

A CHRONOLOGY OF MISSILE  
AND ASTRONAUTIC EVENTS

1686 - 1961

REPORT  
OF THE  
COMMITTEE ON  
SCIENCE AND ASTRONAUTICS  
U.S. HOUSE OF REPRESENTATIVES  
EIGHTY-SEVENTH CONGRESS  
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Serial b



MARCH 8, 1961.— Committed to the Committee of the Whole House on  
the State of the Union and ordered to be printed

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## LETTER OF SUBMITTAL

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HOUSE OF REPRESENTATIVES,  
COMMITTEE ON SCIENCE AND ASTRONAUTICS,  
*Washington, D.C., March 8, 1961.*

HON. SAM RAYBURN,  
*Speaker of the House of Representatives,*  
*Washington, D.C.*

DEAR MR. SPEAKER: By direction of the Committee on Science and Astronautics, I submit the following report on "A Chronology of Missile and Astronautic Events" for the consideration of the 87th Congress.

Two reports issued by the predecessor Select Committee on Astronautics and Space Exploration included chronologies which have proved useful to many readers interested in our emerging missile and space capabilities and in world progress in these areas. It has seemed useful to expand slightly upon the original efforts and to bring the revised listings up to date.

The chronology must be viewed as preliminary. Although an effort has been made to make it correct, unofficial sources have been relied upon quite heavily in order to widen the coverage. Dr. Charles S. Sheldon II, technical director of the committee, supplemented his main compilation with a few items collected either by the Legislative Reference Service of the Library of Congress or by the Historian of the National Aeronautics and Space Administration. The manuscript was reviewed by other members of the professional staff, and also by appropriate offices in NASA, the Army, Navy, and Air Force for which appreciation is expressed.

OVERTON BROOKS, *Chairman.*

## LETTER OF TRANSMITTAL

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HOUSE OF REPRESENTATIVES,  
COMMITTEE ON SCIENCE AND ASTRONAUTICS,  
*Washington, D.C., February 24, 1961.*

HON. OVERTON BROOKS,  
*Chairman, Committee on Science and Astronautics.*

DEAR MR. CHAIRMAN: I am forwarding herewith for committee consideration a report on "A Chronology of Missile and Astronautic Events" prepared by Dr. Charles S. Sheldon II, technical director of the committee.

Two reports issued by the predecessor Select Committee on Astronautics and Space Exploration included chronologies which have proved useful to many readers interested in our emerging missile and space capabilities and in world progress in these areas. It has seemed useful to expand slightly upon the original efforts and to bring the revised listings up to date.

The chronology must be viewed as preliminary. Although an effort has been made to make it correct, unofficial sources have been relied upon quite heavily in order to widen the coverage which was possible even at the risk of some inaccuracies. It is hoped that readers will call any inconsistencies to the attention of staff for correction in any future edition. The main compilation prepared in the Committee has been supplemented with a few items collected either by the Legislative Reference Service of the Library of Congress or by the Historian of the National Aeronautics and Space Administration. The manuscript was reviewed by other members of the professional staff, and also by appropriate offices in NASA, the Army, Navy, and Air Force for which appreciation is expressed.

CHARLES F. DUCANDER,  
*Executive Director and Chief Counsel.*

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*1st Session* } } No. 67

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## A CHRONOLOGY OF MISSILE AND ASTRONAUTIC EVENTS

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MARCH 8, 1961.—Committed to the Committee of the Whole House  
on the State of the Union and ordered to be printed

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Mr. BROOKS of Louisiana, from the Committee on Science  
and Astronautics, submitted the following

## R E P O R T

# A CHRONOLOGY OF MISSILE AND ASTRONAUTIC EVENTS

## INTRODUCTION

As the world moves visibly into what is popularly called the "space age," events are piling up so fast that soon the path down which we have come will be quite obscured by the continuing flood of news. It is instructive to step back sufficiently for some small perspective which a chronology of the nature reported here permits.

It would be valuable to assess the relative importance of different contributions in science, technology, and public policy which have brought us to our present levels of achievement. But this is a job which must be left to the full-time researcher in a more cloistered atmosphere than that of a Congressional office.

The goal of the listing contained in this report is relatively modest. It is intended as a handy reference for the non-specialist to some of the significant events in both missile and astronautics. Several categories of information have been covered. Dates of important launchings have been included, and wherever available, the contemporary information has been cross-checked against later information on performance and characteristics to permit refinements and corrections. Included are all known satellite and deep space probe efforts.

A second category of information includes key administrative decisions and directives important to either the organization or the pursuit of space progress. Because of our legislative responsibilities in this committee, a special effort has been made to record all major reports, legislation, and organizational steps in the Congress which relate to space.

A third category of information is more subjective in character. Enough statements of future plans, predictions of progress, and policy views have been included to give more insight into trends than a listing of physical events alone would provide. Such a tabulation of policy views and predictions can not be complete, but it is indicative of trends.

A fourth category represents a catchall of announcements of discoveries, issuances of key books and reports, and even a few birthdays that have some bearing on space.

A word is necessary on source materials and how they have been used. Legislative information has been derived from internal information including reference to the reports and bills in question and the official calendar of the committee, together with such information as has been made available by the Senate Committee on Aeronautical and Space Sciences.

The semiannual and annual reports of the executive branch of Government related to space have also been scrutinized, and occasional press releases summarizing launching data have been put to use.

Newspaper clippings and indexes have been used very extensively because the thoroughness of the American press in reporting has added greatly to the value of the record which could be put together.

However, such reports frequently have to be written hurriedly and on the basis of incomplete information, so the information is subject to some errors of fact and interpretation.

Because this chronology does not purport to be a definitive listing based exclusively on officially announced policies and factual events there has been the freedom to use many unofficial items which add to the overall value of the study. It should particularly be emphasized that there is no absolute way to check the accuracy of every Soviet claim which has been included. These and many other uncheckable items have been included nevertheless because of their general usefulness, and whether all of them are accurate or not, their appearance at the time became factors in policy making, and therefore their place in history is legitimate. The committee must make clear that it neither infers agreement with any views expressed in the items listed, nor does it confirm the accuracy of any rumors or claims expressed in these items.

A few items in the chronology date back about a century. There was no effort to trace every idea or invention which has made space exploration possible, for such a review would in effect be a complete history of science and technology. A few of the rocket developments between the two world wars have been reported, and since World War II, many missile events have been included. Particularly since the IGY satellite programs were planned in 1954 and 1955, newspaper coverage has grown by leaps and bounds. Since 1958, there have been legislative acts and reports, and corresponding developments in the executive branch which have been included.

Readers can help the accuracy and completeness of any future committee chronology by calling to our attention items of interest incomplete or in error in the span of years covered by this report.

As far as possible, specific days have been listed in chronological order. Where the month but not the day is known, these items have been listed at the end of the month in question, and the same is true where only the year is known: these items appear at the end of the year. In some cases a specific date is not known, but the item is listed under the date announcement was made in the press release or the newspaper.

#### THE CHRONOLOGY

1686

Sir Isaac Newton described how an Earth satellite is placed in orbit.

1857

September 5: Birthday of Konstantin Tsiolkovsky at Ijevsk, Ryazan, Russia. Anniversary regarded as possible target date for Soviet space exploits.

1865

Jules Verne published the first half of "De la Terre á la Lune" (From the Earth to the Moon).

1869

Edward Everett Hale published "The Brick Moon" which discusses a heat-resistant, manned, communications, reconnaissance, and navigation satellite.

1882

October 5: Birthday of Robert H. Goddard at Worcester, Mass.

1893

Tsiolkovsky wrote "On the Moon".

1894

June 25: Birthday of Hermann Oberth at Sibiu (Hermannstadt), Transylvania.

1895

Tsiolkovsky published his first article on space travel in *Nature and Men*.

1898

Tsiolkovsky submitted "The Rocket into Cosmic Space" to the editors of *Science Survey*. (It was not printed until 1903).

1906

Robert H. Goddard began early experiments with skyrockets.

1912

Robert H. Goddard began serious rocket experiments.

1915

March 3: The National Advisory Committee for Aeronautics (NACA) was founded as provided in a rider to the Naval Appropriation Act, "\* \* \* to supervise and direct the scientific study of problems of flight, with a view to their practical solution." The sum of \$5,000 a year was appropriated for five years.

1919

May 26: Robert H. Goddard submitted to the Smithsonian Institution "A Method of Reaching Extreme Altitudes" (published in January 1920).

1922

March —: Robert H. Goddard tested the first liquid fueled rocket in the world.

Hermann Oberth wrote "Die Rakete zu den Planetenräumen" (The Rocket into Interplanetary Space).

1924

April —: Friedrich A. Tsander, Konstantin E. Tsiolkovsky, and Felix E. Dzherzhinsky started the Society for Studying Interplanetary Communications in the Soviet Union.



1926

March 16: The first liquid-fueled rocket flight burning oxygen and gasoline was made at Auburn, Mass., by Robert H. Goddard. It traveled 184 feet at 60 miles per hour.

1927

June 5: The Verein für Raumschiffahrt was founded by Johannes Winkler at Breslau, Germany.

June 8: The Astronautics Committee of the Société Astronomique Française was established. The word "astronautics" was invented by Robert Esnault-Pelterie and André Hirsch, and was used in the lecture given on this date by Esnault-Pelterie.

1928

April 11: The first manned rocket car was tested by Fritz von Opel and others at Berlin, Germany. It attained a speed of 62 miles per hour.

June 11: Friedrich Stamer made the first manned rocket-powered flight in a von Opel glider, traveling about one mile from a takeoff point in the Rhön Mountains of Germany.

Formation of GIRD (Group for the Study of Reactive Motion) in Moscow and Leningrad.

The Soviet Union established at Leningrad a laboratory for work on liquid rockets, leading to the testing of the ORM-1 rocket.

The first of nine volumes of an encyclopedia on interplanetary travel was published by Professor Nikolai A. Rynin in the Soviet Union. The final volume reached print by 1932.

1929

July 17: Robert H. Goddard launched a liquid fueled rocket at Auburn, Mass., which carried a camera, thermometer, and barometer, all of which were recovered intact.

September 30: Another rocket powered glider, the Opel Sander Rak. 1, made a successful two-mile flight near Frankfurt-am-Main, Germany.

October 15: The premier was held of "Frau im Mond" (The Girl in the Moon), a movie with Hermann Oberth as technical adviser.

Hermann Oberth was awarded the first REP-Hirsch international prize for "the best original scientific work, either theoretical or experimental, which tends to improve the solution of the problem of interplanetary navigation or of any one of the branches of science which are included in 'Astronautics'."—at Paris.

1930

April 4: Formation of the American Interplanetary Society, led by Dr. G. Edward Pendray and David Lasser; later renamed in 1934 the American Rocket Society.

September—: The Verein für Raumschiffahrt (VfR) of Germany opened the Raketenflugplatz launching site for rockets at Berlin.

## 1930—Continued

- December 17: Captain Doctor Walter Dornberger was placed in charge of German Army rocket studies.
- December 30: Dr. Goddard launched a rocket to an altitude of 2000 feet, reaching a speed of 500 miles per hour. This was the first launching in New Mexico, and the rocket weighed 33.5 pounds.

## 1931

- January 4: A rocket powered glider with ten rockets was kept aloft 30 minutes at Atlantic City, New Jersey, with William G. Swan at the controls.
- March 14: Johannes Winkler made the first liquid fueled rocket test in Europe at Dessau, Germany.
- May—: The Repulsor, a liquid fueled rocket, rose 1000 yards, and traveled  $2\frac{1}{2}$  miles for the VfR in Germany.
- Rocket study groups were established in both Moscow and Leningrad.

## 1932

- July—: The first rocket demonstration of the VfR by Dr. Wernher von Braun for the German Army and Capt. Dr. Walter Dornberger was carried out with Mirak II, which rose to a height of 200 feet.
- August—: The German Army made formal its rocket development work with Captain Dr. Walter Dornberger in charge.
- October 1: Dr. Wernher von Braun joined the German Army Ordnance office rocket program at Kummersdorf.
- December—: Dr. Wernher von Braun tested his first new rocket for Walter Dornberger, and it exploded.
- The rocket study groups of Moscow and Leningrad were combined under the centralized control of Moscow.

## 1933

- May 14: The first American Rocket Society liquid fueled rocket (No. 2) test was conducted at Marine Park, Staten Island, N.Y., attaining 250 feet altitude in 2 seconds.
- August 17: The first Soviet liquid fueled rocket, weighing 44 pounds, was successfully fired, according to Soviet reports.
- Formation of the British Interplanetary Society, led by Philip E. Cleator.

## 1934

- September 9: At Marine Park, Staten Island, American Rocket Society rocket number 4 became the first to pass the sonic barrier, reaching 700 miles per hour, climbing 400 feet and traveling 1,600 feet horizontally.
- December —: The German Army rocket development group fired the A-2 rocket a distance of 1.4 miles, on the island of Borkum.

## 1935

- March 28: Dr. Goddard launched a gyroscopically controlled rocket to 13,000 feet, reaching a speed of 550 miles per hour, near Roswell, N. Mex.
- May 31: Another Goddard rocket was launched in New Mexico, attaining an altitude of 7,500 feet.
- During the course of the year, a Soviet rocket designed by M. K. Tikhonravov successfully reached an altitude of six miles in a meteorological experiment, according to Soviet reports.

## 1936

- February —: The Germans tested an A-3 rocket with 3,300 pounds of thrust which was a development model of later military rockets.
- March 16: The Smithsonian Institution published Robert H. Goddard's "Liquid Propellant Rocket Development".
- April 5: The Soviet Union successfully launched a liquid rocket weighing more than 210 pounds, by Soviet reports.
- During the year Dr. Theodore van Kármán at California Institute of Technology, Pasadena, Calif., founded the group which began experiments in design fundamentals of high altitude sounding rockets, and this led to the creation of the Jet Propulsion Laboratory.

## 1937

- May—: The German Army rocket experiment station at Peenemünde was opened, under Capt. Dr. Walter Dornberger.

## 1939

- October—: The German Army test rocket A-5 weighing one ton climbed 5 miles before burnout at Peenemünde.

## 1941

- July-August: Capt. Homer A. Boushey, U.S. Army Air Force, flew a rocket-propelled Ercoupe on several occasions, to constitute the first such flights in the United States.

## 1942

- June 13: The first launching attempt was made with the A-4 rocket (V-2) at Peenemünde. It rose above the cloud cover, and then fell back, after a climb to 0.8 mile. The V-2 missile stood 46 feet 11 inches tall, and 5 feet 5 inches in diameter. It weighed 14 tons at take-off. It carried a warhead variously listed as 1,650 and 2,150 pounds. Its maximum range was 200 miles, with a combat trajectory height of 60 miles. Its speed was approximately 3,300 miles per hour at burnout.
- August 16: The second V-2 launching attempt carried it to about 5.4 miles altitude.
- October 3: The third V-2 launched climbed about 30 miles and traveled to a point 118 miles from Peenemünde, credited as the first successful flight.

## 1942—Continued

October 21: The fourth V-2 launched traveled 91.3 miles from Peenemünde.

December 2: The first nuclear chain reaction was achieved at the University of Chicago.

## 1943

February 17: The tenth V-2 launched traveled 121.8 miles from Peenemünde.

April 14: The fifteenth V-2 launched traveled a distance of 178.3 miles from Peenemünde.

May-June: The Germans conducted operational tests of the V-2 rocket by firing over 100 from Blizna against Sarnaki, Poland, including 10 on 1 day.

July 7: Adolf Hitler assigned the highest military priority to the V-2 program.

August 17: The British carried out a saturation air raid on the Peenemünde rocket development center in Germany.

November —: Theodore von Kármán of the Jet Propulsion Laboratory (JPL) recommended to Army Ordnance the development of long-range surface-to-surface missiles.

## 1944

March 15: Dr. Wernher von Braun was arrested by the S.S. for overconcentration on space travel rather than military missile problems. He was later released on the grounds his services were indispensable.

June 13: Shortly before dawn, the first V-1 pulsejet winged missile crossed from the Pas de Calais to explode in the center of London. The V-1 missile had a speed of 400 miles per hour and a range of 190 miles. It carried a warhead of 1,988 pounds.

June —: A V-2 missile from Peenemünde overshot the Baltic and landed in Sweden where the remains were collected and flown to England for analysis.

August 13: Two American GB-4 glide bombs carrying television cameras and under radio control were launched from aircraft against German naval installations at Le Havre, France.

September 6: Two V-2 missiles were fired toward Paris, of which one arrived there. Some reports indicate the first V-2 hit London some hours later on the same day, while other reports mark September 8 as the first attack against London. From this time until March 1945 when the launching sites were overrun by the Allies, something like 1,027 were fired from the vicinity of The Hague, with 92.3 percent launched successfully. Of the total number fired from all sites toward Britain, there were about 1,300 fired at London and 40 at Norwich. Some 518 fell in the London Civil Defense Region, and none at Norwich. The results in London were 2,511 persons killed and 5,869 seriously wounded, and elsewhere 213 killed and 598 seriously wounded.

November 15: U.S. Army Ordnance began the Hermes program of research and development on ballistic missiles.

## 1945

- January 24: The Germans successfully launched a winged version of the V-2, the A-9, designed to be the upper stage of an ICBM for ultimate attack on North America. It reached an altitude of 50 miles, and a speed of 2,700 miles per hour.
- February 20: The White Sands Proving Ground was established in New Mexico.
- February —: The Army Air Force placed a contract with Bell Aircraft Corp. to build 3 transonic aircraft to be propelled by liquid-fueled rockets; these aircraft were designated the XS-1.
- May 5: Peenemünde fell into the hands of advancing Soviet forces.
- July 13: The White Sands Proving Ground, N. Mex., was formally commissioned.
- July 4: The first test rocket was launched at the Auxiliary Flight Research Station, Wallops Island, Va.
- July 16: The first nuclear bomb in the world was test fired at Alamogordo, N. Mex.
- July 23: Life magazine published detailed drawings of a large manned space station, including a large space mirror, as envisioned by the German scientists of Peenemünde.
- August 6: The first nuclear weapon used in combat, a gun barrel type of uranium-235 bomb, was dropped on Hiroshima, Japan. It had a nominal yield equivalent to 20,000 tons of TNT.
- August 9: The second nuclear weapon used in combat, an implosion plutonium bomb, was dropped on Nagasaki, Japan. It had a nominal yield equivalent to 20,000 tons of TNT.
- August —: Components for approximately 100 V-2 weapons were shipped from Germany to White Sands, N. Mex.
- September 26: In the first development flight of an Army Wac Corporal, an altitude of 43.5 miles was reached. This was the first liquid fueled rocket developed with Government funds in the United States.
- September 29: The New York Times reported that the creation of an interplanetary rocket was seen as not basically insurmountable.
- December 14: The Army Air Force placed a contract with Bell Aircraft to build 2 supersonic liquid fueled rocket aircraft, designated the XS-2 (later X-2).
- December —: More than 100 German rocket scientists and engineers arrived at Fort Bliss, Tex.

## 1946

- January 26: The Army Air Force created the First Experimental Guided Missiles Group at Eglin Field, Fla.
- January —: The first missile was launched at the Naval Air Facility, Point Mugu, Calif., a Loon, patterned after the German V-1.
- March 22: The first United States-built rocket, the Wac, by Douglas, to reach outside most of the Earth's atmosphere climbed to 50 miles altitude.
- March —: The Army Air Force established Project Rand, a separate department of Douglas Aircraft Co. to study supersonic aircraft and space satellites, etc.

## 1946—Continued

- April 16: The first German V-2 in this country was launched at White Sands, N.M. It climbed 5 miles.
- (April 19: The Army Air Force started Project ~~MX-774~~ with Consolidated-Vultee to study rocket capabilities leading to an ICBM.)
- April 22: A contract was placed with North American Aviation to develop the Navaho winged rocket missile with a range up to 500 miles. Not until March 1948 was this redesigned as a ramjet-propelled missile of intercontinental range. This never reached operational status; however, the large liquid fueled rocket which was to boost it to ramjet speed later provided the basic engine used in the Thor, Jupiter, Atlas, Saturn, and other vehicles or missiles.
- May 12: Project Rand presented its report to the Army Air Force entitled "Preliminary Design of an Experimental World-Circling Space Ship," which indicated the technical feasibility of building and launching an artificial satellite.
- June 28: The first V-2 fully instrumented by Naval Research Laboratory for upper air research was launched at White Sands, and attained an altitude of 67 miles.
- July 9: A subcommittee of the Guided Missile Committee of the Joint Chiefs of Staff recommended that a search be made for a missile range to test ballistic missiles with a range of up to 2,000 miles. Admittedly a long-term project, it was recommended a joint Army-Navy commission carry out this work.
- August 6: Two unmanned B-17 drones flew from Hilo, Hawaii to Muroc Air Base, California, demonstrating the possibility of accurate long-range guided missiles armed with atomic warheads.
- October 6: The New York Times reported that Dr. S. Herrick described how rocket space travel to other planets was possible, and that he had worked out the navigation problems concerned, at the University of California.
- October 24: The V-2 rocket number 13 launched at White Sands took motion pictures of the Earth from an altitude of 65 miles.
- December 2: Details were revealed of the XS-1 rocket plane, to fly at speeds up to 1700 miles per hour. It had been tested as a glider, but not yet under power. It was built by the Bell Aircraft Co.
- December 8: The first American (designed for the purpose) rocket powered manned flight was made at Muroc, Calif., by the XS-1 research aircraft, at approximately 550 miles per hour.
- December 17: A program of space biology was initiated at Holloman Air Force Base, N. Mex., by the National Institutes of Health.
- December 22: Tiamat, a winged rocket vehicle, made the first flight in the United States with preprogramed maneuvers, at Langley, Va.
- During the year, the Signal Corps bounced radio signals against the Moon, proving that relatively low power could transmit signals over great distances.

1947

- January 23: A V-2 at White Sands carried telemetry successfully for the first time, climbed 31 miles.
- February 20: For the first time, a V-2 at White Sands ejected a canister for parachute recovery of fruit flies and seeds exposed to cosmic rays, after a climb to 68 miles.
- March 20: The first photograph made at an altitude of 100 miles was released by the U.S. Navy following a V-2 test at White Sands, N.M. The launching of more than 2000 pounds of equipment took place on March 7. Search parties spent several days locating the returned cameras.
- April 24: The French opened a new rocket test range at Colomb Bechar in the Sahara Desert of Algeria.
- April —: The Army Air Force awarded a contract to Aerojet Engineering Corp. to build an experimental rocket engine test station at Muroc, Calif. (later Edwards Air Force Base).
- May 27: The first Army Corporal E surface-to-surface rocket was fired.
- July 1: The MX-774 contract with Convair to develop ballistic missiles was ~~cancelled~~ by the Army Air Force; however, the company decided to pursue some phases of the work with its own funds, leading ultimately to the present Atlas, with its gimbaled motors.
- July 26: The Armed Services Unification Act was signed, creating a Department of Defense and a third service, the Air Force.
- August 20: The Douglas D-558-1 Skystreak was flown by Commander T. Caldwell to a new speed record of 640.7 miles per hour.
- August 22: Dr. Hugh L. Dryden was appointed Director of Aeronautical Research of the NACA.
- September 6: A V-2 missile was fired from the deck of the U.S.S. *Midway* near Bermuda.
- September 22: A United States Air Force C-54 made an automatic flight across the Atlantic from Stephenville, Newfoundland to Brise Norton, England. The crew on board had absolutely nothing to do except monitor the operation of the automatic flight system.
- September 25: The first flight of an unmanned plastic balloon in Project Skyhook of the Navy occurred from the base at St. Cloud, Minn.
- : The first successful firing was made of an Aerobee research rocket of the Applied Physics Laboratory at White Sands, N. Mex.
- October 8: The same C-54 aircraft which earlier crossed the Atlantic eastbound completed its automatic flight program by landing at Wilmington, Ohio. Human control had been required only on the two landings at Stephenville where an ILS system was lacking.
- October 14: The XS-1 made the first supersonic manned flight by traveling 760 miles per hour over Muroc Dry Lake with Capt. Charles E. Yeager at the controls.

## 1947—Continued

- October —: The Committee on Guided Missiles of the Research and Development Board was assigned responsibility for coordinating work on the Earth satellite program scattered among the separate services.
- November 24: The first complete Aerobee rocket was flown to a height of 37 miles at White Sands, N. Mex.

## 1948

- January 15: Gen. H. S. Vandenberg, Vice Chief of Staff, USAF, approved a policy calling for development of Earth satellites at the proper time.
- February 2: Bell Aircraft indirectly confirmed that the X-1 (formerly called the XS-1) had attained speeds of about 1,700 miles per hour and altitudes of 88,000 feet.
- February 6: The Army reported that it had achieved successful electronic guidance of a V-2 missile at White Sands, in a climb to 70 miles.
- March 5: A Navy Aerobee rocket reached an altitude of 74 miles.
- April 21: General James Doolittle and H. F. Guggenheim predicted that interplanetary rocket flights are near.
- May 3: The seventh Aerobee was launched to an altitude of 71 miles.
- May 13: The first Project Bumper shot was made at White Sands. This was a two-stage combination of a V-2 German rocket carrying an American Wac Corporal. On this flight the V-2 rose 69.7 miles and the Wac Corporal reached 79.1 miles.
- May 26: The first North American Navaho rocket test vehicle was launched as part of the Navaho program.
- June 11: A V-2 was launched at White Sands carrying an Air Force Medical Laboratory monkey, Albert, to an altitude of 39 miles.
- July 13: The first Convair MX-774 test missile built under the ballistic missile program was test fired.
- July 26: A V-2 was launched at White Sands to an altitude of 60.3 miles, and a Navy Aerobee to 70 miles, with cameras which showed the curvature of the Earth.
- August 19: The second Bumper rocket combination was fired at White Sands. The V-2 stage reached 8.28 miles and the Wac Corporal reached about 8 miles.
- August 21: General Spaatz called for the development by the United States of a 5,000-mile missile.
- September 1: In an improvement of aerial reconnaissance, an XR-12 aircraft photographed a 2,700-mile continuous-strip of the United States from coast to coast, using 390 frames and 325 feet of film.
- September 14: Professor E. P. Wigner discussed the application of nuclear energy to space propulsion.
- September 15: The Committee on Guided Missiles of the Research and Development Board recommended that the Army Hermes project provide a continuing analysis of problems related to development of an Earth satellite.
- September 27: The second MX-774 ballistic missile was test fired by Convair.



## 1948—Continued

- September 28: An Army Signal Corps balloon set an altitude record of 140,000 feet after launch at Belmar, N.J.
- September 30: The third Bumper rocket at White Sands sent a V-2 to 93.4 miles but the Wac Corporal failed.
- October 19: It was announced that an Aerobee and a V-2 had photographed 800,000 square miles of the American Southwest from high altitude in tests. (Possibly the same as the July 26 report.)
- November 1: The fourth Bumper sent a V-2 to 3 miles, and the Wac Corporal was not fired, at White Sands.
- November 4: The Air Force announced the formation of The Rand Corporation, as a successor to Project Rand.
- November 6: Dr. H. Tsien at California Institute of Technology described plans for a nuclear powered space ship.
- November 10: The first Symposium on Space Medicine was held at the USAF School of Aviation Medicine.
- December 2: The third and final MX-774 test ballistic missile was test fired by Convair.
- December 20: The Soviet Union claimed to have had the first piloted supersonic rocket plane.
- December 29: The First Report of the Secretary of Defense, James Forrestal, reported that the United States had been engaged in research on an Earth satellite. The Report of the Executive Secretary of the Research and Development Board, contained as an appendix, stated:
- “The Earth Satellite Vehicle Program, which was being carried out independently by each military service, was assigned to the Committee on Guided Missiles for coordination. To provide an integrated program with resultant elimination of duplication, the committee recommended that current efforts in this field be limited to studies and component designs; well-defined areas of such research have been allocated to each of the three military departments.”

## 1949

- February 9: The Department of Space Medicine was established at the School of Aviation Medicine, Randolph Field, Tex.
- February 14: The Air Force asked for the creation of a 3,000-mile missile test range.
- February 24: The fifth Bumper test at White Sands sent a V-2 to 63 miles, and a Wac Corporal to 250 miles, a new record height above the Earth, and attained a speed of 5,150 miles per hour. It measured ion densities in the upper atmosphere and near space.
- March 1: Search has been abandoned for the remains of the Wac Corporal which rose to 250 miles altitude at White Sands atop a V-2 in Project Bumper.
- March 12: The Navy announced the development of a multichannel telemetering system.
- April 21: The sixth Bumper rocket sent a V-2 to 31 miles, but the Wac Corporal did not fire.

## 1949—Continued

- May 3: The U.S. Navy launched Martin Viking rocket No. 1 at White Sands to reach an altitude of 51.5 miles and a speed of 2,250 miles per hour. A payload of 464 pounds of instruments was carried by this single stage research rocket. Upper air pressure and temperature were measured.
- May 11: President Truman signed the bill authorizing the range which now is the Atlantic Missile Range beginning at Cape Canaveral.
- May —: A Soviet rocket climbed to a height of 68 miles with between 264 and 286 pounds of instruments, by Soviet claim.
- June 14: Another V-2 flight at White Sands carried a monkey, Albert II to a height of 83 miles. The monkey survived the flight but was killed when his compartment impacted.
- June —: The Gesellschaft für Weltraumforschung, successor to the Verein für Raumschiffahrt, passed a resolution calling for an international meeting of all astronautical societies.
- September 6: Viking research rocket number 2 was launched at White Sands to reach an altitude of 32 miles.
- September 23: President Truman announced that the Soviet Union had exploded an atomic device in August of 1949.
- September 26: It was rumored that German scientists had been ordered in the Soviet Union to build an ICBM.
- November 4: The Army's rocket team of German scientists was being shifted from Fort Bliss, Tex., to Huntsville, Ala.
- December 12: Monkey Albert IV suffered no ill effects from a V-2 flight until moment of impact at White Sands. (Flight referred to probably occurred December 8.)
- During the year, Rocketdyne fired the first large liquid rocket engines based on the German engine used in the A-4 (V-2).
- During 1949-1952, the Soviet Union sent nine dogs up to 100 kilometers, three of which made two trips each. (Moscow Radio home service.)

## 1950

- January 23: The Air Force created the Air Research and Development Command.
- January 29: The charred tail of the Wac Corporal which reached an altitude of 250 miles a year ago has finally been found in the desert of New Mexico.
- January 30: President Truman directed the Atomic Energy Commission to proceed with thermonuclear weapons research.
- February 9: Viking research rocket No. 3 was launched at White Sands to reach an altitude of 50 miles.
- February 17: A V-2 was launched to an altitude of 92 miles at White Sands, N. Mex.
- February —: The North American Aviation rocket engine facility at Santa Susana, Calif. became operational.
- March 2: The first full-thrust test of the 75,000-pound thrust liquid rocket engine in the Navaho program was conducted. (The XLR-43-NA-1.)

## 1950—Continued

- March 15: The Joint Chiefs of Staff recommended exclusive responsibility for long-range strategic missiles to the Air Force, which assignment was made March 21 by Secretary of Defense Louis Johnson.
- April 1: The German missile team headed by Dr. Wernher von Braun had been completely moved from White Sands, N. Mex., to Redstone Arsenal at Huntsville, Ala.
- April 22: Igor Sikorsky predicted the arrival of manned interplanetary flight by 1970.
- May 10: The President signed the Act creating the National Science Foundation.
- May 11: Viking research rocket No. 4 was launched by the U.S.S. *Norton Sound* near Jarvis Island to reach an altitude of 106.4 miles. It studied cosmic rays, temperatures and pressures.
- May 19: The first Army Hermes A-1 rocket was test fired at White Sands.
- June 13: The Department of Defense assigned responsibility for the operation of the White Sands Missile Range to the Army, the Point Mugu California Range to the Navy, and the Long Range Proving Ground at Banana River Florida to the Air Force.
- July 24: Bumper No. 8, a combination of V-2 and Wac Corporal was launched at Cape Canaveral and reached a total distance of 25 miles in a horizontal distance test; this was the first missile launching at the Cape. The V-2 exploded.
- July 29: Bumper No. 7 reached a velocity of Mach 9 at Cape Canaveral, the highest yet attained. The Wac Corporal traveled 189.4 miles.
- August 31: A mouse was launched in a V-2 at White Sands, and was photographed by a camera which survived the impact.
- September 30: First International Congress on Astronautics was assembled at Paris, with representatives from Argentina, Austria, Denmark, France, Germany, Great Britain, Spain, and Sweden. Proposals were studied for the creation of a permanent federation.
- October 24: K. T. Keller was appointed Director of Guided Missiles for the U.S. Armed Services.
- October-December: The Rand Corp. confirmed the military practicality of long-range rocket weapons.
- November 21: Viking research rocket No. 5 was launched at White Sands to reach an altitude of 108 miles. It took photographs of the Earth which were recovered.
- December 11: Viking research rocket No. 6 was launched at White Sands to reach an altitude of 40 miles.
- Arthur C. Clarke published "Interplanetary Flight".

## 1951

- January 16: The decision was made to resume studies of the MX-774, redesignated the Atlas.
- January 23: Atlas was reactivated as a project at Convair.
- February 5: General Collins predicted that nuclear warheads for missiles would be available in a few years.
- April 18: The first Aerobee rocket with a biomedical experiment was launched at Holloman Air Force Base, N. Mex.

## 1951—Continued

- May 14: The Air Force Missile Test Center was established at Cape Canaveral, and assigned to ARDC.
- June 20: The first Martin Matador flight down range from Banana River toward the Bahamas was carried out.
- June 25: The Arnold Engineering Development Center at Tullahoma, Tenn. was dedicated by President Truman.
- August 7: The Douglas D-558-II Skyrocket reached a speed of 1238 miles per hour with William Bridgeman as pilot.
- : Viking rocket No. 7 set a new single stage rocket altitude record of 136 miles at White Sands, N. Mex., reaching a top speed of 4100 miles per hour.
- August 15: The Douglas D-558-II reached 79,494 feet altitude with William Bridgeman as pilot.
- September 3: The Second International Congress on Astronautics opened at London, and the International Astronautical Federation was formed. The United States, Switzerland, and Italy joined the organization in addition to earlier participants, bringing to 10 the total membership.
- September 7: H. H. Koelle of Redstone Arsenal reported that the Soviet Union is racing to set up a military space station.
- October 4: M. K. Tikhonravov in the U.S.S.R. stated that Soviet science makes feasible space flight and the creation of an artificial Earth satellite; he reported that Soviet rocket advances equalled or exceeded those of the West, foresaw craft in 10 to 15 years.
- October 12: The U.S.S.R. was said to be planning a 1,000 ton rocket ship for a trip to the Moon in 10 to 15 years.
- October 29: The 66th V-2 was fired at White Sands, concluding use of this German missile for upper atmosphere research in the United States.
- During 1951 the Air Force initiated development of a liquid rocket engine of 120,000 pounds thrust. (The XLR 43-NA-3.)
- During 1951 the NACA Lewis Laboratory completed the first rocket combustion tests using fluorine.
- Arthur C. Clarke published "The Exploration of Space".

## 1952

- March 19: The Air Force revealed that five monkeys on different flights had been rocketed to an altitude of 80 miles in the nose of V-2 missiles. Mice survived the same trips successfully. Four of the monkeys died as a result of parachute failure, although telemetry showed that they withstood the rocket flight as such. The fifth monkey died of heat prostration while awaiting rescue on the surface of the desert.
- March 22: Colliers Magazine published its first space symposium results under the title, "Man Will Conquer Space Soon". Contributors were Dr. Wernher von Braun, Dr. Joseph Kaplan, Dr. Heinz Haber, Willi Ley, Dr. Oscar Schachter, and Dr. Fred L. Whipple.
- April —: The NACA directed its laboratories to begin study of problems associated with flight beyond the atmosphere.

## 1952—Continued

- May 16: The Special Committee for the International Polar Year was established by the International Council of Scientific Unions, to coordinate the IPY programs. (Later called the IGY.)
- May 22: An Air Force Aerobee carried two monkeys and two mice to 36 miles altitude and they were recovered unharmed.
- June 6: Viking research rocket No. 8, a new model, was destroyed during a static test at White Sands.
- June 18: H. Julian Allen of NACA Ames Laboratory conceived the blunt nose principle for reentry vehicles, later used in ICBM's and Project Mercury.
- June 20: Col. J. L. Zoeckler of the Air Force has told the Congress in executive committee sessions that the Soviet Union is making spectacular progress on guided missiles, and during the coming year will spend the equivalent of more than a billion dollars on these devices.
- June —: The Navy's Johnsville, Pa. human centrifuge went into operation.
- July 26: An Aerobee again carried two monkeys and two mice to about 40 miles, and they were recovered unharmed.
- September 1: Third International Congress on Astronautics opened at Stuttgart, formally adopting a constitution for the International Astronautical Federation.
- October 18: Colliers published "Man on the Moon".
- October —: The International Polar Year was broadened and changed into the International Geophysical Year.
- November 19: The first liquid rocket engine with a thrust of over 100,000 pounds was test fired in the Santa Susana Mountains, California, in connection with the Navaho program.
- December 6: Dr. Wernher von Braun replied to Lieut. Gen. Craigie who had advised dropping space work, seeing a space station as a curb to Soviet military aims.
- December 15: Viking research rocket No. 9 was launched at White Sands to reach an altitude of 135 miles.
- Dr. Wernher von Braun published "Das Marsprojekt" (The Mars Project), a detailed plan for a manned expedition to Mars and return. He had described this project September 6 at the I.A.F. meeting in Stuttgart.
- The Soviet Union sent 12 animals in 18 launchings on flights up to 100 kilometers, then parachuted them safely from heights of 30 or 40 kilometers, according to Soviet sources.
- During the year the Air Force began design work on a 405,000-pound thrust liquid rocket engine for the Navaho program.

## 1953

- February 8: A B-29 was flown from the Boston area to within 10 miles of the Los Angeles International Airport without reference to any external information by using an inertial guidance device developed at M.I.T.
- February —: The U.S. National Committee for the IGY was established by the National Academy of Sciences.

## 1953—Continued

- March 30: The Navy revealed that it has put into production a new guided missile propelled by a turbine engine. This was the *Regulus*, and a submarine had been equipped to launch it. The missile was said to have supersonic speed.
- June 30: Viking research rocket No. 10 suffered an explosion on the launching pad at White Sands, but was salvaged.
- August 3: The Fourth International Congress on Astronautics met at Zurich, and was joined by the Union of South Africa and Yugoslavia.
- : At Zurich, Dr. S. Fred Singer unveiled his proposal for Project Mouse (Minimum Orbital Unmanned Satellite Experiment)—the first satellite in the modern sense, to weigh 100 pounds.
- : At the I.A.F. Congress, Eugen Sänger and Irene Sänger-Bredt set forth a proposal for an ultimate photon rocket for interstellar travel.
- August 12: The Soviet Union successfully tested a thermonuclear bomb which was air deliverable, according to Igor V. Kurchatov in April 1958.
- August 20: The first Redstone missile was test fired by the Army at Cape Canaveral.
- August 28: A liquid rocket engine for the Navaho program was test fired at a thrust of over 200,000 pounds.
- September 9: Trevor Gardner was appointed by Secretary of Defense Wilson to head a committee to eliminate interservice competition in development of guided missiles.
- October 14: The X-10 prototype for the North American Navaho made its first flight.
- November 27: Nesmeyanov of the U.S.S.R. Academy of Sciences announced "science has reached such a stage that the launching of a stratoplane to the Moon, the creation of an artificial satellite of the Earth, is a real possibility." (World Peace Council, Vienna)
- The thermonuclear breakthrough which made possible the construction of powerful warheads small enough to mount in a missile came during the year and led to the recommendation of the Air Force Strategic Missiles Evaluation Committee that the program for the Atlas ballistic missile which had been proceeding with only limited funds since 1951 be redirected, expanded and accelerated. Dr. John von Neuman was chairman of this committee. (See February 10, 1954.)
- During 1953 Dr. Hubertus Strughold published "The Green and Red Planet: A Physiological Study of the Possibility of Life of Mars".

## 1954

- January 12: Lt. Gen. James Doolittle predicted that an Earth satellite would be built within 50 years.
- January 30: Vice President Pryor of Pan American Airways saw danger if only one nation were to acquire the ability to build satellites.
- January —: Satellites were officially described as practical by the U.S.S.R.

## 1954—Continued

- February 6: The Soviet Union published the charge that United States science fiction, films, publications, and broadcasts were a forerunner of new imperialism aimed at conquering other planets.
- February 8: The Rand Corporation recommended that ICBM efforts be increased and that the characteristics of Atlas be eased to permit an ICBM at an earlier date.
- February 10: The von Neumann Strategic Missile Evaluation Committee reported a highly significant possibility of a major technological breakthrough on warhead size of thermonuclear weapons, and recommended that the ICBM be pursued through the formation of a special management organization. It also noted the advantages of an IRBM.
- March 1: The United States exploded its first hydrogen bomb in the Marshall Islands.
- March 20: The United States exploded a second hydrogen bomb in the Marshall Islands.
- March 23: The Chief of Staff, U.S. Air Force approved an Air Force Council recommendation to reorient and accelerate the ICBM program.
- March 24: Moscow Radio urged Soviet youth to be first to reach the Moon.
- April 3: The Moscow Air Club formed an astroaviation section to study interplanetary flight. A. A. Shternfeld reported Soviet scientists hold that space flight is possible in the foreseeable future.
- May 5: American and German scientists warned that the Soviet Union may lead the United States in rocket research. George Sutton thought that the U.S.S.R. might have a device capable of firing into the skies an artificial Earth satellite symbolic of Soviet power; he suggested this might include a 1-ton payload in an orbit 200 miles up. Dr. S. Fred Singer urged the United States to start work on a 100-pound satellite which could be ready by 1957.
- May 7: Viking research rocket No. 10 was launched at White Sands to climb to an altitude of 136 miles.
- May 19: The Soviet Union is expected to have manned Moon flights in a few years.
- May 24: Viking research rocket No. 11 was launched at White Sands to climb to an altitude of 158 miles, and reached a speed of 4,300 miles per hour.
- May —: The NACA determined the characteristics of what was later to become the X-15 aircraft.
- : Joseph and Stewart Alsop reported that the Pentagon estimate was that by 1960 the Soviet Union would launch an intercontinental missile. They warned that previous official estimates had been uniformly bettered by at least two years by Soviet developers.
- June 10: A Matador missile was launched at Cape Canaveral, and hit its target at supersonic speed.
- June 21: Responsibility for Atlas was assigned to the Air Research and Development Command, and on July 29, Brig. Gen. B. A. Schriever was put in charge of the project.

## 1954—Continued

- June 25: Secretly arranged by Durant, Dr. Wernher von Braun, Frederick C. Durant III, Alexander Satin, David Young, Dr. Fred L. Whipple, Dr. S. Fred Singer, and Commander George W. Hoover met to agree that a Redstone rocket with a Loki second stage could launch a satellite into a 200-mile orbit without major new development. Five pounds could be put up fairly soon, and a heavier, better instrumented one soon afterward if an official project were set up. Rear Admiral Frederick R. Furth, Chief of Naval Research, approved the idea and authorized an approach to the Army missile directors at Redstone arsenal. This was to become Project Orbiter.
- August 1: Fifth International Congress on Astronautics opened at Innsbruck. Membership in the IAF was applied for by societies from Egypt, Japan, Brazil, and the United States (American Astronautical Society).
- August 3: The Army and Navy representatives met at Redstone Arsenal and agreed upon a joint Army-Navy project which was given the designation Orbiter. Then contracts were let to Alabama Engineering and Tool Co., Aerophysics Corp., and Varo Manufacturing Co. for various components.
- August 4: Dr. Ernst Stuhlinger described his plan for ion propulsion of rockets, at the I.A.F. meeting in Innsbruck.
- August 7: The Air Force revealed that the School of Aviation Medicine had received the first specifically built space cabin simulator.
- August 21: The rocket ship X-1A with Major Arthur Murray at the controls reached 90,000 feet at Edwards Air Force Base.
- August 26: The Supplemental Appropriations Act, 1955, appropriated \$2,000,000 to the National Science Foundation for carrying out the United States program for the International Geophysical Year.
- August 29: Hanson Baldwin reported that sometime in the 1960's ICBM's by the United States and presumably by the Soviet Union would be operational. He noted it was not yet clear whether these could carry thermonuclear warheads.
- August —: The Western Development Division (now Ballistic Missile Division) under the Air Research and Development Command was activated to manage Atlas research, development, and testing, with the highest Air Force priority given the program.
- September 3: The Air Force announced it was planning a range 5,000 miles long from Cape Canaveral to Ascension Island.
- September 24: The Soviet Union established the Tsiolkovski Gold Medal to be awarded every three years for outstanding accomplishment in interplanetary communications.
- September 26: Moscow Radio announced that the U.S.S.R. had sent rockets to a height of 240 miles, and that an interplanetary rocket had been designed and its flight principles worked out.
- September 29: Chrysler received a contract from the Army to build the Redstone missile.
- October 4: The Special Committee of the International Geophysical Year concluded its meeting in Rome, Italy, during which it adopted the following recommendation:



## 1954—Continued

- “In view of the great importance of observations during extended periods of time of extraterrestrial radiations and geophysical phenomena in the upper atmosphere, and in view of the advanced state of present rocket techniques, CSAGI recommends that thought be given to the launching of small satellite vehicles, to their scientific instrumentation, and to the new problems associated with satellite experiments, such as power supply, telemetering, and orientation of the vehicle.”
- October 14: The first American 4-stage rocket was launched by the Pilotless Aircraft Research Division of NACA Langley Laboratory at Wallops Island, Va.
- October 18–19: At the suggestion of Dr. Theodore von Kármán, the Ad Hoc Committee of the Scientific Advisory Board reviewed the case for the nuclear rocket, quiet since a 1947 study by North American Aviation and a 1953 report of Oak Ridge. They recommended that the work be a continuing study at a modest level.
- October—: A Naval Research Laboratory Aerobee took the first picture of a complete hurricane from an altitude of 100 miles over White Sands.
- November 17: Secretary of Defense Charles E. Wilson denied knowledge of any United States scientists working on Earth satellites, and stated he would not be alarmed if the U.S.S.R. built one first.
- November 30: Milt Rosen of the American Rocket Society urged the United States to undertake construction of an Earth satellite.
- December 10: Lt. Col. John P. Stapp rode a rocket sled at Holloman Air Force Base at 632 miles per hour, a world land record, and then came to a full stop in 1½ seconds.
- December 16: Convair was announced to be building the Atlas ICBM for the Air Force.
- December 21: The Department of Defense in a two-sentence comment reported that studies continued to be made in the Earth satellite vehicle program. The statement, approved by Secretary of Defense Charles E. Wilson, was issued after a press conference statement by the Secretary that he was unaware of an American satellite program.
- December—: Walt Disney produced the film, “Man in Space”.
- During 1954–1957, the Soviet Union launched a number of geophysical rockets to altitudes up to 250 kilometers, according to Soviet sources.

## 1955

- January 10: Moscow Radio reported that Soviet scientists hold that satellite flight was possible in the near future, to be followed shortly by interplanetary flight.
- January 20: The Air Force was invited to join Project Orbiter and to supply help including tracking. The plan was submitted to Assistant Secretary of Defense Donald A. Quarles.
- January 22: The Department of Defense announced that work was underway on an ICBM with a range of 5,000 miles and an accuracy of 10 miles C.E.P.

## 1955—Continued

- January 27: In a recognition of Soviet progress, the United States Air Force called for early development of an ICBM with a thermonuclear warhead.
- February 4: Viking research rocket No. 12 was launched at White Sands to climb to an altitude of 144 miles.
- February 14: The Killian Committee recommended the concurrent development of an IRBM of 1,500 miles range, to match the ICBM effort.
- March 14: The U.S. National Committee for the IGY completed a feasibility study on Earth satellites, and endorsed them favorably for consideration by the National Academy and the National Science Foundation.
- March —: The feasibility of the F-1 million-pound-thrust liquid rocket engine was established by Rocketdyne.
- : Dr. Alan T. Waterman went to the White House with the proposal for a scientific satellite as recommended at the October 1954 Rome meeting for the IGY.
- April 6: The Atomic Energy Commission tested an air-to-air nuclear warhead missile 30,000 feet over the Nevada desert at Yucca Flats, following launch from a B-36.
- April 15: The Soviet newspaper, *Vechernaya Moskva*, announced the recent creation in the Soviet Union of a Permanent Interdepartmental Commission for Interplanetary Travel in the Astronomical Council of the U.S.S.R. Academy of Sciences, for "coordinating work on the solution of the problems of mastering cosmic space." As an initial step it was to develop an Earth satellite which would improve weather forecasting by taking photographs of the Earth. Peter Kapitsa was a member.
- April 18: The Astronomer Royal of Great Britain foresaw no interplanetary trips for several centuries.
- April 21: The first Aerobee-Hi was launched, reaching 113 miles altitude.
- April 24: Senator Symington charged that the Soviet Union led in the development of the ICBM.
- April 26: Moscow Radio reported that the Soviet Union plans to explore the Moon with a tank remotely controlled by radio, and foresaw trips by man in 1 or 2 years. It also reported that a team of scientists had been formed to develop an Earth satellite. American Rocket Society executive James J. Harford ridiculed the possibility of a Soviet Moon trip so soon.
- May 2: The Titan ICBM was also assigned to the Air Force Ballistic Missile Division.
- May 21: Senator Symington warned that the Soviet Union might lead in the development of missile warheads.
- May 23: The Orbiter team gathered at Redstone Arsenal and a day later at Cape Canaveral to see a Redstone firing and to establish the timetable for Orbiter, to lead to a launching in midsummer or autumn of 1957.
- May 29: Moscow reported research on hydrogen fusion as a means for space propulsion.
- June 13: *Aero Digest* editor Eric Bergaust held that the U.S.S.R. was closer to space conquest than the United States.

## 1955—Continued

- June 30: The Independent Offices Appropriation Act, 1956, appropriated "\$10,000,000 to remain available until June 30, 1960," for the American International Geophysical Year program.
- July 29: The National Academy of Sciences and the National Science Foundation announced that the United States was planning to construct an Earth satellite which would be launched during the International Geophysical Year. These organizations would sponsor the project with assistance from the Department of Defense which would furnish the equipment and facilities. The program was to be carried out under the IGY program and "the results obtained will be made available to the scientists of the world." A White House briefing on the announcement was given by James C. Hagerty and noted scientists, who discussed the scientific data which Earth satellites would provide. They announced that the satellite would probably be the size of a basketball and might carry instruments; few other details of the vehicle were described. A letter from Joseph Kaplan, chairman of the United States National Committee for the International Geophysical Year, announcing United States satellite plans in response to the October 1954 resolution of the Special Committee for the International Geophysical Year was delivered to Professor Sydney Chapman, its president. The satellite was to be patterned after Professor Fred Singer's MOUSE concept.
- July 30: The Soviet Union revealed that it planned to launch an Earth satellite like that of the United States. American scientists stated the Russians had worked on this problem as long as scientists in the United States.
- : Satellites were stated to have no foreseeable military value, according to "informed" American Government sources.
- July 31: Dr. Karpenko offered Soviet cooperation in launching an Earth satellite, suggesting Sedov play a key role in a joint effort, but he would not state when the U.S.S.R. would build a satellite.
- July–October: Instrumented Loki I and Deacon rockets were launched from balloons from shipboard off Greenland in a University of Iowa cosmic ray study sponsored by the Office of Naval Research, using Army Ordnance Jet Propulsion Laboratory rockets.
- August 2: N. S. Khrushchev reported that the U.S.S.R. would cooperate with the United States if the project was "in the interests of man."
- : Sixth I.A.F. Congress opened at Copenhagen. Soviet representatives appeared at the Congress for the first time. Chile joined the I.A.F.
- : L. I. Sedov, chairman of the U.S.S.R. Academy of Sciences Interdepartmental Commission on Interplanetary Communications, made the following statement at a press conference during the International Congress of Astronautics, according to the Tass announcement: "In my opinion, it will be possible to launch an 'artificial satellite of the Earth' within the next two years, and there is the technological possibility of creating 'artificial satellites' of various sizes and weights."

## 1955—Continued

- August 3: Professor Leonid Sedov reported that the U.S.S.R. was considering vehicles of various sizes, using a large rocket launcher, and that these satellites would be much larger than under the United States plan. He stated that reentry problems were under study, but that the first satellite would burn on reentry. He said the first launching should come in 2 years, using a 2- or 3-stage launching combination. He foresaw future cooperation with the United States.
- August 5: Sedov was quoted in Pravda and Izvestia as saying, "It will be feasible to launch an artificial earth satellite within the next two years. I do not venture to specify a more exact time."
- August 15: A. G. Karpenko reported that construction of the Soviet satellite would begin soon. It was noted by Pravda that radio directed rockets carrying animals have reached an altitude of 300 miles. The first satellite was to orbit between 125 and 625 miles, and later ones between 935 and 1,250 miles.
- August 20: G. I. Pokorovsky interviewed by Izvestia held that regularly-scheduled interplanetary flights would come in the future. He also spoke of unmanned rockets to the Moon, and said the first stage of satellite research had been completed.
- September 8: The President assigned the highest national priority to the ICBM programs.
- September 9: The Stewart Committee reviewed the alternatives of waiting for an Air Force Atlas launcher for the first satellite, using a modified Army Redstone, or developing a new Navy rocket derived from the Viking. The committee voted 7-2 in favor of abandoning Orbiter and developing Vanguard; Secretary Quarles ruled with the committee majority in the Department of Defense Policy Committee which approved this decision.
- September 13: The President approved the development of a 1,500-mile ballistic missile system with megaton warhead yield, "both land and sea-basing to be considered."
- September 14: A Soviet reporter at a scientific conference was non-committal on the Soviet role in observations and on announced Soviet plans for Earth satellites.
- September 23: General White noted Soviet stress on the development of an ICBM.
- October 2: The National Academy of Sciences' IGY Committee established the Technical Panel for the Earth Satellite Program with Dr. Richard W. Porter as Chairman, to plan the scientific aspects of the program, including selection of experiments, establishment of optical tracking stations, and international and interdisciplinary relations.
- October 7: The Martin Company was awarded the prime contract to build the Vanguard satellite launching vehicle, and General Electric received the contract for the first stage rocket engine.
- October 8: Rear Admiral F. R. Furth, Dr. Cornell, and Dr. Hugh Odishaw denied that the United States was racing to get into space ahead of the U.S.S.R., and stated that its only interest was to further the world's scientific knowledge.

## 1955—Continued

- November 2: The Atomic Energy Commission approved the general study plans of the Los Alamos Scientific Laboratories, and recognized the interest of the Department of Defense in the nuclear rocket.
- November 6: Secretary Donald Quarles expressed confidence that the United States led the Soviet Union in development of an ICBM, but that there was a future threat.
- November 8: The Department of Defense approved the assignment of an intermediate range ballistic missile project to the Air Force. The assignment of this 1,000 mile missile was not to limit the Army in pursuing the development of Redstone which had a range of about 200 miles but also has a further growth potential. This decision led later to development of the Air Force Thor and Army Jupiter. (See next entry.)
- : The Secretary of Defense authorized the Army and Navy to proceed jointly with the development of an intermediate-range ballistic missile "with the dual objective of achieving an early shipboard capability and also providing a land-based alternate" to the Air Force Thor program.
- November 17: The Secretary of the Navy created the Special Projects Office to handle the problems associated with the ship-launched Jupiter weapon system. Rear Adm. W. F. Raborn, Jr., was named Director, reporting directly to the Secretary of the Navy.
- November 18: The Air Research and Development Command was assigned IOC (initial operating capability) responsibility for ICBM's; on December 14, 1955, this responsibility was transferred to the Air Force Ballistic Missile Division.
- November 26: The Soviet Union announced that it had detonated a hydrogen weapon at great height.
- November —: The X-2 research rocket plane made its first flight, and was powered with the first throttlable rocket engine, the XRL 25-CW-1.
- December 9: The Thor IRBM was also assigned to the Air Force Ballistic Missile Division.
- : Hanson Baldwin reported that the Soviet Union had developed a 600-800 mile range ballistic missile.
- December 13: Aerojet-General was picked to build the second stage rocket propulsion system for the Vanguard satellite project.
- December 29: Premier Bulganin hinted that Soviet ICBM development was underway.

## 1956

- January 3: The London Daily Worker reported that the U.S.S.R. might launch a satellite in 1956, 6 months ahead of the United States. It repeated the claim that animals had been sent several hundred miles into space by rocket, and the animals recovered safely.
- January 10: The first American liquid rocket engine having a thrust over 400,000 pounds was fired at Santa Susana, Calif.
- : General Maxwell Taylor announced that the Army was going to develop an IRBM derived from its more limited range Redstone missile.

## 1956—Continued

- January 13: A Northrop Snark built for the Air Force flew 2,000 miles from Cape Canaveral into the central Atlantic. The missile was powered with a jet turbine engine.
- : Patrick Air Force Base (Cape Canaveral) was selected as the launching site for the United States IGY satellite (Vanguard).
- February 1: Senator Jackson in a speech on the Senate floor warned that the Soviet Union was likely to win the race to develop a 1,500-mile ballistic missile, possibly with a first firing before the end of 1956. Therefore he called for a three-shift program in the United States to advance our own efforts, together with a new organization to give the necessary push and direction.
- : The Army activated the Army Ballistic Missile Agency (ABMA) at Redstone Arsenal, Huntsville, Alabama, to pursue the Redstone and Jupiter.
- February 4: Ex-President Truman expressed doubts about the satellite program.
- February 8: Trevor Gardner resigned as Assistant Secretary of the Air Force for Research and Development as a protest against Pentagon policies with regard to missiles.
- February 9-10: Secretary Quarles testified before Congress that the United States led the missile race, and that any race to speed IRBM's would affect the military balance of power.
- February 17: Deputy Premier Mikoyan stated the Soviet Union could deliver a thermonuclear warhead to any target on Earth.
- February 19: Trevor Gardner claimed the Soviet Union led in the development of ballistic missiles. Harold Stassen on the other hand stated the Soviet Union ranked behind both the United States and Great Britain in this respect.
- February 25: Secretary Quarles saw the ballistic missile threat as being great in 5 to 10 years, but doubted the current Soviet ability.
- March 4: Dr. Wernher von Braun saw the U.S.S.R. working hard to develop a manned space ship and said the United States had no time to lose.
- : Air Secretary Quarles was quoted as saying, "On the basis of facts at my disposal, I feel confident that we are ahead of the Russians in the evolution of an intercontinental ballistic missile suitable for our purposes." The same article quoted Brig. Gen. J. F. Phillips, "We knew how vital it was for us to get an ICBM before the Russians did." The claim was that U.S. work began before corresponding Soviet work, for a special committee of the most gifted Army Air Force officers studied the problem in January 1945.
- March 6: Radio Moscow reported that the first satellites would be "small, spherical, and weigh about 50 kilograms."
- March 13: A Chinese Communist report said that the U.S.S.R. had sent a monkey 310 miles into space in a rocket, and had recovered it safely.
- March 14: The Jupiter A (Redstone) was launched at Cape Canaveral by the Army.

