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The Talking Atlas

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Introduction

While Soviet engineers used the R-7 ICBM to launch their first Sputniks, the first American satellite launch vehicles were based on re-engineered versions of small scientific rockets, and later, short range military missiles like the Redstone, Jupiter and Thor. At the dawn of the Space Age, the bulk of the America's aeronautical engineering resources were being poured into the development of ICBMs. This was in response to President Eisenhower's policy that separated the ICBM and satellite efforts so that the latter would not interfere with the former. As a result, initial development of American satellite carrier rockets lagged.

But during 1958 things changed radically. The Soviet Union's early lead in the Space Race and the public's reaction resulted in a reevaluation of priorities. Policy makers decided that ICBM development would continue unabated with the goal of deploying a viable weapon at the earliest possible date to counter the perceived Soviet threat. But now these rockets were also to be seriously considered as the basis of satellite launch vehicles far larger than those used to launch the first American space payloads. However until the ICBM test programs were completed and production could be increased to meet an expanded demand, satellite launches using these larger rockets could only proceed when surplus hardware was available. Because of its advance state of development, the Atlas would be the first American ICBM pressed into service as a launch vehicle.

The Atlas ICBM

The SM-65 Atlas program, which initially went by the name "Weapon System 107A", began in February of 1954 after it had been determined that an ICBM was feasible. Because of its early ICBM-related development work, Convair (which later became part of General Dynamics) was chosen as the prime contractor for the project in January of 1955. By June the project was given a "A-1" priority which placed it first in line for the nation's engineering and material resources.

Unlike most rockets at the time, the Atlas would not rely on aircraft-style monocque construction where the propellant tanks and exterior shell were attached to an internal framework. Instead the Atlas used the same thin stainless steel structure to act an both the outer shell and propellant tanks with internal pressure providing the rigidity needed to keep it from collapsing. This balloon or integral tank-type structure was successfully tested by Convair on the MX-774 rocket which flew from 1946 to 1948. With a diameter of 3 meters (ten feet) and a total length of about 24 meters (80 feet), the stainless steel structure of the Atlas was no thicker than one millimeter (0.04 inches) which resulted in an immense weight savings.

Convair, working together with engineers from Rocketdyne, devised a brilliant means of shedding excess mass during flight and greatly increasing the range of the Atlas. After the Atlas had lifted off and gained sufficient altitude, it would jettison a pair of booster engines and their supporting structure. Greatly lightened, the Atlas would continue to accelerate towards its distant target powered by a single sustainer engine feeding off the remaining kerosene and liquid oxygen propellants in the tanks. This eliminated the need of igniting engines at high altitude as would be required in a conventional multi-stage ICBM design.

But while this innovative stage-and-a-half concept with integral tanks promised to allow Atlas to attain the USAF's range goal of 8,000 kilometers (5,000 miles), the design departed too much from the existing rocket engineering paradigm for many. To ease these concerns, on May 2, 1955 the development

of a more conventional, two-staged ICBM called the SM-68 Titan I was approved just in case Atlas proved to be a little too innovative.

The launch of Atlas 10B on December 18, 1958 with the Project SCORE experimental communication package attached. (USAF)

During the Atlas test program several models were built and flown from the Eastern Test Range in Florida to evaluate various systems and allow the design to evolve into a working weapon. The first model was the Atlas A. It was equipped only with a pair of booster engines and was meant to test the basic Atlas design during an abbreviated flight. The first flight occurred on June 11, 1957. Although Atlas 4A lifted off successfully, it quickly started to tumble out of control. While the test was unsuccessful, the rocket's structure withstood the strain of the ordeal before being destroyed by range safety thus vindicating the strength of its design. The first successful launch in the series took place on December 17, 1957 when Atlas 12A flew over the prescribed 800 kilometer (500 mile) range.

