



The Refractor

The Bulletin of the Eastbay Astronomical Society

Founded in 1924 at Chabot Observatory, Oakland, California

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March 2000

2000: A Space Odyssey

The Remarkable Recent Discoveries of Galileo
And Whatever Happened to Mars Polar Lander?

Saturday, 18 March 2000

- General Meeting - 7:31 PM
- Lecture - 8:20 PM

Chabot Observatory

4917 Mountain Boulevard, Oakland

Dr. Jeff Moore

NASA Ames Research Center

Last month, on February 22, the Galileo spacecraft skimmed just 124 miles above the surface of Jupiter's moon Io, the most volcanic object known to man. Taking the most detailed images to date of this weird and mysterious object, Galileo capped a stunning five-year mission orbiting Jupiter and its moons. Recently, a series of remarkable discoveries have been made by Galileo, including one in particular that may be one of the most important scientific discoveries ever, but more about that below. To enlighten us we will hear from Dr. Jeff Moore of NASA and the SETI institute. Dr. Moore will just be back from a meeting of the American Astronomical Society's Division of Planetary Sciences and will brief us on some of the just-released results of Galileo. As a bonus he will also discuss the latest thinking in NASA as to what happened to the Mars Polar Lander. Dr. Moore is eminently qualified to discuss both topics as he is a Galileo Orbiter Imaging Team Associate as well as being on the landing site committee for the Polar Lander.

To begin with, Dr. Moore will present us with some of the latest images from the Io fly-by, including some never seen before by the general public. We will see images of 2000-degree lava fountains over one mile high, an enormous volcanic lake over 10 miles across and its Hawaiian analog, a sulfur lava flow, mountains thirteen thousand feet high, volcanic plumes sixty miles high, and a caldera over 100 miles across!

As to Jupiter itself, we will see some of the latest beautiful and dramatic images of the clouds, belts and zones (not to mention the Great Red Spot). And if that weren't enough, we now have images of massive lightning storms hundreds of miles across on Jupiter!

Perhaps the most exciting discovery made just a few weeks ago, however, relates to Jupiter's second moon Europa. It has long been suspected since the Voyager fly-by of Jupiter that



NASA's Galileo spacecraft has scored another success by completing a third and closest flyby of Jupiter's volcanic moon Io, dipping to only 199 kilometers (about 124 miles) above the fiery surface. The spacecraft's camera and other instruments were poised to capture the encounter with images and other observations. According to plan, the data will be transmitted to Earth over the next several months for processing and analysis. The earlier image shown here was taken by Galileo in July, 1998.

there may be a water ocean—interesting that in astronomy we have to specify what type of ocean we are talking about!—below the smooth ice of Europa. Over the years evidence has accumulated. Galileo recently took some pictures of what appeared to be large icebergs that had broken apart and drifted across Europa's surface. The near-infrared spectro-meter discovered evidence of salts in the recently resurfaced ice. The surface has a paucity of craters indicating that it is geologically young and

