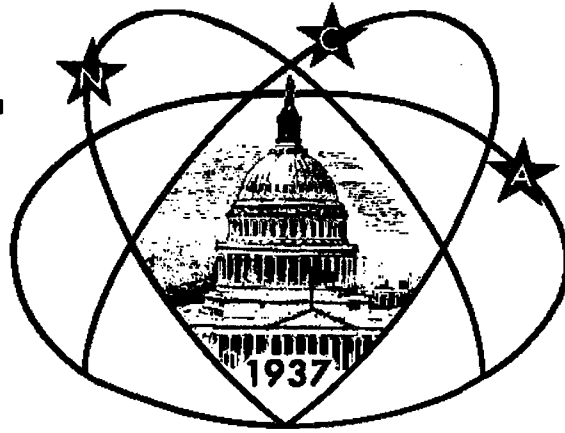


Star



Dust

National Capital Astronomers, Inc.

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Radio Galaxies

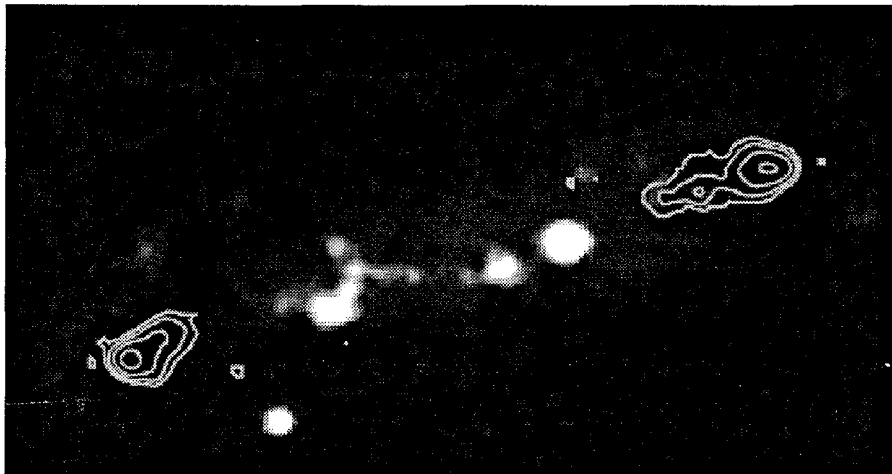
by John Graham

Radio galaxies will be the topic of the October meeting of the National Capital Astronomers which will be held Saturday, October 5, at 7:30 PM in the Lipsett Amphitheater located on the first floor of the Clinical Center (Building 10) of the National Institutes of Health (NIH). Our speaker, John Graham, was born and educated in Australia and since then worked at observatories in South Africa, Holland and Chile before coming to the Department of Terrestrial Magnetism of the Carnegie Institution of Washington 11

years ago. He has been a member of NCA for most of that time. In his talk he will relate how an enormous change has occurred in observational astronomy over the last 50 years. Formerly, all our information about the universe came to us in visible light. Now we are able to detect extraterrestrial radiation

ranging from the radio through to the gamma ray spectrum. The radio sky looks very different from the visible sky with which we are familiar. Most of the discrete sources are not stars but are much more distant galaxies. All galaxies, such as our own, radiate radio waves at some level but some are extraordinarily bright.

They are in fact among the most energetic objects that we know. John Graham will describe how radio galaxies were first recognized, where the immense energy comes from and how they have been used to probe the distant and early universe. ○



The radio and optical emission seen in the above superimposed images of the radio galaxy 3C368 indicated that energetic processes are at work. A radio galaxy is a galaxy that is visible to radio telescopes. A large radio signal usually indicates very powerful phenomena. The optical light is shown in red (grey) and the radio emission in blue (white) contours.

Currently, one can only guess what causes the unusual radio and optical features. Scientists working with the Hubble Space Telescope speculate that the radio emission might have resulted from jets of high-velocity material thrown off from the center of the galaxy, while the optical light from gas and dust that are remnants of a burst of star formation triggered by the radio jet. Credit: National Aeronautics and Space Administration, National Radio Astronomy Observatory, Very Large Array, Hubble Space Telescope, Wide Field Planetary Camera 2, M. Longair (U. Cambridge), 9/30/95.

Calendar of Monthly Events

The Public is Welcome!

NCA Home Page: <http://myhouse.com/NCA/home.htm>

Fridays, November 1, 8, 15, and 29, 7:30 PM- Telescope making classes at American University, McKinley Hall Basement. Information: Jerry Schnall, 202/362-8872.

Fridays, November 1, 8, 15, and 29, 8:30 PM- Open nights with NCA's Celestron-14 telescope at Ridgeview Observatory; near Alexandria, Virginia; 6007 Ridgeview Drive (off Franconia Road between Telegraph Road and Rose Hill Drive). Information: Bob Bolster, 703/960-9126.

Saturday, November 2, 5:30 PM- Dinner with the speaker and other NCA members at O'Donnel's Seafood Restaurant, 8301 Wisconsin Ave., Bethesda, MD. See map and description on back page.

Saturday, November 2, 7:30 PM- NCA meeting, will feature Dr. John Graham (Carnegie Institution of Washington, Department of Terrestrial Magnetism). His talk will be "Radio Galaxies" More information on Comet Hale-Bopp will also be provided. For directions, see map and description on back page.

Mondays, November 4, 18, and 25, 8:30 PM- Public nights at U.S. Naval Observatory (USNO), in Northwest Washington, D.C. (off Massachusetts Avenue). Includes orientation on USNO's mission, viewing of operating atomic clocks, and glimpses through the finest optical telescopes in the Washington-Baltimore region. Held regardless of cloud cover. Information: USNO Public Affairs Office, 202/762-1438. Home page: <http://www.usno.navy.mil>.

