

CANOPUS

The Astronomical Society of Southern Africa

Johannesburg Centre

Monthly Newsletter for March 2002

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**The Sir Herbert Baker Library, 18a Gill Street, Observatory, Johannesburg
P.O.Box 93145, Yeoville, 2143**

Editorial

Having recently returned from a short visit to the pollution-free (light pollution that is...) Overberg region, I wonder at the difference in viewing between the various areas in our country. I commented, several months ago, on the condition of the skies in the KZN South Coast area where even on clear and relatively unpolluted nights, there seems to be a haze which affects the general viewing. In the Overberg, (L'Agulhas to be precise) we have a coastal area which seems to have no haze at all and the seeing is really crisp and clear. It must be something to do with the lack of humidity at Cape Agulhas. On the way back from the coast, we stayed overnight at a farm near Colesburg and were treated to an even better view of the heavens. In fact, we saw so many stars that it was difficult to make out some of the constellations. The view through a pair of small 8 x 40 binoculars was brilliant and when using larger 10 x 50 glasses, it was quite breathtaking. What a pity we can't organise convenient power cuts in Jo'burg during viewing evenings at the observatory.

Jupiter and to a lesser extent Saturn are still putting on a good show for observers and Venus has started to climb up into the evening skies, though she's a little early at this time.

Wolf Lange supplies the next in his series, "The A to Zee of Astronomiee" covering items starting with the letter "D" and **Eben van Zyl** lets us in on the techniques used by astronomers of old - in particular, those used by Kepler.

Brian Fraser gives us some pointers to a few heavenly happenings for the next 2 months, including a table of the rising and setting of the Sun and the 5 "original" planets. Remember, if you need the tables for the Sun, Moon and Planets - just dive into the website where they will shortly be loaded covering the whole year.

ECLIPSE chasers - remember we have a solar eclipse on 4th December. If you would like to be there, contact a committee member, or Brian Fraser for further details on how to get to the area of interest.

The Editor

chris@penberthy.co.za

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Notice of Monthly Meeting

The Monthly Meeting of the Johannesburg Centre of the Astronomical Society will be held in the Sir Herbert Baker Library, 18a Gill Street, Observatory, on Wednesday the 13th of March, 2002 at 20:00.

Plotting Meteors and Fireballs

By: **Tim Cooper**

Telescope Making Classes

Would you like to make your own telescope?...or finish off a partially finished one? Well your opportunity has arrived (once again). Join the Telescope Making Class being held under the guidance of Brian, Evan and Chris. Contact Brian on (016) 366-0955 if you are interested.

If you have any ideas for topics or subjects that you feel should be presented at future meetings of the Johannesburg Centre, please contact one of the Committee members, or email us with the details thereof.

The Editor.

Public Viewing (*weather permitting*)

Public viewing nights are held *subject to suitable weather conditions* on the Friday nearest First Quarter, and are held at the Old Republic Observatory, 18a Gill Street, Observatory, Johannesburg. Starting time around 19:30. *See the ASSA event calendar for the proposed viewing dates.*

Centenary Star Party/Braai/Social day

There are some very old telescopes in this country of ours. One of them is the 18-inch refractor, "The McClean", at the observatory in Cape Town, which celebrated it's centenary a year or two ago.

Another is the Franklin-Adams 10-inch F4.5 photographic refractor, which is now housed at the old Broederstroom observatory overlooking the Haartebeespoort dam, which is 100 years old this year.

This telescope was housed at the Union observatory in Johannesburg for many years and was used to take the photographic plates on which Proxima Centauri (the closest known star to our sun) was discovered. It was also used to discover most of the 146 minor planets that were found at the Johannesburg observatory.

To celebrate this fine old lady's 100th birthday, the Johannesburg and Pretoria centres will be jointly holding a star-party at the Broederstroom observatory on the afternoon and evening of April 20th 2002.

There is another telescope on the site, the twin 16-inch Rockefeller refractor (which was also used for photography). You are all invited to come along. Bring some mopani worms to braai, or something, and some witsblitz to drink. Plenty of space for the kids to run around and a nice koppie to climb, as well as a stone-age structure with some archaeological significance on the site.

Please come along. Directions will be provided in next month's issue.

