Reflections

ASTRONOMICAL SOCIETY

Journal of the Northern Sydney Astronomical Society Inc.

Volume 25 Number 2 April 2014

In this issue

President's Message

Hello all Members and Prospective Members

We are now well into 2014 and as a result of the efforts of our contributing members and indefatigable Editor, Jean-Luc, we are now into the second edition for 2014 of Reflections, arguably the finest amateur astronomy journal in the land.

After a very successful 2013, we will be building further on our strengths and looking to develop NSAS into a strong, cohesive and welcoming unit.
A fundamental need for this to occur is to maintain and add to the participation of our members and, especially, our new ones.
Many of the participants who attended the New Astronomers Program last year joined as new members.
Some have been infrequent attendees at meetings and functions since, and I make a special appeal to you to come along and join with us and get to know us.

On May 27th, the 4th Tuesday in the month, the 2014 New Astronomers Group program will commence, under the custodianship of Bob Fuller and Paul Byrne, plus expert members of NSAS.
All members are invited, as are, of course, all interested persons generally.
There has been a refinement of the course content, and papers will be made available.
Accordingly, a fee to cover costs will be charged, but the standard of content, presentation and material to be distributed will be more than worth the cost.
To provide for a greater outdoors and hands-on element, we are also looking at integrating the NAG with Observation Nights.

Mention is made also of the Macquarie Open Night coming up April 5th, hopefully Reflections will be distributed before then as Irene is still on the lookout for additional telescopes and for assistance at our stand on the night.
NSAS has always been a strong supporter of the MON with telescopes and we would like to keep that up as one of our main Outreach functions of the year.

Other Outreach events on hand in the near future are Castle Cove School in August / September, and possibly a talk with one of the senior citizen groups at Asquith, date to be confirmed.

On a more social note, and coming up in just a few weeks, is the get-together at the College on 13 April. More details to come by email but this will be a special event/ solar spectacular, with quality equipment on hand through Lawrie and Ken.
Details to come but keep this date free.
All are welcome, especially those who have not yet viewed our Sun directly.
Don't be shy, this is for everybody.

Please make also a note on your calendars for Saturday 24 May for our long awaited observing visit to Linden in the Blue Mountains.
Hopefully the 30 inch scope will be available to us.
Keep an eye out for details such as sleeping over.
Good interest has been expressed in this event, with there also being interest in a Jindabyne observations trip a bit later on. Could be fun!

Have a look at the NSAS library; it is now being presented in a top class condition, as befitting a top class organisation.
A host of Committee members have spent many hours cataloguing, categorising, grouping and culling the books and even half a minutes viewing will show you what has been achieved.
The library is in fact one of our strengths and now deserves much more attention. New books have been purchased, and "lost" books have been found (thanks Gordon).

A couple of points to finish on:

- Yes, we still need a secretary to help out on the Committee, somebody?
- The club telescope has undergone some significant improvements and will be available to all on observation nights.
- We are looking for the NSAS binoculars: who can offer any help as to who may have borrowed them at any time over the last few years?
- We are thinking on some possible long-term aims, maybe a suitable project to undertake. More as/if this develops.

Best wishes to all

Bruce Retallick
President

Calendar

General Meetings:	April 15th	Speaker: Trevor Leaman (UNSW) - Daisy Bates and the Oodea Indigenous Astronomy
	May 20th	Speaker: Paul Byrne (NASA) - My journey as a new astronomer
	June 17th	Speaker: TBA
Macquarie Open Night:	April 15th	Irene is still looking for volunteers. If you can help please contact her ASAP!
Observing Nights:	Consult NSAS' web site at http://nsas.org.au/observing/	
Deadline:	Please send your contributions to the April issue of Reflections in time to reach the editor **before June 15th** to nsas.editor@ozemail.com.au	

Launch of "Cosmos a Spacetime Odyssey"

On February 17, 2014 Foxtel launched their new television series "Cosmos, A Spacetime Odyssey" at a cocktail party at the Sydney Opera House's Marquee.

Foxtel have described the series as a "13-part reboot of Carl Sagan's legendary series" which went to air in 1980.
The programs use today's technology and animation to bring to dazzling life the stories of the universe.

This new series is hosted by world renowned astrophysicist, Neil deGrasse Tyson. Involved as executive producer, writer and director is Ann Druyan, Carl Sagan's widow, who co-wrote the original series with Carl Sagan.
Both Neil and Ann addressed the audience at the launch and participated in a Q&A session.
The series began on Sunday March 16 on Foxtel's National Geographic Channel.