## 1956—Continued

- March 20: The Department of Defense Ballistic Missile Committee approved the Navy solid propellant program for component development to determine weapon system feasibility.
- March 21: Secretary Donald A. Quarles announced that the Air Force was developing three ballistic missile projects: Atlas and Titan of ICBM range and Thor of 1500 mile range.
- March 22: The Air Force Ballistic Missile Division was assigned IOC (initial operating capability) responsibility for IRBM's, including the preparation of bases, the provision of supporting equipment, and the training of IOC crews.
- March 27: Eger Murphree, president of Esso Research Laboratories, was appointed by Secretary of Defense Wilson as "missile czar" over the three services as head of the Office of the Assistant for Guided Missiles.
- March 28: Airman D. F. Smith remained in a sealed space cabin simulator for 24 hours at the School of Aviation Medicine, Randolph Field.
- April 11: The Navy awarded Lockheed a contract for system development and to Aerojet for solid rocket development for what later became the Polaris missile system.
- April 19: Nikita Khrushchev cited Soviet gains in ICBM development, and warned against pressuring the Soviet Union.
- April 23: Khrushchev indicated that thermonuclear warheads in Soviet ICBM's would be able to hit any target on Earth.
- : Secretary Quarles pointed out that the United States still led the Soviet Union in its technical abilities.
- : The Army reported to the Office of the Secretary of Defense that if given the go-ahead, it could use a Jupiter to launch a small Earth satellite by January of 1957.
- April 24: Secretary Quarles indicated he was not surprised by the Khrushchev statement in England that the U.S.S.R. would "soon" have hydrogen bomb warhead missiles capable of reaching any point on Earth. He said it depended upon the meaning of the word "soon".
- May 8: An Aerobee-Hi was launched to an altitude of 116.5 miles.
- May 19: Under the Second Supplemental Appropriation Act, 1956, the National Science Foundation received an appropriation of "\$27,000,000, to remain available until June 30, 1960" for the International Geophysical Year.
- May 21: The first American airborne H-bomb was dropped by a B-52 bomber at 50,000 feet to explode over Bikini Atoll.
- May —: The Air Force began a joint program of support with the AEC for developing Project Rover, the nuclear rocket.
- June 21: The Rand Corporation issued a research memorandum, "A Casebook on Soviet Astronautics," by F. J. Krieger. The casebook contained both a bibliography of Soviet literature and complete translations of selected Russian articles and papers on this subject.
- June 22: The Japanese meteorological service reported that the U.S.S.R. had exploded a missile-borne H-weapon at an altitude of 22 miles.

## 1956—Continued

- June 29: An Aerobee-Hi rocket was launched to an altitude of 163 miles over White Sands.
- July 6: The first Nike-Cajun rocket was fired at Wallops Island, Va. and reached an altitude of about 85 miles.
- July 23: The rocket ship X-2 was flown at 1,900 miles per hour by Lt. Col. Frank K. Everest, and reached 75,000 feet over Edwards Air Force Base.
- August 24: The first 5-stage solid-fueled rocket was launched at Wallops Island, reaching a speed of Mach 15.
- September 7: The rocket ship X-2 was flown to 126,200 feet by Captain Iven C. Kincheloe, over Edwards Air Force Base.
- September 15: The Special Committee for the International Geophysical Year announced that among the resolutions approved by scientists from 40 countries, including the United States and the Soviet Union, were those recommending the use of standard instruments for tracking satellites and the release of technical information on tracking equipment by those countries with satellite programs.
- September 20: The first Redstone Jupiter C test vehicle was launched from Cape Canaveral to reach an altitude of 682 miles and a range of 3,300 miles over the South Atlantic.
- September 21: The U.S.S.R. announced completion of a study project to send a rocket to the Moon and back. It also was said to be working on nuclear and photon propulsion. The Soviet lunar probe was stated to be 2,200 pounds, and through the study stage. United States scientists were dubious of the reports.
- September 27: The X-2 reached 2,148 miles per hour with Capt. Milburn G. Apt before crashing.
- September —: The Seventh I.A.F. Congress opened at Rome. Societies from the U.S.S.R., France, Poland, and Germany joined the I.A.F. During the Congress, Papal approval of astronomical endeavor was granted.
- October 10: The N.A.C.A. revealed that it had research rockets of four stages which had reached speeds as high as 6,864 miles per hour.
- October —: NACA scientists were directed to study a followon to the X-15 manned rocket research vehicle.
- November 16: The Department of Defense transferred part of Camp Cooke, California, to the Air Force to create the first ICBM base. This is now Vandenberg Air Force Base.
- November 26: Secretary of Defense Wilson ruled that the Army would be restricted to development and operation of missiles with a range not exceeding 200 miles, for point defense and tactical support of ground forces; the Navy would be responsible for ship-based systems suitable to its assigned functions; and the Air Force would be responsible for area air defense missiles, IRBM's, and ICBM's.
- November 30: The Martin TM-61 Matador became the first Air Force tactical missile after completing its test program.



## 1956—Continued

- December 8: Viking research rocket No. 13 was launched at Cape Canaveral as the first test of Vanguard satellite vehicle components, including the Minitrack radio transmitter which was ejected in space. The rocket flew at 4,100 miles per hour, climbed 125 miles and landed 180 miles away. (This has been labeled Vanguard TV-O).
- : The Secretary of Defense authorized the Navy to terminate participation in the Jupiter IRBM program and to proceed with the development of the solid-fueled Polaris for shipboard use.
- December 12: Dr. John Hagen said the Vanguard program was on schedule, but denied any race with the Soviet Union.
- December 15: It was revealed the United States had launched a Jupiter test vehicle which flew 3,300 miles from Cape Canaveral, reaching an altitude of 682 miles, and a speed of 15,000 miles per hour. (See September 20, 1956.)
- December 18: The Special Projects Office of the Navy was made weapons system manager for the entire Fleet Ballistic Missile Program, in place of the original more limited assignment.
- December 21: The Atomic Energy Commission began a development program for auxiliary nuclear power electric energy sources for use in space ships at the request of the Air Force. This was given the name Project SNAP.

## 1957

- January 10: President Eisenhower in his State of the Union Message declared that "we are willing to enter any reliable agreement which would \* \* \* mutually control the outer space missile and satellite development."
- January 21: It was announced that the Snark guided missile of intercontinental range and propelled by turbine engine would be delivered to the Strategic Air Command in about a year.
- January 25: Just thirteen months after letting the contract, the first Thor missile was tested at Cape Canaveral. Unofficial observers reported that just after liftoff, it toppled back to crash and burn.
- February 10: Missiles and Rockets magazine stated that the United States and the U.S.S.R. might be entering into a space rocket bomber race.
- February 20: The U.S. Committee for the IGY submitted a report of its technical panel on the Earth Satellite Program to the National Science Foundation and the Department of Defense outlining a post-IGY space program.
- February 25: Dr. Lee De Forest stated man would never be able to reach the Moon.
- March 18: As a result of guidance from the Department of Defense, the Atomic Energy Commission reduced its effort on nuclear rockets by phasing out the work at the Livermore Laboratory and concentrating all efforts at Los Alamos.
- March 24: The Soviet Union released a photograph of a dog said to enjoy space flights in a rocket.
- March —: The Army fired a second Jupiter missile, but apparently a malfunction terminated the flight after about 100 miles; however, useful telemetry was returned.

## 1957—Continued

- April 7: It was reported that the Soviet Union had organized a separate rocket force on a par with the three other services to spur missile development and air defense.
- April 11: Satellite equipment, including a radio transmitter and instruments for measuring temperature, pressure, cosmic rays, and meteoric dust encounters, was tested above Earth for the first time, as a rocket containing this equipment was fired by the Navy to a 126-mile altitude.
- April 15: The First Missile Division and the 392nd Air Base Group were actuated by the Air Force.
- April 19: A second Thor launching was carried out, but was destroyed by the range safety officer when it appeared to be going off course.
- April 23: First details were made public of the planned X-15 high altitude and high speed research craft being built by North American.
- April 24: The X-17 rocket exceeded 9,000 miles per hour after launch at Patrick Air Force Base.
- April 30: Aerobee-Hi No. 41 was launched at White Sands to reach 193 miles altitude, and 4,900 miles per hour.
- April —: The Upper Atmosphere Rocket Research Panel was renamed the Rocket and Satellite Research Panel, with Dr. James A. Van Allen as chairman.
- May 1: Vanguard Test Vehicle (TV-1), a modified Martin Viking first stage, Grand Central rocket second stage, and Vanguard third stage launched an instrumented nose cone to 121.2 miles altitude at Cape Canaveral.
- May 6: William M. Holaday was named Special Assistant for Guided Missiles in the Department of Defense.
- May 19: Dr. Richard W. Porter indicated that Vanguard might be delayed until the spring of 1958 because the camera tracking network would not be complete until April 1958.
- May 31: A first successful Jupiter was fired 1,500 miles, reaching between 250 and 300 miles above the Earth, at Cape Canaveral.
- May —: A third test of the Thor missile at Cape Canaveral ended in failure.
- : A Soviet rocket carried 5 dogs to 131 miles altitude in a capsule with a total weight of 4,841 pounds; reported in Pravda of March 27, 1958; all returned successfully, by Soviet claim.
- : Andrew Stone of Metro-Goldwyn-Mayer offered to pay the price of launching an Earth satellite using the Jupiter C rocket, based upon estimates of what would be possible to achieve an orbit ahead of the Soviet Union given him by Dr. William H. Pickering of the Jet Propulsion Laboratory. He made the proposal in person at the Pentagon, but it was rejected.
- June 2: Captain Joseph W. Kittinger, Jr., USAF remained aloft in a plastic Man High I balloon over Minnesota for 6 hours, 34 minutes, including over 2 hours over 90,000 feet, and reaching 96,000 feet.
- : An article in Pravda quoting Professor Nesmeyanov stated that the rockets and the instruments for the first Earth satellite were complete, that it would be launched in a few months, and that it would be big enough to be seen through field glasses. It was to be used for ionospheric studies.

## 1957—Continued

- June 7: An anonymous scientist stated that the United States Army had available a missile which could launch an Earth satellite.
- June 9: The U.S.S.R. Literary Gazette stated that dogs would take part in the Soviet space program. It reported that 100 rockets would be fired from three areas to altitudes of 50 to 125 miles.
- June 10: The Soviet Union announced that it planned to launch satellites in a few months, in a document sent to Dr. Lloyd V. Berkner, of the IGY Committee. Contents of the report, which stated that the Soviet Union would launch 125 rockets, were made public at International Geophysical Year headquarters on June 21 and supplemented information supplied at a Soviet press conference June 18, 1957.
- June 11: The first launching attempt was made of an Atlas missile at Cape Canaveral, but it exploded shortly after takeoff, at about 10,000 feet.
- : Nesmeyanov announced that the first Soviet satellite would be launched in a very few months. Ogonok magazine stated that it would use a multistage rocket.
- June 20: Soviet scientists reported their first satellite would be launched before the end of 1957 and superior to the United States satellite in size, racing to be first. Soviet IGY Chairman Fedorov reported that no definite launching date had been set, stating there were still many difficulties to be overcome. The satellites were expected to fly between 120 and 300 miles in an elliptical orbit at close to 18,000 miles per hour. They would measure air density, meteorites, and cosmic rays.
- June 21: "A Casebook on Soviet Astronautics—Part II" by F. J. Krieger was issued by the Rand Corporation as a continuation of its research memorandum of June 21, 1956.
- June 22: The first Soviet satellite was to measure close to 18 inches in diameter, travel near the Arctic and the Antarctic, but not over the poles. The satellites would measure the shape of the Earth, relativity theory, ultra-violet, X-ray, and corpuscular solar radiation. The weight of the first Soviet satellite was estimated on the order of 110 pounds.
- June 23: Franklin Institute Planetarium Director I. M. Levitt foresaw the Soviet satellite as being more impressive than its American equivalent. In the Soviet Union Khlebtsevich predicted that the U.S.S.R. would send a radio-guided rocket to the Moon early in the 1960's, and also predicted unmanned flights to Mars and Venus, with remotely controlled guidance to insure their arrival.
- June 27: The Soviet Union predicted a Moon probe in the early 1960's, a Moon base 5 to 10 years later, a Mars probe in the 1965-71 period, and 5 Venus probes. The Soviet Union expects to use the Moon as a television relay point.
- June —: "Observations on Radio Signals from the Artificial Terrestrial Satellite and Their Scientific Value," an article by A. Kazantsev in Radio, reported that the first Russian satellite would contain two radio transmitters operating at about 20 and 40 megacycles and described the manner in which the signals from the transmitters would be emitted.

## 1957—Continued

- July 1: The International Geophysical Year began. Sixty-four nations were to participate in the scientific program which would last for 18 months and would be carried out under a special committee of the International Council of Scientific Unions.
- July 11: The North American Navaho ramjet intercontinental missile project was cancelled by the Air Force.
- July 15: Soviet rocket expert A. Blagonravov urged that the United States and the Soviet Union cooperate on space exploration and on attempts to fly to the Moon.
- July 16: The First Missile Division was moved from Inglewood, Calif., to Cooke (later renamed Vandenberg) Air Force Base.
- July 19: The Air Force fired a nuclear warhead air-to-air nuclear rocket Genie MB-1 from an F-86J over Yucca Flat, Nevada.
- July 24: Khlebtsevich reported that the Soviet Union expected to send a television-equipped interplanetary probe to Venus by means of a five-stage rocket within the next 10 years.
- August 4: E. Fedorov, head of the Soviet satellite program repeated that no launching date had been set yet for the first satellite attempt.
- August 6: The first measurements of the Earth's magnetic field in the auroral zone were made by L. Cahill and J. A. Van Allen, using a Rockoon (balloon-launched rocket).
- August 7: An Army Jupiter C carried a scale model nose cone 1200 miles and to an altitude of 600 miles from Cape Canaveral. The ablation-type cone was recovered next day, and shown to the Nation by the President on November 7, 1957.
- August 15: The Army shot a Jupiter over a distance of 1200 miles and was reported to have come within 400 yards of intended target.
- August 20: Major David G. Simons completed a 32-hour flight in a balloon, which reached an altitude of over 100,000 feet and remained above 90,000 feet for 26 hours. The experiment tested man's adaptation to life at high altitudes through creation of an artificial atmosphere; cosmic radiation tests were also made. He flew from Crosby, Minn. to Elm Lake, S. Dak.
- August 26: The Soviet Union announced the successful flight of an ICBM a few days earlier. It was described as a multistage vehicle which could be directed to any part of the world, and was said to have reached its target area in the test. At the same time it was announced that a series of nuclear and thermonuclear explosions had also been conducted a few days earlier at very high altitude.
- August 28: The Supplemental Appropriation Act, 1958 appropriated \$34,200,000 for the United States scientific satellite "to be derived by transfer from such annual appropriations available to the Department of Defense as may be determined by the Secretary of Defense, to remain available until expended."
- August 30: The Department of Defense in Washington revealed that from four to six Soviet ICBM tests took place in the Spring of 1957.
- August—: A fourth Thor missile was launched at Cape Canaveral, but exploded 96 seconds later.

1957—Continued

- September 1: The U.S.S.R. announced that it planned two types of Earth satellites.
- September 18: Moscow Radio announced that the launching of the first Soviet satellite was coming soon.
- September 20: A fifth Thor missile was launched, and made the first successful flight down range from Cape Canaveral.
- September 22: Soviet Fleet reported that the Soviet satellites would be similar to those designed as wooden models by K. Tsiolkovsky 54 years earlier.
- : A. Shternfeld reported that a new Soviet rocket could carry passengers from Moscow to New York in half an hour.
- September—: The second Atlas was destroyed in a launching attempt at Cape Canaveral.
- October 1: The U.S.S.R. announced that it would use the 20 and 40 megacycle bands for its first satellite. Only successful launchings were to be announced. Military rocketry would be used for lifting purposes.
- October 2: Soviet reporters at the IGY conference in Washington evaded queries on the date for the first launching.
- October 4: The Soviet Union launched the first Earth satellite, Sputnik I. Spherical in shape, it weighed 184 pounds and was 22.8 inches in diameter. Four whip antennas 7 feet 10.5 inches to 9 feet 6 inches in length protruded from the satellite skin which was constructed of aluminum alloys. The satellite carried instruments (their weight was not announced) to measure internal temperatures, pressures "and other data." Two radio transmitters, radiating on frequencies of 20.005 and 40.002 megacycles, were carried; both ceased operating on October 27, 1957. The radios were powered by chemical batteries. The satellite's initial perigee was 142 miles, its apogee 588 miles, and its period 96.17 minutes. It was launched with an inclination to the Equator of 64.3°. The satellite's perigee speed was about 18,000 miles per hour; its speed at apogee was about 16,200 miles per hour. Soviet sources put the total weight in orbit as close to 8,800 pounds. The nose cone of the launching vehicle reentered and burned on November 25, 1957. The large carrier rocket reentered on December 1, 1957. The satellite reentered the atmosphere and presumably disintegrated on January 4, 1958.
- October 5: Resolutions of an international conference on rockets and satellites provided for continuation of internationally coordinated research in these fields beyond the International Geophysical Year. Both American and Russian scientists were present at the conference.
- : Professor Fred Whipple reported that analysis of the radio signals of Sputnik I revealed it was transmitting temperature information. General Blagonravov denied this.
- October 6: The Eighth I.A.F. Congress opened at Barcelona.
- : General Blagonravov announced that Sputnik I was only a test satellite, and was not a part of the regular IGY program which would include satellite shots to follow soon.
- October 8: An Australian station picked up evidence that Sputnik I was triggered to give out collected data.

## 1957—Continued

- October 9: Pravda revealed for the first time that Sputnik I was returning coded information on temperatures.
- : President Eisenhower in a White House press release congratulated the Soviet scientists on Sputnik I. He gave a brief history of the development of the United States satellite program and pointed to the separation of Project Vanguard from work on ballistic missiles.
- October 10: Radio Moscow reported that Sputnik I was returning data on micrometeorites.
- October 11: The seventh Thor made a successful flight of 1100 miles from Cape Canaveral.
- October 13: Aviation Week reported that Lockheed has been working since 1956 on a project called Pied Piper, or unofficially Big Brother. The report was officially denied. The magazine said the satellite would have television or regular photographic capabilities, and use infrared and radar scanners. Orbits would lie between 300 and 1000 miles.
- October 14: The Air Force and NACA reviewed studies of a followon to the X-15, and the combined plan based on all these studies was later designated Dyna-Soar.
- : The American Rocket Society presented to President Eisenhower a program for outer space development formulated after months of study. It proposed establishment of an Astronautical Research and Development Agency similar to the National Advisory Committee for Aeronautics and the Atomic Energy Commission, which would have responsibility for all space projects except those directly related to the military. The report contained a schedule of proposed space projects and pointed out the benefits which would accrue from them. The annual budget of the agency was estimated at \$100 million.
- October 16: The United States Air Force fired an Aerobee rocket at Holloman Air Force Base fitted with three shaped charges in the nose. At 54 miles, these were fired, and it is believed that they sent small pellets of a few grams each at speeds sufficiently high that at least two attained escape velocity and left the Earth. Measurements were made by photographing the meteorlike trail.
- October 20: Sputnik I was revealed also to be reporting cosmic ray data.
- October 21: Aviation Week revealed that the United States had been monitoring Soviet ballistic missile launchings for over 2 years from a large radar installation near Samsun, Turkey.
- October 22: A Jupiter was launched to land in a preselected target area.
- October 23: The United States Air Force, as part of Project Farside, launched a sounding rocket from a balloon 100,000 feet over Eniwetok in mid-Pacific. A four-stage rocket of 1,900 pounds was used. Although the attained altitude was first reported as 4,000 miles, this was in doubt, as contact by radio was lost, and the altitude attained may have been about 2,500 miles.
- : A Vanguard first stage was fired at Cape Canaveral to climb to 109 miles, and fell in the ocean 328 miles off the coast in a successful test. It reached a speed of 4,250 miles per hour. This rocket was labeled TV-2.

## 1957—Continued

- October 24: A completely successful launching of the Thor missile was carried out on Cape Canaveral, the third such in eight attempts. Earlier another launching was credited as partly successful. This one traveled 2,645 miles, according to the reports, but such a distance would greatly exceed the nominal range.
- October 26: The radio in Sputnik I fell silent with exhaustion of batteries.
- October 31: A Snark missile was flown 5,000 miles with a simulated thermonuclear warhead to hit its target with unprecedented accuracy. The launching was from Cape Canaveral and the target was in the vicinity of Ascension Island.
- October —: The sixth Thor was destroyed on the pad in a launching attempt at Cape Canaveral.
- November 3: Sputnik II, carrying a dog, Laika, was launched by the Soviet Union. According to the Tass announcements, the "containers with apparatus" of this rocket-shaped satellite weighed 1,120 pounds, and it contained instruments for studying solar radiation in the short wave ultraviolet and X-ray regions of the spectrum, instruments for cosmic ray studies, instruments for studying the temperature and pressure, an airtight container with an experimental animal (a dog), an air conditioning system, food and instruments for studying life processes in the conditions of cosmic space, measuring instruments for transmitting the results of scientific measurements to the Earth, two radio transmitters operating on frequencies of 20.005 and 40.002 megacycles, both of which ceased operating on November 10, 1957. The radios were powered by chemical batteries. The satellite's initial perigee was 140 miles, its apogee 1,038 miles, and its period 103.75 minutes. Its inclination to the Equator when launched was 65.4°. Its perigee speed was 18,000 miles per hour; its apogee speed 15,100 miles per hour. Sputnik II was attached to its carrier rocket. Never confirmed, Soviet sources suggested a total weight in orbit of about 11,000 pounds. The satellite reentered the atmosphere and presumably disintegrated on April 14, 1958.
- November 7: President Eisenhower in a radio and television address on science and security announced that scientists had solved the problem of re-entry and showed the nose cone of a missile which was intact after a flight through outer space. He announced the creation of the office of Special Assistant to the President for Science and Technology and the appointment of Dr. James R. Killian, president of the Massachusetts Institute of Technology to the new post.
- November 8: Secretary of Defense McElroy directed the Department of the Army to make preparations for launching a satellite with the Jupiter-C test rocket and thus supplement the existing Vanguard program. William M. Holaday, Assistant to the Secretary of Defense for Guided Missiles, was given authority for coordinating this project with the overall satellite program.
- November 9: Dr. Wernher von Braun was quoted as saying that it would take the United States 5 years to catch up with Soviet capacities in space operations.

## 1957—Continued

- November 10: Secretary Quarles denied that a 5-year "gap" estimate was realistic.
- : The radio transmitters of Sputnik II fell silent.
- November 13: President Eisenhower, in a speech on future security, proposed adoption of a formula for decisions on undertaking space projects, which would include the following criteria:
- "If the project is designed solely for scientific purposes, its size and its cost must be tailored to the scientific job it is going to do."
- "If the project has some ultimate defense value, its urgency for this purpose is to be judged in comparison with the probable value of competing defense projects."
- November 15: William M. Holaday, special assistant to the Secretary of Defense, was named Director of Guided Missiles by Secretary of Defense McElroy. Under terms of the Defense Department directive: "The Director of Guided Missiles will direct all activities in the Department of Defense relating to research, development, engineering, production, and procurement of guided missiles." In his press conference Secretary McElroy disclosed that the Department of Defense was thinking of establishing a centralized organization which would handle both outer space and anti-missile-missile projects.
- : Nikita Khrushchev informally challenged the United States to engage in a peaceful shooting match with ICBM's to demonstrate to the world which country could perform over the distance and with the accuracy which indicated superiority.
- November 21: The Rocket and Satellite Research Panel proposed the creation of a National Space Establishment in the executive branch of the Government. Under civilian leadership but cognizant of defense requirements, this establishment would carry out a unified program of space research in its own facilities and by contract. An annual budget of \$1 billion for ten years was recommended.
- : The National Advisory Committee for Aeronautics authorized establishment of a special committee on space technology. This committee would both supervise and help formulate a space research program and would be assisted by specialized subcommittees. Dr. H. Guyford Stever of M.I.T. was named chairman.
- November 22: The first fluorine-hydrogen rocket was operated successfully at the NACA Lewis Laboratory, demonstrating a 40 percent performance improvement over other propellant combinations.
- November 25: The Preparedness Investigating Subcommittee of the Senate Committee on Armed Services began extensive hearings on the Nation's satellite and missile programs. Approximately 70 experts appeared before the Subcommittee during the course of these hearings, and written testimony was submitted by about 200 others.
- : The Air Force awarded a contract for the Sentry reconnaissance satellite to Lockheed.
- : The nose cone of the Sputnik I rocket carrier reentered and burned.



## 1957—Continued

- November 27: Both the Thor and the Jupiter were ordered into production.
- November 29: The First Missile Division was to be transferred from AFBMD to the Strategic Air Command, effective January 1, 1958.
- November —: Thor and Jupiter deployment was charged to the Air Force.
- December 1: The large carrier rocket of Sputnik I fell from orbit. Khrushchev charged that it had fallen in United States territory, probably in Alaska. United States investigations failed to support this claim.
- December 4: The American Rocket Society's proposal for an Astronautical Research and Development Agency, which was presented to President Eisenhower on October 14, 1957, was announced. Commander Robert C. Truax, president of the Society, stated that he felt \$100,000,000 a year would be required at first for the astronautical agency.
- December 5: The Advanced Research Projects Agency, ARPA, was to be created in the Department of Defense to direct Defense space projects.
- December 6: A mechanical failure in the propulsion system of the Vanguard rocket, TV3, caused it to burst into flames two seconds after it was fired in an attempt by the Navy to launch a 6.4 inch, 3.25 pound, test satellite.
- December 7: The ninth Thor was launched at Cape Canaveral at too high an angle trajectory when the guidance malfunctioned.
- : Soviet scientists firmly stated that pieces of the carrier rocket of Sputnik I fell on Alaska. The Academy of Sciences issued a formal appeal requesting return of remnants of the rocket. This in effect repeated the informal charge of Khrushchev on December 6 that the rocket had fallen in United States territory. American authorities were convinced the object seen near Fort Greeley, Alaska, was a fireball, not the rocket.
- December 9: The Secretary of Defense authorized acceleration of the Polaris program to achieve completion of the first armed submarine in 1960.
- December 10: A Directorate of Astronautics was established by the Air Force to manage and coordinate astronautical research programs, including work on satellites and anti-missile weapons. Brig. Gen. Homer A. Boushey was named to head the office.
- December 13: The National Academy of Sciences offered to help the Soviet Union to recover its missing rocket, but asked for clues as to where it might be.
- : The order creating a Directorate of Astronautics was suspended by James H. Douglas, Secretary of the Air Force, as creation of such a group before establishment of the proposed Advanced Research Projects Agency was felt to be premature.

## 1957—Continued

- December 14: Maj. Gen. John B. Medaris, Commander of the Army Ballistic Missile Agency, in testifying before the Senate Preparedness Investigating Subcommittee stated: "Because I have no responsibility to carry this out, I think I can say in open meeting that it is my personal opinion unless this country can command 1 million pounds of thrust by 1961, we will not be in space \* \* \* we will not be in the race."
- December 17: The first successful flight was made by the third Atlas missile at Cape Canaveral over a distance of about 600 miles.
- December 19: The tenth Thor missile, (the eighth tested), and the fourth success, used an all-inertial guidance system, the first such flight.
- December 24: The Soviet Union reported that a dog, Albina, had twice ridden in rockets; most recently parachuting safely after an ascent to 125 miles.
- December —: The B-70 Mach 3 bomber contract was awarded by the Air Force to North American Aviation.
- During 1957 The NACA Lewis Laboratory experimentally operated a 20,000 pound thrust hydrogen-oxygen rocket engine, leading to the development of the Centaur vehicle.

## 1958

- January 1: The Strategic Air Command was assigned responsibility for the United States operational ICBM capability.
- January 4: Sputnik I reentered and burned.
- : The American Rocket Society and the Rocket and Satellite Research Panel issued a summary of their proposals for a National Space Establishment. Preferably independent of the Department of Defense, but in any event not under one of the military services, this establishment would be responsible for the "broad cultural, scientific, and commercial objectives" of outer space development. A timetable of the achievements necessary for attaining United States leadership in space technology was included in the document.
- January 9: In his State of the Union Message, President Eisenhower reported: "In recognition of the need for single control in some of our most advanced development projects, the Secretary of Defense has already decided to concentrate into one organization all antimissile and satellite technology undertaken within the Department of Defense."
- January 10: The fourth Atlas made a successful limited flight.
- January 11: James H. Doolittle, chairman of the National Advisory Committee for Aeronautics, announced the authorization of a special committee on space technology on November 21, 1957. Dr. H. Guyford Stever was to head the committee.
- : The first launching was successfully made of a Polaris test vehicle at the Naval Air Missile Test Center, Point Mugu, Calif.

## 1958—Continued

- January 12: President Eisenhower, in answering the December 10, 1957, letter of Soviet Premier Nikolai A. Bulganin regarding a summit conference and disarmament, proposed that the Soviet Union and the United States "agree that outer space should be used only for peaceful purposes." This proposal was compared with the 1948 offer of the United States to cease production of nuclear weapons and dedicate atomic energy to peaceful uses, an offer which was not accepted by the Soviet Union.
- January 13: In his Budget Message to Congress, President Eisenhower stated that in his request: "Funds are provided for an expanded research and development effort on military satellites and other outer space vehicles and on antimissile missile systems, to be carried out directly under the Secretary of Defense." The budget for fiscal year 1959 showed that \$340,000,000 in new obligational authority was being asked for the Advanced Research Projects Agency. No new authorizations were sought for the International Geophysical Year, but estimated obligations for earth satellite exploration of the upper atmosphere under this program were \$8,139,834 for the fiscal year 1958 and \$21,000,000 for fiscal year 1959.
- : Secretary of Defense Neil H. McElroy, in testifying before the House Armed Services Committee, stated:  
"Such long-range programs as the antimissile missile and the military satellite programs are in the research and exploratory development stages. They are important and must be pursued, but they must not distract us from the speedy development of our other missile systems. To handle them, I am establishing within the Department of Defense an Advanced Research Projects Agency, which will be responsible to the Secretary of Defense for the unified direction and management of the antimissile missile program and for outer space projects. I would expect to assign other special projects of this general nature to this agency from time to time in the future."
- : General Orval Cook, President of the Aircraft Industries Association proposed that the NACA be adapted to become the space agency for the United States research program in this field.
- January 14: Censored Air Force testimony made public that a reconnaissance satellite with a recoverable capsule was expected to be launched in the spring of 1959, with a Thor-launched test vehicle by October 1958. Purposes of the capsule were not officially revealed.
- : Senator Lyndon B. Johnson in an address before Columbia Broadcasting System affiliates in Washington, D.C., urged the United States "to demonstrate its initiative before the United Nations by inviting all member nations to join in this adventure into outer space together." Growth of America's space research program and establishment of a government agency for its direction were also demanded by Johnson as part of the Nation's answer to the Soviet challenge.
- : The NACA issued a staff study entitled "A National Research Program for Space Technology".

## 1958—Continued

January 16: The NACA adopted a resolution recommending that the national space program be a cooperative effort among the Department of Defense, the NACA, the National Academy of Sciences, the National Science Foundation, together with private institutions and companies, with the Department of Defense responsible for military development and operations, and NACA responsible for research and scientific operations in space.

—: Representative Carl T. Durham, chairman of the Joint Committee on Atomic Energy, announced the establishment of a Special Subcommittee on Outer Space Propulsion with Senator Clinton P. Anderson as chairman.

January 17: The first launching was made of a Polaris test vehicle at Cape Canaveral.

January 22: Nikita S. Khrushchev in a speech at Minsk, Byelorussia, stated that the Eisenhower proposal to dedicate outer space to peaceful purposes was an attempt of the United States to ban weapons it did not possess and to protect itself from those weapons which would harm its own territory.

January 23: Membership of the Special Subcommittee on Outer Space Propulsion of the Joint Committee on Atomic Energy was announced:

Senators: Clinton P. Anderson, chairman, Henry M. Jackson, Albert Gore, Bourke B. Hickenlooper, John W. Bricker.

Representatives: Chet Holifield, Melvin Price, James E. Van Zandt, James T. Patterson.

—: Senator Clinton P. Anderson in a speech before Congress explaining his bill, S. 3117, proposed that control of the Nation's outer space program for the "peaceful conquest of space" be given to the Atomic Energy Commission. He stressed that such a decision would save needed time and would give control to an established civilian agency with extensive laboratories. Senator Anderson pointed out that nuclear propulsion should play an essential part in space technology.

—: Senator Lyndon B. Johnson read a statement unanimously adopted by the Senate Preparedness Investigating Subcommittee at the conclusion of its hearings. Largely concerned with guided-missile development, it stated that the Russian satellite program "demonstrates beyond question that the Soviet Union has the propulsive force to hurl a missile from one continent to another." The American program since the launching of Sputnik I was reviewed, and the report made 17 recommendations for American security, including:

"Start work at once on the development of a rocket motor with a million-pound thrust."

"Accelerate and expand research and development programs, provide funding on a long-term basis, and improve control and administration within the Department of Defense or through the establishment of an independent agency."

1958—Continued

January 27: Hugh L. Dryden, Director of the National Advisory Committee for Aeronautics, delivered a speech, "Space Technology and the NACA," to the Institute of the Aeronautical Sciences. Stressing the importance of a well-planned and logical space program embracing both civilian and military uses, Dryden pointed to the organization of the NACA for both military and nonmilitary aeronautical research and reviewed the Committee's work in space research since World War II. He related the view expressed by the NACA at its January 16, 1958, meeting that the national space program should be under the joint control of the Department of Defense, the NACA, the National Academy of Sciences, and the National Science Foundation; in addition to research flights, the NACA would "coordinate and conduct research in space technology in its own laboratories and by contract in support of both military and nonmilitary projects."

January 28: Thor number eleven was fired successfully, but went off course.

January 29: The Department of Defense announced plans for the establishment of the Pacific Missile Range, with Point Mugu the nucleus.

January 31: The first American satellite, Explorer I, was launched under the IGY program. The launching of this and succeeding Explorer satellites was accomplished by the Army Ballistic Missile Agency and the Jet Propulsion Laboratory of the California Institute of Technology using a Jupiter C modified Redstone for the first stage and scaled-down Sergeants for the three upper stages. The gross take off weight was 64,000 pounds. The first stage had 83,000 pounds thrust; the second stage, 733 pounds thrust; the third stage 200 pounds thrust; and the fourth stage, 67 pounds thrust. Cylindrical in shape, the satellite was 80 inches long, 6 inches in diameter, and weighed 30.8 pounds with a payload of 18.13 pounds. The satellite was constructed of steel, with eight aluminum oxide stripes painted on its surface to control temperatures. The satellite had 2 antennas: A turnstile type with 4 whip elements each 22.5 inches long and a dipole antenna using the skin of the satellite itself. Instrumentation weighing 10.63 pounds was designed to measure cosmic rays, micrometeors, and temperatures within and on the skin of the satellite. One radio transmitter, operating on a frequency of 108 megacycles at 10 milliwatts of power, telemetered data on cosmic rays, micrometeor erosion, and front-skin and nose-cone temperatures. The second radio transmitter, operating on a frequency of 108.03 megacycles at 60 milliwatts of power, telemetered data on cosmic rays, micrometeor impact, and internal and rear-skin temperatures. The low-power transmitter ceased operating on May 23, 1958. The high-power transmitter first stopped transmitting on February 11, 1958; it began again on February 24, and ceased operating finally on February 28, 1958. The radios were powered by mercury batteries. The satellite's initial perigee was 224 miles, its apogee 1,573 miles, its period 114.8 minutes. It was launched at an inclination to the Equator of 33.5°. Its perigee speed was 18,400, its apogee speed 13,700 miles per hour. The satellite is still in orbit, and was expected to remain in orbit from 3 to 5 years.

## 1958—Continued

- February 1: The Army has proposed a plan for a 500-pound reconnaissance satellite.
- February 2: Senator Jackson predicted the United States could launch a Moon rocket with just a few months' preparation.
- February 3: The Army reconnaissance plan might run as high as 700 pounds, for a television carrying unit to be launched late in 1958, based on the Jupiter C launching device.
- : Soviet Premier Nikolai A. Bulganin in a letter to President Eisenhower stated that the Soviet Union "is ready to examine also the question of the intercontinental rockets if the Western Powers are willing to reach agreement to ban atomic and hydrogen weapons, to end tests thereof, and to liquidate foreign military bases in other nations' territories. In that case, an agreement on the use of outer space for peaceful purposes only would unquestionably meet no difficulties."
- : Scientists at the California Institute of Technology reported that initial data from Explorer I showed that cosmic radiation in its orbit did not exceed 12 times the amount on Earth and thus appeared to pose no great threat to travel in this region. In addition, no positive evidence of encounter with meteoritic particles had been found.
- February 4: Republican Congressional leaders were informed that President Eisenhower had directed James R. Killian, Jr., to study and make recommendations on the governmental organization of the Nation's space and missile program.
- February 5: The second trial firing of a Vanguard test satellite failed as defects in the first-stage engine control system caused the rocket to veer to the right and break in two about 60 seconds after launching, 4 miles up. The rocket was destroyed by the range safety officer at the Air Force Missile Test Center, Cape Canaveral, Fla. The satellite weighed 3.25 pounds, was 6.4 inches in diameter. The payload included yeast. This rocket was labeled TV-3 backup.
- February 6: The Senate passed S. Res. 256 by a vote of 78 to 1, creating a Special Committee on Space and Astronautics to frame legislation for a national program of space exploration and development.
- February 7: The Advanced Research Projects Agency was established by the Department of Defense, and Roy W. Johnson, a vice president of General Electric Co., was appointed by Secretary of Defense McElroy as its director. ARPA was placed in charge of the Nation's outer space program including the development of military space weapons and was made responsible for antimissile missile projects. William M. Holaday, Director of Guided Missiles, was to transfer responsibilities in these fields to Mr. Johnson.
- : The fifth Atlas was destroyed about 2 minutes after launching, but otherwise was successful in meeting test objectives.

## 1958—Continued

February 10: The following Senators were named to the Senate Special Committee on Space and Astronautics: Lyndon B. Johnson, Styles Bridges, Richard B. Russell, Leverett Saltonstall, Clinton P. Anderson, Bourke B. Hickenlooper, Theodore Francis Green, Alexander Wiley, John L. McClellan, Karl E. Mundt, Warren G. Magnuson, John W. Bricker, Stuart Symington.

———: The first known radar contact was made with Venus on this day and again on February 12. Signals were sent from Millstone Hill, Mass. These results were announced on March 19, 1959, after many months of analysis of records.

———: Senator Michael J. Mansfield urged the members of the North Atlantic Treaty Organization to take the initiative in exploring space on a cooperative basis. Other nations who wished "to participate in good faith" would be included in this international undertaking. Senator Mansfield also recommended that the United States should propose extending the International Geophysical Year "into a decade of worldwide scientific cooperation."

February 11: The Supplemental Defense Appropriation Act, 1958, stated: "The Secretary of Defense is authorized to transfer not exceeding \$10,000,000, to remain available until expended, from any appropriations available to the Department of Defense for the current fiscal year for such advanced research projects as he may designate and determine. \* \* \*" It was provided that current fiscal year appropriations for related programs might be transferred to and merged with this appropriation, and that amounts of this appropriation might be transferred to other appropriations for advanced research under the Department of Defense.

February 12: Public Law 325 gave the Department of Defense authority to participate in advanced research projects, including space projects. Section 7 read in part:

"The Secretary of Defense or his designee is authorized to engage in such advanced projects essential to the Defense Department's responsibilities in the field of basic and applied research and development which pertain to weapons systems and military requirements as the Secretary of Defense may determine after consultation with the Joint Chiefs of Staff; and for a period of one year from the effective date of this Act, the Secretary of Defense or his designee is further authorized to engage in such advanced space projects as may be designated by the President."

February 13: The National Society of Professional Engineers proposed establishment of a Federal Space Exploration Commission to undertake and have unified responsibility for a program of space exploration. The commissioners would be appointed by the President, and the civilian commission "would be able to give the military services adequate opportunity for rocket and missile development—as consistent with the defining of service roles at the highest policy level."

February 14: "Basic Objectives of a Continuing Program of Scientific Research in Outer Space," a report by the Technical Panel on the Earth Satellite Program of the United States National Committee for the International Geophysical Year was published.

## 1958—Continued

The report proposed a program of space research extending beyond the International Geophysical Year. It outlined the technical investigations which should be made by sounding rockets, lightweight and advanced satellites, lunar probes, planetary and interplanetary research, and manned space flight, and gave a detailed description of the scientific information which could be gained from these experiments.

February 16: Airman Donald G. Farrell completed a week's isolation in a sealed space cabin at Randolph Air Force Base in an experiment testing atmospheric equipment for space flight on a simulated trip to the Moon, and the effects of this artificial environment on man's working ability. The small cabin was comparable in dimensions and equipment to what might go into a future spaceship. Air and liquids were recycled to simulate an actual space flight. During the course of the week Farrell was given various tasks to perform, and emergencies to meet.

———: Rocketdyne was assigned an Air Force study contract to develop a nuclear rocket.

February 17: In a letter to Soviet Premier Nikolai A. Bulganin, President Eisenhower repeated his plea for the dedication of outer space to peaceful uses. Denying that this proposal was intended "to gain strategic advantages for the United States," he stressed the urgency of dealing with outer space before its use for military purposes had, like nuclear weapons, advanced to the point where complete international control was almost impossible.

———: Vice President Nixon asked that space development be put into civilian hands.

February 18: The Air Force expected to launch a 3,000-pound satellite by October 1958, based on the Atlas. This would be part of the Lockheed Pied Piper system. Photographic, television, and infrared scanning systems are under consideration.

February 20; The sixth Atlas was destroyed about 2 minutes after launching.

———: Senator Lyndon B. Johnson was elected chairman of the Senate Special Committee on Space and Astronautics.

February 21: According to the Soviet Geophysical Year Committee, the Russians fired to a 294-mile altitude a rocket containing 3,340 pounds of instruments for measuring the ion composition of the atmosphere, electronic temperature, air pressure, encounters with micrometeorite particles, the ultraviolet sector of the spectrum, and the concentrations of free electrons in the ionosphere and of positive ions. This was a single-stage rocket.

February 25: Lieutenant General Putt requested permission to send a rocket to the Moon, to get there ahead of the Soviets.

February 27: The Air Force announced that plans were well advanced for a reconnaissance satellite weighing in excess of 1,300 pounds.

———: The Department of Defense assigned responsibility for land-based ICBM's and IRBM's to the Air Force, and directed it to develop the Minuteman solid propellant ICBM capable of launch from underground sites.

February 28: Thor No. 12 was credited as partially successful in a launching at Cape Canaveral.



## 1958—Continued

- March 5: Pentagon sources expected the Army would be given a Moon assignment while the Air Force concentrated on manned vehicles.
- : Explorer II was launched using a Jupiter C, but did not go into orbit because of failure of the final rocket to ignite. Unable to achieve the required velocity, it re-entered the atmosphere and was probably burned up before falling into the Atlantic Ocean 1900 miles southeast near Trinidad. The satellite weighed 31.5 pounds, was 80 inches long.
- : H. Res. 496, passed by the House of Representatives, established a Select Committee on Astronautics and Space Exploration to investigate the problems of outer space and to submit recommendations for the control and development of astronautical resources. Congressmen appointed to the Committee were: Majority Leader John W. McCormack, chairman, Overton Brooks, Brooks Hays, Leo W. O'Brien, Lee Metcalf, William H. Natcher, B. F. Sisk, Minority Leader Joseph W. Martin, Jr., vice chairman, Leslie C. Arends, Gordon L. McDonough, James G. Fulton, Kenneth B. Keating, Gerald R. Ford, Jr.
- : The following appointments to the Advanced Research Projects Agency were announced by the Department of Defense: Rear Admiral John E. Clark, USN, Deputy Director; Lawrence P. Gise, Director, Program Control and Administration; Lambert L. Lind, Special Assistant to the Director.
- March 7: George J. Feldman, New York attorney, was appointed director and chief counsel of the House Select Committee on Astronautics and Space Exploration.
- March 9: Harold E. Stassen, in an address on foreign policy, urged the United States "to express willingness to join in a United Nations Space Development Agency which would endeavor as a United Nations project to send the first man into space and to send the first inspection photographic satellite around the Earth."
- March 12: Five Air Force officers in a B-36 cabin began a simulated five day space flight.
- March 14: General Medaris said that only the military services had the experience to run a successful space program.
- March 15: In a Foreign Ministry statement the Soviet Union proposed that banning the use of outer space for military purposes, as suggested by President Eisenhower, be coupled with the liquidation of foreign military bases on the territories of other countries, especially in Europe, the Middle East, and North Africa. An international program for space research would be established under the control of the United Nations and each country would pledge to launch rockets only under this program. A new United Nations agency for international cooperation in research on cosmic space would develop this space program, continue the International Geophysical Year research program on a permanent basis, and serve as a clearing house and coordinator for national research.
- March 16: Secretary of the Army Brucker said a rocket would be launched to the Moon "right soon," in a matter of a few months.

1958—Continued

March 17: Vanguard I, a test sphere weighing 3.25 pounds, was launched at Cape Canaveral as the second United States IGY satellite by the Naval Research Laboratory. Spherical in shape, the satellite is 6.4 inches in diameter and weighs 3.25 pounds. It was constructed of aluminum and has one turnstile antenna and one dipole antenna with a total of six 12-inch rod elements. Although the satellite is not actually instrumented, temperatures can be deduced from changes in its radio frequencies. Two radio transmitters are carried: one operated on a frequency of 108.00 megacycles at a power of 10 milliwatts; the other radiates at 108.03 at 5 milliwatts of power. The higher power transmitter, powered by mercury batteries, ceased operating on April 5, 1958. The lower power transmitter, powered by six groups of solar converters, may operate indefinitely. The satellite's initial perigee was 409 miles, its apogee 2453 miles, its period 134.39 minutes. It was launched at an inclination to the equator of 34.25°. The launching vehicle with the Martin Co. as prime contractor weighed 22,600 pounds at takeoff. The first stage General Electric engine had a thrust of 28,000 lbs. The second stage Aerojet engine had a thrust of 8,000 pounds at altitude. The third stage Grand Central Rocket engine had a thrust of 1440 pounds. The satellite's perigee speed was 18,400 miles per hour; its apogee speed was 12,400 miles per hour. The satellite is still in orbit, and is expected to remain there for perhaps 200 years. This rocket was labeled TV-4. There is also in orbit the 50-pound carrier rocket casing.

—: An experiment testing the behavior of crews under conditions of long confinement was concluded at Wright Air Development Center, as 5 Air Force officers ended a 5-day simulated space flight.

March 18: The Institute for Defense Analysis, a nonprofit corporation serving the Department of Defense, announced the formation of an Advanced Research Projects Division and the appointment of Dr. Herbert F. York as its head. In this capacity Dr. York would serve as Chief Scientist for the Defense Department's Advanced Research Projects Agency. He had been director of the University of California Radiation Laboratory at Livermore, California.

March 19: The House of Representatives voted \$100,000 for expenses of its new space committee. (H. Res. 500, Report 1523.)

—: The IGY Satellite Panel offered a space program for the United States.

March 21: Richard P. Hines was appointed clerk of the House Select Committee on Astronautics and Space Exploration.

—: A rocket propelled sled at Holloman Air Force Base reached a speed of 2,700 miles per hour on the test track.

March 23: The Navy conducted its first "pop-up" launching of a full-scale Polaris vehicle from the submerged launcher at San Clemente Island, Calif. This is the first known full-scale test of underwater launching of a large, long-range surface-to-surface missile.

1958—Continued

March 24: Senator Lyndon B. Johnson, chairman of the Senate Special Committee on Space and Astronautics, made the following staff appointments: Dr. Glen P. Wilson, coordinator of technical information; Eilene Galloway, special consultant.

March 25: Senator Lyndon B. Johnson announced the following appointments to the Senate Special Committee on Space and Astronautics: Edwin L. Weisl, consulting counsel; Cyrus R. Vance, consulting counsel; Dr. Homer Joe Stewart, scientific consultant.

March 26: President Eisenhower in a brief statement made public the President's Science Advisory Committee's report, "Introduction to Outer Space; an Explanatory Statement." This report set forth the basic factors making the advancement of space technology a national necessity and explained to the nontechnical reader the principles and potentialities of space travel. The many uses of space technology for scientific and military purposes were summarized, and a timetable for carrying out these objectives was included.

—: Explorer III, the third United States IGY satellite, was launched by the Army using a Jupiter-C rocket combination again. Cylindrical in shape, it was 80 inches long, 6 inches in diameter, and weighed 31.0 pounds including a payload of 18.56 pounds. The satellite had two dipole antennas, using the skin of the satellite itself which was constructed of steel. Instrumentation weighing 10.83 pounds was designed to measure cosmic rays, employing a tape recorder feature; micrometeor erosion; and temperatures within and on the skin of the satellite. One radio transmitter, operating on a frequency of 108.00 megacycles at 10 milliwatts of power, telemetered data on all of the experiments; the other transmitter, radiating on a frequency of 108.03 at 60 milliwatts of power, telemetered data on cosmic rays only. The 108.00 transmitter first ceased operating on May 10, 1958; its beacon feature only functioned again from May 15 to June 16, 1958. The 108.03 transmitter first ceased operating on May 14, 1958; it responded again erratically from May 22 to June 5, 1958. Both transmitters were powered by mercury batteries. The satellite's initial perigee was 121 miles, its apogee 1,746 miles, and its period 115.9 minutes. It was launched at an inclination to the Equator of 33.37°. Its perigee speed was 18,860 miles per hour, and its apogee speed was 13,450 miles per hour. It reentered the atmosphere sometime between June 27-29, 1958, and presumably disintegrated.

March 27: President Eisenhower gave his approval to the plans for outer space exploration announced by Secretary of Defense Neil H. McElroy. The Advanced Research Projects Agency was to undertake several space projects including the launching of earth satellites and lunar probes. The Air Force Ballistic Missile Division was authorized by ARPA to carry out three lunar probes with a Thor-Vanguard system, and one or two lunar probes utilizing the Jupiter-C rocket were assigned to the Army Ballistic Missile Agency. Eight million dollars was initially allocated. A mechanical ground scanning system for lunar investigations was to be developed by the Naval Ordnance Test Station, China Lake, Calif.

## 1958—Continued

- March 27: Dr. Charles S. Sheldon II was named assistant director of the House Select Committee on Astronautics and Space Exploration.
- March 28: Some military leaders were said to think the space probe plan was too limited in scope and imagination.
- March 29: The Air Force Academy established a Department of Astronautics.
- March 31: General John B. Medaris was made head of the Army Ordnance Missile Command, with direct access to the Secretary and the Chief of Staff. General Toftoy was his deputy, and General John A. Barclay was the head of the Army Ballistic Missile Agency.
- April 2: President Eisenhower in a message to Congress proposed the establishment of a National Aeronautics and Space Agency into which the National Advisory Committee for Aeronautics would be absorbed. This agency was to have responsibility for civilian space science and aeronautical research. It would conduct research in these fields in its own facilities or by contract and would also perform military research required by the military departments. Interim projects pertaining to the civilian program which were under the direction of the Advanced Research Projects Agency would be transferred to the civilian space agency. A National Aeronautics and Space Board, appointed by the President and composed of eminent persons outside the Government and representatives of interested Government agencies (with at least one member from the Department of Defense), was to assist the President and the director of the National Aeronautics and Space Agency.
- : The original budget request of \$340,000,000 in new obligational authority for the Advanced Research Projects Agency for fiscal year 1959 was raised to \$520,000,000 for advanced research projects in a letter from the Director of the Bureau of the Budget, Maurice H. Stans, which was transmitted to Congress by President Eisenhower.
- April 3: In a message to Congress on the organization of the Nation's Defense Establishment, President Eisenhower recommended creation of the position of Director of Defense Research and Engineering, which would have a higher rank and replace the present Assistant Secretary of Defense for Research and Engineering. Among his other responsibilities, the Director would supervise the research activities of the Advanced Research Projects Agency.
- April 5: The seventh Atlas was sent 600 miles from Cape Canaveral.
- : Dr. S. Fred Singer, physics professor at the University of Maryland, was named head, scientific evaluation consultants of the House Select Committee on Astronautics and Space Exploration.
- April 11: The Navy fired the second full-scale dummy Polaris missile from an underwater launcher near San Clemente Island, California.

1958—Continued

April 14: Sputnik II plunged to earth.

———: The proposal for a National Aeronautics and Space Agency drafted by the Bureau of the Budget was contained in the following congressional bills:

S. 3609, Senator Lyndon B. Johnson and Senator Styles Bridges

H.R. 11881, Representative John W. McCormack

H.R. 11882, Representative Leslie C. Arends

H.R. 11887, Representative Harry G. Haskell, Jr.

H.R. 11888, Representative Kenneth B. Keating

H.R. 11946, Representative William H. Natcher

H.R. 11961, Representative Peter Frelinghuysen, Jr.

H.R. 11964, Representative James G. Fulton

H.R. 11996, Representative Gordon L. McDonough

April 15: The Select Committee on Astronautics and Space Exploration of the House of Representatives opened hearings on outer space as a step toward formulating a national space program. During the hearings, which continued for three weeks, military and scientific experts discussed the scientific development of outer space and offered recommendations on the establishment of a civilian space agency.

April 17: Lieutenant General Gavin and Major General Medaris testified that appearance of a reconnaissance satellite over the United States should be treated as invasion, but urged the early development of a capability to operate such devices ourselves.

———: Six Navy men began a 7-day simulated trip to the Moon in a compression chamber at the Philadelphia Naval Base. The experiment met expectations, and the men stepped out afterward alert and healthy.

———: A British Skylark missile with instruments was fired to an altitude of 90 miles at Woomera, Australia.

April 18: A Polaris test vehicle was fired successfully at Cape Canaveral.

April 19: A Thor missile blew up on the launching pad at Cape Canaveral.

April 21: A naval flier began a 24-hour experiment wearing a space suit in a chamber evacuated to the equivalent of 80,000 feet altitude. He emerged tired but hungry.

April 22: Hearings on proposed reorganization of the Department of Defense opened before the House Committee on Armed Services.

———: Dr. Hugh Dryden testified that large aluminized balloons might be put in orbit around the Moon, after being carried to that vicinity in a small rocket, and then inflated.

April 23: Thor-Able test vehicle number 1 was launched at Cape Canaveral in a reentry test. The nose cone contained the mouse Mia I. The Vanguard second stage failed to fire, and the mouse and cone were not recovered, as the shot fell short of the 5,000-mile goal.

April 24: Major General Schriever testified that Pied Piper has been assigned a priority equal to ballistic missiles.

———: A Navy rocket sled at China Lake attained a speed of 2,827.5 miles per hour.

## 1958—Continued

- April 25: Spencer M. Beresford was appointed special counsel of the House Select Committee on Astronautics and Space Exploration.
- April 27: An article in Pravda on Soviet satellite findings reported that Laika's heartbeat had taken three times as long as expected to return to normal, once its acceleration due to the satellite's speed had ceased. Weightlessness affecting the nerve centers was suggested as the cause. The Soviet report disclosed that the density and temperature of the atmosphere at a given altitude were not uniform, and that cosmic ray intensity was 40 percent greater at 400 miles than at 135 miles. The article also contained information on the density of electrons and reported one mysterious 50-percent increase in radiation intensity.
- April 28: An instrumented Vanguard satellite was launched by the Navy at Cape Canaveral, but due to failure of the third-stage rocket, did not attain the speed required to orbit around the Earth. It burned up on reentry 1,500 miles away. The satellite was 21.5 pounds, 20 inches in diameter. Instruments were to record X-rays, temperatures, and meteor data. The fault was blamed on wiring. This rocket was labeled TV-5.
- April 29: General Doolittle opposed a Moon shot stunt of hitting the surface with a thermonuclear warhead.
- April —: Maj. Gen. F. A. Bogart testified that by late fall the Air Force could launch 5 to 7 Moon rockets, with a 70 percent chance of success of impact for each one.
- May 1: Scientific findings from the 2 Explorer satellites disclosed an unexpected band of high-intensity radiation extending from 600 miles above Earth to possibly an 8,000-mile altitude. The radiation, which was described by Dr. James A. Van Allen as "1,000 times as intense as could be attributed to cosmic rays," was believed to come from ionized gas; Dr. Van Allen felt lead shielding 1 millimeter thick would reduce this radiation about 90 percent. The Explorers also showed that the atmosphere at 220 miles was denser than predicted, that satellite temperatures would not be too great for humans, and that cosmic dust was only a small hazard to space travel. The radiation was totally unexpected, and raised many questions about manned flight into space because of the shielding which might be required. Future satellites will be instrumented to learn more of the characteristics of this band which were first reported from the original Explorer satellites.
- : Department of Defense responsibility for Project Vanguard was transferred from the Navy to the Advanced Research Projects Agency.
- May 6: The Senate Special Committee on Space and Astronautics opened hearings on the administration's proposal for a National Aeronautics and Space Agency.
- May 8: A Polaris test vehicle launched at Cape Canaveral exploded after takeoff, but was successful in testing components as planned.
- May 12: Scientists at an ICSU meeting in The Hague warned against any nuclear explosion on the surface of the Moon which would endanger later scientific measurements of its surface.

## 1958—Continued

- May 13: Majority Leader John W. McCormack introduced, at the direction of the House Space Committee, House Concurrent Resolution 326 calling for the peaceful use of space.
- May 14: American scientists indicated in Washington that future Moon rockets would be sterilized to forestall any biological contamination of the Moon which would endanger later scientific studies of that body.
- May 15: Sputnik III was launched by the Soviet Union. Conical in shape, it was reported to be 11 feet 9 inches long, 5 feet 8 inches wide at the base, and weighed 2,925 pounds. It had folded dipole and trailing rod antennas, and its shell composition was mainly of aluminum alloys. Instrumentation weighing 2,134 pounds was designed to measure atmospheric pressure and composition; concentration of positive ions; the satellite's electrical charge and the tension of the Earth's electrostatic field; tension of the Earth's magnetic field; intensity of the Sun's corpuscular radiation; composition and variations of primary cosmic radiation; distribution of photons and heavy nuclei in cosmic rays; and micrometeor and temperature measurements. The satellite carried 1 radio transmitter, powered by chemical and solar batteries, operating on a frequency of 20.005 megacycles; a second transmission at 40.01 megacycles is a harmonic of the first. The satellite's initial perigee was 135 miles, its apogee 1,167 miles, its period 106 minutes. It was launched with an inclination to the Equator of 65°. Its perigee speed was 18,337 miles per hour, its apogee speed 14,637 miles per hour. Never confirmed, Soviet sources suggested a total weight in orbit of about 13,200 pounds. The carrier rocket reentered on December 3, 1958, and the satellite reentered on April 6, 1960. Its radio operated to the very end.
- May 16: In level flight at Edwards Air Force Base, Capt. Walter W. Irwin, USAF in an F-104A Starfighter set a world speed record for a 10-mile course of 1404.19 miles per hour.
- May 18: A Jupiter missile fired from Cape Canaveral traveled 1,600 miles, and for the first time a full-scale nose cone was recovered intact.
- May 21: The House Select Committee issued its first report to the House on "The National Space Program". (House Report No. 1758.)
- May 23: The House Foreign Affairs Committee approved House Concurrent Resolution 332 (revision of 326). (House Report 1769.)
- May 24: Capt. E. L. Breeding at Holloman Air Force Base withstood a gravity load of 83 g's for a small fraction of a second in the arresting of the rocket sled on which he was riding. He went into a state of shock, but recovered from this in about 10 minutes.
- : The House select committee reported out a clean bill calling for the creation of a civilian space agency. (H.R. 12575, House Report 1770, entitled "Establishment of the National Space Program.")

