

26 AUG

STAR



DUST

National Capital Astronomers, Inc.

Washington, DC (301) 320-3621

Volume XLV Number 11

Summer 1988

ISSN 0898-7548

IAU, IDA, NCA, et al, Attack Sky Pollution



Design by Kate Kellogg, NOAO;
NOAO is operated by AURA Inc under
contract with the National Science Foundation.

Light Pollution

Speakers include:

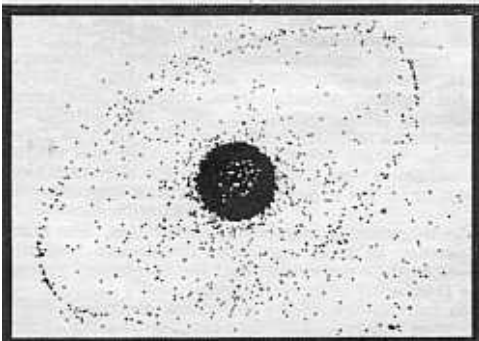
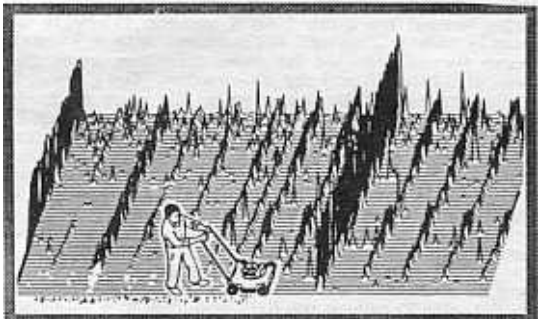
- Robert Brucato, Caltech
- David L. Crawford, KPNO/NOAO
- David DiLaura, Lighting Technology Inc.
- Roy Garstang, Univ. of Colorado
- Tim Hunter, Univ. of Arizona
- Terry McGowan, General Electric Corp.
- Paul Murdin, Royal Greenwich Observatory
- William Robinson, Tucson, AZ USA
- Douc Schreuder, Netherlands
- Richard Schwab, Dept. of Transportation
- Norm Sperling, Chabot Observatory
- Jurgen Stock, Univ. of Merida
- Merle Walker, Univ. of California
and others

Design by George Kessler, NRAO Graphics Department;
NRAO is operated by AUI under
contract with the National Science Foundation.

Radio Interference

Speakers include:

- Patrick C. Crane, NRAO
- Michael M. Davis, NAIC
- James G. Ennis, Fletcher, Heald, & Hildreth
- John Findlay, IUCAF
- J. Richard Fisher, NRAO
- Tomas E. Gergely, NSF
- Hans Kahlmann, Westerbork
- Vernon L. Pankonin, NSF
- Richard Parlow, NTIA
- R. Marcus Price, Univ. of New Mexico
- Martin Rothblatt, Geostar Corp.
- A. Richard Thompson, NRAO
- Gowind Swarup, TIFR (India)



Produced by Teledyne Brown Engineering,
for NASA

Space Debris

Speakers include:

- Donald Kessler, NASA
- Larry Taff, MIT
- Sidney van den Bergh,
Dominion Astrophys Observ.
and others

AUGUST CALENDAR -- *The public is welcome.*

Tuesday, August 16, 23, 30 7:30 pm -- Telescope-making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 362-8872.

Friday, August 12, 19, 26, 7:30 pm -- Telescope-making classes at American University, McKinley Hall basement. Information: Jerry Schnall, 362-8872.

Saturday, August 13, 8:30 pm -- *Exploring the Sky*, presented jointly by NCA and the National Park Service, Glover Road south of Military Road, NW, near Rock Creek Nature Center. Planetarium if cloudy. Information: John Lohman, 820-4194.

Thursday, August 18, 6:00-9:00 pm -- *Fly by Night*, presented jointly by NCA and the National Air and Space Museum. See page 55.

