The Refractor

The Bulletin of the Eastbay Astronomical Society

Founded in 1924 at Chabot Observatory, Oakland, California

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December 1996

Shannon Lucid's Peaceful Journey

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

Chuck Marble

Tri-Valley Stargazers

NASA Astronaut Shannon Lucid's record-breaking stay on board the Russian Space Station Mir captured the hearts and minds of the American public.

In December's presentation, Chuck Marble will cover this historic mission in a multimedia presentation that includes highlights of Shannon's training in Russia, her thoughts before the flight as well as her on-board adventures while serving with the four separate crews involved in this mission. Also to be featured will be the "Heroes Welcome" Shannon received upon her return to Earth, as well as her thoughts upon completion of this historic international mission.

If time permits, Chuck will also briefly cover the past, present and future of space stations and cooperative international efforts in space.

Chuck Marble last spoke to the Eastbay Astronomical Society in July, 1995, when he brought his unique blend of education and entertainment with a multimedia presentation on the joint American and Russian space program. But this was prior to the record-setting adventure of astronaut Shannon Lucid, and that makes a story that Chuck is well-qualified to tell, and one that should be of great interest to our group.

Chuck Marble has had a lifelong interest not only in astronomy, aviation, aerospace, meteorology and radio communications, but he is also an accomplished song writer and performer, a noted audio-video engineer, and a producer of award-winning nonprofit educational documentary videos.

Join us for

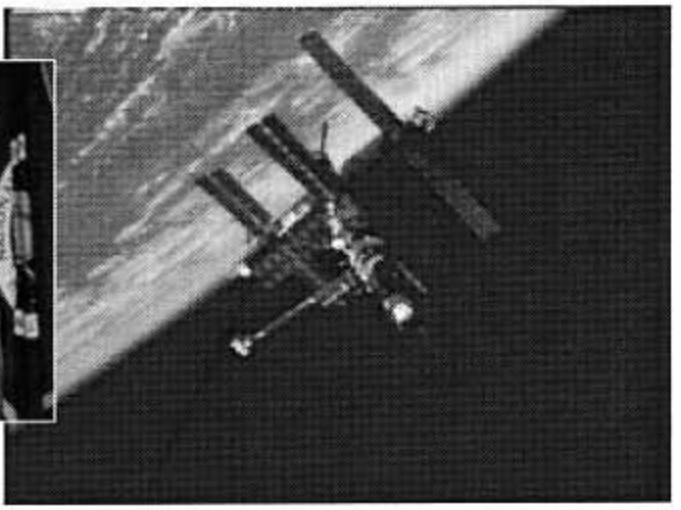
DINNER WITH THE SPEAKER

5:28 p.m., 7 December 1996

PEARL OF SIAM RESTAURANT

5498 College Avenue, Oakland (510) 420-8600)

Please call Betty Neall at 510 / 533-2394 by Friday, 6 December 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.



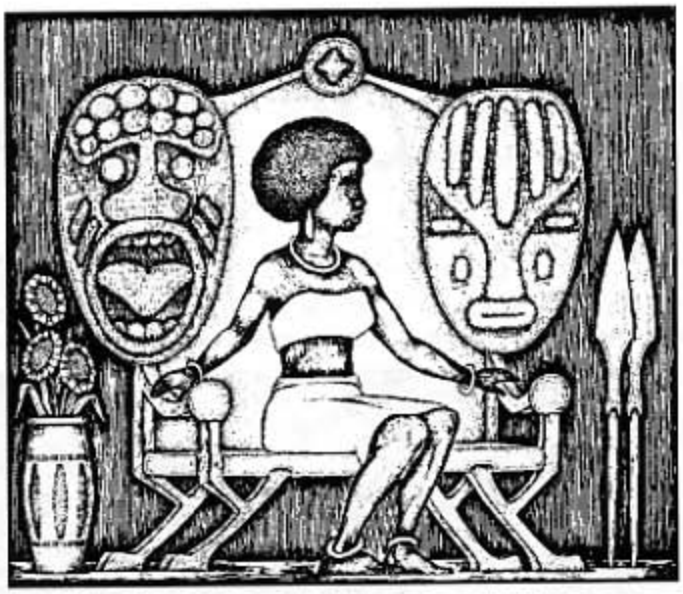
Shannon Lucid, born in Shanghai, China, grew up in Bethany, Oklahoma, and received her education at the University of Oklahoma with a B.S. in chemistry and a Ph.D. in biochemistry. She became an astronaut in August 1979. She has served as spacecraft communicator (CAPCOM) in the JSC Mission Control Center during numerous Space Shuttle missions. A veteran of five space flights, Dr. Lucid has logged 5,354 hours (223 days) in space. She served as a mission specialist on STS-51G (1985), STS-34 (1989), STS-43 (1991), STS-58 (1993).

