The Refractor

The Bulletin of the Eastbay Astronomical Society

Founded in 1924 at Chabot Observatory, Oakland, California

Volume 73
Number 5
January 1997

How To Star Hop

Saturday, 4 January, 7:30 p.m.
Lecture Room, Chabot Observatory
4917 Mountain Boulevard, Oakland

Robert Garfinkle

Astronomer

Local astronomer Bob Garfinkle will present a talk on "How to Star-Hop." He is the author of the popular amateur astronomy book *Star-Hopping: Your Visa to Viewing the Universe* (Cambridge University Press, 1994). What is star-hopping? It is basically the technique of using the brighter celestial objects as guides to finding fainter objects.

Star-hopping involves knowing how much of the sky you can see through your bionoculars or telescope and how that field of view is represented on your star charts. This allows you to know how far to move your telescope from one object to find the next and to plan your evening's viewing so that you will be able find the celestial objects that you are looking for. Bob will discuss in greater detail just how to star-hop. He will also cover some aspects of our lunar nomenclature. We look forward to a very interesting evening.

Bob Garfinkle was born and raised in Alameda. He has been a life-long amateur astronomer. Since 1985, Bob has written numerous astronomy book reviews and several star-hopping articles for *Astronomy* magazine. He is the author of one astronomy book and is working on two books dealing with the Moon. The first, a lunar observers' handbook, will be published by Willmann-Bell. The second book consists of brief biographies of the people for whom the lunar features are named. Bob creates the monthly SkyChart and SkyTalk pages for the Astronomical Society of the Pacific (ASP) publication *Mercury*.

Bob is a senior engineering writer at Northrop Grumman in Sunnyvale and is the Vice Mayor of the City of Union City. In 1993, he beat an attempt to recall him from office by one vote and was then overwhelmingly re-elected to a second term three months later. (Go figure). Bob is a member of the Association of Lunar and Planetary Observers, ASP, the San Jose Astronomical Association, the Royal Canadian Astronomical Society, the American Lunar Society, and the Irish Astronomical Association. Bob has earned B.A.'s in History and English from Cal State University, Hayward.

Refractor Is Now On-line

at http://home/earthlink.net/~jpreston/eas/ through the courtesy of EAS member Jack Preston. It can also be accessed through a link from the Chabot Observatory and Science Center Internet site at http://www.cosc.org.

The newly revised Eastbay Astronomical Society pages include, in addition to the current copy of this newsletter, a description of the activities of the organization, and there is also a directory of the officers of the club, and an information summary for prospective new members.

A feature of the presentation is a selection of astrophotographs made by members. If you wish to submit your work for display, please contact the *Refractor* editor, Ellis Myers. We are eager to have your pictures on-line. We are also hoping that you will give us your comments on how our Web page can be improved.

