DEVIL'S ASHPIT TRACKING STATION, ASCENSION ISLAND

ASCENSION ISLAND

MANNED SPACE FLIGHT TRACKING STATION

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PREPARED BY
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INTRODUCTION

As far back as we can trace the history of human thought, man has been fascinated with the idea of understanding and conquering space. Indeed, all the constellations in the Zodiac were pictured and named hundreds of years before the birth of Christ; as long ago as A.D. 160, Lucian of Greece wrote his Vera History, the story of a flight to the moon. Man's preoccupation with space travel has been recorded in many documents over the centuries, but the end of each story always had to be fiction, since man did not have the tools to enter, let alone conquer, outer space.

During the early part of the twentieth century, this situation began to change with the development of, first, solid-fuel and, then, liquid-fuel rockets. Dr. Robert H. Goddard, a U.S. scientist working alone and often ridiculed for his efforts, was preeminent in these developments. He launched the world's first liquid-fuel rocket on March 16, 1926. In recognition of his great contributions to space flight, the National Aeronautics and Space Administration has named in his honor the Goddard Space Flight Center, the nerve center for its world-wide tracking and data acquisition networks. The Ascension Island Tracking Station is a part of this world-wide tracking complex.

Building upon the investigations of Dr. Goddard and other scientists, rocket developments were accelerated during World War II and the cold war, until finally the military missiles developed during the cold war produced several types of rockets that could be adapted to space exploration. The United States used one of them to put its first satellite, Explorer I, into orbit on January 31, 1958.

Having overcome the first great obstacle of being able to enter space, man immediately wanted to explore space. To that end, Dwight D. Eisenhower, President of the United States, requested the U.S. Congress to enact a bill to create an independent agency of the U.S. Government whose mission would be the peaceful exploration of space. In response to his request, both Houses of the U.S. Congress passed "The National Aeronautics and Space Act of 1958," and on October 1, 1958, a new, civilian, technical agency of the U.S. Government, the National Aeronautics and Space Administration (NASA) was born.

The new agency began immediately making plans to send a man into outer space. These plans reached fruition on May 5, 1961, when astronaut Alan B. Shepard, Jr., spent 15 minutes and 22 seconds in a suborbital flight in his Freedom 7 Mercury spacecraft. Shortly after this tremendously successful flight, President John F. Kennedy, on May 25, 1961, sent a special message to the U.S. Congress which stated in part:

> "I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to earth."

The Congress quickly endorsed these words, and the less-than-three-year-old space agency was embarked upon a program which, since almost the dawn of civilization, has fired the imagination of mankind.