NSAS was represented at the launch by Peter Korber, Graham Nicholson and Josephine Lindquist.

Josephine Lindquist

Though I'm not sure Reflections is the finest amateur astronomy journal in the land it is possibly one of the oldest.
As far as I know it has been published more or less regularly since the very beginning of NSAS in 1986.

Geoff Welch was an early and prominent member of our club.
Following his death, the club was given some monies to fund an annual "literary prize".
This endowment was recently added to by his widow Gwen.

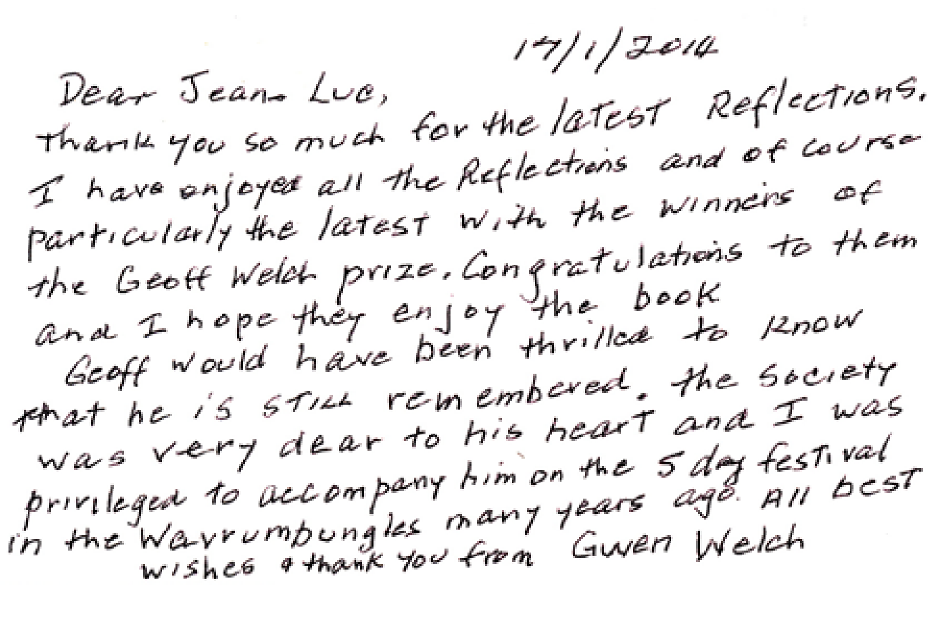
I think it would therefore be a shame if we did not continue this fine tradition, but I need your help: you have read our President's appeal for more active contribution from members to the various club activities and, once again I will add my own one for members, old and new, to put pen to paper or dust their keyboards and send me whatever contribution they come up with.

Keep also in mind that this coming July edition will be your last chance to enter this year competition.
And, for those new to the club the rules of the competion can be find at:
http://nsas.files.wordpress.com/2009/08/final-form-of-rules-for-g-welch-prize.pdf

Finally, here is the card Gwen sent me for the new year that I wish to share with you.

Cheerio,

Jean-Luc Gaubicher



17/1/2014

Dear Jean-Luc,
Thank you so much for the latest Reflections. I have enjoyed all the Reflections and of course particularly the latest with the winners of the Geoff Welch prize. Congratulations to them and I hope they enjoy the book.
Geoff would have been thrilled to know that he is still remembered. The Society was very dear to his heart and I was privileged to accompany him on the 5 day festival in the Warrumbungles many years ago. All best wishes & thank you from Gwen Welch

How to improve the performance of a budget telescope

The 'scope here is a National Geographic Newtonian with a 76 mm mirror and a 350 mm focal length.

The first problem was to do with the base feet. They were molded in a shiny plastic and, when put on a smooth surface, they allowed the whole 'scope to slide about.
Gluing antiskid disks intended for the tips of chair legs was a quick fix.

The second problem was with the turntable rotation. The action suffered from excess "sticktion" The rotation was jerky and resulted in constant over or under movement and loss of contact with the object.
The pedestal was removed from the base by undoing a central screw under a plastic cover *(1)*. The upper part of the turntable was in contact with the base by 3 plastic buttons sweeping the periphery of the base.
Lubrication of this assembly with silicone spray did not solve the problem. Therefore, the buttons were discarded and a sheet of Teflon fixed between the upper and lower parts of the turntable *(2)*.
This resulted in a very smooth action. So much so that a "dampener" of Blu Tack was needed between the edges of the base and pedestal to prevent accidental movement during observations.

