Intermediate-Range Ballistic Missiles

Jupiter (SM-78/PGM-19A)

Summary

In early 1956 the Army began developing the Jupiter, an intermediate range ballistic missile with a range of 1,500 miles. The missile program was initially a joint development effort between the Army and the Navy, but after the Navy withdrew from the program in late 1956 the Army won approval to continue on its own. Although many critics complained the Army missile was of limited use, beginning in July 1960 the United States deployed three Jupiter squadrons in Italy and Turkey. The missiles, however, were operational for only a short time; the last were withdrawn from service in April 1963.

Technical Specifications

Length: 60 feet

Diameter: 8 feet, 9 inches

Weight: 108,804 pounds (fully fueled)

Fuel: Rocket grade RP-1 (kerosene)

Oxidizer: Liquid oxygen

Propulsion: A single S-3D engine generating 150,000 pounds of thrust

Range: 1,500 miles

Guidance: All-inertial

Accuracy: 1,500 meters

Reentry vehicle: Mark 3—ablative

Warhead: W-49, 1.44 megaton yield

Contractors

Airframe: Prototypes were built by the Army Ballistic Missile Agency, Redstone Arsenal, Huntsville, Alabama. Full-scale production was by the Chrysler Corporation Ballistic Missile Division, Detroit, Michigan.

Propulsion: Rocketdyne Division of North American Aviation, Canoga Park, California

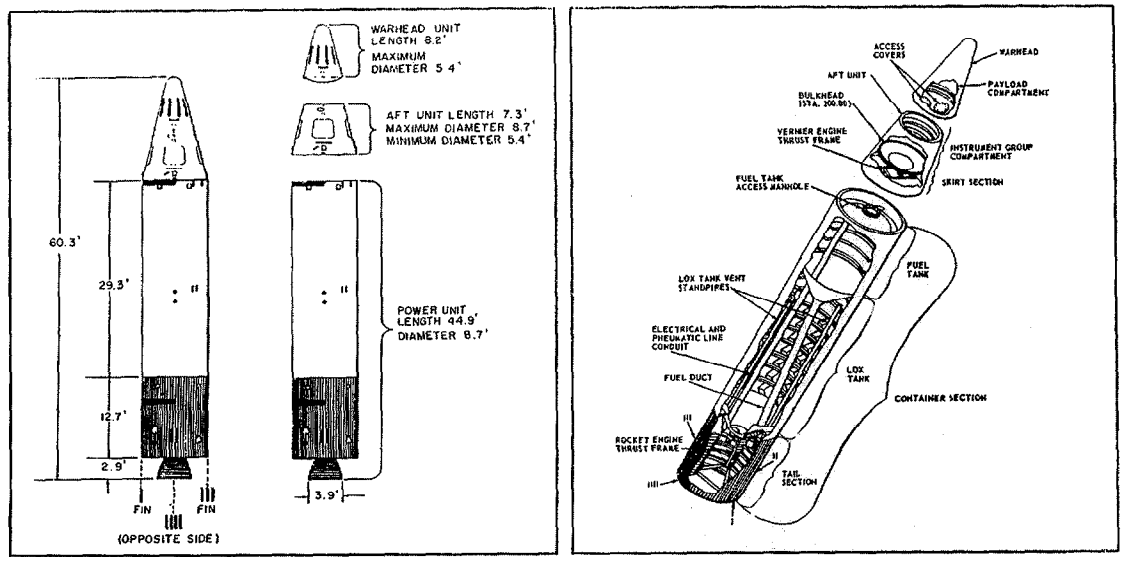
Guidance: Ford Instrument Company, Long Island City, New York

Reentry vehicle: General Electric, Saratoga, New York

Technical Notes

Jupiter was originally designed for shipboard use, and adapting a liquid-fuel missile to operate in that environment posed a host of challenges. For example, the Army initially

In this April 1961 photograph a Jupiter IRBM is readied for a test flight at Cape Canaveral, Florida.

