Star Dust

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Steve Maran to Talk About Hubble Space Telescope Servicing and Science

By Wayne H. Warren Jr.

The next meeting of the National Capital Astronomers will be held on April 2, 1994 at 7:30 PM in the Lippsett Auditorium of the Clinical Center (Building 10, floor 1) at the National Institutes of Health. At this meeting, Dr. Stephen P. Maran of the NASA Goddard Space Flight Center will tell us about the first servicing mission for the Hubble Space Telescope (HST) and the new science that can now be done with HST's improved instrumentation.

As most of us know so well by now, the crew of NASA's STS-61 mission, on board the space shuttle Endeavor, performed flawlessly during the first HST servicing mission last December. Following the mission, which ended on 13 December 1993, and during which two instruments were replaced (one with a second generation version and one with the new optical correction system known as COSTAR) along with several gyroscopes, fuses and other minor electrical equipment, and the troublesome solar panels that had caused serious long-term "jitter" each time the spacecraft crossed Earth's terminator, engineers, scientists, and the general public had to wait a full month to find out if all the repairs had been successful. While the Wide Field and Planetary Camera (WF/PC 2) was known to be performing well within a week (the first images were transmitted to the Space Telescope Science Institute (ST ScI) in the late evening of the December 17), the WF/PC operates independently of the COSTAR system. However, the corrective optics were essential for successful operation of the other two instruments, the Faint Object Camera and the Goddard High Resolution Spectrograph (GHRS). So, we waited somewhat apprehensively until January 13, 1994, when images taken with the aid of COSTAR were officially released, although I must admit that I knew the outcome several days ahead of time by having a friend in the operations group at the ST ScI.

Although most of us have heard and read about what happened on the STS-61 mission, few of us are either familiar with the details of how the mission was carried out or fully understand the impact of HST's successful transformation on the science that can now be accomplished. As a co-investigator on the GHRS, and as a scientist who has been closely associated the HST project since its inception, Dr. Stephen P. Maran, of Goddard's Laboratory for Astronomy and Solar Physics, has this detailed knowledge. Dr. Maran will first describe the STS-61 mission, augmenting his talk with a video taken by the astronauts. He will then show some of the results in the form of improved images and describe some of the scientific investigations that have been made possible by the successful refurbishing of the HST. Finally, he may have some results from the GHRS, which is now capable of taking the truly high-resolution spectra that it was originally designed for.

Dr. Stephen P. Maran was born in Brooklyn, New York and became interested in astronomy at an early age, resulting in frequent visits to New York's Hayden Planetarium and eventual association with its affiliated amateur/professional group. He earned his BS degree from Brooklyn College in 1959, and his MA (1961) and PhD (1964) degrees from the University of Michigan in Ann Arbor. For the next 5 years, he was in charge of the remotely controlled telescope (a 1.3-meter instrument) at Kitt Peak National Observatory. He joined NASA in 1969 and has been at the Goddard Space Flight Center since. At GSFC, he directed Operation Kohoutek (1973-74) while heading the Advanced Systems and Ground Observations Branch (1970-77); he became a Senior Staff Scientist in 1977. As mentioned earlier, he is currently a co-investigator on Goddard's High Resolution Spectrograph. Among his many "extracurricular" activities, Dr. Maran is the American Astronomical Society's Press Officer, a job that keeps him very busy and always in the news.

Come and join Dr. Maran and other NCA members to learn about the HST servicing mission and the outstanding science that will be possible in the years to come with this first of NASA's Great Observatories. Since the telescope is now expected to work well until the next servicing mission scheduled for 1997, we can expect to see many exciting results over the coming years, including the best views of most of our favorite astronomical objects that have ever been seen by humans.

April Calendar

The Public is Welcome!

Fridays, April 1, 8, 15, 22, and 29, at 7:30 PM - Telescope making classes at American University, McKinley Hall Basement. Information: Jerry Schnall, 202/362-8872.

