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## Views From Galileo

by Nancy Byrd

At the Saturday, December 5, 1998 meeting of National Capital Astronomers (NCA), Dr. Gordon Bjoraker will talk to us on the subject of The Galileo Mission, its design, history and scientific results. He will feature many of the striking images returned by the spacecraft.

Dr. Bjoraker earned his bachelor's degree at the University of Wisconsin and his PhD from the University of Arizona. He is currently a planetary astronomer in the Planetary Systems Branch at NASA's Goddard Spaceflight Center, working with the Composite Infrared Spectrometer (CIRS) instrument on the Cassini Mission. He has maintained an interest in and has fol-

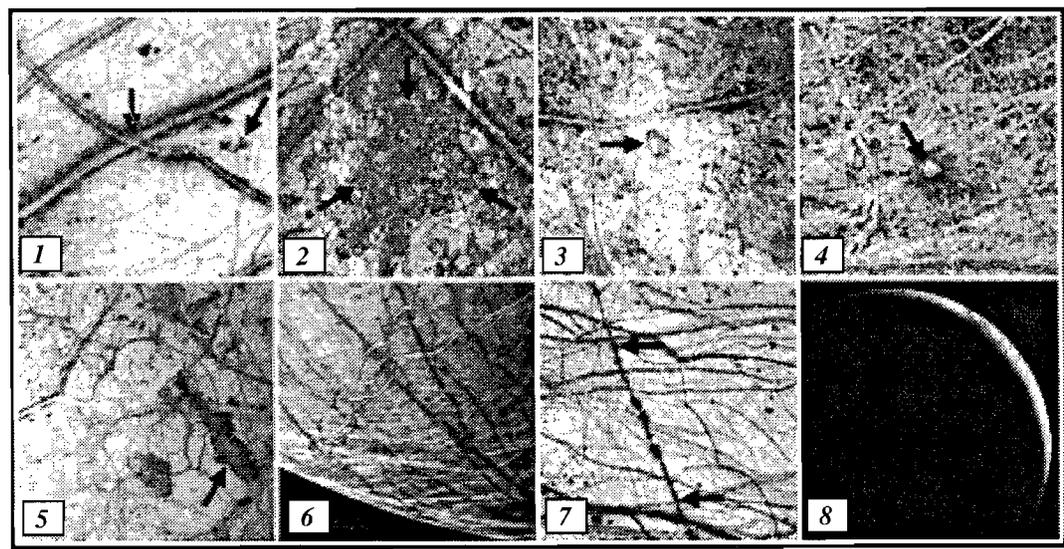
lowed closely the results of the Galileo Mission as well as the Cassini mission.

The Galileo spacecraft, designed to study Jupiter's atmosphere, satellites and surrounding magnetosphere, was launched in 1989 and is ongoing. In spite of the failure of the high gain antenna to deploy early in the mission, Galileo is certainly a huge success. On the way to Jupiter, it sent images of the asteroids, Caspra and Ida, confirming that Ida has a moon. It sent us the startling images of Jupiter's encounter with the fragments of Comet Shoemaker-Levy. It sent a probe into the Jovian atmosphere, taking valuable measurements of composition, wind velocity, transparency, air pressure,

temperature, etc. Finally, it has sent us images of the moons of Jupiter, which have forever changed our view of the Jovian system. The next satellite fly-by of Europa (November 22) will have occurred by the December 5 meeting. Additional fly-bys of Europa, Callisto and Io are planned. We look forward seeing some of these spectacular images. ☉

*Note - Leave extra time to find parking at NIH, because construction has made a mess of the campus. Our old parking is gone, and as of last month, entrance to parking under the building is not intuitive.*

### Europa Imaging Highlights



- 1) Triple bands and dark spots
- 2) Conamara Chaos
- 3) Mannan'an Crater
- 4) Cilix
- 5) Agenor Linea and Thrace Macula
- 6) South polar terrain
- 7) Rhadamanthys Linea
- 8) Europa plume search

credit:  
NASA Planetary Photojournal

## Calendar of Monthly Events

### The Public is Welcome!

NCA Home Page: <http://myhouse.com/NCA/home.htm>

**Fridays, December 4, 11, and 18, 7:30 PM** - Telescope making classes at American University, McKinley Hall Basement. Information: Jerry Schnall, 202/362-8872.