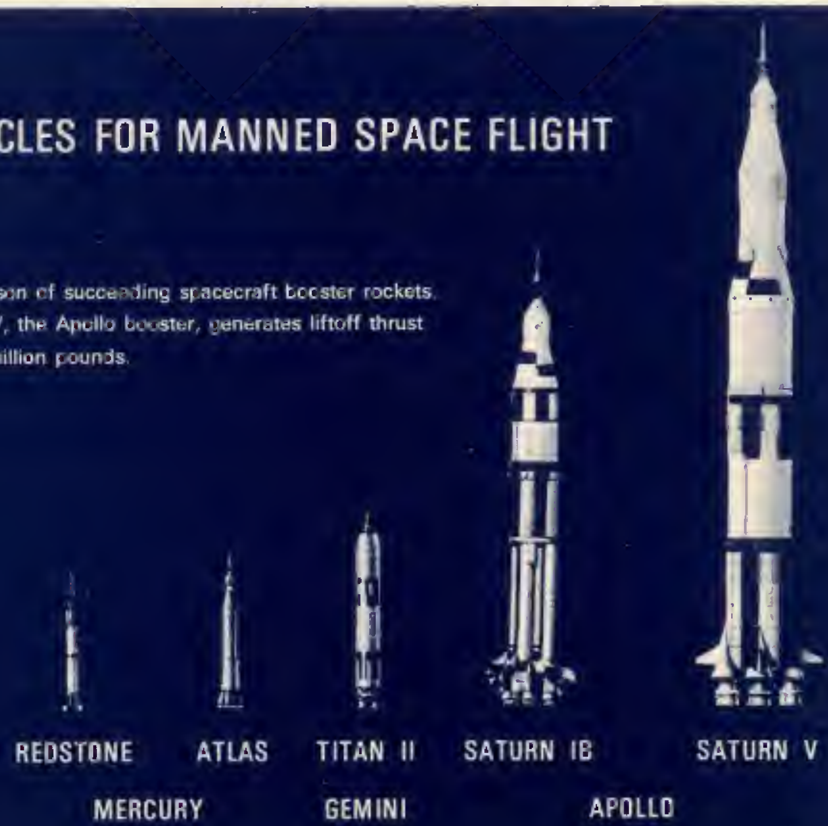
HISTORY OF MANNED SPACE FLIGHT IN UNITED STATES

The "Flight to the Moon" started slowly; outer space was a hostile environment, and many hitherto unthought-of scientific problems had to be solved before the trip could begin.

The new space agency decided to attack the problems step-by-step so that, insofar as it was humanly possible, the safety of the astronauts would be assured. The six one-man flights of Project Mercury provided sufficient information and confidence that the two-man flights of Project Gemini could be started. In like manner, the ten Gemini flights permitted the beginning of Project Apollo—the three-man flights that would, as requested by President John F. Kennedy, land a man on the moon and return him safely to earth.

VEHICLES FOR MANNED SPACE FLIGHT

Comparison of succeeding spacecraft booster rockets. Saturn V, the Apollo booster, generates liftoff thrust of 7.5 million pounds.



PROJECT MERCURY

Project Mercury was NASA's first program aimed at putting men into space. The aims of the Mercury program were simple, however complex may have been the technological knowledge necessary to achieve them. These aims were to put a manned spacecraft into orbital flight around the earth, to investigate man's ability to perform in a space environment, and to recover both man and spacecraft. All these aims were completely realized.

On May 5, 1961, astronaut Alan B. Shepard, Jr., "rode" the first manned Mercury in a successful suborbital flight of a little more than fifteen minutes. On May 15 and 16, 1963, astronaut L. Gordon Cooper, Jr., made the last of the Mercury flights, twenty-two orbits of the earth in thirty-four hours and twenty minutes. During six manned flights, Project Mercury had provided for such advances in the understanding of space flight that NASA could move ahead to Project Gemini.

Astronaut John Glenn suited for his historic flight in Friendship 7, first U.S. manned spacecraft to orbit the earth, February 20, 1962.

Mercury Control room during John Glenn's three-orbit flight of the earth. Map shows track of spacecraft in orbit.

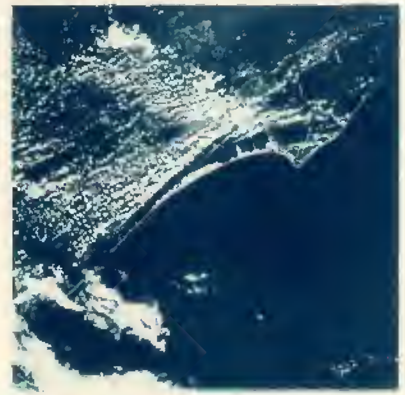
PROJECT GEMINI

Project Gemini was named after the Constellation Gemini (The Twins). There were ten manned Gemini flights between March 23, 1965, and November 15, 1966. The aims of this project went considerably beyond those of Project Mercury. Now NASA was putting two astronauts into orbit together. They were to carry out experiments to prove that men could maneuver their spacecraft during flight, changing its flight path; that they could leave their spacecraft during flight and successfully perform tasks while "walking in space"; that they could rendezvous with another spacecraft and link up with it during flight; that they could spend long periods of time in flight (up to two weeks) without ill effects; and that they could control a spacecraft during descent so as to land it in a selected area on earth.

Project Gemini achieved all these goals and added immensely to the sum of scientific and technological knowledge as well.

Astronauts John W. Young and Michael Collins walk toward spacecraft during prelaunch countdown for Gemini X.

Astronaut Edward H. White II during his historic "walk in space" during Gemini IV. White spent twenty-one minutes outside the spacecraft.