Join us for

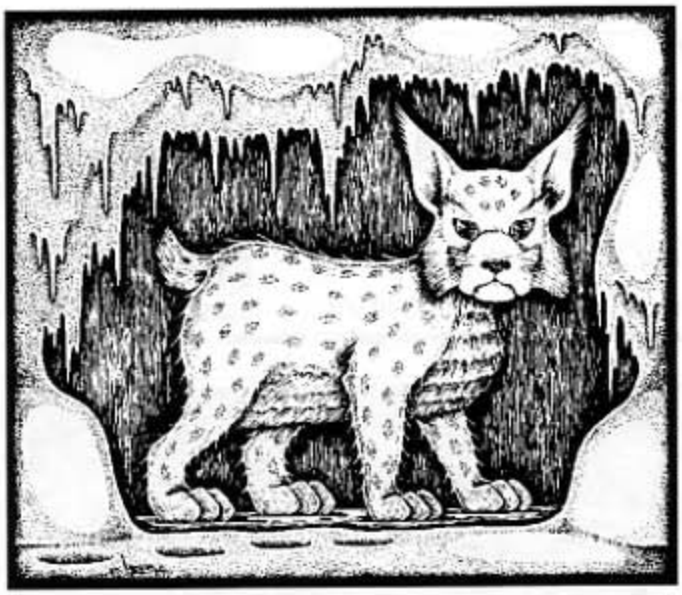
DINNER WITH THE SPEAKER

5:28 p.m., 4 January, 1997

PEARL OF SIAM RESTAURANT

5498 College Avenue, Oakland (510) 420-8600

Please call Betty Neall at 510 / 533-2394 by Friday, 3 January to confirm your place. Please be on time to allow ample time for dinner and to facilitate a prompt meeting time of 7:30 p.m.



You Have To Be Lynx-Eyed

to see the faint stars of the constellation Lynx. So wrote the prosperous brewer Johannes Hevel (Hewelke) in the busy port town of Danzig, in the mid-1600s. He became an amateur astronomer as a hobby, and built for himself an observatory at his home. Only about 40 years after the invention of the telescope, he chose as a first project to develop an atlas of the Moon. This work contained the best maps up to that time, and many of the 250 names shown on his charts are still in use today. This *Selenographia* was finished in 1647. However, unsatisfied with the quality of his telescopic observations owing to chromatic aberration, Hevelius (this was the Latinized version of his name) began to make telescopes of increasingly longer focal lengths. At last he built a telescope with a focal length of 150 feet. This instrument was suspended from a 90-foot mast. Of course, this proved to be an impractical arrangement, for even the slightest breeze made it unusable. The mounting burned in the great Danzig fire of 1679, and Hevelius never again returned to productive astronomical observing.

Hevelius died in 1687; but his star chart published in 1690 put forth seven new constellations, including Lynx. The others, all in the north, included Canes Venatici (the Hunting Dogs), Lacerta (the Lizard), Leo Minor (the Lion Cub), Sextans (the Sextant of Urania, first called Sextans Uraniae), Scutum (the Shield, first called Scutum Sobieskii, the Shield of John Sobieski, a Polish heroking), and Vulpecula (the Fox, first known as Vulpecula et Anser, the Fox and Goose).

This image was made with the Nickel one-meter reflector at Lick Observatory by Michael Bolte, Andrew MacFadyen and Neal Turner. Exposure: 30 minutes, red Spinrad R-band filter.

Lynx is a winter constellation that lies directly to the north of Gemini's bright star Castor. But there are no bright stars in the constellation itself, as Hevelius pointed out. There is no asterism here, and the only pattern is of a wobbly line beginning from a point between Dubhe in Ursa Major and Capella in Auriga, then dropping south and east toward Leo Minor.

Our drawing associates the Lynx with the polar regions, fitting with its northern location, and with its best observation during the winter months. None of the stars have names, although Lynx's two brightest, α and 38 Lyncis, form a pair distinguished by their location at the corners of an equilateral triangle with two other similar pairs in Ursa Major.

Of a number of good multiple stars in the constellation, one of the best is the triple 38 Lyncis. A 3.9-magnitude star is accompanied by a 6.6-magnitude star 3 arcseconds distant and a third star 88 arcseconds away at magnitude 10.8.

Another challenge for small telescopes is the triple system 12 Lyncis. These stars are about 200 light years away. Companion B is 1.7" from the primary, and companion C is separated by 8.7". A medium sized telescope should enable you to resolve all three of these 5th, 6th, and 7th magnitude stars.

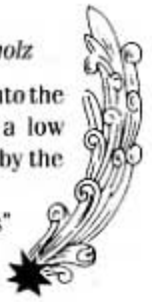
From 12 Lyncis, star-hop to Struve 958 by moving four degrees south, past 13 Lyncis, and slightly east, about three arc minutes. Here you will find a binary, two 6th magnitude stars 4.9" apart, with a third (11th magnitude) star nearby.

Kui 37 is one binary better known by another name: 10 Ursae Majoris. With a proper motion toward the west, this star has moved from Ursa Major to Lynx but kept its old name. It is a close visual binary with the companion revolving its primary every 21.9 years.