**Saturday, December 5, 5:30 PM**-Dinner with the speaker, and NCA members at Costa del Sol, 4906 Fairmont, Bethesda, MD. See map and directions on back page.

**Saturday, December 5, 7:30 PM**-NCA meeting, will feature Dr. Gordon Bjoraker, speaking on "Views From Galileo," See map and directions on back page.

**Friday, December 4, 11, and 18, 8:30 PM** - Open nights with NCA's Celestron C-14 telescope at Ridgeview Observatory; near Alexandria, Virginia; 6007 Ridgeview Drive (off Franconia Road between Telegraph Road and Rose Hill Drive). Information: Bob Bolster, 703/960-9126. Call before 6:00 PM.

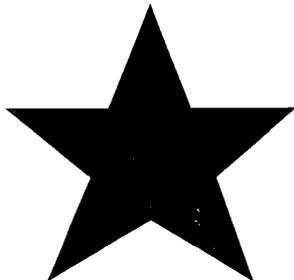
**Mondays, December 7, 14, 21, and 28, 7:30 PM** - Public nights at U.S. Naval Observatory (USNO), in Northwest Washington, D.C. (off Massachusetts Av-

enue). Includes orientation on USNO's mission, viewing of operating atomic clocks, and glimpses through the finest optical telescopes in the Washington-Baltimore region. Held regardless of cloud cover. Information: USNO Public Affairs Office, 202/762-1438. Home page: <http://www.usno.navy.mil>.

**Tuesdays, Closed** - Telescope making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Classes from November 10th through April will be cancelled due to construction and will resume in May. Information: Jerry Schnall, 202/362-8872.

See page 6 for more Washington area astronomical events. Other events too numerous to list in *Star Dust* are listed in the publications, *Sky & Telescope*, the *Astronomical Calendar 1998*, the *Observer's Handbook 1998*. NCA members can purchase all these (and much more) at a discount. Information can also be found in numerous software packages, and links available on the NCA Home Page (see above for address). To join NCA, use the membership application on page 7.

## Welcome New Members



*Happy Holidays*  
*from the Editors of*  
**Star Dust**

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# Water on the Terrestrial Planets and the Moon

*NCA Lecture given on November 7, 1998 By William J. Webster, Jr.*

*(Reported by Leith Holloway)*

Beyond the asteroid belt, water is common. In fact, the most common solid surface there is water ice of various degrees of purity. The giant planets contain substantial fractions of water in their atmospheres and rings. Twenty years ago the terrestrial planets were expected to be devoid of volatiles because of their proximity to the Sun.

As late as ten years ago, it was thought that only the Earth had water both initially and at the present time. We now know, however, that water, either liquid or solid, is present on all of the terrestrial planets, including even the Moon and Mercury in varying abundance and from various sources.

The evidence for water ice on Mars became clear with the recent Mars Pathfinder mission. Clean and unambiguous evidence of a past flood at the landing site has given credence to work suggesting that Mars was wet and warm in the geologic past. The atmospheric chemistry of Venus strongly suggests that Venus had a deep primordial ocean that was lost because of a runaway greenhouse effect.

Both the Moon and Mercury retain significant deposits of ice near their poles, presumably deposited by icy meteoroid impacts over the last two billion years. The ice has remained in place

because of the shadowing of much of their polar region by crater rims.

## **Water's Role in Planet Formation**

All of the large terrestrial planets formed with a great deal of internal water, but all of the external water and much of the internal water were lost when the Sun turned on and the planetary cores formed. The thermal activity by the Sun, core formation and impacts were sufficient to remove the water.

