AIR FORCE SYSTEMS COMMAND

Newsreview

August, 1969 *U.S. Air Force—Aerospace Power for Peace* Volume XIII, No.8

Editorial

One Of Man's Finest Hours

Gen. James Ferguson

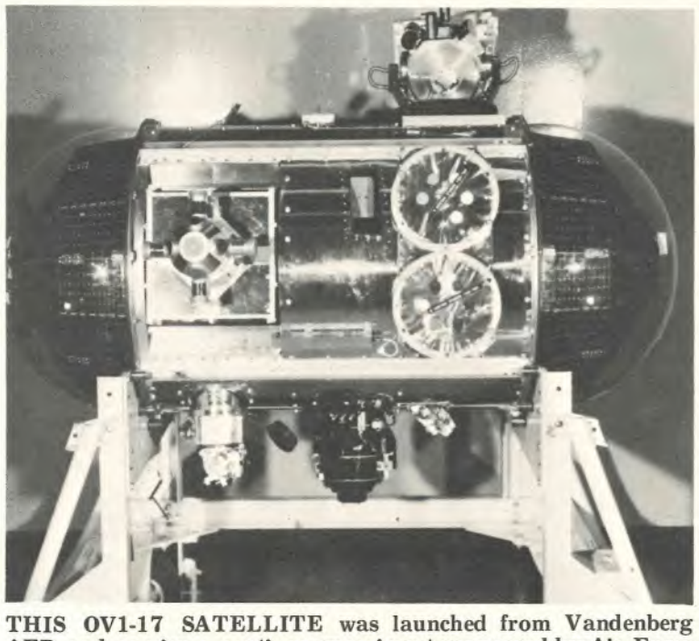
Man has set foot off the Earth and returned. This is tremendous news. Man has reached out and touched the moon in our lifetime. We are witness to one of the finest expressions of man's courage, his daring, and his inquisitiveness.

We have also witnessed man's ability to set a distant goal, organize for its accomplishment, and reach that goal through the combined and cooperative efforts of thousands of men and women. If, like the early Vikings or Columbus at the shores of the New World, Amundsen at Antarctica, Hillary at the peak of Mt. Everest—our astronauts stood alone with their thoughts on unknown soil, they were not alone. With them was the invisible presence of the most extensive, highly trained, professionally competent, and thoroughly dedicated task force we have known.

We in the Air Force Systems Command salute the astronauts on their accomplishment. We are proud that we have been able to contribute to their magnificent achievement.

Coatings Experiment At ⇦ WPAFB

WAVI LEHNER of Wright-Patterson AFB shows a materials experiment now orbiting the earth on an OV1-17 satellite. The six "poker chips" are really samples of thermal control coatings that absorb or reflect specific amounts of the sun's energy. Air Force Materials Laboratory here is sponsoring the test to determine effects of space on coatings that could be used on future satellites and aerospace vehicles.



THIS OV1-17 SATELLITE was launched from Vandenberg AFB and carries a coatings experiment sponsored by Air Force Materials Laboratory, Wright Patterson AFB, Ohio. The two discs have poker-chip sized samples of thermal control coatings that absorb or reflect specific amounts of the sun's energy. AFML is sponsoring the test to determine the effects of space on coatings that could be used on future satellites and aerospace vehicles.

SAMSO Adds Its Support To Successful Moon Trip

SAMSO, Los Angeles, Calif.

The support provided to Apollo 11 by the Space and Missile Systems Organization (SAMSO) continued in much the same manner as it has for the previous Apollo flights. While SAMSO's support to NASA in the Gemini and Mercury programs included booster development and launch assistance for both manned and unmanned payloads, the Apollo support is completely different in that it centers on safety aspects for the manned flights.

During the past year SAMSO's Satellite Test Center, Sunnyvale, California, has provided solar activity and space environmental radiation monitoring support to NASA's Apollo flights VII, VIII, IX, and X. This was accomplished by the operation of the Vela satellites in such a manner that the data from these spacecraft could be analyzed in realtime for the detection of radiation hazards during the time periods specified as critical by the Manned Spacecraft Center, Houston, Texas.

The Vela satellites operate in circular orbit around the earth at an altitude of 60,000 nautical miles which is well above the Van Allen radiation belts. About a third of the orbit toward the sun is directly in the solar wind to permit direct detailed monitoring of solar activity, and the remainder is in the magnetosphere. These spacecraft have senors aboard designed specifically to monitor the space radiation background around the earth including solar X-ray and proton, electron, and alpha particle fluxes that could constitute hazards to the astronauts while in flight.

The Air Force Satellite Control Facility which controls and operates these satellites includes the Satellite Test Center (STC) in Sunnyvale, and several tracking stations located around the world. The remoteness of one of the stations is such that the data it gathers from the spacecraft are returned to the STC with the aid of a communications satellite link. The data taken from the spacecraft by each of the tracking stations is returned to the STC in realtime for analysis and proper distribution.

The data gathered for support of the Apollo flights is provided directly to Detachment 3, Hq. Air Weather Service, which is stationed at the STC. They monitor the data for the occurrence of solar X-ray flares and proton events and pass event notification directly to the Space Environment Console at the Manned Spacecraft Center for large or potentially hazardous events, and to the Air Force Solar Forecast Center, on a routine basis.

The support provided for the Apollo mission has averaged 24 hours per day for each of the flights to date, and is projected to continue at this level for the remaining flights in the series.

In a second area of Apollo support, SAMSO's 6594th Test Group at Hickam AFB, Hawaii was listed as an available agency for rescue or recovery support of the Apollo 11 mission, should it have been required.

Front Cover Artist

The front cover was painted by Ben Lawler, Supervisor of the Typography and Design section of the AFSC Printing Plant. Lawler is a native of Maryland, and has attended the National Art Academy in Washington, D. C. and the University of Maryland School of Art. He has exhibited his paintings at many art shows throughout the area.

AIR FORCE SYSTEMS COMMAND
Newsreview
August, 1969 Volume XIII, No. 8

The AFSC NEWSREVIEW is an official Class V Air Force newspaper, published monthly by and for personnel of the Air Force Systems Command. Opinions expressed herein do not necessarily represent those of the Air Force. Information contained in the AFSC NEWSREVIEW may be reproduced provided proper credit is given the source. Official USAF photos unless otherwise indicated.

Gen. James Ferguson
Commander, AFSC

Lt. Gen. Charles H. Terhune, Jr.
Vice Commander, AFSC

Col. James W. Rawers
Director of Information, AFSC

Maj. Thomas G. Martin
Chief, Internal Information Division

Mr. William E. Fein
Editor

When Det. 11 'Spoke' - Apollo 11 'Listened'

Patrick AFB, Fla.

Words from the weathermen are weighed very carefully in making a decision to launch men into space. Thus, the role of the 6th Weather Wing's Detachment 11 became an important one in support of the Apollo 11 lunar landing mission.

