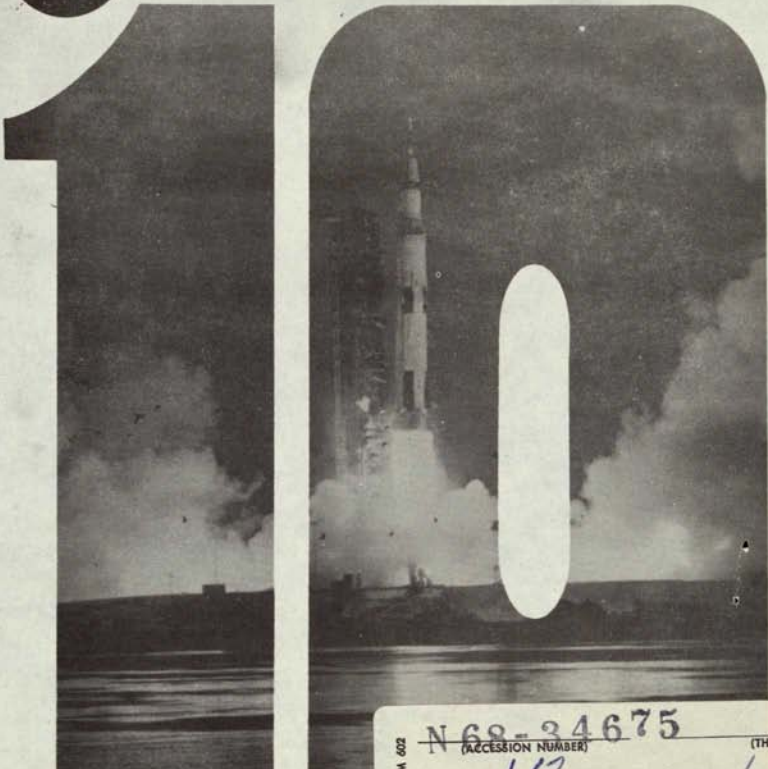
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



10th ANNIVERSARY

OCTOBER 1, 1968

NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
September 29, 1968

SPECIAL

PROJECT: NASA TENTH ANNIVERSARY

PRESS KIT

contents

NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
September 29, 1968

TENTH ANNIVERSARY SPECIAL (1)

NASA'S FIRST TEN YEARS

"The Congress declares that the general welfare and security of the United States requires that adequate provision be made for aeronautical and space activities."

This was the official language giving the National Aeronautics and Space Administration its mandate 10 years ago.

Now, after a decade of successes, disappointments, triumphs and tragedies, the United States civilian space agency is continuing to enrich the nation's capability with new technology and knowledge growing out of aeronautical, nuclear and space research.

-more-

NASA came alive Oct. 1, 1958, with a nucleus of personnel from the National Advisory Committee for Aeronautics, its facilities, and personnel and space projects inherited from the Army and Navy. Its mission was clearly defined.

The Space Act established continuing goals of:

1. Unmanned lunar and planetary exploration.

2. Development and application of communications and weather satellites.

3. Development of launch vehicles and propulsion systems.

4. Extended aeronautical research.

5. Expansion of knowledge relating to space and how man adapts to it.

6. International cooperation in space research.

7. Effective use and dissemination of new scientific and technical knowledge derived from space-related research and development.

Since its beginning, NASA has launched satellites which have extended global communications channels, improved accuracy of weather forecasting and shown promise of assisting air and water navigation around the globe.

Scientific spacecraft have probed the space environment, taken pictures of the Moon and Mars and measured characteristics of Venus and the Sun.

Its manned spacecraft have rendezvoused and docked in space; its astronauts have "walked" around the world in space in acquiring the knowledge needed to assure the success of the lunar landing scheduled for 1969.

The overall NASA aeronautics program is constantly growing and changing to meet the needs of the rapidly expanding air transportation industry and of general aviation.

Among the continuing research and development projects in aeronautics are noise abatement, flight safety, the materials, propulsion and flight dynamics of supersonic and hypersonic aircraft, lifting bodies and Vertical Short Takeoff and Landing (VSTOL) craft.

NASA scientists and engineers, working with university and industry groups, are pushing ahead in the fields of space power: electric, nuclear and chemical propulsion to enhance the capability of already-developed launch vehicles.

NASA's first budget was $330.9 million for FY 1959. By FY 1965, its peak year, the appropriation was $5.25 billion. In accomplishing its goals -- all of them -- NASA permanent employees rose from 9,000 to a top of 35,000 in the summer of 1967.

KNOW-HOW FORCE

An industry work force of over 400,000 was built up and used to apply NACA's accumulation of aeronautical knowledge to space work, to expand the nation's base of space competence, and then feed back much of the resulting know-how into aeronautics.

One fourth of this work force has been disbanded as projects such as Ranger, Lunar Orbiter, Surveyor, Mercury and Gemini were completed. But a group of 10,000 men and women -- scientists, engineers, teachers and students have been oriented to space science and engineering, most of whom are at work under NASA funding at about 200 universities.

By the end of fiscal 1969, the 400,000 work force will be down to just over 200,000, but there remains a hard-core national capability in aeronautical and space-related science and engineering to carry out the Space Act's mandate.

James E. Webb, NASA Administrator said recently: "Ten years ago we were looking forward hopefully to space applications in meteorology, communications, navigation and geodesy.

"Today there are satellite systems and their Earth-based components in operation for all of those areas while still other possibilities are becoming apparent, for example: Earth resource surveys and worldwide data collection and dissemination."

KNOWLEDGE THE KEY

While manned flight with its compelling human involvement has dominated news of space achievements in this decade, none of it would be possible without the hand-in-glove scientific and technological knowledge developed from the most elementary sounding rocket to the ultra-sophisticated Surveyor unmanned lunar landing missions.

During its first decade, NASA has completed 234 major U.S. and international launches -- this does not include thousands of sounding rockets or flights of three X-15 and other types of research aircraft.

In the 234, NASA had 189 launch vehicle successes and 174 spacecraft or mission successes, with two missions still under evaluation.

For these launches NASA developed rockets ranging from the workhorse Scout with a thrust of 88,000 pounds to the Saturn V Moon rocket with 7.5 million pounds of thrust. The Scout is 68 feet high and can place 240 pounds in orbit while the Saturn V stands 363 feet tall and can send 100,000 pounds to the Moon.

So, at the end of 10 years, NASA is in business to stay with the challenge of maintaining a sound program of meeting the objectives of the future: manned and unmanned exploration of the Moon and beyond for "peaceful purposes and the benefit of all mankind, as directed by the Space Act."

# # #

NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546
TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
September 29, 1968

TENTH ANNIVERSARY SPECIAL (2)

AERONAUTICS FIRST "A" IN NASA

When the National Aeronautics and Space Administration was formed 10 years ago a great amount of time and effort was devoted to recruiting trained scientists and engineers to manage the huge space program which was soon to come.

But the newly formed agency had no problem in building an aeronautical research organization -- an experienced group already existed in NASA's predecessor, the National Advisory Committee for Aeronautics.

When NASA was created, aeronautical research had been going on steadily for more than 40 years under NACA guidance at the Langley Research Center near Hampton, Va., and today the center plays a leading role in solving complex aeronautical problems and lending assistance to other government agencies involved in aviation.

-more-

Although Langley has long been recognized as a leader in aeronautical research, much of the work of other NASA centers goes into vital research and development in support of aeronautical progress.

OTHER CENTERS

At the Lewis Research Center, near Cleveland, basic and applied research is pursued on problems of aircraft propulsion. It is at Lewis that NASA initiated its "Quiet Engine" program which is an attempt to combine all known noise control techniques into an engine which would be considerably quieter than present subsonic jets.

The Flight Research Center at Edwards, Calif., is the home of the X-15 which has established a set of well known records -- 4,534 miles-per-hour and 67 miles peak altitude since the first flight nine years ago. However, equally important but lesser known flights take place every day in research to cope with the many problems of flight, from take-off to landing. It is here that the wingless research craft that may be forerunners of recoverable spacecraft are undergoing flight tests after high altitude drops from B-52 carrier aircraft.

Aeronautical research receives considerable attention from a staff of engineers at the Ames Research Center south of San Francisco with emphasis on Vertical/Short Takeoff and Landing (V/STOL), supersonic aircraft and hypersonic research.

-more-

The program includes the focal point for studies of piloting problems with numerous fixed-base, moving base, and flight simulators. Flight research on V/STOL aircraft is an important part of the center's research.

Shortly after the Electronics Research Center was established at Cambridge, Mass., it initiated several programs designed to advance knowledge in avionics which will be required for the advanced airplanes of the future, from V/STOL to supersonic.

As it was with NACA, a major share of NASA's research effort at these Centers is devoted to support of other government agencies involved in aircraft development and operation, and in 1967 the agency estimated that about 45 per cent of the testing time was for these purposes.

GENERAL AVIATION

Recognizing the continuing increase in the number of "general" aviation type aircraft using the nation's airways, NASA has placed greater emphasis on research to cope with the problems facing the non-commercial, non-military pilot.

As the performance of these executive and pleasure-type airplanes increases they are being used more and more for basic transportation. With the increased performance he can get from the airplane, the pilot is inclined to venture further into unfamiliar environments where there is greater risk.

NASA is concentrating on research to prevent these circumstances from creating a hazardous situation for the non-professional pilot.

The emphasis NASA is placing on general aviation research is a reflection of the growing recognition of the need for advanced technology to solve the many problems which will be facing the users of a predicted 180,000 private planes by 1977.

In cooperation with the FAA, NASA is working on warning indicators to prevent air collisions. One possible method for clear weather conditions is the use of xenon flashing lights and electronic detectors. The lights not only give a brilliant visual flash but also send off a large amount of infrared energy which can be picked up by an infrared detector and used to alert the pilot who can then visually sight the other aircraft and avoid a collision.

A great percentage of the work going on within NASA to improve the performance of commercial aircraft is not immediately recognizable to the man on the street -- or to the passenger in the seat.

Many of the beneficial changes and safety improvements involve complex engineering and aerodynamic designs. A good example of this is the NASA-developed "supercritical wing" which is a method for designing an airplane wing so that the shock on the upper surface does not cause separation of air flow and thus impede the airplane's speed.

Fog is a serious threat to air safety, and NASA has been working with the Cornell Aeronautical Laboratory on methods for solving the problem. The most promising technique involves seeding the fog with very fine crystals of ordinary table salt (sodium chloride) which readily absorbs moisture. NASA is confident that the successful laboratory tests can be translated to actual field operations and tests are planned at airports in upper New York state in cooperation with the Federal Aviation Administration.

A NASA research project at the Wallops Station, Va., has attracted considerable attention and the interest of airlines, the U.S. Air Force and several state highway departments. It involves the grooving of runways to assist in increasing braking at the landing speed of aircraft, when the surface is covered with water or slush. The Air Force and the FAA are experimenting with this concept at several locations.

SAFETY RESEARCH

The NASA program of aviation safety research reaches beyond the threats of adverse weather conditions and extends to research involving the physical stress on the pilot and the dangers from equipment failures.

The program includes research to insure the safety and survival of passengers and crew in the event of an accident by minimizing the effects of impact and fire. Beginning in 1964, NASA, working with the military, undertook a research program to design an aircraft seat for greater protection and safety of the traveling public.

Just as NASA has gained considerable experience in the physiological and psychological limits of the astronauts, the human factors experts in the NASA aeronautical program are accumulating data on the ability of pilots to perform under varied conditions. Results from this research are providing vital information on how quickly a pilot receives information and what displays provide it best; how the pilot can make decisions based on available information; how rapidly he can initiate proper control action and what conditions limit his ability to control his aircraft.

As airplanes grow bigger and fly faster, NASA continues to search for light-weight and high-temperature materials. This research has led to new alloys for use on turbine blades for supersonic aircraft engines which operate with gas temperatures over 2,000 degrees Fahrenheit.

The high speed aircraft pose a demand for a material to line the fuel tanks and prevent the loss of fuel.

At the Marshall Space Flight Center, Huntsville, Ala., researchers are favoring a new class of inorganic, high temperature polymer containing silicon and heterocyclic atomic structures.

AVIONICS STUDY

Avionics -- electronics for aviation -- is being relied upon more and more for aids to navigation, guidance, turbulence detection, collision avoidance, all-weather operation and automatic landing systems. Whereas in present day aircraft, different functions are provided by separate "black boxes," NASA's experience in spacecraft design has shown that all functions can be integrated into a single electronic system.

An advanced class of supersonic commercial transports has been selected as a model for the development of integrated electronic systems technology. A target date of 1972 has been set to have available the technology, as developed in this program, for the design by industry of an advanced avionics systems for future supersonic transports. The Electronics Research Center is the lead center for this effort.

Avionic devices are available which provide greater operating safety for the non-professional pilot, but the equipment is often too expensive for the general aviation public. NASA has been working on an economical flight control package which would reduce the pilot's workload in the cockpit. The plan is to give the pilot better cockpit displays and improve the aircraft's handling qualities.

Aircraft that can take off and land vertically or with a very short runway can play a major role in the nation's future short haul transportation system. By 1980, it is estimated that more than 40 million people will be concentrated in a metropolis along the Atlantic coast, over 35 million in the area of the Great Lakes, and over 20 million along the California coast. The projected number of major urbanized areas is 194. These are prime markets for rapid transportation such as can be supplied by V/STOL aircraft.

The basic objectives of short-haul air transportation are to improve service to the customer by decreasing trip time, cost, and annoyance, and at the same time, to improve safety to the greatest degree possible.

Unfortunately, despite the obvious civil and military needs, many technical obstacles still remain to be solved. One major problem involves the inability of any craft built to date to hover for any length of time while maneuvering around the airport and also to cruise at high speed. NASA is putting emphasis into research to find the answer to this and other problems of V/STOL flights, including a satisfactory device for converting power from forward thrust to lift with the transition being accomplished smoothly and under well-controlled conditions.

STOL FIRST

Because of its relative lack of design complexity and less stringent operational requirements, the short take-off and landing (STOL) aircraft is expected to precede that of the V/STOL in civil use. Operation of such transport aircraft will enable use of small airstrips closer to the city center, with a reduction in travel time.

Results of previous NASA research have indicated several promising and efficient means of using power to augment the aerodynamic lift. One of these is the rotating cylinder flap, considered especially for propeller-driven transports. Large-scale wind tunnel model tests have shown that a cylinder mounted at the flap leading edge and rotating at high speed in the direction of the air stream, can delay flow separation and enable attainment of very high lift. NASA plans to carry this concept to flight research to determine if it can be integrated successfully into a complete operational aircraft system.

Starting shortly after its organization, the NACA (and subsequently the NASA) has been concerned about the aircraft noise problem and has actively supported research relating to it. In this regard, several hundred technical reports and documents have been produced and made generally available to industry regarding concepts of noise generation and reduction, and the application of basic principles of noise reduction in the design and operation of aircraft.

This work has paralleled the technological advancements in the aircraft industry and, as such, has involved such research areas as propeller noise, reciprocating engine exhaust noise and mufflers, and jet engine exhaust noise and suppressors.

To assist in the national aircraft noise abatement effort, the National Aeronautics and Space Administration has embarked on a three-pronged attack to the problem.

As a partial and near-time solution to the noise problem, NASA has called upon two of the nation's leading aerospace firms -- McDonnell Douglas and Boeing. Under contract to NASA, they are working on methods of lining engine housings with acoustical material to suppress noise. The aim of the project is to bring the noise down to an acceptable level until a longer range solution of basically quieter engines can be achieved. Although these programs are not scheduled to be completed until 1970, the results are being disseminated throughout the industry as soon as they become available.

The objective of the second approach to the noise problem is to accumulate the technology required to develop a subsonic aircraft engine which would generate a minimum amount of noise. This would be done by suppressing the noise sources within the engine by basic engine design changes.

This is known as the "Quiet Engine" program. Aeronautical experience shows that noise reductions of about 15 decibels could be possible with the use of a new design engine. (This is equivalent to moving the noise source about five times away.) The use of acoustic material to line the engine housing will make possible further noise reductions so that the installed engine noise output will be 20 to 25 decibels less than current engines. This experimental quiet engine program will be used to prove the design concepts for such an engine and the results will establish a firm technological base for quiet engines for subsonic transport aircraft.

The third approach to the noise problem would have the airplane land at a steeper angle, keeping the source of the noise further away from the ground during the landing approach. By increasing the approach angle from three to six degrees, it is possible to lessen the noise heard on the ground.

The aircraft operational problems associated with steeper approach angles are being carefully researched by NASA. A long series of test flights by NASA clearly show that a conventional aircraft will need new control aids to fly the steeper angle.

Further study is required to improve the performance of cockpit displays, throttle controls and aircraft aerodynamic controls which a pilot uses in bringing jet airliners into the final phases of approach and landing. NASA is tackling the problem through a research project called "Direct Lift Control."

While research on control of noise is emphasized in the NASA Aeronautical Research Program, other research of importance to both military and civil aircraft is also underway. Greater cruise performance, improved high speed maneuverability, solution to clear air turbulence, reducing speed and its relation to all-weather landing and safer runway operation, are examples of research where NASA is applying its talents in advanced technology.

# # #

NEWS NASA
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546
TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
September 29, 1968

TENTH ANNIVERSARY SPECIAL (3)

ADVANCED RESEARCH: FREEDOM OF CHOICE

"None of us knows what the final destiny of man may be -- or if there is any end to his capacity for growth and adaption. Wherever this venture leads us, we in the United States are convinced that the power to leave the Earth -- to travel where we will in space -- and to return at will -- marks the opening of a brilliant new stage in man's evolution."

This statement was made by the late Dr. Hugh L. Dryden, distinguished former Deputy Administrator of the National Aeronautics and Space Administration and internationally-known scientist. His words help explain the role of NASA's Office of Advanced Research and Technology (OART).

The goal of those who work under the OART banner is to help assure this nation of a freedom of choice -- to go wherever it wishes to go in space or in the atmosphere.

-more-

The special role of OART in NASA has many names -- "planning ahead," "anticipation engineering," "being prepared," "problem solving," or simply "pioneering."

OART's primary responsibility, regardless of what it is called, is to conduct hard-hitting, technically-sound efforts aimed at accomplishing the most important national objectives of the future. In aeronautics, the responsibility also includes efforts to improve present aircraft and their safe operation.

This OART assignment is met by planning and managing, on a continuing basis, a broadly-based program of advanced research and technology. This over-all effort by OART is so diverse and multidisciplinary in nature that it could not possibly be done by NASA alone.

Universities, industry, non-profit organizations, and other government agencies participate and support this national effort. The program is implemented by NASA research and flight centers from coast to coast. OART, therefore, serves as a focal point, marshalling the great resources of American science and engineering wherever they may be.

PLANNING, MANAGING

This planning and managing involves the direction, execution, evaluation, documentation, and dissemination of the results of all NASA research and technology programs which are conducted primarily to demonstrate the feasibility of a concept, structure, component, or system which may have general application to the nation's aeronautical and space objectives.

Another responsibility assigned to OART is that of coordinating NASA's research and technology that is related to carrying out the specific flight missions. This is done in order to avoid unnecessary duplication and to insure an integrated and balanced agency-wide research program.

Certain NASA research centers are primarily involved in conducting advanced research programs. These centers, organizationally, are placed within the responsibility of OART. These installations are: Ames Research Center, Mountain View, Calif.; Electronics Research Center, Cambridge, Mass.; Flight Research Center, Edwards, Calif.; Langley Research Center, Hampton, Va.; Lewis Research Center, Cleveland; and the Space Nuclear Propulsion Office, Germantown, Md., and SNPO's field installation, known as the Nuclear Rocket Development Station at Jackass Flats, Nev. The SNPO is a joint office of the Atomic Energy Commission and NASA.

The program conducted by OART is the equivalent of a $500-million-per-year research and development effort that accounts for approximately 10 per cent of NASA's budget, a third of all NASA personnel, and more than 3,500 separate and specific advanced research and technology tasks that cover the spectrum from atomic physics to structural dynamics.

In order to monitor these tasks and maintain a program that is both dynamic and flexible in terms of reaction to technological and scientific advances as well as changing national priorities, OART has established various line divisions that are assigned independent and specific areas of activity.

