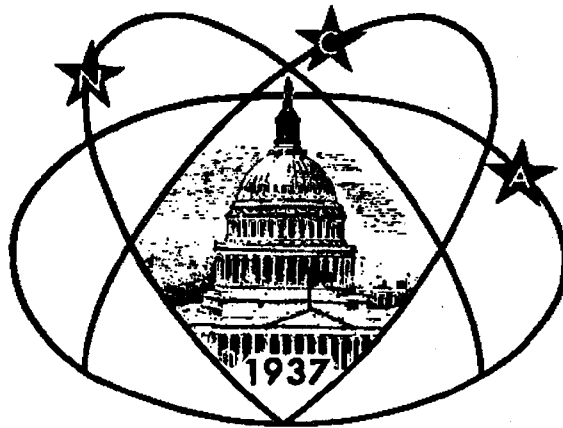


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Goetz Oertel to describe "Astronomy at the National Centers"

By John Graham

At the next meeting of National Capital Astronomers on May 1, we will have the pleasure of an address by Dr. Goetz Oertel, the President of the Association of Universities for Research in Astronomy (AURA). The meeting will be held as usual at the National Institutes of Health (in the Bunim Room on floor 9 of the Clinical Center, Building 10). The subject of Dr. Oertel's talk will be "Astronomy at National Centers - Developments and Plans."

Modern instruments and new telescopes with improved technology are advancing astronomy in space and on the ground. Examples are the Gemini 8 meter telescopes, the Hubble telescope, the Global Operations Network Group (GONG), and new facilities at Cerro Tololo, Kitt Peak and Sacramento Peak observatories. Some are bearing fruit already. Cooperation among U.S. and foreign parties continues to increase. Dr. Oertel will describe some of the present activity and where it is leading us in our continuing quest for knowledge of our universe.

AURA Inc. is a non profit corporation with 21 member universities. It manages the National Optical Astronomy Observatories (NOAO) for the National Science Foundation and for NASA, the Space Telescope Science Institute (STScI) in Baltimore. NOAO operates observatories at Cerro Tololo in Chile, Kitt Peak in Arizona, and Sacramento Peak in New Mexico.

Dr. Oertel graduated from the University of Kiel, Germany. He earned a PhD in Physics at the University of Maryland. He held several important positions in NASA, the National Science Foundation and in the Department of Energy (DOE), before coming to AURA. At NASA, he was Chief of Solar Physics and Program Scientist for Sounding Rockets, Satellites and the Apollo Telescope Mount on Skylab. At the National Science Foundation, he served as Head of the Astronomy Section for a period during the 1970s when he was also Policy Analyst with the President's Science Advisor and Budget Analyst with the Office of Management and Budget for a time. At DOE, he directed defense nuclear waste organizations and managed Operations Offices in Aiken, South Carolina and Albuquerque, New Mexico. In 1985-86, he was Deputy Assistant Secretary for Safety, Health and Quality Assurance in the Department of Energy.

Dr. Oertel will have a tremendously interesting message about what is going on today in US astronomy on a national scale and I strongly recommend that you come and hear him.

May Calendar

The Public is Welcome!

Saturday, May 1, 9:30 AM - Ellen Sprouls (NASM), "Samuel P. Langley and the New Astronomy." At The Smithsonian Institution, National Air and Space Museum (NASM), Albert Einstein Planetarium.

Saturday, May 1, 5:30 PM - Dinner with the speaker at Frascati's Restaurant in Bethesda before the monthly meeting. Reservations are for 5:30 Sharp!

Saturday, May 1, 7:30 PM - Dr. Goetz Oetel: "The AURA Gemini Project." Meeting will be held in the Bunim Room at the National Institutes of Health. For directions refer to map and description on inside back page.

Saturday, May 15, 10:00 AM- 4:00 PM - U.S. Naval Observatory (USNO) Centennial Celebration Open House. Limited parking available. For details, call Steve Dock at (202) 653-1541.

Saturday, May 15, 9:00 PM - "Exploring the Sky." See article on page 3 for more information..

