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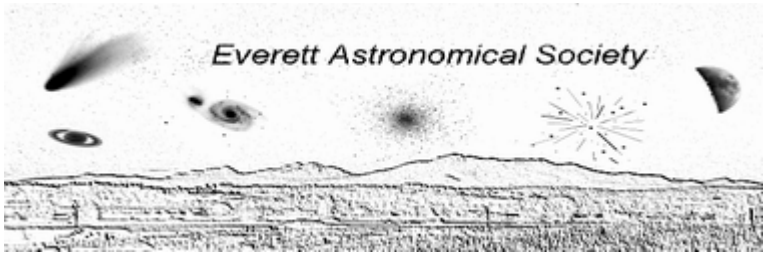

The Stargazer

November 2006

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

EAS BUSINESS…

NEXT EAS MEETING – TUESDAY NOVEMBER 14ST AT 6:30 PM AT THE EVERETT PUBLIC LIBRARY, IN THE AUDITORIUM (DOWNSTAIRS)

THIS MONTH'S MEETING PROGRAM:
"The Astronomers: Percival Lowell" – The legacy of Percival Lowell and the Lowell Observatory for the study of planetary astronomy – Mars, Pluto, extrasolar planets, Earth-crossing asteroids by astronomers including Lowell, Claude Tombaugh, and Gene and Carolyn Shoemaker.

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:

EAS member Ron Tam has offered a flexible opportunity to EAS members to come to his home north of Snohomish for observing on clear weekend evenings and for EAS starparties. Anyone wishing to do so needs to contact him in advance and confirm available dates, and let him know if plans change**. "**Our place is open for star parties any Saturday except weekends of the Full Moon. People can call to get weather conditions or to confirm that there is a star party. Our phone number is (360) 568-5152. They can e-mail me too (tam1951@nwlink.com) but I don't check my email daily. They can email me for directions if they never have been out here."

People should also join and send mail to the mail list *everett_astronomy@topica.com* 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.

$$ - FINANCIAL HEALTH - $$

The club maintains a $650+ 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

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 14 – EAS October Meeting 6:30 pm – Everett Public Library
Nov 17 - Leonids Meteor Shower Peak

December 2006

Dec 13 - Geminids Meteor Shower Peak
Dec 16 – EAS HOLIDAY Meeting – 7:00 PM – Alfy's on Broadway
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)
Jan 27 – EAS January Meeting – 3:00 PM – Everett Public Library

February 2007

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

March 2007

Mar 21 - Vernal Equinox, 00:07 UT

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

Nov 16	Last Quarter Moon
Nov 20	New Moon
Nov 28	First Quarter Moon
Dec 05	Full Moon
Dec 12	Last Quarter Moon
Dec 20	New Moon
Dec 27	First Quarter Moon
Jan 03	Full Moon
Jan 11	Last Quarter Moon
Jan 19	New Moon
Jan 25	First Quarter Moon
Feb 02	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	**7:11 am**	**11:53**	**16:35**	**Lib**	**-27.5**
Mercury	**6:13 am**	Daylight	Daylight	**Lib**	**+1.8**
Venus	Daylight	Daylight	Daylight	**Lib**	**-3.9**
Mars	**6:35 am**	Daylight	Daylight	**Lib**	**+1.6**
Jupiter	Daylight	Daylight	Daylight	**Lib**	**-2.0**
Saturn	**23:16**	**6:28 am**	Daylight	**Leo**	**+0.5**
Uranus	Daylight	**19:27**	**0:57 am**	**Aqr**	**+5.8**
Neptune	Daylight	**17:55**	**22:45**	**Cap**	**+7.9**
Pluto	Daylight	Daylight	**19:06**	**Oph**	**+13.9**

(times local time for Everett PST)

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.

Night Sky Network - Teleconference: "Kepler Mission" by Dr. David Koch Thursday, November 16th - 6:00 pm Pacific
All club members can call in and participate in the Nov 16th teleconference on the Kepler Mission with Dr. David Koch and the Q&A session to immediately follow. *** PLEASE NOTE THE NEW TELECON CALL-IN NUMBER: 1-888-456-0346 *** Download the companion PowerPoint to this teleconference here: http://nightsky.jpl.nasa.gov/docs/KeplerKoch.ppt The Powerpoint can also be viewed online at http://www.astrosociety.org/nsntelecon
(NOTE: You may need to refresh the page.) Toll-free conference call line: 1-888-456-0346. Call anytime after 5:45 pm PST the

evening of the telecon. An operator will answer and:
- You will be asked for the passcode: NIGHT SKY NETWORK
- You might be asked for the call leader: MICHAEL GREENE
- You will be asked to give your NAME and the CLUB you belong to, and number of people listening with you. If you have any questions send an email to Night Sky Network Administrator (nightskyinfo@astrosociety.org)

CONSTELLATION OF THE MONTH: LEO

LEO (The Lion). One of the 48 "original" constellations. The possessive form of this famous constellation is known as Leonis. Asterisms associated with Leo include The Sickle, The Spring Triangle, and The Diamond (of Virgo). Constellations bordering on Leo (and the directions from Leo) include Cancer(W), Coma Berenices (E), Crater(S), Hydra(S), Leo Minor(N), Sextans (S and W), Ursa Major(N), and Virgo(S and E). The overall brightness (the number of visible stars per unit area = # of visible stars in constellation/size of constellation in square degrees x 100) of Leo is 5.491 (ranking Leo 70th in brightness among the constellations). The central point of Leo is located at RA=10h37m, and Dec. = +13.5 degrees. The size of Leo is 946.96 square degrees (2.296% of the sky), making Leo the 12th largest constellation in area.

