CANOPUS

The Astronomical Society of Southern Africa

Johannesburg Centre

Monthly Newsletter for April 2001

<u>Contents:</u>

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

Editorial

March 21st, a Public Holiday here in South Africa, and the Autumnal Equinox - how many realise that we're officially half way to Winter? The weather has still been acting a little strange, but the observers among us are still getting some really good views when the clouds disappear. Mercury has dropped out of sight and Venus is following at a gallop and it won't be too long before it reappears in the East as our morning "star". Saturn and Jupiter are following at a more leisurely rate and Mars is trying to catch up, but is still a few hours adrift.

Have any of you been watching Delta Scorpii lately - it is really changing the whole look and "feel" of the head of Scorpius and is appreciably brighter than most of the nearby stars that were up to a few months ago, it's superiors. No-one *really* seems to know what's happening here but many theories abound - far to many to mention here, but we will report on them as and when they are formalised.

Barbara Cunow's "Galaxies" presentation was very well received and caused quite a fair amount of discussion, especially after the meeting was officially over. Chris Stewart's mini-Bateman lecture was also very interesting and we now all have a good idea of what's in the bag - or should I say, what should be in the bag. A lot of thought and practicality has gone into the collection of astronomical paraphernalia and I think we should all say a thank-you to Chris for the good ideas he has supplied.

Brian supplies the Heavenly Happenings as per usual and also gives us information and a chart on the very easily observable T-Centauri. This is always a good variable to visit and if you have a CCD Camera, you will be able to create a series of images covering the whole variation in about 3 months. Eben van Zyl supplies episode number 2 in the fascinating saga of *Life in the Universe*. It is really a privilege having a writer of his skill to explain this subject to us in terms that most of us understand.

The answer to Gill Stewart's puzzle from the last issue can be found next to a new puzzle supplied by an occasional correspondent, Isa da Rocha-Chomse. She has supplied a series of puzzles which will be inserted (alternating with Gill's) over the next few months. Thanks Isa.

According to recent reports, Danie Overbeek is getting better in leaps and bounds and is once again mobile. ***Our hopes and good wishes for your full recovery remain with you Danie***.

Remember to contact Brian Fraser if you wish to fly to Lusaka for the June 21st Eclipse.

The Editor - *chris@penberthy.co.za*

Committee of the Johannesburg Centre of the ASSA for 2000/1

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Notice of Meeting

The **April** meeting of the Johannesburg Centre of the Astronomical Society will be held in the Wits Planetarium, on the Wits University Grounds (access via Yale Road), on **Wednesday the 11th of April, 2001 at 18:00.**

Society Members must produce their membership cards to obtain free entrance.

Topic:

"Astronomy's Devices"

By: Prof V Radhakrishnan

>>> PLEASE NOTE THE EARLIER STARTING TIME < < <

Future Meetings

May 9th	**Planispheres**	**T.B.A.**
June 13th	**Eclipse explained**	**Medley of Speakers**
July 16th (Saturday)	**A.G.M.**	
August 8th	**Eclipse Experiences**	**Miscellany of Speakers**

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. 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.

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

Public Viewing *(weather permitting)*

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. There will be no Public viewing in April as the appropriate Friday falls on a Public Holiday.

Please note that the Public viewing nights are held subject to suitable weather conditions.

25th May	21st September
29th June	19th October
27th July	23rd November
24th August	

Annual General Meeting.

We have decided once again to hold the A.G.M. on a Saturday to encourage members to attend and enjoy a bring 'n braai as soon as the Society business is finished (hopefully no more than an hour). We will also be opening the "Mars Bar" and the Domes and hope some of you will bring your 'scopes along as the time of the year (if not the lighting) lends itself to clear viewing.

Jo'burg Centre Outings for 2000/1

Your Committee is making arrangements for several outings during the year. Amongst these are some old favourites as well as a couple of new ones which should prove interesting.

Nylsvlei - we have a booking for the weekend of the 14th - 16th September for 30 people.

You may contact Ed Finlay on 083-449-1103 if you wish to book a place on this outing.

Boyden - dependant on availability of a suitable weekend.

Haartebeeshoek - Sunday 22nd of July at 16:00. (Just be by the main gate from about 15:45).