## 1958—Continued

- May 27: Vanguard SLV-1 was launched at Cape Canaveral. Takeoff was normal, all stages fired. Satellite was 21.5 pounds, 20 inches diameter. Instruments included meteor detectors, solar radiation measurers, and thermometers. Incorrect angle carried it 2,440 miles up, then it burned on reentry between Antigua and Africa, 5,000 miles away. Radio returned data.
- : Representative Carl Albert introduced H. Res. 580 to create a Standing Committee on Science and Astronautics.
- May —: NACA shot a balloon to 50 miles, at Wallops Island. At that altitude, it was inflated. A 4-stage rocket launched the 9-pound balloon.
- June 2: The House of Representatives adopted House Concurrent Resolution 332, the outer space peace resolution.
- : The House of Representatives passed unanimously its Select Committee bill H.R. 12575 to create a civilian space agency.
- June 3: Atlas No. 8 was credited as a complete success over short range in a test from Cape Canaveral.
- June 4: A successful Thor launching was made at Cape Canaveral, the first from a tactical type launcher.
- June 5: Dr. Walter Dornberger opposed any early rocket shot at the Moon as a stunt, stating weapons development was more important.
- June 10: Lt. Gen. Samuel E. Anderson stated the Air Force would launch Moon probes in August, September, and October. Air Force Secretary Douglas and ARPA Director Johnson denounced the report as unauthorized, premature, and inaccurate; suggested launching dates should be wholly disregarded.
- June 11: The Senate Special Committee on Space and Astronautics reported out S. 3609 as amended. (Senate Report 1701.)
- June 13: A successful Thor launching was made at Cape Canaveral.
- June 16: The Senate passed H.R. 12575 with the text of S. 3609, as amended, substituted for the House text, and the bill was sent to conference.
- : The Pacific Missile Range was officially established.
- June 22: Aviation Week in an article termed speculative by ARPA officials predicted that the first Pied Piper satellite would be launched from Camp Cooke, California, using the Thor at the end of 1958 or in early 1959. A variety of scanning instruments were to be used, and the vehicle was to be stabilized in orbit. It was called WS 117L.
- June 26: Vanguard SLV-2 was launched at Cape Canaveral. Takeoff was normal, but the second stage cut off prematurely. The satellite was 21.5 pounds, 20 inches in diameter. The instrument load was the same as for the April 28 attempt.
- June 28: Explorer III reentered the atmosphere and burned sometime between June 27 and June 29.
- June —: The Space Science Board was to be established by the National Academy of Sciences with Dr. Lloyd V. Berkner as Chairman to advise and assist in formulation of United States post-IGY space research, including world-wide cooperation.
- : For the first time, a data capsule was recovered from a Thor missile after flight from Cape Canaveral.



## 1958—Continued

July 1: Japan made its first entry into the rocket era with the successful launching of a Kappa-6tw two-stage rocket which rose 30 miles at the Michikawa Rocket Center.

July 9: A second Thor Able was launched at Cape Canaveral. It traveled 6,000 miles into the South Atlantic. Its mouse passenger, Mia II, was believed to be still alive when the cone reached the surface of the ocean, but after 3 days the search was called off when the radio in the cone became silent.

July 15: House and Senate conferees agreed upon a compromise version of H.R. 12575 to create the National Aeronautics and Space Administration. (House Report 2166.)

July 16: The House and Senate adopted the conference report on H.R. 12575.

July 17: The cone of a Jupiter missile was successfully recovered after a flight of 1,500 miles.

July 19: An Atlas missile was destroyed two minutes after launching at Cape Canaveral, probably because of a failure in guidance. This was the first attempt at flight with all three engines.

July 21: The House of Representatives approved House Resolution 580 establishing a 25-member standing Committee on Science and Astronautics.

July 23: A third Thor Able was launched at Cape Canaveral in another reentry test. A safe landing 6,000 miles downrange near Ascension was indicated, but the cone with its mouse passenger, Wickie, was not located after 2 days of searching.

———: The Senate approved House Concurrent Resolution 332 calling for the peaceful exploration of outer space.

July 24: The Senate established a standing committee on Aeronautical and Space Sciences, under Senate Resolution 327.

July 25: The Air Force awarded a contract to Rocketdyne to begin work on a million pound thrust liquid rocket engine.

July 26: Explorer IV, the fourth United States IGY satellite, was launched by the Army using a Jupiter C again. Cylindrical in shape, it was 80 inches long, 6 inches in diameter, and weighed 38.4 pounds, with a payload of 25.76 pounds. The satellite had two dipole antennas, using the skin of the satellite itself which was constructed of stainless steel. It carried 2 Geiger-Mueller counters and 2 scintillation counters to measure corpuscular radiation at several intensity levels. The instrumentation weighed 18.26 pounds. Two radio transmitters were carried: one operated on 108 megacycles at 10 milliwatts of power and ceased transmitting on September 8, 1958; the other operated on 108.03 megacycles at 60 milliwatts of power and ceased transmitting on October 6, 1958. Both were powered by mercury batteries, and both broadcast all five channels of information simultaneously and continuously, although the low-power transmitter was primarily for tracking. The satellite had an initial perigee of 163 miles, an apogee of 1,380 miles, and a period of 110 minutes. It was launched with an inclination to the Equator of 50.13°. Its perigee speed was 18,406 miles per hour, its apogee speed was 14,232 miles per hour. It reentered October 23, 1959.

## 1958—Continued

- July 26: A Navy balloon carried Comdr. Malcolm Ross and Comdr. M. Lee Lewis to 82,000 feet in a flight lasting 34 hours 29 minutes, a new high altitude duration record. Televised pictures were returned to Earth. The launching occurred near Crosby, Minn., and the landing near Jamestown, N. Dak.
- : Capt. Iven Kincheloe, slated to fly the X-15, was killed in a jet fighter crash.
- : A Thor burst in the sky a minute or so after launching.
- July 28: Brig. Gen. Homer A. Boushey was named Director of Advanced Technology for headquarters of the Air Force.
- : Scientists of East and West recommended that satellites be used to detect any violations of agreements to suspend nuclear tests.
- July 29: The President signed H.R. 12575, making it the National Aeronautics and Space Act of 1958, Public Law 85-568.
- July 30: An unmanned balloon carrying instruments was able to reach an altitude of 133,000 feet.
- : The President requested \$125 million to launch the new NASA.
- July 31: The U.S.S.R. released its first comprehensive Sputnik data to foreign scientists on this occasion, but subsequent negotiations in Moscow brought no assurance that further information would be forthcoming automatically.
- : The Senate Special Committee on Space and Astronautics approved S. 4208 authorizing the appropriation of \$47.8 million for NASA construction and equipment during fiscal 1959. (Senate Report 2076.)
- August 1: Army Redstone No. 50 was successfully fired at Johnston Island in the Pacific as part of the Project Hardtack tests in which a thermonuclear bomb was tested in the upper atmosphere. The flash was visible in Honolulu, 750 miles away. Newspaper speculation was that such a blast in space could send out swarms of neutrons capable of triggering prematurely the nuclear warhead of an approaching ICBM. Study of communications blackout was more likely the objective.
- : The Senate voted to approve S. 4208.
- : The House Select Committee on Astronautics and Space Exploration held a public hearing on the proposed construction and equipment authorizations for NASA, and reported out H.R. 13619, a companion bill to S. 4208.
- : A complete inertial guidance system for ballistic missiles in place of the radio inertial system now in use was announced by the Air Force Ballistic Missile Division.
- August 2: An Atlas missile was flown for the first time with all three engines operating. It traveled 2,500 miles from Cape Canaveral. Although no attempt was made to recover the nose cone, a data capsule was ejected. This was missing for ten weeks until it showed up October 17 floating off Barbados where a fishing boat recovered it and returned it to the Air Force.

## 1958—Continued

- August 2: The National Academy of Sciences and the National Research Council set up a new Space Science Board of 16 members, with Dr. Lloyd V. Berkner as chairman. The purpose is to study scientific research opportunities, to make recommendations to interested agencies, and to stimulate research interest and cooperative activities with groups at home and abroad. Some 11 ad hoc committees have been organized to carry on the work of the Space Science Board in various areas of interest.
- August 4: The House of Representatives passed S. 4208, in substitution for H.R. 13619, authorizing funds for NASA.
- August 6: The eighteenth Thor made a routine 1,500 mile flight in a test from Cape Canaveral.
- : Rocketdyne was assigned a contract by the Air Force to develop a million-pound thrust liquid rocket engine.
- : Under House Resolution 635, the House voted an additional \$85,000 for the operation of the Select Committee on Astronautics and Space Exploration. (House Report 2468.)
- August 8: Dr. T. Keith Glennan, President of the Case Institute of Technology, was nominated to be Administrator and Dr. Hugh L. Dryden, Director of the National Advisory Committee for Aeronautics, as Deputy Administrator of the NASA.
- August 12: Army Redstone No. 51 was successfully fired at Johnston Island in the Pacific as a part of the Project Hardtack series in which a thermonuclear bomb was tested in the upper atmosphere. The flash was visible in Honolulu.
- August 13: The Senate Appropriations Committee approved the Supplemental Appropriations bill (H.R. 13450), containing \$75 million in funds for NASA for fiscal 1959, a reduction of \$50 million below the amount requested by the President. (Senate Report 2350.)
- August 14: The President signed Senate 4208 authorizing appropriations to NASA for construction, making it Public Law 85-657.
- : The Senate Special Committee on Space and Astronautics approved the nominations of Dr. Glennan and Dr. Dryden.
- August 15: Project Saturn was initiated by order of the Advanced Research Projects Agency, with the work assigned to the Redstone Arsenal.
- : The Senate approved the Supplemental Appropriation bill with the \$50 million cut restored along with an amendment by Senator Johnson requiring annual authorizations henceforth before any additional funds could be appropriated for NASA.
- : Dr. Glennan and Dr. Dryden were confirmed by the Senate.
- August 17: First Air Force lunar probe was launched, using Thor Able. An explosion ripped it apart 77 seconds after launch, at an altitude of about 10 miles. It has been designed to put 40 pounds of instruments in an orbit around the Moon, to take pictures of the back side. In addition to the scanning devices, it contained a magnetometer, a meteorite counter, and thermometers. The voyage had been intended to take 2½ days.
- August 19: House and Senate conferees agreed on \$80 million for NASA for fiscal 1959, a cut of \$45 million below the amount requested by the President, together with the Johnson rider on authorizations. (House Report 2677.)

## 1958—Continued

- August 20: The House approved the Supplemental Appropriations bill conference report containing the \$80 million in funds for NASA, but rejected the Johnson rider, sending this provision back to conference. The Senate voted to insist on the Johnson rider.
- August 21: The House and Senate passed a new conference report on the Supplemental Appropriation bill including the \$80 million for NASA and a new compromise requiring for a one year period new authorization authority over all appropriations for NASA.
- August 24: The Senate appointed the membership of its new standing Committee on Aeronautical and Space Sciences. They were: Senators Johnson (Chairman), Russell, Green, Hayden, Magnuson, Anderson, Symington, Kerr, Bridges, Wiley, Hickenlooper, Saltonstall, Bricker, Smith (Maine), and Javits.
- : Explorer V was launched by the Army at Cape Canaveral, using a Jupiter C. Takeoff was normal. But after separation of the first stage, its residual fuel carried it forward to bump and deflect from course the remaining stages. They fired normally, but failed to carry it into orbit, on a path northeast from the Cape. Flight lasted 659 seconds. The satellite weighed 38.43 pounds, was 80 inches long, and was designed to measure radiation belt.
- August 25: The International Astronautical Federation opened its Ninth Annual Congress for a week of meetings in Amsterdam, the Netherlands.
- August 26: It was announced that two mice at the University of Texas had been kept alive 36 days sealed in a space chamber, depending exclusively on the oxygen production of algae sealed into the same system with them.
- August 27: The Soviet Union sent two dogs to an altitude of 281 miles and returned them safely. The payload of the rocket was 3,726 pounds. In addition to the biological equipment, the rocket contained cameras to study the dogs, and a variety of instruments for geophysical purposes. The rocket was stabilized in flight, to prevent rotation. The dogs were named Belyanka and Pestraya. The instruments included measurers of free electrons in the ionosphere, the ionic composition, the concentration of positively charged ions, electronic temperatures, air pressure, infrared radiation, and micro-meteorite impact. The rocket was of single stage construction. Aerodynamic brakes were used, and the dog compartment was separated from the main rocket for parachute landing near the end of the ride.
- : The President signed the Supplemental Appropriation bill, HR 13450, making it Public Law 85-766. The law included \$80 million for NASA, including \$50 million for research and development, \$25 million for construction and equipment, and \$5 million for salaries and expenses.
- : The *Norton Sound* in the South Atlantic launched a rocket which contained an atomic bomb exploded in space as part of a test of the physical phenomena associated with such explosions. This was Project Argus.
- : A routine 1,500-mile flight was made by a Jupiter missile launched from Cape Canaveral in its tenth launching.

## 1958—Continued

- August 29: A second successful Atlas launching with all three engines was conducted at Cape Canaveral, and the missile traveled 3,000 miles. It was equipped with radio-inertial guidance for the first time.
- August 30: The *Norton Sound* launched a second rocket as part of Project Argus, to explode an atomic bomb in space.
- August 31: The First Colloquium on Space Law was held in connection with the I.A.F. Congress at The Hague. Societies from Japan, Bulgaria, Greece, Israel, and Nationalist China joined the I.A.F. Observer status was granted to societies from India, Belgium, Czechoslovakia, Iran, and Canada.
- September 2: Speaking for the President, Ambassador Henry Cabot Lodge announced the United States would propose to the United Nations a plan for international cooperation in the field of outer space.
- September 4: The President appointed to the National Aeronautics and Space Council Detlev W. Bronk, President of the National Academy of Sciences, William A. M. Burden, Lt. Gen. James H. Doolittle (ret.), and Alan T. Waterman, Director of the National Science Foundation. Statutory members additionally include the Secretary of State, the Secretary of Defense, the Chairman of the Atomic Energy Commission, and the Administrator of the National Aeronautics and Space Administration.
- September 5: Lt. Richard H. Tabor, USN, began a stay of several days in a pressure suit in a chamber exhausted to the equivalent of 80,000 to 100,000 feet altitude.
- : The Air Force announced a delay in the second launching attempt of a lunar probe from September 13 until the appropriate time in October.
- September 6: The *Norton Sound* launched the third rocket carrying an atomic bomb which was exploded in space to conclude the Project Argus experiments.
- September 7: The British Black Knight missile was launched at Woomera, Australia to an altitude of over 300 miles. The rocket had a sealevel thrust of 16,400 pounds.
- September 8: An Office of Naval Research unmanned balloon carried a telescope and camera to an altitude of 104,600 feet.
- : A Navy lieutenant spent 72 hours in a simulated space pressure chamber. (See September 5.)
- September 11: An attempt to put into space in a vertical probe an inflatable balloon for satellite work failed.
- : Secretary General Dag Hammarskjold called for an international agreement banning possible national claims to the Moon or other outer space bodies.
- September 12: Wallops Island was announced as a future satellite launching station for the NASA.
- September 14: An Atlas missile was successfully fired at Cape Canaveral.
- September 17: A launching attempt with a Vanguard failed, but the rocket assembly was saved from destruction while still on the pad.
- September 18: An Atlas was launched in its first full-range test, but was destroyed 80 seconds after launching.

## 1958—Continued

- September 24: The first Polaris test vehicle approximating the Polaris missile configuration was launched at Cape Canaveral but had to be destroyed shortly after takeoff when it appeared to take a wrong heading.
- : The President held the first meeting of the National Aeronautics and Space Council.
- September 26: Vanguard SLV-3 was launched at Cape Canaveral. Takeoff was normal, and all stages fired. The slight failure to attain desired speed may have carried it into an orbit around the world for at least one pass, then it burned on reentry. It climbed 265 miles up, and is believed to have fallen 9,200 miles away in the Indian Ocean. The satellite weighed 21.5 pounds, was 20 inches in diameter. It carried instruments designed to measure cloud cover, with a tape recorder to store data for command release.
- September 28: The Thor missile was chosen over the Jupiter for continued IRBM production.
- September 29: A Nike ASP rocket was fired to an altitude of 150 miles over the Pacific.
- : The United States formally announced it would take measures to prevent contamination of the Moon on all lunar probes, and that it had done so for the abortive August attempt.
- September—: Dr. W. Albert Noyes was appointed chairman of a 4-man United States committee to draft proposals for international cooperation in the space sciences for the consideration of the ICSU (International Council of Scientific Unions).
- October 1: The NASA was activated, and the NACA was abolished at the close of business on September 30, with all personnel and facilities transferred to the new agency. At the same time, major control of space activities in the Department of Defense was transferred to NASA. Project Vanguard personnel of the Navy were moved to NASA. Two Air Force and two Army lunar probes were transferred, but the services kept the actual work of construction and launching.
- October 2: The ICSU executive board presented a plan to create a Committee on Space Research, to be known as COSPAR.
- October 4: Vandenberg Air Force Base was dedicated.
- October 7: The National Aeronautics and Space Administration formally organized a project to orbit and recover a manned capsule, together with associated studies. = *Project Mercury*
- October 8: Lt. Clifton M. McClure, USAF, attained an altitude of 99,900 feet in the Man High III balloon launched from Holloman Air Force Base.
- : For the first time, the Soviet Union supplied to other IGY members a telemetry code to Sputnik III, covering only the space radiation measurements.
- October 9: A Jupiter missile blew up 28 seconds after launching at Cape Canaveral.

## 1958—Continued

- October 11: Pioneer I, the first successful space probe, was launched by the United States from Cape Canaveral, Fla., at 3:42 a.m., eastern standard time. The launching was accomplished by the Air Force Ballistic Missile Division under the management direction of the National Aeronautics and Space Administration using a Thor-Able rocket combination. The space probe, named Pioneer I, reached a record altitude of about 70,700 miles and telemetered to Earth data on radiation encountered in outer space, micrometeors, temperatures, and the Earth's magnetic field. The launching vehicle was a 4-stage rocket weighing approximately 112,000 pounds with a total length of 88.1 feet. A velocity of 35,250 feet per second (24,015 miles per hour) had been planned for the probe. However, because the Pioneer I traveled about  $3.5^\circ$  above the designed flight path, the actual velocity attained was about 34,400 feet per second (23,447 miles per hour). The toroidal-shaped payload, pierced by the terminal-stage rocket, was 29 inches in diameter and weighed 84.4 pounds. The weight of the instrument package itself was approximately 39 pounds, and included a Navy infrared camera to photograph the Moon. Pioneer I was constructed of Fiberglas, and was painted in a special pattern as a means of controlling temperatures. The probe carried one radio on 108.06 mc with 300 mw for telemetry and Doppler command, and another on 108.06 mc with 1 watt for controls. Last radio contact with Pioneer I occurred at 10:46 p.m., eastern standard time, October 12, 1958, as it fell back toward the Earth. The probe presumably disintegrated in the Earth's atmosphere over the South Pacific shortly thereafter. Attempts to modify its flight path into a permanent eccentric orbit around the Earth failed because a retro-rocket could not be fired following a battery failure.
- October 14: The NASA asked that both the Jet Propulsion Laboratory and the space team and facilities at the Army Redstone Arsenal be transferred to NASA.
- October 15: The second full-scale Polaris test vehicle launching ended with an explosion at Cape Canaveral.
- : The X-15 rocketship was publicly unveiled for the first time. It is designed to be dropped from a bomber over Wendover, Utah, rocket upward to coast as much as 100 miles high, then glide to a landing at Edwards Air Force Base, Calif. The top speed is to be about 3,500 miles per hour. The ship is equipped with both normal aerodynamic controls for use in the atmosphere and with small steering rockets for use in space. It is intended to supply many answers to heating and control. Three such ships are being built by North American Aviation for the NASA, the Air Force, and the Navy's joint program. Although not a true space ship, the X-15 is an important forward step toward the knowledge future ships, particularly those used for controlled reentry, will require.
- October 17: The Air Force recovered a capsule from an Atlas flight occurring August 2, 1958.
- October 19: The House Astronautics and Space Exploration Committee released a report calling for greater international cooperation in the space sciences and rocketry.

## 1958—Continued

- October 23: Beacon, an intended satellite, was launched at Cape Canaveral by a Jupiter C. The final stage weighed 42.77 pounds, and included a 9.26 pound aluminized plastic balloon of 12 feet diameter for inflation in space. It was to circle at 400 miles, although alternatively announced for a 1,500-mile orbit. Within 2 or 3 minutes of launching, it was apparent the last 2 stages had not fired. The point of reentry was unknown. It impacted after 526 seconds.
- October 27: The first Air Force satellite in a polar orbit was expected to be launched in December 1958 or January 1959 from Vandenberg Air Force Base, to study the radiation band of Earth.
- October 29: The President held the second meeting of the National Aeronautics and Space Council to give preliminary consideration to the possible transfer of the Army Ballistic Missile Agency facilities and personnel at Huntsville and the Army's Jet Propulsion Laboratory at the California Institute of Technology, Pasadena, to NASA. L
- October 30: William M. Holaday was appointed chairman of the Civilian-Military Liaison Committee between NASA and the Department of Defense.
- October—: The Air Force awarded contracts for the development of the Centaur high-performance upper stage.
- November 4: The Air Force revealed that in September 1958 a rocket sled at Holloman Air Force Base reached the speed of 2,853 miles per hour.
- November 5: A Thor was launched at Cape Canaveral but was exploded 30 seconds later by the range safety officer.
- November 6: The Army completed the test program for the Redstone with a successful 250-mile shot.
- : Dr. Newell D. Sanders said that Thor Able was capable of launching probes to Mars and Venus. Venus was to enter a favorable position in 1959, and Mars in 1960-61.
- November 8: Pioneer II, launched by a Thor Able, climbed from Cape Canaveral about 1,963 miles, then fell 45 minutes later 7,500 miles away over east central Africa, burning on reentry. The third stage failed to ignite. The failure seems to have been caused by a broken wire. The probe weighed 86.4 pounds including 34.3 pounds of instruments. Its radios were on 108.06 mc with 300 mw and 108.09 mc with 100 mw.
- November 13: The United States proposed the appointment of a United Nations study committee to consider the problems of outer space.
- November 15: COSPAR (Committee on Space Research) ended its first meeting begun November 14 at the Royal Society in London in which bylaws and rules were drawn up for the approval of ICSU (International Council of Scientific Unions). The president of the executive committee was Prof. H. C. van der Hulst of the Netherlands. Other countries represented were the United States, France, the U.S.S.R., and the United Kingdom. Nine scientific unions and three other scientists were represented in COSPAR.



## 1958—Continued

November 17: An Atlas was sent 3,000 miles downrange in a flight from Cape Canaveral.

——: Senator Lyndon B. Johnson appeared before the Political Committee of the General Assembly of the United Nations to demonstrate bipartisan political support for the United States plan for study of outer space problems.

November 18: The Soviet Union withdrew its demand that the problems of outer space study be coupled with withdrawal of the United States from forward bases.

——: The Vanguard satellite was abandoned for any further launching attempts during the IGY.

November 19: ARPA announced that late in 1960, a large communications satellite was to be placed in a stationary orbit over the Equator at a distance of 22,300 miles above the Earth. This relay satellite was to weigh many tons. Launched by a 3-stage rocket, the first stage would include 8 Jupiter-type motors clustered to produce about 1.5 million pounds of thrust. Either an Atlas or a Titan would make the second stage. A third stage was under development. The project has since been revised and delayed.

November 21: After a deadlock of United States-Soviet negotiations on the outer space plan, the United States and 17 other nations came forward with a new formula for a study committee.

——: A Vanguard was test-fired on the stand, but not launched.

November 24: The 18-nation plan for a study committee was approved by the main Political Committee of the United Nations by a vote of 54 to 9 with 18 abstentions. The Soviet bloc voted against the plan. Provisions of the plan as passed included the establishment of an ad hoc committee to study the resources available for the peaceful use of outer space. Work similar to that of the IGY was to be continued. There was to be mutual exchange of information, and plans were to be coordinated to the greatest extent possible, with opportunity made for all nations to participate. The committee was to consider future organizational relations with the United Nations, and the nature of legal problems expected to arise in carrying out programs to explore outer space.

November 25: NASA planned for 1959 some 8 space probes, including ones to be sent to the vicinity of the Moon, Mars, and Venus, as well as the 4 remaining Vanguard satellites.

November 26: The name Project Mercury was officially assigned to the man-in-space effort of the United States.

November 28: An Atlas missile was shot over full range for the first time, a distance of 6,325 miles from Cape Canaveral, into the South Atlantic to within 30 miles of the predicted point of impact.

December 1: Aviation Week reported that a Soviet nuclear-powered bomber was now flying. Its speed was said to be in the sonic range, with two 35,000 pound thrust nuclear jets, and two conventional jets. The gross weight was 300,000 pounds, and the length about 195 feet.

1958--Continued

December 1: The Los Alamos Laboratory announced it was working on a space ship propulsion scheme using small nuclear explosions rather than an atomic reactor. Rail mounted sleds were to be used in the early stage of experimentation.

December 3: The Department of Defense announced a long-range program to put mice, monkeys, and finally men into orbit. The first launching of new Project Discoverer was to take place at Vandenberg AFB on the California coast in January 1959, at first to test the capabilities of the Thor launcher, and later to carry animals, leading up to later launchings with Atlas with as much as 5 tons placed in orbit. Reentry tests were to be conducted, and the 5th or 6th would carry a monkey instead of mice. The polar orbit called for a southward launching over the Pacific. The first vehicle was to weigh about 1,300 pounds, with a payload of several hundred pounds. Another purpose of the project was to develop an early warning capability against enemy missile launchings. ARPA Director Johnson indicated Sentry launchings would be delayed. The early warning version was to be called Midas, and was to be equipped with infrared detectors.

-----: A new radio telescope at Camp Irwin, Calif., called the Goldstone Tracking Facility, operated by the Jet Propulsion Laboratory was described. It can maintain radio contact at distances up to 400,000 miles, and by 1962 should be capable of receiving signals from as far as 4 billion miles.

-----: The President held the third meeting of the National Aeronautics and Space Council. At this meeting it was decided to transfer the Jet Propulsion Laboratory of the California Institute of Technology, an Army contractor, to similar status within NASA. The Redstone Arsenal was not transferred at this time, but was to serve as a contractor for the NASA on a fully cooperative basis. The JPL had property of \$55 million and a staff of 2300.

-----: The rocket carrier of Sputnik III reentered the atmosphere.  
December 5: The Navy fired a modified version of the Terrier rocket to take photographs at an altitude of 86 miles at Wallops Island, Virginia. On recovery, a composite view of frontal cloud formations covering 1,000 miles was developed.

December 6: Pioneer III, the fourth of five space probes scheduled by the United States as part of its contribution to the IGY and the second to travel many Earth radii out into space, was launched from Cape Canaveral, Fla., at 12:45 a.m. eastern standard time. The launching was accomplished by the Army Ballistic Missile Agency and the Jet Propulsion Laboratory of the California Institute of Technology, under management direction of the National Aeronautics and Space Administration. The vehicle consisted of a modified Jupiter IRBM, called Juno II, as the booster or first stage, and 15 Sergeant rockets clustered in 3 high-speed upper stages: 11 in the second stage, 3 in the third, and 1 in the fourth stage. The 12.95-pound, gold-plated probe was instrumented to provide information on the Van Allen radiation zone. The scientific data were telemetered to Earth on a frequency of 960.05 megacycles at 180 mw. Although the probe did not

## 1958—Continued

- achieve its maximum objective, the environs of the Moon and beyond to a heliocentric orbit, its altitude of about 63,580 statute miles above the surface of the Earth enabled it to obtain valuable scientific data through measurements of the Van Allen radiation zone at 2 different times and also at 2 different locations. It is estimated that the probe reentered the atmosphere at 2:51 p.m. eastern standard time, December 7, 1958, over French Equatorial Africa and, presumably, disintegrated. The reason the speed reached 24,000 miles per hour instead of 24,955 was the premature cut-off of fuel in the first stage, 3 seconds too soon.
- December 10: Senator Hubert Humphrey reported to President Eisenhower that Premier Khrushchev told him the Soviet Union had an ICBM with a range of 8,700 miles and a thermonuclear warhead of 5 megatons force.
- December 13: The United Nations by a vote of 59 to 9 with 19 abstentions approved the United States plan to set up an 18 nation study committee on outer space.
- : The Army launched a Jupiter missile at Cape Canaveral which climbed 300 miles and traveled 1500 miles downrange. On board was a Navy-trained squirrel monkey, Gordo, or Old Reliable, whose physiological reactions were telemetered. The monkey made the trip without untoward effects, including 8.3 minutes of weightlessness, 10 g pressure in takeoff, and 40 g pressure in reentry at 10,000 miles per hour. Unfortunately a leak developed in the nose cone allowing the float mechanism to fail so that the equipment including monkey all sank before rescue could be effected.
- December 16: The first Thor launching at Vandenberg Air Force Base went its scheduled 1,500 miles out the Pacific Missile Range to open such use of the new facility. The same day a shot with similar results were obtained at Cape Canaveral with another Thor.
- December 17: NASA publicly assigned the code name Project Mercury to the man-in-space goal. Rocketdyne of North American was awarded by NASA a contract to build a single-chamber liquid-rocket engine of up to 1.5 million pounds of thrust.
- December 18: The United States Air Force launched for the Advanced Research Projects Agency at Cape Canaveral the entire rocket casing of Atlas missile 10B at 6:02 p.m. that day. With a launch weight of 244,000 pounds, approximately 8750 pounds reached orbit. Of this weight about 150 was payload, including 35 pounds of communications equipment supplied by the Army Signal Corps. Given the name Project Score, this satellite carried out active real time and delayed signal repetition to relay voice and Morse messages from one ground station to another. The experiment also tested the missile itself including a new inertial guidance system. The satellite carried FM radios on 132.435 mc and 132.905 mc for communications. It also had minitrack radio at 107.97 mc and 107.94 mc. Batteries were mercury-type. Launched with a thrust of 360,000 pounds, its orbit was inclined 32° to the Equator, had an apogee of 928 miles and a perigee of 114 miles. It was estimated it should stay in orbit for 20 days.

## 1958—Continued

- December 19: The Atlas Project Score satellite transmitted the voice of President Eisenhower from outer space with a Christmas message for the world. These were broadcast on 132,435 and 132,905 megacycles. Another radio on board broadcast other data on 107,970 and 107,940 megacycles.
- : The Bold Orion, WS-199, test vehicle was launched from a B-58 bomber flying at 1100 miles per hour over Cape Canaveral. The new ballistic missile with a range of 1,000 to 1,500 miles was to be launched at altitudes up to 60,000 feet, climb to 150 miles. Earlier versions built by Martin launched from B-47 bombers have traveled over 1,000 miles. There was an equally successful Convair-Lockheed version.
- December 20: New messages were sent to the Atlas Project Score satellite, both voice and teletype, to be recorded, erasing the previous ones, and then rebroadcast on command later.
- : The first attempt to launch a Titan at Cape Canaveral was cut off after ignition because of a malfunction. There was an explosion on the pad. General Schriever announced that later the Titan will be capable of manned circumlunar flight.
- : Leonid Sedov in Moscow pointed out that all three Soviet sputniks put heavier carrier rockets into orbit than the Atlas satellite, and that in contrast with the announced Atlas payload, even the 184 pounds of Sputnik I was greater, not to mention the 1120 pounds of Sputnik II and the 2925 pounds of Sputnik III. He also pointed out that the lowest Sputnik altitudes were 135 miles, giving a longer lifetime for all launchings.
- December 21: Seven teletype messages were sent simultaneously to the Atlas Project Score satellite, and on the next orbit all seven messages were delivered simultaneously. Later that day, seven simultaneous messages were sent to the satellite, and concurrently were rebroadcast with successful pickup at other stations.
- : The House Committee on Astronautics and Space Exploration released a report on space law, calling for regulation and advanced notice of launchings.
- December 22: The Atlas Project Score satellite received a message direct from Fort Monmouth, NJ., while it was over the Pacific which it then rebroadcast to various ground stations.
- December 23: The first C-series Atlas was fired at Cape Canaveral, performing perfectly in a 4,000-mile flight.
- December 24: Dr. Herbert F. York, Chief Scientist of ARPA was named by President Eisenhower as Director of Defense Research and Engineering for the Department of Defense.
- December 27: The President approved establishment of a new Federal Council for Science and Technology, to be headed by Dr. James R. Killian, Jr. The move was apparently designed to head off the creation of a new Department of Science. The President's Scientific Advisory Committee prepared the report. The Council was probably to include the heads of the National Science Foundation, the Atomic Energy Commission, the National Aeronautics and Space Administration, the Research and Engineering Assistant Secretary of the Department of Defense, and policy officials from Commerce, Interior, Agriculture, and Health, Education, and Welfare.

## 1958—Continued

- December 27: Dr. James Van Allen revealed from Pioneer III data that the Earth is surrounded by two bands of radiation. The first band begins 400 to 600 miles up, reaches a peak between 1,400 and 3,400 miles, falls off sharply, then rises to a new peak between 8,000 and 12,000 miles out, then falling off to very low values. The Earth's magnetic field is insignificant after about 36,000 miles. The radiation belt has openings at the poles so that launchings can escape the worst effects. It was not yet known whether the particles were electrons or protons, with a consequent uncertainty over the number of roentgens strength. If protons, the peak strength (the second layer) is 100 roentgens an hour; if electrons, about 10 roentgens an hour.
- December 29: The Department of Defense revised the estimated life of the Atlas Project Score satellite to 45 days, from the previously estimated 20 days.
- December 30: A Thor missile blew apart shortly after launch at Cape Canaveral, when the range safety officer observed it was going off course.
- : A Polaris test vehicle was destroyed about 90 seconds after launch at Cape Canaveral.
- December 31: The Project Score Atlas satellite ended its transmissions with the weakening of the batteries it carried. During the 12 days it broadcast, there were 97 successful contacts made with the satellite.
- December —: Senator Lyndon B. Johnson announced appointment of Col. Kenneth E. Belieu as staff director of the Senate Committee on Aeronautical and Space Sciences. He also stated that Dr. Glen P. Wilson would be the chief clerk.
- During the year, the Navy conducted tests in California under Project Pilot which might lead to a small, air-launched satellite. Several tests were run, and at least one of them may have put a small satellite into orbit, but lack of definite proof has excluded any claim to success. Using a fighter plane to make the launching, the rocket weighed 2500 pounds and the satellite 3 pounds.

## 1959

- January 1: Radio Moscow predicted that during 1959 the Soviet Union would send an interplanetary rocket around the Moon. It also predicted that the first trials of a nuclear powered aircraft would occur.
- January 2: The House Committee on Astronautics and Space Exploration recommended unanimously less than one hour before the Moscow broadcast of the Soviet rocket launched toward the Moon that the United States should order two additional American rockets for this purpose to replace those earlier ones which failed.
- : The Soviet Union announced that it had successfully launched a cosmic rocket toward the Moon. The final stage was said to weigh 3,245.2 pounds, and the scientific equipment to weigh 796.5 pounds. The announced purpose of the experiment was said to be: (1) Ascertain the magnetic field of the Moon; (2)

## 1959—Continued

Study the intensity and variation of the intensity of cosmic rays outside the magnetic field of the Earth; (3) Register photons in the cosmic radiation; (4) Discover the amount of radioactivity on the Moon; (5) Study the distribution of heavy nuclei in cosmic radiation; (6) Study the gas components of interplanetary matter; (7) Study corpuscular solar radiation; and (8) Study meteoric particles. Transmitters were said to have broadcast on 19.995 and 19.997 megacycles in one instance, and on 19.993 in a second. A third transmitter worked on 183.6 megacycles for tracking purposes. Fort Monmouth, N.J., discovered a fourth transmission on 70.2 megacycles. The scientific container was spherical and pressurized at 1.3 atmospheres. The Soviet Union claimed that when the rocket crossed the constellation of Virgo it emitted a sodium vapor cloud as a visual tracking device. Although not used officially, the nick-name Lunik has been applied to the Soviet vehicle at Moscow University and elsewhere. (It was also called Mehta, see below.)

January 3: The Soviet Union announced that their cosmic rocket would pass within 5,000 miles of the Moon, then enter into an orbit around the Sun.

January 4: Vandenberg Air Force Base and the Pacific Missile Range were declared operational.

January 5: The Soviet Union announced that the cosmic rocket passed within 4,660 miles (later corrected to 3,700 miles) of the Moon at the closest point. The estimated orbit around the Sun had a perihelion of 91.5 million miles, an aphelion of 123.25 million miles, and a period of 15 months.

January 5: The radio transmitters of the Soviet cosmic rocket went dead when the rocket was an estimated 373,125 miles from Earth. Although no official name had yet been assigned to the cosmic rocket, Alexander Kazantsev suggested it be called Mehta, meaning dream.

January 7: Sir Arnold Hall announced that the Royal Society has recommended to the British Government that a program of launching small satellites is justified on purely scientific grounds.

January 10: The House Astronautics and Space Exploration Committee released its final report, "The United States and Outer Space", calling for a vigorous program and suggesting that with about an 18 month lag then, it probably would take 5 years to close the gap with the Soviet Union in space exploration.

January 11: The batteries of the Atlas Project Score satellite went dead. (This was for its beacon radio; communications ended earlier.)

January 11: Vice President Nixon relayed informally to newsmen the view that the United States is ahead in the ballistic missile race and is catching up fast in other phases of the space race.

January 12: Senator Symington disagreed strongly with the reported remarks of the Vice President. Friends of the Vice President said that he had been misquoted.

## 1959—Continued

January 12: The NASA selected the McDonnell Aircraft Corp. of St. Louis to construct the manned satellite vehicle to be used under Project Mercury. It was hoped that it could carry a man in orbit in about two years.

———: In a Soviet review of details of the cosmic rocket, it was revealed that it carried a segmented sphere which would shatter on impact into its component pieces. The stainless steel components were each stamped on one side with the Soviet coat of arms and "U.S.S.R.," while the other side said "U.S.S.R. 1959". Also contained in the final stage was a pennant of metal ribbon saying "Union of Soviet Socialist Republics," and on the other side, the Soviet coat of arms and the words "1959 January 1959". The Soviet Union claimed that both the instrument package and the last stage entered into the orbit around the Sun although they were separated. The instrument package was protected by a nose cone which was jettisoned. It was spherical in shape and made of aluminum-magnesium alloy. Electrical power was supplied by silver-zinc and by mercury oxide batteries.

January 13: A woman completed seven days in complete isolation with considerable sensory deprivation in a test related to the psychological problems of future space flight, in a test conducted at the Air Force Aeromedical Laboratories.

January 14: President Eisenhower at the National Press Club stated that it would be stupid not to believe that the Soviet Union was somewhat ahead in certain phases of missile development, considering their much earlier start on long-range missiles. But he also believed the United States has made remarkable progress. Senator Dirksen charged that any lags in missiles should be layed to the previous Administration.

January 15: The United States Bureau of Mines laboratory at Albany, Oreg., succeeded in making the first successful castings of molybdenum, important to future space research.

———: The Air Force launched an Atlas from Cape Canaveral to fly over full range to the vicinity of St. Helena, about 6,000 miles, but it was rumored to have failed after 200 miles.

January 16: The Atomic Energy Commission revealed a new 5-pound atomic generator of electricity. Called SNAP III, it provides from one third of a gram of polonium 210 an output of 5 watts, an efficiency of 8 to 10 percent. Over a 140 day period, it produces at 3 watts, a conversion efficiency of 5 to 6 percent. In 280 days, the total output is equal to that of 1,450 pounds of the best conventional batteries. It is viewed as of use in supplying auxiliary power in space devices. The Martin Company was prime contractor.

January 17: An Atlas missile flew 200 miles in a test at Cape Canaveral.

January 19: The final test vehicle configuration of the Polaris missile made its first flight to a distance of only 60 miles from Cape Canaveral, due to first stage malfunction.

## 1959—Continued

January 19: The National Aeronautics and Space Administration signed a formal contract with North American Aviation Inc. for \$102 million covering the design and development of a single chamber liquid propellant rocket engine in the one to one and a half million pound thrust class. (The F-1, to be used in the Nova concept.)

January 21: The first tactical model of the Jupiter missile made a successful 1,700-mile flight from Cape Canaveral, and hit its target.

———: Observers on Guam and on the cruiser *Rochester* are believed to have seen the fiery reentry of the Atlas Project Score satellite, after approximately 500 trips around the world.

January 22: Secretary McElroy stated there was no positive evidence that the Soviet Union had an operational ICBM yet.

January 23: A Thor Able test failed at Cape Canaveral, falling short of its 4,400-mile goal in a reentry test.

———: Senator Symington disagreed with the implications of the McElroy statement, charging that the missile gap would widen under our present budgetary plans.

January 27: The NASA announced that 110 possible candidates for the first United States flight in orbit had been selected from among military test pilots, and that further screening and testing would continue until the final group had been chosen.

———: An Atlas missile flew from Cape Canaveral some 4,500 miles to the vicinity of Fernando de Noronha.

———: Moscow Radio suggested an international cooperative effort in carrying out interplanetary exploration because the costs might be too great for a single nation.

January 28: It was revealed that study of Vanguard I established the Earth as slightly pear-shaped, rather than flattened at both poles. The report was issued by NASA.

———: A 12-foot diameter inflatable satellite test package was fired vertically to a height of 75 miles, inflating successfully in a test at Wallops Island, Va. The launching vehicle was a Nike-Cajun.

January 29: Secretary McElroy testified before the Senate Preparedness Subcommittee that the United States does not plan to match the U.S.S.R. missile for missile in the production of ICBM's.

February 2: President Eisenhower released the first annual report of space progress, which reviewed what had been accomplished since the launching of Explorer I on January 31, 1958. A 10-year future program was included.

February 3: A second launching attempt was made for the Titan, but it failed on the launching pad at Cape Canaveral.

———: The Air Force unveiled a new coined word, "aerospace", which it used to describe its interests and activities. Since that time, it has been adopted by segments of industry, but has been regarded with moderate suspicion in Congress.



## 1959—Continued

- February 3: Marshal Rodin Y. Malinovsky claimed that Soviet missiles with thermonuclear warheads have pinpoint accuracy in reaching any point on the globe, and supported Premier Khrushchev's earlier statement that these missiles were in "serial" production. Secretary of Defense Neil H. McElroy described the statements as normal to a war of nerves. General Nathan F. Twining denied that he believed the validity of the Soviet report.
- : An Atlas missile made a flight from Cape Canaveral which was unofficially reported to have been about 3,400 miles.
- February 6: The Titan ICBM was launched for the first time, flying about 300 miles from Cape Canaveral (Number A-3).
- February 11: The Army announced a new record for balloons of 146,000 feet altitude, following a launching at Fort Monmouth, N.J.
- February 12: Secretary McElroy issued a directive defining the duties of the newly created Director of Defense Research and Engineering. (Dr. Herbert F. York.)
- February 17: Vanguard II (SLV-4), using a launch vehicle similar to Vanguard I, was launched at Cape Canaveral as an experimental weather reporting satellite. The first successful full-scale Vanguard, and the second one put into orbit, it is a 20-inch sphere weighing 20.74 pounds. The former Navy project was launched by the National Aeronautics and Space Administration, and carried instruments developed by the Army Signal Research and Development Laboratory, Fort Monmouth. The initial perigee was estimated as 350 miles, and the apogee 2,061 miles. Its period was 126 minutes. The satellite carried 2 photocells for scanning cloud patterns, the information being recorded on a tape recorder for later release on ground command. Signals were broadcast while the mercury batteries were active on a radio of 108.03 megacycles at 1 watt, lasting 18 days. A second radio with separate batteries broadcasted on 108 megacycles at 10 mw, lasting 27 days, for tracking purposes and to report the temperature within the payload. The orbit was inclined at 33 degrees to the Equator. The purpose of the two infrared detector phototubes was to detect variations in reflection of heat from the surface and clouds below the satellite as it revolves. The resulting signals as later recorded on the ground were then fed into computers to determine what part of the signal represented a report on the reflection from the Earth, and geographically what area was being scanned, so as to reconstruct in time a crude map of cloud cover. The early results seemed to indicate that although all apparatus functioned properly, the wobbling was too erratic for the computer to reconstruct the meaning of the infra-red reported signals. The total weight in orbit is estimated as about 71 pounds, including the spent rocket casing. Lifetime is estimated as 10 years or more.
- February 20: An Atlas missile launched from Cape Canaveral exploded from a malfunction three minutes after launch.

## 1959—Continued

**February 28:** The French Defense Ministry announced that tests of space rockets would open on February 25 at Colomb Bechar in Algeria. A study committee on space is to supervise development of a multistage rocket capable of putting satellites into orbit, this rocket probably to be made up of Veronique and Monique.

**February 28:** The Navy revealed the successful development of a steerable nozzle to be used by the solid-fueled Polaris missile, an important breakthrough in solid rocket technology. The nozzle is made of molybdenum.

**February 25:** Titan missile A-5 made a successful flight at Cape Canaveral, over a distance of from 250 to 300 miles.

**February 28:** The Air Force fired for the Advanced Research Projects Agency Discoverer I from Vandenberg Air Force Base, California, into a polar orbit. Launched by a Douglas Thor missile, the second 19 feet by 5 feet stage was built by Lockheed with a Bell Hustler engine to propel a 1,300-pound package into orbit. The rocket had a lift off weight of 108,400 pounds. About 100 items of telemetry were to be returned on wave lengths which were not announced. Although telemetry was complete until after burnout, supplying enough data to establish the orbit, tracking stations failed to pick up signals as the first orbits were completed. The final stage was supposed to stabilize in attitude, both as preparation for later reentry tests, and for the transmission of highly directional signals. On board were a horizon-scanning device, and high-pressure nitrogen to operate vernier jets for positioning. The weight of instruments was 40 pounds. A day after launching, random signals began to be reported by some tracking stations on the correct Discoverer frequencies. Visual tracking by the regular observation network was not possible because of the timing of launching, determined by experimental needs to test Pacific area radio and radar facilities. The combination of initial telemetry and later signals established the orbit as having an initial perigee of 99 miles and an apogee of 605 miles. The orbit was inclined 89.7° to the Equator with a period of 96 minutes. Although proof was not absolute, the best estimate was that the spottiness of signals was occasioned by a failure of the stabilization device, so that with the tumbling of the final stage, the highly directional signals were difficult to receive. Discoverer I reentered and burned some time between March 5 and 10, 1959.

**March 1:** First details were announced for the comparatively economical Scout satellite launching vehicle, whose development was planned from 1958 on at NACA Langley, to have solid fuel engines, were announced by NASA and the Air Force.

**March 3:** Pioneer IV was launched at Cape Canaveral by the Army for the National Aeronautics and Space Administration, using a Juno II launching device. This consists of a Jupiter first stage of 150,000 pounds thrust, a second stage of 11 scaled-down Sergeants for 733 pounds thrust, a third stage of 3 scaled-down Sergeants of 200 pounds thrust, and a fourth stage of 1 scaled-down Sergeant of 67 pounds thrust, for a total takeoff weight of 121,000 pounds. The final stage was a gold-plated cone

## 1959—Continued

weighing 13.4 pounds. It carries instruments to measure the inner and outer radiation belts which encircle the Earth; to detect the intensity of particles streaming from the Sun; to measure the intensity of the cosmic rays in interplanetary space beyond the influence of the Earth's magnetic field. The data were radioed back on 960.05 megacycles with 180 milliwatts of mercury battery power which was to last about 90 hours. Because the aim was off slightly, the device passed the Moon at a distance of about 37,300 miles, about 38 hours after launch. The velocity at burnout was 24,791 miles. The final stage also carried a trigger which was a photoelectric sensor to be turned on by reflected light from the Moon, as a test for future photographic missions. The approach to the Moon was not close enough for the trigger to function. Pioneer IV passed the Moon at a distance of 37,300 miles on March 4. It entered into an orbit around the Sun with a perihelion of 91.7 million miles and an aphelion of 107.9 million miles, and an orbit period of 394.75 days. Its estimated life is considered equal to that of the Solar System.

March 3: The first 6-stage rocket was launched at Wallops Island, Va.

March 4: First meeting of the British National Committee on Space Research was held with H. S. W. Massey as chairman.

March 5-10: Discoverer I was estimated to have reentered and burned, although its fate is uncertain.

March 6: Final radio signals were received from Pioneer IV at a distance of 406,620 miles from Earth, a record; some weak signals were heard even longer.

March 7: Two rats survived a rocket sled ride at Alamogordo, New Mexico, at a speed of 1,050 miles per hour, after withstanding high g loads.

—: The first French rocket probe, a Veronique, was fired at Colomb Bechar, to test radio control techniques. This rocket has an ultimate capability of probing to 155 miles altitude. The French expect later to release sodium at great heights for radio wave reflective purposes.

March 10: The X-15 was carried aloft the first time by a B-52 as a preliminary check of equipment and systems, with Scott Crossfield in the cockpit of the rocket plane.

—: The Senate authorized a supplemental appropriation of \$48,354,000 for the National Aeronautics and Space Administration during fiscal 1959.

March 12: The second Black Knight British rocket reached an altitude of 350 miles in a test at Woomera, Australia.

March 12-14: The second meeting of COSPAR was held at The Hague, the Netherlands.

March 13: The first ultraviolet pictures of the Sun were taken by a camera at an altitude of 123 miles from an Aerobee-Hi research rocket at White Sands, under the direction of the Naval Research Laboratory.

March 14: The National Academy of Sciences delegate at COSPAR conveyed an offer of the United States to carry the experiments of scientists of all nations in our space vehicles.

## 1959—Continued

- March 15: An Army Redstone ejected a television camera which transmitted pictures of the impact area of the rocket.
- March 17: The Advanced Research Projects Agency announced that Discoverer I was no longer in orbit. The orbit calculation was based upon some 41 reports. That it entered orbit is considered confirmed when all the evidence is weighed; that it was no longer in orbit also seemed definite, although the time of reentry is not known.
- March 18: An Atlas was believed to have traveled 4,500 miles from Cape Canaveral with a new style nose cone in a continuing program of experimentation. However, a later report showed it traveled only 800 miles.
- : President Eisenhower nominated William A. M. Burden and Dr. John T. Rettaliata to be members of the National Aeronautics and Space Council.
- : The Army Signal Corps and Radio Corporation of America announced the development of new micromodules for electronic devices, which might allow ultimately up to 500,000 components to be packed into a cubic inch of space.
- March 19: The New York Times finally broke the story on some of the details of Project Argus which included the explosion of three nuclear weapons in space, on August 27, August 30, and September 6, 1958. These were exploded at a nominal altitude of 300 miles, and had a yield close to 1 kiloton each. Modified versions of the X-17 were used for the launchings which took place from the *Norton Sound* in the South Atlantic. Argus established that if a nuclear weapon is used to insert high energy electrons at the right latitude and altitude, these will travel in a spiral path along the Earth's magnetic lines of force, until reaching a mirror point above the atmosphere, where they reverse general direction of travel and oscillate to the opposite mirror point. These electrons then spread to create a shell around the Earth, in effect the artificial equivalent of the two natural Van Allen radiation belts, and lying between them. Those which leak out at the mirror points create an artificial aurora which interferes locally with certain radio transmissions.
- March 20: The Massachusetts Institute of Technology revealed that it had succeeded in sending radar signals to Venus on February 10 and 12, 1958, which had been detected by the Lincoln Laboratory as echos by the Millstone Hill equipment. Venus was 27,530,000 miles away on the 10th, and 28,227,000 miles on the 12th. It took over a year of work with a computer to confirm the actual receipt of the return signal amidst other radio "noise". The experiment showed the Solar System to be somewhat smaller than previously assumed. The roundtrip for the signals was 295.51 seconds on the 10th and 302.98 on the 12th. The return signals were about only one ten-millionth as strong as the outgoing pulse. An IBM 704 computer made about 100 million multiplications to separate out the signals.

## 1959—Continued

- March 21: A Thor Able was fired more than 5000 miles down range successfully from Cape Canaveral on a reentry test, but the nose cone was not recovered.
- : A Thor missile was sent on a 1600 mile test flight from Cape Canaveral.
- March 26: A Thor missile made a successful flight of 1600 miles from Cape Canaveral, and a data capsule was recovered.
- March 31: The Navy announced the coming establishment of a communication link between Washington and Pearl Harbor by way of the Moon. Antennas were to be located at Annapolis and Cheltenham, Maryland, and at Wakiawa and Opana on Oahu.
- April 2: A Bold Orion air-launched ballistic missile was launched from a B-47 jet bomber in test development.
- : President Eisenhower announced the appointment of Major General Bernard A. Schriever, to be promoted to Lieutenant General, as head of ARDC, terminating his former assignment as Commander of the Ballistic Missile Division, U.S. Air Force.
- : The National Aeronautics and Space Administration selected 7 candidates for final training as part of Project Mercury to put a man into orbit, possibly in 1961. Three of the test pilots were from the Air Force (Capt. Leroy G. Cooper, Jr., Capt. Virgil I. Grissom, Capt. Donald K. Slayton), three from the Navy (Lt. Malcolm S. Carpenter, Lt. Comdr. Alan B. Shepard, Jr., Lt. Comdr. Walter M. Schirra, Jr.), and one from the Marine Corps (Lt. Col. John H. Glenn, Jr.).
- April 3: Titan missile A-4 made a successful flight at Cape Canaveral, traveling 300 miles.
- : A Jupiter was successfully fired 1,500 miles from Cape Canaveral.
- April 7: The Los Alamos Scientific Laboratory announced the development of a new plasma thermocouple for the direct conversion of the energy from a nuclear reactor into electricity, based upon uranium metal and cesium in gaseous form. The device is viewed as important particularly as an auxiliary source of power in space ships.
- : The first operational Snark flew successfully to its target in a 5,000-mile flight from Cape Canaveral.
- April 8: A Thor Able was launched from Cape Canaveral to travel about 5,000 miles down range, where for the first time a nose cone was recovered following a flight of intercontinental length.
- April 9: A liquid-rocket engine of over 1 million pounds of thrust has been fired by Rocketdyne in the Santa Susana Mountains, it was revealed.
- April 13: Discoverer II was launched successfully at Vandenberg Air Force Base, California, into a polar orbit. Liftoff weight was 108,400 pounds. The first stage was a Thor; the second stage was a Lockheed Bell-Hustler. The 1,600 pound satellite carried an instrument package of 245 pounds, and a 195 pound capsule 27 by 33 inches of additional instruments for return and recovery. They included emulsion packs for radiation study. The period of the satellite was 90.84 minutes, its perigee was 156 miles and its apogee was 225 miles. The orbit was inclined

## 1959—Continued

- 89.8° to the Equator. This project was under the direction of the Advanced Research Projects Agency and was conducted by the Air Force. The satellite had horizon locating and position stabilizing devices which operated properly making this satellite the first known example of an attitude controlled device in orbit. Telemetry lasted until April 14, tracking radio until April 21, and reentry of the upper stage occurred on April 26.
- April 13: A Vanguard (SLV-5) was launched at Cape Canaveral, with two satellites in the final stage. One was a 0.44-pound aluminum coated sphere to be inflated in orbit to a 30-inch diameter balloon, and the other was a 13-inch sphere with a 2.5 by 17.5 inch projecting magnetometer, this combination weighing 22.6 pounds. There was trouble with the pitch attitude control in the second stage, and the satellites failed to orbit. They impacted several hundred miles away, 500 seconds after launch.
- April 14: Although a miscalculation lost the opportunity to recover the Discoverer II capsule as planned near Hawaii, an automatic triggering device ejected the capsule on the 17th orbit. The capsule was visually sighted suspended from its parachute following successful reentry over Spitzbergen. Subsequent search failed to locate the container with its instruments and records. Speculation is that Soviet personnel recovered the capsule.
- April 13: An Atlas was launched at Cape Canaveral, but had to be destroyed 15 seconds later.
- April 16: The first Thor fired by a British crew was successfully launched at Vandenberg Air Force Base.
- April 17: The United States formally requested that the United Nations Committee on the Peaceful Use of Outer Space meet in New York on May 6.
- April 18: The Soviet Union announced the development of a new atomic battery with a 24,000 volt output of electric current.
- April 19: The Navy announced at Honolulu that Discoverer II would reenter the atmosphere on either the 19th or the 20th of April.
- April 20: A Polaris testvehicle made a successful flight from Cape Canaveral.
- : The United States and Canada announced a cooperative program for exploring the ionosphere over the Arctic with rockets and satellites. It was expected that the first United States satellite with a Canadian payload would be launched late in 1960. The research is to be strictly non-military.
- : Minister of Supply Aubrey Jones told the House of Commons that Britain is considering a space research program using Earth satellites, in the light of the advice of the Advisory Council on Scientific Policy.
- April 21: The Department of Defense announced that Discoverer II would reenter and burn on April 24 or 25.
- April 23: The President announced the transfer, effective July 1, of Richard E. Horner from Assistant Secretary of the Air Force for R. & D. to become Associate Administrator of NASA.