Fridays, April 1, 8, 15, 22, and 29, 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, April 2, 1994, 5:30 PM - Dinner with the speaker at The Thai Place Restaurant (4828 Cordell Avenue, Bethesda) before the monthly meeting. Reservations are for 5:30PM sharp.

Saturday, April 2, 1994, 7:30PM - Dr. Stephen P. Maran will speak on "The Hubble Space Telescope Servicing Mission and Subsequent Science." Meeting will be held in the Lippsett Amphitheater at the National Institutes of Health. For directions, refer to map and description on back page.

Tuesdays, April 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.

Thursday, April 21, 7:00 PM - Daniel Costanzo (NCA), "Astronomy O!O!O!: Life, The Universe & Everything (In Between)." Three week adult education course at Arlington Planetarium. For details and cost, call 703/358-7200.

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Solar System Volcanism, A Guided Tour from James Zimbelman

Reviewed by Nancy Byrd

Dr. James R. Zimbelman of the Center for Earth and Planetary Sciences at the National Air and Space Museum presented a tour of volcanism as it has been observed to-date in the Solar System to NCA members at the Saturday, March 5, 1994 monthly meeting. His talk was in two parts: (1) the variety of volcanism that has been observed on Earth and (2) evidence of volcanism elsewhere in the Solar System, using sources, ranging from the Mariner mission in 1974 to the recent Magellan Venus radar mapping mission.

In discussing Earth volcanism, Dr. Zimbelman divided his lecture by the 3 main volcanic rock types: *basalt, andesite* and *rhyolite*. These rock types differ mainly by containing different amounts of SiO_2 (silica) in their minerals, basalt containing the least silica and rhyolite, the most. A major thrust of Dr. Zimbelman's talk was that an increase in silica content in a volcanic magma is accompanied by a corresponding increase in viscosity. Viscosity greatly controls the resulting landforms from a volcano's eruption. He drew special attention to volcanic landforms seen both on Earth and on other bodies in the solar system.

Dr. Zimbelman began with a discussion of basaltic volcanism. A profile view of Mauna Loa on the big island of Hawaii demonstrated the gentle slope of shield volcanos, which derive their name, he said, from their resemblance to shields. These volcanos typically erupt with fountains of lava, often forming curtains of fire, and flows. These eruptions are gentle enough that tourists can approach them in relative safety. These volcanos often have lava lakes where the molten rock is about 1200°C in temperature.

With an aerial photograph of the spectacular Mauna Loa eruption of 1984, Dr. Zimbelman showed how fusion takes place at the top center of a flow just seconds after escaping from the vent. He pointed out how basaltic flow often takes place between two levees, several meters high, composed of the basalticlinkers that have cooled along the sides of the flow. These flows are good analogues of what we observe on Mars.

Another common basaltic landform is a cinder cone, such as the dome known as Sunset Crater in Arizona. This dome, which is a few 100 meters high, is composed of basalt clinkers which were launched ballistically. When hot basalt encounters groundwater, it can explode, forming cinder cones and leaving behind craters. Another feature which may be observed on basaltic volcanos is a dike, which forms along vertical fractures in the preexisting rock filled by moving magma. A dike becomes visible on the surface when less competent host rock weathers away, leaving a vertical slab of rock. Sometimes water itself can erupt. Old Faithful at Yellowstone National Park is an example of a water eruption. The ground water repeatedly is heated to the boiling point by contact with still-hot rock below the surface.

The second major volcanic rock type seen on Earth is andesite, named after the Andes Mountains of South America. Dr. Zimbelman showed an example of a strato volcano, an andesitic mountain near Villarrica, Chile. The slopes of a strato volcano are typically steeper than those of a basaltic volcano. The steeper geometry results from the fact that andesite is more viscous, stickier, than basalt and so does not flow as readily. These volcanos can obtain considerable relief; in fact, the highest point on Earth, (measuring from the center of the Earth) is Chimborazo a strato volcano in Ecuador. Strato volcanos, such as Fuji, Cotopaxi and Mt. St.

