

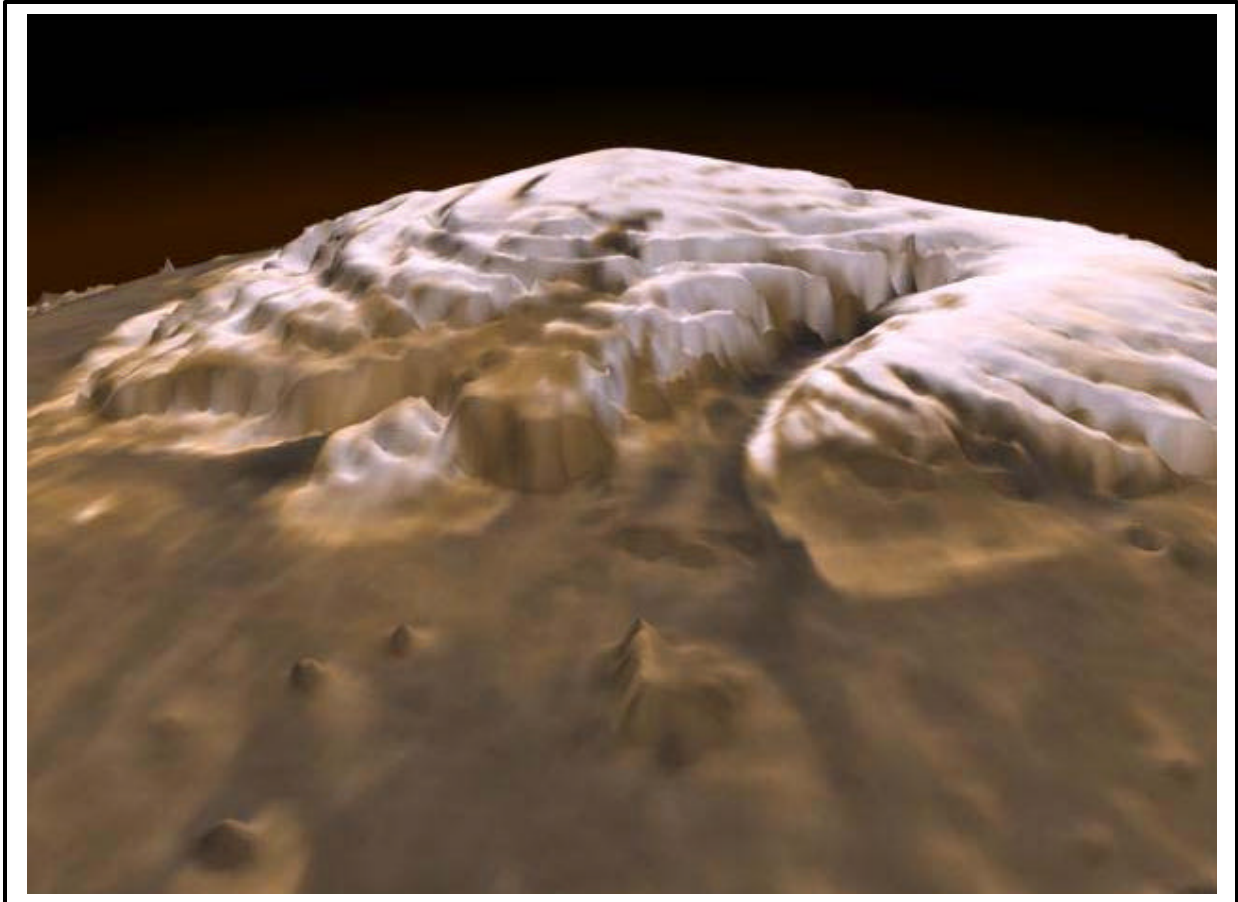
# SIRIUS ASTRONOMER

NEWSLETTER OF THE ORANGE COUNTY ASTRONOMERS  
See our web site at <http://www.chapman.edu/oca/>

January 1999

*Free to members, subscriptions \$12 for 12 issues*

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This striking image of the North Polar Region of Mars is the first three-dimensional view from MOLA, the **Mars Orbiter Laser Altimeter**, taken aboard NASA's Mars Global Surveyor by its laser altimeter instrument during the spring and summer of 1998, as the spacecraft orbited Mars in an interim elliptical orbit. For more information, see "Space Update" in this issue, beginning on page 8.

#### CHAPMAN MEETINGS

The next meeting of the OCA is on Friday, January 8, at 7:30pm in the Science Hall of Chapman University in Orange. The free and open meeting will feature Dr. Nathan Bridges, whose talk will focus on the Mars Pathfinder mission, as well as a "What's Up?" presentation by Chris Butler, plus a raffle and open slides/videos.