Please contact Wolf Lange on 849-6020 or 636-4725 to supply numbers & remember to bring along briquettes/fire starters/matches as well as eats & drinks for the braai afterwards.

A visit to the Suikerbosrand Nature Reserve.

Tswaing Crater - still trying to set up a day visit under the guidance of Prof. Reimold

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

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.

Solar Eclipse - June 21st 2001

Total eclipses of the sun are spectacular and awe inspiring. For those within the path of totality there are dramatic effects as the moon's shadow races across the earth's surface at around 2000 km/hour.

Just before the sun disappears behind the moon, it shines through valleys on the moon's edge to create an effect which has been likened to a diamond ring. It then becomes quite dark and the sun's corona, that extended shell of ionised gas which is normally hidden by the sun's glare, shines forth in a scene of great beauty.

On June 21st this year there will be a total eclipse of the sun visible from a narrow band that stretches from Angola in the west across Zambia, Zimbabwe and Mozambique and on to Madagascar. The circumstances for this eclipse are very favourable, with weather prospects being exceptionally good. Totality will last from 4 minutes in Angola to about 2 mins in Madagascar. A Total eclipse happens in any one locality, on average, once in 118 years.

Thousands are people from all over the world will be converging on Africa for this event. All hotels in Zambia were fully booked 18 months ago. It promises to be a spectacular event.

The Johannesburg Center of the Astronomical Society of Southern Africa has been fortunate in being able to charter two aircraft for the day and will be flying to Lusaka in Zambia to observe the eclipse. (Lusaka lies in the path of totality). Flights leave Johannesburg at about 10:00 and will return from Lusaka after the eclipse at about 17:00.

Cost is R2400-00 per person, which includes meals on the flights, free bar facilities and all airport taxes.

Bookings can be made via Brian Fraser on (011) 871-0370 or email fraserb@intekom.co.za.

“Astronomy’s Devices”

Prof V Radhakrishnan

Astronomy nowadays is beautiful pictures and amazing discoveries of black holes and distant galaxies. “Rad” Radhakrishnan will be taking us behind the scenes, to the instruments and devices that reveal these wonders, and the surprisingly familiar technology that astronomers use, now and in the past.

Prof V Radhakrishnan, Distinguished Professor-Emeritus at the Raman Research Institute (Bangalore, India), is visiting South Africa to attend the national SciFest in Grahamstown, where he will be giving talks on two of his other specialities: pulsars and sailing.

HOW HAS THE EARTH FORMED?

PART I

To answer this question, it is advisable to turn firstly to the formation of the Sun and the stars. According to the Big Bang theory the universe started with radiation at a temperature of about 10^{12} degrees - a temperature too high for atoms to exist. This was the so-called Cosmic Egg, first postulated by Georges Lemaitre in 1945. Then sudden expansion took place. Rather than calling this the big bang, a better name would be the "Cosmo-genesis", i.e. the beginning and subsequent development or evolution of the universe. The radiant energy was then converted into matter when the temperature dropped below 10^{10} degrees. Einstein worked out the relationship between energy and matter and expressed it in the formula $E = mc^2$, where **E** is the energy in ergs; **m** the mass of the matter produced in grams; and **c** is the speed of light in centimetres per second, namely 2,99792 x 10^{10},which we can call 3 x 10^{10} centimetres per second (a 3 followed by 10 zeros). From this formula we see that the amount of matter produced is given by $m = E \div c^2$; so when we look at the amount of matter in the universe, we are forced to admit that the amount of energy **E**, must have been a quantity unimaginably large.

The matter produced, consisted only of hydrogen and helium in the proportion of 75% to 25% with a slight admixture of lithium, carbon and oxygen. The hydrogen atom consists of one Proton which carries a positive electric charge. This charge is neutralised by the negative charge of an electron outside the nucleus. The mass of the proton is 1836 times the mass of the electron. The nucleus of the helium atom contains two protons and two chargeless particles, called neutrons, with two negative electrons outside the nucleus. The mass of the neutron is approximately equal to that of the proton.