HOW OART WORKS

The divisions and their functions include:

a. Space Power and Electric Propulsion -- to provide a balanced and coordinated power generation technology program that will meet a wide range of future mission requirements and to conduct a similar program associated with electric propulsion.

b. Space Vehicles -- to identify and solve critical design problems associated with the launch and ascent of space vehicles, their flight through the atmosphere and through space, and entry into the atmosphere of the Earth and other planets, and landing.

c. Nuclear Propulsion -- to provide the technology for nuclear rocket propulsion systems that may be required for future missions and that, by serving as upper stages, can enhance the launch capability of already-developed boosters.

d. Chemical Propulsion -- to provide the technology for improving existing chemical propulsion systems as well as advancing the technology for those required in the future. This includes both liquid and solid propellants for launch vehicles and their associated components and systems.

e. Electronics and Control -- to provide the technological capability and advance the technology of electronics associated with guidance and control systems, communications, tracking and data acquisition, instrumentation, data handling and processing, and avionics.

f. Biotechnology and Human Research -- to provide for the management of advanced research and technology programs that encompass life support and protective systems, man-system integration, human research and performance, and advanced concepts related to the support and utility of man in space.

g. Basic Research -- to provide and manage fundamental research work in the field of physics and applied mathematical sciences in order to further the knowledge necessary to solve aeronautical and space problems and to provide scientific guidance on projects under development.

h. Aeronautics -- to provide a broadly based program of advanced research and applied technology in aerodynamics, propulsion, structures, and operations. This is the only organizational element in NASA responsible for aeronautical research and it extends the responsibility of NASA's predecessor agency, the National Advisory Committee for Aeronautics (NACA), which was established in 1917.

The efforts underway include a very broad spectrum dealing with current aircraft operating problems, such as flight safety, jet noise, sonic boom, instrumentation, flying and handling qualities, and operating environments. Additionally, this division conducts efforts related to the advancement and improvement of subsonic, supersonic and hypersonic flight.

Here are examples of how OART efforts tie in with other NASA programs:

Three Pegasus satellites devised and launched for OART provided unprecedented actual measurements of the nature of the meteoroid environment in the space region around and near the Earth. Their data confirmed some predictions and provided a new evaluation and enhanced revision of others.

Most importantly, the Pegasus-obtained information gave assurance to the planners of the Apollo manned flight to the Moon that the allowances they had made for possible meteoroid impacts were conservative, well within safety margins, and had not added a great deal of unnecessary weight to the Apollo spacecraft.

It was OART reflector experiments on early Earth-orbiting spacecraft that established the feasibility and precision of using ground-based laser beams to track spacecraft. With the NASA launch of the GEOS-A, Explorer 29, on Nov. 6, 1965, the laser system of tracking demonstrated by OART became operational for NASA's Office of Space Science and Applications (OSSA).

Similarly, the successful operation in late 1967 of an electric thruster known as a resistojet on the ATS III satellite completed the flight experiment phase of an OART program that demonstrated the concept, and the resistojet was declared ready for OSSA operational use on subsequent Earth satellites. The resistojet's tiny thrust can be used on a satellite for attitude control and station-keeping.

Acceptance by others means OART has done its job and is ready for the next challenge.

# # #

NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
September 29, 1968

TENTH ANNIVERSARY SPECIAL (4)

WIDE-SCOPE UNMANNED SATELLITE PROGRAM

During the ten years since it was established, the National Aeronautics and Space Administration has launched numerous sounding rockets and scientific satellites; it has developed satellites for direct, commercial use in the fields of communication and meteorology; and it has sent unmanned lunar and interplanetary spacecraft on incredibly complicated scientific fact-finding missions.

Satellites and sounding rockets, equipped with various kinds of instruments, are measuring upper atmosphere and space phenomena. They have added greatly to the knowledge about the Earth itself, and are providing an abundance of data on space.

-more-

EXPLORER SATELLITE SERIES

One family of these satellites, the Explorer series, has greatly advanced the frontiers of space research. The first Explorer (the nation's first man-made satellite) made one of the most significant discoveries of the Space Age.

Explorer I (launched Feb. 1, 1958) confirmed existence of a previously theorized zone of intense radiation in space surrounding Earth. This was later named the Van Allen Radiation Region for the scientist responsible for this experiment.

Generally, Explorers are relatively small satellites carrying a limited number of experiments and placed into differing orbits that serve the particular purposes of their experiments. Each is tailored for the requirements of its mission. For example, Explorer XXIV measured the thin wisps of air in the upper atmosphere and determined air density by latitude and altitude.

Explorer XXI provided data on the composition of Earth's ionosphere to bounce back certain radio waves, thus making possible long range radio communications on Earth.

Explorer XVII studied the composition, density, pressure, and other properties of the upper atmosphere. Explorers XVI and XXIII provided information on micrometeoroids (tiny particles of matter in space).

Explorer XXXVIII (Radio Astronomy Explorer I) opened a new window to the Universe by monitoring the low-frequency natural radio signals from space that Earth's atmosphere cuts off from ground observatories. And Explorers XXIX and XXXVI measured the small variation Earth's gravity field and fixed more precisely locations of points on Earth.

The first satellite to be placed into orbit around the Moon without a mid-course maneuver enroute was Explorer XXXV, (IMP) launched from Earth July 19, 1967. Explorer XXXV was more concerned with the physics of the Moon and interplanetary space than with the Moon's physical appearance. It provided information on micrometeoroids around the Moon, the apparent absences of a lunar magnetic field and radiation belt, and the Earth's long magnetospheric tail through which the Moon passes for about four days during each month.

The first Interplanetary Explorer was Explorer XVIII, launched Nov. 27, 1963, into an orbit stretching initially from 192 to 106,635 miles above Earth. Racing inside and outside of the Earth's magnetosphere, it provided much new scientific information and confirmed existence of a shock wave around Earth.

OBSERVATORY SATELLITES

NASA's Orbiting Solar Observatory satellites are studying the Sun during an entire 11-year solar cycle when the Sun's activity--as evidenced by the frequency and extent of solar flares, Sun spots, and other acute eruptions--ranges from high to low and then to high again.

From an approximately 400-mile altitude above Earth, the spacecraft are pointing instruments at the Sun with an accuracy comparable to hitting a penny a half-mile away with a rifle bullet.

OSO is providing information on solar radiation from above the obscuring effects of Earth's atmosphere. Data from OSO are helping man understand the Sun and are suggesting that techniques may be developed to forecast the major solar flares that flood space with intensities of radiation potentially detrimental to space travelers and their machines.

By correlating information from OSO with that gained from other spacecraft, scientists are acquiring more knowledge about how radio-blackouts and weather on Earth are influenced by solar activity.

OSO I was launched March 7, 1962; OSO II, Feb. 3, 1965; OSO III, March 8, 1967; and OSO IV, Oct. 18, 1967.

Orbiting Geophysical Observatories are designed to provide more knowledge about the Earth and space and how the Sun influences and affects both. The approximately 1,000-pound OGO furnishes many times the data provided by smaller scientific satellites such as the Explorers. For example, OGO V carries 24 different experiments as compared to the eight experiments of Explorer XVIII.

The principal advantage of OGO is that it makes possible the observation of numerous phenomena simultaneously for prolonged periods of time. This permits study in depth of the relationships between the phenomena.

For example, while some OGO experiments report on the erratic behavior of the Sun, others may describe concurrent fluctuations in Earth and interplanetary magnetic fields, space radiation, and properties of the Earth's atmosphere.

OGO is launched on a regular schedule into pre-assigned trajectories. When launched into an eccentric orbit (perigee about 150 miles, apogee about 60,000 miles) OGO studies energetic particles, magnetic fields, and other geophysical phenomena requiring such an orbit.

When launched into a low-altitude polar orbit (apogee about 500 miles, perigee about 140 miles), OGO is instrumented chiefly for study of the atmosphere and ionosphere, particularly over the poles.

NASA's OGO program consists of six spacecraft. OGO's I, III, and V were placed into long elliptical orbits. OGO's II, IV, and VI are for low-altitude polar orbits. OGO I was launched Sept. 4, 1964; OGO II, Oct. 14, 1965; OGO III, June 7, 1966; OGO IV, July 28, 1967; and OGO V, March 4, 1968.

Man's study of the Universe has been narrowly circumscribed because the atmosphere blocks or distorts much electromagnetic radiation (X-rays, infrared rays, ultraviolet rays) from space.

These emissions can tell much about the structure, evolution, and composition of celestial bodies. A new family of satellites, the Orbiting Astronomical Observatories (OAO), will make it possible to observe the universe for extended periods from a vantage point point above the shimmering haze of the lower atmosphere that contains 99 per cent of Earth's air.

OAO will see celestial bodies shining steadily against a black background. It will clearly delineate features which from the Earth are either fuzzy or indistinguishable. Astronomers predict that OAO will furnish a wealth of new knowledge about the solar system, stars, and composition of space.

OAO will be a precisely stabilized 3,900-pound satellite in a circular orbit about 500 miles above the Earth. It will carry about 1,000 pounds of experimental equipment such as telescopes, spectrometers, and photometers. The scientific equipment will be supplied from designs recommended to NASA by leading astronomers.

BIOSATELLITE SPACECRAFT

Biological investigations into the environment of space are being conducted by a family of spacecraft known as Biosatellites. Biosatellites carry into space a wide variety of plants and animals ranging from micro-organisms to primates. The experiments are aimed primarily at studying the biological effects of zero gravity or weightlessness, weightlessness combined with a known and measured source of radiation, and removal of living things from the influence of the Earth's rotation. They are expected to contribute to knowledge in genetics, evolution, and physiology, and to provide new information about the effects of prolonged flight in space.

Biosatellite II was launched Sept. 7, 1967 and recovered on re-entry into the Earth's atmosphere Sept. 9, 1967. Results of the effects of the space flight were studied after its 13 experiments were taken to Earth laboratories for observation.

Biosatellite I was successfully launched into Earth orbit Dec. 14, 1966, and its experiments functioned well in space flight. However, because retrofire did not occur, no recovery of living specimens was possible. Biosatellite I re-entered the Earth's atmosphere and burned Feb. 15, 1967.

SOUNDING ROCKETS

Man's early adventures into the atmosphere and space were with sounding rockets. The first were accomplished by early rocket societies in several countries and by Dr. Robert Goddard, an American. Sounding rockets may have one or more stages. Generally speaking, they are designed to attain altitudes up to about 4,000 miles and return data by telemetry or capsule recovery. Those designed for lower altitude may simply investigate geophysical properties of the upper atmosphere surrounding the Earth. These have returned information on atmospheric winds, the Earth's cloud cover, and the properties of the ionosphere. Higher altitude sounding rockets have sent back data on cosmic rays, the radiation belts, ultraviolet rays, solar flares, and many other phenomena.

Sounding rockets permit the performance of scientific studies in a vast region of the atmosphere too low for satellites and too high for balloons to reach. The area ranges from 20 to 100 miles in altitude.

Another significant, but less known, value derived from sounding rockets is the in-flight development testing of instruments and other equipment intended for use in satellites. By first checking out the performance of these components during sounding rocket flights in the near-Earth space environment, investigators are assured of greater satellite reliability and may avoid costly failures.

New experimenters from universities, industry and foreign organizations find the sounding rocket program a logical and inexpensive starting for gaining experience in space science techniques. Another attribute is that sounding rockets provide scientists with instruments at the time and place needed.

They require relatively little ground support equipment or launch preparations. Among the sounding rockets used are the Aerobee, the Nike and the Arcas.

First fired Nov. 14, 1947, Aerobee launchings include the solar beam experiment program to monitor background radiation from the Sun during quiet periods of solar activity; studies of ultraviolet radiation of the stars and nebulae; gamma radiation studies; and many other scientific programs.

With upper stages, the Nike has been employed largely in upper atmosphere experiments. In one experiment, a series of small grenades are ejected and exploded at intervals along the rocket's trajectory.

The explosion's location is determined by radar and/or optical methods; the time of arrival of the sound wave front at the ground is measured by microphones. This information with appropriate meteorological data on the lower altitudes indicates wind and temperature as a function of altitude.

Another kind of experiment releases a sodium vapor trail which glows orange in twilight along the upper portion of the rocket's trajectory. The deformations of this trail are recorded on time lapse photographs from which information is derived. A third method is the pitotstatic tube experiment by which atmospheric density, temperature, and wind data are derived from measurements of pressure during flight of the rocket.

The Arcas meteorological sounding rockets provide information about the atmosphere at altitudes from about 20 to approximately 40 miles. The rockets eject such sensors as chaff, parachutes, inflated spheres, and bead thermistors at the high points of their trajectories and these provide information about the atmosphere as they fall to Earth.

(The bead thermistor is in a package that radios its temperature information to Earth. The chaff, parachute, and inflated sphere provide information on wind. The inflated sphere also provides information on air density.)

Sounding rockets can be used for space experiments ranging from study of weather to picking up the faint ultra-violet rays from distant stars. On May 30, 1965, Arcas sounding rockets were used in conjunction with high flying jet aircraft, instrumented balloons, and ground-based observatories to study a solar eclipse.

An eclipse, among other things, presents an unusual opportunity to view the Sun's atmosphere, or corona, which is normally masked by bright sunlight and to find out what happens to the Earth's upper atmosphere, particularly the ionosphere, when solar radiation is abruptly curtailed.

Significant scientific discoveries made by study of data from sounding rockets include the fact that temperatures in the mesosphere, an atmospheric layer 30 to 55 miles above Earth, are as much as 60 degrees higher in winter than in summer. Sounding rockets have also provided evidence of pronounced wind shears at altitudes above 40 miles. Wind shears refer to shifts in wind direction from altitude to altitude.

Sounding rockets have reported the lowest temperatures ever measured for Earth's atmosphere. U.S.-Swedish cooperative sounding rocket studies conducted from Swedish Lapland found temperatures as low as -143 degrees Centigrade (-225 degrees Fahrenheit) in the upper atmosphere. They have also solved the mystery of noctilucent clouds. Such clouds, existing at altitudes of about 60 miles and peculiar because they shine at night, appear to be composed of ice-coated dust particles.

COMMUNICATIONS SATELLITES

In another broad area of effort, NASA's Space Science and Applications program has pioneered the development of satellite systems for use in weather forecasting, communications, and navigation. Echo I, orbited Aug. 12, 1960, proved that it is possible to communicate between distant areas on Earth by reflecting radio microwaves from a man-made satellite. Radio signals were literally bounced off the satellite from one point on the Earth to another. Echo II, launched Jan. 25, 1964, was the first satellite to be used in cooperation with the U.S.S.R.

Project Relay demonstrated the feasibility of intercontinental and transoceanic transmission of telephone, television, teleprint, and facsimile radio signals via a medium-altitude (several thousand to 12,000 miles) active-repeater (radio-equipped) satellite.

Two Relay satellites have been launched in this now completed program, one Dec. 13, 1962, and the other Jan. 21, 1964. Thousands of tests and public demonstrations of trans-oceanic and intercontinental communication were conducted via these experimental satellites.

Among the noteworthy public telecasts were the unveiling of the Mona Lisa at the National Gallery of Art in Washington, D.C.; the funeral of Pope John and the coronation of Pope Paul; the stirring telecast of President Kennedy signing a bill bestowing honorary American citizenship on Sir Winston Churchill; events surrounding the assassination of President Kennedy, the national political campaigns and election of 1964; and the opening of the Winter Olympic Games of 1964 in Austria. Among the technological firsts in the program were live transpacific telecasts between Japan and the United States.

NASA's Project Syncom (for synchronous communication) demonstrated the feasibility of employing synchronous active-repeater satellites for global communication. Syncom satellites have been used in many experiments and public demonstrations. Among the latter was the telecast of the Olympic games from Japan to the United States in October 1964. Syncom III, launched Aug. 19, 1964, was the world's first stationary satellite.

Syncom I, launched Feb. 14, 1963, was placed in a nearly synchronous orbit but contact with the satellite was lost. Syncom II, launched July 26, 1963, was placed in an inclined synchronous orbit which crosses over rather than stays over the equator. As a result, Syncom II travels north and south but not east or west.

Telstar--like Relay--was an experiment using active-repeater satellites in medium-altitude orbits. Because the two satellites differed in important structural and other features, they permitted comparison or different designs. This helped NASA acquire information needed to develop equipment for an operational communications satellite system.

Telstar was developed by the American Telephone and Telegraph Co. and launched by NASA. The company reimbursed NASA for expenses of launching, tracking, and acquiring data from the satellite.

Two satellites were launched in the Telstar program. Telstar I, launched July 10, 1962, made communications history by relaying the first telecast from Europe to the United States on the day of launch. Telstar II was launched May 7, 1963. Both satellites were successful.

The launch of Early Bird on April 6, 1965, opened the first commercial communications satellite link across the Atlantic Ocean. Using technology developed in Syncom, the Communications Satellite Corporation (COMSAT) built and guided the experimental Early Bird into a nearly stationary orbit.

With the orbiting of additional satellites, more powerful and versatile than Early Bird, the corporation was able to provide communications service to an area stretching west from Pakistan to Siam and covering Europe, Africa, North America, South America, and lands in and around the Pacific Ocean.

Under an agreement between COMSAT and NASA, the corporation reimburses the agency for expenses in launching, tracking, and monitoring commercial communications satellites. The corporation was set up in accordance with the Communications Satellite Act, which became law on Aug. 31, 1962. The act called for establishment, in conjunction and cooperation with the other nations, of a commercial communications satellite system.

The satellites are owned by the International Telecommunications Satellite Consortium (INTELSAT) which consists of more than 60 nation-owners of the global communications satellite system. Communications Satellite Corp. acts as manager for INTELSAT.

Cooperation in this largest of international joint ventures is helping to bring nations and peoples of the world closer together.

INTELSAT plans satellites over the Indian Ocean. When this is done, the whole world will be linked by communications satellites.

NAVIGATION AND METEOROLOGY SATELLITES

NASA is studying a satellite system to aid aircraft and ships in determining their exact locations regardless of weather. The system will also serve to control trans-oceanic traffic and to facilitate air-sea rescue operations. Plans call for the equipment on the satellite, ships, and airplanes to be simple and durable.

Moreover, the ship and aircraft equipment will be relatively easy to operate and maintain. As currently envisioned, the system would operate as follows: The ship or aircraft radios a signal to the satellite which relays it to a ground station.

Computers at the ground station, using the satellite as a reference point, calculate the position of the plane or ship and flash this information via the satellite to the ship or aircraft. The operation takes less than a second.

NASA's ATS program is designed to test in space promising new techniques and equipment for incorporation in future meteorological, navigation, and communications satellite systems.

It also conducts scientific experiments such as measurement of radiation in space. The experimental program opened with ATS I, launched Dec. 7, 1966.

ATS is testing ways to keep satellites oriented toward Earth without use of power. It also tests long-lasting devices to keep a stationary satellite from drifting relative to Earth.

ATS III, launched Nov. 5, 1967, is making significant contributions to meteorology. The versatile satellite, from a stationary orbit at an altitude of about 22,240 miles, has taken color photographs of half the globe.

The color photographs convey new details about the Earth and its cloud cover. For example, cloud height can be deduced because low clouds are bluer than higher ones and land covered by green vegetation is clearly identified from arid land.

During the first half of 1968, ATS III was enlisted in the task of gathering new clues about the formation of tornadoes. It may have helped pinpoint a possible new origin for the tornadoes that periodically devastate the American Midwest.

TIROS, originally a research and development project, has evolved into an operational weather observation system. TIROS stands for Television and Infrared Observation Satellite. The first TIROS satellite was launched April 1, 1960. Since then, TIROS I and subsequent satellites have proved themselves the most effective storm detection system known.

They have provided meteorologists with more than half a million usable cloud-cover pictures, enabling them to track, forecast, and analyze storms. Through TIROS observations, the U.S. Weather Bureau has issued thousands of storm bulletins to countries throughout the world.

Advanced equipment intended for use in future operational weather satellites is tested in Nimbus, a research and development project. Nimbus I was launched Aug. 28, 1964. Equipped with advanced television cameras and with a high resolution infrared observation system, the satellite was the first to provide both day and night pictures of the Earth. The cameras provided the day pictures; the infrared equipment, the night pictures.

Nimbus II, launched May 15, 1966, contained equipment not only for providing day and night pictures of the Earth and its clouds but also for measuring the Earth's heat balance. Heat balance refers to how much of the Sun's radiation it reflects back into the atmosphere.

The Nimbus II experiment represents the first time such information was obtained on a global basis. Study of heat balance data may increase understanding of how storms are born, develop, and die.

NASA's research and development work with meteorological satellites has led to the world's first operational weather satellite system, called TOS (for TIROS Operational Satellite). The TOS system is furnishing weathermen daily with pictures of the weather over nearly the whole Earth. TOS is financed, managed, and operated by the Weather Bureau, a part of the Environmental Science Services Administration (ESSA) of the United States Department of Commerce. A TOS satellite is also named ESSA, for Environmental Survey Satellite. After NASA launches and checks out the satellite, the Agency transfers it to the Environmental Science Services Administration.

