# WAS NEWS

Monthly Newsletter of the **W**orthing **A**stronomical **S**ociety

**Number 138** *official website*: www.worthingastro.freeserve.co.uk **January 2001**


# ALMANAC

**All times U.T. January / February**

## LUNAR

| January | Date | Time | rise | set |
|---|---|---|---|---|
| Full Moon | 9th | 20.24 | 15.49 | 07.42 |
| Last Quarter | 16th | 12.35 | **.** | 11.32 |
| New moon | 24th | 13.07 | 08.04 | 16.25 |
| **February** | | | | |
| First Quarter | 1st | 14.02 | 10.59 | 00.18 |
| Full Moon | 8th | 07.12 | 17.17 | 07.54 |
| Last Quarter | 15th | 03.24 | 01.18 | 10.43 |
| New moon | 23rd | 08.21 | 07.30 | 17.32 |

## EARTH

| January | Sunrise | Sunset |
|---|---|---|
| 9th | 08.03 | 16.12 |
| 16th | 07.58 | 16.22 |
| 24th | 07.50 | 16.36 |
| **February** | | |
| 1st | 07.39 | 16.50 |
| 8th | 07.27 | 17.03 |
| 15th | 07.14 | 17.15 |
| 23rd | 06.58 | 17.30 |

## PLANETS

(as at January 24th.)

| | Constellation | Rises | Sets | Mag. |
|---|---|---|---|---|
| **Mercury** | Capricornus | 08.38 | 18.15 | -0.8 |
| Evening object | | | | |
| **Venus** | Pisces | 09.25 | 21.04 | -4.5 |
| Brilliant evening object | | | | |
| **Mars** | Libra | 02.11 | 11.32 | +1.1 |
| Morning object | | | | |
| **Jupiter** | Taurus | 11.55 | 03.33 | -2.6 |
| Evening object | | | | |
| **Saturn** | Taurus | 11.44 | 02.47 | 0.0 |
| Evening object | | | | |
| **Uranus** | Capricornus | 08.33 | 18.00 | +5.9 |
| Unfavourable | | | | |
| **Neptune** | Capricornus | 07.54 | 16.47 | +8.0 |
| Unfavourable | | | | |
| **Pluto** | Ophiuchus | 03.43 | 13.46 | +13.9 |
| Morning object | | | | |

## PHENOMENA

| Day | Hour | January |
|---|---|---|
| 9th | 20 | Total eclipse of moon |
| 17th | 07 | Venus at greatest elongation E. 47° |
| 17th | 22 | Mars 3° S. of moon |
| 25th | 00 | Saturn at stationary point |
| 25th | 09 | Jupiter at stationary point |
| 26th | 04 | Neptune in conjunction |
| 26th | 05 | Mercury 3° N. of moon |
| 28th | 14 | Mercury at greatest elongation 18° E. |
| 28th | 20 | Venus 6° N. of moon |
| | | **February** |
| 2nd | 11 | Saturn 2°N. of moon |
| 2nd | 23 | Jupiter 3°N. of moon |
| 4th | 02 | Mercury at stationary point |
| 9th | 12 | Uranus in conjunction |
| 13th | 00 | Mercury in inferior conjunction |
| 15th | 11 | Mars 3° S. of moon |
| 21st | 19 | Mercury 6° N. of moon |
| 22nd | 01 | Venus at greatest brilliancy |
| 25th | 16 | Mercury at stationary point |
| 26th | 17 | Venus 10° N. of moon |

