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ROBERT H. GODDARD

WORLD ROCKET PIONEER

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Preface

In response to requests, the following is a biographical sketch on the great contribution of Robert H. Goddard to the science and technology of rocket propulsion.

There is no full-fledged biography of Dr. Goddard existent. His notebooks, correspondence, and papers are in the process of being edited by Mrs. Goddard with the assistance of the Smithsonian Institution. Mr. Milton Lehman of Garrett Park, Maryland, is completing a definitive biography, and he was very helpful in the preparation of this sketch. A select bibliography was included to guide the stimulated reader until Mr. Lehman's biography appears and Dr. Goddard's papers are placed in the Library of Congress.

The National Aeronautics and Space Administration has been assigned the mission of conducting the United States program for the exploration, scientific investigation, and utilization of space for peaceful purposes. Appropriately, and with Mrs. Goddard's approval; N.A.S.A. named its new Space Flight Center at Greenbelt, Maryland, after Robert H. Goddard. PIONEER V, the successful U.S. communications space probe launched on March 11, 1960, and TIROS I, the world's first weather satellite launched on April 1, 1960, were but illustrative of early labors of the Goddard Space Flight Center. The creative achievements of this great American, Dr. Robert H. Goddard, will thus be ever remembered as well as honored.

Dr. Eugene M. Emme
NASA Historian

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R O B E R T H. G O D D A R D

WORLD ROCKET PIONEER

I

The father of modern rocket propulsion is the American, Dr. Robert Hutchings Goddard. Along with Ziolkovsky of Russia, Oberth of Germany, and others, Goddard early envisioned the exploration of space.

A physicist of great insight, Goddard had an unique genius for invention. Not only realizing the potentialities of space flight, Goddard also constructed, static tested, and flew rockets to confirm his propulsion theories. This rare talent in both creative science and inventive engineering places Goddard high among the rocket pioneers. Yet his scientific papers were copiously studied, his speculations and experiments ridiculed, and his genius largely unappreciated in his own day. Little wonder that this modest man once called "Moony" has only recently been fully recognized.

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 but one of Goddard's "firsts" in the now booming significance of rocket propulsion in

military missilery and the scientific exploration of space.

Primitive in their day as the achievement of the Wrights', Goddard's rocket successes made little impression upon government officials. Modest grants from the Smithsonian Institution, and later grants from the Daniel and Florence Guggenheim Foundation, as well as a protracted leave of absence from Clark University (where he was Head of the Physics Department) — these enabled Goddard to sustain his lifetime of devoted research, development and flight testing.

Eighteen years after his successful demonstration at Auburn, Goddard's basic concepts and many of his technical designs came to life in the German V-2 ballistic missile. The advent of intercontinental missiles, earth satellites and spacecraft was not only based upon that which Robert H. Goddard invested his creative talents, but also opened up a new era in the accelerating impact of science and technology upon the affairs of mankind.

II

Robert H. Goddard's notebooks date back to 1899. Begun when he was seventeen years of age they contain his speculation about the use of rockets for exploring the atmosphere and beyond.

Eight years later, his thoughts were expressed by both deed and word. He obtained some public notice in 1907, in fact, in a cloud of smoke from a powder rocket fired in the basement of the physics building at Worcester Polytechnic Institute. School officials took lively interest in the work of student Goddard. They did not expel him. That same year, Goddard prepared an

article suggesting that heat from radioactive materials could serve as a means of propulsion sufficient to navigate into interplanetary space. He submitted it to the editors of Popular Science Monthly and Popular Astronomy for publication. It was twice rejected.

Based upon continuing research and study, Goddard received two U.S. patents in 1914. One was for a rocket using liquid and solid fuels, the other for a two or three step rocket for reaching high altitudes. He began actual experimentation as an honorary fellow in physics and instructor at Clark Univerity. At his own expense, he made systematic studies about propulsion. Reaching the limit of his personal financial resources by 1916, he wrote a lengthy technical paper on the potentialities of rockets in order to gain financial support. This was his classic study which obtained a $5000 grant from the Smithsonian Institution in 1917, through the efforts of Dr. Charles D. Walcott, its Secretary, and Dr. Charles C. Abbot, his successor as Secretary. Dr. Walcott was also very instrumental in the early days of the National Advisory Committee for Aeronautics (NACA).