By three billion years ago, Mercury and the Moon were anhydrous, but by then their orbits and spins were stable. Impacts of icy bodies in highly elliptical orbits deposited ice in cold traps (sheltered crater floors near the poles) and ice began to accumulate.

Mars, Venus and the Earth all developed global oceans, and about three billion years ago, all three of these planets were wet and warm. Volcanic activity replenished those atmospheric components lost to photo-dissociation and added water to the surface.

On Venus, the greenhouse effect kicked in as a result of the increased carbon dioxide from volcanic activity. Geochemical reactions were unable to fix most of the carbon dioxide. On Mars, the volcanic activity died out and the

climate became cold. As its atmosphere dissipated, the water froze into permafrost.

Before volcanic emissions could generate a runaway greenhouse on Earth, living things became abundant enough to influence the chemical composition of the atmosphere. The carbon dioxide was fixed by biologic activity in the oceans. Oxygen became the second most abundant gas in Earth's atmosphere as a result of the increase of photosynthesis.

## **Terrestrial Planets Today and Their Exploitation**

The Moon has dry mineralogy, deposits of ice at the poles and abundant solar energy. Mercury is like the Moon, but has tremendous solar energy. Venus is hell with no water left and totally anhydrous; its greenhouse effect has run to completion. Mars is no more harsh than the Earth's poles; it has abundant ice and oxygen for mining.

Earth's environment is dominated by her oceans. The oceans exist today because of the presence of life. The future stability of the Earth's environment depends on the fixing of carbon dioxide by life (plant plankton) and by the forests.

The key to opening up the inner solar system for human habitation and economic exploitation is lunar ice. The first step is to return to the Moon and stay this time. ○

## **Astronomical Calendars for 1999**

I am again volunteering to place a bulk order for Guy Ottewell's Astronomical Calendar. As the procedure of collecting the money up front worked quite well last year, we will repeat that method. The discount is substantial for orders of four or more, and is even more this year than last because the single copy price has been increased to \$22.00, to which \$3.00 is added for mailing, for a single copy cost of \$25.00. The discount price is \$17.60 (4 or more) + \$4.00 mailing (one-shot). I am willing to collect \$18.00 from anyone who wants a copy, which means that I need 10 orders to break even. To keep things simple, I will collect \$18.00 for each copy at the December NCA meeting, so please bring payment with you. If we have fewer than 10 orders, I reserve the right to withdraw from service and refund your money, but I may not do that if we have close to 10 orders. If we have considerably more than 10 orders, I will refund according to the final cost.

Wayne Warren

## **Newsletter Deadline for January *Star Dust*, December 15, 1998**

Send Submissions to Alisa & Gary Joaquin, at [ajglj@erols.com](mailto:ajglj@erols.com) or fax submissions to 703/658-2233. Text must be in ASCII and graphics submitted must be in TIFF, GIF, or JPEG. Thank you.

## Occultations in the Mid-Atlantic States Region, December 1998 & Beyond

The better total lunar occultations during the rest of 1999 visible from throughout the Washington-Baltimore greater metropolitan area are listed below. They can be accurately timed by aiming a camcorder into a low-power eyepiece of your telescope and recording WWV with the audio:

DATE	Day	EST	Star	Mag	%	alt	CA	Notes
Dec 4	Fri	21:23	R 71 Ori	5.2	97-	34	61N	north of Mare Crisium
Dec 7	Mon	23:30	R Pi Cnc	5.6	74-	24	69N	
Dec 10	Thu	4:54	R Chi Leo	4.7	53-	55	90N	
Dec 15	Tue	4:50	R xi1 Lib	5.8	11-	8	74S	
Dec 16	Wed	5:48	R ZC 2245	6.4	6-	9	78S	
Dec 21	Mon	19:25	D pi Cap	5.2	9+	1	23S	
Dec 28	Mon	20:45	D mu Cet	4.4	78+	61	66S	
Dec 30	Wed	16:46	D Aldebaran	0.8	93+	18	68N	Sun alt. -1 deg.
Dec 30	Wed	17:38	R Aldebaran	0.8	94+	28	-64N	Sun alt. -8 deg.
Dec 31	Thu	3:53	D ZC 0741	5.7	95+	17	12S	
*** Direct camcorder (no scope needed) events, 1st half of 1999 ***								
Jan 26	Tue	18:25	D gamma Tau	3.9	74+	58	53S	need 20x camcorder; Hyades
Jan 27	Wed	0:36	D ZC 0677	4.8	76+	29	51S	need 35x camcorder; Hyades
Jan 27	Wed	2:52	D Aldebaran	0.8	77+	4	84N	12x; shortly before moonset
*** Dates and times below are EDT ***								
Apr 19	Mon	21:15	D 119 Tauri	4.7	20+	29	80S	need 20x camcorder
May 22	Mon	0:19	D Regulus	1.3	49+	19	87N	8x; Naked-eye event

“D” following the time denotes a disappearance, while “R” indicates that the event is a reappearance. The Dec. 30th “D” of Aldebaran might be recorded with 12x or greater camcorders directly, no telescope needed. The times are for Greenbelt, MD, and will be good to within +/- 1 min. for other locations in the Washington-Baltimore metropolitan areas unless the cusp angle (CA) is less than 30 deg., in which case, it might be as much as 5 minutes different for other locations across the region.

“Mag” is the star’s magnitude. “%” is the percent of the Moon’s visible disk that is sunlit, followed by a + indicating that the Moon is waxing and - showing that it is waning. So 0 is new Moon, 50+ is first quarter, 100+ or - is full Moon, and 50- is last quarter. The Moon is crescent if % is less than 50 and is gibbous if it is more than 50.

“CA” Cusp Angle is the angle of event measured around the edge of the Moon’s disk, measured from the nearest cusp, N (north) or S (south). Negative values indicate a bright limb event, while positive values are for the more common (rather, more observable) dark-side event. 0N would mean that the event would be right at the Moon’s cusp (near its north pole), while 90N or 90S would place it at the center of the Moon’s dark side, near the lunar equator.

### Presidential Comments

*Andrew W. Seacord, II, President*

The request for a TV and VCR for NCA meetings has been answered. The Joaquins have donated a VCR and Harry Tanner has donated a 19-inch TV. I also want to thank Wayne Warren for his efforts in acquiring a TV. Presently, the TV and VCR reside in my study, sitting next to my 10-inch Meade LX 2000. The TV just (barely) fits in the trunk of my Saturn. If anyone has (1) room to store the RV and VCR, (2) a larger

vehicle (Metro does not count!) and(3) will be able to transport them to an NCA meeting when needed, I would like to hear from you!

Also, I would like to take this opportunity to thank the many members - those on the board and others - who keep NCA running. This includes Alisa and Gary Joaquin for their work on the Star Dust, Nancy Byrd for acquiring excellent speakers, Nancy Grace Roman for

keeping the membership records and mailing the renewal notices, Jeff Norman for managing the treasury, Jay Miller for providing our meeting place, and Joe Morris for coordinating the Exploring The Sky program (We get 40 people even on a totally overcast night!!). I also want to thank those who have written, and will write, the review for each of our monthly lectures. Many thanks to all. ○

## Planned Grazing Occultation Expeditions

As the Moon moves, the occultation shadow sweeps across the Earth's surface, defining a region of visibility of the occultation. At the northern and southern edges, or limits, of this region of visibility, the star appears to move along a line just tangent to the Moon's disk, and an grazing occultation occurs, with the star disappearing and reappearing repeatedly among the mountains and craters in the lunar polar areas. We organize expeditions to these lines to set up telescopes across the approximately two mile wide graze zone; by timing the successive events at several locations, the profile of the lunar mountains can be accurately traced. The timing methods are quite simple (a car radio, and either a tape recorder or camcorder can be used) and some extra equipment, even telescopes, are available for those who need them and who can fit these interesting events into their schedule. IOTA's Web site given at the bottom has more information about them.