Tuesdays, November 5, 12, 19, and 26, 7:30 PM- Telescope making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 202/362-8872.

Saturday, November 9, 7:00 PM- NCA and National Park Service (NPS) *Exploring the Sky* program, in Rock Creek Park at parking lot nearest Military and Glover Roads NW (near Nature Center). Bring binoculars and telescopes; some telescopes available, thanks to NCA. Volunteers always needed! If cloudy, planetarium program inside Nature Center. No reser-

vations required. Details & Directions: Nature Center, 202/426-6829; Joe Morris (NCA), 703/620-0996. Nature Center Home page: <http://www.nps.gov/rocr/>.

Friday, November 8, 7:00 PM- Thanksgiving Stars, Historic Bladensburg Waterfront Visitor Center, 4601 Annapolis Rd., Bladensburg, MD. Details & Directions: Geoffery C. Lane (NCA), 301/927-2163, or 301/927-8166 (fax).

Saturday, November 16, Night- Leonid meteor shower peak. Also good several nights before and after; active November 14-20. May be strengthening to a "meteor storm" in 1998 or 1999. Don't miss it, if far from light pollution and weather is clear. Viewing requires only unaided eyes.

Tuesday, November 19, 6:30 PM- Lecture: Alan Boss, "Finding and Forming Extrasolar Giant Planets and Brown Dwarfs." Carnegie Institute of Washington. Details: 202/328-6988: Carnegie Home Page: <http://www.ciw.edu>.

Saturday, November 30, 10:00 AM to 4:30 PM- NCA and NASM astro-consumer clinic: "Binoculars! Telescopes! Astronomy!" NASM, Milestones of Flight Gallery. See page 6.

Saturday, December 7, 7:30 PM- December NCA meeting, speaker TBO in next newsletter. Meeting also includes updates on Comet Hale-Bopp.

See page 8 for more Washington area astronomical events. Other events too numerous to list in *Star Dust* are listed in the publications *Sky & Telescope*, the *Astronomical Calendar 1996*, the *Observer's Handbook 1996*, in numerous software packages, and other links available on the NCA Home Page (see above for address). NCA members can purchase all these (and much more) at a discount. To join NCA, use membership application on page 9.

During questionable weather, call the IOTA Hotline (Phone: 301/474-4945) for NCA meeting status. Cancellation notice on the Hotline means the meeting will take place.

Life on Mars, Another Take

A Discussion and Review of Munir Humayun's October Meeting Talk

by Nancy Byrd

At the October 5th meeting of National Capital Astronomers, Dr. Munir Humayun of the Carnegie Institution of Washington Department of Terrestrial Magnetism treated National Capital Astronomers to a provocative, well-organized and dynamically presented talk, entitled, "Was There Life on Mars?" In the talk, Dr. Humayun reviewed many lines of evidence bearing on the topic and presented his own explanations for the observed data.

This lecture and much recent media attention have centered on whether a contaminated, 4.2 pound meteorite, called ALH84001, found in Allan Hills ice field, Antarctica harbors persuasive evidence of past Martian life. In an August 7, NASA press release and an article, a team of scientists headed by David S. McKay of NASA make the claim and present a tantalizing case that it does. The article, "Search for Past Life on Mars: Possible Relic Biogenic Activity in Martian Meteorite ALH84001," appeared in *Science*, August 16, 1996, and was authored by David S. McKay and Everett K. Gibson Jr., Kathie L. Thomas-Keprta, Hojatollah Vali, Christopher S. Romanek, Simon J. Clemett, Xavier D. F. Chillier, Claude R. Maechling and Richard N. Zare.

What is ALH84001?

ALH84001 is a meteorite. The rock is a coarse grained igneous rock, an orthopyroxenite. The major phase consists of orthopyroxene [(Mg,Fe)SiO₃]. Lesser phases include apatite [Ca₃(PO₄)₂], maskelynite [NaAlSi₃O₈], chromite [FeCr₂O₄] and olivine [(Mg,Fe)SiO₄]. The rock bears fractures from multiple impacts. On these fracture surfaces and in pore spaces are tiny carbon rich features ("globules") bearing polycyclic aromatic hydrocarbons (PAHs) (*see Star Dust*, October, 1996, p. 4). The carbonate is younger than the more major phases and appears to be secondary. Minor phases, magnesite [MgCO₃], magnetite [Fe₃O₄] and Fe sulphides occur and are concentrated in reaction rims around the carbonate

globules. In addition to the globules, a scanning electron microscope image shows enigmatic, worm like features less than 100 nanometers in length, associated with the globules (also in *Star Dust*, October 1996, p. 4). It is these strange features and the PAHs that have most excited the scientific community as possibly being traces of ancient Martian life.

Dr. Humayun reviewed for NCA what is known about ALH84001. That the rock originated on Mars is not in dispute. ALH84001 was found in 1984; it was recognized as meteoritic, and bears a 500 μm thick fusion crust, but was misclassified as being of asteroidal origin (1 μm = 1 micron = 1×10^{-6} meter, thus 500 μm = 1/2 mm). Its possible Martian origin was recognized in 1993, and it is now classed as a Shergotty-Nakhla Chassigny (SNC) meteorite, one of only about 12 such rocks known to exist; however it is different from the others in that it is the only one believed to come from the southern hemisphere of Mars. The others are all basalts. We used to think that pieces of one planet could not travel to another. Studies at Lawrence Livermore Laboratories in 1994 have demonstrated that, given an impact of energy sufficient to produce ejecta with the planet's escape velocity (about 5 kg/sec for Mars) and under special conditions, a meteorite could find its way into orbit and then to Earth. Indeed, two of the SNC meteorites contain traces of what we believe to be Martian atmosphere trapped within. The chemical and isotopic signature of each planet is unique and can be used much like we use fingerprints for identification. The isotopic and chemical composition of the gases contained within the SNC meteorites agrees remarkably well with the Viking lander analyses of the Martian atmosphere and does not agree with the composition of the Earth's atmosphere. ALH84001, reports Dr. Humayun, has D/H (i.e. hydrogen isotopes) of the Martian hydrosphere, but not the characteristic noble

gases.