The detachment, commanded by Col. Howard D. Turner, provides three basic weather services; these include forecasts, observations and consultation. For the Apollo 11 launch, detachment personnel worked jointly with NASA's Kennedy Space Center Spaceflight Meteorology Group (SMG), which is part of the U. S. Weather Bureau.

As part of the Air Force weather service provided for the launch, the detachment also gave meteorological advice to the range safety officer, range operations officer and the Department of Defense Manager for Manned Space Flight (DDMS).

Working as staff meteorologist for DDMS during the Apollo 11 flight was Lt. Col. Robert H. Dowd, a staff meteorologist from Detachment 11. Colonel Dowd was at the Manned Spacecraft Center, Houston, Tex., for the launch.

Air Force Eastern Test Range (AFETR) weathermen, working with the U. S. Weather Bureau, provided weather forecasts for the downrange weather stations and obtained current weather observations from each site. Located on each downrange tracking station to take the observations are contract weathermen employed by Pan American Airways, under the range management program. These 109 weather people, plus the 45 officers, enlisted men and DOD civilians, make the detachment one of the largest in Air Weather Service.

Besides being one of the largest units, the detachment also had one of the "highest" jobs. It had the responsibility of providing weather data (forecasts and observations) to an altitude of 295,000 feet above the Apollo 11 launch pad.

Maj. Leon R. Tucker, primary assistant meteorologist for the Apollo program, said that normal meteorological rocket (Metrocket) weather observations are from ground level to approximately 200,000 feet. This leaves a gap of nearly 100,000 feet to be covered. Metrocket observations to 400,000 feet are also provided by the Cape weather station for spacecraft re-entry in the Atlantic.

The detachment, which fires daily Metrockets from the Cape, uses the Viper Dart rocket to gather its high altitude weather data.

The 11-foot-long rocket is tracked by radar and is capable of reaching the required altitudes. The weather data is processed by a computer and relayed to the weather console at the Cape Kennedy Forecast Facility (CKFF), located in the Range Control Center (RCC).

The weather detachment begins providing weather forecasts for the launch area two days prior to launch.

Providing the launch weather data is only part of the important job of the weather people supporting the Apollo launch. During this time, the detachment also works with the Air Force global weather network at Offutt AFB, Neb., and other weather units in providing complete weather forecast service in support of the EC-135N Apollo Range Instrumentation Aircraft (ARIA) mission.

Prior to deployment of the ARIA worldwide, the weather detachment issues a complete itinerary and mission plan to the Offutt Central. The detachment specifies each computerized time phased route required from Offutt to support the deployment, missions, and return flights to Patrick AFB. Once the ARIA begin deploying, the weather detachment at the Air Force Eastern Test Range receives the required weather information directly from the Global Weather Central.

Weather messages are screened at CKFF and then sent to the primary users, the Airborne Operations Control Center (AOCC) and the deployed ARIA crews. If at anytime during the mission, an ARIA crew must be diverted from its planned mission, the weather status of that aircraft is immediately known at the AOCC.

Although Detachment 11 was working around the clock during the Apollo 11 mission, the unit continued to provide its normal round-the-clock weather service to the Air Force Eastern Test Range.

Recovery Ship

THE USS HORNET (CVS-12) was designated as prime recovery ship for Apollo 11. The 899 foot Hornet carried a crew of 340 officers, 2,890 enlisted men and 28 aircraft.

Cooperative Venture

Men, Planes, Ships Backed Moon Trip

Patrick AFB, Fla.

Air Force Eastern Test Range personnel joined with other units of the Department of Defense—Air Force, Army, Navy and Marines—in support of the Apollo 11 launch and lunar landing mission.

The launch of the huge Saturn V from Pad 39A of NASA's John F. Kennedy Space Center that boosted the Apollo 11 crew on their way to the moon took place Wednesday, July 16, 1969, at 9:32 a.m. (EDT).

The multi-service force provided 6,865 people, 54 aircraft and 9 ships during the planned eight-day mission. The DOD support force was under the operational control of Major General David M. Jones, Air Force Eastern Test Range commander and DOD Manager for Manned Space Flight Support Operations (DDMS).

During the flight of America's historic first lunar landing mission, AFETR personnel provided radar, telemetry, communications and other varied support along the 10,000-mile Air Force Eastern Test Range.

AFETR extends from Patrick Air Force Base and Cape Kennedy Air Force Station on the eastern coast of Florida over the south Atlantic to the Indian Ocean.

Tracking stations along the range included Patrick AFB which provided C-band radar coverage for launch and orbit; Cape Kennedy AFS which provided C-band radar, range safety, optics, meteorology, telemetry (receiving and recording), and command destruct control; Merritt Island which furnished C-band radar and telemetry; Grand Bahama Island with telemetry, C-band radar, and command destruct; Grand Turk and Antigua Islands with C-band radar and UHF command destruct; Ascension Island and Pretoria, Republic of South Africa, each provided C-band radar.

Also, an Air Force C-135 aircraft equipped with Airborne Lightweight Optical Tracking System (ALOTS) filmed the Apollo 11 launch from approximately 40,000 feet. ALOTS is a 70 millimeter high resolution motion picture system. The ALOTS aircraft is maintained and operated by AFETR at Patrick AFB.

Other EC-135N aircraft, the Apollo Range Instrumentation Aircraft (ARIA), were deployed from Patrick, and provided S-band tracking, voice relay and both S-band and UHF telemetry. These aircraft crews provided communications links in areas outside the limits covered by land stations and tracking ships.

Other Air Force units supporting the Apollo 11 mission included the Air Force Western Test Range at Vandenberg AFB, Calif.; North American Air Defense Command (NORAD) headquartered at Ent AFB, Colo.; and the Aerospace Rescue and Recovery Service (ARRS), a unit of the Military Airlift Command with headquarters at Scott AFB, Ill.

Units working in lesser roles were from the Air Force Communications Service (AFCS); Ground Electronics Engineering Installation Agency (GEEIA) from the Air Force Logistics Command; the Air Weather Service; and units from the United States Air Forces in Europe (USAFE).

Army units providing support for Apollo 11 were the White Sands Missile Range and Defense Communications Agency. Navy units taking part in the overall DOD effort included Navy Task Force 130, or the Pacific Manned Spacecraft Recovery Force, and Navy Task Force 140, or the Atlantic Recovery Force.

The Marine's 2nd AMTRAC Battalion was on hand if they were needed for launch abort recovery, using their tracked landing vehicles.

AOCC Is The Focal Point For ARIA Control

Personnel Assure That EC-135 Is In Right Place

ARIA PLOTTED—Using a giant world map as a plotting board, MSgt. Harold V. Tillman (center) takes instructions from ARIA controller in positioning aircraft during Apollo mission.

Patrick AFB, Fla.

A small, unobtrusive looking building adjacent to the runway area played an important role in the historic lunar landing flight of Apollo 11.

This building, known as the Aircraft Operations Control Center (AOCC), is the focal point for command and control of the Air Force EC-135 Apollo Range Instrumentation Aircraft (ARIA).