This matter was then fairly evenly dispersed into space while space expanded and the temperature kept falling. The microwave background radiation which was discovered rather accidentally by A A Penzias and R M Milson in 1965, is the remnant of the original radiation. It has since cooled to -270°C. This radiation is very evenly distributed but it does have slight unevennesses so that we can conclude that the matter also had slight concentrations here and there. These concentrations of cold gas very quickly exercised gravitational attraction on the surrounding less concentrated matter, causing the surrounding matter to spiral in on the concentrations because wherever matter occurs, the fabric of the space-time continuum becomes curved and the world lines of gravitational attraction become more and more concentrated in the clumps of matter which became the first galaxies. Because of the spiraling motion, these masses began rotating in the curved space-time continuum. Subsequently everything in the universe had spin. Because the speed of rotation varied with the distance from the centre the particles of matter were constantly overhauled by faster-moving particles nearer the centre. These differential speeds caused the particles to clump together and to serve as nuclei of separate stars. The mass of gas which went to form a star, in its turn, rotated about its own centre of gravity. It is more accurate to say that the gas particles rotated because they were constrained by the curvature of space-time around the centre of concentration of the proto-star.

As the gas became more and more concentrated, the overlying layers exerted more and more pressure on the centre of attraction. We know that increase of pressure, raises the temperature; for example, if one rapidly pumps up a bicycle tyre, the lower end of the pump, where the air becomes compressed, gets so hot that one cannot hold it.

The increase in temperature at the centre (nucleus) of the compressed gas eventually led to the atoms of hydrogen and helium becoming ionised, i.e. losing their electrons, thus forming a plasma which is highly electrically conducting and glows so that the proto-star began to shine. This ionisation came about when the temperature rose to about 10 000°. Despite the high pressure in the nucleus, the ions, consisting of single protons and electrons, moved about freely. At this stage the coagulation of matter could be termed a star-in-the-making.

As the gravitational attraction drew in more and more matter, the inexorable pressure of the overlying layers of gas, caused the temperature in the nucleus to rise ever higher and higher and volume, or size of the clump of gas became greater and greater. The matter in the clump occupied a volume which was so great that the gravitational force experienced by the outlying particles, outside the clump of gas, no longer acted from a single point in the centre of the clump. Thus the outlying particles started describing ellipses around the nucleus. In these elliptical orbits, the particles clumped together to form the nuclei of planets. Meanwhile the proto-star got bigger and hotter. When the temperature of its nucleus reached 10 million degrees, the pressure was so great that the separate protons were crushed into each other. The pressure overcame the force of repulsion between the individual positively charged protons and formed a nucleus of deuterium. Very adroitly one of two protons succeeded in shooting its positive charge out into the surroundings as a positron and the proton had become a changeless particle, a neutron, which could stick to the positive proton. This newly formed nucleus is called deuterium.

$$\frac{1}{1}H + \frac{1}{1}H \rightarrow \frac{2}{1}H + positron\,.$$

A free proton was then forced into the deuterium and a transformation took place whereby a helium nucleus was formed:

$$\frac{2}{1}H + \frac{1}{1}H \rightarrow \frac{3}{2}He + gammarays\,.$$

The transformation into helium set free gammarays, which was radiation at the highest possible frequency. The proto star became a real star when this radiation reached the surface. Two of these helium nuclei, each consisting of two protons and one neutron, i.e. a mass of 3 atomic mass units (**amu**) were then forced into each other to form a helium nucleus of 2 protons and 2 neutrons;

$$\frac{3}{2}He + \frac{3}{2}He \rightarrow \frac{4}{2}He + \frac{1}{1}H + \frac{1}{1}H\,.$$

Two protons were set free, to start the process all over again. The star had succeeded in transforming hydrogen into helium and in so doing copious amounts of radiation were set free as gammarays at a frequency of 1025 Hertz. These rays, in working their way up to the surface of the star are continually absorbed by the protons and re-emitted again, but each time at a lower frequency - a condition of thermal equilibrium, which can only prevail in the nucleus of a star. By the time these rays reached the surface, the frequency had decreased to 10^{14}; i.e. they had become visible light. The star had thus begun to shine in all its glory. The gammarays radiated by the star, constitute a loss of mass by the star. The mass of the original 4 protons totaled 4,03252 **amu** but that of the helium formed was only 4,00389 **amu**, i.e. a loss of mass of 0,02863 **amu** had taken place. This constitutes 0,75 of the original four protons. This loss of mass had been converted into energy in the form of gammarays, according to Einstein's equation