How Old is ALH84001?

ALH84001 has been subjected to extensive radioactive isotopic analysis for dating. Such dating usually measures the ratio of the abundance of two isotopes of an element or of an element and its radioactive decay product to extrapolate the age of the sample. The method works because radioactive decay is one of the most uniform processes in nature. Samarium-neodymium (Sm-Nd) and Rubidium-Strontium (Rb-Sr) analyses (Jagoutz, 1994 and Nyquist et al., 1995) have both yielded a crystallization age of 4.5 billion years. A younger Rb-Sr date of 3.8 billion years age (Ga) (Wadhwa and Lugmair, 1996) may represent a shock undergone by the rock which affected the ratio. A potassium-argon (K-Ar) date (Ash et al., 1996) of 4 billion years ago may represent cooling after a meteoric event. K-Ar dates can be altered by a heating event which allows the gas, argon to escape from the system. These dates are considerably older than ages obtained for other SNC meteorites which are basalts; these basalts are mostly 160 to 140 million years old, and a few are 1.3 billion years.

The age of the carbonate globules is not well constrained, varying from a Rb-Sr age of 1.39 billion years ago (Wadhwa and Lugmair, 1996) to a K-Ar age of 3.6 billion years ago (Knott et al., 1995). Measurements of ³He (helium), ²¹Ne (neon) and ³⁸Ar (argon) have been used to measure how long the meteorite orbited in space before coming to Earth. These studies have yielded dates ranging from 12 to 17 million years. The terrestrial age, how long since the meteorite fell to earth, is about 13,000 years, as given by ¹⁴C (carbon) dating (Jull et al., 1995).

The Martian Environment, Past and Present

Today, the Martian environment is hostile to life as we know it. Dr. Humayun

See MARS, continued on page 4

MARS, continued from page 3

recounted the analysis of the Viking data and how that prompted Lynn Margulis et al (1979) to state that the presence of organics was, if anything, less than on the moon. The Viking experiments demonstrated that organic molecules, naphthalene, glycine and adenine were destroyed within hours to minutes when subjected to the corrosive, ozone-bearing Martian atmosphere. Moreover, Mars is now cold and dry. But this was not always the case. Evidences of past running water are abundant in the southern hemisphere of Mars. The former presence of liquid water implies that once Mars had a much warmer temperature and an atmosphere at least 100 times denser than at present.

The northern hemisphere of Mars is dominated by very large basaltic volcanoes and few large craters; the southern hemisphere is a heavily cratered upland. Lunar studies have shown that the period of heavy cratering (which happened throughout the Solar System) occurred over 4 billion years ago. Thus, reasons Dr. Humayun, the southern hemisphere must be much older than the northern hemisphere. The prospect that ALH84001 represents a sample of Mars at a time when life as we know it could have existed there has prompted the extensive study of the rock.

Dr. Humayun characterized the prospect of finding signs of life in a 4.5 billion year old deformed igneous rock as "dismal", but "not completely preposterous." We know that SNC meteorites were permeated by Martian water, because they bear the D/H (deuterium/hydrogen) ratio characteristic of Mars. This value is higher than for Earth, because the lighter isotope of hydrogen has preferentially escaped into space leaving the deuterium (heavy hydrogen)

Figure A. Averaged mass spectrum of an interior, carbonate-rich, fracture surface of ALH84001. The spectrum represents the average of 1280 individual spectra defining an analyzed surface region of 750 by 750 μm mapped at a spatial resolution of 50 by 50 μm . [Source: Mckay et al., Science, August 16, 1996.]

behind. Moreover, ALH84001 shows extensive fracturing and post magmatic alteration, providing ample opportunity for any Martian life to get started within. Unfortunately, unless the fusion crust forms an impenetrable barrier; the same would be true for Earth life, as Dr. Humayun pointed out.

Humayun's Criteria for Contamination

Dr. Humayun presented four different criteria for contamination by the Earth environment, which he claims ALH84001 satisfies and researchers must address. Explanatory comments in square brackets are from the author. [Superscripts preceding the element symbol represent the number of protons and neutrons in the nucleus of the isotope.]

1- ^{36}Ar , an isotope present only in Earth's atmosphere is abundant in ALH84001.

2- Elements common in Earth sea water which are carried long distances into the Antarctic continent as sea spray, potassium, calcium, chlorine, etc. are present in ALH84001 in the same relative proportions as sea water.

3- While $\delta^{13}\text{C}$ in the carbonates ranges from -17 to 42 per mil according to McKay et al., Dr. Humayun reported