Friday, August 19, 9:00 pm -- 14-inch telescope open night with Bob Bolster, 6007 Ridgeview Drive, south of Alexandria off Franconia Road between Telegraph Road and Rose Hill Drive. Call Bob at 960-9126.

For other organizations' events of interest see elsewhere in this issue.

JUNE COLLOQUIUM

Dr. David L. Crawford, Astronomer, Kitt Peak National Observatory, Tucson, Arizona, addressed the June National Capital Astronomers colloquium on light pollution, at the National Air and Space Museum.

Because of a technical problem, there is no tape of this talk; the following general account of the presentation, made chiefly from memory, includes some editorial liberties.

Light pollution, long decried, by astronomers, has been largely ignored by almost everyone else. The problem has reached a severity that demands action; it is threatening the very existence of ground-based astronomy, and, to various extents, is damaging other aspects of nature. The effective area of the 200-inch Hale telescope at Palomar Mountain has been reduced to 40 percent of its former value.

Dr. Crawford has undertaken a vigorous program of action on several fronts to attack this accelerating irresponsible destruction of the night — a rapidly diminishing, essential natural resource. He proposed a multi-faceted program to be pursued through a newly established International Dark-sky Association (IDA), based at Tucson, with National Capital Astronomers, Inc., as the Washington adjunct.

Proper outdoor lighting is needed, and Astronomers need light as much as anyone. It is the irresponsible, wasteful, and damaging sky lighting that is being addressed. There are ways of accomplishing more effective, more economical, and less damaging lighting — "a win-win-win situation," Crawford describes it. Everyone benefits. This is the theme of the positive approach that Crawford is promoting: increased awareness with emphasis on the benefits for everyone.

Crawford showed several dramatic examples of various kinds of lighting situations which could be, should be, or have been improved with benefits to all. Difficulty in seeing beyond the glare from a common 175-watt mercury vapor security light could actually hide a prowler. Replacement with a 35-watt low-pressure sodium lamp in a proper fixture provided far more effective, even, glare-free visibility over the whole area, with insignificant sky illumination. The glaring, ineffective illumination of a prison yard was substantially improved by the more economical low-pressure sodium. Savings from a similar improvement in a parking lot paid for the change in three months. All of these improvements greatly reduced the sky illumination.

The main usefulness of the popular, but inefficient, unshielded, glaring mercury-vapor and high-pressure sodium lights, Crawford says, is for lighting the bellies of overflying aircraft. They certainly are not the best for providing the intended illumination — and they are terrible polluters.

The distinction between the low- and high-pressure sodium lamps must be understood. Their spectra are very different. The high-pressure sodium emits a wideband continuum, several emission lines, and is impossible to filter satisfactorily. The low-pressure lamps show no continuum, and only the 589-nm twin D-line in emission. These can be filtered at the detector to reduce the light pollution to a reasonably tolerable level. Illumination by low-pressure sodium is also more efficient (more lumens per watt), hence, more economical than either high-pressure sodium or mercury vapor.

Our efforts are being directed along several lines. An extensive data base is being assembled, including examples in which improvements can yield benefits, lists of appropriate authorities in those areas, lists of manufacturers, equipment catalogs, specifications and other technical data, costs, schedules, and any other related information useful to those responsible for lighting specifications. General awareness must be raised through various media, including print, radio, television, and lectures to appropriate groups. Some popular misconceptions must be corrected: "It's all done from space anyway now," and "Now they use radio. Seeing the sky is just a hobby that has to give way to progress," and such other nonsense. These people haven't the slightest idea of the necessity of ground-based astronomy, or of the importance of applied astronomy to our present "hi-tech" way of life.

Consultation must be made available to licensing or regulating authorities, who must be encouraged to pass ordinances as necessary to make rapacious developers "see the (low-pressure sodium) light." Manufacturers must be convinced that low-pressure sodium lamps will become a major market, thus be persuaded to provide them.

