CANOPUS

The Astronomical Society of Southern Africa

Johannesburg Centre

Monthly Newsletter for January 2001

Millennium Edition

Contents:

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

Editorial

Welcome to the new Millennium. Unlike this time last year, there has been little hype and razzmatazz to usher in the New Year - but the planets have greeted the change of year in quite spectacularly beautiful fashion. Venus is at it's brightest in the West just after sunset, and Saturn and Jupiter are putting on a pretty good show overhead in the late evening…

…and a new "star" has made it's presence known in the sky as the International Space Station unfurled it's wings during the second week of December. It is certainly the brightest of all the satellites and will become more so as it grows larger to eventually span several hundred square metres. Just imagine a peaceful early evening, observing a favourite deep sky object and suddenly this magnitude -2 object springs into view at some 300 times magnification - instant arc-eye!!!

Brian has supplied monthly tables of the celestial happenings for the year to come, and the January issue contains the table for the whole year. From February, we will revert to showing only the current and following month's events. A precis of some of the other information Brian has supplied is also contained within this issue, and the expanded tables will all be available on our website.

Danie's Variable of the Month makes a welcome return to these pages, and a selection of interesting articles which have been received from NASA and other Astronomical institutions have been included for your perusal.

The Web between the Worlds has been supplied by Evan and this series will hopefully become (once again) a regular feature within these pages. Some of these websites contain the most amazing information which can be of great benefit to the amateur astronomer - if you have the opportunity, and of course, the requisite internet access, it is well worth your while browsing some of the sites.

Our year end Star Party was rather poorly attended, but those who arrived enjoyed themselves and each other's company under relatively clear skies. It clouded over around 21**:**00 and we were unable to do any viewing after the braai - however, a good time was had by all. **…**and to those who couldn't attend - well maybe we'll see you all at the next Star Party.

And my perennial cry for articles is once again repeated here - please send in any piece you would like to see in print - I can guarantee, if astronomically related, it *will* be published in the Canopus.

The Editor - chris@penberthy.co.za

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Notice of Meeting

The **January** 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 10th of January, 2001 at 20:00.

Topic:

Impact Craters

By: **Prof. Uwe Reimold**

Future Meetings

February 14th	**T.B.A.**	T.B.A.
March 14th	**T.B.A.**	T.B.A.
April 11th	**T.B.A.**	T.B.A.

Sorry about all the T.B.A.s - but no finality on the Speakers and their subjects had been reached at the time of going to press. Ed.

Dark Sky Viewing

On the Saturday nearest New Moon at Tom Budge's Farm in the Magaliesberg. Remember that this is by arrangement only as most observers will be following specific viewing programmes and if you don't have your own 'scope, you should contact one of the observers (e.g. at the monthly meeting) to arrange some eyepiece time with them.

20th January	23rd June	17th November
24th February	21st July	
24th March	18th August	**Year End Star Party 2001**
21st April	15th September	*"T.B.A."*
19th May	13th October	8th December (*provisionally*)

Public Viewing

Public viewing nights are on the Friday nearest First Quarter, and are held at the Old Republic Observatory, 18a Gill Street, Observatory, Johannesburg. Starting time around 19:30.

2nd February	27th July
2nd March	24th August
30th March	21st September
25th May	19th October
29th June	23rd November

Jo'burg Centre Outings for 2000/1

Your Committee is making arrangements for several outings during the year.
Swinburne or Nylsvlei (or both)!
Boyden - dependant on availability of a suitable weekend.
Other ASSA Centres (e.g. the Pretoria Centre) - try to see if we can organise some joint ventures.
Haartebeeshoek and possibly a visit to the Suikerbosrand Nature Reserve.
Tswaing Crater - still trying to set up a day visit under the guidance of Prof. Reimold.
…and finally - a Star Party to be held at a public venue such as Delta Park.

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 803-8291 if you are interested.

Eclipse 2001 Opportunity

Bill Lockhart has an "auto-villa" in which he is planing to drive to Lusaka for the eclipse next June. He is looking for someone to share expenses. **Ring 083-244-9138** to contact him in this regard. Anyone interested must have a valid passport, and get the necessary visas.