#### STAR PARTIES

The Silverado site will be open for observing on Saturday, January 9. The Anza site and Observatory will be open Saturday, January 16. Both events are open to members and their guests, not the general public. Come prepared for cold weather -- dress warmly (layers), and if in doubt, check the satellite weather pictures before leaving town or call the observatory.

#### COMING UP

Astrolmage '99 arrives Feb. 6. See p.13 for details! Next Month's speaker will be Prof. Tammy Smecker-Hanes of UCI, who will talk on the Evolution of Galaxies. Dr. Hanes is a researcher and lecturer who works in both theoretical and observational astronomy.

# The President's Message

**by Wayne P. Johnson (aka Mr. Galaxy)**

The holidays have come and gone and we've arrived at a New Year: the last of an old millennium, on the cusp of a new one! I hope everyone enjoyed the festive season.

Included within this newsletter is a ballot so that you can cast your vote for a new Board of Trustees. I want to say thanks for all the hard work and cooperation of our most recent Board members and especially wish the best for Chris Butler and Joel Harris, who will not be running for office this time. A position on the OCA's Board is not something to be taken lightly. Since we have 700 members to report to and an Observatory with property to maintain, a Board position carries a good amount of responsibility. We have been fortunate to have responsible people on our Board in all the years that I have been a member, and I'm sure with the wisdom of the club's voters, it will continue to be that way. I also want to thank our trustworthy volunteers who are not Board members for all their hard work in keeping the OCA running smoothly.

We have a couple of projects that were accomplished this past year, most notably the completion and dedication of the Anza House for members to use when staying at our observing site. Remember that space is at a premium in the facility. We have generated a set of rules to use as a guideline, but the success of the house depends upon everyone's cooperation. There are still many things that need to be done inside the place, such as installing curtains, fixing wallpaper and various sundry details to finally get the place looking sharp. If you have the time or maybe even talents along those lines please give Anza House Coordinator Roy Weinberger a call (949-768-5205) to find out what needs to be done. Most of the jobs are fairly minor, but having a few people help at a time makes the task much easier to accomplish, especially the wallpapering (or painting) and curtain installation. We will probably need an evaporative cooler to make the place more comfortable during the summer. If you know of a good operational one or two, let Roy know about it. We can always use monetary donations to the Anza House Fund so that we could preferably buy a new cooler instead. After all, the OCA is a non-profit, educational organization. If you need a tax write-off, we'll gladly accommodate!

We are in the process of working on two other projects: one is the MOCAT (Multi-functional OCA Telescope) project, which now has a cement pad poured for it. An observatory building donated by Mount Wilson is on the site ready to be positioned on the pad. Early in December, several of us picked up the 12-inch and 8-inch telescopes and mount from Dave Rettig's house and were hoping that it would be a simple transfer to the site for installation. However, it appears that the telescope mount needs a bit of work done on it (rust removal, painting and re-lapping the 18-inch gear). If you would like to offer some help, give me a call at home. I would like to get the telescope completed sometime in the spring and transport it back out to Anza. It will be housed in the above-mentioned building which is just west of the Anza House, near the house's control room so that observers can use the telescope at a distance if it is too cold or windy to be outside.

The other project is an in-town observatory that has been a low-level joint effort between the Discovery Museum of Orange County (DMOC) and the OCA for several years. The time is coming to bring it to completion. We have recently raised \$8500 from corporate donations (mostly from my company, Boeing, and some from Meade). We estimate that a total of \$25,000 would be needed to properly house the classic 8-inch Clark refractor that we plan to have installed at the DMOC site in Santa Ana. It is hoped that several OCA members will form a docents' group when the building is complete to show the moon and the planets to various groups of people who would otherwise never have the chance to look through such a telescope. Contact me or Sally Sherlock at the DMOC (714-540-0404) if you have the appropriate point of contact at your company, etc., or if you know of other specific philanthropic organizations. It shouldn't take too much more of an effort to complete this worthwhile project.

One last item to mention is that the OCA is sponsoring an all-day conference on Astrophotography and CCD Imaging and anything that goes along with these methods of recording astronomical objects. It is called AstroImage '99 and will be held from about 9am to 6pm on Saturday, February 6th at the Ruby Gerontology Center on the Cal State Fullerton campus. There will be about 10 speakers on various topics, some vendors, and a display area for images. The cost is only \$25 and includes 2 snack breaks. If you have a talk that you would like to present, contact me ASAP (wayne.p.johnson@boeing.com). Registration information can be obtained from Charlie Oostdyk (charlie@cccd.edu). See the OCA's website for more details.

