

The following article prepared by NASA Marshall Space Flight Center Historian Mike Wright appeared in 1994 in *Research and Technology, Annual Report of the Marshall Space Flight Center* upon the Silver Anniversary of Apollo 11.

Saturn Apollo Program Answered Challenge To the Nation

The landing of humans on lunar surface in July 1969 verified President John F. Kennedy's prediction that it would be the "the greatest adventure on which man had ever embarked." For the first time humankind walked on the lunar surface.



*Test firing of
Saturn IC stage
at MSFC.*

In a figurative sense, the journey started long before a Marshall Space Flight Center-developed Saturn V lifted the Apollo astronauts on their way to the lunar surface on July 16, 1969. In the same way, the journey did not end when the Apollo astronauts splashed down in the Pacific Ocean. The journey began in the minds of men like Wernher von Braun who, even as a young boy growing up in Germany, dreamed of space travel. The journey

continued in 1994 in the minds of employees and others associated with NASA and the Marshall Center.

Historians, who like to cite the origin of events in terms of place and time, usually note Kennedy's "Special Message to Congress on Urgent National Needs" on May 25, 1961: "I believe this Nation should commit itself to achieving the goal, before

this decade is out, of landing a man on the Moon and returning him safely to the Earth.”

To prepare for that speech, the President had sought advice from Vice President Lyndon Johnson on the Nation’s space options. One of the experts who provided Johnson with advice was Von Braun, the first Director of MSFC. Von Braun wrote Johnson a letter dated April 29, 1961. “This is an attempt to answer some of the questions about our national space program raised by the President in his memorandum to you dated April 20, 1961.” One question that Von Braun addressed concerned the possibility of a manned lunar landing. “We have an excellent chance of beating the Soviets to the first landing of a crew on the Moon (including return capability, of course),” he told Johnson. The amount of influence that Von Braun’s letter may have had on the Administration is open to debate. Nevertheless, Kennedy’s call for a manned lunar landing directly impacted the future of the Marshall Center. As a result, the Center was directed to proceed with development of the Saturn V launch vehicle. Based on the F-1 rocket engine and the hydrogen-fueled J-2 engine, the Saturn V would be larger than any vehicle ever built. It would build upon MSFC’s experience with the Saturn I and Saturn IB launch vehicles. More powerful than the Saturn I or Saturn IB, the Saturn V would provide the capability for lunar and planetary expeditions. Its design called for three stages and an instrument unit to manage guidance and control.

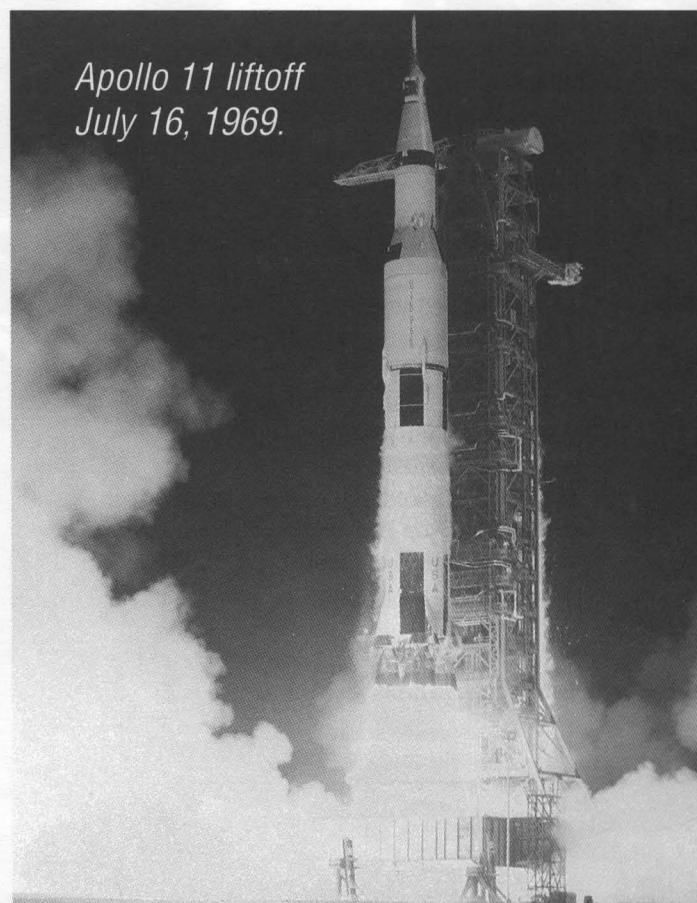
Kennedy had said that the manned lunar landing program would challenge the Nation. Speaking at Rice University in Texas on September 12, 1962, he said, “We choose to go to the Moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills...” Developing the Saturn V meant just that for MSFC. More than 3 million pieces, making up 700,000 parts, were contained in a single Saturn V. At the height of the Saturn program, as many as 20,000 contractor companies were involved. Their involvement ranged from manufacturing the smallest components to static testing complete vehicle stages.