When the Atlas A test flight program concluded in March of 1958, there were only three successful flights in eight tries. Despite the record, enough was learned to move on to the Atlas B. This rocket would test the entire system from launch to the injection of a dummy warhead into an intercontinental trajectory. The Atlas B would use the same MA-2 propulsion system built by Rocketdyne the operational missile would use. It consisted of a pair of LR89 booster engines generating 734 kilonewtons (165,000 pounds) of thrust each and a LR105 sustainer engine with a thrust of 263 kilonewtons (59,000 pounds) yielding a total liftoff thrust of 1,731 kilonewtons (389,000 pounds). The Atlas B would be the largest American rocket yet flown.

Project SCORE

While the Atlas program was gearing up for full-range test flights in 1958, the USAF and ARPA (Advanced Research Projects Agency) officials were hoping to use one of the Atlas B test flights to launch a satellite. The USAF had proposed using the Atlas to launch a satellite as early as 1955 when the Department of Defense was considering satellite proposals from the Naval Research Laboratory (with what would become Vanguard) and the Army Ballistic Missile Agency (who proposed Project Orbiter). While the USAF proposal was turned down because of Eisenhower's policy, the Atlas design was still capable of orbiting a satellite with only minor modifications.

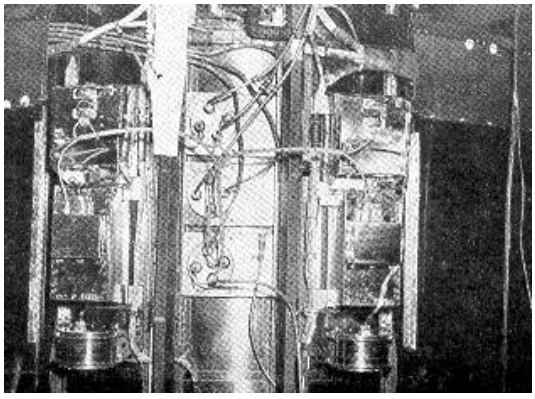
But with the shift in national priorities in early 1958, the USAF working with ARPA began to secretly move forward to modify an Atlas B missile to launch a test satellite. For the payload ARPA turned to the U.S. Army Signal Research and Development Laboratory at Fort Monmouth, New Jersey. A group headed by George F. Senn proposed to use the Atlas to launch an experimental UHF communication package to forward recorded messages and act as a real-time relay. In late July 1958 ARPA officially

approved the Army proposal and Project SCORE (Signal Communication by Orbiting Relay Experiment) was born.

At the start of the project, the launch date was set for early November 1958. To avoid conflicts with prelaunch preparations, the communication payload would have to be ready by the middle of October. In addition, ground stations would have to be operational and crews trained by November 1. With only three months until launch, the experimental communications package would have to rely upon proven, off-the-shelf systems to meet the tight development schedule.

Because of the performance limitations of a stripped down Atlas B, the Project SCORE experiment package was limited to a mass of 68 kilograms (150 pounds). Calculations indicated that the Atlas could loft this payload into an orbit with a perigee of about 160 kilometers (100 miles) and an apogee of between 800 and 1,300 kilometers (500 and 800 miles). With such a relatively high orbit, real-time communication relay tests could be performed between ground stations as far as 1,600 kilometers (1,000 miles) from the satellite.

For the project, four mobile ground stations each consisting of appropriately equipped army type V-51 vans and a Quad helix tracking antenna mounted on a searchlight base were established. These were located at Fort MacArthur, California, Fort Huachuca, Arizona, Fort Sam Houston, Texas, and Fort Stewart, Georgia. They would all be connected to a control center at the Signal Corps Laboratory at Fort Monmouth by telephone lines and HF radio.



A closeup of the Project SCORE communication payload before launch. (U.S. Army)

The SCORE payload itself would consist of a redundant pair of battery-powered, vacuum tube-based UHF communication packages with a nominal design life of 21 days. This equipment would be housed in a cylindrical anodized metal housing at the nose of the missile designed to keep the temperature in the 4 C to 49 C (40 F to 120 F) range. The payload would remain attached to the Atlas once in orbit yielding an impressive total in-orbit mass of 3,970 kilograms (8,750 pounds) - comparable to the mass of the Soviet's Sputnik 2 with its spent booster attached.