Continued on Page 3

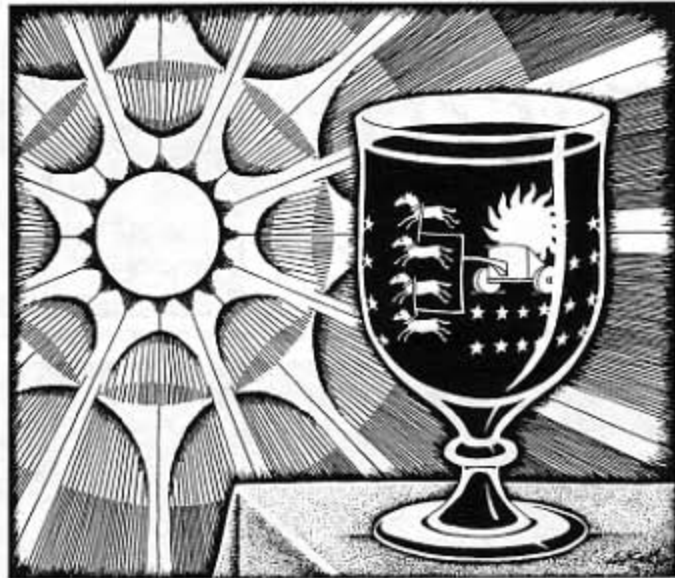
DINNER WITH THE SPEAKER

5:27 PM, Saturday, 18 March 2000

BLUE NILE RESTAURANT

2525 Telegraph Avenue, Berkeley (510) 420-8600

Please call Betty Neall at 510/533-2394 by Friday, 17 March to confirm your place. Note the time has been advanced to allow everyone to be able to get to the meeting promptly at 7:31 PM.



Crater, the Cup

is one of the lesser-known of the constellations, and for good reason: it has but four naked-eye stars. Its identity was important to the classical story tellers, though, for it surely resembles a stemmed wine goblet, and it is part of the Greek legends of Dionysus and Apollo.

Dionysus is probably more well-known as the Roman Bacchus, son of Jupiter and the mortal Semele. Juno, in one of her many displays of jealousy over Jupiter's infidelities, conceived a plot that led to Semele's death. The infant Bacchus was nurtured through childhood by the Nysæan nymphs. In gratitude, Jupiter placed the nymphs in the sky where we see them as the Hyades.

When Bacchus grew up he discovered the culture of wine. Again Juno struck, suffering Bacchus with madness and driving him away from his homeland. He was cured, however, by the goddess Rhea; and finally he settled in Greece, where he taught his knowledge of wine. Eventually he became revered by the people, and was worshiped at the Bacchanalia, frenetic celebrations in his honor. These events, which supposedly originated in spring nature festivals, became occasions for intoxication, at which the celebrants danced, drank, and generally misbehaved. Crater is supposed to be the wine cup of Bacchus.

In China, the stars of the Cup are known as the Heavenly Dog, a creature with a bad reputation. It is this beast that is responsible for causing fearsome eclipses. And, even more to be dreaded by families which come under his control, he prevents the birth of a son. There was no greater defeat for a Chinese

Welcome New Members

Please welcome these new members of the Eastbay Astronomical Society.

Jack Carpenter	Alameda
Rick Caskey	Oakland
Pat Rafferty	Oakland
Jay Reinfeld	Aventura, Florida

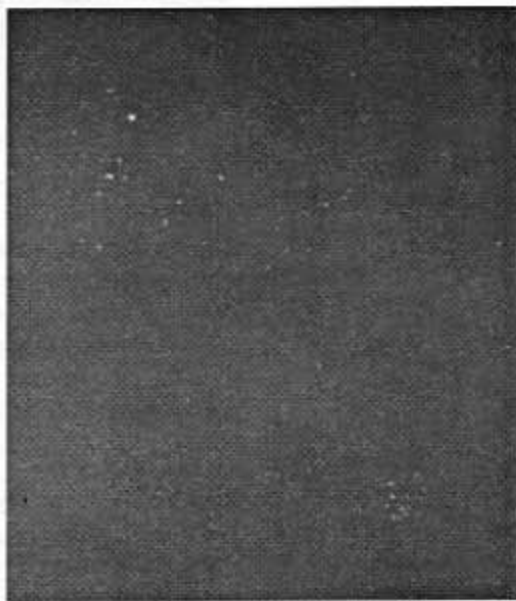
family than to fail to have a son to carry on the traditions, to make offerings at the graves of the ancestors, and to provide for the welfare of the family. The unfortunate Chinese women who have not been able to produce a son pray to Chang Hsien, who sometimes can overpower the Heavenly Dog. Chang Hsien is a white-bearded, kindly little old man whose home is in the sky among the stars near the Dog. He cannot kill the immortal scoundrel with his bow and arrow, but he can often keep the hound at bay until a son is born in answer to the family's prayers.

Crater is about 30 degrees directly south of the star Denebola in Leo. It is 20 degrees west of Spica in the constellation Virgo. It is made up of just two named stars, Al Sharasif (δ Cra, magnitude 3.8); and Alkes (α Cra, magnitude 4.2); with two other fourth-magnitude stars they form the stem of the glass.