Throughout the Apollo 11 mission, the AOCC was a beehive of activity. Using a complex worldwide communications network, personnel on duty at the AOCC made certain that the ARIA covering Apollo 11 were in position to support the mission at the right place and at the right time.

Personnel at the AOCC are in continuous contact with all airborne aircraft regardless of their worldwide location. The AOCC is linked to a network communication system made up of both the NASA Manned Spaceflight and Department of Defense networks.

There are two circuit links between the AOCC and each ARIA. One circuit permits communications between the crews in the aircraft and personnel at the AOCC. The other circuit is configured to relay voice contact with the astronauts through Cape Kennedy AFS where it is tied in with the NASA network and fed to the Mission Control Center (MCC) in Houston, Tex.

The AOCC team acts as a key communications link between the Mission Control Center, Goddard and ARIA. The system can receive, verify, and relay voice and teletype messages and information.

Throughout the entire mission, constant updated spacecraft trajectory information was provided to the AOCC from the MCC in Houston. If, for any reason, the planned orbit of the spacecraft had changed, the MCC would have queried the AOCC about the feasibility of redeploying the ARIA.

By the use of high speed computers, personnel in the AOCC can provide alternate test support position and compensate for almost any contingency. In addition, they continuously monitor the quality of the ARIA support.

Operations at the AOCC are controlled through 14 sections comprising two major consoles. The two consoles, located stair-step fashion, are the nerve center of the whole operation. It is through these consoles that personnel at the AOCC are able to maintain contact and control of the airborne aircraft on a worldwide basis.

The primary console contains the command and control elements. It accommodates three ARIA controllers, ARIA task force commander, AFETR commander, and a ground communications coordinator.

The other console, the staff support section, comprises those elements necessary to maintain status of the various aircraft. It includes positions for a navigator, an instrumentation advisor, computer advisor, mission advisor, Department of Defense representative, a documentation clerk, and a status and records clerk.

CONTROLLER CONSOLES—ARIA Controllers Majors John F. Harvell (right) and George R. Freeman (center) man ARIA consoles along with Ground Communications Coordinator Peter J. O'Malley during peak of network activity.

Col. Oakley W. Baron has the dual responsibility of chief, Aircraft Operations Division and ARIA task force commander.

"When we first began operations of the AOCC in November 1967, we were not sure exactly what to expect," said Colonel Baron. "It was the first time that any system like this had been tried, and, with no past performance for judging purposes, we had to experiment with the system the first couple of times."

Backing Colonel Baron in the AOCC are about two dozen highly specialized Air Force and AFETR contractor personnel. One of these individuals is Maj. Richard E. (Doc) Weaver, chief ARIA controller for the Apollo 9 and 10 missions. Major Weaver is a veteran of 6 Apollo missions. "Apollo 11 has been a perfect mission for us," commented Major Weaver.

Lunar Scoop

USING A SPECIAL SCOOP, Apollo 11 Lunar Module Pilot Edwin Aldrin demonstrates how he collected samples of the lunar surface. In the background is the Lunar Module. (NASA Photo)

TWO AIR FORCE officers assigned to the installation and testing of a new airborne ultra-high frequency communications terminal are shown here with the equipment on board a C-135 jet transport at the Eastern Test Range, Patrick AFB, Florida. Left and right are Capt. David D. Kintigh of the Aircraft Engineering Division, Eastern Test Range and Capt. Terry M. Stark of the Tactical Satellite Communications Program Office, Air Force Electronic Systems Division, Hanscom Field. Terminal is part of the joint service TACSATCOM program that includes equipment on jeeps, trucks, vans, back-packs, ships, and submarines to relay communications through a parked satellite.

Terminal May Be Used For Space-Surface Talk

L.G. Hanscom Field, Mass.

A new type ultra-high frequency (UHF) communications terminal, developed by the Air Force Systems Command's Electronic Systems Division and now undergoing testing, may be the answer to problems in relaying messages between spacecraft and surface stations.

Designed for use on Air Force aircraft as part of the joint service Tactical Satellite Communications (TACSATCOM) Program, the terminals will be installed and tested on Air Force jet transport tracking stations and used for communications support in the Apollo program.

TACSATCOM is a joint effort of the U. S. Army, Navy, Marine Corps, and the Air Force under the guidance of the Tactical Satellite Communications Executive Steering Group, a joint-service organization headquartered in the Pentagon.

The Electronic Systems Division at Hanscom Field is also developing the UHF shipboard, jeep and van-mounted, and team pack terminals and is conducting the feasibility testing.

Basically, the TACSATCOM Program presents an innovation in tactical communications by permitting reliable long distance message transmission using mobile terminals and a 22,000 mile high parked satellite.

The jet transport that will be involved is the Apollo/Range Instrumented Aircraft (ARIA), a C-135 transport specially modified and equipped last year under an Electronic Systems Division program.

The ARIA aircraft carries a distinctive bulbous nose specially designed to accommodate the steerable antenna that is used to lock on to the Apollo spaceship for line-of-sight communications (telemetry, voice and other data) which is recorded on board or relayed to appropriate control centers. These aircraft are used in areas where the spacecraft is not visible to land mass tracking stations (or preposition ships) to insure greater coverage of the spacecraft as it orbits the earth.

Maj. Henry Zinke, TACSATCOM Air Force test director at the Electronic Systems Division, explained, "These terminals will allow the airborne tracking stations to reliably relay spacecraft information and recovery operations from parts of the globe where communications has been a problem.

"For instance, if the Apollo spacecraft comes down some distance from the recovery forces, the jet transport can maintain radio contact with the spacecraft over considerable distance because of the increased line-of-sight distance at the high altitudes where it normally flies. Now with the aid of the satellite terminal, the information received from the spacecraft can be relayed instantly over long distances directly to the recovery forces and NASA control centers. Previously, only high frequency radio with its severe propagation difficulties was available to relay this information."

The antenna used on the ARIA aircraft is the standard blade type normally used for communications on most fast aircraft because of obvious design limitations.

The Communications Deputate of the Air Force Electronic Systems Division at Hanscom Field is now engaged in the feasibility testing phase of the TACSATCOM system's development. A one-year testing program began in March.

Colonel Olson Receives Additional Job With DOD

Patrick AFB, Fla.

Colonel Royce G. Olson has been appointed Deputy Department of Defense Manager for Manned Space Flight Operations.

Colonel Olson will fill the vacancy created by the nomination of Major General David M. Jones as DOD Manager. The new position with DOD is in addition to Colonel Olson's present job as director, Department of Defense Manned Space Flight Support Office. No transfer will be involved in Colonel Olson assuming the new DOD position.

Col. Royce G. Olson

The colonel was born March 24, 1917 and is a native of Illinois where he attended the University of Illinois. He enlisted in the Army Air Corps in November, 1940, as a flying cadet and was commissioned a second lieutenant on July 12, 1941. He advanced to the rank of colonel on April 11, 1955.