Brian Fraser

ASSA Jo'burg Centre - Calendar of Events

Month	Day/ Date	Event	Details
Mar	Thu 7 - Sun 10	ASSA stand at HobbyX	The Dome@Northgate
	Sat 9	Overnight at Tswaing Crater	Dr Dion Brandt
	Mon 11	Committee Meeting 17:30	
	Wed 13	Monthly Meeting	Trevor / Tektites
	Fri 15	<i>Public Viewing</i>	Meteorite Workshop
	Fri 29	Easter Expedition / Kalahari Safari > 7/4	Trevor
Apr	Mon 8	Committee Meeting 17:30	
	Wed 10	Monthly Meeting	Basic Quantum Theory / Rob Scott
	Fri 12	<i>Public Viewing</i>	
	Sat 20	Broederstroom visit: Celebration of centenary of Franklin-Adams telescope	
May	Mon 6	Committee Meeting 17:30	
	Wed 8	Monthly Meeting	Fermi's First Reactor/ Mike Smith
	Fri 17	<i>Public Viewing</i>	
	Sat 18	Telescope Extravaganza	Chris S
Jun	Mon 10	Committee Meeting 17:30	
	Wed 12	Monthly Meeting	TBA
	Fri 14	<i>Public Viewing</i>	FireWalking
Jul	Mon 8	Committee Meeting 17:30	
	Wed 10	ASSA Jo'burg Centre A.G.M.	
	Fri 12	<i>Public viewing</i>	
Aug	Fri 9	<i>Public Holiday - probably no viewing</i>	
	Mon 12	Committee Meeting 17:30	
	Wed 14	Monthly Meeting	TBA
Sep	Fri 6	<i>Public viewing</i>	
	Mon 9	Committee Meeting 17:30	
	Wed 11	Monthly Meeting	TBA
Oct	Mon 7	Committee Meeting 17:30	
	Wed 9	Monthly Meeting	TBA
	Fri 11	<i>Public viewing</i>	
Nov	Fri 8	<i>Public viewing</i>	
	Mon 11	Committee Meeting 17:30	
	Wed 13	Monthly Meeting	TBA
Dec	Tue 3	Star Party at Tshipese before	
	Wed 4	Solar Eclipse 2002	
	Mon 9	Committee meeting	
	Wed 11	Year End Monthly Meeting	Informal get together and viewing

Reminders

2002	ASSA Symposium / hosted by Pretoria Centre/ poss. At Aloe Ridge December 4, Solar Eclipse
2003	Centenary of Flight August: Mars opposition
2004	Centenary Sir Herbert Baker Library Building Johannesburg Centre to host 2004 ASSA Symposium June 8, Venus Transit

The “A to Zee” of Astronomiee.

By: Wolf Lange

A selective mixture of interesting terminology, objects, people of interest to all that love and are involved in Astronomy. Compiled by Wolf Lange who will deny any wilful exclusions

Sources include: Collins Dictionary of Astronomy 2nd Edition, Burnhams Celestial Handbook Revised and Enlarged Edition, Patterns in the Sky by Julian DW Staal and the Amateur Astronomers Handbook by JB Sedgwick.

Dark Matter – Matter that probably comprises 75% of the mass of the Universe but is undetectable except by its gravitational effect. The term missing mass was coined amounting to between 10 and 100x the amount of visible matter in the galaxies. In the 1970s research in rotation of spiral galaxies have shown that these galaxies have Dark Halos containing 10x more matter than the visible parts of the galaxies. This topic is still getting a high level of attention from scientists and astronomers. Our own Prof. Bloch has done significant research work in this field.

Dark Nebula – an absorption nebula that is of such density that it obscures partially or completely the light of stars and other objects behind it. Normally these nebulas become visible to the naked eye as dark extrusions because of their positioning in front of emission or reflection nebulas.

Declination - a co-ordinate used with Right Ascension, in the Equatorial Co-ordinate System. The declination of a celestial body is its angular distance between 0 and 90 degrees North or South of the Celestial Equator.

Deep Impact – a NASA mission planned for January 2004, to intercept comet Tempel 1 on July 4, 2005. It is proposed to send a 500kg copper projectile into the comet and study the ejected matter from both the spacecraft and ground based observatories.

Deimos – a satellite of Mars lying further from Mars than the slightly larger Phobos. Irregular in shape (15 x 12 x 11km) it is too small to be called a moon. Like Phobos, it may be a captured asteroid similar to the Carbonaceous Chondrite meteorites.

