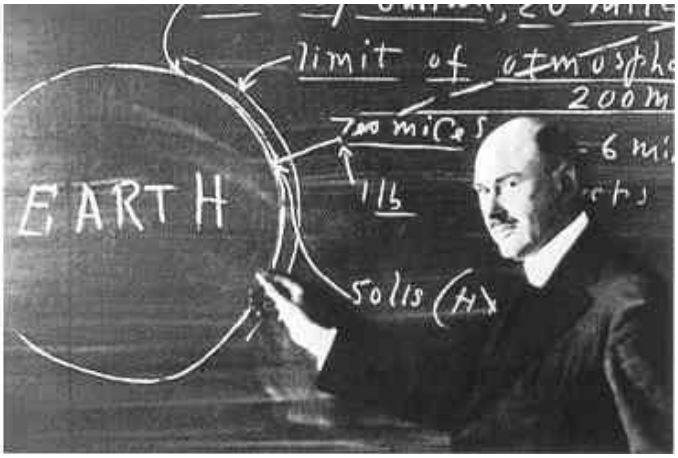

Robert Goddard

On October 5, 1882, Nahum Danford Goddard, a businessman, and Fannie Hoyt Goddard delivered a son, Robert, in Worcester, Massachusetts. Early in life, young Robert suffered from pulmonary tuberculosis which kept him out of school for long periods of time. However, he kept up with his studies and was an avid reader, devouring Cassell's Popular Educator as well as popular science fiction novels. In Fact, it was after reading H.G. Wells's "The War of the Worlds" that he first became interested in space exploration.

He later wrote in his autobiography about an inspiration that came to him as a boy. While his family was staying at the suburban home of friends in Worcester, on October 19, 1899, he climbed into an old cherry tree to prune its dead branches. Instead, he began daydreaming: "It was one of the quiet, colorful afternoons of sheer beauty which we have in October in New England, and as I looked toward the fields at the east, I imagined how wonderful it would be to make some device which had even the possibility of ascending to Mars, and how it would look on a small scale, if sent up from the meadow at my feet."

"I was a different boy when I descended the tree from when I ascended, for existence at last seemed very purposive."

October 19 became "Anniversary Day," noted in his diary as his personal holiday.

Five years later, after graduating from school, Robert Goddard applied and was accepted at Worcester Polytechnic Institute. In 1907, while a student at Worcester Polytechnic Institute in Massachusetts, Goddard experimented on a rocket powered by gunpowder in the basement of the physics building. Clouds of smoke caused a lot of commotion and the faculty, rather than expel him, took an interest in his work.

He received his degree in physics in 1908 and was made a Fellow in the physics department at Clark University. There, he received his master's degree in 1910 and in 1911 he received his doctorate.

By 1914, Goddard already had received two U.S. patents (#1,103,503 and #1,102,653): one for a rocket using liquid fuel and the other for a two- or three-stage rocket using solid fuel. Until that time, propulsion was provided by various types of gunpowder.

That year, he began teaching physics at Clark University in Worcester. His thoughts on space flight started to emerge in 1915, when he theorized that a rocket would work in a vacuum, and didn't need to push against air in order to fly. This meant that in the vacuum of space, rocket engines would be able to produce thrust. At his own expense, he began to make systematic studies about propulsion provided by various types of gunpowder. He began experiments on the efficiency of rockets. He bought some commercial rockets and measured their thrust using a ballistic pendulum, a heavy mass suspended by ropes, to which the rocket was attached. The rocket was fired, and the height to which the pendulum rose provided a measure of the total momentum (mass times velocity) imparted to it. Goddard also used an equivalent set-up, where the mass pushed against a spring, instead of being suspended.

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.

Goddard's discoveries were given little attention by the U.S. government. Funding from the Smithsonian Institution allowed Goddard to continue his rocket research and develop the mathematical theories of rocket propulsion. In 1920, the Smithsonian published his original paper, "A Method for Reaching Extreme Altitudes," in which he included a small section stressing that rockets could be used to send payloads to the Moon 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.

He responded to a reporter's question by stating, "Every vision is a joke until the first man accomplishes it; once realized, it becomes commonplace."

In 1922 Goddard went back to his alternative idea, proposed independently by Hermann Oberth in Germany and also noted by Tsiolkovsky: a liquid-fuel rocket. It would have two lines running into its combustion chamber, one feeding fuel, the other oxygen, similar to the way a steel-cutting blowtorch operated, except here both lines carried liquids, not gases--in Goddard's design, gasoline and liquid oxygen.

Goddard was named director of the Physical Laboratory in 1923.

On March 16, 1926, Goddard flight-tested his first liquid-fuel rocket. He thought stable flight could be obtained by mounting the rocket ahead of the fuel tank, with the tank shielded from the flame by a metal cone and the lines for fuel and oxygen pulling it behind the rocket: the design worked, but did not produce the hoped-for stability. The rocket burned about 20 seconds before reaching sufficient thrust (or sufficiently lightening the fuel tank) for taking off. During that time it melted part of the nozzle, while the camera with which Mrs. Esther Goddard was trying to record the flight ran out of film, so that no photographic record of that flight remains. Then it took off to a height of 41 feet, leveled off and later hit the ground, all within 2. 5 seconds, averaging about 60 mph.

During this time, several copies of the 1920 Smithsonian report had reached Europe. The German Rocket Society was formed in 1927, and the German Army began its rocket program in 1931. 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, gimbalsteering, power-driven fuel pumps and other devices. His rocket flight in 1929 carried the first scientific payload, a barometer, and a camera.

In 1930, Goddard and a small crew of workers moved to New Mexico to continue his research in seclusion. He had 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 died on Aug. 10, 1945, holding 214 patents in rocketry but having received little attention for his propulsion research. When American rocket scientists began to earnestly prepare for space exploration, they discovered it was almost impossible to build a rocket or launch a satellite without acknowledging the work of Goddard.

Now known as the father of modern rocketry, Goddard's significant achievements in rocket propulsion have contributed immensely to the scientific exploration of space. Goddard didn't live to see the age of space flight, but his foundation of rocket research became the fundamental principles of rocket propulsion.

A day after Apollo 11 set off for the Moon, in July of 1969, the New York Times printed a correction to its 1920 editorial section, stating that "it is now definitely established that a rocket can function in a vacuum as well as in an atmosphere. The Times regrets the error."

NASA's Goddard Space Flight Center in Greenbelt, Md., a major space science laboratory, was named in his honor.