Saturday, May 22, 6:00 PM to ?? - Open House at Hopewell Observatory. See article on page 5 for directions.

Tuesday, May 1,8,15,22,29, at 7:30 PM - Telescope making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 202/362-8872.

Friday, May 7, 14, 21, 28, at 7:30 PM - Telescope making classes at American University, McKinley Hall Basement. Information: Jerry Schnall, 202/362-8872.

Friday, May 14, 21, 28, 9:30 PM - Open nights with NCA's Celestron-14 telescope with Bob Bolster, 6007 Ridgeview Drive, south of Alexandria off Franconia Road between Telegraph Road and Rose Hill Drive. Call Bob for details and more dates at (703) 960-9126. The May 28 session will be dedicated to lunar photography.

Friday, May 21 - Saturday, May 22 - Earth Night 1993 - May, at Shenandoah National Park. See article on page 5 for more information.

All May - Chance to view the exhibit "Landsat: Monitoring Earth's Environment," at the Library of Congress. Closes June 20. For details call (202) 707-5458. This is the largest display of Landsat spacecraft imagery ever assembled for public viewing. Don't miss this unprecedented opportunity!!

MARIO ACUÑA: AMAGNETIC TOUR OF THE SOLAR SYSTEM

By Nancy Byrd

At the April 3, 1993 colloquium, NASA's Dr. Mario Acuña treated NCA members to an intriguing view of the Solar System, a magnetic view, with emphasis on the magnetic field of Neptune. In doing so, he compared the magnetic field of Neptune with that of other Solar System bodies and sketched the history of the Voyager 2 mission. Dr. Acuña has been associated with the "fields and particles" experiments of many of the Solar System exploration missions and currently serves as Project Scientist for the International Solar Terrestrial Physics Program and as Principal Investigator on the Mars Observer magnetic field investigation. The Mars Observer spacecraft is now on route to Mars.

Voyager 2, launched on August 20, 1977, arrived at Neptune on August 24 1989. Voyagers 1 and 2 have provided the world with the now familiar, magnificent pictures of the outer planets; these images and the results of the scientific experiments changed forever our understanding of the nature of these

bodies. But how was it decided what experiments to run on these missions? According to Dr. Acuña, budget would determine the size of the rocket, but by using the orbital energy of Jupiter, the "big fuel tank in the sky," much bigger payloads are possible than without using such an assist. For instance, Voyager was accelerated by 11 kilometers per second at the cost of slowing Jupiter by 0.2 angstroms per century. After the size of the payload was determined and a prioritized list of experiments was determined by asking scientific advisory groups what measurements were most important, the necessary decisions were made. In the case of the Voyager spacecraft, besides the cameras and the necessary support equipment (for instance a radio isotope energy source), there were instruments to measure atmospheric composition, structure, meteorology; heat balance, magnetic fields, both remote and in situ. Also, experiments to measure the environment in the interplanetary medium and others were included.

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These missions measured much more than the visible spectrum, including cosmic rays, UV and IR emissions, and carried magnetometers capable of measuring a range of over 10 orders of magnetic field strength. The "fields and particles" experiments had to be protected from interference caused by other equipment on board the spacecraft. For instance, the process by which Carl Sagan's greeting disk was made involves nickel which created interference with the magnetic field measurements on Voyager, requiring development of a whole new process to cope with this interference. Also, some of the magnetometers had to be carried on an arm 14 meters long to get away from the effects of other instruments.

All did not go well with the Voyager 2 mission even after launch. About five minutes after launch in 1977, both the primary and secondary command receivers failed with the result that one could not lock on to a particular frequency, the command frequency. This function was recovered though great ingenuity, and even today, Voyager is still receiving and accepting commands, as it heads out of the Solar System in the direction of Ursa Minor (estimated date of arrival - 44,230 AD).

