was tugging at his feet more strongly than at his head. As he plunged downwards, the difference in forces would quickly increase, stretching him and tearing him apart before finally crashing his remnants into the black hole.
But according to Polchinski, quantum effects would turn the event horizon into a scorching wall of particles: anyone who fell into it would be burned to a crisp in an instant.

There is just one, big, problem with this theory: it violates one of the most fundamental principles of physics known as the equivalence principle that states in part that an observer falling in a gravitational field, even the powerful one inside a black hole, will see exactly the same phenomena as an observer floating in empty space.

Well aware of the implications of their claim, Polchinski and his co-authors offered an alternative plot ending in which a firewall does not form. But this solution came with a huge price: quantum mechanics would have to be sacrificed!
The result has been a flurry of research papers about firewalls, all struggling to resolve the impasse, none succeeding to everyone's satisfaction.

The Disney film The Black Hole has an altogether different end: the astronaut will go on a psychedelic trip through hell and heaven.
The answer according to physicists in 2013 is even more of a let-down: they don't know, and there is more at stake than the grisly demise of a single free-floating space traveller. The physics is complicated but the take-home message is this: if the astronaut fries, then Einstein's general relativity goes up in smoke with it; if the astronaut is torn and crushed by the black hole's gravity, then quantum mechanics flies apart.

So which is it, relativity or quantum theory; heaven or hell? Debate continues. One compromise has the astronaut hang around outside the black hole to get some quantum information as it leaks, use it to do some maths and then jump in to see if either theory is right. So far so good (for the laws of physics if not the astronaut, who perishes either way) except that the maths is so difficult that, by the time scientists have an answer, the black hole will have evaporated beneath them.
Now that would make for a better ending, at least for the astronaut who would have died of old age.

Jean-Luc Gaubicher

With the kind permission of nature.com
The complete article is available at:
http://www.nature.com/news/astrophysics-fire-in-the-hole-1.12726

Artist Impression
Andy Potts/nature.com

As usual, you will find that this issue of Reflections contains quite an eclectic bunch of articles on top of the reports on our outreach activities.

Once again, mathematically and historically minded readers will be in for a treat with the first part of a lengthy and quite dense article by Bob Roeth on pages 4 & 5.
On page 6, John Walker takes us back with him on his winter trip to Northern Europe and gives us a fascinating description of one of the most intriguing clocks of the world.
Then, on page 8, David Wallace, in a piece of writing that is not without being reminiscent of "The Garden on the Moon" by Pierre Boulle, describes how Mars could be within reach of an "Ozzie-naut" as long as he would be willing to fly on a one-way ticket!

As the ballot for the Geoff Welch competition are held during our September general meetings, the entries for this year are now closed.
Please review this year issues and make your choice before the night!
If you have lost your hard copies of Reflections you can peruse them online at http://nsas.org.au/media/

Finally, Graham Nicholson has asked me to inform you that a very interesting short movie about SOFIA (Stratospheric Observatory for Infrared Astronomy) can be seen at: http://tinyurl.com/pkx8anq
Cheers,

Jean-Luc Gaubicher

PS: don't forget, this year literary competition is closed but you can already think about *YOUR* contribution(s) to Reflections for next year!

Outreach Activities

Macquarie University Open Night - May 16th, 2013

Macquarie University switched their Astronomy Open Night from October to May this year to give them better skies for observing, in terms of objects to view and likely weather.

They were rewarded with a very good, cloudless night after a number of previous marginal skies.
NSAS pulled out all the stops to support them this year, as MON is one of our major exposures to the public.

We managed to get 8 scopes, including Geoff Unsworth's 16" dob. Tim Herridge managed the observing, along with Geoff, Graham Nicholson and Josephine Lindquist, Gary Maass, Richard Sproge, Gordon Ogborne, Peter Nosworthy and Bryan Cokely.

The observing list included: Omega Centauri, NGC 5286, Saturn, Jewel Box, Eta Carinae, Beta Crux carbon star, Ghost of Jupiter, Sombrero Galaxy, Alpha Crux and the 1st quarter Moon.

The NSAS stand in the main hall was run by Irene Justiniano, Ken Schofield and Peter Korber who also supported the observers. Bob Fuller managed the NSAS program but, on the night, was looking after the Aboriginal Astronomy program.

Macquarie later reported that they had nearly 1500 visitors and were very appreciative of the help given by all the organisations, including NSAS.

