OCTOBER LECTURE

Space Shuttle Astronaut Dr. John-David F. Bartoe, Payload Specialist on board Spacelab 2, Shuttle flight 51f, spoke at the 5 October 1985 meeting of National Capital Astronomers. The approximately one-trillion bits of data acquired by the experiments, which ended in August, are still being reduced; he described instead the instrumentation and scientific investigations of the mission and some of the highlights of the flight.

"In this age, we can easily get ourselves buried in ones and zeros," said Bartoe, "The results are not yet ready, but there is an interesting story about the efforts to collect these experimental data."

Bartoe's story was interesting indeed!

The mission, which was designed in 1977, concentrated on astronomy, physics, and biology. The entire payload bay was packed with experiments; there was no live-in module. All seven of the crew lived in the nose of the orbiter. All of the instruments for the 13 experiments required the vacuum of space in order to function.

While Bartoe spoke mainly on the astronomy, he did comment on two life-science experiments on bone demineralization and lignification of trees.

The astronomical instrument complement comprised the Cosmic-Ray Telescope, the largest instrument ever flown to study cosmic rays; the Infrared Telescope to seek cool IR sources; X-Ray Telescope to study hot, active galaxies and clusters of galaxies; Solar Telescope cluster on a Sun-tracking mount; and on the end of the manipulator arm, a plasma detector to map the orbiter-induced perturbations of the surrounding plasma. The solar experiments were operated periodically throughout the seven-day mission, the plasma experiments sporadically. The two high-energy (cosmic- and x-ray) physics experiments were operated primarily from the ground, essentially continuously.

Each experimenter had seven days of work to do, described minute-by-minute by the inch-thick, science time-line document, prepared over months of diligent study of every detail of the mission to ensure the utmost efficiency.

About five minutes into the launch, the number one engine was lost, resulting in a lower orbit than planned - about 300 instead of 360 km; the entire time line was changed! The orbital period was shortened; the times of entering and leaving the South Atlantic Anomaly were changed.

An enormous real-time replanning effort by both the space and ground crews, focused on the Marshall Operations Ctr in Houston, saved the mission. The result was an outstanding success.

(Ed. note - NASA has elaborate backup plans for almost every conceivable contingency; the overall systems are extremely reliable. If a system comprises one million parts, each of which can average 125 years of continuous operation between failures, one failure can be expected each hour!)

On board the Shuttle, all the operations were done by remote control from the rather cramped nose of the orbiter. The crew of seven operated on two shifts, three at work while three slept, with the Commander working half of each. Bartoe emphacized credit to the large ground staff at Houston.

The compositions of high-energy primary cosmic rays were measured as a function of enrgy. Compositions were measuresd by large scintillation counters of one square meter area. Energies were measured by gas Cerenkov detectors - large gas chambers surrnded by abt 200 photomultipliers. Highest energies were measured by transition radiation detectors - large sheets of polyethylene woven into 1-m square panels sandwiched between proportional x-ray counters. The X rays thus counted are produced by impingement of high-energy cosmic rays on the polyethylene.

The cosmic-ray experiment, supplied by the University of Chicago, is especially designed for light weight - about 2 tons.

Millions of cosmic-ray events were recorded. Reductions require determining the paths and energies of the individual particles. Energies as high as four trillion eV are being sought in the data. About one event in ten thousand is expected to show such energy.

Both discrete and diffuse infrared sources were sought from 2 to 120 microns with about 1-minute angular resolution. The infrared-telescope mirror of 10-cm aperture was held at cryogenic temperature by a 250-gallon dewer of liquid helium. The telescope scanned 45 degrees to right and left every 15 seconds to sweep a large section of sky during an orbit. On successibe orbits during the measurements the shuttle was rolled to scan a new sector of sky.

Early in the mission it was found that the expected background level was exceeded by about 10 times at 4 microns, and about 500 times at 120 microns. Seeking an explanation, Bartoe checked the telescope when he had an opportunity, and found a loose piece of mylar (part of the insulation material) within the field of the telescope. The temperature of the stray material could easily account for at least a large part of the result. One function of the infrared experiment was to evaluate the feasibility of infrared astronomy from the Space Shuttle. It is still not certain whether the Shuttle environment will be satisfactory.

The infrared telescope system was a result of collaboration of the Smithsonian Astrophysical Observatory at Cambridge, the University of Arizona, and the Marshall Space Flight Center.

The X-ray telescope, one of two British experiments on the mission, was built by the University of Birmingham.. Its purpose is to attempt to measure the hot gases in which cluster galaxies seem to be imbeded - perhaps some of the "missing" mass necessary to account for the observed non-Keplerian orbits.

The X-ray telescope is a dual device operating from 2 to 20 microns. It contains two star cameras for calibration, and two multiwire proportional X-ray counters. Over each of the latter is a Dickie mask (a gold plate having a random pattern of holes of various sizes), which casts an X-ray shadow on the counter. The direction of arival of the X-rays can thus be determined. Even many overlaid shadows can be processed. The fields of the two are 3 and 12 arcminutes.