## Minima of Algol

**Jan** 14th 07.24 17th 04.12 20th 01.00 22nd 21.48 25th 18.26

**Feb.** 6th 05.54 9th 02.48 11th 23.36 14th 20.24

## Lunar Occultations

Times as at W.A.S. Observatory

| Date | U.T. | Z.C.No | Mag | Phase |
|---|---|---|---|---|
| **Jan** | **h. m. s.** | | | |
| 14th | 03.44.25 | 1702 | 4.0 | reapp |
| 15th | 06.43.13 | 1823 | 8.1 | reapp |
| 17th | 03.17.15 | 2043 | 6.5 | reapp |
| 17th | 03.44.19 | 2047 | 6.6 | reapp |
| 27th | 18.50.58 | 3382 | 7.8 | diss |
| 29th | 19.00.03 | 71 | 8.6 | diss |
| 31st | 17.57.25 | 306 | 6.8 | diss |
| 31st | 19.35.54 | 316 | 8.9 | diss |
| **Feb.** | | | | |
| 3rd | 17.56.14 | 718 | 6.0 | diss |
| 3rd | 22.41.43 | 736 | 6.4 | diss |
| 5th | 00.15.38 | 905 | 6.9 | diss |
| 14th | 05.05.59 | 2123 | 8.0 | reapp |
| 15th | 05.11.16 | 2246 | 7.3 | reapp |

## Planetary report

**Mercury.** At greatest elongation 18° E. on Jan 28th and in inferior conjunction on Feb. 13th, will be visible for about the last ten days of Jan and the first three or four days of Feb. in this time it will fade from -0.9 to +0.9, a one day old moon will be close by on the 25th

**Venus**. At greatest elongation E.47°on Jan 17th, at Mag. -4.5 it's a brilliant evening object visible before sunset and still getting brighter as it gets nearer to Earth.

**Mars.** Visible before dawn in the S.E. At Mag +1.3 at the beginning of Jan it will fade as it moves eastwards from Virgo into Libra and on into Scorpius in Feb.

**Jupiter. and Saturn**. At Mag -2.6 and 0.0 respectively are only about 8° apart in Taurus, their retrograde motion will stop on the 25th when they both reach their second stationary point

**Uranus and Neptune**. Are both in conjunction and therefore unsuitably placed.

### *Editors Note*

A Happy New Year, One and all.

Only a short editorial this month, and then only to suggest a New Years resolution to all out there – forget quitting smoking, turn your back on your promise to lose weight, all you need to do this year is to write an article for Was News!!! You won't believe how much better it'll make you feel.

Until the next meeting then, and if you're counting it is only 3024000 seconds away.

Rob

## Happy New Year

Brian Halls

As I write these words, the chimes of Big Ben have just ushered in the year 2001.

About 35 years ago Arthur C Clarke wrote a novel and screen play (with Stanley Kubrick) concerning events in the year 2001 and I suppose, we will want to know (as much people did in 1984 when comparing the George Orwell novel with reality) how much forecast has come about.

Sadly we do not have orbiting space stations that create artificial gravity or fully occupied moon bases. Man went to the moon and then lost the will to stay there way back in the 1970's but, we have seen at least partly occupied space stations like Mir and the newly being built International Space Station. The ISS will become very much a part of night sky observations now and in the future.

The film and novel of 2001 differ slightly. In the novel, it is a manned expedition to the planet Saturn, which reveals the monolith, while in the film it, is the planet Jupiter.

How neat it is that both these gas giant planets are close to each other in the evening sky during the winter months, and are well placed for observation. Certainly I would recommend anyone to give these two objects regular observations as the months continue.

Sadly manned expeditions to the outer planets are far in our future, quite probably not even in my lifetime, and I intend to be around a long time! However we have been out there, albeit by proxy. Pioneer and Voyager robot probes have sent back much information about the outer planets while the Galileo probe at Jupiter and the Cassini mission to Saturn have or will be sending back detailed data and pictures that not even Clarke could have dreamt about in the mid-1960's.

We do not have complicated artificial intelligence in our computers as Clarke did in his HAL 9000. HAL was a Heuristic Algorithmic computer; modern computers are still someway from this development, though the anti virus software on the PC which I am writing this, has heuristic analysis to look for virus and associated activity in it. It's a start! However I have just spent this New Year's weekend tackling PC faults which make me believe that Windows has a plan to overthrow mankind by refusing to do what I want it to!