Deep sky objects in Lynx include the most distant of all globular clusters, 210,000 light years away from the center of the Milky Way. This is actually farther than the Large Magellanic Cloud, and this cluster, NGC 2419, has been called the Intergalactic Wanderer. None of the individual stars are brighter than 17th magnitude, yet the total cluster achieves a magnitude of 11.5. A large cluster, with a diameter of about 400 light years, it shows as an object 4 minutes across. The total luminosity of the cluster equals 175,000 suns.

There are a number of faint galaxies in this part of the sky. The best of these is the one pictured here, NGC 2683. It is a spiral galaxy which we see nearly edge-on, and so its spiral structure is difficult to discern. In true-color photographs, it shows a red color where dust on the nearer side of the galaxy obscures and reddens the light coming from the more distant side. The galaxy occupies an area about 9.3 × 1.3 arcminutes in size and shines at a magnitude of just under 10.

Comet Comments *by Don Machholz*



Comet Hale-Bopp passes north of the Sun and into the morning sky on December 31. Observers with a low eastern horizon should be able to pick it up again by the third week of January.

In the past few weeks stories of "mysterious" objects in the vicinity of the comet have circulated. The most popular–a Saturn-like object imaged on November 14 by an amateur astronomer–turned out to be nothing other than an 8.5-magnitude star. Other similar objects that I've seen on Internet images appear to be out-of-focus images of bright stars. In all respects Comet Hale-Bopp is behaving as an average comet. It is bigger than perhaps any comet we have seen, but its variable brightness, tails and jets are normal. If anything mysterious truly appears, you will find it reported in the mainstream press, and in most cases be able to go outside and see it yourself through your telescope.

Meanwhile, Comet Tabur dims in our morning sky. Its magnitude has been unpredictable lately. Periodic Comet Wirtanen is returning. The Hubble Space Telescope imaged it in August 1996 and "measured" the nucleus's diameter to be 1.16 km. Finally, Periodic Comet Wild 2 should be visible for several months.

Date (00UT)	R.A. (2000)	Dec.	Elong.	Sky	Mag.
C/1995 O1 (Hale-Bopp) [Serpens Cauda-Aquila]					
12-28	18h36.7m	+03°51'	27°	E	3.1
01-02	18h44.0m	+05°01'	28°	M	2.9
01-07	18h51.7m	+06°18'	29°	M	2.7
01-12	19h00.0m	+07°45'	31°	M	2.5
01-17	19h08.9m	+09°22'	32°	M	2.2
01-22	19h18.5m	+11°11'	34°	M	1.9
01-27	19h29.0m	+13°13'	36°	M	1.7
02-01	19h40.5m	+15°29'	38°	M	1.4
02-06	19h53.4m	+18°01'	40°	M	1.1
C/1996 Q1 (Tabur) [Hercules]					
12-28	16h11.8m	+14°07'	50°	M	11.8
01-02	16h13.8m	+13°02'	53°	M	12.0
01-07	16h15.4m	+12°05'	56°	M	12.2
01-12	16h16.4m	+11°13'	59°	M	12.4
01-17	16h16.9m	+10°27'	62°	M	12.6
01-22	16h16.9m	+09°47'	66°	M	12.8
01-27	16h16.2m	+09°11'	70°	M	13.0
02-01	16h14.7m	+08°39'	75°	M	13.1
46P/Wirtanen [Aquarius-Cetus]					
12-28	22h34.1m	-19°11'	57°	E	12.6
01-02	22h45.5m	-17°40'	55°	E	12.4
01-07	22h57.4m	-16°02'	53°	E	12.2
01-12	23h09.8m	-14°19'	52°	E	12.0
01-17	23h22.6m	-12°30'	50°	E	11.8
01-22	23h35.9m	-10°34'	49°	E	11.6
01-27	23h49.7m	-08°33'	48°	E	11.4
02-01	00h03.9m	-06°26'	47°	E	11.2
02-06	00h18.7m	-04°13'	46°	E	11.1
81P/Wild 2 [Cancer]					
12-28	08h21.7m	+16°49'	153°	M	11.7
01-02	08h19.9m	+17°02'	158°	M	11.6
01-07	08h17.4m	+17°18'	164°	M	11.4
01-12	08h14.3m	+17°38'	170°	M	11.2
01-17	08h10.6m	+18°01'	176°	M	11.0
01-22	08h06.5m	+18°27'	177°	E	10.9
01-27	08h02.3m	+18°54'	172°	E	10.8
02-01	07h58.2m	+19°22'	166°	E	10.6
02-06	07h54.3m	+19°49'	159°	E	10.5