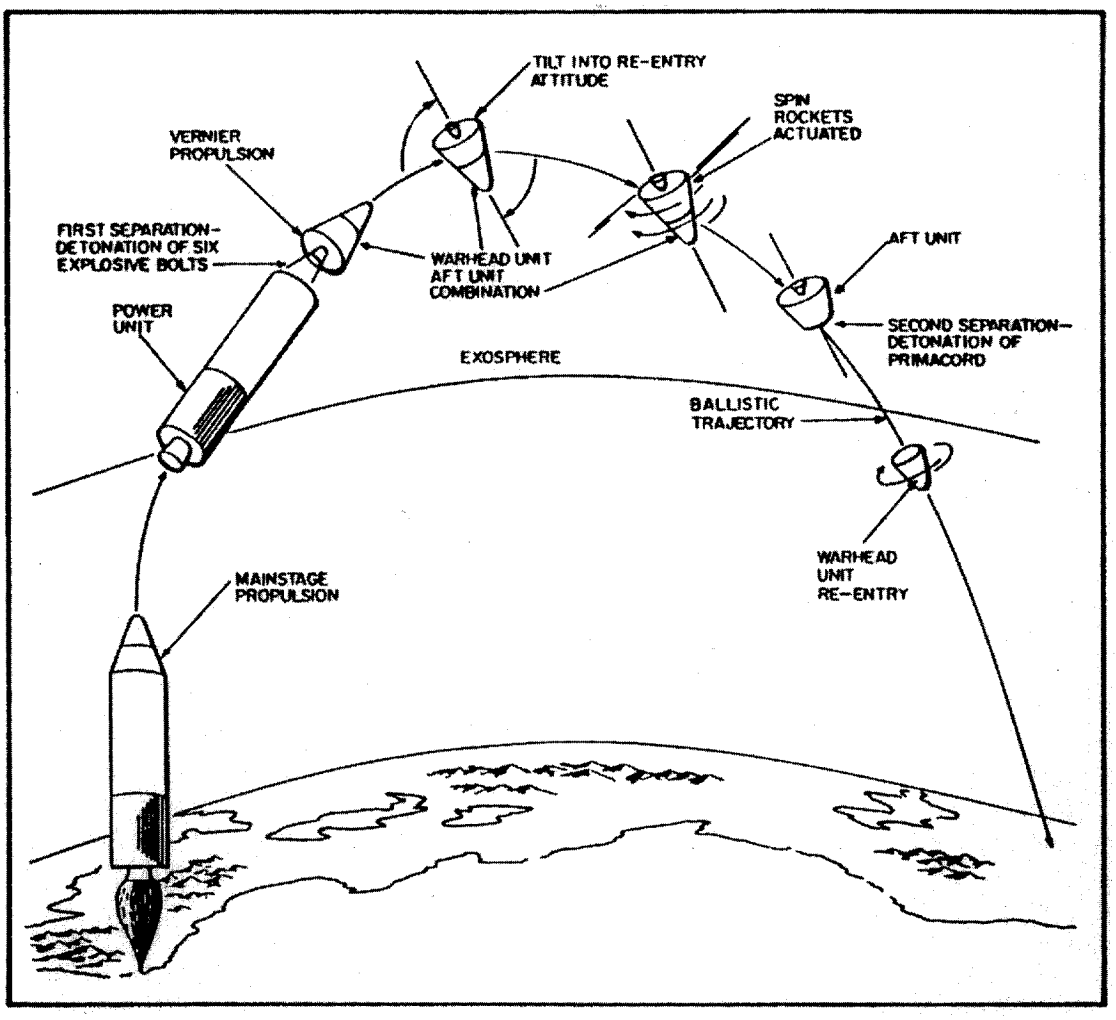


Line drawing of a Jupiter IRBM. The Army originally envisioned that Jupiter would operate from mobile launch facilities. Consequently, both the missile and its support equipment were designed to be easily transportable.

proposed building a missile over 90 feet long, while the Navy wanted a 50-foot missile. After some discussion they compromised on a missile that was 60 feet long and 105 inches in diameter.

System Operation

Immediately after the launch control officer pressed the firing button, the main engine roared into life. It burned for 157.8 seconds, boosting the missile to a speed of Mach 15.4 and an altitude of 73 miles. Two seconds after the main engine burned out and fell away, the solid-fuel vernier motor fired. The vernier burned for approximately 12 seconds until the missile reached the desired velocity, whereupon the engine shut down and detached from the reentry vehicle. Almost 10 minutes into the flight the missile, now



The flight profile for a 1,500 mile Jupiter flight.