The Chairman's Column.

Most readers by now know that I am the society's chairman again this year. How I got back into the hot seat is anyone's guess. Years back, society was run on a more formal basis. Today one has to rely on the goodwill of the volunteer staff who make up the committee. Please never underestimate the enormous effort that they put in to keep the wheels turning.

As chairman, both now as it was in the past, my ambition is two-fold: to maintain good governance and to satisfy the needs of the membership base. Good governance is easy to achieve, it requires good discipline, a little vision, and a tight rein on the budget. To satisfy the needs of the membership base is far more difficult.

Societies like ours compete with the Internet. One can research and obtain information far more readily on the Internet than one can at any of the society's meetings. How then do we compete against the likes of the Internet? Well, quite frankly, we cannot. No matter how hard we try to communicate through our publication Canopus, we can never do as well as publications like Sky and Telescope.

I suppose the only way we can excel, is to provide a forum where members can meet with each other to discuss matters of common interest. We can also arrange special outings to wonderful places like HartRAO, the impact crater north of Pretoria, the gamma-ray observatory near Potchefstroom and the Planetarium. These are some things we have on the agenda for the remainder of this financial year.

Sadly, our society's membership has been dwindling over the last few years. It is my heartfelt belief that if we focus our attention properly, we will slowly be able to turn this trend around. Please feel free to share your thoughts and ideas about a society with me at any time. I look forward to meeting you in person and I hope that you will be both proud of the society and find your membership entertaining informative and enjoyable.

Tom Budge

Telescope for Sale

Intras 100mm F10 Reflector

- With pillar stand, Clock-Drive & Filters
- Bought 1974, used once - in original box

R1200-00

Please contact **Simon** at (011) 442-5164
or 082-452-1236

VARIABLE OF THE MONTH; MYRA AND HER SISTERS

Brian Fraser reports that when Omicron Ceti (Mira to you) was last at naked eye brightness, he had the following exchange with a Johannesburg Centre member:

Brian: Have you seen Mira?
Member: Myra who?

Over the years, a few Mira variables featured in the "Variable" column but I have not been as persuasive about the value of long period variable star observations as Lee Anne Willson, a much respected professional and president of the AASO. Below is a letter from her. If this motivates you to do Miras, then Brian and I will be glad to get you started.

Danie Overbeek

We're buried in snow and cold. I expect you're looking forward to warm & sunny holidays -

President's message:

The meeting in Huntsville last April was tremendously exciting - one of the best meetings I've been to in the last several years. There are certainly a lot of new and exciting opportunities for professional/amateur collaboration, even in areas that until recently were very much limited to a few professionals with access to the right spacecraft. Given these new opportunities, what is the importance, if any, of the AAVSO's traditional specialties?

The AAVSO archives contain nearly 10 million observations, and roughly 60% of those are observations of long period variables extending to the early 20th Century or late 19th in many cases and longer in a few. Only fairly recently have these data become widely accessible, both in the "Quick-look" files for very up-to-date light-curves and by instant-request for verified data. Given the extensive archives and the long time-line, do we have "enough" data on long-period variables? Should we be concentrating on new sources reachable only by CCDs or 24" telescopes??

With all the news flashes, alert notices, and other special notifications that AAVSO sends out, it is easy to get the impression that the AAVSO no longer cares about long period variables. On the web site, as well, other classes of variables get most of the attention, at least until one digs a little.

Are long period red variables passe? I would argue that the Miras and their close relations are still, and justifiably, the most important variables in the AAVSO's data base. Let me tell you why, and speculate a little about what would be required if we were to try to replace the AAVSO observers by some mechanical device(s). Note that if one looks at the activities of headquarters, rather than just the web and electronic publications, then one finds a somewhat different picture. Most of the requests for data are for Miras. Several recent research papers from headquarters deal with these stars, and the newest professional staff member is an astronomer who specializes in these objects.

1. Miras are fundamentally important objects for understanding the fates of stars and planets.

   Most stars, including our Sun, will go through a Mira stage of evolution during which they will shed most of their mass. What is left will be a white dwarf star with a final mass around 60% of the Sun's present mass. The size that the Sun achieves during this stage determines the fate of the Earth - to be incinerated or merely singed. Perhaps, by observing Miras, we will be able to pick up some signs of planets plunging to their final fates!

