Star Dust

National Capital Astronomers, Inc. **http://capitalastronomers.org**

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May Speaker: Dr. John C. Pearl,"Into Saturn's Realm: Results from the Cassini/Huygens Mission"

Submitted by Jeff Guerber

Dr. John C. Pearl will present the talk "Into Saturn's Realm: Results from the Cassini/ Huygens Mission" at the May 7 meeting of the National Capital Astronomers..

Abstract of Talk

The Cassini spacecraft, together with the Huygens probe, first orbited Saturn on July 1, 2004. Important discoveries have followed. The composition of the magnetosphere includes relatively abundant H_3O^+ ions that arise principally from the icy satellites and rings. Phoebe, a heavily cratered satellite, has CO_2 and organics on its surface, as has Iapetus. Iapetus is now shown to be heavily cratered, and to possess a 20-km high mountain belt around much of its equator. Enceladus possesses an amazing variety of landforms that indicate numerous episodes of surface activity. Saturn's main ring system shows ringlets and waves at the finest scales observed. Saturn's equatorial winds appear to be

(Continued on page 2)

Review of talk by Dr. Michael J. Mumma: "The Organic Origins Observatory"

by Dr. Walter L. Faust

Dr. Michael J. Mumma was one of the speakers at the April 2 meeting of the National Capital Astronomers at the University of Maryland Astronomy Observatory. He spoke on the topic ."The Organic Origins Observatory" The following is a review of his talk by Dr. Walter L. Faust.

Dr. Mumma began with a discussion of the molecular species with which Earth began its story as a cradle of life-forms, according to the origins of these species within the proto-solar disk. His account exhibited a remarkably detailed picture of this very complex history, and of ongoing research. He began by listing three current Astrobiology Initiatives under the NASA Discovery Program: the Organic Origins Observatory [principal topic today], The Mars Organic Observatory [minor], and The Analysis of Returned Samples [not today].

Earth accumulated a steady rain of icy planetesimals.

At ~20 My age, Earth experienced a giant impact with a Mars-sized object. The debris developed into Mars and the Moon. The Moon formed largely of silica, with some iron. Earth acquired an iron core. For ~ 400 My thereafter, Earth accumulated a steady rain of icy planetesimals, perhaps also with prebiotic organics from cometary nuclei. The concern being with the specific origins of the latter, we inquire how to learn more. The key lies in the D/H isotopic ratio in comets, vs. Earth's water. Dr. Mumma introduced the factors involved here with a slide depicting the proto-Sun, its accretion disk, materials in-migrating from the interstellar medium, and cosmic rays. Studying these factors involves ion-molecule chemistry, photochemistry, thermochemistry, and mixing.

(Continued on page 3)

Review of talk by Mr. Ian Jordan: "UMBRAS: The External Occultation Technique for Observing Exoplanets"

by Dr. Walter L. Faust

This review will appear in the June *Star Dust.*

NCA Events This Month

The Public is Welcome!

NCA Home Page: http://capitalastronomers.orgt

NCA Mirror- and Telescope-making Classes: Fridays, May 6, 13, 20, and 27 6:30 to 9:30 P.M. at the Chevy Chase Community Center, at the northeast corner of the intersection of McKinley Street and Connecticut Avenue, N.W. Contact instructor Guy Brandenburg at 202-635-1860 or email him at gfbrandenburg @yahoo.com.

Observing with NCA's 14-inch telescope: Sunday, May 8, and Saturdays, May 21 and28 Mike McNeal's backyard, 5410 Grove St, Chevy Chase, MD, (Friendship Heights Metro). Please make reservations by 10 p.m. the Friday before. See more information on this page. Call Mike at 301-907-9449 or e-mail him at mcnealmi@verizon.net to let him know you are coming.

Exploring the Sky: Saturday, May 14 with NCA's 14-inch and other telescopes in Rock Creek Park, DC. See next page.

Open house talks and observing at the University of Maryland Observatory in College Park on the 5th and 20th of every month at 9 P.M. The talks are non-technical. There is telescope viewing afterward if the sky is clear.

