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Star Dust

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Dr. Peggy Kidwell Will Discuss The History of American Women in Astronomy

The contributions of American women in Astronomy and Astrophysics have been substantial. From Maria Mitchell's discovery of a comet in 1847 (for which she was awarded the gold medal by the King of Denmark) to the development of the first spectral classification scheme by Annie Cannon to Henrietta Leavitt's unveiling of the period-luminosity relationship; American women have conducted dedicated research in Astronomy and received considerable renown. In other cases, others have had to stand by while their male colleagues took first authorship on the papers based on their research.

The May colloquium will feature Dr. Peggy Kidwell presenting a study of the role of women in Astronomy, particularly in the United States from a historical perspective. Women in this country have studied the heavens, from at least the eighteenth century. In the late nineteenth century, the opening of women's colleges, and the growth of observatories all created places for women to do paid astronomical work. This talk traces the entry of women into astronomical careers, with particular emphasis on the American experience.

Peggy Aldrich Kidwell received her Ph.D. in History of Science from Yale University. As a curator, she currently cares for the collection of mathematical instruments at the National Museum of American History.

May Calendar..... *The Public is Welcome*

Saturday, May 4, 7:30 pm - NCA Monthly Colloquium will be held in room A-06 of Building #42 on the Van Ness Campus of the University of the District of Columbia (UDC), at 4200 Connecticut Ave NW. Dinner with the speaker at 5:45 PM at Charlie Chaing's Restaurant at 4250 Conn Ave. NW (dinner will be in upper level of restaurant).
For directions refer to map and description on last page.

Tuesday, May 7, 14, 21, 28 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 3, 10, 17, 24, 31, 7:30 pm - Telescope-making classes at American University, McKinley Hall Basement. Information: Jerry Schnall, (202) 362-8872.

Friday, May 3, 10, 17, 24, 31, 9:00 pm - NCA 14-inch telescope open nights with Bob Bolster, 6007 Ridgeview Drive, south of Alexandria off Franconia Road between Telegraph Road and Rose Hill Drive. Call Bob at (703) 960-9126.

Saturday, May 11 at 8:30 pm - Exploring the Sky at Rock Creek Park, on Glover Rd. NW, near the Nature Center. For further information call John Lohman at (703)820-4194 (Arlington).

April Colloquium

The speaker at the April colloquium was Dr. Nancy Boggess of NASA/Goddard, Deputy Project Scientist on the Cosmic Background Explorer. She had previously spoken to NCA in March 1990, when she presented the initial results.

COBE's objective is to study the "radiative relics" of the Big Bang -- the Cosmic Microwave Background (CMB), "the oldest fossil in the universe", as Dr. Boggess put it, and the Cosmic Infrared Background (CIB). The CMB is the radiation left over from the era, at a few 10^5 years after the Big Bang and a temperature of about 10^6 K, when matter (particles) and light (photons) decoupled -- the Universe became transparent, and particles were able to form into atomic nuclei; before this time it was an undifferentiated mix of quarks, leptons, and photons. The CMB has long been known to have a black body spectrum of 2.7 K and to be highly isotropic (ie., the same everywhere), but no one knows how such a smooth early Universe could evolve into the highly structured one we see today. Deviations from isotropy would give clues to the origin of structure in the Universe, while deviations from a blackbody spectrum could signify major injections of energy after the Big Bang, perhaps from primordial black holes or gravitational waves. The CIB, which has been predicted but never seen, would be the light from the first objects to form after the decoupling. The characteristics of its spectrum and any deviations from isotropy would give an indication of the nature of these objects; for instance, it is not known whether stars formed first and then became organized into galaxies or whether "galaxies" of hydrogen and helium formed first, in which the stars then formed. The three instruments -- FIRAS, DIRBE, and DMR -- between them cover a wavelength range of 1 micrometer to 1 centimeter. However, the CMB and CIB are not the only sources of radiation in this range, and the effects of stars, interplanetary and interstellar dust, and synchrotron radiation must all be determined and subtracted from the data.

COBE was launched on November 18, 1989 by the last NASA-owned Delta rocket. Originally scheduled to be launched from a Space Shuttle, following the Challenger accident it was remanifested for the Delta, which required extensively redesigning the spacecraft to reduce its weight from 10000 to 5000 lbs; this was accomplished in 2 1/2 years and without jeopardizing any of the analytical capabilities. Two of the instruments, FIRAS and DIRBE, sit in a liquid-helium dewar to keep them within a few degrees of absolute zero; the supply lasted until September 21, 1990. Since pointing at the Sun or Earth would rapidly deplete the liquid-helium supply, the spacecraft is in a near-polar, sun-sychronous orbit -- a 103 min orbit at about 900 km that precesses one degree per day. The spacecraft rotates at 0.8 rpm, to allow DIRBE and DMR to scan half the sky each day and to help even out any thermal effect, especially on the DMR, though none have been detected.