Bob Fuller

Photos by Peter Korber

The Attraction of Gravity (Part I)

Whilst a young scholarship student at Tübingen University, the Austrian Johannes Kepler (1571-1630), learned of the Copernican view of the universe in one (possibly biased) lecture from a professor, Michael Mästlin, who still maintained a belief in the Ptolemaic Universe. The Copernican view impressed Kepler from this first meeting.

Kepler had made no secret of his disagreement with his (Lutheran) Church on quite a few matters and now added the Copernican Question to his list.

The Church controlled the Tübingen University amongst others so, to avoid any embarrassments, it reacted by preventing a deserving Kepler from filling a vacant position on the Mathematics faculty there, offering instead a (successful) recommendation for a less rewarding post in Astronomy and Morals at Graz.

Thus, the Lutheran Church did Astronomy a great favour as Kepler applied himself to his task with great diligence despite considering Graz to be, relatively speaking, an academic backwater.

Johannes Kepler

The Roman Catholic Church regained control there in the Counter-Reformation and, a few years later, Kepler and his family being Protestants were suddenly expelled from Graz.

Kepler had earlier visited the ex-pat Dane, Tycho Brahe, at Prague in Bohemia and was now invited to work with him at the observatory there. The Roman Catholic Church thus helped to bring together two men of considerable yet contrasting and complementary capabilities.

Their collaboration in Prague lasted only from 1600 till Brahe's death in 1601.

Though many encyclopaedias give the impression that Tycho was only good at observation, he published a number of books and had some theories of his own.

As an example, Tycho rejected both the Ptolemaic and the Copernican views of the universe and produced his own hybrid system in which the Earth was stationary and was orbited by the Sun and the Moon. The remaining planets orbited the Sun and all but the orbits of the inferior planets, Mercury and Venus, reached beyond the Earth and the Moon.

In Prague, at the beginning of the work that eventually produced his first two Laws of Planetary Motion, Kepler rejected the philosophers' idea that a planet in orbit is merely displaying its "natural motion". Instead he conceived the idea of a real but unseen solar force drawing or pushing the planets forward in their paths about an immovable Sun.

We could argue that he anticipated gravity waves but miscued on the detail.

Later, in his De astronomia lunari published four years after his death, Kepler wrote a highly-imaginative dream-story (Sci Fi of its day?) involving a trip from the Earth towards the Moon and passing through a place where those bodies exerted equal pulls on the traveller's vessel.

Tycho Brahe

Kepler was probably the first person to suspect that heavenly bodies, especially the Sun, had the propensity to exert a mechanical as distinct from an astrological influence at a distance. Though Kepler was a mystic, he had no belief in astrology except to supplement his oft-unpaid wages.

Whether or not Kepler was serious about this precursor to Newton's gravity cannot be known. In either case, the story does not make it clear whether it was intended to replace or to be added to his original idea of a solar force.

Kepler was strongly attracted to the idea that some form of magnetism might be involved in the solar force. He was impressed by the first reports of geomagnetism in Gilbert's De Magnete, newly published in 1600.

Kepler, plagued from infancy by a frail constitution, very poor eyesight and a lame arm, was singularly ill-equipped to withstand the rigours of nocturnal observations in cold observatories.

Nevertheless, his fertile imagination and ready intuition together with his computational and other more impressive mathematical skills, notably in three dimensional geometry quickly made him the mathematical astronomer of his time.

Despite being recognized as such by Tycho, he was given only limited access to the best observations available to date; many of the positional measurements had been made at Hven before Tycho moved to Prague.

On Kepler's promotion following Tycho's demise, access to the results remained difficult. Tycho's family tried to hold Kepler to the bitter promise extracted by Tycho that the records would not be used to promote the Copernican cause.

In our time, the generally accepted attitude to Kepler's work on planetary movement goes like this: despite Kepler having a theory about a solar force acting on planets, his three laws of planetary motion were not developments from this theory. Rather, they resulted from tedious arithmetical testing of a large number of mathematically described paths that, by happy accident, included the correct form.

Hence, the laws have to be regarded merely as empirical and certainly not deductive.

We should remember that Kepler deduced the Earth's movement about the Sun by reversing Brahe's solar theory which was based on the assumption that the Sun's apparent motion was real.

Kepler, in his Prodromus (1596), had proved that he was more Copernican than Copernicus by correctly explaining both retrograde motion and the variation in ecliptic latitude of the planets.

Recognizing the true nature of the Sun's movement, Kepler routinely used the solar theory to determine Earth's position in space while working on the problem of Mars' orbit.