Those who pursue the science are also fully aware of the esthetics. Certainly there is no recreational activity more inspiring than simply looking into the vast depths of this marvelous universe with the appreciation that we are very much a living part of it, able to perceive and contemplate its grandeur. (Grandfather, is it true that when you were a little boy you could really see the stars? — ed.)

Robert H. McCracken

OCCULTATION EXPEDITIONS PLANNED

Dr. David Dunham is organizing observers for the following occultations. For further information call (301) 495-9062 (Silver Spring, MD).

Date	Time	Place	Vis Mag	Pent Sunlit	Cusp Angle	Min Aper
09-01-88	03:35	Pittsburgh, PA,	5.7	71	7995 cm	
09-02-88	06:26	Charles County, MD	5.6	59	12N	5 cm

NCA WELCOMES NEW MEMBERS

Christopher Bass
9800 Thunderhill Court
Great Falls, VA 22066

Jeanne Chesley
5028 Bass Court
Waldorf, MD 20601

Steve Chien
9431 Sunnyfield Court
Potomac, MD 20854

Andrea Dickens
9812 Summerday Drive
Burke, VA 22015

Dennis M. Gaughan
326 North Oxvord Street #6
Arlington, VA 22203

William F. Gent
1400 Casino Circle
Silver Spring, MD 20906-5903

Arthur P. Guarinello
8229 Stacey Road
Alexandria, VA 22308

Christopher A. Harvel
6161 Stevens Forest Road
Columbia, MD 21045

Jennifer Lombard
5922 Burnside Landing Driv
Burke, VA 22015

Louisa Rebull
2407 Vermont Street
Arlington, VA 22207

Eric D. Scheirer
4616 Hillbrook Drive
Annandale, VA 22003

Drexel Sprecher & Associates
PO BOX 5500
Washington, DC 20016-1100

Ramsey Stuart
8401 Cathedral Avenue
New Carrollton, MD 20784

AIR AND SPACE MUSEUM, NCA OFFER PROGRAMS

On Thursdays during August, 6:00-9:00 pm, The Air and Space Museum and National Capital Astronomers present a series of free family activities entitled "Fly by Night," featuring aviation, space science, and astronomy. On August 18, National Capital Astronomers displays astronomical exhibits and activities, presents a telescope fair, and, weather permitting, offers telescopic sky viewing.

TREASURER'S REPORT

1. GENERAL FUND

INCOME

Dues		\$8,041.00
Sale of Observer's Handbooks		390.50
Orders for other publications		162.49
Telescope-making classes		135.00
Interest		282.20
Donations		25.00
Total Income		\$9,036.19

EXPENSES

Sky and Telescope subscriptions		\$4,665.50
Purchase Observer's Handbooks		368.50
Purchase other publications		162.49
Star Dust Printing	\$1,552.87	
Postage	1,272.96	
Total		2,825.83
Speakers' Dinners		74.21
Astronomical League dues		453.84
Insurance - Liability		344.00
Telephone		351.80
Security services		315.00
Admin. incl. postage and copying		327.53
Total Expenses		\$9,888.70

Balance 1 July 1987	\$4,718.51
Excess expense over income	\$852.51
Balance 30 June 1988	3,866.00

Ruth S. Freitag
Treasurer

2. NCA TRAVEL

Balance 1 July 1987	1,610.31
Interest	88.28
Balance 30 June 1988	1,698.59
GENERAL FUND BALANCE	3,866.00

3. TOTAL NCA BALANCE 1 JULY 1988

\$5,564.59

Robert H. McCracken
Trustee

ASTRONOMY AND PERSONAL COMPUTERS by Joan B. Dunham

Long-distance Communication - Recent adventures in long-distance computer-to-computer communication (in Australia) taught us a few lessons. The first lesson was, of course, that planning for sufficient time so that the communication could be mailed via floppy disk is probably the best, and certainly the cheapest, way of getting data from one computer to the other.