The Far Infrared Absolute Spectrophotometer, FIRAS, measures the spectrum of the Cosmic Microwave Background. It is a Fourier-transform spectrometer (a Michelson interferometer configured as a spectrometer) with two detectors and an absolute blackbody calibrator that can be physically moved into the field of view and whose temperature can be precisely varied around 2 K on command. It has a spectral range of 500 μ to 1 cm, and a 7 degree field-of-view aligned on the spin axis. FIRAS has found that the spectrum of the CMB shows no deviations from a 2.735 K blackbody, within the 1% error bars. [When FIRAS Principal Investigator (and COBE Project Scientist) John Mather showed this spectrum at the American Astronomical Society meeting in January 1990, the audience gave him a standing ovation. I have now heard that at the April meeting of the American Physical Society they announced that they had reduced the error bars to 0.25%.] This rules out large injections of energy in the early universe, and in particular refutes the infrared excess reported by a group from Berkeley and Nagoya using sounding-rocket observations. The FIRAS group has been working to understand the outlying fluctuations in the interferograms, which they have identified as galactic molecule lines. Dr. Boggess showed maps of the galaxy in N+ at 205 μ, which has never been detected before, in C+ at 158 μ, and in the dust continuum near 205 μ.

The Differential Microwave Radiometer, or DMR, looks for variations in the CMB to probe the universe's evolution, geometry, and dynamics, and the contribution of the interstellar electrons. It has three matched pairs of microwave receivers, at 3.3, 5.7, and 9.5 mm (90, 53, and 31 GHz), each tilted 60 degrees from the spin axis, with 7 degree fields-of-view. The DMR maps show the +/- 3 mK dipole variation in the microwave background caused by the Milky Way's motion; the motions of the spacecraft, Earth, and Sun (and eventually the galaxy's and the Local Group's) must be accounted for in the processing. So far, the DMR data show no intrinsic variations in the CMB to a level of 4×10^{-5},

or 1 part in 25000; the DMR group expects to eventually get 10x better, but to achieve this the effect of Earth's magnetic field on the instrument must also be taken into account. The data, which agrees very well with the standard Big Bang model, is beginning to be uncomfortable for theorists involved with the formation of structure, and it is expected that it will really begin to distinguish between models when the accuracy reaches 1 part in 10^5. DMR is continuing to operate for a second year, since it does not require cryogenic temperatures; this will improve its detection statistics and sky coverage.

The Diffuse Infrared Background Experiment, or DIRBE, is an off-axis Gregorian telescope with a 0.7 degree field-of-view, tilted 30 degrees to the spin axis; it is designed so that no supports are visible to the sensors. It provides photometric coverage in 10 bands from 1 to 300 μ, and photopolarimetry in the three shortest wavelengths, from 1 to 3.3 μ, which will allow it to distinguish solar system from galactic dust. DIRBE has two missions: 1) to make a definitive search for the the Cosmic Infrared Background, and 2) to measure the properties, distribution, origin, and physical conditions of the interplanetary dust and interstellar dust. This instrument has produced maps showing the distribution of dust across the sky, and the distribution of stars without dust, which shows the Milky Way as a classic edge-on spiral galaxy. However, it has not yet given information on the first objects to condense, because the data processing is the most involved of the three instruments and because their signal is far below that of the nearby solar-system and galactic dust. The three shortest-wavelength bands are continuing to operate, though with reduced sensitivity.

It will still be several years before the analysis of the data returned by COBE is complete -- FIRAS alone generated an interferogram every minute for 10 months, and the people involved want to be sure that the data they present is real and cannot be attributed to instrumental effects or changing conditions on orbit. However, Dr. Boggess and the others are already looking ahead to the future: since it probably will not be possible to do better from low-Earth orbit, and not much better from anywhere in the inner solar system, there has been a concept proposed to send a spacecraft to the vicinity of Uranus or Neptune.

Jeff Guerber

Occultation Expeditions Planned

Dr. David Dunham is organizing observers for the following occultations. For further information call the NCA-IOTA information line (301) 474-4945 (Greenbelt, MD).

Date Grazing Lunar:	Time EDT	Locality	Visible Magnitude	Percent Sunlight	Cusp Angle	Minimum Aperture
1-May	02:31	Dinwiddie, VA	3.1	94	7N	5 cm
17-May	22:14	Far Hills, NJ	5.3	20	12N	5 cm

Asteroidal:	Time	Locality	Star Mag.	Delta Mag.	Name	Aperture
8-May	03:31	Virginia	8.8	5	(462)Eriphyla	5 cm
20-May	21:38	Carolinas	11.7	1.3	(48)Doris	20 cm

*Appulse to be observed for possible satellites or path shift.