Until the early 1940s and 1950s, we did not know the extent of the Earth's magnetic field. We thought that space was mostly a vacuum and that the field resembled that of a big bar magnet. But early space missions discovered the Solar Wind, plasma (charged particles) from the Sun. The interaction between the Earth's mag-

netic field and the Solar Wind results in a teardropped magnetosphere, with the magnetic field lines compressed sunward and elongated in the direction away from the Sun. This field is similar in shape to a supersonic shockwave, and for the same reason; the earth is in a supersonic plasma wind emanating from the Sun. The magnetic field of the Earth normally screens out the solar wind except at the poles. Among the most obvious manifestations of this interaction are the aurorae where the plasma from the sun follows the magnetic field lines to where they intersect with the Earth's atmosphere at the poles, which glows from the excitation. Do we see such magnetic behavior at other planets? According to Dr. Acuña, if the planet has a magnetic field, the answer is yes, for we have not yet found the end of the heliosphere, which is what we call the region where of the Solar Wind has an appreciable effect on the planets.

On Earth, the compass points North, as the axis of symmetry of the Earth's magnetic field is similar to the Earth's axis of rotation. But what of the other planets? What would be the nature of the magnetic field of Uranus with its rotation axis lying in the plane of the ecliptic? We had an a priori assumption, said Dr. Acuña, that the axis of symmetry of the magnetic field would be close to a planet's rotation axis. We thought that at Uranus, maybe there would be a continuous aurora over the equator. But we learned that we were wrong. However, at Neptune, scientists found a planet rotating not in the ecliptic plane,

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Exploring the Sky: 1993 Calendar

These are the coming dates and times for the 1993 Exploring the Sky programs. On clear nights, they will be held with telescopes at the open field nearest the Rock Creek Park Nature Center. If the sky is cloudy, they will be held at the Nature Center's planetarium. In case of rain or snow, they are cancelled.

Saturday 15 May	1993:	9:00 PM EDT
Saturday 19 June	1993:	9:00 PM EDT
Saturday 17 July	1993:	9:00 PM EDT
Saturday 21 August	1993:	9:00 PM EDT
Saturday 18 September	1993:	8:30 PM EDT
Saturday 16 October	1993:	8:00 PM EDT
Saturday 13 November	1993:	7:30 PM EST

Persons coming to Exploring the Sky will be able to see the planets, stars and other astronomical objects in the night through the telescopes. Exploring the Sky is brought to you by National Capital Astronomers and by the National Park Service. Information can be obtained by telephoning (202) 426-6829 (the Rock Creek Park Nature Center) or (301) 320-3621 (National Capital Astronomers).

National Capital Astronomers
National Park Service

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but with a magnetic field axis more or less in the ecliptic plane.

We learned, said Dr. Acuña, that a planetary magnetic field can also be distorted by local phenomena. Jupiter also has the axis of symmetry of its magnetic field approximately perpendicular to the plane of its ecliptic; however, the presence of the moon, Io, spewing charged particles (sulphur and sodium ions) combined with Jupiter's rapid rotation stretches out the magnetic field at the equator, forming a "centrifugal plane."

Dr. Acuña then gave us a detailed breakdown of a magnetometer image of Jupiter as recorded by the Pioneer 11 spacecraft in 1979. In such a graph, one can see a series of jumps in field intensity where the spacecraft crosses various boundaries such as the bow shock, where the Solar wind has compressed the magnetosphere, the magnetopause, where the magnetic field of Jupiter begins to dominate, and then a steady increase in intensity inward towards the planet. As you leave, the magnetic tail of the planet shows a gradual diminution in field strength; the entire magnetic field intensity record is imprinted with a periodic magnetic signature, due to the rotation of the planet. These boundaries appear to be crossed more than once by the spacecraft, possibly because the field itself is changing during planetary rotation. A magnetometer view of Uranus shows a simpler, but essentially similar structure.

An encounter with the magnetic field of Neptune, however, shows no multiple encounters, "one jump and you are in." The explanation for this difference is that (1) the Solar Wind is more or less tangential here, "all wrapped around", and (2) there is no Io to spew plasma. A great puzzle found at Neptune was a double peak in the magnetic field intensity near the surface. Possibly this peak was caused by two convection cells near the surface of the planet, picked up because of the close proximity of the spacecraft to Neptune.