Eric Aiton in the U.K. and Curtis Wilson in the U.S.A., working quite independently, saw that the general attitude was unfair, to say the least, to Kepler's derivation of his first two laws. Their conclusions are summarised in the articles:

- EJ Aiton: How Kepler Discovered the Elliptical Orbit, Mathematical Gazette, Vol. 59, Dec 1975.

- C Wilson: How Did Kepler Discover His First Two Laws? Scientific American Vol. 226, 1972.

Both writers had studied Kepler's original publication (in Latin) in reaction to what they thought were inconsistent statements about his work.
It became immediately obvious to them that Kepler's aim had been to construct a physical theory of planetary motion from which the real orbit could be deduced.
One surprise was that Kepler had deduced his distance hypothesis by using his solar force idea with Aristotle's assertion, since discarded in favour of Newton's corresponding idea involving acceleration, that it is the velocity of a body that is proportional to the force acting on it.
Kepler, then still testing circular orbits about an eccentric Sun, thought that the solar force was confined to a planet's orbital plane and was spread around the circumference. From this assumption, he deduced that the strength of the solar force must vary inversely with the first power of the planet's distance from the Sun.
He easily combined this deduction with the two hypotheses already mentioned and the standard formula for speed to conclude, yes, another deduction, that the times to cover equal tiny orbital arcs are directly proportional to the radii from the Sun to the planet.
Kepler considered this to be the true physical law and he proceeded to use it, and deductions from it, as tools in deriving the nature of the orbital path. He was particularly fortunate to have deduced a correct result from false premises! There were no errors in his deductive argument, only in the premises.

Kepler's distance hypothesis had converted the summing of times required to travel the large set of equal, tiny, orbital arcs into the addition of radii.
The calculus method of integration had not yet been invented so he totalled the radii by summing a series algebraically. He called his procedure the sum of the radii method.
To shorten this laborious method he converted it to the summing of the areas swept out by the radii. This did eventually save time as it completed a sequence of deductions culminating in his area law: in equal times, the radius vector sweeps across equal areas of the orbit.

The area law came into being while Kepler was still testing a circular orbit with the Sun in an eccentric position and the planet moving with constant angular velocity about a special point called the "equant". Historically then, the area law was his first law (!) in defiance of the current logical numbering and it preceded by some years his discovery of the true elliptical nature of the orbit of Mars. (1)

Using the best instruments available at the time, Tycho Brahe determined Mars' (geocentric) position by measuring one angle around the ecliptic starting from the vernal equinox and called the ecliptic (or celestial) longitude, and another angle north (+) or south (-) of the ecliptic and called the ecliptic (or celestial) latitude. Together, these angles are called ecliptic coordinates.

Kepler had watched Tycho Brahe and his assistants at Prague Observatory making and usually at least double-checking their meticulous observations of the apparent positions of Mars so he fully appreciated the significance of the precision, that is the level of accuracy, of their measurements. Some reports say they had an error range as small as 0.3 of a minute of angle.
Tycho's measurements had not been made according to any plan and only serendipitously included any with Mars in or near positions easily recognised by the Copernican Kepler to be special or critical: if the Earth is on the line of nodes of Mars' orbit, and Mars is in quadrature, Mars' latitude equals the tilt of its orbit from the ecliptic.

Kepler's letters, translated and published by Carol Beaumgardt in Kepler's Life and Letters, clearly show that, over a number of years, to fill these serious gaps he asked his correspondents, including Galileo, to take readings at special times that he nominated.
Unfortunately, Kepler could have no confidence in the precision of these observations. In testing a plethora of possible paths, no prediction of Mars' ecliptic coordinates was acceptable unless both were within two or three minutes of arc of Brahe's observations.
Kepler had to abandon circular orbits as their errors were regularly up to eight minutes.

Many years of repetitious calculations eventually paid dividends and Tycho's observations, supplemented by others collected from Kepler's correspondents, were transformed into his first two laws which were published in his Astronomia Nova in 1609.
The third law, Kepler's Law of Periods, was entirely empirical in its formulation. Its brief, low-key mention in Book V of Kepler's imaginative work, Harmonices Mundi (1619), belies its great importance. Its derivation took ten years despite Kepler's using computational logarithms. Their timely publication in 1614 followed years of hard work by the amateur mathematician, John Napier, who was the Baron of Murchiston and a Scottish Laird and also inventor of Napier's Bones. The third law alone considered several bodies together but Kepler's treatment made no mention of direct interaction between planet, planetary perturbation as we now call it.

