Star Dust

National Capital Astronomers, Inc. Washington, DC (301) 320-3621

Volume LI, Number 7 March 1993 ISSN 0898-7548

James Crowley - Imaging Spectrometer Studies of Earth and Beyond

By Nancy Byrd

The next meeting of National Capital Astronomers, March 6, 1993 at 7:30 PM, will be held at the National Institutes of Health (in the Bunim Room on floor 9 of the Clinical Center, Building 10). At this colloquium, Dr. James Crowley of the U.S. Geological Survey will speak on "Imaging spectrometer studies of the Earth and beyond."

Imaging spectrometers are remote sensing instruments that provide detailed spectral information over the visible and near-infrared (VNIR; 0.4 - 2.5 μm) wavelength range. Whereas more familiar imaging systems, such as the Landsat Thematic Mapper, provide a small number of broad-band images centered at different VNIR wavelengths, imaging spectrometers acquire imagery in as many as 224 narrowly-spaced spectral channels. This high spectral resolution provides much more detailed information than the simple elemental tallies that astronomers are accustomed to. It permits diagnostic spectral features to be discerned in Earth surface materials and facilitates efforts to "unmix" spectral components that are combined within individual image pixels. Airborne imaging spectrometers are currently being used in diverse studies of the Earth, including efforts to map surface rocks, soils, and vegetation, to study chemical cycling in plant canopies, to measure atmospheric water vapor and other gases, and to look for evidence of vegetation stress associated with environmental disturbances. In addition to their usage in global change studies on Earth, imaging spectrometers borne by spacecraft will eventually play an important role in mapping the surface composition of other planets and their satellites.

Dr. Crowley has worked with imaging spectrometer data as applied to geologic studies since the mid 1980s. He will provide a "mini short-course" on the VNIR spectral properties of minerals and other surface materials and review ongoing imaging spectrometer research.

See CROWLEY, Page 6

March Calendar

The Public is Welcome!

Saturday, March 6, 9:30 AM - Judith Lean (Naval Research Laboratory), "Do Changes in Solar Radiation Affect the Earth's Climate?" At Smithsonian Institution, National Air and Space Museum (NASM), Albert Einstein Planetarium (Judith spoke at NCA's 1992 November and 1991 February Colloquia).

Saturday, March 6, 5:30 PM - Dinner with the speaker at Frascati's Restaurant in Bethesda before the monthly meeting. Reservations are for 5:30 Sharp!

Saturday, March 6, 7:30 PM - Dr. James Crowley: "Imaging Spectrometer Studies of the Earth and Beyond." Meeting will be held in the Bunim Room at the National Institutes of Health. For directions refer to map and description on inside back page.

Tuesday, March 2, 9, 16, 23, 30 at 7:30 PM - Telescope making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 202/362-8872.

Friday, March 5, 12, 19, 26 at 7:30 PM - Telescope making classes at American University, McKinley Hall Basement. Information: Jerry Schnall, 202/362-8872.

Friday, March 5, 12, 19, 26, 8:30 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 for details and more dates at (703) 960-9126. Although receding from the Earth, Mars will be worth observing and is well placed.

Next Month:

Saturday, April 3, 7:30 PM - Dr. Mario Acuna: "Neptunes Magnetic Field and Magnetosphere."

IS ANYONE OUT THERE?

By Richard J. Byrd

The issue as to whether there is intelligent life elsewhere in the universe has captured the imagination of mankind since the dawn of history. Certainly the earliest ancestor of man must have stared at the heavens and wondered if other humanoids existed somewhere in that vast void. In this century, we have at least been able to advance what was only a rudimentary speculation and conjecture to at least the level of being the subject of scientific investigation. At our February colloquium, Dr. Steven J. Dick of the U.S. Naval Observatory led us from ancient times to the present in a detail examination of the Search for Extraterrestrial Intelligence (SETI).

Dr. Dick is currently serving as an astronomer and historian at the U.S. Naval Observatory, where he is compiling the history of the Naval Observatory. In addition, he is the official historian for NASA's High Resolution Microwave Survey (HRMS) program to conduct the Search for Extraterrestrial Intelligence (SETI). Dr. Dick has authored many publications, including the book, *Plurality Of Worlds: The Origins of Extraterrestrial Life Debate From Democritus to Kant* (Cambridge University Press, 1982).