$$E = mc^2.$$

While all this was going on in the nucleus of the star, the bodies in the elliptical orbits, the planets, went on accumulating matter from the primeval nebula of cold gas. These planets were hopelessly unfit to harbour life forms. They consisted almost entirely of gas and had only very tiny cores of solid substances. But these planets were not destined to survive because their parent stars very quickly became very massive because of the highly concentrated gas. Because of their great masses the temperatures at their centres rose to hundreds of millions of degrees and they were able to form heavier elements such as carbon, oxygen, nitrogen, neon magnesium, calcium, silicon, until they eventually started forming iron of mass 56 **amu**. By this time the amount of hydrogen available as fuel had become seriously depleted, so much so that there was a sudden drop in the amount of radiation from the centre. This radiation had up to that time assisted the resistance by the gas to the crushing pressure by the overlying layers which tended to crush the material into a point. When the radiation suddenly decreased, the inexorable pressure of the overlying gas layers, caused the temperature at the centre to rise to 100 million degrees. This sudden rise in temperature had two effects**:** atoms heavier than helium were produced, such as carbon, oxygen, nitrogen, magnesium, aluminium, silicon and even iron; and the second effect was that a rebound from the centre took place and a large part of the star was blasted into space as a supernova explosion. In this explosion atoms as heavy as uranium were formed. The whole region in the neighbourhood became littered with heavier atoms constituting 1% of the whole. It is masses of supernova explosions such as these that we see today as the quasars.

According to D N Schramm, in his treatise "The Ages of the Elements", there was a peak of supernovae explosions round about 9 milliard (9 x 10^9) years ago. The matter shot out into space, vaporised the planets and they became intermixed with the material of the nebula. The first generation of stars and planets had come to an end!

This nebula, enriched with heavy elements, became the source from which the second generation of stars and planets could be born by the same process of accretion (packing together) which had produced the first generation of stars. However, the new stars and planets which were formed from this material, contained heavy atoms (although only 1%). On average, the second generation of stars was less massive because the matter was now more spread out, After another four milliard years (i.e. 5 milliard years ago), a second peak of supernovae explosions took place and once again space was littered with enriched material, now containing as much as 2% of heavier atoms. This material formed the source from which the third generation of stars was formed, one of which happened to be our Sun.

Jan Eben van Zyl

WATCH THIS SPACE!

The Keck Interferometer

NASANews@hq.nasa.gov

Extract from RELEASE: 01-42

AN ASTRONOMY FIRST: TELESCOPES DOUBLE-TEAM HAWAIIAN NIGHT SKY

Proving that two telescopes are better than one, NASA astronomers have gathered the first starlight obtained by linking two Hawaiian 10-meter telescopes.

This successful test at the W.M. Keck Observatory on Mauna Kea makes the linked telescopes, which together are called the Keck Interferometer, the world's most powerful optical telescope system. The project will eventually search for planets around nearby stars and help NASA design future space-based missions that can search for habitable, Earthlike planets.

Monday night, March 12, starlight from HD61294, a faint star in the constellation Lynx, was captured by both Keck telescopes and transported across a sophisticated optical system across the 275 feet separating the two telescopes. In an underground tunnel that links the telescopes, the collected light waves were combined and processed with a beam combiner and camera. In order to properly phase the two telescopes, adaptive optics on both telescopes removed the distortion caused by the Earth's atmosphere. In addition, the optical system in the tunnel adjusted the light path to within a millionth of an inch.

Testing of the Keck Interferometer will continue for the next several months. Limited science operations, including the search for planets, are expected to begin this Fall. Scientists around the world will soon be invited to propose studies they'd like to conduct using the Keck Interferometer. Their proposals will undergo a formal review and selection process.

The development of the Keck Interferometer is managed by JPL for NASA's Office of Space Science, Washington, DC. JPL is a division of the California Institute of Technology (Caltech). The W.M. Keck Observatory is funded by Caltech, the University of California, and NASA, and is managed by the California Association for Research in Astronomy, Kamuela, HI.