In Huntsville, the thunder rolled and the ground shook when engineers test-fired the mighty first stage of the Saturn V. Von Braun was at the helm, directing all aspects of Saturn V development. His commitment and dedication were unparalleled. To

anyone who might have thought of turning back or who might have felt weak in the knees after grasping the enormous proportions of the challenge, Von Braun portrayed confidence. “We have thrown our hat across the river,” he wrote in 1964. The pace of the Center was fast and it grew faster. One employee recalled a visit to his work site by Von Braun: “You couldn’t keep up with him as he walked down the hall.”

Quality, however, was never sacrificed to urgency. Components were tested and retested and then tested again. Reliability became the hallmark of the Center. “The confidence factor derived from conservative design, extensive testing, and stringent quality control all based on meticulous attention to detail,” an MSFC report stated.

Saturn changed the landscape. Old facilities were renovated and new facilities were constructed. Existing test stands were remodeled and a new test area was developed for propulsion and structural dynamic testing. Thousands of new workers joined the Marshall team, working either in Huntsville or at other sites. On July 15, 1960, when the Marshall Center came into existence, permanent civil service and contractor strength, both in Huntsville and at other locations, stood at 5,843. By Fiscal Year 1964, it had risen to 54,835. The 1960 Huntsville





census put the city's population at 72,000. By 1964 that number had risen to 123,000.

Saturn development and testing continued. As a prelude to Apollo 11, NASA launched two unmanned and three manned Saturn V vehicles. All of that experience came together on July 16, 1969, when the giant launch vehicle lifted the Apollo 11 astronauts on their journey to the lunar surface.

The Apollo 11 astronauts spent a total of 21 hours and 36 minutes on the lunar surface. In addition to leaving behind several ceremonial articles, the astronauts returned 46 pounds of lunar samples to Earth.

After the Apollo astronauts completed their mission, Marshall Center employees and others in Huntsville danced in the streets. At one such celebration, Von Braun told those present, "Because of the beginning we have made here, the planets and stars may belong to mankind."

By 1974, the fifth anniversary of the first lunar landing, NASA had depended on the Saturn V

launch vehicle to launch six more Apollo missions as well as the *Skylab* space station. The anniversary was an opportunity for Von Braun to reflect on the Apollo program and on the development of the Saturn V. His recollections were candid. When the decision was made to begin the Apollo program, "there wasn't a single discipline in which all the answers were available to support a manned flight to the Moon..." It was a "process of asking these various disciplines impossible questions and hoping they would come up with impossible answers to these impossible questions. This I believe had a tremendous catalytic effect on all these sciences and technologies. If you are told 'unless you come up with a meaningful answer we can't do it' that is a strong incentive..." *

A tour through the Marshall Center test area or a glimpse inside its laboratories would have substantiated Von Braun's claim by revealing hundreds of engineers and scientists at work on a myriad of technical challenges. For example, the propulsion system for the first stage of the Saturn V depended on a cluster of five F-1 engines, each

producing 1.5 million pounds of thrust. In utilizing this cluster concept, first developed by the Von Braun team, engineers faced challenge after challenge. This system and others in the Saturn V required unique pumping, ducting, and venting schemes to obtain uniform propellant flow. The upper stages of the vehicle were fueled by liquid hydrogen. As a result, the whole field of cryogenics changed. Engineers not only learned more about using this highly explosive supercooled liquid as

rocket fuel, they learned more about transporting it and storing it in massive quantities.

Historian Roger Bilstein has traced the history of MSFC's development of the gigantic Saturn rockets throughout the 1960's. "In dealing with the technology of the Saturns in general, the most consistent factor seemed to be the enormous size of the vehicles," Bilstein wrote. The Saturn V stood 363 feet tall and weighed more than 6 million



Enthusiastic crowd carries Dr. Wernher von Braun to celebrate Apollo 11 astronauts landing safely.

pounds when fully fueled. Even though the prototypes of some components existed, they were not as large as the new vehicle required. This meant that engineers at the Marshall Center and at other sites across the Nation had to develop special fabrication techniques. Gigantic tooling was required to form structures. In addition to basic advances in rocketry and propulsion, the work demanded advances in metallurgy, welding, insulation, materials science, static testing, and hundreds of other fields.

The Saturn V was also a study in contrasts. Engineers called it “the beast.” Yet the design also called for the development of super-lightweight durable materials, microminiature components, and advances in the design of logic devices, computers, and other electronic components. A successful ground testing program was absolutely critical. MSFC laboratories developed new techniques for simulating harsh launch and space-flight conditions. Electronic simulators were developed to determine how the vehicle and its components would react to extreme pressures, temperatures, and dynamics. Special instrumentation was created to gather exacting analytical data on engine and component performance.

After visiting the Marshall Center during the 1960's, Gene Bylinsky, a writer for *Fortune Magazine*, reported that each stage of the Saturn V vehicle contained approximately 77 miles of wiring and that the fuel tanks were cavernous as cathedrals. The technological advances the project required were equally impressive. But the Saturn/Apollo Program provided more than a harvest of scientific and engineering advances. It answered Kennedy's challenge to “make this effort, to solve these mysteries, to solve them for the good of all men, and to become the world's leading space-faring nation.” This is the legacy of the Saturn/Apollo Program that continued at the Marshall Space Flight Center in 1994.

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“Houston... Tranquility Base here.
The Eagle has landed.”
– Neil Armstrong, July 20, 1969.

