The PRETORIA CENTRE

of the

Astronomical Society of Southern Africa

www.pretoria-astronomy.co.za

NEWSLETTER MAY 2007

The next meeting of the Pretoria Centre will take place at Christian Brothers College, Pretoria Road, Silverton, Pretoria

Date and time	Wednesday 23 May at 19h15
Chairperson	Lorna Higgs
Beginner's Corner	"Observing variable stars" by Michael Poll
What's Up	by Hein Stoltsz

++++++++++ LEG BREAK - Library open +++++++++++++

MAIN TALK

Leonardo da Vinci's telescope*

by

Prof Andrè Buys (UP)

The meeting will be followed by tea/coffee and biscuits as usual.

The next social/practical evening will be held on Friday 18 May at the Pretoria Centre Observatory, which is also situated at CBC. Arrive anytime from 18h30 onwards.

*See page 9

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Last month's meeting — Fred Oosthuizen

The April meeting was unfortunately rather poorly attended with 28 members and 1 visitor present. Fred Oosthuizen chaired the meeting.

Forthcoming events:

Michael Poll handed out details with regard to an observing weekend which will take place over the weekend June 16. (in-lieu of our annual Nylsvlei trip as the facility is closed for renovations) for further details contact Michael.

In Beginners Corner, Fred Oosthuizen presented a brief history of the pioneers of Amateur Telescope Making such as, William Herschel, Lord Rosse, Lassell, With, von Liebieg (Inventor of depositing Silver onto Glass) and LEON FOUCAULT who developed the Lamp and Knife-Edge test which made it possible for the A.T.M workman to see what he was doing while figuring the reflected surface of the Paraboloidal mirror under construction.
Perfection: That is what the Concave Speculum has attained in the years of late. It is possible for a worker of sufficient skill and experience to set about making a mirror, secure in the knowledge that he can produce the most extraordinarily delicate paraboloidal surface using to days materials in conjunction with the Foucault test procedure.

The Foucault test applied at the **centre of curvature** is still the most commonly used method, thousands of good mirrors made by it in the passed 100+ years provide tangible proof of this fact.

While there is no particular difficulty in interpretation of zonal measurement of the parabolic shadows for mirrors of aperture ratio f/8 upwards, the test becomes increasingly difficult for short-focus mirrors i.e. from f/7 to f/3.

Foucault's test is a **null-test** for a sphere; it is therefore logical to divide an aspherical surface into a number of small practically spherical segments and resort to testing these little spheres in pairs by locating their foci. But with the knife -edge at the crossover point it is still inside the centre of curvature of both little spheres thus reducing the reading to a poorly designed photometer.

If we cover the mirror with a mask twice as wide as the mirror and the same height with a 25mm hole in its centre, and place the mask so that the left edge of the hole is even with left edge of the mirror as viewed from the work bench, and then proceed to move the mask from the left to right across the horizontal diameter of the mirror the average centre of curvature of the small portion of the mirror exposed by the hole traces out a curve which is called the **CAUSTIC CURVE**. Thus there are two modes of expression. AT THE CENTRE OF CURVATURE or ON THE CAUSTIC CURVE.

The process of parabolization starts with a spherical mirror whose caustic curve is a single point (since a sphere has but one centre of curvature) It proceeds with the centre of curvature of each zone slowly being changed by figuring until the mirror produces a caustic curve of the proper shape.

In summing up. The Foucault test applied at the centre of curvature is nulled (greyed out) and measured along the (Y) optical axis, whereas the Caustic Curve test is applied at the exact distance between the centre of curvature of each pair of zones nulled (balancing the number of diffraction lines on each side of the centre of curvature thereby obtaining the zones exact centre) and measured along the (X) horizontal axis, from the outer edge zones in toward the central zone at the optical axis.

In conclusion. The **CAUSTIC CURVE** testing method used in the parabolizing of **fast mirrors** is more precise and therefore more accurate than the standard Foucault testing method.

What's up was presented by Johan Smit in his usual flamboyant style. He handed out a Southern Sky Almanack for the month of May and proceeded to highlight the salient points and happenings that are going to take place in our night sky.

The main speaker for the evening was Ad Sparrius on the subject Asteroids and Comets under the title of **Cubewanos, Alindas, Atens and Centaurs.**

The space between our planets appears to be empty It’s not: Comets, meteoroids and asteroids are found there. These bodies, along with gas and dust, make up the interplanetary debris.

Asteroids: Most asteroids orbit the sun in a belt between Jupiter and Mars, at an average distance of 2.8 AU. A few deviate widely from this value. Icarus actually skirts the sun at perihelion closer than Mercury does. Asteroids are irregular, rocky hunks, small both in size and in mass. The largest known asteroid, Ceres, has a diameter of only about 1000 km.
Most asteroids fluctuate in brightness. Such variations indicate that they may have irregular surfaces or shapes or both.

The albedos of asteroids indicate that they fall into two compositional classes. Some are relatively bright (albedos of about 15 percent) and others are much darker (albedos of 2 to 5 percent), an indication that they contain a substantial percentage of dark matter such as carbon. Those in the lighter class are dubbed S-type asteroids; the darker ones have been christened C-type. The S-type, in addition to having higher albedos, also show spectral features indicative of silicate materials. A third class, called M-type, has characteristic suggestive of metallic substances. They have albedos of about 10 percent. Only 5 percent of asteroids belong in this class.