Elements for C/1995 O1 (Hale-Bopp):
Perihelion: 0.9141030 AU [1997 04/01.13453]; Arg. (2000): 130.59083°
Ascending node (2000): 282.47069° Eccentricity: 0.9950969
Inclination (2000): 089.42936° Orbital period: ~4700 years

Elements for C/1996 Q1 (Tabur):
Perihelion: 0.8398272 AU [1996 11/03.52688]; Arg. (2000): 057.40724°
Ascending node (2000): 031.40177° Eccentricity: 0.9989006
Inclination (2000): 073.35813° Orbital period: Long period

Elements for 46P/Wirtanen:
Perihelion: 1.0637469 AU [1997 03/14.14299]; Arg. (2000): 356.34322°
Ascending node (2000): 082.20387° Eccentricity: 0.6567490
Inclination (2000): 011.72255° Orbital period: 5.46 years

Elements for 81P/Wild:
Perihelion: 0.8398272 AU [1997 05/06.62789]; Arg. (2000): 041.77000°
Ascending node (2000): 136.15458° Eccentricity: 0.5402220
Inclination (2000): 003.24276° Orbital period: 6.39 years

How to read these tables:

Date: This is the Unversal Time for the comet's position. The positions are for 00 hr UT. The United States is a few hours earlier than this, so for a comet viewable in the evening, look for it on the night preceding the indicated date. For morning viewing the comet has already passed the position indicated for 00 hr. UT position, so the comet has passed that point and moved on.

R.A. and Dec.: Right Ascension and Declination in 2000 equinox coordinates. These can be plotted on a star chart and found by star-hopping, or by using setting circles.

Elong.: The elongation of the comet–the number of degrees it is from the Sun as seen from the Earth.

Sky: Morning (M) or evening (E) sky.

Mag.: The predicted magnitude or brightness of the comet. The brightness of a comet is difficult to predict so this is only a guess based upon past performance and comet theory.

Perihelion: The distance from the comet to the Sun at perihelion, in Astronomical Units; and the date the comet is closest to the Sun (year, followed by month and day).

Arg. (argument of the perihelion), Ascending Node, Inclination: These define the angle of the comet's orbit. If the figure for the ascending node is under 180° the comet reaches perihelion north of the ecliptic. If the inclination of the orbit is under 90° the comet is in a direct orbit, while over 90° means it is in a retrograde orbit.

Eccentricity: This is the shape of the orbit. An eccentricity of 1.0 indicates a parabola, while zero indicates a circle. An eccentricity of greater than 1 is a hyperbola; such an orbit means that the comet will never return.

Orbital period: The length of time it takes for the comet to orbit the Sun.

These elements can be entered into most comet orbit computer programs to further project the comet's positions.

Jupiter's Big Icy Moon

Ganymede is not only the size of a planet—it sounds like one too, as heard in audio recordings made from data returned by NASA's Galileo spacecraft.