The English amateur, Jeremiah Horrocks, 1619-41, was the first astronomer to undertake any serious observations to check that the Moon moves about the Earth according to Kepler's Laws.
Horrocks used angular diameters of the Moon to calculate sets of relative distances to the Moon's positions.
His early and sudden death interrupted a similar study of the Earth's orbit after more than three years of observations of the Sun's angular diameter.
Accepting Kepler's idea of solar force, Horrocks argued that the magnitude of this invisible force, which pulled the planets forward in their orbits, decreased with increasing distance from the Sun.
Also, that the more distant a planet was from the Sun, the larger the planet had to be to allow the solar force to act on it sufficiently.
Horrocks thought that a (refractory? hypothetical observer on the Sun would find that all the planets had angular diameters of 28 seconds of arc. (In Mathematics, 28 is a "magic number". It would have appealed to Kepler's mystic tendencies.)
In those days, Saturn was the most distant planet known but planetary sizes were obviously not well known.
Horrocks obtained the first worthwhile information on the angular diameters of stars by observing lunar occultations, initially of the Pleiades.
Also, he established reliable nodal positions and orbital inclinations for the inferior planets and detected Kepler's error in predicting transits of Venus.
This writer has yet to find any direct evidence that Horrocks believed in an unseen terrestrial force that pulled the Moon forward in its orbit about the Earth just as the Sun pulled Mars forward - but why check the orbit otherwise?

Bob Roeth

To be continued

(1) In establishing the laws of orbits using the calculus of vectors, the first to be proved is the area law. In this modern method, the law is shown to apply to parabolic and hyperbolic as well as to elliptical orbits. Elliptical generally includes circular.

The Jens Olsen Clock

Are you planning to visit Copenhagen? What do you want to see there, the Little Mermaid perhaps, or Strøget, the longest shopping mall in the world? Tucked away in the City Hall of Copenhagen is something that should delight anyone with an interest in astronomy: the Jens Olsen Astronomical Clock.

Jens Olsen was born in Ribe, Denmark in 1872. From an early age he wanted to be a clock maker but when he left school he was apprenticed to a locksmith, training that gave him the skills he later used in clock making. He also had a passionate interest in astronomy that he satisfied by extensive reading.

For five years after 1897 Olsen travelled widely in Europe, taking work wherever he could get experience working on clocks.
A major influence during this period was his stay in Strasbourg where he carefully studied the third Strasbourg clock in the Cathedral, with the intention of improving on its design.
Shortly after his return to Copenhagen he established his own business as an instrument maker and clock maker.
Over the next twenty years, Olsen worked on the design of his astronomical clock, finally completing his calculations when he was about 50 years old.
An astronomer, Professor Elis Strömgren, examined the detailed plans and confirmed their accuracy.

Jens Olsen Clock front view

However, it took another twenty years to accumulate the money needed for the construction of the clock and Jens Olsen was in his 70s when work commenced.
Tragically, in November 1945, he died suddenly of a thrombosis following an apparently successful operation.
His clock was completed in 1955 and set in motion on December 15th that year by King Frederik IX and Olsen's youngest granddaughter, Birgit.
The clock consists of twelve units divided into three major sections, housed in a stainless steel frame mounted on a granite base.

Jens Olsen Clock back view

Dry, warm air inside the case is maintained at a positive pressure relative to the room to prevent the entry of dust into the mechanism, which is driven by weights and wound each week.
As can be seen in the photograph of the rear of the clock, the various parts are interconnected through chains of wheels and steel rods connected to differential gears, so that the whole system relates to the primary clockwork mechanism in the centre.

In the centre, viewed from the front, a large dial shows Central European time and a smaller dial below indicates sidereal time.
Beneath these two dials is the main calendar with five dials showing the dominical letter, epact, solar cycle, cycle of indiction and lunar cycle, all parameters involved in calculating the dates of Easter and other feasts.
The calendar mechanism is activated once a year, at midnight on New Year's night, when it then computes and displays all the phases of the moon and the dates on which they occur, the names of the days of the week for each date and all moveable feasts for the coming year.