The instruments worked flawlessly. Fortuitously, the lower-than-planned orbit actually benefitted the experiment, since the interfering background radiation level within the South Atlantic anomaly was less by a factor of 10.

A small satellite which carried 14 instruments, the Plasma Diagnostics Package, measured the plasma environment and perturbations caused by the Shuttle. It measured low-energy electrons, proton distributions, plasma waves, electric field strength, electron densities and temperatures, ion energies, directions, and pressures. By manipulating it with the remote arm it was used to survey the payload bay, and even to map the radiation pattern of the Ku-band antenna. It was then launched into orbit, and the Shuttle was flown around it to measure the plasma wake turbulence of the Shuttle.

Four solar instruments were flown: an ultraviolet telescope provided by the Naval Research Laboratory, a visual band instrument from Lockheed, the Spectral Irradiance Monitor (NRL), and an extreme-ultraviolet instrument from England.

The Spectral Irradiance Monitor, for precision aeronomy, maintained its precise calibration throughout the mission while measuring components of the upper atmosphere. The Solar Optical Universal Polarimeter (Lockheed), which has the ability to make solar magnetograms, concentrated on the solar photosphere. The NRL Solar Ultraviolet Telescope which covers the 1200 to 1700-angstrom region, studied the chromosphere and transition region. The Helium-Abundance Experiment (England) examined the high-temperature regions of the corona in the extreme ultraviolet.

Dr. Bartoe showed a number of interesting solar features such as very local explosive events showing large Doppler both positive and negative, moving and growing orange features, and many features which show mostly red-shifted lines, indicating inward falling.

He concluded with weveral excellent slides of various interesting features of the earth.

R.H.McCracken

OCCULTATION EXPEDITIONS PLANNED

DR. David Dunham is organizing observers for the following asteroidal and cometary occultations. For further information call Dunham at 585-0989.

Asteroidal:	Place (prelim)	star Mag	Delta Mag	Name	
11-04-85 03:32	Bahamas	7.7	4	(70) Panopaea	5 cm
11-27-85 01:17	WA, W. Canada	5.3	10	(651) Antikleia	3 cm
11-29-85 10:55	Nicaragua (if shift)	9.0	0.8	(18) Melpomene	10
Cometary:		Star Mag		Comet	
11-10-85 03:57	North Carolina	11.6		Halley	18cm
11-22-85 05:13	Florida	11.3		Halley	15 cm
11-22-85 08:27	Southern USA	10.9		Halley	15 cm

NCA INVITED TO HOPEWELL CORPORATION OBSERVATORY FOR COMETS

NCA members, families, and their guests are invited to view Comet Halley and two other telescopic comets, Hartley-Good (1985l) and Thiele (1985m), from Hopewell Observatory on Friday evening, 15 November. Arrive in late afternoon, or as soon after dark as convenient.

If you wish, bring your own telescopes. If you come early, bring your prepared picnic dinner. Coffee, tea, cocoa, and soft drinks will be provided by the Hopewell Corporation.

From the Beltway, go west on I-66 25 miles to the Haymarket exit, left 0.25 mile to traffic light, right on Route 55 0.8 mile to County Road 681, right 3 miles to end, left on County Road 601 (dirt) 1.2 miles to County Road 629, right on 629 1.0 mile to narrow paved road on right (Directly across from easier-to-see entrance gate with stone facing on left). Turn right, go 0.3 mile to top of ridge, go around microwave station and continue on dirt road through woods a few hundred feet to site.

Carpooling is recommended. For further information, call Bob McCracken at 320-3621. If no answer, 229-8321 to leave a message for callback.

NCA WELCOMES NEW MEMBERS

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8514 Whittier Blvd.
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6511 Seven Locks Road
Cabin John, MD 20818

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9720 Holmhurst Road
Bethesda, MD 20817

Garold Stone
PO Box 153
Annapolis Junction, MD 20701

EXCERPTS FROM THE IAU CIRCULARS

1. September 14 - Koutchmy and Dossin, Institute Astrophysique at Meudon Observatory, obtained photographs of Comet Halley with the 62-cm F/3 Schmidt telescope of Haute Province Observatory. They show a 6-second central region with the coma extending out 1 minute. The inner corona was V-shaped with 3.5-second arms 90 degrees apart, and there was a jet-like feature 15 seconds long in line with one arm.

2. September 24 - W. Liller, Vina del Mar, Chile, discovered a possible nova of 10th-magnitude in Scorpius using projection-blink comparison. He also obtained an objective spectrogram showing H-alpha emission.

3. September 26 - Prieto, Kidger, and Beckman, La Palma, obtained a pectrograph of Comet Halley with the 2.5-m Isaac Newton telescope showing CN, C_2 and C_3 emission out to 4 seconds from the nucleus, and some evidence of coma exending out to 10 minutes.