One of the subtitles of **2001: A Space Odyssey** was 'the year we made contact'. At the moment we have the SETI (Search for Extra Terrestrial Intelligence) project which is checking the natural radio noise in the galaxy for something that may be artificial and alien. Arthur C Clarke has had the knack to quite often get things right, I wonder how right he will be with *that* prediction.

May I take this opportunity to wish you all clear skies in the coming year.

### *Dates for your Diary*

Graham L. Boots

## Lunar & Planetary Photographic Evenings At The Observatory

Those wishing to undertake photography of Jupiter, Saturn, Venus and the Moon please come to the Observatory (weather permitting) around 7.00 p.m. on the dates listed below. The Celestron 8 f10 Schmidt/Cassegrain will be in use at prime focus and eyepiece projection method with and without filters. Speed of film (not supplied) can be anything between 50 and 400 ISO colour or black and white. Many adapters are available for your own single lens reflex (SLR) camera. I regret automatic cameras will not be suitable but we are able to supply SLRs on site. If in doubt about seeing conditions please telephone: 01903 505346.

Monday 29th January 2000 5 day Moon

Wednesday 31st January 2000 7 day old Moon

## Solar Section Report

November 2000

By Section Director, Brian Halls

There was a rise in sunspot activity when compared with recent months.

**30 October – 5 November**

There was an appearance of low latitude sunspot groups – a rarity this sunspot cycle until now. Region 9213 ($N02^0$, L = $270^0$, Hax/250 on 4 November), was active and associated with a halo coronal mass ejection.

Region 9210 ($S30^0$ L=$293^0$, Dso/110 on 31 October) was the highest of the sunspot groups visible during the month..

Region 9218 ($N20^0$, L=$248^0$, Eao/270 on 4 November) first appeared on 1 November as a small group, rapidly growing in size. As one would expect, this group was responsible for a large number of flares.

**6 - 12 November**

Region 9218 concluded its active phase through the second week of the month eventually exhausting itself, by 7 November, and reducing in size to an Hax type spot when it vanished over the western solar limb on 10 November.

Overall, sunspot activity quietened down.

**13 - 19 November**

Sunspot region 9231 ($S23^0$ L=$058^0$, Fac/370 16 November) was an interesting group that appeared on 13 November and grew in size rapidly producing associated flares with the size change.

**20 - 26 November**

About the time that Region 9231 was active in the southern solar hemisphere, Region 9236 ($N24^0$ L=$352^0$, Eki/600 26 November) was rapidly growing in size and producing associated flare activity.

**27 November – 3 December**

Region 9236 ($N20^0$, L = $352^0$, Eko/630 on 27 November), which was responsible for
the previous week's major flare activity, was beginning to decay and associated activity began to die with it.

Despite poor weather, members observed the Sun on 20 days in November. Graham Boots, Nick Quinn and the Director submitted reports this month.

WAS MDF = 7.05 (N = 5 ; S = 4) R = 96.05

BAA MDF = 7.74 (N = 4.1 ; S = 3.5) R = 122.38

AAVSO R = 138.1

## *December Lecture Reviewed*

By Vanessa Wegner

### Stellar Winds

Dr Klaus-Peter Schroeder

Dr Schroeder began the lecture by looking at the very beginning of time, the Big Bang. The world now consists of much heavier elements then those created by the Big Bang such as hydrogen, helium & lithium. The other elements making up just 1% of the total material in the universe were forged by stars. They were then scattered throughout space by stars shedding matter in their death throes. Massive stars can create elements as heavy as iron in their cores, when they try to fuse iron they explode as supernovas blasting their matter into space. Supernovas however do not happen very often. The other method of expelling matter into space is stellar winds, without this process we would not exist.

Is there evidence of stellar wind emanating from our sun? Yes there are two pieces if evidence. When there is a total solar eclipse one can see the material floating away from the sun. The second piece of evidence is comets. The pressure of the solar wind blows the gas & dust cloud away from the head of the comet to form a tail.

