NASA Facts

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771
301-286-8955

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Robert H. Goddard: American Rocket Pioneer

The father of modern rocket propulsion is the American, Dr. Robert Hutchings Goddard. Along with Konstantin Eduordovich Tsiolkovsky of Russia and Hermann Oberth of Germany, Goddard envisioned the exploration of space. A physicist of great insight, Goddard also had an unique genius for invention.

By 1926, Goddard had constructed and tested successfully the first rocket using liquid fuel. Indeed, the flight of Goddard's rocket on March 16,1926, at Auburn, Massachusetts, was a feat as epochal in history as that of the Wright brothers at Kitty Hawk. Yet, it was one of Goddard's "firsts" in the now booming significance of rocket propulsion in the fields of military missilery and the scientific exploration of space.

Primitive in their day as the achievement of the Wrights, Goddard's rockets made little impression upon government officials. Only through the modest subsidies of the Smithsonian Institution and the Daniel Guggenheim Foundation, as well as the leaves of absence granted him by Worcester Polytechnic Institute of Clark University, was Goddard able to sustain his lifetime of devoted research and testing. He worked for the U.S. Navy in both World Wars. Eighteen years after his successful demonstration at Auburn, Goddard's pioneering achievements came to life in the German V-2 ballistic missile.

Goddard first obtained public notice in 1907 in a cloud of smoke from a powder rocket fired in the basement of the physics building in Worcester Polytechnic Institute. School officials took an immediate interest in the work of student Goddard. They, to their credit, did not expel him. He thus began his lifetime of dedicated work.

In 1914, Goddard received two U.S. patents. One was for a rocket using liquid fuel. The other was for a two or three stage rocket using solid fuel. At his own expense, he began to make systematic studies about propulsion provided by various types of gunpowder. His classic document was a study that he wrote in 1916 requesting funds of the Smithsonian Institution so that he could continue his research. This was later published along with his subsequent research and Navy work in a Smithsonian Miscellaneous Publication No. 2540 (January 1920). It was entitled "A Method of Reaching Extreme Altitudes." In this treatise, he detailed his search for methods of raising weather recording instruments higher than sounding balloons. In this search, as he related, he developed the mathematical theories of rocket propulsion.

Dr. Robert H. Goddard, Rocket Pioneer for whom the Goddard Space Flight Center is named. *Photo courtesy of Mrs. Robert H. Goddard.*

BIOGRAPHICAL DATA

Born:	Worcester, Massachusetts, October 5, 1882
Died:	August 10, 1945
Education:	B.S. Degree, Worcester Polytechnic Institute, 1908; M.A. Clark University, 1910; Ph.D. Clark University, 1911
Academic Career:	Instructor of Physics, Worcester Polytechnic Institute, 1910-1911; student at Princeton university, 1914-1915; Assistant Professor, 1915-1919; full Professor at Clark after 1919.

Towards the end of his 1920 report, Goddard outlined the possibility of a rocket reaching the moon and exploding a load of flash powder there to mark its arrival. The bulk of his scientific report to the Smithsonian was a dry explanation of how he used the $5000 grant in his research. Yet, the press picked up Goddard' s scientific proposal about a rocket flight to the moon and erected a journalistic controversy concerning the feasibility of such a thing. Much ridicule came Goddard's way. And he reached firm convictions about the virtues of the press corps which he held for the rest of his life. Yet, several score of the 1750 copies of the 1920 Smithsonian report reached Europe. The German Rocket Society was formed in 1927, and the German Army began its rocket program in 1931.

Goddard's greatest engineering contributions were made during his work in the 1920's and 1930's (see list of historic firsts). He received a total of $10,000 from the Smithsonian by 1927, and through the personal efforts of Charles A. Lindbergh, he subsequently received financial support from the Daniel and Florence Guggenheim Foundation. Progress on all of his work was published in "Liquid Propellant Rocket Development," which was published by the Smithsonian in 1936.