Based on albedos, compositions in the asteroid belt vary with distance from the sun. Near the orbit of Mars, almost all asteroids have S-type characteristics. Farther out, we find fewer high-albedo ones and more dark ones. At the outer edge of the belt, 3 AU from the sun, some 80 percent of asteroids are C-types.

In the broader picture, why didn’t all this debris and rocky matter form a planet? Probably because of the gravitational influence of the proto-Jupiter, which tugged on the planetesimals just within its orbit. Meanwhile, the sun would pull these planetismats toward it. In this tug of war, the orbits of the planetismals changed from circular to elliptical. Some crashed into others, shattering them into smaller pieces. Some of these pieces caromed into the inner part of the solar system and eventually rained onto the surfaces of Mercury, Venus, the Moon the Earth, and Mars, forming craters, some of which are still evident today. The remainder of the broken planetesimals stayed mainly in the region about 3 AU from the sun; these remnants are today’s asteroids.

Comets: Comets are the snowballs of space. As a comet heads toward perihelion, it grows brighter and sprouts a tail. A comets tail may stretch millions of kilometers and always points away from the sun. Comets have two types of tails: gas and dust. The physical differences between the two show up in there spectra. The spectrum of the gas tail has emission lines. The other tail does not show emission lines, but rather a spectrum of sunlight, reflected from dust expelled out of the coma. The pressure from the sunlight detaches dust from the coma tail.

The gas tails spectrum shows carbon monoxide, carbon dioxide, molecular nitrogen, and free radicals of ammonia and methane. Gas tails point away from the sun because they are blown by solar wind, which consists of ions carrying magnetic fields at high speeds through interplanetary space. For all their stunning length against the sky, comets have very small masses. With so little mass, a comet achieves its spectacular display only by spreading itself very thin.

Many visiting comets that have come our way are now recognized as permanent members of the solar system, with calculated elliptical, periodic orbits, but there are many that have come and gone the orbits of which remain a mystery.

DeepSkyStacker

What is DeepSkyStacker? It is a freeware for astrophotographers that simplifies all the pre-processing steps of deep sky pictures. Go to website

http://deepskystacker.free.fr/english/index.html

Last Month's Observing Evening - by Michael Poll

Not a bad evening. Cloud early on, but it cleared away later. About 15 people attended, including newcomers Olga and her daughter Shirley.

Saturn was the first object visited. It is now well placed for observing. We looked at the Orion Nebula (M42) before it got too low in the west, and later, nearby, we looked at M41, the open cluster in Canis Major.

Early on in the northwest we saw the setting crescent moon, eerily dark when seen in the telescope through some low cloud. Venus was near the moon and the gibbous phase was well shown.

Double stars we looked at were alpha Centauri, alpha Crucis, and, in the north, Gamma Leonis, the star which currently hangs below Regulus in the sickle of Leo.

The brightest part of the Milky Way, the Carina-Centaurus-Crux area is now well placed and was duly scrutinized, although the light pollution was washing out the clusters somewhat. We looked at some of the usual favourites : Theta Carinae (IC 2602) Eta Carinae (NGC 3372). NGC 3532, one of the best open clusters, and NGC2516, an open cluster just off the long axis of the False Cross. Later on the globular cluster Omega Centauri (NGC 5139) was high enough to be seen.

A further observation : April 29th 2007

The Sky Guide 2007 for April 29th 2007 stated that Mars would be 40 arc seconds south of Uranus on this date, the two being in the sky before sunrise, and closely grouped with the star phi Aquarii. This grouping was observed by MP, and it was a wonderful sight in binoculars, with the stars psi 1, psi 2 and psi 3 Aquarii to the south in the same field.

Gauging Angles in the 17th Century - by Michael Poll

Astronomers faced a number of new challenges in the 1600s. Did the earth really move around the sun as Copernicus claimed in his book published in 1543? Were the planetary orbits really ellipses as Kepler's first law had stated in 1609? And …how far away were the stars?
To prove or show any of these things involves the measurement of tiny celestial angles. In order to do this new instruments were invented – around 1640 the modified camera obscura, the long refracting telescope and the visual micrometer appeared. These devices were used extensively over the next few decades to find the shape of lunar and planetary orbits and to improve astronomical constants.

Allan Chapman built replicas of these instruments for use in order to appreciate the inter-relationship of the scientist and the craftsman, and to try and reproduce the 17th century experiments.

Considering Kepler's laws, if the earth moved in an ellipse around the sun, then the sun's apparent diameter would change during the year (by a factor of 3½%), because of the varying distance of the Earth from the sun. The Englishman Jeremiah Horrocks (1618 – 1641) set up a camera obscura whereby a ray of sunlight was admitted through a pinhole into a darkened chamber. Horrocks measured the projection distance and the linear diameter of the sun's image, and then calculated the angular diameter of the sun by trigonometry. Horrocks' friend, William Gascoigne (1612 – 1642) was doing the same experiment. They were working near the December solstice of 1640, when the altitude of the sun was about 13 degrees. Chapman did his experiments at the same time of year, also with a camera obscura.