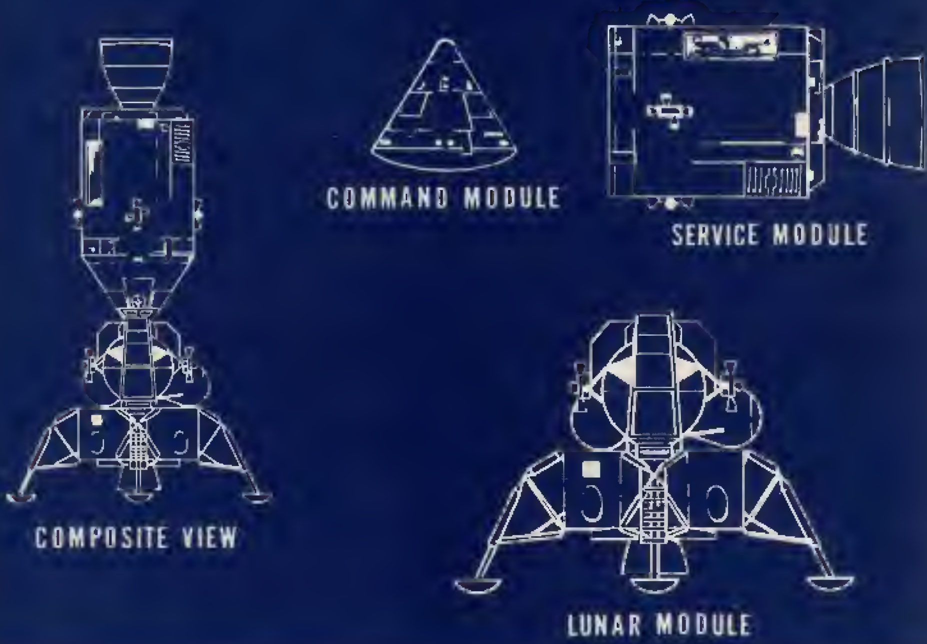
Cape Kennedy as viewed from Gemini capsule.

Picture of Gemini VII taken from Gemini VI during rendezvous. The two spacecraft maneuvered to within a foot of one another.

Agena docking vehicle, an unmanned spacecraft used by Gemini XII during historic first linkup of two vehicles in space.

Astronaut Edwin E. Aldrin on life raft, awaiting pickup by helicopter after splashdown of Gemini XII.

PROJECT APOLLO

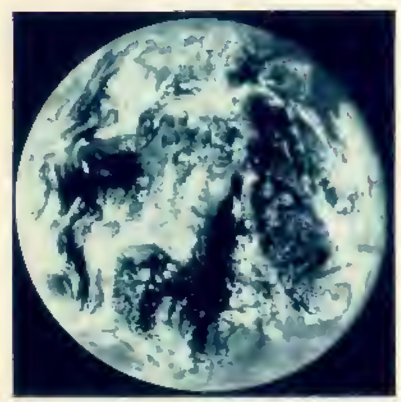


A drawing of the three modules that comprise the Apollo spacecraft. This assembly is 82 feet tall and weighs about 45 tons.

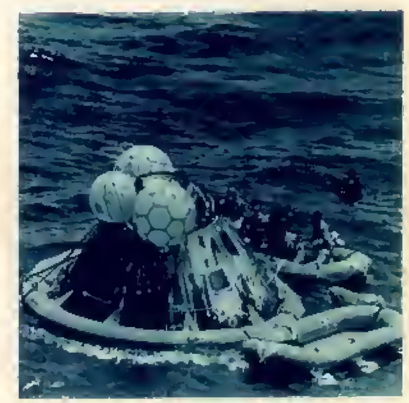
Project Apollo is NASA's most ambitious program for manned space flight. Its aim is simple: to land United States explorers on the moon and to bring them safely back to earth.

The spacecraft designed to propel U.S. astronauts to the moon is powered by the world's most powerful rocket engine, the Saturn V. The spacecraft itself consists of three parts: (1) The Command Module provides space for three astronauts to live and work in a "shirt sleeve environment," i.e. without pressure suits, and it contains the instruments for flying the spacecraft. (2) The Service Module houses fuel and propulsion systems so that the spacecraft can change course in flight and can align itself for orbit around the moon. (3) The Lunar Module (LM) is stored in an adapter section behind the Service Module until the spacecraft is in translunar trajectory. Two astronauts will enter the LM from the Command Module during lunar orbit and will use the LM's own rockets and instruments to land on and take off from the moon. Only the Command Module will return to earth, reentering the atmosphere through a precisely selected "reentry corridor" at a speed of about 25,000 miles per hour.

