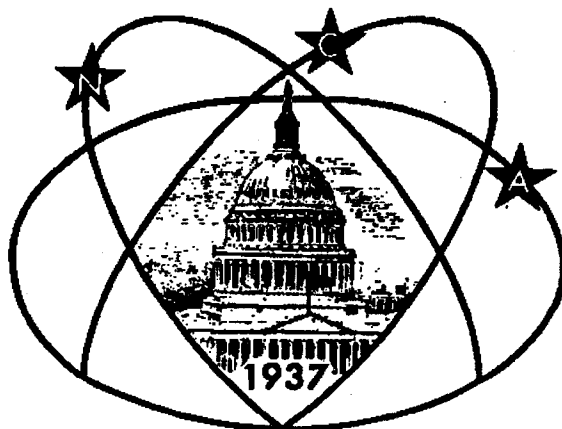


Star



Dust

National Capital Astronomers, Inc.

Washington, DC (301) 320-3621

Volume LII, Number 9

May 1994

ISSN 0898-7548

Sally Heap to Describe Hubble Space Telescope Studies of Star Formation in Other Galaxies

By Wayne H. Warren Jr.

The next meeting of the National Capital Astronomers will be held on May 7, 1994 at 7:30 PM in the Bunim Room of the Clinical Center (Building 10, floor 9) at the National Institutes of Health. At this meeting, Dr. Sara R. Heap of the Laboratory for Astronomy and Solar Physics, NASA Goddard Space Flight Center will describe her studies of star formation in galaxies other than the Milky Way using various data obtained with instruments aboard the Hubble Space Telescope (HST).

Three fundamental questions concerning the evolution of elemental abundances in the universe involve the formation of stars and their contributions to element synthesis. These questions are: (1) What were galaxies like in the distant past when early generations of stars formed? (2) How and why do stars form from giant gas clouds? (3) How do stars enrich the universe in "heavy elements"?

It is generally believed that elements heavier than helium were originally synthesized deep inside stars and later spewed out in high-velocity outflows (stellar "winds") and in supernova explosions. It is also generally accepted that all elements heavier than iron are produced only in the extreme conditions prevailing at the time of a supernova explosion. While this scenario provides a natural explanation for the build-up of the elements in the universe, there are many details that are still rather sketchy. Since its launch in April 1990, the HST has helped to fill in certain gaps in our knowledge of these processes. After describing recent theoretical results on stellar evolution, Dr. Heap will discuss three areas in which observations by the cameras and spectrographs onboard the HST are making major contributions.

These areas are: (1) Stellar Evolution. How does heavy-element abundance influence what kinds of stars form from the interstellar medium?; (2) Star Clusters. Under what circumstances did star clusters and starbursts form?; and (3) Long Ago and Far Away. How and when did the first generations of stars form and what were these primitive stars like?

Dr. Sara Ridgway Heap was born in Washington, DC (a "real" native) and grew up less than a mile from the NIH, where (according to Sally) kind researchers gave her pet mice on several occasions. She was educated at Wellesley College, where she earned a BA in 1964, and at the University of California in Los Angeles (UCLA), where she was awarded a Ph.D. in astrophysics in 1970 under the guidance of Professor Lawrence H. Aller. She began her professional career in 1969 when she joined Goddard Space Flight Center's Laboratory for Optical Astronomy, where she has been since, although that laboratory merged with Solar Physics and became known as the Laboratory for Astronomy and Solar Physics in 1977. She has contributed significant research in the areas of ultraviolet photometry and spectroscopy, studies of hot stars, and nuclei of planetary nebulae, much of which has been done with the International Ultraviolet Explorer Satellite launched in early 1978. She is currently a Co-principal Investigator for the Goddard High Resolution Spectrograph (GHRS), where her studies of hot stars continue. Among her recent honors is the 1992 John C. Lindsay Memorial Award bestowed by the Goddard Space Flight center for significant research by a staff scientist. Dr. Heap is a member of the International Astronomical Union and the American Astronomical Society.

See HEAP, Page 4

May Calendar

The Public is Welcome!

Fridays, May 6, 13, 20, and 27, at 7:30 PM - Telescope making classes at American University, McKinley Hall Basement. Information: Jerry Schnall, 202/362-8872.

Saturday, May 7, 1994, 5:30 PM - Dinner with the speaker at Bangkok Garden Restaurant (4906 St. Elmo Avenue, Bethesda) before the monthly meeting. Reservations are for 5:30PM sharp.