Spectrums of neighbouring stars show the temperature, density & so forth of stars & we can learn much from spectra, (this study is called spectroscopy). If you observe a light source like a star the source of the light comes from the inside, it has to fight its way through the stellar source. A spectrograph is the instrument used, a PC is required to trace the signal & the result is the actual recording of the spectrum showing the dips & peaks as the star changes. The other aspect we should be aware of is the Doppler effect, if the object has some velocity then the incoming waves get squeezed. The

spectra is very useful for physicists observing stellar winds.

In the modern age with the invention of satellites much observing has been done which can not be carried out from the ground. There are government funded projects where astronomers can spend time observing specific subjects using state of the art equipment, e.g. in Chilli there is such a project which the UK is considering becoming part of. The Spectrograph in the Chilean observatory is highly technical, it is entirely operated remotely & the technical apparatus is so over-whelming one has an assistant to explain the set-up. Dr Schroeder who has visited the observatory took his own telescope & whilst the main telescope was in the pain-staking process of exposing the data Dr Schroeder took some magnificent pictures of the southern sky. Only one week is spent in observation, the rest of the year is spent in interpreting the data.

Different stars produce different types of stellar winds. The mass of the star determines the wind. A massive star produces so much energy it is short-lived as it is burning energy so quickly. Massive stars are also very hot, the surface can get up to 50,000 centigrade & as they burn very quickly 100 million years old would be a typical life-span of such a star. Our sun can expect a life-span of 12 billion years as it is relatively cool & burning its fuel slowly. Massive stars as they burn hydrogen, they convert it into helium & in principle can burn into even heavier elements such as iron but of course this does not produce energy. Under the pressure of the rest of the material the centre gets more & more dense, this is called de-generate matter & it is very compact. There is a critical limit of 1.4 solar masses & at this stage it implodes & produces a super-nova which is a huge amount of energy. A super-nova can easily out-shine its host galaxy. This only happens to the supermassive stars, for others like our sun which is much less dense at the core, has less luminosity & is not so hot, about 10,000 Kelvin, it will slowly build up a helium rich core which never exceeds the critical mass limit. When the core ceases to burn energy the burning zone will move out to the rest of the star & it will increase in size substantially to what we call a super red giant. It will of course start to brighten & there will be enough radiation to produce what is called a cool wind, the wind will gradually shed all the material. We will at least have a very peaceful end! What will be left will be a planetary nebula.

Dr Schroeder showed some beautiful slides of Supernova 1987A, 3rd magnitude & easily visible to the naked eye, actually the event itself happened long before man walked the earth. The ring nebula is a good example of when the core becomes naked as the material is gradually blown away by the stellar wind, unlike the crab nebula which would have been a very violent explosion lighting up the whole sky, as observed by the Chinese in the 10th century.

Dr Schroeder's lecture was extremely interesting & absorbing & much appreciated by the audience.

## Eclipsing Binary Stars

Alex Vincent

The stars seem to be unchanging from year to year, but many vary in brightness. These are known as variable stars and there are many kinds such as eclipsing binaries, Cepheids, long-periods, irregulars and so on. There are about 30,000 or so variable stars recorded and all have their own special ways and characters. Mira (Omicron Ceti) is the most famous case.

An eclipsing binary is where the orbit of a binary star is seen edge-on or at a very small angle. The stars come periodically into the line of sight between the observer and the companion star and therefore eclipses it. Algol (Beta Persei) being the most famous of this type and also the first example of its kind to be discovered. Montanan first noted its variations in 1669, but it is possible that the ancients first noticed it.

John Goodricke, who was a serious astronomer (who was deaf and dumb from birth), took a particular interest in Algol in 1782 and deduced that the variability was due to the periodic eclipse of the bright star by a fainter companion. He was right and so Algol is not a true variable star at all. He also discovered the other eclipsing binary 'Beta Lyrae' and the variable 'Delta Cephei'.