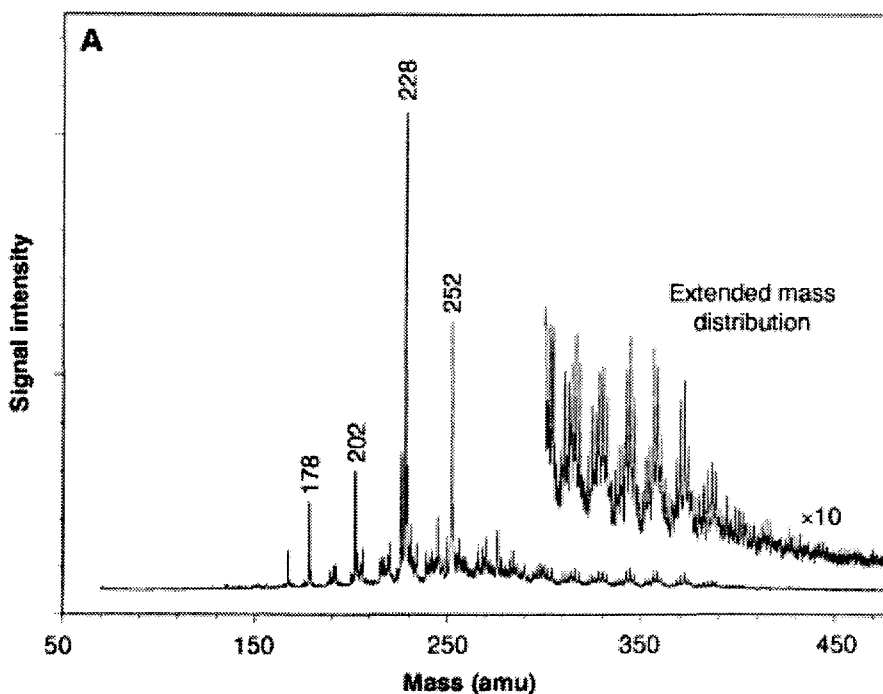
that the organic carbon (which includes the PAHs) in ALH84001 is identical to that of Earth's atmosphere, with a $\delta^{13}\text{C}$ of -21.5 per mil. [$\delta^{13}\text{C}$ is a shorthand for the ratio of carbon-13 to the normal isotope of carbon, carbon-12, referred to a standard. The formula is:

$$\delta^{13}\text{C} = 1000 \times \left[\frac{(^{13}\text{C}/^{12}\text{C})_{\text{in sample}} - (^{13}\text{C}/^{12}\text{C})_{\text{in standard}}}{(^{13}\text{C}/^{12}\text{C})_{\text{in standard}}} \right]$$

$\delta^{13}\text{C}$ for atmospheric CO_2 on Earth is -7 per mil.] $\delta^{13}\text{C}$ for most terrestrial plants ranges from -24 to -34 per mil. Some natural gases have values as low as -70 per mil. Earth-like $\delta^{13}\text{C}$ values would further complicate the case for extraterrestrial origin of the PAHs in ALH84001.]

Carbon-14 values indicate an old age [for carbon dating, that is greater than 10,000 years]. Dr. Humayun speculates that the carbon could have been incorporated into the sample when the meteorite landed on Earth, possibly incorporating carbon even from "penguin feathers" into itself.

4- Similarly, Dr. Humayun states that $\delta^{34}\text{S}$ is 5 to 8 per mil, similar to Earth sea water. [$\delta^{34}\text{S}$ is a measure of the sulfur-34 to sulfur-32 ratio and is defined similarly to $\delta^{13}\text{C}$. $\delta^{34}\text{S}$ has varied widely over time and place on Earth. The value for sea water now is about 20 per mil. Av-



erage values for sea water have ranged from about 10 per mil to 30 per mil. $\delta^{34}\text{S}$ for the Canyon Diablo meteoritic troilite is 0 per mil.]

Polycyclic Aromatic Hydrocarbons in ALH84001

An important part of McKay et al.'s paper is the presentation of the mass spectrometer data. Figure A shows 2 series of spectra for mass from 50 to 500 amu (1 atomic mass unit = 1.66×10^{-24} gram). The series from 178 amu to 276 amu clearly shows the presence of 5 identifiable polycyclic aromatic hydrocarbons: phenanthrene (178), pyrene (202), chrysene (228), perylene or benzopyrene (252) and anthanthracene (276). The heavier mass series, with much lower intensity and notable short term periodicity McKay et al. describe as mixtures with alkylated side chains which cannot be resolved unambiguously into individual species. Figures B through E are the spectra corresponding to 4 atomic mass unit values, plotted against distance in μm from the fusion crust exterior. No such plots are given for anthanthracene or for any of the peaks of the second series shown in A. McKay et al. argue that this data is

evidence for extraterrestrial origin of the PAHs because the plots show no PAHs within the fusion crust nor extending to a depth of 500 μm . They state, "This concentration profile is consistent with volatilization and pyrolysis of indigenous PAHs during atmospheric entry of the meteorite and formation of a fusion crust, but inconsistent with terrestrial introduction of organic material into the interior of ALH84001 along cracks and pore spaces during burial in the Antarctic ice sheet."

Humayun's Interpretation

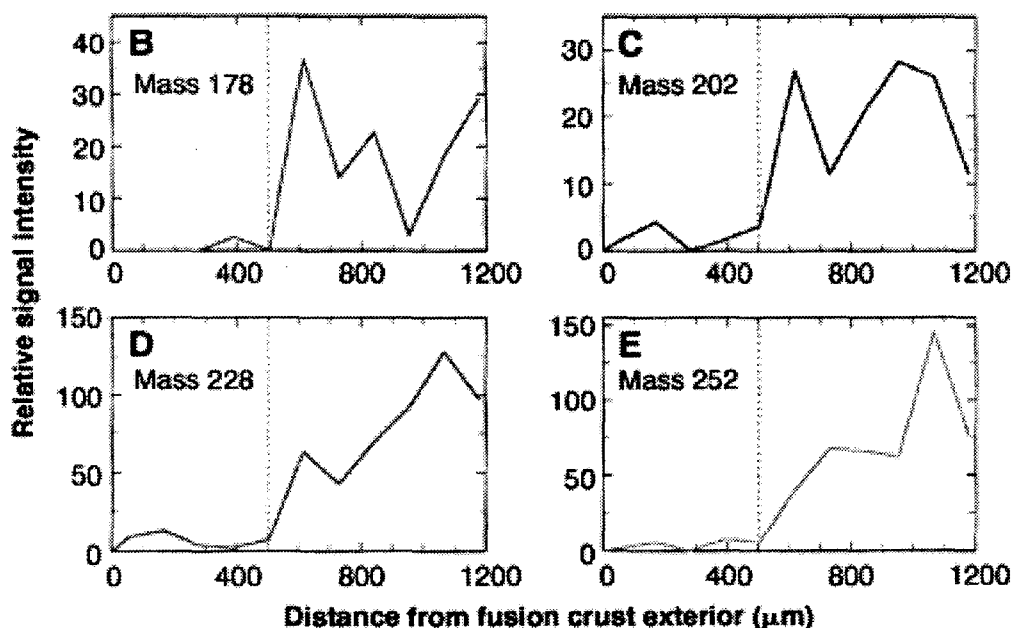
Our speaker, Dr. Humayun, however, claims that these data show exactly the opposite. The fusion crust is too smooth and glassy for introduced Earth based life to adhere to, he argues, but it could and did adhere farther away from the rock surface. He also contended that, if these features are extraterrestrial, the area adjacent to the fusion crust would also have been cooked somewhat and should show an enrichment of the heavy PAHs. The cooking would cause preexisting PAHs to lose hydrogen and build larger ring structures. This is basically the coalification process on Earth. But, he argues, the observed distribution pre-