Apollo spacecraft at liftoff from Cape Kennedy, Florida.

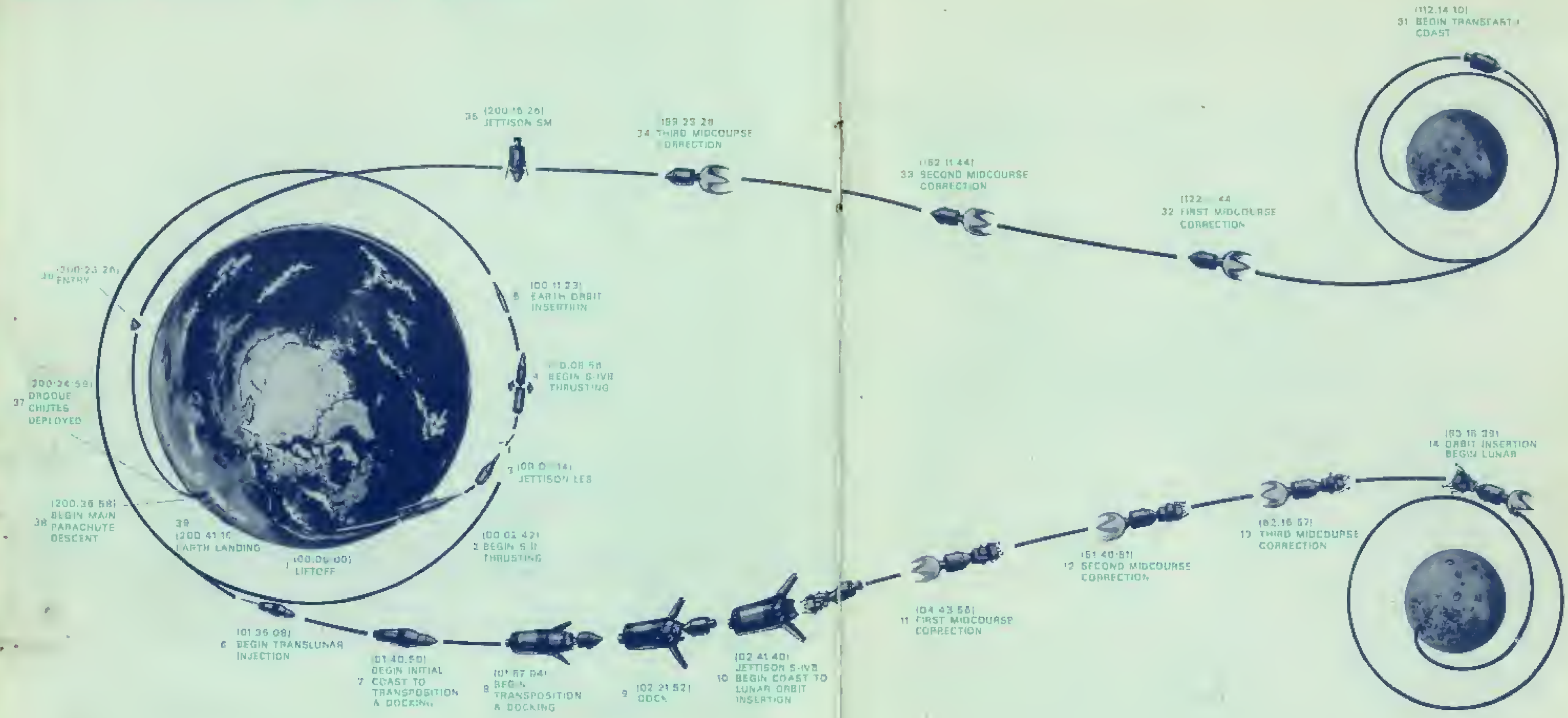


A view of the earth from outer space.



Recovery of Apollo Command Module after reentry. Note charring on heat shield from intense heat encountered during reentry into earth's atmosphere.