MOON EXPLORATION

In its third major area of effort, NASA's Office of Space Science and Applications has acquired dramatically new knowledge about the Moon and made significant progress in exploring interplanetary space through its unmanned lunar and interplanetary programs. These include Ranger, Lunar Orbiter, Surveyor, Mariner, and Pioneer.

The Ranger program conducted the nation's first successful reconnaissance of the Moon. In the program, Ranger spacecraft telecast to Earth 17,255 close-up pictures, making visible certain lunar features as small as 10 inches across.

The Ranger close-ups added to and in some ways altered man's knowledge of the Moon. Man is likely to study them for years to come. Rangers VII through the last of the series, Ranger X, began telecasting when they were about 20 minutes away from the Moon and continued until they crashed on the lunar surface. Some of these pictures were telecast "live" to audiences through commercial television.

Lunar Orbiter spacecraft were placed in orbits around the Moon ranging from an apolune (high point) of several hundred to a thousand miles to a perilune (low point) as near as 25 miles. From perilune, Lunar Orbiter high-resolution photographs revealed objects as small as three feet across. The smallest objects that can be seen through the best telescopes on Earth are a half mile across.

Unlike Ranger and Surveyor, Lunar Orbiter is a spaceborne photographic laboratory. Its camera system snaps pictures, develops film, and converts the images on the negatives to electrical signals for transmission to Earth. Its camera, loaded with 200 feet of 70-mm film, takes high- and medium-resolution photographs simultaneously by means of a dual lens, with the high-resoultion picture centered within the area covered by the medium-resoultion picture.

Lunar Orbiter achieved much for mankind, providing a nearly complete atlas of the Moon, both the side facing Earth and the part that is always turned away. Its pictures, coordinated with views from Surveyor on the ground, helped to select potential landing areas for the Apollo lunar exploration expedition.

It provided information about micrometeoroids (tiny particles of matter) in the Moon's vicinity and helped to refine data on the Moon's size, shape, and gravitational field. It served as a tracking target for the Manned Space Flight Network, helping to train tracking crews with active spacecraft in lunar orbit for the coming Apollo mission.

Among firsts was the Lunar Orbiter I photograph of Earth on Aug. 23, 1966, the world's first view of itself from the Moon. Another was the Lunar Orbiter III photograph on Feb. 22, 1967, of Surveyor I in Oceanus Procellarum.

The latter was significant in that the Orbiter vertical view permitted better scaling of distances and determination of size of features seen in Surveyor telecasts. It also permitted extrapolation of Surveyor's ground view of lunar surface characteristics to other lunar areas that, according to Orbiter pictures, looked like the one in which Surveyor landed.

During the Surveyor program, four of these spacecraft landed and reported from positions in the Ocean of Storms, the Sea of Tranquility, the Central Bay, and the rugged highland area north of the great Tycho crater. Surveyors achieved much for man, telecasting pictures of the moonscape, the soil of the area on which they landed, and the parts of their bodies in range of the camera eye. Altogether, Surveyors returned about 70,000 pictures to experimenters on Earth.

LUNAR CHEMCIAL ANALYSIS

Standing on three legs, the robot spacecraft, working on command, also dug trenches in the Moon. It sent alpha rays into the ground and analyzed their reflections to determine chemical content of the soil. Its camera eye observed its electromagnet to determine iron content of the soil.

It struck the ground and squeezed clods of soil to determine how much weight the Moon's surface could support and to determine the cohesiveness of lunar soil clods. It telecast photographs of the Moon through orange, green, and blue filters, enabling scientists to acquire a fairly accurate color representation of the Moon (various shades of gray).

Additionally, Surveyor VI fired its tiny orientation rockets in a brief lift-off from the Moon. It demonstrated that a rocket blast on the Moon may not create a cloud of dust.

Surveyor VII returned telecasts of laser beams transmitted from Earth. This was the first use of light to communicate over such a great distance. Laser tests like these are significant for future communication on Earth and in space because light beams can carry much more information than presently used radio beams.

The Surveyor spacecraft, designed to land softly and work on the Moon, is about 10 feet high. With its tripod landing gear extended, it has a maximum diameter of 14 feet. At launch, it weighs about 2,000 pounds. Landing weight on the Moon, after Surveyor has jettisoned its altitude radar, retroricket, and porpellants is about 600 Earth pounds. This is about 100 pounds on the Moon, whose gravity is one-sixth that of Earth.

Equipment carried by Surveyors varied with the missions. Surveyor I carried only a television camera. Surveyor VII carried every device with which one or more of the earlier Surveyors were equipped.

These included a surface sampler for digging, an alpha scattering instrument for analyses of the soil chemistry, a television camera, and an electromagnet to determine iron content of the soil.

PLANETARY MISSIONS

Beyond the Moon, in its interplanetary research, NASA conducted missions aimed at obtaining information about Venus and Mars. Close-range planetary observations by Mariner II and V partially lifted the veil from cloud-shrouded Venus. And Mariner IV as it swept near Mars photographed, not the famous canals, but a cratered Marscape whose discovery many considered about as startling.

Mariner II probed Venus with instruments from as close as 21,645 miles on Dec. 14, 1962. Mariner V came within 2,500 miles of the planet to check its thick atmosphere blanket.

On July 14, 1965, Mariner IV snapped the first close-range pictures ever taken of another planet as it cruised near Mars at distances ranging from 7,400 to 10,500 miles. It veered as close as 6,118 miles but was then on Mars' night side where lighting was insufficient for photography.

During their multi-million miles to and after passing their planetary objectives, Mariners reported on interplanetary space. Mariner II was in space during a period of relatively low solar activity. Mariners IV and V sent back data during the ascending part of the solar cycle. The cycle is a period of 11 years in which solar activity falls from a high to a low and then rises again to a peak.

Tracking data acquired as the Mariners sped through space are contributing to refinements of important measurements. Among these are the Astronomical Unit, or AU, a yardstick for measurements in the solar system.

The AU is the distance between Earth and the Sun, about 93 million miles. The tracking data are also helping to increase accuracy in estimating the orbits and masses of Mars and Venus.

Mariners IV and V gave scientists unexpected scientific bonuses during August to October 1967. At one time, Mariner IV, Earth, and Mariner V were located along an imaginary line extending radially from the Sun. The spacecraft were about 70 million miles apart with the Earth in between.

With the three observing stations, scientists were able to make simultaneous measurements at three points of the solar wind and the interplanetary magnetic field lines embedded in the wind.

In October 1967, experimenters turned on Mariner IV's picture transmission equipment and fired its rocket engine, operating them for the first time in about two and one half years. The spacecraft was about 56 million miles from Earth when the operations were carried out.

The successful picture transmission and rocket firing that resulted gave engineers confidence for future space missions of longer duration than those to Mars and Venus--such as to Jupiter.

On Jan. 4, 1968, Mariner V's orbit probably carried the spacecraft within about 54 million miles of the Sun. This was closer than any other man-made object has reached to the fiery center of our solar system.

Mariner IV, launched Nov. 28, 1964, continued to talk to Earth until Dec. 20, 1967, more than three years after starting its multi-million mile journey through space. Mariner V, launched June 14, 1967, significantly refined and added to knowledge about Venus gained through Mariner II and other observations.

NASA opened a new series of Pioneer experiments with the launch of Pioneer VI on Dec. 16, 1965. Pioneer VII was launched Aug. 17, 1966, and Pioneer VIII on Dec. 13, 1967.

The purpose of the current Pioneer program is to study interplanetary space continuously from widely separated points in space during an entire solar cycle of 11 years. In a solar cycle, the Sun's activity falls from a maximum to a minimum and then rises again to a maximum.

Among achievements of the new Pioneers is the discovery of the extent of Earth's long magnetic tail--about 3.5 million miles on the side away from the Sun. They have provided man with the broadest picture yet of conditions in interplanetary space and of the nature and interrelationship of interplanetary magnetic fields, the solar wind, and solar cosmic rays. They are contributing to accuracy in forecasting solar flares.

Today's Pioneers are relatively small craft. They are drum-shaped, 35 inches high and 37 inches in diameter. They weigh about 140 pounds on Earth. They are powered by solar cells that convert sunlight to electricity and by rechargeable storage batteries.

Pioneer was also the designation of NASA's first series of interplanetary spacecraft. The most notable of these was Pioneer V, launched March 11, 1960. Radio contact with Pioneer V was maintained until June 26, 1960, when the craft was 22.5 million miles away, marking a communications record for that time.

HISTORICAL SUMMARY
UNMANNED LUNAR AND PLANETARY PROGRAMS

The U.S. unmanned lunar and planetary programs have performed a wide range of missions, with 32 launches in the first decade of U.S. spaceflight. The unmanned lunar program concluded with the launch of Surveyor VII in January, 1968.

Mission and Launch Date	Launch Vehicle and Spacecraft Weight	Highlights
	LUNAR PROGRAM	
Able I Aug. 17, 1958	Thor-Able 84 lb.	First-stage failure.
Pioneer I Oct. 11, 1958	Thor-Able 84 lb.	Probe reached apogee of 70,700 miles. Final stage had premature shutdown.
Pioneer II Nov. 8, 1958	Thor-Able 87 lb.	Third-stage failure.
Pioneer III Dec. 6, 1958	Juno II 13 lb.	Probe reached apogee of 63,580 miles. Final stage had premature shutdown.
Pioneer IV March 3, 1959	Juno II 13 lb.	Passed within 37,300 miles of Moon.
Atlas-Able IV Nov. 26, 1959	Atlas-Able 372 lb.	Launch vehicle shroud failure.
Atlas-Able VA Sept. 25, 1960	Atlas-Able 387 lb.	Second-stage failure.
Atlas-Able VB Dec. 15, 1960	Atlas-Able 388 lb.	First-stage failure.
Ranger III Jan. 26, 1962	Atlas-Agena B 727 lb.	Second-stage failure. Spacecraft passed within 22,862 miles of Moon.
Ranger IV April 23, 1962	Atlas-Agena B 730 lb.	First U. S. lunar impact. Spacecraft failure.
Ranger V Oct. 18, 1962	Atlas-Agena B 755 lb.	Missed Moon by 450 miles. Spacecraft failure.
Ranger VI Jan. 30, 1964	Atlas-Agena B 804 lb.	Impacted Moon. TV system failure.
Ranger VII July 30, 1964	Atlas-Agena D 806 lb.	Impacted Moon. First U. S. lunar success. Returned 4,308 photos.
Ranger VIII Feb. 17, 1965	Atlas-Agena B 809 lb.	Impacted Moon. Returned 7,137 lunar photos.
Ranger IX March 21, 1965	Atlas-Agena B 809 lb.	Impacted Moon. Returned 5,814 photos.

-more-

Surveyor I May 30, 1966	Atlas-Centaur 2,193 lb.	First U.S. soft landing. Returned over 11,150 photos.
Surveyor II Sept. 20, 1966	Atlas-Centaur 2,204 lb.	Crashed on Moon southeast of Copernicus crater. Spacecraft failure.
Surveyor III April 17, 1967	Atlas-Centaur 2,280 lb.	Soft landing. Performed soil sampling and returned over 6,300 photos.
Surveyor IV July 14, 1967	Atlas-Centaur 2,294 lb.	Crashed on Moon in Sinus Medii crater. Spacecraft failure.
Surveyor V Sept. 8, 1967	Atlas-Centaur 2,216 lb.	Soft landing. Made surface chemical analysis and over 19,000 photos.
Surveyor VI Nov. 7, 1967	Atlas-Centaur 2,219 lb.	Soft landing. Made surface chemical analysis and over 30,000 photos; lifted off and returned to lunar surface.
[Surveyor VII Jan. 7, 1968	Atlas-Centaur 2,289 lb.	Soft landing. Soil sampling; chemical analysis; over 10,000 photos (1/15/68)]
Orbiter I Aug. 10, 1966	Atlas-Agena D 853 lb.	First U.S. orbiting success; 206 wide-angle, 11 high-resolution photos.
Orbiter II Nov. 6, 1966	Atlas-Agena D 861 lb.	Returned 206 wide-angle and 205 high-resolution photos.
Orbiter III Feb. 5, 1967	Atlas-Agena D 850 lb.	Returned 153 wide-angle and 144 high-resolution photos.
Orbiter IV May 4, 1967	Atlas-Agena D 860 lb.	Returned 125 wide-angle and 145 high-resolution photos.
Orbiter V Aug. 2, 1967	Atlas-Agena D 862 lb.	Returned 212 wide-angle and 212 high-resolution photos.

PLANETARY PROGRAM

Mariner I July 22, 1962	Atlas-Agena B 446 lb.	Venus probe; launch vehicle failure.
Mariner II Aug. 26, 1962	Atlas-Agena B 447 lb.	First successful flyby of Venus on Dec. 14, 1962 within 21,600 miles of surface; temperature, and magnetic field and charged particle measurements.
Mariner III Nov. 5, 1964	Atlas-Agena D 575 lb.	Mars probe. Launch vehicle shroud failure.
Mariner IV Nov. 28, 1964	Atlas-Agena D 575 lb.	Passed 6,120 miles from Mars on July 14, 1965; measured atmospheric density; returned 21 photos.
Mariner V June 14, 1967	Atlas-Agena D 540 lb.	Passed within 2,600 miles of Venus on Oct. 19, 1967; measured magnetic field and atmospheric properties.

# # #

NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
September 29, 1968

TENTH ANNIVERSARY SPECIAL (5)

MERCURY, GEMINI PIONEERED MANNED FLIGHT

In its first decade, the National Aeronautics and Space Administration developed successfully the spacecraft, launch vehicles, launch facilities, flight operations team and management structure it needs to land U.S. astronauts on the Moon next year.

In Mercury and Gemini, the United States established 20 manned space flight world records which include almost 2,000 man hours in space and distance traveled of more than 17 million miles.

The third major program in the NASA Manned Space Flight effort is Apollo, which is designed to land men on the Moon and return them safely to Earth in this decade. This goal was established by President John F. Kennedy in May 1961. To date, 16 unmanned Apollo missions have been flown successfully.

-more-

Preparations are underway for launching the first manned Apollo mission, Apollo 7, October 11.

MERCURY UNDERWAY

The first phase of the manned flight program, Project Mercury, was initiated seven days after NASA was established. Its objective was to launch a man into orbit and return him safely to Earth.

This objective imposed a challenge upon the available engineering and technology to design and develop a spacecraft which would provide the astronaut a habitable environment, shield him from the environment of space, withstand the aerodynamic forces imposed by rocket-powered flight and survive temperatures of up to 3,000 degrees F. during reentry into Earth's atmosphere.

The engineering design concepts employed to accomplish the task were successfully demonstrated through sub-orbital flight tests, including the manned flights by Astronauts Alan B. Shepard, Jr. on May 5, and the late Virgil "Gus" Grissom on July 21, 1961.

The Project Mercury objective was achieved Feb. 20, 1962, when John H. Glenn, Jr. completed a three-orbit mission. The succeeding missions by M. Scott Carpenter and Walter M. Schirra, Jr. later that year and the final orbital flight by L. Gordon Cooper, Jr. in May 1963 demonstrated that man could not only survive in weightlessness but also could operate efficiently as a pilot-engineer-experimenter for as long as 34 hours.

GEMINI PROGRAM

The Gemini program was announced in December 1961 to advance the capabilities of man to explore space for up to two weeks duration, and to perfect operational techniques of rendezvousing and docking vehicles in space, a requirement of the Apollo lunar landing mission.

Named for the twin stars, Castor and Pollux in the third zodiacal constellation, the Gemini spacecraft accommodated a two-man crew. Two unmanned test flights preceeded 10 manned missions during 1965 and 1966. Sixteen astronauts participated.

The long duration flights of four, eight and 14 days confirmed, from a medical viewpoint, that man could carry out the Apollo lunar landing mission. Although physiological changes occurred, they were of a temporary nature and did not impair the ability of the crews to carry out prescribed tasks. No abnormal psychological reactions were observed and no vestibular disturbances occurred during flight.

Gemini pilots carried out ten rendezvous maneuvers with other orbiting spacecraft using seven different rendezvous modes. Nine dockings were achieved with Agena target vehicles and its propulsion system was used to achieve altitudes up to 853 statute miles for the combined spacecraft.

Astronauts demonstrated that work can be performed outside of a spacecraft in more than 12 hours of extra-vehicular activity (EVA). This will be extremely valuable in the Apollo program and in future manned space operations.

A station-keeping exercise was performed by the undocked spacecraft and Agena connected by a tether. This technique requires minimum use of fuel and may find application in providing artificial gravity in future manned space operations.

Gemini proved that man could operate effectively in space, respond to the unexpected, and execute alternate and contingency plans when necessary.

Also, the NASA flight operations teams, supported by the Department of Defense recovery forces and the U.S. Weather Bureau, achieved the capability of meeting unexpected situations quickly.

-more-

The Gemini experiments program further demonstrated man's ability to perform precise and useful functions in space. The 52 different experiments conducted in Gemini included 17 scientific experiments in astronomy, biology, geology, meteorology and physics. Over half employed photographic techniques which yielded approximately 2,400 color pictures for study of the Earth's terrain and weather.

Technological experiments included 15 investigations for the Department of Defense and 12 in support of NASA programs. Eight medical experiments provided data on the space pilots.

APOLLO UPCOMING

When NASA was established, its aerospace engineers and scientists foresaw the time when man would travel far out into space and explore the Moon, Earth's natural satellite. Because such missions would require high thrust propulsion systems, development of the F-1 engine, rated at 1.5 million pounds' thrust, was initiated in December 1958.

Studies for future manned space systems, a concept called Project Apollo, were outlined to the U.S. aerospace industry in July 1960. The project called for development of a three-module spacecraft to carry three astronauts to fly around the Moon.

The clustered Saturn H-1 engines with high-energy upper stages would serve as the launch vehicles. Development of the 200,000-pound-thrust liquid hydrogen fueled J-2 engine was undertaken a month earlier. Subsequently, the F-1 and J-2 were selected to power the Apollo Saturn V launch vehicle.

A year later the Congress endorsed President Kennedy's proposal to accomplish a manned lunar landing in this decade, and the Apollo program became NASA's principal manned space flight undertaking.

Sixteen unmanned Saturn launch vehicle flights confirmed Apollo engineering concepts and qualified all systems for manned missions.

Ahead are two manned missions in 1968 and five in 1969, culminating in landing three astronauts on the Moon and returning them safely to Earth.

Five landing sites on the Moon have been selected from data provided by the unmanned Lunar Orbiter and Surveyor programs. Geophysical experiments have been developed to be placed on the Moon by astronauts after they have scooped up and stowed about 50 pounds of surface samples for return to Earth.

The scientific instruments on the Moon will transmit data on the lunar surface environment for one to two years after the crew returns. The surface samples returned to Earth will be thoroughly analyzed by more than 100 scientists, including 29 from six foreign nations.

Although the Apollo fire in January 1967 delayed manned missions for almost two years, it has resulted in a vastly improved spacecraft from the standpoint of safety. Non-flammable materials and coatings replaced most of those previously used, and additional safety procedures were adopted throughout the ground test and pre-launch operations.

APOLLO APPLICATIONS

Apollo Applications flights are scheduled to begin in 1971. Modified Saturn vehicles and spacecraft will be used to launch men on long-duration space missions for numerous scientific, technological and engineering investigations.

Initially, the fuel tank of a Saturn IB second stage (S-IVB) will be converted into living space in orbit after the stage has performed its propulsive functions.

-more-

The 10,000-cubic-foot liquid hydrogen tank will provide living quarters and laboratory area for three astronauts. An airlock and spacecraft docking adapter will be mounted to the stage before launch. The crew will be placed in orbit by a second Saturn IB to rendezvous and dock their Apollo command module to the workshop. Three different crews are to visit the workshop; the first for 28 days and the second and third for up to 56 days each.

Extensive biomedical experiments and multi-band photography of the Earth will be conducted. On the third Saturn I Workshop mission, the Apollo telescope experiment will provide astronomers with their first opportunity to observe the Sun's behavior unobstructed by Earth's dense atmosphere.

The national investment in the Apollo program, estimated at approximately $24 billion, will provide the nation with the capability for man to explore space far beyond the immediate goal of landing on the Moon.

The Saturn IB and Saturn V can boost payloads of 20 and 140 tons respectively into Earth orbit. Modifications to the vehicles and associated launch and ground test facilities can increase this payload capability about 50%.