Delphinus (the Dolphin) – a small constellation in the northern hemisphere near Cygnus. The brightest stars being 3rd magnitude (a) and 4th magnitude (b). Approx position: RA 20.5h dec +10degrees and an area of 189 sq degrees.

Deneb – a very luminous white super giant that is also the brightest star in the constellation of Cygnus, lies at one end of the arm of the northern cross. Distance about 500 pc.

Despina – a small satellite of Neptune discovered in 1989.

Dione – a satellite of Saturn discovered in 1684. With a diameter of 1120km it just about qualifies as a moon. It is also slightly larger than Tethys. It has one important characteristic in that it is non-uniform in brightness with the trailing hemisphere being dark and the leading hemisphere being distinctly brighter.

Diurnal – happening in a 24 hour day (daily).

Dobsonian – a telescope with a simple yet very stable altazimuth mounting. Pioneered by John Dobson it is popular for large-aperture, short-focus reflecting telescopes. In addition to providing a simple low cost mount design for telescopes, John Dobson also popularised Astronomy through the means of “pavement” Astronomy i.e. taking the telescope to the ordinary people in cities and suburbs who normally would not have access to either an Observatory or private telescopes.

Donati and De Cheseaux comets – two magnificent comets of the past.

Donati 1858 VI was famous for its Coma with multiple haloes.

De Cheseaux 1744 reached a magnitude of –3 in February. Named after a Swiss astronomer.

Dorado – another small southern hemisphere constellation which contains large parts of the Large Magellanic Cloud with a 3rd magnitude extremely luminous star S Dorado and the Tarantula Nebula NGC 2070, an extensive luminous emission nebula that is a grouping of H II regions characterised by rapid complex motions. It is a strong radio source and visible to the naked eye away from the city lights. The most luminous object lies in its centre and is designated R136. Three components designated a, b and c have been observed by the Hubble

Space Telescope and it found that R136a is an extreme dense cluster of 12 massive young “O” stars within a region only 0.25 parsecs across! (<1ly).

Double star – a pair of stars that appear close together. There are optical and physical double stars. Optical can be described as “in the line of vision” they appear to be double. If we physically moved ourselves to a position far away from earth – even outside of our solar system on either side of the double star, the two stars will no longer appear as a double star. An example is DENEb appearing close because they lie nearly in the same direction if viewed from earth.

Physical simply means the stars are in actually in the same close space vicinity and a good example is: Alpha Centaurus, through a moderate telescope we’ll see two different bright stars near each other.

Dumbell nebula – (M27 NGC 6853) a Planetary nebula in the constellation of Vulpecula. It has an hour-glass shape, a magnitude of 7.6 (not visible

to the naked eye) and covers 330 x 900 arc seconds.

Dwarf – normally short for dwarf star but can also refer to dwarf cepheids, dwarf galaxies, dwarf novae and dwarf planets.

Dwarf stars are any stars that lie on the main sequence of the Hertzsprung – Russell diagram.

Dwarf cepheids are a group of pulsating variables that are classed as RR Lyrae stars with a low luminosity and a short period of about 1 to 5 hours.

Dwarf galaxies – a faint galaxy because of small size, very low surface brightness or both. Since galaxies range from giant ellipticals downwards, the dividing line between average and dwarf is somewhat arbitrary

Dwarf novae – a group of intrinsically faint stars that are characterised by sudden increase in brightness occurring in intervals of weeks or months, the maximum brightness lasting only a few days.

Franklin-Adams Centenary Preview

In just a few short weeks, the historic Franklin-Adams telescope will achieve its century of existence at what was formerly the southern station of Leiden observatory, in Broederstroom. The last time this telescope was seriously used appears to be 1986, when a team of people (including my late father in law, Frank von Maltitz) manned it to photograph Halley’s Comet. Since then, it has essentially languished. In recognition of its soon-to-be birthday, Brian Fraser rallied the troops to clean it up. To this end, several of us pitched up on Sunday 17 Feb.

In my case, it was very much a mixed feelings situation. It was certainly nice to renew my acquaintance with the instruments and the site. However, seeing the extent to which the area has become built up, devastating the surroundings, was extremely dismaying. What was virgin bush not that long ago, has transmogrified into timeshare resorts, conference centers and houses; there is even a shopping center and a petrol station virtually next door. Doubtless the sky, while still better than in the city, has been seriously degraded. On the other hand, the grounds themselves are in some respects better maintained than they were in that golden era when the ASSA Johannesburg Centre was regularly enjoying their use as a dark-sky site.