cludes cooking. [McKay et al. claim that the interiors of meteorites are not heated above 120°C , based on analysis of the Murchison meteorite, a carbonaceous chondrite. They do not address the issue of cooking adjacent to the crust. However, the lightest PAHs, such as naphthalene, do not appear in ALH84001.]

Munir Humayun then addressed the fascinating SEM photo of the worm-like features found in and around the carbonate globules. He noted that McKay et al. had been "brave enough to call them microfossils." He then dismissed them as commonly seen features associated with the dissolution of carbonates. Moreover, he argues that the features, which are usually less than 100 nanometers in length and 20 nanometers long, are much too small to house the big molecules we associate with life, and even hydrogen ions could not be sufficiently numerous to maintain a consistent pH within the boundaries of the "cell."

Conclusions

Given the funding implications of life on Mars, says the speaker, scientists "cannot help but respond and respond in force" to this. Dr. Humayun spoke of some of the many planned experiments to further investigate whether ALH84001 contains evidence of life on Mars. McKay et al. hope to cut open one of the worm like structures to see if there are signs of life within. Stanford University plans to look for other hydrocarbons. Carnegie Institute of Washington also has several proposals, including study of the isotopic composition of submicroscopic features. Dr. Humayun suggested that looking for cooked PAHs would also be fruitful. He ended his talk by stating that even a negative answer to the question of "Was there life on Mars" would be useful. ○



Figures B through E. PAH Signal intensity as a function of distance from the ALH84001 fusion crust for the four primary PAHs shown in figure A. The fusion crust fragment, which showed no preexisting fractures, was cleaved immediately prior to analysis using a stainless steel scalpel and introduced in <2 minutes into the [mass spectrometer]. Each plot represents a section perpendicular to the fusion crust surface, which starts at the exterior and extends a distance of 1200 μm inward. The spatial resolution is 100 μm along the section line and is the average of a 2 by 2 array of 50 by 50 μm analyses, with each analysis spot being the summed average of 5 time-of-flight spectra. [Source: McKay et al., Science, August 16, 1996.]

Mid-Atlantic Occultation Expeditions for the rest of 1996

Lunar Grazing Occultations

Date	Day	EST	Star	Mag	%	alt	CA	Location
Nov15	Fri	20:09	2903	7.9	27+	13	4S	Hughesville, MD; Fredericksburg, VA
Dec04	Wed	04:21	1697	7.8	39-	38	2S	La Plata, MD; Triangle, VA
Dec19	Thu	23:05	110328	7.2	78+	43	4N	Marlton & Temple Hills, MD; Alexandria, VA
Dec22	Sun	18:28*	a.Tauri*	0.8	96+	13	9S	s. of Gary, IN Sun alt. -2 deg.

Asteroidal Appulses and Occultations

Date	Day	EST	Star	Mag	Asteroid	dmag	dur sec.	ap. in.	Location
Nov05	Tue	18:45	G6308-1617	12.0	52 Europa	1.0	10	8	Florida, Bermuda
Dec02	Mon	22:11	PPM 098650	11.0	471 Papagena	0.6	18	8	Cuba, Puerto Rico
Dec07	Sat	22:36	G1853-1759	9.6	22 Kalliope	0.9	15	5	northern Florida
Dec10	Tue	19:37	pi Arietis	5.2	975 Persev.	9.5	7	1	Florida, Bermuda
Dec17	Tue	04:08	G2345-0183	9.0	704 Interamnia	1.6	30	5	Georgia, S.Carolina
Dec21	Sat	06:30	G0303-0485	9.7	13 Egeria	2.2	8	6	western Cuba
Dec26	Thu	20:42	PPM 240941	9.8	39 Laetitia	1.7	6	6	s.w. Canada
Dec28	Sat	06:32	SAO 078707	8.3	972 Cohnia	5.0	6	3	Kentucky, N.Carolina

For more information, call the IOTA Occultation recorded message at 301-474-4945 (Greenbelt, MD) or visit their web site at <http://www.sky.net/~robinson/iotandx.htm>.

Notes:

Observers in Woodbridge and Temple Hills might try to observe from their homes; others outside the path should join our expedition, which will meet at 7:15 pm in the graze path on the south side of the intersection of MD highways 202 and 193 between Largo and Upper Marlboro. You need to meet by 7:00 pm if you need to borrow a tape recorder and/or a WWV receiver. Call the IOTA occultation line at 301-474-4945 for the go-cancel decision that will be made late in the afternoon, or sooner. The long-range weather forecast indicates a high probability of clouds.

*Dec. 22: The star is alpha Tauri (Aldebaran), the brightest star that can be occulted by the Moon. The time is CST.

Binoculars! Telescopes! Astronomy!