800 miles from its launch point and soaring at an altitude of 384 miles, reached the apogee of its elliptical flight path. From there it began its gradual descent toward the target. Total flight time from takeoff to impact: 15½ minutes.

Developmental History

The Jupiter was the direct descendant of the Army's Redstone, a tactical-range ballistic missile with a range of 150 miles. Under the direction of Dr. Wernher von Braun, the Redstone program began in 1951 at the Army's newly established Ordnance Guided Missile Center (OGMC) at Redstone Arsenal in Huntsville, Alabama.

As the Redstone took shape, the Ordnance Department also expressed interest in developing a ballistic missile with a range of 1,000 miles. By 1953 experience gained from the Redstone program convinced von Braun that building the longer range missile was feasible, and he petitioned the Chief of Ordnance for permission to develop it.

Initially the Army showed little interest in von Braun's proposal, and the Chief of Ordnance relegated the 1,000-mile range missile program to a low priority study project. The project would have probably languished there had it not been for the Killian Report, released in February 1955.

In its influential report to President Eisenhower, the Killian Committee urged that in addition to the intercontinental ballistic missiles (ICBM) the United States should also develop a new class of 1,500-mile intermediate-range-ballistic missile (IRBM) as a counterweight to a similar program thought to be under way in the Soviet Union. The committee recommended that the United States develop both land- and sea-based variants of the new missile. By stationing the missiles at bases in Europe, and on ships hovering off the Soviet coast, the committee envisioned that the IRBMs would counterbalance the Soviet program and reassure the United States' skittish allies.

Spurred on by the committee's recommendations, by the fall of 1955 all three services requested permission to develop IRBMs. Before development could begin, however, the military had to resolve the crucial issue of which major service would operate the new missiles. In early November the Joint Chiefs of Staff were unable to reach a consensus on the issue, forcing Secretary of Defense Charles Wilson to fashion a compromise: the Air Force would develop the ground-launched version and a joint Army/Navy team would develop the ship-launched model. Reflecting the urgency of the situation, in December 1955 President Eisenhower designated the IRBM one of the military's most pressing programs, second in importance to only the ICBM.

Because of the Army's considerable experience in missile development, the Navy agreed that Jupiter development and the initial fabrication would take place at Huntsville. To manage the new program, in February 1956 the Army established the Army Ballistic Missile Agency (ABMA) at Redstone Arsenal. Secretary of the Army William Brucker granted the ABMA's first commander, General John B. Medaris, sweeping authority to manage every facet of the IRBM development effort.

In many ways the political hurdles facing the Army program were more daunting than the technological challenges. Within a year the Jupiter program suffered two major setbacks. The first came in September 1956 when the Navy withdrew from the project in order to build the solid-fuel Polaris submarine-launched ballistic missile (SLBM). Two months later Jupiter suffered what many thought was a mortal blow when Secretary of Defense Charles Wilson finally gave the Air Force sole responsibility for building and operating all surface-launched missiles with a range in excess of 200 miles. The ruling meant that the Army would never operate the missile it was building, and it appeared that there was little reason to continue the program. Brucker and Medaris thought otherwise, and in response to their impassioned plea, the Department of Defense (DoD) allowed the Army to continue developing Jupiter as an alternative to the Air Force's troubled Thor IRBM program.

Using the proven Redstone missile as a test platform, beginning in September 1955 the Army launched 28 Jupiter A and C missiles from the Atlantic Missile Range (AMR) at Cape Canaveral, Florida. Jupiter A testing, which focused on general design criteria, the guidance system, and propulsion thrust control, began in September 1955 and continued through June 1958. The Jupiter C was an elongated Redstone with clusters of scaled-down Sergeant rockets forming the second and third stages. This configuration was designed to test reentry vehicles and procedures, and in September 1956 a Jupiter C fired from the AMR completed a successful flight of 3,300 miles. In May 1957 a prototype Jupiter soared 1,150 miles out over the Atlantic, an event the Army hailed as the United States' first successful IRBM launch.

Although the Jupiter program was living on borrowed time, Medaris and the ABMA hoped that the missile's early success, which was a marked contrast to the Air Force's Thor program, would convince the Secretary of Defense to choose the Army missile. External events, however, would soon dramatically alter the nation's IRBM program. In October 1957 the Soviet Union launched Sputnik I, the world's first artificial satellite. The event shattered American complacency and bred fresh fears over the danger posed to the United States by the Soviet missile program. Anxious to take action to blunt the Soviet advantage and reassure the American public, on October 10, 1957, President Eisenhower ordered both the Jupiter and Thor into full production.