As it happens, my relatively late arrival and the fact that the telescope itself has weathered well meant that there was little for me to do but take a few photos, chat to the group and enjoy a picnic lunch. In fact, it was all very mellow. Frans van Nieuwkerk and Melvyn Hannibal diligently exercised broom and vacuum cleaner, some metal polishing was performed. Needless to say, a fair degree of prognosticating occurred. All in all, the scope seems in good shape, needing only the odd minor mechanical attention, a lick of paint and the eviction of the mud-dauber wasp’s nest to be presentable. The grease has of course gone a bit dusty and therefore gungey. These sorts of things will be handled in the near future by students from the Pretoria Technikon, under the watchful eye of Louis Barendse of the ASSA Pretoria Centre. Louis has already done sterling work getting the other instrument on site (the twin 16-inch Rockefeller telescope) into shape, as well as performing invaluable work on the 60-inch at Boyden.

Soon you will read announcements of the celebration to be held at the observatory to honour the telescope and the people who used it to make history. You should make the effort to join us! In the meantime, here’s a sneak preview of what you will see.

--- Chris Stewart

Mars Odyssey Mission Status

MEDIA RELATIONS OFFICE
 JET PROPULSION LABORATORY
 CALIFORNIA INSTITUTE OF TECHNOLOGY
 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 PASADENA, CALIF. 91109. TELEPHONE (818) 354-5011
<http://www.jpl.nasa.gov>

NASA's Mars Odyssey spacecraft is now in its mapping orbit after completing two maneuvers this week to fine-tune its nearly circular orbit and prepare it for the start of the science mission.

At 12:14 p.m. Pacific Time today, Odyssey fired its thrusters for 25 seconds and decreased the velocity of the spacecraft by less than 2 meters per second (less than 4 miles per hour).

On Monday, January 28, Odyssey fired its thrusters for 15 seconds, increasing its speed by just over 1 meter per second (about 2.5 miles per hour).

"These small orbit trim maneuvers complement the larger maneuvers we executed two weeks ago and tweak the orbit to get just the right altitude and ground track coverage that we desire. The net effect is that we move the periapsis point, the point nearest the planet, directly over the south pole and keep it there," said Bob Mase, Odyssey's lead navigator at NASA's Jet Propulsion Laboratory, Pasadena, Calif. "We are now in our final mapping orbit and we don't expect to perform any additional maneuvers to change the orbit."

Engineers are continuing to check out the spacecraft systems and science instruments in

preparation for the science mapping mission that will begin in February. Two of the science instruments, both neutron spectrometers that are part of the gamma ray spectrometer suite, are currently operating and collecting science data about the composition of the Mars surface.

JPL manages the 2001 Mars Odyssey mission for NASA's Office of Space Science, Washington, D.C. Principal investigators at Arizona State University in Tempe, the University of Arizona in Tucson, and NASA's Johnson Space Center, Houston, Texas, operate the science instruments. Additional science investigators are located at the Russian Space Research Institute and Los Alamos National Laboratories, New Mexico. Lockheed Martin Astronautics, Denver, Colo., is the prime contractor for the project, and developed and built the orbiter. Mission operations are conducted jointly from Lockheed Martin and from JPL, a division of the California Institute of Technology in Pasadena. NASA's Langley Research Center in Hampton, Va., has provided aerobraking support to JPL's navigation team during mission operations.

Any wannabe eclipse tour guides out there?

Please can you publicise that I am receiving a number of enquiries from tour organisers in SA, Botswana and Zimbabwe for knowledgeable persons to assist with their tours for the solar eclipse on 4 December 2002.

Most operators are offering a free ride to and from Johannesburg (plus accom / grub) to view the eclipse, and in exchange want someone who can keep their guests informed as to what will be / is happening in the sky.

Any enquiries to be sent to me - rigel@stars.co.za or eclipse@stars.co.za and I will put them directly in contact with the tour operator.

Regards and clear skies!