Therefore, if at some future date, it should be in the national interest to conduct Earth-orbital missions of several years duration, or extensive exploration on the lunar surface, Apollo flight vehicles, ground facilities and management teams could provide the means to accomplish such undertakings.

WORLD RECORDS FOR MANNED SPACE FLIGHT

1. Longest Duration Manned Space Flight: 330 hours, 35 minutes, 17 seconds by Frank Borman and James A. Lovell, Jr. of Gemini 7. Old record of 190 hours, 56 minutes, set by Gemini 5 astronauts L. Gordon Cooper, Jr., and Charles P. Conrad on Aug. 21-29, 1965.

2. Total Man Hours in Space for One Nation (elapsed time, liftoff to splashdown): 1993 hours, 43 minutes, 53 seconds by the United States.

3. Longest Multimanned Space Flight: 330 hours, 35 minutes set by Gemini 7, surpassing the 190 hours, 56 minutes set by Gemini 5.

4. Most Miles Traveled on a Manned Space Flight: 5,716,900 miles by Gemini 7, surpassing the 3,338,000 miles by Gemini 5.

5. First Rendezvous of Two Manned Maneuverable Spacecraft: Gemini 7 and Gemini 6 flew for 20 hours, 22 minutes within 62 miles of each other, including a minimum distance of within one foot.

6. First Docking of Two Orbiting Spacecraft: Gemini 8 with Agena 8.

7. Individual With Most Space Flight Time: Astronaut James A. Lovell, Jr., 425 hours, 9 minutes, 31 seconds, exceeding Frank Borman, 330 hours, 35 minutes; Charles Conrad, 262 hours, 13 minutes, 8 seconds; L. Gordon Cooper, 225 hours, 15 minutes, 47 seconds.

8. Most Manned Space Flights: United States, 16.

9. Most Astronauts Making Space Flights: United States, 26, including seven who made two flights.

10. Most Manned Flights in One Year by One Nation: United States, 5 in 1965 and again in 1966.

-more-

11. Most Men Sent into Space in One Year by One Nation: 10 by United States in 1965 and again in 1966.

12. Total Manned Spacecraft Hours: 1015 hours, 47 minutes, 40 seconds by United States.

13. Dual Rendezvous: Gemini 10 first achieved rendezvous with a cooperative target, Agena 10, and then, after a series of maneuvers utilizing Agena as well as Gemini maneuvering capability, achieved rendezvous with a passive target, Agena 8.

14. Altitude: Following a 40½ second burn of the Agena 11 primary propulsion system while docked, Gemini 11 reached a record high altitude of 853 miles at apogee on September 14, 1966, surpassing Gemini 10 altitude of 475 miles.

15. First Orbit Rendezvous: Rendezvous with Agena 11 was achieved by Gemini 11 spacecraft and crew two-thirds of way through the first revolution, with initial docking over southern United States.

16. First Tethered Flight: After undocking from Agena 11, Gemini 11 was backed away 100 feet to the end of a tether, after which a downward thrust was applied to establish an essentially in-plane rotation. The centrifugal force between the tethered Gemini and Agena resulted in artificial gravity of approximately 0.00015 g.

17. Distance Traveled in Manned Space Flight: Mercury and Gemini combined, 17,616,810 miles.

18. Single EVA: Eugene Cernan, two hours, 7 minutes outside Gemini 9 on June 5, 1966, surpassing Edwin E. Aldrin, Jr.'s two hours, six minutes on Nov. 12, 1966.

19. Total EVA for One Flight: Edwin E. Aldrin, Jr., five hours, 30 minutes, Gemini 12.

20. Total EVA Time for Gemini Program: 12 hours, 25 minutes.

APOLLO PROGRAM FLIGHT SUMMARY

Mission Designation	Launch Date	Mission Description
Apollo Saturn IB (AS - 201)	February 26, 1966	unmanned, suborbital, space vehicle development flight, demonstrated space vehicle compatibility and structural integrity; spacecraft heat shield qualification for Earth orbital reentry speeds.
Apollo Saturn IB (AS - 203)	July 5, 1966	unmanned, orbital, launch vehicle development flight; demonstrated second stage restart and cryogenic propellants storage at zero g conditions. Liquid hydrogen pressure test.
Apollo Saturn IB (AS - 202)	August 25, 1966	unmanned, suborbital, space vehicle development flight; demonstrated structural integrity and compatibility, spacecraft heat shield performance.
Apollo 4	November 9, 1967	First Apollo Saturn V flight, unmanned, Earth orbital to 11,234 miles apogee, space vehicle development flight. Demonstrated Saturn V rocket performance and Apollo spacecraft heat shield for lunar mission reentry speeds.
Apollo 5	January 22-23, 1968	first Apollo lunar module flight on Saturn Ib, unmanned, Earth orbital. Demonstrated spacecraft systems performance, ascent and descent stage propulsion firings and restart, and staging.
Apollo 6	April 4, 1968	second flight of Saturn V, unmanned, Earth orbital, launch vehicle development flight. Demonstrated Saturn V rocket performance and Apollo spacecraft subsystems and heat shield performance.

NOTE: Ten previous successful Saturn I vehicle tests were conducted during 1961-65.

NASA MANNED SPACE FLIGHTS

Project	Date	Pilot (s) *rank at present	Time in Space	#Orbits or Revs.
MERCURY				
Mercury Redstone 3 "Freedom 7"	May 5, 1961	Naval Comdr. Alan B. Shepard *Capt.	0:15:22	suborbital
Mercury Redstone 4 "Liberty Bell 7"	July 21, 1961	Air Force Maj. Virgil I. Grissom *Lt. Col. (deceased)	0:15:37	suborbital
Mercury Atlas 6 "Friendship 7"	Feb. 20, 1962	Marine Lt. Col. John H. Glenn *retired	4:55:23	three orbits
Mercury Atlas 7 "Aurora 7"	May 24, 1962	Naval Lt. Comdr. Scott Carpenter *Comdr.	4:56:05	three orbits
Mercury Atlas 8 "Sigma 7"	Oct. 3, 1962	Naval Comdr. Walter M. Schirra *Capt.	9:13:11	six orbits
Mercury Atlas 9 "Faith 7"	May 15-16, 1963	Air Force Maj. L. Gordon Cooper *Col.	34:19:49	22 orbits
		***		
GEMINI				
Gemini 3 "Molly Brown"	March 23, 1965 Recovery Ship - Intrepid	Air Force Maj. Virgil I. Grissom Naval Lt. Comdr. John W. Young *Lt. Col. Grissom *Comdr. Young	4:53	three orbits
Gemini 4 EVA - 20 min.	June 3-7, 1965 Recovery Ship - Wasp	Air Force Majors James A. McDivitt and Edward H. White II *Lt. Cols. (White is deceased)	97:56	62 revs.
Gemini 5	Aug. 21-29, 1965 Recovery Ship - Lake Champlain	Air Force Lt. Col. L. Gordon Cooper Naval Lt. Comdr. Charles Conrad, Jr. *Col. Cooper *Comdr. Conrad	190:56	120 revs.

-more-

Project	Date	Pilot(s)	Time in Space	#Orbits or Revs.
Gemini 6	Dec. 15-16, 1965 Recovery Ship - Wasp	Naval Capt. Walter M. Schirra Air Force Maj. Thomas P. Stafford *Capt. Schirra *Lt. Col. Stafford	25:51	16 revs.
Gemini 7	Dec. 4-18, 1965 Recovery Ship - Wasp	Air Force Lt. Col. Frank Borman Naval Comdr. James A. Lovell *Col. Borman *Capt. Lovell	330:35	206 revs.
Gemini 8	March 16, 1966 Recovery Ship - Leonard F. Mason	Neil A. Armstrong, civilian Air Force Maj. David R. Scott *Lt. Col. Scott	10:42	7 revs.
Gemini 9A EVA of 2 hrs. 7 min. (umbilical)	June 3-6, 1966 Recovery Ship - Wasp	Air Force Lt. Col. Thomas P. Stafford Naval Lt. Comdr. Eugene A. Cernan *Lt. Col. Stafford *Comdr. Cernan	72:21	44 revs.
Gemini 10 EVA - 39 min. umbilical & 49 min standup	July 18-21, 1966 Recovery Ship - Guadalcanal	Naval Comdr. John W. Young Air Force Maj. Michael Collins *Comdr. Young *Lt. Col. Collins	70:47 (highest altitude 475 S. M.	43 revs.
Gemini 11 EVA 33 min umbilical & 2 hrs. & 5 min. of standup	Sept. 12-15, 1966 Recovery Ship - Guam	Naval Comdr. Charles Conrad Naval Lt. Comdr. Richard F. Gordon, Jr. *Comdr. Conrad *Comdr. Gordon	71:17 (highest altitude 853 S. M.)	44 revs.
Gemini 12 EVA - 2 standup EVAs, 2 hrs. & 29 min. & 55 min.; umbilical, 2 hrs. & 6 min.	Nov. 11-15, 1966 Recovery Ship - Wasp	Air Force Maj. Edwin E. Aldrin, Jr. Naval Capt. James A. Lovell, Jr. *Lt. Col. Aldrin *Capt. Lovell	94:35	59 revs.

# # #

NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
September 29, 1968

TENTH ANNIVERSARY SPECIAL (6)

TRACKING AND DATA ACQUISITION

How does the National Aeronautics and Space Administration keep track of what's up there?

Because of the efforts of NASA's Tracking and Data Acquisition complex, a spacecraft is not just a small speck in space, but is linked to ground stations, computers, laboratories, scientists and engineers. It is always known where the spacecraft is, where it's going, where it's been, when its routing must be changed and the general conditions of the spacecraft as it moves through space.

To do all this it is necessary to track, receive telemetry, control and command and communicate with the vehicle even though it may be as far away as the other side of the Sun.

-more-

Tracking provides the information necessary to know precisely where the spacecraft is no matter if it is launched on a ballistic arc of a few hundred miles or is in a deep space probe more than a hundred million miles from Earth.

A scientist or engineer must know the spacecraft's location so that an experiment can be turned on, for example, or so that guidance or other information can be sent for a change in flight plan. Other reasons include the scientific necessity for accurate satellite location for interpretation of sensor data, true orbital information for use by all stations in a network in pointing their antennas and for calculations of effects on the spacecraft of space and other phenomena.

Telemetry involves the measuring of a quantity or quantities, transmitting these data to a ground station and there recording and interpreting the information. That is, a sensor reacts to an event, be it solar pressure or an astronaut's heartbeat, which is transformed into an electrical signal and transmitted to the ground for recording and decoding. The resulting information flows into computers which then feed data to technical or scientific personnel.

Command and control of the spacecraft involves directing a satellite to perform a specific function as it passes over succeeding stations or passes out of view on a deep space mission as the Earth turns under it.

This might be a command to a meteorological satellite to snap a sequence of pictures over a particular area or to transmit these photos to Earth. Or on manned missions particularly, information must be gathered and displayed quickly at a central location as soon as it happens. In all cases a global network is kept informed of a spacecraft's location so that a particular mission can be performed successfully.

THREE NETWORKS

To accomplish the various missions, three basic NASA networks have been established. They are: The Manned Space Flight Network (MSFN), the Deep Space Network (DSN), and the Space Tracking and Data Acquisition Network (STADAN).

These three networks consist of 26 sites, some single network sites, others of multiple purpose, located in 15 countries including the United States. Each network is designed to support specific types of missions, depending on whether it is near Earth, manned or in deep space.

The MSFN has five stations located in U.S. territory, ten in foreign and, in addition, four instrumentation ships and eight aircraft, to provide support for Apollo, the nation's man-to-the-Moon program. The network consists of: 30-foot-diameter antennas located at Cape Kennedy, Fla., Bermuda, Antigua, Ascension, and Canary Islands; Carvarnon, Australia; the islands of Guam and Kauai, Hawaii; Guaymas, Mexico, and Corpus Christi, Texas; and three 85-foot antennas, spaced about 120 degrees apart at Mardid, Spain; Canberra, Australia and Goldstone, Calif.; and a transportable 30-foot diameter antenna at Grand Bahama Island. In addition, the DSN facilities with 85-foot diameter antennas located at the last three sites have been modified to support the missions.

The aircraft are used to provide communications with the astronauts during the critical period when the spacecraft is injected into the trajectory to the Moon and upon return, reentry, as well as to receive telemetry from the spacecraft.

With Apollo missions spaced as close together as 70 days, the MSFN must conduct a high level of effort to be ready for the different missions including comprehensive simulations of a mission beginning weeks before launch. This effort is conducted in coordination with the Mission Control Center (MCC), Houston, Tex. Goddard Space Flight Center, Greenbelt, Md., has operational responsibility for the MSFN.

The NASA Communications Network, NASCOM, also a Goddard responsibility, provides a world-wide two million miles of communications circuitry--teletype, voice and digital data links between the stations and control centers for the MSFN and the unmanned DSN and STADAN. One of the most critical functions of the world-wide network is obtaining data and transmitting it at high speed to control centers. Tracking data from the sations goes by high speed communications circuits to computing complexes at Goddard and Houston.

DEEP SPACE NET

The Deep Space Network has six stations including four in foreign countries. They are located at 120 degree intervals of longitude so that among three stations one will always have line-of-sight communications with a lunar or planetary mission as the Earth rotates.

The network is operated by the Jet Propulsion Laboratory, Pasadena, Calif., where the network control center is located.

DSN stations were first located at Goldstone, Calif.; Woomera, Australia; and Johannesburg, South Africa. Later more facilities were added at Goldstone, at Canberra, Australia and near Madrid, Spain. In addition to three 85-foot-diameter antennas at Goldstone which have been used to track such missions as the Pioneers, Mariners, Lunar Orbiters and Surveyors, a new 210-foot-diameter antenna has been made available for DSN use. The 210 is the largest fully-steerable spaceflight antenna in the world.

Even when spacecraft are more than 100 million miles from Earth these powerful antennas can track them to within an accuracy of 45 feet.

THE STADAN NET

The Space Tracking and Data Acquisition Network (STADAN) consists of 14 stations, ten of them located outside the United States in cooperation with other nations.

STADAN forms two "fences" around the world. One of these is north-south, the other east-west. As a result, when a satellite circles the Earth it must pass over one or the other "fences."

The prime key station and center of the world-wide network is at Rosman, N.C., with a companion facility at Fairbanks, Alaska. Information from these stations and the others around the world is reported to Goddard Space Flight Center which operates the network. Two more STADAN stations in the United States are located at Ft. Myers, Fla., and Goldstone, Calif.

The STADAN facilities include the Minitrack (Minimum Weight Tracking), which consists of a stationary antenna of steel rails lying parallel to the ground, a movable parabolic or dish-shaped antenna and a mutiple element yagi array antenna for telemetry reception.

The Minitrack facilities have a receiving antenna which operates with a simple reception pattern much like a fan. As a spacecraft passes through the fan pattern the beacon signal of the transmitter on board is picked up by the ground equipment and the spacecraft's direction is determined with great accuracy.

The dish antenna not only can receive but also can transmit commands to the satellite as it passes overhead. Also, the dish antenna can swing from the horizon to directly overhead and a full 180 degrees left or right. It locates the spacecraft far away and follows its flight, gathering data to calculate parameters as well as information data from experiments.

To complement the data acquisition functions of the dish antenna systems, a wide-beam yagi type antenna system is also used.

Foreign stations are located at Canberra, and Toowoomba, Australia; St. John's, Newfoundland, Canada; Santiago, Chile; Lima, Peru; Quito, Ecuador; Winkfield, England; Tananarive, Madagascar; and Johannesburg, South Africa.

SMITHSONIAN AID

Still another method of receiving tracking information is through the Smithsonian Astrophysical Observatory's (SAO) Optical Tracking Network. The SAO operates this network under a NASA grant.

This network consists of 12 specially-designed satellite tracking cameras, Baker-Nunn, to photograph satellites in space. SAO cameras have taken pictures of the grapefruit-sized Vanguard Satellite at a distance of 3,500 miles and the six-foot-long Orbiting Geophysical Observatory at 23,000 miles.

The camera takes a picture against a star background with the object appearing as a "trace" on the photograph.

For the Apollo missions, NASA's Manned Space Flight Network had to undergo extensive alterations to accommodate the greater volume of information exchanged with ground stations over longer periods of time and at greater distances than in Gemini and Mercury.

The Apollo Unified S-Band System (USB) was developed to accommodate the greater needs. It combines in one transmission the multiple functions previously requiring four separate systems. These include tracking to determine flight path and spacecraft velocity, commanding the spacecraft via coded radio signals, receiving coded radio signals or telemetry on the condition of the spacecraft--batteries, fuel, temperatures and voice communications.

The USB network consists of 14 stations; ten land stations equipped with 30-foot diameter antennas, three with 85-foot antennas, and one with a transportable, erectable 30-foot antenna.

# # #

NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
September 29, 1968

TENTH ANNIVERSARY SPECIAL (7)

INTERNATIONAL COOPERATION ACHIEVED

Solid progress in international space cooperation has marked the first decade of space exploration. On this foundation, nations large and small can build in pursuing together this challenging and rewarding area of scientific and technical effort.

The wealth of discovery achieved during the past decade only convinces us of the nearly limitless possibilities for the advancement of human knowledge which lie ahead as man develops his capability to explore the regions beyond the Earth.

The Congress of the United States recognized the importance of international space cooperation in framing the National Aeronautics and Space Act of 1958. It provides that "the aeronautical and space activities of the United States shall be conducted so as to contribute materially to.... cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof...."

-more-

How has the National Aeronautics and Space Administration, created by the Act, carried out its international cooperative responsibilities?

The fields of communications, meteorology and Earth resources surveying offer examples of the role of international cooperation in the contributions of space exploration to these three important fields of activity.

These projects have engaged the efforts of scientists and engineers in many countries. In 1961, several countries entered into cooperative agreements with NASA to explore the upper atmosphere by means of sounding rocket experiments. Sounding rockets fly to various altitudes as high as 1,000 miles and radio to Earth data on the nature of the upper regions before falling back to Earth.

These rockets cost only a few thousand dollars, require relatively simple launching and tracking facilities and carry inexpensive instrumented payloads. Much useful data on conditions affecting radio transmissions as well as valuable scientific information on the nature of the upper atmosphere have been obtained from experiments with some 350 sounding rockets carried out by some 20 countries in cooperation with the United States.

In 1962 a scientific satellite, designed, engineered and funded by the Canadian telecommunications establishment, was placed in Earth orbit by a NASA Thor-Agena rocket. The satellite, Alouette I, for the first time measured electron densities from above as it circled the Earth at an altitude of some 600 miles. Alouette I has provided valuable data contributing to an understanding of the behavior of radio waves for a record period of more than five years.

Other scientific satellites prepared by France, Italy and the United Kingdom and the 10-nation European Space Research Organization have been launched by NASA in cooperative projects which have produced a wealth of data about the region between 100 and 600 miles above the Earth, including San Marco II, an Italian project launched from a platform in the Indian Ocean.

Many scientists and engineers cooperated to solve the problems posed by the early experimental communications satellites. Experience gained from these satellites, Relay, Telstar and Syncom, paved the way for establishment in 1964 of the International Telecommunications Consortium (Intelsat). Sixty-one nations are now members of Intelsat. Its four synchronous satellites with a total of 960 channels carry telephone, teleprinter and television signals between all member nations that have installed ground terminals.

Satellite transmissions have the advantages over intercontinental land lines in that they are not restricted by geographic factors and are relatively simple since only a single relay, the one on the satellite, is used.

But satellite communications is still in its infancy and international cooperation will continue to play an important role in the development of space communications systems which will provide instantaneous voice and picture transmissions between peoples in all parts of the world.

Meteorology and its application to weather forecasting have benefited from international cooperation in space. Sounding rocket and satellite experiments in which many countries have joined have given scientists new data which is helping us to better understand weather and weather forecasting.

Effective weather analysis depends upon data collected on a global basis. Space age techniques for the first time make possible both the daily assemblage of data on a worldwide basis and the continuous observation of hurricanes and major storms.

In 1961, 42 countries accepted an invitation to take part in weather observations which were coordinated with cloud photography obtained by the United States' first weather satellite, TIROS (Television Infrared Observation Satellite).

Beginning with TIROS VIII in 1963 and continuing with the experimental Nimbus and the operational ESSA satellites, United States' meteorological spacecraft have been equipped with a television system called automatic picture transmission (APT).

APT enables a weather satellite to take cloud cover pictures over wide areas of the globe and immediately transmit them directly to simple and inexpensive ground stations. The photographs covering an area some 1,200 miles square can be used to provide useful information to weather services, farmers, fishermen and others for whom weather data is highly important.