Characterized by a soaring whistle and hissing static, Ganymede's song reveals that the Solar System's largest moon is also the only one known to possess a planet-like, self-generated magnetic cocoon called a magnetosphere, which shields the moon from the magnetic influence of its giant parent body, Jupiter. Published in the scientific journal Nature in December, these new Galileo findings and other measurements from several Galileo sensors were presented in a news briefing held at NASA's Jet Propulsion Laboratory (JPL), Pasadena, California. Taken together, scientists say the new Ganymede findings are painting a portrait of a body that from the inside out closely resembles a planet like Earth rather than other moons in the Solar System.

"The data we get back is in the form of a spectrogram, and reading it is kind of like looking at a musical score," said Dr. Donald Gurnett, University of Iowa physicist and principal investigator on Galileo's plasma wave instrument. It was his experiment that first detected the telltale signals of a magnetosphere during the spacecraft's close flybys of that moon on June 27 and September 6. Gurnett said the unique pattern of frequencies his instrument detected is characteristic of a magnetosphere and closely matches his previous studies of the magnetospheres of Earth, Saturn and Jupiter.

Describing the electromagnetic wave activity that his experiment detected at Ganymede, Gurnett said the approach to the large moon was relatively quiet, "until all of a sudden, there's a big burst of noise that signals the entry into Ganymede's magnetosphere. Then, for about 50 minutes, we detected the kinds of noises that are typical of a passage through a magnetosphere. As we exited the magnetosphere, there was another big burst of noise."

Gurnett checked with Dr. Margaret Kivelson of the University of California at Los Angeles, principal investigator for the magnetometer experiment on the spacecraft. Kivelson confirmed the detection of a large increase in magnetic field strength near Ganymede. Related data from the two close flybys have confirmed that Ganymede has a magnetic field of its own.

Using extremely precise data from tracking the spacecraft, investigators on Galileo's celestial mechanics team also have been able to confirm that Ganymede's interior is differentiated, probably having a three-layer structure. "These data show clearly that Ganymede has differentiated into a core and mantle, which is in turn enclosed by an ice shell," said JPL planetary scientist Dr. John Anderson, team leader on the Galileo radio science experiment.

"Combined with the discovery of an intrinsic magnetic field, our gravity results indicate that Ganymede has a metallic core about 250 to 800 miles in," said Anderson. "This is surrounded by a rocky silicate mantle, which is in turn enclosed by an ice shell about 500 miles thick." This differentiated structure is the most likely cause of Ganymede's newly discovered magnetic field, which in turn gives rise to the magnetosphere. Scientists suspect Ganymede's magnetic field is generated the same way as Earth's, through the dynamo action of the fluid mantle rotating above a metallic core. The only other solid bodies in the Solar System known to have magnetic fields are Mercury, Earth and possibly Jupiter's volcanic moon Io.

Newly received Galileo images of Jupiter's moon Callisto and one of Europa also were released at the briefing. Scientists were surprised by the lack of small craters visible in the images. Some small craters appear to have been softened or modified by downslope movement of debris, revealing ice-rich surfaces.

Galileo's next moon encounter occurred December 18-19, when the spacecraft made its first close approach to Europa, the moon thought to harbor a liquid ocean beneath its icy surface. Results from that flyby will be radioed to Earth starting in the last half of December through early February.

This view of Jupiter's moon Europa shows a portion of the surface that has been highly disrupted by fractures and ridges. This picture covers an area about 238 kilometers (150 miles) wide by 225 kilometers (140 miles), or about the distance between Los Angeles and San Diego. The youngest ridges, such as the two features that cross the center of the picture, have central fractures, aligned knobs, and irregular dark patches. These and other features could indicate cryovolcanism, or processes related to eruption of ice and gases.

This picture, centered at 16 degrees south latitude, 196 degrees west longitude, was taken at a distance of 40,973 kilometers (25,290 mi) on November 6, 1996 by the Galileo spacecraft solid state imaging television camera onboard the Galileo spacecraft during its third orbit around Jupiter.