APOLLO FLIGHT TO THE MOON



This schematic shows the progress of the Apollo spacecraft from liftoff (1) to splashdown and recovery. The spacecraft orbits earth, jettisoning its first- and second-stage rockets, until the best time for moon take-off occurs (2-5), when the third stage refires and adds enough speed for the spacecraft to escape from earth orbit (6). On the way to the moon, the crew disengages the Command and Service Modules and turns them around to link up the nose of the Command Module with the nose of the Lunar Module. The LM is thus extracted from the adapter and third-stage rocket, which is then abandoned (8-10). About sixty-eight hours into the mission, the spacecraft swings into lunar orbit (11-14). Two astronauts enter the LM and pilot it to the moon, where they will spend about a day exploring the moon's surface. The LM then blasts off to link up again with the Command Module, and the astronauts rejoin the third pilot, who has maintained the spacecraft in lunar orbit. The LM is jettisoned and the trip back to earth begins (31-34). After using the Service Module for final course corrections, the astronauts abandon it (35), and the Command Module alone reenters the earth's atmosphere.

MANNED SPACE FLIGHT TRACKING NETWORK

Highest priority in all manned space flights is given to the safety of the astronauts. Since their safety cannot be assured after liftoff without information provided directly from the spacecraft, it was evident at the very beginning of the Mercury program that a world-wide tracking and communications network was absolutely essential to the success of every manned flight. The Goddard Space Flight Center was, therefore, assigned the responsibility of designing, building, and managing a network capable of providing support for the Manned Space Flight Program.

Initially, during the Mercury program, the Manned Space Flight Network utilized equipments very similar to the conventional electronic systems designed to test high-speed aircraft. Later on, as each successive flight became more complex, the network was modified by the addition of more sophisticated equipments to solve the more complicated problems encountered. Finally, with the advent of the Apollo program, it was obvious that modifications of existing equipments would no longer provide satisfactory results, and an entirely new concept of instrumentation had to be evolved. This new concept required radically new equipments, the addition of new tracking stations capable of providing coverage at lunar distances, and deletion of tracking stations no longer adequate for manned space flight programs. The map above shows the fourteen land-based Apollo tracking stations.

THE HISTORY OF ASCENSION ISLAND

Ascension Island was discovered in 1501 by Portuguese Admiral Jose Da Nova Gallege, on his way to India, but it was left unnamed until two years later when it was visited by another Portuguese, Alfonso de Albuquerque, on Ascension Day.

The island is 34 square miles in area. With its 42 volcanoes and little vegetation (the only exception being Green Mountain, which rises to 2,819 feet), it is not surprising that it was left undisturbed for over three centuries. In 1815 a British Naval garrison of 150 personnel was established to prevent the use of the island as a base for rescuing Napoleon, who was exiled on St. Helena, a lush island only 700 miles to the south. During the next seven years, the Royal Navy built the original Georgetown and the Mountain Farm where vegetation and livestock were introduced.

After Napoleon's death in 1821, Ascension was used as a refueling point and as a sanatorium for the British Navy Marines. The Marines employed West African "Kroomen" in payment for their freedom and continued fortifying and developing the island.

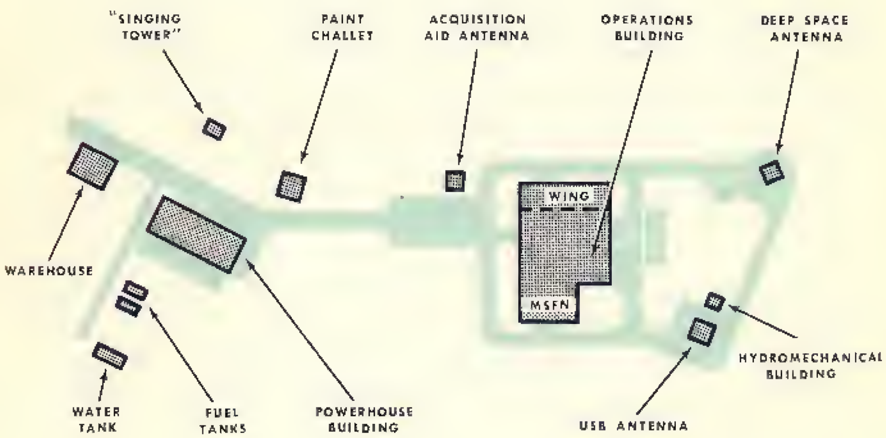
At the beginning of the twentieth century, Cable and Wireless, Ltd., a British concern, built a relay station on Ascension for communication between West Africa, South America, South Africa and the United Kingdom. In 1922, when the British Navy no longer used the island for refueling purposes, it was handed over to the Colonial Office and came under the jurisdiction of St. Helena. The then manager of Cable and Wireless, Ltd., was made responsible for governing the island. The company continued to govern the island until 1964, when, as a result of the development of several new British interests, including the building of the B. B. C. transmitting station, it became necessary to have an administrator.