Colonel Olson has served in various major air commands within the Air Force. He trained British pilots for a period of time during World War II. He was stationed in Germany throughout the Berlin Airlift and held squadron and group command positions.

He served as a B-36 squadron commander and as director of operations, and as vice commander and director of operations of a Stragetic Air Command B-52 wing.

He served a tour of duty with the Air Staff as Operations Program Manager and served with the Joint Chiefs of Staff before assuming his present duties.

Colonel Olson was instrumental in the initial development of missile operational readiness testing monitored by the Joint Chiefs of Staff.

He is a graduate of the Armed Forces Staff College and the National War College. He holds the Air Medal and Legion of Merit among his other decorations.

Heavenly Hardware

APOLLO 11 SPACECRAFT COMMANDER, Neil Armstrong (right) and Lunar Module pilot Edwin E. Aldrin inspect tools they used to collect samples on the lunar surface. Armstrong is holding a scoop device and Aldrin a "claw" that permitted him to pick up items. (NASA Photo)

Here Men From The Planet Ea

July 19

We Came In Peac

SPACECRAFT COMMANDER NEIL ARMSTRONG (front) simulates adjusting an S-Band antenna which he has just deployed. Deployment of the antenna was an alternate plan in the event problems developed in transmitting signals to earth through the Lunar Module antenna systems. In the background, Lunar Module Pilot Edwin Aldrin practices collecting material in a scoop.

ANOTHER ANGLE OF THE Apollo 11 moon landing crew as they practice lunar surface activities. Lunar Module Pilot Edwin E. Aldrin (left) is in the process of collecting samples of the lunar surface while Spacecraft Commander Neil Armstrong takes pictures with a chest camera.

Honor Roll

Alan Shepard

Virgil Grissom

John Glenn

Scott Carpenter

Walter Schirra

Gordon Cooper

John Young

James McDivitt

Edward White

Charles Conrad

Thomas Stafford

Frank Borman

THE WINNERS! The Apollo 11 cr (left to right) Neil A. Armstrong, module pilot; and Edwin E. Aldrin.

Photograp

FROM PAD 39-A, the mighty Sat ward the moon.

th First Set Foot Upon The Moon

'9, A. D.

e For All Mankind

' that successfully landed on the moon: ommander; Michael Collins, command ., Lunar Module pilot.

s By NASA

ı rocket hurled the Apollo 11 crew to-

Honor Roll

James Lovell

Neil Armstrong

David Scott

Eugene Cernan

Michael Collins

Richard Gordon

Edwin Aldrin

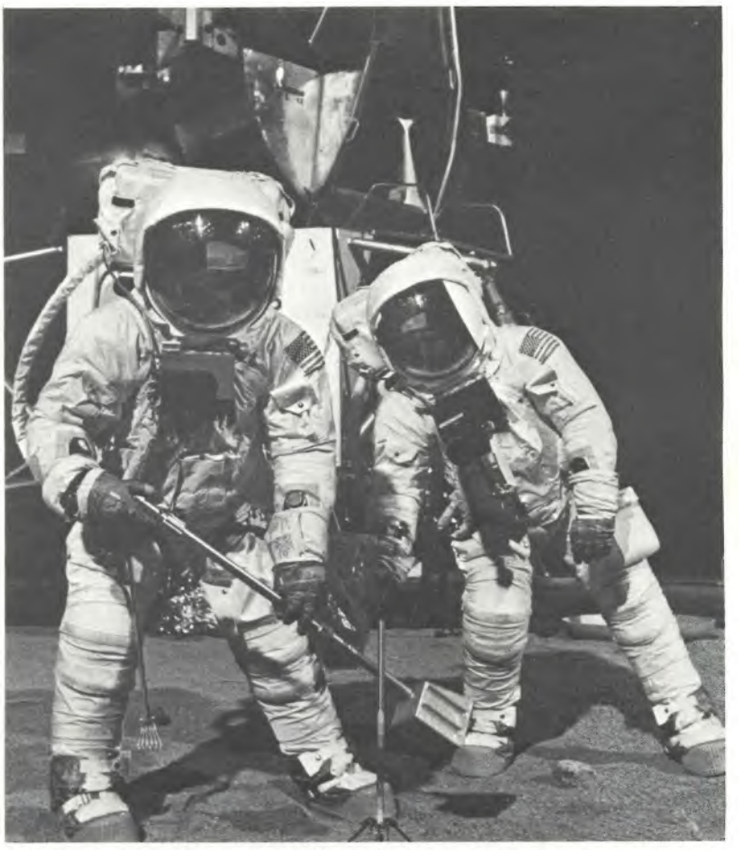
Roger Chaffee

Donn Eisele

Walt Cunningham

William Anders

Russ Schweickart



APOLLO 11 LUNAR MODULE Pilot Edwin E. Aldrin (front) and Spacecraft Commander Neil Armstrong practice lunar surface activities. Aldrin is using a scoop to collect samples of the surface while Armstrong takes pictures. The Lunar Module is in the background. The astronauts are in space suits, and breathing oxygen, pressurization and temperature control are provided by backpacks.

COMMANDER NEIL ARMSTRONG (front) simulates adjusting the passive seismometer and Lunar Module pilot Edwin Aldrin is placing an array of laser reflectors on the surface. The experiments are part of the early Apollo scientific experiments package which was left on the moon. The seismometer will radio to earth information of the moon seismic activity and the reflectors will be used to return laser beams directed at the moon from earth to provide a means for determining such data as earth-moon distances, etc.

Ships At Sea Aid Ship In Space

A VIEW FROM THE main deck with the Unified S-Band antenna on the right. Each of the Apollo Instrumented Ships is equipped with sophisticated tracking, telemetry, communications, data processing equipment and state-of-art navigation equipment.

Vandenberg AFB, Calif.

For centuries man's exploration of his environment has been closely linked with the sea. The pages of history are filled with such voyages. The journey of Columbus, for example, led to the discovery of a "new world." Today man's "new world" is the moon. With the flight of Apollo 11 man has extended his explorations to a new planet. Symbolically, men at sea provided vital support to the voyage of the Apollo 11 astronauts.

Four ships, the USNS Vanguard, Huntsville, Mercury and Redstone are each equipped with over 445 tons of extremely complex electronic and communications equipment required for the support of manned missions. Known as the Apollo Instrumentation Ships, they are part of NASA's worldwide tracking network for Apollo missions. These ships can be thought of as floating tracking stations. Operating in the broad ocean area, they are used to track and maintain communications with the Apollo spacecraft when it is out of reach of land based stations.

Using C-Band radar, unified S-Band radar and telemetry receivers, these ships gather data on spacecraft performance and the well being of the astronauts. Such data is transmitted from the ships in real time (as it happens) and relayed via satellite by the ship's communications system to the Mission Control Center at Houston. Commands originated at NASA's Mission Control Center can be sent in real time to the Apollo spacecraft through the digital command systems on each of the ships.