Dr. Lucid currently holds the United States single mission space flight endurance record on the Russian Space Station Mir. Following a year of training in Star City, Russia, her journey started with liftoff at Kennedy Space Center, Florida, on March 22, 1996 aboard STS-76 Atlantis. As a Board Engineer 2 on the Mir Space Station, she performed numerous life science and physical science experiments. Her return journey to KSC was made aboard STS-79 Atlantis on September 26, 1996. In completing this mission Dr. Lucid traveled 75.2 million miles in 188 days, 04 hours, 00 minutes, 14 seconds. She continues to hold the U.S. record for the most flight hours on orbit by a woman.

A $5,000 reward

has been offered by scientists at the University of California Los Angeles for the first chunk weighing at least 4 ounces of a meteoroid that streaked through Southern California two months ago. On Thursday, October 3, my wife and I were visiting with my sister and had just finished dinner at a fine restaurant, Paohe's, in Coronado. Shortly before nine p.m. we were returning to Balboa Park's Reuben H. Fleet Science

Continued on page 3



Cassiopeia, Queen of Ethiopia

was a woman of supreme beauty, but she was as proud as she was lovely. At first, she boasted that she was the fairest in all of Ethiopia; and then, she claimed to be the most beautiful in all the world. At last, she proclaimed that she was more beautiful even than any goddess above. One day the Nereids, the water nymphs renowned for their grace and beauty, heard her say that she was fairer than any water nymph that ever lived. The Nereids complained to their father, Neptune, who rose in anger, plunged his trident into the sea and created the most evil and ferocious monster, Cetus. This creature he sent off to Cassiopeia's land of Ethiopia with the command to lay waste the country and to terrorize the inhabitants. This Cetus did, and the people begged King Cepheus to save them from further harm. At a loss, Cepheus consulted the oracle, and he was advised that his only recourse was to sacrifice his daughter Andromeda to the appetite of the monster. Well, you know what happened to the princess, and how she was saved by the hero Perseus. All these mythical characters were transformed into constellations and placed in the northern sky. Queen Cassiopeia, bound into her celestial chair, was placed where she swings upside down as she revolves around the Pole Star. Thus, for half of every night the once proud Queen must hang head down in an uncomfortable and humiliating position.

Of course, that is myth; the real story is this:

On a bright autumn day four brothers went out in their canoe to hunt for elk. Their younger brother stayed home along the Quillayute River in what is now the Olympic Peninsula of the State of Washington. A good distance upriver, the eldest of the brothers declared that this was a good location and the group pulled their canoe ashore, packed up what they would need for lunch and for hunting, and set off on foot in search of game.