Clear skies,

Wayne

# Leonids 1998 Trip Report

**W. B. Whiddon,**  
**member South Bay Astronomical Society**

On the night of 16-17 Nov., my wife Nina and I observed the Leonids from a site we commonly use at Red Rock-Inyokern road, approximately 40 miles north of Mojave. While the predictions were not so good for observers in North America, I had waited 32 years since the last meteor storm, and had committed to observing regardless of the predictions. We arrived in the late afternoon and were greeted with overcast conditions associated with a frontal passage. Rain was predicted for later that night and the following day. At least the air under the clouds was clear, with about 100 miles visibility.

Near sunset, the clouds began breaking from the west and we were treated to a spectacular sunset of fiery clouds. Soon after sunset the clouds cleared and it remained mostly clear for the rest of the night. The early cloud cover had kept the temperatures above normal, and the expected winds did not materialize - overall a very pleasant and unexpectedly good night. There were about 30 observers present, with about ten of these SBAS members.

In the clear areas the limiting magnitude was approximately 6.4, but when clouds passed this changed radically. Clouds passing over China Lake, Bakersfield, or Mojave were illuminated, while overhead they were dark. In the early evening we were treated to an -8 magnitude bolide in the south which had two explosions (but no sound). This was obviously not a shower meteor, since the Leonid radiant would not rise until around midnight. Jupiter and Saturn put on a good show for those who brought telescopes. Most folks settled in for some shuteye about 10 PM. I set my alarm for midnight, hoping to see some long grazing meteors with the radiant low in the sky. In the meantime I wanted some rest and warmth.

At about midnight I was forced to leave my warm sleeping bag by a brilliant parade of -6 or brighter fireballs to the north. Most of the observers had set their alarms for 2:30a.m., but they were to be awakened at 12:30a.m. due to the shouting of all those who were awake. It looked like we would get a good show after all. I started a long series of photographs using a 50mm f/1.4 lens set to f/2, with Ektachrome P-1600 slide film. The camera was placed on a Cam-Trak equatorial platform and aimed at interesting constellations or star fields 45-90 degrees from the radiant. All exposures were 5 minutes long. This setup worked very well, and I was able to capture meteors down to about magnitude 0. It took me about three hours to use up a 36 exposure roll in this manner, and then I switched to tripod mounted shots, with emphasis on capturing the persistent trains from the bright meteors.

We were not disappointed. While we did not encounter a meteor storm, this was the best shower I have seen since the 1966 Leonids. The rates were high, and there were numerous bright fireballs and bolides, with many trains. I did not set up to record the observations formally, and took limited notes, but I can reconstruct much of what we observed. I did not formally determine zenithal hourly rates, but did note group observations:

<u>Hour (PST)</u>	<u>Rate per Hour</u>
12-1am	70
1-2am	200
2-3am	300
3-4am	450
4-5am	350
<b>Total:</b>	<b>1370</b>

Single observer rates would be about one-quarter or one-fifth of these numbers. These numbers are very rough estimates over an hour period. There were times that we would go for several minutes without any, and times of 15+ per minute. These are more than a factor of two below minor storm levels, but still quite a rare show.

In terms of magnitudes observed, my crude estimates are as follows (again, these are for the whole group):

<u>Approx. Magnitude</u>	<u>Approx. Nbr. Observed</u>
-8	7
-7	25
-6	35
-5	50
-4	60
-3	70
-2	90
-1	150
0	200
1	250
2	200
3	125
4	50
5	40
6	20



Leonid photo courtesy of Brent Miller (copyright, all rights reserved).

As for the trains, my crude notes indicate:

<u>Train Duration (visual)</u>	<u>Number Observed</u>
15min	2+
10-15 min	6
5-10min	10
1-5 min	30+
5 sec-1 min	60+

Other visual observations of note:

- One binocular meteor was observed
- Most meteor heads were blue white or yellowish, trails were greenish, trains were colorless or perhaps yellow-green (to the naked eye, but note they proved to be quite different photographically)
- One multi-colored trail was observed visually, with blues, reds, greens, and golds, displayed in sequence
- Trains were spectacular in binoculars and there were so many, and they lasted so long they were very easy to observe
- Several trains were definitely tubular when observed in binoculars
- One meteor exhibited a definite curved path near its termination
- Several very short meteors were observed near the radiant (near head-on)
- Three meteors were observed simultaneously, pointing out the radiant in real time
- Several dozen bolides were observed, but no sounds were noted
- There were at least three pairs of simultaneous, parallel meteors
- There were six leader-follower pairs on the same path, two of which passed through an existing train, one of which appeared to deform the train
- The display of zodiacal light was one of the brightest I have seen. At the maximum extent just before morning twilight, the eastern pyramid was over 40 degrees wide at the base, and extended to nearly the zenith. In the brightest part of the pyramid, the limiting stellar magnitude was about 3.5. We had to limit our exposures in this region. The glow was bright enough to light the landscape, and one had the impression of shadows, but I could not confirm this. The gegenschein was visible to several observers (independently noting its presence and location), and the zodiacal band was visible for its full length. These observations may indicate enhancements of these phenomena due to passage through the meteor stream. I wonder if other observers noted these as well. Only those at the darkest sites would have seen the gegenschein or the band, but even observers in moderately polluted skies should have seen the eastern pyramid.

As a final observational treat, we watched a very unusual moonrise. The nearly new moon had only a very thin illuminated waning crescent and the earthshine-illuminated portion rose first. Nearly the entire moon was above the horizon, glowing only by earthshine, before the first beads of solar-illuminated crescent appeared. The clear desert air allowed this observation at the horizon. Few of us had ever seen anything quite like it.

On Friday my slides came back from processing. I still can't believe some of the images. As a summary, I captured:

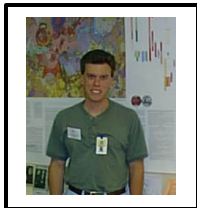
- 18 total meteors in 161 minutes exposure time, or 6.7 photographed per hour, corresponding to 137 photographic meteors/hour over the whole sky (seems to confirm the very high visible rates). Nearly all the meteors were Leonids, with one possible Southern Taurid and a few sporadic ones recorded.
- 20 individual trains were recorded. Nearly all trains were beautiful multi-colored objects, which changed shape and color over time. Most of the trains were blue or lavender at high altitude, changing to golden, yellowish, or white at lower altitudes. All trains turned golden for their entire length after a minute or so. Many were severely distorted by high altitude winds in as little as a few seconds. Most drift rates seemed to be around the commonly observed 50 meters/second, but I'm still working out the numbers on these. Many strong wind shears were noted. Some trains were obviously tubular. Some distorted into full loops.
- The bi-color nature of young trains seems to be an indication of physical or chemical processes in the upper atmosphere. The transition from blue to golden may correspond to the passage of the train through atmospheric discontinuities. There are three candidate discontinuities which come to mind:
  - 1) the mesopause, or boundary between the thermosphere and mesosphere, at about 80 km altitude,
  - 2) the boundary between the heterosphere and the homosphere, at about 90 km, or
  - 3) the boundary between the ionospheric E layer and the D layer, at about 110 km. Of these, I would guess the second item is the more likely cause, since the atmospheric chemistry changes substantially in this region. I will spend more time reducing the train photos to get better altitude estimates and look for a correlation. I do not know of this coloration change being observed before. The kind of film required to enable this work has only been available for the last 10-15 years and, trains are rare events, so it is possible this is a new observation.
- 4) One side-by-side simultaneous pair of meteors (and this happened to be in an exposure of a bright train)
- 5) One leader-follower pair, with the second passing near or through the train of the first
- 6) One exposure with three meteors in 5 minutes (all Leonids)
- 7) Three shots of two meteors
- 8) One shot with two meteors and two trains
- 9) One shot with two meteors and one train
- 10) One shot with two trains
- 11) Two train sequences of three exposures and two sequences of two exposures (these show the color and shape changes, as well as the drift)
- 12) Zodiacal light (eastern pyramid)
- 13) Tried for gegenschein but cannot confirm it without special processing.

If I had only known things would turn out so well... I only had one camera body and did not tape-record the observations. Next year I will totally ignore any bad predictions for shower or weather and go all out. Come to think of it, I haven't seen a shower like this since the last time I did not go all out—which was 1966... Maybe I'll leave the camera home next year.

*(Editor's note: I am deeply grateful to Bill Whidden for allowing us to present his findings. I wasn't able to get photos from Bill at press date. However, I've invited him to come to one of our meetings—with the slides, of course!—for a presentation.*

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## JANUARY'S FEATURED SPEAKER



**Dr. Nathan Bridges, Geologist  
Jet Propulsion Laboratory, Pasadena, CA**

Dr. Bridges was heavily involved in the Pathfinder mission during the pre-landing and operational phases of the mission, analyzing data returned by the Pathfinder Lander and the Sojourner Rover. Together with other scientists, Dr. Bridges continues to study the plethora of images, chemistry information, and other data on the Ares Vallis landing site. Dr. Bridges is also involved in the planning of future robotic Mars missions.