The performance of these four ships during earlier Apollo missions demonstrates their contribution to the overall mission. For example on Apollo 7, the first mission supported by all of the Apollo ships, the fleet tracked 212 passes of the spacecraft during the ten day mission and gathered 7,494 pounds of data. Included in this extraordinary amount of data were 699 reels of magnetic computer tape and 1,112 rolls of strip charts.

By way of comparison, the data obtained by the Apollo fleet during that one mission is equivalent to the amount of data collected from approximately 100 ballistic missile launches. Total fleetwide tracking time during Apollo 7 was the longest mission coverage by the ships up to that time—nearly 26 hours.

During Apollo 9, an eight day earth orbital mission, the fleet tracked a total of 258 passes of the spacecraft and gathered 9,698 pounds of data during more than 32 hours of tracking.

Although the ships gather less data during a lunar orbit mission (since the spacecraft makes fewer earth orbits) the ships provide important coverage during several critial maneuvers and events. For example the Vanguard, generally stationed some 1,000 miles southeast of Bermuda in the Atlantic, must confirm to Mission Control that the spacecraft has attained the proper velocity and altitude for insertion into an earth orbit. This insertion maneuver is one of the critical phases of the flight. Since it occurs over the broad ocean area, it must be covered by a tracking ship.

During a lunar orbit or landing mission, the Mercury and Redstone are stationed in the Pacific to provide tracking coverage during the translunar injection maneuver. This maneuver takes the spacecraft out ot its earth orbit and sends it on a course toward the moon. Finally, as the Apollo astronauts make the journey back to earth, the Redstone and the Huntsville provide tracking during the reentry into the earth's atmosphere. The Apollo Instrumentation Ships performed these tasks for the Apollo 11 flight.

To track and command the Apollo spacecraft, the location of an instrumentation station relative to the spacecraft must be known. Since this poses great difficulties on the high seas, the Apollo ships are equipped with state-of-the-art navigation equipment to pinpoint their position. The ships use star sightings (both night and day), navigational satellite tracking and an inertial navigation system to precisely define their location.

Readying these ships for their complex mission requires a great deal of work and coordination between several agencies. The overall management of the Apollo ship operations is the responsibility of the Air Force Western Test Range. The Military Sea Transportation Service provides maritime crews and the Federal Electric Corporation (under contract to the Western Test Range) provides the technical instrumentation crews. About 400 such technicians are aboard the four ships. NASA's Goddard Space Flight Center is responsible for the configuration control and network interface of the ships in support of Apollo missions.

Despite the fact that these are "space age" ships, they are not entirely immune to the same problems that must have faced Columbus' fleet. For example, the Mercury tracked Apollo 7 while in the midst of a typhoon and during the Apollo 9 mission the Vanguard endured nearly three weeks of storms with high seas and winds up to 50 knots. Additionally, one of the onboard Satellite Communications Systems suffered a critical failure six days before the launch of the spacecraft. Using techniques developed and used during each of the previous two missions, the Apollo Ships Operational Readiness Force (a special Western Test Range task force who insure the ships are ready to support each mission) made arrangements for an emergency air drop of replacement parts. While it was only five days prior to the mission, the air drop provided the parts needed to ready the Satellite Communications System for support of the Apollo 9 flight.

With these four highly instrumented ocean going vessels, man's exploration of the moon will be made easier and safer.

INSIDE ONE OF THE Apollo ships, technicians of ITT's Federal Electric Corporation, the Air Force Western Test Range's prime operation and maintenance contractor, monitor internal and external communications. Selected telemetry links and high and low speed data are transmitted from the ships in real time—and relayed via the ship's communication system to and from Mission Control and the Apollo spacecraft.

3 Arrive From Cocos Island Where They Supported Apollo 11

Patrick AFB, Fla.

Three firefighters from the Patrick AFB fire department are on their way back from a remote island in the Indian Ocean.

The three men, Sergeants John I. Harris and Randall W. Blackmon, and Mr. Joseph Mealey, all fire protection specialist, were part of the worldwide Department of Defense forces supporting the Apollo 11 lunar landing mission.

The team has been working on the tiny island to provide fire protection for the EC-135N Apollo Range Instrumentation Aircraft (ARIA) in case of emergencies.

Cocos Island, located 1,200 miles northwest of Perth, Australia, was one of the staging bases for ARIA crews. Other ARIA crews staged out of additional areas in the Indian Ocean and South Pacific providing telemetry recording and real-time voice relay between the Apollo 11 spacecraft and the Mission Control Center, Houston, Tex., during the critical translunar injection maneuver.

Equipment necessary to support the operation included a 1,000-gallon water tank truck, a trailer with a 300-pound CO (carbon dioxide) capacity plus related supplies and materials.

The tank truck, previously only a water distributor, was modified and redesigned into an aircraft firefighting unit. Modifications included the installation of a 10-gallon chlorobromomethane (CB) distributor on the top front, a 100-gallon foam tank atop the main tank and reworking of hoses and valves.

A quick opening valve was installed between the water and foam tanks to permit quick mixing of the substances. At full pressure, the mixture of water and foam can be dispersed in a concentrated stream at a rate of 500 gallons per minute.

Confident Smile

APOLLO 11 SPACECRAFT COMMANDER, Neil Armstrong gives a smile of satisfaction as he suits up. His smile was well founded as he and Lunar Module pilot Edwin Aldrin became the first humans to set foot on the moon. (NASA Photo)

Airmen Subject To Weightless Tests For Future Space Travel

Brooks AFB, Texas

Fourteen airmen at the U. S. Air Force School of Aerospace Medicine, Brooks Air Force Base, Tex., participated in a bedrest study designed to determine the effects of weightlessness on human kidney function and the hormone regulation of body glucose (sugar).

The study entitled "Carbohydrate and renal changes associated with prolonged bedrest in man," began April 1 and ended July 3.

In the second phase which began May 31, the subjects were confined to bed at Wilford Hall U. S. Air Force Hospital for two weeks of limited body movement to simulate the effects of weightlessness.

Doctors participating in the study include Lieutenant Colonel Edwin M. Bradley and Major David J. Kudzma from the hospital, and Major Murray Epstein and Captain Richard L. Lipman from the school.

Airmen who volunteered as test subjects are Randall M. Tumblin, Lakewood, Calif.; Raymond F. Berry, Rochester, Pa.; William R. Groome, Mechanicsville, Md,; Jeffrey W. Smith, Baltimore, Md; Raymond W. Bowers, Jr., Easton, Pa.; David J. Walton, Phoenix, Ariz.; Richard W. Swanson, Santa Clara, Calif.; James H. Frink, Shallotte, N. C.; Jonathan R. Andrews, Dover, Del.; David M. Lapic, Novato, Calif.; Nick W. Barbaro, Seaside, Calif.; James R. Griffin, Craigsville, Pa.; Carlos S. Ortega, Pittsburg, Calif.; Michael B. McDonough, Chicago.