Saturday, May 7, 1994, 7:30PM - Dr. Sara R. Heap will speak on "Star Formation in Other Galaxies, Results from the Hubble Space Telescope." Meeting will be held in the Bunim Room at

Smithsonian Sky Watchers' Report

Non-technical information recording on astronomical events, objects, and phenomena in the Washington, D.C. region's sky. Updated weekly.
202/357-2000

Sky & Telescope's "Skyline"

Moderately technical information recording on latest in space technology, astronomy, and related sciences. Updated weekly, or sooner if necessary.
617/497-4168

the National Institutes of Health. For directions, refer to map and description on back page.

Tuesdays, May 3, 10, 17, and 24, 7:30 PM - Telescope making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 202/362-8872.

Fridays, May 13, 20, and 27, 8:30 PM - Open nights with NCA's Celestron-14 telescope with Bob Bolster, 6007 Ridgeview Drive, south of Alexandria off Franconia Road between Telegraph Road and Rose Hill Drive. Call Bob for details 703/960-9126.

Saturday, May 14, 9:00 PM - "Exploring the Sky," telescope viewing at the open field in Rock Creek Park nearest to the Nature Center. NCA members please bring telescopes. For more information, see article on page 3 and call John Lohman, 703/820-4194.

Hubble Space Telescope Science and Servicing

Reviewed by Wayne H. Warren, Jr.

At the April 2, 1994 meeting of the National Capital Astronomers, Dr. Stephen P. Maran of the Laboratory for Astronomy and Solar Physics, NASA Goddard Space Flight Center, presented an overview of the scientific accomplishments of NASA's Hubble Space Telescope (HST) and described the recently completed and eminently successful first servicing mission.

Dr. Maran began by reminding us that, although the 94.5-inch (2.4-meter) primary mirror of the HST is flawed by spherical aberration, the observatory still produced many new results even before the December 1993 servicing mission and is capable of making valuable observations not heretofore possible from the ground. As examples of new discoveries made with the unrepaired telescope, Dr. Maran showed an image of a pair of red dwarf stars of magnitude 20.5 and separated by only a quarter of an arcsecond. This physical binary system was discovered by John N. Bahcall of the Institute for Advanced Study and his colleagues and represents a new class of binary consisting of a pair of faint late-type dwarf stars high above the galactic plane. Also shown were light curves of Cepheid variable stars in the galaxy Messier 81, obtained by a team of astronomers of which our own John Graham is a member. Data for at least 31

Cepheids now exist, all but one of which are newly-discovered variables. Their light curves were used to determine the first accurate distance to a galaxy outside the Local Group, which turned out to be 3.6 +/- 0.3 Mpc (about 11.7 million light years). This method, applied to more distant galaxies, will eventually produce a more accurate value for the Hubble constant, which relates the velocity of expansion to the age of the universe.

Samples of deconvolved images of the Veil Nebula and of the center of Messier 31 were then shown, the latter clearly demonstrating that there are two nuclei at the center of our nearest spiral neighbor. It has been shown by Dr. Tod Lauer (Kitt Peak National Observatory) that the fainter nucleus rather than the brighter is located at the geometric center of the galaxy. What the brighter nucleus is and why it is there are still unanswered questions.

Dr. Maran then showed a video consisting of slides taken during the first HST servicing mission and narrated by the seven participating astronauts. The slides showed the highlights of the mission, including the replacement of the Wide Field and Planetary Camera (WF/PC 1) with a new WF/PC 2 that con-

MARAN, From Page 2

tains corrective optics, the COSTAR optical correction system that replaced the University of Wisconsin High-Speed Photometer, the installation of three new gyroscopes, and replacement of the solar panels that provide energy to the observatory. The repairs were all performed successfully and have resulted in an optical system that now meets the critical specifications of the HST.

Dr. Maran then showed comparison images of various objects taken before and after the optical system repairs. The new images clearly demonstrate significantly higher resolution in the raw data than it was possible to obtain before, even following extensive computer processing. He stressed, however, that the scientific research performed with pre-repair observations has not been done on computer-enhanced images, but rather on the original data. New stellar images show that the diffraction limit of the optical system is now being realized, while images of extended objects, such as Messier 100 in the Virgo cluster, demonstrate that all previous blurring has disappeared and that much fainter stars are visible, including a pair of 28th magnitude stars that could not be discerned before. The new image of Messier 100 clearly shows spiral structure descending almost to the center of the galaxy.