# OCA Outreach Programs

by Jim Benet

Since the last publication the OCA has conducted several successful Outreach programs. We drove down to Dana Point on November 20 to participate in the Cub Scout Hibernation. These boys stay up all night participating in various activities. Viewing Jupiter and Saturn for the first time was one of their hibernation experiences. There were about 100 scouts and adults participating.

Four days later, the Outreach volunteers traveled to Gilbert Elementary School in Buena Park. Here is what David Mauldin, who is both the teacher there and an OCA member, reported on Outreach.

“On November 24<sup>th</sup>, OCA members hosted the Gilbert Elementary School Astronomy Club. The meeting was very well attended with over 75 students from the school along with many parents. The response from the students was tremendous. Comments like, ‘That’s cool!’ and ‘Wow!’ were just a few of the phrases heard again and again throughout the evening. Students were treated to views of Saturn, Jupiter and the moon. Originally, a classroom was scheduled as its meeting place, yet with attendance as it was, the school cafeteria was the only place large enough to accommodate its size. My deepest gratitude and thanks go out to all of the OCA who volunteered their time at no cost and a special thanks to Jim Benet who coordinated the time. The majority of the kids who attended come from underprivileged homes. I am sure I speak for all of them when I say it was a unique experience that will no doubt leave them with a new perspective about life and the world around them.” .....David Mauldin



Bill Johnson shows one of the planets to students at Gilbert Elementary School.

In December, John Sanford did a presentation on the moon and planets to students at Capistrano High School in Mission Viejo. However, the telescope viewing session had to be cancelled due to rain. The climax of the year was the Outreach program at Perry Elementary School in Huntington Beach. About 200 students, parents, and teachers peered through eight telescopes set up to view Saturn, Jupiter, the Great Orion Nebula and even a double star. The PTA chairperson was so pleased by the event that she sent the OCA a large donation!

I feel a real sense of pride in what we have accomplished with our Outreach programs during this past year. The OCA has conducted over two dozen Outreaches for schools, for Boy Scouts, Girl Scouts, and Cub Scouts, and for the public at large. This does not even include the many Explore the Stars programs sponsored by the Department of Forestry. We were able to show a little bit of the sky to almost 2000 people this year alone. We are looking forward to continuing this success in 1999.

This was my first year as the coordinator for the Outreach program; but I cannot take credit for its success. The real credit goes to all those OCA members who have participated. A great big thank you goes to an outstanding group of volunteers: John Sanford, Kenneth Baird, Tony Bill, Rosie Walcek, Don French, Bob Gill, Clary Leggett, Liam Kennedy, Bill Johnson, Dick Greenwald, Fabian, Jim Thorpe, Tony Obra, Don Lynn, Joe Ewach, Keith Benicek, Dennis Fandrich, Gary Hufton, Russell Sipe, Russ Tanton, Jim Smallwood, Jay Glowacki, and a few others whose names I have unintentionally omitted.

We have an Outreach for Boy Scouts on January 11 at Trinity Lutheran Church in Anaheim and a big public showing at Orange Coast College in Costa Mesa on February 6. Please let me know if you can participate.

# Virtual Astronomy

by Dave Kodama

My obsession with Leonid meteor shower photos continues....I now have links to Leonid meteor photos from 11 photographers (2 OCA members), and hopefully, by the time you read this, a third OCA member. If you missed Wally Pacholka and Dan Schechter's presentations during the "Open Slides" segment of the December, 1998 meeting, you can see them using the links on the Virtual Astronomy page of the OCA's web site:

<http://www.chapman.edu/oca/virtual.htm>

Dan seemed to have the best luck that I am aware of in capturing so many meteors (30 with 3 cameras going, if I recall correctly). But Wally takes the prize for persistence (684 exposures over 3 nights) and he managed to get some great shots of wind-blown meteor trails. Not all of his shots are up on his site, but perhaps if we bug him enough, he'll get around to posting them.

I also want to bring attention to Wally's photos as a great inspiration to would-be astrophotographers (Film is NOT dead, contrary to early reports!). Using very simple equipment (a 35mm camera and 60mm scope on a non-tracking mount) and a somewhat nonstandard technique of taking many short exposures, he's managed to take some literally award-winning photos of comets and meteors. Check out his web site at:

<http://www.astropics.com/>

After seeing his photos, if you feel inspired to try your hand at it, here's some reading for those cloudy winter nights:

**The Backyard Astronomer's Guide**, by Terence Dickinson & Alan Dyer  
**Astrophotography for the Amateur**, by Michael Covington

The Dickinson/Dyer volume has three chapters on introductory astrophotography embedded in a very good general book on amateur astronomy. The Covington book is a "must" for anyone getting seriously interested in astrophotography. This book is currently out of print, but is being revised and updated by Covington. It should be available again in early 1999.