The results for the solar diameter were:
Horrocks: 1 890 seconds of arc (31,5 minutes of arc)
Gascoinge: 1 980 seconds of arc (33,0 minutes of arc)
Chapman: 1 915 seconds of arc (31,92 minutes of arc)
Current value: 1 955 seconds of arc (32,58 minutes of arc)

The conclusion to be drawn from these measurements was that the method gave consistent results for the solar diameter, and that, if applied throughout the year probably would have shown the sun's seasonal variation in size, and also would probably have provided acceptable proof that the Earths distance from the sun did vary.

Around 1640 Gascoigne invented a form of micrometer, which made use of the measuring potential of a fine-pitch screw. Gascoigne's micrometer was the forerunner of the filar micrometer, a tool later used extensively in astronomical research. Gascoigne's original had two fine-pitch screws that moved a pair of pointers placed at the prime focus of a refracting telescope. The device would fit into a special cell in the eyepiece, so that the moon and pointers would all seen in focus at the same time. The number of turns of the screw per unit of angular measure (a "table of revolves") would be calculated for the particular micrometer. To measure the lunar diameter, the observer started by placing the two pointers together. The pointers were then moved apart by turning the two screws, and the number of turns required to make one pointer touch the left limb of the moon and for the other to touch the right limb was recorded. By this means a measurement of the moons diameter is made. As with the solar measurements, using the focal length of the telescope, and trigonometry, the angular diameter of the moon in the sky can be calculated.

Chapman tried to reproduce the observing conditions as authentically as possible. He set up a "long refractor" of a lens of 65.5 inch (166.4 centimetres) focus in a square wooden tube and used a single element convex lens as an eyepiece. The telescope was supported at one end on the window frame and the eyepiece end was supported on a wooden frame on the floor. There were no fine adjustments, either for focusing or for moving the telescope. Tracking was done by moving the stand along the floor with one's foot because both hands were used for operating the two pointers of the micrometer,. In spite of the tracking difficulty, Chapman found that he could easily, with practice, obtain reproducible results, especially when an object was on the meridian, because its movement there was effectively horizontal (i.e it moved in azimuth, with little or no change in altitude). A modification of Gascoigne's micrometer was introduced in 1667, by his friend and assistant, Richard Towneley. Towneley's micrometer had a single screw, so that one hand was now free to make tracking adjustments.

Chapman measured the diameters of the sun, moon and Venus in order to compare them with values obtained by Gascoigne, and to compare them with the current values. Gascoigne had observed the moon and Venus from Yorkshire between 1640 and 1642. The results are listed in the table.

Notes on the table:

Chapman's observations were all made on a single date, so his range of results, both for the moon and Venus, is a measure of the reproducibility of his measurements, and therefore is a test of his apparatus and of his observing technique. Gascoigne's measurements of the moon were done on many different dates, and the larger range of his results (400" versus 177"for Chapman) although including statistical errors, will also be due to actual size differences in the moon's angular diameter. As with the sun, actual differences in apparent size occur because the moon's orbit around the earth is an ellipse. The column "difference from currently accepted value" was calculated for each individual observation and averaged. In the case of Gascoigne's measurements the "currently accepted value" was calculated for the actual 17th century date that the observations were made. Chapman notes that the results for measurements made by himself and Gascoigne were all too high and suggests that the overestimations of size were the result of glare from the bright objects. Nevertheless, he also notes that Gascoignes's results were much nearer the true value, and Gascoigne had no prior knowledge of what the result should be! As well as the sun and moon, the variation in the angular size of Venus during its various phases might have provided an indication that the planets orbited the sun.