Messier objects included within its borders are M65 (spiral galaxy – NGC 3623), M66 (spiral galaxy – NGC 3627), M95 (spiral galaxy – NGC 3351), M96 (spiral galaxy – NGC 3368), and M105 (elliptical galaxy – NGC 3379). Meteor showers (and peaks) associated with Leo are the delta Leonids (Feb. 26), the sigma Leonids (April 17), and the famous Leonids (Nov. 17). The midnight culmination date is March 1st, making Leo a wonderful Spring constellation for observing. The solar conjunction date is August 31st. There are 52 visible stars brighter than magnitude 5.5; some of the famous named stars in Leo include Regulus, Denebola, Algieba, Adhafera, and Chort. Regulus is one of the four Royal Stars of the ancient Persians (the other three are Aldebaran (Taurus), Antares (Scorpius), and Fomalhaut (Piscis Austrinus). Among the nearest stars to our solar system include Wolf 359 (the 4th nearest star), AD Leo (the 37th nearest star), and Ross 104 (the 79th nearest). Wolf 359 has an apparent magnitude of 13.5; an absolute magnitude of 16.5; a parallax (arcsec) of 0.429; and is at a distance of 7.6 light years. Leo is completely visible from latitudes +84 degrees to -57 degrees, and portions of it are visible worldwide.

The Leonid meteor shower (peak Nov. 17th) is unusually active every 33 years. Fantastic and well-known displays were noted in 1799, 1833, 1866, and 1966, with meteors in the tens of thousands reported per hour on these occasions. This year, a last quarter moon will be visible, which may interfere with some of the fainter meteors which might be visible, but the Leonids are always worth checking out if the night is clear.

PLANETARY FOCUS - NEPTUNE

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 "LINGO"

Astronomy "Lingo": OORT CLOUD: An immense spherical halo of icy objects around the solar system; it is the repository of long-period comets.

Telescope / Equipment "Lingo": INTERFEROMETRY: The use of more than one telescope, with the goal of increasing resolution by combining light or radio waves emitted from the same celestial object.

YOUNG ASTRONOMER'S CORNER

It's time for some questions and answers again!!!

Q: Can we see footprints on the Moon?

A: No. Using the largest telescopes on Earth, the smallest objects we can visualize on the Moon are about a half-mile (approximately one kilometer) across. Astronauts in the Apollo program wore big boots, but they were not THAT big!!

Q: Why should we be helping to build the International Space Station (ISS)?

A: Primarily and importantly, if human beings are ever going to explore more of space, we need to know a lot more about space, including its effects on us. Space has no air to breathe and it is an environment of micro-gravity; gaining a better understanding of human survival and other experiments on board the ISS will help to make it a better world on planet Earth. Because the ISS is in space right now and has been for quite some time, there is no need to design experiments in the weightlessness of space to last only one or two weeks like the Shuttle experiments are designed to do. Experiments could be run for much longer periods of time, gaining more valuable information. Long-term effects of weightlessness on the human body could be studied, as well as the growth of crystals, plants, etc…… This information can be applied to life on Earth (medical care is a good example of an area that has benefited from space research in the past), and would also be useful going forward to improve other space missions as well.

ASTRONOMY FUN FACTS AND MIRROR IMAGES WILL RETURN IN DECEMBER

ASTRONOMICAL NOTES -- ON & OFF THE WEB…

NOT SO DEAD AFTER ALL - MOON'S ESCAPING GASSES EXPOSE FRESH SURFACE

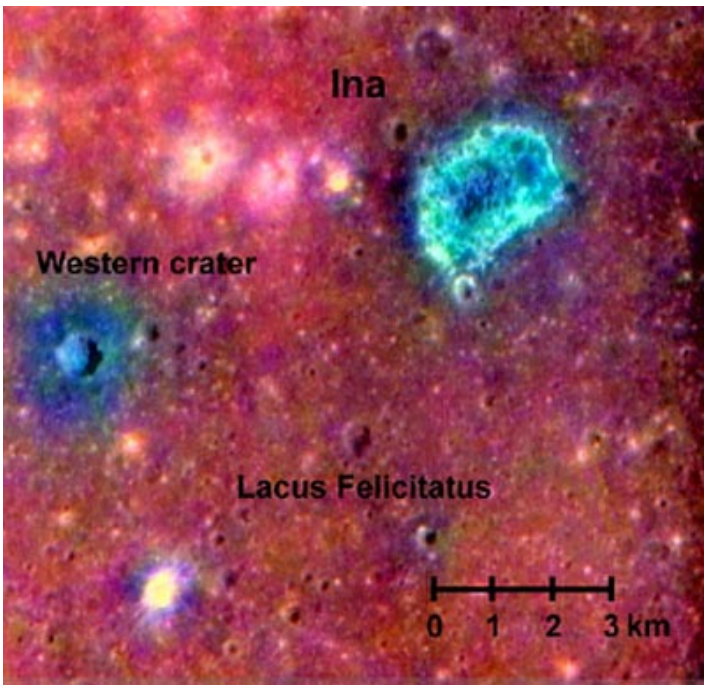
A fresh look at Apollo-era images combined with recent spectral data leads researchers to re-examine conventional wisdom about the Earth's moon. Several lines of evidence suggest that the moon may have seen eruptions of interior gasses as recently as 1 million years ago, rather than 3 billion years ago - the date that had been most widely accepted. Conventional wisdom suggests that the Earth's moon has seen no widespread volcanic activity for at least the last 3 billion years. Now, a fresh look at existing data points to much more recent release of lunar gasses.

