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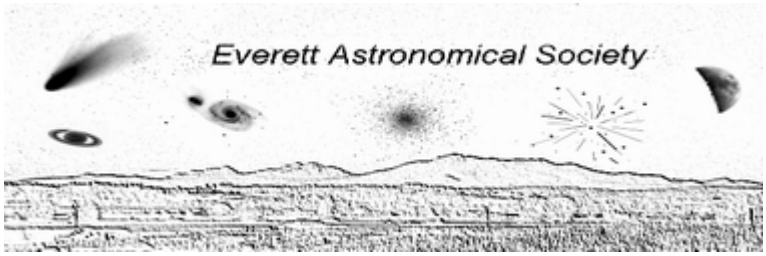
Volume MMVI. No. 5



The Stargazer

May 2006

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		(change 'at' to @ to send email)	http://members.tripod.com/everett_astronomy

EAS BUSINESS…

NEXT EAS MEETING - SATURDAY MAY 27TH AT 3:00 PM AT THE EVERETT PUBLIC LIBRARY, IN THE AUDITORIUM (DOWNSTAIRS)

This month's presentation will be **'Amateur Astronomy - Star Party Sights'** – by EAS president Mark Folkerts - *A new detailed visual tour of summer star parties, including Table Mountain, Oregon Star Party, and Camp Delaney, with solar and daytime scenes, night sky shots, tour of objects in the night sky, all as really seen by amateur astronomers, not the enhanced color mega-pictures from Hubble. What to expect, and what you will actually see. Even includes some 3D star party views…*

Map to library - http://www.epls.org/about/mlmap.htm

2702 Hoyt Avenue
Everett, WA 98201

Directions to library - http://www.epls.org/about/mldirect.htm

STAR PARTY INFO

Upcoming EAS star party schedule:

People should send also mail to the mail list to coordinate spur-of-the-moment observing get-togethers, on nights when the sky clears. We try to hold informal close-in star parties each month during the spring, summer, and fall months on a weekend near the New moon at a member's property or a local park. (call Mike Locke at (425) 259-5995 for info or check the EAS website.) Members contact Mike Locke for scope borrowing.

Other Western US Star Parties this season:

May 26-28 – NWRAL - Klickitat May 2006 Star Party
http://klickitatstarparty.net/ Goldendale WA

May 26-29 – Fire In The Sky (FITS) 2006 Star Party
And Hi-Power rocket launching - Mansfield, WA
http://www.washingtonaerospace.org/fits2006.php

May 26-28 Riverside Telescope Makers Conference (RTMC)
http://www.rtmcastronomyexpo.org/ Riverside CA

Jun 10 – RCA Summer Solstice Celebration - Rooster Rock State Park located 22 miles east of Portland on I-84 (east of Sandy River) at exit 25, starting at 7:30 pm. Parking is $3 per vehicle. For possible weather cancellation, call (503) 797-4610 on June 10 after 3:00 PM to get the latest information.
http://www.omsi.edu/visit/planetarium/starparties.cfm

Jun 17-24 - Grand Canyon SP
http://www.tucsonastronomy.org/gcsp.html

Jun 21-26 - Shingletown Star Party 2006
http://www.shingletownstarparty.org/ Mt. Shasta, CA
Registration due May 1.

Jun 22-25 - The Rocky Mountain Star Stare (RMSS)
http://www.rmss.org/ Pike Nat Forest, Colorado Springs, CO

Jun 23-25 Craters Star Party
Craters of the Moon National Monument, ID
http://www.boiseastro.org/

Jul 08 – RCA Lunar Viewing - Rooster Rock State Park - located 22 miles east of Portland on I-84 (east of Sandy River) at exit 25, starting at 7:30 pm. Parking is $3 per vehicle. For possible weather cancellation, call (503) 797-4610 to get the latest information. http://www.omsi.edu/visit/planetarium/starparties.cfm

Jul 20-22 – Table Mt. Star Party (TMSP) 2006
http://www.tmspa.com/ Ellensburg WA

Jul 26-30 - Mt Bachelor Star Party (MBSP) 2006
http://www.mbsp.org/ Mt. Bachelor (Bend) OR

Jul 28-30 - Klickitat July 2006 Star Party
http://klickitatstarparty.net/ Goldendale WA

Jul 28-30 - Blue Mountain Star Party
http://www.tri-cityastronomyclub.org/bluemtn_starparty.htm Ukiah, OR

Aug 05-07 - Montana Starwatch, 2005 Great Falls, Montana
http://www.montana.edu/smasweb/swatch.html

Aug 11 - RCA Perseid Meteor Shower Watch - Rooster Rock State Park - located 22 miles east of Portland on I-84 (east of Sandy River) at exit 25, starting at 7:30 pm. Parking is $3 per vehicle. For possible weather cancellation, call (503) 797-4610 for latest info. http://www.omsi.edu/visit/planetarium/starparties.cfm

Aug 24-27 – Oregon Star Party (OSP) Ochocco NF
http://www.oregonstarparty.org/ Jul 28 reg deadline

Aug 19-Aug 27 - Mt. Kobau Star Party 2006
http://www.mksp.ca/ Mt. Kobau, BC

Aug 18-20 - Klickatat August 2006 Star Party
http://klickitatstarparty.net/ Goldendale WA

Aug 25-27 - Idaho Star Party
Bruneau Dunes State Park
http://www.boiseastro.org/

Sep 02 - RCA Autumnal Equinox Celebration - Rooster Rock State Park - located 22 miles east of Portland on I-84 (east of Sandy River) at exit 25, starting at 7:30 pm. Parking is $3 per vehicle. For possible weather cancellation, call (503) 797-4610 for latest info. http://www.omsi.edu/visit/planetarium/starparties.cfm

Sep 20-23 - The Enchanted Skies Star Party 2006
http://www.socorro-nm.com/starparty/ Socorro NM

Sep 22-24 - Klickatat September 2006 Star Party
http://klickitatstarparty.net/ Goldendale WA

Sep 22-24 - Craters Star Party -
Craters of the Moon National Monument, ID
http://www.boiseastro.org/

Sep 21-24 - Alberta Star Party 2006
http://calgary.rasc.ca/asp2006.htm

Sep 21-23 - California Star Party (CAS)
San Jose Astronomical Association 2
Lake San Antonio Park http://www.sjaa.net/

Oct 20-22 - Klickatat October 2006 Star Party
http://klickitatstarparty.net/ Goldendale WA

Oct 19-22 - Annual Nightfall (RTMC)
Riverside, CA

Nov 08 – RCA observing of the Mercury Transit
OMSI East Parking Lot, Portland OR
http://www.omsi.edu/visit/planetarium/starparties.cfm

$$ - Financial Health - $$

The club maintains a $500+ balance. We try to keep approximately a $500 balance to allow for contingencies. .

Club Scopes

Scope	Loan Status	Waiting
10-inch Dobsonian	On loan	No wait list
8-inch Dobsonian	Free	No wait list

EAS members: contact Mike Locke at (425) 259-5995 or 'mlocke at lionmts.com' to borrow a scope.

Astro Calendar for 2005

May 2006
May 04 - Jupiter at Opposition
May 05 - Eta Aquarids meteor shower peak
May 14 - Griffith Observatory reopens
May 27 – May EAS Meeting – 3:00 PM Everett Public Library

June 2006
Jun 07 - Comet Schwassmann-Wachmann 3-C Perihelion (0.937 AU)
Jun 07 - Comet Schwassmann-Wachmann 3-B Perihelion (0.939 AU)
Jun 17 – June EAS Meeting – 3:00 PM Everett Public Library
Jun 21 - Summer Solstice, 12:26 UT
Jun 18 - Mars Passes 0.6 Degrees from Saturn
Jun 21 - Summer Solstice, 12:26 UT
Jun 21 - Mercury at Greatest Eastern Elongation
Jun 29 - Asteroid 2 Pallas At Opposition (9.5 Magnitude)

July 2006
Jul 03 - Earth At Aphelion (1.017 AU From Sun)
Jul 12 – July EAS Meeting – Wednesday 6:30 PM Everett Public Library – NOTE WEEKNIGHT TIME !!!
Jul 20-22 – Table Mt. Star Party (TMSP) 2006
Jul 26-30 - Mt Bachelor Star Party (MBSP) 2006
Jul 20 - 30th Anniversary (1976), Viking 1, Mars Landing
Jul 29 - South Delta-Aquarids Meteor Shower Peak
Jul 29 - Asteroid 15 Eunomia At Opposition (8.4 Magnitude)

August 2006
Aug 01 - Alpha Capricornids Meteor Shower Peak
Aug 04 - Asteroid 6 Hebe At Opposition (7.8 Magnitude)
Aug 06 - Southern Iota Aquarids Meteor Shower Peak
Aug 07 - Mercury at Greatest Western Elongation
Aug 10 - Mercury Passes 2.2 Degrees From Venus
Aug 10 - Neptune at Opposition
Aug 11 - Asteroid 1 Ceres Closest Approach To Earth (1.984 AU)
Aug 12 - Perseids Meteor Shower Peak
Aug 16 - Asteroid 1 Ceres At Opposition (7.6 Magnitude)
Aug 20 - Mercury Passes 0.5 Degrees From Saturn
Aug 24-27 – Oregon Star Party (OSP) Ochocco NF
Aug 25 - Northern Iota Aquarids Meteor Shower Peak
Aug 26 - Venus Passes 0.1 Degrees From Saturn

September 2006
Sep 05 - Uranus at Opposition
Sep 07 - Partial Lunar Eclipse
Sep 08 - 40th Anniversary (1966), 1st Star Trek Episode on TV
Sep 22 - Annular Solar Eclipse
Sep 23 - Autumnal Equinox (04:03 UT)
Sep 23 - Cassini, Titan Flyby

October 2006
Oct 09 - Draconids Meteor Shower Peak
Oct 17 - Mercury at Greatest Eastern Elongation (25 Degrees)
Oct 21 - Orionids Meteor Shower Peak
Oct 29 - Daylight Saving - Set Clock Back 1 Hour

November 2006
Nov 03 - Taurids Meteor Shower Peak
Nov 08 - Mercury Transits the Sun
Nov 13 - Asteroid 7 Iris At Opposition (6.8 Magnitude)
Nov 17 - Leonids Meteor Shower Peak

December 2006
Dec 13 - Geminids Meteor Shower Peak
Dec 22 - Winter Solstice, 00:22 UT
Dec 22 - Ursids Meteor Shower Peak

January 2007
Jan 03 - Earth At Perihelion (0.983 AU From Sun)
Jan 03 - Quadrantids Meteor Shower Peak
Jan 08 - Stephen Hawking's 65th Birthday (1942)

February 2007
Feb 07 - Mercury at Greatest Eastern Elongation
Feb 18 - Chinese New Year

March 2007
Mar 21 - Vernal Equinox, 00:07 UT

April 2007

Apr 01 - Daylight Saving - Set Clock Ahead 1 Hour
Apr 08 - Easter Sunday
Apr 11-17 - Astronomy Week
Apr 16 - Astronomy Day
Apr 22 - Lyrids Meteor Shower Peak

UW Astronomy Colloquium Schedule

The Astronomy Department weekly colloquium meets Thursdays at 4:00 pm in PAB A102 (the classroom part of the Physics/Astronomy Building complex).