Already in such widely separated areas as Japan, the Fiji Islands and Malagasy, prompt information on typhoons and other severe storms, provided by APT, has been instrumental in avoiding loss of life and damage to property.

An interesting cooperative meteorological project has been agreed to by NASA and the French National Space Commission. Project Eole will used an Earth-orbiting satellite to obtain global wind data from several hundred constant-level balloons.

France is developing the satellite, to be placed in orbit in 1969 by a NASA Scout rocket, the long-life balloons and the miniaturized instruments and transmitters with which each balloon will be equipped.

Project Eole is expected to provide data of the kind needed by the proposed World Weather Watch being planned by the UN World Meteorological Organization.

This is but one example of the contributions of international space exploration to the science of meteorology and its useful application for worldwide human benefit.

One of the newest and most interesting areas of space exploration is that of Earth resources surveying. Aircraft equipped with new types of instruments have been experimenting with promising techniques which may permit measurement of the flow of rivers, the health of crops, the condition of forests and many other characteristics of our natural resources.

This information, acquired rapidly and on a global basis by satellites, could be used to assist farmers, fishermen, transportation managers, conservationists and others.

The hopeful possibilities for Earth resources surveying provide an excellent example of the way in which science and technology can develop hand in hand as space exploration progresses. Biologists, oceanographers and geologists are learning the importance of a synoptic or overall view of parts of the Earth and engineers are making such observations possible through the development of more sensitive instruments which provide a greater volume of more detailed measurements than was previously available.

A cooperative international project, begun in early 1968, involves teams from Brazil, Mexico and NASA in developing techniques and systems for acquiring, interpreting and utilizing Earth resources data obtained from aircraft.

It is too early to know what the results of this project will be but scientists and engineers in many countries are becoming interested in the potential benefits to be gained from Earth resources surveying.

Much of the scientific interest in space exploration centers on the wealth of new data which can now be obtained about the Sun and its relationship with the Earth. Scientists have long recognized that the thick blanket of Earth's atmosphere prevents them from observing and measuring solar radiation and the characteristics of space between us and the Sun.

Already scientists and agencies of some 83 countries have engaged in various forms of space cooperation with the U.S. In both the manned and unmanned missions of the future, the scientists and engineers of many countries will play an important part.

NASA's international activities recognize the interests of United States and foreign scientists, establish a basis for sound programs of mutual value and contribute substantively and literally to the objectives of international cooperation.

The United States and the USSR are the two countries carrying on the most comprehensive programs of space exploration. What is the extent of space cooperation between them? The United States and the USSR have engaged in limited cooperation in four areas of space exploration: meteorology, exchange of magnetic field data, communications and a joint review of space biology and medicine.

The NASA does not regard its program of space exploration as a race with the Soviet Union or any other nation. The United States program is a serious scientific effort to be pursued, whatever other nations may do. President Johnson has said, "I want to renew today, America's offer to cooperate fully with any nation that may wish to join forces in this last -- and greatest -- journey of human exploration. Space is a frontier common to all mankind and it should be explored and conquered by humanity acting in concert."

# # #

NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
September 29, 1968

TENTH ANNIVERSARY SPECIAL (8)

NEW TECHNOLOGY UTILIZED

To build machines that can operate and keep men alive in space is stretching the skills and expanding the knowledge of American scientists and engineers in practically every field of technology.

They have had to design valves, pumps, filters, and switches that function with a reliability never before achieved. They have created miniature medical sensors of unprecedented sensitivity to monitor the astronauts' reactions to stress. They have vastly extended the range of communications equipment.

They have developed compact new electronic parts, new long-life power sources, new alloys, new adhesives, new lubricants. They have invented ingenious tools and techniques for shaping and joining metals.

-more-

They have broken new ground in materials science to fashion a heat shield that will withstand the 5,000-degree temperature of reentry into the Earth's atmosphere at 25,000 miles-per-hour. For manned flight, they have devised high-performance heating, cooling, ventilating, and water-repurification systems.

Much of this new technology is also proving useful in industry, medicine, and other non-aerospace applications as an extra dividend from the Nation's investment in space research and development.

For example, a technique that was devised to clarify spacecraft photos of Mars and the Moon by putting the signals through a computer is now being further developed to clarify medical X-rays. The National Aeronautics and Space Administration studies of airplane landing accidents on wet runways led to a way of grooving the surface to reduce skidding, and this is now being done to highways to reduce automobile accidents on rainy days.

An electromagnetic hammer that smooths weld seams without weakening the metal, invented for building the giant Saturn V rocket, is now being tried in shipyards, airplane factories, and automobile plants.

-more-

HOW IT WORKS

Such innovations are made known to potential users by NASA through its Technology Utilization Program. Here's how it works:

Technical information specialists in NASA field centers continuously review research and development projects for promising new ideas. In addition, contractors are required to report inventions, discoveries, innovations, and improved techniques they develop in their work for NASA.

Reports from the centers and contractors are reviewed by independent research institutes, and ones that appear to have non-aerospace uses are announced in technical bulletins, called Tech Briefs, or in more detailed Technology Utilization publications.

The Office of Technology Utilization also sponsors several experimental dissemination projects. In one, a number of universities operate centers that provide industrial companies with specialized information services based on NASA's worldwide collection of nearly 400,000 scientific and technical documents. Another center reviews NASA computer programs to see which ones might useful to others and sells these at the cost of reproducing them.

In the medical field, three NASA-supported teams of scientists and engineers help researchers define technical problems currently holding up their progress and then seek solutions from NASA technical documents and experts at NASA laboratories.

SOME INNOVATIONS

Besides broad advances in the state-of-the-art stimulated by space research, NASA has announced more than 2,500 individual technical innovations of potential value in non-aerospace fields, and several hundred more are being reviewed for possible commercial value. Users of the information aren't required to report back to NASA, but many do. Following are some typical cases from the files of the Office of Technology Utilization:

... A 24-ounce, battery-operated television camera no bigger than a king-size pack of cigarettes, which photographs the separation of Saturn V rocket stages in flight, is on sale in a commercial version for monitoring industrial processes.

... Bearings now being marketed are coated with a ceramic-bonded dry lubricant developed for use at high temperatures in a vacuum where other lubricants evaporate away.

... Research done in developing models to display spacecraft trajectories has resulted in the marketing of a new educational device that enables a student quickly to determine the relative positions of the planets on any day in this century.

... A modification of a NASA technique of polishing metal masters for shaping elliptical glass mirrors is being used industrially in making projectors of bowling scores.

... New alloys have resulted from a discovery by NASA metallurgists that a hexagonal crystal structure makes better bearings than any other form of crystal structure; these alloys will be useful in many industrial applications and possibly in making artificial hip joints.

MEDICAL BY-PRODUCTS

In the medical field, other practical by-products from space research include:

... Electronic sensors that were used to keep tabs on astronauts during Mercury and Gemini flights have been adapted to continuously measure the pulse, respiration rate, temperature, and blood pressure of heart patients in hospitals.

... The basic idea of the space helmet has been used in the design of a hood worn by patients in a children's clinic so that their consumption of oxygen can be measured while they perform exercises.

... A plastic-metallic spray for attaching heart electrodes to test pilots is being used experimentally in equipment with which electrocardiograms of ambulance patients can be flashed ahead by radio to a hospital receiving room.

.... A sensor designed to count meteorite hits on a spacecraft is the basis of an instrument that, by measuring muscle tremors, may help doctors in early detection of certain neurological ailments, including Parkinson's disease.

... A meter used to measure stresses inside a solid-fuel rocket is being used to measure the elasticity of bones in living people in a study of why bones become brittle with aging.

... Techniques developed for building and assembling biologically sterile spacecraft to explore the planets are being applied in the design of hospital operating and recovery rooms.

... An instrument designed to measure air pressure on small flight models in wind-tunnel tests has been adapted to measure blood pressure. The sensor is so small it can be inserted through a hypodermic needle and pass along an artery into the heart.

# # #

NEWS NASA
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546
TELS. WO 2-4155
WO 3-6925.

FOR RELEASE: SUNDAY
September 29, 1968

TENTH ANNIVERSARY SPECIAL (9)

LAUNCH VEHICLES

The first decade of space exploration is largely a story of the growth of launch vehicle lift capacity since the primary task is "to get there."

The first U.S. orbital attempts, for example, were made with the Vanguard, which could place a weight of about 56 pounds into orbit. Today's Saturn V has orbited a total weight of over 278,000 pounds.

-more-

VANGUARD

On Sept. 9, 1955, the Department of the Navy was authorized to start rocket development for the launch of America's International Geophysical Year Satellite. The rocket's design was to be based on an earlier scientific sounding rocket, the Viking, which had its first flight in May of 1949.

For its time, Viking was the largest and most ambitious of this country's sounding rockets and had the most advanced liquid propellant engine. The choice of this system was recommended by two features--it was the only one then in existence which had been designed from the start for scientific payloads, and its development would least interfere with the Nation's military missile programs.

On July 29, 1955 the United States had formally announced its intention to launch a satellite in support of the International Geophysical Year (1957-8). The IGY satellite program was to be entirely for scientific purposes. The Department of Defense was to supply the rocketry; scientific responsibility was assigned to the American Academy of Sciences and fiscal responsibility to the National Science Foundation. This program was later to be called Vanguard.

-more-

EARLY FAILURES

By spring of 1956 the Vanguard rocket basic design had been completed (see table, "Launch Vehicles"). This structure got its first flight test on Oct. 23, 1957 when a live first stage with dummy upper stages was launched from the (then) Cape Cannaveral on a 109-mile-high, 335-mile-long trajectory.

On Dec. 6 the first Vanguard with three live stages failed to launch a test satellite--settling back on the pad and exploding. On Feb. 5, 1958 the next attempt failed after 57 seconds' flight, with the rocket veering off course and breaking apart at 20,000 feet. Vanguard successfully placed its first payload (3.25 lbs.) in orbit on March 17, 1958.

Vanguard had four more failures, then placed Vanguard II in orbit Feb. 17, 1959; the program came to an end with the orbiting of Vanguard III in September, 1959. The rocket's upper stages were used in later combinations.

Meanwhile, the Soviet Union had already succeeded in placing the first man-made object in Earth orbit--Sputnik I, on Oct. 4, 1957. The active payload weighed about 184 lbs., but had attached to it a spent rocket casing estimated at four tons. On Nov. 3, Sputnik II was placed in orbit with a payload weight of 1,120 lbs., carrying the dog, "Laika", and the same size spent rocket casing.

While few details were revealed on Soviet launch vehicles, it was generally calculated that the first few Russian payloads could have been launched with a rocket having a total thrust of about 800,000 pounds.

JUPITER C

One of the effects of the early Soviet success with the Sputniks was to bring to the fore a previously-shelved plan of the Army Ballistic Missile Agnecy at Huntsville, Ala. On Nov. 8, 1957 this group was authorized to proceed with its proposal to launch satellites on the Jupiter C, a four-stage rocket which was a direct outgrowth of the military missile program.

Jupiter C placed Explorer I, the first U.S. satellite, into orbit on Jan. 31, 1958 on its first attempt. Explorer I's total weight in orbit was 30.8 pounds.,--an 18-pound active payload attached to a 12.8-pound spent fourth-stage casing. Jupiter C, in some records called Juno I, also placed Explorers III and IV in orbit and failed in three other attempts.

THOR, JUNO II, AND ATLAS

The Thor and Juno II launch vehicles were next to appear; both had first stages based on intermediate range military missiles.

-more-

Thor was first used under NASA sponsorship with an Able upper stage for two deep space probes. Pioneer I, launched Oct.11, 1958, had an error in burnout velocity and angle and plunged back into the Earth's atmosphere after reaching an altitude of over 70,000 miles. Pioneer II, launched Nov. 8, had a third stage failure.

The Able upper staging was adapted from Vanguard--a liquid-fueled second stage and a solid-fueled third stage. The Thor first stage was to see use in later combinations, such as the Delta.

Another of these is the Thor Agena, one of today's group of standard vehicles. NASA's first orbital launch with this vehicle was on Sept. 29, 1962, of the Canadian Alouette I. The second stage re-startable Agena, which permits greater flexibility and precision in orbit selection, was developed by the Air Force for use in its own programs. Thrust-Augmented Thor-Agena, a later variation, employs three "strap-on" solid motors attached to the Thor (see Thrust-Augmented Delta).

Next to appear on the launch schedule after Thor Able was the Juno II. Its first stage was based on the Army Jupiter missile, with the same fuel and thrust as the Air Force Thor; its three upper stages were adaptations of the Sergeant solid-fueled rocket. Juno II was first used to launch Pioneer III on Dec. 6, 1958, which confirmed a major discovery by Explorer I of Earth's radiation belt. It was employed for some nine additional major launches into 1961.

Atlas was the first of the modified intercontinental missiles to appear on a NASA launch pad. On Sept. 9, 1959 it lifted a test Mercury spacecraft into an unmanned ballistic flight in a forerunner of the four manned Atlas-boosted Mercury orbital flights which proved man could live and work in space.

This LOX-RP-1 stage has continued in use with various adapatations--until recently with an Agena upper stage (see Thor Agena--NASA's 26th and final Atlas Agena was launched in March of this year)--and its flights with the Centaur upper stage are scheduled for many launches in the future. Today's Atlas has the same fuel and diameter as the 1959 version but is taller and produces greater thrust.

PARALLEL STAGING

An unusual feature of the Atlas is its parellel staging--as contrasted to the more common sequence staging. Atlas has a booster stage, consisting of two engines, in an assembly fitting around the single engine of the sustainer stage. At liftoff, all three engines are burning; a few seconds later the booster stage is jettisoned and the sustainer continues to burn in flight. In the more common sequence type, each stage completes its action before its successor is ignited.

The development of the Centaur upper stage pioneered the use of liquid hydrogen as a space rocket fuel. The unique cryogenic properties of liquid hydrogen (-423 degrees F) required a significant extension of the cryogenic technology and has had a highly beneficial effect on the cryogenic industry in many related fields of research. This development program has resulted in the highest performing upper stage in the national launch vehicle family and provides a significant high velocity capability for space exploration.

Like Agena, Centaur's propulsion system is designed for stop and re-start in space. Its first launch was on May 8, 1962 in a vehicle development test in which it exploded before separation from Atlas. Beginning in June 1966, it launched the highly successful Surveyor series of spacecraft which soft-landed on the Moon, relayed back photos of the Lunar surface and made analyses of the Moon's soil.

-more-

SCOUT

Scout, the first NASA developed launch vehicle, was originated in late 1958 at Langley Research Center. The first NASA launch vehicle to utilize solid fuel for all stages, Scout was designed as a research vehicle and was later adopted as the smallest member of NASA's launch vehicle stable. Scout is utilized for the performance of a variety of missions, including orbital, reentry and probes. The first development firing, with two live motors and two inert motors, took place on April 18, 1960. The first operational flight took place on July 1, 1960. To date, 64 Scouts have been launched, making this one of NASA's most widely used launch vehicles.

The Scout vehicle was designed to use solid propellant rocket motors existing in 1960. Since that time, all of the rocket motors used on Scout have been upgraded, allowing an increase in performance of approximately 250 per cent, while maintaining the same basic vehicle configuration and operating concept.

DELTA

On April 29, 1959, NASA signed a contract with Douglas Aircraft Co., Inc. for the development of the Delta vehicle. This was the first NASA contract for the development of a launch vehicle.

The first Delta launch in May 1960, was an attempt to orbit an Echo passive communications satellite. Although this attempt failed because of a second stage malfunction, the Delta vehicle then established a NASA record with 22 consecutive successes. To date, the Delta vehicle, which has launched approximately 45 per cent of NASA's unmanned satellites since 1960, has orbited satellites to improve weather predictions, global communications and extend man's scientific knowledge of our universe.

Delta's history has been one of reliability, low cost, and increased performance. To date, (Aug. 1968) Delta has launched a total of 58 missions, and has performed successfully in 53 of these missions making it NASA's most successful operational launch vehicle. Since its maiden flight in 1960, the performance capability of the Delta vehicle has tripled from 425 pounds to 1,500 pounds (see table, Delta Growth).

Initially, the Delta vehicle was expected to be an interim launch vehicle to be used through 1960 and 1961 until larger boosters became flight qualified. However, the Delta vehicle has since established itself as the "workhorse" of the NASA vehicle stable.

GEMINI-TITAN

A modified USAF Titan II was selected as the launch vehicle to boost the Gemini two-man spacecraft into orbit. It was first used successfully in the Gemini series on April 8, 1964.

It was chosen for the Gemini mission because of its payload capability and importantly because its propellants are non explosive--a feature permitting use of an ejection-seat escape system instead of the rocket escape tower of Mercury. All engines operate on a mixture in which the fuel is a blend of unsymmetrical dimethylhydrazine (referred to as (UDMH) and hydrazine, and the oxidizer is nitrogen tetroxide. The mixture is hypergolic, meaning that when the fuel and oxidizer are brought together the combination ignites spontaneously, without need for an ignition system.

The propellants can also be stored for some time in Titan's fuel tanks. As a result, the launch vehicle can be readied for use on comparatively short notice and need not be drained of fuel if a launch is postponed.

-more-

DELTA GROWTH (1960 - 1967)

Delta Configuration	Earth Orbit (575 Statute Miles)
DM19 (1960)	425 lbs.
DSV-3B (1962) 3-foot longer second-stage tanks	600 lbs.
DSV-3C (1963) X-258 motor replaced X-248 motor	700 lbs.
DSV-3D (1964) three strap-on solid motors added to Thor	740 lbs.
DSV-3E (1965) 2-foot larger diameter second stage	850 lbs.
DSV-3E-1 (1967) FW4 motor replaced X-258 motor	940 lbs.
DSV-3J (1968) TE-364 motor replaced FW 4 motor	1,050 lbs.
DSV-3M (1968) Thor propellant tank and Thor extended 3 feet	1,590 lbs.

SATURN I-B

The original Saturn launch vehicle project was conceived in 1958 to provide early capability for large payloads. The decision to arrange the engines and tanks in clusters allowed the use of equipment already developed for earlier rockets as well as the machine tools that produced them. Thus, the first stage of the two-stage Saturn I was a cluster of eight H-1 engines, each capable of generating 188,000 pounds of thrust. The second stage of the early version had six liquid-oxygen, liquid-hydrogen RL-10 engines, each generating 15,000 pounds of thrust.

Saturn I is part of a family of heavyweight lifting launch vehicles, used first in the Apollo program. The first ten vehicles, called Saturn I, were launched for research and development purposes, and also placed into Earth orbit engineering test models of the command and service modules of the Apollo spacecraft. The last three Saturn I's placed meteoroid technology satellites into Earth orbit to examine the size and distribution of particles in space near the Earth.

The first Saturn I was launched successfully in October, 1961, with only the first stage live. When a live second stage was used for the first time, in January, 1964, the fifth Saturn I placed 37,900 pounds into Earth orbit.

On a trip to the Moon, the first stage engines burn for about $2\frac{1}{2}$ minutes, boosting the Apollo astronauts to an altitude of 36 miles and a velocity of about 6,000 miles per hour. The first stage then drops away, and the second stage ignites.

The second stage is powered by five J-2 engines, each producing 200,000 pounds thrust. These hydrogen-oxygen engines, burning for $6\frac{1}{2}$ minutes, push the spacecraft to an altitude of about 100 miles and near-orbital velocity. Its mission completed, the second stage is separated and falls back to Earth.

The third stage of the Saturn V, the same as the second stage of the Saturn IB, has a single J-2 engine which develops 200,000 pounds thrust. This stage ignites to give Apollo spacecraft the final shove that places it into Earth orbit, at an altitude of about 115 miles. Then the engine shuts down, while the spacecraft is checked out, and the proper moment is awaited for continuing the trip to the Moon. At the precise moment, the third stage engine is reignited. It burns for about $6\frac{1}{2}$ minutes, accelerating the spacecraft from its Earth orbital speed of 17,400 miles an hour to about 24,600 miles an hour, the velocity needed to overcome Earth's gravity.

The Saturn V can place a payload of 285,000 pounds into Earth orbit or send almost 100,000 pounds to the Moon. This heavy payload capability can be used in both manned and unmanned missions for the continuing exploration of space.

Saturn V has thus far seen two launches; both vehicle development missions--Apollo 4 on Nov. 9, 1967 and Apollo 6 on April 4, 1968. The first was a complete success; in the second, the third stage failed in a planned re-start and the first stage showed a vertical vibration problem ("pogo effect") due to engine synchronization.