Although the President's decision appeared to be a victory for the Army missile program, it had little lasting effect. The ABMA was never able to convince the Pentagon that Jupiter was superior to Thor, and neither was it able to reverse Secretary Wilson's November 1956 ruling barring the Army from operating long-range missiles. As a result, although the Army won the right to build Jupiter, it did so as a subcontractor to the Air Force. Much to the Army's chagrin, in early 1958 the Air Force began to assume control of the Jupiter program. In early February 1958 the Air Force opened a Jupiter program management office at the ABMA, and the following month established the Jupiter Liaison Office (JUPLO) to coordinate activities between the Army and the Strategic Air Command, the Air Materiel Command, and the Air Training Command.

While the Army and the Air Force were forging the necessary infrastructure to deploy the missile, in mid-January 1958 the Air Force activated the 864th Strategic Missile Squadron at ABMA. Although the Air Force briefly considered training its

Jupiter crews at Vandenberg AFB, California, it later decided to conduct all of its training at Huntsville. In June and September the Air Force activated two more strategic missile squadrons at the ABMA: the 865th and 866th.

At the same time the Air Force was training Jupiter crews, the State Department was searching for a host nation willing to accept the missiles. In late April 1958 DoD told the Air Force that it had tentatively planned to deploy the first three Jupiter squadrons in France. Negotiations between the two nations fell through, however, prompting the United States to explore the possibility of deploying the missiles in Italy and Turkey. In late 1958 the Italian government agreed to accept two squadrons, with the proviso the missiles be manned by Italian crews. In May 1959 the first contingent of Italian airmen arrived at Lackland AFB, Texas, for language and technical training. In late October 1959 the Turkish government also agreed to host a squadron of the American missiles, under similar terms.

The Air Force accepted delivery of its first production Jupiter in August 1958. Prior to that, Air Force missile crews received individual and crew training on Redstone missiles. Once Jupiter missiles and ground support equipment became available, the Air Force crews began Integrated Weapons System Training (IWST) on a launch emplacement set up on a large field at the Redstone Arsenal. On October 20, 1960, an Air Force crew successfully fired a Jupiter missile under simulated tactical conditions from AMR. The first three-missile Jupiter launch position in Italy went on operational alert in July 1960, and by June 20, 1961, both squadrons in Italy were fully operational. The first Jupiter squadron in Turkey did not become operational until 1962.

Basing Strategy

The United States began negotiations to deploy Jupiter missiles abroad in the spring of 1958. The discussions were complex and time consuming because deploying the missiles on foreign soil involved the delicate issues of national sovereignty, as well as more mundane matters such as training, technology transfer, maintenance, and who would foot the bill.

The United States and Italy concluded an arrangement to base Jupiters in that Mediterranean nation in March 1958 and Italian crews began training in the United States in May 1959. All of the technical details were resolved in a supplemental agreement signed the following August, and in October 1960 the Italian Air Force crews completed their training in the United States. Under the terms of the basing agreement, the missiles would be operated by Italian Air Force crews but the warheads would remain under American control.

Negotiations to deploy Jupiter missiles in Turkey took slightly longer. The two governments reached an understanding in October 1959, and in May 1960 a technical agreement cleared up the remaining questions. To hasten the deployment process, the Turkish government agreed that at the outset, the missiles would be manned by United States Air Force personnel. The United States would, however, train Turkish crews to operate the missiles and would eventually relinquish control of the site to the host nation. By April 1962 the Air Force declared its Jupiter at Cigli Air Base, Turkey, operational.

Jupiter Deployment

Designation	Squadrons	Base	Operational
NATO I	2	Gioia Dell Colle, Italy	1960-1963
NATO II	1	Cigli AB, Turkey	1962-1963

Site Configuration

The Army originally planned that Jupiter would be a mobile missile; a road-transportable weapon that could be moved from one location to another in a matter of hours. The Air Force thought there was little to be gained in having a mobile IRBM and elected to deploy the missiles at fixed launch sites.