Goddard's 1916 essay requesting funds so that he could continue his research was later published along with his subsequent research in the Smithsonian Miscellaneous Publication No. 2540 (January 1920). It was entitled "A Method for Reaching Extreme Altitudes." Like all Smithsonian publications, it was available to the rest of the scientific world. Upon request, Goddard sent an autographed copy to Hermann Oberth of Germany in 1922 and received a warm letter of thanks from the early

German pioneer of rocketry.

Towards the end of his 1920 report, Goddard discussed 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 was a dry explanation on how he had used the $5000 grant in his development of mathematical theories of rocket propulsion in the search for methods of raising weather data recording instruments higher than sounding balloons. Yet the press corps 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. He thus reached reservations in 1920 about the virtues of the general accuracy of the popular press which he apparently held for the rest of his life. Several score of the 1750 copies of the 1920 Smithsonian Report reached Europe, according to Willy Ley. The German Rocket Society was formed in 1927, while the Reichswehr began its rocket program in 1931.

Goddard's work for the U.S. Signal Corps funds during World War I also should not be forgotten. Until 1917, Goddard had done most of his laboratory research on breechblock and feeding mechanisms for dry fuel rockets. One of them blew up in the Magnetic Laboratory of Worcester Polytechnic Institute on July 9, 1917, much to the notice of the surrounding neighborhood. He offered to investigate possible military applications of his rocket in correspondence with General Dunwoody.

In January 1918, Goddard received U.S. Signal Corps finan-

cial support. He worked on two projects: (1) a rocket for long-range bombardment propelled by a solid-fuel rocket motor charged intermittently like repeating-rifle; and (2) the progenitor of the famed "bazooka" rocket mortar of World War II fame.

The bazooka-type rocket was demonstrated at the Aberdeen Proving Ground on November 10th, 1918. The launching platform consisted of two frail music racks to demonstrate the absence of recoil in rocket firing. This test was highly successful both as to trajectory and target impact. U. S. Army Air Service representatives strongly recommended its development for future combat employment. But the Armistice the next day put an end to the war as well as the active interest of the U. S. Army in rocket experiments until World War II. Things were different in Germany and Russia before World War II, but that is another story.

III

Goddard's great engineering achievements resulted from his work in the 1920's and the 1930's. On November 1, 1923, he static tested a rocket motor using liquid oxygen and gasoline fuel, both supplied by pumps on the rocket. By December 1925, this motor was operated independently of the testing frame. And, on March 16, 1926, this rocket flew 184 feet in 2.5 seconds, the world's first liquid fuel rocket flight.

His last rocket flight at Auburn was on July 17, 1929, which was witnessed by observers who thought it a flaming air-

plane and called out the ambulances. It was heard all over town by most citizens. The wire services quickly spread the word that Professor Goddard's moon rocket had exploded violently. The Massachusetts Fire Marshal prohibited future rocket launchings within the boundaries of the State of Massachusetts. Even the Smithsonian quickly commented that "no such project as going to the moon is contemplated." Significant to note, this highly publicized flight carried an instrumented payload, an aneroid barometer, thermometer, and a camera triggered to operate when the parachute opened. They were successfully recovered. In spite of the unwarranted publicity, Goddard's work did attract the attention of Charles A. Lindbergh. Lindbergh enlisted the support of Harry F. Guggenheim and his father Daniel Guggenheim, for Goddard's work.

The Smithsonian had, by this time, indispensibly supported Goddard with $11,000 for his determined work. Between 1929 and 1941, Daniel Guggenheim and later the Daniel and Florence Guggenheim Foundation provided Goddard with almost $150,000. This money supported his development of large gyro-controlled pump-operated liquid fuel rocket experiments in New Mexico. Progress on his work was published in "Liquid Rocket Propellant Rocket Development," published by the Smithsonian in 1936 (Miscellaneous Pub. 3381). This modest financial aid supported the nascent efforts of Goddard which ultimately created a multi-billion dollar industry and brought forth the enormous potenti-

alities of long-range missiles, earth satellites, and space flight.