The study by geologists Peter Schulz and Carle Pieters and Matthew Staid of the Planetary Science Institute, uses three distinct lines of evidence to support the assertion that volcanic gas has been released from the moon's surface within the last 1 to 10 million years. The researchers focus on a D-shaped area called the Ina structure that was first recognized in images from Apollo missions.

Millions of years - not billions

Apollo images of the D-shaped Ina structure indicate that gas releases may have exposed fresh surfaces on the moon. The unusual sharpness of the features first called Schultz's attention to the area. "*Something that razor-sharp shouldn't stay around long. It ought to be destroyed within 50 million years*," said Schulz. On Earth, wind and water quickly wear down freshly exposed surface features. On the airless moon, constant bombardment with tiny space debris accomplishes a similar result. By comparing the fine-scale surface features within the Ina structure to other areas on the moon with known ages, the team was able to place its age at closer to 2 million years.

The scarcity of asteroid impact craters on the surface within Ina provided a second line of evidence for the feature's relative youth. The researchers identified only two clear impact craters larger than 30 meters on the 8 square kilometers of the structure's floor. This frequency is about the same as at South Ray Crater, near the Apollo 16 landing site. The surface material ejected from South Ray Crater has long been used as a benchmark for dating other features on the moon's surface and most lunar scientists studying these rocks agree on a date of approximately 2 million years, based on cosmic ray exposure.



The third piece of support for the authors' hypothesis comes from comparing the spectral signatures of deposits in the Ina depression to those from very fresh craters. As lunar surface deposits weather, the wavelengths of light they reflect change in predictable ways. Overall reflectance, or albedo, gets less bright and the ratio of light at 1,000 nm wavelengths to 750 nm wavelengths increases. Based on these color ratios, the deposits on Ina's floor are exceptionally young - and possibly even newly exposed.

The appearance of the surface at Ina does not indicate an explosive release of magma, which would result in visible rays of

ejecta surrounding a central crater. Rather, it suggests a rapid release of gasses, which would have blown off the surface deposits, exposing less weathered materials. This interpretation is particularly appealing because Ina is located at the intersection of two linear valleys or rilles - like many geologically active areas on Earth.

Ina also does not appear to be alone. The authors identify at least four similar features associated with the same system of rilles, as well as others in neighboring rille systems. Although several kinds of evidence support the authors' conclusion that the moon is more geologically active than previously thought, the only sure way to resolve the question would be to collect samples at such sites. "*Ina and other similar features are great targets for future exploration, by people or robots*," said G. Jeffrey Taylor, a lunar researcher at the University of Hawaii. "*They might be the best place to get a good look at the interface between the powdery regolith and the consolidated rock beneath*."

Over the years, says Schultz, amateur astronomers have seen puffs or flashes of light coming from the moon's surface. Although most professional observers have upheld the conclusion that the moon was inactive, such sightings have kept open a window of doubt. A coordinated observation campaign, including both professional and amateur astronomers, would be one way to build additional evidence for activity, says Schultz. A gas release itself would not be visible for more than a second or so, but the dust it kicked up might stay suspended for up to 30 seconds. With modern alert networks, that's long enough to move a professional telescope into position to see what's happening.

Study Shows Titan and Early Earth Atmospheres Are Similar

Organic haze in the atmosphere of Saturn's moon, Titan, is similar to haze in early Earth's air -- haze that may have helped nourish life on our planet-- according to a NASA Astrobiology Institute study. Study scientists simulated both the atmospheric conditions of early Earth and those of present-day Titan. Their study, "Organic Haze on Titan and the Early Earth," describing the scientists' work, appears in Proceedings of the National Academy of Sciences. The principal author is Melissa Trainer. "*It's exciting to see that the early Earth experiments produced so much organic matter*," said Carl Pilcher, director of the Astrobiology Institute. "*An organic haze produced this way on early Earth could have contributed to the formation and sustenance of life*."

According to the study's researchers, their experiments help scientists interpret observations of Titan's atmosphere from the Cassini mission, while also showing how a major source of organics could have been produced on Earth billions of years ago. The researchers reported that the aerosols produced in the laboratory could serve as analogs for the observed haze in Titan's atmosphere. The scientists also estimated that aerosol production on early Earth could have served as a primary source of organic material to the surface.