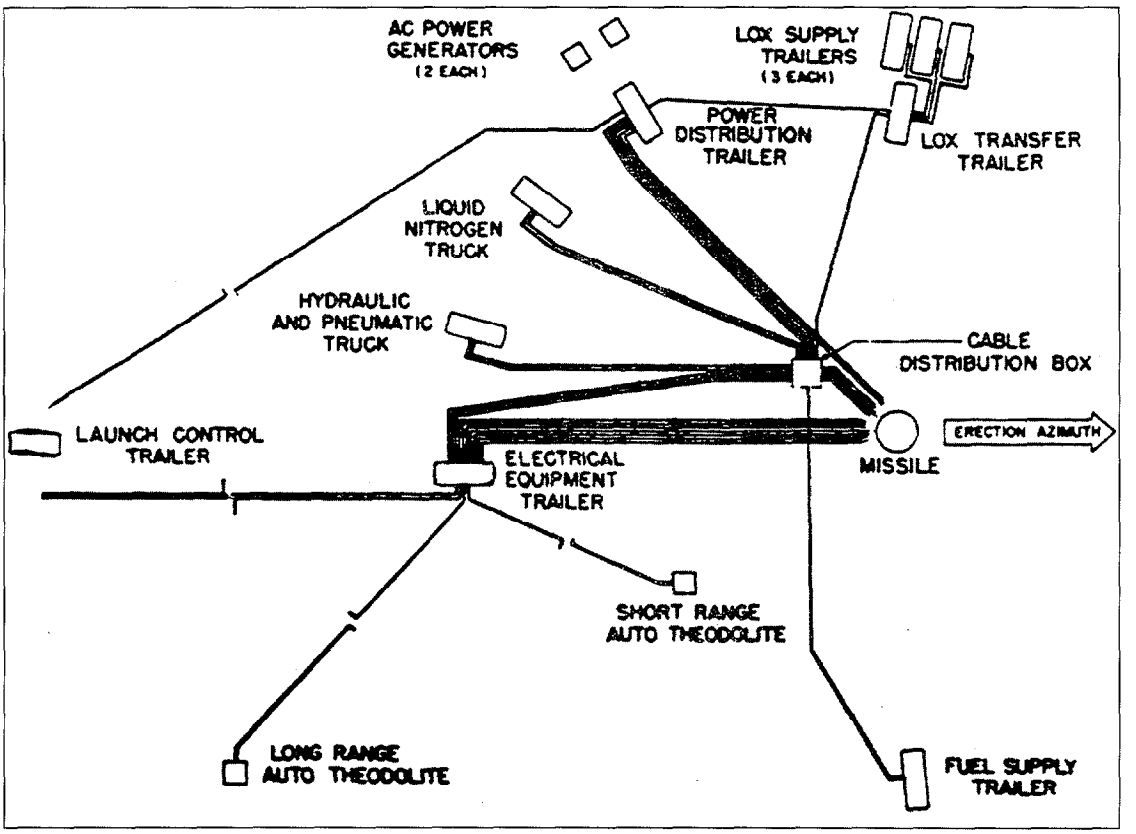
A Jupiter squadron consisted of 15 missiles and approximately 500 officers and men. The missiles were organized into five "flights" of three missiles each. To reduce their vulnerability, the flights were located several miles apart. Each flight contained three launch emplacements, each of which was separated by a distance of several hundred years. Each flight was composed of five officers and ten airmen.

The ground support equipment for each emplacement was housed in approximately 20 vehicles. They included two generator trucks, a power distribution truck, short- and long-range theodolites, a hydraulic and pneumatic truck, and a truck carrying liquid oxygen. Another trailer carried 6,000 gallons of fuel, and three liquid oxygen trailers each carried 4,000 gallons.