NCA meeting: Saturday, May 7 at 7:30 P. M. at the University of Mary-land Astronomy Observatory on Metzerott Road in College Park, MD. There is observing through the observatory's telescopes at the end of the meeting if the sky is clear.

Dinner with NCA members and speaker: Saturday, May 7 at 5:30 P.M., preceding the meeting, at the Garden Restaurant in the University of Maryland University College Inn and Conference Center. See map and directions on Page 6.

If you are planning to come to the dinner before the meeting, please tell Benson J. Simon, telephone: 301-776-6721, e-mail st88@ioip.com, so that we can make reservations for the right number of people.

Upcoming NCA Meetings
2005: May 7, and June 4

Observing with the NCA C-14

Mike McNeal

Day, Date and Time	Prime Objects
Sun., May 8, 9:00 P.M.	Saturn
Sat., May 14, 9:00 P.M.	(at *Exploring the Sky*)
Sat., May 21, 9:30 P.M.	Jupiter, M31
Sat., May 28, 9:30 P.M.	M51

In Mike McNeal's backyard, 5410 Grove St, Chevy Chase, MD, (Friendship Heights Metro).

Please make reservations by 10 p.m. the Friday before.

Call Mike at 301-907-9449 or email him at mcnealmi@verizon.net to let him know you are coming.

May Speaker, *continued*

(Continued from page 1)
considerably slower than when observed by Voyager. A crown jewel of the mission to date is the successful descent of the Huygens probe onto Titan, revealing super-rotating winds, a nearly uniformly mixed haze, and a surface with a wide range of puzzling characteristics. And these results represent only the beginning of the four-year tour.

Bio
Present Position: AST, Space Sciences (Planetary Astronomer) Planetary Systems Branch, Laboratory for Extraterrestrial Physics.
Research Area Experience: Free molecular flow in cavities; kinematics of electron impact excitation of atoms to metastable states; co-investigator on Mariner 9 (Mars orbiter) infrared spectroscopy experiment; planetary atmospheric pressure determination from infrared spectra; co-investigator on Voyager (outer planet flyby mission) infrared spectroscopy experiment; thermal infrared studies of outer planets' satellites; co-investigator on Mars Global Surveyor (orbiter) thermal emission spectroscopy experiment; co-investigator on Cassini (Saturn orbiter) infrared spectroscopy experiment.

Education:
1961 - B.S.E., University of Michigan
1963 - M.S., University of Michigan
1970 - Ph.D., Physics, Univ. of Michigan
Project Working Groups:
Voyager Satellites WG
Cassini Satellite Surfaces WG
Cassini Satellite Orbiter Science Team (SOST)
Cassini Atmospheres Target Working Team
Cassini Cross-Discipline Target Working Team
Cassini Rings Target Working Team,
Cassini Magnetosphere Target Working Team

Publications
Author or co-author of over fifty papers,
From 1969: " Detection of Metastable Atoms and Molecules with Continuous Channel Electron Multipliers," D.P. Donnelly, J.C. Pearl, R.A. Heppner, and J.C. Zorn, *Rev. Sci. Inst.* **40**: 1242.
To: 2005: "Atmospheric Temperatures, Winds, and Composition " F. M. Flasar, R. K. Achterberg, et al., submitted to *Science*.

Do You Want to Get *Star Dust* Electronically?

Any member wishing to receive *Star Dust,* the newsletter of the National Capital Astronomers, via e-mail as a PDF file attachment, instead of hardcopy via U.S. Mail, should contact Nancy Grace Roman, the NCA Secretary, at nancy.roman6@verizon.net or 301-656-6092 (home).