Each package consisted of a command receiver, a transmitter, and an endless loop tape recorder. The tape recorder, which was borrowed from an Army meteorological satellite development program, used 23 meters (75 feet) of 25 micron (1 mil) thick mylar tape that was capable of providing four minutes of recording or playback time. Upon command from the ground, the package would either record or playback a stored message. Alternatively the system could be commanded to relay a live message from one ground station or another. A metallic contact at the end of the tape loop would automatically switch the system off at the end of the message. To reduce power consumption, the receiver was turned on for only a quarter of a second every 2.5 seconds to listen for commands from the ground. In addition to the experimental communication package, a pair of telemetry beacons similar to those used by the early Explorer satellites were also carried.

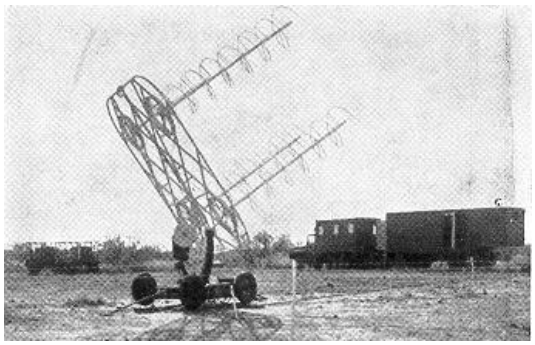
The Mission

Not unexpectedly, the Project SCORE schedule proved to be a bit too ambitious and the launch date slipped several weeks. Delays with Atlas B test flights also contributed to the scheduling problems. The first Atlas B launch in July of 1958 failed but the second test flight on August 2 met its goal by flying more than 4,000 kilometers (2,500 miles) downrange. After three more largely successful test flights, the Atlas B exceeded its design goal on November 28, 1958 when it flew 9,660 kilometers (6,000 miles). The way was clear to launch Project SCORE.

When the launch of Atlas 10B with its secret communication payload took place on the night of December 18, 1958, only a handful of people knew its true mission. As ground controllers monitored the quickly ascending Atlas' progress, an apparent "malfunction" occurred near the end of powered flight. Inexplicably ground computers monitoring the impact point of the missile eventually told controllers that there was no impact point. Because of the secrecy surrounding Project SCORE, not even the ground controllers were aware that there was no malfunction and that Atlas 10B had instead entered a

177 by 1,480 kilometer (110 by 920 mile) orbit with an inclination of 32.3 degrees and a period of 101.5 minutes.

Once in orbit, the USAF immediately heralded the event making special note of the nearly four metric ton (8,800 pound) orbital mass (which consisted almost entirely of the now inert Atlas missile). While one of the two communication packages failed after the first orbit when its tape recorder jammed, the backup continued to function and relayed a recorded Christmas message from President Eisenhower during the 13th orbit on December 19. With this, Project SCORE's launch vehicle was dubbed "the talking Atlas" by the press.



A typical ground station for Project SCORE. (U.S. Army)

During the following 12 days, 28 separate messages were played back 78 times for a total of 5 hours, 12 minutes of operation. The Project SCORE experiment also relayed 11 real-time messages for a total of 43 minutes over distances in excess of 4,800 kilometers (3,000 miles). An undetermined number of unauthorized recordings and interrogations were also made from unidentified sites in the Eastern hemisphere during the mission indicating the need for more secure command systems in future communication satellites.

The experimental communication package operated until December 30, 1958 when the battery was finally exhausted. Atmospheric drag brought the now silent Atlas out of orbit on January 21, 1959. While Project SCORE was to some extent a USAF publicity stunt designed to garner public support, it did show that a satellite could provide a much needed communication link between distant sites. It also paved the way for the Atlas to serve as a launch vehicle for future programs including Project Mercury.

Bibliography

David Baker, *The Rocket*, Crown Publishers, Inc. (New York), 1978

S.P Brown and G.F. Senn, "Project SCORE", *Proceedings of the IRE*, Vol 48, No. 4, pp. 624-630, April 1960

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