The other thing to do to start out in astrophotography is to subscribe (for free) to the Astro Photo Mailing List (APML) which is an email "discussion" group for astrophotographers. It's a great way to learn from the masters as well as to keep tabs on the latest films, techniques, and equipment being used for astrophotography. To join the list, send an email to:

[majordomo@nightsky.com](mailto:majordomo@nightsky.com)

and include the words "subscribe astro-photo" in the body of the message. You should get an automatic confirmation email back, followed by a copy of any email posted by others on the list. You can also browse through the APML message archive at:

<http://www.system.missouri.edu/apml>

You don't have to subscribe to the APML list to check out the archives, so if you find the APML mail volume overwhelming, you may wish to simply scan the archives occasionally.

But the main thing is to get out there and take some pictures! And don't forget to share them with us by sending them to Aaron Imaoka ([imaokay@hotmail.com](mailto:imaokay@hotmail.com)) for posting on the club's image gallery.

(If you would like to be emailed weekly notices of upcoming OCA meetings, send a note to me at: *kodama@alumni.caltech.edu*.)

# Space Update

**Gathered by Don Lynn from NASA and other sources**

To find out more on these topics, or those of past months' columns, through the World Wide Web, send your Web browser to our OCA website (<http://www.chapman.edu/oca/>), select Space Update Online, and the topics are there to click on.

**NEAR (Near Earth Asteroid Rendezvous)** - is scheduled to rendezvous with and go into orbit around asteroid 433 Eros on January 10 at 7:00 am PST. Color and black-and-white images of the asteroid should be available in the days after. NEAR was launched in February 1996, and a few of the OCA members saw it again when it made its gravity assist slingshot by Earth many months later. There have been only 3 flybys of asteroids (1 by NEAR and 2 by Galileo), but this is the first long-term asteroid observation while in orbit.

**Voyager 1 & 2 (outer planets missions)** - have continued to explore beyond the planets since their last planetary visit (Neptune) in 1989, and they are leaving the solar system. In November, the ultraviolet instrument in Voyager 2 was turned off due to insufficient power as the radioactive power system decays. At that time, contact was lost with the spacecraft as it apparently misinterpreted a command and turned off a part of its radio transmitter. Within a few days, controllers had managed to turn it back on and restore the spacecraft to operation. Scientists expect Voyager 1 to enter in 2001 the heliosheath, a transition region between the Sun's sphere of influence and the interstellar medium, though the year is very uncertain since no spacecraft has reached there before. As you will recall from this column last March, Voyager 1 had just become the farthest human-made object from us when it exceeded Pioneer 10's distance.

**Mars Climate Orbiter** - was launched on December 11, delayed by 1 day to correct a software problem in the battery-charge control unit. Upon arrival at Mars next October, the spacecraft will observe seasonal changes on the planet by mapping its surface and atmosphere for an entire Martian year (687 Earth days). Before the mapping, it will also serve as a radio relay for the Mars Polar Lander spacecraft.

**HST (Hubble Space Telescope)** - has taken another deep field image (called Hubble Deep Field South or HDF-S), like the one commonly seen on posters now, to verify science work done from that original deep field. The original area was chosen hoping that they had selected a typical part of the sky, so science discoveries there applied generally to the entire sky. HDF-S is almost in the opposite direction, in the far south part of the sky instead of near the Big Dipper, and again took about 10 days to complete. All HST instruments were used simultaneously, not just the camera. The field included a quasar, which the original did not, and may become the most studied area of the sky for the next 5 years. Like the original, it will provide ground-based astronomers with an astronomical gold mine of objects for follow-up observations. The quasar's light is estimated to have traveled over 3/4 of the way from the edge of the visible universe, and spectral information in its light tells us what interstellar material the light has passed through. It would take astronomers 900,000 years to use HST to survey the entire sky to this depth, and so astronomers need to get much science from these tiny parts of the sky.

**Galileo (Jupiter mission)** - has returned images of a fault, known as *Astypalaea Linea*, on Jupiter's icy moon Europa that stretches as long as the California segment of the infamous San Andreas fault. One side of the fault, which lies near Europa's south pole, has slipped about 30 miles with respect to the other. Bends in the fault have allowed the surface to be pulled apart as this movement took place. The fault is one of the largest strike-slip faults known to exist. A strike-slip fault is one in which 2 crustal blocks move horizontally past one another, somewhat like 2 opposing traffic lanes.