The next problem was of alignment: "what is the 'scope pointing at?"
Sighting along the barrel is OK some of the time but you could be miles off your target. The purchase of a Red Dot finder (this inexpensive one was made for air rifles) was a worthwhile investment.
But how to mount it on a tube?
This finder is meant to be fitted to the top of the barrel of a gun that has mounting ridges ready for it.
A piece of a 10x10 mm aluminium bar was cut to length and a V shaped groove filed into the long axis so it would not wobble when fitted to the tube of the scope.
Using an engineer's (or carpenter's) square across the back end of the tube for guidance, masking tape was laid on the long axis of the tube to give a datum for fixing the mount for the finder *(3)*.
It is crucial to align the mount with the long axis otherwise you will never find things.
The mounting bar was then super-glued to the tube and left to set *(4)*.

The Red Dot finder was then screwed to the mount and adjusted against a distant viewing object *(5)*.
The result? A really worthwhile, very portable instrument for low power viewing at minimal expense and an interesting, simple project for any handyman *(6)*.

Graham Nicholson
Pictures by the Author

Materials used:

- PSP anti-chafe patch.
  From Whitworth's Marine and Leisure. Cost $19.95. More material than you need, but sure to come in useful for some other job.
- Aluminium Bar.
  From Edcon Steel, Brookvale for about $10. Much more than you need but a hobby shop could help or you could use any suitable piece of plastic or wood.
- Red Dot finder.
  About $12 from Ebay

(3)

(4)

(1)

(5)

(2)

(6)

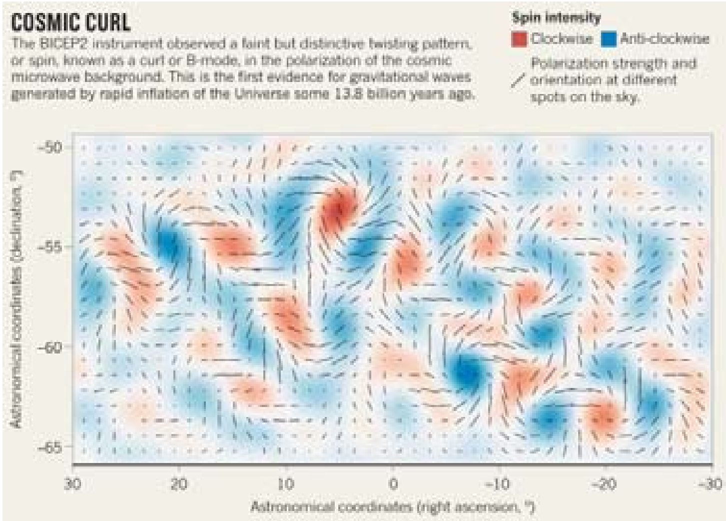
Inflation Confirmed

No, not the inflation Treasurers and Central Bank Governors all over the world are trying to rein in but the exponential growth that was theorized to have occurred instant after the Big Bang during the first tiny fraction of a second of the Universe existence.

Using a radio telescope at the South Pole, a team of astronomers of the Harvard-Smithsonian Center for Astrophysics (CfA) in Cambridge, Massachusetts has detected the first evidence of primordial gravitational waves, the ripples in space that inflation generated 13.8 billion years ago when the Universe first started to expand.