One of the goals of Voyager 1 was to investigate the

coupling between Jupiter and Io. Now Io is a conductor moving at 57 kilometers per second with respect to the Jovian magnetic field. Our scientists used measurements of the Jovian magnetic field to calculate the electric field induced in Io by Jupiter's field, yielding 500 kilovolts across Io. So they decided to send a spacecraft to determine the current flowing between Io and the surface of Jupiter and found a current of 2.5×10^6 amperes, a big effect due to the coupling between Jupiter, Io and perhaps the surface of the planet.

Dr. Acuña then showed how particle counts taken by Pioneer 11 at Jupiter could be related to the magnetic field intensity and the location of Jupiter's moons. Magnetic particles would move along the magnetic field lines of Jupiter. However, a moon in orbit around the planet would intersect these magnetic field lines and act as a big vacuum cleaner for the particles there. As expected, dips in the particle count could be found where the moons crossed the field. But there were also dips at about 1.8 Jovian radii, inside the Roche Limit! (The Roche limit is a sphere about a body, within which a satellite cannot exist without being broken up by tidal forces.) On the basis of these data, the scientists involved predicted the existence of a ring at this position. This was 1976, before Voyager 1 "discovered" the ring at the same location. This was the real discovery of Jupiter's ring, a fact which was later acknowledged. This was also the first application of a new discipline called ring-particle-magnetic field astronomy, a technique that would be used extensively later on in the analysis of the rings of Saturn.

Most of these planets had magnetic field axes of symmetry that were relatively close to their rotation axes. Uranus was the first highly asymmetric and off-center magnetic field encountered. Scientists gave up trying to correlate the particle data with the magnetic field data and the location of the moons, because now there was a multiplicity of solutions due to the complexity of Uranus' magnetic field. They wrote off Uranus as a weird planet with possibly an unusual history, like maybe a collision had tilted only the crust, but left interior and hence the magnetic field where it was. However, when Voyager reached Neptune, they found another very asymmetric and offset magnetic field. Perhaps such things were more common than had been thought.

Earth, said Dr. Acuña, is simple magnetically, with a magnetic axis tilt of about 10° and a displacement of about 150 kilometers from the axis of rotation and is reasonably dipolar. Jupiter is not that different, a bit

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Lunar Photography with the C-14

Would you like to take some photographs of the Moon and learn about astrophotography? The May 28 observing session with the C-14 will be dedicated to photography of the quarter Moon. Bring your loaded single-lens reflex camera with a "T" adapter (we have adapters for Canon, Nikon, Olympus OM-1, and Praktica). Slow, fine-grain color or black and white film such as Tech-Pan 2415 is recommended. For further information call Bob Bolster, (703) 960-9126.

HOPEWELL OBSERVATORY OPEN HOUSE

NCA members, families, and guests are invited to the spring open house at Hopewell Observatory on Saturday evening / Sunday morning May 22/23 to observe the spring sky, numerous Messier objects, and Jupiter. Sunset will be at 8:23 pm, civil twilight ends at 8:54, and astronomical twilight at 10:14. If you wish, come any time after 6:00 pm and bring your prepared picnic dinner. Coffee, tea, and cocoa will be provided by the Hopewell Corporation.

Directions:

(1) From the Beltway (I-495) go west on I-66 25 miles to Exit 40 at Haymarket onto U.S. 15. (2) Turn left on U.S. 15 at the end of the exit ramp. (3) Go 0.3 mile to traffic light, turn right onto Va. 55. (4) Go 0.8 mile to Antioch Road (Rt. 681) and turn right. (5) Go 3.2 miles to the end of Antioch Rd. and turn left onto Waterfall Road (601). (6) Go one mile and bear right onto Rt. 629. (7) Go 0.9 mile on 629 to narrow paved road at right with an orange pipe gate. (Directly across from an entrance gate with stone facing.) (8) Turn right through pipe gates, go 0.3 mile to top of ridge, and around the microwave station. (9) Continue on dirt road through the white gate and woods a few hundred feet to the observatory. Park along the road short of the buildings.