This pulling-apart along the fault's bends created openings through which warmer, softer ice from below the brittle ice shell surface could reach the surface. This upwelling of material formed large areas of new ice within the boundaries of the original fault. A similar pulling-apart phenomenon occurred in the geological trough surrounding the Salton Sea and in Death Valley. However, in those cases, the pulled-apart regions include sedimentary material rather than ice.

*Astypalaea Linea* is probably no longer active, since large ridges formed more recently cross it without interruption. Scientists suspect that the fault motion is induced by the pull of variable daily tides generated by Jupiter's gravitational tug on Europa's surface, which cause one side to move a little with each tide in a phenomenon called walking. This walking may explain the appearance of many other faults and areas of cracks and ridges on Europa. In contrast, the motion on Earth's strike-slip faults is caused by plate tectonic forces, that is, movement of the continents or plates.



Galileo suffered another computer glitch shortly before its November flyby of Europa, which caused the spacecraft to go into safe mode and abandon many planned observations. In safe mode, the spacecraft shuts down unnecessary operations and awaits further instructions from Earth. This glitch, along with several previous ones, is blamed on the high radiation levels near Jupiter, particularly in the radiation belts inside Europa's orbit. Within 3 days, controllers returned Galileo to normal operations.

**Mars Global Surveyor (Mars orbiter)** - has provided striking new measurements by its laser altimeter of the North Pole of the red planet. This is the first 3-dimensional picture of this pole, and enables scientists to estimate the volume of water in the ice cap with unprecedented precision, and to study its surface variations and the heights of clouds in the region. The map produced reveals that the ice cap is about 750 miles across, with a maximum thickness of 1.8 miles. Canyons and troughs that plunge as deep as 3000 feet beneath the surface cut the cap. Similar features do not occur on any glacial or polar terrain on Earth. They appear to be carved by wind and evaporation of ice.

The altimeter data also reveal that large areas of the ice cap are extremely smooth, with elevations that vary by only a few feet over many miles. In some areas, the ice cap is surrounded by large mounds of ice, tens of miles across and up to half a mile in height. These structures appear to be remnants of the cap from a time when it was larger than at present. Impact craters surrounding the cap appear to be filled with ice and dust, but it is not known if the ice was deposited by wind and condensation, or remained from when the cap was larger.

The shape of the polar cap indicates that it is composed primarily of water ice, with a volume of 300,000 cubic miles. This volume is less than half that of the Greenland ice cap on Earth. The Martian cap has an average thickness of 0.64 miles and covers an area 1.5 times that of Texas. The volume is about 10 times less than the minimum volume of an ancient ocean that some scientists believe once existed on Mars. If that ocean existed, it is not primarily stored in the north ice cap now (and the south ice cap is smaller), so must be stored below the surface or have been lost to space. Current models of Martian evolution do not easily explain such a large amount of unaccounted-for water.

Reflections by the altimeter from the clouds occurred at altitudes from just above the surface to more than 9 miles on about 80% of the laser measurements. Most clouds were observed at high latitudes, at the boundary of the ice cap and surrounding terrain. Clouds over the cap are likely composed of carbon dioxide (dry ice) that condenses out of the atmosphere during winter. Many clouds exhibited dynamic structure probably caused by winds interacting with surface features, much as occurs on Earth when winds collide with mountains.

**Topex/Poseidon (sea radar satellite)** - has detected a rise in the Earth's seas of 0.8 inch during the recent El Niño event. Because the measurements have a precision of 1/6 inch, this was easily detected. However, changes in climate over just a few years should be significantly smaller than the El Niño effect, so will be more difficult, and so will take at least 10 years of data to become apparent. Topex/Poseidon has been taking measurements for 6 years now. A follow-on mission called Jason-1 is scheduled for launch in 2000. El Niño caused the rise in global sea level by heating much of the tropical Pacific water, which then expanded and therefore rose the global sea level. The satellite is a joint project of NASA and the French space agency CNES.

**Deep Space 1 (asteroid, comet and technology test mission)** - turned on the ion propulsion on November 10, but it failed in less than 5 minutes. After much analysis and testing, it was turned on again 2 weeks later, and was found to work fine. The problem is being blamed on contamination, probably metallic grit, between the high-voltage grids, which has now been shaken or burned away. Although ion engines have been under design for decades, this is the first mission depending on one. It uses as fuel xenon, a colorless, odorless and tasteless gas more than 4 times heavier than air. The ion engine electrically charges atoms of xenon, then electrostatically accelerates them to far higher speeds (60,000 mph) than is possible with chemical rocket exhaust. The electrical energy comes from solar panels. The engine produces about as much force as the weight of a sheet of paper, but it makes up for this lack by longevity. It will run for years before running out of fuel, as opposed to the few minutes that the best chemical rocket can maintain.