Exploring the Sky
by Joe Morris

2005 Schedule

Date	Time	Notes
5/14	9:00 P.M.	Moon and Saturn near Gemini; Beehive cluster
6/11	9:00 P.M.	The Big Dipper and the Summer Triangle
7/16	9:00 P.M.	10-day-old Moon; Jupiter in the western sky
8/27	8:30 P.M.	Pegasus and Andromeda rising; Hercules
9/24	8:00 P.M.	Rock Creek Park Day; Andromeda Galaxy
10/8	7:30 P.M.	Draconid meteor shower peak 10/8
11/5	7:00 P.M.	Pleiades; possible Taurids meteor shower

Exploring the Sky is an informal program that for nearly fifty years has offered monthly opportunities for anyone in the Washington area to see the stars and planets through telescopes from a location within the District of Columbia.

Sessions are held in Rock Creek Park once each month on a Saturday night from April through November, starting shortly after sunset. We meet in the field just south of the intersection of Military and Glover Roads NW, near the Nature Center. A parking lot is located immediately next to the field.

Beginners (including children) and experienced stargazers are all welcome—and it's free!

Questions? Call the Nature Center at (202) 895-6070 or check the Internet sites: http://www.nps.gov/rocr/planetarium http://www.capitalastronomers.org

A presentation of the National Park Service and National Capital Astronomers.

Congratulations to NCA Science Fair Winners!

We are pleased to announce the winners in the 2005 science fair judging. They are:

Fairfax County Regional Science and Engineering Fair
Hillary A. Dennison, *The Effect of Filters on the Clarity of Saturn*

Prince George's Regional Science Fair
Phillip M. Hannam, *X-ray interference at 8.35 Å*

Patrick M. Hanns, *Nature of the Peaks in the Lunar Crater Copernicus*

Katarzyna A. Oldak, *Laplacian Orbit Determination*

Montgomery Area Science Fair
Abbey Fraeman, *Modeling the distribution of extra solar comets around the star IRC+10216*

Renee Park, *Effects of Atmospheric Turbulence on Simulated Starlight in a Low-Pressure Telescope Environment*

Judges: Bob Bolster, Steve Robinson, and Wayne Warren.

These science fair winners will be honored at the May NCA meeting. They will bring their projects to the meeting, where each will give a three to five-minute summary of his or her project. Each student will be presented with a certificate. The award also includes a one-year membership in NCA with a one-year subscription to *Sky and Telescope.*

Review of talk by Dr. Michael J. Mumma, *continued*

(Continued from page 1)

[Reviewer: Ion-molecule reactions start with collisions between radicals and molecules. Because of attractive polarization forces, these are characterized by: very large cross sections, high yields, and skeletal scrambling. The cross sections emerge from an orbital calculation for a $1/r^3$ attractive center.]. Our probes include UV, optical, and x-ray spectroscopy.

From Dr. Mumma's humorously anthropocentric perspective, the significance of stars lies in the creation of heavy nuclei and as potential suns furnishing gravity for planetary systems, and supplying them heat and light.

Two families of comets are recognized, as distinguished by origin: those from the Oort Cloud, and those associated with Jupiter (earlier thought to come from the Kuiper Belt). Using images of IP/Halley, 19P/Borrelly, and 81P/Wild-2, he illustrated that their gross appearance does not correlate with origin, but with age and attendant loss of overburden.

He described the gross appearance of three comets.

Emphasizing that impacts were quite frequent early-on, Dr. Mumma described:

- Efforts to construct a taxonomy of chemical processes based on interstellar heritage, dependence upon the radial distance from the Sun, and especially the chemical gradients in the protoplanetary disk. The chemistry was diverse. In environments exceeding their sublimation temperatures, ices vanished (those of H_2O, CH_4, CO …). Hence, those found are primordial, the temperatures never having been high.
- Characterization of organic volatiles and water in dozens of comets, hundreds of circumstellar disks, dozens of exoplanets, and other solar system planets.

The prior picture of simple accumulation from micron-sized icy granules has been replaced as follows: Most of the cometary flux at early Earth was due to gravitational

(Continued on page 5)

The deadline for the June Star Dust is May 15. Please send your material to Elliott Fein by that date to ensure inclusion. Send submissions to Elliott Fein at elliott.fein@erols.com.