## 1959—Continued

- April 23: A Thor missile launched at Cape Canaveral flew 1,500 miles in an accuracy test, and for the fourth time a data capsule was recovered.
- April 24: Dr. Hugh L. Dryden and Loftus E. Becker had been appointed to assist Henry Cabot Lodge in the forthcoming meetings at the United Nations of the Committee on Peaceful Uses of Outer Space.
- April 26: Discoverer II was believed to have been sighted over South Africa on reentry, burning like a skyrocket, but this was later viewed with doubt.
- : Professor G. V. Petrovich writing in the official organ of the Soviet Academy of Sciences said the Soviet Union plans to build surveillance satellites.
- : The Air Force and Westinghouse announced a new discovery in the field of molecular electronics creating even smaller miniaturized electronic devices wherein an entire radio circuit could be reduced to the size of a matchhead.
- : The Air Force fixed the time of reentry of Discoverer II as prior to 11:40 a.m. this date, though probably not over South Africa.
- April 27: The Soviet Union through United Nations delegate Arkady A. Sobolev protested the May 6 meeting of the Committee on Peaceful Uses of Outer Space, and also predicted that the U.S.S.R. would boycott COSPAR unless greater representation was given to Iron Curtain countries.
- : Project Mercury was assigned a DX (highest) priority rating.
- April 28: NASA announced a contract with Douglas for the Thor-Delta combination rocket for satellite launching.
- May 1: The Smithsonian Optical Tracking Station at Woomera, Australia, succeeded in photographing Vanguard I, measuring 6 inches across, at a distance of 2,500 miles, using a Baker-Nunn precision camera. The feat was repeated on May 3 and May 4.
- : The new space projects center at Greenbelt, Maryland was named this day after Dr. Robert Hutchings Goddard, the famous American rocket pioneer.
- May 3: Dr. Otto Struve of the University of California was appointed director of the National Radio Astronomy Observatory, to be located at Green Bank, W. Va.
- May 4: The Bureau of Standards released some details of the August 1 and August 12, 1958, high altitude thermonuclear shots called Teak and Orange. These were in the megaton range, and were fired more than 25 miles above Johnston Island in the Pacific. They caused a radio blackout for several thousand square miles, and also caused marked disturbances of the Earth's magnetic field lasting an hour or more. The tests proved theories that the ionizing effect of the Sun's rays produce electric currents in the atmosphere during daylight which practically disappear at night.
- : Titan made its fourth flight from Cape Canaveral and for the first time successfully attempted stage separation on the 300 mile flight.

## 1959—Continued

- May 6: A Jupiter made a successful flight of 1,500 miles from Cape Canaveral, and was declared ready for operational use by the Air Force, which was taking it over from the Army.
- : Another Snark flew successfully over a 5,000-mile course, from Cape Canaveral.
- : The United Nations Committee on the Peaceful Uses of Outer Space approved the United States plan for the establishment of two separate study groups—one on scientific, and the other on legal, aspects of the subject. The meeting was boycotted by the Soviet Union, Poland, Czechoslovakia, India, and the United Arab Republic. Dr. Koto Matsudaira of Japan was elected chairman of the committee.
- : The NASA awarded a contract to Convair Division of General Dynamics for the development of the Vega rocket combination for advanced work in launching deep space probes and manned satellite stations.
- : NASA created a committee to study problems of long-range lunar exploration. Dr. Robert Jastrow was named chairman.
- May 8: A Polaris test vehicle made a successful flight, hitting close to the impact area 700 miles down range from Cape Canaveral.
- May 9: The House Science and Astronautics Committee released a report on international control of outer space calling for United States leadership in seeking international agreements for the control and use of outer space. Initial efforts should be directed toward the scientific and commercial uses of space, leaving for later attention the military problems of outer space.
- May 11: The House Science and Astronautics Committee released a report on communication by satellite.
- May 12: A Thor missile flew 1,500 miles from Cape Canaveral and the recovered data capsule carried in it a 16 millimeter camera which took pictures of the nose cone separation at 125 miles altitude, and the terrain below.
- : Prime Minister Macmillan officially announced British plans for a space research program, to start with the development of an Earth satellite.
- May 13: The Avco Research Laboratory at Everett, Massachusetts has achieved the creation of shock waves traveling about 1 million miles per hour, the highest known speeds to be achieved in a laboratory.
- : Prime Minister Harold MacMillan told the House of Commons that Britain would begin development of an Earth satellite, perhaps to be launched with a United States rocket, although study of eventual British launching rockets would also be conducted. Professor H. S. W. Massey was to head the team of British scientists visiting the United States to plan cooperation and exchange of information. The general target area of 1,000 pounds of instruments was suggested in a subsequent press conference with W. H. Stephens, director of the Royal Aircraft Establishment. Lord Hailsham, Lord President of the Council, said the program was motivated by purely scientific considerations. These plans were based on a report of the Royal Society, endorsed by the Advisory Council on Scientific Policy.



## 1959—Continued

- May 14: A Jupiter was successfully flown on a 1,500-mile course from Cape Canaveral, following which it was declared operational.
- : The first successful use of the Moon as a relay station for intercontinental messages was made with a transmission from Jodrell Bank, England, to the Air Force Cambridge Research Center at Bedford, Mass.
- May 18: An Atlas missile blew up one minute after launching at Cape Canaveral.
- : In a Polaris test at Cape Canaveral, the second stage failed to fire.
- : The National Aeronautics and Space Administration announced formation of a Committee on Long Range Studies to find and assess peaceful applications of space technology.
- May 20: The House of Representatives approved the 1960 fiscal year authorization bill for NASA, for an outlay of \$480,550,000.
- May 21: A Thor-Able missile was sent 5,000 miles from Cape Canaveral, and the cone was recovered near Ascension Island.
- May 26: The Department of Defense told Congress that it had no long-range program for space research, but that Dr. Herbert F. York was in charge of its military space research.
- May 28: A Jupiter missile was fired by the Army from Cape Canaveral 1700 miles to the vicinity of Antigua, reaching a high point of about 300 miles. On board were two monkeys, Able and Baker, a rhesus and a spider monkey respectively. The nose cone was recovered, and the monkeys survived the trip without any discernible harm. In addition, during flight, data were telemetered on the physiological condition of the monkeys. The same flight carried a number of other biological experiments. Two capsules carried mold spores sensitive to radiation. Three capsules carried sea urchin experiments. One contained pre-fertilized eggs, one contained a triggering mechanism to bring fertilization during flight, and a final one was similar but included a fixative to stop activity during deceleration. There were five other experiments: a sample of human blood to determine gravity and radiation effects; onion skin tissue and seeds to discover cosmic ray effects; fruit flies to discover cosmic ray effects; a cell suspension of yeast to study radiation; corn seeds to discover the effects of cosmic rays.
- : Dr. James R. Killian, Jr., resigned as special assistant to the President for science and technology. He was replaced by Dr. George Bogdan Kistiakowsky of Harvard University.
- June 1: The space rhesus monkey Able died at the Army Medical Research Laboratory at Fort Knox, Ky., from the effects of trichlorethylene anesthesia given for the removal of electrodes placed beneath the skin. The death was quite unexpected, and autopsy revealed no connection between the stress of the flight and the subsequent death. Monkey Baker was operated on by Navy doctors at Pensacola, Fla., without untoward effect.

## 1969—Continued

- June 3:** The Air Force launched Discoverer III at Vandenberg into the start of a polar orbit. On board were four black mice in a 160 pound reentry capsule which it had been hoped could be recovered after 26 hours in orbit. However, no pickup of signals was received after the satellite had had time to circle the Earth. It was concluded that the injection angle was incorrect, and that an orbit was not achieved. It was believed the second stage burned on reentry a few thousand miles south of the launching point. With a takeoff weight of 108,400 pounds, the launch vehicle was a Thor first stage and a Lockheed Bell Hustler second stage weighing 1610 pounds in orbit, including 195 pounds associated with the capsule and 245 pounds of other instruments, including nickel-cadmium batteries. The rocket is estimated to have climbed to 140 miles altitude, during flight.
- : President Eisenhower's voice by recording was broadcast from the Millstone Hill Radar Observatory in Westford, Mass., bounced off the Moon, and received at Prince Albert, Saskatchewan where the Canadian Defense Research Board was opening a new laboratory.
- June 4:** The Senate passed the 1960 fiscal year authorization bill for NASA to the amount of \$485,300,000.
- June 6:** An Atlas exploded 2 minutes after launching at Cape Canaveral.
- : The Army announced that life cell development could continue under space conditions. The sea urchin eggs carried in the Jupiter nose cone which were fertilized before takeoff continued to grow normally. Those fertilized during flight did not develop, but the reasons for the failure of this part of the experiment could be manifold and not necessarily related to space flight per se.
- June 7:** The Army revealed a joint United States-Japanese project for the close measuring of distances between points on Earth, bringing the error down to less than 90 feet, and with the prospect of reducing even this error from yards to feet. This process involves noting time differences in the eclipse of stars passing behind the Moon. The greater accuracy will depend upon completion of a topographical atlas of the Moon.
- June 8:** The House passed the Senate version of the 1960 authorization act for NASA, granting the full \$485.3 million as requested by the Administration.
- : The X-15 made its first successful glide drop without power from a B-52 over the Mojave Desert, with Scott Crossfield at the controls. The flight from 38,000 feet took 5 minutes, 10 seconds.
- : A Regulus I missile launched from a submarine off the Atlantic coast carried about 3,000 letters to the Mayport Auxiliary Naval Air Station near Jacksonville. This was credited as the first official carriage of mail by missile. The air-breathing missile flew in about 100 miles at a speed of 600 miles per hour after launch from the U.S.S. *Barbero*.
- June 9:** The first Polaris-carrying nuclear submarine, the *George Washington*, was launched at Groton, Connecticut.

## 1959—Continued

- June 10: The first report from the working group of the Legal Subcommittee of The United Nations Committee on Peaceful Uses of Outer Space listed freedom of outer space for exploration and use as the most urgent question before the U.N., and suggested that Soviet and United States actions to date have already established this rule. It advised against premature codification of legal problems when so little is still known.
- : The British launched Black Knight No. 3 at Woomera, Australia, reaching an altitude of 500 miles.
- June 11: A Thor Able was flown 5,500 miles from Cape Canaveral, but the cone was not recovered, although telemetry was complete to impact point.
- June 12: The Scientific Subcommittee of the United Nations Committee on Peaceful Uses of Outer Space called for the creation of a center to promote international cooperation in outer space research. They lauded the work already undertaken by ICSU, seeing no need to duplicate it, and further recommended that the situation be reviewed a year hence to see what developments occur. They emphasized the importance of early assignment of radio frequencies to space vehicles, and suggested the ultimate establishment of cooperative launching ranges.
- June 19: The Air Force test fired a Bold Orion air-launched ballistic missile.
- June 20: The Kiwi-A nuclear reactor was successfully tested at Jackass Flats, Nev. This is the static model of a nuclear rocket planned under Project Rover. Kiwi-A is to be followed by Kiwi-B, Dumbo, and Condor, which represent progressive steps from static testing to a flyable nuclear rocket.
- June 22: Vanguard SLV-6 was launched at Cape Canaveral with a payload sphere of 22.5 pounds, and 20 inches in diameter. It was designed to measure solar-Earth heating processes related to weather generation. The sphere was of magnesium alloy and carried four metal rod antennas. Powered by mercury batteries, one transmitter was on 108 mc at 10 mw, and the other on 108.03 at 100 mw. A faulty second stage pressure valve caused failure. A regulator designed to control helium flow which drives the second stage propellants into the engine did not respond to command. Pressure then built up in the helium reservoir which ruptured about 40 seconds after second stage ignition. Without sufficient pressure on the propellants, the second stage engine ran roughly. The helium tank burst when the vehicle was at 40 to 50 miles altitude. The rocket rolled over in a ballistic trajectory at an altitude of about 90 miles. The third stage ignited before plunging into the Atlantic about 300 miles north-east of Cape Canaveral. The instrumentation of the satellite had been planned by Professor Verner E. Suomi of the University of Wisconsin.

## 1959—Continued

June 25: Discoverer IV was launched at the Vandenberg Air Force Base for ARPA for a polar orbit try at 3:49 p.m. Pacific time. A two-stage vehicle with a takeoff weight of 108,500 pounds, it carried its entire 1610-pound (after burnout) second stage into orbit, including a 195-pound reentry capsule and 245 pounds of instruments. It was launched by a Thor missile topped by a Hustler-powered second stage. The capsule carried telemetry equipment to measure the performance but no biological payload was carried on this flight. Apparently it failed to achieve orbit although telemetry showed that the second stage fired. The satellite was not acquired by tracking stations on its first or possible later orbits, and therefore it was presumed to have had insufficient velocity to enter orbit, but burned on reentry at some considerable distance from the launching point.

——: Professor Gyodor Rybkin in an article in Soviet Fleet reported that the Soviet Union has the capability of detecting nuclear explosions in space up to an altitude of 1000 kilometers.

——: The Committee on the Peaceful Uses of Outer Space approved a preliminary work plan for future United Nations action in this field. The two reports, legal and technical, were approved by all 13 participating members in the continued absence of the 3 Soviet bloc members and 2 neutralist members who were boycotting the meetings and work of the committee.

June 27: Six Navy sailors emerged from an 8-day test of a simulated spaceship cabin at Philadelphia which had used a new oxygen purification system for recirculation of the same air.

——: Secretary McElroy announced that the Atlas JCBM would not become operational until September 1, 1959, instead of July 1. He also offered the opinion that the Soviet ICBM had suffered similar delays in attaining operational status and that the intelligence estimate was that the U.S.S.R. would have only 10 ICBM's by the end of 1959.

June 29: The Navy successfully tested a Polaris test vehicle at Cape Canaveral.

——: The British launched Black Knight No. 4 at Woomera, Australia, and it was successful, but the altitude attained was not announced.

July 1: The test reactor Kiwi-A was operated at full power at Jackass Flats, Nev., as a step in the development of the Project Rover nuclear rocket.

——: The Department of Defense announced that William M. Holaday had been relieved as chief of its guided missiles office to devote full time to the Chairmanship of the Civilian Military [Space] Liaison Committee. The President expanded the authority of the CMLC to settle any disputes between the Department of Defense and the National Aeronautics and Space Administration. Previously, the CMLC could intervene only at the request of one of the two agencies. The CMLC is made up of 8 members, 4 each from the Department of Defense and from NASA.

1959—Continued

- July 2: The Soviet Union launched an experimental single-stage IRBM carrying a payload of more than 4,400 pounds, including a biological capsule with two dogs, *Otvazhnaya* (Courageous) and *Snezhinka* (Snowflake) and a rabbit, *Marfusha* (Little Martha). The telemetry returned both biological and geophysical data. All three animals were recovered successfully. The altitude attained was not announced, but many unofficial reports credited the flight with 300 miles as the "great height" attained; it is even more likely to have been closer to 150 miles. In addition to the goal of successful separation and recovery of the biological capsule, a special purpose was to measure the composition of light gases in the upper atmosphere. The launching is said to have taken place at 6:30 a.m. Moscow time. Other instruments on board were to determine the structure of the ionosphere, the micrometeorite stream, the direction and speed of air currents at different heights, and the density, pressure, temperature, and composition of the atmosphere according to height. The animal capsule returned valuable information about the composition of light gases in the atmosphere. *Otvazhnaya* was making her third flight in a rocket.
- July 6: Commander M. Lee Lewis was killed in a freak accident at St. Paul, Minnesota shortly before scheduled launching of a high-altitude balloon test.
- July 7: A four-stage rocket carried a payload for the ARDC from Wallops Island, Va., to an altitude of 750 miles.
- July 9: The NASA Lewis Research Center operated a research model of an ion rocket in a new test facility.
- July 10: The Soviet Union claimed to have launched a second single-stage ballistic missile to an unspecified high altitude. This time the payload was 4840 pounds. *Otvazhnaya* was again a passenger together with a second dog which was not named publicly. In general, the purposes and instrumentation of the rocket were similar to the flight made eight days earlier. Both dogs were recovered successfully after ejection of their capsule. Western sources again estimated the altitude reached as 300 miles, but a later Soviet report indicated a height of 131 miles. The missile also made measurements of the infrared radiation of the Earth and its atmosphere, photographed cloud masses, analyzed ionic and neutral composition of the atmosphere, and made measurements of the electrostatic field.
- : United States, British, and Soviet scientists recommended at Geneva to their governments that satellites be put in orbit above 18,000 miles, and weighing several thousands pounds as a means to detect nuclear tests. Five or six would be required. As an alternative, six to ten detection satellites could be orbited at 300 to 450 miles. A third plan would use two to four satellites at this same lower altitude. The two alternate systems would leave some blind spots which would require ground stations, perhaps as many as 180. A further part of the plan called for four planetoids in orbit around the Sun to police any tests behind the Sun or the Moon.

## 1959—Continued

- July 11: The second series of Project Stratoscope opened with the launching of a balloon to 81,250 feet with an advanced camera to photograph the Sun. The launching took place at Lake Elmo Field, St. Paul, Minnesota, under the control of the Navy.
- July 13: The Office of Naval Research launched the biggest plastic balloon yet—6 million cubic feet—to 139,500 feet over Canada, from Fort Churchill. It carried 173 pounds of instruments for cosmic ray research.
- July 14: The Navy launched the first of a new series of Nike-Asp solid rockets, which recorded radiation to an altitude of 150 miles. This was also the first ballistic shot from Point Arguello, California.
- July 15: A Polaris test vehicle was destroyed in flight in a launching at Cape Canaveral.
- July 16: The Lick Observatory 120-inch reflector telescope, second largest in the world was dedicated, after 12 years of preparatory work.
- July 17: A Juno II (Am 16) rocket exploded when only 10 feet off the launching pad in an attempt to put up a satellite of 91.5 pounds which would have become Explorer VI if it had been successful. The experiments contained in the satellite stage were concerned with weather phenomena.
- July 17: A Nike-Asp was launched in connection with Project Sun-flare, but reached only 18 miles when the second stage failed to fire.
- July 21: The first successful firing with recovery of the nose cone since February 4 was conducted with an Atlas, after a string of disappointments. The flight was about 5,500 miles long. This was the first tactical nose cone to be recovered after such a flight.
- July 22: A Thor missile launched at Cape Canaveral was ordered destroyed by the range safety officer seconds after liftoff.
- July 24: A Thor missile was fired 1,500 miles downrange from Cape Canaveral and recovered near Antigua. A data capsule recovered included a 16 mm motion picture camera which took pictures 300 miles above the Earth. This was the second time that nose cone separation had been filmed, and was the first stabilized flight for this missile cone.
- July 26: Secretary McElroy estimated that the Soviet Union had fewer than 10 ICBM's capable of hitting the United States. This statement was made in a television interview with Senator Kenneth B. Keating.
- July 29: Lord Hallsham announced that NASA had agreed to supply Scout satellite launchers to the United Kingdom for orbiting British experiments. At least three were to be supplied, and the launchings were to be made either from Wallops Island or Vandenberg Air Force base. Sir Edward Bullard was chairman of the Steering Group on Space Research, who said it would be about two years before the British payloads were launched in the American rockets.
- August 6: A Polaris test flight suffered a second-stage malfunction after a launching from Cape Canaveral.

## 1959—Continued

August 7: Explorer VI was successfully launched at Cape Canaveral by a three-stage Thor Able rocket. It carried an instrument package of 142 pounds equipped with four "paddle wheels" mounting 8,000 solar cells for its power supply. Its orbit took about 12.75 hours to complete, and the apogee was 26,357 miles and the perigee 156 miles. Some 15 experiments were contained in the payload which was a spheroid 26 inches in diameter and 29 inches deep. The purpose was to map the size and intensity of the Van Allen radiation belts, the dimensions of the Earth's magnetic field, and ionospheric studies. The satellite also contained an elementary scanning device to provide the first sketchy television pictures of the Earth. It also carried a detector for micrometeorites. Data were broadcast to Earth from three transmitters—two of 500 mw on 108.06 and 108.09 megacycles, and a higher power 5-watt primary transmitter on a frequency kept secret for security reasons, later disclosed to be 378 mc. This transmitter required so much power that it was to broadcast only on command for limited periods so that its nickel-cadmium storage batteries would not be exhausted. There were also two receivers, one on a low frequency for use in the ionospheric propagation studies, and one for receiving command signals. Explorer VI was accompanied in orbit by the empty casing of 50 pounds of the spent third stage of the Able rocket. The orbit was inclined  $46.9^\circ$  to the Equator.

—: The Department of Defense revealed a new Navy Project Tepee, a radio monitoring system capable of detecting almost instantly more than 95 percent of all atmospheric nuclear tests or rocket launchings anywhere in the world. Already the system had revealed important information on the Soviet test program. The new system was devised by Dr. William J. Thaler of the Office of Naval Research. The system has been checked by successfully monitoring almost all United States missile, satellite, and atmospheric nuclear tests since the late fall of 1957. The principle of operation is called high frequency ionospheric backscatter radar. The ionized trails of rockets or of nuclear explosion clouds reflect back radar waves which have been bounced over great distances between the Earth and the ionosphere. The return echos on the radar scope can with experience be interpreted.

—: The Air Force launched successfully for the first time a weather balloon from a rocket, at an altitude of about 50 miles. The 39-inch sphere, called Robin, carried a built-in radar reflector.

August 10: The Air Force canceled its contract for the boron-fueled jet engine under development by General Electric, the J-93-5. This was slated for use in the F-108 and the B-70 aircraft. It also canceled the Olin-Mathieson fuel contract at Lewiston, N. Y.

August 11: The Soviet Union gave formal acceptance at Geneva to the plan for using satellites to detect nuclear explosions at high altitude.

## 1959—Continued

August 11: The Department of Defense cancelled the Navy production contract for boron fuels at the Muskogee, Oklahoma plant of the Callery Chemical Corp.

—: The Air Force fired successfully an Atlas 5,500 miles down-range from Cape Canaveral, but did not attempt recovery of the nose cone.

August 13: Discoverer V, with a takeoff weight of 108,500 pounds was successfully placed in polar orbit from Vandenberg. The second stage on the Thor booster was called Agena, built by Lockheed and powered with the Bell Hustler rocket engine. The orbit had an apogee of 718 miles and a perigee of 120 miles, with an orbital time of 98.3 minutes. The orbit was inclined 78.9° to the Equator. The final stage after burnout weighed 1700 pounds, and contained a reentry capsule weighing 300 pounds. The Agena stage reentered and burned September 28, 1959.

August 14: The Titan on its first full-powered test flight exploded on the launching pad when the countdown reached zero.

—: The capsule of Discoverer V was ejected over the Pacific, but was not recovered. Apparently there was a malfunction in the sequencing of steps related to proper reentry and signals. (See February 10, 1960.)

—: A Juno II (Am 19B) rocket was launched with a takeoff weight of 121,000 pounds at Cape Canaveral to place a 12 foot balloon in orbit. Although the stages all fired, injection into orbit was not angled correctly, and it is presumed the satellite burned in the atmosphere. If it had been successful, the satellite would have been named Beacon. The satellite would have weighed 15.3 pounds, and have been accompanied into orbit by the empty 58.5-pound third-stage rocket case. Total payload would have been 25.8 pounds for a total weight in orbit of 84.3 pounds.

—: A Thor missile was launched at Cape Canaveral on a 1,700 mile flight, carrying a camera to take pictures at an altitude of 300 miles, but the recovery capsule eluded searchers.

—: A Polaris test vehicle was successfully launched from the ship motion simulator at Cape Canaveral.

—: While Explorer VI was passing over Mexico at an altitude of 19,500 miles, it successfully transmitted a crude picture of a portion of the North Central Pacific Ocean. (See September 28, 1959.)

August 17: The first Nike-Asp sounding rocket to measure wind activity between 50 and 150 miles was successfully launched at Wallops Island, Va. It created an orange sodium vapor reaching more than 150 miles up. The payload was 75 pounds. A second shot a day later failed.

—: It was revealed that a team of scientists at the Naval Research Laboratory in Washington, D.C., may have found the route to a breakthrough in taming thermonuclear power, holding a plasma at 15 million degrees for about 10 microseconds using a magnetic mirror.



1959—Continued

August 19: Discoverer VI was launched with a 108,500-pound Thor-Agena at Vandenberg into a polar orbit. The Agena stage weighed 1,700 pounds after burnout, and contained a 300-pound reentry vehicle. The orbit was 95.3 minutes with an apogee of 537 miles and a perigee of 139 miles. The Agena reentered and burned on October 20, 1959.

August 20: It was announced that in recent tests an Army-developed rocket sled of 7,500 pounds reached a speed of 1,940 miles per hour on the test track at Holloman Missile Development Center, N. Mex.

\_\_\_\_\_ : The Air Force failed to recover the capsule of Discoverer VI. It was successfully ejected, but its radio signals were not heard, suggesting a temperature control problem for its batteries.

August 21: The National Aeronautics and Space Administration established a Bioscience Advisory Committee with Dr. Seymour S. Kety as chairman.

\_\_\_\_\_ : A Project Mercury escape system was being readied at Wallops Island for a test when it ignited prematurely and lofted the capsule into the surf nearby. The plan had been for operation of the escape system at about 500 feet from a Little Joe rocket booster. The 2,000-pound capsule mockup was unoccupied.

August 24: The fourth successful Atlas launching in a row was accomplished in a 5,500-mile shot from Cape Canaveral. The nose cone data capsule was successfully recovered, for the first time from an Atlas. Motion picture films taken 700 miles up showed one-sixth of the Earth's surface.

August 25: The Royal Radar Establishment at Malvern, England, successfully bounced signals off the Moon which were received at the University of Texas.

\_\_\_\_\_ : A Polaris flight was marred by a failure in second stage separation.

August 26: The Army fired a Jupiter missile over a distance of 300 miles from Cape Canaveral to demonstrate its range versatility.

August 27: The Army failed in its first attempt to launch a Nike-Zeus test rocket when it exploded.

\_\_\_\_\_ : It was announced that the Woomera satellite tracking station had successfully photographed Explorer VI at a distance of 14,000 miles.

\_\_\_\_\_ : A Thor was sent 1500 miles from Cape Canaveral, and its data capsule was successfully recovered. It carried a camera.

\_\_\_\_\_ : A Polaris test vehicle was fired from a ship for the first time, on board the *Observation Island* just off Cape Canaveral. It traveled a distance of about 700 miles.

\_\_\_\_\_ : The first British Commonwealth Symposium on Space Flight opened in London.

August 29: A Navy technician riding in the Johnsville, Pa., human centrifuge withstood a load of 31 g's.

August 31: The Tenth International Astronautical Federation Congress opened in London.

## 1959—Continued

- September 1: The Atlas missile was officially declared operational, and was taken over by the Strategic Air Command at Vandenberg Air Force Base.
- September 2: Dr. Theodore von Kármán was named chairman of a committee to establish an international academy of astronautics.
- September 4: A new altitude record for balloons was set in a flight by an unmanned balloon to 148,000 feet. It was launched for the University of Chicago by Raven Industries of Sioux Falls, S. Dak.
- September 5: Professor Leonid I. Sedov, chairman of the Astronautics Commission of the Soviet Academy of Sciences was elected president of the International Astronautical Federation in London.
- September 9: Combat Air Force troops fired an Atlas for the first time. It was fired from Vandenberg to a target point near Wake Island, 4,400 miles away. The same day another Atlas was fired at Cape Canaveral.
- : For the first time a boiler plate Mercury capsule was fired with an Atlas booster in a Big Joe configuration. Despite a malfunction which made it depart from the planned trajectory, it was recovered successfully. It flew about 1,500 miles instead of the 2,000 planned. In its unplanned trajectory, it experienced more extreme heat and shock conditions than planned. However, if a man had been on board with a life-support system, he would have survived the reentry, and the results were so good that a second try at a similar shot was cancelled as no longer needed. It had survived surface temperatures up to 10,000° F.
- September 12: The Soviet Union launched a second cosmic rocket. By Soviet account, the final stage weighed 3,342 pounds without fuel. It carried a container of spherical form which separated from it in space, and this weighed 859.8 pounds. The rocket was launched at higher than escape velocity inclined 65° to the Equator. One radio transmitter broadcast on 20.003 and on 19.997 megacycles. The signals were in coded messages lasting from .8 to 1.5 seconds, to alternate between the two frequencies. A second transmitter broadcast on 19.993 and 39.986 megacycles, with messages in impulses ranging from .2 to .8 seconds about once every second. A third transmitter operated on 183.6 megacycles. The container carried pennants with the Soviet coat of arms and the inscription, "September 1959." The rocket carried apparatus to emit a sodium vapor cloud at a prearranged time to aid visual observation. The rocket also contained radios on 20.003 megacycles and 19.997 megacycles. All instruments were said to have worked according to plan. Their purposes were said to include study of the magnetic field of the Earth and the Moon, the radiation belts of the Earth, the intensity of cosmic radiation, heavy nuclei in cosmic radiation, the gas components of interplanetary matter, and meteoritic particles. Western reporters referred to this rocket as Lunik II.

## 1959—Continued

- September 13: At 5:02:24 p.m. Eastern Daylight Time, the Second Soviet Cosmic Rocket struck the Moon, according to Soviet announcements, and as provisionally verified by data from the Jodrell Bank Radio Telescope near Manchester, England. The flight took about 35 hours, for a distance of 236,875 miles. Radio signals were from the capsule, and the probability is that the heavier but separate rocket last stage also reached the Moon. The instrument container is estimated to have hit at a point about 270 miles from the center of the Moon. Its speed at impact was approximately 7,500 miles per hour.
- September 15: Premier Khrushchev started from Moscow in a giant Tu-114 turboprop to visit the United States. Also the first nuclear-powered icebreaker, *Lenin* sailed into the Baltic on its maiden voyage.
- : Premier Khrushchev presented to President Eisenhower a replica of one of the spheres carrying the Soviet coat of arms and date September 1959 on his arrival in Washington. He denied any basis for the reported statement of Vice President Nixon that three previous attempts to launch a rocket to the Moon had failed during the previous two weeks.
- September 16: A full-sized Minuteman model was fired from an underground silo.
- : A Jupiter missile carrying 14 pregnant mice, 2 live frogs, and a miscellany of other biological experiments was launched at Cape Canaveral. Trailing black smoke as it took off, the range safety officer had to explode it at approximately 1,000 feet.
- September 17: President Eisenhower suggested in a news conference that the pennants carried by the Soviet rocket most probably vaporized on hitting the Moon at high speed.
- : The X-15 manned rocket ship made its first powered flight, released from a B-52 over the Mojave Desert. On this first test, it flew at a speed of 1,400 miles per hour with Scott Crossfield of North American Aviation at the controls. It was under power for 3 minutes and landed 7 minutes later.
- : Transit I-A, the first new all-weather navigation beacon satellite was launched at Cape Canaveral by a 105,000-pound Thor Able rocket combination. The test sphere was 265 pounds. It had bands of solar cells to power its two ultrastable oscillators which were to broadcast on 54 mc, 324 mc, 162 mc and 216 mc. The third stage failed to fire, and it fell with the satellite still attached, 2,500 miles away, near the southwest tip of Ireland. It had climbed 400 miles.
- September 18: Vanguard III (SLV-7) was launched successfully into orbit from Cape Canaveral. This was the final shot in the Vanguard series of 13 attempts. The 22,600 pound launching vehicle used the same first and second stages as Vanguard I and II but had a new third stage with a 3000-pound thrust Allegany Ballistic Laboratory engine. The satellite weighed 100 pounds including a 50-pound instrument pack and still attached, a spent rocket casing weighing 50 pounds. The orbit, inclined 33.3° to the Equator, had an initial apogee of 2,329 miles and a perigee of 319 miles with a period of 130 minutes. Instruments carried by the

## 1959—Continued

satellite were to measure the Earth's magnetic field, temperatures inside the satellite, meteorite penetration, dust erosion, and related phenomena, and the intensity of solar X-rays. Tracking and telemetry were broadcast on 108 mc at 30 mw, and more telemetry and command information on 108.03 mc at 80 mw. The satellite is a 20 inch sphere attached to a 26 inch long tapered tube, with a magnetometer at its end.

September 19: In a talk with Senators, Premier Khrushchev revealed that about a week before the successful Moon shot, a similar rocket on the pad showed malfunctions, and so a duplicate rocket assembly was used instead, saving the first rocket for a later test.

September 20: The Soviet Union announced that instruments on the Second Cosmic Rocket showed no magnetic field or belts of radiation around the Moon. It did find a concentration of ionized particles in space when approaching the Moon. The point of impact was redefined as 497 miles from the center of the visible surface, east of the Sea of Serenity, near the craters of Aristylus, Archimedes, and Autolyceus. It hit at a speed of 7,200 miles per hour at an angle of 60 degrees.

September 21: The first test tactical Polaris missile was successfully launched at Cape Canaveral in a test of stage separation and general performance.

September 22: The U.S.S. *Patrick Henry*, a Polaris-launching nuclear submarine was launched at Groton, Conn.

September 23: The Department of Defense reorganized its space program again. The Air Force was assigned primacy in military space activities, keeping control of all the long-range missiles and boosters except for Polaris, which remained under Navy control. The Advanced Research Projects Agency was to continue responsibility for advanced research on missile defense, on solid propellants, special materials, and other projects as decided by the Secretary of Defense. Although the reassignments were not made immediate, the move was toward Air Force development, production, and launching of military space vehicles. Projects Midas and Samos were assigned from ARPA to the Air Force; Project Transit from ARPA to the Navy; and Project Notus from ARPA to the Army.

September 24: During a static test at Cape Canaveral, the Atlas booster intended for the next Atlas Able IV, lunar shot exploded. Fortunately the 375 pound instrument payload was not in place on the missile, and therefore was not lost.

—: It was disclosed that the Navy had before the Joint Chiefs of Staff a plan for a unified command for military space and missile development, operating directly under the Joint Chiefs of Staff. The proposal was not adopted.

September 27: A malfunction in the second stage terminated a Polaris flight from Cape Canaveral in sight of the beach.

## 1959—Continued

- September 28: The NASA released the first pictures taken August 14, 1959, in space from a satellite when facsimile transmissions from Explorer VI were processed and released in picture form. Although the picture was crude, it showed the crescent shape of part of the Earth in sunlight. The picture was taken about 19,500 miles over Mexico looking at the Pacific Ocean. Because this was only a test for ultimate very long range transmissions from millions of miles away, a band width of only 1.5 cycles per second was used, in contrast to the 4 million cycles of commercial television. Explorer VI also had reported that the inner Van Allen radiation belt is made up of very energetic protons. The picture was received in Hawaii, taking 40 minutes to transmit.
- October 2: The last of the early development test vehicles of the Polaris missile program launched at Cape Canaveral blew up 40 seconds later.
- October 4: On the second anniversary of Sputnik I, the Soviet Union launched their Cosmic Rocket III toward the Moon. The last stage of the rocket without fuel weighed 3,424 pounds. The instrument capsule, termed an "Automatic Interplanetary Station," weighed 614 pounds, while the last stage also carried 345 pounds of additional instruments for a total instrument weight of 959 pounds. One transmitter broadcast on 39.986 megacycles in pulses varying from .28 seconds. The other transmitter on 183.6 megacycles was intended both for telemetry and for use in orbit element control. Through the use of solar cells and storage batteries, data collected by the instruments were to be broadcast for intervals of from 2 to 4 hours daily. It was predicted that the rocket would take pictures of the side of the Moon invisible from the Earth. Western reporters called this rocket Lunik III. The Automatic Interplanetary Station reentered and burned on April 20, 1960. The carrier rocket reentered and burned on May 19, 1960.
- : A Little Joe test with a boiler plate version of the Mercury capsule was launched at Wallops Island to rise about 40 miles before a planned destruction was carried out. The test was termed successful by NASA.
- October 6: Soviet Cosmic Rocket III passed the Moon at its closest point of 4,349 miles by Soviet calculation. Its orbit was then inclined at 80 degrees to the Equator of Earth. It was estimated that its orbit would have an apogee of 292,000 miles and a perigee of 24,840 miles, and a period of about 15 days.
- : An Atlas missile was successfully fired over full range of 5,500 miles from Cape Canaveral.
- : A Thor missile was successfully fired over full range of 1,700 miles from Cape Canaveral.
- : The Soviet Union announced that it would call for an international scientific conference on the exchange of information on the exploration of space, following the pattern of the conferences held on nuclear energy.
- : For unexplained causes, the long-life broadcasting system in the Explorer VI satellite ended its transmissions.

1959—Continued

- October 7: The United States and the United Kingdom welcomed the Soviet proposal in principle for an international conference on the peaceful use of outer space.
- : Cameras in the Third Soviet Cosmic Rocket were triggered 40,000 miles behind the Moon to take a sequence of 40 minutes of film of the hidden backside.
- October 9: Evgeny K. Fedorov, director of the Soviet Institute of Applied Geophysics, charged that the Discoverer satellites in the United States were carrying a broad program of instruments and that the United States was withholding data from scientists of other countries. He claimed the U.S.S.R. was not withholding basic scientific information it learned from space experiments.
- : An Atlas missile made a successful full-range flight from Cape Canaveral.
- October 10: The Soviet Cosmic Rocket III reached its maximum distance from Earth of 291,870 miles, by Soviet calculation.
- October 12: For the first time the Soviet Union revealed in public print the details of its training program for manned flight to altitudes up to 300 miles, including a discussion of dog shots and the work of three men being trained for space flight—Alexei Grachev, Alexei Belokonev, and Ivan Kachur. An unofficial source said 20 men were in training for possible space flight.
- : The second test version of the Polaris tactical missile launched at Cape Canaveral suffered a second stage malfunction.
- October 13: The Air Force launched a Bold Orion missile from a B-47 bomber near Patrick Air Force Base to pass within about 4 miles of Explorer VI at an altitude of 160 miles as a test of satellite rendezvous or intercept techniques. The missile used was built by Martin Aircraft. It landed in the ocean 1,000 miles away.
- : Explorer VII was successfully launched by the Army at Cape Canaveral, using a Juno II booster (No. 19A). The satellite weighed 91.5 pounds, had a payload of 70 pounds, and was shaped like a top, measuring 30 inches in diameter and 30 inches long through its axis. The satellite had an apogee of 680 miles and a perigee of 342 miles, inclined 50.3 degrees from the Equator. Its period was 102 minutes. Seven major experiments were contained: a radiation balance set of six sensors to measure radiation from the Sun and the amount reradiated by the Earth; two sensing devices to measure the intensity of X-rays and ultra-violet rays from the Sun; a device to measure the intensity of heavy cosmic rays; an instrument to measure the total intensity of charged particles and cosmic rays both in and below the Van Allen radiation belts; a test of ionospheric composition through its effects on radio transmissions; a study of micrometeorite impacts; and a study of solar cell erosion. Two radio transmitters were carried. One on 108 megacycles at 15 milliwatts was for tracking and telemetry, powered by solar cells recharging nickel-cadmium batteries. The other transmitter on 20 megacycles had a power output of .63 watts, drawn exclusively from chemical batteries intended to last only a few months. A clock was to end all transmissions from the satellite after one year so as not to clutter the radio spectrum, but failed to act.

## 1959—Continued

- October 14: The first successful test flight of a Nike-Zeus missile was conducted by the Army at White Sands. The flight terminated short of the planned trajectory but returned the data sought. A previous test on August 26 exploded after launch.
- : Prime Minister Macmillan named Duncan Sandys to head a new Ministry of Aviation, responsible for missiles, radar, electronics, as well as the aviation industry. He also named Viscount Hailsham, the Lord Privy Seal, as in effect the Minister of Science, responsible for the Atomic Energy Authority, the Department of Scientific and Industrial Research, and research in medicine, agriculture, and outer space.
- October 17: Roy W. Johnson announced that he was resigning as head of the Advanced Research Projects Agency as soon as a successor could be found.
- : The X-15 made a successful second powered flight. With Scott Crossfield at the controls, it climbed after launch from a B-52 to 60,000 feet, and flew between 1400 and 1500 miles per hour. The total flight lasted about 10 minutes after drop.
- October 18: The Soviet Union announced that it had been successful in taking pictures of the far side of the Moon with its Cosmic Rocket III. The vehicle also reached the perigee of its orbit around the Earth on this day, passing within about 29,498 miles of the surface. (Other estimates placed perigee at 24,820 miles.)
- October 19: General John B. Medaris, Commander of the Army Ordnance Missile Command at Huntsville, Alabama, announced his retirement, effective January 31, 1960.
- October 20: The President met with officials concerned with the missile and space programs, but not through the medium of the National Aeronautics and Space Council, to discuss the possible reassignment of the Army Ballistic Missile Agency and the Saturn booster project. Those invited were Secretary McElroy, T. Keith Glennan, Dr. Hugh Dryden, Deputy Secretary Thomas S. Gates, Dr. Herbert F. York, Dr. George Kistia-kowsky, Elmer Staats, and White House staff members. General Twining may have been present, too.
- : The Agena stage of Discoverer VI ceased to orbit on its 965th pass around the Earth, reentered the atmosphere and burned.
- October 21: The President announced that he was transferring, subject to Congressional approval, the Army's space rocket team and facilities at Huntsville, headed by Dr. Wernher von Braun, and formerly under General Medaris, to the new control of the National Aeronautics and Space Administration. At the same time the work being conducted by the Army at Huntsville on the Saturn booster was also transferred to the control of NASA. In effect these decisions took the Army out of space work except in a supporting role such as the work done by the Signal Corps on communications satellites.
- October 23: Explorer IV ceased to orbit.

1959—Continued

- October 26: The Soviet Union released the first photo taken of the far side of the Moon by their Cosmic Rocket III. This showed 70 percent of the back side. They also gave details of how the picture taking and transmission had been accomplished. When the instrument container was in the approximate location from which pictures were to be taken, its rotating motion was stopped, and the camera was pointed at the Moon. Over a period of 40 minutes, a series of pictures were recorded on film in a variety of exposures to insure getting some which were correct. By control from the Soviet Union, the pictures were developed in chemicals and then stored until on the return trip the instrument container was in a suitable position for broadcast of the pictures with electronic scanning of the films. At greater distances, the transmission was slow to insure clarity, but speeded up as the container approached the Earth. The pictures were taken at a distance of from 37,000 to 43,000 miles from the Moon. The camera used 35 millimeter film with pictures made through two lenses, one with a focal length of 200 and the other 500 millimeters. When the pictures were transmitted, they contained 1,000 lines of scan to the frame.
- October 28: The National Aeronautics and Space Administration launched successfully for the first time a 100-foot plastic balloon from Wallops Island using a Sergeant-Recruit combination of rockets to carry the payload of 130 pounds to an altitude of 250 miles where it was inflated. It fell 500 miles away from the launching point.
- October 29: A Thor missile made a successful 1,500-mile flight from Cape Canaveral.
- : An Atlas missile made a successful flight of 5,500 miles with a second generation tactical nose cone. A camera took cloud cover pictures at an altitude of 300 miles.
- November 2: President Eisenhower confirmed his intention to transfer Project Saturn to the National Aeronautics and Space Administration.
- November 3: The Air Force sent a Thor missile some 1,700 miles on a launch from Cape Canaveral.
- : The United States Navy reported that its planes had spotted Soviet ships possibly of a missile tracking configuration between Midway and Kamchatka. Three Soviet ships had been sighted in that area for the past several weeks.
- November 4: A Jupiter missile launched at Cape Canaveral made a successful flight of about 1,500 miles.
- : A second Little Joe rocket launching test was conducted at Wallops Island in which a Mercury capsule was fired out over the Atlantic to test the emergency escape system. The capsule was recovered 5 miles away from the launching site after being separated from the Little Joe booster at an altitude of about 7 miles, and 30 seconds after launching.
- : Dr. Charles L. Critchfield was nominated to become Director of the Advanced Research Projects Agency, on a without-compensation basis, continuing to receive his regular salary from the Convair Division of General Dynamics Corp.



1959—Continued

- November 4: An Atlas missile made a successful 4,800-mile flight from Cape Canaveral as programmed, on the tenth consecutive successful flight since July 21.
- : A Thor missile launched from Cape Canaveral made a successful flight of 1,500 miles.
- November 5: The X-15 made its third powered flight at Edwards Air Force Base, but experienced an explosion in the after section. Pilot Scott Crossfield made a successful landing; however, the ship sustaining some damage in the process.
- November 7: Discoverer VII was successfully launched into a polar orbit from Vandenberg Air Force base by a Thor-Agena with a takeoff weight of 108,500 pounds. The final stage after burnout weighed 1,700 pounds, including a 300-pound reentry capsule. The orbit had an apogee of 550 miles and a perigee of 104 miles, with 95 minutes the orbit time. The orbit was inclined 82 degrees to the Equator. The Agena stage reentered and burned on November 26, 1959.
- November 8: The reentry capsule of Discoverer VII failed to separate as scheduled because of an electrical malfunction which did not permit stabilization of the Agena vehicle.
- November 9: The Air Force announced the long-delayed award of development contracts for the Dyna-Soar space glider. Boeing Aircraft was to build the glider stage, and Martin Co. the first stage rocket booster. The first Dyna-Soar is viewed as an initial step toward Mrs. V. (Manueverable, Recoverable Satellite Vehicle), radically different from Project Mercury.
- November 10: The Atomic Energy Commission's SNAP-2 experimental reactor for space achieved a power of 50 thermal kilowatts in a test at Santa Susana, Calif. It was built by Atomics International.
- : The Army launched at Wallops Island for the National Aeronautics and Space Administration a 5-stage rocket which rose to 1050 miles. The purpose was to measure the density of electrons in the upper atmosphere, in the interest of better global communications. A transmitter in the rocket broadcast on 37 and on 148 megacycles. The rocket stages included an Honest John, 2 Nike boosters, a modified Recruit, and a scaled down Sergeant. The payload weighed 15 pounds.
- : A British Black Knight rocket was successfully fired at Woomera, Australia, reaching an altitude in excess of 450 miles. The nose cone was retrieved intact.
- November 11: The Soviet discovery of a 62,000-mile-long tail of air escaping from the Earth was noted in Washington following translation of a Hungarian report of the study of Vasily G. Fesenkov. The Soviet estimate is that the Earth loses 11,000 tons of air each day, a small part of the 5.2 trillion tons in the atmosphere. The tail of air points away from the Sun because of the pressure of the Sun's radiant energy.

## 1959—Continued

November 13: Samples of more than 1,000 clear photographs of the Sun were released by the National Science Foundation and the Office of Naval Research. The photographs showing a wealth of detail were taken on balloon flights July 11, August 17, and September 4, as part of Project Stratoscope I, at about 80,000 feet over Minnesota.

—: Premier Khrushchev reported that one Soviet plant produced rockets with thermonuclear warheads in the amount of 250 in one year.

November 14: Dr. Charles L. Critchfield withdrew his acceptance of the nomination to the post of Director of the Advanced Research Projects Agency on the grounds his usefulness had been impaired over the criticism of his possible dual interests to the Government and to his source of salary, the Convair Division of General Dynamics Corp.

—: The Soviet Union announced that it had unexpectedly lost radio contact with Cosmic Rocket III. The possibility was not excluded that a collision with a meteorite might have punctured the satellite's pressurization. American scientists wondered whether an internal failure in equipment was not more likely.

—: The Air Force opened its new Aerospace Medical Center at Brooks Field, Tex.

November 15: Senator Henry M. Jackson proposed that all 15 members of NATO join scientific forces to explore the world of space.

November 16: Missiles and Rockets magazine reported that American radar in the Aleutians had tracked a Soviet ICBM recently on a flight to a point north of Midway Island in the Pacific.

—: Capt. Joe Kittinger made a record parachute jump from the gondola of a balloon at 76,400 feet.

November 17: The Avco Research Laboratory at Everett, Mass., announced that work done for space projects in the field of MHD (magnetohydrodynamics) shows great promise of bringing a revolution in electric power production. Economic application is not expected for perhaps a decade, but could increase operating efficiency over present levels by 25 percent, and also eliminate the need for a substantial part of present electric plants. Electricity would be generated by passing a superheated gas through a magnetic field—the gas coming either from combustion of conventional fossil fuels or having been heated in a nuclear reactor.

November 18: The Atomic Energy Commission announced the development of a 220-pound nuclear reactor to supply electrical power for advanced space vehicles. This has been designated SNAP II, and is capable of generating 3 kilowatts of power for long periods of time, or hundreds of times that of the SNAP III radioisotope power source unveiled earlier in the year, or the solar-powered paddle wheel satellites developed. The life span is set by the durability of the mechanical parts of the generator, not the nuclear fuel supply. Highly enriched uranium heats liquid sodium which in turn vaporizes mercury to spin the turbine coupled to an electric generator. The 220-pound reactor is the size of a 5-gallon can; the generator weighs 30 pounds more, and the shielding could run to another 400 pounds. Developed by Atomics International Division of North American Aviation, at a cost of \$6.5 million, individual units would cost about \$400,000.

## 1959—Continued

November 18: The Department of Defense transferred management control of Project Saturn from the Army to the National Aeronautics and Space Administration.

———: The National Aeronautics and Space Administration launched at Wallops Island a Nike-Asp rocket combination which emitted a sodium vapor trail at altitudes from 50 to 150 miles, creating a cloud which was visible up and down the East Coast. The purpose was to obtain geophysical information about the upper atmosphere, including wind velocities. The payload was 75 pounds including 4 pounds of sodium pellets.

November 19: A second sodium vapor cloud test was attempted at Wallops Island, but failed to eject its sodium cloud.

———: In separate news conferences, T. Keith Glennan of NASA and Professor Leonid Sedov of the Soviet Academy of Sciences expressed great hopes that the United States and the Soviet Union could move toward a program of space cooperation.

November 20: Discoverer VIII was launched at a takeoff weight of 108,500 pounds from Vandenberg Air Force Base into a polar orbit. Launched by a Thor missile, the Agena upper stage weighed 1,700 pounds after burnout, and carried a 300 pound reentry capsule. The orbit was somewhat more eccentric than planned, with an apogee of 1,056 miles and a perigee of 120 miles; the orbital time was 103 minutes, and the orbit was inclined 81 degrees to the Equator. The Agena stage reentered and burned March 8, 1960.

———: The Navy successfully test-fired a Polaris missile from Cape Canaveral.

November 21: The capsule of Discoverer VIII was ejected, and was then presumed to have plunged into the sea near Hawaii. Sea and air search failed to locate it.

———: Soviet Deputy Premier Mikoyan announced in Mexico City that the Soviet Union would launch a rocket "to visit the Sun".

November 24: The Air Force test launched an Atlas with unstated results.

November 26: Unfortunately referred to as "America's Space Turkey", the 255,000 pound takeoff weight Atlas Able IV rocket attempt to put a satellite into orbit around the Moon failed. The 372-pound instrument package with a variety of experiments, 2 radios on 378 mc at 5 watts, 4 paddles with 8800 solar cells, and a retrorocket was lost in the Atlantic. The Atlas booster and second stage seemed to perform as intended, and fell in the Gulf of Guinea off the coast of Africa. However, apparently the fairing around the satellite came off very soon, making the rocket unstable. Some debris even fell on the beach, and more was fished out of off-shore waters. This was America's most ambitious space experiment attempt to date, and no follow-up was expected for a period of up to two years as no backup rocket was available short of robbing other high priority projects. Both parts of the fairing and the instrument capsule were found close to Cape Canaveral. No cause was assigned for the accidental premature shedding of the nose shroud.

———: The Agena stage of Discoverer VII with its still attached capsule reentered and burned.

## 1959—Continued

- November 28: It was revealed that the Mach-3 B-70 bomber would not be pursued as a weapons system. Instead, on a stretchout basis, only two prototypes were to be developed to test the air frame concept. Cancellation of all the supporting guidance, navigation, and bombing systems would add years to ultimate delivery if ever a later decision were made to put the aircraft to military use.
- November 28-29: Commander Malcolm Ross and Dr. Charles B. Moore went aloft in a balloon, Stratolab-High IV, to about 80,000 feet from Rapid City, South Dakota, to measure the atmosphere of Venus, using instruments, 16-inch telescope, and camera above most of the Earth's atmosphere. The result was to find for the first time water vapor in the Venusian atmosphere, previously screened by the vapor of Earth's own atmosphere. The balloon landed in Kansas on November 29. Dr. John Strong of the Office of Naval Research headed the project.
- November 30: On this day and the day following, the British Government successfully launched at Woomera three Skylark research rockets. The first ejected a sodium cloud at 40 miles. The second ejected explosive grenades at regular altitudes up to 90 miles, plus bits of metal foil which were tracked by radar. The third carried both these experimental devices, plus radio emissions to measure ionosphere density.
- December 1: Twelve nations signed a treaty making the Antarctic continent a preserve for scientific research, and immune from political and military strife. Signatories are Argentina, Australia, Britain, Chile, France, New Zealand, Norway, Belgium, Japan, South Africa, the Soviet Union, and the United States. Legal experts have suggested that Antarctica provides a first step which may lead to similar agreements demilitarizing the Moon and other bodies in space at some future date.
- : A Thor missile was launched at Cape Canaveral making a successful flight of 1700 miles. However, the nose cone carrying a motion picture camera was not recovered. The pictures would have been the first taken in color in outer space. (See February 16, 1960.)
- : The Air Force cut back the order for the B-70 to only two prototypes, and at the same time returned all work to the prime contractor, North American Aviation. Cancelled were the bomb-navigation system with International Business Machines Corp., the defensive subsystem with Westinghouse, and traffic control system with Motorola. Also cancelled were the subcontracts for wings with Boeing, for stabilizers with Chance-Vought, and for fuselage with Lockheed.
- December 2: A study released by the Institute of Strategic Studies, sponsored by the Ford Foundation, estimated that the Soviet Union now had about 100 principal missile bases, manned by about 200,000 men. These were said to be arrayed along the Baltic Coast, in East Germany, in the southern Ukraine, and in the Carpathian Mountains. The T-3 ICBM was credited with a range in excess of 5,000 miles. Also named were the T-2 with 1,600 miles range and the T-4 with 1,000 miles range. The same report listed seven bases for the Western powers to support intermediate range missiles.

1959—Continued

- December 2: The Department of Defense announced a new program to build a major missile tracking station on Roi Namur Island near Kwajalein in the Central Pacific. The work would relate to studying intercept techniques for intermediate-range missiles launched from Johnston Island, 1,420 miles away. Tests were expected to get underway late in 1961 or in 1962.
- December 4: The National Aeronautics and Space Administration tested the escape system for Project Mercury at Wallops Island with a third Little Joe rocket launching. In a 13-minute trip, the Mercury capsule was carried 55 miles high and 200 miles to sea. On board was Sam Space, a rhesus monkey who seemed nonchalant about his experience. Full telemetry was returned on his biologic reactions. He experienced up to 19 g's, and 3 minutes of weightlessness. The Mercury escape system was fired at 20 miles, was powered to 30 miles, then coasted the rest of the way until parachutes were deployed. The monkey was safe on board a destroyer two hours after the launching. A number of other biological experiments were sent along with Sam Space not as part of Project Mercury, but for radiation study purposes.
- : The Department of Defense assigned its continuing research on boron high energy fuels to the Callery Chemical Co. plant at Muskogee, Oklahoma.
- December 7: T. Keith Glennan, Administrator of NASA offered the use of the United States world-wide tracking network for any Soviet man-in-space project.
- : A new charter for the Committee on Space Research (COSPAR) related to the International Council of Scientific Unions (ICSU) was approved at The Hague by nine countries, this time with the approval of the Soviet Union which had objected to the previous agreement formulated in London in November 1958. Membership in COSPAR was open to all national academies of science actively taking part in space research by launching and observing rockets and satellites. The executive board would consist of nine representatives, including the president, Professor H. C. Van der Houst of The Netherlands. In addition, a new seven-man bureau was formed. The president of the bureau would be from the United States, and one vice president each would be selected from the United States and from the Soviet Union. Both countries would each select two other members of the bureau. This ended the Soviet walk-out from COSPAR deliberations.
- : A Polaris test vehicle was successfully flown from Cape Canaveral.
- : The Navy set an unofficial world record for altitude with a McDonnell F4H carrier jet at Edwards Air Force base, reaching 98,560 feet. Commander Lawrence E. Flint was the pilot.

1959—Continued

- December 8: The United States and the Soviet Union reached agreement on the membership of the new permanent United Nations body concerned with the peaceful uses of outer space, ending the Soviet boycott of such activity in the United Nations. The new committee membership of 24 would be divided into 12 for Western members, 5 for neutral members, and 7 for Soviet bloc members. Previously, the temporary committee had 12 Western members, 3 Soviet bloc members, and 3 neutralist members. The Soviet Union, Poland, Czechoslovakia, India, and the United Arab Republic walked out of the deliberations of that committee.
- : The Department of Defense picked Brigadier General A. W. Betts, military deputy to Dr. Herbert F. York to head the Advanced Research Projects Agency. At the same time, ARPA was made subject to the control of Dr. York's office (the Director of Defense Research and Engineering). Major General D. R. Ostrander who had been acting head of ARPA was transferred to the National Aeronautics and Space Administration. In NASA, a new division of launch vehicles was to be headed by General Ostrander, leaving Dr. Abe Silverstein largely with the payloads for space in his Office of Space Flight Development. The new launch vehicles office was to superintend in the headquarters of NASA the Redstone Arsenal space work of Dr. von Braun and his team.
- : An Atlas was fired 5,500 miles from Cape Canaveral.
- : The British Advisory Council on Scientific Policy cautioned against the "folly" of seeking national prestige through costly programs of space exploration. This was aimed at an all-British project, not cooperation with the United States or other nations. The recommendation clouded the future of the Blue Streak missile as a possible rocket booster for space.
- December 9: A large unmanned balloon launched at Akron, Ohio, began a free flight to Canaan, Conn., reaching an altitude of about 100,000 feet. It was launched by the Goodyear Aircraft Corp. for the Air Force. The balloon gondola, recovered December 10, took radar photographs of the Earth's surface from stratospheric altitudes.
- December 11: Capt. Joe Kittinger made a parachute jump from the gondola of a balloon at 74,700 feet over White Sands, N. Mex.
- : The membership of the permanent United Nations Committee on Peaceful Uses of Outer Space was to be as follows: Western nations: Argentina, Australia, Belgium, Brazil, Britain, Canada, France, Iran, Italy, Japan, Mexico, and the United States; Soviet bloc nations: the U.S.S.R., Poland, Czechoslovakia, Romania, Bulgaria, White Russia, and the Ukraine; and neutralist nations: Sweden, the United Arab Republic, India, Austria, and Lebanon.
- : The National Aeronautics and Space Administration decided to abandon its \$65 million support of the Vega rocket system, instead using the advanced version of the Agena system of the Air Force called Agena B, of somewhat similar characteristics. About \$17 million would be lost in the Vega work already carried out. Slippage in the production of the Vega rocket reduced its importance. The switch to Agena was expected to buy reliabil-

1959—Continued

- ity, not time. Apparently the second stage of the Vega system, with a General Electric rocket engine, was giving trouble in development. The third stage being developed at Jet Propulsion Laboratory was to continue under development. The Agena, used for the Discoverer series, is built by Lockheed with a Bell engine.
- December 12: The first attempt to launch a Titan with a test of the second stage ended with an explosion of the missile a few feet off the missile pad at Cape Canaveral.
- December 14: Missiles and Rockets magazine reported that the Soviet Union was continuing to drop ICBM's in the Pacific Ocean.
- December 15: A new world's record for altitude was set by Captain Joe B. Jordan in an Air Force F-104C fighter over Edwards Air Force Base, California when he reached 103,395 feet.
- : A Polaris was launched at Cape Canaveral in a partially successful flight in which the second stage shut down prematurely.
- : The National Aeronautics and Space Administration released a major study by Dr. Homer E. Newell, Jr., making a comparative assessment of the United States and Soviet space science programs.
- December 16: The radio transmitters in Vanguard III became silent after 85 days.
- : A new world's record for speed was set by Major Joseph W. Rogers in an Air Force F-106 fighter over Edwards Air Force Base, California when he reached 1525.95 miles per hour.
- : A Nike Zeus rocket test was conducted at White Sands, but the second stage failed to ignite.
- December 17: The payload of the world's largest balloon was found safe in Mississippi after being lost two days on a flight from Rapid City, S. Dak. The payload of 1,800 pounds included cosmic ray measuring equipment.
- : A Thor missile made a successful flight of 1,500 miles from Cape Canaveral.
- December 18: The U.S.S. *Robert E. Lee*, a nuclear-powered Polaris missile submarine was launched at Newport News, Va.
- : For the second time, an Atlas missile made a full range, successful flight, going 6,325 miles from Cape Canaveral to the target near Ascension Island. This was the thirteenth straight success for the Atlas and one of several to exceed 6,000 miles.
- December 19: The Soviet Union released details of how its third Cosmic Rocket was stabilized by Earth command to photograph the back side of the Moon, how the cameras operated, how the film was developed, and the pictures transmitted back to Earth by television. After the picture taking, rotation of the vehicle was restarted as a temperature control.
- December 20: Dr. Melvin Calvin recently reported that molecules have been found in meteorites which resemble the basic constituents of genetic material found on Earth. These complex molecules are supposed to be similar to ones which probably were present in prebiological periods on Earth.