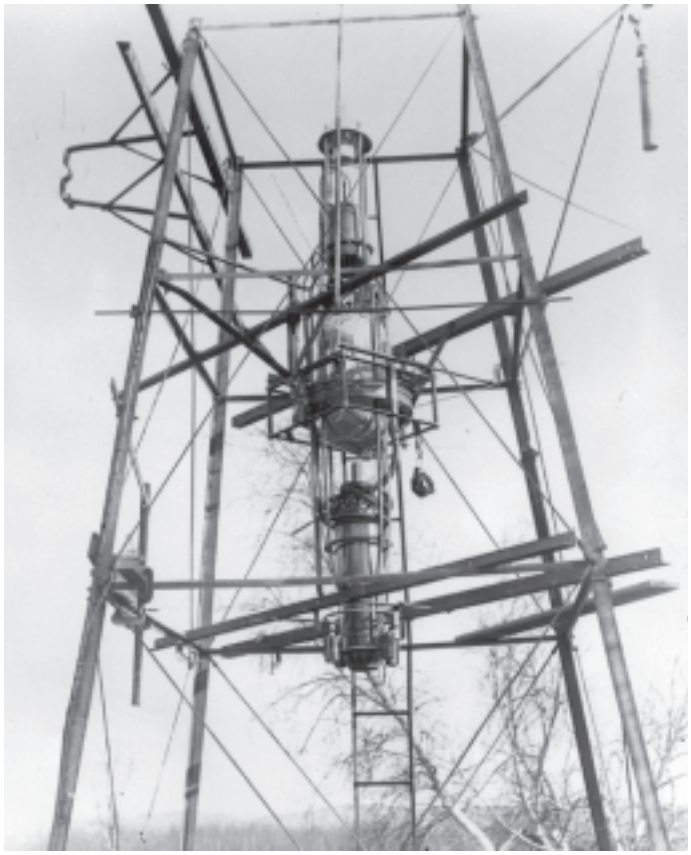
Goddard's work largely anticipated in technical detail the later German V-2 missiles, including gyroscopic control, steering by means of vanes in the jet stream of the rocket motor, gimbal-steering, power-driven fuel pumps and other devices. His rocket flight in 1929 carried the first scientific payload, a barometer, and a camera. Goddard developed and demonstrated the basic idea of the "bazooka" two days before the Armistice in 1918 at the Aberdeen Proving Ground. His launching platform was a music rack. Dr. Clarence N. Hickman, a young Ph.D. from Clark University, worked with Goddard in 1918 and provided continuity to the research that produced the World War II bazooka. In World War II, Goddard again offered his services and was assigned by the U.S. Navy to the development of practical jet assisted takeoff (JATO) and liquid propellant rocket motors capable of variable thrust. In both areas, he was successful. He died on August 10, 1945, four days after the first atomic bomb was dropped on Japan.

Goddard was the first scientist who not only realized the potentialities of missiles and space flight but also contributed directly in bringing them to practical realization. This rare talent in both creative science and practical engineering places Goddard well above the opposite numbers among the European rocket pioneers. The dedicated labors of this modest man went largely unrecognized in the United States until the dawn of what is now called the "space age." High honors and wide acclaim, belated but richly deserved, now come to the name of Robert H. Goddard.

On September 16, 1959, the 86th Congress authorized the issuance of a gold medal in the honor of Professor Robert H. Goddard.

In memory of the brilliant scientist, a major space science laboratory, NASA's Goddard Space Flight Center, Greenbelt, Maryland, was established on May 1, 1959.

Dr. Robert H. Goddard with his rocket in his workshop at Roswell, New Mexico, October 1935. *Photo courtesy of Mrs. Robert H. Goddard.*