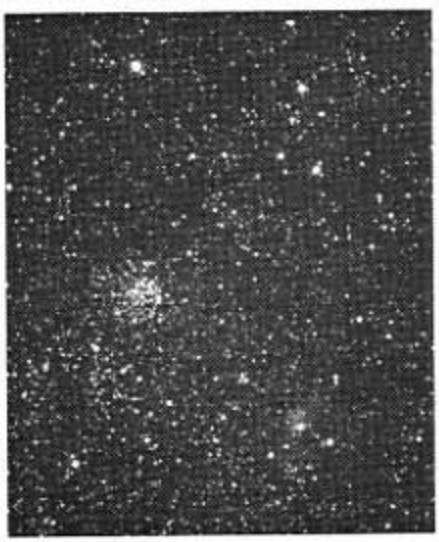
Soon they met a large man walking toward them. He greeted them and asked of their plans. "We are hunting for elk, Man of the Prairie," the boys told him. "I can help you with all the elk you want," the man replied. "Stay here and hide, and I will drive the animals down this ravine for you to shoot." The Man of the Prairie began to walk away, then called to the boys that he would be willing to trade some special arrows he had for the poor ones of theirs. The brothers agreed and exchanged for the good-looking arrows. The man went off, telling the boys to be ready.

After a time, a huge elk charged down the ravine toward the four brothers. The arrows proved to be of no use, and the elk killed all of the four. Then the elk magically turned back into his form of the Man of the Prairie.

The fifth brother, dismayed when the others did not return, set out in search of them, coming finally to the empty canoe. Following his brothers' footsteps across the prairie, he too met the Man of the Prairie.

The trickster tried his evil chicanery on the fifth brother, but the youth was a medicine man with magic of his own. So he could see that this was a trick and declared, "I will not trade with you." When the man turned to leave, the youngest brother hid behind a tree. And when the Man of the Prairie turned himself into an elk and came charging back, the brother was ready with his bow. He shot one arrow into the elk for each of his four brothers, and killed the pretender. When he had skinned the elk he found that the skin stretched larger than the prairie. He threw the elkskin up into the sky. There in the northern sky the elkskin remains. Stars mark the holes where the youngest brother had driven in stakes while stretching the skin to dry.

One of the most distinctive and well-known constellations, Cassiopeia lies along the Milky Way and is rich in telescopic objects, including two from the Messier list, both open clusters. These are M52 and M103. To find M52 in the sky, look first to find the leftmost pair of stars that form the first stroke of the "M", when, as in December's evening sky, Cassiopeia does resemble that letter. These two stars, Schedar above and Caph below and to the left, point nearly directly to the cluster, which is about the distance from Caph as Caph is from Schedar. Nearby, half a degree to the southwest, is the Bubble Nebula, NGC 7635. This object, visible in Conrad Jung's photo below and right of M52, shows a complete spherical shell of gas in large-instrument photographs.



Cassiopeia's position within the Milky Way endows it with a good number of interesting objects. In fact, of the 109 deep-sky targets that astronomer Patrick Moore offers to extend the Messier list (*Sky & Telescope*, December 1995) six are in this familiar constellation. These six include the Bubble Nebula, open clusters NGC 457, 559, and 663, and galaxies NGC 147 and 185. All these are listed as brighter than magnitude 10, and so should be suited for observation with moderate optics. And if you have a radio telescope, you can look for the brightest object in the whole sky, the supernova remnant Cassiopeia-A.

$5000 Reward

Continued from page 1

Center, where my sister had parked her car; and as we had crossed the Coronado-San Diego bridge we saw a bright green light cross the sky, low in the distance and heading west to east. We recognized it easily as a bolide, but could not get further bearings, because we were traveling north on Highway 5 in heavy traffic. Yet it was an awesome and thrilling sight. Later we read in the San Diego Union-Tribune that "An apparent meteorite streaked through the West's nighttime sky Thursday night, transfixing residents from California to New Mexico and briefly turning darkness into day." That's stretching it a bit. It was reported from widely separated locations, however. The light "just blossomed out into something like a flare or a torch flame," said an observer who saw it from the Griffith Park Observatory. A park ranger at Death Valley National Monument said the flash of light was so bright it made it "seem like daytime." The display lasted two to three seconds. A Los Angeles television news helicopter pilot said he swerved to avoid what he initially thought was a spotlight from another helicopter. Residents throughout California and New Mexico also reported the glowing, greenish-yellow flash. A later story reports that the search for remnants of the "Green Flash" meteor may have been narrowed by seismographs that detected explosions as it fell to Earth. The meteor may have struck near Little Lake, a desert region on the southeast flank of the Sierra Nevada, said a seismologist at the California Institute of Technology. Scientists believe it entered the atmosphere over New Mexico, bounced back into space, made a 100-minute orbit and re-entered over the Pacific, crossed the California coast at Point Conception and flew on a course that took it north of Bakersfield. Little Lake is some 70 miles farther on.