The other stars, which form the bowl, are even more faint. There are a few double stars, and several spiral galaxies, but none are brighter than 11th magnitude.

While there are few deep-sky objects of interest in the constellation, one has been recently in the news. That is the multiple star known as HD 98800. This is comprised of a pair of pairs; one, HD 98800A consists of an orange dwarf star and a red dwarf, while the other, B, may be similar or be two orange dwarfs. Each binary pair is separated by about one Astronomical Unit, while the pairs are about 60 AU apart. The stars are 150 light-years away from us. At magnitude 9.5 and with only 0.8 arcseconds of separation, the pair is a challenge for amateurs to split. The binary pairs cannot be split at all. Last Summer, astronomers at the Steward Observatory at the University of Arizona reported their belief that HD 98800B was surrounded by a band of debris that may be similar to the asteroid belt that surrounds the Sun between the orbits of Mars and Jupiter. Their arguments are based on studies of peculiar infrared emission detected by the Hubble Space Telescope's NICMOS instrument, the Near Infrared Camera and Multi-Object Spectrometer.

Writer Ken Crowell provides a fascinating article about this unique and puzzling quadruple star system in the February, 1996 issue of *Astronomy*.



The Hyades, dominated by the bright star Aldebaran, form a V in Taurus above the Plicades in this picture Conrad Jung took in late February from his Oakland home, using a 35mm camera with a 50-mm lens stopped to f/2.5 1/2 minutes on Kodak PJM Ektapress Multispeed film.

In Case You Missed It

The Apollo space missions of 1967-1972 were perhaps the most thrilling adventures in human history. Who can forget the photo of Earthrise from the surface of the Moon? Who does not recall the sense of accomplishment at splashdown? The photo record is an accomplishment in itself.



Our speaker at the February meeting of the East-bay Astronomical Society, San Francisco photographer and artist Michael Light, presented some of the magnificent images from his widely acclaimed book *Full Moon*.

The photos also have fascinated audiences in San Francisco and London

with the exhibition *Full Moon: Apollo Mission Photographs of the Lunar Landscape*. The exhibit will reopen this month at the American Museum of Natural History/Rose Center for Earth and Space in New York.

Light gained unprecedented permission to work with the film masters from NASA's archives of over 32,000 extraordinarily beautiful photographs taken on the Apollo missions by automatic cameras and by the astronauts themselves. He made electronic scans of a selection of these masters at beyond-film grain resolution, and the prints offer a viewer wholly unprecedented clarity, scale and precision. There is nothing like them available through any channel, including NASA itself.

In his talk, Light used two projectors to exemplify the diptych format of the book, and he explained some of the artistic viewpoints that dictated his selection of the pairs.

For information about securing museum-quality prints or copies of the book, you should visit the web site www.projectfullmoon.com.

In a preliminary short presentation, Mark Gingrich announced the forthcoming meeting of The North American Sundial Society to be held in the San Francisco area. Mark remarked on the interesting tripartite sundial in Sebastopol and showed us how this instrument has been painted and refurbished since the time of Carl Trost's talk to EAS in 1998.



Remarkable Discoveries of Galileo *Continued from Page 1*

plastic. Gravimetric studies of the spacecraft's movement past the moon indicate that about five miles below the icy surface there is a sixty-mile deep shell with a density matching that of water. Although tantalizing, the evidence was not definitive. Now it appears we have the smoking gun! Two recent fly-bys of Europa detected a magnetic field with its poles thirty miles or so below the surface. Intriguingly, the position of the poles had shifted! This could only mean that the poles were being generated in an electrically conducting liquid. Since that shell has the density of liquid water and is covered by water ice, the implication is clear: five miles below the ice is a salty ocean sixty miles deep! (In comparison, the deepest spot in the Earth's oceans is the "Challenger deep" in the Marianas trench, about six miles deep.) By volume this ocean is two to two and a half times the volume of all the Earth's oceans put together—on a Moon smaller than our own!