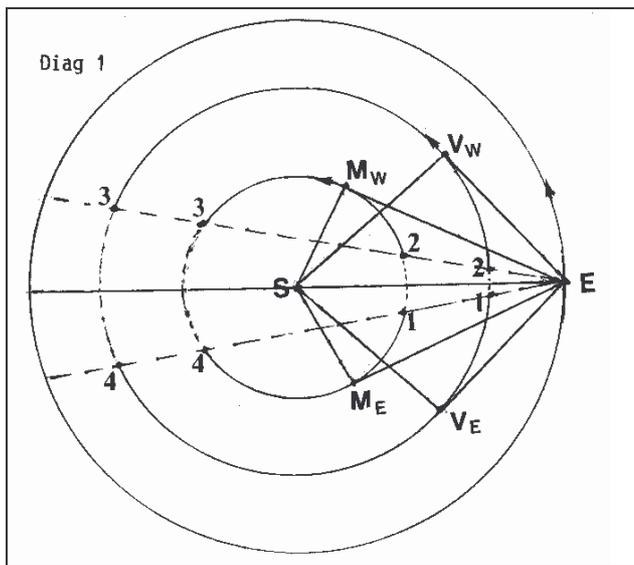
Peter Tiedt

rigel@stars.co.za

Visit my website at <http://www.eclipse.za.net>

HOW DID KEPLER DO IT?

Tycho Brahe (1546 - 1601) spent about twenty years measuring the positions of the planets against the background of the stars; especially Mars which could be seen for most of the year, whereas Mercury and Venus were visible for only parts of the year: in the evenings when they were in eastern elongation (east of the Sun) between points 4 and 1 in their orbits (Diagram 1); and in the pre-dawn sky when they were west of the Sun between points 2 and 3. At other times they were lost in the glow of the Sun.



M_w V_w Greatest western elongation of mercury and Venus west of the Sun before sunrise,
 M_e V_e greatest eastern elongation of Mercury and Venus east of the Sun in the evenings.
 Between points 1 and 2 and between 3 and 4 the two planets are lost in the glow of the Sun, then being less than 10° from the Sun.

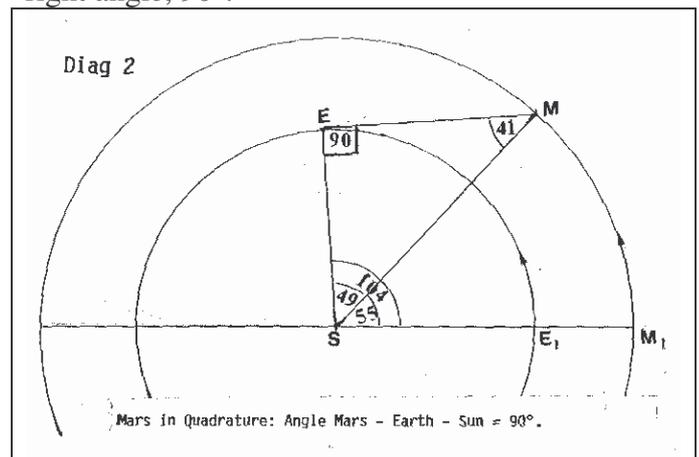
In this diagram the sizes of the orbits are drawn to scale. Mercury's sidereal year is only 88 days and its synodic period 116 days. It takes Mercury 116 days to move from a certain point against the sky relative to the Earth and Sun to return to the same point after one revolution round the Sun. Venus has a synodic period of 584 days.

Of these days Mercury spends 11 days in moving from point 1 to point 2 and 26 days from point 3 to 4 so that it is invisible for 37 days out of the 116 days of its synodic period. The remainder, 79 days is equally divided between eastern and

western elongation from points 2 to 3 and 4 to 1; about 40 days each. Venus is visible between points 2 and 3 and between points 4 and 1 for periods of 245 days and invisible for periods of 12 days between points 1 and 2 and also for 83 days between points 3 and 4.

The angles of greatest elongation varied for the positions in the orbits of these planets because their orbits are ellipses as Kepler proved. Kepler (1571 - 1630) made use of the average greatest elongation when the angles Earth - planet - Sun were 90° to work out the distances of these planets from the Sun in terms of the Earth's distance which was not accurately known in those days - so Kepler called it 1 ASTRONOMICAL UNIT. From Brahe's measurements Kepler found the average greatest elongation of Venus to be $46,5^\circ$ and that of Mercury $22,75^\circ$. In the case of Mars, Kepler made use of the position of Mars when it was in QUADRATURE, i.e. when the angle Mars - Earth - Sun ($M E S$) was 90° (Diag 2).