Excerpts from the IAU Circulars

R.N. Bolster

1• **February** - Baron and Owen, University of Hawaii, observed arcs of infrared emission near both poles of Jupiter, possibly associated with auroral activity. The observations were made at a wavelength of 3.5 micrometers with the NASA Infrared Telescope.

2• **March 16** - Antonin Mrkos, Klet Observatory, discovered a comet (1991k) of 15th magnitude in Virgo.

3• **March 17** - E.F. Helin and K.J. Lawrence discovered a comet (1991l) of 15th magnitude in Virgo, close to the border with Bootes, with the Palomar 46-cm Schmidt telescope. The preliminary orbital elements indicate that it will reach perihelion in 1992 February at a distance of 1.88 AU.

4• **March 29** - Wagner, Bertram, and Ali, Ohio State University, and Starrfield, Arizona State University, obtained spectra of Nova Herculis with the Perkins 1.8-m telescope at Lowell Observatory. They noted that the spectrum was similar to that of Nova V1500 Cyg in 1975, and proposed that it is likewise an outburst of a strongly magnetized white dwarf star.

Astronomy and Personal Computers

Joan Bixby Dunham

Computerizing Research:

A recent Byte magazine has an article on intelligent document management which I read the same day I read newspaper articles on the investigation of fraud committed by Thereza Imanishi-Kari during the course of her research. The Byte article gave examples of how researchers might keep all their records electronically. It remarks that "Laboratory work has changed a lot from the early days when all notes and calculations could be kept in notebooks." The evidence for fraud committed by Dr. Imanishi-Kari was, in part, based on examination of her notebooks, finding that the records could not have been written on the dates claimed but must have been made later, after Dr. Imanishi-Kari had been asked to prove that the data from her experiments existed. Although the Byte article suffers from the lack of experience of its author with practices in scientific research ("early days" indeed!), it does make some good arguments for use of computers to store all research notes.

In many fields the researcher's notebook is sacred. Entries are written in ink, dated, and, while later entries may correct earlier ones, written entries are not changed nor are data removed. The notebooks are used to resolve questions of data accuracy, priority of discovery, patent disputes, and other questions. Using researcher notebooks is not a universal practice in astronomy, although many astronomers do. There are scenes in the PBS series The Astronomers where observers are shown in front of a console, capturing their data with computers, recording the observation date, time, and so on by hand in notebooks. There are occasions when the date and time of an observation becomes important in establishing who first discovered something. If the observer is aware that a comet, nova, or minor planet has been found, then the discovery can be established with a telegram to the IAU. But the observer may not always be aware immediately that the image just taken contains a unique observation. Pre-explosion observations of a supernova, for example, would become valuable only after the star becomes a supernova.

The difficulty with using a computer-based set of research notes to establish precedence is that, absent any outside confirming evidence, there is nothing on a computer that can be dated uniquely. Records can be kept with a date and time stamp provided by the computer clock, but computer users can set the clock to whatever they wish. And in cases where the clock is not under the users' control, changing the date of a record or a file is still no problem for a competent programmer. Also, there may be quite legitimate reasons to do with data storage, archiving, reformatting, or editing why the date of a file could be much later than the actual date the data were originally stored. Methods to establish a unique date all require an outside agent or act, and also require that the researcher be aware that the date specific data were taken must be firmly established. Years may pass before the dates data were taken become important. This was certainly true in the case of the investigation of Imanishi-Kari.

It could be argued that the convenience of using computers to keep observing records and notes outweighs the possible need to establish an observation date in astronomy. Another way to consider the question is that legal disputes as to the legitimacy of observations or time data were taken seldom arise in astronomy, especially among professional astronomers. We would like to think that fraud is not a problem in astronomy, but this may have more to do with the lack of financial incentive than the moral character of those attracted to astronomy. Whoever finally wins the court fights to establish the first inventor of the microprocessor is likely to become very wealthy, while the loser just gets very large legal bills. In astronomy, questions of discovery are handled by attaching all the observers names to the event. This is why numerous comets have multiple names.

A second difficulty in using computers to maintain researcher notebooks is the possibility that changes in technology may leave an observer unable to read old notebooks. Those of us who have used computers for more than 10 years all know of data written to media which can no longer be read. Personal computers used to store data on cassette tapes, when disk drives were expensive and not very common. I certainly have no desire to keep old computers around to read my cassette tape files. The only storage format I disliked even more was punched paper tape. At one time, every installation had card readers and we though they would always be

available. The same was true for old formats of magnetic tape (556 bpi tapes, for example). We still have yet to see a storage format whose ease of access over the long term outdoes the printed page. While it may take a long time to search through printed documents to find relevant information, it can take even longer if a search must begin with a nation-wide hunt for a museum piece in operating condition to read the old files.