Dr. Dick began his lecture with the idea that, historically and analytically, the search for extraterrestrial intelligence involves a "cosmological world view" of the universe. The underlying premise of the biophysical cosmology believed by many SETI proponents is that we humans on this planet are nothing special in the universe. This has its origins in the Copernican viewpoint that the earth occupies no particular or special place in our solar system. Accepting that, one might still have believed that our solar system occupied some special place in our galaxy, the

See SETI, Page 4

Abstracts of Astronomical Articles

By John B. Lohman & John A. Graham

I. "Oldest Stars are Older Still" - R. Wyse in *Nature*, 21 January pp.204-205.

A lower limit to the age of the universe can be obtained by dating the oldest objects in it. New observations reported by Lee suggest that astronomers have underestimated the age of the oldest stars by 1 - 2 billion years. It is proposed that some low-mass metal rich stars in the nuclear bulge of the Galaxy are 16 ± 2 billion years old, consistent with the formation of the Galaxy from the inside, outwards.

II. "Far Ultraviolet Astronomy on the Astro-1 Space Shuttle Mission" - A. Davidsen in *Science*, 15 January, pp.327-334.

Astronomy with small telescopes on the Space Shuttle is discussed. Early results from one instrument, the Hopkins Ulraviolet Telescope, are reviewed. Results include finding a hot gaseous corona surrounding the Galaxy and the realization that low-mass metal rich stars (see previous abstract) are probably responsible for the previously known ultraviolet excess radiation in elliptical galaxies. A further flight is scheduled in 1994.

III. "Catastrophes- Tunguska comes down to Earth" - H.J. Melosh in *Nature*, 7 January, pp.14-15.

Few natural events this century have excited so much interest as the gigantic explosion which rocked the Siberian taiga near the Tunguska river on January 30 1908. Scientists have been moving towards an explanation along the one given by Chyba and colleagues (this issue pp. 40-44). The Tunguska explosion is compatible with the entry of a stony asteroid/ meteorite, roughly 30 meters in size, that broke up and deposited its energy in atmospheric blast waves before reaching the ground.

IV. " A Continent-Sized Ear on the Cosmos" - P. Aldous in *Science*, 22 January, pp.454-456.

U.S. and European astronomers will soon be routinely using arrays that mimic a single instrument thousands of kilometers across to produce images with unparalleled resolution. New user-friendly software packages are making observations with these arrays much more accessible to the scientific community. Typical projects include cosmic distance measurements (distance to the Galactic center), the structure of radio galaxies and quasars, and a new determination of the Hubble constant.

Passing

Dr. Robert S. Harrington, 50, astronomer at the Naval Observatory and former member of National Capital Astronomers, died of cancer on January 23, 1992. Dr. Harrington specialized in solar system dynamics and also was a leader in the search for brown dwarves.

Would you like to see the space station MIR as it passes over the Washington area? NCA trustee Walter Nissan points out that a series of especially favorable evening passes which are easily visible to the naked eye even from brightly lit urban locations is expected to occur between March 10 - 20 for the DC area. Another is expected the first week of April. Call him at 301-585-5711, at least one hour before sunset, for specific easy to follow directions.

SETI From Page 2

Milky Way, until about 1918 when Harlow Shapley demonstrated that our solar system was not even a central figure in Milky Way, being located some 30,000 light years from the galactic center on one of the spiral arms of the galaxy. If our world is nothing special in the solar system, and the solar system is not special in the galaxy, then the development of intelligent life here on earth is probably not special in the universe. It is this hypothesis that the SETI work hopes to establish with hard, scientific evidence.

Dr. Dick explained some of the basic assumptions underlying the work of SETI astronomers. Foremost is cosmic evolution and the nebular theory of planetary formation, the processes by which stars coalesce out of great masses of swirling gas and dust particles, as do the planets which are formed to orbit about them. Earlier theories conjectured that planets were formed by the relatively rare close encounter of two stars. By the nebular theory, dust particles form into rings surrounding a newly formed star, eventually accreting into planetessimals, which form into protoplanets, whose increased gravitational attraction then sweeps much of the remaining dust ultimately to form the planets as we observe them now. Given the formation of a planet, the hypothesis of biological evolution encompasses the synthesis of the biogenic elements on that planet, the formation of life itself and ultimately the evolution of intelligence.