2. Miras are many and thus require many observers.

   There are many more of Miras known than there are professional astronomers in the world, by at least an order of magnitude,

and only a small fraction of professional astronomers are studying stars individually. The only way that professional observers could hope to keep track of this many stars would be through continuing, all-sky monitoring with a lot of data-analysis (to pick out the Miras) and processing. Even assuming such equipment comes "on-line" during the 21st century, it will be costly (many millions of dollars is an estimate based on the costs of proposed all-sky monitoring projects), and it will require nearly a hundred years to catch up with the timeline of the data base at the AAVSO.

3. Miras show a host of not-well-explained phenomena that happen on timescales up to centuries or longer.

   This summer, I've had a group of talented undergraduates working with me to understand more about the properties of Miras as these can be deduced from their light-curves. One comment that these teens and 20-somethings have made several times is "we need a bunch more data on this one!" Again, for any other method of observing these stars, at least a century is needed to build up to the level of AAVSO data. Plus, if other methods can be made compatible, existing and continuing AAVSO data will be essential to provide cross-calibration and extend the timeline back through the 20th century.

4. Mira periods are long (~1 year) so the glimpse that is obtainable during a single observing run on most professional telescopes is too short to reveal what is going on.

   Perhaps it is a strange habit to be thrilled by a string of numbers. But, whenever I am immersed in the analysis of the light curve of a Mira variable or puzzling over the excursions of an SR, I feel both excited and fortunate to be the beneficiary of the dedication of so many observers over so many years.

   Forwarded by
   Danie Overbeek

The Web Between the Worlds

It seems as if every day the marvels of Star Trek get a little closer. Perhaps we will never quite reach the heights of technology that Kirk and Spock take for granted, but the way things are going makes me think we'll get pretty close. Take a look at

http://www.quantum.at/

and learn all about quantum teleportation and cryptography based on tangled photon pairs.

Most people are aware of free web-based email, and probably have an account or two. If you don't have one, get one. They are free, globally accessible, reasonably private and functional. Here is one with a relevant theme too:

http://mail.space.com/

Experilab manufactures and distributes "science & technology" items, gifts and books. I have managed to pick up a decent gifts from them, at prices that are not completely unreasonable. Best of all, they are local. You can find them at:

http://www.experilab.co.za/

Antonio Cidadão has created a nice site devoted Lunar and Planetary observation using CCD cameras. Lots of nice pics, advice and ideas. Point your browser at:

http://astrophoto.org/mercure/cidadao/

Remote telescopes are here, and they are definately here to stay! Well, it seems as if the next step is a virtual telescope. It had to happen! This site also includes a number of links to useful and intersting sites - enough to keep you occupied for at least an hour. I wont say anything else, take a
look for yourself:

http://www.observatory.org/conpanel.htm

Enjoy your Christmas and drive carefully!

Evan Dembskey

Some Astronomical Predictions

It is exciting to step back and imagine what the next 1,000 years might bring in astronomy and space science. Unfortunately, I am firmly of the opinion that we can really only predict advances over the rather short term, maybe 30 years or so under the conditions of the past century. Beyond that, totally unforeseen radical developments take over and dominate everything. However, the game is too much fun *not* to play, so I am willing to guess!

In astronomy, I am only willing to look forward 100 years, as it seems hopeless to guess beyond. Within that horizon, I expect we will have a detailed knowledge of all the significant bodies in the Solar System, the kind of knowledge we now have for Mars. I think we will have direct imaging of all the planets of every star within maybe 10 light years -- and I am almost willing to bet that practically all stars have planets of some kind.

I anticipate that we will have detailed three-dimensional positions and velocities for all the stars in our Galaxy, excluding only distant white dwarfs and brown dwarfs, and a rather complete dynamical understanding of the whole Milky Way. I hope we will understand galaxies and their evolution at least as well as we now seem to understand normal stars.

It is my opinion that space exploration is in every way analogous to the emergence of life from the oceans onto the land. Barring completely unforeseen and unguessable breakthroughs, I suspect this may be a somewhat slow process by our impatient human standards. Within the century I hope we will at least have independently self-supporting settlements at several locations in the inner Solar System.