The event will be cancelled if it is raining or hopelessly cloudy. For further information call (703) 960-9126 or (301) 320-3621.

The Galaxy, Spring Sky, and Nocturnal Nature Smithsonian Institution Resident Associate Program Tour for Earth Night 1993 - May

by Daniel J. Costanzo

On a dark, clear night far from city lights, Earth can be appreciated for what she truly is: a precious ark of life borne upon the currents of a grand, Galactic ocean. Seeking an experience of truly "deep" ecology on a cosmic scale, this tour to Virginia's Shenandoah National Park observes the natural environments of mountain and sky on a night when the brightest parts of our Milky Way Galaxy rise into view. It offers a perfect way to complement celebrating Earth Day 1993 by making your Earth Day an Earth NIGHT!

This tour, offered as the Smithsonian Institution Resident Associate Program (SRAP) Tour for Earth Night 1993 - May: "The Galaxy, Spring Sky, and Nocturnal Nature," is the sixth in a scheduled series of "Earth Night" programs stemming from an idea originated by the author for celebrating "Earth Night" in association with the more famous Earth Day.

He has subsequently developed and improved it, with assistance from Walter Nissen (NCA), Karen Gray (SRAP), and Rob Gibbs (Brookside Nature Center). This

program has been very favorably received, with informal endorsements by the International Dark-Sky Association (IDA) and the Sierra Club. This "Earth Night" program, like the "Exploring The Sky" program, draws on NCA's unique blend of multidisciplinary, interdisciplinary, and transdisciplinary resources. Both are a major NCA contribution towards instilling an appreciation for the natural world by increasing public awareness about Earth in her own environment.

Astronomers Daniel Costanzo and Walter Nissen and naturalist Rob Gibbs will lead this May's "Earth Night" program. Participants journey to Big Meadows on Skyline Drive, high up in Virginia's Blue Ridge Mountains, remaining until dawn. There, a vast open area provides excellent observing possibilities. This tour coincides with the rising of our Milky Way Galaxy, with astronomy activities covering observing using the unaided eye, binoculars, and small telescopes. As the sky and scheduling permits, trip leaders will aid participants in identifying

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numerous objects, including artificial satellites, several planets (including the rings of Saturn and the moons of Jupiter), meteors, stars, star clusters, nebulae, and other galaxies of interest. Emphasis here will be on how the wealth of new knowledge about even our Universe's remotest regions aids in saving our endangered global environment. Discussion of astronomical equipment, nocturnal nature, and Earth's place in the Cosmos will occur even if weather restricts observations.

Naturalist activities include nature walks to watch and listen for nocturnal animals and observe how animals and plants become active in Spring. Trip leaders will attempt to attract owls by calling, to detect bats with special sensing equipment, and to point out deer, foxes, skunks, rodents, frogs, and insects if possible. The influence of night on plant and animal evolution and the environmental degradations of "light pollution" will also be discussed and demonstrated.

The tour lasts from Friday, May 21, 10:00 PM to Saturday, May 22, 10:00 AM. It is by bus from the Smithsonian on The Mall, with an additional stop at the Vienna Metrorail Station's south side Kiss and Ride area. Light snacks will be available during the night, and a stop made in Warrenton, VA for purchasing breakfast on the return trip in the morning. In the event of forecasted general overcast or rain, the program's alternate date is Friday, May 28, 10:00 PM to Saturday, May 29, 10:00 AM. Advice on what to wear and bring, with details on weather cancellation procedures, will be mailed prior to the tour.