Sadly Goodricke died in 1786 at the young age of 21. Had he have lived he would have done much for astronomy.

Variable stars are known as intrinsic variables where fluctuations in brightness are caused by the actual luminosity of the star itself. Eclipsing binary stars are called extrinsic variables where the changes in light are caused by external reasons such as eclipses. In the case of Algol, the eclipses are not total from Earth, only about 79%. If the eclipses were total, the change in brightness would be greater and if no eclipses occurred then the star's light would remain steady.

The periods of eclipsing binary stars (minimum to minimum) vary from a few hours to 27 years and durations (length of eclipse) vary from under two hours to 700 days. The changes in brightness (amplitudes) also vary from a fraction of a magnitude to several magnitudes. For example that of Spica drops only by 0.1 at minimum and RW Tauri drops by three magnitudes at minimum. That of Algol is 2.1 at maximum and drops to 3.4 at minimum.

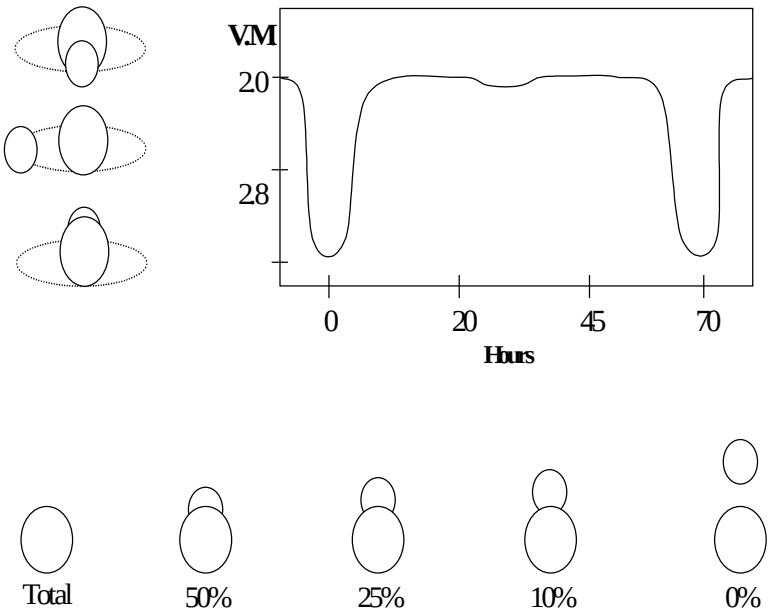
There are three types of eclipsing binary stars. These are Algol type (EA), Beta Lyrae type (EB) and W Ursae Majoris type (EW). Only in the Algol types are the durations of eclipses known with accuracy. A fourth type called 'long-period eclipsing binary stars' are really Algol types. Details of the types, orbits, light curves etc., are found below using the prototype as the example.

**ALGOL (Beta Persei) EA**

Period 2.87 days. Dur 10 hours.

Max 2.1 Min 3.4(sec min 2.2)

Light Curve of Algol





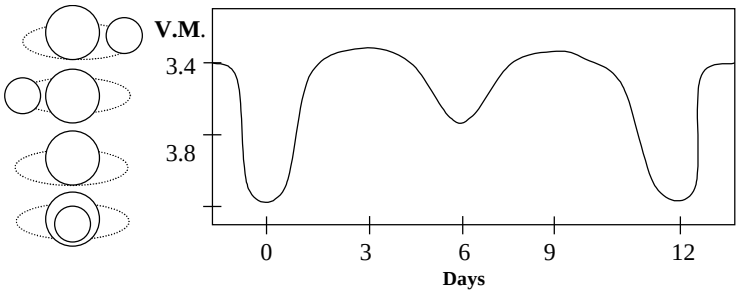


Algol type eclipsing binary stars have periods ranging from 0.2 to 10,000 days and have constant brightness between eclipses. The systems are either a detached or semi-detached binary and the secondary minimum is very small.