"Astro-Consumer" Clinic

Holiday season thoughts of astronomy? Consumer beware! "Bargains" on binoculars and telescopes are just as risky as other "great deals." Learn to wisely choose, use, and care for astronomical instruments from NCA. Our experts are available any time between 10:00 a.m. and 4:30 p.m. with myth-breaking information, guidance, and demonstrations.

This workshop is a joint gift of NCA and the Smithsonian Institution, National Air and Space Museum (NASM). See article about it in *Star Dust*, 1994 October issue, page 5. NCA volunteers are still needed! NASM can provide volunteers with free parking.

FREE. No reservations required. Just stop by.

Details By Phone: Daniel Costanzo (NCA), 703/841-4765
Cheryl Bauer (NASM), 202/357-1529

Saturday, November 30

Details By E-Mail (Cheryl Bauer): splnaspl003@sivm.si.edu

National Air & Space Museum

NASM Home Page: <http://www.nasm.edu>

Milestones of Flight Gallery

TELL FRIENDS, FAMILY & TEACHERS TOO !!!

Comet Hale-Bopp Countdown

By Daniel Costanzo

This past October saw the incoming Comet Hale-Bopp (officially designated C/1995 O1) faintly but definitely visible just after dark and within easy reach of both binoculars and the smallest of telescopes at dark-sky sites, and even at some suburban locations. I was able to easily view this fuzzy visitor from afar with binoculars on a Moon-free mid-October night at NCA's Elkwood, Virginia Field Station, a little over an hour's drive beyond the Beltway. In Celestron 8x56 binoculars, it was a small white puff with a short, faint, but clearly visible tail with a length about three-quarters the angular diameter of the Moon. And in a Celestron-8 telescope its center appeared as a quite stellar central point.

As of October 18, Hale-Bopp was continuing to hold its own, slowly "cooking" under increasing warmth from the Sun's fusion fire, and giving nothing but good omens for a bright visual spectacle early next year. Larger telescopes, including NCA's Celestron-14 (C-14) at Ridgeview Observatory in Alexandria, Virginia, showed it bristling with jet activity. (This telescope is available free for members' use. See

this issue's "Calendar of Monthly Events.") In brightness, it was in the low 5th magnitude range.

As November begins, Comet Hale-Bopp will be found steadily chugging Sunward, eating up almost two million kilometers a day of its comet-to-Sun distance. But at 2.5 Astronomical Units (AU) - 370 million kilometers - from the Sun, a distance corresponding to roughly just inside the Asteroid Belt proper, Hale-Bopp still has quite a way yet to go before reaching "perihelion" (closest approach to the Sun) of 0.9 AU during prime viewing time early next April. (The AU is the common unit of Solar System measurement, where 1 AU is Earth's mean orbital distance from the Sun, or 149,597,870 kilometers. So 0.9 AU is just inside Earth's orbit, or about 135 million kilometers from the Sun.) However, unlike last month, both the comet-to-Sun and comet-to-Earth distances are slowly decreasing, as Hale-Bopp begins a long slide towards "perigee" (closest approach to Earth) of 1.3 AU late next March. And come the end of November/beginning of December, Hale-Bopp will have crossed the Celestial Equator,

beginning its official entry into the Northern Hemisphere of the celestial firmament. And that's a very important event for us observers in Earth's Northern Hemisphere.

November is about the last month to get a reasonable view of Hale-Bopp in the evening sky before it starts eventually getting temporarily swallowed up in twilight's glow come December. Throughout November, with the arrival of dark, the comet can be found highest up, about fifteen to twenty degrees up in the southwestern sky. Best viewing nights are in Moon-free skies during the first two weeks or so of November and the very last nights of November. ○

NCA Welcomes These New Members

Ron Cowen

10109 Gates Ave.
Silver Spring, MD 20902

Loredo M. Lawsin

2720 Wisconsin Ave., NW, Apt. 602
Washington, DC 20007-4653

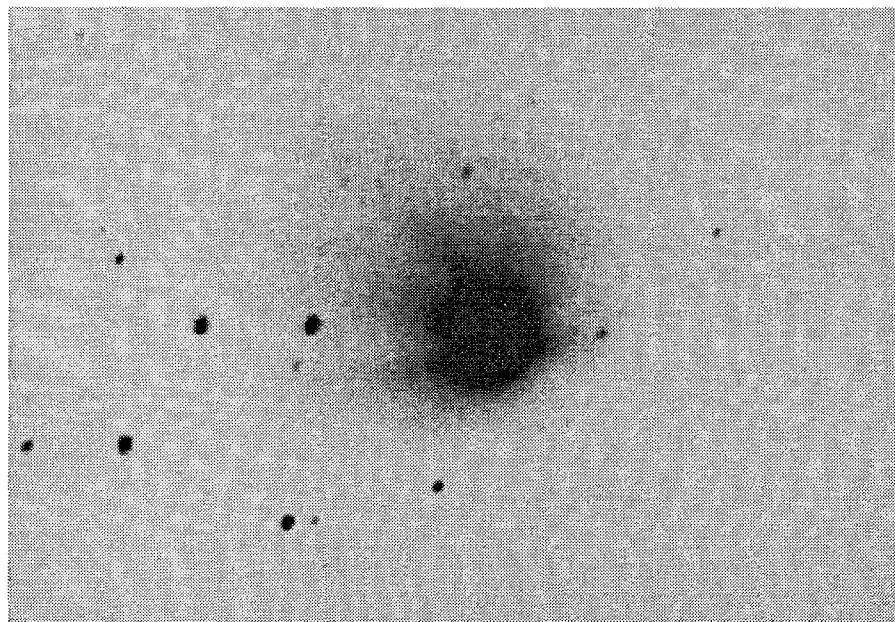
Thomas F. Sheehan

880 College Parkway, Apt. 101
Rockville, MD 20850-1947

Jeffrey C. Thornton

Stephanie Thornton (Jr. member)
7516 Wilhelm Drive
Lanham, MD 20706

We apologize to Jerilyn Stone for misspelling her name in the list of new members published in the September issue of *Star Dust*.