4. October - Charles, Jones, and Naylor, Oxford University, and Boksenberg, Royal Greenwich Observatory, reported that star AC 211 in M 15 is probably not the X-ray source, as they found spectral-line emission from a source 1.5 seconds to its west, but not from AC 211. R.N. Bolster

SPECIAL PUBLIC HALLEY PROGRAM AT BURKE LAKE PARK

On November 16 at 7:00 pm, Geoffrey Chester will offer public telescopic comet viewing at Burke Lake Park in Northern Virginia. Volunteers with telescopes and binoculars will be needed to assist. Call Geoff for details at H: (703) 379-8218, or O: (202) 357-1529.

NASM PROGRAM FEATURES DISCOVERY OF MOONS OF MARS, SOLAR VIEWING

Historian Jan Herman will present the Monthly Sky Lecture, recounting the search and discovery of Deimos and Phobos and the subsequent rivalry, in the Einstein Planetarium of the Air and Space Museum, at 9:30 a.m. on Saturday, November 2. Following the lecture, weather permitting, Stan Cawelti will offer safe, telescopic hydrogen-alpha viewing of the Sun on the deck east of the building.

FOR SALE

Celestron 5.5-inch "Comet Catcher" telescope with custom mounted Celestron 8X50 finder on Gold "Redi-Tilt" tripod, 15-mm RKE eyepiece. $550. Will Thornton, H: (Haymarket, VA) (703) 754-2166; O: (202) 863-4658.

★ STAR DUST WASHINGTON, D.C.

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FIRST CLASS

★ STAR DUST

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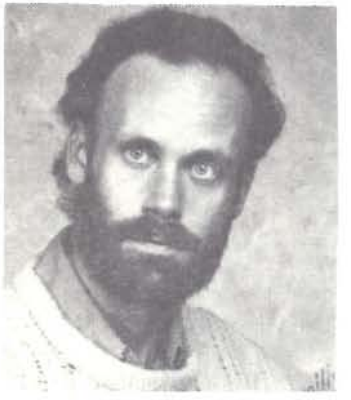
A'HEARN TRACES COMET ORIGINS CHEMICALLY



DR. A'HEARN

Dr. Michael F. A'Hearn, Acting Director of the Astronomy Program of the University of Maryland, will address the 2 November meeting of National Capital Astronomers. He will present recent work which relates the chemistry of comets to their origin.

Recent observations of individual comets have suggested that they accreted from interstellar material which was never heated as it was processed through the solar nebula. Older observations indicate a remarkable uniformity among comets which implies that conclusions about individual comets can be generalized to apply to all comets. The advent of Comet Halley presents an opportunity to make direct measurements which can tell us the temperature at which this particular cometary nucleus, and therefore presumably all cometary nuclei, accreted. A proper understanding will require both Earth-based and *in situ* measurements, a unique combination never before possible.

Born in Wilmington, Delaware and raised in Bainbridge, Massachusetts, Michael F. A'Hearn received his B.S. in physics from Boston College in 1961 and his Ph.D. in astronomy from the University of Wisconsin in 1966. Since then he has served as a faculty member of various ranks at the University of Maryland where he is now Acting Director of the Astronomy Program.

Dr. A'Hearn's research activities have included polarimetric observations and modeling of the atmosphere of Venus, and diffuse bands of interstellar matter. He is currently involved in photometric and spectroscopic observations of comets at ultraviolet, optical, infrared, and radio wavelengths, modeling of theoretical spectra and vaporization processes, and comparison with Earth-approaching asteroids. He also observes occultations of asteroids for comparison with cometary nuclei.

He is Discipline Specialist for Photometry and Polarimetry forthe International Halley Watch, Chairman of the Working Group on Cometary Filters, IAU Commission 15, Member, MOWG for NASA Planetary Astronomy Program, a member of the Astro Halley Science Team, and a member of National Capital Astronomers.

NOVEMBER CALENDAR -- *The public is welcome.*

Friday, November 1, 8, 15, 22, 29, 7:30 pm -- Telescope-making classes at American University, McKinley Hall basement. Information: Jerry Schnall, 362-8872.

Friday, November 1, 8, 8:00 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 960-9126.

Saturday, November 2, 6:00 pm -- Dinner with the speaker at the Ding How Restaurant, 1221 E Street, NW. Reservations unnecessary.

Saturday, November 2, 8:15 pm -- NCA monthly meeting at the U.S. Department of Commerce Auditorium, 14th Street and Constitution Avenue, NW. Dr. A'Hearn will speak.

Tuesday, November 5, 12, 19, 26, 7:30 pm -- Telescope-making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, MW. Information: Jerry Schnall, 362-8872.

Friday, November 15, from 6:00 pm on - NCA invited to Hopewell Observatory for Comet Halley. See page 12.

Saturday, November 16, TIME? pm - Halley Special public program at Burke Lake Park with Geoffrey Chester. See page 12.