While this theory of stellar and planetary formation and evolution certainly has not been dispelled by observation, neither has observation proven it. Dr. Dick described many of the observational programs which have searched for planetary systems other than our own, but our solar system remains the sole planetary system yet directly observed. Because the direct observation of planetary systems through the use of light-telescopes is at the limit of resolution, even for the nearest stars, astrometric measurements involving observations of changes in the radial velocity of stars have been used to infer the presence of planets. If a planet is in orbit around a star, the planet will perturb the trajectory of the star, and this perturbed trajectory may be observable. However, planetary masses are usually small in relation to stellar masses, and the perturbations caused by the planets are consequently small, hence these motions too are at the limits of the tools used for detection. Recently, the space telescope is reported to have found protoplanetary material surrounding several stars in the Orion Nebula, a region in our galactic neighborhood often thought to be a present birthing place of stars. Whether this material will accrete into planets, although a seemingly logical conclusion, is still a matter of conjecture.

Another fundamental hypothesis of proponents of SETI is that after evolution of the stars and the planets has taken place, there follows a definitive and repeatable process by which life evolves. Chemical evolution began on the earth some 4 billion years ago. Then biological conversion of the atmosphere took place, and the reducing atmosphere was changed to an oxidizing one. Eventually, the earth experienced biological evolution resulting in intelligent life forms We know this occurred on our planet, the question is, has it occurred on other planets circling other stars in the universe? Can we infer from our case to the general case?

Dr. Dick described the work of Frank Drake, who attempted to simplify and combine these difficult evolutionary parameters into what is now

See SETI, Page 5

Dark Sky Observing/National Radio Astronomy Observatory Tour

By Sue Bassett

Dr. Jay Lockman, recent NCA guest speaker and newly appointed NRAO Assistant Director for Green Bank Operations, has invited us to tour the National Radio Astronomy Observatory in Green Bank, West Virginia, and in particular to inspect progress on the new Green Bank Telescope. The tour is scheduled for Sunday, April 18. We are planning on combining this with an observing session at Blackwater Falls Park on the night of Saturday, April 17. Blackwater Falls has excellent facilities and very dark skies.

To register for the tour, or for additional information, see Sue Bassett at the next meeting, or call 410-792-2943 and leave a message stating your name, number of people, phone number where you can be reached, and if you need a ride or can provide a ride.

Participants are responsible for making their own reservations at Blackwater Falls. Call 304-259-5216 or 1-800-CALL-WVA. Rates per night are $43.60 single and $52.32 double.

SETI From Page 4

known as the Drake Equation. This equation is an effort to derive the number of communicative civilizations in our galaxy by quantizing such factors as the total number of stars in the galaxy, the percentage of those stars formed which could support planetary systems, the number of planets in each such planetary system so situated as to create conditions which might support life, the fraction of those planets in which life actually develops, and the percentage of those in which life ultimately engages the process of evolution to evolve intelligent life. As might be expected, depending on what values are used for each of these parameters, the Drake Equation can produce disparate results. Some sets of values imply that there are probably 100 million planets in the Milky Way which have developed technological civilizations; other solutions for the equation indicate that our planet is the only one! As Dr. Dick expressed, the Drake Equation is not a scientific formula which is the equivalent of $E=MC^2$ or $F=MA$, but is simply an attempt to quantify the various parameters which are accepted as the precursor elements to intelligent life. However, it would be difficult to find another equation in science which has been used to produce solutions which differ by eight orders of magnitude.

