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Project Orbiter: Prelude to America's First Satellite

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Introduction

In the years following the end of World War II, the possibility of space travel experienced a great surge of interest in Europe and America. This was in large part due to the development of the German A-4 (also known as the V-2) rocket during the war. The A-4, developed and built for the German Third Reich by a team of engineers lead by Wernher von Braun, was the largest rocket developed up to that time and it paved the way for the building of much larger rockets with significantly increased performance. It was recognized by many after the war (as well as by von Braun during the A-4 development) that this new technology would make space travel possible in the near future. As a result, there were a flurry of studies conducted during the late 1940s and early 1950s on the possibility of launching an Earth orbiting satellite.

Project Orbiter

While the bulk of post-war rocket development, both in the Soviet Union and the United States, centered on the creation of new weapons systems for the military, many involved with these endeavors still had the possibility of space travel in the back of their minds. Von Braun, who was relocated to the United States after the war along with many of his colleagues, was also consumed by his passion for space travel. His writings on this topic in popular magazines like Colliers during the 1950s inspired an entire generation with visions of space stations, trips to the Moon, and large expeditions to Mars. All these missions were still far in the future since they required the development of rockets significantly larger than any in existence.

In the near term, von Braun and his team at what was to become the Development Operations Division of the Army Ballistic Missile Agency (ABMA) at the Redstone Arsenal in Huntsville, Alabama had much more modest goals in mind. Advances in the miniaturization of electronics during the late 1940s and early 1950s made it possible for a small satellite weighing just a few kilograms to perform useful investigations from orbit. Such a small payload could be launched using rockets only slightly more powerful than those currently under development. During 1954 the ABMA team, in cooperation with the California Institute of Technology's Jet Propulsion Laboratory (JPL) and the Office of Naval Research, began work on a proposal to launch an Earth satellite called Project Orbiter.

Meeting of the Project Orbiter Team (NASA)

This proposal centered on using a modified Redstone rocket in combination with a cluster of existing solid rocket motors to launch a small satellite into orbit. The Redstone started life as a design study called Hermes C in the late 1940s. The Hermes program was a series of experimental rockets that combined proven German A-4 technology with new American innovations. As such, the Redstone is a direct descendant of the A-4. In July 1950 a feasibility study began for a ballistic missile with a 800-kilometer (500-mile) range based on the Hermes C work.

As the Korean War dragged on, the program received the highest priority and was redirected. In order to speed development and make it a highly mobile field weapon, the range was reduced to 320 kilometers (200 miles) and it was decided to use a smaller Rocketdyne-built engine based on the one used by the Navaho cruise missile's rocket booster. On April 8, 1952 this new rocket was designated Redstone after the Redstone Arsenal. Development proceeded quickly and the first of what would be 37 test flights was launched on August 20, 1953.

For Project Orbiter, a modified version of the Redstone would be employed. While the diameter of the missile remained at 1.8 meters (70 inches), the propellant tanks would be lengthened by 1.65 meters (5 feet 5 inches) to increase their volume. The Redstone's Rocketdyne A-7 engine, which normally burned alcohol and liquid oxygen to produce 334 kilonewtons (75,000 pounds) of thrust, was modified to use what the Army called "Hydyne" (a corrosive mixture of unsymmetrical dimethylhydrazine and diethylene triamine) as a fuel to produce 369 kilonewtons (83,000 pounds) of thrust. The larger propellant load, greater thrust, and improved engine efficiency greatly increased the performance of the rocket.

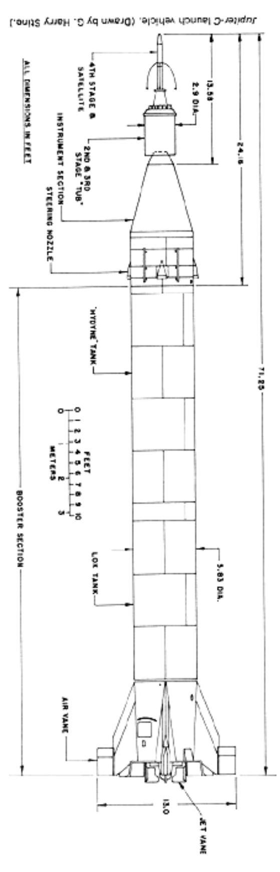
Mounted on top of this modified Redstone would be a high speed assembly consisting of an instrument compartment and a cluster of off-the-shelf solid rocket motors. Originally 37 Loki antiaircraft missiles were considered for this application. But in order to simplify the design and increase the assembly's reliability, it was decided to use a cluster of 15 scaled-down versions of the JPL-developed rocket motor used in the Sergeant surface-to-surface tactical missiles. Each of these motors would be 15 centimeter (6 inches) in diameter, 1.2 meters (four feet) long and would generate 7 kilonewtons (1,600 pounds) of thrust for 5 to 6 seconds. The cluster would be held in an electrically-driven spinning tub mounted on top of the modified Redstone. The cluster was spun to provide gyroscopic stability and to even out any performance variations in the solid rocket motors which were quite primitive by today's standards. This Redstone-based launch vehicle had a total length of 21.7 meters (71 feet 3 inches) and a lift off weight of 29,000 kilograms (64,000 pounds).