PROPULSION: FUEL THRUST (pounds)

NAME	STAGE 1	STAGE 2	STAGE 3	STAGE 4	LENGTH(ft)	DIA.(in)
Vanguard	LOX+-RP-1*** 28,000	IWFNA*-UDMH** 7,600	Solid 3,100	None	72	45
Jupiter C	LOX-UDMH Diethylene Triamane 83,000	Solid 16,500	Solid 5,400	Solid 1,800	71.25	70
Thor Able	LOX-RP-1 150,000	IWFNA-UDMH 7,700	Solid 3,100	None	89.9	96
Thor Agena	LOX-RP-1 172,000	IRFNA++-UDMH 16,000	None	None	76.3	96
Thrust Augmented Thor Agena	LOX-RP-1 333,550+++	IRFNA-UDMH 16,000	None	None	90	162
Delta	LOX-RP-1 172,000	IRFNA-UDMH 7,500	Solid 5,800	None	81	96
Thrust Augmented Delta	LOX-RP-1 332,000+++	IRFNA-UDMH 7,800	Solid 5,900	None	90	162
Juno II	LOX-RP-1 150,000	Solid 16,500	Solid 5,400	Solid 1,800	76.6	105
Atlas Centaur	LOX-RP-1 388,000	LOX-LH_2	None	None	117	120

+Liquid Oxygen
++Inhibited Red Fuming Nitric Acid
+++With strap-ons

*Inhibited White Fuming Nitric Acid
**Unsymmetrical Dimethyl Hydrazine
***Kerosene

-more-

FUEL
PROPULSION: THRUST (pounds) (cont'd)

NAME	STAGE 1	STAGE 2	STAGE 3	STAGE 4	LENGTH(ft)	DIA.(in)
Atlas Agena	LOX-RP-1 388,000	IRFNA-UDMH 16,000	None	None	104	120
Scout	Solid 100,900	Solid 60,700	Solid 20,900	Solid 5,700	64.4	39.6
Gemini Titan II	UDMH-Hydrazine Nitrogen-tetroxide 430,000	IRFNA-UDMH 100,000	None	None	90	120
Saturn I	LOX-RP-1 1.5 million	$LOX-LH_2$ 90,000	None	None	164	258
Saturn IB	LOX-RP-1 1.6 million	$LOX-LH_2$ 200,000	None	None	142	258
Saturn V	LOX-RP-1 7,570,000	$LOX-LH_2$ 1,125,000	$LOX-LH_2$ 225,000	None	281	396

# # #

THE NATIONAL AERONAUTICS & SPACE ACT OF 1958

The Declaration of Policy and Purpose of the National Aeronautics and Space Act is outlined in Section 102 (a) through (c) of PL 85-568 as follows:

Sec. 102.(a) The Congress hereby declares that it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind.

(b) The Congress declares that the general welfare and security of the United States require that adequate provision be made for aeronautical and space activities. The Congress further declares that such activities shall be the responsibility of, and shall be directed by, a civilian agency exercising control over aeronautical and space activities sponsored by the United States, except, that activities peculiar to or primarily associated with the development of weapons systems, military operation, or the defense of the United States (including the research and development necessary to make effective provision for the defense of the United States) shall be the responsibility of, and shall be directed by, the Department of Defense; and that determination as to which such agency has responsibility for and direction of any such activity shall be made by the President in conformity with section 201 (e).

(c) The aeronautical and space activities of the United States shall be conducted so as to contribute materially to one or more of the following objectives:

(1) The expansion of human knowledge of phenomena in the atmosphere and space;

(2) The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;

(3) The development and operation of vehicles capable of carrying instruments, equipment, supplies, and living organisms through space;

(4) The establishment of long-range studies of the potential benefits to be gained from the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes;

(5) The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere;

(6) The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing by such agencies, to the civilian agency established to direct and control nonmilitary aeronautical and space activities, of information as to discoveries which have value or significance to that agency;

(7) Cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof; and

(8) The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States in order to avoid unnecessary duplication of effort, facilities, and equipment.

###

NASA BUDGET HISTORY
FY 1959 - FY 1969
(IN THOUSANDS)

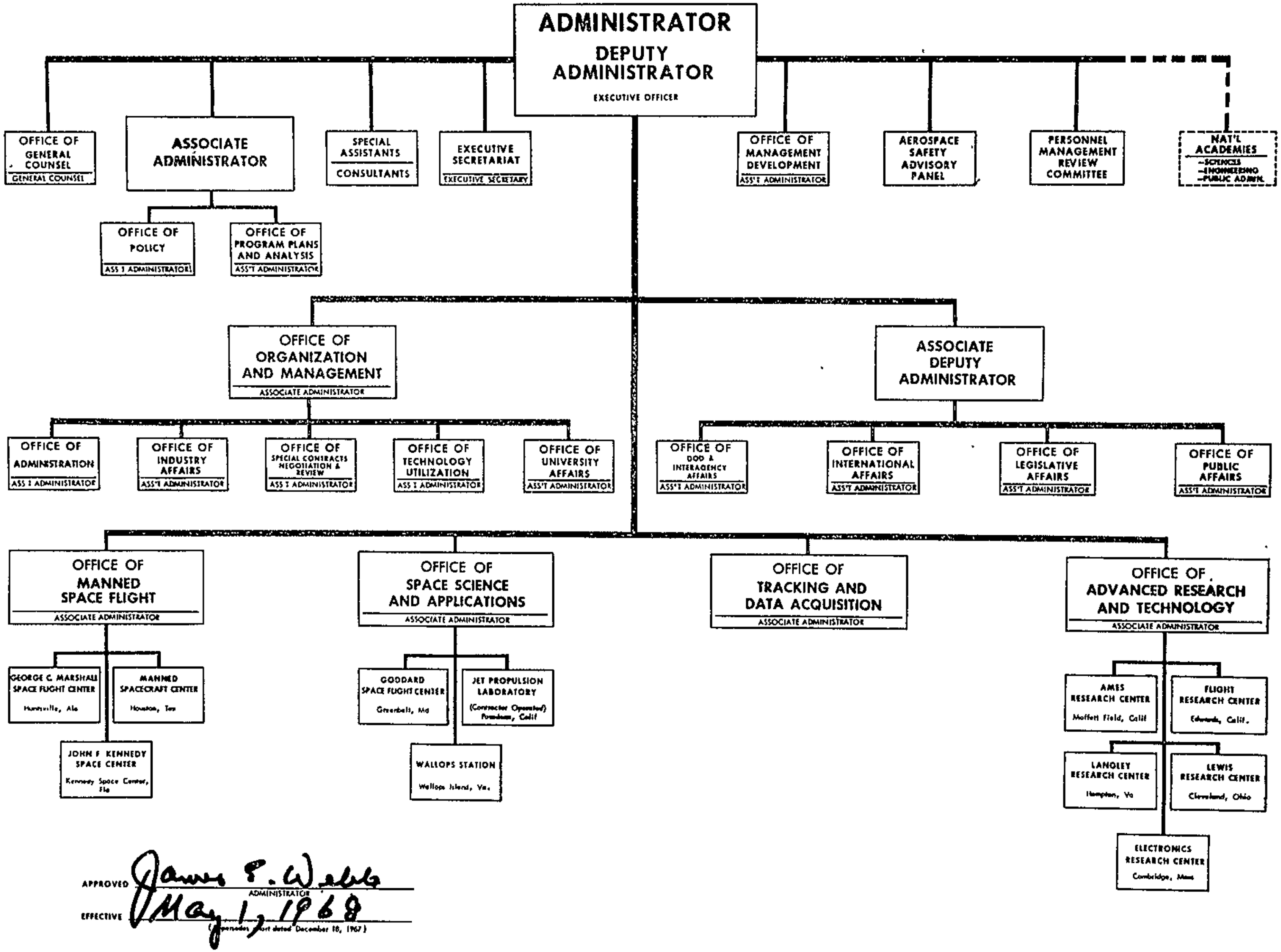
ORIGINAL CONGRESSIONAL APPROPRIATIONS AND SELECTED TRANSFERS FROM OTHER AGENCIES

	FY 1968	FY 1967	FY 1966	FY 1965	FY 1964	FY 1963	FY 1962	FY 1961	FY 1960	FY 1959
Research and Development	3,925.0	4,245.0	4,531.0	4,363.6c/	3,926.0	2,459.2b/	1,302.5	672.1g/	347.6	196.6e/
Construction of Facilities	35.9	83.0	60.0	262.9	680.2	776.2	316.0	123.9h/	84.6	48.0
Administrative Operations	628.0	640.0	584.0	623.5	494.0	438.7b/	206.8a/ (312.5)	170.8a/ (224.3)	91.4a/ (117.1)	86.3a/f/ (88.4)
TOTAL	4,588.9	4,968.0	5,175.0	5,250.0	5,100.0	3,674.1	1,825.3	966.7	523.6	330.9d/

a/ S & E appropriation figures. Equivalents to current Administrative Operations are shown in parentheses.
b/ Comparative figures; FY '63 legislation combined R&D and AO appropriations into RD&O: $2,897.0.
c/ Includes supplemental of 72.5 applied to FY '64 R&D.
d/ Does not include $8.0 DOD working fund.
e/ Includes $171.1 NOA and $25.5 unobligated prior year funds transferred from DOD (U.S. Scientific Satellite: Vanguard).
f/ Includes $1.0 available for FY '58 NACA S&E account.
g/ Includes $1.7 unobligated prior year funds transferred from DOD (ARPA; S&E).
h/ Includes $1.0 unobligated prior year funds transferred from DOD (ARPA; CoF).

Final Congressional action has not been completed on NASA's FY 1969 Budget. The agency's '69 request was $4,370,400,000. NASA is operating under an interim plan in FY '69 which anticipates $3.85 billion of new obligational authority.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546
TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
September 29, 1968

TENTH ANNIVERSARY SPECIAL (13)

MAJOR MILESTONES AND NASA "FIRSTS"

1958

October 11 -- In NASA's first launch, Pioneer I reached an altitude of 70,717 miles to become the first deep space probe. The 84-pound spacecraft returned radiation, magnetic field and micrometeoroid data during its 43-hour lifetime.

1959

August 7 -- Placed in an elliptical Earth orbit, Explorer 6 transmitted information from seven experiments including the first crude TV photo of the Earth.

1960

March 11 -- Placed in solar orbit, Pioneer 5 returned telemetry to a distance of 22.5 million miles from Earth.

-more-

1960 con't

April 1 -- The first meteorological satellite, Tiros I, led off a series of 10 consecutive successful R&D missions and provided a total of 22,952 cloud cover photographs.

August 12 -- Successful inflation in orbit of a 100-foot balloon produced the Echo I passive communication satellite.

1961

May 5 -- The initial U.S. manned sub-orbital flight featured Alan Shepard in Mercury-Redstone 3 ("Freedom 7").

July 21 -- Gus Grissom piloted Mercury-Redstone 4 ("Liberty Bell 7") in a sub-orbital flight down the Atlantic Missile Range. MR-4 achieved an altitude of 118 miles and a distance of 305 miles.

1962

February 20 -- John Glenn in Mercury-Atlas 6 ("Friendship 7") began America's manned orbital space flight program.

March 7 -- The first observatory-type scientific spacecraft, OSO I, was orbited with 13 experiments to study the Sun.

-more-

1962 con't

May 24 -- Scott Carpenter and Mercury-Atlas 7 ("Aurora 7") flew a three-orbit, 4.9-hour mission.

July 10 -- The first commercially financed satellite, Telstar I, carried out a variety of communication tests including--TV, telephone, data and photo facsimile transmission.

August 27 -- The Mariner 2 flight to Venus began. The 447-pound probe passed within 21,598 miles of the planet on December 14 and returned surface temperature measurements.

October 3 -- Walter Schirra carried out a six-orbit, 9.2-hour Mercury-Atlas 8 ("Sigma 7") mission.

1963

May 15 -- Gordon Cooper and Mercury-Atlas 9 ("Faith 7") closed out the Mercury program with a 22-orbit, 34.3-hour flight.

July 26 -- The first successful synchronous satellite, Syncom 2, was placed in an inclined orbit over Brazil.

November 27 -- The initial IMP (Interplanetary Monitoring Platform), Explorer 18, was placed in a highly elliptical Earth orbit.

1964

July 28 -- In the first of three successful Ranger missions, Ranger 7 photographed the Moon during the last 1,120 miles of its approach and subsequent hard landing.

August 28 -- Nimbus I meteorological satellite returned 27,000 cloud cover pictures.

September 5 -- Orbiting Geophysical Observatory program was initiated with launch of OGO 1.

November 28 -- A 228-day, 325-million-mile flight to Mars begun by Mariner 4. The probe passed within 6,118 miles of the planet July 14, 1965, and returned 20 frames of Mars photos.

1965

February 16 -- The eighth Saturn 1 test flight placed the Pegasus 1 meteoroid detection satellite in orbit attached to the S-IV second stage.

March 23 -- Gus Grissom and John Young in Gemini 3 began second phase of U.S. manned space program.

April 6 -- The first commercial communication satellite, Early Bird (Intelsat I), placed in synchronous equatorial orbit above the Atlantic Ocean.

1965 con't

June 3 -- Four-day flight of Gemini 4 was highlighted by a 21-minute "space walk" by Ed White.

August 21 -- Gordon Cooper and Pete Conrad crewed Gemini 5 on an eight-day mission.

December 4 -- Scheduled as a 14-day endurance mission, Gemini 7 manned by Frank Borman and Jim Lovell, also was utilized as Gemini 6's target vehicle.

December 15 -- The first rendezvous in space was performed by Walter Schirra and Tom Stafford in Gemini 6-A.

December 16 -- Pioneer 6 went into solar orbit. The 140-pound probe continues to return solar wind, magnetic field and cosmic ray data.

1966

February 3 -- The Weather Bureau's operational weather satellite system was inaugurated by the 305-pound ESSA 1.

March 16 -- The first docking experiment was conducted by Neil Armstrong and David Scott in Gemini 8.

-more-

1966 con't

May 15 -- The Earth-oriented Nimbus 2 weather satellite was orbited with three AVCS cameras, an APT camera and radiometers. The 912-pound R&D craft continues to return cloud cover photos.

May 30 -- In the initial U.S. try at lunar soft landing, Surveyor 1 touched down in Oceanus Procellarum. The 596-pound probe returned a total of 11,150 pictures.

June 3 -- Gemini 9-A, with Tom Stafford and Gene Cernan, completed 43 orbits in 72.3 hours.

July 18 -- John Young and Michael Collins docked Gemini 10 with its Agena target, also rendezvoused with Gemini 8's target.

August 10 -- Photography from Lunar Orbiter 1 provided data on nine Apollo landing sites plus the back side of the Moon.

September 12 -- Docking was achieved by Pete Conrad and Dick Gordon in a record 94 minutes after the launch of Gemini 11.

November 11 -- Final Gemini mission with Jim Lovell and Buzz Aldrin in Gemini 12 featured docking with Agena target and Aldrin's successful EVA tests.

-more-

1966 con't

December 7 -- Placed in synchronous equatorial orbit above the Pacific, Applications Technology Satellite-1 carried a variety of experiments.

1967

May 4 -- Lunar Orbiter 4 launched. Returned high resolution photos of over 99 percent of front side of Moon.

June 14 -- The third U.S. attempt to fly by Venus with launch of Mariner 5. The 540-pound probe passed within 2,480 miles of the red planet on October 19.

August 1 -- Launch of Lunar Orbiter 5, last most ambitious project mission, completed mapping of entire lunar surface.

September 7 -- The first successful U.S. biological research spacecraft, Biosatellite 2, carried 13 radiation and general biology experiments.

September 8 -- Surveyor 5 soft landed in Mare Tranquillitatis, returned 19,006 photos and performed first on-site chemical analysis of an extraterrestrial body.

November 9 -- The first launch from Kennedy Space Center--Complex 39. Apollo 4/Saturn 5 demonstrated launch vehicle capability and spacecraft development.

1968

January 7 -- Surveyor 7 launched; soft lands on January 9 near Crater Tycho.

July 4 -- Exciting addition to knowledge of new elements and regions of the universe are anticipated from Radio Astronomy Explorer Satellite launch.

###

NASA MAJOR LAUNCH RECORD

October 1959 - August 1968

Year	No. Launches	Vehicle Results Success	Vehicle Results Failure	Mission Results Success	Mission Results Failure
1958	4	0	4	0	4
1959	14	8	6	8	6
1960	17	10	7	9	8
1961	23	16	7	15	8
1962	27	23	4	20	7
1963	13	12	1	11	2
1964	30	26	4	25	5
1965	31	27	4	26	5
1966	36	33	3	26	10
1967	27	25	2	25	2
1968	12	9*	1*	9*	1*
10-Year Totals	234	189	43	174	58

*ATS-D, launched Aug. 10, 1968, and Apollo 6, launched April 4, 1968, have not been officially declared success or failure, pending further evaluation.

MAJOR NASA LAUNCHES

1958

Date	Name	Launch Vehicle	Launch Site	Mission	Results Vehicle	Results Mission
10/11	Pioneer I	Thor-Able	Kennedy	Scientific Lunar Probe	Failure	Failure
10/22	Beacon	Jupiter C	Kennedy	Scientific Earth Satellite	Failure	Failure
11/8	Pioneer II	Thor-Able	Kennedy	Scientific Lunar Probe	Failure	Failure
12/6	Pioneer III	Juno II	Kennedy	Scientific Lunar Probe	Failure	Failure

MAJOR NASA LAUNCHES

1959

Date	Name	Launch Vehicle	Launch Site	Mission	Results Vehicle	Results Mission
2/17	Vanguard II	Vanguard	Kennedy	Meteorology	Failure	Failure
3/3	Pioneer IV	Juno II	Kennedy	Energetic Particles	Success	Success
4/13	Vanguard	Vanguard	Kennedy	Scientific Earth Satellite	Failure	Failure
6/22	Vanguard	Vanguard	Kennedy	Scientific Earth Satellite	Failure	Failure
7/16	Explorer (S-1)	Juno II	Kennedy	Scientific Earth Satellite	Failure	Failure
8/7	Explorer VI (S-2)	Thor-Able	Kennedy	Particles and Meteorology	Success	Success
8/14	Beacon	Juno II	Kennedy	Scientific Earth Satellite	Failure	Failure
9/9	Big Joe (Mercury)	Atlas-Big Joe	Kennedy	Suborbital Mercury Capsule Test	Success	Success
9/18	Vanguard III	Vanguard	Kennedy	Particles and Fields	Success	Success
10/4	Little Joe 1	Little Joe	Wallops	Suborbital Mercury Capsule Test	Success	Success
10/13	Explorer VII (S-1a)	Juno II	Kennedy	Energetic Particles	Success	Success
11/4	Little Joe 2	Little Joe	Wallops	Suborbital Mercury Capsule Test	Success	Success
11/26	Pioneer (P-3)	Atlas-Able	Kennedy	Scientific Lunar Probe	Failure	Failure
12/4	Little Joe 3	Little Joe	Wallops	Suborbital Mercury Capsule Test	Success	Success

-more-

MAJOR NASA LAUNCHES

1960

Date	Name	Launch Vehicle	Launch Site	Mission	Results Vehicle	Results Mission
1/21	Little Joe 4	Little Joe	Wallops	Suborbital Mercury Capsule Test	Success	Success
3/11	Pioneer V (P-2)	Thor-Able	Kennedy	Scientific Deep Space Probe	Success	Success
3/23	Explorer (S-46)	Juno II	Kennedy	Scientific Earth Satellite	Failure	Failure
4/1	TIROS I (A-1)	Thor-Able	Kennedy	Meteorological Sat.	Success	Success
4/18	Scout X	Scout X	Wallops	Launch Vehicle Development	Failure	Failure
5/13	Echo (A-10)	Delta	Kennedy	Communications	Failure	Failure
7/1	Scout	Scout	Wallops	Launch Vehicle Development	Success	Success
7/29	Mercury (MA-1)	Atlas	Kennedy	Suborbital Mercury Capsule Test	Failure	Failure
8/12	Echo I (A-11)	Delta	Kennedy	Communications	Success	Success
9/25	Pioneer (P-30)	Atlas-Able	Kennedy	Scientific Lunar Orbiter	Failure	Failure
10/4	Scout	Scout	Wallops	Launch Vehicle Development	Success	Success
11/3	Explorer VIII (S-30)	Juno II	Kennedy	Ionosphere	Success	Success
11/8	Little Joe 5	Little Joe	Wallops	Suborbital Mercury Capsule Test	Success	Failure
11/23	TIROS II (A-2)	Delta	Kennedy	Meteorological Sat.	Success	Success
12/4	Explorer (S-56)	Scout	Wallops	Scientific Earth Satellite	Failure	Failure
12/15	Pioneer (P-31)	Atlas-Able	Kennedy	Scientific Lunar Orbiter	Failure	Failure
12/19	Mercury (MR-1A)	Redstone	Kennedy	Suborbital Mercury Capsule Test	Success	Success