**SHELIAK (Beta Lyrae) EB**

Period 12.94 days

Max 3.3 Min 4.4(sec min 3.9)



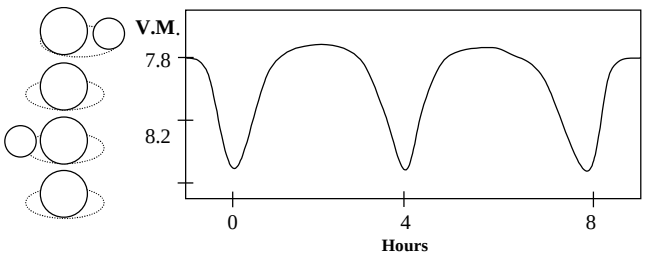

Beta Lyrae type eclipsing binary stars have light curves which show a continuous variation throughout the orbital period. The binary stars are semi-detached and are connected with an accretion disk. There are deep and shallow minima, the former is primary and the latter is secondary.

**W Ursae Majoris EW**

Period 0.333 days

Max 7.8 Min 8.5(sec min 8.4)

Light Curve of W Uma




W Ursae Majoris type eclipsing binary stars have periods of less than one day. The stars are always in contact and light variation is continuous throughout the orbit. Primary and secondary minima are almost the same. Both the components of these systems are dwarf stars.

Long-period eclipsing binary stars.

**Zeta Aurigac. EA.**
Period 972 days. Dur 40 days.

Max 3.7 Mm 4.2

Last minimum in Jul 1998. Next minima in Mar 2001, Nov 2003, Jul 2006, Mar 2009 and Nov 2011.

**VV Cephei. EA**.
Period 7430 days. Dur 490 days.
Max 4.8 Min 5.3

Last minimum in Dec 1997. Next minima in Apr 2018, Aug 2038 and Dec 2058.

**Epsilon Aurigae. EA.**
Period 9892 days (27.1 yrs). Dur 700 days.
Max 2.9 Min 3.8

Last minimum in Jul 1983. Eclipse began on Jul 22 1982, became total on Jan 111983, totality ended on Jan 16 1984 and eclipse ended on Jun 25 1984. Next minima are in Aug 2010, Sep 2037 and Oct 2064.

Epsilon Aurigae is the longest eclipsing binary known and the system comprises of a very luminous supergiant and an invisible companion. The nature of the secondary is unknown and it could be either a young star condensing, a flattened disc or a black hole, but it is more likely to be a hot bluish star surrounded by a shell of dust and gas which blots out its light. More maybe known at its next minimum.

Zeta Aurigae on the other hand comprises of a red supergiant over 200 million miles in diameter and its companion is a blue dwarf some 30 million miles in diameter.

There are some eclipsing binaries which cannot be fitted into the three classes mentioned above, and although they possess the characteristics of the Algol and Beta Lyrae types, their light curves or spectroscopic qualities are sufficiently altered. These are known as 'Peculiar Eclipsing Binary Stars' and examples are RY Scuti, W Serpentis, UX Ursae Majoris and VV Puppis. Also some old novae like DQ Herculis and T Aurigae show evidence of eclipse which means they are binary systems.

## ***What's*** **on the Box**

Wednesday 10th January

*BBC Radio 4*

22.45 ~ Book at Bedtime – 2001: A Space Odyssey (8/10)

William Roberts reads Arthur C Clarke's ground Breaking novel.

Thursday 11th January

*BBC 2*

21.50 ~ Planets – Brief Encounter

(Birth and Death) Documentary series exploring space. This edition looks at the creation and considers the ultimate destruction of our solar system.

*BBC Radio 4*

22.45 ~ Book at Bedtime – 2001: A Space Odyssey (9/10)

William Roberts reads Arthur C Clarke's ground Breaking novel.

