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Extensive Marshall work preceded Hubble launch 20 years ago

By Mike Wright

The Hubble Space Telescope – which the Marshall Space Flight Center started planning for NASA in 1971 – has now been in space more than 20 years. The telescope was initially referred to as the Large Space Telescope.

On April 24, 1990, astronomers from around the world waited for the telescope launch with almost child-like anticipation of unlocking universal mysteries. However, engineers at Marshall who had spearheaded the telescope's singular development reflected that day on the 20 years of hard work that they had devoted to transforming a dream into a reality.

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This new Hubble photo is of a small portion of one of the largest seen star-birth regions in the galaxy, the Carina Nebula. Towers of cool hydrogen laced with dust rise from the wall of the nebula. The scene is reminiscent of Hubble's classic "Pillars of Creation" photo from 1995, but is even more striking in appearance. The image captures the top of a three-light-year-tall pillar of gas and dust that is being eaten away by the brilliant light from nearby bright stars. The pillar is also being pushed apart from within, as infant stars buried inside it fire off jets of gas that can be seen streaming from towering peaks like arrows sailing through the air.

Hubble

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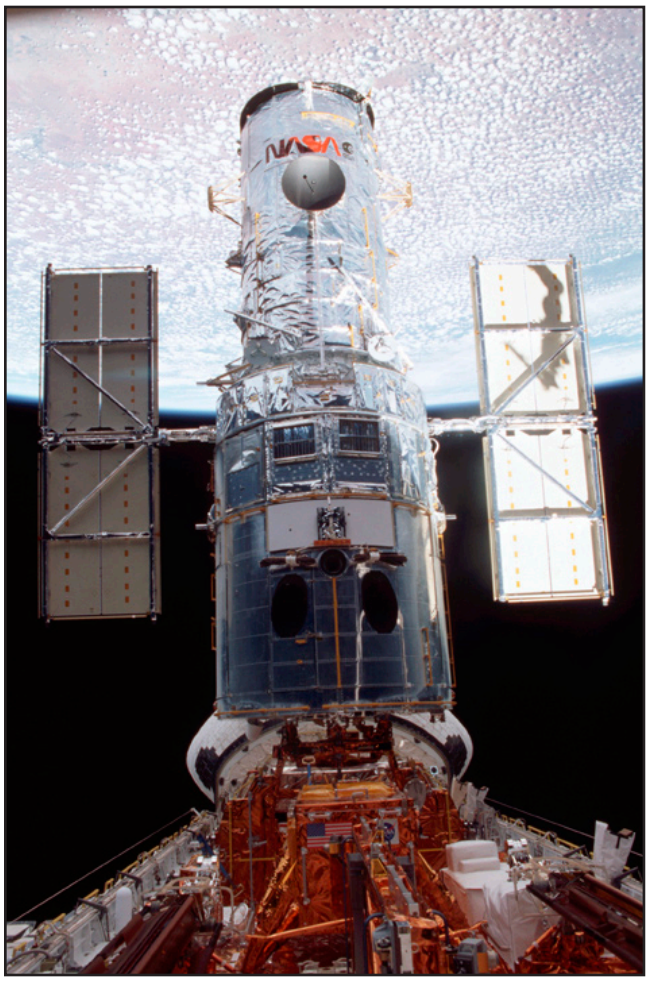
The initial recommendation for developing the telescope and Marshall's assignment to start the official planning process started long before the launch.

In 1962, a National Academy of Sciences study group recommended the development of the Large Space Telescope as a long-range goal for NASA. That goal moved into sharper focus in 1971 when the Marshall Center awarded a $400,000, 12-month contract to Itek Corp., of Lexington, Mass., a Large Space Telescope definition study.

By May 1972, NASA was ready to proceed with detailed planning for the Large Space Telescope, and assigned the management responsibility to Marshall. Goddard Space Flight Center in Maryland was chosen to lead development of the scientific instruments and the scientific control center. The European Space Agency contributed the solar arrays, high-resolution camera and supporting personnel. A status briefing held later in the year at Marshall provided industry representatives with an updated report on NASA's plans to develop the multi-purpose optical telescope and launch it sometime in the 1980s using the space shuttle.



After five days of service and upgrade work on the Hubble Space Telescope, the STS-109 crew photographed the giant telescope in the shuttle's cargo bay. The telescope was captured and secured on a work stand in space shuttle Columbia's payload bay using Columbia's robotic arm, where four of the seven-member crew performed five space walks, completing system upgrades to the telescope.