The left hand section of the clock has four dials. The top one is divided into three showing local time, true solar time in Copenhagen and the equation of time.
Beneath that, on the left, is a dial that shows time everywhere in the world and, on the right, a dial indicating sunrise and sunset by both local time and true solar time. At the bottom is the display of the Gregorian calendar.
The right hand section depicts astronomical motions. The top dial is a star chart arranged behind a mask that makes one counterclockwise revolution each sidereal day. This dial also shows the precession of the earth's axis, taking 25,753 years to complete the circle. This motion will have to be reset and slightly adjusted after 3,000 years and again, every 3,000 years after that.

The Planets dial

Below and to the left is a dial with the sun and moon moving round the central earth. Solar and lunar eclipses and whether they are total or partial are indicated here.
To the right is a large dial showing the position of the planets, Mercury taking 88 days to orbit and Neptune about 165 years.
The Julian calendar, used by astronomers for fixing the interval between two events is on a dial at the bottom of this section.
Between 1995 and 1997, Atelier Andersen of Copenhagen dismantled and restored the Jens Olsen Clock, paying particular attention to reducing friction in the complex mechanism. Every bronze or brass part was gilt with a 5μm gold coating and the dials on the face given more durable surfaces to protect against blackening. This thing of beauty is a joy forever.

John Walker
All photos by the Author
Source: Jens Olsen's World Clock City of Copenhagen, 1980.

Outreach Activities

West Ryde PS Star Party - May 9th, 2013

The evening of 9th May 2013 turned out to be good with clear skies, as they had been ordered beforehand.

NSAS provided six telescopes and a parent a seventh one.
Students and parents were well organised into groups and were allotted 15 minutes observation on each of the seven telescopes and this organisation worked out very well.
Although the school's grounds are bounded by trees, we managed to give all a worthwhile evening of viewing.

The sky that night had no Moon and only one planet, Saturn; never the less, all were kept busy.
The targets we could show were:

The Orion Nebula,
The Jewel box,
Omega Centauri
Saturn
The Carbon Star near Beta Crux

From the comments we got, when mention was made that Omega Centauri was 16,000 LY away, a student came to realise they were looking back 16,000 years in time.
Some people thought that Saturn didn't look real and some students thought it as being painted.
The queues continued well after 8pm as people wanted to see more and the 80 to 100 families who attended appeared to leave contented.

Our thanks go to Iain Bramley, the organising teacher from West Ryde PS and to the NSAS members who made this night a success: Bob Fuller, Chris Anderson, Garry Maass, Gordon Ogborne, Tim Herridge & Peter Korber.
The additional scope supplied by a parent was very welcome.

Peter Korber

Photos by Peter Korber

Herschel Telescope Switched Off

Four years after its launch by the European Space Agency, the Herschel telescope has been switched off and is now drifting like a ghost around the Sun.

Herschel was launched into orbit on May 14, 2009 and reached the L2 Lagrangian point, 1,500,000km from Earth, 2 months later.
Equipped with a 3.5m primary mirror, it was designed to study the far infrared and submillimetre wavelengths, which necessitated cooling down its instrumentation to less than 2K.
To achieve that it used liquid helium boiling away in the near vacuum of space.
The 2,300 litres of liquid helium was expected to last around 3 years after which the telescope would become blind to the wavelengths it wanted to study.
Finally, the helium ran dry on April 29, 2013, rending its super-sensitive instruments useless and ending nearly four years and 22,000 hours of deep space observation without a hitch.
The L2 Lagrangian point being highly sought after for astronomy missions it was necessary that Herschel be disposed of: its thrusters were fired until its tanks of hydrazine were empty, sending it tumbling away from its observation spot.
Then on June 17, ESA's ground control sent the final deactivation order.

Jean-Luc Gaubicher
Source and Images: ESA

Mars on a Budget

Firstly, I do not make any claim on the originality of the ideas, the accuracy of the information or the viability of the proposals in this article.

Every nation wants to be remembered for its scientific, engineering and exploration endeavours.
Textbooks on space exploration will invariably mention:

a) China for inventing gun-powder and the first rockets,
b) Germany for the development of the first modern rocket (the V2),
c) The Soviet Union for launching the first satellite (Sputnik) and the first cosmonaut in space (Yuri Gagarin),
d) America for landing the first astronauts on the Moon (Neil Armstrong and Buzz Aldrin).

It is time for Australia to join this list of great space exploration nations: I propose we sent the first Ozzie-nauts to Mars.
This need not be as horrendously expensive as you may first think. We can take some simple steps to dramatically reduce the cost of such a mission.