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Helens (before the eruption), can be very beautiful, but they can also be very dangerous.

Showing the now famous pictures of the May 18, 1980 eruption of Mt. St. Helens, he observed that this eruption was triggered by a landslide, which decapitated the top of a magma chamber on the north side of the mountain, allowing the magma to blow out that side. This explosion was followed by an ash-charged gas flow which overtook the landslide at 200 mph. The classic vertical column of fragmented magma and magmatic gas, erupting at high velocity ensued and persisted for several hours, while on the south face the now melted glaciers became mudflows. Volcanos which erupt in a more vertical direction (leaving intact rims) can form calderas and crater lakes.

Often the ash flow fills in a valley and solidifies, forming a rock known as *ignimbrite* . As this ignimbrite cools, curved cracks and joints can form in it which are indicative of the shape of the surface on which the ignimbrite formed. Mars Global Surveyor, a satellite planned to partially replace the one recently lost, will carry a new Mars Observer Camera and should give us the resolution to observe these kinds of features on Mars. Scheduled launch is in 1996. In Yellowstone, a prehistoric eruption produced several thousand feet of ignimbrite. No eruption in historic times has been of that magnitude. When these deposits weather, colors, characteristic of the weathering products can develop. These colors can give information as to the composition of ignimbrite on other planets as well.

The third rock type, rhyolite, with even more silica, and so even stickier, piles up into thick deposits, forming domes of *obsidian* (a black glass) and *pumice* (a frothy rhyolite). Just south of the Mono lakes area of California is an area of active rhyolitic volcanism in the U.S. While probably not as large as the andesitic eruption at Yellowstone, such a rhyolitic eruption might also be larger than anything observed in historical times.

Turning our attention elsewhere in the Solar System, Dr. Zimbelman observed that on the moon, basaltic eruptions have occurred forming the maria. Channels similar to those shown for Hawaii can be seen. But the lunar eruptions dwarfed those of the Hawaiian volcanos, being more reminiscent of those which must have produced the Columbia flood basalts - very liquid flows extending to hundreds of kilometers, and tens of meters thick. Apollo 15 landed near a sinuous valley, a type of feature common on the moon. There the astronauts found basalt. The favored interpretation for these features is that they are collapsed lava tubes, covered-over channels through which magma flowed and then drained out, leaving tubes which have since collapsed.

Mercury, as seen by Mariner 10 in 1974, also shows dark maria like features, which we believe to be enormous impact basins, filled with basalt, like those on the moon. Mariner 10 only observed one-half of the planet; so there may be other volcanic features awaiting our features awaiting our discovery on the other side of Mercury.

Venus was hidden from view for many years by its thick atmosphere of sulphuric acid droplets and CO_2. While the Soviet Union had previously observed the planet with radar, the Magellan space craft, within the last three years, has radar mapped Venus to a much higher resolution. Dr. Zimbelman showed Magellan images and an interesting 3D computer reconstruction from Jet Propulsion Laboratories, showing a view one might get if flying over the Venusian terrain at close range. An interesting feature of Venus is a mountain called Saphis Mons[1]. It has two prominent peaks, and radiating away from it are a series of individual lava flows. The mountain is about 400 kms diameter, but only about 1 1/2 kms in height. One interpretation for the low relief is that the higher surface temperatures and pressures on Venus have allowed much slower fusion of the lava flows.

Near Saphis Mons is a prominent mountain called Maat Mons. The summits of most volcanic mountains on Venus are strong radar reflectors. This may be caused either by the surface being especially rough or by its being metal rich near the summit. The chemists propose that the summits are good reflectors because of a mineral phase change. Above a certain elevation, a more radar reflective mineral phase is stable. On the other hand, Maat Mons, an eight kilometer high mountain, shows a non reflective area near the summit. The speculation is that this mountain is geologically young, and the iron-rich, reflective phase has not yet formed. Its steeper sides may indicate that its flows are more

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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 16 April:	8:30 pm
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.)