The upgraded Redstone first stage would loft the high speed assembly above the atmosphere whereupon it would separate from the cluster. The spinning aluminum tub would then coast for a predetermined period of time using variable thrust, compressed gas thrusters to maintain proper attitude. At the right moment, the outer ring of 11 rocket motors would ignite to send the other upper stages and payload on their way. Immediately after burnout, a third stage made up of a cluster of three motors mounted inside this ring would ignite. The final stage in this rapid fire sequence, consisting of a single rocket motor, would then ignite to place the small payload into Earth orbit. In theory this rocket could place 9 kilograms (20 pounds) into orbit but further improvements later raised this to 11 kilograms (25 pounds). The primary advantage of this proposal over its competitors was that it made use of existing technology and proven hardware. As a result, many felt that Project Orbiter would be available to launch a satellite before any other project.

Death of Project Orbiter

In September 1954 the joint Army-Navy Project Orbiter proposal to launch a single satellite was submitted to the Department of Defense for consideration. Over the next few months, as the International Geophysical Year took shape and America was preparing to make a commitment to launch a satellite, the Air Force and the Naval Research Laboratory submitted their own satellite proposals. With three choices before him, Assistant Secretary of Defense Donald A. Quarles deferred the decision to an Advisory Group on Special Capabilities. On September 9, 1955 this group choose the all-Navy proposal which was eventually called Vanguard. While Project Orbiter made the greatest use of off-the-shelf hardware and had the best chance to get a satellite into orbit first, the Eisenhower administration made it clear that they wanted to use as little military hardware as possible to launch America's IGY satellite. This was to give the project as civilian a look as possible as well as minimize any interference between the satellite program and vital defense projects like the Army's Redstone or the Air Force's Atlas. Another perceived weakness in the Project Orbiter proposal was that it would launch only a single satellite with no followup. Of course this could have been easily remedied with more resources but this could have had deleterious consequences for the Redstone development program.

With Project Orbiter officially shelved, development on von Braun's proposed satellite launch vehicle was redirected in September of 1955. In addition to the Redstone, the ABMA, under the command of General Bruce Medaris, was developing the Jupiter IRBM (Intermediate Range Ballistic Missile). With a range of 2,800 kilometers (1,750 miles), Jupiter's warhead would have to withstand much more extreme conditions upon reentry into the Earth's atmosphere than previous entry vehicles. In-flight testing of this new nosecone was needed to verify its design but a purpose-built rocket for this task was not yet available. As a stop gap measure, a modified version of von Braun's satellite launcher was proposed. While it was not powerful enough to loft the actual warhead, the rocket would be capable of accelerating a one third scale model weighing 140 kilograms (300 pounds) to hypersonic velocities. The only major change required was the removal of the final stage and the installation of an adapter for the nosecone. From the start the development of this rocket, now designated Jupiter C ("C" standing for "Composite") to help disguise its heritage under the Jupiter program umbrella, proceeded so that the satellite launch option would be preserved. In the mean time Medaris and von Braun would continue to lobby civilian and military leaders in Washington to allow them to launch a satellite.



