CANOPUS

The Astronomical Society of Southern Africa

Johannesburg Centre

Monthly Newsletter for November 2001

Contents:

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

Editorial

The early morning skies are quite interesting at present - what with Saturn and Aldebaran sitting staring at each other from fairly close range - the one slightly reddish and the other a sort of buttery yellow. One can make out a reasonable amount of detail on Saturn at present, as long as you have a sizeable amount of mirror (or lens as the case may be) collecting the light for you. Jupiter is also still very bright and no longer has to contend with Venus, which is dropping into the morning light, to vie for the title of the brightest object in the morning sky. Orion rises as his nemesis the Scorpion sets and stands above us as a uniquely identifiable constellation.

Of course, the big news this month is that Mars Odyssey has successfully entered its initial elliptical orbit around Mars, and will soon begin aerobraking in order to attain its final circular mapping orbit. *Well done to NASA's JPL and especially the Mars Odyssey team.*

Wolf Lange supplies the next in his series of "The A to Zee of Astronomee" with the first of a multi-part on the letter "C". **Eben van Zyl**'s article, "A Turning Point in Astronomy" tells us of the techniques developed by some Astronomers to calculate the distances to the Stars and Galaxies.

Bruce Dickson supplies an answer to Val's question regarding the Speed of Light as well as submitting an article on the Tinsley telescope, showing us that we do indeed have a unique 'scope on our site, and **Brian Fraser** has supplied us with a general guide to the skies above for the next 2 months. These tables of astronomical happenings are very useful to find daily items of interest and I can highly recommend them.

Those of you who attended the last monthly meeting were privileged to hear a really good presentation by **Bill Sheehan**, noted astronomical writer and historian. As Mars is once again in the news, his talk was all the more appropriate at this time in "history". You will also find a couple of articles relevant to Mars in this issue of Canopus.

Once again a plea to those who have not already done so - please pay your subs for 2002 as soon as possible *and more importantly, fax or email us the proof of payment.* If you don't let us know you've paid, we can't update the database and *Canopus is printed according to the number of active members shown therein*. So if you are subsequently are able to show that you had paid, but had not proved this at the time, we will probably not be able to supply you with a back issue of our own magazine.

The Editor

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Notice of Star Party

We will be having our Annual Star Party in place of the November Monthly Meeting of the Johannesburg Centre of the Astronomical Society. It will be held at Dave Gordon's smallholding in Blue Hills, Midrand, from about 16:00 on the 17th November 2001, and continue through the small hours of the 18th when we hope to have a good view of the Leonids meteor shower.

We start off with a bring 'n braai to build up energy for the evening, so bring along all the food that you wish to eat and drink and if you have a portable braai, bring that along as well as we don't know how many of us there will be - hopefully all of you.

Venue:	**81 Tambotie Road, Blue Hills Midrand**
Tel:	**(011) 702-1219**
Time:	**from 16:00 onwards**

Future Meetings

December	*No meeting*	
January 9th 2002	**Multi-wave Astronomy**	**Tom Marsicano**

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.

Annual Star Party 2001 - 17/18th November
At Dave Gordon's fairly dark site in Midrand
where we will also be able to see the Leonids.

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. The last one of 2001 will be held on 23rd November

Annual Subscription Fees

There are no changes to the Johannesburg Centre's subscription fee structure for the 2001/2 year. The joining fee remains R50-00 and the Annual fee R100-00. The Family membership subscription fee also remains unchanged at R125-00. The Family membership is restricted to couples and their co-resident dependants and although all Family members receive full rights as members of the Centre, only one copy of the monthly magazine, Canopus, will be posted to the family address. The annual subscription form was included with the September issue and we would like to urge you as members to pay your subs as early as possible to enable your committee to plan the Centre's projects for the year ahead.

Please post your subscription fee, or deposit/transfer it directly into the Society's bank account at **NEDBANK**. The Account information is as follows:-

Bank:		NEDBANK
Branch	Name:	Park Plaza
	Code:	19 21 42 44
Account	Type:	Current Account
	Number:	1921 013761
	Name:	ASSA Johannesburg Centre

Please remember to write your name on the deposit slip or to include your name as a reference on a direct transfer. Then fax the details to the Treasurer to let him know that you have paid via direct deposit or transfer so that you will be kept on the Canopus mailing list.

Jo'burg Centre Outings for 2001

Boyden - We are busy attempting to negotiate a suitable weekend with Martie Hoffman. The 60" is out of commission at present (maintenance), but the other instruments are also pretty useful in their own right.

The **Suikerbosrand Nature Reserve**. Wolf Lange has organised several enjoyable visits to this site near Heidelberg and says it is an ideal spot for clear viewing. He will continue with these outings and if you are interested, contact him by phone or email as per the table under the editorial.

Tswaing Crater - we're still trying to set up a day visit under the guidance of Prof. Reimold. This will probably be done on a Saturday but we'll have to wait an see what can be set up.

We will be organising two "outings" involving **Tony Voorvelt** - one to see the new solar observatory on top of the Physics building at Wits and one to be entertained / amazed by his Great Magic Physics Show.

Another visit to the Gamma Ray observatory in Potchefstroom is also in the offing.

Other ASSA Centres (e.g. the Pretoria Centre) - and try to see if we can organise some joint ventures.

If any of our members have places they would like the society to visit, approach one of your committee members with the request and we'll discuss it in committee. Alternately, just send an email to the editor and I'll make sure it is brought up in committee.

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.

A Solo Dark Sky Search 20 - 22 August 2001

When I purchased my telescope in December of '98, I promised myself that I would one day embark on a solo excursion in search of dark skies. This after realising that my astronomical passion - deep sky galaxies - was beyond reach in the murky light-polluted skies of suburban Randburg. I fondly recall my early experiences with a telescope; frustrating evenings searching in vain for those bright galaxies that MUST be within range of a telescope of this size (10 inch Schmitt Cassegrain). Honestly, after an hour of neck twisting, back breaking searching, I could not even locate Centaurus A!

I have experienced what I call a "crystal inky black night" only once - where the stars glitter like diamonds just above your finger tips. The stars are so bright and the sky so dark that the two appear completely disassociated with one another. That was back in May '98 when I was on business at a tea plantation northeast of Louis Trichardt.

Like an addict craving to match that very first "high", I excitedly stocked my Jetta with my telescope, star charts, sleeping bag, Cadac, table, chair, basic food stuff, and a map.