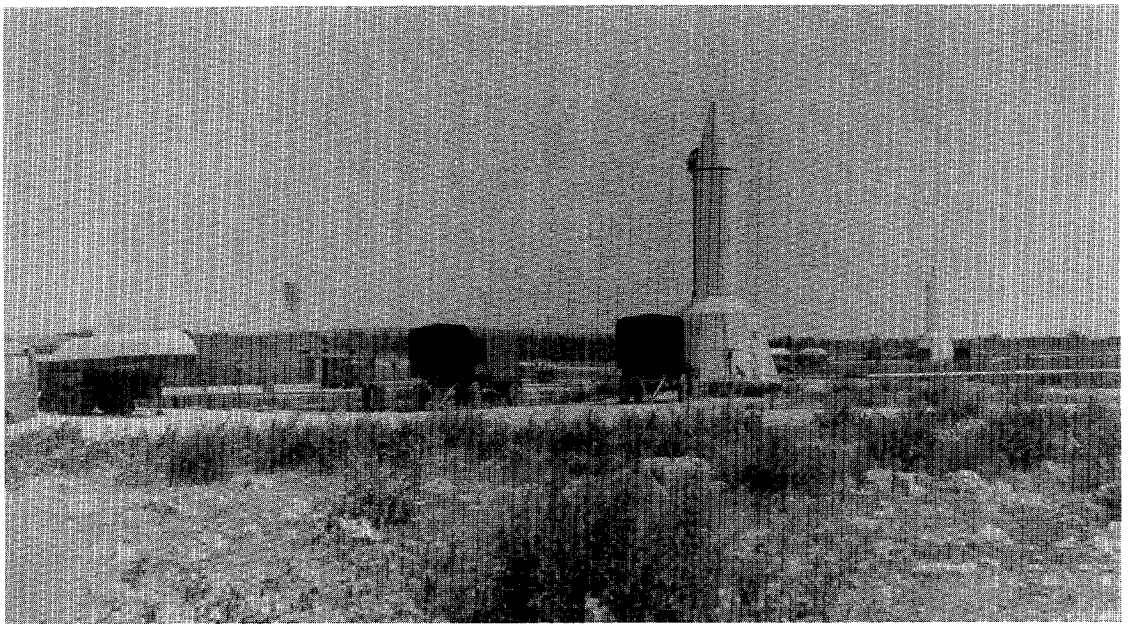
The missile arrived at the emplacement on a large trailer. While it was still on the trailer, the crew attached the hinged launch pedestal to the base of the missile. Using a powerful winch, which drew a cable through a succession of "A" and "H" frames, the crew pulled the missile into its upright firing position. Once the missile was vertical, the crew attached the fuel lines and encased the bottom third of the missile in a so-called "flower petal shelter". The shelter consisted of a dozen wedge-shaped metal panels and allowed the crew to service the missile during inclement weather.

The missiles were stored in an upright position on the launch pad. The firing sequence, which consisted primarily of pumping 68,000 pounds of liquid oxygen and 30,000 pounds of RP-1 aboard, took about 15 minutes. The three missiles that comprised each flight were controlled by an officer and two crewmen seated in a mobile launch control trailer.

Each squadron was supported by a receipt, inspection, and maintenance (RIM) area well to the rear of the emplacements. RIM teams accepted and inspected new missiles, and also provided both scheduled maintenance and emergency repair to missiles in the field. Each RIM area also housed 25-ton liquid oxygen and nitrogen generating plants. Several times a week, tanker trucks carried the gases from the plant to the individual emplacements.



Prepared from an overhead perspective, this diagram shows the layout of a typical Jupiter launch emplacement.



This July 1960 photograph shows two Jupiter IRBMs at launch site number 2 at Gioia del Colle Air Base, Italy. Note the "flower petal shelter" that protected the base of the missile.

References

Substantive information on the Jupiter program is difficult to find. The best account is James M. Grimwood and Frances Strowd, *History of The Jupiter Missile System* (U.S. Army Missile Command, Redstone Arsenal, Huntsville, AL, 1962). This volume contains a good summary of the Jupiter program plus missile specifications, a detailed chronology, test summary, and glossary. Another good source is an ABMA report, "The Jupiter Story," written in December 1959. The report, filled with bitter denunciations of the Air Force and the Thor program, is available at the Army Missile Command History Office, Huntsville, Alabama, file No. 870-5e. For information on the Army's activities at Redstone, see Helen Brents Joiner and Elizabeth C. Joliff, "The Redstone Complex in its Second Decade, 1950–1960" (Redstone Arsenal, AL: Army Missile Command, 1969) also available at the Missile Command in Huntsville.

For additional information on the Jupiter program, including a chronology, technical specifications, launch site configuration, and deployment locations, see *Chronology of the Ballistic Missile Organization* (Norton AFB, Ballistic Missile Organization, History Office, 1990), appendices 3 and 4; and Evert Clark, "Speed Marks Jupiter Development," *Aviation Week* (13 April 1959): pp. 54-67.