Over The Airwaves

"Our group of radio script writers now consists of EAS and SAS members Jim Ehrmin, Greg Donohue, and Ted Vosk, who are now regularly writing and helping to produce our astronomy radio show, "**It's Over Your Head**" on radio station **KSER, FM 90.7.** The six-minute segment is broadcast **every Wednesday morning at approximately 7:20 A.M.** and gives a weekly look at what's up in the sky over Snohomish County, with other information. If you are a listener to the program, show your support by giving the program director of KSER a call!" Web page with lots of archives and other info is available at http://www.itsoveryourhead.org/

KPLU 88.5 FM National Public Radio has daily broadcasts of "Star Date" by the McDonald Observatory of the University of Texas at Austin, Monday through Friday at about 6:05 pm. The short 2 minute radio show deals with current topics of interest in astronomy. The University of Washington TV broadcasts programs from NASA at 12:00 AM Monday through Friday, 12:30 AM Saturday, and 1:30 AM Sunday on the Channel 27 cable station.

EAS Library – Book & Video List

The EAS has a library of books, videotapes, and software for members to borrow. We always value any items you would like to donate to this library. You can contact a club officer or **Librarian Mike Locke**, phone (425) 259-5995, email mlocke at lioninc.com, to borrow or donate any materials. See list here: http://members.tripod.com/everett_astronomy/eas_library.htm

MEMBERSHIP BENEFITS & INFORMATION

Membership in the **Everett Astronomical Society** (EAS) will give you access to all the material in the lending library. The library, which is maintained by Mike Locke, consists of several VCR tapes, many books, magazines, and software titles. Membership includes invitations to all of the club meetings and star parties, plus the monthly newsletter, ***The Stargazer.*** In addition you will be able subscribe to ***Sky and Telescope*** for $7 off the normal subscription rate, contact the treasurer for more information. Link to registration form: http://members.tripod.com/everett_astronomy/application.htm

(**When renewing your subscription to *Sky & Telescope* you should send your S&T renewal form along with a check made out to Everett Astronomical Society to the EAS address.** The EAS treasurer will renew your *Sky and Telescope* subscription for you. **Astronomy** magazine offers a similar opportunity to club members.)

EAS is a member of the **Astronomical League** and you will receive the Astronomical League's newsletter, ***The Reflector***. Being a member also allows you the use of the club's telescopes, an award winning 10 inch Dobsonian mount reflector. Contact Mike Locke (425) 259-5995 to borrow a telescope. EAS dues are $25.
Send your annual dues to the **Everett Astronomical Society**, P.O. Box 12746, Everett, WA 98206. Funds obtained from membership dues allows the Society to publish the newsletter, pay Astronomical League dues and maintain our library.

OBSERVER'S INFORMATION…

Lunar Facts

May 20	Last Quarter Moon
May 27	New Moon
Jun 03	First Quarter Moon
Jun 11	Full Moon
Jun 18	Last Quarter Moon
Jun 25	New Moon
Jul 03	First Quarter Moon
Jul 11	Full Moon
Jul 17	Last Quarter Moon
Jul 25	New Moon
Aug 02	First Quarter Moon
Aug 09	Full Moon

Digital Lunar Orbiter Photographic Atlas of the Moon

The Lunar and Planetary Institute has created a digital version of the Lunar Orbiter Photographic Atlas of the Moon, and Consolidated Lunar Atlas available online at:
http://www.lpi.usra.edu/research/cla/menu.html
http://www.lpi.usra.edu/research/lunar_orbiter

Up In The Sky -- The Planets

Object	Rises	Transits	Sets	Con	Mag
Sun	**5:20 am**	**13:06**	**20:53**	**Tau**	**-27.5**
Mercury	5:44 am	Daylight	21:06	**Tau**	**+0.1**
Venus	**03:54 am**	Daylight	Daylight	**Psc**	**-4.0**
Mars	Daylight	Daylight	**0:35 am**	**Gem**	**+0.8**
Jupiter	**21:04**	**23:27**	4:31	Lib	**-2.5**
Saturn	Daylight	Daylight	**1:05 am**	**Can**	**+0.2**
Uranus	**2:24 am**	Daylight	Daylight	Aqr	+5.9
Neptune	**1:28 am**	Daylight	Daylight	**Cap**	**+8.0**
Pluto	**21:42 am**	**2:47 am**	Daylight	**Ser**	**+13.9**

(times local time for Everett PDT)

Transit times for Jupiter's Great Red Spot in 2006

http://skyandtelescope.com/observing/objects/planets/article_107_2.asp

NOAA Sun Calculator

Need to know exactly what time the sun will set on Sept. 26, 2065? Or when it rose in 565 BC? How about the length of daylight a week from Tuesday in Albuquerque, N.M.? Just go to NOAA's solar calculator, now available on the Web. http://www.srrb.noaa.gov/highlights/sunrise/gen.html

International Space Station – Visible Seattle Passes

ISS Visibility –
http://spaceflight.nasa.gov/realdata/sightings/SSapplications/Post/SightingData/Seattle.html or also see link http://www.heavens-above.com/PassSummary.asp?lat=47.979&lng=-122.201&alt=0&loc=Everett&TZ=PST&satid=25544

Member News

The Northwest Region of the Astronomical League (NWRAL) is putting together a new website and needs the following information from each club of the NWRAL. The EAS is looking for any information from members about the early history. Please contact Mark Folkerts if you have any info that could be of help.
NRWAL would like a brief history of the club
- Club established date
- Who started the club
- When club joined the Astronomical League.

CONSTELLATION(S) OF THE MONTH: CORONA BOREALIS

CORONA BOREALIS: (The Northern Crown). With a midnight culmination date of May 19th, Corona Borealis is perfectly placed for spring viewing. It contains no asterisms, but the stars of the constellation do trace out an "upside-down letter 'C'" (the closed portion of the 'C' faces south), situated between the Northern constellations of Bootes and Hercules. The only other bordering constellation is that of Serpens, located to its south. Corona Borealis ranks 11th in overall brightness among the constellations, but 73rd in size; it takes up almost 179 square degrees of the entire sky (0.433%). It contains no known meteor showers, and no Messier objects. Corona Borealis is completely visible from latitudes North of –50 degrees, and completely invisible from latitudes South of –64 degrees. It has 22 stars greater than magnitude 5.5, and its central point is at RA=15h48m, Dec.= +33 degrees. The solar conjunction date of Corona Borealis is November 18th. Even though Corona Borealis has no Messier objects or known meteor showers, besides being a visually beautiful constellation, it does contain two very interesting objects in their own right. Near epsilon Corona Borealis, a nova suddenly flared up in May, 1866. It reached 2nd magnitude and remained easily visible for over a week. It is now known as the "Blaze Star" (also known as T Corona Borealis), and is the most famous example of a recurring nova. (It last brightened, to 3rd magnitude, in 1946). There is also another interesting variable star within Corona Borealis (CrB), known as R CrB. It is normally a 6th magnitude star, but it dims (at irregular intervals) to as low as 15th magnitude. It is suspected that clouds of carbon (e.g., soot and graphite) are emitted form the star and therefore dim its light; when these materials are reabsorbed, the star brightens. There are two well-known legends associated with the constellation of Corona Borealis. The Native (North) American Indians considered it to be a semicircle of chiefs, at council to discuss the future of their peoples. In ancient Greek mythology, Ariadne (daughter of King Minos) was asked by Bacchus (the god of vegetation and wine) to marry him. But Ariadne did not believe that Bacchus was a god. To prove that he was, Bacchus asked Venus (goddess of love) to design a crown of jewels as his wedding present to Ariadne. When Ariadne saw the crown, she believed that Bacchus was a god, and consented to marry him. Bacchus was so overwhelmed with joy, that he threw the crown into the heavens, where it has resided and shone ever since. Corona Borealis is a visually beautiful Northern constellation, and is well placed to be easily enjoyed by any spring sky-watcher.

YOUNG ASTRONOMER'S CORNER

The Young Astronomer's Corner will return in June, with information on enjoying Star Parties for the summer season. See you then!

PLANETARY FOCUS

This month, our guest planet is Neptune, and these are the facts:

Rotation around the Sun: every 164.79 years

Orbit: from 29.76 (closest or 'perihelion') to 30.36 (furthest or 'aphelion') Astronomical Units (AU)*; this is an orbit that varies between approximately 2.77 billion and 2.82 billion miles from the sun. (*Note: One AU equals approximately 93 million miles).

Inclination of Orbit to Ecliptic: 1.8 degrees.

Mean Orbital Velocity: 5.43 km/sec.

Diameter at Equator: 50,538 kilometers (or 31,586 miles).

Mass: 17.2 (approximately 17.2 times more massive than earth); (5.9742 x (10 e24 (10 to the 24th power)) kilograms = 1 Earth Mass)**.**

Density: approximately 1.80 times that of water (global density).

Surface Gravity (Earth = 1): 1.19

Period of Rotation on its own axis: approximately 18 hours, 25 minutes.

Axis tilt: 29.56 degrees.

Satellites (moons): 8, as well as planetary rings.