Additional details, costs for SRAP members and non-members, and registration can be obtained by calling

Excerpts from The IAU Circulars

By R.N. Bolster

1. March 14 - Jean Mueller, Palomar Mountain Observatory, discovered a comet (1993d) of 17th magnitude in Draco on a photograph taken by herself and J.D. Mendenhall with the 1.2-m Oschin Schmidt Telescope.
2. March 24 - C.S. and E.M. Shoemaker and D.H. Levy discovered a comet (1993e) of 14th magnitude about 4° from Jupiter in Virgo on photos taken with the Palomar 46-cm Schmidt telescope. The object was unusual, appearing to be a bar approximately 1' long. Larger telescopes showed the object to be a string of as many as 17 nuclei, apparently the result of a comet breaking up as the result of a close (0.001 AU) approach to Jupiter. On April 3 Marsden found that the object is at least temporarily orbiting Jupiter.
3. March 28 - J. Luu, University of California at Berkeley and D. Jewitt, University of Hawaii, discovered another faint Kuiper Belt candidate object in Virgo with a CCD detector on the University of Hawaii 2.2-m telescope at Mauna Kea. Marsden's orbit calculation shows the object to be 42 AU from the Sun.
4. March 28 - F. Garcia, Lugo, Spain, discovered a supernova of 11th magnitude 45" west and 160" south of the nucleus of NGC 3031 (M81) in Ursa Major. Spectra indicate that it is a type II supernova. Peak brightness of 10th magnitude apparently was reached on March 31. A red supergiant star has been identified as the progenitor.

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more complicated, but with similar tilt. Saturn is so symmetric that it contradicts Cowling's Theorem which states that an axisymmetric field cannot be self sustaining. Is Saturn's magnetic field decaying rapidly? We don't know. The magnetic field of Uranus is tilted greatly with respect to the rotation axis, and the axis is greatly displaced from the center of the planet, yielding a completely asymmetric magnetic field. The moons, however, are in orbit more or less symmetrically about the rotation axis; so they describe a complex pattern in magnetic coordinates. Thus one cannot predict where the particle absorption will be. Neptune is even worse than Uranus. There is not only a large tilt, but also a tremendous offset. Moreover, the intensity of the magnetic field at the north and south poles differs by as much as ten to one. This produces very strange Van Allen Belts.

In spite of all the differences in the magnetic fields and in the rotation axes, the planets' magnetic axes have roughly the same orientation; this we do not understand. We do not fully understand how these planets, including our own, generate a magnetic field. We think that it is motion in the core, or in convection cells; that the motion of conducting material produces electric currents which generate a magnetic field.

SRAP at 202/357-3030 (Fax: 202/786-2034). This tour is listed as "The Galaxy, Spring Sky, and Nocturnal Nature" (Code: 508-728). Minimum age is 14. Warning: The site will be purposefully kept unlighted. Participants must assume their own personal responsibility for safely moving about in the dark.

Note that these "Earth Night" tours have sometimes been completely sold out, resulting in a long waiting list of standbys. So please sign up early!

National Capital Astronomers, Inc.

is a non-profit, public-service corporation for advancement of the astronomical sciences and is the astronomy affiliate of the Washington Academy of Sciences. For information, call NCA: (301) 320-3621.

SERVICES AND ACTIVITIES:

A **Forum** for dissemination of the status and results of current work by scientists at the horizons of their fields is provided through the monthly NCA Meeting. (See monthly *Stardust* for time and location.) All interested persons are welcome; there is no charge.

Expeditions frequently go to many parts of the world to acquire observational data from occultations and eclipses which contribute significantly to refinement of orbital parameters, the coordinate system, navigation tables and timekeeping. Other results of this work under continuing study include the discovery of apparent satellites of some asteroids, discovery of apparent small variations in the solar radius, and profiles of asteroids.

Discussion Groups provide opportunities for participants to exchange information, ideas, and questions on preselected topics, moderated by a 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.

The **NCA Public Information Service** answers many astronomy-related questions, provides predictions of the

paths and times of eclipses and occultations, schedules of expeditions and resulting data, assistance in developing programs, and locating references.

Astronomical Telescope & Binocular - Public Seminar, for Selection, Use, and Care, held annually in November, offers the public guidance for those contemplating the acquisition of a first telescope, and dispels the many common misconceptions which often leads to disappointment.

Working Groups support areas such as computer science and software, photographic materials and techniques, instrumentation, and others.