Marshall selected two primary contractors to build the telescope. Perkin-Elmer Corp. of Danbury, Conn., was chosen to develop the optical system and the guidance sensors. Lockheed Missiles and Space Company of Sunnyvale, Calif., was selected to produce the protective outer shroud and the spacecraft which supported the optical system. Lockheed also assembled and integrated the finished product.

The major optical element for the telescope, the Large Space Telescope Primary Mirror Blank, was delivered to Perkin-Elmer in early 1979, thus beginning the long process of grinding and polishing the mirror. By spring, the preliminary design review for the telescope was in progress at Marshall.

While development of the Hubble Space Telescope was still in progress at the contractor plants in the late 1970s, the Marshall Center was focusing on the telescope's future in orbit. A series of telescopic servicing simulations began in the Neutral Buoyancy Simulator at Marshall and suited-crew tests were performed to evaluate methods and equipment which might be used to perform in-orbit services for the telescope.

As NASA entered the 1980s, a number of important milestones in the space telescope program had been completed. Several problems had been encountered, however, and Andrew J. Stofan, deputy associate administrator for Space Science, explained those problems to the U.S. House Subcommittee on Space Science and Applications. An in-depth review of the Space Telescope Program was conducted to assess the anticipated additional costs and possible impact on the launch schedule.

By May 1981, technicians finished shaping and polishing the primary mirror. By summer, telescopic solar-wing deployment tests were under way at a British Aerospace Engineering plant in England. A few months later, a subcontractor for the telescope's titanium ring sent that element to the prime contractor, and the half-ton ring was designed to support the optical system as well as the spacecraft.

In December 1981, the telescope passed another major milestone, the coating of the telescope's 94-inch primary mirror. In early 1982, Marshall's Test Laboratory started a 14-month test of the electrical performance of the solar cells making up the solar arrays for the telescope. While these tests were in progress, technicians at Perkin-Elmer were examining the reflectivity of the primary mirror prior to its placement in storage.

During 1982, the Critical Design Review for the spacecraft was completed, and the first space telescope scientific instrument, the High Speed Photometer, was fabricated. Other events in 1982 included initial manufacturing of all major subsystems at Lockheed, completion of the fabrication of the major components of the Optical Telescope Assembly,

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and initial work on final assembly of the telescope.

In May 1983, NASA's airplane, named "Guppy," was flown to Marshall for acceleration tests with the Space Telescope Optical Assembly shipping container. Later in the year, NASA officially named the new telescope in honor of Edwin P. Hubble, one of America's foremost astronomers.

Work on the Hubble Space Telescope continued in 1984. Tests conducted on the telescope's fine guidance sensors ensured they would meet their pointing and tracking requirements. By May, Marshall engineers had developed an intricate balance-beam device for ground installation of the Hubble's scientific instruments and Fine Guidance Sensors.

As part of a 16-hour operation performed by the contractor, the 2.4-meter primary mirror was cleaned, and a remeasurement was taken of the mirror's reflectivity at ultraviolet wavelengths.

Before the end of 1984, NASA transported the Optical Telescope Assembly from the manufacturer in Danbury, Conn., to Lockheed in Sunnyvale, Calif. At approximately the same time, the last Hubble elements were delivered to Lockheed for integration into the main telescope structure. Assembly of the primary structures was completed near the end of July 1985. In May 1986, Marshall staffed the Huntsville Operations Support Center to gather engineering data on the Hubble during a test to prepare for its launch and mission. Lockheed conducted a 60-day thermal vacuum test at Sunnyvale under conditions similar to those the telescope would experience in orbit.

As NASA prepared for delivery of the final elements of the telescope that same year, Marshall's Jim Odom, then manager of the telescope project, said, "It's only a matter of time now until we place the observatory in orbit and perhaps unlock incredible secrets of the universe."