From Brahe's measurements, Kepler found that, on average 105,5 days elapsed between the opposition of Mars when Sun - Earth - Mars were in a straight line ($S - E_1 - M_1$) and the quadrature of Mars when the angle Sun - Earth - Mars, was a right angle, 90° .



Now, in 105,5 days the Earth moves through $105,5 \div 365,25 \times 360$ degrees. This equals 104° . In the same period of time. Mars moves from M_1 to M through an angle of $105,5 \div 687 \times 360 = 55^\circ$. (Mars' sidereal period, the time that Mars takes to make one revolution round the Sun is 687 days and it was well known from Tycho's measurements)

Therefore, the angle ESM = $104 - 55 = 49^\circ$.

Since the sum of the angles of a plane triangle is 180° , angle EMS = $180 - (90 + 49) = 180 - 139 = 41^\circ$. So Kepler was able to make a scale drawing of triangle SEM and measure according to scale the relative distance SM of Mars from the Sun in terms of the Earth's relative distance ES which is 1 astronomical unit. In Diagram 3 the Earth's distance from the Sun is reduced to 200 millimetres. To determine the relative distance of Mars: construct the right angle SEM and construct the angle ESM which equals $90^\circ - 41 = 49^\circ$. Then measure the distance SM, the relative distance of Mars from the Sun. It is found to be 305 mm, correct to 1 millimetre.

$$\therefore \frac{\text{Relative dist of Mars from Sun}}{\text{Relative dist of Earth from Sun}} = \frac{SM}{SE} = \frac{305}{200}$$

= 1.525 astronomical units..

To determine the distance of Venus construct angles SEV = $46,5^\circ$ and ESV = $90 - 46,5 = 43,5^\circ$ on SE. The angle SVE will be 90°

$$\therefore \frac{\text{Relative dist of Venus from Sun}}{\text{Relative dist of Earth from Sun}} = \frac{SV}{SE} = \frac{145}{200}$$

= 0.725 astronomical units

The reader should try and construct these triangles and see how easy it is to get answers close to those obtained by Kepler.

Kepler found the correct values for the relative distances of these planets by making use of trigonometry. In the triangle SEM, right angled at E, the ratio SE divided by SM is the sine of angle SME.

The ratio $SM \leftarrow SE = 1 \leftarrow$ ratio of SE over SM
this = $1 \leftarrow \sin 41 = 1 \leftarrow 0,6561 = 1,524$.
astronomical units. In triangle SEV (for Venus)
 $SV \leftarrow SE = \sin \text{ of SEV} = \sin \text{ of } 46,5^\circ = 0,725$
astronomical units. In the case of Mercury: sine
of SEMe = $\sin 22,75^\circ = 0,3867$. astronomical
units.

Diag 3

MARS: Draw SE 200 mm long (= Dist. Earth - Sun).

Construct right angle SEN. Construct angle ESM $\angle = 49^\circ$. Join SM. It will be found to be 305 mm correct to 1 mm.

^.*. Dist. Sun - Mars ^ S M ^ 305 < ^ ,,,
\ Dist. Sun - Earth S E 200
|4|\ VENUS:

Tswaing Impact Crater visit

The Johannesburg Centre has organised a visit to the Tswaing Impact Crater, 50 odd kilometres North of Pretoria on the Onderstepoort road on Saturday 9 March 2002.

We will meet at 10:00 at Tswaing Crater Museum and will be guided through the geology by Dr Dion Brandt of U.Witwatersrand.

There is an entrance fee of R7.00/pp. The Centre also requests a small donation...