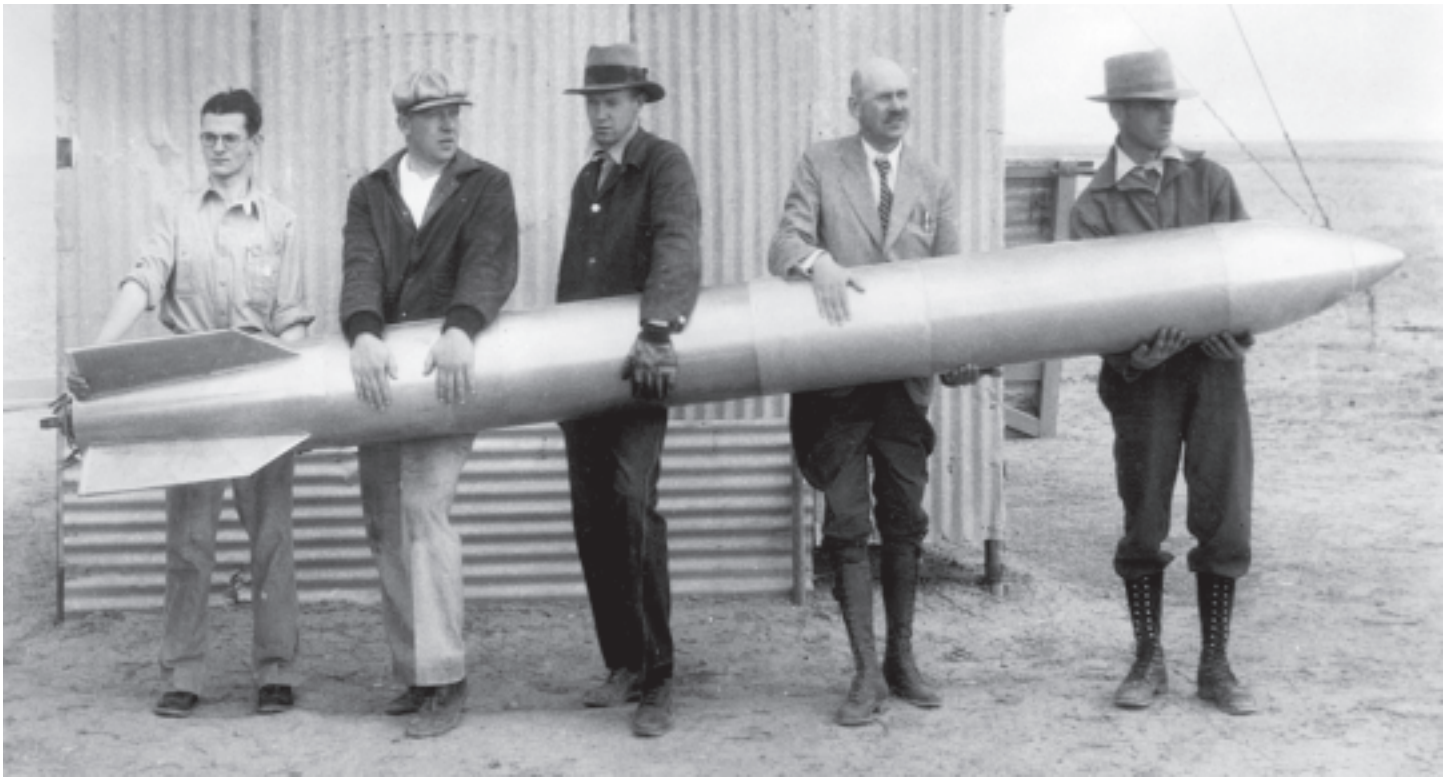


Setup for Dr. Goddard's test of April 20, 1927, with parachute attachment and turntable for launching, at Auburn, Massachusetts. *Photo courtesy of Mrs. Robert H. Goddard.*

GODDARD'S HISTORIC FIRSTS

Robert H. Goddard's basic contribution to missilery and space flight is a lengthy list. As such, it is an eloquent testimonial to his lifetime of work in establishing and demonstrating the fundamental principles of rocket propulsion.

- ➤ First explored mathematically the practicality of using rocket propulsion to reach high altitudes and even the moon (1912);
- ➤ First proved, by actual static test, that a rocket will work in a vacuum, that it needs no air to push against;
- ➤ First developed and shot a liquid fuel rocket, March 16, 1926;
- ➤ First shot a scientific payload (barometer and camera) in a rocket flight (1929, Auburn, Massachusetts);
- ➤ First used vanes in the rocket motor blast for guidance (1932, New Mexico);
- ➤ First developed gyro control apparatus for rocket flight (1932, New Mexico);
- ➤ First received U.S. patent in idea of multi-stage rocket (1914);
- ➤ First developed pumps suitable for rocket fuels;
- ➤ First launched successfully a rocket with a motor pivoted on gimbals under the influence of a gyro mechanism (1937).



Dr. Goddard and colleagues holding the rocket used in the flight of April 19,1932. They are, from left to right, L. Mansur, A. Kisk, C. Mansur, Dr. R. H. Goddard, and Nils Ljungquist. *Photo courtesy of Mrs. Robert H. Goddard.*