Data from 31 seismic stations belonging to the Southern California Seismographic Network operated by Caltech and the U.S. Geological Survey were analyzed. "As it fell, the atmospheric drag caused the meteoroid to explode in midair at least twice," the scientist said. "The explosions generated sound waves in the air similar to a sonic boom, which were detected by the seismographs. The arrival times of sound waves at the various seismic stations were used to estimate where the explosions occurred. The procedure is similar to the one used to locate earthquakes underground. There was good locating data on two of the explosions. Both were 20 to 30 miles above the Fivemile Canyon area in the eastern Sierra foothills. They were separated by about 25 seconds and the second was about five miles lower and about a mile farther eastward than the first.

The seismic station data and eyewitness accounts helped to conclude that any larger fragments surviving the fiery plunge would have landed to the east-northeast of the explosions, perhaps in Rose Valley.

Small fragments would have fallen more or less straight down from the points of explosion. The seismographs didn't pick up a meteorite impact with the ground. That wasn't surprising because a single piece would have to weigh several tons in order for its impact to be detected.

Research on the meteor is being conducted by UCLA meteorite specialist John Wasson and physicist Mark Boslough of Sandia National Laboratories in New Mexico. *By Ellis Myers*

Roberts Rules

Carter Roberts

Let me call your attention to the EAS meeting on December 7, when you will be asked to vote for officers and members of the Board of Directors for the coming year. All current office holders have been renominated, with one exception. Glen Bailey has asked to be retired from the Board, and we want to thank him for his efforts and service. He has been a great help as a Board member, and his wisdom will continue to be available on request. His place on the nomination slate goes to Ken Swagerty.

We extend our thanks to many who assisted with the celebration of Astronomy Day II. Included are Phil Crabbe II, Mike Esslinger, Jerry Fisher, Conrad Jung, Jack Preston, Alan Roche, Dave Rodrigues, Ken Swagerty, Mark Thein, and Paul Zurakowski.

George Roush has contributed a valuable assortment of professional darkroom equipment to EAS, and were are most grateful for his donation. Thanks are also due to Mike Hanley for handling the refreshments at the October meeting.

From Mount Tamalpais

comes a suggestion that could be a boon to those Santas among us who are looking for a small, special, and inexpensive gift for an astronomically-inclined friend (or for yourselves as you spend the nights under the aurora borealis at your North Pole workshop!). Tinka Ross recommends the annual diary published by Norbert Haley of New Zealand. This is a handy reference crammed full of astronomical information: daily Moon data, weekly planet/Sun information, major meteor showers, eclipses, conjunctions–all calculated for the San Francisco Bay Area. Each date has room to jot down your own schedule or notes; and there is a lot of trivia on worldwide holidays, celebrity and historical birthdays, deaths, anniversaries, *etc.* Measuring four inches by five and a quarter inches, it fits easily into your pocket.

You can check it out on the Internet at http://www.rat.de/apd/APD.HTM. If you agree that this is a good way to be organized and plan observing sessions in 1997, send $10 by check payable to MTIA (Mt. Tam Interpretive Association) for each 1997 Astronomical PocketDiary you wish to order. Mail to Tinka Ross at 89 Dominican Drive, San Rafael, CA 94901-1337. $5 of each purchase will be a donation toward the astronomical programs on Mt. Tam.