## 1959—Continued

- December 22: A Javelin test rocket was launched at Wallops Island, Va., by NASA, carrying United States and Canadian instruments for radio astronomy purposes. It carried a payload of 48 pounds. The rocket reached an altitude of 560 miles and landed 600 miles away.
- December 23: A Polaris missile had to be destroyed during second-stage flight after launch from the ship motion simulator at Cape Canaveral.
- December 26: It was reported that new radio astronomical measurements of Venus for three years put the surface temperature at 585 degrees Fahrenheit. Tests of Jupiter indicate a radiation belt of such intensity (100 to 1,000 times that of Earth) as to raise doubt that its satellites could be approached by manned space ships.
- December 28: Dr. Wallace R. Brode, retiring president of the American Association for the Advancement of Science, and also science advisor to the Department of State, recommended the creation of a cabinet Department of Science and the complete integration into Government of Government-owned laboratories which are presently operated by contractors as a way to get around Civil Service salary limitations. He stated that a national science policy administered by a department was needed for a wise and rational distribution of funds among the many competing programs. Among recommended bureaus in the new department would be ones for work on problems of space, atomic energy, medicine, patents, physical science, geology, and weather.
- December 30: The U.S.S. *George Washington*, first fleet ballistic missile nuclear submarine, was commissioned. It was to carry 16 Polaris missiles, and operate with two complete crews taking turns to keep it on station almost continually.
- : Explorer VII has detected sporadic bursts of radiation apparently caused by disturbances in the Sun which could be of grave concern to plans for space flight between and beyond the Van Allen radiation belts.

## 1960

- January 2: Staphylococci were found in suspended animation in ice 100 feet below the surface in Antarctica in ice perhaps a century old. When the ice was melted, they became active and multiplied.
- : A Senate report showed that because of rising costs, Project Mercury was being restricted to a four and a half hour flight instead of 24 hours; also that funding was being delayed for a year on advanced manned space vehicles such as a two-man space laboratory. The change of Mercury plans was probably conditioned by the weight of the capsule in relation to the thrust of the Atlas booster.
- January 6: An Atlas missile was sent for the second time its full range of 6,325 miles to its target, for the fifteenth successful shot in an unbroken series.



## 1960—Continued

- January 7: For the first time, a Polaris test vehicle was fired with its operational all-inertial guidance system, successfully making a 900-mile flight from Cape Canaveral.
- : The President called for revisions of the National Aeronautics and Space Act of 1958 to abolish the National Aeronautics and Space Council, and the Civilian-Military Liaison Committee.
- : The Soviet Union announced a target zone about 280 miles long and 160 miles wide for the testing of long range missiles, approximately 1,100 miles southwest of the Hawaiian Islands. The Soviet tests were described as the first on a new more powerful rocket to be used for heavy satellites and for interplanetary flights. Soviet ships were despatched to the area to carry out measurements, in the general period of January 15 to February 15. The rockets to be tested were to be the complete assembly except for the last stage.
- : President Eisenhower stated in his message to Congress that in the last 14 Atlas missile tests at ranges over 5,000 miles, the average circular error had been less than 2 miles, insuring that if thermonuclear warheads have to be used, virtually any target could be destroyed. (There were 15 successes by the time his message was delivered.)
- January 8: The United States renewed its request that the Soviet Union participate actively in a meeting of the United Nations Committee on the Peaceful Uses of Outer Space which was established in December 1959 but had not yet met.
- : The preliminary session of COSPAR opened at Nice, France, although the Soviet delegates appeared later.
- January 9: The president of the Committee on Space Research (COSPAR) in session in Nice, France, announced that scientists from the Soviet Union, Poland, and Czechoslovakia had agreed to join with those of Western nations in the cooperative effort to advance knowledge of space. This was arranged only after certain organizational concessions were made. COSPAR was a followon to the IGY space activities, continuing the pattern of international cooperation begun under IGY. The new compromise organization included an inner bureau or executive committee consisting of President H. C. Van der Hoult of the Netherlands, Anatoli A. Blagonravov of the U.S.S.R., Richard W. Porter of the United States, Emil Bucara of Czechoslovakia, H. S. W. Massey of the United Kingdom, Maurice Roy of France, and W. Zonn of Poland. A two-thirds vote of this executive committee of seven was required to confirm its decisions. Also, the more or less neutral president of COSPAR was supported by two vice presidents, one each of whom must be from the United States and from the Soviet Union, the only countries to launch satellites. There was to be a voting parity between Eastern and Western nations.
- January 11: A Soviet commentary by Professor Y.A. Pobedonostsev strongly criticized Project Mercury as inadequate and "sheer sensationalism." He believed the capsule would get too hot on reentry and the designed parachute system would burn up.

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**January 11:** General Thomas D. White announced the Air Force was developing a new air-launched ballistic missile, the Sky Bolt, with a range of about 1,000 miles. Prototypes had already been launched from both subsonic and supersonic aircraft.

**January 12:** Private French scientists asked Soviet aid in launching their instruments in a Soviet satellite and General Blagonravov said that such a project would be considered if the French would ask for it officially.

———: Dr. S. Fred Singer announced that gigantic bursts of energy from the Sun could destroy space ships and their crews on rare occasions when solar activity reaches a peak. No shielding would be effective against these destructive rays.

**January 13:** A test Polaris tactical missile made another successful flight of 900 miles from Cape Canaveral.

———: The National Aeronautics and Space Administration received permission from the White House to proceed with negotiating contracts for construction of upper stages to be used on the 1.5-million pound thrust Saturn launch vehicle, to burn high-energy fuels.

**January 14:** The President formally transmitted his message calling for revisions of the National Aeronautics and Space Act of 1958, as referred to in his state of the Union message a few days earlier, calling for abolishing the National Aeronautics and Space Council and the Civilian Military Liaison Committee. He also sent forward a reorganization plan calling for the transfer of the Development Operations Division personnel (Von Braun team) and facilities of the Army Ballistic Missile Agency at Redstone Arsenal, Huntsville, Ala., to the National Aeronautics and Space Administration.

———: Premier Khrushchev made reference in his speech to the Supreme Soviet to a new weapon "more incredible" and "more formidable". "The weapon is being developed and is, as they say, in the portfolio of our scientists and designers. It is a fantastic weapon." Malinovsky told the Supreme Soviet that ICBM's carry a warhead equal to 2 megatons of TNT. Western observers speculated Khrushchev's weapon might relate to outer space. He also stated he planned major cuts in troops and in manned bomber construction, with missiles playing the dominant role.

———: A test Thor missile with an improved engine was launched at Cape Canaveral, and a data capsule was recovered 1,700 miles away near Antigua.

———: The President ordered an accelerated program of development for the Saturn space vehicle system.

**January 16:** NASA launched a rocket from Wallops Island, Virginia, carrying in its second stage a 28-inch container with a balloon which was ejected and inflated in space to a diameter of 100 feet. The balloon was sent to an altitude of 250 miles, making its glow in reflected sunlight visible for hundreds of miles along the Eastern seaboard. Radio signals were bounced against it to relay between Holmdel, N.J. and Round Hill Station, Mass. This was the second such test, using a Sergeant-Delta launcher. It fell 490 miles away from the point of launch.

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- January 16: The House Science and Astronautics Committee announced appointment of a Panel on Science and Technology to consult with it on the range of problems of concern to the committee. Those appointed were: Dr. Edward J. Baldes of the Mayo Clinic, Dr. Lee A. DuBridgde of the California Institute of Technology, Dr. Clifford C. Furnas of the University of Buffalo, Martin Goland of the Southwest Research Institute, Dr. Thomas F. Malone of the Travelers Insurance Companies, Dr. W. Albert Noyes of the University of Rochester, Dr. Clarence P. Oliver of the University of Texas, Dr. Sverre Pettersen of the University of Chicago, Dr. Roger Revelle of the Scripps Institution of Oceanography, Dr. Richard J. Russell of the Louisiana State University, Dr. H. Guyford Stever of the Massachusetts Institute of Technology, Dr. James A. Van Allen of the State University of Iowa, Dr. Fred L. Whipple of the Smithsonian Astrophysical Observatory, and Dr. Maurice J. Zucrow of Purdue University.
- January 20: The National Aeronautics and Space Administration presented its 10-year plan of space activities to Congress, calling for 260 satellites and major probes, with a manned landing on the Moon some time after 1970.
- : The Navy fired another Polaris test vehicle in a successful test from Cape Canaveral, which carried it more than 900 miles down range.
- : The Soviet missile tracking and support ships *Sibir*, *Suchan*, and *Sakhalin* were located by the U.S. Navy on their way to the intended Soviet impact area southwest of Hawaii.
- : Under Secretary of State Livingston T. Merchant in testimony before the House Committee on Science and Astronautics conceded current Soviet superiority over the United States in terms of its worldwide prestige in the space posture of each nation.
- : The Soviet Union fired a rocket which they claimed traveled 7,762 miles from an unspecified point in the Soviet Union climbing 765 miles high to impact in the reserved area southwest of Hawaii. They reported that at an altitude of 49 to 55 miles the next to the last stage of the rocket partially burned and disintegrated as it reentered the atmosphere. The nose cone is said to have entered the water near to the predetermined point, with an accuracy of within 1.24 miles. In the Soviet release, the test was linked with future plans for interplanetary flights. Professor Dobronravov also linked the experiment to a recoverable space vehicle. American speculation was that the Soviet test was not that of a new space launch vehicle, but of a regular ICBM. The impact was observed by American forces.
- January 21: In a fourth test of the Little Joe rocket test system for Project Mercury, a monkey, Miss Sam, survived successfully a flight at Wallops Island, Virginia. This was a test of capsule separation through use of the emergency escape rocket. The Little Joe rocket was launched, and deliberately at 36,500 feet, the escape rocket was fired, separating the Mercury capsule containing Miss Sam, and it reached an altitude of 48,900 feet before it was lowered safely to the surface by parachute.

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January 22: George V. Allen, Director of the U.S. Information Agency, warned the House Science and Astronautics Committee that the United States was facing a loss of prestige throughout the world because of Soviet successes in space. He reported that polls and other studies showed there was a tendency in world opinion to equate Soviet space feats with a preeminence in all fields of science and technology, and that a certain "cockiness" was appearing in the behavior of Soviet officials which endangered world peace. He reported that world opinion credited the Soviet Union with a five- to ten-year lead over the United States in space technology. It was not his aim to assess the correctness of any of these attitudes, but to report what the opinions were.

January 23: Hanson Baldwin reported that the Soviet Union was known to have only two ICBM launching stations, those at Kapustin Yar and at Tyura Tam. He also reported that prior to the new shot southwest of Hawaii that only one previous Soviet missile landed in the Pacific. He said the rest landed either in the Sea of Okhotsk or on the Kamchatka Peninsula with a circular probable error of 7 to 10 miles. Their distance traveled was on the order of 4,300 miles from Kapustin Yar or 3,850 miles from Tyura Tam. This report presumably reflected official views in some parts of the Pentagon, but this could not be confirmed.

———: The United States achieved the "ultimate record" in "inner space" by sending a manned bathyscaph, the *Trieste*, to the bottom of the Marianas Trench off Guam. Lt. Don Walsh and Jacques Piccard started down late on January 22, and after an eight-hour trip, including about half an hour on the bottom, resurfaced on the 23d. The depth attained was 35,800 feet.

———: The X-15 aircraft in a new test exceeded 1,400 miles per hour and 65,000 feet altitude, with Scott Crossfield at the controls.

January 25: The Army announced the successful firing of a Jupiter missile at Cape Canaveral which traveled a distance of 1,500 miles as planned.

———: The Bioscience Advisory Committee of the National Aeronautics and Space Administration filed its report which set forth the role of the life sciences in space, and recommendations for implementing an office in NASA devoted to these needs.

———: The United States and the United Kingdom announced a cooperative project to launch a scientific satellite using an American Scout rocket and carrying several British experiments in the satellite vehicle. Launching was expected late in 1961.

January 26: The Navy launched the largest balloon ever sent up from a ship. With an inflated diameter of 173 feet, it was launched from the U.S.S. *Valley Forge* about 2,000 miles east of Puerto Rico. In its payload of 1,630 pounds were two film packs of 800 pounds each to trace cosmic ray and secondary particles as recorded in the sensitive film. The 800-pound film packs were recovered on the 27th in the Caribbean by the destroyer *Hyman*.

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**January 26:** Successful Atlas shots of approximately 5,000 miles were made both from Cape Canaveral and from Vandenberg Air Force Base, the sixteenth and seventeenth in an unbroken series of successes.

—: The National Aeronautics and Space Administration tested at Wallops Island a new sounding rocket, the Javelin, with four stages, which reached an altitude of 600 miles.

—: In a press conference, President Eisenhower indicated that he did not feel the international prestige of the United States was at stake in the space achievement comparisons of the United States and the Soviet Union.

**January 27:** A Polaris test vehicle made a successful 900-mile flight from Cape Canaveral.

**January 28:** The Navy transmitted a radio photograph from Hawaii to Washington by bouncing the signals off the Moon. The method is viewed as a useful supplement to other communications channels particularly at times of solar disturbances.

**January 30:** Airman 1/c Bruce Barwise completed a 72-hour test of staying afloat in a small survival capsule designed primarily for the B-70 aircraft.

—: The U.S.S. *Valley Forge* launched a balloon for cosmic ray research 150 miles south of San Juan, Puerto Rico. The payload of three 800-pound blocks of photographic emulsion was recovered January 31 by the destroyer *Compton* in the Caribbean.

**January 31:** The Soviet Union fired a second rocket from an unspecified point in that country to impact in the Pacific about 1,000 miles southwest of Hawaii, apparently about the same distance of 7,762 miles and altitude of 765 miles attained by the first rocket. Although no details were given, the Soviet announcement claimed that instruments confirmed the high precision of the guidance system. This ended the tests, and the prohibited area was reopened to commerce. A United States Navy aircraft witnessed the arrival of the Soviet test device.

**February 1:** President Eisenhower approved an increase of \$113 million in the 1961 budget request for the program of the National Aeronautics and Space Administration. This brought the total request for NASA to \$915 million, and included \$90 million for Saturn, \$15 million for the single chamber F-1 engine, and \$8 million for a 200,000-pound-thrust liquid hydrogen engine to be used in upper stages of Saturn. He also approved a \$23 million supplemental request for 1960.

**February 2:** A Titan missile made the first successful flight in nearly 9 months when it was launched at Cape Canaveral. This included the first firing of the second stage, which has a thrust of 80,000 pounds. It traveled about 2,000 miles. (This flight probably occurred January 27, 1960.)

**February 3:** Dr. Duane E. Graveline ended a week immersed in liquid to simulate weightlessness with a 5 g spin in a centrifuge to simulate reentry loads in the continuing program of manned space flight research at the Aerospace Medical Laboratory, Wright-Patterson Field, Ohio and School of Aviation Medicine, San Antonio. The tests showed the importance of exercise to

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prevent muscle deterioration in weightlessness prolonged for a period.

February 3: In response to General Power's recent estimate that 300 Soviet ICBM's of one megaton warhead yield each would knock out virtually all of America's deterrent strategic capability, President Eisenhower said, "There are too many of these generals who have all sorts of ideas" which he viewed as parochial. He indicated we have no need to "catch up" with the Soviet Union, because we have a powerful deterrent in being, and adequate is enough. He doubted the need for the kind of airborne alert which General Power urged.

February 4: Discoverer IX was launched at Vandenberg Air Force Base; however, it failed to enter orbit, because of a malfunction in the launch tower which damaged the Agena stage. No signals were received from the 1,700-pound Agena with its 300-pound recovery capsule.

—: A Polaris test vehicle made a successful 900-mile flight from Cape Canaveral.

—: The final flight in the test series of Jupiter was successful in a 1,500-mile shot from Cape Canaveral.

February 5: Scientists at Stanford University announced completion of a study of an experiment conducted in April, 1959 which proved that they were successful in bouncing radar signals off the Sun. The original tests were conducted April 7, 10, and 12. The signals were reflected by the Sun's corona, about half a million miles above the visible part of the Sun.

—: A Titan missile was destroyed 57 seconds after launch at Cape Canaveral.

February 7: Explorer VII has revealed fresh information about the Van Allen radiation belts. The inner belt seems to be stable, but the outer belt varies even from hour to hour, changing in intensity and moving thousands of miles in location.

February 8: The CBS laboratories have announced the development of a new television system for installation in space vehicles which can produce pictures with more than 10,000 lines of scan, rather than the approximately 500 of commercial television. This would provide much higher definition, and also provide up to 30 times more brightness. The new photoscan system involves use of a camera and fixed photograph first which must be developed before the resulting picture is electronically scanned and broadcast.

—: The House passed 92-2 a resolution calling for the immediate transfer of the Development Operations Division of the Army Ballistic Missile Agency to the National Aeronautics and Space Administration.

February 10: According to the New York Times, an unnamed U.S. official stated the Soviet Union made two launching attempts in connection with the January Pacific rocket tests which were unsuccessful. It was not stated whether the countdowns merely were suspended or whether rockets were destroyed.

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February 10: Much excitement was generated by a report of a "dark" satellite discovered in orbit over the United States by the Navy satellite detection fence which was designed to catch any non-transmitting satellites passing over this country. Review of records showed that it had been in orbit for some time, but the data were not recognized at first. General speculation was that it represented either a secret Soviet military satellite or possibly a Soviet failure. Later it was determined that our own missing Discoverer V capsule was still in orbit when the retro rockets were fired with the attitude incorrect for reentry so that it entered a higher orbit. (See August 13, 1959.)

———: President Eisenhower made a three-hour first visit to Cape Canaveral.

———: The sixth consecutive successful flight was made by a Polaris missile from Cape Canaveral.

February 11: The Atlas had its 19th straight success at Cape Canaveral in a 6,300-mile shot down range.

———: The X-15 climbed to 86,000 feet, its highest yet, on a test flight at Edwards Air Force Base.

February 12: First Deputy Premier Anastas I. Mikoyan categorically denied that the mystery satellite was a Soviet satellite.

February 13: France exploded a plutonium bomb in the Sahara desert to become the fourth nuclear power.

February 16: The data capsule of a Thor missile launched December 1, 1959 was found on the beach of Mayaguana Island. It contained the first color photographs of the Earth taken from the edge of space.

February 17: The X-15 was tested in a 6 g power dive.

February 19: Discoverer X was destroyed by the range safety officer at Vandenberg when it veered from its planned course 56 seconds after launch, 20,000 feet up. It would have placed a 1,700-pound Agena with 300-pound recovery capsule in orbit.

———: The first launching was attempted at Eglin Air Force Base, Florida, of an Exos rocket, with four stages, intended to reach an altitude of 415 miles. One stage did not burn for its full period, and only 68 miles altitude was reached.

February 24: A Titan missile from Cape Canaveral was successfully launched on its longest flight, the dummy warhead reaching its target nearly 5,000 miles away.

February 26: A Polaris had to be destroyed after about 100 seconds of flight from Cape Canaveral.

———: The Air Force launched Midas I at Cape Canaveral. This was the first use of the Atlas-Agena rocket combination. It was said to be programed to put about 4,500 pounds into a short-life orbit, including over 3,000 pounds of payload, an amount in excess of the payload of Sputnik III, though not as high up. Telemetry ceased after about 5 minutes, and it was estimated that the Agena stage failed to separate, so the rocket reentered and burned about 2,500 miles from the launching pad. The purpose of Midas is to provide early warning of missile launchings through detection of their infrared radiation. This was Atlas 29D with a takeoff weight of 260,000 pounds.

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- February 27: The National Aeronautics and Space Administration successfully launched at Wallops Island a 100-foot diameter balloon which was inflated at an altitude of 225 miles following its vertical launching. The balloon remained visible for about 10 minutes to viewers up and down the Atlantic coast. Radio signals were passively reflected against the aluminized mylar surface of the balloon for transmissions from Holmdel, N.J., to Round Hill, Mass. In this third test, it landed 540 miles from the point of launch.
- February 29: The final test flight of a Thor missile was conducted at Cape Canaveral as a follow on to the original test series. The newer series of three tested a more powerful rocket motor of 165,000 pounds thrust, and this last one flew successfully over a 1,700-mile course.
- March 1: The National Aeronautics and Space Administration set up a new major division, devoted to research and development in the life sciences related to space. Dr. Clark T. Randt was named director.
- March 5: Although not undergoing countdown, an Atlas missile blew up on the pad at Vandenberg Air Force Base.
- March 8: The Agena stage of Discoverer VIII reentered and burned. —: The 21st straight success was achieved with an Atlas missile flight from Cape Canaveral to a target area about 5,000 miles away. —: A Titan missile was launched at Cape Canaveral, but the second stage failed to fire.
- March 9: A Polaris missile made a successful 1,000-mile flight testing flight-control equipment, after launch at Cape Canaveral. —: The Nike Zeus test rocket made a successful flight.
- March 10: The successful series of 21 Atlas launchings was marred by an explosion a few feet off the pad at Cape Canaveral.
- March 11: The National Aeronautics and Space Administration successfully launched at Cape Canaveral a Thor Able IV rocket combination with a takeoff weight of 105,000 pounds, carrying the space probe Pioneer V. It reached escape velocity and entered an orbit around the Sun inward toward the orbit of Venus. At the closest point, it is 74.9 million miles from the Sun, and at the farthest point, 92.3 million miles. The orbit is inclined  $3.35^\circ$  to the ecliptic, and the period is 311.6 days. The gross weight put into orbit was 144.8 pounds, including a payload for its probe of 94.8 pounds, of which about 40 pounds were instruments. The satellite is spherical, 26 inches in diameter, and once in space extended four paddles carrying 4,800 solar cells for its power supply. It carried two transmitters at 378 megacycles to return telemetry, one with an output of 5 watts, the other for later use, of 150 watts. Pioneer V carried instruments to measure radiation, meteorite impacts, magnetic fields, temperatures, solar plasma, solar ultra-violet and X-rays. The project was conducted for NASA by the Air Force Ballistic Missile Division and Space Technology Laboratories, together with more than 50 supporting organizations. Telemetry was received until June 26, 1960. Estimated life of the planetoid is 100,000 years.



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March 11: Pioneer V was separated from its last stage rocket by command radioed through the Jodrell Bank Radio Telescope which is near Manchester, England.

March 12: Pioneer V passed the orbit of the Moon, its speed relative to that of Earth having dropped to about 6,400 miles per hour from its high of 24,869 at time of final stage burnout.

March 15: The space facilities at Huntsville, Ala., were renamed the George C. Marshall Space Flight Center by Presidential order.

—: Project Saturn was officially transferred to the cognizance of the National Aeronautics and Space Administration.

—: An Army Redstone ejected a television camera to take pictures of the impact area of the rocket.

March 16: The Western powers at the Geneva disarmament conference called for a ban on nuclear weapons in orbit around the Earth. Although no claim was made that specific targets could be hit by such weapons, it was forecast that that time would come.

March 17: The United States called for a system of advance notice for all missile and space launchings to minimize the chances of war by accident.

—: The X-15 was put through a severe 6g test in a climbing turn over Edwards Air Force Base.

March 18: A Polaris missile made a successful flight of close to 1,000 miles from Cape Canaveral.

—: Pioneer V passed more than a million miles from Earth still transmitting clearly with its 5-watt radio.

March 23: The Army launched for the National Aeronautics and Space Administration an intended radiation belt satellite in the Explorer series, using a Juno II four stage booster with a takeoff weight of 120,000 pounds. The satellite was intended to enter an orbit with an apogee of 33,000 miles and a perigee of 200 miles, inclined 28 degrees to the Equator, and a period of 17 hours. The purpose was to make an extended study of the electrons and protons in the Van Allen Belts. The 22.8 pound payload was assembled in a cylinder weighing 35.3 pounds. After first stage burnout, communications ceased, and it was believed that one of the upper stages failed to ignite.

—: For the second time, a Titan missile flew its full 5,000 mile intended route from Cape Canaveral. A capsule was recovered.

—: It was disclosed at Los Alamos Scientific Laboratories that true thermonuclear fusion has been accomplished in a controlled laboratory device. This was achieved by Scylla II, at about 13 million degrees centigrade for a little less than a millionth of a second. This still represents a long way to go to achieve practical power generation.

March 24-25: The first meeting of the Scientific Advisory Panel of the House Committee on Science and Astronautics was held in Washington.

March 25: A Polaris missile with its new inertial guidance system made a successful flight of more than 900 miles from Cape Canaveral.

—: The first flight of the X-15 with a NASA pilot (Joseph A. Walker) was carried out following proving tests by North American Aviation.

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March 25: The Department of Defense announced the assignment of highest priority status to Project Midas, the missile detection system based on infrared satellite surveillance.

March 28: The first static test of two of eight engines in the Saturn launch vehicle was carried out.

March 29: The first fully guided flight of a Polaris from the *Observation Island* traveled 700 miles, but fell short of its target.

April 1: A 100-foot balloon was launched by rocket from Wallops Island, Va., to an altitude of 235 miles. This was the fourth test, and it traveled 570 miles from the point of launch.

———: The French Government exploded a second nuclear device in the Sahara desert of Algeria near Reggan.

———: The National Aeronautics and Space Administration put into orbit the Tiros I weather reporting satellite. It was launched from Cape Canaveral by a Thor Able rocket with a takeoff weight of 105,000 pounds. The satellite was a cylinder 19 inches long and 42 inches in diameter, covered with 9,200 solar cells for its power source to the nickel-cadmium batteries. The total weight put into orbit was 320 pounds of which 270 represented the satellite itself. It was placed in a nearly circular orbit with an apogee of 468 miles and a perigee of 430 miles. The period was 99 minutes. The orbit was inclined  $48.3^\circ$  to the Equator. It carried two television viewing cameras, one with a wide angle lens, the other narrow. Tape recorders carried the pictures to broadcast them to Earth on command. The wide angle lens camera viewed about an 800-mile square at a time, the narrow angle lens took in about 30. The satellite was built by the Radio Corp. of America under the direction of the Fort Monmouth Army Signal Laboratories. In a matter of hours the first pictures were delivered to President Eisenhower; they showed a map and cloud cover of the Gulf of St. Lawrence area. Tiros broadcasted its pictures on two FM radios at 235 megacycles with 2 watts each and tracking information on 108 and 108.03 megacycles, with 30 megawatts. Pictures were received until June 29, 1960.

April 2: The Soviet first cosmic rocket with a weight of 3,245 pounds completed its first orbit around the Sun since its launching on January 2, 1959.

April 4: Tiros had already returned over 1,000 pictures of the Earth by the end of this day.

———: The Soviet Union refused to join in an agreement to prohibit the launching of nuclear bombs into orbit unless the United States agreed to liquidate all military bases abroad.

———: The National Radio Astronomy Observatory, Green Bank, W. Va., began a program of listening for possible intelligent signals from space, on the chance that some pattern of artificiality can be found buried in the natural "noise" of signals. This work has been given the name Project Ozma. Directed by Dr. Frank D. Drake, the first two targets were Tau Ceti and Epsilon Eridani, two of the nearest suns in our galaxy. Initial listening was on 1,420 megacycles, that at which hydrogen emits radio energy. An estimate has been made that 10 percent of the

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- stars in this galaxy may conceivably have life supporting planets, suggesting as many as 20 billion such systems. No major expectation is held that present techniques are likely to detect meaningful signals.
- April 6: Saturn was static fired again, this time with four of eight engines turned on at the same time.
- : The Army disclosed it was testing a ruby Maser device which would increase possible space communications distance by a factor of ten.
- : Sputnik III reentered the atmosphere and burned. It was last detected by a Canadian radar dish at Prince Albert, Saskatchewan at an altitude of 90 miles. Its radio equipment continued to broadcast on command until it was destroyed by reentry.
- : It was announced that Dr. Vannevar Bush had filed a statement with the House Committee on Science and Astronautics to the general effect that plans to put a man into space are little more than a stunt. He contended that instruments can do more than a man in such a location.
- April 7: Major General Donald N. Yates was named Deputy Director of Defense Research and Engineering for Ranges and Space Ground Support.
- : An Atlas exploded on the pad at Cape Canaveral.
- April 8: A Titan was launched from Cape Canaveral on a 3,800-mile flight, but the second stage engine terminated its firing prematurely, and the missile fell short of its programmed distance.
- April 9: The U.S.S. *Patrick Henry* was commissioned as the second nuclear-powered Polaris-launching submarine.
- April 11: The House sent the supplemental bill for \$23 million in the 1960 budget of the National Aeronautics and Space Administration to the White House.
- April 13: Transit I-B, a Navy navigation satellite was successfully placed into orbit following its launch at Cape Canaveral. It was launched by a Thor Able Star rocket with a takeoff weight of 105,000 pounds into a near circular orbit inclined 51 degrees to the Equator, with a perigee of 233 miles and an apogee of 479 miles. The total weight in orbit was 315 pounds of which 265 pounds were in the satellite. It was expected that ships sighting on the Doppler radio signals could determine their position with an accuracy of one half mile. The full operational system later with four such satellites in orbit would provide greater accuracies. The satellite was spherical in shape, measuring 36 inches in diameter, and had a double band of solar power cells around its equator. Its two ultrastable oscillators broadcasted on 54 mc, 162 mc, 216 mc, and 324 mc. An infrared scanner measured the rate of spin.
- : The British Government decided to drop its development of the Blue Streak long range ballistic missile, planning to purchase instead American weapons or plans, with particular interest centered on the Sky Bolt air-launched ballistic missile.
- April 14: A Polaris test vehicle was launched for the first time from underwater, igniting after it sprung from the underwater tube off San Clemente Island. It carried only 5 seconds of fuel supply in order to limit the flight for easy recovery.

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- April 14: William M. Holaday had his resignation accepted by President Eisenhower, releasing him from the post of Chairman of the Civilian-Military Liaison Committee which committee the President had recommended be abolished by revision of the National Aeronautics and Space Act of 1958. The effective date of resignation was April 30.
- : Courtney A. Metzger at the Aerospace Medical Laboratory, Wright-Patterson Air Force Base, emerged from a space capsule after existing for 1 week with a self-sustained source of oxygen, water recycling equipment, and other devices to make him independent of a natural environment for the equivalent of a space flight.
- April 15: The Army disclosed that it was developing a prophylaxis against radiation which might be important to future flight through space.
- : Discoverer XI was successfully launched into orbit from Vandenberg Air Force Base. It was launched into a near polar orbit by a Thor-Agena rocket with a takeoff weight of 108,500 pounds. The satellite Agena stage weighed 1,700 pounds after burnout, was a cylinder about 17 feet long. Circling the world every 92.35 minutes, it had an apogee of 380 miles and a perigee of 109.5 miles, and the orbit was inclined 80.1° to the Equator. Its payload included a 300-pound reentry vehicle measuring 27 by 33 inches and also Transit-type Doppler beacon and external light for optical tracking. The Agena stage reentered and burned April 26, 1960.
- April 16: On the 17th pass the capsule of Discoverer XI was separated on command, but telemetry indicated it remained in orbit, so recovery could not be effected by the planes and ships near Hawaii. Later measurements revealed it fell from its shallow orbit about April 26, 10 days late.
- April 17: Pioneer V reached a distance of 5 million miles from Earth, and its 5-watt transmitter could still be heard broadcasting telemetry.
- April 18: A test version of the new Scout rocket system was launched at Wallops Island. One of the two live stages fired, but the second did not. The rocket climbed about 30 miles and fell into the Atlantic 80 miles away.
- : A Polaris missile was test fired from the *Observation Island*, a support ship, but there appeared to be a second stage malfunction.
- : NASA selected Avco and General Electric to carry out development studies of an electric rocket engine.
- April 19: The Army test fired another Redstone carrying a television camera to be ejected to observe the target impact.
- : The National Aeronautics and Space Administration announced it was negotiating with Thompson-Ramo-Wooldridge a contract for the development of a solar power plant, Sunflower I, for use in space craft.
- : An Aerobee-Hi rocket launched at White Sands, N. Mex., brought back from an altitude of 130 miles a series of X-ray photographs of the Sun. The experiment was conducted by the Naval Research Laboratory.

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- April 19: The House of Representatives tentatively approved a cut of \$38,985,000 in the fiscal 1961 proposed budget of \$915 million for the National Aeronautics and Space Administration, as recommended by the Appropriations Committee. The door was left open to later increases either in conference with the Senate or by supplemental appropriation.
- April 20: By remote control, the spin of Transit I-B was reduced from 170 revolutions per minute to 4; this was slated to be removed, too, to allow the conducting of further experiments.
- : The third Soviet Cosmic Rocket's "Automatic Interplanetary Station" reentered and burned.
- April 21: For the third time, a Titan missile was sent 5,000 miles on a flight from Cape Canaveral.
- April 22: An Atlas missile was fired successfully for the first time from a "coffin" hangar at Vandenberg Air Force Base.
- April 23: It was revealed that a few days previously the failure of a diode in Pioneer V, then 5.5 million miles from Earth, was garbling the telemetry received. By careful analysis, Robert E. Gottfried was able to deduce the source of the trouble so that by reinterpretation of all the suspect data, its correct meaning could be found.
- April 25: A successful flight of more than 1,000 miles was made by a Polaris missile from Cape Canaveral.
- April 26: NASA announced the award to the Aeronutronic Division of the Ford Motor Co. of a contract to construct a 300-pound payload to be landed on the Moon during 1961.
- : NASA announced the award to Douglas Aircraft Corp. of a contract to construct the second stages for the Saturn launch vehicle building at Huntsville, Ala., using four Pratt & Whitney Centaur hydrogen-oxygen engines.
- : Both the Agena stage and the capsule of Discoverer XI reentered and burned.
- : An Aerobee-Hi rocket was launched at Wallops Island, Va., to reach an altitude of 137 miles, carrying instruments to study nighttime ultraviolet radiation.
- April 27: Duncan Sandys disclosed that the United Kingdom was studying the possibility of a cooperative space research effort with Western Europe which would use the Blue Streak missile as a satellite launching device.
- : The Air Force gave the go-ahead signal on Dyna-Soar, the winged space glider, by releasing funds to the Boeing Airplane Co.
- April 28: A successful first test was made in launching a Nike-Zeus rocket from an underground launcher.
- April 29: An Aerobee-Hi rocket was launched at Wallops Island, Va., to reach an altitude of about 155 miles, in a study of the upper atmosphere.
- : All eight engines of the Saturn were ground-tested simultaneously at Huntsville, Ala., for the first time.
- : Two flight tests of the Polaris missile were successfully conducted within 4 hours, from Cape Canaveral.

1960—Continued

- May 1: A high altitude reconnaissance U-2 aircraft of the United States Government made a forced landing in the vicinity of Sverdlovsk, U.S.S.R., and its pilot, Francis G. Powers was taken alive. Apparently, in a flight from Turkey and Pakistan, he had flown over the Tyura Tam missile and satellite center near the Aral Sea and then was headed for the Soviet Arctic and Norway. His flight was part of an undisclosed number designed to provide the United States with both scientific data on the upper atmosphere, and coverage of Soviet military activity in regions less open to our observers than corresponding bases in the United States to Soviet observers. Among other implications were questions about high altitude flight and their similarities to and differences from space flight, from a legal point of view.
- May 3: The Senate passed an authorization for fiscal 1961 for the National Aeronautics and Space Administration of \$970 million, representing an increase of \$50 million over the amount required by the administration, and in contrast to the \$915 million authorized by the House and approximately \$876 million appropriated in the House bill.
- May 5: Premier Khrushchev disclosed that the rocket forces of the Soviet Union had been set up as a separate branch of the armed services. They were under the command of Marshal Mitrofan Ivanovich Nedelin.
- : France fired a 4-stage rocket to 94 miles altitude.
- May 6: An Atlas was launched at Vandenberg Air Force Base from its "coffin" hangar, but had to be destroyed moments later at an altitude of 5,000 feet.
- : The Minuteman made its first public successful flight from a steel-lined underground launch pad. It carried fuel for only 2½ seconds, for the purpose was to test successful ejection, not distance.
- : The X-15 with Major Robert White as pilot flew to 60,000 feet at Mach 2.3.
- May 8: At a distance of 8 million miles from Earth, Pioneer V was commanded to switch from its 5-watt transmitter to the 150-watt device. The more powerful transmitter responded clearly. But because of the power drain, interrogation was to be held down to 2 or 3 minutes every 6 to 8 hours. To date, 109 hours of data had been returned to Earth.
- May 9: The first production model of the Project Mercury capsule was successfully launched from Wallops Island to test the escape system. The capsule reached 2,540 feet, then was landed by parachute and returned by helicopter to the hangar 17 minutes after launch.
- May 10: The U.S.S. *Triton* surfaced off the coast of Delaware after an 84-day cruise of 41,519 miles around the world submerged. Captain Edward L. Beach was skipper of the nuclear-powered craft.
- May 12: An X-15 ventured beyond gliding range of its base in a 110-mile flight during which it reached an altitude of 75,000 feet and a speed of 1,850 miles per hour. Joseph A. Walker was pilot.

1960—Continued

- May 12: It was announced that two regular Strategic Air Command crews had just completed 15-day simulated space trips scaled in a cabin at Wright-Patterson Air Force Base, carrying out arithmetic, perception, audio, and other tests at a flight console in the cabin. They worked on a cycle of 4 hours on duty alternating with 2 off.
- May 13: A Titan made its fourth straight successful flight of 5,000 miles from Cape Canaveral and a data capsule was retrieved.
- : The first launching attempt at Cape Canaveral was made for the Project Echo passive communications balloon satellite, using a Thor Delta vehicle with a takeoff weight of 112,000 pounds, but it failed to orbit when the second stage altitude controls malfunctioned. The payload was 205 pounds.
- May 14: The organization of an International Academy of Astronautics was announced by the International Astronautical Federation and the Daniel and Florence Guggenheim Foundation.
- : The U.S.S. *Abraham Lincoln*, fifth Polaris submarine, was launched at Portsmouth, N.H.
- May 15: The Soviet Union placed in orbit a spaceship satellite, sometimes referred to as Korabl Sputnik I, and in the Western press as Sputnik IV. The device included a ship weight of 10,009 pounds not including the weight of the accompanying final stage rocket. In the payload were 3,250 pounds of instruments and equipment plus a self sustaining biological cabin of 5,512 pounds. The ship was put in an orbit with a perigee of 195 miles and an apogee of 230 miles, very nearly circular, and inclined 64.9° to the Equator. It had a period of 91.1 minutes. The cabin contained a dummy astronaut designed in size, weight, and other characteristics to be equivalent to a human passenger as a check on the smooth functioning of the life support system. The ship carried both batteries and solar cells to supply power. The radio broadcast telemetry and taped voice messages on 19.995 mc. It was announced that later on command the pressurized cabin would be separated from the rest of the ship, but no effort would be made to retrieve it. The cabin would descend on command and burn on reentry.
- : Soviet scientists said that the spaceship satellite was boosted by the same type powerful rocket which had been tested in the Pacific in January.
- : Dr. John Hagen of NASA described the new Soviet ship as representing a minor step forward, suggesting the real problem was to get such a vehicle safely back to Earth, and noting that apparently the Soviet Union lagged in this aspect of its satellite program.
- May 16: It was revealed that since April the United States had begun testing its first BMEWS radar station in Greenland by sweeping the Soviet Union as a first step toward an ability to detect ICBM launchings toward this country.
- May 17: Another static test of the Saturn generated 1.3 million pounds of thrust for 30 seconds at Huntsville, Ala.
- May 18: A Polaris launched from the ship simulator at Cape Canaveral made a successful flight of 1,000 nautical miles.

1960—Continued

- May 19: The X-15 reached an altitude of 107,000 feet, its highest to date, with Major Robert M. White as pilot.
- : The rocket carrier of the third Soviet Cosmic Rocket (Lunik III) reentered and burned.
- : The Soviet Union sent a command which was to brake the space ship satellite, including cabin, for reentry. However, a fault developed in the attitude control, and the retro rockets instead of bringing reentry pushed the ship into a new higher orbit with a perigee of 196 miles and an apogee of 418 miles. In other respects, the Soviet authorities claimed that all systems including attitude stabilization had worked smoothly. United States trackers detected a total of seven new objects in the higher orbit with the ship. Presumably one of these was the separated biocapsule or cabin with the dummy astronaut.
- May 20: For the first time, an Atlas missile was launched from Cape Canaveral, climbing 1,000 miles to fly 9,042 miles, landing in the Indian ocean, a new world's record for ICBM distance. The Air Force announced that the Atlas successfully dropped its nose cone in the intended impact area 1,000 miles southeast of Capetown. Two U.S. aircraft and a ship were at the impact area to witness the blazing reentry. The nose cone did not carry a reduced weight, but a full load of about 1,000 pounds of instruments, and such ballast as to simulate the weight of a hydrogen warhead.
- May 23: A fully guided Polaris missile launched from the *Observation Island* off Cape Canaveral made a successful flight of over 1,000 nautical miles.
- May 24: The Air Force put into orbit from Cape Canaveral Midas II, the first successfully launched missile detection alarm system. It was launched by an Atlas Agena rocket combination with a takeoff weight of 260,000 pounds carrying about 5,000 pounds of second stage into orbit, with more than 3,000 pounds of payload. The orbit achieved was nearly circular, with a perigee of 292.1 miles and an apogee of 322 miles. Its orbital time was 94.34 minutes. Midas contained infrared detecting equipment to spot the launching of missiles, and was viewed as a contribution to peace by the warning it might give of any otherwise surprise attack. The satellite was about 22 feet long and had a diameter of 5 feet. It is worth noting that the payload of Midas II exceeded that announced for Sputnik III. Midas II was given an inclination of 33 degrees to the Equator to minimize any potential diplomatic problems with the Soviet Union.
- May 25: The Army fired its fifth and last early model Nike-Zeus rocket.
- May 26: It was disclosed that the signalling system in Midas II malfunctioned so that there was doubt that it would be able to perform its intended test work with the detection system. The stabilization system to keep the tip pointed toward Earth did work as desired.
- : All eight engines of Saturn were test fired for 35.16 seconds.
- May 27: A fifth straight successful shot was made with the Titan missile over a 5,000-mile range from Cape Canaveral.



1960—Continued

- May 27: The Navy launched to 135 miles altitude at White Sands, N.Mex. an Aerobee-Hi rocket carrying eight telescopes to provide if possible the most complete map of the sky ever obtained by ultraviolet light.
- : Tiros I was commanded from the ground to step up its rate of spin. Two small rockets were fired. At time of launch the rate was 120 revolutions per minute. This was slowed down to 10 by spinning off a pair of weights. By the 819th orbit, this had dropped to 9.4, and the first pair of small rockets were fired to bring the rate up to 12.85.
- May 31: The National Aeronautics and Space Administration launched by rocket in the fifth test at Wallops Island another 100-foot balloon in preparation for Echo, and it attained an altitude of 210 miles, landing 540 miles away. It carried two beacon transmitters.
- : The National Aeronautics and Space Administration selected Rocketdyne to develop a 200,000-pound thrust liquid rocket engine burning hydrogen and oxygen.
- June 1: President Eisenhower signed the NASA fiscal 1961 authorization bill calling for \$970 million in funds.
- June 2: A Redstone missile was fired at White Sands to land 120 miles away in a new extended drop zone, and it carried a new battlefield surveillance TV system, which would show the target area before and after the impact of the missile warhead. The television was carried in a stabilized capsule ejected from the reentry body during the downward leg of the trajectory.
- June 2-3: The second meeting of the Scientific Advisory Panel of the House Committee on Science and Technology was held in Washington.
- June 3: The Saturn eight-engine assembly was test fired for 75 seconds.
- June 5: The Navy launched the largest balloon yet built in a cosmic ray test. The launching was made from Brunswick, Ga. The balloon had a diameter of 500 feet, was of plastic only 1/1000 of an inch thick, and contained 10 million cubic feet of helium. The balloon and payload weighed over 2½ tons, the heaviest load so lifted over 100,000 feet.
- June 7: The National Aeronautics and Space Administration announced the award of a contract for an ion engine to the Hughes Aircraft Co.
- : A Polaris missile launched at Cape Canaveral suffered a second-stage failure and did not go its intended 1,000 miles.
- June 8: An X-15 aircraft suffered a serious explosion during a ground test, but Scott Crossfield, who was in it, was not injured.
- June 9: The Saturn eight-engine assembly was test fired for 110 seconds.
- June 11: An Atlas missile with an all-inertial guidance system made a successful flight 5,000 miles from Cape Canaveral. It arrived at the intended target point.
- June 14: The SNAP-2 experimental space nuclear reactor completed 147,300 kilowatt-hours of operation, including 1,000 hours of continuous operation.

## 1960—Continued

- June 15: The Astronomer Royal of Britain, Dr. Richard Van Der Riet Wooley summed up all talk of interplanetary travel as "utter bilge." This was related to his assessment of the inhospitable environment of other planets and the great cost of round trip travel.
- : The Saturn was run for 122 seconds with all eight engines burning, at Huntsville in a new static test.
- : The Soviet Union made a biological payload rocket test. (See entry of July 5, 1960.)
- June 16: Westinghouse made public a new thermionic-thermoelectric converter allowing direct conversion of energy in a nuclear reactor from heat to electricity without the usual translation through a turbine and generator. The promise of great weight-savings in satellites was held out by successful development of the new power device.
- : The Navy took over responsibility for the operations of the Pacific Missile Range, in implementation of the coordinated national missile range program, with Maj. Gen. Donald Yates coordinating all ranges and tracking at the Department of Defense.
- June 18: The Navy ended its search for the world's largest balloon launched on June 5 at Brunswick, Ga. It was last sighted 650 miles west-southwest of San Diego.
- : The French Government set off an explosive charge at an altitude of 87 miles, using a Veronique rocket fired at Colomb Bechar, Algeria. The purpose of the test was to measure shock waves in the upper atmosphere, and to study the magnetic field of Earth.
- June 20: The Air Force placed a contract with Martin for a new Titan II missile, designed to use storable fuel, an all-inertial guidance system, and greater capacity for distance and payload.
- June 21: A fully guided Polaris missile was launched from the *Observation Island* and flew over 900 nautical miles to its target.
- June 22: An Atlas made a successful flight from Cape Canaveral to its target 5,000 miles away, carrying a new tactical nose cone.
- : A successful Polaris missile launching was conducted with a flight exceeding 1,000 miles from the Cape Canaveral ship simulator.
- : The Navy put into orbit two satellites with a single launching vehicle. Using a Thor Able Star, with a takeoff weight of 105,000 pounds, an Air Force crew put up the Navy's Transit II-A, a 36-inch sphere weighing 223 pounds, and also a 20-inch sphere, 42-pound Naval Research Laboratory scientific satellite, sometimes called GREB. Also in orbit was the 50-pound empty rocket case of the final stage. Transit II-A had an apogee of 665 miles and a perigee of 389 miles. The smaller satellite had similar orbital elements, namely 657 and 382 miles respectively. Their periods were both just under 102 minutes, and their orbits were inclined just under 67 degrees to the Equator. Both carried solar cells. GREB broadcasted on 108 megacycles, and Transit II-A on 54 megacycles, 162 megacycles, 216 megacycles, and 324 megacycles with signals from the two ultrastable oscillators. Batteries were nickel-cadmium.

1960—Continued

- June 24: A 500-watt SNAP turbine alternator was run for 2,500 hours at design conditions.
- June 25: The Aerospace Corp. was set up as a nonprofit research arm to serve the Air Force, as one step in the process to free the Space Technology Laboratories from its existing roles to a position more nearly equal to that of other contractors.
- June 26: The last radio contact was made with Pioneer V by the Jodrell Bank Radio Telescope near Manchester, England, then estimated to be at a distance of 22,462,740 miles from Earth and moving away at a speed of 21,000 miles per hour. The final 6-minute message was broadcast by a 5-watt transmitter, following a command broadcast by the Jodrell Bank Station.
- June 28: The Soviet Union announced the opening of a new series of Pacific Ocean missile tests between July 5 and 31, generally in the area of the previous tests 1,000 miles southwest of Hawaii.
- June 29: Discoverer XII was fired toward a polar orbit from Vandenberg using a Thor-Agena rocket with a takeoff weight of 108,500 pounds, but apparently failed to achieve sufficient velocity to attain an orbit for the Agena stage of 1,700 pounds with 300 pound reentry capsule. It burned over the South Pacific.
- : Tiros I ended its useful transmission of weather pictures from outer space after the receipt of 22,952 views, of which over 60 percent were of good quality useful to meteorological research.
- June 30: A Polaris test vehicle was successfully fired from underwater at the San Clemente Island test station in California. It carried only a small charge of fuel as an aid to immediate recovery at the site.
- July 1: Chlorophyll has been produced synthetically for the first time in both the United States and Germany, according to announcement on this date.
- : The George C. Marshall Space Flight Center was officially opened with Dr. Wernher von Braun as Director.
- : The complete Scout rocket was launched for the first time, but the fourth stage separation and firing was not accomplished because of a tracking failure external to the vehicle. It had been intended for a climb to 2,300 miles, and a distance of 4,700 miles, carrying a payload of 1,931 pounds.
- : The first operational version of the Titan failed in launch at Cape Canaveral.
- : Congress approved the full \$915,000,000 appropriation requested for the National Aeronautics and Space Administration for fiscal year 1961. This followed a \$39 million cut by the House and a \$50 million increase by the Senate from the original amount requested; in conference the exact amount originally requested was agreed to.
- July 2: A reconnaissance RB-47 aircraft was reported missing and presumed down over the Barents Sea north of the Soviet Union.
- : The House Committee on Science and Astronautics called for a revision of the National Space Program timetable so as to put a manned expedition on the Moon during this decade rather than "after 1970", as provided in the NASA 10-year program.

## 1960—Continued

- July 4: The United States Navy reported the presence of Soviet missile recovery ships at a position about 1,000 miles southwest of Hawaii, arranged in a triangular formation about 40 miles apart.
- July 5: The Soviet Union announced that during an unspecified time in June, a Soviet rocket carried two dogs and a rabbit to an altitude of 130 miles, following which they were successfully recovered. One dog, named *Otvazhnaya* (Courageous or Daring), was on her fifth flight. The single-stage rocket carried a total weight in animals and instruments of 4,629 pounds. The rocket carried cameras for photographing cloud systems over a vast area. (Later Soviet disclosures identified this test as occurring June 15, 1960, and added further details. The rocket measured electric fields, infrared radiation, ionization, free electrons, the neutral composition of the atmosphere, ultraviolet light, pressure, and air density in addition to the cloud cover photographs and biological experiments. The launching apparently took place at Kapustin Yar.)
- : The first Soviet rocket of the new series was fired approximately 8,078 miles from an unspecified point in the U.S.S.R., speculatively placed at Tyura Tam, to the preannounced Soviet target area 1,000 miles southwest of Hawaii. The Soviet Union announced that the test involved a powerful booster carrying a dummy last stage which arrived in close proximity to the target after a climb to 744 miles altitude. U.S. Navy aircraft witnessed the reentry through the atmosphere.
- July 6: A Polaris missile launched at Cape Canaveral achieved only a partial success when the second stage cut off prematurely.
- July 7: The Soviet Union claimed a "bull's-eye" at about 8,078 miles distance and altitude peak of 744 miles on their second shot of the new test series in the Pacific, and that the results obtained justified ending the series immediately, thus reopening the area to commercial air and sea traffic. Again, the arrival of the dummy stage was witnessed by U.S. Navy aircraft.
- : Announcement was made of the invention of the Laser by the Hughes Research Laboratories. Using a synthetic ruby, it is capable of amplifying light, producing highly directional beams of pure color. The name stands for "light amplification by stimulated emission of radiation." The project was headed by Dr. Theodore H. Maiman.
- : A Polaris was launched by the *Observation Island* off Cape Canaveral, and ran wild requiring destruction by the range safety officer.
- July 8: The Kiwi-A Prime experimental nuclear reactor was successfully tested at full power at Jackass Flats, Nev. in the development program for Project Rover.
- July 9: Premier Khrushchev threatened the United States with rocket war if it intervened militarily in Cuba, in a speech to a Soviet teachers' convention. He cited the just-concluded Pacific rocket tests as evidence of Soviet capabilities.
- July 10: The House Science and Astronautics Committee called for a strengthened national program of oceanographic research.

## 1960—Continued

- July 11: The National Aeronautics and Space Administration selected Hughes, North American, Space Technology Laboratory, and McDonnell to study designs for a lunar soft landing vehicle.
- : The Bell Telephone Co. outlined to the Federal Communications Commission a plan for worldwide telephone and television service based upon a network of about 50 satellites in polar orbits at about 3,000 miles altitude. It was estimated that providing 600 telephone circuits plus television to 13 pairs of worldwide terminals would total \$170 million. It suggested that the expense of such a system could be shared by Bell with companies abroad. These would be active repeater satellites.
- : R.C.A. announced the development of a new experimental thermionic energy converter with an efficiency of about 14 percent in the direct conversion of heat at 1,100 degrees centigrade to electric energy. It is expected to have important applications in space flight.
- : Richard E. Horner, Associate Administrator of the National Aeronautics and Space Administration announced his departure from Government to become senior vice president for technical matters at the Northrop Corp.
- : Dr. Ivan A. Getting, vice president for research and engineering of the Raytheon Co. was named first president of the Aerospace Corp., new, nonprofit organization formed to manage Air Force missile and space programs.
- : The Soviet Union announced that it shot down the missing RB-47 on July 1, and that the plane had violated Soviet territory on a reconnaissance mission. Two members of the crew survived and awaited trial.
- July 12: The United States charged the Soviet Union with a wanton attack on the RB-47 over international waters and insisted that it had proof the aircraft at no time flew over Soviet territorial waters.
- : The University of Manchester Radio Telescope Facility at Jodrell Bank, Cheshire, was to be known henceforth as the Nuffield Radio Astronomy Laboratories, Jodrell Bank, named after the Nuffield Foundation which contributed toward the cost of the laboratories. Professor A. C. B. Lovell remained as Director.
- : The Air Force entered into a contract with General Electric to produce a new rocket and missile tracking system to be ready at Cape Canaveral in 1962 with an accuracy of 10 to 1,000 times greater than existing systems. It was termed Mistram, meaning "missile trajectory measurement system". The first unit was to operate over distances in excess of 1,000 miles, covering a range of accelerations between 750 and 50,000 feet per second.
- July 13: The first five-stage Strongarm III missile to probe the upper atmosphere was launched at Wallops Island, Va. Intended to rise 1,100 miles and plunge into the Atlantic 700 to 900 miles away, it failed to reach the desired speed and altitude. It was built by the Army Ordnance Corps and was launched by the National Aeronautics and Space Administration.

1960—Continued

- July 15: A Polaris missile was successfully fired over 1,000 nautical miles down range from Cape Canaveral.
- July 17: The rocket case in orbit used to launch Korabl Sputnik I on May 15 reentered the atmosphere and burned over the Pacific Ocean.
- July 18: Robert C. Seamans, Jr., formerly with RCA, was named Associate Administrator of the National Aeronautics and Space Administration.
- July 19: Sixteen mice in a cosmic ray experiment were recovered near Jordan, Mont., after a flight to 133,000 feet in a balloon and 575 miles from the launch site near Bemidji, Minn. These and other specimens were supplied by the School of Aviation Medicine and civilian medical organizations, according to the Air Force.
- : A fully guided Polaris missile was successfully fired over 1,000 nautical miles down range from Cape Canaveral.
- July 20: A Polaris missile was launched for the first time from a submerged submarine. The *George Washington* was 30 miles off Cape Canaveral, and the missile flew to a preselected impact area 1,150 nautical miles down the Atlantic missile range. About 3 hours later, a second shot was made with similar results.
- July 22: The National Aeronautics and Space Administration launched the first Iris sounding rocket at Wallops Island, Va. This was designed to carry 100 pounds to an altitude of 200 miles. On this flight it reached an altitude of 140 miles.
- July 25: In United Nations debate Henry Cabot Lodge disclosed charts which showed from U.S. tracking records that the Soviet Union tried to force the RB-47 into Soviet territorial airspace, and failing that, shot it down far at sea.
- July 26: The Soviet Union vetoed a United States proposal for an independent investigation of the RB-47 incident by the United Nations. Mr. Lodge disclosed track charts of similar Soviet flights near Alaska which included some actual violation of U.S. territorial waters. The Soviet representative denied the validity of all U.S. counterclaims.
- July 28: A Titan started on a 5,000-mile flight from Cape Canaveral had a premature first-stage shutdown so that the missile landed in the ocean 80 miles away.
- July 29: Geoffrey de Freitas addressed the House of Commons as a Labour member to urge a British space program on the Government, building around the recently cancelled Blue Streak missile.
- : An Atlas booster lifted an unmanned Mercury capsule in test MA-1, at Cape Canaveral, but the Atlas exploded shortly after takeoff. Telemetry continued for 65 seconds until the capsule impacted the Atlantic a few miles off the Cape.
- : The SNAP-10 300-electric-kilowatt reactor reached criticality. It was to be thermoelectric with no moving parts in translation of heat to electricity.
- : The National Aeronautics and Space Administration announced the successor to Mercury for manned space flight would be called Apollo, to carry three men either in sustained orbital flight or on circumlunar flight.