There are plans to archive data from major observing programs which include with them the commitment to provide the equipment to read from the archives indefinitely. Research notes stored on those media are more likely to be accessible in the future. However, a researcher's notebook is a personal record of work done. Individuals may not want to spend the money to store their notes on media designed for large data volume and high speed retrieval.

N C A Welcomes New Members

Timothy Kalen Murray
1837 Vernon NW
Washington, DC 20009

N C A Officer Nominations

The nominating committee, consisting of Bob Bolster, Ken Short and Nancy Byrd, met on April 13, 1991 to select nominees of candidates for National Capital Astronomers for the 1991-1992 year for recommendation to the membership. The committee presents the following slate:

President:	Dan Costanzo
Vice President:	John Graham
Secretary:	Leith Holloway
Treasurer:	Jeff Norman
Audio-Visual Manager (formerly Sergeant at arms):	Jeff Guerber
Trustee:	Ken Short

Trustees whose terms do not expire this year include: Maurice Shapiro, Bob McCracken and Walter Nissen.

The committee believes that it has found an excellent slate. However, if a member wishes to place other name(s) in nomination, that member may contact Ken Short or offer the candidate's name at the April meeting, after obtaining agreement to serve from the member nominee.

Naval Observatory, Goddard and Smithsonian Programs

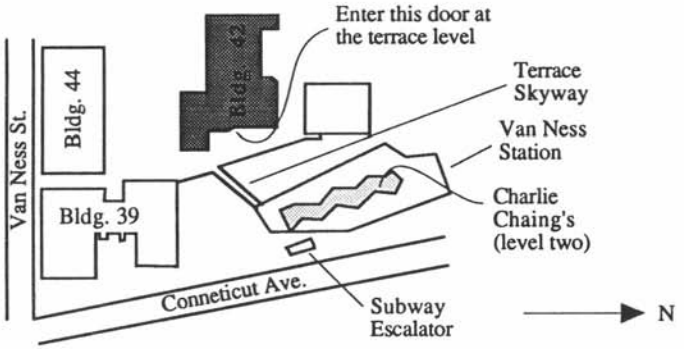
•Anyone who is interested in cataloging occultation timings the 5" telescope at the Naval Observatory is available. Those interested in participating must contact Jay Miller [h(301)530-7942 w(301)496-6941] to be checked out on operation of the instrument and for admission to the observatory. The solid occultation timings are posted on the 5" for that location.

Smithsonian Institution Resident Associate Astronomy Courses
(Talks presented in the planetarium)
Wednesday, May 8, 7:30 pm - "Extragalactic Sociology", by Martha P. Haynes of Cornell University. She will discuss interactions among neighboring galaxies. Call (202)357-3030
Wednesday, June 5, 7:30 pm - "Galaxies and the Missing Matter" by Vera Rubin of The Carnegie Institution of Washington. She will present the latest findings in the area.

Goddard Space Flight Center
(Lectures are held in the Bldg. 3 Auditorium)
Friday, May 3, 3:30 pm - "First Results from the Broad Band X-Ray Telescope", by Peter Serlemitsos
Friday, May 10, 3:30 pm - "Terra-Forming Mars", by Chris McKay.

Friday, May 17, 3:30 pm - Recent Results from the Wide Field Planetary Camera aboard the Hubble Space Telescope", by James Westphal.
Friday, May 31, 3:30 pm - Rashid Sunayaev of the Space Research Institute, Academy of Sciences, USSR (title to be announced).

Getting to the NCA Monthly Colloquium



•From the Van Ness Subway Escalators:
Charlie Chaings can be reached from the second floor mezzanine in the Van Ness Station building (lightly stippled).
The lecture hall is on the terrace level of the University of the District of Columbia (three levels up from the subway escalators). There is a skyway walk from the third floor of the Van Ness Station building, or there are stairways and elevators if you walk through the Van Ness Station building, across the bus lane and through the parking garage. The lecture room is nearest to the door by the skyway.

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 colloquia. (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 ***Sky & Telescope*** magazine and the monthly publication of NCA, ***StarDust***.

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 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 and other astronomical items.

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

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[ ] Regular ($38 per year) Each regular membership receives ***Sky & Telescope*** & ***Star Dust***.
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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 mail label, or indicate the expiration date: _____. A prorated adjustment will be made. Make check payable to National Capital Astronomers, Inc., and send with this form to:
Nancy Byrd, Secretary, 4215 Holborn Ave., Annandale ,VA. 22003.

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

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FIRST CLASS

Dr. Wayne H. Warren, Jr.
8001 Brett Place
Greenbelt, MD 20770