Special Notes About Neptune: **Neptune** is the fourth largest planet in the solar system (one of the gas giants) in terms of equatorial diameter, but is more massive than Uranus, the third largest planet in diameter. Neptune is the most distant of the giant planets, and was discovered in 1846 by J.G. Galle at the Berlin Observatory, based on French (Urbain Leverrier) predictions resulting from disturbances in the orbit of Uranus (there were similar estimates made by Englishman John C. Adams). Neptune returns to opposition two days later every year, and appears as an indistinct magnitude 7.7 bluish-green object in binoculars; in fact, no markings can be seen on its bluish-green disk from earth-bound telescopes. Neptune's color arises primarily from methane within its atmosphere, which is principally helium and hydrogen and a blend of methane, water, and ammonia. In 1989, Voyager 2 sent back remarkable images of Neptune during its fly-by. The Great Dark Spot was noted in its atmosphere. Like Jupiter's Great Red Spot, it occupies a equivalent proportion of the surface area of Neptune (as the GRS does of Jupiter's surface area), and is a high-pressure system around which near-supersonic winds flow in an anti-clockwise circuit. The Great Dark Spot measures approximately 12,000 by 8,000 kilometers. At about 50-70 kilometers above the main cloud plane, there are whitish cirrus-like clouds composed of methane ice crystals. Neptune also has belts and zones similar to Jupiter's, only much fainter. The core of Neptune is believed to be rocky, composed primarily of silicon and iron. The atmosphere of Neptune revolves more slowly than its core, and this is opposite to the atmospheres of the other gas giants; the implication is that circulation of Neptune's atmosphere may take place in a retrograde (backward or opposite) manner. Neptune also gives off more energy than it receives from the Sun, suggesting that it has its own internal source of heat; the planet also has a magnetic field, which is somewhat weaker than that of the other gas giant planets. Four dark planetary rings were discovered during the Voyager 2 fly-by in 1989.

Neptune has 8 known moons; six of them were discovered during the 1989 Voyager 2 fly-by, and the remaining two (Triton and Nereid) were discovered from Earth. Triton is the largest moon of Neptune, and was discovered the same year (1846) as the planet itself; it is about ¾ the size of our own Earth's Moon. Interestingly, Triton has an orbit in the opposite direction to that of Neptune (retrograde), and is slowly coiling its way down towards Neptune. Triton is a very cold moon, and has a thin atmosphere of mostly nitrogen, with some methane and carbon monoxide. Its South Pole cap is pinkish in color (probably nitrogen snow and ice). Triton's face has been shown to have both craters and long cracks, but no mountains; its surface resembles that of a cantaloupe. It has also been noted to have geysers of nitrogen, some reaching 8 km in height! Nereid was discovered from Earth in 1949, and has a very eccentric orbit (going from 2 to 10 million kilometers from the planet at various times during its orbit). When we talk about Pluto next month in our last column of this present series, we will tell you why Neptune, and not Pluto, is sometimes the farthest planet from the Sun. Can you guess why? Stay tuned; see you next month!

ASTRONOMY AND TELESCOPE / EQUIPMENT "LINGO"

ASTRONOMY LINGO: ***DQ HERCULIS STARS:*** A magnetic cataclysmic variable in which the large magnetic field of the white dwarf affects the rotation of and accretion of material onto that white dwarf star. DQ Herculis stars are also known as intermediate polar systems, in which the spin period of the white dwarf is typically 10 times shorter than the orbital period. Accretion flow is channeled along magnetic field lines directly onto the polar cap of the white dwarf, and an accretion disk may be present in an intermediate polar system (i.e., a DQ Herculis star).

TELESCOPE / EQUIPMENT LINGO: ***MAGNETOMETER:*** Any of a variety of instruments used to measure the strength and direction of a magnetic field.

ASTRONOMY FUN FACTS

This column will return in June. See you then.

"MIRROR" IMAGES

"MIRROR" IMAGES" : Because we live in the Northern Hemisphere, we often tend to focus (in both observing and reading) on celestial objects in this hemisphere. The point of this column is to inform club members about similar objects in the Southern Hemisphere (to the ones we are already familiar with in the Northern Hemisphere). The general class of object will first be defined, and then a representative object from each hemisphere will be described. ***Note: "MIRROR" IMAGES" is strictly the name of the new column, and is not intended to imply that there is optical mirror symmetry between the two objects.***

CLASS OF OBJECT: OPTICAL DOUBLE STARS: A pair of stars that *appear* close together in the sky (as opposed to actually *being* close together in the sky: this would be a physical double star system). Optical double stars appear close together because they lie in roughly the same direction – the same line of sight – as seen from Earth. However, unlike physical doubles, they share no gravitational attraction, as they are too far apart to be members of the same stellar system.

REPRESENTATIVE NORTHERN HEMISPHERE OBJECT: *Albireo (Beta Cygni):* This very famous, and very beautiful, double star is a favorite of all astronomers, and a favorite new object of all budding night-sky enthusiasts. It is the second brightest "star" (i.e., it is actually two stars) in Cygnus. The primary star is an orange giant with an apparent visual magnitude of 3.1 and is of spectral type K5-II; the secondary, 35 arc seconds away, is deep blue, has an apparent visual magnitude of 5.1, and is of spectral type B8-V. Albireo is 120 parsecs distant from Earth, and its individual components are separated by about 400 billion miles.

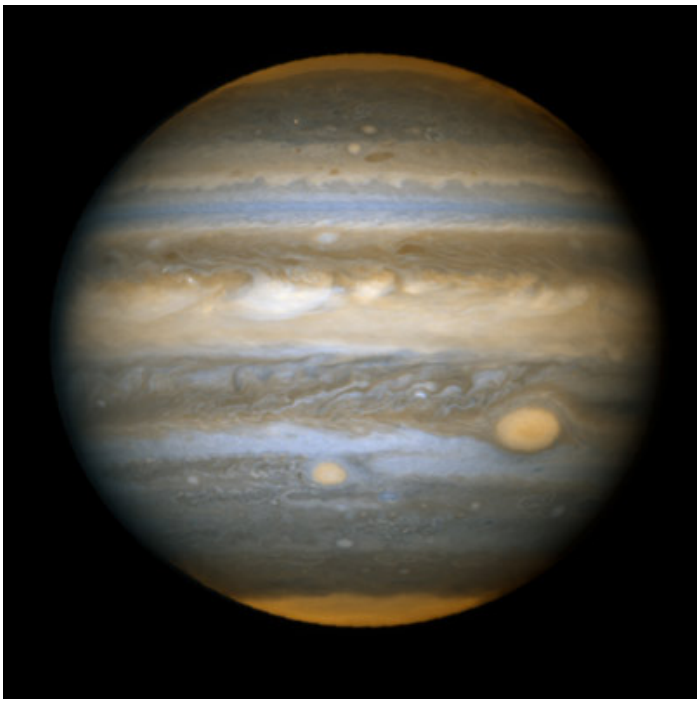
REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT: *AL GIEDI (ALPHA CAPRICORNI):* The brighter of the two stars in this system has an apparent visual magnitude of 3.6, and is a light yellow spectral type G3 supergiant. The dimmer of the pair has an apparent visual magnitude of 4.2, is also light yellow in color, and is classified as a G9 giant. Interestingly, each member of this optical double star system has dimmer, closer companions as well. The G3 supergiant in the line-of-sight Alpha Capricorni star system lies 110 light-years away from Earth, but the G9 giant lies much further away…..1,600 light-years away to be exact!!

ASTRONOMICAL NOTES -- ON & OFF THE WEB...

THE PULL OF JUPITER

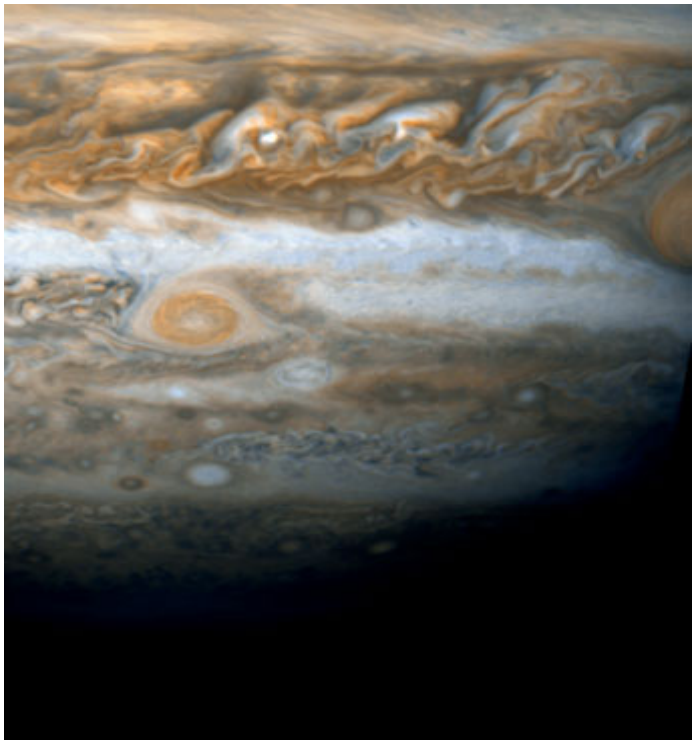
If you feel the urge to look up at the sky this month, you might be feeling the pull of Jupiter. The giant planet is having a close encounter with Earth all month long. On May 6th, the date of closest approach, Jupiter will be 410 million miles away, which is almost 200 million miles closer than it was just six months ago in October. This makes Jupiter unusually big and bright. Look for it rising in the east at sunset. Jupiter is unmistakable, shining ten times brighter than any star around it. The view through a backyard telescope is dynamite. You can see Jupiter's cloud belts, the Great Red Spot and four large moons (Io, Europa, Ganymede and Callisto) circling the planet. When you look at Jupiter through a telescope, you might notice something odd: the planet looks squashed. Your eyes are okay. Jupiter truly bulges around the middle because it spins so fast. One complete turn of the planet takes only 10 hours. That's more than 300 Earth masses (almost enough to make a star) spinning like a nimble asteroid. This spinning allows you to see the entire planet in a single night. On May 6th, Jupiter is "up" for more than 10 hours, or one complete turn. Judo astronomers will attempt a Jupiter marathon: In 10 hours you can see the innermost moons of Jupiter move from one side of the planet to the other. You can watch the Great Red Spot, a hurricane twice as wide as Earth, churn across Jupiter's cloudtops. You might even see "Red Jr.," a baby Great Red Spot trailing the original by about 2 hours: full story http://science.nasa.gov/headlines/y2006/02mar_redjr.htm .