When this landmark is attained, we will have a reasonable assurance that no natural disaster nor any human folly will ever render Humanity extinct. I fancy the complete settlement of the Solar System may take roughly as long as that of the Western Hemisphere of the Earth; so in 500 years I expect the New Worlds to be on a par with the Old: in population, culture, economic strength and by all other important measures.

Finally, I will stick my neck far out and predict that we will achieve interstellar travel, defined as sending humans to the nearer stars, in about 200 years, with an uncertainty of a factor of three in either direction (that is, between 60 and 600 years from now). In this I assume no fundamental breakthroughs allowing warp drives, faster-than-light travel, etc., but only some kind of fission or fusion-powered vehicle. If this should turn out to be accurate, the beginning of the next millennium should find the descendants of modern humans heavily settled throughout a sphere perhaps 20 light years in diameter, and expanding outwards at roughly 0.01c.

I feel I must at least mention a two obvious breakthroughs that seem fairly likely and that would radically alter the future in ways no one can predict. One would be the discovery of extraterrestrial intelligence. Another would be any large changes in the human species, due to some combination of unusually rapid evolution, application of fundamental biological knowledge, and interaction or fusion with artificial intelligence.

Bill Wheaton

Come Laugh with. . . . .

An astronomer is on an expedition to Darkest Africa to observe a total eclipse of the sun, which will only be observable there, when he is captured by cannibals. The eclipse is due the next day around noon. To gain his freedom he plans to pose as a god and threaten to extinguish the sun if he's not released, but the timing has to be just right. So, in the few words of the cannibals' primitive tongue that he knows, he asks his guard what time they plan to kill him.

The guard's answer is, "Tradition has it that captives are to be killed when the sun reaches the highest point in the sky on the day after their capture so that they may be cooked and ready to be served for the evening meal".

"Great", the astronomer replies.

The guard continues, though, "But because everyone's so excited about it, in your case we're going to wait until after the eclipse.

SOLAR SYSTEM'S LARGEST MOON LIKELY HAS A HIDDEN OCEAN

FOR IMMEDIATE RELEASE December 16, 2000

Add Jupiter's moon Ganymede, which is bigger than two of the solar system's nine planets, to the growing list of worlds with evidence of liquid water under the surface.

A thick layer of melted, salty water somewhere beneath Ganymede's icy crust would be the best way to explain some of the magnetic readings taken by NASA's Galileo spacecraft during close approaches to Ganymede in May 2000 and earlier, according to one new report.

In addition, the types of minerals on parts of Ganymede's surface suggest that, in the past, salty water may have emerged from below or melted at the surface, according to a study of infrared reflectance measured by Galileo.

Third, new Galileo images of Ganymede hint how the water or slushy ice may have surfaced through the fractured crust, reminiscent of linear features on Europa, a neighboring moon believed likely to have a deep ocean beneath its ice.

Several of the new images, prepared by researchers at Brown University, Providence, R.I., and the German Aerospace Center (DLR), Berlin, Germany, are available from NASA's Jet Propulsion Laboratory, Pasadena, Calif., at

http://www.jpl.nasa.gov/pictures/jovianmoons
.

They include the most detailed photos ever taken of Ganymede and an animated virtual flyover of an area where a smooth, bright swath resembling parts of Europa cuts across older, more heavily cratered terrain.

The new information about Ganymede is being presented at the fall meeting of the American Geophysical Union, beginning today (Dec. 15) in San Francisco. Ganymede is the biggest moon in the solar system and bigger than the planets Mercury and Pluto. It was named for a boy in Greek mythology who was so beautiful that Jupiter, king of the gods, had him brought to Olympus by an eagle.

The magnetic clues to a possible saltwater layer at Ganymede are more complicated than earlier magnetic evidence of hidden oceans on two other moons of Jupiter, Europa and Callisto, said Dr. Margaret Kivelson, a planetary scientist at the University of California, Los Angeles, and principal

investigator for Galileo's magnetometer instrument. That's because Ganymede has a strong magnetic field of its own, instead of just a secondary field induced by Jupiter's magnetism.