"*This paper shows one of the ways in which the study of other worlds can help us understand Earth*," said Chris McKay. "*Titan has a thick organic haze layer, and this work started out to understand the chemistry of that alien organic haze. Then we realized that we could apply the same approach to the organic haze on early Earth*." "*We hope to determine how the organics were made and their chemical nature*," McKay observed. The scientists reported that when sunlight hits an atmosphere of methane and nitrogen, like the atmosphere of Titan today, aerosol particles form. When an atmosphere also contains carbon dioxide, as in the atmosphere of ancient Earth, different kinds of aerosols form.

The scientists used a special ultraviolet-light lamp to produce particles in the simulated atmospheres, and measured the chemical composition, size and shape of the resulting particles. "*It's somewhat similar to the smog in Los Angeles*," Trainer explained. "*Today's haze on Earth is also created photochemically, which means sunlight powers chemical reactions in the atmosphere. However, the early atmosphere of Earth had different gases present, so chemical composition of the early haze is very different than the haze we have today. There also would have been a lot more of it*."

Spitzer Peels Back Layers of Star's Explosion

Astronomers using the infrared Spitzer Space Telescope have discovered that an exploded star, named Cassiopeia A, blew up in a somewhat orderly fashion, retaining much of its original onion-like layering. "*Spitzer has essentially found key missing pieces of the Cassiopeia A puzzle*," said Jessica Ennis, lead author of a paper on the discovery. "*We've found new bits of the 'onion' layers that had not been seen before*," said Dr. Lawrence Rudnick, principal investigator of the research. "*This tells us that the star's explosion was not chaotic enough to stir its remains into one big pile of mush*."

Cassiopeia A, or Cas A for short, is what is known as a supernova remnant. The original star, about 15 to 20 times more massive than our sun, died in a cataclysmic "supernova" explosion relatively recently in our own Milky Way galaxy. Like all mature massive stars, the Cas A star was once neat and tidy, consisting of concentric shells made up of various elements. The star's outer skin consisted of lighter elements, such as hydrogen; its middle layers were lined with heavier elements like neon; and its core was stacked with the heaviest elements, such as iron.

Until now, scientists were not exactly sure what happened to the Cas A star when it ripped apart. One possibility is that the star exploded in a more or less uniform fashion, flinging its layers out in successive order. If this were the case, then those layers should be preserved in the expanding debris. Previous

observations revealed portions of some of these layers, but there were mysterious gaps.

Spitzer was able to solve the riddle. It turns out that parts of the Cas A star had not been shot out as fast as others when the star exploded. Imagine an onion blasting apart with some layered chunks cracking off and zooming away, and other chunks from a different part of the onion shooting off at slightly slower speeds. "*Now we can better reconstruct how the star exploded*," said Dr. William Reach. "*It seems that most of the star's original layers flew outward in successive order, but at different average speeds depending on where they started*."

How did Spitzer find the missing puzzle pieces? As the star's layers whiz outward, they are ramming, one by one, into a shock wave from the explosion and heating up. Material that hit the shock wave sooner has had more time to heat up to temperatures that radiate X-ray and visible light. Material that is just now hitting the shock wave is cooler and glowing with infrared light. Consequently, previous X-ray and visible-light observations identified hot, deep-layer material that had been flung out quickly, but not the cooler missing chunks that lagged behind. Spitzer's infrared detectors were able to find the missing chunks - gas and dust consisting of the middle-layer elements neon, oxygen and aluminum.

Cassiopeia A is the ideal target for studying the anatomy of a supernova explosion. Because it is young and relatively close to our solar system, it is undergoing its final death throes right in front of the watchful eyes of various telescopes. In a few hundred years or so, Cas A's scattered remains will have completely mixed together, forever erasing important clues about how the star lived and died.

ASTRONOMERS NAB CULPRIT IN GALACTIC HIT-AND-RUN

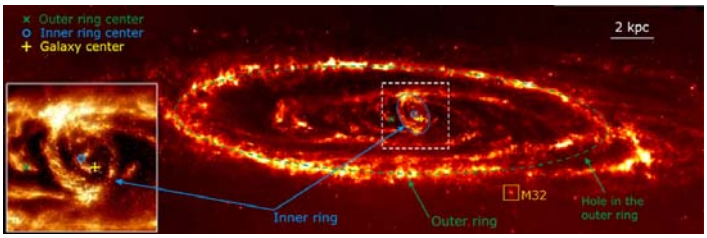
The Andromeda galaxy, the closest large spiral to the Milky Way, appears calm and tranquil as it wheels through space. But appearances can be deceiving. Astronomers have new evidence that Andromeda was involved in a violent head-on collision with the neighboring dwarf galaxy Messier 32 (M32) more than 200 million years ago. "*Like a CSI team, we gathered clues and reconstructed the scene of the crime*," said Pauline Barmby, a member of the research group that made the discovery. "*The evidence clearly shows that M32 is guilty of committing a hit-and-run*."

Dramatic proof of the galactic smash-up came from images taken by the Infrared Array Camera (IRAC) on the Spitzer Space Telescope. Those images revealed a never-before-seen dust ring deep within the Andromeda galaxy. When combined with a previously observed outer ring, the presence of both dust rings suggests a long-ago disturbance whose effects are still expanding outward through Andromeda.