Friday 12th January

*BBC Radio 4*

22.45 ~ Book at Bedtime – 2001: A Space Odyssey (10/10)

Saturday 13th January

*BBC 2*

11.45 ~ The Sky at Night

(Genesis – Earth and Moon) Patrick Moore is joined by Proffesor Chris Kitchin to investigate how the Earth and Moon, like distant planets of other Suns, grew from billions of dust grains.

*Channel 4*

23.25 ~ 2001 – The Making of a Myth

Documentary about the making of Stanley Kubrick's classic space epic.

Wednesday 17th January

*BBC Knowledge*

21.50 ~ Moments of Genius

(Fly me to the Moon) Personal views of some of the greatest thinkers in history. Doctor Donald Marshall a Bangor University Chemist with a passion for explosions, talks about Konstantin Tsiolkovsky, a Russian scientist working at the start of the 20th century, who came up the idea of multi-stage spacecraft and proved it to be the only way to go fast and high enough to leave the Earth's atmosphere.

### *Was News News*

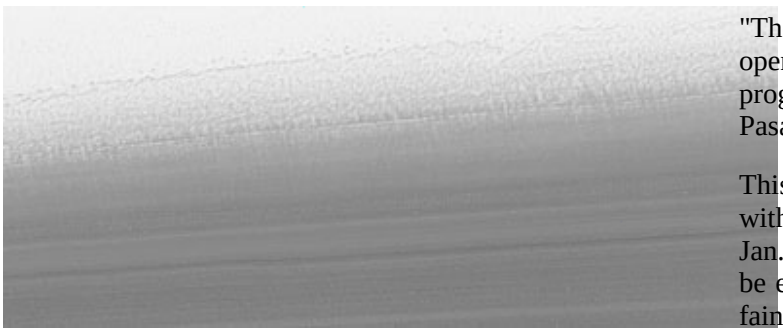
## Seasons greetings from the Martian North Pole!

**NASA / JPL / MSSS PHOTO RELEASE**

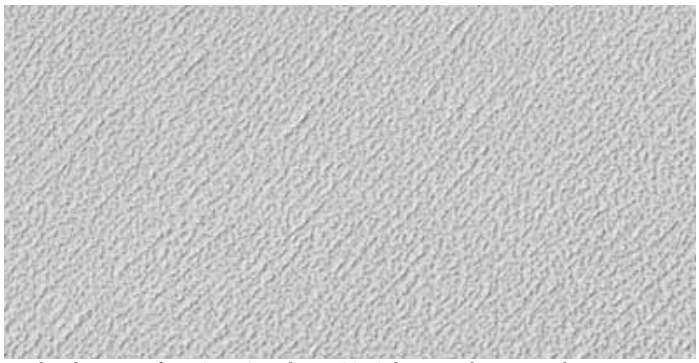
On Mars, Northern Hemisphere Summer (and Southern Hemisphere Winter) began on December 16, 2000. As many children across the U.S. and elsewhere anticipating an annual visit from a generous and jolly red-suited soul from the Earth's North Pole, NASA's Mars Global Surveyor was busy acquiring new views of the region around the Martian North Pole.

The three best views obtained this month are shown here.

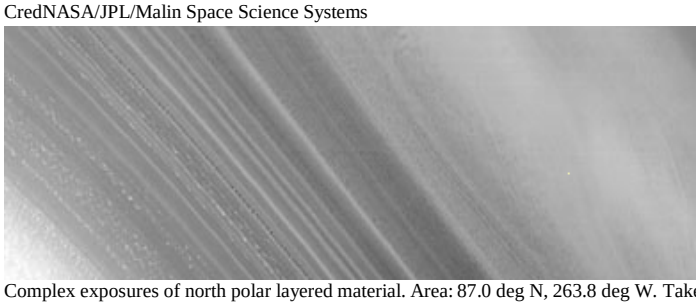
The top and bottom views show many layers exposed and eroded into the form of ridges and troughs on shallow slopes within the Martian north polar cap. The middle view is a picture of the rugged, eroded polar ice cap surface itself. The layers are believed to have formed over tens to hundreds of thousands of years by deposition of dust and ice each cold Martian winter. These surfaces today all appear to have been eroded. The brightest material in each image is frost -- temperatures at this time of year indicate that the frost is composed of frozen water. In winter, temperatures can be cold enough to freeze carbon dioxide, as well