At the bottom of this ocean are thought to be thousands of volcanos and volcanic smokers. These volcanic hot spots would generate vertical rivers of hot, distilled, fresh water that would rise and form lakes just under the ice. This gets even more exciting because it is currently thought that such smokers are where life got started in the Earth's oceans. It is also possible that since Europa lies deep within Jupiter's gravity it may have been "contaminated" by bacteria-bearing fragments thrown off the Earth by an asteroid impact. It is thought that this ocean would have been liquid since the formation of the solar system. It is therefore possible that it is teeming with life!

NASA is now considering an orbiter solely for Europa and even a lander with a robotic submarine that would melt through the ice and be connected to the surface by fiber optic cable! Sound like ice fishing to me!

Finally, as if that weren't enough, Dr. Moore will give us the latest assessment within NASA as to what went wrong with the Mars Polar Lander. This very exciting and ambitious mission would have put a lander equipped with a robot arm and stereoscopic cameras next to the Martian South Pole. It would also have been accompanied by two penetrators that would have punched several inches into the soil looking at its composition and the existence of liquid and frozen water. Nothing has been heard from any of the probes.

Dr. Jeffrey M. Moore is a Research Scientist with the SETI Institute and based at NASA Ames Research Center in Mountain View, California. Dr. Moore was born in Texas in 1953 and was raised in Pauls Valley, Oklahoma. He has both a history and a geophysics degree from the University of Oklahoma. A Lieutenant in the U.S. Army, he had been both a Tank Platoon Leader and a Battalion Staff Officer. He has both a Masters and Ph.D. in Geology from Arizona State University in Tempe. His most recent talk to EAS was in January, 1999 when his topic was "Scientific Study of Mars Since the Invention of the Telescope: Its Impact on Popular Culture."

Will the mystery of the missing Martian spacecraft ever be solved? Have we finally proved that an enormous, strange ocean exists on Europa? Might there be life there? Come to what should be a fascinating and thought-provoking EAS meeting!

By Dave Rodrigues



Roberts Rules

By Carter Roberts

Rachel is looking pretty spiffy in her new coat of paint, all ready to complete her journey from her home since 1915 to her new digs on Skyline Boulevard. Almost 1900 person-hours have been spent on Rachel and she has never looked better. Photos of some of the work can be seen on the Chabot web site at www.chabot.space.org in the news section. The 45-ft dome for Rachel was installed on February 27th and Rachel will have been set in place by the time you read this.

Construction on the new Chabot is moving ahead although the very wet weather during February has delayed progress somewhat. We have rescheduled the EAS Annual Dinner for June 10th. We hope a certificate of occupancy will be issued by then so we don't need to have a hard hat dinner!

The Chabot Board was treated to a preview of the Zeiss planetarium projector. While many features had not yet been installed, what was working was outstanding. I had my best ever naked eye view of M31!

Astronomy Day will be coming up on April 8th. In cooperation with Chabot Space and Science Center we will organize a public presence, perhaps at Jack London Square. Please join us at the EAS Board meeting on March 16 and give us your input and help in completing plans for this event. Astronomy Day was born here in 1973. EAS member Doug Berger, then president of the Astronomical Association of Northern California, decided that rather than try to entice people to travel long distances to visit observatory open houses, telescopes could be set up closer to where the people were—busy locations—urban locations like street corners, shopping malls, parks, etc. When people got a chance to look through a portable telescope, they were fascinated. They wanted to know about larger telescopes, observatories, and astronomy clubs. Astronomy Day is now an international en-

deavor; and the Astronomical League maintains an office that attempts to gain publicity for the day in general and, in cooperation with *Sky & Telescope* magazine, helps League member clubs in their activities. Astronomy Day Headquarters is directed by Gary Tomlinson at the Public Museum of Grand Rapids, Michigan.

Another event this Spring is the Annual Swap Meet hosted by the San Jose Astronomical Association. It has been said that this is the day that astronomical paraphernalia changes garages!

The date will be April 15; more information will be in next month's *Reflector*.