Articles submitted may be edited to fit the space available.

Mid-Atlantic Occultations and Expeditions

by David Dunham

Asteroidal Occultations

Date	Day	EDT	Star	Mag	Asteroid	dmag	s	in.	Location
May 10	Tue	22:25	TYC18820135	11.4	(106) Dione	2.2	4	7	sOH,sWV,sVA
May 14	Sat	2:13	PPM 292574	9.9	Honda	5.5	2	6	Carolinas?
May 16	Mon	3:28	TYC57150773	10.8	4835 1989BQ	7.3	4	6	MD; NY? NC?
May 18	Wed	3:47	2UC22321398	11.7	Garumna	3.5	5	8	NC; sVA?
May 20	Fri	21:26	TYC13920962	9.7	Kassandra	3.6	3	4	ePenn,NJ,NYC
Jun 3	Fri	22:56	TYC14001181	10.4	Sulamitis	4.8	2	5	OH,sWV,wVA,eNC
Jun 5	Sun	3:39	TYC50180409	11.6	Ornamenta	2.3	8	8	nNewEngland,NY

Grazing Occultations

Date	Day	EDT	Star	Mag	% alt	CA	Location
May 11	Wed	22:37	SAO 78191	7.7	13+ 12	12N	Hagrstn,Dmascs,Ashtn,Laurel,MD
May 11	Wed	23:07	X08773	9.9	13+ 6	12N	Opal,Stafford,&KingGeorge,VA
May 12	Thu	22:46	ZC 1093	6.6	20+ 17	12N	Sheril&Kingston,NY&NwMilfrd,CT
May 17	Tue	0:47	SAO 99175	8.8	57+ 22	10N	NwFreedom,PA;Fallston&Joppa,MD

Total Lunar Occultations

Date	Day	EDT	Ph	Star	Mag	% alt	CA	Sp.	Notes
May 11	Wed	21:17	D	ZC 952	8.0	13+ 26	83S	K2	
May 11	Wed	22:30	D	SAO 78191	7.7	13+ 45	17N	A0	Graze, n.DC suburbs
May 11	Wed	22:41	R	SAO 78191	7.7	13+ 45	7N	A0	
May 12	Thu	22:16	D	47 Gem	5.8	20+ 24	7S	A4	ZC 1088
May 12	Thu	22:35	D	ZC 1093	6.6	20+ 21	45N	F8	dbl,see graze note above
May 13	Fri	0:21	D	ZC 1105	6.5	21+ 2	65S	G7	Az303;mg2 7.0 ".1,PA 247
May 13	Fri	21:02	D	ZC 1211	6.3	28+ 46	-3S	A1	D dark Baltimore & n.e.
May 13	Fri	21:43	D	SAO 79888	8.2	28+ 38	8S	K5	
May 14	Sat	0:27	D	SAO 79980	7.3	29+ 8	57N	G8	Azimuth 295 deg.
May 14	Sat	21:36	D	ZC 1330	7.8	37+ 47	66N	G5	
May 14	Sat	22:11	D	SAO 80499	8.2	38+ 40	36S	K0	
May 14	Sat	22:55	D	SAO 80514	8.5	38+ 32	50S	A	close equal dbl,sep ".1
May 14	Sat	23:18	D	ZC 1334	7.0	38+ 28	64N	G5	
May 15	Sun	22:54	D	SAO 98737	8.4	47+ 38	69S	G5	
May 16	Mon	21:41	D	SAO 99149	7.1	57+ 55	69N	A2	
May 17	Tue	1:26	D	SAO 99185	7.9	58+ 15	65N	A3	Azimuth 274 deg.
May 18	Wed	22:37	D	ZC 1732	6.8	76+ 49	47N	K0	close equal dbl,".1,P129
May 19	Thu	20:56	D	ZC 1824	7.8	84+ 45	89N	G0	Sun alt. -7 deg.
May 19	Thu	23:26	D	SAO 138955	7.2	84+ 42	57S	K2	
May 24	Tue	4:18	D	Antares	1.1	100- 14	-24N	M1	Az. 219; ZC 2366
May 24	Tue	5:21	R	Antares	1.1	99- 5	82S	M1	Az. 230; term. 9" away
May 24	Tue	23:15	R	43 Oph	5.3	97- 10	44N	K4	ZC 2505; Az. 140 deg.
May 26	Thu	0:22	R	ZC 2688	7.0	92- 10	50S	G6	Azimuth 141 deg.
May 27	Fri	3:00	R	SAO 188501	7.8	84- 20	37S	K0	
May 27	Fri	4:24	R	ZC 2885	7.6	83- 24	81N	K0	
Jun 1	Wed	4:57	R	SAO 128716	8.0	29- 24	62N	K2	Sun alt. -8 deg.
Jun 4	Sat	4:13	R	ZC 407	7.2	6- 2	44S	K0	Azimuth 69 deg.