I drove west on Monday. At around 4pm, somewhere between Delareyville and Stella, I decided on a right-hand turn onto an old farm road. My first task was to find a farm house and ask permission to stop somewhere in the farm fields for the evening. Finding the farmhouse was a relief after some of the worst corrugated, axel-wrenching dust road I had yet experienced. A very fierce looking elderly lady answered the door. In stammering, nervous and halting Afrikaans, I told her I was an amateur astronomer from Johannesburg looking for a dark site to set my telescope and take some photographs of the stars. Her face broadened into a wide grin as she realised I wasn't the least bit menacing; just some crazy stadsjaapie (city slicker) and enthusiastically offered me the run of the farm.

With renewed confidence and faith in humankind's amazing hospitality, I set out in search of a nice tree to park under for the night - this was the most difficult task of the entire excursion. Plenty of straw bales to park next to

but no trees. I must have driven 10 hectares flat looking for a tree. Distant farm workers watched in fascination as this little blue Jetta traversed the fields like a wannabe tractor.

Just as the sun was kissing the western horizon, I found a location that seemed painted on a farmland postcard. A tall tree, some stone ruins and a rusted 1960's pickup. As I leisurely set my scope, munched at one-minute noodles and sipped a glass of fresh orange juice, I realised that this IS what it means to love stars. As astronomical twilight finally faded, my dream began to realise.

Not a farm light or city glow in sight - just inky black sky with crystal stars. I whooped with joy as I focussed on the lagoon nebula. A gentle nudge northwards and the Trifid Nebula was as three-dimensional in the eyepiece as a child's 3D viewer. A quick look at Omega Centauri - oh, my goodness! Dumbbell nebula - ah, stunning clarity. Butterfly Cluster - crystal - diamonds!

Right, out with the camera. I had a few hours to spare before the realm of the galaxies began their dance in Fornax and Sculptor. So, best to apply the time to some long awaited astrophotography of as many "Hollywood" objects as I could bag.

Ten exposures later and I already felt my impromptu adventure was well worth it. Lagoon, Trifid, Dumbbell, Omega Cen, 47 Tucana, Butterfly cluster, Jewel Box - they were all there, rolled neatly into the receiving spool in the camera. Now it was time for a festival of Galaxies. Fortunately, no other human ears heard my exclamations of joy.

It must have been close to 3am when, exhausted, I finally snuggled into my sleeping bag in the passenger seat. Then, snorting, puffing and munching next to the car. Cows! I checked the time - 6am. Time for breakfast. After managing to coax the cows a distance away from the car, and more importantly, the telescope, I settled into a 'boot hotel' breakfast of muesli, yoghurt, muffins and coffee. By the way, cows don't eat bananas.

With the car packed, and a successful night of astro-photos and spiral galaxies under the belt, I was ready to go deeper west. I found a filling station in Stella with a clean rest room where I washed and freshened up for the exciting day of discovery ahead.

Somewhere between Vryburg and Hartswater, I decided to turn left this time. More torturous suspension-rattling road. Exasperated and hot under the collar, I parked the car next to an old acacia tree. The whole of South Africa is fenced and locked! And I need a 4x4 - this is killing my car!

A bakkie stopped next to me and the farmer climbed out. I introduced myself and again offered my poor Afrikaans - he accepted, saying my Afrikaans was better than his English. I again explained myself the same way as the previous evening. He opened his farm to me! I said I was just looking for a tree to park under and I would be no trouble and leave no mess at all. He went on to offer me a bed, hot bath and breakfast the next morning. I politely declined but insisted that he and his wife come and view through the telescope that evening. He accepted excitedly and promised to call me on my cell phone to confirm an arrival time for the evening.

That hot afternoon, under a large acacia tree, I set the scope, ate a delicious lunch out of the boot and slept deep and long in the passenger seat of the car. I was dreaming of surfing on galaxies when a familiar snorting sound woke me. Cows! What is it with my car and cows?

Dinner was my special hotpot mix on a steaming bed of rice. Home cooking right there in the middle of nowhere has a very special flavour. A beautiful sunset and a lovely feeling of anticipation for the night ahead. Henk and Francina were right on time for their personalised tour of the southern skies. They asked intelligent, searching questions about the stars, light years and UFO's. I was amused by their sudden irritation at their neighbours' distant farm lights. Henk immediately dialled the phone number of one of his neighbours to complain but fortunately only received a mailbox message.

Alone again and total darkness. Paradoxically, I felt so completely safe. It may be a false sense of security but I felt I had travelled far away from crime. If I was unlucky enough to encounter safety issues, then I would probably also be unlucky enough to be hit on the head by a flaming bolide. I happily dispensed with the

programmed unease that we all have in unfamiliar environments and enjoyed a structured tour and tagging operation on the Fornax, Sculptor and Centaurus galaxies. I also indulged in attempting a wide-field panorama photo set of the Milky way galaxy, beginning with the Southern Cross and ending at Cygnus. Regular intervals of coffee, rusks and cup-a-soup - the hunger and thirst wolves were kept well in check.

Bed time was a more reasonable 2am and I was awoken by a totally unexpected visitor - the cold. One valuable lesson learned during this adventure was that a vehicle becomes a refrigerator at 5.30am. I was breathing vapour clouds inside the vehicle. A lone feathered raptor sat transfixed in the acacia tree as I ran laps around the car to warm my toes.

Total cost of solo adventure: 1½ tanks of fuel, some cooking gas, a 20 litre drum for water and a few cans from the pantry! Total preparation and planning time: Sunday afternoon! Value - gorgeous memories that will stay with me for life.

Dave Gordon

Dave supplied some 'photos of his expedition but these did not reproduce too well in monochrome. They will however appear on the web-site in glorious colour. Ed.

The "A to Zee" of Astronomee.

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.

Callisto – the faintest of the four giant Galilean Satellites of Jupiter. Heavily cratered with a radius of 2 400km it has interesting ray systems i.e. craters with radiating bright streaks. There are also some major concentric ring mountains near to the huge Valhalla Basin – slightly north of the equator. Callisto is thought to have a thick crust of ice and rock of at least 200km depth, covering a layer of convecting water or soft ice.