-more-

MAJOR NASA LAUNCHES

1961

Date	Name	Launch Vehicle	Launch Site	Mission	Results Vehicle	Results Mission
1/31	Mercury (MR-2)	Redstone	Kennedy	Suborbital Mercury Capsule Test	Success	Success
2/16	Explorer IX (S-56a)	Scout	Wallops	Atmospheric Physics	Success	Success
2/21	Mercury (MA-2)	Atlas	Kennedy	Suborbital Mercury Capsule Test	Success	Success
2/24	Explorer (S-45)	Juno II	Kennedy	Ionosphere Sat.	Failure	Failure
3/18	Little Joe 5A	Little Joe	Wallops	Suborbital Mercury Capsule Test	Success	Failure
3/24	Mercury (MR-BD)	Redstone	Kennedy	Vehicle Test for Mercury	Success	Success
3/25	Explorer X (P-14)	Delta	Kennedy	Magnetometer Probe	Success	Success
4/25	Mercury (MA-3)	Atlas	Kennedy	Orbital Mercury Capsule Test	Failure	Failure
4/27	Explorer XI (S-15)	Juno II	Kennedy	Gamma Ray Experiment	Success	Success
4/28	Little Joe 5B	Little Joe	Wallops	Suborbital Mercury Capsule Test	Success	Success
5/5	Freedom 7 (MR-3)	Redstone	Kennedy	Suborbital Manned Flight	Success	Success
5/24	Explorer (S-45a)	Juno II	Kennedy	Ionosphere	Failure	Failure
6/30	Explorer (S-55)	Scout	Wallops	Meteoroids	Failure	Failure
7/12	TIROS III (A-3)	Delta	Kennedy	Meteorological Sat.	Success	Success
7/21	Liberty Bell 7 (MR-4)	Redstone	Kennedy	Suborbital Manned Flight	Success	Success
8/15	Explorer XII (S-3)	Delta	Kennedy	Particles and Fields	Success	Success
8/23	Ranger I (P-32)	Atlas-Agena	Kennedy	Scientific Lunar Probe Test	Failure	Failure
8/25	Explorer XIII (S-55a)	Scout	Wallops	Micrometeoroids	Failure	Failure
9/13	Mercury (MA-4)	Atlas	Kennedy	Orbital Mercury Capsule Test	Success	Success
10/19	P-21	Scout	Wallops	Scientific Geoprobe	Success	Success
10/27	Saturn (SA-1)	Saturn I	Kennedy	Launch Vehicle Development	Success	Success
11/18	Ranger II (P-33)	Atlas-Agena	Kennedy	Scientific Lunar Probe Test	Failure	Failure
11/29	Mercury (MA-5)	Atlas	Kennedy	Orbital Mercury Capsule Test	Success	Success

MAJOR NASA LAUNCHES

1962

Date	Name	Launch Vehicle	Launch Site	Mission	Results Vehicle	Results Mission
1/15	Echo (AVT-1)	Thor	Kennedy	Suborbital Communications Test	Success	Success
1/26	Ranger III (P-34)	Atlas-Agena	Kennedy	Scientific Lunar Lander	Failure	Failure
2/8	TIROS IV (A-9)	Delta	Kennedy	Meteorological Sat.	Success	Success
2/20	Friendship 7 (MA-6)	Atlas	Kennedy	Orbital Manned Flight	Success	Success
3/1	Reentry I	Scout	Wallops	28,000 Ft./Sec. Reentry Test	Success	Failure
3/7	OSO-1 (S-16)	Delta	Kennedy	Solar Physics	Success	Success
3/29	P-21a	Scout	Wallops	Scientific Geoprobe	Success	Success
4/23	Ranger IV (P-35)	Atlas-Agena	Kennedy	Scientific Lunar Lander	Success	Failure
4/25	Saturn (SA-2)	Saturn I	Kennedy	Launch Vehicle Development	Success	Success
4/26	Ariel I (S-51)	Delta	Kennedy	Ionosphere Measurements	Success	Success
5/8	Centaur (AC-1)	Centaur	Kennedy	Launch Vehicle Development	Failure	Failure
5/24	Aurora 7 (MA-7)	Atlas	Kennedy	Orbital Manned Flight	Success	Success
6/19	TIROS V (A-50)	Delta	Kennedy	Meteorological Sat.	Success	Success
7/10	Telstar I (A-40)	Delta	Kennedy	Communications	Success	Success
7/18	Echo (AVT-2)	Thor	Kennedy	Suborbital Communications Test	Success	Success
7/22	Mariner I (P-37)	Atlas-Agena	Kennedy	Venus Probe	Failure	Failure
8/27	Mariner II (P-38)	Atlas-Agena	Kennedy	Venus Probe	Success	Success
8/31	Reentry II	Scout	Wallops	28,000 Ft./Sec. Reentry Test	Failure	Failure
9/18	TIROS VI (A-51)	Delta	Kennedy	Meteorological	Success	Success
9/28	Alouette I (S-27)	Thor-Agena	Pacific	Ionosphere Soundings	Success	Success
10/2	Explorer XIV (S-3a)	Delta	Kennedy	Particles and Fields	Success	Success
10/3	Sigma 7 (MA-8)	Atlas	Kennedy	Orbital Manned Flight	Success	Success

-more-

MAJOR NASA LAUNCHES 1962 (Cont'd)

10/18	Ranger V	Atlas-Agena	Kennedy	Scientific Lunar Lander	Success	Failure
10/27	Explorer XV (S-3b)	Delta	Kennedy	Particles and Fields	Success	Success
11/16	Saturn (SA-3)	Saturn I	Kennedy	Launch Vehicle Development	Success	Success
12/13	Relay I (A-15)	Delta	Kennedy	Communications	Success	Success
12/16	Explorer XVI (S-55b)	Scout	Wallops	Micrometeoroids Sat.	Success	Success

-more-

MAJOR NASA LAUNCHES

1963

Date	Name	Launch Vehicle	Launch Site	Mission	Results Vehicle	Results Mission
2/14	Syncom I (A-25)	Delta	Kennedy	Synchronous Comm. Sat.	Success	Failure
3/28	Saturn (SA-4)	Saturn I	Kennedy	Launch Vehicle Development	Success	Success
4/2	Explorer XVII (S-6)	Delta	Kennedy	Aeronomy	Success	Success
5/7	Telstar II (A-41)	Delta	Kennedy	Communications Earth Sat.	Success	Success
5/15	Faith 7 (MA-9)	Atlas	Kennedy	Orbital Manned Flight	Success	Success
6/19	TIROS VII (A-52)	Delta	Kennedy	Meteorological Sat.	Success	Success
7/20	Reentry III	Scout	Wallops	Reentry Demonstration	Failure	Failure
7/26	Syncom II (A-26)	Delta	Kennedy	Synchronous Comm. Sat.	Success	Success
8/28	Little Joe II-#1	Little Joe II	WSMR (1)	Launch Vehicle Test	Success	Success
11/26	Explorer XVIII (IMP-A)	Delta	Kennedy	Particles and Fields	Success	Success
11/27	Centaur (AC-2)	Centaur	Kennedy	Launch Vehicle Development	Success	Success
12/19	Explorer XIX (AD-A)	Scout	Pacific	Atmospheric Physics	Success	Success
12/21	TIROS VIII (A-53)	Delta	Kennedy	Meteorological Sat.	Success	Success

(1) White Sands Missile Range

MAJOR NASA LAUNCHES

1964

Date	Name	Launch Vehicle	Launch Site	Mission	Results Vehicle	Results Mission
1/21	Relay II (A-16)	Delta	Kennedy	Communications	Success	Success
1/25	Echo II (A-12)	Thor-Agena	Pacific	Communications	Success	Success
1/29	Saturn (SA-5)	Saturn I	Kennedy	Vehicle Development	Success	Success
1/30	Ranger VI (RA-A)	Atlas-Agena	Kennedy	Lunar Photography	Success	Failure
3/19 3/27	Beacon Explorer A (BE-A)	Delta	Kennedy	Ionosphere Study	Failure	Failure
3/27	Ariel II (UK-C)	Scout	Wallops	Ionosphere Study	Success	Success
4/8	Gemini (GT-1)	Titan II	Kennedy	Systems Qualification	Success	Success
4/14	Fire I	Atlas-X259	Kennedy	Reentry Test 37,891 ft/sec	Success	Success
5/13	Apollo Transonic Abort	Little Joe II	WSMR (1)	Apollo LES Development	Success	Success
5/28	Saturn (SA-6)	Saturn I	Kennedy	Vehicle Development	Success	Success
6/30	Centaur (AC-3)	Centaur	Kennedy	Vehicle Development	Success	Success
7/20	SERT-I	Scout	Wallops	Ion Engine Test	Success	Success
7/28	Ranger VII (RA-B)	Atlas-Agena	Kennedy	Lunar Photography	Success	Success
8/18	Reentry IV (D)	Scout	Wallops	Reentry Test 27,950 ft/sec	Success	Success
8/19	Syncom III	Delta	Kennedy	Synchronous Comm. Sat.	Success	Success
8/25	Explorer XX (IE-A)	Scout	Pacific	Ionosphere Study	Success	Success
8/28	Nimbus I	Thor-Agena	Pacific	Meteorology	Success	Success
9/4	OGO-I (OGO-A)	Atlas-Agena	Kennedy	Interdisciplinary Data	Success	Failure
9/18	Saturn (SA-7)	Saturn I	Kennedy	Vehicle Development	Success	Success

(1) White Sands Missile Range

-more-

MAJOR NASA LAUNCHES 1964 (Cont'd)

10/3	Explorer XXI (IMP-B)	Delta	Kennedy	Particles, Fields Study	Failure	Failure
10/9	Explorer XXII (BE-B)	Scout	Pacific	Ionosphere Study	Success	Success
11/5	Mariner III	Atlas-Agena	Kennedy	Mars Probe	Failure	Failure
11/6	Explorer XXIII (S-55c)	Scout	Wallops	Micrometeoroids	Success	Success
	(Explorer XXIV			(Air Density)		Success
11/21	((Air Density)	Scout	Pacific	( )	Success	
	(Explorer XXV (Injun)			(Atmospheric Physics)		Success
11/28	Mariner IV	Atlas-Agena	Kennedy	Mars Probe	Success	Success
12/8	Apollo Max Q Abort	Little Joe II	WSMR	Apollo LES Development	Success	Success
12/11	Centaur (AC-4)	Centaur	Kennedy	Vehicle Development	Success	Success
12/15	San Marco I (SM-A)	Scout	Wallops	Atmospheric Studies (Italian)	Success	Success
12/21	Explorer XXVI (EPE-D)	Delta	Kennedy	Particles, Fields Study	Success	Success

-more-

MAJOR NASA LAUNCHES

1965

Date	Name	Launch Vehicle	Launch Site	Mission	Results Vehicle	Results Mission
1/19	Gemini II	Titan II	Kennedy	Unmanned Suborbital	Success	Success
1/22	TIROS IX	Delta	Kennedy	Weather Observation	Success	Success
2/3	OSO II	Delta	Kennedy	Solar Observations	Success	Success
2/16	Pegasus I	Saturn I	Kennedy	Meteoroid Detection	Success	Success
2/17	Ranger VIII	Atlas-Agena	Kennedy	Lunar Photography	Success	Success
3/2	Atlas Centaur 5	Atlas-Centaur	Kennedy	Vehicle Test	Failure	Failure
3/21	Ranger IX	Atlas-Agena	Kennedy	Lunar Photography	Success	Success
3/23	Gemini III	Titan II	Kennedy	Manned Three-Orbit	Success	Success
4/6	Early Bird	Delta	Kennedy	First Commercial Comm. Sat.	Success	Success *
4/29	Explorer XXVII (BE-C)	Scout	Wallops	Geodetic Studies	Success	Success
5/19	Apollo Hi-Alt Abort	Little Joe II	Wh.Sands	Apollo LES Development	Failure	Failure
5/22	Fire II	Atlas-X-259	Kennedy	Reentry Heating	Success	Success
5/25	Pegasus II	Saturn I	Kennedy	Meteoroid Detection	Success	Success
5/29	Explorer XXVIII (IMP-C)	Delta	Kennedy	Particles and Fields	Success	Success
6/3	Gemini IV	Titan II	Kennedy	Manned 4 day Mission	Success	Success
7/2	TIROS X (OT-1)	Delta	Kennedy	Operational Weather Sat.	Success	Success
7/30	Pegasus III	Saturn I	Kennedy	Meteoroid Detection	Success	Success
8/10	Scout Evaluation	Scout	Wallops	Launch Vehicle Evaluation	Success	Success
8/11	Atlas Centaur 6	Atlas-Centaur	Kennedy	Vehicle Development	Success	Success

* Not NASA Mission

MAJOR NASA LAUNCHES 1965 (Cont'd)

8/21	Gemini V	Titan II	Kennedy	Manned 8-day Mission	Success	Success	
8/25	OSO-C	Delta	Kennedy	Solar Observations	Failure	Failure	
10/14	OGO II	Thor-Agena	Pacific	Geophysical Observations	Success	Failure	
10/25	Gemini Target VI	Atlas-Agena	Kennedy	Rendezvous with Gemini	Failure	Failure	
11/6	Explorer XXIX (GEOS-A)	Delta	Kennedy	Geodesy (Earth Mapping)	Success	Success	
11/18	Explorer XXX (SE-A)	Scout	Wallops	Solar Astronomy (for IQSY)	Success	Success	*
11/28	(Alouette II (S-27a)	Thor-Agena **	Pacific	(Topside Sounder)	Success	Success	
	(Explorer XXXI (DME-A)			(Direct Ionospheric Meas)	Success	Success	
12/4	Gemini VII	Titan II	Kennedy	Manned 2-week Mission	Success	Success	
12/6	FR-1 (French)	Scout	Pacific	Ionosphere and Electron Study	Success	Success	*
12/15	Gemini VI-A	Titan II	Kennedy	Manned Rendezvous with Gemini VII	Success	Success	
12/16	Pioneer VI	Delta	Kennedy	Interplanetary Studies	Success	Success	

* Not NASA Mission
** Two Spacecraft Launched by one Booster

MAJOR NASA LAUNCHES

1966

Date	Name	Launch Vehicle	Launch Site	Mission	Results Vehicle	Results Mission
1/20	Apollo Intermediate Altitude Abort	Little Joe II	WS	Apollo LES Development	Success	Success
2/3	* ESSA-I (OT-3)	Delta	KSC	Operational Weather Sat.	Success	Success
2/9	Reentry V	Scout	WI	Test Phenolic Nylon for Heat Shield	Success	Success
2/26	Apollo Saturn (AS-201)	Uprated Saturn I	KSC	Launch Vehicle, Spacecraft and Heat Shield Test	Success	Success
2/28	* ESSA-II (OT-2)	Delta	KSC	Operational Weather Sat.	Success	Success
3/16	Gemini VIII Target Vehicle	Atlas-Agena	KSC	Gemini Rendezvous and Docking Target Vehicle	Success	Failure
3/16	Gemini VIII	Titan II	KSC	2 Man Earth Orbit Rendezvous and Docking and EVA	Success	Failure
4/7	Centaur (AC-8)	Atlas-Centaur	KSC	Centaur Hydrogen Engine Restart (two burn) Test	Failure	Failure
4/8	OAO-I	Atlas-Agena	KSC	Orbiting Astronomical Observatory	Success	Failure
5/15	Nimbus II	Thor-Agena	WTR	Adv. Weather Observ. Sat.	Success	Success
5/17	Gemini IX	Atlas-Agena	KSC	Gemini Rendezvous and Docking Target Vehicle	Failure	Failure
5/25	Explorer XXXII (AE-B)	Delta	KSC	Aeronomy Studies	Success	Success
5/30	Surveyor I	Atlas-Centaur	KSC	Soft Lunar Landing and Photography	Success	Success

-more-

MAJOR NASA LAUNCHES 1966 (Cont'd)

6/1	Gemini IX-A	Atlas	KSC	Augmented Target Docking Adapter	Success	Failure
6/3	Gemini IX-A	Titan II	KSC	Manned Rendezvous and Docking and EVA	Success	Failure
6/6	OGO III	Atlas-Agena	KSC	Study Earth Environment	Success	Success
6/23	PAGEOS I	Thor-Agena	WTR	Passive Geodetic Earth orbiting satellite	Success	Success
7/1	Explorer XXXIII (IMP-D)	Delta	KSC	Earth-Moon Environment Studies out to Lunar Distances	Success	Success
7/5	Apollo Saturn (AS-203)	Uprated Saturn I	KSC	Observe Liquid-Hydrogen in Orbital Flight	Success	Success
7/18	Gemini X Target Vehicle	Atlas-Agena	KSC	Gemini Rendezvous and Docking Target Vehicle	Success	Success
7/18	Gemini X	Titan II	KSC	Manned Rendezvous and Docking (and EVA)	Success	Success
8/10	Lunar Orbiter I	Atlas-Agena	KSC	Lunar Photography for Apollo Landing Sites	Success	Success
8/17	Pioneer VII	Delta	KSC	Interplanetary Studies	Success	Success
8/25	Apollo Saturn (AS-202)	Uprated Saturn I	KSC	Launch Vehicle, Spacecraft, and Heat Shield Test	Success	Success
9/12	Gemini XI Target Vehicle	Atlas-Agena	KSC	Gemini Rendezvous and Docking Target Vehicle	Success	Success
9/12	Gemini XI	Titan II	KSC	Manned Rendezvous and Docking (and EVA)	Success	Success
9/20	Surveyor II	Atlas-Centaur	KSC	Soft Lunar Landing and Photography	Success	Failure
10/2 *	ESSA-III (TOS-A)	Delta	WTR	Operational Weather Sat.	Success	Success

MAJOR NASA LAUNCHES 1966 (Cont'd)

10/26	Centaur (AC-9)	Atlas-Centaur	KSC	Centaur Hydrogen Engine Restart (two burn) Test	Success	Success
10/26**	Intelsat II-A	Delta	KSC	Synchronous Comm. Sat.	Success	Success
11/6	Lunar Orbiter II	Atlas-Agena	KSC	Photography for Apollo Lunar Landing Sites	Success	Success
11/11	Gemini XII Target Vehicle	Atlas-Agena	KSC	Gemini Rendezvous and Docking Target Vehicle	Success	Success
11/11	Gemini XII	Titan II	KSC	Manned Rendezvous, Docking and EVA	Success	Success
12/6	ATS-1	Atlas-Agena	KSC	Communications and Technology	Success	Success
12/14	Biosatellite I	Delta	KSC	Biological Experiments on living organisms in space	Success	Failure

* Launched for Environmental Science Services Admin., U.S. Dept. of Commerce. NASA responsible for spacecraft development and launch.

** Not NASA Mission (Communications Satellite Corporation).

WS White Sands Test Facility, N.M.
KSC Kennedy Space Center, Fla.
WI Wallops Island, Va.
WTR Western Test Range, Calif.