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andesitic than the flows of the smaller Saphis Mons. In Kawelu Planitia, there is a flow field field that extends over 400 kilometers but drops only 400 meters in that distance. How can lava flow for such a great distance over such a shallow slope? How can it stay molten for such a long distance? Dr. Zimbelman and his colleagues are pursuing answers to these questions. Elsewhere on Venus, small bumps, some with holes in the top are suspected of being cinder cones. We also see a channel that extends for almost 7000 kilometers and is only 2 meters wide. Calculations of the viscosity show it to be only about 10 times the viscosity of water. Finding plausible minerals that could fit these observations is currently an active area of research.

A collection of circular features, called pancake domes, are observed on Venus. These domes are approximately the scale of the rhyolite domes of California and may themselves be rhyolitic. However, a very frothy basalt can also produce domes. Concentric cracks have been observed which appear to be individual volcanic centers, some of which show apparent lava flows emanating from their centers, but these features have no relief. They range from about 50 kms to over 230 kms in diameter. How such a structure could exist we do not yet know. Possibly, the crust is so thin on Venus that an upwelling magma could produce the concentric cracks.

The largest volcanos in the Solar System can be seen on Mars. The Tharsus volcanos and Olympus Mons are huge - occupying an area the size of the entire eastern U.S. These appear to be shield volcanos, similar to the Hawaiian volcanos, except for the scale. It may be that Olympus Mons is what happens when you have a volcanic center, like a hot spot in our oceans, but don't have plate tectonics to spread the material out. So it all comes out at one place, making an enormous volcano. Ascreus Mons, one of the Tharsus volcanos shows embayed areas on the flanks which are believed to be sources of eruption on the flanks. This may be some of the last volcanism from the volcano. In the crater, we see a vertical feature believed to be a dike. We can also see channels and flows similar to those of the 1984 eruption of Mauna Loa.

Just to the west of the Tharsus group, there is evidence of more pyroclastic volcanism - ignimbrite. In other areas one can see volcanos bearing impact craters, or flows overruning old volcanos, yielding information about the relative ages of the Martian features. We see also what we believe are cinder cones on Mars.

Dr. Zimbelman informed us that we have found meteorites on Earth probably originating from Mars. Eight meteorites are in the present collection. They are basaltic, with ages of 0.3 million years and contain gas bubbles with the same composition as the Martian atmosphere, as measured by the Viking landers. We don't know where on Mars they came from.

Io, the innermost moon of Jupiter, shows abundant evidence of volcanism. In fact, Voyagers 1 and 2 showed nine volcanos in the act of erupting. The volcanic centers show ash deposits and flows. The red and yellow colors appears to be sulphur. This body is the most volcanically active body in the Solar System. This extreme activity is believed to be due to gravitational forces.

The Saturnian moon, Enceladus, is also interpreted to be volcanically active, but here the distance from the sun is great enough to change the nature of volcanism. Most of Enceladus is ice. But it appears to have infilled impact craters. Still further out, Triton, with measured temperatures as low as -400°F, also shows evidence of an ice caldera. Also, Voyager may have observed evidence of nitrogen geysers. These are spots with about 5 kilometers of relief, showing a trail of a haze.

Dr. Zimbelman showed us that volcanism is an important process throughout the Solar System, but that it can take different forms depending on temperature, composition, atmospheric pressure, and gravitational effects of the environment.

[1]It is possible that this spelling is incorrect. The names of many Venusian features are as yet unpublished, and Dr. Zimbelman was not available for corroboration before press time.

Abstracts of Astronomical Articles

By John B. Lohman and John Graham

I. "Gloomy Picture for Photo Astronomers" - J. Travis in Science, 11 February 1994, p.750.

Some types of photographic plates used by astronomers will no longer be manufactured. In part, the crisis stems from a digital revolution which has, over the past decade, replaced glass plates with light sensitive CCD chips.