As of the deadline for this newsletter, only ten responses had been received to the questionnaire sent out last month. Those replies, however, contained some worthy suggestions which will be reviewed for action at the Board meetings. We want to thank those of you who have sent in their replies, and we would ask the rest of you to let us know how you may want your club to change. Please mail in your questionnaires today. A full analysis will be published



next month; responses to date show:

Five members rate our speakers and meeting topics as above average. Seven members rate the newsletter as above average; one lists it as so-so. Three members say observing opportunities are good, while one says average and one below average. Social activities are average for three members, with two members ranking them above, and one below average. The Internet site meets the approval of three respondents; two rate it as indifferent. For outreach and publicity, there were two marks for above average, one for so-so, and two below expectations. If these tallies do not add to ten—the number of forms received—it is that some people did not express an interest in the item.) The Post Office took from four to 19 days to deliver the newsletter.

Come Join the Volunteers

By Marcia Hale, Volunteer Services Manager

The volunteer recruitment for new Chabot is going well, with lots of new people signing up and attending training. There are dozens of activities in the new building with projected needs of over 500 volunteers per week. That's an ambitious goal!

Many of those projected positions will hopefully be filled by EAS members who have been helping out over the years. If you wish to volunteer in the new facility please fill out a Chabot application. An application is available on line at www.chabotspace.org or it is enclosed with this mailing. We are following school district guidelines for background checks and TB checks for volunteers, details of that will be available soon. All volunteers also attend Chabot Volunteer Orientation, Visitor Service Training, and Learner Driven Education Orientation, as well as science-related classes relevant to the area the volunteer will serve. Our insurance coverage requires all volunteers to have an application on file and to have attended training.

If you'd like a complete application packet detailing the many different options available for volunteers, please contact the Volunteer office at 510-530-3480 x26.

A big thank you to all of you who continue to make the public viewings—through Leah and your own telescopes—possible. Plus, the work done on Rachel is superb beyond belief; what a tremendous job! If you have questions about the Chabot Volunteer program please call or check the website for further details. Trainings are offered generally the final two Tuesday nights of each month and at least one Saturday all-day session.

NEAR

The Near Earth Asteroid Rendezvous mission successfully went into orbit around asteroid Eros on Valentine's day! "Fabulous data are streaming in, and Eros is turning out to be as geologically diverse and fascinating as anyone could have hoped," said Andy Cheng, NEAR Project Scientist. For those of you who would like to gander at a chunk of rock twice the size of the one that broke up the party 65 million years ago, the movie of this little tyke spinning is fairly mesmerizing. See it at <http://near.jhuapl.edu/iod/20000208/index.html>. Other images at <http://near.jhuapl.edu/iod/archive.html> are of interest, too, including some in 3-D.



Why Louis XIV Had Cold Feet

is a subtitle for the April 12, 2000, presentation of the Silicon Valley Astronomy Lecture Series. This will be a discussion by Dr. Sallie Baliunas of the Harvard-Smithsonian Center for Astrophysics on the effects of the Sun's changing activity on our own planet over time.

The lecture, "The Changing Sun and the Climate of the Earth," is free and open to the public; no science background is required. It will be in The Smithwick Theater at Foothill College in Los Altos Hills, at 7:00 PM. The session will be moderated by Dr. Andrew Fraknoi.

The following lecture in the series will be on May 3 and will feature a panel discussion of the latest discoveries about icy worlds, such as Pluto and the moons of Jupiter and Saturn. Titled "Cold, Hard Worlds at the Edge of the Solar System," this presentation will be led by Dr. Jeff Cuzzi, Dr. Dale Cruikshank, and Dr. Jeff Moore, all of NASA Ames Research Center.

To reach the location, exit El Monte Road off Interstate 280, travel west to the campus entrance; or take San Antonio Road exit from Highway 101 South, turn left on Foothill Expressway, right on El Monte Road, then west to the campus entrance. Follow the signs to parking—you will need 8 quarters for parking. Please arrive early, as seating is limited.

Co-sponsored by NASA Ames Research Center, Foothill College, The Seti Institute, and the Astronomical Society of the Pacific, this lecture series is focused on Astrobiology. More information can be obtained by phoning (650) 949-7888.