Although closest approach is May 6th, one of the best nights to look is May 11th when the full Moon and Jupiter appear side by side. The pair will rise in tandem at sunset and remain beautifully close together all night long. With a telescope you can quickly scan back and forth: The lunar Alps. The moons of Jupiter. The Sea of Tranquillity. The Great Red Spot. Do you feel the pull yet? Let's calculate: Jupiter is 318 times more massive than Earth and 410 million miles away. According to Newton's Law of Universal Gravitation, Jupiter pulls you up 34 million times less than Earth pulls you down. Jupiter's "pull" is utterly feeble. So it's all in your mind. But don't let that stop you: give in to the pull!



HUBBLE SNAPS BABY PICTURES OF JUPITER'S 'RED SPOT JR.'

The Hubble Space Telescope is giving astronomers their most detailed view yet of a second red spot emerging on Jupiter. For the first time in history, astronomers have witnessed the birth of a new red spot on the giant planet, which is located half a billion miles away. The storm is roughly one-half the diameter of its bigger and legendary cousin, the Great Red Spot. Researchers suggest that the new spot may be related to a possible major climate change in Jupiter's atmosphere. The images were taken with Hubble's Advanced Camera for Surveys on April 8 and 16, 2006. http://hubblesite.org/news/2006/19 http://www.berkeley.edu/news/



MT. PALOMAR OBSERVES BROKEN COMET

Astronomers have recently been enjoying front-row seats to a spectacular cometary show. Comet 73P/Schwassmann-Wachmann 3 is in the act of splitting apart as it passes close to Earth. The breakup is providing a firsthand look at the death of a comet. Eran Ofek of the California Institute of Technology and Bidushi Bhattacharya of Caltech's Spitzer Science Center have been observing the comet's tragic tale with the Palomar Observatory's 200-inch Hale Telescope. Their view is helping them and other scientists learn the secrets of comets and why they break up.

The comet was discovered by Arnold Schwassmann and Arno Arthur Wachmann 76 years ago and it broke into four fragments just a decade ago. It has since further split into dozens, if not hundreds, of pieces. "*We've learned that Schwassmann-Wachmann 3 presents a very dynamic system, with many smaller fragments than previously thought*," says Bhattacharya. In all, 16 new fragments were discovered as a part of the Palomar observations.

A sequence of images showing the piece of the comet known as fragment R has been assembled into a movie. The movie shows the comet in the foreground against distant stars and galaxies, which appear to streak across the images. Because the comet was moving at a different rate across the sky than the stellar background, the telescope was tracking the comet's motion and not that of the stars. Fragment R and many smaller fragments of the comet are visible as nearly stationary objects in the movie. "*Seeing the many fragments was both an amazing and sobering experience*," says a sleepy Eran Ofek, who has been working non-stop to produce these images and a movie of the comet's fragments. The images used to produce the movie were taken over a period of about an hour and a half when the comet was approximately 17 million kilometers (10.6 million miles) from Earth. Astronomically speaking the comet is making a close approach to Earth this month giving astronomers their front-row seat to the comet's break up. Closest approach for any fragment of the comet occurs on May 12, when a fragment will be just 5.5 million miles from Earth. This is more than 20 times the distance to the moon. There is no chance that the comet will hit Earth.

"*It is very impressive that a telescope built more than 50 years ago continues to contribute to forefront astrophysics, often working in tandem with the latest space missions and biggest ground-based facilities*," remarks Shri Kulkarni. The Palomar observations were coordinated with observations acquired through the Spitzer Space Telescope, which imaged the comet's fragments in the infrared. The infrared images, combined with the visible-light images obtained using the Hale Telescope, will give astronomers a more complete understanding of the comet's break up. http://www.astro.caltech.edu/palomar/images/73p/

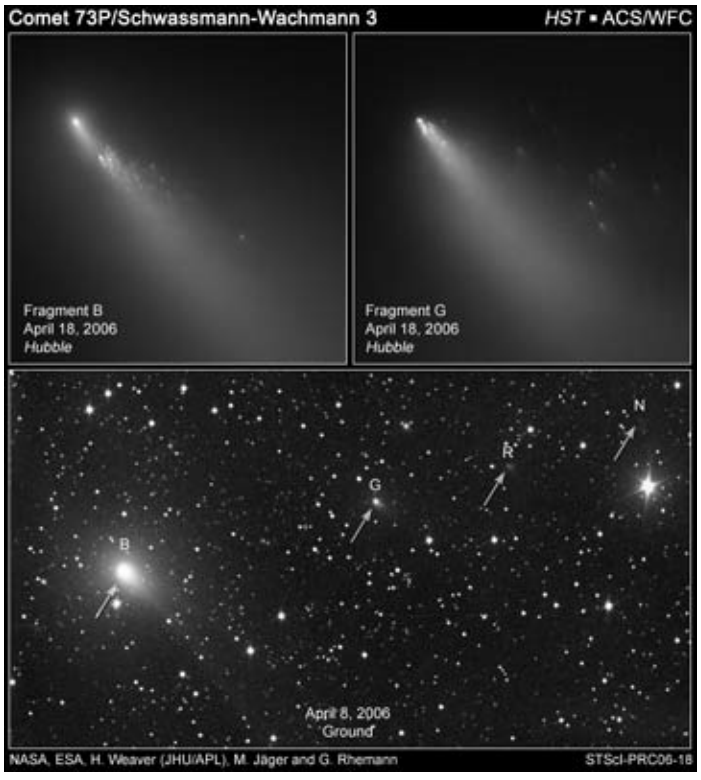
X-RAYS FLY AS CRACKING COMET STREAKS ACROSS THE SKY

Scientists using NASA's Swift satellite have detected X-rays from a comet that is now passing the Earth and rapidly disintegrating on what could be its final orbit around the sun. Swift's observations provide a rare opportunity to investigate several ongoing mysteries about comets and our solar system, and hundreds of scientists have tuned in to the event. The comet, called 73P/Schwassmann-Wachmann 3, is visible with even a small, backyard telescope. Peak brightness was expected May 14, when it came within 7.3 million miles of Earth, or about 30 times the distance to the Moon. There is no threat to Earth, however.

This is the brightest comet ever detected in X-rays. The comet is so close that astronomers are hoping to determine not only the composition of the comet but also of the solar wind. Scientists think that atomic particles that comprise the solar wind interact with comet material to produce X-rays, a theory that Swift might prove true. Three world-class X-ray observatories now in orbit---NASA's Chandra X-ray Observatory, the European-led XMM-Newton, and the Japanese-led Suzaku---will observe the comet in the coming weeks. Like a scout, Swift has provided information to these larger facilities about what to look for. This type of observation can only take place in the X-ray waveband.

"*The Schwassmann-Wachmann comet is a comet like no other*," said Scott Porter, part of the Swift observation team. "*During its 1996 passage it broke apart. Now we are tracking about three dozen fragments. The X-rays being produced provide information never before revealed*." The situation is reminiscent of the Deep Impact probe, which penetrated comet Tempel 1 about a year ago. This time, nature itself has broken the comet. Because Schwassmann-Wachmann 3 is much closer to both the Earth and the sun than Tempel 1 was, it currently appears about 20 times brighter in X-rays. Schwassmann-Wachmann 3 passes Earth about every five years. Scientists could not anticipate how bright it would become in X-rays this time around. "*The Swift observations are amazing*," said Greg Brown, who led the proposal for Swift observation time. "*Because we are viewing the comet in X-rays, we can see many unique features. The*

combined results of data from several premier orbiting observatories will be spectacular." Swift is primarily a gamma-ray burst detector. The satellite also has X-ray and ultraviolet/optical telescopes. Because of its burst-hunting ability to turn rapidly, Swift has been able to track the progress of the fast-moving Schwassmann-Wachmann 3 comet. Swift is the first observatory to simultaneously observe the comet in both ultraviolet light and X-rays. This cross comparison is crucial for testing theories about comets. Swift and the other three X-ray observatories plan to combine forces to observe Schwassmann-Wachmann 3 closely. Through a technique called spectroscopy, scientists hope to determine the chemical structure of the comet. Already Swift has detected oxygen and hints of carbon. These elements are from the solar wind, not the comet. Scientists think that X-rays are produced through a process called charge exchange, in which highly (and positively) charged particles from the sun that lack electrons steal electrons from chemicals in the comet. Typical comet material includes water, methane and carbon dioxide. Charge exchange is analogous to the tiny spark seen in static electricity, only at a far greater energy. By comparing the ratio of X-ray energies emitted, scientists can determine the content of the solar wind and infer the content of the comet material. Swift, Chandra, XMM-Newton and Suzaku each provide complementary capabilities to nail down this tricky measurement. The combination of these observations will provide a time evolution of the X-ray emission of the comet as it navigates through our solar system. Porter and his colleagues tested the charge exchange theory in an earthbound laboratory in 2003. That experiment, at Livermore's EBIT-I electron beam ion trap, produced a complex spectrograph of intensity versus X-ray energy for a variety of expected elements in the solar wind and comet. "*We are anxious to compare nature's laboratory to the one we created*," Porter said. The German-led ROSAT mission, now decommissioned, was the first to detect X-rays from a comet, from Hyakutake in 1996. This was a great surprise. It took about five years before scientists had a suitable explanation for X-ray emission. Now, ten years after Hyakutake, scientists could settle the mystery.