David Dunham, e-mail dunham@starpower.net, more info. http://iota.jhuapl.edu
Phone home 301-474-4722; office 240-228-5609; car 301-526-5590

Review of talk by Dr. Michael J. Mumma, *continued*

(Continued from page 3)
deflection by Jupiter and Saturn from nearby material, which indeed began with 95% of the mass of the Solar system. This cometary material has largely been exhausted, ejected by Jupiter and Saturn into interstellar space. Some objects formed the Oort cloud. The Kuiper Belt comprises others, evidently of the same composition, further pushed out by Neptune. Hence the Oort Cloud is a repository of material we wish to study.

To sort out these issues, Dr. Mumma asserted the need for new observatories: to measure the DHO/ H_2O ratio and compare it with Earth's ocean; to separate several dozen organic species; and to distinguish native vs. distributed sources of volatiles. High angular resolution is needed, of 0.6 arc-sec pixels, a 10 arc-sec slit on the sky.

We need to measure chemical heterogeneities within the cometary nuclei; and to track changes over minutes, hours, and days, so as to discern distinct emissions from different vents, etc. on rotating objects. High spectral resolving power is requisite, and no presently orbiting system meets the requirements. Nothing aloft has such resolving power.

Dr. Mumma displayed two dozen catalogued chemical species. He stated that such a system can also be used upon the atmospheres of planets around other stars, studying the chemical gradients. He showed some very recent results and pointed out that such instruments could also be employed to study Mars, studying methane, ethane, formaldehyde, etc.

Organic Origins Observatory
Representative performance was given for the following parameters.

- Spectral range and resolution: The prime wavelength range is 2.5 to 5.0 μm. Resolving power ~ 30,000. The spectrometer design would employ a Cross-Dispersed Echelle, 1 to 5 μm range; HgCdTe detector, 2k x 2k pixels; 10" slit, $\lambda/\delta\lambda = 85{,}000$.
- Cooling, expendables, power consumption: There will be no Dewars, no stored cryogen, but passively cooled optics and detector; instrument optics < 50 K, detector focal plane 38 K. 511 watts power.
- Mission life: 3 y required, 6 y generally, up to 20 y. Orientation is by momentum wheels. The sole expendable will be 30 kg of reaction gas, to dump angular momentum occasionally.
- Target Access: Maximum pointing flexibility, with all the sky available except within 60° of the Sun line. Operational avoidance of Earth is necessary.
- Moving target capability: Slit-viewing guide camera, dynamic pointing control loop, 1 arc sec/ sec rate.
- Data storage and delivery: Collection rate up to 220 Gbit/day. Downlink rate to 78 Mbit/sec. Store 556 Gbit, downlink and ground system to match the instrument.
- Observatory: Cassegrainian with a primary of only 85 cm; but resolution > highest from the ground. The guiding camera will be focused on the first face of the slit plane. Three grating steps will cover a full octave of frequency.
- Orbit: 60° Sun avoidance, 85% of sky available at a given time. Located at L2 (Lissajous 200,000 x 850,000 km), along the Sun-Earth line, beyond Earth. The "back" is then oriented to Earth and Sun, looking away from both. The net payload will be 980 kg, sent aloft at a price of $360 M. Launch vehicle Delta II 2925-101.