1960—Continued

- July 30: The *George Washington* successfully launched a third Polaris missile from underwater, and it struck the preselected target area 1,100 miles down range.
- July 31: Dr. John F. Victory, employee number one of the NACA in 1915 and recently Assistant to the Administrator of NASA, retired after 52 years of Government service.
- August 1: The *George Washington* launched a fourth Polaris missile in a partially successful operation, but the missile had to be destroyed 47 seconds later when it veered off course at an altitude of about 10 miles.
- : The first photographs were made public of the U.S. Air Force and Army Avrocar saucer-shaped hovercraft being developed in Canada.
- August 2: The National Aeronautics and Space Administration launched for the Army Ordnance Corps a five-stage Strongarm rocket from Wallops Island, Va. The fifth stage failed to function and the maximum altitude attained was only 300 miles; however some useful data were attained on upper atmosphere electron densities for about 32 seconds. The goal had been to reach 1,100 miles altitude.
- : A completely successful flight was made by a Polaris missile on an 1,100-nautical-mile flight from Cape Canaveral.
- August 3: The first public demonstration was carried out of a two-way telephone call relayed by bouncing off the surface of the Moon. The terminals were at Holmdel, N.J., and Goldstone, Calif.
- : The National Aeronautics and Space Administration launched a Sparrowbee test rocket from Wallops Island, Va., to an elevation of 260 miles, carrying an instrumentation payload of 55 pounds built at the University of Michigan Space Research Laboratory.
- August 4: The X-15 set a world speed record for manned flight with Joe Walker of NASA at the controls, a speed of 2,196 miles per hour. Dropped from a B-52 at 45,000 feet over Silver Lake, Calif., the X-15 was pushed in a 4-minute burst of rocket power to 78,000 feet.
- : The United States Government announced settlement of the patent claims of the estate of Dr. Robert H. Goddard. Mrs. Goddard transferred her rights for an undisclosed consideration, and the full sum of \$1 million was to be paid to the Daniel and Florence Guggenheim Foundation, the nonprofit organization which financed much of Dr. Goddard's early work.
- : A new distance record for Polaris was set in a firing from Cape Canaveral to a point over 1,100 nautical miles away.
- August 9: An Atlas missile was launched at Cape Canaveral to fly more than 7,000 miles. The missile reached an altitude of about 1,000 miles, and carried 1,000 pounds of instruments in the dummy warhead.
- August 10: The Army launched a new canard version of the Nike Zeus rocket.
- : In the first full success of the operational model, a Titan J flew 5,000 miles from Cape Canaveral. Reentry telemetry was received. A data capsule was recovered from the nose cone.

1960—Continued

August 10: Discoverer XIII was successfully launched into a polar orbit from Vandenberg. Using a Thor Agena vehicle with a takeoff weight of 108,500 pounds, the weight placed in orbit was 1,700 pounds including a 300-pound reentry capsule. The apogee was 436 miles and the perigee 161 miles. Orbital time was 94 minutes, and the orbit was inclined  $82^{\circ}51'$  from the Equator. The nose section contained detailed instrumentation to check the performance of as many parameters of the satellite as possible as an aid to further improvements. The Agena stage reentered and burned November 14, 1960.

August 11: On the 17th trip around the world, a signal was sent to Discoverer XIII from Alaska, and the reentry rockets were fired which brought the 300-pound capsule back through the atmosphere northwest of Hawaii. It fell somewhat outside the intended 200- by 60-mile drop area, and air retrieval was not possible. However, the *Haiti Victory* reached its location, and Navy frogmen recovered the capsule safely, using a helicopter for the pickup. This represented the first time an object was returned from orbit and recovered by the launching nation.

August 12: The X-15 aircraft set a new world's record for altitude over Edwards Air Force Base, California. With Major Robert M. White at the controls, it reached an altitude of 136,500 feet.

—: The National Aeronautics and Space Administration successfully put into orbit Echo I, a 100-foot diameter aluminized mylar plastic balloon to serve as a passive communications reflector. Launched by a Thor Delta vehicle combination with a takeoff weight of 112,000 pounds, the new satellite attained an apogee of 1,049 miles and a perigee of 946 miles. The orbit was inclined  $47.2^{\circ}$  to the equator, and had a period of 118.3 minutes. The rocket carrier had an apogee of 1,030 miles and a perigee of 954 miles. The payload weight amounted to 163.4 pounds, and the total weight in orbit was 241.4 pounds. At altitude, the cover of the folded balloon was blown off, and residual air plus sublimating powder filled it to its full dimensions so that it became the most visible satellite to date. Immediately it became available to experimental communications stations while in line of sight anywhere in the world. The balloon carried two small radio beacons broadcasting on 107.94 mc at 10 mw, and the third stage rocket casing carried a radio beacon on 108.06 mc at 60 mw.

—: An Atlas was fired 5,000 miles from Cape Canaveral. Important test objectives were fulfilled, but the ton-and-a-half nose cone containing radiation study experiments was not recovered before it sank.

—: A completely successful Polaris shot of 1,100 miles was made from Cape Canaveral.

—: President Eisenhower's voice was bounced from Goldstone, Calif., to Holmdel, N.J., by using the Echo I satellite.

August 13: The first 2-way phone conversations were held between Goldstone and Holmdel using Echo I for reflection.

August 15: Plasmadyne Corp. was selected by NASA to develop a 1-kilowatt electric arcjet rocket engine.



1960—Continued

- August 15: President Eisenhower was presented with a 50-star American flag which orbited inside Discoverer XIII, as the 85-pound returned capsule was put on display in Washington, D.C.
- : The Eleventh Congress of the International Astronautical Federation opened in Stockholm, Sweden.
- August 16: Soviet delegates declined to join the new International Academy of Astronautics and Institute of Space Law.
- : Captain Joseph W. Kittinger, Jr., U.S. Air Force, set a new record for a parachute jump by stepping from a balloon at nearly 103,000 feet. At 17,500 feet, he opened his full parachute, and landed safely.
- August 17: The Moscow trial of Francis Gary Powers, pilot of the U-2, opened.
- August 18: The United States launched Discoverer XIV into a polar orbit from Vandenberg. Using a Thor-Agena with a takeoff weight of 108,500 pounds, 1,700 pounds were placed in orbit including a 300 pound reentry capsule. The payload included a Transit-type Doppler beacon and external lights for optical tracking. The satellite had an apogee of 502 miles, and a perigee of 116 miles. Orbital time was 94.5 minutes, and the orbit was inclined 79.6 degrees to the Equator. The Agena stage reentered and burned on September 15, 1960.
- : An attempt was made at Cape Canaveral to launch the Army's Courier I-A, an active communications satellite, using a Thor Able Star vehicle with a takeoff weight over 105,000 pounds. The satellite weighed about 500 pounds, including about 300 pounds of electronic equipment. When the first stage developed trouble at 15 miles altitude, 2½ minutes after launch, the vehicle was destroyed. The satellite had 19,200 solar cells, 4 transmitters, 4 receivers, and 5 tape recorders.
- : After a lapse of 7 weeks, Tiros I stirred to life again and its radios and television were again in operation. The rate of spin was increased by remote command to the remaining two small rockets. However, it was not expected that useful pictures would be received.
- : A Polaris missile made another successful 1,100-mile flight from Cape Canaveral.
- August 19: The Soviet Union placed in orbit the second spaceship satellite, sometimes called Korabl Sputnik II, and by some Westerners, Sputnik V. Launched from an unknown point, presumably Tyuratam, near the Aral Sea, the new vehicle weighed 10,143 pounds exclusive of the weight of its carrier rocket, by Soviet claim. Placed in a nearly circular orbit, the apogee was 211 miles and the perigee was 190 miles. Two dogs were on board, Strelka (Little Arrow) and Belka (Squirrel), plus a gray rabbit, rats, mice, fleas, plants, algae, fungi, and seeds. Normal biometric telemetry from the animals was supplemented by a monitor TV camera which sent back pictures of the dogs' reactions in flight. Broadcasts were on 19.995 mc. It was announced that a reentry test of the animal compartment would be attempted. The Second Cosmic Ship had an orbital time of 90.72 minutes, and the orbit was inclined 64.57 degrees to the Equator.

## 1960—Continued

- August 19: A wirephoto of President Eisenhower was bounced off Echo I from Cedar Rapids, Iowa, to Dallas, Tex.
- : An Air Force plane made a successful midair snatch of the reentering capsule of Discoverer XIV northwest of Hawaii, the first such recovery on record. On the 17th orbit, a signal was sent from Alaska to the satellite, separating the capsule and firing the retro rockets. The catch was successful even though the reentry occurred 200 miles south of the estimated point. Captain Harold E. Mitchell was pilot of the C-119.
- August 20: Signals were broadcast from Holmdel, N.J., to Echo I and received at Issy les Moulineaux, France.
- : The Soviet Union sent radio commands to the Second Cosmic Ship to reenter with its animal payload. At an unspecified point in the Soviet Union, the Soviets reported, the ship made a successful landing, having completed 17 trips around the world. The capsule containing the dogs was separated from the main body of the ship and also made a safe landing. By Soviet calculation, the landing was 6 miles from the estimated point of impact after return from orbit. The dogs were reported as quite unharmed by their experience. Also returned were the rabbit, rats, mice, algae, plants, seeds, and fungi.
- August 21: Strelka and Belka were flown to Moscow to be displayed as national heroes for their flight in space.
- August 23: Music was broadcast from Holmdel, N.J., to Echo I, and the reflections were received at Jodrell Bank, England.
- : An Aerobee-Hi was launched at Wallops Island, Va., with a payload of 208 pounds of instruments to study radiation, and it reached an altitude of 118 miles, falling into the ocean 60 miles away.
- August 24: The Soviet Union announced that although a man would have survived the trip of the Second Cosmic Ship, further studies would be undertaken before putting a man into space.
- August 30: A Titan missile was sent in a successful high-trajectory shot to fall into the ocean 5,000 miles from Cape Canaveral.
- August 31: The Joint NASA-AEC Nuclear Propulsion Office was established with Harold B. Finger as Manager.
- September 2: A Polaris missile was successfully fired about 1,100 nautical miles down range from Cape Canaveral.
- September 3: Further Soviet details on the flight of Korabl Sputnik II were released. It was claimed that the cabin of the space ship was separated from the main body at an altitude of about 5 miles. This capsule containing the two dogs and some of the rats landed at a speed between 19 and 26 feet per second. The main body of the ship landed nearby at a speed of about 33 feet per second, with the rest of the payload.
- : Premier Khrushchev made an obscure remark to a worker in Finland, where he was visiting, indicating that the Soviet Union would soon launch a satellite weighing 60 tons—"a whole train."
- : As Echo I was spending more time in shadow, wrinkles appeared on its surface, but it was still able to reflect radio signals bounced off its skin.

1960—Continued

September 5: A McDonnell F4H-1 Phantom II Navy fighter with Lt. Col. T. H. Miller as pilot set a world's record for a closed course flight of 500 kilometers by flying 1216.78 miles per hour.

September 8: President Eisenhower dedicated the George Catlett Marshall Space Flight Center at Redstone Arsenal, Huntsville, Alabama.

September 10: The X-15 aircraft was flown to 80,000 feet and at more than 2,100 miles per hour in a stability test.

September 13: Discoverer XV was successfully launched from Vandenberg Air Force Base, Calif., using a Thor Agena rocket with a takeoff weight of 108,500 pounds, circling the Earth every 94 minutes, with a perigee of 130 miles and an apogee of 472 miles, in a polar orbit. The orbit was inclined 80.93° to the Equator. The satellite weighed 1,700 pounds after burnout of the Agena stage, and carried a 300 pound reentry capsule. Equipment included components of future Midas and Samos satellites, according to Air Force announcement. The Agena stage reentered and burned October 17, 1960.

—: The U.S.S. *Patrick Henry* attempted to launch a Polaris missile from underwater but it went off course and had to be destroyed.

September 14: Discoverer XV on the 17th pass around the world was triggered from Alaska to reenter near Hawaii. It came down at some distance from the intended drop area, but the capsule was located 1,000 miles away near Christmas Island. Search aircraft took turns keeping it in view after tracking its radio signals to a visual sighting; however, because of bad weather, pickup required the arrival of a surface ship, and this was not possible before it sank.

—: The United States Navy reported Soviet ship movements of interest to space operations. A Soviet tug and tanker had been observed in the north central Atlantic, with a blimp on the deck of the tug. These vessels were near the route of the *Baltika*, the ship carrying Premier Khrushchev to New York. In the Pacific, three regular tracking ships were approaching the mid-Pacific stations near Hawaii frequented earlier in the year during Soviet space tests. No announcement was made by Soviet authorities.

—: By executive order, a new Aeronautics and Astronautics Coordinating Board has been established with Dr. Herbert F. York of the Department of Defense and Dr. Hugh L. Dryden of the National Aeronautics and Space Administration as co-chairmen. The Board included panels as follows: Launching Vehicles (Dr. Courtland D. Perkins, Chairman); Manned Space Flight (Abe Silverstein, Chairman); Space Flight Ground Environment (Lt. Gen. Donald N. Yates, Chairman); Unmanned Spacecraft (Dr. Homer E. Newell, Jr., Chairman); Support Space Research and Technology (Ira H. Abbott, Chairman); and Aeronautics (Vice Adm. John T. Hayward, Chairman). Members at large were Richard S. Morse of the Army and Robert C. Seamans, Jr. of NASA. Two meetings had been held and more were to be held at least bimonthly.

## 1960—Continued

- September 15: The *Patrick Henry* achieved a successful launching from under water of a Polaris missile of operational configuration.
- : The Agena stage of Discoverer XIV reentered and burned.
- : Capt. William D. Habluetzel and 1st Lt. John J. Hargreaves emerged from a space cabin at Brooks Air Force Base after a simulated flight of 30 days, 8 hours, 21 minutes.
- September 16: A meeting of the new Aeronautics and Astronautics Coordinating Board was held at the Pentagon.
- : An Atlas missile carrying an improved nose cone was flown successfully from Cape Canaveral to its target area 5,000 miles down range; the data capsule was not recovered, but full telemetry was received.
- September 19: The Air Force flew an Atlas missile 9,000 miles from Cape Canaveral to a bull's-eye in the south Indian Ocean 1,000 miles southeast of Capetown. It was not known immediately whether the nose cone made a successful reentry without catching fire as with the test shot of similar length in May 1960. Ships and aircraft were to return the telemetry data received. The Atlas carried a 1½-ton dummy warhead and 1,000 pounds of instruments.
- : A new Argo D-8 rocket called *Journeyman* was launched from Point Arguello by the National Aeronautics and Space Administration. The nose of the four-stage solid-fuel rocket climbed into the Van Allen belt, and then landed 1,200 miles away where it was recovered 3 hours later by a Navy destroyer. The rocket carried both film packs and mold spores for radiation studies. It also measured micrometeorite impacts. The capsule weighed 83 pounds. This was a NERV test (nuclear emulsion recovery vehicle).
- September 21: The Air Force launched a Blue Scout Junior space probe from Cape Canaveral with a 32.8 pound payload aimed to an altitude of 16,600 miles. It was designed to study the detection of nuclear explosions in space. Unfortunately radio signals failed just before burnout of the fourth stage of the solid-fuel rocket, but the rocket was believed to have performed as expected.
- September 22: The Navy announced it had found two submarines accompanying the Soviet tug *Kapitan V. Fedotov* and the tanker *Kokand* which were operating off Newfoundland, tending to obscure the theory that they were there for purposes of tracking a Soviet space shot. The tug had its captive balloon aloft.
- : The *Patrick Henry* made two underwater launching attempts with Polaris missiles. The first broke water but failed to ignite. The second was destroyed by the range safety officer in a spectacular explosion just at the surface.
- September 23: The carrier rocket of the second Soviet spaceship satellite (Korabl Sputnik II) reentered and burned.
- : A fully guided Polaris missile made a successful medium-range flight to its target.
- September 24: A metal object originally part of Korabl Sputnik I reentered and burned.

1960—Continued

- September 25: The National Aeronautics and Space Administration attempted an Atlas Able V lunar satellite launching at Cape Canaveral with a takeoff weight of 260,000 pounds. It carried a 387-pound satellite, in the form of a 39-inch sphere with 4 paddles carrying 8,800 solar cells, which was to enter orbit around the Moon. After launching, an upper stage failed to fire, and, it was discovered later, parts of the assembly fell on a farm in South Africa. The Air Force conducted the launching.
- : The United States Navy won a new official world speed record with a McDonnell F4H-1 Phantom jet fighter flown by Commander John F. Davis who averaged 1,390.21 miles per hour on the prescribed closed course. His actual average speed including times outside the prescribed course was 1,454 miles per hour.
- : The United States invited the U.S.S.R. and 20 other nations to participate in a weather research program built around the upcoming Tiros II weather satellite test.
- September 26: Peter Thorneycroft, Britain's Aviation Minister, conferred in Ottawa with Canadian officials on tentative plans for a cooperative Commonwealth space research program.
- : Premier Khrushchev stated in New York that the Soviet Union was ready to launch a man into space but had not made such an attempt yet.
- September 27: The Soviet radio marked this day as one especially significant in the history of the world. Since no spectacular space event occurred, it remains a mystery whether one was planned, or whether the only significance was to repeat the recording of a miscellany of events as had been done in a Soviet book of 25 years ago.
- September 28: A third operational version of the Titan J missile made a 5,000 mile flight from Cape Canaveral, and a data capsule was recovered by the *Coastal Crusader*.
- October 1: The first BMEWS (ballistic missile early warning system) radar, at Thule, Greenland, commenced regular operations by scanning distances up to 2 or 3 thousand miles to give approximately 15 minutes' notice of any missile attack. Later were to come the stations at Clear, Alaska, and at Flyingdale Moor, England. The BMEWS computer at Thule could calculate ballistic trajectories, but could not track, which will be significant if later missiles can alter course. The BMEWS to be based in England was to have tracking ability.
- : The Harvard Business Review published an article showing a preponderant majority of business executives strongly support a vigorous space program even at the price of foregoing a tax cut. They also favor space research over more leisure and consumer goods, shorter working hours, power plants and dams, and foreign economic aid. Only hospitals, medical research, and education were given a higher priority than space research.
- October 4: A Scout rocket was launched in a component test to an altitude of 3,700 miles, and it impacted 6,100 miles away from the launching point. It also carried on board an Air Force experiment aimed at detecting nuclear explosions in space. The Scout test was conducted from Wallops Island, Va., by the

## 1960—Continued

- National Aeronautics and Space Administration. The payload of instruments in the nose weighed 112 pounds, including the 78-pound Air Force package, and another 80 pounds of instruments were placed in the first and third stages to measure rocket performance.
- October 4: The satellite Courier I-B developed by the Army Signal Corps was launched successfully by a Thor Able Star rocket from Cape Canaveral with a takeoff weight of 105,000 pounds. The 51-inch diameter sphere weighed about 500 pounds, and carried 300 pounds of electronic equipment designed to operate an active repeater communications station. The exterior of the satellite was covered with 19,200 silicon solar cells to convert sunlight into electric energy. The device had 5 tape recorders for storing messages received for later delivery to points not in line of sight when the messages were received by the satellite. Its speed of handling was 68 to 75 thousand words a minute. The orbit was inclined at 28.3 degrees to the Equator, with an apogee of 658 miles and a perigee of 501 miles. Orbital time was 107 minutes. One of the first messages transmitted through the satellite was sent in written form from Deal, N.J., and received from the satellite at Ponce, P.R. Secretary of the Army Brucker's voice was also sent to the satellite, and then rebroadcast to the world. The satellite carried four radio receivers, four FM transmitters, and five tape recorders. It also carried a beacon radio transmitter at 50 m.w. power.
- October 5: A successful flight was made by a Polaris missile at Cape Canaveral flying 1,200 miles downrange.
- October 7: The Federation Aéronautique Internationale meeting at Barcelona, Spain, accepted the first rules to govern the establishment of official records for manned space craft. The first to be recognized must be at least 100 kilometers, and later attempts to set records must exceed the existing record by at least 10 percent. The four categories for records are duration of flight, altitude without orbiting Earth, altitude in orbit, and mass lifted above 100 kilometers. Record claims must be supported by information on the date, time, place of takeoff and landing, identity of the vehicle commander, and any special apparatus used to assist liftoff, landing, or control.
- October 10: A fully-guided Polaris missile flew successfully over a planned shortened course of 700 miles from Cape Canaveral.
- October 11: The Air Force launched its first Samos satellite at Vandenberg Air Force Base. Launched by an Atlas D missile with a total takeoff weight of 273,000 pounds, the satellite used an Agena upper stage and weighed about 4,100 pounds. Although both stages fired successfully, two hours later it was announced that no orbit was achieved.
- : The first Atlas E test at Cape Canaveral fell far short of its intended 5,000 miles.
- October 12: The National Aeronautics and Space Administration through Dr. T. Keith Glennan offered to launch at cost communications satellites developed by private companies.

## 1960—Continued

October 13: An Atlas missile launched from Cape Canaveral flew to an altitude of 650 miles and landed 5,000 miles downrange. Successfully recovered were three black mice, Sally, Amy, and Moe. While in flight Amy also sent back telemetry from a radio attached to her back.

—: It was announced that Courier I-B had been used to relay photographs by facsimile.

—: The Air Force fired a solid-fuel Phoenix rocket to an altitude of 200 miles to make radiation measurements.

—: United States officials were of the opinion that one or more Soviet space attempts probably failed during the time Premier Khrushchev had been in New York, based on circumstantial evidence. The three tracking ships originally spotted in the Pacific were joined by a fourth one, and they formed a line running northwest from Hawaii, with an interval of about 300 miles between ships. For the last 10 days, they had been lying dead in the water to conserve fuel, and had drifted somewhat off their original precisely arranged positions. They first appeared on station 1 day before Khrushchev reached New York. The tug and tanker near Newfoundland, which also carried a heavy array of tracking gear, had since moved down toward the Azores to conduct routine meteorological work.

—: The silencer carried on board Explorer VII, scheduled to end its radio transmissions after 1 year, failed to act, and signals continued unabated.

October 17: The American Telephone and Telegraph Co. was negotiating with the telephone systems of Britain, France, and Germany for the purpose of international cooperation in the operation of intercontinental service via satellite relay.

—: The Agena stage of Discoverer XV reentered and burned.

October 18: A second Iris rocket was successfully tested at Wallops Island, Va., rising to 140 miles with a payload of 125 pounds. It landed 230 miles away.

October 19: It was revealed that by using operational type Polaris missiles unencumbered with the mass of test gear which previously interfered with successes, the *Patrick Henry* successfully launched four missiles between October 15 and 18 from a position about 500 miles off the Florida coast.

—: The National Aeronautics and Space Administration announced the award of preliminary design contracts for solid-fuel rockets with thrusts between 2 million and 15 million pounds. They had been awarded to Aerojet-General, Grand Central, and Thiokol.

—: The Kiwi-A No. 3 test of nuclear rocket components was successfully conducted at the Nevada test site, including 15 minutes operation at full power.

October 20: The Navy reported that the four Soviet tracking ships in the Pacific had then headed for home port without having supported any Soviet shots. Two days after Premier Khrushchev left New York they were observed headed northwest again at 7 knots.

1960—Continued

- October 21: American Telephone and Telegraph Co. made formal application to the Federal Communications Commission for authority to operate a communications satellite. It planned to transmit and receive at Holmdel, N.J., and to use the frequency band from 6,775 to 6,875 megacycles to an active repeater satellite of 175 pounds. The first version would handle simultaneously 50 two-way calls or one television channel. The operational version would handle 600 telephone channels or two television channels. The satellites would be put in a 2,200 mile high orbit.
- October 22: Technical difficulties with Courier I-B ended its ability to retransmit signals back to Earth. During the 18 days it operated, 118 million words were retransmitted. The radio beacon was still transmitting.
- October 24: A Titan missile made its longest flight from Cape Canaveral, reaching 6,100 miles with a tactical type nose cone.
- : The Soviet Union stated that Marshal Mitrofan Ivanovich Nedelin, chief of Soviet rocket forces, was killed in an air crash. He was replaced by Marshal Kyril Mosalenko. Later Western speculation was that Marshal Nedelin was killed with a large group of other officials while observing a spectacular rocket launching which exploded, but this could not be confirmed.
- October 25: The National Aeronautics and Space Administration announced the award of feasibility studies for the advanced Apollo three-man space ship for orbital and circumlunar flights to Convair, General Electric, and the Martin Co.
- October 26: The first attempt was made to launch a Thor-Agena B rocket combination with a takeoff weight of 115,500 pounds for Discoverer XVI at Vandenberg Air Force Base. Apparently the first and second stages did not separate, and no orbit was achieved. The Agena stage was to weigh 2,100 pounds in orbit with a 300-pound reentry capsule.
- October 29: Peter Thorneycroft, British Minister for Air, revealed that during the three day meetings, just ended in Paris, he formally proposed to Premier Debré that France and other European countries join with the British Commonwealth in a joint space program.
- October 31: It was revealed that the Air Force was considering a proposal for a "space plane," capable of horizontal takeoff from the Earth, then scooping up tons of oxygen in the upper atmosphere before flying on as far away as the Moon with rocket power, and returning to land again as an aeroplane on Earth.
- : The Department of Defense ordered a major expansion of developmental work on the B-70 supersonic bomber.
- November 1: It was announced in Commons by Prime Minister Macmillan that Holy Loch, Scotland, was to be used as a supply base by Polaris missile submarines of the United States Navy, with the U.S.S. *Proteus*, a tender, to be stationed there.
- : The National Aeronautics and Space Administration and Atomic Energy Commission called for bids to move directly into the industrial research and development phase of Project Rover without further design studies, based on the encouraging results of tests obtained October 19, 1960.



## 1960—Continued

- November 3: Explorer VIII was successfully placed in orbit for the National Aeronautics and Space Administration at Cape Canaveral, using a Juno II rocket. The new satellite had an apogee of 1,422.6 miles and a perigee of 258.4 miles, and circled the Earth every 112.7 minutes. The orbit was inclined  $49.9^\circ$  to the Equator. The top-shaped vehicle weighed 90 pounds, measured 30 inches high, 30 inches in diameter, and was designed to measure the characteristics of the ionosphere. It was called model S-30 by NASA. The transmitter on 108 megacycles at 70 mw was supported by solar cells, and was to last for about three months. Experiments were to measure the concentration, distribution, and temperatures of negatively charged electrons and positively charged ions in the ionosphere. They were also to measure the frequency, momentum, and energy of micro-meteorites. Indirect measurements were to be made of the density of matter in space.
- November 4: University of California scientists reported encouraging new results in sustaining a hydrogen fusion reaction for 1 millisecond at a temperature of 60 million degrees Fahrenheit. This was using a magnetic mirror machine.
- November 6: The Soviet Union published its atlas of the back side of the Moon, based on full analysis of the photographs taken by the third Cosmic Rocket (Lunik III).
- November 7: The Navy successfully flew one of the last Polaris A-1 missiles 1,150 miles from Cape Canaveral before beginning tests with the improved A-2 version.
- November 8: The last of five Little Joe rocket tests of Mercury components was conducted at Wallops Island, Va. The capsule failed to separate from the booster, and both plunged into the ocean, after climbing to 53,000 feet.
- : A second test of the Air Force Blue Scout Junior rocket was conducted at Cape Canaveral, attempting to carry a radiation detection payload out 24,500 miles from Earth, but it fell into the Atlantic 250 miles away when it burned out too soon.
- November 10: The first flight was made by an A-2 (1,500-nautical mile version) Polaris missile, and it exceeded 1,600 miles in a successful test from Cape Canaveral.
- : The Joint Chiefs of Staff assigned both the Navy Spasur and the Air Force Space Track systems to the direct control of the Continental Air Defense Command.
- November 12: Discoverer XVII was successfully placed in orbit from Vandenberg Air Force Base, using a Thor-Agena B combination vehicle with a takeoff weight of 115,500 pounds. The Agena stage, 25 feet long and 5 feet in diameter, put 2100 pounds into polar orbit, including a 300 pound reentry capsule. The apogee was 616 miles, and the perigee 116 miles. The orbit was inclined  $81.8^\circ$  to the Equator and had a period of 97 minutes. The payload included human cells, bacteria, plant spores, radiation counters, and film emulsions, plus a high-intensity light for visual tracking. The Agena stage reentered and burned December 29, 1960.

## 1960—Continued

- November 14: The Soviet magazine *International Affairs* stated the Soviet Union has the ability to stop any espionage by Samos, Midas, or Discoverer satellites. The article by G. Zhukov insisted that surveillance from any altitude was illegal.
- : After 31 orbits around the Earth, and two days of flight, the 300-pound capsule of Discoverer XVII was ordered down. It was snagged in midair by an Air Force C-119 piloted by Capt. Gene W. Jones.
- : The Agena stage of Discoverer XIII reentered and burned.
- November 15: Professor A. Gib DuBusk, geneticist at Florida State University, reported that bread mold specimens carried to 1,200 miles elevation in Argo D-8 capsule NERV test of September 19, 1960 showed 30 times the normal number of changes.
- : An Aerobee-Hi test rocket climbed 145 miles from Wallops Island, Va., gathering information on the upper atmosphere.
- : Loaded with 16 thermonuclear-tipped Polaris missiles, the U.S.S. *George Washington* departed from Charleston, S.C., on its first patrol.
- : The first flight of the X-15 with the new XLR-99 engine was conducted with Scott Crossfield at the controls. Throttled back, it still reached almost 2,000 miles per hour and 80,000 feet before landing at Edwards Air Force Base.
- : An Atlas missile launched from Cape Canaveral flew 5,000 miles, and its Mark IV nose cone data capsule was recovered within an hour of impact by the *Timber Hitch*.
- November 17: The last A-1 Polaris was tested at Cape Canaveral, and a malfunction occurred shortly after second stage ignition.
- November 20: A recently translated Soviet article disclosed that Soviet scientists may have been able to pinpoint the time of both the Argus and Johnston Island nuclear tests of 1958, although there was no indication that their analysis was made until long after the tests.
- November 21: The first attempt was made at Cape Canaveral to launch an unmanned Mercury capsule by a Redstone rocket at Cape Canaveral for flight MR-1. After rising about an inch off the pad, the rocket cut off, but the escape rocket ignited and roared away, leaving the capsule still attached to the Redstone. Just a few microseconds of delay in a function were detected by a sensor which then triggered the normal escape rocket separation that occurs in space after burnout of the main booster.
- : The capsule of Discoverer VIII finally reentered and burned.
- : The Air Force launched a 500-pound capsule to an altitude of 32 miles at Santa Rosa Island, Fla., making a successful parachute recovery in the Gulf of Mexico.
- November 22: The X-15 made its second flight with the new XLR-99 engine, was brought to full power briefly, and also tested its restart capability. It reached 62,000 feet and nearly 2,000 miles per hour, with Scott Crossfield at the controls.

1960—Continued

- November 22: The Governments of India and the United States agreed to a cooperative series of 40 high-altitude balloon flights carrying up to 2,000 pounds of equipment to 100,000 feet. The studies were to relate to the upper atmosphere including winds and cosmic rays. Launchings were to be made at Hyderabad.
- : An Aerobee-Hi rocket carried to 105 miles four stellar spectrometers for the University of Rochester in a test at Wallops Island, Va.
- November 23: Tiros II was successfully launched from Cape Canaveral for the National Aeronautics and Space Administration, using a Thor Delta vehicle with a takeoff weight of 112,000 pounds. The 280-pound weather satellite was put in orbit inclined 48.5 degrees to the Equator, with an apogee of 453 miles and a perigee of 387 miles. Orbital time was just over 98 minutes. The satellite was shaped like a hat box 19 inches high and 42 inches in diameter, and weighed about 270 pounds. It carried one wide-angle and one narrow-angle television cameras. There were 9,200 solar cells on the exterior of the satellite. Radios contained were 2 on 235 mc at 2 watts, 1 on 237.8 mc at 3 watts, and tracking radius on 108 mc at 30 mw and 108.03 mc at 30 mw. In addition to the equipment carried similar to Tiros I, it also carried infrared sensing instruments to map heat radiation. Five pairs of small rockets were available to increase the spin of the satellite on command, and it was given an electrical system to offset the magnetic forces which tended to tilt Tiros I. An empty 50-pound rocket casing was also in orbit.
- November 24: The narrow-angle lens camera (75 miles to a side) of Tiros II produced pictures about equal to those of Tiros I. But the wide-angle lens camera (750 miles to a side) failed to show the contrast between light and dark which was expected. There was still hope the malfunctioning camera complex would perform better later on. The infrared experiment was working well.
- November 25: Small rockets were fired by remote command to increase the spin of Tiros II, and there was some indication of improvement in the picture quality of the wide angle camera, perhaps because of a build-up of power supply from the solar cells.
- November 26: Scientists from 10 European nations gathered at Geneva, Switzerland to launch a cooperative space program independent of those of the United States and the Soviet Union. Professor Marcel Golay was chairman of the meetings.
- November 27: It was announced that two weeks ago Explorer VII which was supposed to have stopped broadcasting, detected the most lethal outburst of solar radiation in 13 months of operation.
- November 28: Tiros II had been successfully stabilized by its spin rockets. Some 998 pictures were received at Monmouth, N.J., and at San Nicolas Island, Calif. Of the narrow angle pictures, about 85 percent had been useful and of the wide angle lens views, 5 to 10 percent had had some value.
- November 29: A second Atlas missile failure occurred in a high altitude malfunction at Cape Canaveral while attempting a 5,000 mile flight.

1960—Continued

- November 30: A Thor Able Star rocket with a takeoff weight of 120,000 pounds was used at Cape Canaveral in an attempt to place Transit III-A in orbit for the Navy. It was also carrying GREB-2, a solar radiation experiment. Minutes after launch telemetry revealed a premature cutoff of the upper stages, and a range safety officer pressed the destruct button. Portions of the equipment fell on Cuba, where the government issued loud protests. Transit III-A weighed 203 pounds, and GREB-2 weighed 40 pounds. The GREB-2 radio was on 108 mc, and the Transit III-A radios were on 54 mc, 162 mc, 216 mc, and 324 mc.
- December 1: The Soviet Union announced that it had placed in orbit a third large space ship (Korabl Sputnik III) carrying two dogs, other animals, plants, and insects. The weight was given as 10,614 pounds, exclusive of the weight of the final stage rocket which also was in orbit. The dogs were named Pchelka (Little Bee) and Mushka (Little Fly). Because the orbit had an apogee of 164 miles and a perigee of only 116 miles, with an orbital time of only 88.49 minutes, Soviet scientists indicated that a recovery would have to be made very promptly to keep it from burning up. The dogs were watched during flight by a monitor television system, and the life support system functioned normally, according to Soviet account. The orbit was inclined at 65 degrees to the Equator. Telemetry was being received on 19.995 megacycles. Chemical batteries and solar cells supplied power.
- : Delegates of Britain, Norway, Belgium, the Netherlands, and Sweden signed the new agreement binding their countries to a cooperative effort in space research. The agreement was also signed, subject to ratification, by delegates from France, Denmark, Italy, Spain, and Switzerland. West Germany was represented, but the delegation did not have the power to sign. The new organization was to be patterned after CERN for nuclear research. The new commission's annual budget was to be about \$190,000.
- December 2: Exceedingly valuable information was returned by Discoverer XVII, it was revealed, as a result of the recovery from orbit of human tissues which were exposed to an unexpected heavy dose of radiation for 50 hours in flight.
- : The Soviet Union attempted to recover its third space ship from orbit with its cargo of two dogs and other animals and equipment. However, it failed to return on the precalculated path, and it burned on reentry, leaving only the separate carrier rocket in orbit, but it then also reentered and burned.
- December 3: The Senate Committee on Aeronautical and Space Sciences charged in a staff report that the United States lagged in establishing a comprehensive policy for developing space communications even though the need was pressing.
- : A Titan missile exploded in its underground silo at Vandenberg Air Force Base during fueling operations.

1960—Continued

- December 4: Analysis of the NERV test of September 19 revealed surprisingly acute damage to living cells carried in a shielded compartment which probed the Van Allen Radiation Belt, yet the radiation encountered would not normally cause such acute damage. (See November 15, 1960.)
- : The first attempt to launch a satellite from Wallops Island, Va., ended in failure. Using a solid-fuel Scout rocket with a takeoff weight of 36,100 pounds, the National Aeronautics and Space Administration planned to lift into orbit the latest in the Beacon series of balloon tests previously attempted with a Jupiter C and a Juno II. The second stage failed to fire, and the assembly fell into the ocean 80 miles away. This would have carried a 12-foot balloon as part of the 87-pound payload. The Scout rocket first stage was called an Algol with 115,000 pounds of thrust; the second stage was a Castor with 62,500 pounds of thrust; the third stage was an Antares with 13,600 pounds of thrust; and the fourth stage was an Altair with 3,100 pounds of thrust.
- December 5: A second Polaris A-2 missile was successfully fired over 1,600 miles from Cape Canaveral.
- December 6: Hughes Aircraft Co. unveiled a new communications satellite available on an off-the-shelf basis to purchasers. It could be launched by a Scout rocket.
- December 7: Discoverer XVIII was successfully placed in orbit by Thor Agena B rocket with a takeoff weight of 115,500 pounds at Vandenberg Air Force Base. It attained an apogee of 459 miles and a perigee of 154 miles, circling the world in polar orbit every 94 minutes. The orbit was inclined 80.9° to the Equator. The Agena stage weighed 2,100 pounds after burnout, including a 300 pound reentry capsule. The payload included human tissues, algae, spores, gamma globulin, albumin, gold foil, and various films. It also carried components presumably of future Midas and Samos satellites in its classified load. It also carried a high-intensity external light for tracking purposes.
- December 10: It was reported that the cells carried in Discoverer XVII suffered little damage despite the heavy load of solar radiation to which they were exposed. Those lightly shielded with aluminum suffered less damage than those protected by gold or lead which emitted secondary gamma radiation.
- : After 48 orbits of Earth, Discoverer XVIII was ordered to send down its 300-pound recovery capsule, and for the second time, Capt. Gene W. Jones piloting a C-119, caught the capsule in the planned drop area off Hawaii. This was the third air snatch, the fourth American recovery.
- : The New York Times made public excerpts from a letter from the Office of the Secretary of the Air Force to Air Force Commanders pointing to the probability of a battle between the Air Force and the National Aeronautics and Space Administration for the dominant role in space. The letter argued for the primacy of the military role, and further minimized the responsibilities and capabilities of the other two armed services.

1960—Continued

December 10: The National Aeronautics and Space Administration launched a rocket from Wallops Island, Va., to reach an altitude of 212 miles where it released a sodium flare and then on to 450 miles where it released a lithium flare. The purpose was to gather data on wind velocities, and on temperature and density.

—: It was announced that Deception Island in the Antarctic was to be wired extensively to serve as an antenna to catch low-frequency bursts of solar gases. A chain of receiving stations at the magnetic conjugates in the northern hemisphere were being prepared in order to trace so-called whistler signals oscillating along magnetic lines of force. Supplementary chains of stations at other points should give some worldwide coverage of the radio results of solar activity.

December 12: Findings at Brooks Air Force Base based on tissues and other biological materials carried in Discoverer XVII and Discoverer XVIII suggested that shielding against radiation would not be much of a problem for flights of up to 50 hours duration at the altitudes traversed by the Discoverer flights.

December 13: Dr. James R. Killian, Jr. warned against excessive expenditures for space research including man-in-space and big boosters. He suggested the money might better be spent on education.

December 15: The National Aeronautics and Space Administration intended lunar orbiting rocket, launched by the Air Force using an Atlas Able vehicle, exploded above Cape Canaveral, 70 seconds later, with the parts falling into the ocean 8 to 12 miles away. This was the fourth and final failure using the Atlas Able combination, and followed three earlier failures with the Thor Able in attempts to establish a satellite in orbit around the Moon. It was expected that no further attempts would be made in less than nine months until either an Agena or Centaur vehicle was available. The satellite weighed 388 pounds, was spherical in shape, 39 inches in diameter, and had 4 paddles with 8,800 solar cells. It carried 2 UHF transmitters on 378 megacycles at 1.5 watts.

—: The British Government had offered Blue Streak to France as a basis for a joint program of launching satellites.

December 19: The National Aeronautics and Space Administration conducted a repeat launching of MR-1, the Mercury Redstone test of an unmanned Mercury capsule at Cape Canaveral. All phases of the operation were successful. The capsule rose 135 miles and landed in the Atlantic 235 miles away. Thirty-two minutes after landing it was on the deck of the U.S.S. *Valley Forge*. A man would have survived the ride in the 2,400-pound capsule which landed by parachute, and was recovered by helicopter.

—: Westinghouse Electric Corp. announced a new ultraviolet space communication system called "ultracom" which has the potential to a range 50 times as great as that of present radio and radar. It is expected to be less troubled with "noise" than radio, but would require relay from an orbiting satellite to another wavelength in order to penetrate to the surface of the Earth.

## 1960—Continued

- December 20: President-elect Kennedy announced that Vice President-elect Johnson would in the future head the revitalized National Aeronautics and Space Council.
- : Discoverer XIX was successfully placed in orbit from Vandenberg Air Force Base, using a Thor Agena B vehicle. This time the 2,100-pound vehicle did not carry a recovery capsule. It was put into polar orbit inclined  $83.4^\circ$  to the Equator with an apogee of 323 miles and perigee of 128 miles, taking 92 minutes to circle the world. Instruments for radiation studies were to remain operational only four days. The infrared scanners were to test devices to be used in Midas. The Agena stage reentered and burned on January 22, 1961.
- : The first flight was attempted with an improved Titan missile at Cape Canaveral, but the second stage failed to ignite.
- December 21: Space Technology Laboratories was selected to build for the National Aeronautics and Space Administration the OGO, orbiting geophysical observatory, a step toward standardizing scientific Earth satellites. It was to weigh about 100 pounds and carry two solar cell paddles. Later it could weigh as much as 1,500 pounds including a 300 pound "piggy back" satellite.
- December 22: The U.S.S. *Robert E. Lee* fired a Polaris missile from underwater 30 miles off Cape Canaveral and it reached the target accurately over a distance of 1,265 miles.
- December 23: It was announced that the solar storm of November 12, 1960 had made a substantial change in the orbit of Echo I. Where its orbit had been nearly circular at about 1,000 miles altitude, the new apogee was 1,334 miles and the perigee 619 miles.
- December 26: The National Aeronautics and Space Administration announced the recent successful firing of a new solid propellant rocket engine constructed of three standardized modules for assembly in combinations at the launch site. The design, developed by United Technology Corporation, could result in large savings in the development costs of very large boosters.
- : President-elect Kennedy began a two-day meeting on space and other problems at Palm Beach with Vice President-elect Johnson and Senator Kerr.
- December 27: France moved closer to a compact nuclear warhead by exploding a third nuclear device in the Sahara Desert of Algeria, estimatedly in the range of from 10 to 14 kilotons.
- : President-elect Kennedy made known his determination that the United States overtake and lead the Soviet Union in the development of space, following his Palm Beach talks with Senators Lyndon Johnson and Robert F. Kerr.
- December 28: It was reported that for no known reason within an hour on November 9, 1959, the Outer Van Allen Radiation Belt disappeared to the extent of 90-95 percent. It was back in place after a few days.
- : Authoritative sources in London reported that the British Government planned to ask France, West Germany, Italy, and Belgium to attend a conference on space research early in 1961 probably to lead to a proposal to use the Blue Streak missile for a satellite booster, and possibly the French Veronique for an upper stage.

1960—Continued

December 29: President Eisenhower has given his support to a policy of allowing private corporations to build and operate communications satellites.

———: Dr. T. Keith Glennan has offered his resignation as Administrator of the National Aeronautics and Space Administration, effective January 20, 1961, it was announced by the White House.

———: The Agena B stage of Discoverer XVII reentered and burned.  
December 30: The U.S.S. *Patrick Henry* loaded with 16 Polaris tactical missiles departed from Charleston, S.C., on its first patrol.

1961

January 6: The Navy announced development of a new prototype television camera and transmitting station which can be carried in the nose of a small Arcas rocket to a height of 40 miles, and then broadcasts what it sees for a half hour while it returns by parachute. In contrast to the still pictures returned by Tiros using television techniques, the new system returns live pictures immediately. The payload package weighs 8 pounds, is a slim cylinder 16 inches long. It was developed by Thompson Ramo-Wooldridge, Inc.

January 7: The Air Force successfully launched Blue Scout I at Cape Canaveral in an experiment penetrating the lower edge of the Van Allen Radiation Belt. A payload of 393 pounds including eight radiation experiments was carried in a ballistic flight 1,200 miles from the Cape, after a climb to about 1,000 miles. A search plane located the instrument capsule after the 32 minute flight, but apparently it sank before recovery could be effected.

January 10: The first Polaris shot of the new year from Cape Canaveral used new fuels and a glass upper stage to make a successful flight of 1,600 miles.

January 11: The Navy announced that it had spotted three Soviet tracking ships moving into the central Pacific again—the *Sibir*, *Chukotka*, and *Sakhalin*.

———: President-elect Kennedy released a special report made to him by an ad hoc committee of 9 members, with Dr. Jerome B. Wiesner of M.I.T. as chairman. The report called for a sweeping reorganization of the national space program to increase its effectiveness. The report was critical of past leadership and direction, and viewed both national security and prestige as being at stake. It called for effective use of the Space Council, single direction within the Department of Defense of military space efforts, stronger technical management in NASA, and closer partnership with industry.

January 12: The United States set 6 new world's records for aircraft, using B-58 Hustler bombers. Carrying a 4,408 pound load, one plane averaged 1,284.73 miles per hour over a 621 mile course, as compared with the previous Soviet record of 639.18 miles per hour with an unidentified plane. The other B-58 averaged 1,061.80 miles per hour on a 1,242 mile course with the same payload as compared with the previous Soviet record of 596.47 miles per hour with a Tu-104.



## 1961—Continued

- January 13: The National Aeronautics and Space Administration announced that on February 1, it would activate a new life sciences research laboratory at the Ames Research Center in Sunnyvale, Calif., expected to build toward a strength of 60 scientists and 140 supporting technicians.
- : An Air Force radar station at Shemya in the Aleutians detected the flight of a Soviet missile traveling in a southeasterly direction. Although not a secret, this was the first official mention of the Shemya detection point.
- : Lt. Col. Paul D. Hickman at Honolulu stated that the United States had good evidence that two Soviet Astronauts were killed in launching attempts during the time of Premier Khrushchev's stay in New York the previous fall. He said his information was unofficial, but that the identity of one of the dead men was known.
- January 14: Officials of the Japanese science and technology agency announced that Japan planned to launch an Earth satellite by 1963, using American rockets from a launching base in the United States.
- January 16: President Eisenhower sent his final budget message to the Congress. Many observers viewed as the most important policy remark contained in it related to space to be: "Further testing and experimentation will be necessary to establish whether there are any valid scientific reasons for extending manned space flight beyond the Mercury program." In other respects the message reviewed our progress in a number of programs, and called for a new obligational authority for the National Aeronautics and Space Administration of \$1,110 million for fiscal year 1962.
- : The International Telephone and Telegraph Corp. was allocated temporarily by the Federal Communications Commission two frequencies (2120 and 2299.5 megacycles) to use in testing the surface of the Moon, and perhaps artificial satellites as reflecting surfaces for communications. The purpose was for research, not commercial use.
- January 17: The Navy spotted a fourth Soviet tracking ship, the *Suchan*, in the Pacific. The earlier three were already grouped in a loose triangle generally southwest of Hawaii. All four vessels carried helicopters which might be used for recovery purposes.
- January 18: The House Science and Astronautics Committee released a preliminary staff report on space launching vehicles. It included a warning that new examples of duplication of effort in development seemed to be in the making, and also that there were signs that the role of NASA was being degraded in some quarters.
- January 19: The third Iris rocket was launched at Wallops Island, Va., but climbed only 86 miles of the intended 160. It carried 100 pounds of instruments to measure rocket performance.

## 1961—Continued

- January 19: The Federal Communications Commission authorized the American Telephone and Telegraph Co. to establish the first space communication link across the Atlantic on an experimental basis. Experimental satellites are expected to weigh about 175 pounds, and to orbit at 2,200 miles altitude. The National Aeronautics and Space Administration would do the launchings, estimated to cost about \$3 million each, and the company would pay about \$250,000 for each of six. The authority was for experimental work only, not a commercial system. An ultimate commercial system is estimated to require 50 satellites, 13 terminals, and an investment of \$170 million.
- : The National Aeronautics and Space Administration announced the indefinite suspension of interrogation of the Tiros II satellite's wide-angle lens television system, lest its malfunction induce a power drain disabling other equipment in the satellite.
- January 20: T. Keith Glennan left his assignment as Administrator of the National Aeronautics and Space Administration. No successor had been named.
- : The United States withdrew its team of cooperating scientists at Jodrell Bank, England because of the end of the Able series of space probes.
- : A Titan missile was launched at Cape Canaveral, but the second stage failed to ignite, and the rocket fell about 100 miles away.
- : The Soviet Union chose this day to release the news that about three weeks earlier, the dog Strelka which orbited the Earth in August, 1960 gave birth to 6 healthy puppies.
- January 21: The U.S.S. *George Washington* returned from its first patrol in the Atlantic having traveled 67 days underwater with its 16 nuclear-tipped Polaris missiles.
- January 22: Max Lehrer, Assistant Director of the Senate Committee on Aeronautical and Space Science became director of defense business development of the Defense Electronic Products Division of R.C.A.
- : Discoverer XIX reentered and burned.
- January 23: The Radio Corporation of America announced new tunnel diode circuitry capable of operating at close to the speed of light, or 1000 times faster than most present data processors. The development program was sponsored by the Navy Bureau of Ships.
- : A new set of studies and experiments seems to establish that radar waves can be channeled to follow the Earth's magnetic lines of force. Waves aimed at a point over Washington, D.C. were received near Cape Horn, when suitable frequencies were used, and an echo was received back at Washington. The ducts may be as narrow as 200 yards in diameter. Variations in the time for signals to make a round trip may give evidence of external forces influencing the Earth's magnetic field, proving a new diagnostic tool.

## 1961—Continued

- January 23: Dr. Herbert Friedman of the Naval Research Laboratory reported evidence that the Earth may have a hydrogen tail reaching 20 million miles or more, and pointed away from the Sun. The so-called gegenschein which is occasionally observed as a light in the sky on the side of Earth away from the Sun may be light reflected by this comet-like tail.
- : The last Atlas D made a successful flight from Cape Canaveral, putting its nose cone well within 2 miles of its target 5,000 miles away.
- January 25: The Air Force announced it had selected Titan II as a booster for Dyna-Soar.
- January 26: The White House announced the intention to appoint Col. Kenneth E. Be Lieu, Staff Director of the Senate Committee on Aeronautical and Space Sciences and of the Preparedness Subcommittee of the Committee on Armed Forces to the post of Assistant Secretary of the Navy for Materiel.
- January 28: The National Aeronautics and Space Administration announced that it will establish a theoretical research group as a branch of the Goddard Space Flight Center of Greenbelt, Md., It will be located in New York City, begin operations in May, and draw upon the talent in the universities of that area. Dr. Robert Jastrow will be chief of the new bureau and head its permanent staff of 50.
- January 30: Twelve European nations opened a conference at Strasbourg on the possibilities of establishing a cooperative space research program. Present were representatives of the United Kingdom and France, and also Austria, Belgium, Denmark, West Germany, Italy, the Netherlands, Norway, Spain, Sweden, and Switzerland. Observers were also present from Eire, Greece, Turkey, and Canada.
- : President Kennedy announced that he was appointing James Edwin Webb Administrator of the National Aeronautics and Space Administration, and reappointing Dr. Hugh L. Dryden as Deputy Administrator.
- January 31: The National Aeronautics and Space Administration conducted successfully the Mercury-Redstone flight MR-2 at Cape Canaveral. A 37-pound male chimpanzee, Ham, rode in a regular Mercury capsule weighing 2,400 pounds to an altitude of 155 miles and a distance of 420 miles, where after three hours, he was picked up in his capsule by a Marine Corps helicopter. The ape was soon in good spirits and apparently unharmed after his release from his couch. Telemetry was returned during most of the flight. Recovery was delayed because the Redstone rocket cut off 5 seconds early, and this ignited the escape rocket system which gave an extra boost to the capsule, causing it to climb 40 miles higher than planned, and travel 130 miles farther down range. Ham traveled 5,000 miles per hour, about 800 more than planned. This subjected him to g loads of 16 instead of 12 as originally planned. During the flight, which included 4½ minutes of weightlessness, the ape operated successfully certain levers which he had been trained to handle. A red light burned continuously. If the ape did not pull the lever under it

## 1961—Continued

at least once every 20 seconds, he would receive a shock. A white light flashed each time he did pull the lever correctly. A blue light came on every 2 minutes for 5 seconds. If the ape pulled the lever under this light before it went off he avoided a shock. All indications were that Ham performed his chores adequately throughout the flight.

January 31: Samos II was successfully placed in orbit from Point Arguello Naval Base, Calif., using an Atlas missile with an Agena upper stage. The satellite had a perigee of 300 miles and an apogee of 350 miles. It was put into a polar orbit, but the exact inclination was not announced. Its period was 95 minutes. The weight of the Agena stage was given as 4,100 pounds, of which 300 to 400 pounds was believed to be instruments. The main purpose of the test shot was to further experimental work with camera reconnaissance techniques, probably including television readout. There may also have been instruments for measuring cosmic rays, micrometeorites, and the electrical field of Earth, but the Air Force would not confirm this. Batteries were carried to provide power for a few weeks only, and the frequencies on which signals were broadcast were not revealed.

—: The Bell Telephone Laboratories unveiled a new, improved optical maser device which emits a continuous beam suitable for voice transmission, expected in time to allow 1000 times the amount of information transmitted on a given amount of band width sent in a very narrow beam.

—: The Lincoln Laboratories of M.I.T. announced a new error detection method for use in communications, which should reduce the average number of errors from one a minute, when transmitting 100,000 bits of information a minute, to about one in 300 years slipping by undetected.

February 1: Minuteman, the new Air Force ICBM, was launched for the first time at Cape Canaveral in a major test, and the results were very good. All three stages were fired, and the solid-fueled ICBM traveled 4600 miles, carrying a full guidance system which brought the nose cone right to the target area. Some 400 pounds of instruments were carried. The press reported Minuteman to be made up of a Thiokol solid-fueled rocket of 170,000 pounds thrust, 24 feet long and 5.5 feet in diameter; an Aerojet solid-fueled rocket second stage of 55,000 pounds thrust; a Hercules solid-fueled rocket third stage of 35,000 pounds thrust. The total missile is said to weigh 66,000 pounds, and to be 58 feet long. Boeing Airplane Co. is prime contractor. It carries Autonetics guidance, with each stage having 4 steerable nozzles. A Mark V Avco nose cone was carried.

—: A new timing device was announced by the Los Alamos Scientific Laboratory which allows the measurement of events in nuclear physics down to fractions of a billionth of a second. The Mobley buncher produces ion pulses only a fraction of a nono-second (billionth of a second) long, evenly spaced to provide a time scale.

1961—Continued

February 1: The Bell Telephone Laboratories announced the development of a new supermagnet using niobium three-tin, wherein the amount of electricity from an ordinary storage battery would produce a field with a strength which formerly took millions of watts of power to produce.

——: The Navy announced that it would complete its Spasur dark satellite detection fence by the construction of a new transmitter near Archer City, Texas, with a power output of 560,000 watts. This would fill the gap existing between the two existing 50,000 watt stations at Jordan Lake, Ala., and Gila River, Ariz. Receiving stations are at Fort Stewart, Ga., Silver Lake, Miss., Truth or Consequences, N. Mex., and San Diego, Calif. Control of the system passed on this day to the North American Air Defense Command.

February 2: The U.S.S. *Sam Houston*, a nuclear-powered Polaris missile launching submarine was launched at Newport News, Va., the seventh such ship constructed in the program.

——: The 16-nation conference on cooperative space research ended at Strasbourg with most of the delegates supporting the British proposal to use Blue Streak as a first stage launch vehicle, and a French rocket for the second stage in future satellite attempts. British Aviation Minister Peter Thorneycroft offered to increase the British contribution to \$64.4 million with another \$116.2 million to be supplied by the other participants.

——: The Senate Committee on Aeronautical and Space Sciences voted unanimously to approve the selection of James E. Webb as Administrator of the National Aeronautics and Space Administration.

February 3: Observatory scientists at Bochum, Germany claimed they had picked up Russian words in Morse code, coming from space. Radio amateurs at Turin, Italy, claimed they heard "moans from outer space", or labored breathing.

February 4: The Soviet Union announced the launching of Sputnik IV with a weight of 14,295 pounds exclusive of the accompanying carrier rocket. The new satellite was said to have a perigee of 139 miles and an apogee of 203 miles. Its period was 89.8 minutes, and the orbit was inclined 64 degrees 57 minutes to the Equator. It was said that all equipment was functioning normally. Very few details were provided in the Tass announcement, other than to mention an "improved multistage rocket" was used for the launching. Although some speculation was that it could be a 2-man spaceship, the labeling of it as Sputnik IV rather than as Spaceship Satellite IV at least suggested a flight other than a continuation of the 1960 series of biological cabins intended for recovery. A more likely clew of its purposes, and suggesting a partial failure to equipment was provided February 12 by Sputnik V (see below).

1961—Continued

February 5: An Aerobee-Hi rocket was launched at Wallops Island to reach an altitude of 94 miles in a test of the behavior of liquid hydrogen under zero gravity conditions. The National Aeronautics and Space payload weighed 303 pounds.

—: Although the United States tracked Sputnik IV, foreign stations were puzzled by the failure to hear any signals from the vehicle. There was speculation that its radios had failed, or that it was broadcasting on unknown frequencies, or that it represented a military operation which returned data only on command over Soviet territory. The earlier report of codes and breathing were discounted as having come at a time before launching.

—: West German Defense Minister Franz Josef Strauss stated German unwillingness to support financially the specific proposals of the Strasbourg space meeting to create a joint European space effort built around the British Blue Streak.

February 6: When countdown on a Polaris missile at Cape Canaveral reached zero, the upper stage suddenly shot up into the air, and the lower stage shot fire from both ends.

—: A stir was caused by a background briefing at the Department of Defense which purportedly indicated there was no missile gap at the present time.

February 7: The X-15 with Major Robert White flew at 2,275 miles per hour, a new record, and reached 77,000 feet over Edwards Air Force Base, Calif.

February 8: President Kennedy stated it would be premature to make a judgment on whether there is a missile gap, as current studies are not complete.

February 9: Considerable Western speculation was reported that there was doubt whether Sputnik IV was actually in orbit since there were no reported sightings and few authentic radio signals found. However, the Soviet Government broke its silence, sending word to the Edinburgh Royal Observatory as to when it would be visible, and the British scientists saw it pass on the announced schedule. L. J. Carter of the British Interplanetary Society suggested that the West was wide open to unannounced Soviet satellite reconnaissance. The implied reaction of American officials was that the United States had a good capability of tracking satellites but can not know their purpose with any certainty.

—: James E. Webb was confirmed by the Senate as Administrator of the National Aeronautics and Space Administration.

February 10: After second stage failures on the previous two tests, a Titan J made a successful flight of 5,000 miles to its intended target from Cape Canaveral.

1961—Continued

February 10: Professor Leonid Sedov announced in Moscow that the Sputnik IV satellite was an engineering test vehicle designed to prove so large an object could be orbited, and that once there, could be placed in precisely the orbit desired. He denied its purpose was either to test a manned cabin or to conduct scientific measurements of space.

———: The Rocketdyne F-1 liquid-fueled rocket engine was tested for a few seconds at Edwards Air Force Base, Calif., at a power output of 1,550,000 pounds of thrust.

———: The Soviet Union has declined a United States invitation to attend a meeting of a panel of the World Meteorological Organization to develop a plan for international use of weather satellites. The panel was organized in 1959 with American, British, Australian, and Soviet members.

———: Dr. Hugh L. Dryden talked by radio telephone signals bounced off the Moon, using the Goldstone 85-foot radio telescope at the transmitting end, and a similar new antenna at Woomera, Australia at the receiving end.