Additional information and images are available on the Internet at:

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

http://origins.jpl.nasa.gov

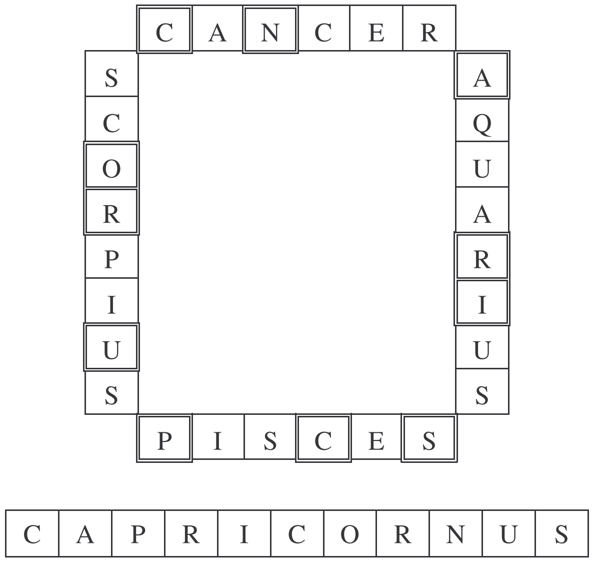
NASA News

Variable of the Month
T Centauri

Here is a variable star that is bright, easy to find, and has a short enough period that you can follow it through its entire cycle in just 3 months. The magnitude range is from about 6.0 to about 8.0 and the period is given as 91 days. In fact you could follow this star with just a good pair of binoculars.

Here is the solution to last month's Zodiac puzzle from Gill Stewart.

The Zodiac



Gamma-rays from an Asteroid

NASA Science

NASA Science News for February 27, 2001
12:00:00 PM

Perched on the surface of asteroid 433 Eros, NASA's NEAR spacecraft is beaming back measurements of gamma-rays leaking from the space rock's dusty soil. Find out what scientists hope to learn about Eros, which might be a real-life planetesimal from the dawn of the solar system.

If you have access to the World Wide Web,
you can find the full story at

http://science.nasa.gov/headlines/y2001/
ast27feb_2.htm?list40309

(Concatenate the above two lines to obtain the full NASA Science Website address)

Galileo to Burn in Jupiter's Atmosphere

NASANews@hq.nasa.gov
Extracts from RELEASE: 01-41

The resilient Galileo spacecraft doesn't know when it call it quits. So, NASA has outlined the details of one last mission extension, which includes five more flybys of the Jovian moons before a final plunge into the crushing pressure of the giant planet's atmosphere.

On May 25, Galileo should pass about 123 kilometers (76 miles) above the moon Callisto, the second largest of Jupiter's 28 known moons. The effects of Callisto's gravity will set up the space probe for a swing over both polar regions of the intensely volcanic moon Io in August and October.

In 2002, having completed its imaging mission, Galileo will continue studies of Jupiter's massive magnetic field with seven instruments. In January, the orbiter will fly near the equator of Io.

In November, it will swing closer to Jupiter than ever before, dipping within about 500 kilometers (about 300 miles) of the moon Amalthea, which is less than one-tenth the size of Io and less than half as far from Jupiter. Scientists will use Galileo measurements to determine the mass and density of Amalthea. They will also study dust particles as Galileo flies through Jupiter's gossamer rings and seek new details of the magnetic forces and the densities of charged particles close to the planet.

Galileo's final orbit will take an elongated loop away from Jupiter. Then in August 2003, the spacecraft will head back for a direct impact and burn up as it plows into Jupiter's 60,000 kilometer-thick atmosphere.