HST Provides Spectacular Detail of Comet Breakup

The Hubble Space Telescope is providing astronomers with extraordinary views of Comet 73P/Schwassmann-Wachmann 3. The fragile comet is rapidly disintegrating as it approaches the Sun. Hubble images have uncovered many more fragments than have been reported by ground-based observers. These observations provide an unprecedented opportunity to study the demise of a comet nucleus. The comet is currently a chain of over three dozen separate fragments, named alphabetically, stretching across the sky by several times the angular diameter of the Moon. Hubble caught two of the fragments, B and G shortly after large outbursts in activity on April 18, 19, and 20, 2006. Hubble shows several dozen "mini-comets" trailing behind each main fragment, probably associated with the ejection of house-sized chunks of surface material. Deep-freeze relics of the early solar system, cometary nuclei are porous and fragile mixes of dust and ices that can break apart due to the thermal, gravitational, and dynamical stresses of approaching the Sun. Whether any of the many fragments survive the trip around the Sun remains to be seen in the weeks ahead. http://hubblesite.org/news/2006/18
http://www.jhuapl.edu/newscenter/pressreleases/2006/060427.asp
http://www.spacetelescope.org

Spitzer Telescope Sees Trail of Comet Crumbs

The Spitzer Space Telescope has snapped a picture of the bits and pieces making up Comet 73P/Schwassman-Wachmann 3, which is continuing to break apart on its periodic journey around the sun. The new infrared view shows several chunks of the comet riding along its own dusty trail of crumbs. "*Spitzer has revealed a trail of meteor-sized debris filling the comet's orbit*," said Dr. William T. Reach. Reach and his team recently observed the comet using Spitzer. The picture can be viewed at http://www.spitzer.caltech.edu/Media/releases/ssc2006-13/ssc2006-13a.shtml Comet 73P/Schwassman-Wachmann 3 consists of a collection of fragments that file along like ducks in a row around the sun every 5.4 years. This year, the bunch will pass by Earth beginning on May 12 before swinging by the sun on June 6. The fragments won't get too close to Earth, about 7.3 million miles, or 30 times the distance between Earth and the moon, but they should be visible through binoculars in the countryside night skies. The icy comet began falling apart in 1995 during one of its tropical trips to the sun. Astronomers believe that its crusty outer layer cracked due to the heat, allowing fresh ice to evaporate and split the comet apart.

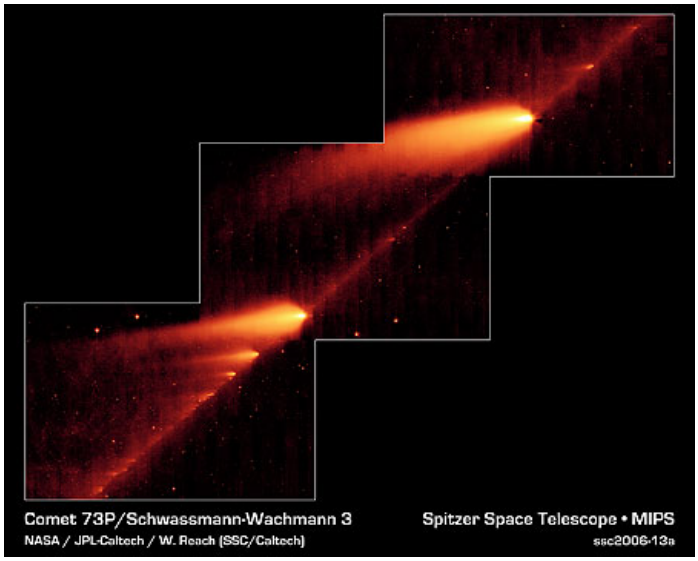
During approximately the past six weeks, amateur and professional astronomers have been watching the comet fall apart before their telescopes' eyes. Spitzer viewed the broken comet from its quiet perch up in space May 4 to May 6, covering a portion of the sky that allowed it to spot 45 of the 58 known fragments. The Spitzer observatory's infrared view also provides the first look at the dusty trail left by the disintegrating comet after it splintered apart in 1995. The trail is made up of comet dust, pebbles and rocks that occasionally rain down on Earth in what is called the Tau Herculid meteor shower. From May 19 to June 19, as Earth passes through the outskirts of the trail, only a weak meteor shower is expected, with just a few "shooting stars" visible in the night sky. A larger meteor shower might occur in 2022 if Earth crosses near the comet's wake as predicted.

Spitzer's infrared eyes were able to see the dusty comet bits lining the trail because the dust is warmed by sunlight and glows at infrared wavelengths. Most of the dust particles, specifically the millimeter-sized nuggets, had never been seen before. Reach said that these particles probably represent the natural deterioration of the comet over the years, a process commonly

observed in intact comets. The comet dust also adds up to more evidence for the "icy dirtball" theory of comets. In recent years, more and more astronomers are coming to think of comets not as snowballs coated in dust, but as dirtballs crusted with ice. "*By measuring the brightness and extent of the debris trail, we are trying to find out whether most of the comet's mass disintegrates into vapors from evaporating ice, the house-sized chunks seen in images from the Hubble Space Telescope, or the meteor-sized debris seen in the Spitzer images*," said Reach.

Reach and his team will continue to study the Spitzer data for clues to how the comet broke up. Their infrared data will tell them the sizes of the major fragments, which might indicate whether the comet did, as believed, crack under the thermal stress.

Comet 73P/Schwassman-Wachmann 3 should be dimly visible through binoculars on a clear night between the Cygnus and Pegasus constellations from May 12 to May 28. None of the comet's fragments pose a danger to Earth.
http://science.nasa.gov/headlines/y2006/24mar_73p.htm
http://www.nasa.gov/mission_pages/hubble/Comet_73P.html



IN SEARCH OF CRATER CHAINS

As the fragments of shattered comet 73P/Schwassmann Wachmann 3 glide harmlessly past Earth in full view of backyard telescopes, onlookers can't help but wonder, what if a comet like that didn't miss, but actually hit our planet? For the answer to that question, we look to the Sahara desert. In a remote windswept area named Aorounga, in Chad, there are three craters in a row, each about 10 km in diameter. "*We believe this is a 'crater chain' formed by the impact of a fragmented comet or asteroid about 400 million years ago in the Late Devonian period*," explains Adriana Ocampo of NASA. Ocampo and colleagues discovered the chain in 1996. The main crater "Aorounga South" had been known for many years - it sticks out of the sand and can be seen from airplanes and satellites. But a second and possibly third crater were buried. They lay hidden until radar onboard the space shuttle (SIR-C) penetrated the sandy ground, revealing their ragged outlines. "*Here on Earth, crater chains are rare*," says Ocampo, but they are common in other parts of the solar system.

The first crater chains were discovered by the Voyager 1 spacecraft. In 1979 when the probe flew past Jupiter's moon Callisto, cameras recorded a line of craters, at least fifteen long, evenly spaced as if someone had strafed the moon with a Gatling gun. Eventually, eight chains were found on Callisto and three more on Ganymede. At first the chains were a puzzle. Were they volcanic? Had an asteroid skipped along the surface of Callisto like a stone skipping across a pond? The mystery was solved in 1993 with the discovery of Comet Shoemaker-Levy 9. SL-9 was not a single comet, but a "string of pearls," a chain of 21 comet fragments created a year earlier when Jupiter's gravity ripped the original comet apart. SL-9 struck back in 1994, crashing into Jupiter. Onlookers watched titanic explosions in the giant planet's atmosphere, and it only took a little imagination to visualize the result if Jupiter had had a solid surface: a chain of craters.

Astronomers have since realized that fragmented comets and rubble-pile asteroids are commonplace. Comets fall apart rather easily; sunlight alone can shatter their fragile nuclei. Furthermore, there is mounting evidence that many seemingly solid asteroids are assemblages of boulders, dust and rock held together by feeble gravity. When these things hit, they make chains. In 1994, researchers Jay Melosh and Ewen Whitaker announced their finding of two crater chains on the Moon. One, on the floor of the crater Davy, is spectacular--an almost perfect line of 23 pockmarks each a few miles in diameter. This proved that crater chains exist in the Earth-Moon system. But where on Earth are they? Earth tends to hide its craters. "*Wind and rain erode them, sediments fill them in, and the tectonic recycling of Earth's crust completely obliterates them*," says Ocampo. On the Moon, there are millions of well-preserved craters. On Earth, "*so far we've managed to find only about 174*."

Sounds like a job for Google. Seriously. Amateur astronomer Emilio Gonzalez pioneered the technique in March 2006. "*I use Google Earth*," he explains. Google Earth is a digital map of our planet made of stitched-together satellite images. You can zoom in and out, fly around and inspect the landscape in impressive detail. It's a bit like a video game?except it is real.

Gonzalez began by calling up Kebira impact crater in Libya - the Sahara's largest. It was so easy to see, he recalls, "*I decided to look around for more*." Minutes later he was "flying" over the Libya-Chad border when another crater appeared. And then another. They both had multiple rings and a central peak, the telltale splash of a high-energy impact. "*It couldn't be this easy*!" he marveled. But it was. At least one of the craters had never been catalogued before, and both, almost incredibly, lined up with the Aorounga crater 200 km away: map http://www.astroseti.org/images/craterchains/map.jpg In less than 30 minutes, Gonzalez had found two good impact candidates and possibly multiplied the length of the Aorounga chain. Hours of additional searching produced no new results. "Beginner's luck," he laughs. (If you would like to hunt for your own craters online, Gonzalez offers these tips http://www.astroseti.org/impacts.php)

Ocampo doubts that these new craters are related to Aorounga. "*They don't appear to be the same age*." But she can't rule it out either. "*We need to do some fieldwork*," she says. To prove a crater is a crater - and not, say, a volcano - researchers must visit the site to look for signs of extraterrestrial impact such as "shatter cones" and other minerals forged by intense heat and pressure. This kind of geological study can also reveal the age of an impact site, marking it as part of a chain or an independent event. Answers may have to wait. Civil war in Chad and the possibility of war between Chad and Sudan prevent scientists from mounting an expedition. Meanwhile, researchers are scrutinizing candidate chains in Missouri and Spain. Although those sites are more accessible than Chad, researchers still can't decide if they are chains or not. It's difficult work. Ocampo believes it's worth the effort. "*The history of Earth is shaped by impacts*," she says.

"Crater chains can tell us important things about our planet." And so the search goes on.

HOW LONG IS A DAY ON SATURN?