Connecting long-distance telephone calls, even when directly dialed, can take considerably longer than when done within the continental United States. Communications software will time-out if there is no answer within some period of time, usually 45 seconds or so. That is not long enough; the connection can take a minute or more. We also learned that some modems contain their own, separate, time-out function which, in the case of ours, has a default of 30 seconds. Both the software and the modem must be set for a long connect time. We used 90 seconds.

Not all long-distance telephone services are equal. Our first connections were extremely noisy, and the computers at both ends were competely tied up receiving long strings of <<<<< and other such. We switched to AT&T lines and the noise was reduced to almost nothing. AT&T lines are accessible by prefixing the telephone number with 10ATT (or 10288) from any of the alternative services.

Computer-to-computer connections are greatly facilitated by having two lines, one for voice and one for computer. This doubles the expense of a single call, of course, but it prevents the comic opera that results when the connections don't work, and the people at each end try to guess what the other is going to do, both call each other, or one switches to voice while the other stays with the computer and hears "hello, hello" out of the modem loudspeaker, etc.

Folded Floppies - I recently received a floppy from Jim Van Nuland with a sample program and data, which had been neatly folded in half to fit into my mailbox. Once a diskette has been folded, the case crimps, and the diskette will not turn, no matter how much uncrimping is trie. I carefully cut away the parts of the case that were crimped, until the diskette was free to move. Then I copied the contents to another diskette. A colleague of mine remarked that he takes diskettes that have failed, slits their cases, throws away the failed diskette, and then uses the cases when he receives a folded diskette. These maneuvers need to be done with care, to avoid cutting the floppy itself, keep from getting fingerprints on the medium, and to leave enough case around the floppy so that it will be held in the right position inside the drive.

Fantastically Clever Software - My job has me using a mathematical scratch-pad software system cald MathCAD, from Mathsoft, Inc. This software does interactive equation computation. It recognizes commands and keystrokes to give the capability to enter equations which could manipulate matrices, compute trigonometric functions, perform summations, generate power series, and so on. The software can display the answers as the data are entered. For example, the user can enter two matrices, A and B, and then ask for the computation of $A*B + B*A =$, and within a short time, the elements of the resulting matrix are displayed. The equations are displayed with graphics, so that a matrix looks like a matrix, pi is the Greek letter Π , an integral symbol looks likew an integral, \int , making the equations much easier to understand because they look like equations, not programs. The software also incorporates an editor, so that equations or data do not need to be retyped, but can be saved as input files and modified later. The input files are ASCII text files that, if we knew the MathCAD "language," we could edit and modify.

We have become very enthusiastic about software with these capabilities, and have recently acquired another package, called PC MATLAB, which promises considerably more than MathCAD. There are ads in computer and science magazines for other software packages that do similar types of mathematical manipulations. I do not know which is the best, and at the prices that are being asked, I doubt I will have much chance to sample more than two or three. These are definitely not public domain or shareware. MathCAD lists at \$349.00, and PC MATLAB, with the capabilities we ordered, is more than four times as much. However, they can easily save thousands in scientific or engineering software development costs, and can be invaluable tools for system prototyping and testing.

Random Number Generators -Almost all personal computer programming languages are delivered with a random-number generator. In BASIC this is called RND, sometimes RAND, and to get a random number x you include the statement $x=rnd(y)$, where y is a number or numeric expression. It is interesting (and sometimes important) to look at the distribution of numbers returned by a sequence of calls to the random-number generator. No computerized random-number sequence generator is truly random, since the computers are finite machines. The functions usually generate numbers spread more or less evenly

RESEARCH DIVISION STUDIES MARS

As March approaches the Earth, the NCA Research Division is engaged in an on-going observational and photographic study of ephemeral phenomena on the planet. Those interested in participating in the project may obtain further information from Nancy Byrd, (703) 978-3440.