"*These dust rings are like ripples in a pond*," said David Block, who is the lead author on the paper. "Plop a stone into water and you get an expanding series of rings or waves. Let a small galaxy collide nearly head-on with a larger one, and you will see waves or rings of gas and dust that propagate outward as a result of the violent gravitational interaction.

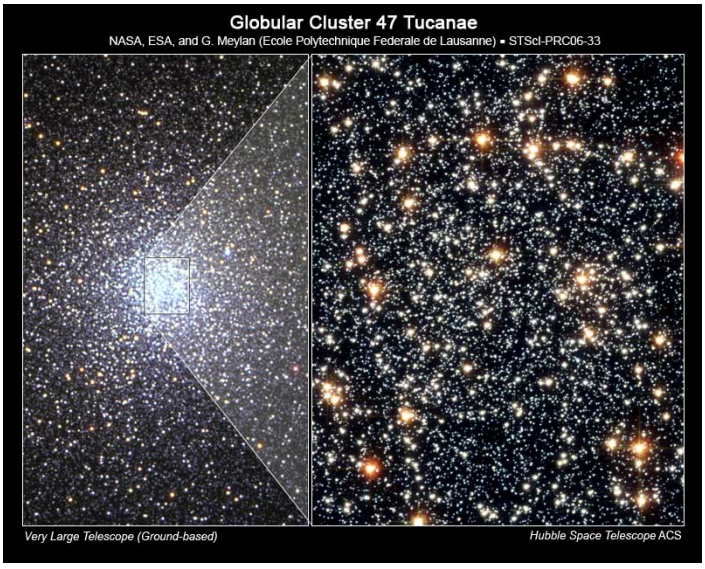
"*While our Atlantic Ocean was still forming, Messier 32 plowed head-long into Andromeda's disk of gas and stars*," he added. "*Only roaming dinosaurs saw the crash and held the secret, until the Spitzer Space Telescope spilled the beans*."

Research team members Frederic Bournaud and Francoise Combes conducted a series of computer simulations to model the collision between Andromeda and M32. They found that M32 plunged through the disk of Andromeda along Andromeda's polar axis approximately 210 million years ago. Since M32 is much less massive than Andromeda, the latter was not substantially disrupted, but the smaller galaxy lost more than half its initial mass in the course of the collision. "*To continue the hit-and-run analogy, you could compare M32 to a compact car while Andromeda would be an 18-wheeler*," explained Barmby. "*In a collision between the two, the truck would be almost unharmed while the car would be wrecked. Similarly, M32 was much more damaged than Andromeda*." Astronomers have predicted that Andromeda and the Milky Way will collide in approximately 5 to 10 billion years. That collision will erase the separate identities of each galaxy, leaving a single elliptical galaxy in their place. http://www.cfa.harvard.edu/press/pr0628image.html



HUBBLE YIELDS DIRECT PROOF OF 'STELLAR SORTING' IN A GLOBULAR CLUSTER

A seven year study with the Hubble Space Telescope has provided astronomers with the best observational evidence yet that globular clusters sort out stars according to their mass, governed by a gravitational billiard ball game between stars. Heavier stars slow down and sink to the cluster's core, while lighter stars pick up speed and move across the cluster to its periphery. This process, called "mass segregation", has long been suspected for globular star clusters, but has never before been directly seen in action.



Imagine trying to understand how a football game works based on just a few fuzzy snapshots of the game in play. This is the just the kind of challenge faced by astronomers trying to understand the dynamics of the swarm of stars in the globular star clusters that orbit our Milky Way Galaxy. The Hubble Space Telescope has provided the best observational evidence to date that globular clusters sort stars according to their mass, governed by a gravitational billiard ball game between stars. Heavier stars slow

down and sink to the cluster's core, while lighter stars pick up speed and move out across the cluster to its periphery. This process, called mass segregation, has long been suspected for globular star clusters, but has never been seen in action directly before.

A typical globular cluster contains several hundred thousand stars. Although the density of stars is very small at the outskirts of such clusters, near the centre it can be more than 10,000 times higher than in the local vicinity of our Sun. If we lived in such a crowded region of space, the night sky would be ablaze with 10,000 stars, all closer to us than the nearest star to the Sun, Alpha Centauri, which is 4.3 light-years away (or approximately 215,000 times the distance between Earth and the Sun). Just as bumps and jostles are much more likely in a crowded commuter train, so are encounters between stars in a densely populated cluster more likely than here in our quiet stellar backwater. These encounters can be as dramatic as collisions or even mergers. Theory predicts that the cumulative result of many such encounters is mass segregation, but the crowded conditions make it extremely difficult to identify individual stars accurately.

Astronomers needed Hubble's pinpoint resolution to trace the motions of many thousands of stars in a single globular cluster. Highly accurate speeds have been measured for almost 15,000 stars at the very centre of the nearby globular cluster 47 Tucanae — one of the densest globular clusters in the southern hemisphere. 23 of these stars are of a very rare type known as "blue stragglers": unusually hot and bright stars thought to be the product of collisions between two normal stars.