VELA Satellite Observes Solar Storms

SAMSO, Los Angeles, Calif.

The two Department of Defense (DOD) Vela satellites launched by the Air Force provided important safeguards when America's astronauts made a moon landing during the Apollo 11 Mission.

For the first time details of how Vela Nuclear Detection Satellite information is used by the Air Force Space and Missile Systems Organization (SAMSO), the Air Weather Service (AWS), and the National Aeronautics and Space Administration (NASA) were revealed by Lieutenant Colonel Fred W. Seybold, Director of SAMSO's Vela Systems Program Office in Los Angeles.

"At the present time," said Colonel Seybold, "the ground based solar observatories and the Vela satellites are the only significant real-time sources of natural space environmental data." He continued, "Information furnished by the Vela spacecraft has served the last two Apollo flights as well as an international audience through the SOlar Forecasting NETwork (SOFNET)."

During the long space flight to the moon, the astronauts were at the mercy of invisible space weather much as the explorers of old were at the mercy of storms at sea. If, for example, a solar flare or other disturbance on the sun produced a large amount of radiation or spewed out a cloud of energetic particles that could be injurious to men, the Vela spacecraft would sense that approaching solar storm. This information would have been passed to NASA flight control headquarters in Houston and displayed on their status board.

As a result of the approaching storm, the Apollo astronauts might have been advised to cut short any planned Extra Vehicular Activity (EVA) including walks on the moon. The descent to the moon in the Lunar Module could have been postponed. If the storm was extremely severe, the spaceship's heat shield could have been turned toward such a storm to give even greater shielding and protection.

The Vela satellites, originally designed to support the limited Nuclear Test Ban Treaty, have X-ray, Gamma-Ray, Neutron, optical and electromagnetic pulse detectors to "see" solar phenomenon, such as solar flares, and nuclear explosions within the earth's atmosphere and farther than 100,000,000 miles into space.

Information received by the sensors aboard the spacecraft is radioed back to ground stations operated by the Air Force Space and Missile Systems Organization's (SAMSO) Satellite Control Facility (SCF) in a fraction of a second. This information is collated at Sunnyvale, Calif. and interpreted by the Air Weather Service (AWS).

The natural space radiation data—or space weather—received from the Vela satellites is used by the Solar Forecast Facility of AWS for daily briefing purposes. This information alerts satellite users to possible sensors and solar cell damage from predicted solar events and advises operators of various satellites to turn on specific sensors so additional data may be obtained.

Since all Air Force and civilian operations involving radio and radar systems, unmanned satellite systems, and manned spaceflight can be significantly affected by the space environment, the Air Weather Service has requested that SAMSO provide space weather data from Vela on a real-time (second by second) basis, 24 hours a day. When the new computer-to-computer system is operational, information will be available to the user in less than five seconds from the time it is sensed by the Vela satellites, 60,000 nautical miles above the earth.

The Vela satellites are jointly sponsored and funded by the Department of Defense Advance Research Projects Agency (ARPA) and the Atomic Energy Commission (AEC).

The Air Force Space and Missile Systems Organization (SAMSO) at Los Angeles, Calif. supervised design, development and construction of the Vela spacecraft and the Titan III-C booster.

'Weightless Wonder' Aided The Apollo 11 Astronauts

Wright-Patterson AFB, Ohio

Apollo 11 astronauts Edwin Aldrin, Neil Armstrong and the lockup Lunar Module pilot, Fred W. Haise received extensive training in the KC-135 "Weightless Wonder" aircraft under the guidance of Aeronautical Systems Division's Zero Gravity Test Engineering Section of the Directorate of Flight Test.

The Zero 'G' crew, headed by Donald Griggs, has conducted tests to verify design of equipment to be used on the Lunar surface, including sample return containers (SRC); contingency sample return containers (CSRC); Lunar geological hand tools; Early Apollo Scientific Experiment Package (EASEP); Close-up Stereo Camera (CSC); S-Band Antenna (SBA); and Modular Equipment Stowage Assembly.

They also studied such intravehicular procedures as a hydrogen separation system; ability to go through the tunnel from the command module to the lunar module; a system to assure that lunar samples are in proper containers and locked; use of a urine collection system, and extra-vehicular transfer procedures.

As a result of a problem encountered by the Apollo 10 crew with bubbles in drinking water, ASD Zero 'G' personnel and technicians from North American Rockwell's Space Division solved the problem by redesigning the water container. In test flights at Wright-Patterson, it was found that the new container eliminated excess hydrogen that caused the bubbles.

Upon recommendation of the Apollo 10 crew, the waste management system for Apollo 11 was greatly improved as a result of flights made at WPAFB.

Lunar 'G' (one-sixth gravity) tests have been flown at Wright-Patterson, Patrick AFB, Florida, and Houston, Texas, for more than three years. Various types of proposed lunar vehicles have been tested under weightless conditions as well as man's ability to walk or maneuver on a simulated lunar surface. Astronauts have trained for many hours on various operating procedures within the command module and the Lunar module mock-ups inside the KC-135 Weightless Wonder.

Two branches of the Aerospace Medical Research Laboratory at Wright-Patterson AFB contributed to the research of materials used in the cabin of Apollo 11. These were the Chemical Hazards and the Toxicology branches.

The Chemical Hazards Branch, under the direction of Dr. S. A. London, considered 1,000 materials which were candidates for the cabin construction.

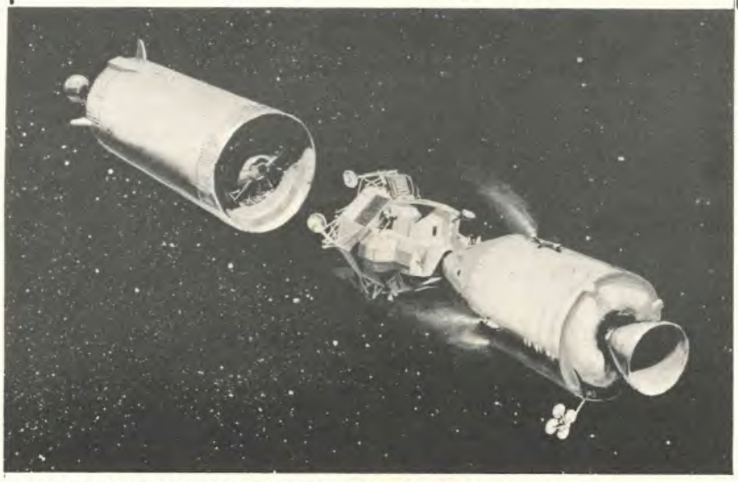
Considered and analyzed were several types of plastics, potting compounds used on electronic components, adhesives, sealants, paints, inks and insulation materials.

After the chemical analyses were completed, the materials (between 300 and 400 of them) were placed in the Thomas Domes operated by the Toxicology Branch under the direction of Dr. K. C. Back. The Thomas Domes provide a closed environment where animals are exposed to the materials for long periods of time. The effects of vapors on animals are determined and then extrapolated to human beings.