EXCERPTS FROM THE IAU CIRCULARS

1. October 1987 -- Sharon Beck, High Altitude Observatory, discovered two Sun-grazing comets on images on images from the Solar Maximum Mission Coronagraph/Polarimeter. Named SMM 1 and 2, the comets appear to be members of the Kreuts group.

2. June 9 -- A number of observers in the southern hemisphere observed the occultation of a 13th-magnitude star by Pluto. Gradual events due to an atmosphere around Pluto were recorded, and Auckland Observatory reported detection of three distinct layers.

3. June 11 -- C. Shoemaker discovered a comet of 13th magnitude in Sagitta on photos taken with the 46-cm Palomar Schmidt by H.E. and H.R. Holt and T.A. Rodriguez.

4. June 11 -- M. A'Hearn et al used IUE and ground-based observations of periodic Comet Temple 2 to determine that it is producing water vapor at the rate of approximately 60 kg/s. 5. June -- K. Rhea, Paragould, AR, noted the beginning of a dust storm in the Hellas region on Mars. During the following 2 weeks it spread over a quarter of the southern hemisphere.

Robert N. Bolster

FOR SALE

Celestron 5.5-inch reflector. 500-mm focal length, 8x50 finder, Redi-tilt tripod. \$300.00. Will Thornton, Haymarket, VA. H: (703) 754-2166, O: (703) 430-5268.

Celestron C-11, One of ten special precision telescopes made for NASA lunar ranging program. "Motofocus" declination motor, wedge, tripod, special ATA-approved hard cases. \$6500.00. Write PO box 5500, Washington, DC 20016, or call (202) 547-6911.

WANTED

Hydrogen-alpha or prominence filter (Daystar, Lumican, etc.) for C-8. Also, "The Sun and the Amateur Astronomer" by Baxter, or other books about building solar instruments. Bill Graham, (703) 379-0719, 5020 S. 10th Street, Arlington, VA 22204.

between an upper limit (usually 1) and a lower limit (usually 0). This type of distribution, known as "uniform deviates," is fine for games, but many times what is wanted is a Gaussian distribution. In a Gaussian distribution, it is more likely that the numbers occur in the middle of the range, and less likely that they occur at the limits. If we plot the frequencies that numbers within specific numeric ranges were generated, we get a bell-shaped curve which is highest where the numbers are most frequent (in the middle of the range) and falls off at the ends. A short program to generate random numbers with a Gaussian distribution is given by Press, et. al., in their book, *Numerical Recipes*, along with a number of comments on the randomness of random numbers, and algorithms for computation your own. They also warn readers to approach RND or RAND functions with caution, and remark that "if all the scientific papers whose results are in doubt because of bad RANS were to disappear from the library shelves, there would be a gap on each shelf about as big as your fist."

Planetarium Programs - are programs that generate a graphic display of the sky at the times and coordinates you specify. There are a number of them distributed as public domain or as shareware, through bulletin boards and user groups. There are also commercial programs sold via ads in *Sky & Telescope* for under \$100.00. I collected several from bulletin boards for a demonstration I was preparing, and found them to be entertaining and even educational. I find the sky displayed on a computer screen so different from the real thing that I do not think that I could learn the constellations from the displays. Also, the number of stars these programs contain is usually too small to make them useful as finder chart generators. I do know someone who told me he uses a fairly primitive PC planetarium to decide what to observe based on what general areas would be visible and what solar-system objects are above the horizon when he has a free evening while traveling. As usual, you get what you pay for, and the more expensive programs have better manuals and more features. The public-domain software may have endearing little flaws, such as misspelled constellation names, so you can learn how to construct software of this type by dissecting another person's efforts.

Optics Software - If you are interested in telescope optics software, you might consider ordering the new optics book and software package by Rutten and Van Venrooij, being offered by Willmann-Bell. (See their ad in the July S&T.)