February 12: The Soviet Union announced that it had placed in orbit a heavy Sputnik V, using an improved multistage rocket. During the same day a guided space rocket was launched from Sputnik V to set Automatic Interplanetary Station II on a flight to the planet Venus, which was to be reached during the second half of May, 1961. This station had a weight of 1,419 pounds, not counting the weight of its carrier rocket. It was transmitting on command at 922.8 megacycles, with transmissions expected about every 5 days. The main objects of the flight were given as testing the injection of a rocket on an interplanetary trajectory, the check of long distance communications, and the more exact measurement of the astronomical unit of distance. As with the Sputnik IV shot a few days earlier, United States organizations were able to supply tracking data to the President before the Soviet announcements.

———: Secretary McNamara's background remarks (see February 6) on the missile gap were said to have been about as follows: The number of missiles available to both the U.S.S.R. and the United States has not yet reached a decisive level; meanwhile, the destruction gap or deterrent gap is not great enough for the Soviet Union to be able to afford the risk of war; strenuous efforts will be required to keep us safe from a deterrent gap in the future. Reporters who wrote stories based on these remarks came up with a variety of interpretations.

February 13: Although United States tracking stations could note the movements of Sputnik V, they were unable to find any signals from Automatic Interplanetary Station II. Professor Blagonravov in Moscow described the Sputnik IV of a few days earlier as having made a great contribution to the later Venus shot. It was revealed that the Venus probe carried a metal pennant with the Soviet coat of arms as did the earlier Soviet Cosmic Rockets in 1959. Solar batteries were used to recharge the chemical batteries. The temperature inside the station was reported as 68° Fahrenheit.

## 1961—Continued

February 14: Tass reported the Venus probe also carried instruments similar to Pioneer V to measure cosmic rays, magnetic fields, to detect interplanetary matter, and to register the collision of micrometeorites. Professor Ari Shternfeld reported the Automatic Interplanetary Station II might reach Venus a month earlier than originally predicted. (This prediction was later disavowed.) President Kennedy sent congratulations to Premier Khrushchev for the scientific achievement.

———: Representative Overton Brooks suggested that the controlled launching of the Venus probe from a parking orbit around the Earth had military implications for future bombs to Earth from orbit.

February 15: The Soviet Union launched geophysical rockets to observe an eclipse of the Sun, and not only received telemetry, but from a stabilized platform took a variety of photographs whose film was recovered on the ground.

———: Premier Khrushchev responded to President Kennedy's message of congratulation on the Venus probe, and made reference to the Inaugural Address call for international cooperation in space. He apparently accepted such an invitation, but it remained linked to plans for disarmament.

———: Dr. Hugh L. Dryden confirmed the view of Representative Overton Brooks that the Soviet Union probably possessed the ability to direct bombs from orbit to targets on Earth; however, he doubted the practical significance of such a capability when ICBM's, in his view, could do the same job more easily.

———: The Soviet tracking ships which had been posted in the mid Pacific were reported to be heading to home port.

———: Soviet Academician I. I. Artobolevskiy writing in Trud claimed that Automatic Interplanetary Station II contained special sensory equipment to allow it to detect meteorites of dangerous size with actuators to change the course of the Station to avoid a collision, and then a computer to determine what further course corrections would continue it on its preprogrammed trajectory as carried in its memory units.

February 16: The National Aeronautics and Space Administration successfully launched its first solid-fuel boosted Scout satellite from Wallops Island, Va., and named it Explorer IX. The payload weighed 80 pounds and included a 12-foot polka-dotted balloon inflated in orbit. The balloon weighed 15 pounds. Tracking radio beacons were contained in both the fourth stage rocket casing and the balloon, which was to measure air drag. The satellite used 136.950 megacycles for its signal, and it was picked up over South Africa and Australia, but then went silent. It was only later that visual observations in several parts of the world confirmed that the balloon was in orbit as well as the rocket casing. The rocket casing was found to have a period of 118.75 minutes, and an inclination of 38 degrees to the Equator. It had a perigee of 410 miles and an apogee of 1,610 miles. The balloon was believed to have similar elements.



## 1961—Continued

- February 16: Secretary McNamara sent a letter to Senator Dirksen in which he denied he had said there was no missile gap. He said he had put emphasis on the view that there was no deterrent or destruction gap, and that for the time being it mattered little which country had the greater number of missiles since they were not yet decisive.
- February 17: The Air Force launched at Vandenberg, Discoverer XX which was successfully placed in a polar orbit. The Agena B stage, lifted by a Thor launch vehicle, weighed about 2,450 pounds after burnout, and contained a 300 pound reentry capsule. The orbit had a perigee of 201 miles, an apogee of 400 miles and a period of 95 minutes. The satellite carried devices to measure the effect of radiation on future Samos and Midas instruments, and a Navy Transit navigation system. There were also external tracking lights.
- : Richard S. Morse, Director of Research and Development, Department of the Army, reported to the House Science and Astronautics Committee a new reason for urgency in pursuing Nike Zeus for anti-ICBM purposes in the "very large effort" the Soviet Union was making in the field of such defenses.
- February 18: The Air Force launched at Vandenberg, Discoverer XXI which was successfully placed in a polar orbit. The Agena B stage, lifted by a Thor launch vehicle, weighed about 2,100 pounds after burnout, but contained no reentry capsule, as it was intended to conduct further infrared tests supporting the Midas project. The period of the orbit was 93.8 minutes. Sometime during the first orbit, the Agena B engine was restarted in space for the first time, and the orbital period was lengthened to 97.8 minutes, with a perigee of 155 miles and an apogee of 670 miles.
- : The Soviet Union announced that Automatic Interplanetary Station II would pass Venus at a distance no greater than 112,000 miles from its center, based upon its original trajectory and making no allowance for course corrections en route.
- February 21: The Air Force launched for the Navy, Transit IIIB and LOFTI I from Cape Canaveral. Aimed for a long life circular orbit by its Thor Able Star vehicle, it entered a short life eccentric orbit with a perigee of 104 miles and an apogee of 617 miles. As best could be determined, the two satellites remained attached to each other and to the empty rocket casing of the final stage. Transit IIIB was equipped with virtually all of the instruments intended for the operational version of the navigation satellites. LOFTI I was designed to study low frequency radio signals in relation to the ionosphere. Transit IIIB weighed 250 pounds, and LOFTI I weighed 54 pounds. The rocket casing presumably weighed about 50 pounds.
- : The National Aeronautics and Space Administration selected Lt. Col. John H. Glenn, Jr., USMC, Capt. Virgil I. Grissom, USAF, and Comdr. Alan B. Shepard, Jr., USN, to begin final training for the first Redstone ballistic flight, one of whom would be selected shortly before launching.

1961—Continued

February 21: The Air Force launched for the National Aeronautics and Space Administration at Cape Canaveral MA-2, the Atlas vehicle carrying a regular Mercury capsule in a severe reentry test. The flight was completely successful, reaching an altitude of 107 miles, and landing 1,425 miles downrange after being subjected to 16 g's, and 3,000 degrees Fahrenheit external heat.

February 22: An equipment malfunction ruled out the possibility of bringing in the capsule of Discoverer XX after four days of flight as originally planned.

—: The French launched a rat named Hector to an altitude of 93 miles using a Veronique rocket at Colomb Bechar, Algeria. Telemetry was received, and the rat was recovered alive by parachute 30 miles away.

SUMMARY OF SATELLITES AND PLANETOIDS

*U.S. satellites and planetoids orbited*

Astronomical designator	Name	Date launched	Date reentered	Total pounds in orbit	Payload (pounds)	Apogee (miles)	Perigee (miles)
1958 Alpha	Explorer I	Jan. 31, 1958	-----	30.8	18.13	1,573	224
1958 Beta-1	Rocket body	Mar. 17, 1958	-----	50.0	-----	2,687	406
1958 Beta-2	Vanguard I	do.	-----	3.25	3.25	2,453	409
1958 Gamma	Explorer III	Mar. 26, 1958	June 28, 1958	31.0	18.56	1,746	121
1958 Epsilon	Explorer IV	July 26, 1958	Oct. 23, 1958	38.4	25.76	1,380	163
1958 Zeta	Score	Dec. 18, 1958	Jan. 21, 1959	8,750.0	150.0	928	114
1959 Alpha-1	Vanguard II	Feb. 17, 1959	-----	20.74	20.74	2,061	350
1959 Alpha-2	Rocket body	do.	-----	50.0	-----	2,273	344
1959 Beta	Discoverer I	Feb. 28, 1959	Mar. 5, 1959	1,300.0	40.0	( <sup>1</sup> ) 605	99
	Pioneer IV	Mar. 3, 1959	-----	13.4	13.4	( <sup>1</sup> )	( <sup>1</sup> )
1959 Gamma	Discoverer II	Apr. 13, 1959	Apr. 26, 1959	1,610.0	245.0	225	156
	Capsule	do.	Apr. 14, 1959	-----	195.0	-----	-----
1959 Delta-1	Explorer VI	Aug. 7, 1959	-----	142.0	142.0	26,357	156
1959 Delta-2	Rocket body	do.	-----	50.0	-----	-----	-----
1959 Epsilon-1	Discoverer V	Aug. 13, 1959	Sept. 28, 1959	1,700.0	245.0	718	120
1959 Epsilon-2	Capsule	do.	Feb. 11, 1961	-----	195.0	1,074	134
1959 Zeta	Discoverer VI	Aug. 19, 1959	Oct. 20, 1959	1,700.0	195.0	537	139
	Capsule	do.	Aug. 20, 1959	-----	300.0	-----	-----
1959 Eta	Vanguard III	Sept. 18, 1959	-----	100.0	50.0	2,329	319
1959 Iota-1	Explorer VII	Oct. 13, 1959	-----	91.5	70.0	680	342
1959 Iota-2	Rocket body	do.	-----	20.0	-----	661	343
1959 Kappa	Discoverer VII	Nov. 7, 1959	Nov. 26, 1959	1,700.0	300.0	550	104
1959 Lambda	Discoverer VIII	Nov. 20, 1959	Mar. 8, 1960	1,700.0	-----	1,056	120
	Capsule	do.	Nov. 21, 1959	-----	300.0	-----	-----
1960 Alpha-1	Pioneer V	Mar. 11, 1960	-----	94.8	40.0	( <sup>1</sup> )	( <sup>1</sup> )
1960 Alpha-2	Rocket body	do.	-----	50.0	-----	( <sup>1</sup> )	( <sup>1</sup> )
1960 Beta-1	Rocket body	Apr. 1, 1960	-----	50.0	-----	465	429
1960 Beta-2	Tiros I	do.	-----	270.0	270.0	468	430
1960 Gamma-1	Rocket body	Apr. 13, 1960	-----	50.0	-----	351	179
1960 Gamma-2	Transit I-B	do.	-----	265.0	265.0	479	233
1960 Gamma-3	Metal object	do.	July --, 1960	-----	-----	-----	-----
1960 Delta	Discoverer XI	Apr. 15, 1960	Apr. 26, 1960	1,700.0	-----	380	110
	Capsule	do.	do.	-----	300.0	-----	-----
1960 Zeta-1	Midas II	May 24, 1960	-----	5,000.0	3,000.0	332	292
1960 Zeta-2	Metal object	do.	Dec. 5, 1960	-----	-----	-----	-----
1960 Eta-1	Transit II-A	June 22, 1960	-----	223.0	223.0	665	389
1960 Eta-2	GREB I	do.	-----	42.0	42.0	657	382
1960 Eta-3	Rocket body	do.	-----	50.0	-----	638	383
1960 Theta	Discoverer XIII	Aug. 10, 1960	Nov. 14, 1960	1,700.0	-----	436	161
	Capsule	do.	Aug. 11, 1960	-----	300.0	-----	-----
1960 Iota-1	Echo I	Aug. 12, 1960	-----	191.4	163.4	1,049	946
1960 Iota-2	Rocket body	do.	-----	50.0	-----	1,030	954
1960 Iota-3	Metal object	do.	-----	-----	-----	1,050	941

1960 Iota-4	Metal object	do				1,044	950
1960 Iota-5	Metal object	do				1,060	940
1960 Kappa	Discoverer XIV	Aug. 18, 1960	Sept. 15, 1960	1,700.0		602	116
	Capsule	do	Aug. 19, 1960		300.0		
1960 Mu	Discoverer XV	Sept. 13, 1960	Oct. 17, 1960	1,700.0		472	130
	Capsule	do	Sept. 14, 1960		300.0		
1960 Nu-1	Courier I-B	Oct. 4, 1960		800.0	300.0	658	501
1960 Nu-2	Rocket body	do		50.0		736	591
1960 Xi-1	Explorer VIII	Nov. 3, 1960		90.14	90.14	1,423	258
1960 Xi-2	Rocket body	do		20.0		1,417	259
1960 Xi-3	Metal object	do					
1960 Omicron	Discoverer XVII	Nov. 12, 1960	Dec. 29, 1960	2,100.0		616	116
	Capsule	do	Nov. 14, 1960		300.0		
1960 Pi-1	Tiros II	Nov. 23, 1960		280.0	280.0	453	387
1960 Pi-2	Rocket body	do		50.0		445	373
1960 Pi-3	Metal object	do					
1960 Sigma	Discoverer XVIII	Dec. 7, 1960		2,100.0		459	154
	Capsule	do	Dec. 10, 1960		300.0		
1960 Tau	Discoverer XIX	Dec. 20, 1960	Jan. 22, 1961	2,100.0	300.0	323	128
1961 Alpha	Samos II	Jan. 31, 1961		4,100.0	400.0	350	300
1961 Delta-1	Rocket body	Feb. 16, 1961		50.0		1,604	404
1961 Delta-2	Explorer IX	do		80.0	80.0	1,604	404
1961 Epsilon	Discoverer XX	Feb. 17, 1961		2,450.0	300.0	400	201
1961 Zeta	Discoverer XXI	Feb. 18, 1961		2,100.0	300.0	670	155
1961 Eta	Transit IIIB	Feb. 21, 1961		250.0	250.0	617	104
1961 Eta	LOFTI I	do		54.0	54.0	617	104
1961 Eta	Rocket body	do		50.0		617	104

<sup>1</sup> Solar orbit.

NOTE.—Careful study of weights reveals lack of standard definitions to describe payload. Further, some data are incomplete.

## U.S. satellites and planetoids not orbited

Launching device	Name	Date launched	Total pounds for orbit	Payload pounds	Performance
Vanguard TV-3	Vanguard (1)	Dec. 6, 1957	53.25	3.25	Lost thrust after 2 seconds.
Vanguard TV-3BU	Vanguard (1)	Feb. 5, 1958	53.25	3.25	Climbed 4 miles.
Jupiter C	Explorer II	Mar. 5, 1958	31.5	18.83	Impacted 1,900 miles away.
Vanguard TV-5	Vanguard (2)	Apr. 28, 1958	71.5	21.5	Impacted 1,500 miles away.
Vanguard SLV-1	Vanguard (2)	May 27, 1958	71.5	21.5	Impacted 5,000 miles away.
Vanguard SLV-2	Vanguard (2)	June 26, 1958	71.5	21.5	2d stage out prematurely.
Thor Able	Pioneer (1)	Aug. 17, 1958	83.8	40.0	Climbed 10 miles.
Jupiter C	Explorer V	Aug. 24, 1958	38.43	25.8	Impacted after 659 seconds.
Vanguard SLV-3	Vanguard (2)	Sept. 26, 1958	71.5	21.5	Burned after 1 orbit.
Thor Able	Pioneer I	Oct. 11, 1958	84.4	39.0	Climbed 70,700 miles.
Jupiter C	Beacon (1)	Oct. 23, 1958	42.77	9.26	Impacted after 526 seconds.
Thor Able	Pioneer II	Nov. 8, 1958	86.4	34.3	Climbed 963 miles, impacted 7,500 miles away.
Juno II	Pioneer III	Dec. 6, 1958	12.95	12.95	Climbed 63,580 miles.
Vanguard SLV-5	Vanguard (3)	Apr. 13, 1959	73.3	23.04	Impacted several 100 miles away.
Thor Hustler	Discoverer III	June 3, 1959	1,600.0	440.0	Impacted several 1,000 miles away.
Vanguard SLV-6	Vanguard (3)	June 22, 1959	72.5	22.5	Impacted 300 miles away.
Thor Hustler	Discoverer IV	June 25, 1959	1,610.0	440.0	Impacted several 1,000 miles away.
Juno II (Am 16)	Explorer (6)	July 16, 1959	91.5	91.5	Exploded 10 feet off pad.
Juno II (Am 19B)	Beacon (1)	Aug. 14, 1959	84.3	25.8	Impacted several 1,000 miles away.
Thor Able	Transit I-A	Sept. 17, 1959	315.0	265.0	Impacted 2,500 miles away.
Atlas Able IV 20D	Pioneer (5)	Sept. 24, 1959	425.0	375.0	Exploded in static test, not launching.
Atlas Able IV	Pioneer (5)	Nov. 26, 1959	422.0	372.0	Impacted 5,000 miles away.
Thor Agena	Discoverer IX	Feb. 4, 1960	1,700.0	300.0	Impacted several 1,000 miles away.
Thor Agena	Discoverer X	Feb. 19, 1960	1,700.0	300.0	Climbed 4 miles.
Atlas Agena 29D	Midas I	Feb. 26, 1960	4,500.0	3,000.0	Impacted 2,500 miles away.
Juno II	Explorer (8)	Mar. 23, 1960	35.3	22.8	An upper stage failed.
Thor Delta	Echo (1)	May 13, 1960	255.0	205.0	Verniers, 2d stage failed.
Thor Agena	Discoverer XII	June 29, 1960	1,700.0	300.0	Impacted several 1,000 miles away.
Thor Able Star	Courier I-A	Aug. 18, 1960	550.0	300.0	Climbed 15 miles.
Atlas Able V A	Pioneer (6)	Sept. 25, 1960	437.0	387.0	Impacted 8,000 miles away, South Africa.
Atlas Agena	Samos I	Oct. 11, 1960	4,100.0	2,600.0	Impacted several 1,000 miles away.
Thor Agena B	Discoverer XVI	Oct. 26, 1960	2,100.0	300.0	2d stage failed to separate.
Thor Able Star	Transit III-A	Nov. 30, 1960	293.0	203.0	2d stage failed, assembly fell on Cuba.
Scout	GREB-2	do	293.0	40.0	2d stage failed, impacted 50 miles away.
Atlas Able V B	Beacon (1) or Explorer (9)	Dec. 4, 1960	87.0	87.0	Climbed 8 miles.
	Pioneer (6)	Dec. 15, 1960	438.0	388.0	

Pioneer IV  
Mar. 3, 1959

Soviet Union satellites and planetoids orbited

Astronomical designator	Name	Date launched	Date reentered	Total pounds in orbit	Payload (pounds)	Apogee (miles)	Perigee (miles)
1957 Alpha-1	Rocket body	Oct. 4, 1957	Dec. 1, 1957	8,616			
1957 Alpha-2	Sputnik I	do.	Jan. 4, 1958	184	184	588	142
1957 Alpha-3	Nose cone	do.	Nov. 25, 1957				
1957 Beta	Sputnik II	Nov. 3, 1957	Apr. 14, 1958	11,000	1,120	1,038	140
1958 Delta-1	Rocket body	May 15, 1958	Dec. 3, 1958	10,275			
1958 Delta-2	Sputnik III	do.	Apr. 6, 1960	2,925	2,134	1,167	135
1958 Delta-3	Nose cone piece	do.	do.	58			
1958 Delta-4	Nose cone piece	do.	do.	58			
1958 Delta-5	Protective piece	do.	do.	58			
	Cosmic Rocket I	Jan. 2, 1959		796	796	(1)	(1)
	Rocket body	do.		2,449		(1)	(1)
	Cosmic Rocket II	Sept. 12, 1959	Sept. 13, 1959	860	860	(2)	(2)
	Rocket body	do.	do.	2,482		(2)	(2)
1959 Theta-1	Automatic Interplanetary Station I	Oct. 4, 1959	Apr. 20, 1960	614	614	292,043	241854
1959 Theta-2	Cosmic Rocket III body	do.	May 19, 1960	2,810	345		
1960 Epsilon-1	Cosmic Ship I	May 15, 1960		10,009	8,762	418	196
1960 Epsilon-2	Rocket body	do.	July 17, 1960	14,991		230	195
1960 Epsilon-3	Metal object	do.				394	172
1960 Epsilon-4	Metal object	do.				367	176
1960 Epsilon-5	Metal object	do.	Sept.-Oct. 60				
1960 Epsilon-6	Metal object	do.	do.				
1960 Epsilon-7	Metal object	do.	Sept. 24, 1960				
1960 Epsilon-8	Metal object	do.	Sept.-Oct. 60				
1960 Epsilon-9	Metal object	do.	do.				
1960 Lambda-1	Cosmic Ship II	Aug. 19, 1960	Aug. 20, 1960	10,143	8,800	211	190
1960 Lambda-2	Rocket body	do.	Sept. 23, 1960	14,857		164	163
1960 Rho-1	Cosmic Ship III	Dec. 1, 1960	Dec. 2, 1960	10,614	9,300	164	116
1960 Rho-2	Rocket body	do.	do.	14,386			
1961 Beta-1	Sputnik IV	Feb. 4, 1961		14,295	2,500	186	120
1961 Beta-2	Rocket body	do.	Feb. 12-13, 61	15,705			
1961 Beta-3	Metal object	do.				197	141
1961 Gamma-1	Automatic Interplanetary Station II	Feb. 12, 1961		1,419	1,419	(1)	(1)
1961 Gamma-2	Rocket body	do.		1,500		(1)	(1)
1961 Gamma-3	Sputnik V	do.		11,376	1,100	176	123
1961 Gamma-4	Metal object	do.				198	123
1961 Gamma-5	Rocket body	do.		15,705		183	123

<sup>1</sup> Solar orbit.

<sup>2</sup> Impact Moon.

NOTE.—Soviet sources have not stated total weights in orbit, except that even Sputnik I exceeded 8,750 lbs. Arbitrary weights assigned have been 8,800; 11,000; and 13,200 for the 3 Sputniks, respectively. Arbitrary weights assigned the 3 Cosmic Ships have

been 25,000. Arbitrary weights assigned the Sputnik IV and V rocket assemblies are 30,000 pounds each. Some Western sources have speculated that Soviet weights are lower than claimed, by use of radar reflectors, etc. Only more knowledge of the Earth's atmosphere and decay rates will tend to verify claims and counterclaims. The figures given above are not official.

*Soviet Union satellites and planetoids not orbited*

Launching device	Name	Date launched	Total pounds for orbit	Payload pounds	Performance

NOTE.—Because of the extreme military secrecy with which the Soviet Union hides its space operations, it is not possible to construct from public sources a meaningful table

of mission failures which are known from a variety of sources including tracking radar to have occurred.

Other Soviet tests which have been announced are as follows:

Nature of device	Date launched	Payload (pounds)	Altitude or distance (miles)
Geophysical laboratory.....	Feb. 21, 1958	3,420	1,294
Biological cabin.....	Aug. 27, 1958	3,726	1,281
Biological cabin.....	July 2, 1959	4,410	1,150
Biological cabin.....	July 10, 1959	4,850	1,131
Launch vehicle.....	Jan. 20, 1960	(?)	7,762
Launch vehicle.....	Jan. 31, 1960	(?)	7,762
Biological cabin.....	June 15, 1960	4,629	1,130
Launch vehicle.....	July 5, 1960	(?)	8,078
Launch vehicle.....	July 7, 1960	(?)	8,078
Geophysical laboratory.....	Feb. 15, 1961	(?)	(?)

- <sup>1</sup> Altitude.
- <sup>2</sup> Not available.
- <sup>3</sup> Distance.

CHECK LISTS OF OTHER LAUNCHINGS

*The V-2 Rocket in Germany*

Date	Missile number	Range (miles)	Performance
<i>1942</i>			
June 13.....	2	0.8	Rolled, unstable.
Aug. 16.....	3	5.4	Nose broke off.
Oct. 3.....	4	118.0	Success, but too steep.
Oct. 21.....	5	91.3	Steam generator misbehaved.
Nov. 9.....	6	8.7	Vertical, height 41.5 miles.
Nov. 28.....	7	5.3	Tumbled, lost vanes.
Dec. 12.....	9	.06	Peroxide explosion.
<i>1945</i>			
Jan. 7.....	10	0	Explosion on ignition.
Jan. 25.....	11	65.2	Too steep, rolled.
Feb. 17.....	12	121.8	Too shallow.
Feb. 19.....	13	3.0	Fire in tail.
Mar. 3.....	16	.6	Vertical, explosion.
Mar. 18.....	18	82.4	Too steep, rotated.
Mar. 25.....	19	.7	Tumbled, exploded.
Apr. 14.....	20	178.3	Fell on land.
Apr. 22.....	21	156.6	Do.
May 14.....	22	155.3	Cutoff switch failed.
May 26.....	25	104.6	
Do.....	25	16.8	Early cutoff.
May 27.....	24	85.7	
June 1.....	23	146.0	Do.
June 11.....	29	147.9	
June 16.....	31	137.3	Do.
June 22.....	28	46.6	Exploded after 70 seconds.
June 24.....	30	173.3	Cutoff switch failed.
June 26.....	36	146.0	
June 29.....	38	1.8	Fell on airport.
Do.....	40	146.6	Impact not observed.
July 1.....	33	0	Exploded at takeoff.
July 9.....	41	0	Fell on pump building.
Do.....	34	0	Cutoff at takeoff.
<i>1944</i>			
June.....			Fell in Sweden.
<i>1945</i>			
Jan. 24.....			First successful winged A-4b flight.
Oct. 15.....			Launched by British orders, Cuxhaven.

Note.—Missile No. 1 was used as a mockup. Missile No. 18 was used for crew training. Missiles Nos. 14, 15, 17 were used in a long duration test of outside storability. Missiles Nos. 27, 32, 35, 37, 39 carried experimental equipment and were fired after 1943.

Source: This list was assembled by Willi Ley, partly from Dr. Walter Dornberger, partly from correspondence, tracing the results of the early tests at Peenemünde.



# 156 A CHRONOLOGY OF MISSILE AND ASTRONAUTIC EVENTS

## The V-2 Rocket in the United States

Date	Missile number	Altitude (miles)	Range (miles)	Performance
<i>1946</i>				
Mar. 15	1	0	0	Static firing.
Apr. 16	2	5.0	0	Terminated by radio command.
May 10	3	70.0	31.0	
May 29	4	70.0	37.6	
June 13	5	73.0	40.0	
June 28	6	67.0	41.0	First fully instrumented for upper air research.
July 9	7	83.0	61.0	
July 19	8	3.0	.5	Exploded.
July 28				
July 30	9	104.0	68.0	
Aug. 15	10	2.0	.7	Terminated by radio command.
Aug. 22	11	0	.1	Do.
Oct. 10	12	102.0	12.0	
Oct. 24	13	65.0	17.0	Took motion pictures of the Earth.
Nov. 7	14	0	5.0	Terminated by radio command.
Nov. 21	15	62.0	12.6	
Dec. 5	16	104.0	111.1	
Dec. 17	17	116.0	21.0	
<i>1947</i>				
Jan. 10	18	72.0	25.0	
Jan. 23	19	31.0	10.3	Extensive telemetry carried successfully.
Feb. 20	20	68.0	13.9	Cannister recovery of fruitflies and seeds.
Mar. 7	21	100.0	35.0	Returned photographs and scientific data.
Apr. 1	22	80.0	24.0	
Apr. 8	23	64.0	19.0	
Apr. 17	24	87.0	45.0	
May 15	26	76.0	35.0	
May 29				Landed near Juarez, Mexico.
July 10	29	10.0	1.4	Terminated by radio command.
July 29	30	99.0	1.0	
Sept. 6			6.0	Launched from U.S.S. <i>Midway</i> .
Oct. 9	27	97.0	28.0	
Nov. 20	Special	13.0	1.5	Malfunctioned.
Dec. 8	28	65.0	28.0	
<i>1948</i>				
Jan. 22	34	99.0	48.0	
Feb. 6	36	70.0	1.4	Successful electronic guidance.
Mar. 19	39	3.0	1.0	
Apr. 2	25	89.0	48.0	
Apr. 19	38	35.0	32.0	Terminated by radio command.
May 13	B-1	69.7	32.0	
May 27	35	87.0	41.0	
June 11	37	39.0	17.0	Malfunctioned; carried monkey Albert.
July 26	40	60.0	23.0	Took pictures showing Earth curvature.
Aug. 5	43	104.0	53.0	
Aug. 19	B-2	8.3	.9	Malfunctioned.
Sept. 2	33	94.0	40.0	
Sept. 30	B-3	93.4	22.0	Terminated by radio command
Nov. 1	B-4	3.0	1.0	Exploded.
Nov. 18	44	90.0	29.0	
Dec. 9	42	67.0	25.0	
<i>1949</i>				
Jan. 28	45	37.0	10.5	Terminated by radio command.
Feb. 17	48	79.0	37.0	
Feb. 24	B-5	63.0	21.5	Measured ion densities.
Mar. 21	41	80.0	32.4	
Apr. 11	50	53.0	20.0	
Apr. 21	B-6	31.0	.4	Malfunctioned.
May 5	46	5.0	1.4	Do.
June 14	47	83.0	37.0	Monkey Albert II killed by impact.
Sept. 16	32	3.0	.5	Exploded.
Sept. 29	49	94.0	43.5	
Nov. 18	56	77.0	32.0	
Dec. 8	31	79.0	37.8	Monkey Albert IV killed by impact.
<i>1950</i>				
Feb. 17	53	92.0	40.5	
July 24	B-8	5.0	15.0	Exploded.
July 29	B-7	13.6	80.5	
Aug. 31	51	85.0	36.1	Photos taken of mouse in flight.
Oct. 26	61	0	0	Exploded.
<i>1951</i>				
Jan. 18	54	1.0	.5	
Mar. 8	57	2.0	.2	Exploded.
June 14	55	0	0	Do.
June 28	52	4.0	.4	Do.
Oct. 29	66			Conclusion of V-2 upper atmosphere program.

NOTE.—All of the above launchings were from White Sands, N. Mex., except as follows: B-7 and B-8 were from Cape Canaveral, Fla. The shot from the U.S.S. *Midway* occurred near Bermuda.

Source: This list was mostly assembled from the final report on Project Hermes by General Electric, supplemented from newspaper accounts.

*Project Bumper Research Rockets*

Date	Vehicle number	Altitude (miles)	Range (miles)	Performance
<i>1948</i>				
May 13.....	B-1.....	79.1.....	.....	Low performance in second stage.
Aug. 19.....	B-2.....	8.0.....	.....	Malfunctioned.
Sept. 30.....	B-3.....	93.4.....	.....	Second stage failed to fire.
Nov. 1.....	B-4.....	3.0.....	.....	Exploded.
<i>1949</i>				
Feb. 24.....	B-5.....	250.0.....	85.0.....	Measured ion densities.
Apr. 21.....	B-6.....	31.0.....	.....	Malfunctioned, second stage failed to fire.
<i>1950</i>				
July 24.....	B-8.....	8.0.....	25.0.....	Exploded.
July 29.....	B-7.....	21.8.....	189.4.....	

NOTE.—Data given are for the total distance traveled by the Wac Corporal upper stage on the V-2 missile.

Source: This list was assembled partly in the final report on Project Hermes by General Electric, and partly from newspaper accounts.

*The Aerobee Family of Research Rockets*

Date	Place	Rocket number	Altitude (miles)	Performance
<b>1947</b>				
	White Sands	1		Dummy firing.
	do	2		Do.
	do	3		Do.
Nov. 24	do	4	37.0	Terminated by radio.
<b>1948</b>				
Mar. 5	do	5	74.0	Cosmic-ray measurements.
Apr. 13	do	6	71.0	Measured Earth's magnetic field.
May 3	do	7	71.0	
July 26	do	7	70.0	Photographed the Earth, successful recovery.
<b>1949</b>				
March	Near Peru			U.S.S. <i>Norton Sound</i> .
Do	do			Do.
Do	do			Do.
<b>1950</b>				
January	Near Alaska			Do.
Do	do			Do.
Dec. 11	White Sands			Carried grenades.
Do	do			Do.
Dec. 12	do			Do.
Do	do			Do.
<b>1951</b>				
Apr. 18	Holloman			First biomedical experiment.
<b>1952</b>				
May 22			36.0	Two monkeys, two mice recovered successfully.
July 26			40.0	Do.
<b>1954</b>				
October				
<b>1955</b>				
Apr. 21		Hi-	113.0	
October	White Sands		70.0	Released sodium vapor.
<b>1956</b>				
Mar. 14	do		60.0	Released nitric oxide.
May 2		Hi-1	2.0	
May 8		Hi-2	116.5	
June 4		Hi-3	39.0	
June 29		Hi-4	163.0	
<b>1957</b>				
Apr. 30		Hi-41	193.0	
Oct. 16	Holloman		54.0	Released shaped charge to send pellets to speed above escape velocity.
<b>1959</b>				
Mar. 13	White Sands	Hi-	123.0	Took ultraviolet photographs of Sun.
<b>1960</b>				
Apr. 19	do	Hi-	130.0	Took X-ray photographs of Sun.
Apr. 26	Wallops	Hi-	137.0	Studied night-time ultraviolet radiation.
Apr. 29	do	Hi-	155.0	Studied upper atmosphere.
May 27	White Sands	Hi-	135.0	Photographed sky in ultraviolet.
Aug. 3	Wallops	Spar'bee	260.0	
Aug. 23	do	Hi-	118.0	Studied radiation.
Nov. 15	do	Hi-	145.0	Studied upper atmosphere.
Nov. 22	do	Hi-	105.0	Carried stellar spectrometers.
<b>1961</b>				
Feb. 5	do	Hi-	94.0	Tested liquid hydrogen under zero gravity.

Source: This list was assembled primarily from newspaper accounts supplemented by other scattered references.

*The Viking Research Rocket*

Date	Vehicle number	Payload (pounds)	Altitude (miles)	Performance
1949				
May 8	I	464	51.5	Premature cutoff turbine leaks. Studied upper atmosphere pressure and temperature.
Sept. 6	II	412	32.3	Premature cutoff, turbine leaks.
1950				
Feb. 9	III	528	50.0	Terminated by radio command.
May 11	IV	959	106.4	Launched from U.S.S. <i>Norton Sound</i> . Studied cosmic rays, temperatures, and pressures.
Nov. 21	V	675	107.5	Took photographs of Earth.
Dec. 11	VI	373	40.0	Tumbled when fins failed.
1951				
Aug. 7	VII	394	135.6	New single-stage record.
1952				
June 6	VIII	0	4.0	Broke loose in static test, destroyed.
Dec. 15	IX	765	135.6	
1953				
June 30	X		0	Motor exploded on pad, but rocket salvaged.
1954				
May 7	X	830	136.0	
May 24	XI	825	158.4	
1955				
Feb. 4	XII	887	144.0	
1956				
Dec. 8	XIII (TV-0)		125.0	Ejected Minitrack radio. Vanguard test.
1957				
May 1	(TV-1)		121.2	First stage, modified Viking, second stage Grand Central rocket, third stage Vanguard.

NOTE.—All launchings took place at White Sands, N. Mex., except IV near Jarvis Island in the Pacific, XIII (TV-0) and TV-1 at Cape Canaveral.

Source: Compiled by Milton W. Rosen, supplemented by newspaper accounts.

*The Vanguard Satellite Vehicle*

Date	Vehicle	Performance
1956		
Dec. 8	TV-0	Viking test, successfully ejected Minitrack radio, climbed 125 miles.
1957		
May 1	TV-1	Viking, Vanguard test, successful stage separation, climbed 121.2 miles.
Oct. 23	TV-2	Vanguard first stage, successful, climbed 109 miles.
Dec. 6	TV-3	Exploded just off pad in first satellite launch attempt.
1958		
Feb. 5	TV-3BU	Reached 4 miles, then broke apart.
Mar. 17	TV-4	Vanguard I in orbit.
Apr. 28	TV-5	Impacted 1,500 miles away when third stage failed to fire.
May 27	SLV-1	Impacted 5,000 miles away, after climbing too steeply.
June 26	SLV-2	2d stage cut off due to low chamber pressure.
Sept. 26	SLV-3	Perhaps one orbit, but uncertain.
1959		
Feb. 17	SLV-4	Vanguard II in orbit.
Apr. 13	SLV-5	Impacted several hundred miles after tumbling motion.
June 22	SLV-6	Impacted 300 miles away, after helium reservoir ruptured in second stage.
Sept. 18	SLV-7	Vanguard III in orbit.

NOTE.—All launchings took place at Cape Canaveral. See the main body of the chronology for full particulars.

Source: Compiled from data supplied by National Aeronautics and Space Administration.



*The Juno II Vehicle*

Date	Vehicle	Performance
1958 Dec. 6	RTV-10	Pioneer III probe to 63,580 miles.
1959 Mar. 3	RTV-11	Pioneer IV solar orbit.
July 16	RTV-12 (Am 16)	Explorer (6) failed to orbit, exploded.
Aug. 14	RTV-13 (Am 19B)	Beacon (1) failed to orbit.
Oct. 13	(Am 19A)	Explorer VII in orbit.
1960 Mar. 23		Explorer (8) failed to orbit.
Nov. 3		Explorer VIII in orbit.

NOTE.—All launchings from Cape Canaveral.

Source: Compiled from newspaper accounts.

*The Thor Missile*

Date	Number	Place	Altitude (miles)	Distance (miles)	Performance
1967 Jan. 25	1	Canaveral		0	Topped back, burned.
Apr. 19	2	do			Destroyed by range safety officer.
May	3	do			Unsuccessful.
August	4	do			Exploded 96 seconds after launch.
Sept. 20	5	do			First successful flight.
Oct.	6	do			
Oct. 11	7	do		1, 100	Successful.
Oct. 24	8	do		1, 645	Successful (listed as 2,645 miles).
Dec. 7	9	do			Guidance malfunctioned.
Dec. 19	10	do			Successful, all-inertial guidance.
1968 Jan. 28	11	do			Launched successfully, but off course.
Feb. 28	12	do			Partial success.
Apr. 19		do			Exploded on pad.
Apr. 23	Able	do			Reentry test, mouse Mia I, fell short.
June 4		do			Successful, used tactical launcher.
June 13		do			Successful.
July 9	Able	do		6, 000	Successful reentry test; mouse Mia II, cone lost.
July 23	Able	do		6, 000	Successful reentry test; mouse Wickia, cone lost.
July 26		do			Exploded near launch site.
Aug. 6	18	do		1, 500	Successful.
Aug. 17	Able	do	10		Exploded 10 miles up in lunar flight.
Oct. 11	Able	do	70, 700		Lunar probe attempt.
Nov. 5		do			Exploded by range safety officer after 10 seconds.
Nov. 8	Able	do	1, 963	7, 500	Lunar probe attempt.
Dec. 16		Vandenberg		1, 500	Successful.
Dec. 16		Canaveral			Do.
Dec. 30	30	do			Exploded by range safety officer soon after launch.
1969 Jan. 23	Able IV	do			Fell short in reentry test.
Jan. 30	32	Vandenberg			
Feb. 28	Agna	do	Earth orbit		Discoverer I in orbit.
Mar. 21	Able	Canaveral			Successful reentry test; cone lost.
Mar. 21		do		1, 600	
Mar. 26		do		1, 600	Successful, data capsule recovered.
Apr. 8	Able	do		5, 000	Successful reentry test, cone recovered first time.
Apr. 13	Agna	Vandenberg	Earth orbit		Discoverer II in orbit.
Apr. 16	RAF-1	do			Successful.
Apr. 23		Canaveral		1, 500	Accuracy test, data capsule recovered fourth time.
May 12		do		1, 500	Motion pictures of cone separation.
May 21	Able	do		5, 000	Successful reentry; cone recovered.
June 3	Agna	Vandenberg	140		Discoverer III failed to orbit.
June 11	Able	Canaveral		5, 500	Successful reentry; cone lost.
June 16	RAF-2	Vandenberg			Destroyed in flight.
June 25	Agna	do			Discoverer IV failed to orbit.

*The Thor Missile—Continued*

Date	Number	Place	Altitude (miles)	Distance (miles)	Performance
<i>1959</i>					
July 21		Canaveral			Exploded by range safety officer soon after launch.
July 24		do		1,500	Motion pictures recovered; first stabilized cone.
Aug. 3	RAF-3	Vandenberg			Successful.
Aug. 7	Able	Canaveral	Earth orbit		Explorer VI in orbit.
Aug. 13	Agna	Vandenberg	Earth orbit		Discoverer V in orbit.
Aug. 14	RAF-4	do			Successful.
Aug. 14		Canaveral		1,700	Motion pictures, but cone lost.
Aug. 19	Agna	Vandenberg	Earth orbit		Discoverer VI in orbit.
Aug. 27		Canaveral		1,500	Motion pictures, data capsule recovered.
Sept. 17	Able	do	400	2,500	Transit I-A failed to orbit.
Do	RAF-5	Vandenberg			Successful.
Oct. 6	RAF-6	do			Do.
Do		Canaveral		1,700	Do.
Oct. 21	RAF-7	Vandenberg			Do.
Oct. 29		Canaveral		1,500	Do.
Nov. 3		do		1,700	
Nov. 4		do		1,500	Do.
Nov. 7	Agna	Vandenberg	Earth orbit		Discoverer VII in orbit.
Nov. 12	RAF-8	do			Successful.
Nov. 20	Agna	do	Earth orbit		Discoverer VIII in orbit.
Dec. 1	RAF-9	do			Successful.
Do		Canaveral		1,700	Motion pictures in color, recovered later.
Dec. 12					
Dec. 14	RAF-10	Vandenberg			Destroyed itself.
Dec. 17		Canaveral		1,500	Successful.
<i>1960</i>					
Jan. 14		do		1,700	Successful, data capsule recovered.
Jan. 21	RAF-11	Vandenberg			Successful.
Feb. 4	Agna	do			Discoverer IX failed to orbit.
Feb. 19	Agna	do	4		Discoverer X failed to orbit.
Feb. 29		Canaveral		1,700	Successful, ending series.
Mar. 2	RAF-12	Vandenberg			Successful.
Mar. 11	Able IV	Canaveral	Solar orbit		Pioneer V in orbit.
Apr. 1	Able	do	Earth orbit		Tiros I in orbit.
Apr. 13	Able Star	do	Earth orbit		Transit I-B in orbit.
Apr. 15	Agna	Vandenberg	Earth orbit		Discoverer XI in orbit.
May 13	Delta	Canaveral			Echo failed to orbit.
June 22	Able Star	do	Earth orbit		Transit II-A, GREB in orbit.
Do	RAF-13	Vandenberg			Successful.
June 29	Agna	do			Discoverer XII failed to orbit.
Aug. 10	Agna	do	Earth orbit		Discoverer XIII in orbit.
Aug. 12	Delta	Canaveral	Earth orbit		Echo I in orbit.
Aug. 18	Agna	Vandenberg	Earth orbit		Discoverer XIV in orbit.
Do	Able Star	Canaveral	15		Courier I-A failed to orbit.
Sept. 13	Agna	Vandenberg	Earth orbit		Discoverer XV in orbit.
Oct. 4	Able Star	Canaveral	Earth orbit		Courier I-B in orbit.
Oct. 11	RAF-14	Vandenberg			Successful.
Oct. 26	Agna B	do			Discoverer XVI failed to orbit.
Nov. 12	Agna B	do	Earth orbit		Discoverer XVII in orbit.
Nov. 23	Delta	Canaveral	Earth orbit		Tiros II in orbit.
Nov. 30	Able Star	do			Transit III-A, GREB II failed to orbit.
Dec. 7	Agna B	Vandenberg	Earth orbit		Discoverer XVIII in orbit.
Dec. 20	Agna B	do	Earth orbit		Discoverer XIX in orbit.
<i>1961</i>					
Feb. 17	Agna B	do	Earth orbit		Discoverer XX in orbit.
Feb. 18	Agna B	do	Earth orbit		Discoverer XXI in orbit.
Feb. 21	Able Star	Canaveral	Earth orbit		Transit III-B, LOFTI I in orbit.

Source: Compiled from newspaper accounts.

*The Thor Able, Thor Delta, Thor Able Star Vehicles*

Date	Model	Mission	Performance
<i>1968</i>			
Apr. 23	Able	Reentry	Second stage failed to fire, mouse Mia I lost.
July 9	do	do	6,000 miles; mouse Mia II, cone not recovered.
July 23	do	do	6,000 miles; mouse Wickie, cone not recovered.
Aug. 17	do	Lunar	Exploded at 10 miles.
Oct. 11	do	do	Pioneer I 70,700 miles altitude.
Nov. 8	do	do	Pioneer II 963 miles altitude.
<i>1969</i>			
Jan. 23	do	Reentry	Fell short of 4,400-mile goal.
Mar. 21	do	do	5,000 miles, cone lost.
Apr. 8	do	do	5,000 miles, cone recovered first time after IOBM distance.
May 21	do	do	5,000 miles; cone recovered.
June 11	do	do	5,500 miles, cone lost.
Aug. 7	do	Satellite	Explorer VI in orbit.
Sept. 17	do	do	Transit I-A failed to orbit.
<i>1960</i>			
Mar. 11	Able IV	Probe	Pioneer V solar orbit.
Apr. 1	Able	Satellite	Tiros I in orbit.
Apr. 13	Able Star	do	Transit I-B in orbit.
May 13	Delta	do	Echo (1) failed to orbit.
June 22	Able Star	Satellites	Transit II-A, GREB-I in orbit.
Aug. 12	Delta	Satellite	Echo I in orbit.
Aug. 18	Able Star	do	Courier I-A failed to orbit.
Oct. 4	do	do	Courier I-B in orbit.
Nov. 23	Delta	do	Tiros II in orbit.
Nov. 30	Able Star	Satellites	Transit III-A, GREB-II failed to orbit.
<i>1961</i>			
Feb. 21	do	do	Transit III-B, LOFTI-I in orbit.

NOTE.—All launchings from Cape Canaveral.

Source: Compiled from newspaper accounts.

*The Atlas Able Vehicle*

Date	Mission	Performance
<i>1960</i>		
Sept. 24	Lunar satellite	Exploded in static test.
Nov. 26	do	Failed to orbit.
<i>1960</i>		
Sept. 25	do	Do.
Dec. 15	do	Do.

NOTE.—All launchings from Cape Canaveral.

Source: Compiled from newspaper accounts.

*The Atlas Missile*

Date	Missile number	Place	Distance (miles)	Performance
<i>1967</i>				
June 11	1	Canaveral		Exploded at 2 miles altitude.
Sept. —	2	do		Destroyed in launching.
Dec. 17	3	do	600	First successful launching.
<i>1968</i>				
Jan. 10	4	do		Successful limited flight.
Feb. 7	5	do		Destroyed 2 minutes after launching.
Feb. 20	6	do		Do.
Apr. 5	7	do	600	
June 3	8	do		Successful limited flight.
July 19		do		Destroyed 2 minutes after launching.
Aug. 2		do	2,500	All 3 engines used; data capsule recovered later.
Aug. 29		do		
Sept. 14		do		Successful.



## The Atlas Missile—Continued

Date	Missile number	Place	Distance (miles)	Performance
<i>1958</i>				
Sept. 18		Canaveral		Destroyed 80 seconds after launching.
Nov. 17		do	3,000	
Nov. 28		do	6,325	First full range, within 30 miles of target.
Dec. 18	10B	do	Earth orbit	Project Score in orbit.
Dec. 23	1C	do	4,000	Successful.
<i>1959</i>				
Jan. 15	18	do	200	Destroyed.
Jan. 17		do	200	
Jan. 27		do	4,500	
Feb. 3	20	do	3,400	
Feb. 20		do		Exploded 3 minutes after launching. Carried new nose cone.
Mar. 18		do	800	Exploded 2 minutes after launching. 1st tactical nose cone recovered.
June 6		do		
July 21	8C	do	5,500	
July 29	11D	do	5,000	
Aug. 11	14D	do	5,000	Nose cone not recovered.
Aug. 24	11C	do	5,500	Recovered photographs from 700 miles up for first time.
Sept. 9		do	1,500	Big Joe shot, boilerplate Mercury capsule.
Do		Vandenberg	4,400	Successful, by combat troops first time.
Sept. 24	Able IV	Canaveral		Exploded in static test, for lunar flight.
Oct. 6		do	5,500	Successful.
Oct. 9		do	5,500	Do.
Oct. 29		do	5,500	New tactical nose cone, cloud cover photographs.
Nov. 4		do	4,800	Successful.
Nov. 24	15D	do		Do.
Nov. 26	Able IV 20D	do	5,000	Failed to orbit, for lunar flight.
Do	10D	do		Successful.
Dec. 8		do	5,500	
Dec. 18		do	6,325	Do.
<i>1960</i>				
Jan. 6		do	6,325	Do.
Jan. 26	44D	do	5,000	Do.
Do		Vandenberg	5,000	Do.
Feb. 11		Canaveral	6,300	Do.
Feb. 26	Agema 29D	do	2,500	Midas I failed to orbit.
Mar. 5		Vandenberg	0	Explosion on pad.
Mar. 8		Canaveral		
Mar. 10		do	0	Explosion just above pad.
Apr. 7		do	0	Exploded on pad.
Apr. 8		do		
Apr. 22		Vandenberg		Successful, from "coffin" hangar.
May 6		do	1	Destroyed in flight above pad.
May 20	56D	Canaveral	9,042	Distance record, but cone burned.
May 24	Agema	do	Earth orbit	Midas II in orbit.
June 11		do	5,000	All-inertial guidance, reached target.
June 22		do	5,000	New nose cone, reached target.
July 22		Vandenberg		Destroyed in flight.
July 29		Canaveral	5	Exploded after liftoff. Carried MA-1 Mercury capsule.
Aug. 9	D	do	7,200	Climbed 1,000 miles.
Aug. 12		do	5,000	Cone with radiation experiments lost.
Sept. 12		Vandenberg		Propulsion failed.
Sept. 16		Canaveral	5,000	Improved nose cone; data capsule lost.
Sept. 19		do	9,000	Successful reentry of cone.
Sept. 25	Able V	do	8,000	Failed to orbit for lunar flight.
Sept. 29		Vandenberg		Unsuccessful.
Oct. 11	Agema	do		Samos I failed to orbit.
Do	1E	Canaveral		Felt short.
Oct. 12		Vandenberg		Unsuccessful.
Oct. 13		Canaveral	5,000	Recovered mice Sally, Amy, Moe, and color photographs 700 miles up.
Oct. 22	D	do	7,200	Successful.
Nov. 15		do		Mark IV nose cone data capsule recovered.
Nov. 29		do		High altitude malfunction.
Dec. 15	Able V	do	12	Failed to orbit for lunar flight.
<i>1961</i>				
Jan. 23	D	do	5,000	Successful.
Jan. 24	E	do	100	Engine trouble.
Jan. 31	Agema	Vandenberg	Earth orbit	Samos II in orbit.
Feb. 21		Canaveral	1,425	Successful; carried MA-2 Mercury capsule.

*The Titan Missile*

Date	Missile number	Distance (miles)	Performance
<i>1953</i>			
Dec. 20	A-1	0	Static tests.
	A-1	0	Do.
	A-2	0	Damaged on stand.
	A-3	0	Failed on pad, exploded.
<i>1959</i>			
January	A-4	0	Trouble on pad.
Feb. 3	A-4	0	Failed on pad.
Feb. 6	A-3	300	First successful flight.
Feb. 25	A-5	275	Successful.
Apr. 3	A-4	300	Do.
May 4	A-6	300	Successful stage separation.
May 15	B-4	0	Exploded in static test.
July 3	B-3	0	Do.
Aug. 14	B-5	0	Exploded on pad. <sup>1</sup>
Dec. 12	C-2	0	Exploded just above pad.
<i>1960</i>			
Jan. 27	B-7A	2,200	Successful, second stage fired.
Feb. 5			Destroyed 57 seconds after launching.
Feb. 24		5,000	Successful.
Mar. 8		300	Second stage failed to fire.
Mar. 23		5,000	Capsule recovered.
Apr. 8		3,800	Second stage cutoff prematurely.
Apr. 21		5,000	Successful.
May 13		5,000	Successful, capsule recovered.
May 27		5,000	Successful.
July 1		0	First operational model, failed on pad.
July 28	J		
Aug. 10	J	5,000	Successful, capsule recovered.
Aug. 30		5,000	Successful high trajectory.
Sept. 28	J-3	5,000	Successful, capsule recovered.
Oct. 24		6,100	Successful, tactical nose cone.
Dec. 3		0	Exploded in underground silo.
<i>1961</i>			
Jan. 20	J	100	Second stage failed to ignite.
Feb. 10	J-11	5,000	Successful.

Missile A-1, B-3, B-4, static tested at Denver, then at Cape Canaveral. All subsequent listings are for Cape Canaveral, until Dec. 3 which was at Vandenberg.

Source: Compiled from newspaper accounts.

*The Polaris Missile*

Date	Missile number	Place	Distance (miles)	Performance
<i>1958</i>				
Jan. 11		Point Mugu		First launching, successful.
Jan. 17		Canaveral		Successful component test.
Mar. 23		San Clemente		First underwater launch.
Apr. 11		do		Second underwater launch.
Apr. 18		Canaveral		Successful.
May 8		do	0	Exploded at takeoff.
Sept. 24		do		Destroyed by range safety officer.
Oct. 15		do		Exploded.
Dec. 30		do		Destroyed 90 seconds after launch.
<i>1959</i>				
Jan. 19	AX-4	do	60	Partially successful.
Apr. 20		do		Successful.
May 8		do	700	Successful, close to target.
May 18		do		Second stage failed to fire.
June 29		do		Successful.
July 15		do		Destroyed in flight.
Aug. 6		do		Second stage malfunction.
Aug. 14		do		Successful, from ship motion simulator.
Aug. 25		do		Second stage failed to separate.
Aug. 27		At sea	700	Successful, from <i>Observation Island</i> .

*The Polaris Missile—Continued*

Date	Missile number	Place	Distance (miles)	Performance
<i>1959</i>				
Sept. 21.....		Canaveral.....		Successful.
Sept. 27.....		do.....		Second stage failed near beach.
Oct. 2.....		do.....		Exploded 40 seconds after launch.
Oct. 12.....		do.....		Second stage failed.
Nov. 20.....		do.....		Successful.
Dec. 7.....		do.....		Do.
Dec. 15.....		do.....		Partially successful, premature shutdown of second stage.
Dec. 23.....		do.....		Exploded above ship motion simulator.
<i>1960</i>				
Jan. 7.....		do.....	900	Successful, all-inertial guidance.
Jan. 13.....		do.....	900	Successful.
Jan. 20.....		do.....	900	Do.
Feb. 4.....		do.....	900	Do.
Feb. 10.....		do.....		Do.
Feb. 26.....		do.....		Destroyed after launch.
Mar. 9.....		do.....	1,000	Successful test of flight control.
Mar. 18.....		do.....	1,000	Successful.
Mar. 25.....		do.....	900	Successful, with all-inertial guidance.
Mar. 29.....		At sea.....	700	Fell short, from <i>Observation Island</i> .
Apr. 14.....		San Clemente.....		First underwater launch, powered flight.
Apr. 18.....		At sea.....		Second stage malfunction, <i>Observation Island</i> .
Apr. 25.....		Canaveral.....	900	Successful.
Apr. 30.....		do.....		Do.
Apr. 30.....		do.....		Do.
May 13.....		do.....	1,000	Successful, ship motion simulator.
May 23.....		At sea.....	1,000	Successful from <i>Observation Island</i> .
June 7.....		Canaveral.....		Second stage failed.
June 21.....		At sea.....	900	Successful, from <i>Observation Island</i> .
June 22.....		Canaveral.....	1,000	Successful, from ship motion simulator.
June 30.....		San Clemente.....		Successful underwater launch.
July 6.....		Canaveral.....		Second stage cutoff prematurely.
July 7.....		At sea.....		Destroyed after launch from <i>Observation Island</i> .
July 15.....		Canaveral.....	1,000	Successful.
July 19.....		do.....	1,000	Do.
July 20.....		At sea.....	1,150	Successful, from submerged <i>George Washington</i> .
July 20.....		do.....	1,150	Do.
July 30.....		do.....	1,100	Successful to target from submerged <i>George Washington</i> .
Aug. 1.....		do.....		Destroyed 47 seconds after launch from <i>George Washington</i> .
Aug. 2.....		Canaveral.....	1,100	Successful.
Aug. 4.....		do.....	1,100	Do.
Aug. 12.....		do.....	1,100	Do.
Aug. 18.....		do.....	1,100	Do.
Sept. 2.....		do.....		Do.
Sept. 13.....		At sea.....		Destroyed after launch from submerged <i>Patrick Henry</i> .
Sept. 15.....		do.....		Successful from submerged <i>Patrick Henry</i> .
Sept. 22.....		do.....	0	Failed to ignite, from submerged <i>Patrick Henry</i> .
Sept. 22.....		do.....	0	Destroyed at surface, from submerged <i>Patrick Henry</i> .
Sept. 23.....		do.....		Successful.
Oct. 5.....		Canaveral.....	1,200	Do.
Oct. 10.....		do.....	700	Do.
Oct. 15-18.....		At sea.....		Successful, from submerged <i>Patrick Henry</i> .
Oct. 15-18.....		do.....		Do.
Oct. 15-18.....		do.....		Do.
Oct. 15-18.....		do.....		Do.
Nov. 7.....	A1.....	Canaveral.....	1,150	Successful.
Nov. 10.....	A2-1.....	do.....	1,600	Do.
Nov. 17.....	A1.....	do.....		Last A-1, malfunction in second stage.
Dec. 5.....	A2-2.....	do.....	1,600	Successful.
Dec. 22.....		At sea.....	1,265	Successful to target from submerged <i>Robert E. Lee</i> .
<i>1961</i>				
Jan. 10.....	A2.....	Canaveral.....	1,600	Successful.....
Jan. 11.....	A1.....	At sea.....		Launched from submerged <i>Robert E. Lee</i> , destroyed in flight.

Source: Compiled from newspaper accounts.