Canals – linear markings on Mars that were first observed by Giovanni Schaparelli in 1877 and later charted by many observers most notable by Percival Lowell who strongly advocated that they were irrigation ditches dug by Martians to distribute the planets rare water resources. For many years these markings confounded observers until both the early Mariner and Viking spacecraft observations show that neither the canals nor the associated plant growth on the assumed embankments, exist.

Cancer (the crab) – faintest of the 12 constellations of the Zodiac between Gemini and Leo. In ancient Egyptian history also seen as a Beetle or Lobster and by the Tibetans as a Frog. The cancer constellation contains many double and variable stars, the beehive open cluster (Praesepe) and the fainter open cluster M67 as well as a strong radio source NGC 2623.

Canis Major and Minor (Sirius and Procyon) – in Greek mythology these are the two hunting dogs of Orion the hunter. Two of the three stars making up the northern hemisphere winter triangle or our southern hemisphere summer triangle. The third star of the triangle is Betelgeuse, the second brightest star in the constellation of ORION. Sirius is shimmering blue-white and the brightest star next to the sun and Procyon is yellow-white (See further information under Sirius and Procyon later on).

Capricornus (sea goat) – a southern hemisphere zodiac constellation following Sagittarius. It contains the globular cluster M30. Also the general area where the minor meteor Capricornids "showers" are observed, maximising on 25 July.

Carbon or C stars – red giant stars of low temperature that have an over abundance of carbon relative to oxygen in their surface layer. These "cool" stars combine carbon and oxygen atoms to form stable carbon monoxide All carbon stars undergo mass loss enriching the interstellar medium with considerable carbon, some nitrogen and oxygen. In earlier Harvard classification, carbon stars were divided into *R & N* stars. *N* stars were the classical carbon stars many of which were discovered in the Magellanic clouds and other galaxies. *(Carbon, nitrogen, oxygen are all vital building blocks of life as we know it – it makes you wonder what's out there!)*

Cartwheel galaxy – a remnant of a large galaxy that has been distorted by a head-on collision with a small neighbour into a shape resembling a cartwheel. *This sounds like a great object to observe with a decent size telescope because*……. the "hub" and "spokes" of the wheel are formed by the old stars of the original galaxy and are surrounded by a "rim" of young blue stars and ionised gas triggered by a rippling outward shock wave. Now next question: *Where is this object?!*

Cassegrain – Guillaume *Cassegrain* a Frenchman who designed an excellent innovative telescope with a convex hyperboloid secondary mirror mounted inside the focal plane of the primary mirror. The final image is project through a hole in the centre of the paraboloid primary mirror where the eyepiece is placed just behind the primary normally in a stardiagonal fitting for easy viewing. This type of telescope design has been adopted for most modern large reflectors and it effectively "triples" the focal length within a third of the physical dimensions of the telescope!

Cassiopeia – a conspicuous northern hemisphere constellation named after the queen of Ethiopia. The outline is in the shape of a slightly skewed capital letter *W* and can also be imagined as the crown adorning the royal head of the queen.

CCD – "Charged Coupled Device". one of many new innovations brought about by the revolutionary advancements of computer technology. It is a light sensitive electronic detector, invented as far back as 1970 *(I thought I would never write that the 1970s were far back!!)* and now widely used in ground- and space-based astronomy for Imaging, Photometry, Spectroscopy and Astrometry. What makes CCDs special is the ability to have wide-spread sensitivity over a wide range of wavelengths from blue to near-infrared. Further advancements have pushed CCD ability into infrared, ultraviolet & X-ray regions. Compared to photographic plates CCDs are small – normally only a few square centimetres, covering a relative small field of view.

Astronomical CCDs are fabricated as a two-dimensional arrays of tiny pixels on a thin wafer of semiconductor – normally silicon – with literally thousands of rows and columns of pixels. Each pixel responds to the photons falling on it by producing electrons. The values that result from the exposure are digitised and stored in computer storage for further analysis. CCDs can be super cooled with liquid gasses to reduce "noise" when charges are moved out of a CCD into computer storage.

Celestial equator – imagine the terrestrial equator being projected against the sky – in short that would represent the celestial equator. The plane of the celestial equator is perpendicular to the celestial axis and is the reference plane for the equatorial co-ordinates Right Ascension and Declination used for….. correct….. to find objects like stars, clusters and galaxies in the sky using e.g. setting circles. *Important Note:* the celestial equator is slowly changing – about one zodiac constellation shift per every 2 000 years – as a result of the Precession of the Earth's axis.

Cepheid – ever wondered how the distances of stars are measured that are too far away to use the diameter of the earth's orbit around the sun as a baseline? Cepheid variables are used in this process.

Cepheids are a large group of very luminous yellow supergiant stars that are pulsating variables with periods mainly in the range of 1 to 50 days. Over 700 are known in our galaxy and several thousand in our local group. Found in two areas of galaxies, we have Type I or classical Cepheids that are found in spiral arms on the galactic plane and less common type II which are much older and less massive, are found in the galactic centre or halo.

The refurbished Hubble Space Telescope can study classical Cepheids in galaxies as far away as the Virgo cluster (about 15 megaparsecs). By measuring period vs absolute magnitude Baade and Kukarkin demonstrated the two categories. This in turn forms the basis for measuring the distances of stars further than about 300 ly away and galaxies.

We'll continue with C in the next edition of Canopus.

Wolf Lange

A TURNING POINT IN ASTRONOMY

Up to the beginning of the 20th century astronomers were able to measure the distances of stars only as far as 300 light years. The first measurement of a stellar distance was accomplished by Friedrich W Bessel (1784 - 1846) who, in 1838 succeeded in measuring the distance of the star 61 Cygni, a 5th magnitude star. He chose this star because it has a large proper motion, moving 5,2 seconds of arc per annum against the background of the stars. Bessel found the parallax of 61 Cygni to be 0,31 arcseconds, which meant that its distance was 1 ÷ 0,31 = 3,2 parsecs, i.e. 3,2 x 3,25 = 10,4 lightyears.

E Henderson at Cape Town had measured the parallax of Alpha Centauri in 1831 - 33 but the calculations were only completed in 1839**;** so he just missed being the first.