Comet Hale-Bopp, 10/12/96, 00:36 Universal Time (UT), NCA C-14 f/5.5, ST-6 CCD camera, 30 sec. exposure, reverse (negative) image, Ridgeview Observatory, VA—Bob Bolster (NCA)

Don't throw this newsletter away. If you finish with it, pass it on to someone else to read or recycle it. It's right for astronomy and the environment.



National Capital Area Astronomical Events

Free Lectures at the Einstein Planetarium and Other Daily Events
National Air & Space Museum

202/357-1550, 202/357-1686, or 202/357-1505 (TTY)
Home page: <http://www.nasm.edu>

(Outside observing follows each lecture, weather permitting.)

November 2, 9:30 AM—"The Search For Our Origins: NASA's New Mission For the Next Millennium," lecture by Harley Thronson. Observing by NCA. Free.

Daily, 10:10 AM to 5:45 PM—"Langley Theater continuing movies, "To Fly," four shows starting at 10:10 AM; "Cosmic Voyage," four shows, starting 10:45 AM; "Destiny In Space," two shows, starting 11:30 AM; "Living Planet," one show at

3:50 PM; "Mystery of The Maya," one show at 5:45 PM. Details & Cost: See above numbers.

Daily, 11:00 AM—"SkyQest", Details & Cost: See above numbers.

Daily, 11:40 AM to 5:00 PM—"The New Solar System", Details & Cost: See above numbers.

Daily, 3:00 PM—"The Stars Tonight", Free.

Other Area Astronomical Events

November 1, 8, and 22, 7:30 PM—"There's No Place Like Home," lecture by Howard B. Owen, Science Center (Lanham, MD). Details: 301/918-8750. Home Page: http://www/gsfsc.nasa.gov/hbowens/hbowens_home.html.

November 4, 7:30 PM—Arlington Planetarium (Arlington, VA) lecture, "Stars Tonight for November." Outside observing follows (weather permitting). Details & Cost: 703/358-6070.

November 5, 8:00 PM—University of Maryland (College Park, MD) Observatory Open House and lecture, "Life in The Universe," by Virginia Trimble. Outside observing follows (weather permitting).

November 9, 7:00 PM—"Goddard At Night" sky watching program at Goddard Space Flight Center (GSFC—Greenbelt, MD) Visitors Center. Bring binoculars and telescope, or look through ones there. If cloudy, then presentation on astronomical topic. Details: 301/286-

8981 (TDD 301/286-8103). Visitors Center Home page: <http://www.pao.gsfsc.nasa.gov>.

November 10, 1:00 PM—"Tropical Rainfall Measuring Mission," Tom Lavigna, Center. Details: GSFC numbers above.

November 15, 6:00 PM—Howard B. Owens Science Center open house. Details: Owen Science Center numbers on November 1 notice.

November 20, 8:00 PM—UMD Observatory Open House and lecture, "Life of The Sun," by Grace Deming. Outside observing follows (weather permitting).

Mondays Through Saturdays, 11:30 AM & 2:30 PM; 1st & 3rd Sundays of Month, 11:00 AM—GSFC (Greenbelt, MD) guided walking tours of Hubble Space Telescope Control Center and NASA Communications Center. Start at Visitors Center. Details: See November 9 notice.

"Deep Night" Periods For Star Viewing

November 12, 13, and 14 (Tuesday, Wednesday, and Thursday) at dusk will be an excellent night for viewing the stars. A young (waxing) crescent Moon with Earthshine, will be conveniently situated for observation and enjoyment. It will be easily visible with the unaided eye, even from light polluted areas. For details, call on the above dates: 202/357-2000.

There is no better place to experience the Universe than at a dark-sky site during "deep night" periods. For many, Saturday nights represent the most convenient times to do that, though some of the best nights for viewing also fall during the week. Daniel Costanzo and Jay Miller have prepared a list of these dates. Several relatively dark-sky sites area available for NCA members' use in Maryland, Virginia, and West Virginia. Information: Daniel Costanzo, 703/841-4765.

"Sky Watch"

Look for the "Sky Watch" column in *The Washington Post* "Style" section on the first Wednesday of each month. It lists many current events for the month.

Newsletter Deadline for December *Star Dust* November 15, 1996

***DO NOT BE LATE!!!!**

Send Submissions to Alisa & Gary Joaquin, at 7821 Winona Ct., Annandale, VA, 22003, Leave a message on voice mail 703/750-1636. Text files or graphic files in .GIF or .TIFF may be sent via E-Mail to ajglj@erols.com or fax submissions to 703/658-2233. **No submissions will be accepted after the 20th.** There will be no exceptions. We need a reasonable amount of time to design, edit, and review this newsletter. Though we have adequate time and resources to publish this newsletter, it is even more important this year to receive submissions on time. We would appreciate everyone's help in this matter. Thank you.

National Capital Astronomers, Inc.

SERVING SCIENCE & SOCIETY SINCE 1937

NCA is a non-profit, membership supported, volunteer run, public-service corporation dedicated to advancing space technology, astronomy, and related sciences through information, participation, and inspiration, via research, lectures, presentations, publications, expeditions, tours, public interpretation, and education. NCA is the astronomy affiliate of the Washington Academy of Sciences. All are welcome to join NCA. For information: 301/320-3621 or 703/841-4765.

SERVICES & ACTIVITIES:

Monthly Meetings feature presentations of current work by researchers at the horizons of their fields. All are welcome; there is no charge. See monthly *Star Dust* for time and location.