*Combinations with the Agena Vehicle*

Date	First stage	Agena model	Apogee	Perigee	Performance
<i>1959</i>					
Feb. 28.....	Thor.....	A	605	99	Discoverer I in orbit.
Apr. 13.....	do.....	A	225	156	Discoverer II in orbit, capsule seen.
June 3.....	do.....	A	0	0	Discoverer III failed.
June 25.....	do.....	A	0	0	Discoverer IV failed.
Aug. 13.....	do.....	A	718	120	Discoverer V in orbit.
Aug. 19.....	do.....	A	537	139	Discoverer VI in orbit.
Nov. 7.....	do.....	A	550	104	Discoverer VII in orbit.
Nov. 20.....	do.....	A	1,056	120	Discoverer VIII in orbit.
<i>1960</i>					
Feb. 4.....	do.....	A	0	0	Discoverer IX failed.
Feb. 19.....	do.....	A	0	0	Discoverer X failed.
Feb. 26.....	Atlas.....	A	0	0	Midas I failed.
Apr. 15.....	Thor.....	A	390	110	Discoverer XI.
May 24.....	Atlas.....	A	332	292	Midas II in orbit.
June 29.....	Thor.....	A	0	0	Discoverer XII failed.
Aug. 10.....	do.....	A	436	161	Discoverer XIII in orbit, capsule recovered.
Aug. 18.....	do.....	A	502	116	Discoverer XIV in orbit, capsule recovered.
Sept. 13.....	do.....	A	472	130	Discoverer XV in orbit, capsule seen.
Oct. 11.....	Atlas.....	A	0	0	Samos I failed.
Oct. 26.....	Thor.....	B	0	0	Discoverer XVI failed.
Nov. 12.....	do.....	B	616	116	Discoverer XVII in orbit, capsule recovered.
Dec. 7.....	do.....	B	459	154	Discoverer XVIII in orbit, capsule recovered.
Dec. 20.....	do.....	B	323	128	Discoverer XIX in orbit.
<i>1961</i>					
Jan. 31.....	Atlas.....	A	350	300	Samos II in orbit.
Feb. 17.....	Thor.....	B	400	201	Discoverer XX in orbit.
Feb. 18.....	do.....	B	670	155	Discoverer XXI in orbit.

NOTE.—All launchings from Vandenberg except for the two Midas satellites from Cape Canaveral.  
Source: Compiled from newspaper accounts.

*The Scout Family*

Date	Configuration	Payload	Place	Altitude (miles)	Distance (miles)	Performance
<i>1960</i>						
Apr. 18.....	2-stage Scout.....	0	Wallops...	30	80	Second stage failed.
July 1.....	4-stage Scout.....	1,931	do.....	860	1,500	Tracking failure blocked 4th stage firing.
Sept. 21.....	Blue Scout Junior.....	33	Canaveral.....	16,600	-----	Radio failed.
Oct. 4.....	4-stage Scout.....	192	Wallops.....	3,700	6,100	Component test.
Nov. 8.....	Blue Scout Junior D-2.....	-----	Canaveral.....	-----	250	Motor cut off too soon.
Dec. 4.....	4-stage Scout.....	87	Wallops.....	-----	80	Second stage failed.
<i>1961</i>						
Jan. 7.....	Blue Scout I.....	393	Canaveral.....	1,000	1,200	Successful.
Feb. 16.....	4-stage Scout.....	80	Wallops..	1,610	In orbit	Do.

Source: Compiled from newspaper accounts.

*Tests for Project Mercury*

Date	Vehicle	Place	Altitude (miles)	Distance (miles)	Performance
<i>1959</i>					
Sept. 9	Big Joe I	Canaveral		1,500	Tested Atlas-boosted reentry of boiler-plate Mercury capsule.
Oct. 4	Little Joe I	Wallops	40		Tested integration of booster and capsule.
Nov. 4	Little Joe II	do	7	5	Tested critical low-altitude abort.
Dec. 4	Little Joe III	do	55	200	Tested high-altitude escape, monkey Sam Space.
<i>1960</i>					
Jan. 21	Little Joe IV	do	10		Tested high airload escape, monkey Miss Sam.
May 9	Escape system	do	.5		Tested off-the-pad abort.
July 29	MA-1	Canaveral			Malfunctioned, capsule destroyed.
Nov. 8	Little Joe V	Wallops	10		Malfunctioned, capsule failed to separate.
Nov. 21	MR-1	Canaveral	0	0	Malfunction ignited escape rocket, left capsule behind on pad.
Dec. 19	MR-1 BU	do	135	235	Successful Mercury-Redstone flight.
<i>1961</i>					
Jan. 31	MR-2	do	155	420	Successful, chimpanzee Ham.
Feb. 21	MA-2	do	107	1,425	Successful.

Source: Compiled from newspaper accounts.

*The Shot Put Series for Echo*

Date	Vehicle	Altitude (miles)	Distance (miles)	Performance
<i>1959</i>				
Oct. 28	1	250	500	Successfully inflated.
<i>1960</i>				
Jan. 16	2	250	490	Do.
Feb. 27	3	225	540	Do.
Apr. 1	4	235	570	Do.
May 31	5	210	540	Do.

NOTE.—All launchings took place at Wallops Island, Va.  
Source: Compiled from newspaper accounts.

*The Skylark Research Rocket*

Date	Vehicle number	Altitude (miles)	Performance
<i>1957</i>			
Feb. 14.....	1.....	7	Test of rocket only.
May 22.....	2.....	47	Test only.
July 23.....	3.....	53	Telemetry check.
Nov. 13.....	4.....	77	Instruments, grenades, "window."
<i>1958</i>			
Apr. 2.....	6.....	0	Propulsion test.
Apr. 17.....	7.....	91	IGY instruments, grenades, "window."
May 20.....	5.....	95	Instruments for airglow measurements.
June 18.....	18.....	0	Motor failure.
June 19.....	9.....	90	IGY instruments for electron density.
Sept. 19.....	8.....	97	Instruments, but telemetry failed.
Dec. 3.....	11.....	79	Sodium vapor experiment.
<i>1959</i>			
Apr. 6.....	10.....	0	Unsuccessful.
July 8.....	14.....	58	Ion probe, X-ray plates.
Aug. 19.....	17.....	90	Ion probe, etc.
Sept. 17.....	12.....	83	Ion cage ejected.
Sept. 24.....	15.....	100	Do.
Nov. 30.....	16.....	97	Sodium vapor experiment.
Do.....	60.....	100	Grenades and "window."
Dec. 1.....	38.....	100	Grenades, "window," electron density.
<i>1960</i>			
Apr. 13.....		136	
Nov. 16.....		68	R.A.E. test of gyros.
Nov. 17.....			Successful test of wind velocities and temperatures.
Nov. 24.....			Successful test of electron density.

NOTE.—All launchings from Woomera, Australia.

Source: Compiled from information in *The Aeroplane and Flight* magazines.

*The Black Knight Research Vehicle*

Date	Missile number	Altitude (miles)	Performance
<i>1958</i>			
Sept. 7.....	1	300	Successful.
<i>1959</i>			
Mar. 12.....	2	350	Do.
June 10.....	3	500	Do.
July 29.....	4	500	Do.
Nov. 10.....	5	450	Nose cone retrieved.
<i>1960</i>			
May 24.....	6		Successful, 2-stage severe reentry.
June 21.....	7	300	Do.

NOTE.—All launchings from Woomera, Australia.

Source: Compiled from newspaper accounts.

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## The X-15 Aircraft

Date	Flight number	Aircraft number	Pilot	Performance
<i>1959</i>				
Mar. 10	1	1	Crossfield	Captive flight checkout.
Apr. 1	2	1	do	Captive flight checkout, glide aborted.
Apr. 10	3	1	do	Do.
May 21	4	1	do	Do.
June 8	5	1	do	Gliding flight from B-52.
July 24	6	2	do	Captive flight, checkout, full fuel.
Sept. 4	7	2	do	Captive flight, aborted power drop.
Sept. 17	8	2	do	Power flight at mach 2.3.
Oct. 10	9	2	do	Captive flight, aborted power drop.
Oct. 14	10	2	do	Do.
Oct. 17	11	2	do	Power flight at mach 2.3, 60,000 feet.
Oct. 22	12	2	do	Captive flight, aborted power drop.
Oct. 31	13	2	do	Do.
Nov. 5	14	2	do	Power flight, explosion in landing.
Dec. 16	15	1	do	Captive flight, aborted power drop.
<i>1960</i>				
Jan. 23	16	1	do	Power flight, mach 2, 65,000 feet.
Feb. 4	17	2	do	Captive flight, aborted power drop.
Feb. 11	18	2	do	Power flight, mach 2.15, 86,000 feet.
Feb. 17	19	2	do	Power flight, mach 1.6, 50,000 feet.
Mar. 17	20	2	do	Power flight, mach 2.1, 50,000 feet.
Mar. 18	21	2	do	Captive flight, aborted power drop.
Mar. 25	22	1	Walker	Power flight, mach 2, 48,500 feet.
Mar. 29	23	2	Crossfield	Power flight, mach 2, 50,000 feet.
Mar. 31	24	2	do	Do.
Apr. 13	25	1	White	Do.
Apr. 19	26	1	Walker	Power flight, mach 2.6, 60,000 feet.
May 5	27	2	Crossfield	Captive flight, aborted power drop.
May 6	28	1	White	Power flight, mach 2.3, 60,000 feet.
May 12			Walker	Power flight, 1,850 miles per hour, 75,000 feet.
May 19			White	Power flight, 107,000 feet.
June 8			Crossfield	Explosion on ground.
Aug. 4			Walker	Power flight, 2,196 miles per hour, 78,000 feet.
Aug. 12			White	Power flight, 136,500 feet.
Sept. 10				Power flight, 2,100 miles per hour, 80,000 feet.
Nov. 15			Crossfield	Power flight, 2,000 miles per hour, 80,000 feet.
Nov. 22			do	Power flight, 2,000 miles per hour, 62,000 feet.
<i>1961</i>				
Feb. 7			White	Power flight 2,275 miles per hour, 77,000 feet.

NOTE.—All flights from Edwards Air Force Base, Calif.

Source: Compiled from newspaper accounts and Flight magazine.

## CHECK LIST OF CONGRESSIONAL REPORTS AND BILLS

### HOUSE OF REPRESENTATIVES

#### *Chronological List of Reports*

1958

- May 21: H. Rept. 1758, Select Committee on Astronautics and Space Exploration, "The National Space Program."
- May 24: H. Rept. 1770, Select Committee on Astronautics and Space Exploration, "Establishment of the National Space Program," to accompany H.R. 12575.
- July 7: H. Rept. 2118, Committee on Armed Services, "National Advisory Committee for Aeronautics Construction Program," to accompany H.R. 11805 for fiscal year 1959.
- July 15: H. Rept. 2166, Conference Committee report on H.R. 12575.
- July 18: H. Rept. 2221, Committee on Appropriations, "Supplemental Appropriation Bill, 1959," to accompany H.R. 13450.
- August 1: H. Rept. 2351, Select Committee on Astronautics and Space Exploration, "Construction and Equipment Authorization for National Aeronautics and Space Administration," to accompany H.R. 13619.

1958—Continued

- August 19: H. Rept. 2677, Conference Committee, "Supplemental Appropriation Bill, 1959," to accompany H.R. 13450.  
 August 21: H. Rept. 2686, Conference Committee, "Supplemental Appropriation Bill, 1959," to accompany H.R. 13450.  
 August 22: H. Rept. 2689, Committee on Appropriations, "Independent Offices Appropriation Bill, 1959," to accompany H.R. 13856.

1959

- January 3: H. Rept. 2709, Select Committee on Astronautics and Space Administration, "International Cooperation in the Exploration of Space."  
 ———: H. Rept. 2710, Select Committee on Astronautics and Space Administration, "The United States and Outer Space."  
 February 24: H. Doc. 86, Select Committee on Astronautics and Space Exploration, "Space Handbook: Astronautics and Its Applications."  
 ———: H. Doc. 87, Select Committee on Astronautics and Space Exploration, "Summary of Hearings, Astronautics and Space Exploration."  
 ———: H. Doc. 88, Select Committee on Astronautics and Space Exploration, "The International Geophysical Year and Space Research."  
 ———: H. Doc. 89, Select Committee on Astronautics and Space Exploration, "Survey of Space Law."  
 March 9: H. Rept. 189, Committee on Science and Astronautics, "Authorizing the National Aeronautics and Space Administration Through the Administrator of General Services To Lease Buildings for the Use of the Administration in the District of Columbia," to accompany H.R. 4913.  
 March 18: H. Rept. 226, Committee on Science and Astronautics, "Authorizing Appropriations to the National Aeronautics and Space Administration," to accompany S. 1096 for supplemental appropriations authorization for fiscal year 1959.  
 March 20: H. Rept. 238, Committee on Appropriations, "Second Supplemental Appropriation Bill, 1959," to accompany H.R. 5916.  
 April 20: H. Doc. 115, Select Committee on Astronautics and Space Exploration, "The Next Ten Years in Space, 1959-69."  
 May 7: H. Rept. 343, Committee on Science and Astronautics, "Satellites for World Communication."  
 May 11: H. Rept. 353, Committee on Science and Astronautics, "U.S. Policy on the Control and Use of Outer Space."  
 May 13: H. Rept. 355, Conference Committee, "Second Supplemental Appropriation Bill, 1959," to accompany H.R. 5916.  
 May 14: H. Rept. 361, Committee on Science and Astronautics, "Authorizing Appropriations to the National Aeronautics and Space Administration," to accompany H.R. 7007 to authorize appropriations for fiscal year 1960.  
 June 10: H. Rept. 521, Committee on Science and Astronautics, "The Ground Cushion Phenomenon."  
 June 18: H. Rept. 562, Committee on Science and Astronautics, "Status of Missile and Space Programs."



1959—Continued

- June 23: H. Rept. 575, Committee on Science and Astronautics, "Nuclear Explosions in Space."
- June 26: H. Rept. 579, Committee on Appropriations, "Supplemental Appropriation Bill, 1960," to accompany H.R. 7978.
- July 30: H. Rept. 740, Committee on Science and Astronautics, "Amending the National Science Foundation Act," to accompany H.R. 8284.
- August 3: H. Rept. 744, Committee on Science and Astronautics, "Amending Public Law 85-880," to accompany H.R. 8374, with regard to World Sciences—Pan Pacific Exposition in Seattle, Wash.
- August 10: H. Rept. 815, Committee on Science and Astronautics, "Report on Research in CBR (Chemical, Biological, and Radiological Warfare)."
- : H. Rept. 824, Committee on Science and Astronautics, "National Medal of Science," to accompany H.R. 6288.
- August 18: H. Rept. 943, Conference Committee, "Supplemental Appropriation Bill, 1960," to accompany H.R. 7978.
- August 21: Committee on Science and Astronautics, "Briefing by National Bureau of Standards," Committee Print.
- August 31: H. Rept. 1086, Committee on Science and Astronautics, "The First Soviet Moon Rocket."
- : H. Rept. 1087, Committee on Science and Astronautics, "Space Propulsion."
- September 1: H. Rept. 1104, Conference Committee, "Century 21 Exposition," to accompany H.R. 8374.
- September 11: H. Rept. 1179, Committee on Science and Astronautics, "Dissemination of Scientific Information."
- : H. Rept. 1180, Committee on Science and Astronautics, "Scientific Manpower and Education: Deficiencies in the Tabulation and Study of Scientific Manpower."
- : H. Rept. 1181, Committee on Science and Astronautics, "Progress of Atlas and Polaris Missiles."
- : H. Rept. 1182, Committee on Science and Astronautics, "Basic Scientific and Astronautic Research in the Department of Defense."
- September 30: Committee on Science and Astronautics, "Report on the Activities of the Committee on Science and Astronautics," Committee Print.
- October 13: H. Rept. 1191, Committee on Science and Astronautics, "Boron High-Energy Fuels."

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- January 4: Committee on Science and Astronautics, "A Study of Scientific and Technical Manpower," Committee Print.
- January 27: H. Rept. 1228, Committee on Science and Astronautics, "Project Mercury, First Interim Report."
- February 4: H. Rept. 1240, Committee on Science and Astronautics, "Effecting Immediate Transfer of the Development Operations Division of the Army Ballistic Missile Agency to the National Aeronautics and Space Administration," to accompany H.J. Res. 567.

1960—Continued

- February 19: H. Rept. 1280, Committee on Appropriations, "Supplemental Appropriations, 1960, National Aeronautics and Space Administration," to accompany H.J. Res. 621.
- February —: Committee on Science and Astronautics, "Outer Space—The Road to Peace (Observations on Scientific Meetings and International Cooperation)," Committee Print.
- March 3: H. Rept. 1333, Committee on Science and Astronautics, "Authorizing Appropriations to the National Aeronautics and Space Administration," to accompany H.R. 10809, authorizing appropriations for fiscal year 1961.
- March 8: Committee on Science and Astronautics, "Proposed Revisions to the Patent Section, National Aeronautics and Space Act of 1958," Committee Print.
- April 14: H. Rept. 1519, Committee on Appropriations, "Independent Offices Appropriation Bill, 1961," to accompany H.R. 11776.
- April 28: H. Rept. 1591, Committee on Science and Astronautics, "Making American Nationals Eligible for Scholarships and Fellowships Authorized by the National Science Foundation Act of 1950," to accompany H.R. 11985.
- May 4: H. Rept. 1587, Committee on Science and Astronautics, "Panel on Science and Technology, First Meeting."
- May 19: H. Rept. 1629, Conference Committee, "Authorizing Appropriations to the National Aeronautics and Space Administration," to accompany H.R. 10809.
- : H. Rept. 1633, Committee on Science and Astronautics, "Amending the National Aeronautics and Space Act of 1958, and for Other Purposes," to accompany H.R. 12049.
- June 21: Committee on Science and Astronautics, "Current Developments in the Law of the Sea and Outer Space," Committee Print.
- June 22: H. Rept. 1931, Committee on Science and Astronautics, "Army Lunar Construction and Mapping Program."
- June 27: H. Rept. 2006, Committee on Science and Astronautics, "Hydrofoil Development."
- : Committee on Science and Astronautics, "Report on Cape Canaveral Inspection," Committee Print.
- June 28: H. Rept. 2021, Committee on Science and Astronautics, "Research on Mechanical Translation."
- June 30: H. Rept. 2041, Committee on Science and Astronautics, "Supersonic Air Transports."
- : H. Rept. 2063, Conference Committee, "Independent Offices Appropriation Bill, 1961," to accompany H.R. 11776.
- July 1: H. Rept. 2078: Committee on Science and Astronautics, "Ocean Sciences and National Security."
- July 5: H. Rept. 2091, Committee on Science and Astronautics, "The Practical Values of Space Exploration."
- : H. Rept. 2092, Committee on Science and Astronautics, "Space, Missiles, and the Nation."
- : Committee on Science and Astronautics, "Management and Operation of the Atlantic Missile Range," Committee Print.
- August 31: H. Rept. 2215, Committee on Science and Astronautics, "Report on Activities of the Committee on Science and Astronautics."

1960—Continued

- September 27: H. Rept. 2226, Committee on Science and Astronautics, "Panel on Science and Technology, Second Meeting."  
 October 4: H. Rept. 2227, Committee on Science and Astronautics, "Life Sciences and Space."  
 October 13: H. Rept. 2229, Committee on Science and Astronautics, "Noise: Its Effect on Man and Machine."

*Chronological List of Published Hearings*

1958

- April 15, 16, 17, 18, 21, 22, 23, 24, 25, 28, 29, 30, May 1, 5, 7, 8, 12: Select Committee on Astronautics and Space Exploration, "Astronautics and Space Exploration," H.R. 11881 (later H.R. 12575).  
 May 20: Committee on Foreign Affairs, "Peaceful Exploration of Outer Space," H. Con. Res. 326 (later H. Con. Res. 332).  
 August 1: Select Committee on Astronautics and Space Exploration, "Authorizing Construction for the National Aeronautics and Space Administration," H.R. 13619 (later S. 4208).

1959

- February 2, 3, 4, 5, 9, 10, 17, 18, March 2, 12: Committee on Science and Astronautics, "Missile Development and Space Sciences."  
 February 16: Committee on Science and Astronautics, "Weather Modification."  
 February 25, March 12, 13, May 5, 18, 19, 20, 22, 26: Committee on Science and Astronautics, "Scientific Manpower and Education, Part I."  
 February 26: Committee on Science and Astronautics, "Authorizing the Leasing of Buildings in the District of Columbia by the National Aeronautics and Space Administration," H.R. 4913.  
 February 27: Committee on Science and Astronautics, "Basic Research in Agriculture."  
 March 3, 4: Committee on Science and Astronautics, "Satellites for World Communication."  
 March 5, 6, 11: Committee on Science and Astronautics, "International Control of Outer Space."  
 March 9, 10, 11: Committee on Science and Astronautics, "Authorizing Appropriations to the National Aeronautics and Space Administration," H.R. 4990 (later S. 1096).  
 March 16, 17, 18, 19, 20, 23: Committee on Science and Astronautics, "Space Propulsion."  
 April 10: Committee on Science and Astronautics, "Nuclear Explosions in Space."  
 April 13, 14, 15: Committee on Science and Astronautics, "The Ground Cushion Phenomenon."  
 April 20, 21, 22, 24, 27, 29, May 4: Committee on Science and Astronautics, "Authorizing Appropriations for the National Aeronautics and Space Administration," H.R. 6512 (later H.R. 7007).  
 May 7, 8, 21: Committee on Science and Astronautics, "Briefing by the National Bureau of Standards."  
 May 11, 12, 13, 14, 28, 29: Committee on Science and Astronautics, "Soviet Space Technology."  
 May 25, 26, 28, June 2, 17: Committee on Science and Astronautics, "Dissemination of Scientific Information."

## 1959—Continued

- May 28: Committee on Science and Astronautics, "Meeting with the Astronauts (Project Mercury, Man-in-Space Program)."
- June 3: Committee on Science and Astronautics, "Jupiter Missile Shot—Biomedical Experiments."
- June 4, 8, 9, 10, 11, 12, 18, 19, 30: Committee on Science and Astronautics, "Basic Scientific and Astronautics Research in the Department of Defense."
- June 16, 22: Committee on Science and Astronautics, "Chemical, Biological, and Radiological Warfare Agents."
- June 22, 23, 25, July 29, August 6, 26, 27: Committee on Science and Astronautics, "Miscellaneous Reports, and H.R. 7981."
- June 23: Committee on Science and Astronautics, "National Defense Plan Briefing."
- June 24, 25: Committee on Science and Astronautics, "Scientific Manpower and Education, Part II."
- July 8, 9, 23: Committee on Science and Astronautics, "H.R. 7982, H.R. 8203, H.R. 8374: Century 21 Exposition."
- July 22, 23, 24: Committee on Science and Astronautics, "Amending the National Science Foundation Act as amended," H.R. 8284.
- July 28, 29: Committee on Science and Astronautics, "Progress of Atlas and Polaris Missiles."
- July 30, August 5: Committee on Science and Astronautics, "National Medal of Science," H.R. 6288.
- August 19, 20, November 30, December 1, 2, 3, 4, 5: Committee on Science and Astronautics, "Property Rights in Inventions Made Under Federal Space Research Contracts."
- August 25: Committee on Science and Astronautics, "Education in the Field of Oceanography," H.R. 6298.
- August 26, 27, September 1: Committee on Science and Astronautics, "Boron High Energy Fuels."

## 1960

- January 12, 22, February 1, March 31, April 29, May 6: Committee on Science and Astronautics, "Miscellaneous Committee Business, Reports, and H.J. Res. 460."
- January 20, 22, 25, 26, 26, 27, 28, 29, February 1, 2, 3, 4, 5: Committee on Science and Astronautics, "Review of the Space Program, Part I."
- January 27, 29: Committee on Science and Astronautics, "The Production of Documents by the National Aeronautics and Space Administration for the Committee on Science and Astronautics."
- February 3: Committee on Science and Astronautics, "Transfer of the Development Operations Division of the Army Ballistic Missile Agency to the National Aeronautics and Space Administration," H.J. Res. 567.
- February 8, 9, 15, 16, 17, 18: Committee on Science and Astronautics, "Review of the Space Program, Part II."
- February 17, 18, 19, 22, 23, 24, 26: Committee on Science and Astronautics, "Authorizing Appropriations for the National Aeronautics and Space Administration," H.R. 10246 (later H.R. 10809).
- February 23, 24, March 7: Committee on Science and Astronautics, "Review of the Space Program, Part III."

## 1960—Continued

- March 8, 9, 10, 14, 15, 16, 17, 21, 22, 24, 28, 29, 30, 31, April 4: Committee on Science and Astronautics, "Amending the National Aeronautics and Space Act of 1958," H.R. 9675 (later H.R. 12049).
- April 28, 29: Committee on Science and Astronautics, "Frontiers in Oceanic Research," H.R. 6298.
- May 4, 25: Committee on Science and Astronautics, "Providing for the Establishment, Under the National Science Foundation, of a National Science Academy," H.R. 4986.
- May 6: Committee on Science and Astronautics, "Making American Nationals Eligible for Scholarships and Fellowships Authorized by the National Science Foundation Act of 1950," H.R. 11985.
- May 10: Committee on Science and Astronautics, "Lunar Mapping and Construction in Support of Space Programs."
- May 11, 12, 13, 16: Committee on Science and Astronautics, "Research on Mechanical Translation."
- May 17, 18, 19, 20, 24: Committee on Science and Astronautics, "Supersonic Air Transports."
- May 23: Committee on Science and Astronautics, "Hydrofoil Development."
- June 15, 16: Committee on Science and Astronautics, "Space Medicine Research."
- August 23, 24, 25: Committee on Science and Astronautics, "Noise: Its Effect on Man and Machine."
- December 6: Committee on Science and Astronautics, "A Bill to Provide for the Establishment, under the National Science Foundation, of a National Science Academy," H.R. 4986.

## SENATE

*Chronological List of Reports*

1958

- March 27: Special Committee on Space and Astronautics, "Compilation of Materials on Space and Astronautics, No. 1," Committee Print.
- April 14: Special Committee on Space and Astronautics, "Compilation of Materials on Space and Astronautics, No. 2," Committee Print.
- June 11: S. Rept. 1701, Special Committee on Space and Astronautics, "National Aeronautics and Space Act of 1958," to accompany S. 3609 (later H.R. 12575).
- July 30: S. Rept. 2042, Special Committee on Space and Astronautics, "Construction of Aeronautical Research Facilities by the National Advisory Committee for Aeronautics," to accompany H.R. 11805.
- July 31: S. Rept. 2076, Special Committee on Space and Astronautics, "Construction of Aeronautical and Space Research Facilities by the National Aeronautics and Space Administration," to accompany S. 4208.
- August 13: S. Rept. 2350, Committee on Appropriations, "The Supplemental Appropriation Bill, 1959," to accompany H.R. 13450.

1958—Continued

- August 22: S. Rept. 2495, Committee on Appropriations, "Independent Offices Appropriation Bill, 1959," to accompany H.R. 13856.
- December 31: Special Committee on Space and Astronautics, "Space Law, a Symposium," Committee Print.

1959

- March 5: S. Rept. 82, Committee on Aeronautical and Space Sciences, "NASA Supplemental Authorization for Fiscal Year 1959," to accompany S. 1096.
- March 11: S. Rept. 100, Special Committee on Space and Astronautics, "Final Report."
- April 18: S. Rept. 207, Committee on Appropriations, "Second Supplemental Appropriation Bill, 1959," to accompany H.R. 5916.
- April 20: S. Rept. 213, Committee on Aeronautical and Space Sciences, "Amendment to the National Aeronautics and Space Act of 1958," to accompany H.R. 4913. (Leasing in the District of Columbia.)
- June 2: S. Rept. 332, Committee on Aeronautical and Space Sciences, "Authorizing Appropriations to the National Aeronautics and Space Administration," to accompany H.R. 7007, on fiscal year 1960 appropriations.
- July 31: S. Rept. 597, Committee on Appropriations, "Supplemental Appropriation Bill, 1960," to accompany H.R. 7978.
- August 25: S. Rept. 806, Committee on Aeronautical and Space Sciences, "Governmental Organization for Space Activities."
- December 1: S. Rept. 1014, Committee on Aeronautical and Space Sciences, "Project Mercury: Man-in-Space Program of the National Aeronautics and Space Administration."

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- February 24: S. Rept. 1142, Committee on Aeronautical and Space Sciences, "To Effect Immediately the Transfer of the Development Operations Division of the Army Ballistic Missile Agency to the National Aeronautics and Space Administration," to accompany H.J. Res. 567.
- February 26: S. Rept. 1140, Committee on Appropriations, "Supplemental Appropriations, 1960, National Aeronautics and Space Administration," to accompany H.J. Res. 621.
- March 19: Committee on Aeronautical and Space Sciences, "Radio Frequency Control in Space Telecommunications," Committee Print.
- April 29: S. Rept. 1300, Committee on Aeronautical and Space Sciences, "Authorizing Appropriations to the National Aeronautics and Space Administration," to accompany H.R. 10809, on fiscal year 1961 appropriations.
- June 17: S. Rept. 1611, Committee on Appropriations, "Independent Offices Appropriation Bill, 1961," to accompany H.R. 11776.
- July 15: Committee on Aeronautical and Space Sciences, "Space Research in the Life Sciences: An Inventory of Related Programs, Resources, and Facilities," Committee Print.
- December 4: Committee on Aeronautical and Space Sciences, "Policy Planning for Space Telecommunications," Committee Print.

1960—Continued

December 31: Committee on Aeronautical and Space Sciences, "Legal Problems of Space Exploration: A Symposium," Committee Print.

*Chronological List of Published Hearings*

1957

November 25, 26, 27; December 13, 14, 16, 17: Preparedness Investigating Subcommittee of the Armed Services Committee, "Inquiry Into Satellite and Missile Programs."

1958

January 10, 13, 15, 16, 17, 20, 21, 23: Preparedness Investigating Subcommittee of the Armed Services Committee, "Inquiry Into Satellite and Missile Programs."

May 6, 7, 8: Special Committee on Space and Astronautics, National Aeronautics and Space Act, Part I," S. 3609 (later H.R. 12575).

May 13, 14, 15: Special Committee on Space and Astronautics, "National Aeronautics and Space Act, Part II," S. 3609 (later H.R. 12575).

August 14: Special Committee on Space and Astronautics, "Nominations of T. Keith Glennan and Dr. Hugh L. Dryden To Be Administrator and Deputy Administrator, Respectively, of the National Aeronautics and Space Administration."

1959

January 29, 30: Committee on Aeronautical and Space Sciences, "Missile and Space Activities."

February 19, 20: Committee on Aeronautical and Space Sciences, "National Aeronautics and Space Administration Supplemental Authorization for Fiscal Year 1959," S. 1096.

March 24, 26; April 14, 15, 22, 23, 24, 29; May 7: Committee on Aeronautical and Space Sciences, "Investigation of Governmental Organization for Space Activities."

April 7, 8, 9, 10: Committee on Aeronautical and Space Sciences, "National Aeronautics and Space Administration Authorization for Fiscal Year 1960, Part I, Scientific and Technical Presentations," H.R. 7007.

April 7: Committee on Aeronautical and Space Sciences, "Amendment to the National Aeronautics and Space Act," H.R. 4913.

May 19: Committee on Aeronautical and Space Sciences, "Nominations of William A. M. Burden and Dr. John T. Rettaliata To Be Members of the National Aeronautics and Space Council."

May 21: Committee on Aeronautical and Space Sciences, "National Aeronautics and Space Administration Authorization for Fiscal Year 1960, Part II, Program Detail for Fiscal Year 1960," H.R. 7007.

1960

February 2, 3, 4, 8, 9; March 16: Committee on Aeronautical and Space Sciences, "Missiles, Space, and Other Major Defense Matters."

February 18: Committee on Aeronautical and Space Sciences, "Transfer of Von Braun Team to National Aeronautics and Space Administration," H.J. Res. 567.

1960—Continued\*

- March 28, 29, 30: Committee on Aeronautical and Space Sciences, "National Aeronautics and Space Administration Authorization for Fiscal Year 1961, Part I, Program Detail for Fiscal Year 1961," H.R. 10809.
- June 30: Committee on Aeronautical and Space Sciences, "National Aeronautics and Space Administration Authorization for Fiscal Year 1961, Part II, Scientific and Technical Aspects of National Aeronautics and Space Administration Program," H.R. 10809.
- 1961
- February 2: Committee on Aeronautical and Space Sciences, "Nomination," (of James Edwin Webb to be Administrator of the National Aeronautics and Space Administration).

JOINT COMMITTEES

*Chronological List of Published Hearings*

1958

- January 21, 22; February 6: Joint Committee on Atomic Energy, "Outer Space Propulsion by Nuclear Energy."

LEGISLATIVE HISTORY OF SELECTED BILLS AND RESOLUTIONS

1958

- February 5: S. Res. 256, introduced by Senator Johnson of Texas and others, and referred to Rules and Administration. Reported out February 5 (S. Rept. 1274). Passed the Senate February 6, 1958. Created a Special Committee on Space and Astronautics.
- March 5: H. Res. 496, introduced by Representative McCormack. Passed the House March 5, 1958. Created a Select Committee on Astronautics and Space Exploration.
- March 6: H. Res. 500, introduced by Representative McCormack and referred to House Administration. Reported out March 19 (H. Rept. 1523). Passed the House March 19, 1958. Provided \$100,000 for the expenses of the Select Committee on Astronautics and Space Exploration.
- April 1: H.R. 11805, introduced by Representative Kitchin and referred to Armed Services. Reported out on July 7 (H. Rept. 2118). Passed the House July 23. Reported out by the Senate Special Committee on Space and Astronautics July 30 (S. Rept. 2042). Passed the Senate July 31. Became Public Law 85-617 on August 8, 1958. Authorized \$29,933,000 for NACA.
- April 14: H.R. 11881, introduced by Representative McCormack and referred to the Select Committee on Astronautics and Space Exploration. Replaced by H.R. 12575, a clean bill.
- : S. 3609, introduced by Senator Johnson of Texas and Senator Bridges and referred to the Special Committee on Space and Astronautics. Reported out June 11 in amended form (S. Rept. 1701). Senate passed H.R. 12575 on June 16, substituting for the House-passed language the language of S. 3609.
- May 13: H. Con. Res. 326, introduced by Representative McCormack and referred to Foreign Affairs. Replaced by H. Con. Res. 332.



1958—Continued

- May 20:** H.R. 12575, introduced by Representative McCormack and referred to the Select Committee on Astronautics and Space Exploration. Reported out on May 24 (H. Rept. 1770). Passed the House June 2. Passed the Senate, amended, June 16. Senate asked for a conference June 16. House agreed to a conference June 18. Conference report filed July 16 (H. Rept. 2166). House agreed to conference report July 16. Senate agreed to conference report July 16. Became Public Law 85-568 on July 29, 1958. Created NASA and National Aeronautics and Space Council.
- May 22:** H. Con. Res. 332, introduced by Representative McCormack and referred to Foreign Affairs. Reported out May 23 (H. Rept. 1769). Passed the House under suspension of the rules June 2. Reported out by Senate Foreign Relations June 19 (S. Rept. 1728). Passed the Senate July 23, 1958. Called for the dedication of outer space to peaceful purposes.
- May 27:** H. Res. 580, introduced by Representative Albert and referred to Rules. Reported out May 29 (H. Rept. 1837). Passed the House July 21, 1958. Created a standing Committee on Science and Astronautics.
- July 15:** S. Res. 327 introduced by Senator Johnson of Texas and Senator Bridges and referred to Rules and Administration. Reported out July 23 (S. Rept. 1925). Passed the Senate July 24, 1958. Created a standing Committee on Aeronautical and Space Sciences.
- July 16:** H. Res. 635, introduced by Representative McCormack and referred to House Administration. Reported out August 6 (H. Rept. 2468). Passed the House August 6, 1958. Provided \$85,000 additional for the expenses of the Select Committee on Astronautics and Space Exploration.
- July 18:** H.R. 13450, introduced by Representative Cannon and referred to Appropriations. Reported out July 18 (H. Rept. 2221). Passed the House July 22. Reported out by Senate Appropriations August 13 (S. Rept. 2350). Passed the Senate, amended, August 15. Senate asked for a conference August 15. House agreed to a conference August 18. Conference report filed August 19 (H. Rept. 2677) House and Senate agreed only in part August 20, and Senate called for further conference August 20. House agreed to a further conference August 21. Conference report filed August 21 (H. Rept. 2686). House agreed to conference report August 21. Senate agreed to conference report August 21. Became Public Law 85-766 on August 27, 1958. Appropriated \$80 million to NASA.
- July 31:** S. 4208, introduced by Senator Johnson of Texas and referred to Special Committee on Space and Astronautics. Reported out July 31 (S. Rept. 2076). Passed the Senate August 1. Passed the House under suspension of the rules August 4. Became Public Law 85-657 on August 14, 1958. Authorized \$47,800,000 for NASA.
- : H.R. 13619, introduced by Representative McCormack and referred to the Select Committee on Astronautics and Space Exploration. Reported out August 1 (H. Rept. 2351). Tabled by the House on August 4 when S. 4208 was passed in its stead.

1958—Continued

August 22: H.R. 13856, introduced by Mr. Thomas and referred to Appropriations. Reported out August 22 (H. Rept. 2689). Passed the House August 22. Reported in the Senate from Appropriations August 22 (S. Rept. 2495). Passed the Senate, amended, August 23. House agreed to amendments August 23. Senate agreed to amendments August 23. Became Public Law 85-844 August 28, 1958. Appropriated \$101,100,000 for NACA.

1959

- January 21: H.R. 2971, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Replaced by H.R. 4990 and by H.R. 6299.
- January 22: H. Res. 133, introduced by Representative Brooks of Louisiana and referred to Rules. Reported out January 6 (H. Rept. 7). Passed the House January 27, 1959. Authorized the the Committee on Science and Astronautics to conduct investigations.
- January 27: H. Res. 139, introduced by Representative Brooks of Louisiana and referred to House Administration. Reported out January 29 (H. Rept. 23). Passed the House January 29, 1959. Provided \$300,000 to the Committee on Science and Astronautics to pursue the investigations authorized by H. Res. 133.
- February 5: H.R. 4148, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Replaced by H.R. 9675.
- February 17: S. 1096, introduced by Senator Johnson of Texas and Senator Bridges and referred to Aeronautical and Space Sciences. Reported out March 5 (S. Rept. 82). Passed the Senate March 10. Referred to House, Science and Astronautics. Reported out March 18, amended (H. Rept. 226). Passed the House, amended, April 14. Senate agreed to amendments April 15. Became Public Law 86-12 on April 22, 1959. Authorized \$48,354,000 for NASA.
- February 24: H.R. 4913, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Reported out March 9 (H. Rept. 189). Passed the House, amended, March 16. Referred to Senate Aeronautical and Space Sciences March 18. Reported out April 20 (S. Rept. 213). Passed the Senate April 29. Became Public Law 86-20 on May 13, 1959. Authorized NASA to lease buildings in the District of Columbia.
- February 25: H.R. 4990, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Replaced by S. 1096 on March 11, 1959.
- March 20: H.R. 5916, introduced by Mr. Thomas and referred to Appropriations. Reported out March 20 (H. Rept. 238). Passed the House March 24. Reported out by Senate Appropriations April 18 (S. Rept. 207). Passed the Senate, amended, April 30. The Senate asked for a conference April 30. House agreed to a conference May 12. Conference report filed May 13 (H. Rept. 355). House agreed to conference report May 14. Senate agreed to conference report May 14. Became Public Law 86-30 on May 20, 1959. Appropriated \$3,186,300 to NASA.

1959—Continued

- April 7: S. 1582, introduced by Senator Johnson of Texas and Senator Bridges and referred to Aeronautical and Space Sciences. Replaced by H.R. 7007.
- April 13: H.R. 6288, introduced by Representative Anfuso and referred to Science and Astronautics. Reported out August 10 (H. Rept. 824). Passed the House August 19. Passed the Senate August 20. Became Public Law 86-209 on August 25, 1959. Created the National Medal of Science.
- : H.R. 6299, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Replaced by H.R. 6512.
- April 20: H.R. 6512, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. May 6, the committee agreed to a clean bill (H.R. 7007).
- May 7: H.R. 7007, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Reported out May 14 (H. Rept. 361). Passed the House May 20. Referred to Senate Aeronautical and Space Sciences May 21. Reported out June 2 (S. Rept. 332). Passed the Senate, amended, June 4. Senate asked for a conference June 4. House agreed to Senate amendments June 8. Became Public Law 86-45 on June 15, 1959. Authorized \$485,300,000 for NASA.
- May 28: S. 2065, introduced by Senator Magnuson and Senator Jackson and referred to Foreign Relations. Replaced by H.R. 8374.
- June 26: H.R. 7978, introduced by Representative Thomas and referred to Appropriations. Reported out June 26 (H. Rept. 579). Passed the House June 29. Reported out by Senate Appropriations July 31 (S. Rept. 597). Passed the Senate, amended, August 3. Senate asked for a conference August 3. House agreed to a conference August 18. Conference report filed August 18 (H. Rept. 943). House agreed to conference report August 19. Senate agreed to conference report August 19. Became Public Law 86-213 on September 1, 1959. Appropriated \$517,250,000 to NASA.
- : H.R. 7982, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Replaced by H.R. 8203.
- July 14: H.R. 8203, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Replaced by H.R. 8374, a clean bill.
- July 20: H.R. 8284, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Reported out July 30 (H. Rept. 740). Passed the House August 17. Placed on Senate calendar August 19. Passed the Senate August 24. Became Public Law 86-232 on September 8, 1959. Amended the National Science Foundation Act of 1950, as amended.

## 1959—Continued

July 23: H.R. 8374, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Reported out August 3 (H. Rept. 744). Passed the House August 18. Placed on the Senate calendar August 19. Passed the Senate amended August 21. House asked for a conference August 27. The Senate agreed to a conference August 29. House agreed to the conference report September 2 (H. Rept. 1104). Became Public Law 86-250 on September 9, 1959. Amended Public Law 85-880, regarding the Century 21 Exposition in Seattle.

## 1960

January 18: H.R. 9675, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Replaced by a clean bill, H.R. 12049.

January 21: H.J. Res. 567, introduced by Representative Sisk and referred to Science and Astronautics. Reported out February 4 (H. Rept. 1240). Passed the House February 8. Referred to Senate Aeronautical and Space Sciences February 9. Reported out February 26 (S. Rept. 1142). No further action taken. Related to transfer of the Von Braun team.

January 26: H.R. 9918, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Replaced by H.R. 10246.

February 6: H.R. 10246, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Replaced by H.R. 10809, a clean bill.

February 19: H.J. Res. 621, introduced by Representative Thomas and referred to Appropriations. Reported out February 19 (H. Rept. 1280). Passed the House February 23. Reported out of Senate Appropriations February 26 (S. Rept. 1140). Passed the Senate amended March 24. House agreed to amendments April 11. Became Public Law 86-425 on April 14, 1960. Appropriated \$23 million to NASA.

March 1: H.R. 10809, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Reported out March 3 (H. Rept. 1333). Passed the House March 9. Referred to Senate Aeronautical and Space Sciences March 10. Reported out April 29 (S. Rept. 1300). Passed the Senate amended May 3. Senate asked for a conference May 3. House agreed to a conference May 6. Conference report was filed May 19 (H. Rept. 1629). House agreed to conference report May 23. Senate agreed to conference report May 24. Became Public Law 86-481 on June 1, 1960. Authorized \$970 million for NASA.

April 14: H.R. 11776, introduced by Representative Thomas and referred to Appropriations. Reported out April 14 (H. Rept. 1519). Passed the House April 20. Reported out by Senate Appropriations June 17 (S. Rept. 1611). Passed the Senate amended June 22. Senate asked for a conference June 22. House agreed to a conference June 25. Conference report filed June 30 (H. Rept. 2063). House agreed to conference report July 1. Senate agreed to conference report July 1. Became Public Law 86-626 July 12, 1960. Appropriated \$915 million to NASA.

## 1960—Continued

- April 28: H.R. 11985, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Reported out May 6 (H. Rept. 1591). Passed the House May 16. Passed the Senate June 18. Became Public Law 86-550 on June 29, 1960. Made American nationals eligible for NSF scholarships and fellowships.
- May 3: H.R. 12049, introduced by Representative Brooks of Louisiana and referred to Science and Astronautics. Reported out May 19 (H. Rept. 1633). Passed the House June 9. Referred to the Senate Aeronautical and Space Sciences. No further action taken. Referred to reorganization of NASA.

## CHRONOLOGICAL LIST OF DOCUMENTS

## 1958

- April 2: H. Doc. 365, message from the President on "Space Science and Exploration."

## 1959

- February 2: H. Doc. 71, "First Annual Report on the Nation's Activities and Accomplishments in the Aeronautics and Space Fields."
- April 27: S. Doc. 6, "The 44th and Final Report of the National Advisory Committee for Aeronautics."
- June 24: H. Doc. 187, "First Semiannual Report of the National Aeronautics and Space Administration."

## 1960

- January 14: H. Doc. 296, message from the President recommending certain amendments to the National Aeronautics and Space Act of 1958.
- : H. Doc. 297, message from the President transmitting a transfer plan headed "Making Certain Transfers from the Department of Defense to the National Aeronautics and Space Administration."
- January 18: H. Doc. 300, "9th Annual Report of the National Science Foundation."
- February 25: H. Doc. 349, "Second Annual Report on the Nation's Activities and Accomplishments in the Aeronautics and Space Fields."
- March 18: H. Doc. 361, "Second Semiannual Report of the National Aeronautics and Space Administration."
- August 30: H. Doc. 454, "Third Semiannual Report of the National Aeronautics and Space Administration."

## 1961

- January 18: H. Doc. 55, "Fourth Semiannual Report of the National Aeronautics and Space Administration."
- : H. Doc. 56, "Third Annual Report on the Nation's Activities and Accomplishments in the Aeronautics and Space Fields."

## CHRONOLOGICAL LIST OF PUBLIC LAWS

1958

- February 11: Public Law 85-322, H.R. 10146, Supplemental Defense Appropriation Act, 1958, contained funds for the Advanced Research Projects Agency in the Department of Defense, permitting transfers of available defense funds up to \$10 million.
- February 12: Public Law 85-325, H.R. 9739, authorized the Secretary of Defense to engage in civilian space activities for a period of 1 year, as a part of the advanced research projects effort.
- July 29: Public Law 85-568, H.R. 12575, the National Aeronautics and Space Act of 1958, established NASA and the National Aeronautics and Space Council.
- August 6: Public Law 85-599, H.R. 12541, Department of Defense Reorganization Act of 1958. In setting up the Director for Defense Research and Engineering in the Office of the Secretary of Defense, it also reaffirmed the 1-year grant of authority to engage in civilian space activities on the part of ARPA.
- August 8: Public Law 85-617, H.R. 11805, authorized construction by the NACA of aeronautical research facilities to the amount of \$29,933,000 (fiscal year 1959).
- August 14: Public Law 85-657, S. 4208 (H.R. 13619), authorized construction by the National Aeronautics and Space Administration to the amount of \$47,800,000.
- August 27: Public Law 85-766, H.R. 13450, Supplemental Appropriation Act, 1959. Appropriated funds for the National Aeronautics and Space Administration in the amount of \$5 million for salaries and expenses, \$50 million for research and development, and \$25 million for construction and equipment, for a total of \$80 million.
- August 28: Public Law 85-844, H.R. 13856, Independent Offices Appropriation Act, 1959, appropriated funds for the National Advisory Committee for Aeronautics, and transferable to the National Aeronautics and Space Administration in the amount of \$78,100,000 for salaries and expenses, and \$23 million for construction and equipment, for a total of \$101,100,000.

1959

- April 22: Public Law 86-12, S. 1096, authorizing appropriations to the National Aeronautics and Space Administration, 1959. Authorized \$3,354,000 for salaries and expenses, \$20,750,000 for research and development, and \$24,250,000 for construction and equipment, for a total of \$48,354,000.
- May 13: Public Law 86-20, H.R. 4913, amending the National Aeronautics and Space Act of 1958 to authorize NASA to lease buildings in the District of Columbia.
- May 20: Public Law 86-30, H.R. 5916, Second Supplemental Appropriation Act, 1959; appropriated funds for the National Aeronautics and Space Administration in the amount of \$3,186,300 for salaries and expenses, to cover cost of pay increases.
- June 15: Public Law 86-45, H.R. 7007, authorizing appropriations to the National Aeronautics and Space Administration, 1960. Authorized \$94,430,000 for salaries and expenses, \$333,070,000 for research and development, and \$57,800,000 for construction and equipment, for a total of \$485,300,000.

1959—Continued

- August 25: Public Law 86-209, H.R. 6288, National Medal of Science. Established to provide recognition for individuals who make outstanding contributions in science and engineering.
- September 1: Public Law 86-213, H.R. 7978, Supplemental Appropriation Act, 1960. Appropriated funds for the National Aeronautics and Space Administration under the authority of Public Law 86-12 in the amount of \$16,675,000 for research and development and \$21,825,000 for construction and equipment, and additionally in the amount of \$91,400,000 for salaries and expenses, \$318,675,000 for research and development, and \$52 million for construction and equipment, for a grand total of \$500,575,000. (Later by executive order, \$550,000 was transferred from salaries and expenses, and \$14,450,000 was transferred from research and development, for a total of \$15 million added to construction and equipment.)
- September 8: Public Law 86-232, H.R. 8284, amending the National Science Foundation Act of 1950, as amended.
- September 9: Public Law 86-250, H.R. 8374, amending Public Law 85-880 (Century 21 Exposition in Seattle).

1960

- April 14: Public Law 86-425, H.J. Res. 621, Supplemental Appropriation for the National Aeronautics and Space Administration, 1960. Appropriated funds for NASA in the amount of \$12,200,000 for research and development, and \$10,800,000 for construction and equipment, for a total of \$23 million.
- June 1: Public Law 86-481, H.R. 10809, authorizing appropriations to the National Aeronautics and Space Administration, 1961. Authorized \$170,760,000 for salaries and expenses, \$621,453,000 for research and development, and \$122,787,000 for construction and equipment, for a total of \$915 million. In addition it provided authorization for emergency funds in the amount of \$50 million for research and development, and \$5 million for construction and equipment, making a grand total authorization of \$970 million.
- June 29: Public Law 86-550, H.R. 11985, making American nationals eligible for scholarships and fellowships authorized by the National Science Foundation Act of 1950, as amended.
- July 12: Public Law 86-626, H.R. 11776, Independent Offices Appropriation Act, 1961. Appropriated funds for the National Aeronautics and Space Administration in the amount of \$170,760,000 for salaries and expenses, \$621,453,000 for research and development, and \$122,787,000 for construction and equipment, for a total of \$915 million.

SUMMARY OF AUTHORIZATIONS AND APPROPRIATIONS FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

[In dollars]

Budget request	Authorizations			Appropriations		
	Reported by committee	Passed	Public Law	Reported by committee	Passed	Public Law
<b>1959 NACA:</b> 80,490,000 S&E (2) R&D 28,220,000 C&E <hr/> 108,700,000	H. Rept. 2118: (1) S&E (2) R&D 29,933,000 C&E <hr/> 29,933,000  S. Rept. 2042: (1) S&E (2) R&D 29,933,000 C&E <hr/> 29,933,000	H.R. 11805: (1) S&E (2) R&D 29,933,000 C&E <hr/> 29,933,000  H.R. 11905: (1) S&E (2) R&D 29,933,000 C&E <hr/> 29,933,000	Public Law 85-617: (1) S&E (2) R&D 29,933,000 C&E <hr/> 29,933,000	H. Rept. 2689: 78,100,000 S&E (2) R&D 23,000,000 C&E <hr/> 101,100,000  S. Rept. 2495: 78,100,000 S&E (2) R&D 23,000,000 C&E <hr/> 101,100,000	H.R. 13856: 78,100,000 S&E (2) R&D 23,000,000 C&E <hr/> 101,100,000  H.R. 13856: 78,100,000 S&E (2) R&D 23,000,000 C&E <hr/> 101,100,000	Public Law 85-844: 78,100,000 S&E (2) R&D 23,000,000 C&E <hr/> 101,100,000
<b>1959 NASA:</b> 7,000,000 S&E 70,200,000 R&D 47,800,000 C&E <hr/> 125,000,000	H. Rept. 2351: (1) S&E (1) R&D 47,800,000 C&E <hr/> 47,800,000  S. Rept. 2076: (1) S&E (1) R&D 47,800,000 C&E <hr/> 47,800,000	(H.R. 13619): (1) S&E (1) R&D 47,800,000 C&E <hr/> 47,800,000  S. 4208: (1) S&E (1) R&D 47,800,000 C&E <hr/> 47,800,000	Public Law 85-567: (1) S&E (1) R&D 47,800,000 C&E <hr/> 47,800,000	H. Rept. 2221: (2) S&E (2) R&D (2) C&E <hr/> (2)  H. Rept. 1230: (2) S&E 12,200,000 R&D 10,800,000 C&E <hr/> 23,000,000  S. Rept. 2350: 5,000,000 S&E 35,000,000 R&D 35,000,000 C&E <hr/> 75,000,000  S. Rept. 1140: (2) S&E 12,200,000 R&D 10,800,000 C&E <hr/> 23,000,000	H.R. 13450: (2) S&E (2) R&D (2) C&E <hr/> (2)  H. J. Res. 621: (2) S&E 12,200,000 R&D 10,800,000 C&E <hr/> 23,000,000  H.R. 13450: 7,000,000 S&E 70,200,000 R&D 47,800,000 C&E <hr/> 125,000,000  H.J. Res. 621: (2) S&E 12,200,000 R&D 10,800,000 C&E <hr/> 23,000,000	Public Law 85-766: (2) S&E 5,000,000 R&D 50,000,000 C&E 25,000,000 <hr/> 80,000,000  Conference: H. Rept. 2677, H. Rept. 2686.  Public Law 86-425: (2) S&E 12,200,000 R&D 10,800,000 C&E <hr/> 23,000,000

See footnotes at end of table, p. 189.



SUMMARY OF AUTHORIZATIONS AND APPROPRIATIONS FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION—Continued

[In dollars]

Budget request	Authorizations			Appropriations		
	Reported by committee	Passed	Public Law	Reported by committee	Passed	Public Law
1959 Supplemental: 3,354,000 S&E	H. Rept. 226: 3,354,000 S&E	(H.R. 4990): 3,354,000 S&E	Public Law 86-12: 3,354,000 S&E	H. Rept. 238: 3,018,600 S&E;	H.R. 5916: 3,018,600 S&E	Public Law 86-30: 3,186,300 S&E
20,750,000 R&D	20,750,000 R&D	20,750,000 R&D	20,750,000 R&D	H. Rept. 579: 18,675,000 R&D	H.R. 7978: (?) R&D	Conference: H. Rept. 355
24,250,000 C&E	24,250,000 C&E	24,250,000 C&E	24,250,000 C&E	22,725,000 C&E	(?) C&E	Public Law 86-213: 16,675,000 R&D 21,825,000 C&E
48,354,000	48,354,000	48,354,000	48,354,000	41,400,000		38,500,000
	S. Rept. 82: 3,354,000 S&E 20,750,000 R&D 24,250,000 C&E	S. 1096: 3,354,000 S&E 20,750,000 R&D 24,250,000 C&E		S. Rept. 207: 3,354,000 S&E	H.R. 5916: 3,354,000 S&E	
	48,354,000	48,354,000		S. Rept. 597: 20,750,000 R&D 24,250,000 C&E	H.R. 7978: 20,750,000 R&D 24,250,000 C&E	Conference: H. Rept. 943
				45,000,000	45,000,000	
1960:	H. Rept. 361: 94,430,000 S&E 333,070,000 R&D 57,800,000 C&E	H.R. 7007: 94,430,000 S&E 333,070,000 R&D 57,800,000 C&E	Public Law 86-45: 94,430,000 S&E 333,070,000 R&D 57,800,000 C&E	H. Rept. 579: 91,400,000 S&E 300,000,000 R&D 52,000,000 C&E	H.R. 7978: 91,400,000 S&E 318,675,000 R&D 52,000,000 C&E	Public Law 86-213: 91,400,000 S&E 318,675,000 R&D 52,000,000 C&E
94,430,000 S&E	94,430,000 S&E	94,430,000 S&E	94,430,000 S&E	443,400,000	462,075,000	462,075,000
333,070,000 R&D	333,070,000 R&D	333,070,000 R&D	333,070,000 R&D			
57,800,000 C&E	57,800,000 C&E	57,800,000 C&E	57,800,000 C&E	S. Rept. 597: 94,430,000 S&E 333,070,000 R&D 57,800,000 C&E	H.R. 7978: 94,430,000 S&E 333,070,000 R&D 57,800,000 C&E	Conference: H. Rept. 943
485,300,000	480,550,000	480,550,000	485,300,000	485,300,000	485,300,000	
	S. Rept. 332: 94,430,000 S&E 333,070,000 R&D 57,800,000 C&E	H.R. 7007: 94,430,000 S&E 333,070,000 R&D 57,800,000 C&E				
	485,300,000	485,300,000				

1961:	H. Rept. 1333:	H.R. 10809:	Public Law 86-481:	H. Rept. 1519:	H.R. 11776:	Public Law 86-626:
167,560,000 S&E	170,760,000 S&E	170,760,000 S&E	170,760,000 S&E	166,500,000 S&E	166,500,000 S&E	\$170,760,000 S&E
545,153,000 R&D	621,453,000 R&D	621,453,000 R&D	671,453,000 R&D	602,240,000 R&D	602,240,000 R&D	621,453,000 R&D
89,287,000 C&E	122,787,000 C&E	122,787,000 C&E	127,787,000 C&E	107,275,000 C&E	107,275,000 C&E	122,787,000 C&E
<u>802,000,000</u>	<u>915,000,000</u>	<u>915,000,000</u>	<u>970,000,000</u>	<u>876,015,000</u>	<u>876,015,000</u>	<u>915,000,000</u>
1961 amendment:	S. Rept. 1300:	H.R. 10809:	Conference:	S. Rept. 1611:	H.R. 11776:	Conference:
3,200,000 S&E	170,760,000 S&E	170,760,000 S&E	H. Rept. 1629	170,760,000 S&E	170,760,000 S&E	H. Rept. 2063
76,300,000 R&D	671,453,000 R&D	671,453,000 R&D		671,453,000 R&D	671,453,000 R&D	
33,500,000 C&E	127,787,000 C&E	127,787,000 C&E		122,787,000 C&E	122,787,000 C&E	
<u>113,000,000</u>	<u>970,000,000</u>	<u>970,000,000</u>		<u>965,000,000</u>	<u>965,000,000</u>	
1961 Supplemental:						
49,606,000 R&D						
1962:						
189,986,000 S&E						
819,819,000 R&D						
* 10,000,000 R&D						
99,825,000 C&E						
<u>1,119,630,000</u>						

<sup>1</sup> No specific authorization required.

<sup>2</sup> No amount included.

<sup>3</sup> Anticipated reimbursements from non-Federal sources (42 U.S.C. 2473).

S&E refers to salaries and expenses.

R&D refers to research and development.

C&E refers to construction and equipment.

NOTE.—In addition to the direct legislative history of authorizations and appropriations, the National Aeronautics and Space Administration received \$154,619,532 from the Department of Defense of fiscal year 1959 funds, under the authority of 72 Stat 433.

Also by executive order, funds for fiscal year 1960, granted by Public Law 86-213 were transferred internally by the National Aeronautics and Space Administration: \$550,000 from salaries and expenses and \$14,450,000 from research and development, to make a total of \$15,000,000 added to construction and equipment account. By executive order, funds for fiscal year 1961, granted by Public Law 86-213 under fiscal year 1960 provisions, were transferred internally by the National Aeronautics and Space Administration: \$3,538,000 from research and development to construction and equipment account.