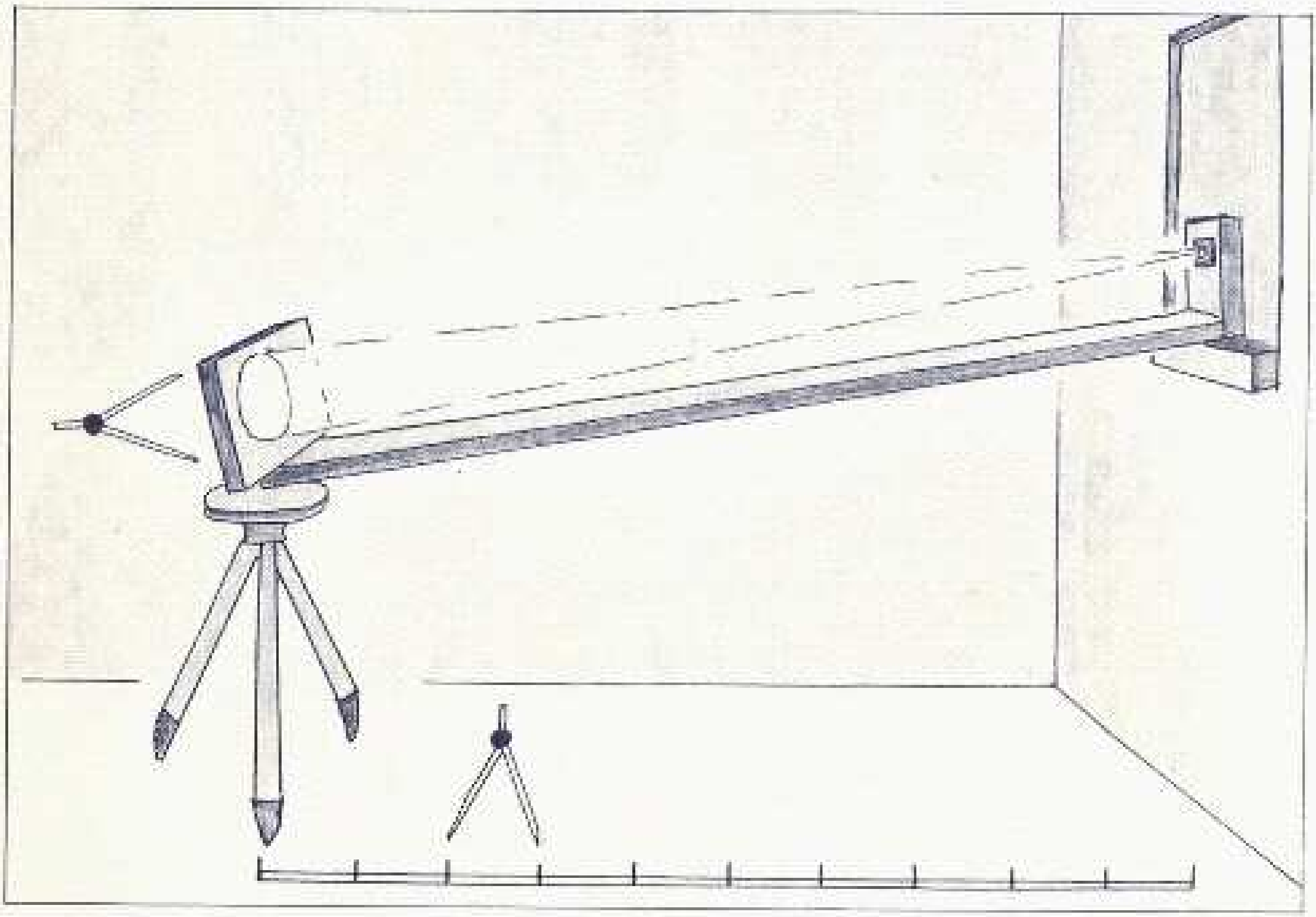
There is no indication in Chapman's paper that measuring the change in apparent angular diameter of the sun, the moon and Venus were used by Horrocks and Gascoigne to prove that that the planets orbited the sun. Horrocks did prove that the moon moved in an elliptical orbit, and was the first person to do so, but it seems that he used the duration of lunar eclipses to show the eccentricity of the orbit, not the change in angular diameter. Isaac Newtom used Horrocks' discovery in developing his theory of gravitation later in the 17th century.

Footnote : Horrocks is the same Jeremiah Horrocks who, in 1639, became the first human to observe Venus in transit across the face of the sun.

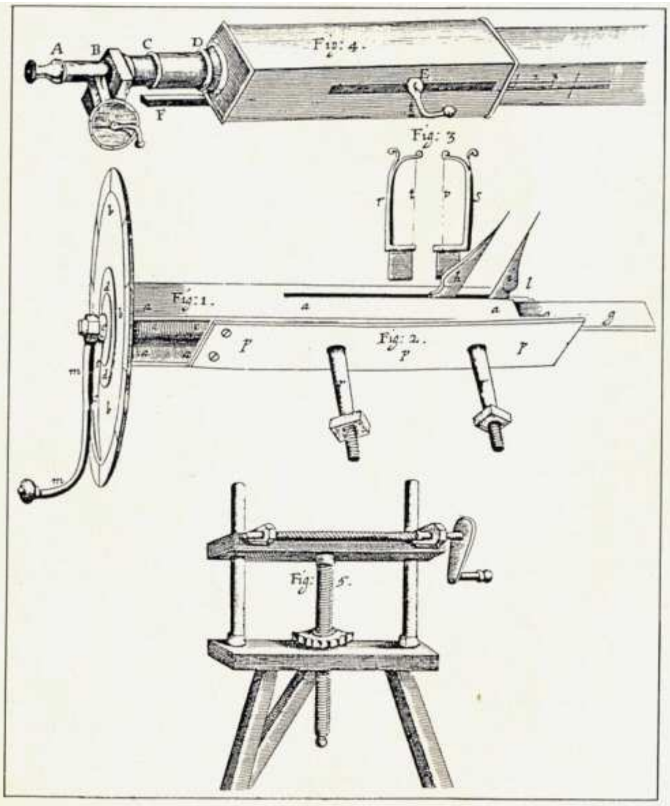
References:

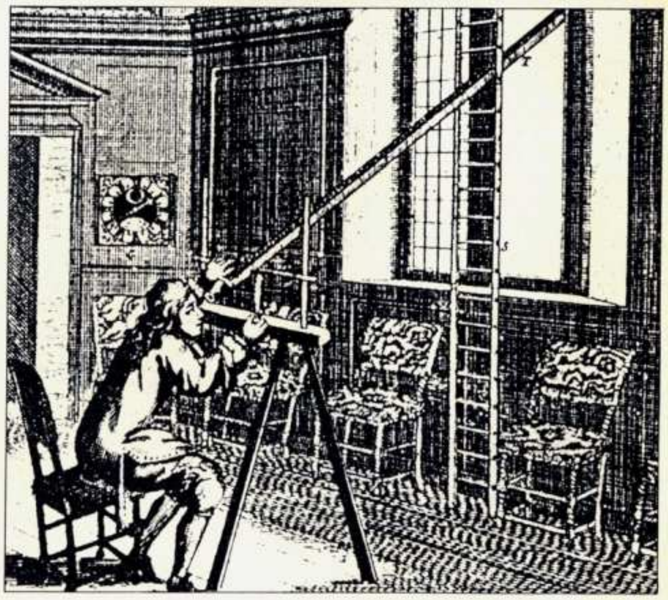
Allan Chapman. Gauging Angles in the 17th Century. Sky & Telescope April 1987 p 362.
IAU Colloquium 196. Transits of Venus: New Views of the Solar System and Galaxy. June 2004.