Sketch of Jupiter C (NASA)

Development of the Jupiter C proceeded quickly during the next year with the first test vehicle, Round 27, ready for launch only a year after authorization. This vehicle was essentially the same as the proposed satellite launch vehicle except that it carried an inert fourth stage. The 38.0 kilogram (83.6 pound) payload for this flight, a lightweight transmitter and some ballast, was the forerunner of the satellite payloads to come. According to some popular accounts of this flight, the ballast was carried to prevent von Braun from "accidentally" launching the payload into Earth orbit. Having been turned down twice again during 1956 for authorization, von Braun's desire to launch a satellite was hardly a secret. The first launch of the Jupiter C went off without a hitch on September 20, 1956. The inert fourth stage and its dummy satellite payload reached a record peak altitude of 1,097 kilometers (682 miles) and landed 5,366 kilometers (3,335 miles) down range in the Atlantic Ocean. The principle objectives of the flight were met and the miniature transponder and microlock instrumentation payload was tracked throughout the flight. Von Braun and his team now had the means of launching a satellite into orbit.

On May 15, 1957 Jupiter C Round 34, the first to carry a scaled Jupiter IRBM nosecone payload, successfully lifted off. Although the rocket operated as intended, a guidance system malfunction caused the nosecone to overshoot the target area and the payload was not recovered. Radar tracking, however, indicated that the test vehicle's ablative heat shield worked as intended and that the nosecone survived reentry. With this second successful flight, the press started taking great interest in von Braun's Jupiter C launched satellite proposal. Of course von Braun was all too eager to extol the virtues of his system in comparison to the America's "official" IGY satellite program, Vanguard, which was making painfully slow progress. Since the Defense Department could see no military benefit in space exploration (never mind that the satellite "problem" was already being solved by Vanguard), they did not want defense dollars being spent on space programs. As a result, military leaders took a dim view of von Braun's proselytizing. Finally on July 29, 1957 the Pentagon issued a directive to the three branches of the military forbidding them from discussing with the press space, space technology and space vehicles. The NRL's Vanguard program was of course exempt from the directive since, on paper at least, they received their money and direction from civilian agencies like the National Science Foundation and the National Academy of Sciences.

The third flight of the Jupiter C, Round 40, was launched just ten days later on August 8, 1957. The nosecone payload reached a peak altitude of 600 kilometers (373 miles) before arcing back into the atmosphere at a velocity of 19,300 kilometers (12,000 miles) per hour. The nosecone came down by parachute 2,140 kilometers (1,330 miles) downrange within the prescribed 400 meter (1,300 foot) diameter target circle. It was quickly recovered and within days presented by President Eisenhower on national television as the first object to be successfully recovered from space. With this successful third flight, the Jupiter C program had met all of its objectives and the program was declared completed. Future test flights of warhead nosecone designs would use purpose-built rockets like the Air Force's X-17 which had already started flights. The remaining three Jupiter C rockets, which could be converted into satellite launchers with only a couple of months notice, were consigned to storage in the hopes that the Eisenhower administration and the Department of Defense would soon authorize a satellite launch.

Fate Intervenes

After the completion of the Jupiter C program, von Braun and Medaris continued to press for permission to launch a satellite as part of a six-vehicle program that would serve as a backup for Vanguard. The proposal would have probably languished indefinitely had fate not intervened. As luck would have it, von Braun and Medaris were attending a cocktail party with Secretary of the Army Wilbur Brucker and the new Secretary of Defense, Neil McElroy, in the officer's club at the Redstone Arsenal on the evening of October 4, 1957. In the midst of the festivities the announcement of the launch of Sputnik was made. One can only imagine von Braun's frustration knowing he could have placed a satellite into orbit a year earlier if he had only received permission. Von Braun immediately made his now famous pitch to launch a satellite using a surplus Jupiter C within 60 days of authorization. Medaris suggested that 90 days would be a more realistic goal.

A series of meetings ensued culminating in a three-day long meeting starting on October 23 at Fort Bliss, Texas where von Braun and Medaris presented their proposal to the Army Scientific Advisory Panel. As a result of this meeting, ABMA's confidence in their hardware, and the public's strong reaction to the Soviet satellite launch, Brucker was now much more supportive of the project. On October 27 the Advisory Group on Special Capabilities, now under Homer J. Stewart, approved the launching of two satellites using a four-stage version of the Jupiter C. To further distance the project from military programs, this satellite launch vehicle was now designated Juno 1. On November 8, just five days after the launch of Sputnik 2, Secretary of Defense McElroy finally authorized the two-satellite program with the first launch to take place in March of 1958. Within a month $3.5 million had been earmarked for the launches and, as result of the advance state of preparation, the date of the first flight was pushed up to the end of January 1958. With the failure of the Vanguard TV-3 flight on December 6, 1957, von Braun and the ABMA would finally get their chance to launch America's first Earth satellite.

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