DATE	Day	EST	Star	Mag	%	alt o	CA	Location
Dec 12	Sat	7:45	gamma Vir	2.9	34-	49	6S	Wilmington, DE (Sun +4 deg.)
Dec 13	Sun	4:46	65 Vir	5.9	26-	26	2S	Allentown & Trenton, NJ
Dec 15	Tue	6:39	ZC 2135	7.1	11-	25	3S	Doswell, VA
Dec 26	Sat	23:35	ZC 0128	7.3	57+	14	2N	Mattawoman, MD & Woodbridge, VA
*** Approximate information about the better 1999 grazes, EDT Apr-Sep ***								
Jan 28	Wed	2:02	119 Tauri	4.2	85+	25	8N	Aberdeen, MD
Apr 19	Mon	20:25	ZC 823	6.6	20+	38	2S	Beltsville, MD; Sun alt. -8deg.
Jun 2	Wed	0:09	xi2 Sgr	3.6	92-	13	14S	Mt. Holly & Willingboro, NJ
Sep 4	Sat	4:28	64 Orionis	5.2	34-	36	10N	Pittsburgh, PA

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## Asteroidal Appulses, 1998 December to 1999 early January

More challenging than lunar events are occultations of stars by asteroids. Those with good finder scopes and/or setting circles who can find deep sky objects or variable stars are especially encouraged to monitor close approaches, called appulses, that are listed below, since an occultation is possible in Maryland or adjacent States. We often get rather good astrometric updates for these events a few days in advance, making it sometimes worthwhile to travel to the updated path, which is usually about 100 miles wide. See below for updates, and check IOTA's asteroidal Web site, <http://www.anomalies.com/iota/splash.htm> for more information about these events.

DATE	Day	EST	Star	Mag	Asteroid	dmag	dur.ap. s in.	Occultation Location
Dec 10	Thu	23:36	SAO 077824	10.1	Vera	1.7	8 8	s. Quebec
Dec 21	Mon	19:59	SAO 077608	8.9	Vera	2.6	8 4	Lake Superior
Dec 23	Wed	19:07	PPM 206242	9.5	Pales	3.5	5 6	e. NC, se VA
Dec 29	Tue	4:51	TAC -5d7818	10.8	Lutetia	2.2	4 8	w. PA, MD, DE
Dec 31	Thu	6:09	PPM 228349	9.5	Charybdis	5.2	4 6	w. PA, MD, DE
Jan 5	Tue	19:44	ACT29671618	9.6	Bettina	2.2	8 6	n.VA, s. & e. MD, DE, s. NJ
Jan 7	Thu	1:13	59 Orionis	6.0	Chaldaea	5.4	14 1	NY, s. New England

Notes:

Dec. 23: Pales has a light curve suggesting an unusual shape or even a large satellite.

Phone the IOTA occultation line, 301-474-4945, for updates and details, or check IOTA's Web site at <http://www.sky.net/~robinson/iotandx.htm> For asteroidal occultations, finder charts can be found at <http://members.home.net/dega/astchart.htm> Good luck with your observations.

## National Capital Area Astronomical Events

Free Lectures at the Einstein Planetarium and Other Daily Events  
National Air & Space Museum

202/357-1550, 202/357-1686, or 202/357-1505 (TTY)

Home page: <http://www.nasm.edu>

### Other Area Astronomical Events

**Arlington Planetarium, Arlington, VA** — "tis the Season", Dec. 4-20, 7:30 PM Fri. & Sat., 1:30 & 3:00 PM Sun. Matinees. (Admission to all events: \$2.50/Adults. \$1.50/Sr. Citizens & Children 12 & under.)

**Campus Observatory, Depart. of Astronomy, University of Maryland, College Park** — "Our Nearest Neighbors", Speaker, Dr. Stephen White, Dec. 20, 8:00 PM.