North polar cap layers and frost on the first day of Summer. Area: 86.5 deg N, 324.0 deg W. Taken: December 16. Credit: NASA/JPL/Malin Space Science Systems



North polar cap surface. Area: 85.7 deg N, 307.9 deg W. Taken: December 2. CredNASA/JPL/Malin Space Science Systems



Complex exposures of north polar layered material. Area: 87.0 deg N, 263.8 deg W. Take December 12. Credit: NASA/JPL/Malin Space Science Systems

Malin Space Science Systems and the California Institute of Technology built the MOC using spare hardware from the Mars Observer mission. MSSS operates the camera from its facilities in San Diego, CA. The Jet Propulsion Laboratory's Mars Surveyor Operations Project operates the Mars Global Surveyor spacecraft with its industrial partner, Lockheed Martin Astronautics, from facilities in Pasadena, CA and Denver, CO

## Cassini probe keeps its scientific eye on Jupiter

**NASA / JPL STATUS REPORT**

NASA's Cassini spacecraft has continued collecting new scientific information from Jupiter's environs every day since making its closest approach to the giant planet on Dec. 30, 2000, and is scheduled to keep studying the Jupiter system for another three months while proceeding on toward Saturn.

"The flyby went smoothly, and the spacecraft is operating flawlessly again," said Bob Mitchell, Cassini program manager at NASA's Jet Propulsion Laboratory, Pasadena, Calif.

This week's targets of observation by Cassini begin with Jupiter's atmosphere and rings. Between Jan. 5 and Jan. 12, the moons Io, Europe and Ganymede will each be examined while in eclipse for information that their faint airglows can reveal about those moons' tenuous atmospheres. Today (Thursday), Cassini is measuring natural radio emissions from Jupiter's radiation belts, a research project that will also draw upon results from Earth-based radio telescope observations by students in 25 middle schools and high schools in 13 states.

The flyby of Jupiter, at a distance of about 9.7 million kilometres (6 million miles), gave Cassini a boost from Jupiter's gravity that accelerated the spacecraft by about 2 kilometres per second (about 4,500 miles per hour) and will enable it to reach its ultimate destination, Saturn, in July 2004.

A higher-than-normal drag that was detected on one of Cassini's reaction wheels more than two weeks ago has not reappeared. The reaction wheels are used to rotate the spacecraft in different directions, and the problem led to suspension from Dec. 19 to Dec. 28 of scientific observations that would have required pointing the spacecraft, such as for taking pictures.

"That problem appears to be behind us, except that we have an extra workload to prevent recurrence of the conditions we think caused it," Mitchell said. Mission engineers believe that the excessive friction at one reaction wheel resulted from lessened lubrication after prolonged operation at relatively low speed. Operating the wheel at higher speeds apparently restored proper dispersal of the lubricant. The Cassini flight team is developing procedures for avoiding prolonged operation of the reaction wheels at relatively low speeds.

## Diary

| | |
|---|---|
| **Jan 10th** | **2001 WAS Social Evening** |
| **Feb 14th** | **John Mason (South Downs AS) Building the South of England Planetarium** |
| **Mar 14th** | **Professor Andrew Liddle (University of Sussex) 'Is the Universe Accelerating?'** |

All monthly meetings (**bold**) are held at the Heene Church Rooms, Heene Rd, Worthing @ 7:30pm

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**Note to Contributors**

Contributions to the **February** issue of WAS NEWS should be with the Editor by **February 1st**. All material for inclusion should be sent to the Editor.

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