The slower measured velocities of the blue straggler stars agree with the predictions of mass segregation. In particular, a comparison between blue stragglers (that have twice the mass of the average star) and other stars shows that, as expected, they do move more slowly than the more typical, lighter stars.

Georges Meylan and collaborators took ten sets of multiple images of the central region (within about 6 light-years of the centre) of 47 Tucanae using Hubble's Wide Field and Planetary Camera 2 and the newer Advanced Camera for Surveys. Images were taken at regular intervals over nearly seven years. Extremely small position changes could be measured over time by carefully measuring the positions of as many as 130,000 stars in every one of these "snapshots", revealing the motions of the stars across the sky. The velocities of 15,000 stars were measured precisely. This is the largest sample of velocities ever gathered for a globular cluster in the Milky Way by any technique with any instrument. The results were also used to look for the gravitational pull of a black hole to check whether one exists in the cluster's core. The measured stellar motions have ruled out the presence of a very massive black hole.

The study would have been impossible without Hubble's sharp vision. From the ground, the smearing effect of the Earth's atmosphere blurs the individual images of the numerous stars in the crowded cluster core. The typical angular motion of even the normal stars in the centre of 47 Tucanae was found to be just over one ten millionth of a degree (equivalent to the angular size of a 10 cent coin seen from 7,000 kilometers away) per year. To take full advantage of these exquisite Hubble images, astronomers developed entirely new data analysis methods that eventually provided measurements of proper motions (velocities) that corresponded to changes in the positions of stars at the level of about 1/100th of a pixel (picture-element) on Hubble's digital cameras.

SPACE RADIATION THREATS TO ASTRONAUTS STUDIED

A better understanding of solar storms and how best to protect astronauts from space radiation is needed as NASA pushes toward manned missions to the moon and Mars in the coming decades, according to a new National Research Council report. Researchers have been stepping up studies on radiation biology and space shielding in recent years, said Daniel Baker, chair of the committee that issued an NRC report this week titled, "Space Radiation Hazards and the Vision for Space Exploration."

The report probes the physical risks and technology obstacles of extended space journeys and is tied to a 2004 presidential mandate to return to the moon by 2020 and then send human travelers on to Mars, said Baker. Baker, an internationally known space weather expert, said the report brought together space physicists and radiation biologists, amplifying common interests between the groups. "*This was an important step*," he said. "*One of the benefits of this report is that we are beginning to lower the error bar on the health impacts of space radiation to astronauts, and are looking hard at other challenges like more accurate solar forecasting and improved space engineering techniques*."

Astronauts are regularly exposed to high doses of radiation, including galactic cosmic rays -- thought to come from distant supernova explosions -- as well as energetic particles from the sun and charged particles trapped in Earth's magnetic field, he said. Potential health effects include leukemia and other cancers, and degenerative tissue effects like cataracts, heart disease, digestive diseases and respiratory diseases, according to the report. Radiation also can cause damage to the central nervous system and cause acute risks like vomiting and nausea, said Baker. "*One concern is that astronauts could become ill from space radiation effects and vomit in their space suits, which could be extremely serious*," he said.

The report noted that a violent solar storm that occurred in August 1972 between the Apollo 16 and Apollo 17 missions could have been extremely hazardous to astronauts had they been on the moon. The radiation exposure levels would have varied depending on whether the astronauts were exploring the lunar surface or were inside the landing vehicle, which would have offered more protection, said the report. "*We know that this storm was large enough that it could have had potentially fatal consequences to astronauts had they been on the moon at that time*," said Baker.

The report also addresses the issue of "storm shelters" to protect astronauts from harmful radiation, which can be built both inside spacecraft or on the surface of the moon and Mars, Baker said. Such shelters could include cylindrical "cocoons" of thick shielding material for astronauts to crawl in or shelters lined with thick tanks filled with water, since water is not only essential for space travel but also contains large amounts of hydrogen, a proven buffer for mitigating harmful radiation, he said. Plastic polymers containing large amounts of hydrogen also might be a potentially useful building material for shielding, according to the report. "*There is always the possibility that a spacecraft can be blasted by significant doses of radiation, and we need to take that into account when designing spacecraft*," he said.

Soils on the moon and Mars also could be used to build efficient shelters from solar storms, especially if astronauts were on extended expeditions putting them hours away from base camps or space vehicles, Baker said. The report recommends creating a "color-coded alert system" for intense solar events that could be transmitted quickly to astronauts roaming alien soils, he said. In September, NASA selected 12 radiation biology proposals for

funding that target reduction of health and safety risks for astronauts, said Baker.

MARS MAY BE COZY PLACE FOR HARDY MICROBES

A class of especially hardy microbes that live in some of the harshest Earthly environments could flourish on cold Mars and other chilly planets, according to a research team of astronomers and microbiologists. In a two-year laboratory study, the researchers discovered that some cold-adapted microorganisms not only survived but reproduced at 30 degrees Fahrenheit, just below the freezing point of water. The microbes also developed a defense mechanism that protected them from cold temperatures. The researchers are members of a unique collaboration of astronomers from the Space Telescope Science Institute and microbiologists from the University of Maryland Biotechnology Institute's Center of Marine Biotechnology. Their results appear on the International Journal of Astrobiology website.