But the indications of an induced field at Ganymede are "highly suggestive" of a salty ocean on Ganymede, too, Kivelson said. "It would need to be something more electrically conductive than solid ice," she said.

A melted layer several kilometers or miles thick, beginning within 200 kilometers (120 miles) of Ganymede's surface would fit the data if it were about as salty as Earth's oceans, Kivelson said.

Ganymede is covered with lots of ice and frost, both in the older, dark terrains and younger, bright terrains, said Dr. Thomas McCord, a geophysicist at the University of Hawaii, Honolulu, who has been using Galileo's infrared spectrometer instrument to identify surface materials on Ganymede. Portions of the moon appear to have types of salt minerals that would have been left behind by exposure of salty water near or onto the surface, he said.

"They are similar to the hydrated salt minerals we see on Europa, possibly the result of brine making its way to the surface by eruptions or through cracks," McCord said. The infrared evidence does not indicate whether or not an ocean persists at Ganymede today, he said.

Photos Galileo took as it passed within 809 kilometers (503 miles) of Ganymede on May 20 display details of a tumultuous past, according to Drs. James Head III and Robert Pappalardo, planetary scientists at Brown.

"Bright broken swaths, disrupted dark plains and the astounding Arbela Sulcus suggest

Ganymede may be more similar to uropa than previously believed," Pappalardo said. Arbela Sulcus is a relatively smooth, bright band interrupting a more cratered, older landscape. The new images show subtle striations along its length. "It is possible that Arbela Sulcus has formed by complete separation of Ganymede's icy crust, like bands on Europa, but unusual for Ganymede," he said.

Natural radioactivity in Ganymede's rocky interior should provide enough heating to maintain a stable layer of liquid water between two layers of ice, about 150 to 200 kilometers (90 to 120 miles) below the surface, said Dr. Dave Stevenson, planetary scientist at the California Institute of Technology, Pasadena. That's a difference from Europa, where interior flexing from tidal effects of Jupiter's gravity provides much of the internal heat, he said.

"I would have been surprised if Ganymede had not had an ocean, but the issue of whether it's there is different than the issue of whether you can expect to see it clearly in the data," Stevenson said.

Galileo has been orbiting Jupiter since Dec. 7, 1995. It will fly past Ganymede again on Dec. 28, but will not come as close as it did in May. Additional information on Galileo is available at http://galileo.jpl.nasa.gov . The Galileo mission is managed for NASA's Office of Space Science, Washington, D.C. by JPL, a division of the California Institute of Technology.

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Some more Astro-humour

Astronauts do it above the atmosphere.
Astronomers do it all night.
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Astronomers do it Charging, Coupling and Devising (CCDs).
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Astronomers do it in the dark.
Astronomers do it in voids.
Astronomers do it in X-ways.
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Astronomers do it on mountain tops.
Astronomers do it orbitally.
Astronomers do it parabolically.
Astronomers do it spectroscopically.
Astronomers do it telescopically.
Astronomers do it under the stars.
Astronomers do it universally.
Astronomers do it variably.
Astronomers do it while gazing at Uranus.
Astronomers do it with binaries.
Astronomers do it with dwarfs.
Astronomers do it with giants.
Astronomers do it with lenses.
Astronomers do it with light.
Astronomers do it with lights out.
Astronomers do it with long tubes.
Astronomers do it with mirrors.
Astronomers do it with sextants.
Astronomers do it with stars.
Astronomers do it with Uranus.
Astronomers do it with young stars.
Astronomers are much nicer than real people.