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Quasars reside in a variety of galaxies, from normal to highly disturbed. When seen through ground-based telescopes, these compact, enigmatic light sources resemble stars, yet they are billions of light-years away and several hundred billion times brighter than normal stars. These Hubble Space Telescope images show examples of different quasar home sites. All the sites must provide the fuel to power these unique light beacons. Astronomers believe that a quasar turns on when a massive black hole at the nucleus of a galaxy feeds on gas and stars. As the matter falls into the black hole, intense radiation is emitted. Eventually, the black hole will stop emitting radiation once it consumes all nearby matter. Then it needs debris from a collision of galaxies or another process to provide more fuel. The image on the left represents a normal galaxy; the center, colliding galaxies; and the right, a peculiar galaxy.

Left: This image shows quasar PG 0052+251, 1.4 billion light-years from Earth, at the core of a normal spiral galaxy. Astronomers are surprised to find host galaxies, such as this one, that appear undisturbed by the strong quasar radiation. Center: Hubble has captured quasar PG 1012+008, located 1.6 billion light-years from Earth, merging with a bright galaxy (the object just below the quasar). The two objects are 31,000 light-years apart. The swirling wisps of dust and gas surrounding the quasar and galaxy provide strong evidence for an interaction between them. The compact galaxy on the left of the quasar also may be beginning to merge with the quasar. Right: A tidal tail of dust and gas is seen beneath quasar 0316-346, located 2.2 billion light-years from Earth. The peculiar-shaped tail suggests that the host galaxy has interacted with a passing galaxy not in the image.

Credits: John Bahcall (Institute for Advanced Study, Princeton), Mike Disney (University of Wales) and NASA

Dramatic Hubble Space Telescope Images

show that quasars live in a remarkable variety of galaxies, many of which are violently colliding. This complicated picture suggests there may be a variety of mechanisms – some quite subtle – for "turning on" quasars, the universe's most energetic objects. The Hubble researchers also are intrigued by the fact that the quasars studied do not appear to have obviously damaged the galaxies in which they live. This could mean that quasars are relatively short-lived phenomena which many galaxies, including the Milky Way, experienced long ago.

John Bahcall of Princeton's Institute for Advanced Study emphasizes that Hubble's clarity opens a complicated picture. "If we thought we had a complete theory of quasars before, now we know we don't," says Bahcall. "No coherent, single pattern of quasar behavior emerges. The basic assumption was that there was only one kind of host galaxy, or catastrophic event, which feeds a quasar. In reality we do not have a simple picture – we have a mess." Mike Disney, University of Wales College, Cardiff, U.K., who is the leader of the European team, says, "People had suspected that collisions might be an important mechanism for feeding black holes and generating the vast amounts of energy emitted by quasars. Now we know they are and we didn't know that before Hubble. This is a really exciting achievement."

Though a number of the images show collisions between pairs of galaxies which could trigger the birth of quasars, some pictures reveal apparently normal, undisturbed galaxies possessing quasars. "We were amazed by the beauty and clarity of the Hubble images, as well as the diversity of quasar environments," says Donald Schneider of Pennsylvania State University, State College, PA.

Discovered only 33 years ago, quasars are among the most baffling objects in the universe because of their small size and prodigious energy output. Quasars are not much bigger than Earth's solar system but pour out 100 to 1,000 times as much light as an entire galaxy containing a hundred billion stars.

A super massive black hole, gobbling up stars, gas and dust, is theorized to be the "engine" powering a quasar. Most astronomers agree an active black hole is the only credible possibility that explains how quasars can be so compact, variable and powerful. Nevertheless, conclusive evidence has been elusive because quasars are so bright they mask any details of the "environment" where they live. "These problems couldn't be solved without the Hubble Telescope," Disney said.

Observations by the European team, using the Wide Field Planetary Camera 2 (WFPC2) in high-resolution mode, reveal that quasars appear to be born in environments where two galaxies are interacting violently and probably colliding.