Observer	Object	No of observa-tions	Observed Diameter	Range	Difference from currently accepted value.
Chapman	Moon	20	1852" - 1929"	177"	+ 121"
Gascoigne	Moon	80	1698" - 2098"	400"	+ 20"
Chapman	Venus	22	44" – 54"	10"	+ 28"
Gascoigne	Venus	1 (?)	25"	N/a	+13"



Early measures of the Sun's diameter were made without lenses. Pinhole projection, a pair of dividers, and a reference scale sufficed. Drawing by the author.





Above: A long refracting telescope at Greenwich Observatory in about 1676. Francis Place's engraving is reproduced by permission of the National Maritime Museum, London.

Left: At a London meeting of the Royal Society in July, 1667, Richard Towneley exhibited Gascoigne's micrometer with improvements of his own. These diagrams of it appeared later the same year in the society's ***Philosophical Transactions.***

364 Sky & Telescope, *April, 1987*

Pale blue dot

The following excerpt from the book *Pale Blue Dot* by Carl Sagan was inspired by an image taken, at Carl Sagan's suggestion, by Voyager 1 on February 14, 1990. As the spacecraft left our planetary neighborhood for the fringes of the solar system, engineers turned it around for one last look at its home planet. Voyager 1 was about 6.4 billion kilometers away, and approximately 32 degrees above the ecliptic plane, when it captured this portrait of our world. Caught in the center of scattered light rays (a result of taking the picture so close to the Sun), Earth appears as a tiny point of light, a crescent only 0.12 pixel in size.

"Look again at that dot. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every "superstar," every "supreme leader," every saint and sinner in the history of our species lived there--on a mote of dust suspended in a sunbeam.

The Earth is a very small stage in a vast cosmic arena. Think of the rivers of blood spilled by all those generals and emperors so that, in glory and triumph, they could become the momentary masters of a fraction of a dot. Think of the endless cruelties visited by the inhabitants of one corner of this pixel on the scarcely distinguishable inhabitants of some other corner, how frequent their misunderstandings, how eager they are to kill one another, how fervent their hatreds.

Our posturings, our imagined self-importance, the delusion that we have some privileged position in the Universe, are challenged by this point of pale light. Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity, in all this vastness, there is no hint that help will come from elsewhere to save us from ourselves.

The Earth is the only world known so far to harbor life. There is nowhere else, at least in the near future, to which our species could migrate. Visit, yes. Settle, not yet. Like it or not, for the moment the Earth is where we make our stand.

It has been said that astronomy is a humbling and character-building experience. There is perhaps no better demonstration of the folly of human conceits than this distant image of our tiny world. To me, it underscores our responsibility to deal more kindly with one another, and to preserve and cherish the pale blue dot, the only home we've ever known."

Left: Planet Earth as seen by Voyager 1 on February 14, 1990.

Editor's note: I have read Carl Sagan's book, and I consider it one of the best books I have ever read. I recommend reading it.

Virtual tour of the solar system

You can do this on website

http://www.nationalgeographic.com/solarsystem/ax/low.html?2d

Een pool van die son kouer

Inligting wat deur die ESA-NASA ruimtetuig, Ulysses, ingewin is wys die eienaardige feit dat een van die Son se pole kouer as die ander is. Hierdie tuig is in staat om die pole waar te neem weens sy unieke gekantelde baan. In die figuur hieronder word die baan van Ulysses getoon. Daar is reeds in 1994 en 1995 vasgestel dat daar 'n temperatuurverskil van 7% tot 8% tussen die pole is, maar niemand kon dit verklaar nie. Na 'n verdere omwenteling oor die Son se Suidpool weet wetenskaplikes dat daar steeds so 'n temperatuurverskil is. Sien webwerf