Those who search for extraterrestrial intelligence, explained Dr. Dick, obviously believe that the solution to the Drake Equation is not singular, and hence they search for that second or that ten-millionth planet out there housing an advanced civilization. If such other technological civilizations exist, how would they attempt to communicate with us? How should we look for their signals? It was long-ago decided that such communication would probably be by the use of microwave radiation in the electromagnetic spectrum. The next question then would be in what regions of the spectrum would such communication be most likely to travel the longest distance while conserving its contained intelligence. In the range of the electromagnetic spectrum much below 2GHz, synchrotron radiation from electrons spiraling in galactic magnetic fields generates an unacceptable amount of noise. At much above 20GHz, Dr. Dick explained that the fundamental quantum limits of atoms would begin to degrade such communication. Therefore, the most reasonable range in which to observe would be between about 1GHz and 50GHz, with the lowest noise being in the range of 1-10GHz. This is the range in which virtually all of the SETI work has taken place, and where the HRMS program now being done by NASA has its focus.

See SETI, Page 6

NCA WELCOMES THESE NEW MEMBERS!

Sarah Clemmitt
4616 Fessenden St., NW
Washington, DC 20016

Paul N. Connor
4401 River Road, NW
Washington, DC 20016

Richard & Mary Hubbard
and sons, Mark & Steve
6008 Wheaton Drive
Burke, VA 22015

Joel Marshall Iams
(Junior member)
5516 Oakmont Avenue
Bethesda, MD 20817

John A. Macy & Claudia Vess
4630 43rd Place, NW
Washington, DC 20016

Robert L. Morris
9109 Rouen Lane
Potomac, MD 20854

Marvin J. Poyourow
13303 Vandalia Drive
Rockville, MD 20853-3313

Excerpts from The IAU Circulars

By R.N. Bolster

1. January 11-14 - Davies, Royal Observatory, Edinburgh; Spencer, Lowell Observatory; Sykes, Steward Observatory; Tholen, University of Hawaii; and Green, University of Kent, observed (5145) Pholus in thermal infrared and visible wavelengths with the NASA Infrared Telescope Facility and the U.K. Infrared Telescope at Mauna Kea. The thermal model fitting the data indicates the asteroid has a diameter of about 190 km and a albedo of 0.044.

2. January 29 - T. Kojima, Chiyoda, Gunma Ken, Japan, obtained a photograph of Periodic Comet Schwassmann-Wachmann 1 indicating that the comet was in outburst, with the coma extended to the north. The comet's brightness was about 14th magnitude.

3. January 31 - An intense gamma-ray burst at energies > 0.72 MeV was detected by the BATSE experiment on the Compton Telescope. The source was localized to an area 3 degrees square. Using data from Ulysses, the Ulysses/Compton Interplanetary Network Team further localized to source to an arc 1' wide crossing this square. Observers at other wavelengths were urged to search this area for the source.

SETI, From Page 5

In general, naturally-occurring noise is broadband, whereas one would expect transmitted intelligence to be relatively narrowband. Therefore, most SETI observation is being done with a multi-channel analyzer, observing only a 1Hz bandwidth. Focusing on the frequency range between 1GHz and 10GHz still encompasses 10 billion channels in which to look, if one is to observe bandwidths as small as 1Hz. In addition to the difficulty of covering 10 billion channels in this broad frequency range, there is the problem of which direction do we look in; what sort of signal modulation do we attempt to detect, and what polarization alternatives do we investigate. As Dr. Dick opined, this is the cosmic equivalent of the needle-in-a-haystack. In 30 years of observations, very little of this entire continuum has really been observed.

NASA began its SETI search in 1969 with a program at the AMES Research Center. The principal investigator of this study was John Dillingham. His studies during this period have served as a paradigm for thorough investigative techniques in SETI. Dillingham's work has evolved into the "Bluebook" of SETI now adopted by NASA and forms the basis for the High Resolution Microwave Survey. The HRMS uses a *dual mode search strategy*, and it was this research strategy which was implemented by NASA on October 12, 1992 with the HRMS. The first leg of this strategy is the *targeted search*, observations are made in the direction of the 1,000 stars most like our sun which are within 100 ly of our position. These would be the stars most likely to have formed planets similar to those in our solar system and where one might then expect to find intelligent life. The electromagnetic spectrum is searched in the 1-3GHz range in the targeted search. This range is used as being most acceptable for the large radio telescopes in use by the program, since large radio telescopes do not work well at frequencies much higher than 3 GHz. The other leg of the dual mode search strategy is the sky search. For this observation, all radial directions are observed in the 1-10GHz range. The targeted search uses high resolution and high sensitivity, whereas the sky search uses moderate resolution and sensitivity. For the targeted search, the largest radio telescope in the world, the 1,000 foot diameter dish in Arecibo, Puerto Rico, was put into use, whereas the *sky search* was implemented by the Deep Space Network in Goldstone, California, using the 34 meter dish.