-more-

MAJOR NASA LAUNCHES

1967

Date	Name	Launch Vehicle	Launch Site	Mission	Results Vehicle	Results Mission
1/11	* Intelsat IIB	Delta	KSC	For Comsat	Success	Success
1/26	**ESSA IV	Delta	WTR	Operational Weather Sat.	Success	Success
2/4	Lunar Orbiter III	Atlas-Agena	KSC	Photograph Lunar Landing Sites	Success	Success
3/8	OSO III	Delta	KSC	Solar Observation	Success	Success
3/22	* Intelsat II (F-3)	Delta	KSC	For Comsat	Success	Success
4/5	ATS II	Atlas-Agena	KSC	Communications and Technology	Failure	Failure
4/17	Surveyor III	Atlas-Centaur	KSC	Lunar Photography and Surface Sampler	Success	Success
4/20	**ESSA V	Imp. T-A Delta	WTR	Operational Weather Sat.	Success	Success
4/26	San Marco	Scout	Mombasa platform	Study Air Density	Success	Success
5/4	Lunar Orbiter IV	Atlas-Agena	KSC	Lunar Photographs from Polar Orbit	Success	Success
5/5	Ariel III	Scout	WTR	Cooperative U.K.-U.S. Satellite Launch	Success	Success
5/24	Explorer XXXIV	TAD	WTR	Particles and Fields	Success	Success
5/29	ESRO II	Scout	WTR	Study Solar, Cosmic Rays	Failure	
6/14	Mariner Venus	Atlas-Agena	KSC	Flew within 2,500 miles of Venus on Oct. 19	Success	Success
7/14	Surveyor IV	Atlas-Centaur	KSC	Lunar Photography and Surface Sampler	Success	Failure
7/19	Explorer XXXV	TAD	KSC	Particles and Fields	Success	Success
7/28	OGO IV	Thor-Agena D	WTR	Study Sun Effects on Earth	Success	Success
8/1	Lunar Orbiter V	Atlas-Agena	KSC	Photograph Lunar Landing Sites	Success	Success

MAJOR NASA LAUNCHES 1967 (Cont'd)

9/7	Biosatellite II	TAT	KSC	Experiments on Space Effects on Cells, Tissues	Success	Success
9/8	Surveyor V	Atlas-Centaur	KSC	Photography and Chemical Analysis of Lunar Surface	Success	Success
9/27 *	Intelsat II-D	Delta	KSC	For Comsat	Success	Success
10/18	OSO IV	Delta	KSC	Solar Observation	Success	Success
11/5	ATS III	Atlas-Agena	KSC	Communications and Technology	Success	Success
11/7	Surveyor VI	Atlas-Centaur	KSC	Photography and Chemical Analysis of Lunar Surface	Success	Success
11/9	Apollo 4	Saturn V	KSC	First Flight Test of Saturn V launch vehicle	Success	Success
11/10**	ESSA VI	Delta	WTR	Operational Weather Sat.	Success	Success
12/13	(Pioneer VIII ((TTS-1	Delta	KSC	(Interplanetary Solar) (Observation) (Apollo Tracking Check)	Success	Success

* Not NASA Mission (Environmental Science Services Admin., U.S. Dept. of Commerce)

** Not NASA Mission (Communications

KSC Kennedy Space Center, Fla.
WTR Western Test Range, Calif.

-more-

MAJOR NASA LAUNCHES
1968

Date	Name	Launch Vehicle	Launch Site	Mission	Results Vehicle	Results Mission
1/7	Surveyor VII	Atlas-Centaur	KSC	Lunar Photos Lunar Surface Analyses	Success	Success
1/11	Explorer XXXVI	Delta	WTR	Geodesy	Success	Success
1/22	Apollo 5	Saturn IB	KSC	Lunar Module Test	Success	Success
3/4	OGO V	Atlas-Agena	KSC	Earth-Sun data	Success	Success
3/5	Explorer XXXVII	Scout	WI	Solar radiation	Success	Success
4/4	Apollo 6	Saturn V	KSC	Launch vehicle test	Unrated	Unrated
5/16	ESRO II-B	Scout	WTR	Radiation investigation	Success	Success
5/18	Nimbus B	TAT-Agena	WTR	Meteorology	Failure	Failure
7/4	Explorer XXXVIII	Delta	WTR	Radio astronomy	Success	Success
7/8	Explorer XXXIX Explorer XL	Scout	WTR	Atmospheric Density data Charged particle data	Success Success	Success Success
8/10	ATS-D	Atlas-Centaur	KSC	Spacecraft technology	Unrated	Unrated
8/16	ESSA 7	Delta	WTR	Cloud cover photos	Success	Success

NASA ASTRONAUT STATUS

Total selected:	66	
Resigned or Transferred		6
Deceased		8
		14
Total Active Astronauts:	52	

Selection Dates:

		Losses (and Actives)
Group I (7)	April 9, 1959	Carpenter, Glenn, Grissom (Active: Cooper, Schirra, Shepard, Slayton)
Group II (9)	Sept. 17, 1962	See, White (Active: Armstrong, Borman, Conrad, Lovell, McDivitt, Stafford, Young)
Group III (14)	Oct. 8, 1963	Bassett, Chaffee, Freeman Williams (Active: Aldrin, Anders, Bean, Cernan, Collins, Cunningham, Eisele, Gordon, Schweickart, Scott)
*Group IV (6)	June 28, 1965	Graveline (Active: Garriott, Gibson, Kerwin, Michel, Schmitt)
Group V (19)	April 4, 1966	Givens, Bull (Active: Brand, Carr, Duke Engle, Evans, Haise, Irwin, Lind, Lousma, Mattingly, McCandless, Mitchell, Pogue, Roosa, Swigert, Weitz, Worden)

*Scientist-Astronaut

*Group VI (11)	Aug. 4, 1967	O'Leary, Llewellyn (Active: Allen, Chapman, England, Henize, Holmquest, Lenoir, Musgrave, Parker, Thornton)

*Scientist-Astronaut

Details of Losses and Non-Actives:

1. Cdr. M. Scott Carpenter, USN, resigned September 1967 and transferred to U. S. Navy Project Sealab.

2. Col. John H. Glenn, USMC(Ret), resigned 1964 to enter Ohio politics, enter private business; remains NASA consultant.

3. Lt. Col. Virgil I. Grissom, USAF, died in Cape Kennedy Apollo 204 fire January 27, 1967.

4. Elliot M. See, Jr., Civilian, died in T-38 jet crash February 28, 1966, at St. Louis' Lambert Municipal Airport.

5. Lt. Col. Edward H. White II, USAF, died in Cape Kennedy Apollo 204 fire January 27, 1967.

6. Maj. Charles A. Bassett II, USAF, died in T-38 crash with See February 28, 1966, at St. Louis.

7. Lt. Cdr. Roger B. Chaffee, USN, died in Cape Kennedy Apollo 204 fire January 27, 1967.

8. Capt. Theodore C. Freeman, USAF, died in T-38 jet crash at Ellington AFB, Houston, October 31, 1964.

9. Maj. Clifton C. Williams, Jr., USMC, died in T-38 jet crash near Tallahassee, Fla., October 5, 1967.

10. Duane B. Graveline, Civilian Scientist-Astronaut, resigned in 1965.

11. Maj. Edward Givens, Jr., USAF, died in an automobile accident near Houston June 6, 1967.

12. Brian T. O'Leary withdrew April 23, 1968, for personal reasons.

-more-

13. Lt. Cdr. John S. Bull withdrew July 6, 1968, due to pulmonary disease.

14. John A. Llewellyn withdrew August 23, 1968, for personal reasons.

Astronauts Grissom, See, Bassett, Chaffee, Freeman and Williams were buried in Arlington National Cemetery with full military honors (See was a member of the USNR). Astronaut White was buried at USMA; Astronaut Givens was buried in Quanah, Texas, his hometown. Memorial services were held for each astronaut at local churches in the Manned Spacecraft Center, Houston, area.

# # #

NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
September 29, 1968

TENTH ANNIVERSARY SPECIAL (16)

FILLERS

LUNAR STUDIES

WASHINGTON, D.C. -- A total of 113 scientists or scientist groups are currently scheduled to study lunar surface material, when it is brought back from the first manned Apollo flight to the Moon.

MARS MISSION

WASHINGTON, D.C. -- The Mariner Mars missions, scheduled for 1971 by the National Aeronautics and Space Administration, will provide the first opportunity to make measurements from Martian orbit.

-more-

NORTHERN LIGHTS

WASHINGTON, D.C. -- A large-scale scientific assault on the secrets of the Aurora Borealis or Northern Lights is being made in a series of flights sponsored by NASA.

EARTH PHOTOS

WASHINGTON, D.C. -- The first continuous high-quality color pictures of the Earth from "stationary" orbit, were taken by an Applications Technology Satellite launched Nov. 5, 1967.

SATURN POWER

WASHINGTON, D.C. -- The Saturn V Moon vehicle is 100 times more powerful than the Jupiter-C that hurled Explorer I into orbit in January, 1958.

SOIL ANALYZER

WASHINGTON, D.C. -- The alpha scatter device carried aboard Surveyor V, which soft landed on the Moon in September 1967, logged 93.5 hours of operation. Purpose of the device was to provide an analysis of the lunar soil.

LARGEST BUILDING

KENNEDY SPACE CENTER, Fla. -- The Vehicle Assembly Building here where NASA's giant Saturn V rockets are assembled is the largest building in the world in volume. It covers eight acres.

QUICK THRUST

WASHINGTON, D.C. -- Ignition to 200,000 pounds full thrust in a Saturn IB first stage H-1 engine takes only one second. The 1.5 million-pound-thrust F-1 engine on the Saturn V first stage takes four seconds.

GRAVITY VARIATIONS

WASHINGTON, D.C. -- Minute variations in the Earth's gravitational force are enough to cause a satellite to deviate from a perfect elliptical path by hundreds of feet.

SCIENCE PAYLOADS

WASHINGTON, D.C. -- Science payloads of 1,000 to 2,000 pounds in lunar orbit and 1,000 to 8,000 pounds on the lunar surface appear feasible for extended Apollo missions, according to the National Aeronautics and Space Administration.

-more-

EARTH'S TAIL

WASHINGTON, D.C. -- Data from the Pioneer VIII spacecraft indicates that the Earth's magnetic tail may be far shorter than some scientists have thought.

LIFTING CAPACITY

WASHINGTON, D.C. -- America's weight lifting capacity in space rose dramatically from 31 pounds placed in orbit with a Jupiter rocket in 1958 to more than a quarter million pounds orbited by NASA's Saturn V in November 1967.

TINY ENGINE

WASHINGTON, D.C. -- Resistojet electric engines capable of only 20 millionths of a pound of thrust will be used to keep NASA's next two Applications Technology Satellites anchored in orbit.

LANGLEY CENTER

HAMPTON, Va. -- NASA's Langley Research Center here is named for Dr. Samuel Pierpont Langley, one of America's major scientists and a pioneer in aeronautics.

-more-

AIRCRAFT TECHNOLOGY

WASHINGTON, D.C. -- The largest single area of NASA's aeronautical program by dollar amount is the supersonic aircraft technology activity.

ICEBERG WATCHERS

WASHINGTON, D.C. -- NASA scientists believe that monitoring of great icecap movements to an accuracy to three or four yards can be done via geodetic satellites as well as by automated stations on the icecaps. This could be effective in providing long term (possibly years in advance) forecasts of general iceberg populations constituting a hazard to shipping.

EXPERIMENT RECORD

WASHINGTON, D.C. -- OGO V, a 1,347-pound Orbiting Geophysical Observatory, carries 24 scientific experiments, a record for unmanned U.S. satellites.

SHAPE OF THE EARTH

WASHINGTON, D.C. -- During the past decade, largely because of satellite techniques, knowledge of the shape and gravitational field of the Earth has been advanced as much as in the centuries since the Greek postulation of a spherical Earth about 600 B.C.

BOOSTER RECORD

WASHINGTON, D.C. -- Explorer XXXVI (GEOS-B) launched Jan. 11 from Lompoc, Calif., by the National Aeronautics and Space Administration, set a new flight record for the Delta booster. Delta Number 56 was the 23rd consecutive success for the 92-foot-tall booster, breaking its own record of 22 consecutive successes from 1960 through 1964.

POWERING APOLLO

WASHINGTON, D.C. -- The electrical power system of NASA's Apollo spacecraft provides electrical energy sources, power generation and control, power conversion and conditioning and power distribution to the spacecraft throughout the mission.

X-15 RECORDS

FLIGHT RESEARCH CENTER, Calif. -- The X-15 research aircraft set an altitude record of 354,000 feet Aug. 22, 1963, with the late Joe Walker at the controls. The craft's speed record was set by Maj. William J. Knight Oct. 3, 1967 at 4,520 miles-per-hour.

INQUIRIES

WASHINGTON, D.C. -- In 1967, NASA received about 14,000 industrial inquiries for information on technology, an increase of 75 percent over 1966.

SUN SURVEY

WASHINGTON, D.C. -- NASA's Orbiting Solar Observatories survey the sun's activity to learn how it affects radio blackout, Earth's weather and other phenomena.

ORBITER END

WASHINGTON, D.C. -- NASA's Lunar Orbiter Project ended Jan. 31, 1968, when Lunar Orbiter V was ordered to crash itself on the Moon because its attitude control gas was nearly depleted.

TIROS COVERAGE

WASHINGTON, D.C. -- Since its inauguration in February, 1966, the TIROS Operational Satellite System (TOS) has provided continuous coverage of the world's cloud cover on a regular, dependable basis.

BUSY CIRCUITS

WASHINGTON, D.C. -- More than 100,000 ground commands were received and acted upon by Surveyor I during flight and after soft landing on the Moon in 1966.

INTEREST IN JUPITER

WASHINGTON, D.C. -- Jupiter is of particular interest to physical scientists as it is the largest of the planets and has characteristics more like a star than terrestrial planets.

STERILE SPACECRAFT

WASHINGTON, D.C. -- Spacecraft scheduled to land on Mars will be sterilized to prevent the planet's contamination with Earth-based micro-organisms.

LONG LIVED

WASHINGTON, D.C. -- Designed for a six-month life, Nimbus II meteorological satellite was still operating satisfactorily almost two years later.

-more-

SPACE EXPLORATION

WASHINGTON, D.C. -- Biological exploration of the planets is expected to contribute significantly to a better understanding of life on Earth.

PHOTOGRAPHIC COVERAGE

WASHINGTON, D.C. -- NASA's Lunar Orbiter missions provided photographic coverage of the entire surface of the Moon.

SOFT LANDING

WASHINGTON, D.C. -- Surveyor I performed the first fully-controlled soft landing on the Moon June 1, 1966.

###

NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
September 29, 1968

TENTH ANNIVERSARY SPECIAL (17)

NASA INSTALLATIONS

NASA HEADQUARTERS, WASHINGTON

NASA Headquarters formulates policy and coordinates the activities of the space flight centers, research centers and other activities which comprise the National Aeronautics and Space Administration. James E. Webb is the agency's Administrator (until Oct. 7, 1968, at which time Dr. Thomas O. Paine, now Deputy Administrator, becomes Acting Administrator).

AMES RESEARCH CENTER, MOFFETT FIELD, CALIF.

The work of the Ames Research Center is concerned with laboratory and flight research in unmanned space flight projects and in aeronautics. The fields of interest include fundamental physics, materials, guidance and control, chemistry and life sciences. Ames aeronautical projects include the supersonic transport, V/STOL aircraft and operations research. The space flight projects involve management of scientific probes and satellites, and payloads for flight experiments. The Center Director is Dr. H. Julian Allen.

-more-

ELECTRONICS RESEARCH CENTER, CAMBRIDGE, MASS.

This Center was established to stimulate research and advanced development in electronics and related fields for application in space and aeronautics. The Center organizes, sponsors and conducts programs in the basic disciplines of guidance, control, navigation, communications, data processing, electronic components, microwave and electromagnetic technology, and reliability. The Center Director is James C. Elms.

FLIGHT RESEARCH CENTER, EDWARDS, CALIF.

The Flight Research Center is concerned with manned flight within and outside the atmosphere, including low-speed, supersonic, hypersonic and reentry flight, and air operations and safety problems. Major programs include aeronautics projects such as the X-15, supersonic transport and paraglider; space vehicle programs are typified by studies such as flight behavior of lifting bodies. In biotechnology, man-machine integration problems are studied. The Center Director is Paul F. Bikle.

GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.

The Goddard Space Flight Center, named for the rocket pioneer, Dr. Robert H. Goddard, is responsible for the development and management of a broad variety of unmanned Earth-orbiting satellites and sounding rocket projects. Scientific, communications and meteorological satellites are included. (Orbiting Observatories, Explorers, TIROS, Nimbus, Relay, Syncom and others). Goddard also is the nerve center for the worldwide tracking and communications network for both manned and unmanned satellites. The Center Director is Dr. John F. Clark.

JET PROPULSION LABORATORY, PASADENA, CALIF.

The Jet Propulsion Laboratory is operated under contract to NASA by the California Institute of Technology. Its primary missions are the development of spacecraft for unmanned lunar and planetary exploration (Ranger, Mariner, Surveyor) and the operation of a world-wide deep space tracking and control network. There is a broad-scale program of supporting research. The Center Director is Dr. William H. Pickering.

JOHN F. KENNEDY SPACE CENTER, FLA.

Manned and unmanned spacecraft are launched at the John F. Kennedy Space Center on Cape Kennedy. "The Cape" is the site from which the astronauts of Projects Mercury and Gemini were rocketed into space. Functions of the Kennedy Space Center include complete planning, designing, development and utilization of launching facilities. Center Director is Dr. Kurt H. Debus.

LANGLEY RESEARCH CENTER, HAMPTON, VA.

Oldest of the NASA Centers, Langley has the task of providing technology for manned and unmanned exploration of space and for improvement and extension of performance and utility of aircraft. The major technical areas of Langley are theoretical and experimental dynamics of flight through the entire speed range, flight mechanics, materials and structures, space mechanics, instrumentation, solid rocket technology, and advanced ramjet engine research. The Center conceives, develops and operates simulators for the supersonic transport and lunar landing and the Gemini project, and conducts an extensive program of V/STOL flight research projects. Center Director is Dr. Edgar M. Cortright.

LEWIS RESEARCH CENTER, CLEVELAND

The mission of this Center is propulsion and space power generation. Fields of investigation are materials and metallurgy, problems concerned with the use of extremely high and low temperature materials, combustion and direct energy conversion, chemical, nuclear and electric rocket propulsion systems, advanced turbojet power plants, fuels and lubricants, plasmas and magneto-hydrodynamics. Lewis has technical management of a number of chemical, solid and liquid rocket projects including the Agena and Centaur.

Plum Brook Station at Sandusky, Ohio, with facilities for propulsion research and development, is operated as an arm of Lewis. The Center Director is Dr. Abe Silverstein.

MANNED SPACECRAFT CENTER, HOUSTON

The Manned Spacecraft Center is a NASA facility located 20 miles southeast of Houston, Tex. on the edge of Clear Lake. It has the responsibility for the design, development, and testing of manned spacecraft and associated systems, for the selection and training of astronauts, and for operation of manned space flights. Mission Control for manned space flights, formerly at Cape Kennedy, now is based at the Manned Spacecraft Center.

The scientists and engineers who make up the technical staff of the Manned Spacecraft Center were responsible for placing the first American astronauts in space. Valuable experience gained in Project Mercury now is being utilized in Projects Gemini and Apollo. The Center Director is Dr. Robert R. Gilruth.

GEORGE C. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.

Launch vehicles essential to Apollo and other major space missions are designed and developed by the scientists and engineers of the Marshall Space Flight Center. Named for General George C. Marshall, the Center is presently concerned with launch vehicles of the Saturn class, as well as studying rendezvous operations, launch systems, feasibility, and other requirements. Center Director is Dr. Wernher von Braun.

Michoud Operations at Michoud, La. has been established to manufacture Saturn and other large launch vehicle stages. The Center Director is Dr. George N. Constan.

The Mississippi Test Facility, located in a sparsely settled area about 50 miles east of New Orleans, is a facility for static tests of launch vehicles. The Center Director is Jackson M. Balch.

NUCLEAR ROCKET DEVELOPMENT STATION, JACKASS FLATS, NEV.

This facility, located at Jackass Flats, near Las Vegas, Nev., is managed by the Space Nuclear Propulsion Office, a joint operation of NASA and the Atomic Energy Commission. This major facility contains the laboratories, test stands and equipment for development of reactor technology and the nuclear engine and rocket stage for the nuclear rocket. The Station is the scene of many tests for the nuclear rocket program, which is in the advanced phases of research for missions to follow after the Apollo lunar landing project. Chief is John P. Jewett.

PACIFIC LAUNCH OPERATIONS OFFICE, LOMPOC, CALIF.

The NASA Pacific Launch Operations Office provides administrative, logistic, and technical support for NASA programs and projects at the Western Test Range. The Center Chief is H. R. Van Goey.

WALLOPS STATION, WALLOPS ISLAND, VA.

The rocket-borne experiments flown from the Wallops Island Range are conceived, designed and built, by scientists and engineers in laboratories and research centers throughout the U.S. and in many of the countries of the world. Functions of Wallops Station are payload checkout, vehicle preparation and launching, instrumentation and data acquisition, processing and reduction of data, and tracking of vehicles. The Center Director is Robert L. Krieger.

NASA PASADENA OFFICE

The NASA Pasadena Office is a branch of NASA Headquarters serving all operational interests of the agency in the Western states. Primary mission of the Office is contract negotiation and management of research and development contracts with Western aerospace industry. The Center Director is Earle J. Sample.

# # #