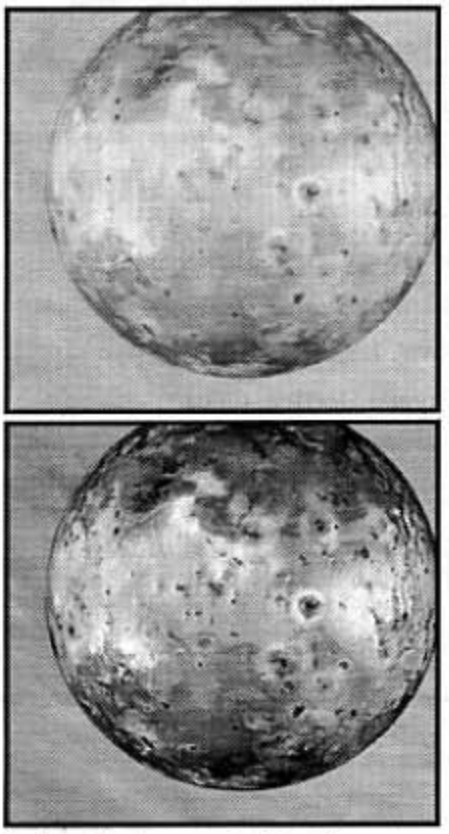
The new Europa image received from the spacecraft shows the cracked surface of this moon in greater detail than it has been seen before. The new image shows an area 150 by 140 miles that has been highly disrupted by fractures and ridges.

Arizona State University planetary scientist Dr. Kelly Bender of Galileo's imaging team said that symmetric ridges in the dark bands suggest that Europa's surface crust was separated and filled with darker material, somewhat analogous to spreading centers in the ocean basins of Earth. Although some impact craters are visible, their general absence indicates a youthful surface, she said. The youngest ridges, such as the two features that cross the center of the picture, have central fractures, aligned knobs, and irregular dark patches. These and other features could indicate cryovolcanism, or processes related to eruption of ice and gases.

nasa

Global View of Io

Jupiter's volcanic moon, obtained on 7 September, 1996 Universal Time using the near-infrared, green, and violet filters of the Solid State Imaging system aboard NASA/JPL's Galileo spacecraft. The top disk is intended to show the satellite in natural color, similar to what the human eye would see, while the bottom disk shows enhanced color to highlight surface details. (To view these images in color, please see the *Refractor* on the WorldWideWeb. Or, you can find them on the Galileo Home Page at http://www.jpl.nasa.gov/galileo.)



The reddest and blackest areas are closely associated with active volcanic regions and recent surface deposits. Io was imaged here against the clouds of Jupiter. North is to the top of the frames. The finest details that can be discerned in these frames are about 4.9 km across.

Launched in October 1989, Galileo entered orbit around Jupiter on December 7, 1995. The spacecraft's mission is to conduct detailed studies of the giant planet, its largest moons and the Jovian magnetic environment. The Jet Propulsion Laboratory, Pasadena, CA manages the mission for NASA's Office of Space Science, Washington, D.C. nasa

Eastbay Astronomical Society

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Articles and photos for *The Refractor* are encouraged. Deadline for the February issue is January 17, 1997. Items may be submitted by mail to the editor, Ellis Myers, 215 Calle La Mesa, Moraga, CA 94556. Internete-mail address: emyers@a.crl.com. For further information please call (510) 284-4103.

WorldWideWeb: http://www.cosc.org or http://home.earthlink.net/~jpreston/eas/

Roberts Rules

By Carter Roberts

The year 1997 is here, and with it an agenda that will certainly include much of interest to amateur astronomers, including our EAS membership. Our Program Director, Dave Rodrigues, will continue to sign on prominent speakers for our monthly meetings. And we owe him a great vote of thanks for the arrangements he made during 1996. Naming just one of the people who will visit us this year, the renowned science author Timothy Ferris will be the keynote speaker at our annual banquet meeting this spring. Although we have not finalized the time and place for this affair, it is tentatively scheduled for 10 May, so please keep your calendars open for that date.