**Polar (satellite observing Earth's poles)** - has found the first direct evidence that bursts of energy from the Sun, called coronal mass ejections, can cause oxygen and other gases to gush from Earth's upper atmosphere into space. Scientists have known since the early 1980s that Earth's upper atmosphere leaks oxygen, helium, and hydrogen ions (charged atoms) into space, but this observation was the first that correlated it to an outburst from the Sun. The amount of oxygen and other gases lost during the observation in September amounted to a few hundred tons. Much of the gas ejected is caught in Earth's wake, and then flows back toward Earth while being heated and accelerated in a manner similar to auroral particles.

**SWAS (Submillimeter Wave Astronomy Satellite)** - was launched in early December by a Pegasus rocket from Vandenberg near Santa Barbara. Pegasus rockets are launched from an L-1011 airplane about 8 miles up and going over 500 mph, in order

to increase the efficiency and payload of the relatively small rocket. SWAS will study star formation areas in submillimeter waves, those relatives of light waves that lie at the extremes of radio waves, almost into infrared. These waves do not penetrate our atmosphere well, and hence we need to observe them from a satellite. The goal of the 2-year mission is to better understand star formation by determining the composition of interstellar clouds, and establishing the means by which these clouds cool as they collapse to form star systems. This is important not only to understand stars, but also the processes that led to formation of our Sun, the Earth, and the rest of the solar system. SWAS is one of NASA's Small Explorers series of inexpensive satellites, weighing only about 625 pounds. It will observe typically 3-5 astronomical objects per orbit (97 minutes).

**Leonid Sample** - During the Leonid meteor shower in November, NASA sent a mission above our atmosphere to try to capture in aerogel (described in last month's column) microscopic shards of meteoroids. The mission was launched by balloon, not rocket, and rose over 20 miles. The balloon burst, as designed, and the payload dropped into a briar patch in Chatsworth, Georgia, where it was found by its radio beacon. An environmental scanning electron microscope will examine the collector to find and identify any meteoroids, whose composition will then be measured.

**Kuiper Belt Object (KBO)** - 1998 FS144 was discovered by 3 high school students, who with their teacher were examining images taken with the 4-meter Blanco Telescope in Chile by the Supernova program in order to see if any asteroids had been caught in the images. Kuiper Belt Objects lie beyond the planets, that is, they have orbits outside Pluto's. There are now more than 70 of them known. The students are part of the National Science Foundation's program called hands-on Universe, which involves students in significant science work.

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**ASTROIMAGE '99 is coming soon!** The Orange County Astronomers and its SIG, Electronics Oriented Astronomers, with California State University Physics Department co-sponsor AstroImage '99, a one-day seminar on astronomical imaging. It will be held at the Ruby Gerontology Center at California State University, Fullerton California, on Saturday, February 6th. Doors open at 0830 and the program will begin at 0900. The program covering both electronic and silver-based astronomical imaging, techniques, equipment, and applications will last until about 1700.

This is a continuation of the series of seminars on astronomical imaging begun in 1977 as the Astrophoto Seminars. It was renamed AstroImage several years ago when electronic imaging became an increasingly important part of the content. AstroImage Seminars draw about 150 people from all over the country to present and hear papers on the progress of amateur and professional astro-imaging on both film and electronic media. A trade show is also held during the seminar, with about a dozen manufacturers and outlets represented, showing the latest in camera, telescope, and software products. An important part of the event is an image show, presented both electronically using computers with large screen displays, as well as a print show for film images.

All are invited to participate. Admission to the event is \$25 for the day, which includes complementary refreshments at 2 breaks. You may pre-register for AstroImage '99 by completing the registration form below and sending it with your check to the registrar.

**Registrar:** Charlie Oostdyk 714-751-5381 (h) email: charlie@cccd.edu  
 714-438-4624 (w)  
**Coordinator,** Wayne Johnson 909-653-8813 (h) email: wayne.p.johnson@boeing.com  
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## ASTROIMAGE '99 REGISTRATION

Mail to: Charlie Oostdyk  
 Orange County Astronomers  
 P O Box 1762  
 Costa Mesa, CA 92628

February 6, 1999  
 Ruby Gerontology Center  
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