Of all the materials tested by the two branches for use in Apollo space cabins only one was found to be toxic if raised to a high enough temperature.

Techniques for the use of electroluminescent displays for the Apollo program were developed by the Flight Control Division.

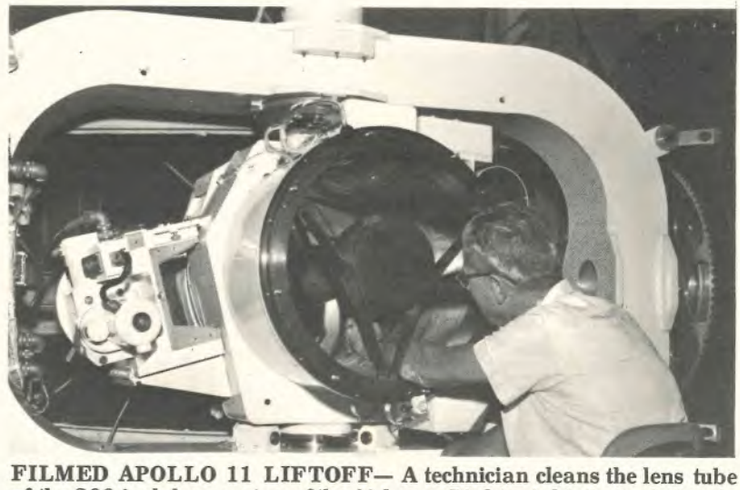
Space Voyage



AN ARTIST'S CONCEPTION SHOWING the Apollo Command and Service Modules docked to the Lunar Module and pulling away from the Saturn V third stage using its Automatic Control System (ACS). The Saturn V third stage is left in Earth orbit. (NASA Photo)

ALOTS Films The Historic Lift-off Of Moon Craft

ALOTS CAMERA CONSOLE—This automatic tracking console of the Airborne Lightweight Optical Tracking System (ALOTS) mounted in an Air Force Eastern Test Range NKC-135 was used in the filming of the Apollo 11 lunar launch. After the two operators lined up and centered the picture of the Apollo vehicle, the system automatically kept it centered on the screens of the monitor.



FILMED APOLLO 11 LIFTOFF— A technician cleans the lens tube of the 200-inch lens system of the Airborne Lightweight Optical Tracking System (ALOTS) which filmed the Apollo 11 lunar launch.

Patrick AFB, Fla.

One of the very few aircraft allowed near Launch Pad 39A when Apollo 11 lifted off on its journey to the moon was an Air Force Eastern Test Range (AFETR) C-135 from Patrick Air Force Base. Its mission was to film the Apollo 11 launch with the Airborne Lightweight Optical Tracking System (ALOTS).

ALOTS is a 70 mm motion picture system carried in a 5-foot-diameter pod externally mounted on the left side of the aircraft's fuselage. It has a focal length of 200 inches, enabling it to photograph a 12-foot target 200 miles away. This high resolution camera system has yielded exceptional footage of space launches and re-entries in the past.

The aircraft was flying at 40,000 feet above the major portion of the earth's atmosphere, and atmospheric distortion was virtually eliminated.

When Apollo 11 lifted off, the ALOTS was flying 30 nautical miles east of Melbourne Beach, Fla., and 41 nautical miles east southeast of the launch pad. It performed banking and S-turn maneuvers while filming the Saturn V booster, from T-plus 200 seconds. This time frame included primary staging and jettison of the Launch Escape Tower.

Preflight operations began in the early morning hours of launch day. Just loading the pod with its 1,000 feet of Ektacolor film took two hours.

Another preflight operation was the window checkout. The ALOTS camera and telescope viewed the booster through a three-inch-thick glass. It is optically flat within 25/ten-thousandths of an inch and it is valued at $123,000.

'Beach Boys' Were Ready If Needed

Team Geared For Any Type Of Eventuality

BIG LIFT—An HH-53 helicopter launch site recovery tactics by lifting a "boilerplate" version of the Apollo spacecraft from the beach off Cape Kennedy Air Force Station.

Patrick AFB, Fla.

An elite team of Patrick Air Force Base and other Department of Defense personnel were among the closest spectators to Complex 39-A during the Apollo 11 launch to the moon.

This team was the launch site rescue and recovery force under the command of Air Force Colonel Lawrence T. Gordon, whose recovery force title is "Beach Boss."

"We were responsible for providing necessary and rapid support in case of a launch site emergency," Colonel Gordon pointed out. "It was a vital mission for which we trained long and hard."

Near Launch Pad

Colonel Gordon directed his team of about 100 persons from an HH-3E command helicopter hovering near the launch pad. Also placed strategically within the launch recovery area were two airborne HH-53C helicopters temporarily attached to Detachment 15 of the Aerospace Rescue and Recovery Center located at Patrick AFB. The HH-53s were from Eglin AFB, Fla.

Providing necessary backup rescue and recovery support for the helicopters were two U. S. Marine Corps Landing Vehicle Tracked Recovery (LVTR) vehicles and a Landing Craft Utility (LCU) ship.

Apollo 11 Had LES

The Apollo 11 spacecraft was provided with a Launch Escape System (LES) which could have been activated while on the pad or during the early phase of the flight. When activated, the LES detaches the command module carrying the three astronauts from the booster and allows it to land safely on land or water.

"Once the LES is activated due to an emergency, the task force of aircraft, land vehicles, or water vessel locate and recover the astronauts and the command module," said Colonel Gordon. "We had that capability under any impact conditions, whether on land, swamp, in the surf, or in deep open water. We were geared for any eventuality."

Aboard each helicopter was a three-man pararescue team ready to leap into the ocean and attach the all-important flotation collar around the spacecraft, had a launch problem caused it to fall into the Atlantic.

LAUNCH SITE RECOVERY forces, using HH-53 helicopters, practice recovery of a "boilerplate" Apollo spacecraft from the surf of Cape Kennedy Air Force Station.

Airlift Help

If a malfunction in the Saturn V booster had caused the Apollo 11 spacecraft to fall back on land, the Helicopters would have immediately airlifted firefighters and their equipment into the area. At least one of the HH-53Cs carried a fire suppression kit suspended beneath it to combat either hypergolic or brush fires. A second kit was located only a short distance from the pad and could have been transported to the area within minutes.

"Although our launch site rescue and recovery force constituted only a small portion of the overall DOD forces participating in the Apollo 11 launch, we were active during one of the most critical portions of the mission," Colonel Gordon added.

The launch site recovery forces assumed an active position from arming of the LES at T-40 minutes to approximately T-plus 100 seconds. If an emergency had occurred after that time, rescue and recovery became the responsibility of other DOD elements stationed further out in the Atlantic.

World's Largest Steerable Antenna

Patrick AFB, Fla.

Eight EC-135N Apollo Range Instrumentation Aircraft (ARIA) staged out of various areas in the Indian and Pacific Oceans in support of the Apollo 11 lunar landing mission.