Measuring the rotation period of a rocky planet like the Earth is easy, but similar measurements for planets made of gas, such as Saturn, pose problems. Researchers from JPL, Imperial College London and UCLA present new results that may solve the mystery. Using the magnetometer instrument on Cassini, they have found a clear period in the magnetic field of the planet that they believe indicates a day of 10 hours and 47 minutes. This is a whole 8 minutes slower than NASA Voyager results from the early 1980s, and slower than previous estimates from another Cassini instrument. The magnetometer results provide the best estimate of the Saturn day to date, because it can see deep inside Saturn. Planets rotate around their "spin" axes as they orbit about the Sun. Rocky planets like the Earth and Mars have rotation periods that remain quite constant and are easy to measure because we can see the surfaces rotate.

Gaseous planets do not have a solid surface to track and are not as rigid as rocky planets. Thus, their periods may change more than those of rocky planets while being less easy to measure. Scientists have sought to use proxy measures such as the repetition rate of radio signals or the period of the rotation of the direction of the magnetic axis of the planet. However for Saturn this has proved difficult because previous missions could not detect a period in the magnetic field measurements and whilst radio data have shown a period - it has changed in the time between previous missions and Cassini.

Since the Voyager days scientists have been seeing changes in the period of radio observations. They knew that it was virtually impossible to slow down or speed up a mass as large as Saturn. As Cassini's measurements of the rhythms of natural radio signals from the planet continued to vary, scientists began to realize these signals were probably not a direct measurement of the internal rotation rate. Suddenly the length of Saturn's day became uncertain. Measurements of the magnetic field help scientists "see" deep inside Saturn and may have finally solved this puzzle. Michele Dougherty says "*Making this measurement has been one of team's most important science goals. Finding a period in the magnetic field rotation helps us to understand the internal structure of Saturn's magnetic fields and from that, of Saturn itself, which will help us understand how the planet formed. After almost two years of collecting data, we are starting to get fascinating insights in Saturn, but we still have more questions than we do answers*." According to Dr Giacomo Giampieri, a researcher and lead author of the paper, Saturn's rotation posed a great challenge to scientists in the past. In fact, Saturn's internal magnetic field is almost perfectly aligned with the rotation axis. To explain the consequences of this alignment, Giampieri says to consider a Compact Disc in a CD player. "*Imagine you want to check whether the CD is playing*" Giampieri says "*If your CD has a label it is easy to see at a glance that it is spinning very fast in the CD player. But if the CD has no label, you would not be able to tell whether the CD is moving or not because it would look static*". Giampieri explains that "*Saturn's magnetic field is similar to a blank CD: if you just look at it, it seems that it is not rotating at all*."

In the past, Pioneer 11 and two Voyager spacecraft encountered Saturn during brief fly-bys and collected data, but no clear periodic signals were found in their magnetic field data. In July 2004 the Cassini spacecraft was inserted into orbit about Saturn and it now has completed many orbits around the gaseous planet. Thanks to the extent of data collected over this extended period of time and the use of appropriate algorithms, a small but regular periodic signature in the magnetic field close to the planet has been detected, with a period of 10 hours 47 minutes and 6 seconds (plus or minus 40seconds). This discovery is like finding a small spot on a CD that allows you to measure how fast it is spinning. The result is somewhat surprising. Giampieri explains "*the period we found from the magnetic field measurements has remained constant since Cassini entered orbit almost 2 years ago, while radio measurements since the Voyager era have shown large variability. By monitoring the magnetic field over the rest of the mission, we will be able to solve this puzzle*". The periodic signal of Saturn's magnetic field does not fit simple models for planetary magnetic fields. Giampieri explains "*Saturn's periodic magnetic field differs from that found at Jupiter, which can be modelled as a dipole field tilted with respect to the rotation axis*." This study opens a new perspective on the internal structure and dynamics of Saturn, and how it affects the source of the magnetic field. "*We now know that the internal rotation of Saturn and its connection to the external magnetic field is very complex. Our study is the first step in breaking the code*" Giampieri says.
http://saturn.jpl.nasa.gov/multimedia/images/images.cfm?categoryID=1

TITAN'S SEAS ARE SAND

Until a couple of years ago, scientists thought the dark equatorial regions of Titan might be liquid oceans. New radar evidence shows they are seas -- but seas of sand dunes like those in the Arabian or Namibian Deserts, a University of Arizona member of the Cassini radar team and colleagues reports. Radar images taken when the Cassini spacecraft flew by Titan last October show dunes 330 feet (100 meters) high that run parallel to each other for hundreds of miles at Titan's equator. One dune field runs more than 930 miles (1500 km) long, said Ralph Lorenz .

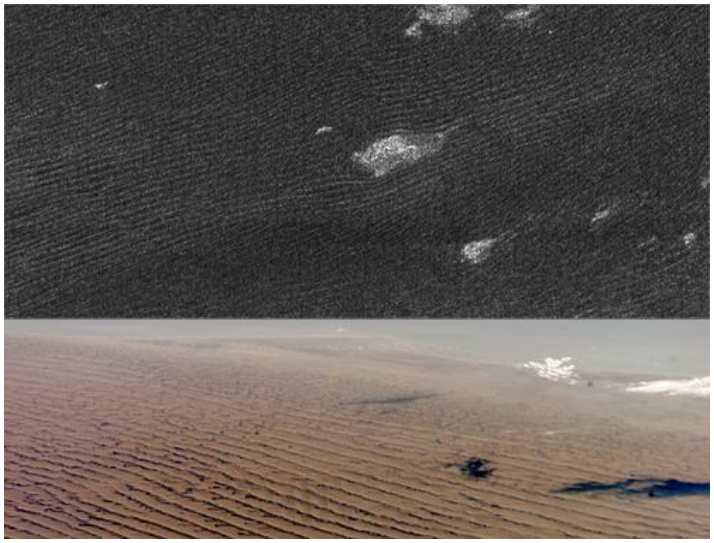
"*It's bizarre*," Lorenz said. "*These images from a moon of Saturn look just like radar images of Namibia or Arabia. Titan's atmosphere is thicker than Earth's, its gravity is lower, its sand is certainly different -- everything is different except for the physical process that forms the dunes and resulting landscape*." Ten years ago, scientists believed that Saturn's moon Titan is too far from the sun to have solar-driven surface winds powerful enough to sculpt sand dunes. They also theorized that the dark regions at Titan's equator might be liquid ethane oceans that would trap sand. But researchers have since learned that Saturn's powerful gravity creates significant tides in Titan's atmosphere. Saturn's tidal effect on Titan is roughly 400 times greater than our moon's tidal pull on Earth. As first seen in circulation models a couple of years ago, Lorenz said, "*Tides apparently dominate the near-surface winds because they're so strong throughout the atmosphere, top to bottom. Solar-driven winds are strong only high up*."

The dunes seen by Cassini radar are a particular linear or longitudinal type that is characteristic of dunes formed by winds blowing from different directions. The tides cause wind to change direction as they drive winds toward the equator, Lorenz said. And when the tidal wind combines with Titan's west-to-east zonal wind, as the radar images show, it creates dunes aligned nearly west-east except near mountains that influence local wind direction. "*When we saw these dunes in radar it started to make sense*," he said. "*If you look at the dunes, you see tidal winds might be blowing sand around the moon several times and working it into dunes at the equator. It's possible that tidal winds are carrying dark sediments from higher latitudes to the equator, forming Titan's dark belt*."

The researchers' model of Titan suggests tides can create surface winds that reach about one mile per hour (a half-meter per second). "*Even though this is a very gentle wind, this is enough to blow grains along the ground in Titan's thick atmosphere and low gravity*," Lorenz said. Titan's sand is a little coarser but less dense than typical sand on Earth or Mars. "*These grains might resemble coffee grounds*."

The variable tidal wind combines with Titan's west-to-east zonal wind to create surface winds that average about one mile per hour (a half meter per second). Average wind speed is a bit deceptive, because sand dunes wouldn't form on Earth or Mars at their average wind speeds. Whether the grains are made of organic solids, water ice, or a mixture of both is a mystery. Cassini's Visual and Infrared Mapping Spectrometer, led by UA's Robert Brown, may get results on sand dune composition.

How the sand formed is another peculiar story. Sand may have formed when liquid methane rain eroded particles from ice bedrock. Researchers previously thought that it doesn't rain enough on Titan to erode much bedrock, but they thought in terms of average rainfall. Observations and models of Titan show that clouds and rain are rare. That means that individual storms could be large and still yield a low average rainfall, Lorenz explained. When the Descent Imager/Spectral Radiometer (DISR) team produced images taken during the Huygens probe landing on Titan in January 2005, the world saw gullies, streambeds and canyons in the landscape. These same features on Titan have been seen with radar. These features show that when it does rain on Titan, it rains in very energetic events, just as it does in the Arizona desert, Lorenz said. Energetic rain that triggers flash floods may be a mechanism for making sand, he added. Alternatively, the sand may come from organic solids produced by photochemical reactions in Titan's atmosphere. "*It's exciting that the radar, which is mainly to study the surface of Titan, is telling us so much about how winds on Titan work*," Lorenz said. "*This will be important information for when we return to Titan in the future, perhaps with a balloon."*



METEORITES DISCOVERED TO CARRY INTERSTELLAR CARBON

Like an interplanetary spaceship carrying passengers, meteorites have long been suspected of ferrying relatively young ingredients of life to our planet. Using new techniques, scientists at the Carnegie Institution's Department of Terrestrial Magnetism have discovered that meteorites can carry other, much older passengers as well - primitive, organic particles that originated billions of years ago either in interstellar space, or in the outer reaches of the solar system as it was beginning to coalesce from gas and dust. The study shows that the parent bodies of meteorites - the large objects from the asteroid belt - contain primitive organic matter similar to that found in interplanetary dust particles that might come from comets. The finding provides clues about how organic matter was distributed and processed in the solar system during this long-gone era.

"*Atoms of different elements come in different forms, or isotopes, and the relative proportions of these depend on the environmental conditions in which their carriers formed, such as the heat encountered, chemical reactions with other elements, and so forth*," explained lead author Henner Busemann. "*In this study we looked at the relative amounts of different isotopes of hydrogen (H) and nitrogen (N) associated with tiny particles of insoluble organic matter to determine the processes that produced the most pristine type of meteorites known. The insoluble material is very hard to break down chemically and survives even very harsh acid treatments*." The researchers used a microscopic imaging technique to analyze the isotopic composition of insoluble organic matter from six carbonaceous chondrite meteorites - the oldest type known. The relative proportion of isotopes of nitrogen and hydrogen associated with the insoluble organic matter act as "fingerprints" and can reveal how and when the carbon was formed. The isotope of nitrogen that is most often found in nature is 14N; its heavier sibling is 15N. Differing amounts of 15N, in addition to a heavier form of hydrogen called deuterium, (D), allow researchers to tell if a particle is relatively unaltered from the time when the solar system was first forming.