But it will be more difficult in the future to carry out some types of observations, such as those concerned with imaging large areas in the sky.

II. "Shape of Asteroid 4769 Castalia (1989 PB) from Inversion of Radar Images" - R.S. Hudson and S.J. Ostro, in Science 18 February 1994, p. 940.

Radar observations of Earth-crossing asteroids can be analysed to determine their detailed shape. Asteroid 4769 Castalia yields a model which is bifurcated into two distinct, kilometer-sized lobes apparently in contact with each other. Castalia, the smallest planetary object imaged so far, is also the most irregularly shaped.

The Arecibo and Goldstone radars can now achieve resolution of the order of magnitude finer than that of the Castalia data. By 1996, completion of instrumentation upgrades now underway should allow the useful imaging and reconstruction of several of the currently known Earth-crossing asteroids per year. Observations of this type provide fundamental data about the way our planetary system was built up.

III. "The Orbit and Atmospheric Trajectory of the Peekskill Meteorite from Video Records" - P. Brown et al. in Nature, 17 February 1994, p. 624.

On 9 October 1992, a bright fireball appeared over West Virginia, traveled some 700 km in a northeasterly direction, and culminated in at least one impact: a 12.4-kg ordinary chondrite recovered in Peekskill, New York. Fortuitously, the event was captured on several video recordings, which provide a detailed record of the fragmentation of the object and related atmospheric effects. These are the first motion pictures of a fireball from which a meteorite has been recovered. We report here the preliminary analysis of 14 video recordings of the event, from which we determine the ground path and original orbit of the object.

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.

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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!

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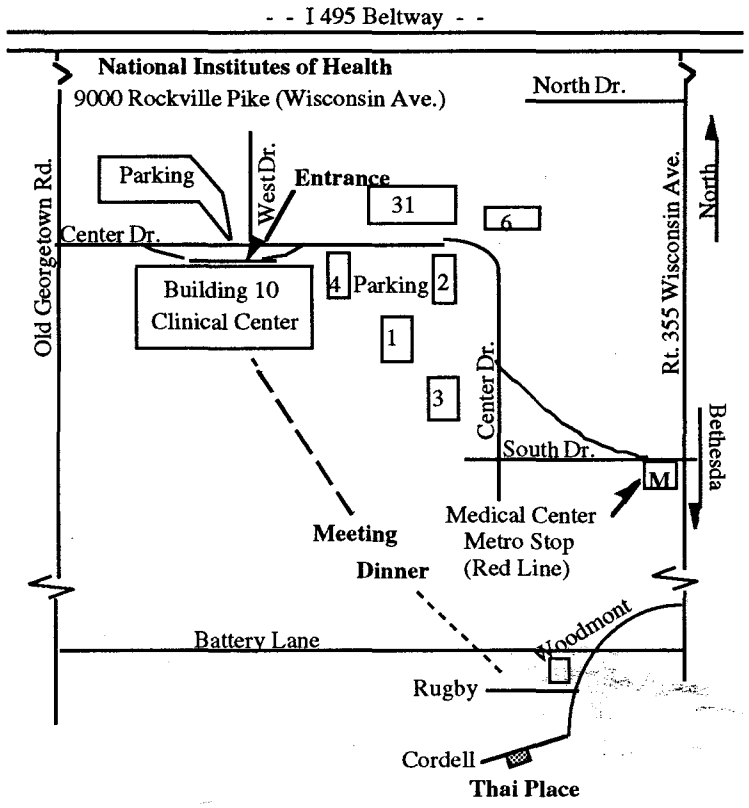
Getting to the NCA Monthly Meeting

•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 Thai Place: Take Wisconsin Avenue toward Bethesda and bear right onto Woodmont (or take the next right onto Battery Lane). Follow Woodmont to Cordell (2 blocks south of Battery) and make a right at the Thai Place Restaurant. Look for parking immediately. There should be adequate space on the street outside the restaurant or in the lot across the street. Seats are not guaranteed after 5:30.



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