By this trigonometrical method the parallax that theoretically could be measured was 0,01 seconds of arc, namely a distance of 1 ÷ 0,01 = 100 parsecs = 100 x 3,26 = 326 light years. At distances of 300 light years the probable error in the measurements was as great as the measurements themselves, the accuracy thus being ± 50%. In all directions around the Earth, astronomers could therefore measure stellar distances encompassing a sphere of diameter 600 light years. We know today that the diameter of the disc of the Milky Way is 100 000 light years. 600 is only one one-hundred and sixty-sixth of the diameter of the Milky Way. Most of the stars in our Galaxy are crowded together near the centre of the Galaxy and we occupy a position near one of the outermost spiral arms and we had succeeded in measuring the distances of one to two thousand close-by stars.

During the first twenty years of the 20th century a great dispute arose among astronomers as to whether the nebulae seen in the sky were within the bounds of the Milky Way or whether they were outside the limits of the Milky Way. Things came to a head when Harlow Shapley and Heber Curtis faced each other in open debate at the National Academy of Sciences, USA. Shapley maintained that those nebulae which showed spiral structures were masses of gas within the Milky Way and not outside it. He ascribed their continuous spectra as due to the scattering of light from nearby stars. Curtis maintained that these nebulae were stellar systems, like the Milky Way but at distances so great that the individual stars could not be resolved.

Shapley based his arguments on Van Maanen's estimate of the distance of the spiral "nebula" M101, based on its speed of rotation which could be accurately determined by the Doppler effect. Van Mann had found a period of rotation of M101 of 850 000 years implying a speed of rotation in excess of the speed of light if M101 were located outside the Milky Way.

Shapley held that the surface brightness of the Milky Way as determined by F Seares was much greater than would be the case if the nebulae were outside the Milky Way. Shapley said that the nova S Andromedae which shone brightly at 6th magnitude in the nucleus of the Andromeda "nebula" in 1885 was far brighter than the brightnesses of all known novae, if Andromeda lay outside the Milky Way. Shapley also asked why no spiral nebulae were to be seen in the plane of the Milky Way. He did not agree that it was due to the obscuring effects of gas and dust in the plane of the Milky Way. Shapley pointed to the great velocities of recession of the nebulae found by V M Slipher and said they could not be correct if the nebulae were external to the Milky Way.

Little did Shapley know that nova S Andromedae (1885) was indeed a most exceptional nova, being at least 6 magnitudes brighter than any nova -- it was the first Supernova.

On the other hand Curtis argued that Shapley's estimate of 20 000 light years for the distances of nearby spirals must be far too low and in any case some spirals had angular sizes that would place

them 20 million light years away, proving that they were outside the Milky Way.

He argued that if the novae in the Andromeda "nebula" were of the same average brightness as novae in the Milky Way, Andromeda must be outside the Milky Way. Curtis asked how it could be that the speeds of recession of the "nebulae" could be so inordinately large.

As always in Astronomy, observation would be the deciding factor.

From 1905 to 1912 Henrietta Swan Leavitt measured the brightnesses and periods of variation of Cepheid variable stars in the Magellanic Clouds. In 1912 she published her findings. She found that the brightnesses were proportional to the logarithms of the periods of variation of these Cepheids -- a remarkable discovery! This formed the basis of the Period-Luminosity Law. Although no Cepheid could be found, near enough to check its distance, the law gave a method of determining the absolute magnitudes of these stars. By comparing the absolute magnitudes so calculated, with the observed apparent magnitudes, the distances could be calculated. The distances determined by E P Hubble, M L Humason and Shapley, showed that the Magellanic Clouds must be more than 100 000 light years away! They were thus stellar systems (galaxies) outside the Milky Way. In one fell swoop astronomers' abilities to determine stellar distances had leapt from 300 light years to more than 100 000 light years!

These distances showed that the diameter of the Milky Way is at least 100 000 light years and that the Andromeda Galaxy (now, no longer a nebula) was at least one million light years away, far beyond the limits of the Milky Way. (Today's known distance of the Andromeda Galaxy is 2 200 000 light years.

Furthermore it was found that the galaxies (now no longer nebulae) are all receding from each other and that the fainter, and thus further, galaxies are receding faster and faster. This was the basis of Hubble's Law**:** $V = H_o D$, and it showed that the universe is expanding. Cosmology took on a new complexion and the theory of relativity came into its own. The Period-Luminosity Law was certainly the single most revolutionary advance in Astronomy.

Due to the work of W Baade the Period-Luminosity Law became divided into three categories:

1. the very short period pulsating variables, the R R Lyrae variables of periods less than two days**;**
2. the classical Cepheids with periods of two to 20 days**;** and
3. the long period variables.

It was now possible to draw up a correct scale of distances in the universe to as far as the edge of the observable universe, 10 to 15 milliard light years away (10 to 15 thousand million light years) a universe 10 to 15 milliard years old!

Jan Eben van Zyl

Question:- *Why does light travel at approximately 300,000 km/s?*

Bruce Dickson Answers:-

Val's question is quite a subtle one.

Gamma rays, x-rays, light, infrared, microwaves and radio waves are all electromagnetic (em) disturbances. As an em wave propagates, energy in its electric and magnetic fields sloshes back and forth. The speed of light is determined by how quickly this can take place.

Two constants are used to describe this behavior - permittivity (ε) and permeability (μ). Permittivity tells you how easily a charge can be developed by an electric field, while permeability measures how easily it can be magnetically polarised. The speed of light is obtained from:- $v := \frac{1}{\sqrt{\varepsilon \cdot \mu}}$.

Permittivity and permeability are usually normalised to the permittivity and permeability of the vacuum $\varepsilon_0 = 8.854 \cdot 10^{-12} \frac{\text{farad}}{\text{m}}$ and $\mu_0 := 4 \cdot \pi \cdot 10^{-7} \cdot \frac{\text{henry}}{\text{m}}$. We write $\varepsilon := \varepsilon_0 \cdot \varepsilon_r$ and $\mu := \mu_0 \cdot \mu_r$. In a vacuum,

$\varepsilon_r = 1$ and $\mu_r = 1$ so that the speed of light is given by $c = \frac{1}{\sqrt{\varepsilon_0 \cdot \mu_0}}$. In SI units, this gives us $c = 2.998 \times 10^8 \, m \cdot s^{-1}$. Notice I've used its special symbol "c".

For light moving through other materials we find that $1 < \varepsilon_r < 12$ and $\mu_r = 1$, although ε_r and μ_r vary a great deal in other parts of the electromagnetic spectrum. $\sqrt{\varepsilon_r}$ is called the "refractive index", and uses the symbol "n". The speed of light in other materials is therefore closely approximated by $v := \frac{c}{n}$. Since n is always greater than 1, the speed of light in some medium is always less than the speed of light in a vacuum.