http://science.nasa.gov/headlines/y2007/20feb_coolmystery.htm?list50005

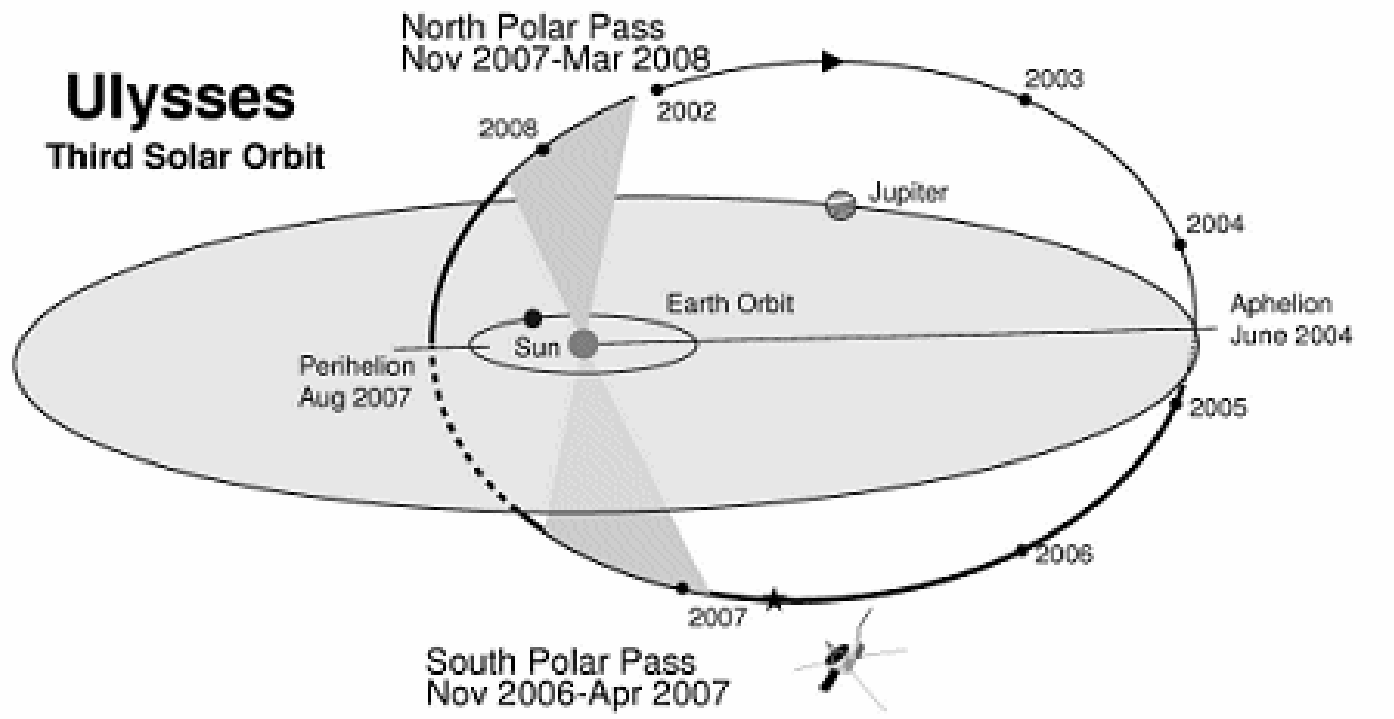


Image capturing and processing

There is an article about image capturing and processing software in MNASSA*, volume 66, nos 3 & 4, April 2007, pp. 78 - 83. This may interest those members who use webcams, CCD cameras or digital cameras with a personal computer for creating astronomical images.

*MNASSA = **M**onthly **N**otes of the **A**stronomical **S**ociety of **S**outhern **A**frica.

This month's main talk

Galileo Galilei (1564 – 1642) is recognised as the first astronomer to use a telescope. However, we know that he did not invent the telescope, but based his design on the invention of the Dutch spectacle maker Hans Lipperhey. But Lipperhey's application for a patent had failed because it was not recognised as novel, especially after other Dutch spectacle makers also claimed to have made the invention. So who invented the telescope? Some of the other contenders are Roger Bacon (1220 –1292), Leonardo da Vinci (1452-1519), and Leonard and Thomas Digges (1520-1595). The work of these and other candidates will be discussed, but the focus of the presentation will be on Leonardo da Vinci's contribution. The talk will include a demonstration of a working model of Leonardo's telescope.

History of Deep Space Station 51 at Hartebeesthoek

What is now the Hartebeesthoek Radio Astronomy Observatory was originally built in 1961 by NASA, the National Aeronautics and Space Administration of the USA, as a tracking station for its probes that were being sent to explore space beyond Earth orbit.

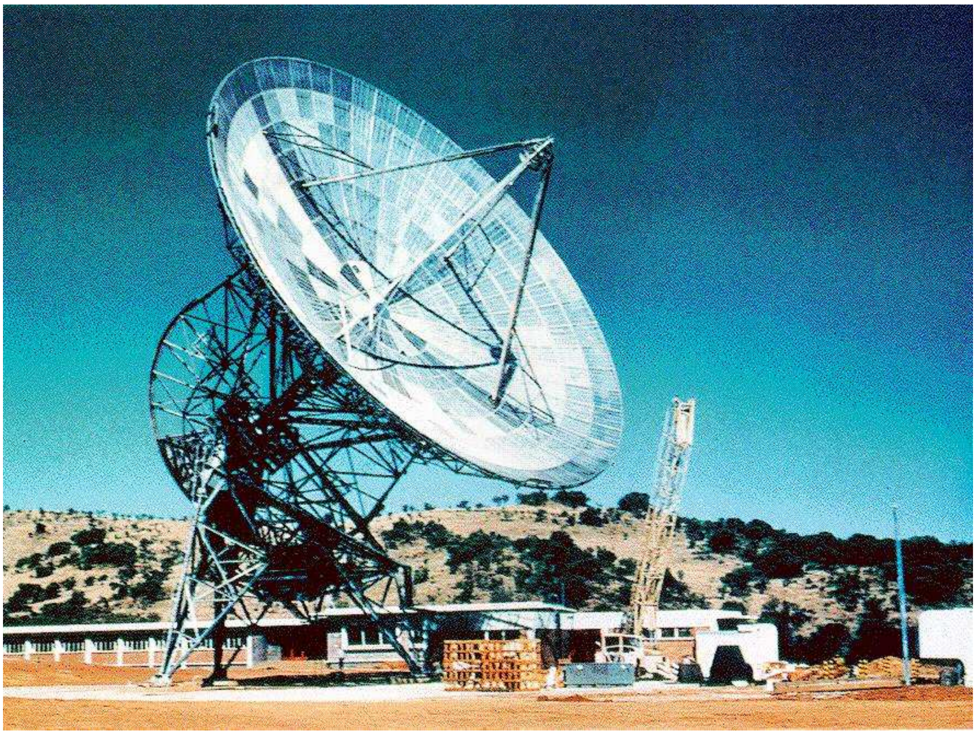
The facility was actually operated by the South African Council for Scientific and Industrial Research (CSIR) on behalf of NASA, until its closure in 1974. It became a radio astronomy observatory, operating under first the CSIR, then the Foundation for Research Development (FRD), which became the National Research Foundation (NRF) in 1999.