"*The tell-tale signs are lots of deuterium and 15N chemically bonded to carbon*," commented co-author Larry Nittler. "*We have known for some time, for instance, that interplanetary dust particles (IDP), collected from high-flying airplanes in the upper atmosphere, contain huge excesses of these isotopes, probably indicating vestiges of organic material that formed in the interstellar medium. The IDPs have other characteristics indicating that they originated on bodies - perhaps comets - that have undergone less severe processing than the asteroids from which meteorites originate*." The scientists found that some meteorite samples, when examined at the same tiny scales as interplanetary dust particles, actually have similar or even higher abundances of 15N and D than those reported for IDPs. "*It's amazing that pristine organic molecules associated with these isotopes were able to survive the harsh and tumultuous conditions present in the inner solar system when the meteorites that contain them came together*," reflected co-author Conel Alexander. "*It means that the parent bodies - the comets and asteroids _ of these seemingly different types of extraterrestrial material are more similar in origin than previously believed*."

"*Before, we could only explore minute samples from IDPs. Our discovery now allows us to extract large amounts of this material from meteorites, which are large and contain several percent of carbon, instead of from IDPs, which are on the order of a million million times less massive. This advancement has opened up an entirely new window on studying this elusive period of time*," concluded Busemann.

This work is supported through the NASA Astrobiology Institute (NAI) and the Cosmochemistry Research Program, and the Carnegie Institution. The NAI, founded in 1998, is a partnership between NASA, 16 major U.S. teams and six international consortia. NAI's goal is to promote, conduct, and lead integrated multidisciplinary astrobiology research and to train a new generation of astrobiology researchers. For more information about the NAI on the Internet, visit: http://nai.nasa.gov/

BREATHING MOONROCKS

The Moon has plentiful oxygen for future astronauts. It's lying on the ground. An early, persistent problem noted by Apollo astronauts on the Moon was dust. It got everywhere, including into their lungs. Oddly enough, that may be where future Moon explorers get their next breath of air: The moon's dusty layer of soil is nearly half oxygen. The trick is extracting it. "*All you have to do is vaporize the stuff*," says Eric Cardiff of NASA's Goddard Space Flight Center. He leads one of several teams developing ways to provide astronauts oxygen they'll need on the Moon and Mars. (See the Vision for Space Exploration http://www.nasa.gov/missions/solarsystem/explore_main.html)

Lunar soil is rich in oxides. The most common is silicon dioxide (SiO2), "*like beach sand*," says Cardiff. Also plentiful are oxides of calcium (CaO), iron (FeO) and magnesium (MgO). Add up all the O's: 43% of the mass of lunar soil is oxygen. Cardiff is working on a technique that heats lunar soils until they release oxygen. "*It's a simple aspect of chemistry*," he explains. "*Any material crumbles into atoms if made hot enough*." The technique is called vacuum pyrolysis--pyro means "fire", lysis means "to separate." "*A number of factors make pyrolysis more attractive than other techniques*," Cardiff explains. *"It requires no raw materials to be brought from Earth, and you don't have to prospect for a particular mineral*." Simply scoop up what's on the ground and apply the heat.

In a proof of principle, Cardiff and his team used a lens to focus sunlight into a tiny vacuum chamber and heated 10 grams of simulated lunar soil to about 2,500 degrees C. Test samples included ilmenite and Minnesota Lunar Simulant, or MLS-1a. Ilmenite is an iron/titanium ore that Earth and the Moon have in common. MLS-1a is made from billion-year-old basalt found on the north shore of Lake Superior and mixed with glass particles that simulate the composition of the lunar soil. Actual lunar soil is too highly prized for such research now. In their tests, "*as much as 20 percent of the simulated soil was converted to free oxygen*," Cardiff estimates. What's leftover is "slag," a low-oxygen, highly metallic, often glassy material. Cardiff is working with colleagues at NASA's Langley Research Center to figure out how to shape slag into useful products like radiation shielding, bricks, spare parts, or even pavement. The next step: increase efficiency. "*In May, we're going to run tests at lower temperatures, with harder vacuums*." In a hard vacuum, he explains, oxygen can be extracted with less power. Cardiff's first test was at 1/1,000 Torr. That is 760,000 times thinner than sea level pressure on Earth (760 Torr). At 1 millionth of a Torr -- another thousand times thinner -- "*the temperatures required are significantly reduced*."

Cardiff is not alone in this quest. A team led by Mark Berggren of Pioneer Astronautics in Lakewood, CO, is working on a system that harvests oxygen by exposing lunar soil to carbon monoxide. In one demonstration they extracted 15 kg of oxygen from 100 kg of lunar simulant--an efficiency comparable to Cardiff's pyrolysis technique: http://www.lpi.usra.edu/meetings/leag2005/pdf/2069.pdf D.L. Grimmett of Pratt & Whitney Rocketdyne, is working on magma electrolysis. He melts MLS-1 at about 1,400 deg. C, so it is like magma from a volcano, and uses an electric current to free the oxygen: http://www.lpi.usra.edu/meetings/leag2005/pdf/2042.pdf Finally, NASA and the Florida Space Research Institute, through NASA's Centennial Challenge, are sponsoring MoonROx, the Moon Regolith Oxygen competition. A $250,000 prize goes to the team that can extract 5 kg of breathable oxygen from JSC-1 lunar simulant in just 8 hours.

NEW CAPTURE SCENARIO EXPLAINS ORIGIN OF NEPTUNE'S ODDBALL MOON TRITON

Neptune's large moon Triton may have abandoned an earlier partner to arrive in its unusual orbit around Neptune. Triton is unique among all the large moons in the solar system because it orbits Neptune in a direction opposite to the planet's rotation (a "retrograde" orbit). It is unlikely to have formed in this configuration and was probably captured from elsewhere. Recently planetary scientists Craig Agnor, and Douglas Hamilton have described a new model for the capture of planetary satellites involving a three-body gravitational encounter between a binary and a planet. According to this scenario, Triton was originally a member of a binary pair of objects orbiting the Sun. Gravitational interactions during a close approach to Neptune then pulled Triton away from its binary companion to become a satellite of Neptune. "*We've found a likely solution to the long-standing problem of how Triton arrived in its peculiar orbit. In addition, this mechanism introduces a new pathway for the capture of satellites by planets that may be relevant to other objects in the solar system*," said Agnor.

With properties similar to the planet Pluto and about 40 percent more massive, Triton has an inclined, circular orbit that lies between a group of small inner moons with prograde orbits and an outer group of small satellites with both prograde and retrograde orbits. There are other retrograde moons in the solar system, including the small outer moons of Jupiter and Saturn, but all are tiny compared to Triton (less than a few thousandths of its mass) and have much larger and more eccentric orbits about their parent planets. Triton may have come from a binary very similar to Pluto and its moon Charon, Agnor said. Charon is relatively massive, about one-eighth the mass of Pluto, he explained. "*It's not so much that Charon orbits Pluto, but rather both move around their mutual center of mass, which lies between the two objects*," Agnor said. In a close encounter with a giant planet like Neptune, such a system can be pulled apart by the planet's gravitational forces. The orbital motion of the binary usually causes one member to move more slowly than the other. Disruption of the binary leaves each object with residual motions that can result in a permanent change of orbital companions. This mechanism, known as an exchange reaction, could have delivered Triton to any of a variety of different orbits around Neptune, Agnor said.

An earlier scenario proposed for Triton is that it may have collided with another satellite near Neptune. But this mechanism requires the object involved in the collision to be large enough to slow Triton down, but small enough not to destroy it. The probability of such a collision is extremely small, Agnor said. Another suggestion was that aerodynamic drag from a disk of gas around Neptune slowed Triton down enough for it to be captured. But this scenario puts constraints on the timing of the capture event, which would have to occur early in Neptune's history when the planet was surrounded by a gas disk, but late enough that the gas would disperse before it slowed Triton's orbit enough to send the moon crashing into the planet. In the past decade, many binaries have been discovered in the Kuiper belt and elsewhere in the solar system. Recent surveys indicate that about 11 percent of Kuiper belt objects are binaries, as are about 16 percent of near-Earth asteroids. "*These discoveries pointed the way to our new explanation of Triton's capture*," Hamilton said. "*Binaries appear to be a ubiquitous feature of small-body populations*." The Pluto/Charon pair and binaries in the Kuiper belt are especially relevant for Triton, as their orbits abut Neptune's, he said. "*Similar objects have probably been around for billions of years, and their prevalence indicates that the binary-planet encounter that we propose for Triton's capture is not particularly restrictive*," Hamilton said. The exchange reaction described by Agnor and Hamilton may have broad applications in understanding the

evolution of the solar system, which contains many irregular satellites. The researchers plan to explore the implications of their findings for other satellite systems.

GIANT ASTEROID FRAGMENT MAKES IMPACT

A first-ever discovery of a fragment from a giant meteorite which crashed to Earth millions of years ago could cause a re-think about asteroid collisions with our planet. Dr Iain McDonald of the School of Earth Ocean & Planetary Sciences was among the international research team who identified the 25cm sized fragment, found in a frozen magma pool at the bottom of the giant Morokweng crater in South Africa. The unique discovery, gives a direct insight into what was happening in the solar system 144 million years ago. The researchers found the fossilised meteorite fragment 766m below the surface while helping a company searching for copper and nickel in the giant Morokwong crater in South Africa. Dr McDonald said: "*This was a huge stroke of luck, as had the borehole been sited just a meter away, it may have missed the object altogether. For the first time it is possible to hold in your hand an actual piece of a giant asteroid that hit the Earth. This intact fragment may tell us a lot more about the insides of asteroids than we currently know*." Scientists have long believed that large asteroids or comets are obliterated by the enormous temperatures created when they collide with the Earth. Smaller impact craters of less than 4 kilometers diameter have been found to contain meteorite fragments. It was thought that any asteroid generating a crater larger than 4 kilometres in diameter would be completely destroyed, but the new discovery challenges that view. Morokweng is a very large crater of 70 kilometres diameter, and the fragment's survival suggests the asteroid struck the Earth at a lower speed than has been assumed in the past. Dr McDonald, who analysed the composition of the fragment, revealed a further twist to the story of the meteorite, of a type called an ordinary chondrite. He said: "*Morokweng is no run of the mill meteorite. It shows some striking differences when compared with other known meteorites, such as the absence of iron-nickel metal. It appears that the Morokweng meteorite may have come from a very different part of the parent asteroid than other ordinary chondrites which currently fall to earth*."