Brian Fraser

and God said,

$$E = hf = hc/\lambda, \quad eV_0 = hf\text{-}W, E = mc^2, E^2 = P^2c^2 + m^2c^4, \Psi(x,t) = \int_{-\infty}^{\infty} A(k)e^{j(kx-\omega t)}dk,$$

$$p = h/\lambda, \Psi(x,t) = e^{j(k_0 x-\omega_0 t)}\int_{-\infty}^{\infty} A(k)e^{j(k-k_0)[x-(d\omega-dt)_{k_0}]}dk, V = \left(\frac{d\omega}{dk}\right)_{k_0}, E = p^2/2m,$$

$$\Psi(x,t) = e^{j(k_0 x-\omega_0 t)}\int_{-\infty}^{\infty} A(k)e^{j(k-k_0)[x-(d\omega-dt)_{k_0}]}dk, V = \left(\frac{d\omega}{dk}\right)_{k_0} \quad \hbar\omega e^{j(kx-\omega t)} = \frac{\hbar^2k^2}{2m}e^{j(kx-\omega t)}$$

$$E = \hbar^2k^2/2m, \quad E = \hbar\omega = \hbar^2k^2/2m, m_{rel} = \frac{m}{\sqrt{1-v^2/c^2}}, \quad \frac{\hbar^2}{2m}\frac{\partial^2\Psi}{\partial x^2} = j\hbar\frac{\partial\Psi}{\partial t}$$

$$\frac{\partial^2\psi}{\partial x^2} + \frac{2m(E-V)}{\hbar^2}\psi = 0, \quad k^2 = \frac{2m(E-V)}{\hbar^2}, \quad \lambda = \frac{\hbar}{\sqrt{2m(E-M)}}, \quad E = \frac{1}{2}kx^2$$

$$E\psi = -\frac{\hbar}{2m}\left(\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2}\right) - \frac{2e^2}{4\pi\varepsilon_0 r}\psi, \quad J = \nabla \times H, \quad \frac{d^2x}{dt^2} + \frac{k}{x}x = 0$$

$$J = \frac{1}{r\sin\theta}\left[\frac{\partial H_\phi \sin\theta}{\partial\theta} - \frac{\partial H_\theta}{\partial\phi}\right]\bar{a}_r + \frac{1}{r}\left[\frac{1}{\sin\theta}\frac{\partial H_r}{\partial\phi} - \frac{\partial(rH_\phi)}{\partial r}\right]\bar{a}_\theta + \frac{1}{r}\left[\frac{\partial(rH_\theta)}{\partial r} - \frac{\partial H_r}{\partial\theta}\right]\bar{a}_\phi$$

$$-\frac{\hbar^2}{2m}\left(\frac{\partial^2\psi}{\partial x^2} + \frac{\partial^2\psi}{\partial y^2} + \frac{\partial^2\psi}{\partial z^2}\right) + V\psi = E\psi, \quad V = -\frac{e^2}{4\pi\varepsilon_0}\frac{1}{r} = \frac{e^2}{4\pi\varepsilon_0}\frac{1}{\sqrt{x^2+y^2+z^2}}$$

$$\nabla^2 V = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial V}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial V}{\partial\theta}\right) + \frac{1}{r^2\sin^2\theta}\frac{\partial^2 V}{\partial\phi^2}, \quad J = \lim_{\Delta S_n\to 0}\frac{\oint H\cdot dl}{\Delta S_n}$$

$$\nabla\cdot D = \frac{1}{h_1h_2h_3}\left[\frac{\partial}{\partial u}(h_2h_3D_u) + \frac{\partial}{\partial v}(h_3h_1D_v) + \frac{\partial}{\partial w}(h_1h_2D_w)\right]$$

$$P_e = \int_{vol}\frac{1}{\sigma^2}J_1^2dV = \int_{-l}^{0}\int_{0}^{2\pi}\int_{a}^{b}\frac{4\sigma V_0}{\left[r\ln\left(b/a\right)\right]^2}\sin^2\beta z\sin^2\omega t\,dr\,d\theta\,dz = \frac{4\pi\sigma V_0^2}{\ln\left(b/a\right)}\left(l - \frac{\sin 2\beta l}{2\beta}\right)\sin^2\omega t$$

$$J_v(z) = \sum_{m=0}^{\infty}\frac{(-1)^m z^{v+2m}}{m!\,\Gamma(m+v+1)2^{v+2m}}, \quad J_{-v}(z) = \sum_{m=0}^{\infty}\frac{(-1)^m z^{-v+2m}}{m!\,\Gamma(m-v+1)2^{-v+2m}}$$