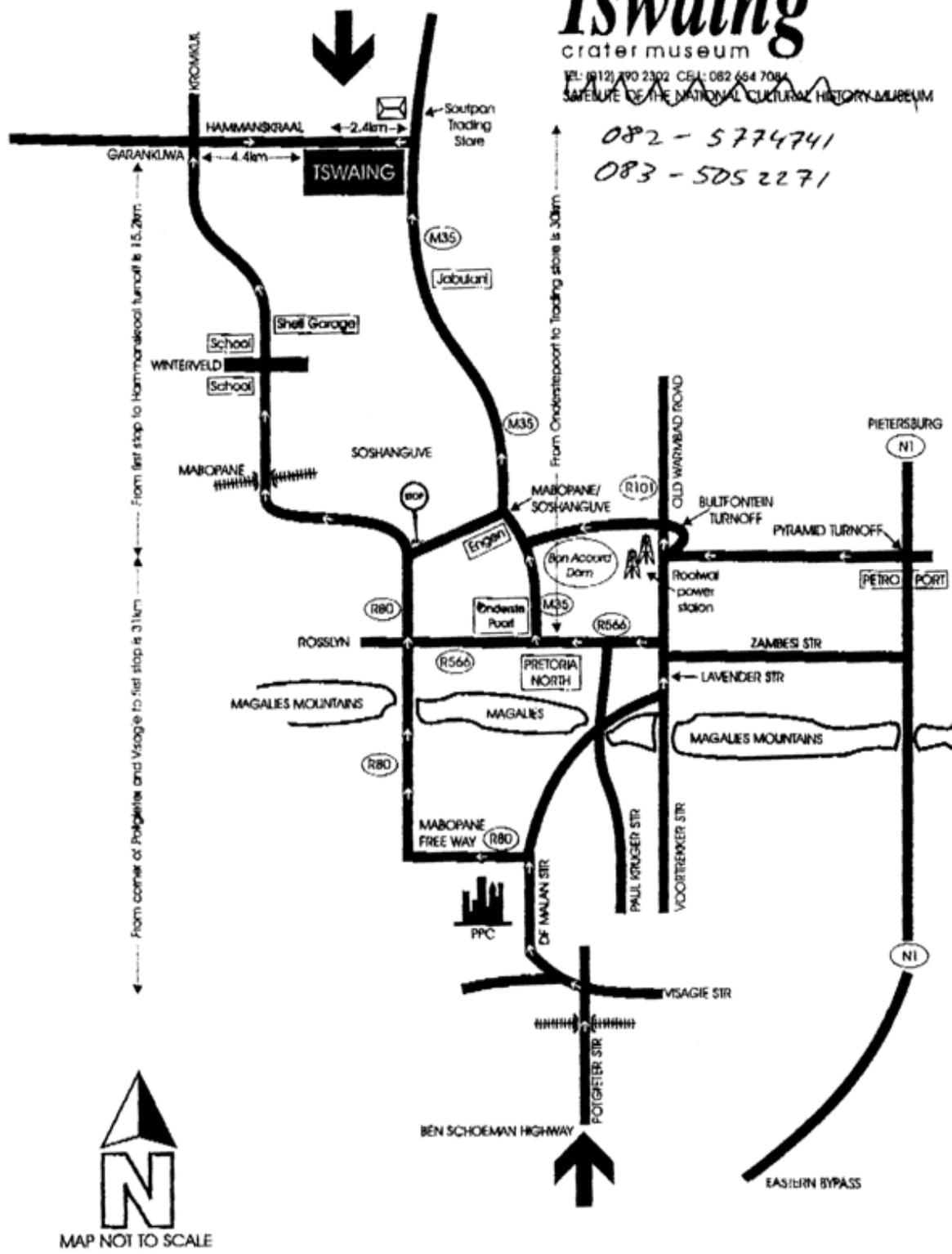
Following the geology tour, we hope to hike through the wetlands surrounding the crater and do some bird-watching. Later we will braai [bring your own] down in the crater and set up telescopes [bring that too!] and camp.

Rondawels may be booked at 012-790-2302 or bring your own tent.

We will leave Tswaing Sunday morning.



082 - 5774741
083 - 5052271



An indication of the number of participants is needed, so please let Trevor Gould [083-212-8945] know.

“ScopeX” Telescope & Astronomy Exhibition

Do you:

- Own or want a telescope or related gadget, be it self-made or bought...
- Have accessories, books, magazines etc. of an astronomical nature to swap/sell...
- Have something of interest that you would like to show off...
- Just enjoy talking astronomy and telescope making?

Then...

Join the ASSA Johannesburg Centre’s ScopeX Telescope & Astronomy Exhibition.

The intention is for ScopeX to be an annual event for the astronomers and sky gazers of Gauteng (and beyond) to meet and mingle, generate public interest in astronomy and attract new members to ASSA and the Telescope Making Class.

This year’s event is provisionally scheduled for Saturday 18 May.
It will start around mid-day and close with a star party in the evening.