"In nearly every quasar we look at we clearly see one galaxy apparently swallowing another," Disney said. He selected three quasars known to be strong infrared emitters, suggesting that they might be in spiral galaxies, which typically contain a great

deal of gas and dust. "When we image them with Hubble we see the most colossal smashups, where two giant spiral galaxies like our own Milky Way have crashed head on into one another and flung off pieces violently in all directions. Some of those bits seem to have finished up in the nucleus of one of the spirals where there is probably a giant black hole feeding on it."

Bahcall, Schneider and Sofia Kirkahos also used the WFPC2, but in wide-field mode, to survey 20 quasars. Bahcall finds about half of the quasars studied have host galaxies which look undisturbed. "Either the interacting companion is very close to the nucleus and below Hubble's resolution, or other mechanisms are at work in igniting quasars."

Both teams agree that Hubble images do show conclusively:

* That most quasars lie at the cores of luminous galaxies, both spiral and elliptical. Though underlying galaxies were suggested in ground-based quasar observations, astronomers had to wait for Hubble's capabilities to show the host galaxies clearly enough for astronomers to begin to classify their shapes.

* Interactions between galaxies, either through direct collisions or near encounters, can be important in "turning on" a quasar, by dumping fuel onto a black hole. However, some quasars look unperturbed, so there may be other, more subtle mechanisms for feeding the black hole. "Some of the galaxies we observed don't appear to know they have a quasar in their cores," says Bahcall. "This may be a very important clue, since it was a completely unexpected result."

* Quasars that are "radio quiet" are often in elliptical galaxies, not always in spiral galaxies, as previously believed.

Further quasar research will be challenging because of the great distance and long time scales involved. "It's like having a few still shots of a football game and trying to decipher both the rules and the final score. It's very challenging, and great fun, but you are obviously open to making the most dramatic mistakes. We'll get there in the end but we may need a lot of Hubble pictures to be certain what is going on," Disney said.

Now that more is known about the environments in which quasars exist, the teams emphasize astronomers must address even larger puzzles. Do most quasars flare up for a brief period of a galaxy's life (100 million years or less)? If so, then most galaxies, including our Milky Way, could be "burned out" quasars. If, alternatively, quasars are long-lived, it implies they are more rare. "This means a few extremely massive black holes formed very early in the universe," says Disney.

Astronomers also need to address a "chicken and egg" problem about the birth of quasars. Did the massive black holes form first and the galaxies form around them, or did galaxies precede black holes, which quickly grew in their cores through stellar collision and merger?

Advanced instruments planned for Hubble should also help pin down more details. The Near Infrared Camera and Multi-Object Spectrometer (NICMOS), to be installed in 1997, and the Advanced Camera, to be installed in 1999, will have coronagraphic devices which will block out the glare of a quasar, allowing astronomers to see closer into a galaxy's nucleus. By viewing galactic structures in infrared light, the NICMOS should be able to provide important new details about the host galaxies of quasars. vasa

Comet Comments *by Don Machholz*

Comet Hale-Bopp continues to brighten as it passes north of the Sun and into the morning sky as 1996 draws to a close. Northern Hemisphere observers will have difficulty seeing it for a few weeks, while Southern Hemisphere observers won't see it until May 1997. While Comet Hale-Bopp has developed jets near the nucleus and a tail a few degrees long, Comet Tabur began to fade rapidly in late October. This was unexpected and it is unusual behavior for a comet. It may now be fainter than the adjusted magnitude estimates listed in the ephemerides below.

Several comets should be easily visible to us in 1997. Comet Hale-Bopp will likely be the brightest, reaching perihelion in late March. Between January and June, Periodic Comet Wild 2 will reach magnitude ten in the northern evening sky. At nearly the same time Periodic Comet Wirtanen will be of similar brightness. Periodic Comet Encke is visible to the Southern Hemisphere in mid-summer. Toward the end of the year Periodic Comet Hartley 2 may reach binocular visibility in the evening sky, while Periodic Comet Tempel-Tuttle crosses through the north polar region at magnitude nine. In addition to these returning periodic comets, one never knows when and where new comets will be discovered.