Telescope-Making Classes teach the student to grind and polish, by hand, the precise optical surface that becomes the heart of a fine astronomical telescope.

NCA Travel offers occasional tours, local and world-wide, to observatories, laboratories, and other points of interest. NCA sponsored tours for comet Halley to many parts of the southern hemisphere.

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

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

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Note: If you already subscribe to *Sky & Telescope*, please attach a recent mailing label. You may renew this subscription through NCA for \$22 when it expires.

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

Leith Holloway 10500 Rockville Pike Apt. M-10, Rockville, MD 20852.

The following information is optional. Please indicate briefly any special interests, skills, vocation, education, experience, or other qualifications which you might contribute to NCA.

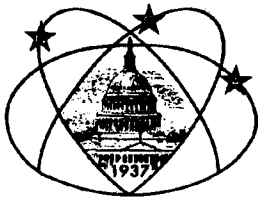
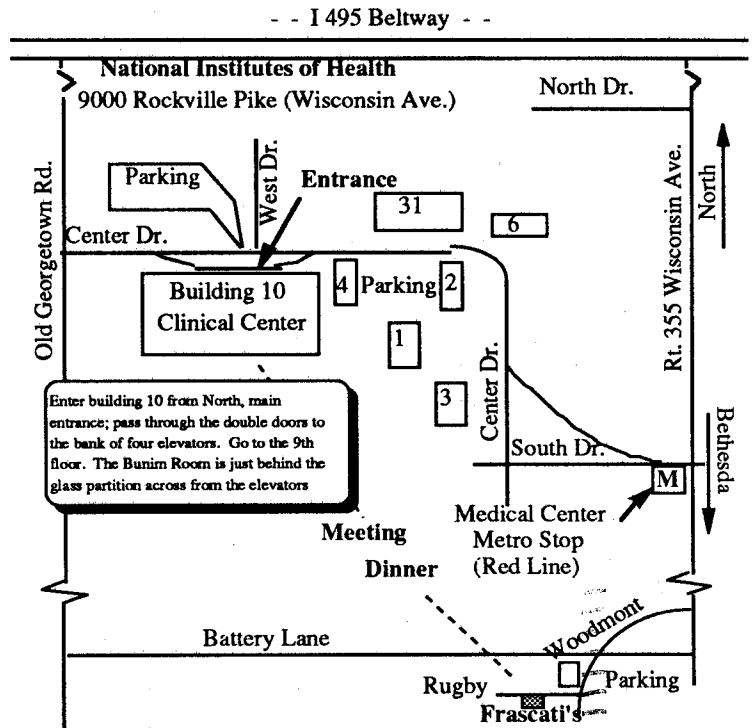
Thank you, and welcome!

Getting to the NCA Monthly Meeting

•Subway Riders - From Medical Center Metro Stop: Walk down the hill, pass the bus stops and turn right at the anchor (onto Center Drive). Continue uphill to building 10, the largest building on campus. Also, the J2 bus line connects the Bethesda (7:16 PM) and NIH (7:23 PM) Metro stops with Building 10 (7:25 PM).

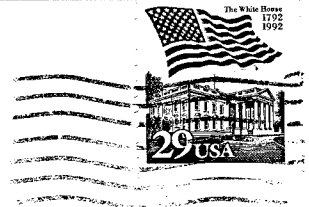
•To Frascati's: Proceed down Wisconsin Avenue toward Bethesda. Bear right onto Woodmont (or the next right onto Battery Lane), follow Woodmont across Battery, take a right onto Rugby and park. The restaurant will not guarantee seats after 5:30.

Stardust is published ten times yearly (September - June) by National Capital Astronomers, Inc. (NCA), a non-profit, public-service corporation for advancement of astronomy and related sciences through lectures, expeditions, discussion groups, conferences, tours, classes, public programs, and publications. NCA is an affiliate of the Washington Academy of Sciences. President John Graham. Deadline for *Stardust* is the 15th of the preceding month. Editor, Nicoletta Stephanz, 202-332-7756. NCA Phone Number is 301/320-3621.



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