The antenna was originally built with an aluminium mesh surface, and operated at a frequency of 960 MHz, or a wavelength of about 30 cm.

The photograph below shows the appearance of the telescope shortly after completion, with a very light tetrapod supporting the 960-MHz microwave feed mounted at the primary focus.

Read more about its history on website
http://www.hartrao.ac.za/other/dss51/dss51.html

Read more about the chronology of South African astronomy on website
http://assa.saao.ac.za/html/his_-time-line.html



Prys ontvang

Navorsers by die PUK kampus van Noordwes Universiteit vorm deel van die "High Energy Stereoscopic system" (HESS) navorsingsgroep wat die Descartes Prys vir Wetenskap in Brussels op 7 Maart ontvang het. In die Europese Unie word hierdie prys algemeen beskou as die "Nobelprys" vir transnasionale wetenskaplike groepe. Prof. Okkie de Jager van NWU is projekleier van die Suid-Afrikaanse groep. (Hy het by ons byeenkoms in Julie verlede jaar 'n voordrag gelewer.)

First Light for VLT's Auxiliary Telescope No. 4

On the night of 15 December 2006, the fourth and last-to-be-installed VLTI Auxiliary Telescope (AT4) obtained its 'First Light'. The first images demonstrate that AT4 will be able to deliver the excellent image quality already delivered by the first three ATs.

The VLT is composed of four 8.2-m telescopes (Antu, Kueyen, Melipal and Yepun) on top of Cerro Paranal in Chile. They have been progressively put into service together with a vast suite of the most advanced astronomical instruments and are operated every night in the year.

Contrary to other large astronomical telescopes, the VLT was designed from the beginning with the use of interferometry as a major goal. The VLT Interferometer (VLTI) combines starlight captured by two or three 8.2-m VLT Unit Telescopes, dramatically increasing the spatial resolution and showing fine details of a large variety of celestial objects.

SA possible site for another giant new telescope project

South Africa is one of the locations under consideration for the location of the proposed European Extremely Large Telescope (E-ELT). This country already hosts the Southern African Large Telescope (SALT), which was inaugurated in November last year and released its first research results recently. But while SALT has a mirror which is 10 m in diameter – currently the biggest in the southern hemisphere and the largest in Africa – the E-ELT would have a mirror with a diameter of around 42 m.

The agency behind the E-ELT is the European Southern Observatory (ESO), which has 11 member countries. It is based in Garching, near Munich, in Germany. Its telescopes are located in Chile.

Chile and South Africa are the main locations for optical astronomy in the southern hemisphere, because both can provide very favourable environmental conditions for the science. The ESO originally (in 2005) considered a project designated Overwhelmingly Large Telescope (OWL), which would have had a primary mirror with a diameter of 100 m – a staggering size which would have made it by far the biggest telescope ever. The OWL would have been able to see earth-size planets orbiting other stars.

A review board concluded that, while OWL was technically feasible, it would be far too expensive, with a cost estimated at around €1,5-billion. (About R15-billion.) So the concept was scaled down to a telescope with a mirror with a diameter between 30 m and 60 m.

Read more on website
http://www.engineeringnews.co.za/eng/utilities/search/?show=92373

IYA2009

The International Year of Astronomy 2009 (IYA2009) will be a global celebration of astronomy and its contributions to society and culture, stimulating worldwide interest not only in astronomy, but in science in general, with a particular slant towards young people. IYA2009 will mark the monumental leap forward that followed Galileo Galilei's first use of the telescope for astronomical observations, and portray astronomy as a peaceful global scientific endeavour that unites astronomers in an international, multicultural family of scientists working together to find answers to some of the most fundamental questions that humankind has ever asked.

IYA2009 is, first and foremost, an activity for the citizens of Planet Earth. It aims to convey the excitement of personal discovery, the pleasure of sharing fundamental knowledge about the Universe and our place in it and the value of the scientific culture.

The vast majority of IYA2009 activities will take place on several levels: locally, regionally and nationally. Several countries have already formed National Nodes to prepare activities for 2009. These Nodes are collaborations between professional and amateur astronomers, science centres and science communicators.