In 1942 the American Air Force built an air field for refueling bombers enroute to the Middle East. Fifteen years later, in 1957, the first radar site was built on the flattened top of one of the volcanoes. Other sites rapidly followed, thus forming one of the most important stations of the Eastern Test Range, which is controlled by the American Air Force.

The most recent additions to the island are the NASA Apollo site, built in 1965 on the southeast side of the island at Devil's Ashpit, and the earth-satellite station, built in 1966 and operated by Cable and Wireless, Ltd.

DEVIL'S ASHPIT TRACKING STATION

Devil's Ashpit, the name of the tracking station site, is located in the southeastern part of the island. Green Mountain, which has an elevation of 2,819 feet, separates the station from the main activity area of the island. This ensures maximum protection from noise or interference from both the British concerns (the B. B. C. transmitter station and the Cable and Wireless, Ltd.) and the Eastern Test Range tracking sites of the American Air Force.



This site, by virtue of having two independent 30 ft. antennas and independent unified "S" band systems, can provide simultaneous support to both Apollo and Deep Space Missions.

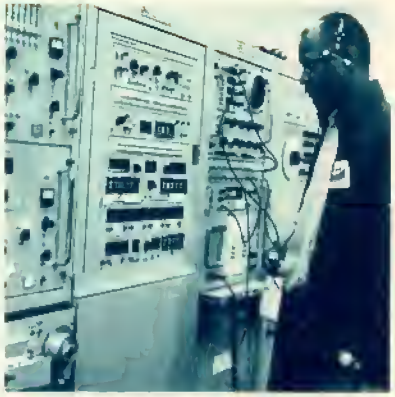
The heart of the station is the unified S-band equipment, and the heart of the USB equipment is the antenna. During lunar flights, all signals from the station to the spacecraft and from the spacecraft to the station will pass through the USB antenna.

The USB equipment is a unique tracking system. It utilizes a single carrier frequency in the S-band frequency range to transmit and receive all information between the ground and the spacecraft. In other words, it "unifies" the measurement of range and velocity of the spacecraft, the transmissions of radio commands and voice communications with the spacecraft, and the reception of hundreds of spacecraft measurements onto a single carrier frequency. This arrangement was adopted to reduce the amount of equipment required aboard the spacecraft and, more important, to reduce the amount of electrical power necessary to transmit information from the spacecraft to the ground.

In addition to the 30-foot diameter antenna shown on the preceding page, the Ascension Island Tracking Station's USB equipment includes the timing system (shown above), which will take over 200 years to gain or lose a millisecond; the antenna control console (top left); and consoles to monitor signal reception (bottom left).

Because Project Apollo is a research and development program, it is very important that the scientists and engineers involved in the project know what is happening in the spacecraft at every instant throughout the flight. To this end, many measurements are made in the spacecraft and transmitted to the USB equipment on the ground. Typical measurements are the pressure and temperature of the spacecraft's cabin, the oxygen and fuel remaining, and the temperature, heart-beat waveform, and respiration rate of the astronauts. This information is processed by the station's telemetry systems to enable the scientists and engineers to assure the safety of the astronauts during the flight, and the information is also recorded in the station's recording equipment to permit devising better methods of meeting in-flight problems in future missions.

Shown are portions of the station's prime telemetry system (upper picture), back-up telemetry receivers (middle picture), and recording equipment (bottom picture).