We also saw a spectacular mosaic of images of the now famous Comet Shoemaker-Levy 9, the pieces of which are predicted to impact the atmosphere of Jupiter in mid July 1994. This comet now consists of 23 known individual nuclei that result from a close encounter with Jupiter during a previous flyby. The approach of these objects is currently being monitored by a team of astronomers led by Harold Weaver of the Space Telescope Science Institute. Although the impact is predicted to occur on the side of Jupiter that will be away from Earth at the time, we may be able to observe the result shortly thereafter when the region becomes visible as Jupiter rotates. It is also planned to turn on an ultraviolet instrument aboard the Voyager 2 spacecraft, which is beyond Jupiter, in an attempt to directly observe the impact region.

Images of the Orion Nebula show unusual features thought to be regions of proto-planetary-system formation and outflow structures that could not be seen previously with ground-based observations. We then saw images of the bright supernova 1987A in the Large Magellanic Cloud (LMC) that show the increased size of the central cloud of expanding ejecta and a glowing ring formed from circumstellar gas ejected by the supernova progenitor star. Images

See MARAN, Page 4

EXPLORING THE SKY

by John B. Lohman

National Capital Astronomers and the National Park Service offer Exploring the Sky, an astronomy observing program for the general public, every year from April through November. The program is held at the open field nearest the Rock Creek Park Nature Center. NCA members bring telescopes for the program.

The schedule for 1994 follows:

Saturday 14 May:	9:00 pm
Saturday 11 June:	9:00 pm
Saturday 23 July:	9:00 pm
Saturday 13 August:	9:00 pm
Saturday 24 September:	8:30 pm
Saturday 08 October:	8:00 pm
Saturday 19 November:	7:30 pm

In case of cloudy weather, the observing program is replaced by a planetarium show at the Rock Creek Park Nature Center. In case of rain the program is cancelled. (The program continues as late into the night as seems appropriate.)

MARAN, From Page 3

of Nova Cygni 1992 show a ring of outflowing material ejected during the nova outburst. Observations of a dense cluster of stars within the 30 Doradus nebula in the LMC show a large number of early-type stars in a region known as R 136. Prior to resolving these objects, the blended image seen in previous observations was predicted to be a supermassive object that violated the theoretical upper mass limit for stars. Now the HST has given new detail to the evidence that this supermassive star does not exist. A new HST image of the famous nebula eta Carinae shows a structure of jets and filaments of material ejected from the central object. Perhaps the most breathtaking image is of the central region of the bright southern-hemisphere globular

cluster 47 Tucanae, which completely resolves the core into a myriad of faint stars. Now it will be possible to construct a Hertzsprung-Russell diagram showing even the white dwarfs in a globular cluster and to determine improved ages for this and other distant globular clusters within the Milky Way.

Dr. Maran concluded his presentation by discussing the performance of the Goddard High Resolution Spectrograph, both before and after the servicing mission. The spectra were seen to be comparable in terms of intensity of the light, since some light is lost because of the additional reflections from the COSTAR mirrors, while light is gained from the improved concentration of photons through the entrance slit of the spectrograph. Thus, it is now possible to take high-resolution spectra in densely

HEAP, From Page 1

Come and join Dr. Heap and other NCA members and guests to learn about some of the fundamental discoveries now being made by the HST. It is often stated that we are made of material that formed in the interiors of massive stars, so the formation of these stars and how they have synthesized the heavy elements that make up much of the Earth and its inhabitants has a special interest for humankind. Although we can never know exactly which stars have contributed to our constitution, especially because they are now nothing but condensed cinders somewhere in the Galaxy, this topic still holds a certain fascination for all of us.

NCA OFFICER NOMINATIONS

By Robert N. Bolster

The nominating committee, consisting of Bob Bolster, Dick Byrd, and Benson Simon, has selected the following slate of nominees for positions as officers of National Capital Astronomers for the 1994-1995 year:

President:	Dr. Wayne H. Warren, Jr.
Vice President:	Dr. Harold A. Williams
Secretary:	Leith Holloway
Treasurer:	Jeffrey B. Norman
Audio-Visual Engineer:	Clifford Kristal
Trustee:	Dr. John A. Graham

Trustees whose terms do not expire this year are: Ken Short, Bob Bolster, and Nancy Byrd.