Date (00UT)	R.A. (2000)	Dec.	Elong.	Sky	Mag.
C/1995 O1	(Hale-Bopp)	[Serpens Cauda]			
11-28	18h01.1m	-00°58'	33°	E	4.2
12-03	18h06.2m	-00°22'	31°	E	4.1
12-08	18h11.6m	+00°18'	29°	E	3.9
12-13	18h17.3m	+01°03'	28°	E	3.7
12-18	18h23.4m	+01°57'	27°	E	3.5
12-23	18h29.9m	+02°53'	27°	E	3.3
12-28	18h36.8m	+03°55'	27°	E	3.1
01-02	18h44.0m	+05°05'	28°	M	2.9
01-07	18h51.8m	+06°23'	29°	M	2.7
C/1996 Q1	(Tabur)	[Serpens Caput-Hercules]			
11-28	15h51.2m	+23°37'	45°	M	10.0
12-03	15h55.9m	+21°36'	45°	M	10.3
12-08	15h59.9m	+19°47'	45°	M	10.6
12-13	16h03.5m	+18°09'	46°	M	10.9
12-18	16h06.7m	+16°40'	47°	M	11.2
12-23	16h09.5m	+15°20'	48°	M	11.5
12-28	16h11.9m	+14°08'	50°	M	11.8
01-02	16h13.8m	+13°04'	53°	M	12.0

Elements for C/1995 O1 (Hale-Bopp):
Perihelion: 0.9170703 AU [1997 03/31.86770]; Arg. (2000): 130.40061°
Ascending node (2000): 282.46983° Eccentricity: 0.99674010
Inclination (2000): 089.38442° Orbital period: 4700 years

Elements for C/1996 Q1 (Tabur):
Perihelion: 0.84001480 AU [1996 11/03.50419; Arg. (2000): 057.37495°
Ascending node (2000): 031.41231° Eccentricity: 1.0
Inclination (2000): 073.36167° Orbital period: Long period

Please welcome as new EAS members:

Douglas Dooley Family Castro Valley

DATELINE DECEMBER

14	1546	Tycho Brahe, born
7	1571	Johannes Kepler, born
25	1642	Isaac Newton born
8	1656	Edmund Halley, born
16	1857	Edward E. Barnard, born
11	1863	Annie J. Cannon, born, pioneer spectroscopist
24	1968	Apollo 8, First manned spacecraft to orbit the Moon
2	1996	Last Quarter Moon, 21:07 PST = 05:07 UT 3 December
10	1996	New Moon, 08:55 PST = 16:55 UT
13	1996	Geminid meteors peak.
17	1996	First Quarter Moon, 01:31 PST = 09:31 UT
21	1996	Winter solstice. 06:05 PST = 14:05 UT
24	1996	Full Moon, 12:40 PDT = 20:40 UT

FUTURE CONJUGATIONS

7 December. EAS Lecture, 7:30 p.m.
Chuck Marble, Tri-Valley Stargazers
Shannon Lucid's Peaceful Journey

12 December. EAS Board meeting.

4 January. EAS Lecture meeting.

9 January. EAS Board meeting.

20 February. COSC Benefit.

27 June. ASP Annual Meeting, Chicago

2 August. Star-B-Que. Fremont Peak.

Rotary-Chabot Planetarium shows. Fridays and Saturdays, 7:30 p.m.
Information, (510) 530-5225.

December

	6	7	13	14	20	21	27	28
The Final Frontier								
The Sky Tonight								
Star of Wonder								

First and third Friday evenings

JUNIOR ASTRONOMERS

December 6: Planetarium Show and Birthday Party
December 20: Chart Comet Hale-Bopp
For Fourth Graders and Older
Chabot Observatory, 7:30 p.m.
Call **Mrs. Louise Predovic** for more information.
510 / 523-1096

Eastbay Astronomical Society, Inc.
4917 Mountain Boulevard
Oakland, CA 94619

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