$$\oint_l \bar{E}\cdot\bar{dl} = emf = -\int_s\frac{\partial\bar{B}}{\partial t}\cdot ds, \quad \oint_l \bar{H}\cdot\bar{dl} = I = \int\left(\bar{J}_c + \frac{\partial\bar{D}}{\partial t}\right)\cdot ds, \quad \oint_s \bar{D}\cdot\bar{dS} = Q = \int_v \nabla\cdot\bar{D}dv$$

$$E_r = \frac{J_0e^{-\gamma r}}{4\pi}\left(\sqrt{\frac{\mu}{\varepsilon}}\frac{2}{r^2} + \frac{2}{j\omega\varepsilon r^3}\right)\cos\theta, \quad E_\theta = \frac{J_0e^{-\gamma r}}{4\pi}\left(\frac{j\omega\mu}{r} + \sqrt{\frac{\mu}{\varepsilon}}\frac{1}{r^2} + \frac{1}{j\omega\varepsilon r^3}\right)\sin\theta$$

$$E(r,\theta,t) = \frac{-\omega\mu J_0}{4\pi r}\sin\theta\sin(\omega t - \omega r\sqrt{\mu\varepsilon})a_\theta, \quad H(r,\theta,t) = \sqrt{\frac{\varepsilon}{\mu}}E_\theta a_\phi, \quad \gamma = j\omega\sqrt{\mu\varepsilon} \quad \ldots$$

and there was light.

Submitted by **Chris Stewart**

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**
Jan 01	05.21	19.02	05.33	19.22	08.53	21.54	01.11	14.04	16.04	02.48	15.27	02.25
Jan 11	05.28	19.03	06.11	19.48	09.04	21.46	00.50	13.51	15.22	02.06	14.46	01.44
Jan 21	05.36	19.03	06.49	20.03	09.10	21.33	00.29	13.37	14.41	01.26	14.06	01.04
Jan 31	05.43	18.59	07.07	19.55	09.11	20.58	00.09	13.24	14.01	00.46	13.27	00.25
Feb 10	05.51	18.53	06.21	19.02	09.11	20.58	23.49	13.09	13.24	00.08	12.49	23.46
Feb 20	05.57	18.46	04.55	17.51	09.02	20.32	23.28	12.54	12.47	23.31	12.11	23.08
Mar 02	06.03	18.37	04.10	17.15	08.42	20.00	23.07	12.38	12.13	22.55	11.34	22.30
Mar 12	06.09	18.27	04.04	17.07	08.07	19.17	22.46	12.20	11.39	22.20	10.58	21.53
Mar 22	06.13	18.16	04.20	17.09	07.13	18.25	22.23	12.01	11.06	21.46	10.23	21.17
Apr 01	06.18	18.06	04.48	17.15	06.07	17.30	21.59	11.40	10.34	21.13	09.48	20.41
Apr 11	06.23	17.55	05.25	17.25	05.04	16.42	21.33	11.16	10.03	20.41	09.13	20.05
Apr 21	06.27	17.46	06.15	17.40	04.16	16.05	21.04	10.49	09.33	20.09	08.39	19.30
May 01	06.32	17.37	07.14	18.04	03.46	15.39	20.31	10.18	09.03	19.38	08.05	18.55
May 11	06.38	17.31	08.06	18.31	03.28	15.20	19.53	09.43	08.34	19.07	07.32	18.20
May 21	06.43	17.26	08.30	18.48	03.20	15.05	19.10	09.02	08.04	18.37	06.58	17.45
May 31	06.48	17.23	08.18	18.43	03.18	14.54	18.21	08.16	07.35	18.07	06.25	17.11
Jun 10	06.52	17.22	07.31	18.07	03.20	14.45	17.28	07.26	07.06	17.37	05.51	16.36
Jun 20	06.55	17.23	06.24	17.11	03.26	14.38	16.33	06.33	06.37	17.07	05.17	16.01
Jun 30	06.57	17.26	05.34	16.24	03.34	14.35	15.40	05.40	06.08	16.37	04.43	15.27
Jul 10	06.56	17.30	05.22	16.03	03.44	14.34	14.52	04.52	05.38	16.08	04.09	14.52
Jul 20	06.54	17.34	05.44	16.16	03.55	14.37	14.09	04.10	05.09	15.38	03.35	14.16
Jul 30	06.49	17.39	06.25	17.02	04.06	14.43	13.33	03.33	04.38	15.08	03.00	13.41
Aug 09	06.43	17.44	07.00	17.58	04.17	14.52	13.02	03.03	04.08	14.37	02.24	13.05
Aug 19	06.34	17.49	07.18	18.46	04.27	15.05	12.37	02.38	03.36	14.07	01.48	12.28
Aug 29	06.25	17.53	07.23	19.21	04.33	15.19	12.15	02.16	03.04	13.35	01.11	11.51
Sep 08	06.14	17.57	07.21	19.46	04.38	15.35	11.57	01.58	02.32	13.03	00.34	11.14
Sep 18	06.03	18.01	07.12	20.00	04.39	15.51	11.43	01.41	01.58	12.30	23.55	10.35
Sep 28	05.52	18.05	06.51	19.54	04.39	16.06	11.30	01.26	01.24	11.56	23.16	09.56
Oct 08	05.42	18.09	06.08	19.07	04.36	16.22	11.20	01.12	00.48	11.21	22.36	09.17
Oct 18	05.32	18.14	05.06	17.38	04.33	16.38	11.12	00.57	00.11	10.44	21.55	08.36
Oct 28	05.23	18.20	04.34	16.57	04.30	16.54	11.05	00.42	23.34	10.06	21.14	07.55
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
Jan 06	05.24	19.03	06.43	20.15	05.14	18.56	10.21	22.43	18.35	05.05	16.15	02.59