As the excellence of our activities in the new year builds from our experiences of past months, please join me in acknowledging some of the good work from the previous year. Glen Bailey has retired from the Board of Directors, to be succeeded by Ken Swagerty. Glen has been of great help with his efforts both at Board meetings and during our public outreach programs and other activities. He was also instrumental in acquiring useful and valuable equipment for the machine shop at the new Chabot Observatory and Science Center facility.

Glen Bailey is also in the forefront of a group of members I want to thank for their donations of books and magazines to the Burns Library. Others who made gifts to the library were Dorothy Williams and Don Stone. *[Editor's note: Carter Roberts was also a donor, reminds Librarian Anne Creese.]*

Astronomical events that will happen in 1997 include the approach of Comet Hale-Bopp, and I am sure that many of you will want to help us help the public enjoy and understand this beautiful phenomenon. A particularly interesting date to look forward to will be the night of March 23, when the comet should be near its peak display, and when the full Moon will move into nearly full eclipse (92%). Two events for the price of one!

I want to mention that I recently had the privilege, along with Conrad Jung and Don Stone, of visiting with Kingsley Wightman in Fresno. When we arrived he was reading last month's issue of the *Refractor*, and he was sincere in praise of its content and quality. Kingsley's health remains well. We were most pleased that he had been able to come to the October ceremonies for the beginnings of the new Chabot Science Center project.

From Page 1 of this issue, you have learned that the *Refractor* is now appearing on the WorldWideWeb. We hope that this new publication location will be of benefit to you, in that you will have access to the newsletter's information without waiting for the mail to bring it to you. Editor Ellis Myers plans to have the information on the Web about the same time that the print edition goes into the mail.

Please welcome as new EAS members:

Winifred Heppler	Berkeley
Chuck Marble	Patterson
Samuel Paniccia	Santa Cruz
Elizabeth Stone	Sonoma
Judy, Andrew, Adrian Thomas	Oakland
George Takahashi	Oakland
Avta Betsy Elbinger	Fremont

DATELINE JANUARY

7	1610	Jupiter moons discovered, Galileo Galilei
17	1786	Comet Encke first observed
1	1801	Ceres, first asteroid discovery
2	1920	Isaac Asimov, born Petrovichi, Russia
31	1958	Explorer 1, first US satellite in orbit
27	1967	Virgil (Gus) Grissom, Edward H. White, Roger B. Chaffee killed when fire erupted in Apollo spacecraft during pre-launch tests
28	1986	Challenger STS 51-L, Francis (Dick) Scobee, Michael Smith, Ronald McNair, Ellison Onizuka, Judith Resnik, Gregory Jarvis, Sharon Christa McAuliffe
1	1997	Last Quarter Moon, 17:45 PST = 01:45 UT 2 January
8	1997	New Moon, 20:26 PST = 04:26 UT 9 January
15	1997	First Quarter Moon, 12:02 PST = 20:02 UT
23	1997	Full Moon, 07:11 PST = 15:11 UT
31	1997	Last Quarter Moon, 11:40 PST = 19:40 UT

FUTURE CONJUGATIONS

4 January. EAS Lecture, 7:30 p.m.
Bob Garfinkle, How To Star-Hop

9 January. EAS Board meeting.

31 January. AL Young Astronomer Award application deadline.
Info: http://www.mcs.net/~bstevens/al

1 February. EAS Lecture meeting.

20 February. COSC Benefit.

9 March. Total solar eclipse. Mongolia.

22 March. AANC Workshop. Comets and Crashes.

10 May (Tentative). EAS Annual Banquet.

27 June. ASP Annual Meeting, Chicago

First and third Friday evenings
JUNIOR ASTRONOMERS
For Fourth Graders and Older
Chabot Observatory, 7:30 p.m.
Call **Mrs. Louise Predovic** at **510 / 523-1096** for more information.

Rotary-Chabot Planetarium shows
Fridays and Saturdays, 7:30 p.m.
For information and show schedule, call (510) 530-5225.
EAS Members receive free admission.

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