NCA Volunteers serve as skilled observers frequently deploying to many parts of the National Capital region, and beyond, on campaigns and expeditions collecting vital scientific data for astronomy and related sciences. They also serve locally by assisting with scientific conferences, judging science fairs, and interpreting astronomy and related subjects during public programs.

Discussion Groups exchange information, ideas, and questions on preselected topics, moderated by an NCA 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.

NCA Information Service answers a wide variety of inquiries about space technology, astronomy, and related subjects from the public, the media, and other organizations.

Consumer Clinics on selection, use, and care of binoculars and telescopes, provide myth-breaking information, guidance, and demonstrations for those contemplating acquiring their first astronomical instrument.

Dark-Sky Protection Efforts educate society at large about the serious environmental threat of light pollution, plus seek ways and means of light pollution avoidance and abatement. NCA is an organizational member of the International Dark-Sky Association (IDA), and the National Capital region's IDA representative.

Classes teach about subjects ranging from basic astronomy to hand-making a fine astronomical telescope. NCA's instructors also train educators in how to better teach astronomy and related subjects.

Tours travel to dark-sky sites, observatories; laboratories, museums, and other points of interest around the National Capital region, the Nation, and the World.

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

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

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

Fine Quality Telescopes up to 36-cm (14-inch) aperture are available free for member's use. NCA also has access to several relatively dark-sky sites in Maryland, Virginia, and West Virginia.

YES! I'D LIKE TO JOIN THE NATIONAL CAPITAL ASTRONOMERS

Enclosed is my payment for the following membership category:

Regular

Sky & Telescope and *Star Dust*. (\$51 per year)

Star Dust only (\$24 per year)

Junior (Only open to those under age 18) Date of birth: _____

Junior members pay a reduced rate.

Sky & Telescope and *Star Dust*. (\$42 per year)

Star Dust only (\$15 per year)

First name Middle Last name (_____) Telephone

Street or Box Apartment City State Zip

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 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:

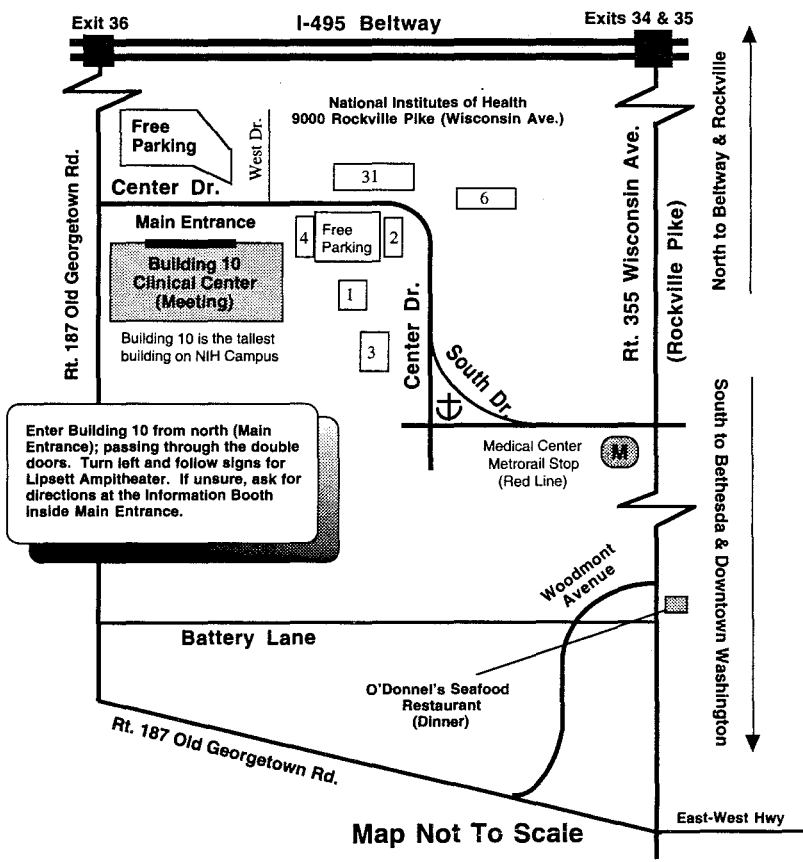
NCA c/o Jeffrey B. Norman, 5410 Connecticut Avenue, NW, Apt. #717, Washington, D.C. 20015-2837.

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

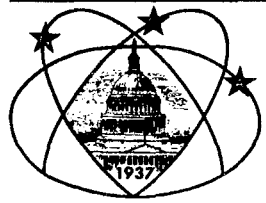
Getting to the NCA Monthly Meeting

Metrorail 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 (walking time about 10 minutes), the tallest 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 O'Donnel's Seafood Restaurant - Take Wisconsin Avenue passed Woodmont Ave. toward Battery Lane. It is located on the corner of Rosedale and Wisconsin Ave., on the left side of the street. There is free parking across the street on Rosedale. The address is 8301 Wisconsin Ave., Bethesda, MD.

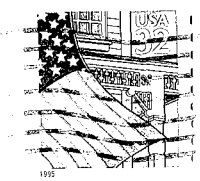


Star Dust is published ten times yearly (September through June) by the National Capital Astronomers, Inc. (NCA), a nonprofit, astronomical organization serving the entire National Capital region, and beyond. NCA is the astronomy affiliate of the Washington Academy of Sciences and the National Capital region's representative of the International Dark-Sky Association. NCA's Phone Numbers: 301/320-3621 or 703/841-4765. President: Harold Williams, 301/565-3709. Deadline for *Star Dust* is the 15th of the preceding month. Editors: Alisa & Gary Joaquin, 7821 Winona Ct., Annandale, VA 22003, 703/750-1636, E-mail: ajglj@erols.com. Editorial Advisor: Nancy Byrd. *Star Dust* © 1996 may be reproduced with credit to National Capital Astronomers, Inc.



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