Project ASTRO

is searching for amateur or professional astronomers who would like to work with teachers in grades 4-9. This is a great opportunity to help kids learn science while sharing the wonder of astronomy with the most enthusiastic audience you can find (and you'll also sharpen your own communication skills).

Through Project ASTRO, you will be paired in a one-on-one partnerships with a Bay Area teacher at a school near you. Together, astronomer and teacher partners attend a free two-day summer training workshop where they learn effective hands-on astronomy activities and receive the 800-page curriculum resource book, "The Universe at Your Fingertips." This required workshop will be held August 11-12, 2000, at the San Mateo County Office of Education in Redwood City.

The project emphasizes ongoing partnerships, not just one-time class visits. During the school year, astronomers make at least four visits to their adopted classroom. Some partners go beyond the classroom to organize stargazing events, field trips, or astronomy clubs.

Applications are now being accepted for the 2000-2001 school year. The deadline is April 26. Space is limited to 20-25 partnerships. Forms are available from Project ASTRO, 390 Ashton Avenue, San Francisco, CA 94112; telephone (415) 337-1100 x101; email astro@aspsky.org. Forms can also be downloaded from www.aspsky.org/astro/volunteer.html.

Project ASTRO, a program of the nonprofit Astronomical Society of the Pacific, began in the Bay Area in 1993 and has now expanded to 11 other sites around the country.

Join the Eastbay Astronomical Society

Membership per year:

- | | |
|---|---|
| <input type="checkbox"/> Regular, \$24 | <input type="checkbox"/> Family, \$36 |
| <input type="checkbox"/> Contributing, \$40 | <input type="checkbox"/> Sustaining, \$60 or more |

Contact: Don Stone, EAS Membership Registrar
Telephone: (510) 336-3680 E-mail: dcdstone@earthlink.net

Eastbay



Astronomical Society

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DATELINE MARCH

- 25 1655 Discovery of Titan, Saturn's largest satellite,
Christian Huygens, Netherlands
- 13 1781 Uranus discovered, Sir William Herschel
- 13 1855 Percival Lowell birthday
- 8 1916 Public opening, Chabot's 20-in. telescope *Rachel*
- 13 1930 Pluto announced, Clyde Tombaugh
- 11 1977 Discovery of rings of Uranus,
NASA's Kuiper airborne observatory
- 25 1993 Discovery of Comet Shoemaker-Levy 9
- 5 2000 New Moon, 21:18 PST = 05:18 UT 6 March
- 12 2000 First Quarter Moon, 22:59 PST
= 06:59 UT 13 March
- 19 2000 Full Moon, 20:44 PST = 04:44 UT 20 March
- 19 2000 Spring Equinox, 23:35 PST = 07:35 20 March
- 27 2000 Last Quarter Moon, 16:23 PST
= 00:23 UT 28 March

FUTURE CONJUNCTIONS

March

- 16 7:30 PM EAS Board meeting
- 18 7:31 PM EAS Meeting, Dr. Jeff Moore
Galileo Update

April

- 8 Astronomy Day
- 8 7:31 PM EAS Meeting
- 15 SJAA Auction, San Jose
- 20 7:30 PM EAS Board meeting

May

- 13 EAS Meeting
- 18 7:30 PM EAS Board meeting

Eastbay Astronomical Society

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Treasurer, Membership: Don Stone (510) 336-3680
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Articles and photos for *The Refractor* are encouraged. Deadline for the April issue is March 9, 2000. Items may be submitted by mail to the editor, Ellis Myers, 215 Calle La Mesa, Moraga, CA 94556. Internet e-mail address: eas@silicon.com. For further information please call (925) 284-4103.

Internet: <http://silicon.com/~eas> • <http://chabot.cosc.org/~eas>

Chabot Observatory Programs • March

Planetarium programs at the Mountain Blvd. Observatory location are suspended pending the move to the new Chabot Space and Science Center.

However, through the end of March, our 8" telescope will continue to be available for free public viewing on Friday and Saturday evenings, 7 - 11 PM, weather permitting. EAS members will also have smaller telescopes set up at these times. No reservations are needed.