**Campus Colloquia, Depart. of Astronomy, University of Maryland, College Park** — "The Hubble Deep Fields", Speaker, Dr. Henry Ferguson, Dec. 2, 4:00 PM.

**Carnegie Institute of Washington, Depart. of Terrestrial Magnetism, Washington, DC** — Seminars held

Wednesdays in the Seminar Room of the Main Building.

"TBA", Speaker, Donald Lyndel-Bell, Dec. 4, 11:00 AM.

"Giant Planet Formation: Core Accretion or Disk Instability", Speaker, Alan Boss, Dec. 16, 8:00 PM.

**Maryland Space Grant Observatory** — Open House every Friday evening (weather permitting), Bloomberg Center of Physics and Astronomy, Johns Hopkins University, Baltimore, MD. Information: 401/516-6525 or check their web site at [www.pha.jhu.edu/facilities/observatory/telescope.html](http://www.pha.jhu.edu/facilities/observatory/telescope.html).

**Montgomery College's Planetarium, Takoma Park** — "The Day the Sun's Return: the Winter Solstice", Dec. 21, 7:00 PM.

### NASA Goddard Scientific Colloquia

— All colloquia will be held in the Building 3 Auditorium at 3:30 pm.

"Searching for Gravitational Waves with the Laser Interferometer Gravitational Wave Observatory (LIGO)", Speaker, Stanley Whitcomb, Dec. 4, 8:00 PM.

"Planetary Nebulae with Hubble Space Telescope", Speaker, Howard Bond, Dec. 11, 8:00 PM.

### Space Telescope Science Institute (STScI)

— Free lectures held the first Tuesday of each month at 8:00 PM in the STScI Auditorium at Johns Hopkins University. Following the lecture visit the Maryland Space Grant Observatory. Free parking is available.

"Semi-analytical models of galaxy formation and the high red-shift universe," Speaker, Cedric Lacy, Dec. 3.

"Process in Galactic Chemical Evolution from Ground-Based Near UV Spectroscopy," Speaker, Jeremy King, Dec. 7.

"The Fundamental Plane and Luminosity Function of Gravitational Lenses," Speaker, Chris Kochanek, Dec. 9.

"Massive Stars in the Galactic Center," Speaker, Don Figer, Dec. 11.

"Mass Inflow in Barred Galaxies and its Effect on the Evolution of the Nuclear Regions of Galaxies," Speaker, Mike Regan, Dec. 16.

TBA, Speaker, Stefano Casertano, Dec. 18.

### US Naval Observatory Colloquia

— All Colloquia will take place in Bldg. 52, Room 300, with coffee and cookies at 10:00, talk at 10:30, and lunch at 12:00

"The Future of the Origins Program", Speaker Dr. Harley Thronson, Dec. 4.

## Meteor Showers

### Full Moon

1998 December 3

### Major Activity

Radiant	Duration	Maximum
Geminids (GEM)	December 6-19	Dec. 13 at 22 hours UT

### Minor Activity

Radiant	Duration	Maximum
Delta Arietids	Dec. 8-Jan. 2	Dec. 8/9
11 Canis Minorids	Dec. 4-15	Dec. 10/11
Coma Berenicids	Dec. 8-Jan. 23	Dec. 18-Januray 6
Sigma Hydrids	Dec. 4-15	Dec. 11/12
Monocerotids	Nov. 9-Dec. 18	Dec. 11/12
N. Chi Orionids	Nov. 16-Dec. 16	Dec. 10/11
S. Chi Orionids	Dec. 2-18	Dec. 10/11
Phoenicids	Nov. 29-Dec. 9	Dec. 5/6
Alpha Puppids	Nov. 17-Dec. 9	Dec. 2-5

### Daylight Activity

None



Don't throw this newsletter away. If you're finished with it, pass it on to someone else to read or recycle it. It's right for astronomy and the environment.