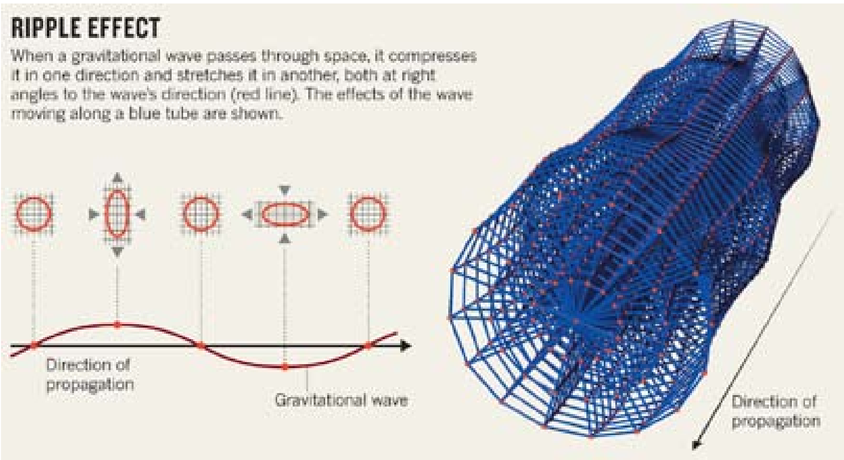
The telescope captured a snapshot of the waves as they continued to ripple through the Universe some 380,000 years later, when stars had not yet formed and matter was still scattered across space as a broth of plasma.
The image was seen in the cosmic microwave background (CMB), the glow that radiated from that white-hot plasma and that over billions of years of cosmic expansion has cooled to microwave energies.

“This is a totally new, independent piece of cosmological evidence that the inflationary picture fits together,” says theoretical physicist Alan Guth of the Massachusetts Institute of Technology (MIT) in Cambridge, who proposed the idea of inflation in 1980. He adds that the study is “definitely” worthy of a Nobel prize.



Picture Bicep2 Collaboration

Guth’s idea was that the cosmos expanded at an exponential rate for a few tens of trillionths of trillionths of trillionths of seconds after the Big Bang, ballooning from subatomic to football size.
Inflation solves several long-standing cosmic conundrums, such as why the observable Universe appears uniform from one end to the other. Although the theory has proved to be consistent with all cosmological data collected so far, conclusive evidence for it has been lacking.



Picture Markus Pössel/Einstein-online.info

The fact that inflation, a quantum phenomenon, produced gravitational waves demonstrates that gravity has a quantum nature just like the other known fundamental forces of nature, experts say.
Moreover, it provides a window into interactions much more energetic than are accessible in any laboratory experiment.
In addition, the way that the team confirmed inflation is itself of major significance: it is the most direct evidence yet that gravitational waves, a key but elusive prediction of Albert Einstein’s general theory of relativity, exist.

Cosmologists knew, however, that inflation would have a distinctive signature: the brief but violent period of expansion would have generated gravitational waves that compress space in one direction while stretching it along another.
Although the primordial waves would still be propagating across the Universe, they would now be too feeble to detect directly. But they would have left a distinctive mark in the CMB: they would have polarized the radiation in a curly, vortex-like pattern known as the B mode.
Last year, on July 22, another telescope in Antarctica, the South Pole Telescope (SPT), became the first observatory to detect a B-mode polarization in the CMB.
That signal, however, was over angular scales of less than one degree and was attributed to how galaxies in the foreground curve the space through which the CMB travels while the signal from primordial gravitational waves is expected to peak at angular scales between one and five degrees.
And that is exactly what John Kovac of the CfA and his colleagues now say they have detected, using an instrument dubbed BICEP2 that is located just metres away from its competitor, the SPT.

Detecting the tiny B mode required measuring the CMB with a precision of one ten-millionth of a Kelvin and distinguishing the primordial effect from other possible sources, such as galactic dust.
“The key question,” says Daniel Eisenstein, an astrophysicist at the CfA, “is whether there could be a foreground that masquerades like this signal”.
But the team has all but ruled out that possibility, he says. First, the researchers were careful to point BICEP2, an array of 512 superconducting microwave detectors, at the Southern Hole, a patch of sky that is known to contain only tiny amounts of such emissions.
They also compared their data with those taken by an earlier experiment, BICEP1, and showed that a dust-generated signal would have had a different colour and spectrum.
Furthermore, data taken with a newer, more sensitive polarization experiment, the Keck array, which the team finished installing at the South Pole in 2012 showed the same characteristics.

Continued page 8

The Drake Equation

In Astronomy, you have the practical side and you have the theoretical side.
The practical side is concerned with the observation of the motion and light from stars.
The theoretical side is concerned with explaining the observations.
Some of the equations that we use to explain the observations are truly scary, think of Quantum Mechanics or General Relativity.
Other equations are relatively simple such as Einstein's famous $E=MC^2$ equation.

Another famous equation that you may come across is the Drake equation.
This is a simple equation developed by the radio astronomer Dr Frank Drake of the National Radio Astronomy Observatory (NRAO) in Green Bank, West Virginia in 1961.
Dr Drake (currently on the board of the SETI Institute) was the first person to conduct a methodical search for extra-terrestrial intelligence in our galaxy.