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 motor, gimbal-steering, power-driven fuel pumps and other devices. He sought no publicity and did not widely make known details of his work. He called his rockets "Nell" after the girl "who ain't been done right by." When asked by Lt. Homer Boushey of the Army Air Corps in 1940 why he did not publicize his work, Goddard stated that his earlier publications had been translated and reproduced in Europe virtually verbatim, often without mention of Goddard or their source.

During the late 1930's, Goddard unsuccessfully tried to interest the War Department in the military utility of his rocket work. In 1941, the Navy became interested in jet-assisted take off and rocket bombs and did enlist his services. One of his young assistants from Clark University in 1918, Dr. Clarence N. Hickman, also provided continuity on the development of the World War II bazooka. Goddard worked on rocket projects at the Naval Experiment Station at Annapolis from 1941 until his death, following a throat operation, on August 10, 1945.

IV

Praise of Goddard's basic work is vogue today. When the German rocketeers were asked about the V-2 in 1945, they are

quoted as saying: "Why don't you ask your Dr. Goddard." Wernher von Braun has said: "Dr. Goddard was ahead of us all."

In hindsight, which is easy, Dr. Robert H. Goddard was one of the first scientists who not only realized the potentialities of space flight and missiles but also contributed directly to bringing them to practical realization. This rare creative and practical talent was, as Mrs. Goddard points out, combined with his dogged persistence and methodical scientific dedication. More than 200 patents on rockets and rocket apparatus have been given to Robert H. Goddard, many after his death.

The labors of this modest man went largely unrecognized 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 his honor. Goddard Day dinners and awards are honored occasions of the American Rocket Society and the National Rocket Society. NASA's new Goddard Space Flight Center will be a living and working tribute to his historic contributions in the development of space technology. Once his biography, notebooks, and papers are fully available, Robert H. Goddard's trail-blazing role in the theory and application of rocket propulsion will be even more appreciated.

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SELECT BIBLIOGRAPHY

Boushey, Brig. General Homer A., "Vignettes of Dr. Robert A. Goddard," address at 3rd Annual Goddard Memorial Dinner, Washington, D. C., February 17, 1960.

Edson, J.B., and R.J. Snodgrass, "Prelude to Missilery," Ordnance (July - August 1958), pp 67-70.

Gartmann, Heinz, The Men Behind the Space Rockets, New York: McKay, 1956.

Goddard, Robert H., "A Method for Reaching Extreme Altitudes," Smithsonian Miscellaneous Publication No. 2540 (January 1920); reprinted by the American Rocket Society, (1946).

Goddard, Robert H., "Liquid-Propellent Rocket Development," Smithsonian Miscellaneous Publication No. 3381 (March 1936); reprinted in The Air Power Historian, Vol. V (July 1958), pp 152-60.

Goddard, Robert H., Rocket Development: Liquid Fuel Rocket Research, 1921-1941, edited by Esther C. Goddard and G. Edward Pendray, New York: Prentice-Hall, 1948.

Goddard, Mrs. Robert H., "Account of Dr. Goddard's Work, 1917-18," in The Congressional Record, September 9, 1959, p A7904.

Lehman, Milton, "The Strange Story of Doctor Goddard," Reader's Digest (November 1955), pp 147-52

Ley, Willy, Rockets, Missiles, and Space Travel, New York: Viking, 1951.

Pendray, G. Edward, The Coming Age of Rocket Power, New York: Harpers, 1945.

Southwick, Albert B., "The Memorial Which Dr. Goddard Would Have Liked Best of All," Worcester Evening Gazette, May 9, 1958, reprinted in The Congressional Record, September 9, 1959, p A7904.

Williams, B., and Samuel Epstein, The Rocket Pioneers, New York: Messner, 1955.