NASA ADMINISTRATOR DANIEL S. GOLDIN ANNOUNCES RESIGNATION

NASANews@hq.nasa.gov

RELEASE: 01-191

After nearly ten years as the head of America's space program, NASA's longest-serving Administrator, Daniel S. Goldin, today announced his resignation, effective November 17.

"For nearly a decade, it has been my honor to serve the American people by leading our Nation's space program and its dedicated personnel," Administrator Goldin said in a letter to President George W. Bush. "It was the highlight of my life when your father asked me in 1992 to serve as America's ninth Administrator for the National Aeronautics and Space Administration."

In his letter, the Administrator added he was happy and proud to serve three presidents and considered it an honor and a duty to stay when President Bush asked him to minister the office until a new NASA Administrator was found.

While no replacement has been selected, Administrator Goldin will work with the Administration before he leaves office to identify an interim Acting Administrator.

Administrator Goldin, 61, was appointed NASA Administrator April 1, 1992, by President George H.W. Bush and became the Agency's longest-serving chief on March 5, 2001, surpassing James Fletcher's previous record of nearly nine years during two separate terms.

The Administrator also announced he has accepted an interim position as a Senior Fellow for the Council on Competitiveness in Washington, as he transitions into the private sector. The Council sets an action agenda to drive U.S. economic competitiveness and leadership in world markets to raise the standard of living for all Americans, and focuses on strengthening domestic innovation, upgrading the workforce, and benchmarking national economic performance.

In a speech to NASA employees broadcast nationwide on NASA Television, Administrator Goldin thanked the Agency workforce and applauded their dedication.

"We have been through a lot together these past ten years. Our Agency's greatest strength is this team of highly qualified and diverse people," said Administrator Goldin. "Each and every day, you have demonstrated an unyielding devotion to teamwork, communication, creativity and respect. You are clearly committed to excellence. I am proud to have been a part of that commitment and NASA's continuing mission to expand the frontiers of flight, space and knowledge.

During his tenure, Administrator Goldin initiated a revolution to transform America's aeronautics and space program. Despite lower budgets, his "faster, better, cheaper" approach enabled NASA to deliver programs of high value without sacrificing safety.

Through aggressive management reforms, Administrator Goldin reduced annual budgets by cumulative total of $40 billion. He implemented a more balanced aeronautics and space program by reducing human space flight funding from nearly half of NASA's total budget to a little more than one-third. This allowed him to increase funding for science and aerospace technology by more than 10 percent.

While serving as Administrator, the Agency's civil service workforce was reduced by about a third, while the Headquarters' civil service and contractor workforce was reduced by more than

half. However, during this time, NASA's overall productivity climbed 40 percent.

Administrator Goldin cut the time required to develop Earth- and space-science spacecraft by 40 percent and reduced the cost by two-thirds, while increasing the average number of missions launched per year by a factor of four. The number of Earth-observing satellites in orbit, collecting vital data, has tripled over the past nine years.

The Administrator played a pivotal role in redesigning the International Space Station and reduced Space Shuttle costs by about one-third, while improving all of NASA's safety indicators. He has been a vigorous proponent for increased exploration of Mars, and expanded opportunities for public and educational participation in the adventure of space exploration. NASA contract awards to minority, small and disadvantaged businesses, and women-owned ventures have more than tripled.

During the Administrator's tenure, NASA launched 171 missions, of which 160 have been successful.

"Being appointed NASA Administrator was the fulfillment of a childhood dream. This is the greatest job in the world and it is difficult to leave a job you love," Administrator Goldin concluded. "But NASA's mission of discovery will continue. Humanity will continue to benefit from the fruits of this journey and I am proud and deeply humbled by the opportunity that was given me. The people of NASA have my unconditional respect and eternal gratitude."

Before coming to NASA, Administrator Goldin was Vice President and General Manager of the TRW Space and Technology Group in Redondo Beach, Calif. During a 25-year career at TRW, he led projects for America's defense, and conceptualized and managed production of advanced communication spacecraft, space technologies and scientific instruments.

Administrator Goldin began his career in 1962 at NASA's Lewis Research Center in Cleveland, now known as the Glenn Research Center. While there he worked on electric propulsion systems for human interplanetary travel.

Administrator Goldin is a member of the National Academy of Engineers and a Fellow of the American Institute of Aeronautics and Astronautics.

Additional images and information about Administrator Goldin and his accomplishments are available on the Internet at:

http://www.nasa.gov

http://www.nasa.gov/bios/goldin_gallery.html

Nasa News

Return to Mars

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The United States returned to Mars tonight as NASA's 2001 Mars Odyssey fired its main engine at 7:26 p.m. Pacific time and was captured into orbit around the red planet.

At 7:55 p.m. Pacific time, flight controllers at the Deep Space Network station in Goldstone, Calif., and Canberra, Australia, picked up the first radio signal from the spacecraft as it emerged from behind the planet Mars.

"Early information indicates everything went great," said Matt Landano, the Odyssey project manager at NASA's Jet Propulsion Laboratory in Pasadena. "The orbit insertion burn went off just as we planned and we will now begin the three-month long aerobraking phase."

Through tonight and the early morning hours tomorrow, the flight team will be analyzing the information they are receiving from Odyssey. This will help them evaluate the health and status of the spacecraft and determine the precise orbit geometry.

Tonight's firing of the main engine slowed the spacecraft's speed and allowed it to be captured by Mars' gravity into an egg-shaped elliptical orbit around the planet. In the weeks and months ahead, the spacecraft will repeatedly brush against the top of the atmosphere in a process called aerobraking. By using atmospheric drag on the spacecraft, flight controllers will reduce the long, highly elliptical orbit into a shorter, 2-hour circular orbit of approximately 400 kilometers (about 250 miles) altitude for the mission's science data collection.

"Orbit insertion is our single most critical event during the mission, and we are glad it's behind us," said David A. Spencer, Odyssey's mission manager at JPL. "But we cannot rest on our laurels. The aerobraking phase will be a demanding, around-the-clock operation, and it requires the flight team to react as the atmosphere of Mars changes."

The aerobraking phase is scheduled to begin on Friday, October 26.

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. 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., will provide aerobraking support to JPL's navigation team during mission operations.