One science objective is to map organic source/sink regions.

Dr. Mumma showed drawings of the complete observatory. The optics reside within a cylindrical sun shade, while the spectrometer lies within a hexagonal wafer at one end.

Mars Organic Observer
The essential questions are whether Mars is "alive", biologically and geochemically. Hubble found areas with atmospheric methane and water. A rather intense methane source was observed near the equator. Water vapor was absent at the poles, frozen out.

Dr. Mumma gave us the following additional information about the planned Mars Organic Observer:

- Science Objectives: Map organic source/sink regions. Establish sources of methane, water, and related species. Achieve 15 km resolution on surface; ultimately desire tens of meters (only 300 km is available from Earth). For methane, seek detection of 1 ppb (at 3 σ) in one hr, locally. Evaluate sinks, heterogeneous chemistry; hope for use of lander, ultimately.
- Test factors affecting methane origins and release: Dependence upon surface temperature (season, time of day). Study isotopic species. Study chemical sequences (CH_4, CH_3OH, H_2CO…) and homologous series (CH_4, C_2H_4, …).
- Mission Duration: 3 Earth-years required, 6 year goal; two full Mars years goal. Provide long dwell-time over specific sites.
- Observatory: 30 cm telescope, < 50 K optics, 35 K focal plane/detector. Mass TBD. Watts consumption TBD. Echelle grating spectrometer, resolving power > 24,000. No moving parts. Target pre-set spectral regions for methane, etc. Slit-viewing camera. Data collection rate TBD. Downlink rate TBD (optical communications?).
- Orbit: L1 Lissajous, oriented back to the Sun and facing Mars; 10^4 km inside Mars' solar orbit, far enough not to be thermally loaded by Mars itself. Launch vehicle TBD.
- Cost of mission TBD; expect preliminary design completion within a few weeks.

Dr. Mumma stated that this observatory will "revolutionize the infrared science of planetary systems." He noted that many more infrared scientists have been attracted to seek involvement than can actually be accommodated.

Next steps: Identify areas of special interest. Select Tiger teams. Conduct preliminary study. Develop mission proposal.

Getting to the NCA Monthly Meeting and the Dinner Before the Meeting

Jeff Guerber

NCA meetings are now held at 7:30 p.m. at the University of Maryland Observatory, in College Park on Metzerott Rd. between University Blvd. (MD-193) and Adelphi Rd. To get there from the Capital Beltway (I-495), either take US Rt. 1 south about a mile, turning right onto MD-193 West, then at the first light turn right onto Metzerott; or, take New Hampshire Ave. (MD-650) south, turn left at the second light onto Adelphi Rd., two more lights, turn left onto Metzerott, and proceed about a mile to the observatory. The observatory is on the south side of Metzerott Rd., directly opposite the UM System Administration building; you can park there if the observatory lot is full, but be careful crossing Metzerott Rd.

At 5:30 p.m., before the meeting, please join us for dinner at the Garden Restaurant in the UMD University College Inn and Conference Center, 3501 University Blvd. East at Adelphi Rd. From the Beltway, either take New Hampshire Ave. south, turn left onto Adelphi, and at the third light (passing Metzerott) turn left onto University then immediately right into the garage; or, take US-1 south, turn right onto University Blvd. west, and take it to the intersection with Adelphi Rd. Park either in the garage (costs), or in Lot 1 nearby (free). To get to the Observatory, exit to the right onto University Blvd. (MD-193) east, and at the second light turn left onto Metzerott Rd.