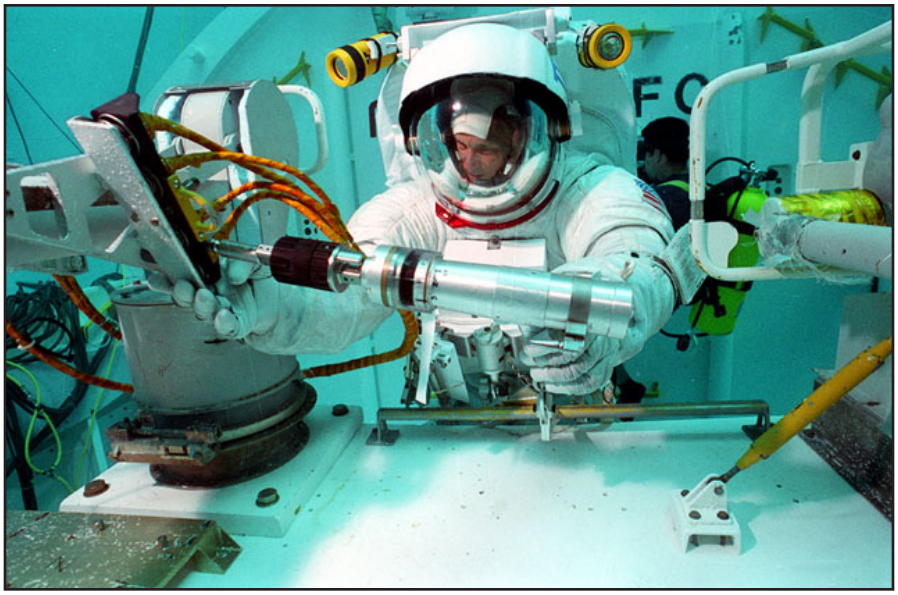
The Hubble Space Telescope was deployed April 25, 1990. The photograph was taken by the IMAX Cargo Bay Camera mounted in a container on the port side of space shuttle Discovery during the STS-31 mission.

In 1987, a three-day ground test was conducted, simulating 28 orbits of typical Hubble science operations and involving five of the telescope's science instruments. Goddard and Marshall, supported by their respective contractors, performed the test. In 1988, NASA conducted a five-day Hubble ground system test.

Additional testing continued in 1988 and 1989. Finally, in October 1989, the Hubble Space Telescope was shipped from Lockheed to the Kennedy Space Center in Florida to be prepared for launch aboard STS-31. On the morning of April 24, 1990, space shuttle Discovery left the launch pad to begin the STS -31 mission and the deployment of the Hubble Space Telescope.

Even though initially impaired by a flaw in its main mirror – it was expertly made but to the wrong "prescription," causing its images to be blurred – Hubble's position above the distortion of Earth's atmosphere enabled it to begin making major discoveries. This happened even before astronauts initiated the first in a series of repair and servicing missions that spanned from 1993 through 2009.

When corrective optics were installed during that dramatic first servicing mission, the universe suddenly snapped into sharp focus, and initiated 20 years of spectacular



Astronaut Storey Musgrave conducts Hubble Space Telescope training in Marshall's Neutral Buoyancy Simulator in 1993.

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images and discoveries which have forever changed how humans view the cosmos.

Soon after the telescope launched in 1990, Fred Wojtalik, who served as project manager on Hubble at Marshall and was involved in the project for eight years, talked about its technical challenges. "We've done things on the Hubble that have never been done before," he said a few days prior to the launch. "We've had to tackle problems others said could never be solved."