NASA News

Chart for Variable of the Month

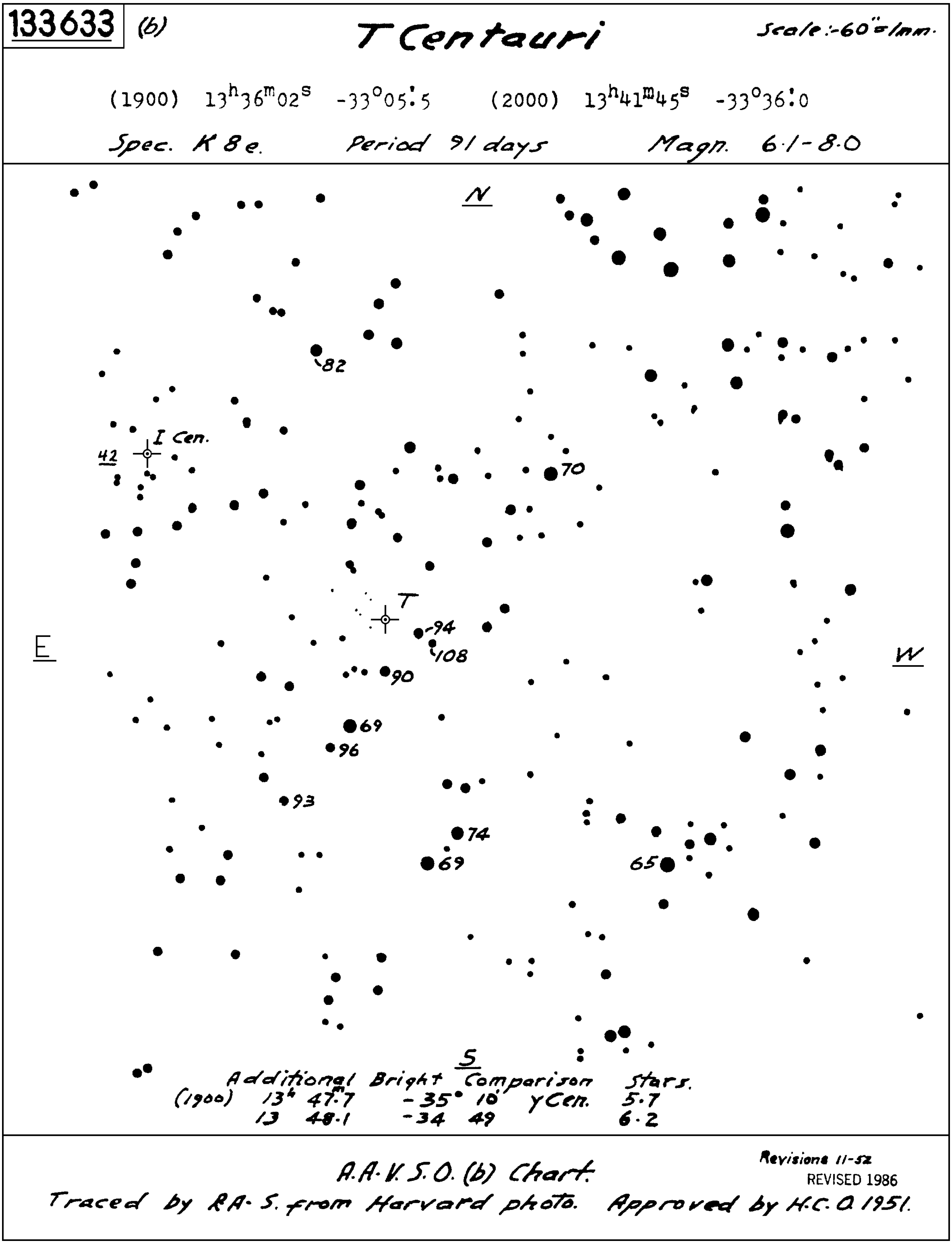


Chart courtesy of the AAVSO Website *http://www.aavso.org*

DEEP SPACE 1 LOADS UP FOR TREK TO COMET

JPLNews@jpl.nasa.gov
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NASA's Deep Space 1 spacecraft, sailing through the solar system today, has taken delivery of a new cargo: the latest software for its ambitious encounter with Comet Borrelly this September.

After successfully finishing its primary mission in 1999 as a testing ground for important new technologies, NASA approved a risky bonus mission to Comet Borrelly for Deep Space 1. There the spacecraft will take black-and-white pictures, use infrared pictures to find out the nature of the comet's surface, measure and identify the gases coming from the comet, and measure the interaction of solar wind with the comet. To take pictures of the comet, Deep Space 1 must upgrade its software's pointing system to turn the spacecraft from a testbed for advanced technologies to a chronicler of Comet Borrelly.