EVIDENCE MOUNTS FOR SUN'S COMPANION STAR

The Binary Research Institute (BRI) has found that orbital characteristics of the recently discovered planetoid, "Sedna", demonstrate the possibility that our sun might be part of a binary star system. A binary star system consists of two stars gravitationally bound orbiting a common center of mass. Once thought to be highly unusual, such systems are now considered to be common in the Milky Way galaxy.

Walter Cruttenden, Professor Richard Muller, Dr. Daniel Whitmire, amongst several others, have long speculated on the possibility that our sun might have an as yet undiscovered companion. Most of the evidence has been statistical rather than physical. The recent discovery of Sedna, a small planet like object first detected by astronomer Dr. Michael Brown, provides what could be indirect physical evidence of a solar companion. Matching the recent findings by Dr. Brown, showing that Sedna moves in a highly unusual elliptical orbit, Cruttenden has determined that Sedna moves in resonance with previously published orbital data for a hypothetical companion star.

In the May 2006 issue of Discover, Dr. Brown stated: "*Sedna shouldn't be there. There's no way to put Sedna where it is. It never comes close enough to be affected by the sun, but it never goes far enough away from the sun to be affected by other stars ... Sedna is stuck, frozen in place; there's no way to move it, basically there's no way to put it there -- unless it formed there. But it's in a very elliptical orbit like that. It simply can't be there. There's no possible way -- except it is. So how, then?*" "*I'm thinking it was placed there in the earliest history of the solar system. I'm thinking it could have gotten there if there used to be stars a lot closer than they are now and those stars affected Sedna on the outer part of its orbit and then later on moved away. So I call Sedna a fossil record of the earliest solar system. Eventually, when other fossil records are found, Sedna will help tell us how the sun formed and the number of stars that were close to the sun when it formed*."

Walter Cruttenden agrees that Sedna's highly elliptical orbit is very unusual, but noted that the orbit period of 12,000 years is in neat resonance with the expected orbit periodicity of a companion star as outlined in several prior papers. Consequently, Cruttenden believes that Sedna's unusual orbit is something indicative of the current solar system configuration, not merely a historical record. "*It is hard to imagine that Sedna would retain its highly elliptical orbit pattern since the beginning of the solar system billions of years ago. Because eccentricity would likely fade with time, it is logical to assume Sedna is telling us something about current, albeit unexpected solar system forces, most probably a companion star*".

Outside of a few popular articles, and Cruttenden's book "Lost Star of Myth and Time", which outlines historical references and the modern search for the elusive companion, the possibility of a binary partner star to our sun has been left to the halls of academia. But with Dr. Brown's recent discoveries of Sedna and Xena, (now confirmed to be larger than Pluto), and timing observations like Cruttenden's, the search for a companion star may be gaining momentum.

NASA LACKS RESOURCES $$ NEEDED TO SUSTAIN VIGOROUS SCIENCE PROGRAM

NASA does not have the resources necessary to maintain a vigorous science program, complete the Space Station, and return humans to the moon, says a new congressionally mandated report from the National Academies' National Research Council. "*There is a mismatch between what NASA has been assigned to do and the resources with which it has been provided*," said Lennard A. Fisk, chair of the committee that wrote the report. "*We are particularly concerned that the shortfall in funding for science has fallen disproportionately on small missions and on funding for basic research and technology. These actions run the risk of disrupting the pipeline of human capital and technology that is essential for the future success of the space program*." The committee reviewed NASA's plan for research programs for the next five years in space science, which includes astrophysics, heliophysics, planetary science, and astrobiology; earth science; and microgravity life and physical sciences. The committee found that the program proposed for space and earth sciences is neither robust nor sustainable, and that it is not properly balanced to support a healthy mix of small, moderate-sized, and large missions.

The report recommends that NASA restore small missions, research and analysis programs, and technology investment in the future missions. The agency also should preserve the ground-based and flight research required to support long-duration human space flight. For space and earth sciences, the committee concluded that the short-term resource allocation problem is modest, probably slightly more than 1 percent of the total NASA budget. To revive the microgravity life and physical sciences, the

short-term allocation of resources needed is also modest -- less than 1 percent of the total NASA budget.

ANCIENT ROCK STAR FINDS A HOME AT CANADIAN UNIVERSITY

The University of Alberta is welcoming a very, very old rock star into its hallways. No, it's not Keith Richards. It is, perhaps, the most important rock on the face of the Earth. The Tagish Lake meteorite is the only one of its kind known to exist on Earth, and may contain insights into the beginnings of our solar system, said Dr. Christopher Herd. Because the space-born rock fell on the frozen surface of a northern B.C. lake in the middle of January and was collected without being touched by human hands, it represents the most pristine sample of minerals from outer space. "*No other meteorite's ever been collected in this manner and I suppose that arguably makes it the most important rock that's ever been found anywhere on the Earth*," said Herd. "*It can tell us new information about the birth and evolution of our solar system, and the very fact that it's been kept frozen, essentially pristine, uncontaminated by human hands, gives us an unprecedented opportunity to explore new scientific avenues that were heretofore impossible. We can do things with this meteorite that nobody's ever done before*."

The Tagish Lake meteorite is being carefully stored in sub-zero conditions in the U of A's meteorite collection and has never been in temperatures above freezing. It was formed in space, protected from the heat of re-entry by a *crust of minerals, and landed during a northern Canadian winter. "What that means is that we can look for minerals in there that are not normally preserved under normal circumstances, where they're collected above freezing*," said Herd. "*It has actually been reported that for some of these meteorites, when they're warmed up, you actually can smell kind of sulphurous smells or metallic smells as the volatile components are kind of de-gassing. So, it gives us an opportunity to look at this when those volatile components are still there. It even provides us the opportunity to look for extraterrestrial ices. I mean, who knows whether they're there, but we can look because of the way this thing's been collected*."

The other thing that makes this meteorite so special is its composition. It's an extremely rare type of formation that has preserved the goings-on of more than 4.57 billion years ago. Of all the meteorites that fall to Earth, only two or three per cent are of the same category as the Tagish Lake stone, said Herd. "*The meteorite is a carbonaceous chondrite, which is quite a rare type of meteorite. These meteorites represent the left-over material from the formation of the solar system*," he said. "*This is in the broader context for the theories that we have for the formation of the solar system, which is that the planets formed from a rotating disk of dust and gas around the early sun. So, this material is left over from that. It's basically a sampling of the dust and gas that were present in that disk before the planets started to form*." For Herd, this is the something he's been waiting a long time for. "*Shortly after I started here three years ago, I thought this would be a great meteorite to have because of its scientific value. It also fell in Canadian territory. It's a Canadian meteorite and it really needed to be in a Canadian institution in order to maximize the science and to demonstrate that we could do great science on this*," he said. "*So, it means a lot. I'm not going to do everything; I can't do everything on this. It will be a matter of setting up a research consortium with other researchers across Canada, with input from researchers around the world, who are all eager to work on this as well -- to really tease out as much as we can about the formation of the solar system*." http://www.museums.ualberta.ca/dig/naturalhist/earth/meteorite/index.html

FOLLOW THE NITROGEN TO EXTRATERRESTRIAL LIFE

The narrow search for water can miss important clues. The great search for extraterrestrial life has focused on water at the expense of a crucial element, say geobiologists, who propose searching for organic nitrogen as a direct indicator of the presence of life. Nitrogen is essential to the chemistry of living organisms. Even if NASA were to find water on Mars, its presence only would indicate the possibility of life, said Kenneth Nealson. "*It's hard to imagine life without water, but it's easy to imagine water without life*," Nealson said.

The discovery of nitrogen on the Red Planet would be a different story. "*If you found nitrogen in abundance on Mars, you would get extremely excited because it shouldn't be there*," Nealson said. The reason has to do with the difference between nitrogen and carbon, the other indispensable organic element. Unlike carbon, nitrogen is not a major component of rocks and minerals. This means that any substantial organic nitrogen deposits found in the soil of Mars, or of another planet, likely would have resulted from biological activity.

Dimming the hopes of life-on-Mars believers is the makeup of the planet's atmosphere. The abundant nitrogen in Earth's atmosphere is constantly replenished through biological activity. Without the ongoing contribution of living systems, the atmosphere slowly would lose its nitrogen. The extremely low nitrogen content in the Martian atmosphere suggests that biological nitrogen production is close to zero.

However, the authors write, it is possible that life existed on Mars at some hypothetical time when nitrogen filled the atmosphere. Co-author Douglas Capone, said NASA should establish a nitrogen detection program alongside its water-seeking effort. He noted that next-generation spacecraft will have advanced sampling capabilities. "*What we're suggesting here is basically drilling down into geological strata, which they're going to be doing for water anyway*," Capone said. "*The real smoking gun would be organic nitrogen*." Said Nealson: "*If your goal is to search for life, it would be wise to include nitrogen*."

FROM THE EDITOR'S TERMINAL

The Stargazer is <u>your</u> newsletter and therefore it should be a cooperative project. Ads, announcements, suggestions, and literary works should be received by the editor before the 1st of the month of publication, for example, material for May's newsletter should be received May 1st. If you wish to contribute an article or suggestions to ***The Stargazer*** please contact Mark Folkerts by email or by telephone (425) 486-9733 or co-editor Bill O'Neil, at (774) 253-0747.

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In May's Stargazer:

The next EAS Meeting is 3:00 P.M. SATURDAY, May 27th 2006 at the Everett Public Library Auditorium.