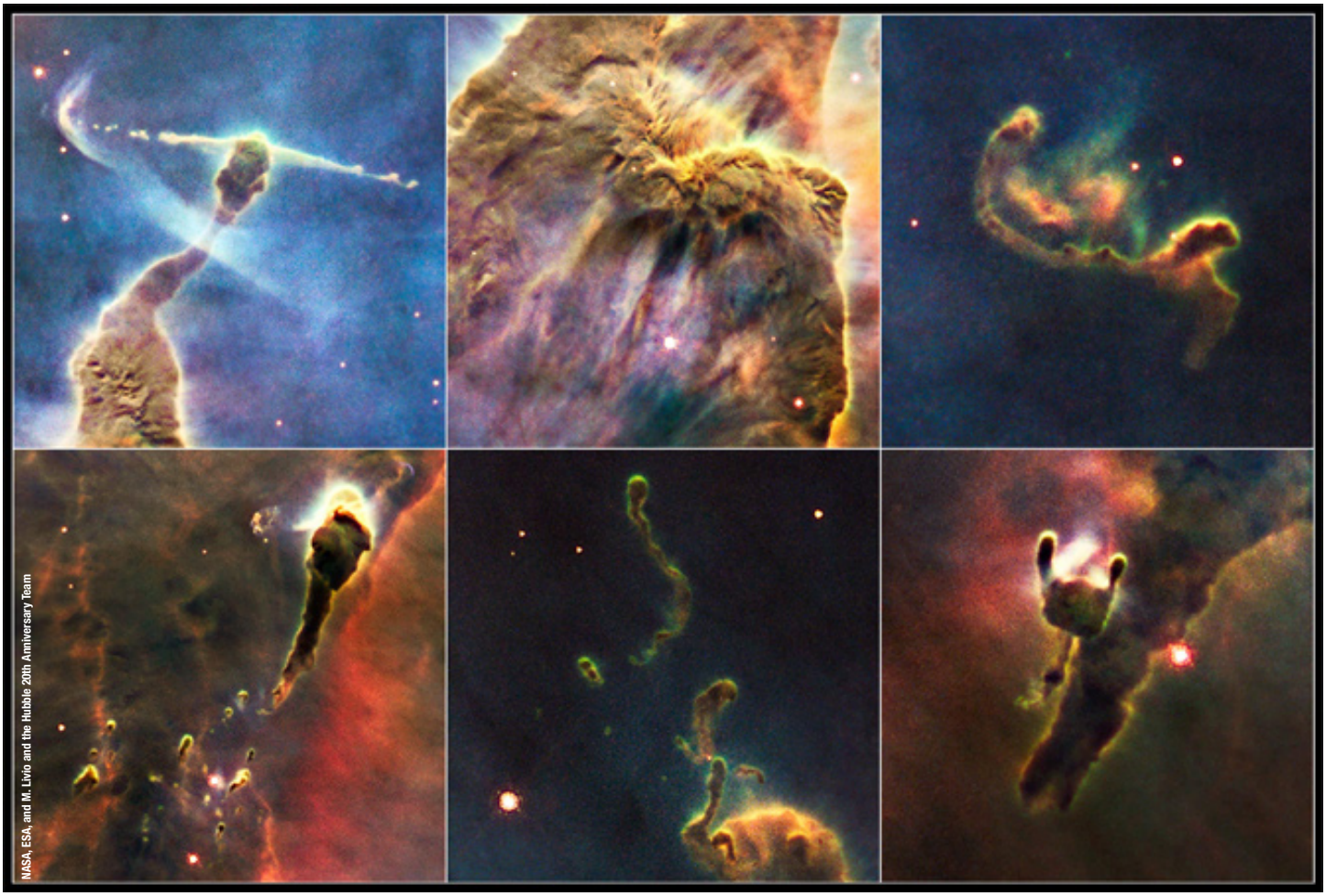
One of the most important decisions that NASA made related to the telescope was making the Hubble repairable by astronauts in orbit, Wojtalik said. "This was something we had to jump through hoops to make happen." However, he said, the successful repair missions that the astronaut crews have conducted proved that the effort was worth it.

Jim Odom's biggest "worries" about the telescope concerned how its batteries, as well as its pointing system, might perform. "I was in front of both of the horses," Odom said. The success the telescope has experienced over the last 20 years belongs to the entire Hubble team, he added, including former Marshall Center Director William Lucas, who "saw it through difficult times and helped keep it alive."

The Hubble Space Telescope has had a major impact in every area of astronomy, from the solar system to objects at the edge of the universe. To date, more than 3,500 technical publications have reported Hubble results. Hubble's major scientific results have included the accelerating universe and dark energy, the distance scale and age of the universe, the evolution of galaxies, and the birth of stars and planets.

Jean Olivier served as chief engineer and was involved in the project throughout his career at Marshall.

Wright is the Marshall Center historian in the Office of Strategic Analysis & Communications.



This is a series of close-up images taken by Hubble of the complex gas structures in a small portion of the Carina Nebula. The nebula is a cold cloud of predominantly hydrogen gas laced with dust, which makes the cloud opaque. It is being eroded by a gusher of ultraviolet light from young stars in the region. They sculpt a variety of fantasy shapes, many forming tadpole-like structures. In some frames, smaller pieces of nebulosity can be seen freely drifting, such as the 2.3-trillion-mile-long structure at upper right. The most striking feature is a 3.5-trillion-mile-long horizontal jet at upper left. It is being blasted into space by a young star hidden in the tip of the pillar-like structure. A bowshock has formed near the tip of the jet. To view photos in color, visit http://marshallstar.msfc.nasa.gov/.