Getting to the NCA Meeting
Star=Observatory R=Restaurant P=Parking

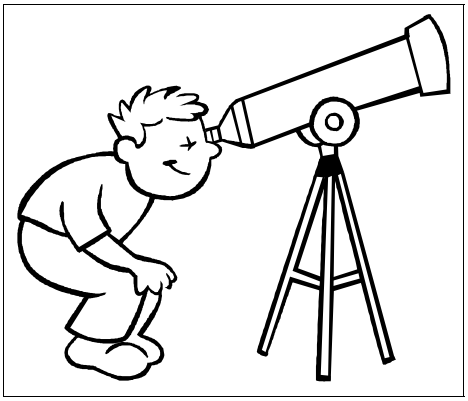
Observing after the Meeting

Elizabeth Warner

Following the meeting, members and guests are welcome to tour through the Observatory. Weather permitting, several of the telescopes will also be set up for viewing.

Are You Coming to Dinner?

If you are planning to come to the dinner before the meeting, please tell Benson J. Simon, telephone: 301-776-6721, e-mail st88@ioip.com, so that we can make reservations for the right number of people.



Do You Need a Ride?

Please contact Jay Miller, 240-401-8693, if you need a ride from the metro to dinner or to the meeting at the observatory. (Please try to let him know in advance by email at rigel1@starpower.net.)

Support the IDA

Join the International Dark-Sky Association

3225 N. First Avenue Tucson, AZ 85719-2103

www.darksky.org

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SERVING SCIENCE & SOCIETY SINCE 1937

NCA is a nonprofit, membership-supported, volunteer-run, public-service corporation dedicated to advancing astronomy, space technology, 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. NCA is an IRS Section 501(c)(3) tax-deductible organization. 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 in a number of capacities. Many members serve as teachers, clinicians, and science fair judges. Some members observe total or graze occultations of stars occulted by the Moon or asteroids. Most of these NCA members are also members of the International Occultation Timing Association (IOTA).

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

Consumer Clinics: Some members serve as clinicians and provide advice for the selection, use, and care of binoculars and telescopes and their accessories. One such clinic is the semiannual event held at the Smithsonian Institution National Air and Space Museum.

Fighting Light Pollution: NCA is concerned about light pollution and is interested in the technology for reducing or eliminating it. To that purpose, NCA is an Organization Member of the International Dark Sky Association (IDA). Some NCA members are also individual members of IDA.

Classes: Some NCA members are available for educational programs for schools and other organizations. The instruction settings include star parties, classroom instruction, and school-teacher training programs that provide techniques for teaching astronomy. NCA sponsors a telescope-making class, which is described in the *Star Dust* "Calendar of Monthly Events."

Tours: On several occasions, NCA has sponsored tours of astronomical interest, mainly to observatories (such as the National Radio Astronomy Observatory) and to the solar eclipses of 1998 and 1999.

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, and others. Contact: Joe Morris, joemorris@erols.com or (703) 620-0996.

Members-Only Viewing Programs periodically, at a dark-sky site.

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

Fine Quality Telescope, 14-inch aperture, see "Calendar of Monthly Events."

Yes, I'd like to join NATIONAL CAPITAL ASTRONOMERS!

Name: _____ Date: ____/____/_____
Street address: _____ ZIP Code:_____
Telephone: ____-____-_____ E-mail: _____
Would you prefer to get *Star Dust* by e-mail? ____
Present or Former Occupation (or, If Student, Field of Study): _____
Academic Degrees: _____ Field(s) of Specialization: _____
Employer or Educational Institution: _____

MEMBERSHIP CATEGORIES AND ANNUAL DUES RATES

All members receive Star Dust*, the monthly newsletter announcing NCA activities. As an added optional benefit to extend your knowledge of astronomy you may also choose* Sky and Telescope *magazine at the discounted rate of $33.*

Student Membership: ……..… $15 ……..with *Sky and Telescope*....$48
Standard Individual or Family Membership: …….. $27 ……...…..with *Sky and Telescope*....$60

You are welcome to make contributions in any amount in addition to the dues shown above.
Contribution amount:_____

Please mail this form with your check payable to National Capital Astronomers, to:
Mr. Jeffrey Norman, NCA Treasurer; 5410 Connecticut Avenue, NW #717; Washington, D.C. 20015

National Capital Astronomers, Inc.
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