ANTARCTIC/ALASKA-LIKE WIND TURBINES COULD BE USED ON MARS

NASA Ames Research Center

Extract from -RELEASE: 01-72AR

Wind turbines designed to make electricity at the South Pole and in remote regions of Alaska may someday lead to similar wind machines for Mars bases, according to NASA scientists.

During missions to Antarctica, where there are about six months of darkness each year, NASA scientists first seriously considered modifying cold-weather wind machines so they could make vital electric power for bases on Mars. One reason scientists proposed use of wind power on Mars is that wind turbines still could generate electricity during month-long martian global dust storms that can make days on the red planet as dark as night.

"Wind power and solar power may complement each other on Mars. When you have a large dust storm blocking the sunlight on Mars, a wind turbine can still generate electricity," said scientist David Bubenheim of NASA's Ames Research Center in California's Silicon Valley. "Only during dust storms on Mars is there enough wind energy to operate a wind turbine," said Michael Flynn, another NASA Ames scientist. On Earth about 10 meters (33 feet) per second wind speed is needed to make electricity with wind turbines; on Mars about 30 meters (98 feet) is needed because of the extremely thin air, according to Bubenheim.

"What we are proposing is a hybrid wind-solar system," Flynn said. "This system would use solar cells to generate electricity during sunny periods, and a wind turbine to make electricity during dust storms."

"We've looked at wind profiles based on atmospheric computer models of Mars," Bubenheim said. A scheme of complementary wind and solar power appears to be an option, he added.

More information is available on the NASA Ames research Website:

www.arc.nasa.gov

The Tinsley Telescope.

Hi Chris

A lot's been said about our Franklin Adams instruments, but do many members realise that the Tinsley in the Popadopolous dome is a classic? Tinsley Labs has an interesting history - among other things they "fixed" the Space Telescope, and are developing the optics for the NGST. Judging from this article, our 12" was made around 1955, and the collimation woes were well known then too.

I culled this from http://home.europa.com/~telscope/tsus.txt

regards, Bruce

TINSLEY

In 1926, Clayton R. Tinsley, a high school teacher, formed a company making telescopes,mirrors and telescope making kits, in Berkeley, Calif. A Tinsley Optical 12 inch Cassegrain telescope, circa 1929, was listed at Mt. Wilson in 1932 and 1935, where astronomers found that the optics were imperfect. It was then placed at the visitor's hotel at Mt. Wilson, later owned by David Levy, and then Bill Marriot, who measured the primary at f/3.8 & undercorrected, and polished the back of the secondary to find it full of bubbles & striae, and of a spherical profile -- thus possibly a Dall-Kirkham. Max Bray began his career in 1933, at Tinsley.

An undated catalog 'Supplies for the Amateur / Telescopes for School and Home', address 3017 Wheeler St., Berkeley, was issued during the 1930s but before 1937, when ATM 2 was published. Products are identical to the catalog described below, but including draw tube spyglasses 7/8 inch to 2 1/4 inch aperture, vulcanized fiber body. The 'Saturn' trademark was already in use. Tinsley sold the company to Donald A. Jenkins in 1937. An undated catalog, noting 'sixteen years of research and experience' (which must reflect Clayton's pre-professional experiences), includes the ATM 2 book and so is post 1937. It uses the 3017 Wheeler address, and an identical catalog uses the address 2035 Ashby Ave., Berkeley.

These catalogs list: -Cassegrainian, f/16, equatorial on pier, electric clock drive, with 3 Ramsden or Huyghenian eyepieces; 6 inch $390, 8 - 10 - 12 - 14 - 16 inch, 20 inch $5500. -Newtonian, f/8, equatorial on pier, electric clock drive, 6 inch, 8 inch; 10 inch $675. -Four inch f/8 equatorial Newtonian, 'Saturn' mount, tripod, $175. Also altazimuth mount. -Equatorial mounts & rough castings for mounts, mirror cells, parabolic mirrors 4 to 12 inches, objective lenses to 4 inches, telescope making kits, mirror blanks, objective lens blanks to 6 inches, eyepiece lens blanks, Foucault tester, spherometer, focuser, terrestrial eyepiece, Ramsden & Huyghenian eyepieces 1/4 inch to 2 inch focal length, solar Herschel wedge, prism & mirror diagonals. -Services: correction work on customer's mirrors, silvering mirrors using Brashear process (lacquered on request); aluminizing using 'new Pancro process', an alloy of magnesium and aluminum, overcoated with aluminum oxide (panchromatic meaning true colors, reflectivity across the spectrum is superior to aluminum).

During WWII, the company made binoculars and optical parts. The "Optical Elements Code Chart, 9 March 1944, Ordnance Fire Control Sub- Office, Frankford Arsenal", notes the glass parts were required to be identified by maker on the rough ground edge of the optics, using a letter code in black ink or a color code in 2 dots; Tinsley Laboratories codes being TLA, or white-green.

During 1946, Tinsley incorporated, and began manufacturing a line of spotting telescopes and riflescopes. Two inexpensive amateur refractors, on altazimuth mounts and wood tripods, were introduced in 1955; a 44 mm for $48; and a 3 inch for $199. By 1955, the address was 2350 Grove St., Berkeley, Calif. An undated brochure for Tinsley Laboratories / Saturn Precision Telescopes, uses the address 2526 Grove St., and notes a quarter century of experience. -The Saturn Junior Refractor was 44 mm, 60 power with a 4 lens erecting eyepiece, at $48. -3 inch ($199) and 4 inch ($345) refractors, altaz on portable tripod. -3 inch ($860), 4 inch ($1,185), and 5 inch ($2,750) f/15 refractors, equatorial mounts. -8 inch ($1,412), 10 inch ($2,148), and 12 inch ($3,480) Cassegrains, f/16, equatorial mount on pier. -6 inch ($960), 8 inch ($1,266), and 10 inch ($1,864) Newtonians, f/8, equatorial mount on pier. -Other unspecified products: Maksutovs, Schmidt systems, mounts, binoculars, spotting scopes, eyepieces, flats, mirrors, lenses, prisms, Abbe prisms, Wollaston prisms, Amici prisms, aluminizing and coating.