"*The low temperature limit for life is particularly important since, in both the solar system and the Milky Way Galaxy, cold environments are much more common than hot environments*," said Neill Reid, an astronomer at the Space Telescope Science Institute and leader of the research team. "*Our results show that the lowest temperatures at which these organisms can thrive fall within the temperature range experienced on present-day Mars, and could permit survival and growth, particularly beneath Mars's surface. This could expand the realm of the habitable zone, the area in which life could exist, to colder Mars-like planets*." Most stars in our galaxy are cooler than our Sun. The zone around these stars that is suitable for Earth-like temperatures would be smaller and narrower than the so-called habitable zone around our Sun. Therefore, the majority of planets would likely be colder than Earth.

In their two-year study, the scientists tested the coldest temperature limits for two types of one-cell organisms: halophiles and methanogens. They are among a group of microbes collectively called extremophiles, so-named because they live in hot springs, acidic fields, salty lakes, and polar ice caps under conditions that would kill humans, animals, and plants. Halophiles flourish in salty water, such as the Great Salt Lake, and have DNA repair systems to protect them from extremely high radiation doses. Methanogens are capable of growth on simple compounds like hydrogen and carbon dioxide for energy and can turn their waste into methane. The halophiles and methanogens used in the experiments are from Antarctic lakes. In the laboratory, the halophiles displayed significant growth to 30 degrees Fahrenheit (minus 1 degree Celsius). The methanogens were active to 28 degrees Fahrenheit (minus 2 degrees Celsius).

"*We have extended the lower temperature limits for these species by several degrees*," said Shiladitya DasSarma. "*We had a limited amount of time to grow the organisms in culture, on the order of months. If we could extend the growth time, I think we could lower the temperatures at which they can survive even more. The brine culture in which they grow in the laboratory can remain in liquid form to minus 18 degrees Fahrenheit (minus 28 degrees Celsius), so the potential is there for significantly lower growth temperatures*." The scientists also were surprised to find that the halophiles and methanogens protected themselves from frigid temperatures. Some arctic bacteria show similar behavior.

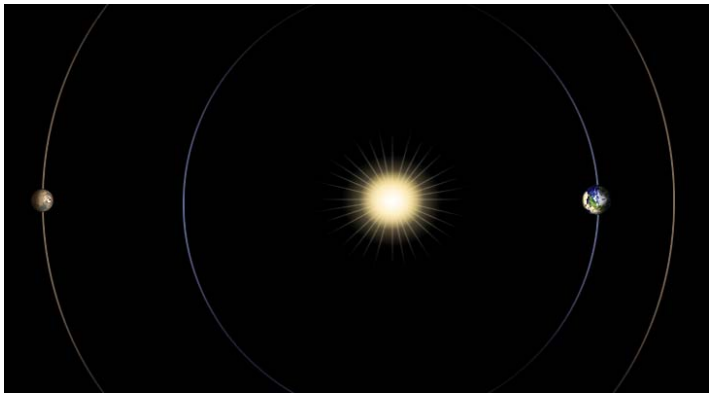
"*These organisms are highly adaptable, and at low temperatures they formed cellular aggregates*," DasSarma explained. "*This was a striking result, which suggests that cells may 'stick together' when temperatures become too cold for growth, providing ways of survival as a population. This is the first detection of this phenomenon in Antarctic species of extremophiles at cold temperatures*." The scientists selected these extremophiles for the laboratory study because they are potentially relevant to life on cold, dry Mars. Halophiles could thrive in salty water underneath Mars's surface, which can remain liquid at temperatures well below 32 degrees Fahrenheit (0 degrees Celsius). Methanogens could survive on a planet without oxygen, such as Mars. In fact, some scientists have proposed that methanogens produced the methane detected in Mars's atmosphere.

"*This finding demonstrates that rigorous scientific studies on known extremophiles on Earth can provide clues to how life may survive elsewhere in the universe*," DasSarma said. The researchers next plan to map the complete genetic blueprint for each extremophile. By inventorying all of the genes, scientists will be able to determine the functions of each gene, such as pinpointing the genes that protect an organism from the cold. Many extremophiles are evolutionary relics called Archaea, which may have been among the first homesteaders on Earth 3.5 billion years ago. These robust extremophiles may be able to survive in many places in the universe, including some of the roughly 200 worlds around stars outside our solar system that astronomers have found over the past decade. These planets are in a wide range of environments, from so-called "hot Jupiters," which orbit close to their stars and where temperatures exceed 1,800 degrees Fahrenheit (1,000 degrees Celsius), to gas giants in Jupiter-like orbits, where temperatures are around minus 238 degrees Fahrenheit (minus 150 degrees Celsius).

The discovery of planets with huge temperature disparities has scientists wondering what environments could be hospitable to life. A key factor in an organism's survival is determining the upper and lower temperature limits at which it can live. Although Martian weather conditions are extreme, the planet does share some similarities with the most extreme cold regions of Earth, such as Antarctica. Long regarded as essentially barren of life, recent investigations of Antarctic environments have revealed considerable microbial activity. "*The Archaea and bacteria that have adapted to these extreme conditions are some of the best candidates for terrestrial analogues of potential extraterrestrial life; understanding their adaptive strategy, and its limitations, will provide deeper insight into fundamental constraints on the range of hospitable environments*," DasSarma said.