We would like you all to participate - as exhibitors, organisers and visitors!

Contact us NOW!

Name	Phone
Chris Stewart	011 763 3301 (Home)
Lerika Cross	082 650 8002 (Cell)
Evan Dembskey	011 340 4017 (Work)
Brian Fraser	011 871 0423 (Work)

Mailto:scopex_comm@list.to

<http://www.angelfire.com/de/evyn/>
http://www.aqua.co.za/assa_jhb.htm
<http://home.mweb.co.za/mw/mwgringa/>

COLUMBIA BEGINS THIRD DECADE IN SPACE WITH FEB. 28 LIFTOFF

*NASA*News@hq.nasa.gov

RELEASE: 02-29

America's first Space Shuttle, Columbia, will return to orbit fresh from two years of work that have left it safer and more capable than ever before.

Columbia is set to launch Feb. 28 at 6:48 a.m. EST on mission STS-109, pending review of data on the Space Shuttle's hydraulic pump attach bolts. The mission is dedicated to maintaining and enhancing the Hubble Space Telescope, the fourth such flight since the telescope's launch in 1990.

"Returning Columbia to orbit to improve the Hubble Space Telescope is a fitting start to what will be a busy and vital year in space." Said Space Shuttle Program Manager Ron Dittemore. "We have more spacewalks planned in the next 12 months than we have ever done in a single year. We are going to fly diverse missions, dedicated to satellite maintenance, research and Space Station assembly, showcasing capabilities unique in the world. The shuttle team has done a great job in preparing for this mission."

A maintenance and upgrade period completed last year installed a new "glass cockpit" in Columbia, increased its cargo capacity, strengthened its crew cabin and enhanced the protection of its cooling system from orbital debris.

The Sky this Month

March 2002

dd hh	dd hh
1 14 Jupiter stationary	18 01 Mars 4.0 N of Moon
6 01 LAST QUARTER	20 10 Saturn 0.4 S of Moon...Occn.
9 02 Mercury 1.2 S of Uranus	20 19 Equinox
10 09 Neptune 3.7 N of Moon	21 04 Pluto stationary
11 17 Uranus 3.9 N of Moon	22 02 FIRST QUARTER
12 01 Mercury 2.7 N of Moon	22 11 Jupiter 1.1 S of Moon...Occn.
13 22 Moon at apogee	28 06 Moon at perigee
14 02 NEW MOON	28 18 FULL MOON
15 06 Venus 4.0 N of Moon	31 15 Saturn 4.1 N of Aldebaran

April 2002

dd hh	dd hh
4 15 LAST QUARTER	15 23 Mars 2.4 N of Moon
6 16 Neptune 4.0 N of Moon	16 20 Saturn 0.8 S of Moon...Occn.
7 08 Mercury in superior conjn.	17 23 Mercury greatest brilliancy
8 01 Uranus 4.2 N of Moon	18 22 Jupiter 1.6 S of Moon
10 04 Moon at apogee	20 12 FIRST QUARTER
12 19 NEW MOON	25 14 Moon at perigee
13 06 Mercury 4.4 N of Moon	27 03 FULL MOON
14 17 Venus 3.1 N of Moon	29 13 Mars 6.4 N of Aldebaran

LOCAL TIMES of RISE and SET for the MAJOR PLANETS, 2002

Site Location:- Long. **+28.0** deg. Lat. **-26.0** deg.

Local Time:- UT **+2.0** hrs.

Date	Sun		Mercury		Venus		Mars		Jupiter		Saturn	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
Mar 02	6.03	18.37	04.07	17.22	06.53	19.15	09.42	21.01	14.40	01.08	12.36	23.19
Mar 12	6.08	18.27	04.32	17.31	07.09	19.11	09.35	20.43	14.01	00.29	11.59	22.41
Mar 22	6.13	18.16	05.06	17.41	07.25	19.07	09.28	20.27	13.24	23.52	11.23	22.04
Apr 01	06.18	18.06	05.49	17.53	07.41	19.03	09.21	20.11	12.48	23.16	10.47	21.28
Apr 11	06.23	17.56	06.40	18.09	07.58	19.02	09.14	19.55	12.13	22.41	10.12	20.52
Apr 21	06.27	17.46	07.35	18.28	08.16	19.03	09.06	19.41	11.39	22.08	09.37	20.17