In 1957, Jenkins retired & sold the company to a group of employees and investors. Tinsley then was producing telescopes for universities, and Schlieren optical systems. Tinsley became a public corporation in 1961. A 20 inch triplet apochromatic refractor was made during 1963-4 for Ben Morgan, who paid Tinsley about $250,000 for it, and sued Tinsley over its performance. Lowell observatory purchased it circa 1963 for $100,000 or less, where John Hall tested it and thought it was good enough. The objective was returned to Tinsley for work once or twice; and taken to the U. of Arizona optical shop, where Don Loomis reworked & respaced it. At Lowell, it was intended for lunar mapping, but it was not a successful lens, and it need to be stopped down

to about 16 inches to provide a sharp image. The telescope is shown in the Dec. 1964 S & T, p368, in a Tinsley ad, which describes it as 'ordered for lunar mapping'. The objective is now on display at Lowell, and the dome & part of the mounting are still in use.

For Boeing, in the mid 1960s, Tinsley made a wide field optical collimator using a modified Wright-Schmidt design, 18 inches aperture, with a 5 inch flat focal plane. This was used in a vacuum housing, which gave the Schmidt corrector plate the proper profile. An undated brochure is devoted to The Tinsley Five Inch, Maksutov Cassegrain, 5.65 inch primary, 5.1 inch corrector, f/15 overall, focuser uses a Starrett micrometer, near focus 22 feet, single arm fork mount; DC variable speed drive, rheostat speed control, rechargeable battery. $1450. Accessories include a 'photographic module' camera adapter with flip out diagonal mirror, which replaces the eyepiece housing. A 12 inch Tinsley Cassegrain is being restored as of 2001 by the Peninsula Astronomical Society near San Jose, Calif. Collimation is difficult because the mirror cell has no adjustments for centering or tilting the primary; the mirror is installed by placing the forward surface against a stop and the telescope back is then bolted in place to hold the mirror. Speculation is that the primary might be spherical and the system an exotic type of Cassegrain. An 18 inch Tinsley cassegrain is in a private observatory in Idyllwild, California, as of the 1980's. The Mt. Cuba Observatory, (Greenville, Delaware) 24 inch Tinsley Cassegrain is from 1964, and has f/16 and f/32 secondaries. A Baker corrector lens for prime focus astrophotography yields a 7 degree field, but requires the primary be stopped down to 20 inches, using a built in aperture ring in the mirror cover.

Most of the blueprints are copies of those for the U. Virginia 30 inch telescope. The 'Richard B. Herr Memorial Telescope' is in active use to this day. (From Emil Volcheck) Brigham Young U. owns a 24 inch Tinsley. Robinson Observatory of the Central Florida Astronomical Society owns a 26 inch Tinsley cassegrain, with a small hole in the back of the secondary, used to align the secondary with the focuser by inserting a laser pointer or a flashlight, to project a beam to the focuser. This telescope can be seen at their web site: www.cfas.org. University of Virginia's McCormick Observatory, Fan Mountain station, has a 30 inch Tinsley Cassegrain with a 5 inch Tinsley Maksutov as a finder scope. A source at U.V. is quoted that the mirror is 32 inches, but for prime focus work is stopped down to 30 inches, because the Baker corrector lens shows distortion at full aperture. U.V. has a student observatory on campus, that circa 1970 apparently housed a Tinsley 8 inch telescope that is now replaced.

The Fernbank Science Center, Atlanta, Georgia, has a 36 inch Tinsley. The 1 meter Ritchey-Chretien telescope at USNO Flagstaff was designed & built by George W. Ritchey, and completed in 1934. The Pyrex optics were replaced with Corning fused quartz in 1969, and Tinsley figured the primary to a modified concave hyperboloid, and the secondary to a modified convex hyperboloid. The Air Force Research Lab, Maui Space Surveillance Site, uses pair of Tinsley 1.2 meter open tube classical Cassegrains (parabolic primary and hyperbolic secondary), mounted on opposite sides of a single polar axis and fixed to a common declination axis.

See: http://ulua.mhpcc.af.mil/AMOS/gallery.html.

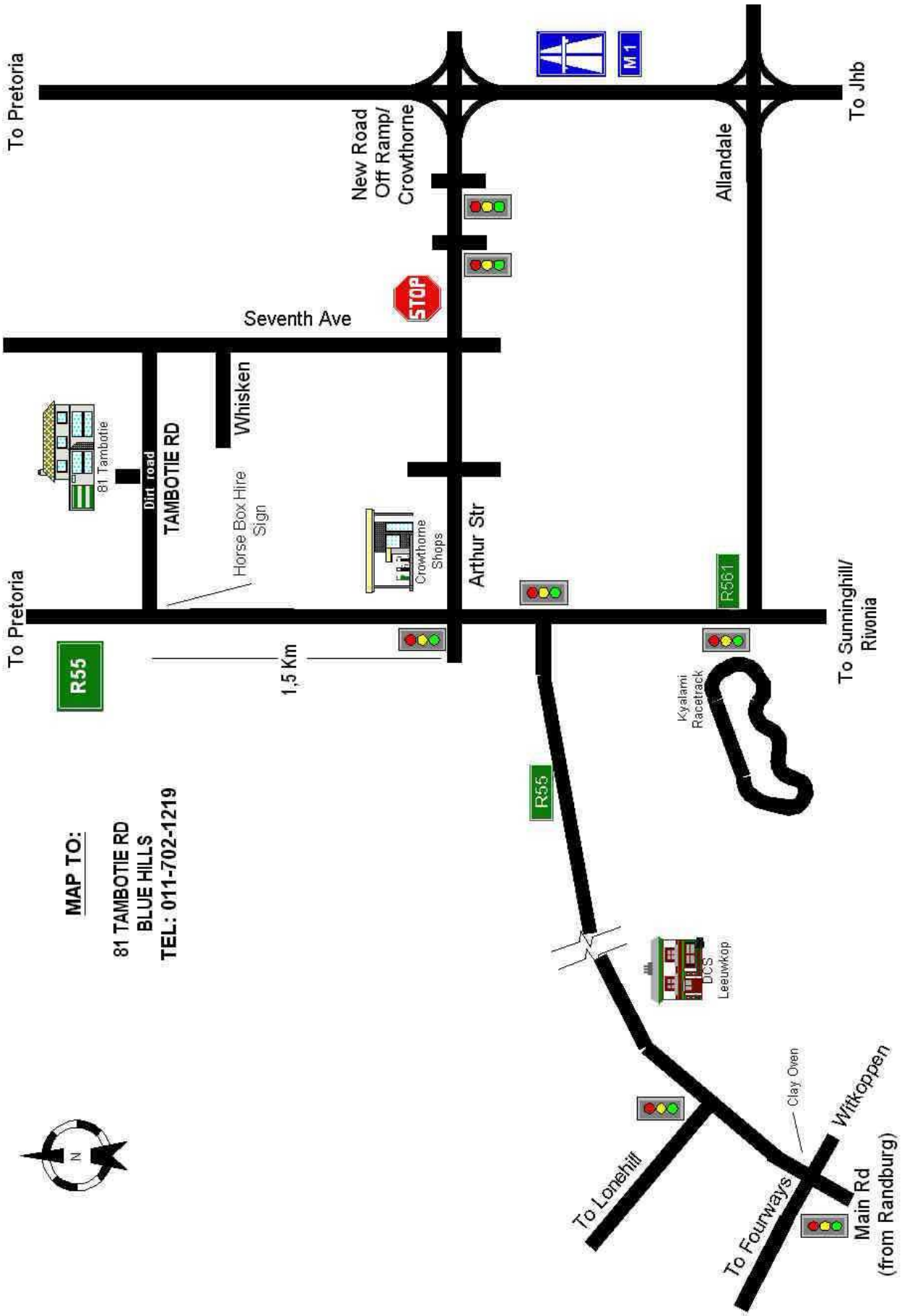
U. Michigan's 1.3 meter (52 inch) Tinsley reflector, installed 1969 at the Portage Lake Observatory in Michigan, and was moved in the early 1970s to MDM Observatory on Kitt Peak. Tinsley was the prime contractor, and figured the optics from Cer-Vit (f/2.6 primary, secondaries, and two Coude flats). The secondary rotates to switch between f/13.5 and f/7.6 Cassegrain optics, and a third secondary is gimballed in place for f/33.5 Coude. The primary rests on an 18 point cell, with radial support from six teflon coated steel straps, each wrapping around 120 degrees of the mirror's circumference. The two pier English mounting and major mechanical parts were done by L and F Machine Co., Huntington Park, Calif. The telescope is still in use every clear night. See Sky & Telescope, Feb 1971, page 72. (from Patrick Seitzer)