The Drake Equation is:

$$N = R_* \cdot f_p \cdot n_e \cdot f_l \cdot f_i \cdot f_c \cdot L$$

This equation is used in the search for extra-terrestrial life to predict the number of alien civilisations (N) that we could communicate with.
Although it is a simple equation, it has proved surprisingly difficult to solve.

R_* (R star) is the average rate of star formation in our galaxy.
The value of 7 new stars formed per year being generally accepted.

f_p is the fraction of those stars that have planets.
The average value of 1 planet per star is supported by recent planet hunting surveys.

n_e is the average number of planets that can potentially support life per star that has planet.
Based on life on Earth, we can assume that any planet that has liquid water could support life.
There is evidence for water on Mars (a long time ago) and on the moons Europa and Enceladus.
It is possible that non-water-based life exists, such as in the methane lakes on Titan. A value for n_e of 0.4 is reasonable.

f_l is the fraction of planets that could support life that actually develop life at some point.
As Earth is the only planet that we know of that has developed life, we do not have any estimate for this value.

f_i is the fraction of planets with life that actually go on to develop intelligent life (civilisations).
This value could be small. If there is life on Mars, we would expect it to be deep underground (within porous rocks) were liquid water could possibly exist.
It could survive on chemosynthesis, similar to how life on Earth survives on under-sea volcanic vents. As such, it is hard to see how life on Mars could have evolved pass single cell organisms.
Also, evolution does not automatically lead to more intelligent life, just life that is "fitter" for its environment.
Cataclysmic events (think asteroid impact or near-by supernova) would reduce this value.

f_c is the fraction of civilisations that develop a technology that releases detectable signs of their existence into space.
This value could also be small. If intelligent life exists on Jupiter's moon Europa, then it is trapped under a thick layer of ice.
Living in an aquatic environment, it is hard to imagine how they could produce the high temperatures necessary to make glass or ceramics and to smelt metals that we use for our radio transmitters.
Having said that, animals on Earth (such as the electric eel) can produce electro-magnetic radiation using biological processes.
Transmitting a radio signal through several kilometres of ice would also be difficult.

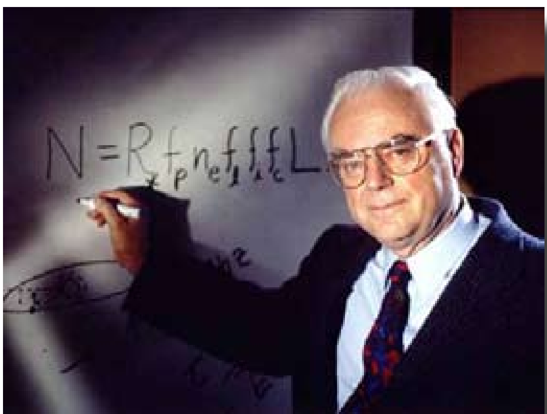
L is the length of time for which such civilisations release detectable signals into space.
We have been transmitting radio signals into space for several decades. How much longer we continue to do is debatable.
With the development of fibre-optics, we do not need to transmit data over the air.
Also using cellular phone technology, we are using less powerful transmitters (but more of them).
And at the rate that we are going in trashing the planet, we might not be around that long anyway.

The net result of the unknowns in the equation parameters, is that the resulting value of N is also unknown.
Because we exist, we know N must be greater than zero.
However, over 50 years of search for extra-terrestrial intelligence signals without success leaves us to conclude that N must be very small.
If we can continue the search, and find a single extra-terrestrial intelligent civilisation, not only would we be able to refine the value of N, but that would also have a profound impact on the human self-centred view of the world.

What we can conclude is that intelligent life is either unique to Earth or very rare in our galaxy and as such we should treasure it.
If we do so, we can increase our value of L, which would be a good thing not only for ourselves but also for any other alien civilisation that may be listening.

David Wallace

Sources:
http://en.wikipedia.org/wiki/Drake_Equation
http://www.seti.org/drakeequation



Frank Drake

Jantar Mantar:
The Astronomical Observatory of Jaipur

In the October 2009 edition of Reflections Bob Fuller wrote an interesting article on the 18th century observatories in Delhi and Jaipur in India.