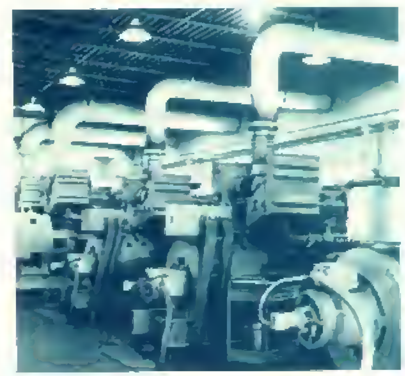
To keep abreast of the numerous problems caused by the constantly changing conditions encountered in space flight, the station is equipped with three digital computers. The antenna program positioning computer (upper right) predicts the spacecraft's trajectory, based on data obtained from other tracking stations. Its predictions are accurate enough to position the USB antenna onto the spacecraft. The command computer (center picture, foreground) sends instructions to the spacecraft directing it to perform specific tasks. The telemetry computer (background) routes the many telemetry measurements obtained from the spacecraft to various preassigned destinations.

The multitude of tasks that must be precisely performed each time the spacecraft is tracked make it necessary to have a command post to direct operations. The two consoles (bottom picture) are used to accomplish the necessary coordination within the station and with the Mission Control Center, Houston, Texas.

The entire Manned Space Flight Network is served by a comprehensive communication system to permit rapid coordination of the activities of all tracking stations participating in a mission. Shown above is the station's communication center which is the Ascension Island terminal for NASA's world-wide communication system.

Shown at right center is the station's wire room, through which all signals entering or leaving the station must pass.

Shown at lower right is the station's test equipment laboratory, where the many pieces of test equipment used to maintain the station's electronic systems are calibrated.



The station generates its own electricity. At left center are shown the diesel generators inside the power plant, and below the diesel switching equipment is shown. The top picture shows the cooling and exhaust systems for the diesels.

The International activities of the National Aeronautics and Space Administration are planned to demonstrate the peaceful purposes of space research and exploration by the United States, to provide opportunities for the participation of scientists and agencies of other countries in the task of increasing man's understanding and use of his spatial environment, and to support operating requirements for the launching and observation of space vehicles and craft.

NASA's international activities follow guidelines which recognize the interests of U.S. and foreign scientists, establish a basis for sound programs of mutual value, and contribute substantively and literally to the objectives of international cooperation. Twenty-five countries have cooperative project agreements with NASA; and a total of 74 countries cooperate in some form.

The European Space Research Organization "ESRO" forms an important part of the cooperative program.

The United States Space Program is an integrated effort; however, the major launches can be broadly categorized under several headings.

The following lists are not all inclusive but merely representative.

1. Scientific:

Vehicle	Date	Purpose/Study
Explorer I	1 Feb 58	Van Allen radiation belts
Vanguard I	17 Mar 58	Earth shape measured
OSO I	7 Mar 62	Orbiting solar observatory
Mariner II	27 Aug 62	Data from Venus
Anna IB	31 Oct 62	Geodetic satellite
Ranger VII	28 Jul 64	Lunar close-up pictures
Mariner IV	28 Nov 64	Mars pictures
Pegasus I	16 Feb 65	Micrometeorite satellite
Orbiter I	10 Aug 66	Lunar orbit pictures
Surveyor III	17 Apr 67	Lunar trenching
Dodge	1 Jul 67	Color picture of full earth face
Surveyor V	8 Sep 67	Lunar soil chemical analysis
OAO-II	10 Dec 68	Point-stabilized OAO
Apollo VIII	21 Dec 68	Live lunar TV broadcast

2. Bio-med and manned flight:

Vehicle	Date	Purpose/Study
Gemini III	23 Mar 65	Manned orbital maneuver
Gemini IV	3 Jun 65	Controlled extravehicular activity
Gemini VI, VII	4 Dec 65	Space rendezvous
Gemini VIII—Agena	16 Mar 66	Manned docking of two craft
Apollo VIII	21 Dec 68	Manned lunar orbit
Apollo XI	16 Jul 69	Manned lunar landing

3. Space craft and propulsion:

Vehicle	Date	Purpose/Study
Transit/solrad	22 Jun 60	Multiple payloads and orbits
Discoverer XIII	10 Aug 60	Payload recovery
Discoverer XIV	18 Aug 60	Air snatch payload recovery
Syncom II	26 Jul 63	Synchronous satellite
Centaur II	27 Nov 63	Hydrogen-fueled rocket orbited
Gemini X—Agena	18 Jul 66	Docked spacecraft maneuver
Surveyor VI	7 Nov 67	Lunar liftoff
Apollo I	9 Nov 67	Lunar-return velocity reentry
Apollo XII	14 Nov 69	Pin point lunar landing capability