NCA PARK PROGRAMS SCHEDULED FOR MARS, SATURN, URANUS, PERSEIDS

The 1988 series of National Capital Astronomers - National Park Service joint programs, "Exploring the Sky," continues with an unusually interesting season.

On Saturday, 13 August, at 8:30 pm, just past the maximum of the annual Perseids shower, the meteors will share the limelight (Mercury vapor, neon, h.p. sodium, etc!) with Mars, Saturn, and Uranus. The planets will be quite bright and in good position for telescopic views, with Mars now approaching the Earth.

On Saturday, 24 September, at 7:30 pm, Mars will be very near its closest approach to the Earth, will be quite bright, and will offer the best telescopic view for many years. Although the sky will be Moonlit that night (Natural light pollution!), both Mars and Saturn (as well as the Moon) will be bright enough for good viewing.

These agenda assume suitable weather. If not, we will be treated to Naturalist Bill Rudolph's tutorial entertainment in the Nature Center Planetarium. Either way, Dr. John Lohman's usual excellent descriptive handouts will add to make two super evenings for the whole family . . . and they're free!

U.S. NAVAL OBSERVATORY TOURS IN AUGUST

The Monday night public tours of the Naval Observatory will begin at 8:30 pm (EDT) on August 3, 10, 17, 24, and 31. Passes will be issued to the first 100 persons in line at the main gate at 34th Street and Massachusetts Avenue, NW, beginning at the scheduled time.

Visitors will see various observatory facilities and, weather permitting, appropriately selected celestial objects, including the Moon, Saturn, and Uranus, with the historic 26-inch Clark refractor with which the satellites of Mars were discovered.

For details, call the taped Observatory message: (202) 653-1543.

UNIVERSITY OF MARYLAND OPEN HOUSE SCHEDULED

The Astronomy Program, University of Maryland, holds open house on the 5th and 20th of each month at the University's Observatory on Metzert Road in College Park. Talks and slide shows are presented, followed by telescopic sky viewing, weather permitting.

On Saturday, August 20, Dr. J.P. Harrington will discuss asteroids. The public is invited; there is no charge, and no reservations are necessary for individuals. Groups larger than ten should call (301) 454-3001 at least 5 days prior to the program.

WASHINGTON ACADEMY OF SCIENCES ELECTS OFFICERS

Of the half hundred professional scientific societies affiliated with the Washington Academy of Sciences, National Capital Astronomers is the astronomical affiliate. Academy officers elected for fiscal 1989 are: President (Elected as President Elect in 1987), James E. Spates; President Elect (for President in fiscal 1990), Robert H. McCracken; Vice President for Administrative Affairs, JoAnne A. Jackson; Vice President for Affiliate Affairs, John G. Honig; Vice President for Membership Affairs, Sue M. Bogner; Chairperson, Junior Academy, Marilyn F. Krupsaw; Secretary, Donald O. Buttermore; Treasurer, R. Clifton Bailey; Managers-at-Large, 3-year term, Jean K. Boek and Thomas N. Pyke, Jr.; 2-year term, Lawson M. McKenzie and Marcia A. Smith; 1-year term, William M. Benish and Carl Pierchala.

Among other services, the Academy offers monthly lectures, September through May, from the entire gamut of science.

Held at American University, the talks are preceded by a reception and dinner. It is not necessary to attend these to hear the lecture, and there is no charge for the lecture only. For further information on the Academy call Bob McCracken at (301) 320-3621

COVER FEATURE: IAU COLLOQUIUM 112 URGES "CLEAN UP THE SKY!"

Depicted on the cover of this issue are the three logos adopted to help increase general awareness of the seriousness of light pollution, radio spectrum pollution, and space debris. These are the subjects of about 75 presentations at the Shoreham Omni Hotel during the four days, August 13-16, of the Washington series of Colloquium 112 of the International Astronomical Union.