Both are called "Jantar Mantar" (instrument for calculation) and they comprise architectural astronomical instruments built in the 1720's-1730's by Maharaja Sawai Jai Singh II, a Rajput king during the time of the Mughal Empire.

Jai Singh II constructed a total of five similar observatories in India, including the ones in Delhi and Jaipur.

1- Brihat Samrat Yantra (Giant Equatorial Sundial). Parts of the western and eastern quadrants can also be seen.

The Jaipur observatory is the largest and best preserved of these and during a study tour in Rajasthan with my husband and a group of fellow Australians and New Zealanders in January 2014 I was privileged to be able to visit this facility.

According to a UNESCO study of the site, there are nineteen main astronomical instruments or groups of instruments at Jantar Mantar today.

As a layperson, I was immediately impressed by not only the range of measurements able to be calculated by these instruments but also by the grand scale of many of them.

3- Jantar Mantar with Brihat Samrat Yantra (Giant Equatorial Sundial) in background.

Two instruments particularly caught my eye: the Brihat Samrat Yantra (the Giant Equatorial Sundial) and the Jai Prakash Yantra

The Brihat Samrat Yantra is a sundial that can give the time to an accuracy of 2 seconds and is probably the largest gnomon-sundial ever built.

It is constructed in the shape of a right-angled triangle whose base is 44m long. Its hypotenuse, placed in a north-south facing direction, makes an angle of 27 degrees (an angle equal to the latitude of Jaipur - 27 degrees North) and rises to a height of 27 metres.

The shadow of the hypotenuse (the gnomon) moves across two giant-sized (15m radius) masonry quadrants to the western and eastern sides of the triangle. These quadrants have markings dividing them into 6 hours each, for the mornings and the afternoons respectively.

Further graduations on these quadrants divide them into minutes and seconds. The shadow travels about 4 metres during one hour along these quadrants, or 66mm (about the width of a wrist), each minute.

At apparent noon the shadow seems to disappear as it leaves the western quadrant, but a moment later it begins its journey along the eastern quadrant sliding silently and steadily over the etched hours, minutes and seconds for another six hours. You really can watch time moving.

2- Brihat Samrat Yantra showing the western quadrant on which is marked the hours, minutes and seconds

4- Close up of a quadrant showing some of the divisions of time.

Reflections is published quarterly by the Northern Sydney Astronomical Society Inc
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5- Jai Prakash Yantra with its concave bowl, white marble slabs, and showing the cavities between the slabs in which observers can sit and take readings. Steps leading down into the bowl can just be seen in this photo in the cavity adjacent to the right-most marble slab.

The Brihat Samrat Yantra has other uses.
One of these is the annual practice of studying the movement and direction of the wind from the top of this tall structure to help in forecasting rain.
Crops in India are still reliant on the monsoon so in June and July and coinciding with the full moon, astrologers meet at the instrument and raise a lightweight flag at sunset.
If the flag shows an easterly breeze this is an indication that there'll be good monsoon crops that year.
If the wind is southern in direction, there is little chance of rain and therefore crops will be poor and food shortages could occur.
It is therefore extremely important for the people of India to be able to plan for such disasters.
The Jai Prakash Yantra is another type of sundial. It was the last of the instruments to be built at Jantar Mantar and enabled Jai Singh II and the site's astronomers to verify the readings and calculations of the other instruments.
It consists of two concave bowls, each about 5.5m in diameter. These represent the celestial hemispheres turned upside down and the rim of the bowls represents the horizon.
The two bowls are divided into six marble slabs, and these have markings dividing the slabs into minutes and seconds.
The twelve signs of the Zodiac are also inscribed on the marble along with the meridian and equator.
A metal ring hangs from a thin wire in the middle of the bowls. The shadow of the sun passes through this ring onto the marble surfaces.

Observers can do a number of calculations including local time, altitude, azimuth, zenith distance and declination of the sun and longitude.

For night time observations viewers can go inside the bowls and sit between the white marble slabs. They then observe the celestial body through the hole in the metal ring.

All instruments were built for naked-eye observations and precision was achieved through their massive dimensions.
They were generally constructed of brick rubble and plaster and a few were made of bronze.
20th century restorations have replaced some of the plaster with marble, however experts say that the integrity of the instruments has been maintained.