The membership may nominate additional candidates by a petition signed by ten members.

populated star fields, since each image is considerably smaller than before. Whereas, only the larger of two slits (2 seconds of arc) could be used prior to COSTAR, the smaller slit (1/4 seconds of arc) can now be employed in crowded fields where near neighbor stars must be removed from an observation. All this means that the "spectral purity" is much improved.

It is clear that, although larger and increasingly capable ground-based telescopes are under construction, such as the Very Large Telescope (VLT) being built by the European Southern Observatory, the higher spatial resolution of the HST across the visible spectrum will not be surpassed from the ground for a long long time, if ever, across a significant field of view. In addition, ground-based telescopes will never be able (we hope) to observe the ultraviolet region of the spectrum as can the HST. The new instruments that are now under construction for installation into the HST during upcoming servicing missions scheduled for 1997 and 1999 will continue to improve the remarkable capabilities of this space observatory, so we have much to look forward to in the coming years.

I am indebted to Steve Maran for reviewing a draft of this article and for making suggestions that have improved it.

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:

Jeffrey Norman Apt. 717, 5410 Connecticut Avenue, NW, Washington, D.C. 20015.

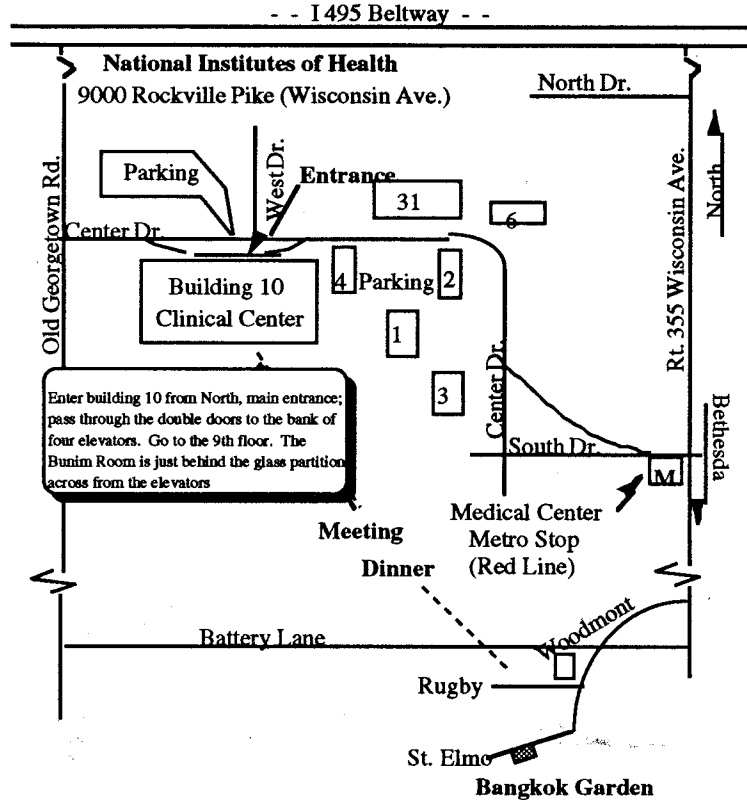
The following information is optional. Please indicate briefly any special interests, skills, vocation, education, experience, or other qualifications which you might contribute to NCA.

Thank you, and welcome!

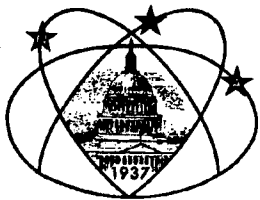
Getting to the NCA Monthly Meeting

•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 Bangkok Garden: Take Wisconsin Avenue toward Bethesda and bear right onto Woodmont (or take the next right onto Battery Lane). Follow Woodmont to St. Elmo (3 blocks south of Battery) and make a right. Proceed one block and cross Norfolk Avenue, then look for parking immediately, as the restaurant is just up the street on the left. Seats are not guaranteed 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 Stepanz, 1511 17th St., NW #5, Washington, DC 20036, 202/332-7756. NCA Phone Number is 301/320-3621.



National Capital Astronomers, Inc.

If undeliverable return to
Leith Holloway, Apt. M-10
10500 Rockville Pike
Rockville, MD 20852-3331



Exp. 3/95

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