The IAU, Associated Universities for Research in Astronomy (AURA), the International Dark-sky Association (IDA), the U.S. Naval Observatory (USNO), and National Capital Astronomers (the Washington-area adjunct of IDA), and other astronomers and organizations worldwide are making a concerted attack on these sky-pollution problems.

Local Organizing Committee:

Thomas E. Gergely, NSF, Chairman
 Peter B. Boyce, American Astronomical Society
 Gail S. Cleere, U.S. Naval Observatory
 James G. Ennis, Fletcher, Heald, & Hildreth
 William C. Erickson, University of Maryland
 Claud M. Kellett, National Science Foundation
 Stephen P. Maran, NASA - GSFC
 Robert H. McCracken, National Science Foundation
 Vernon Pankonin, National Science Foundation
 Lynn Schoolfield, Environmental Protection Agency
 Richard Schwab, Federal Highway Administration
 Judy Ross, AURA Inc.
 John Trasco, University of Maryland

Scientific Organizing Committee:

D. Crawford (USA), Chairman
 A. Rodgers (Australia)
 F. Sanchez (Spain)
 D. Schreuder (CIE)
 N. Steshenko (USSR)
 J. Stock (Venezuela)
 G. Swarup (India)
 S. van den Bergh (Canada)
 G. Coyne (Vatican)
 T. Gergely (LOC Chairman)
 H. Kahlmann (Netherlands)
 J. Kovalevsky (France)
 Y. Kozai (Japan)
 P. Murdin (UK)
 A. Potter (COSPAR)

National Capital Astronomers thanks all of those who volunteered to assist in meeting NCA's responsibility for providing audio-visual services for the meetings. Among the many, those actually scheduled are: John Birch, Andrew Davis, Jeffrey Guerber, Susan Harrison, Thomas Hartnett, Eric Nyström, Irving Price, Louis Sheffield, Mark Trueblood, and Thomas Wiederrecht. We of course thank any others who volunteered for this or other services.



National Capital Astronomers, Inc.

is a non-profit, public-service corporation for advancement of the astronomical sciences. NCA is an affiliate of the Washington Academy of Sciences.

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 colloquia held at the National Air and Space Museum of the Smithsonian Institution. 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 *Sky & Telescope* magazine and the *NCA Star Dust*.

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.

The **Telescope Selection, Use, and Care Seminar**, 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 lead 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 and other astronomical items.

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

PLEASE ENROLL ME IN NATIONAL CAPITAL ASTRONOMERS MEMBERSHIP

- Regular (\$32 per year) Each regular member receives *Sky & Telescope* and *Star Dust*.
 Junior (Only open to those under age 18.) Date of birth _____
Junior members pay a reduced rate and may elect not to receive *Sky & Telescope*.
 Sky & Telescope and *Star Dust* (\$25 per year)
 Star Dust only (\$10 per year)

First name or initial Middle or initial Last Telephone _____

Street or box Apartment City State Zip

The following information is optional. If you would like to participate actively in NCA affairs, please indicate briefly any special interest, talent, skills, vocation, education, experience, or other qualifications which you might contribute. Thank you, and welcome!

NOTE: If you already subscribe to *Sky & Telescope*, please attach a recent mailing label, or indicate expiration date: _____. An adjustment will be made. Make check payable to National Capital Astronomers, Inc., and send with this form to: Patricia B. Trueblood, Secretary, 10912 Broad Green Terrace, Potomac, MD 20854.

S T A R



D U S T

National Capital Astronomers, Inc.

Washington, DC 20032-3621

Published eleven times yearly by NATIONAL CAPITAL ASTRONOMERS, INC., 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, Walter L. Sisson. *Star Dust* deadline 15th of preceding month. Information: (301) 320-3621. Material for publication: Robert H. McCracken, Editor, 5120 Newport Avenue, Bethesda, MD 20816.

WARKEN, WAYNE H.,
 BOUL BRELL PL,
 GREENBELT, MD 20770

FIRST CLASS