So, have we yet observed *I Love Lucy* transmitted from Betelgeuse? Not yet. No definitive electromagnetic radiation has been detected which would appear likely to have been sent by life from other worlds. Is anybody out there? We don't know, but we certainly will continue to look.

CROWLEY, From Page 1

Dr. Crowley has been employed at the U. S. Geological Survey in Reston, Virginia since 1980, where he specializes in geological remote sensing. He received a Bachelor's degree in Environmental Science from the University of Virginia, a Master's degree in Geology from the George Washington University, and a Ph.D. in Geology from the University of Maryland. Moreover, Dr. Crowley has been a member of NCA since 1966, and built a telescope under the tutelage of Jerry Schnall. We look forward to a glimpse of an exciting and rapidly evolving discipline of spectroscopy.

National Capital Astronomers, Inc.

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

SERVICES AND ACTIVITIES:

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

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

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

Publications received by members include the monthly newsletter of NCA, *Star Dust*, and an optional discount subscription to *Sky & Telescope* magazine.

The NCA Public Information Service answers many astronomy-related questions, provides predictions of the paths and times of eclipses and occultations, schedules of expeditions and resulting data, assistance in developing programs, and locating references.

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

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

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

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

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

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

PLEASE ENROLL ME IN NATIONAL CAPITAL ASTRONOMERS MEMBERSHIP

[ ] Regular
- [ ] *Sky & Telescope* and *Star Dust*. ($46 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*. ($32 per year)
- [ ] Star Dust only ($10 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:
Leith Holloway 10500 Rockville Pike Apt. M-10, Rockville, MD 20852.

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

Thank you, and welcome!

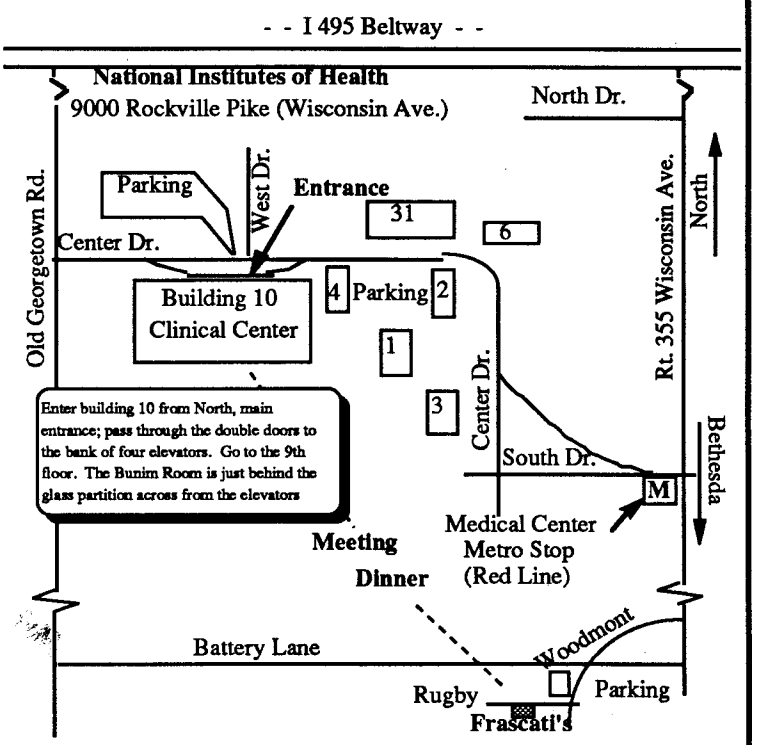
_____

_____

Getting to the NCA Monthly Meeting

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

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



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

National Capital Astronomers, Inc.
c/o Nicoletta Stephanz
1511 17th Street, NW #5
Washington, D.C. 20036

Dr. Wayne H Warren, Jr
8001 Brett Place
Greenbelt, MD 20770-3001