DURING SOLAR CONJUNCTION, MARS SPACECRAFT WILL BE ON AUTOPILOT

Every day for the past decade, the U.S. has had a presence at Mars, using spacecraft to understand this extreme world and its potential as a past or present habitat for life. During that time, all spacecraft have become virtually incommunicado for about two weeks every two years. The reason is solar conjunction, which occurs again from October 18-29, 2006. Solar conjunction is the period when Earth and Mars, in their eternal march around the Sun, are obscured from each other by the fiery orb of the Sun itself. Like dancers on either side of a huge bonfire, the two planets are temporarily invisible to each other.



Mission controllers at Jet Propulsion Laboratory respond in a variety of ways. They turn off some instruments. They collect data from others and store it. In some cases, they continue sending data to Earth, knowing that some data will be lost. Whether they get a break from everyday operations depends on what mission they're supporting. No one attempts to send new instructions to Mars during solar conjunction. It's impossible to predict what information might be lost due to interference from charged particles from the Sun, and that lost information could potentially endanger the spacecraft. Instead, prior to solar conjunction, engineers send two weeks worth of instructions and wait. While that may seem risky, automatic pilot has come a long way. Engineers have become skilled at letting spacecraft be on their own. Like parents who raise youngsters to be responsible and let them go on a short vacation with their friends, they've done all they can to ensure the voyagers will be healthy and safe.

The Question: To Rest ...

"*We worry a little bit because it's always possible that something unexpected could happen*," said Jake Matijevic, engineering team chief for Mars Exploration Rovers. "*But, the rovers have made it through solar conjunction before and we think they'll be OK*." Mission planners have already sent detailed schedules of activities to the rovers. Spirit and Opportunity will scan the Martian sky for clouds, measure atmospheric dust, conduct chemical analysis of dust, rocks, and soils, and take pictures. Opportunity will join Spirit in staying put temporarily. Both rovers will store the data and transmit it to Earth later. Solar conjunction might even be an opportune time for some team members to take a few, well-deserved vacation days.

... Or Not to Rest?

In contrast, it's hard for the Mars Reconnaissance Orbiter team to stay away. The newest mission to arrive at Mars, the orbiter recently began operating all of its instruments for the first time. The team is lining up to see some of the most detailed images of Mars ever returned, as well as new data that will likely rewrite our current understanding of the Martian environment. Though scientists will turn off the high-resolution camera during solar conjunction, some other instruments may still collect data.

"*The spacecraft is getting a break, but everyone on the ground is still working just as hard*," said engineer Robert Sharrow. That's true for the Mars Odyssey team too, who may be busier than usual in coming weeks. "*Solar conjunction is not typically looked at as time off*," said Gaylon McSmith. "*One of the things we'll be doing is getting ready to increase our global mapping coverage of Mars, using a technique known as off-nadir pointing*."

Starting in December, instead of keeping the spacecraft pointed straight down at the surface of Mars (nadir), navigators will rotate the spacecraft to collect stereo images -- slightly offset images of the same terrain. Like a pair of human eyes, the stereo views will enable Odyssey's thermal camera to perceive depth and the relative position of surface features. Odyssey will continue sending its own data to Earth and relaying data from the two Mars rovers. Based on experience, Mars explorers know they will lose some data while Mars is behind the sun with respect to Earth. "*After solar conjunction, we'll have a big cleanup job telling the rovers what information to re-transmit*," said Matijevic.

Some Things Get Better with Age

These activities pose no problems for the pros. Mars Global Surveyor, the granddaddy of all spacecraft at Mars, has continuously mapped Mars since 1999. Team members have solar conjunction down pat, and rest easier than in prior solar conjunctions, when an antenna problem caused some worries. For a long time, explained Tom Thorpe, an obstruction limited the range of motion of the dish antenna that sends data to Earth. To get around the problem, navigators flip-flopped the spacecraft's high-gain antenna in a fairly complex procedure called a "Beta Supplement http://mars.jpl.nasa.gov/mgs/technology/, which enabled them to point the dish at Earth. They had to be careful to keep the dish from hitting the boom that supports it. Suddenly, last year, the obstruction disappeared. Engineers concluded that the problem likely resulted from a kink in the cabling rather than, as some had originally thought, a loose screw that wiggled loose during launch. "*This is our fifth solar conjunction and we've pretty much got it down to a science," Thorpe said. "We're in our 5th Mars year of sensing -- one Mars year is equal to almost 2 Earth years -- and we're still making new discoveries all the time*." http://marsrovers.jpl.nasa.gov/spotlight/20061020.html

FROM THE EDITOR'S TERMINAL

The Stargazer is your 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.

The Star Gazer
P.O. Box 12746
Everett, WA 98206

In November's StarGazer:

The next EAS Meeting is 6:30 P.M. Tuesday November 14th at the Everett Public Library Auditorium.