IYA2009 website: **http://www.astronomy2009.org/**

A website has been created for South Africa's IYA2009 outreach. It is

http://astronomy2009.saao.ac.za/home/

Editor's note: I think we should start thinking how our Centre can get involved in this**.**

Sad news

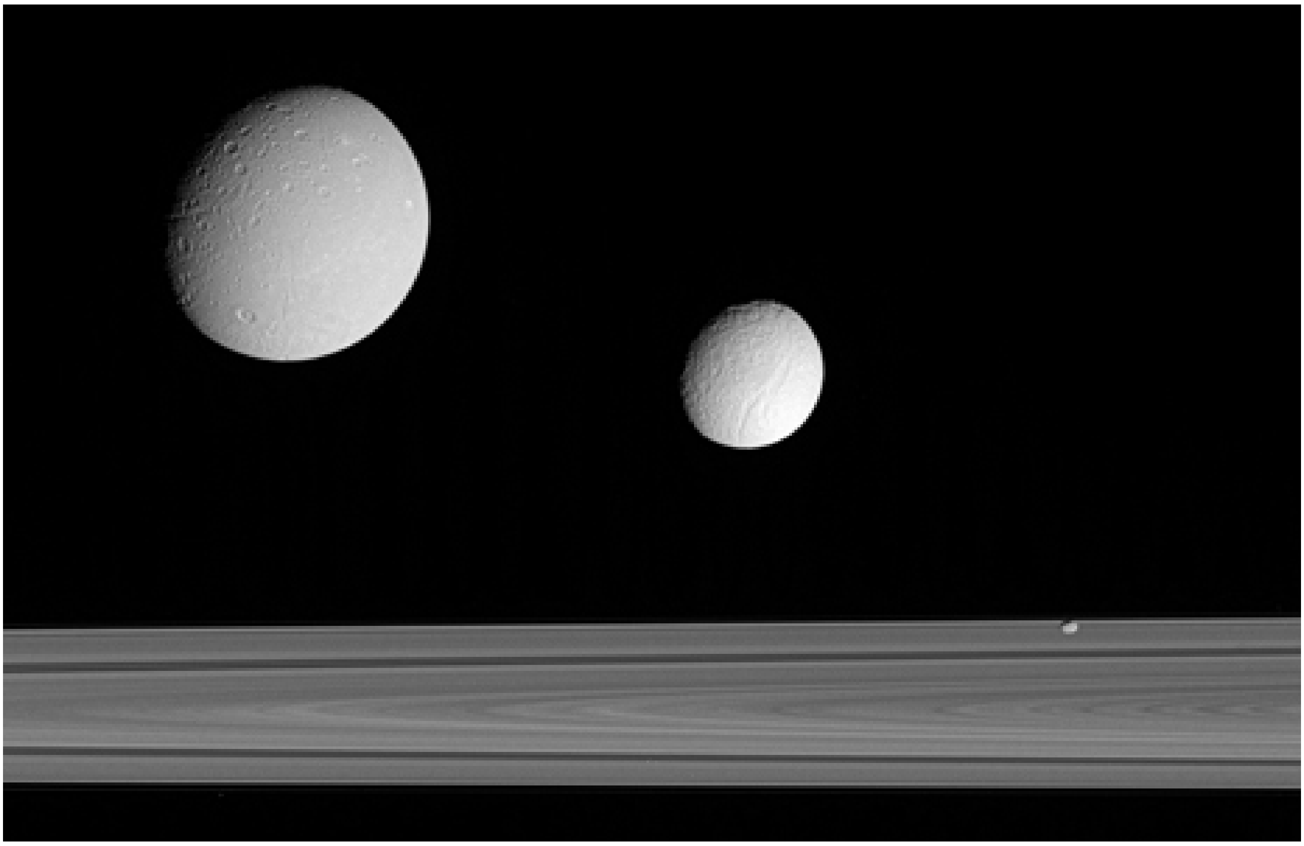
Alan Hamer Jarrett was born on 2 February 1925 and died on 28 January 2007. He obtained a Ph.D. at St Andrews University in Britain in 1952. During his life he occupied several positions. Amongst these were a lectureship in Astronomy at St Andrews University, a lectureship and later a senior lectureship in Astronomy at Queen's University in Northern Ireland, Director of the Boyden Observatory near Bloemfontein, and Professor of Astronomy at the University of the Orange Free State.

Drie van Saturnus se mane

'n Beeld teruggestuur aarde toe deur die Cassini ruimtetuig wat tans om Saturnus wentel. Bokant die ringsisteem is drie van Saturnus se talle mane. Van links na regs is hulle Dione (deursnit 1118 km), Tethys (1059 km) en Pandora (79 km).

Sien meer beelde op webwerf

http://www7.nationalgeographic.com/ngm/0612/feature1/gallery1.html



Stellarium

Stellarium is a free open source planetarium for your computer. It shows a realistic sky in 3D, just like what you see with the naked eye, binoculars or a telescope.

Website: **http://www.stellarium.org/**

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Curator of Instruments :	Johan Smit 083 306 1199 (c)
Member :	Dirk Wolmarans 083 303 0348 (c)
Member :	Fred Oosthuizen 072 373 2865 (c)
Member :	Hein Stoltsz 083 302 5096 (c)