Firstly, we do not need to re-invent the technology for this mission.
Various countries already have the technology for putting people and equipment into earth orbit, retuning them safely to Earth and sending space craft to Mars. We just need to pay them money for them to do that stuff for us. (Given the financial straights that some of these countries are in, we should be able to negotiate a good price).

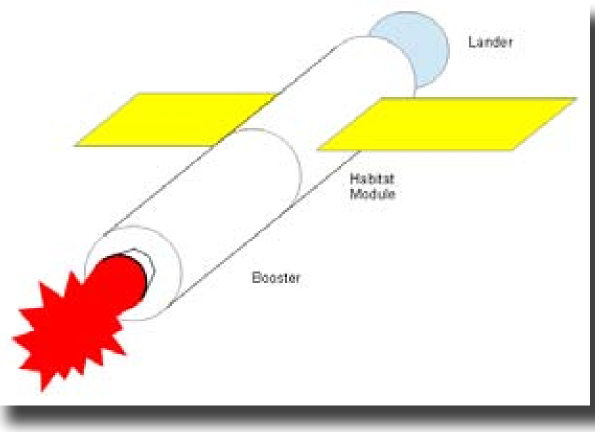
Secondly, we could plan this as a one-way mission. A one-way mission saves the complexity (and hence expense) of a return mission. The cost of a one-way mission has been estimated at 20% of the cost of a return mission. A one-way mission is a valid (and necessary) step to a return mission.

It also reduces the time an Ozzie-naut would have to spend in zero gravity, locked in a metal box and be exposed to space radiation. It also eliminates the chance of contamination of the Earth from any deadly Martian microbes that may be found there.

I don't think there would be any shortage of volunteers for such a mission. If you look at the "Reality" programs on TV, there are plenty of people who will do almost anything for 15 minutes of fame. Being the first to Mars will offer a lifetime of fame (all be it a very short lifetime).

This mission will be based on the technology used for the International Space Station. The spacecraft would be assembled in low-earth-orbit and then sent to Mars with an Ozzie-naut on board.

The spacecraft would consist of booster, habitat and landing modules as illustrated in the following diagram:



The Mars mission would consist of the following phases:

a) Design/Prototype – where we work out what is needed to send a person to Mars (and keep them alive for the duration of the trip)
b) Manufacture – where we make or buy the components and assemble them on Earth.
c) Ozzie-naut Selection – where we put candidate Ozzie-nauts into a metal box for 9 months and find out who is sane at the end (assuming they were sane at the beginning).
d) Launch – where we can use Russia, America, Chine and Europe rockets to launch modules into low-earth-orbit.
e) Assembly – where we can use Russia automatic docking systems (used to re-supply the International Space Station) to assemble the spacecraft.
f) Boost – where the spacecraft is boosted from low-earth-orbit into an Earth-Mars transfer orbit.
g) Transfer – where the spacecraft travels to Mars, taking between 6 and 9 months. The spacecraft would rely on solar cells for power during this phase.
h) Landing – where the Ozzie-naut lands on the Martian surface using a modified Russian Soyuz craft. Due to the low Mars atmospheric pressure, parachutes would provide insufficient braking. Hence, additional landing rockets would be required to land safely.
i) Bask in the Glory – where we let the rest of the world know of our triumph (possibly using one of the currently orbiting Mars satellites to relay the radio signals).

Now the bad news. Even with all this cost-cutting, this mission will be extremely expensive.
The cost of establishing and running the International Space Station is estimated at $5.5 million per person per day. So a trip to Mars for a single person would be something like 1 to 2 billion dollars or a third of the cost of the North-West Rail Link. (I'm sure the people in Rouse Hill will not mind waiting a few extra years for their train line).
For those of you who don't like me giving made-up numbers with very little justification, I will back up that number using more made-up numbers with absolutely no justification.

If anybody wishes to elaborate or correct this article, feel free to update and re-submit.
If you are interested in helping push Mars exploration ahead, may I suggest you contact Mars Society Australia at http://marssociety.org.au

David Wallace

Item	Cost (Millions of Dollars)	
Booster Module (relatively simple comprising two fuel tanks and a rocket engine)	Design	$50
	Manufacture	$10
	Launch	$200
Habitat Module (comprising solar cells, water recycling, air recycling, climate control, communications, navigation etc)	Design	$500
	Manufacture	$100
	Launch	$200
Lander Module (using existing hardware with some modifications)	Modify/Manufacture	$20
	Spacesuit	$10
	Launch (with Ozzie-naut)	$40
	Ozzie Flag (made in China)	$0.000001
Total		$1,130.000001