"Deep Space 1's previous version of software, which was transmitted to the spacecraft eight months ago, has proven itself during the surprisingly successful flight through the solar system since then, but now we're giving the probe a new assignment," said Dr. Marc Rayman, the project manager. "And in order to prepare for this exciting and daring comet encounter, the software needs to be upgraded."

The spacecraft team will be checking the software, radioed to Deep Space 1 throughout the week of March 5. The first check came when the team actually received a signal from the spacecraft after it shut the main computer off and restarted it. Since the software sent by the team works well, the spacecraft sent a signal indicating it is healthy. Now engineers are giving the spacecraft's new software a thorough physical checkup.

"The process of transmitting the new software to the spacecraft, rebooting the on-board computer to begin running it, verifying that the spacecraft is working properly with the new software and restoring the craft to its cruise configuration, all when the spacecraft is 318 million kilometers (197 million miles) away, is a complex and tricky operation, " said Daniel Eldred, the Deep Space 1 mission manager.

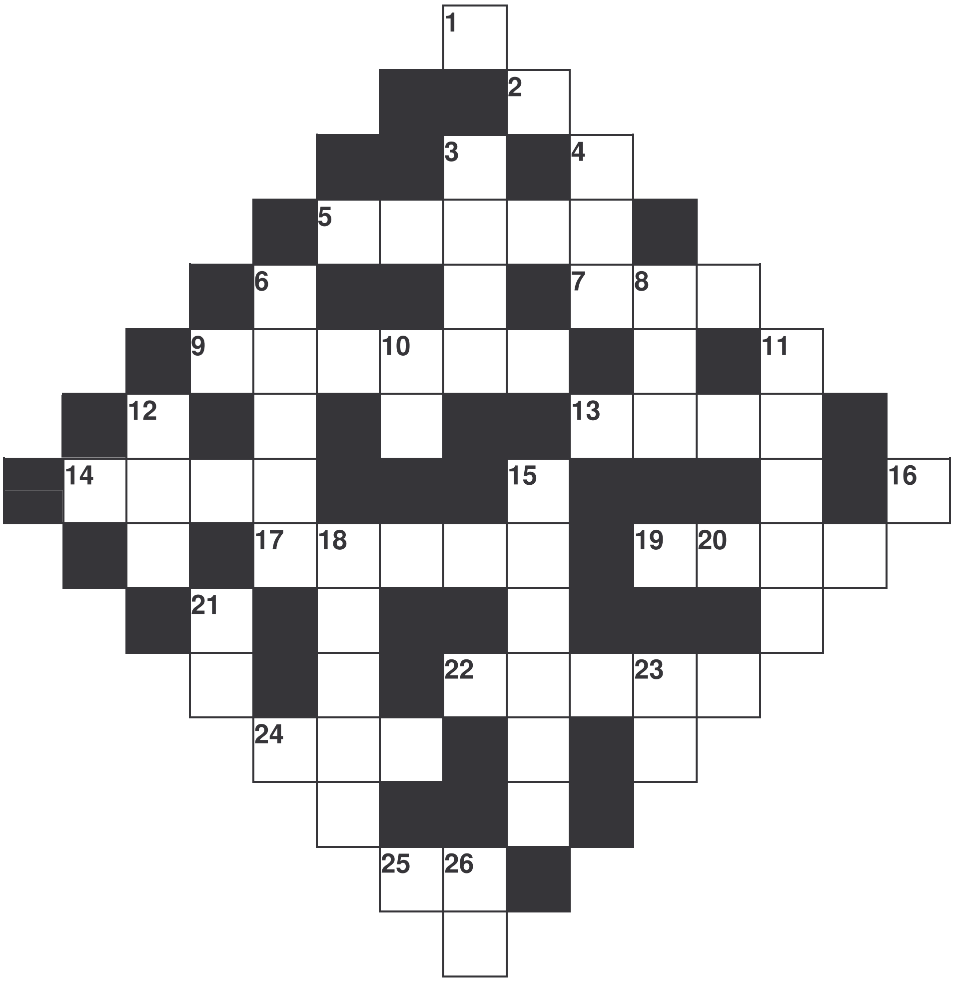
The new software contains capabilities that will be needed when the spacecraft gets to Borrelly. The new commands will include lessons that Deep Space 1 learned in its 1999 encounter with asteroid Braille about the behavior of the spacecraft when it gets close to a solar system object.