The Sky this Month

January 2001

dd hh	dd hh
2 22 FIRST QUARTER	24 13 NEW MOON
3 05 Earth at Perihelion	24 15 Neptune 2.0 N of Moon
6 01 Saturn 2.0 N of Moon	24 17 Moon at apogee
6 14 Jupiter 3.1 N of Moon	25 14 Jupiter stationary
9 20 FULL MOON Eclipse	25 15 Saturn stationary
10 09 Moon at perigee	25 19 Uranus 2.3 N of Moon
13 18 Mercury 2.2 S of Neptune	26 03 Mercury 3.0 N of Moon
16 13 LAST QUARTER	26 03 Neptune in conj. with Sun
17 06 Venus greatest elong. E(47)	27 05 Mercury greatest brilliancy
17 20 Mars 3.8 S of Moon	28 05 Mercury greatest elong. E(16)
22 18 Mercury 0.4 S of Uranus	28 14 Venus 6.4 N of Moon

February 2001

dd hh	dd hh
1 14 FIRST QUARTER	15 09 Mars 2.9 S of Moon,
2 09 Saturn 2.2 N of Moon	20 19 Moon at apogee,
2 22 Jupiter 3.0 N of Moon	20 23 Neptune 2.1 N of Moon,
3 14 Mercury stationary	21 16 Mercury 5.6 N of Moon,
7 21 Moon at perigee	21 23 Venus greatest brilliancy,
8 07 FULL MOON	22 04 Uranus 2.4 N of Moon,
9 12 Uranus in conj. with Sun	23 08 NEW MOON,
13 01 Mercury in inferior conjn	25 05 Mercury stationary,
14 16 Mercury 4.6 N of Uranus	26 08 Venus 11.4 N of Moon
15 03 LAST QUARTER	

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
Jan 01	05.21	19.02	05.33	19.22	08.53	21.54	01.11	14.04	16.04	02.48	15.27	02.25
Jan 11	05.28	19.03	06.11	19.48	09.04	21.46	00.50	13.51	15.22	02.06	14.46	01.44
Jan 21	05.36	19.03	06.49	20.03	09.10	21.33	00.29	13.37	14.41	01.26	14.06	01.04
Jan 31	05.43	18.59	07.07	19.55	09.11	20.58	00.09	13.24	14.01	00.46	13.27	00.25
Feb 10	05.51	18.53	06.21	19.02	09.11	20.58	23.49	13.09	13.24	00.08	12.49	23.46
Feb 20	05.57	18.46	04.55	17.51	09.02	20.32	23.28	12.54	12.47	23.31	12.11	23.08