A circa 1972 booklet notes the 34,000 square foot factory at 2448 Sixth St., Berkeley, built in 1961. Products included: A window for Skylab, 23 by 19 by 1 5/8 inches, transmitted wavefront lambda over 20 peak to peak; parallelism to 0.004 inch. Aluminum mirror, nickel plated, 23 feet diameter, f/1.9, spherical, weight 14 tons, for Martin Marietta, 2 made. Beryllium mirrors, nickel plated, 10 inch, polished to lambda over 10 peak to peak. In 1972, Tinsley ceased production of telescopes, in favor of precision optical systems and components, especially manufacture of aspheric optics.

By the 1990s, Tinsley was owned and operated by the Silicon Valley Group http://www.asphere.com/ Tinsley made COSTAR (Corrective Optics Space Telescope Axial Replacement) for the Space Telescope circa 1992. These were five pairs of mirrors placed over the focal planes of the telescope instruments. Wavefront error was better than 1/100 wave rms, and surface roughness was 4 to 5 Angstroms rms. ------ Sources: Tinsley catalogs & advertisements from Sky & Telescope. Email from various sources. 'Historical Notes About Tinsley', email from the Tinsley Corp., 1992.

Submitted by: **Bruce Dickson**

Star Party - Map to Dave Gordon's Residence in Midrand



The Sky this Month

November 2001

dd hh	dd hh
1 06 **FULL MOON**	14 08 Mercury 2.7 S of Moon
2 06 Mercury 4.6 N of Spica	15 07 **NEW MOON**
2 12 Venus 3.9 N of Spica	20 21 Neptune 3.5 N of Moon
2 16 Jupiter stationary	21 19 Mars 2.5 N of Moon
3 23 Saturn 0.6 S of Moon Occn.	22 02 Uranus 3.7 N of Moon
4 17 Mars 2.2 S of Neptune	22 23 **FIRST QUARTER**
6 07 Jupiter 1.6 S of Moon	23 16 Moon at apogee
8 12 **LAST QUARTER**	26 10 Mars 0.8 S of Uranus
11 19 Moon at perigee	30 21 **FULL MOON**
14 02 Venus 2.9 S of Moon	

December 2001

dd hh	dd hh
1 03 Saturn 0.4 S of Moon Occn.	15 09 Mercury 1.7 S of Moon
2 14 Mercury 4.0 N of Antares	15 11 Venus 9.7 S of Pluto
3 11 Jupiter 1.4 S of Moon	17 19 Saturn 3.7 N of Aldebaran
3 14 Saturn at opposition	18 07 Neptune 3.5 N of Moon
4 21 Mercury in superior conjn.	19 12 Uranus 3.7 N of Moon
6 22 Moon at perigee	20 20 Mars 4.4 N of Moon
7 01 Mercury 11.1 S of Pluto	21 13 Moon at apogee
7 03 Pluto in conj. with Sun	21 19 Solstice
7 20 LAST QUARTER	22 21 FIRST QUARTER
9 15 Venus 5.2 N of Antares	28 08 Saturn 0.1 S of Moon Occn.
14 06 Venus 0.9 S of Moon Occn.	30 11 FULL MOON Eclipse
14 21 NEW MOON Eclipse	30 14 Jupiter 1.0 S of Moon Occn.

LOCAL TIMES of RISE and SET for the MAJOR PLANETS, 2001

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
Nov 07	05.16	18.27	04.32	17.13	04.28	17.10	10.58	00.27	22.54	09.27	20.32	07.13
Nov 17	05.11	18.34	04.40	17.46	04.27	17.28	10.52	00.12	22.14	08.46	19.49	06.31
Nov 27	05.09	18.41	04.52	18.21	04.30	17.46	10.46	23.55	21.32	08.04	19.06	05.48
Dec 07	05.10	18.49	05.11	18.56	04.35	18.05	10.40	23.38	20.49	07.20	18.23	05.06
Dec 17	05.12	18.55	05.37	19.30	04.44	18.24	10.34	23.20	20.04	06.35	17.40	04.23
Dec 27	05.17	19.00	06.10	19.58	04.57	18.42	10.28	23.02	19.20	05.50	16.57	03.41