This open-air observatory was well used during the life of Jai Singh II and employed approximately 20 permanent astronomers. It remained in almost continuous use until around 1800.
During the 19th century the site ceased to function permanently as an observatory however it was restored in 1901 and has been well-maintained since that time and, according to experts, is one of the most complete and impressive collections in the world of pre-telescopic masonry instruments in functioning condition.

Josephine Lindquist

6- The other concave bowl of Jai Prakash Yantra showing markings on the white marble

Sources:
Wikipedia
- *http://www2.astronomicalheritage.net/index.php/show-entity?identity=20&idsubentity=1*

Case Study on the Jantar Mantar in Jaipur in the ICOMOS-IAU Thematic Study on the Heritage Site of Astronomy and Archaeoastronomy (2010), Case Study 6.1 by Michel Cotte.
- *Jantar Mantar Astronomical Observatory of Majaraja Sawai Jai Singh II, Mittal Publishing, New Delhi, 2000*
- *www.aryabhatt.com/samrat_yantra.htm and www.aryabhatt.com/jaiprakash_yantra.htm*

Link to Bob Fuller's article:
http://nsas.files.wordpress.com/2009/12/reflections-oct-09.pdf

Images:
(3) Josephine Lindquist
(1) (2) (4) (6) Graham Nicholson
(5) Howard Davis

Inflation Confirmed

From page 4

"To see this same signal emerge from two other, different telescopes was for us very convincing," says Kovac. "The details have to be worked out, but from what I know it's highly likely this is what we've all been waiting for." says astronomer John Carlstrom of the University of Chicago, Illinois, who is the lead researcher on the SPT. "This is the discovery of inflationary gravitational waves."

Cosmologist Marc Kamionkowski adds: "To me, this looks really, really solid."
He was one of the first cosmologists to calculate what the signature of primordial gravitational waves should look like in the CMB.
The findings are "on a par with dark energy, or the discovery of the CMB, something that happens once every several decades", says Kamionkowski, who is at Johns Hopkins University in Baltimore, Maryland.

The strength of the signal measured by BICEP2, although entirely consistent with inflation, initially surprised the researchers because it is nearly twice as large as estimated from previous experiments.
According to theory, the intensity of a B-mode signal reveals how fast the Universe expanded during inflation, and therefore suggests the energy scale of the cosmos during that epoch.

The data pinpoint the time when inflation occurred, about 10^{-37} seconds into the Universe's life, and its temperature at the time, corresponding to energies of about 1,016 gigaelectronvolts, says cosmologist Michael Turner of the University of Chicago.
That is the same energy at which three of the four fundamental forces of nature, the weak, strong and electromagnetic force, are expected to become indistinguishable from one another in a model known as the grand unified theory.

BICEP2 at the South Pole with the SPT in the background
Picture Steffen Richter/Harvard University

Because inflation took place in the realm of quantum physics, seeing gravitational waves arise from that epoch provides "the first-ever experimental evidence for quantum gravity", says MIT cosmologist Max Tegmark, in other words it shows that gravity is at heart a quantum phenomenon, just like the other three fundamental forces.
Physicists, however, have yet to fully understand how to reconcile general relativity with quantum physics from a theory standpoint.

The researchers reported the findings on March 17th at a press briefing at the CfA, held just after they described their results to scientists in a technical talk.
The team also released several papers describing the results.
In so doing, it seems to have beaten the SPT and also several other groups racing to find the fingerprint of inflation using an assortment of balloon-borne and ground-based experiments and one satellite, the European Space Agency's Planck spacecraft.

More-extensive maps of the B-mode polarization, and especially a full-sky survey, which the Planck telescope may be able to obtain later this year, should provide more clues about how inflation unfolded and what drove it. In addition to looking farther back in time than ever before, the discovery "is opening a window a trillion times higher in energy than we can access with the Large Hadron Collider", the world's premiere atom smasher, notes cosmologist Avi Loeb of the CfA, who is not part of the BICEP2 team.

With the kind permission of Nature 507, 281–283 (20 March 2014)
http://www.nature.com/news/telescope-captures-view-of-gravitational-waves-1.14876

Test Your Knowledge

Just to fill up this blank space...
Can you name this well known open cluster and give some of its characteristics? (Use a mirror to read the solution.)

No, it's not the Eiffel Tower by night!
It's NGC 4755, aka the Kappa Crucis Cluster, aka the Jewel Box.
Containing around 100 stars, it is approximately 14 million years old and is 6,440 ly away.

Picture Jean-Luc Gaubicher.