The spacecraft carries a device, part of the successful new technology system, which holds two cameras. One uses a conventional charge-coupled device detector, the other a new technology detector. The test camera, though performing its initial tests successfully, wasn't equipped to deal with the very dark object that Braille turned out to be. Small bodies like asteroids and comets are still a mystery. Since they're so small and distant, their exact size and shape can't usually be determined from Earth. Deep Space 1 plans to use its tried-and-true CCD camera to try to snap photos of Borrelly. The team will send commands to the new software to stop using the test camera and start using the CCD camera, which will take a larger picture with more light.

In late 1999, after the successful end of its primary mission, Deep Space 1 lost its star tracker, and the spacecraft had to be reconfigured to use the photographic camera to orient itself by the stars around it. In order to take pictures of Borrelly, the camera can't align the spacecraft and snap photos of the comet at the same time. Instead, the spacecraft will have to rely on its fiber-optic gyroscopes to help maintain its orientation. But the gyros are not accurate enough by themselves, so the new software will try to correct for those inaccuracies. The new software is designed to help the camera stay pointed at the comet's nucleus during the 15 minutes that the camera will attempt to observe the comet.

Deep Space 1 was launched in October 1998 as part of NASA's New Millennium Program, which is managed by JPL for NASA's Office of Space Science, Washington, D.C. The California Institute of Technology in Pasadena manages JPL for NASA.

ASTRO-PUZZLE 1



Down

1. Second.
2. Carbon.
3. North and South.
4. Positive answer.
6. Orbiting icy body.
8. Is it a bird…?
10. Unit of distance.
11. Asteroid.
12. All around us.
15. Brightest rings around.
16. Electron.
18. Home of my species.
20. Hydrogen.
21. Unit of mass.
23. Astronomical Units.
26. Not from Earth!

Across

5. Unmanned craft performs experin
7. Brightest star in the sky.
9. Launching vehicle.
13. Imaginary belt surrounds Earth.
14. Rise and fall of the ocean.
17. Earth, in other words!
19. Satellite of Saturn.
22. About the Moon.
24. Seventh Greek.
25. Helium.

Isa da Rocha-Chomse

Diary of Astronomical Phenomena:- 2001

April 2001

dd hh		dd hh	
1 10	FIRST QUARTER	17 19	Venus stationary
5 08	Moon at perigee	17 23	Uranus 2.9 N of Moon
6 22	Mercury 10.0 S of Venus	20 20	Venus 9.5 N of Moon
8 03	FULL MOON	23 08	Mercury in superior conjn.
13 02	Mars 1.4 S of Moon	23 12	Mercury 4.5 N of Moon
15 15	LAST QUARTER	23 15	NEW MOON
16 14	Jupiter 5.1 N of Aldebaran	25 15	Saturn 1.6 N of Moon
16 16	Neptune 2.6 N of Moon	26 13	Jupiter 2.1 N of Moon
17 06	Moon at apogee	30 17	FIRST QUARTER

May 2001

dd hh		dd hh	
1 05	Mercury greatest brilliancy	15 10	LAST QUARTER
2 04	Moon at perigee	16 22	Mercury 2.8 N of Jupiter
4 20	Venus greatest brilliancy	19 09	Venus 4.5 N of Moon
7 14	FULL MOON	22 03	Mercury greatest elong. E(22)
7 18	Mercury 3.7 N of Saturn	23 03	NEW MOON
10 19	Mars 2.0 S of Moon	23 06	Saturn 1.3 N of Moon
10 21	Neptune stationary	24 07	Jupiter 1.5 N of Moon
11 13	Mars stationary	24 19	Mercury 3.1 N of Moon
12 13	Mercury 7.9 N of Aldebaran	25 13	Saturn in conj. with Sun
14 00	Neptune 3.0 N of Moon	27 04	Moon at perigee
15 01	Moon at apogee	29 20	Uranus stationary
15 08	Uranus 3.2 N of Moon	29 22	FIRST 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**
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