## National Capital Astronomers, Inc.

### SERVING SCIENCE & SOCIETY SINCE 1937

NCA is a non-profit, membership supported, volunteer run, public-service corporation dedicated to advancing space technology, astronomy, and related sciences through information, participation, and inspiration, via research, lectures, presentations, publications, expeditions, tours, public interpretation, and education. NCA is the astronomy affiliate of the Washington Academy of Sciences. All are welcome to join NCA.

### SERVICES & ACTIVITIES:

**Monthly Meetings** feature presentations of current work by researchers at the horizons of their fields. All are welcome; there is no charge. See monthly *Star Dust* for time and location.

**NCA Volunteers** serve as skilled observers frequently deploying to many parts of the National Capital region, and beyond, on campaigns and expeditions collecting vital scientific data for astronomy and related sciences. They also serve locally by assisting with scientific conferences, judging science fairs, and interpreting astronomy and related subjects during public programs.

**Discussion Groups** exchange information, ideas, and questions on preselected topics, moderated by an NCA member or guest expert.

**Publications** received by members include the monthly newsletter of NCA, *Star Dust*, and an optional discount subscription to *Sky & Telescope* magazine.

**NCA Information Service** answers a wide variety of inquiries about space technology, astronomy, and related subjects from the public, the media, and other organizations.

**Consumer Clinics** on selection, use, and care of binoculars and telescopes, provide myth-breaking information, guidance, and demonstrations for those contemplating acquiring their first astronomical instrument.

**Dark-Sky Protection Efforts** educate society at large about the serious environmental threat of light pollution, plus seek ways and means of light pollution avoidance and abatement. NCA is an organizational member of the International Dark-Sky Association (IDA), and the National Capital region's IDA representative.

**Classes** teach about subjects ranging from basic astronomy to hand-making a fine astronomical telescope. NCA's instructors also train educators in how to better teach astronomy and related subjects.

**Tours** travel to dark-sky sites, observatories, laboratories, museums, and other points of interest around the National Capital region, the Nation, and the World.

**Discounts** are available to members on many publications, products, and services, including *Sky & Telescope* magazine.

**Public Sky Viewing Programs** are offered jointly with the National Park Service, the Smithsonian Institution, the U.S. Naval Observatory, and others.

**NCA Juniors Program** fosters children's and young adults' interest in space technology, astronomy, and related sciences through discounted memberships, mentorship from dedicated members, and NCA's annual Science Fair Awards.

**Fine Quality Telescopes** up to 36-cm (14-inch) aperture are available free for member's use. NCA also has access to several relatively dark-sky sites in Maryland, Virginia, and West Virginia.

### YES! I'D LIKE TO JOIN THE NATIONAL CAPITAL ASTRONOMERS

Enclosed is my payment for the following membership category:

Regular

*Sky & Telescope* and *Star Dust*. (\$54 per year)

*Star Dust* only (\$27 per year)

Junior (Only open to those under age 18) Date of birth: \_\_\_\_\_

*Sky & Telescope* and *Star Dust*. (\$42 per year)

*Star Dust* only (\$15 per year)

\_\_\_\_\_  
First name(s) Last name ( ) Telephone E-mail

\_\_\_\_\_  
Street or Box Apartment City State Zip Code + 4

If family membership, list names of additional participating immediate family members in same household, with birthdates of all those under 18 years old: \_\_\_\_\_

**Note:** If you already subscribe to *Sky & Telescope*, please attach a recent mailing label. You may renew this subscription through NCA for \$27 when it expires.

Make check payable to: **National Capital Astronomers, Inc.**, and send with this form to:

**NCA c/o Jeffrey B. Norman, 5410 Connecticut Avenue, NW, Apt. #717, Washington, D.C. 20015-2837.**

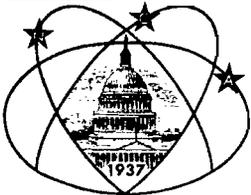
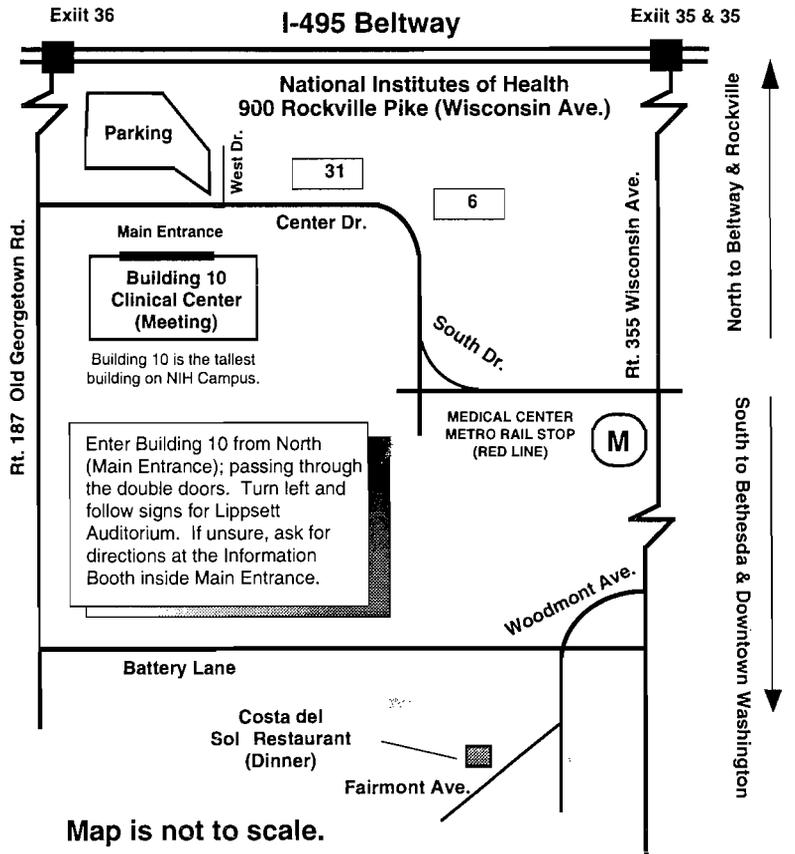
The following information is optional. Please indicate briefly any special interests, skills, education, experience, or other resources which you might contribute to NCA. **Thank you, and welcome to NCA!**

# Getting to the NCA Monthly Meeting

**Metrorail Riders** - From Medical Center Metro Station: Walk down the hill, pass the bus stops and turn right at the anchor onto Center Drive. Continue uphill to Building 10, the tallest building on campus (walking time about 10 minutes). Also, the J2 bus line connects the Bethesda (7:16 PM) and NIH (7:23 PM) Metro stops with Building 10 (7:25 PM).

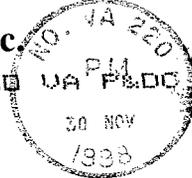
**To Costa del Sol**- Take Wisconsin Avenue toward Bethesda and head right onto Woodmont. Take a right onto Fairmont Ave. The address is 4906 Fairmont. There should be adequate parking on the street outside the restaurant. Seats are not guaranteed after 5:30 PM.

*Star Dust* is published ten times yearly (September through June) by the National Capital Astronomers, Inc. (NCA), a nonprofit, astronomical organization serving the entire National Capital region, and beyond. NCA is the astronomy affiliate of the Washington Academy of Sciences and the National Capital region's representative of the International Dark-Sky Association. President: Andrew Seacord, 301/805-9741. Deadline for *Star Dust* is the 15th of the preceding month. Editors: Alisa & Gary Joaquin, 4910 Schuyler Dr., Annandale, VA 22003, 703/750-1636, E-mail: ajglj@erols.com. Editorial Advisor: Nancy Byrd *Star Dust* © 1998, *Star Dust* may be reproduced with credit to National Capital Astronomers, Inc.



## National Capital Astronomers, Inc.

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**FIRST CLASS**

**DATED MATERIAL**

Wayne H Warren, Jr  
 8001 Brett Pl  
 Greenbelt MD 20770-3001  
 3/31/99