The primary mission of the ARIA was to provide coverage during translunar injection (TLI) and re-entry. TLI coverage by ARIA supplemented the coverage provided by the Apollo Instrumentation Ships (AIS) Mercury, Redstone, and Huntsville, and the Manned Space Flight Network (MSFN) land tracking stations.

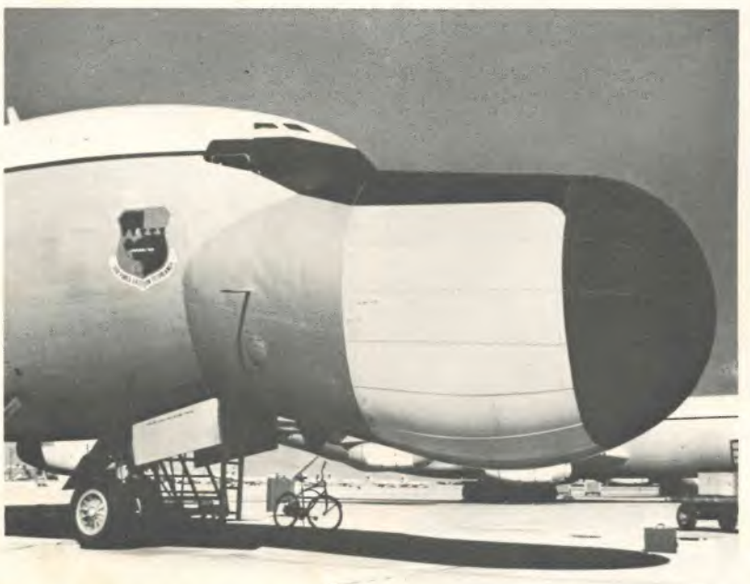
The ARIA provided vital voice relay communications between the spacecraft and the Mission Control Center (MCC) in Houston, Tex. The ARIA were able to provide this support through the use of a seven-foot-diameter parabolic (dish) antennae installed in the nose of each aircraft.

The ARIA also used its dish antennae to receive and record vital telemetry information from the Command Module, Instrumentation Unit and the Saturn IVB stages.

A worldwide network of high frequency, single sideband radio stations, land cables, submarine cables and communications satellites provided communications between ARIA and the MCC.

The ARIA are four-engined jets originally manufactured by the Boeing Company (similar to the 707) and modified by the Douglas Aircraft Company and the Bendix Corporation. The major modification is the ten-foot "droop snoot" which houses the dish antennae. The modification gives the forward section of the ARIA a large bulbous look.

The minimum crew for each ARIA is eleven men. Four make up the aircrew and seven handle the instrumentation.



DROOP SNOOT—The world's largest steerable antenna installed in the 10-foot nose of the Air Force Eastern Test Range EC-135N Apollo Range Instrumentation Aircraft (ARIA) gives the aircraft a bulbous look.

The fleet of eight ARIA is operated by the Air Force Eastern Test Range (AFETR). When not in support of the Apollo missions, the aircraft are home based at Patrick AFB, Fla., headquarters of the AFETR.

During the Apollo 11 mission, the ARIA was directed by Col. Oakley W. Baron, chief of the aircraft operations division of AFETR. Colonel Baron directed the ARIA from the Aircraft Operations Control Center (AOCC) at Patrick AFB. The Manned Space Flight Network was interfaced with ARIA through the AOCC.

Besides providing coverage of those portions of the translunar injection sequence not in view of the injection ships or land stations at Carnarvon, Guam, and Hawaii, the ARIA also provided voice relay service in the recovery area until the astronauts left the spacecraft.

C-141 jet cargo aircraft of the 21st and 22nd Air Forces, Military Airlift Command (MAC) deployed from Patrick AFB, along with the ARIA to provide maintenance support for the tracking aircraft.

Major General Jones Assumes Additional Job In Space Program

Patrick AFB Fla.

Major General David M. Jones has been appointed to succeed Major General Vincent G. Huston as Department of Defense Manager for Manned Space Flight Support (DDMS). The new job will be in addition to his present duty as Air Force Eastern Test Range (AFETR) commander and will not require a transfer from Patrick Air Force Base.

General Huston served a three-hat job: commander, National Range Division, DOD Manager for Space Flight Support and deputy Chief of Staff of Operations, Air Force Systems Command (AFSC). He is being reassigned to Italy as chief, Military Advisor Assistance Group (MAAG).

As DOD Manager for Manned Space Flight Support, General Jones heads up a force of more than 6,800 people from the Air Force, Army, Navy, Marine Corps and Department of Defense (DOD) civilians who provided support for the Apollo 11 lunar landing mission from launch through splashdown and recovery.

General Jones was named Commander of the AFETR, Cape Kennedy, Florida, in May 1967, following an assignment as Deputy Associate Administrator for Manned Space Flight, NASA, Washington, D. C.

He has served in the Air Force since 1938. He started his research and development work in 1956 while assigned as Deputy Chief of Staff for Operations of the Air Proving Ground Command at Eglin AFB, Fla. In August 1964, he was assigned as deputy Chief of Staff systems at Headquarters Air Force Systems Command Andrews Air Force Base, and was named to his NASA assignment in December of the same year.

Space Pioneer Presented To Smithsonian Institute

Andrews AFB, Wash., D.C.

"This aircraft represents one of America's proudest achievements in aerospace design and technology," said General James Ferguson, commander of the Air Force Systems Command, on turnover of United States Air Force X-15 No. 1, rocket powered plane to the Smithsonian Institution in Washington, D. C. for public display.

The aircraft presented to the Smithsonian by Air Force Secretary Robert C. Seamans, Jr., was the first of three X-15s built. It made its first flight in 1959. The last flight in the X-15 research program occurred on October 24, 1968. Over the decade of its operations, the X-15s reached a top speed of 4,520 mph and an altitude of 354,200 feet. Because of the altitudes reached, many of the twelve pilots who flew the airplanes received astronaut wings.

The Air Force Systems Command was responsible for the Air Force portion of this joint Air Force-NASA project.

"But merely to admire the X-15 and recite its accomplishments is to miss its true significance," General Ferguson continued, "it was built by men and it was flown by men. The objectives, data and results of its research program were planned for and accomplished by men. Without these dedicated and courageous people—the pilots, scientists, engineers and many others, the X-15 program would not have been possible."

Among those to fly the stubby-winged aircraft was NASA astronaut Neil Armstrong and Air Force Major William J. Knight, winner of the Harmon International Trophy for 1968.

Referring to the information gathered from the 199 flights made by the three X-15s, General Ferguson said the flights, "have provided us a 'gold mine' of data on hypersonic aerodynamics, reentry heating, reaction controls, and the physiological effects of flight on man. This knowledge has contributed immensely to our present aerospace program and it will continue to pay enormous dividends over the decades to come."

The X-15, constructed of Inconel X, was capable of withstanding temperatures from minus 300 degrees to plus 1200 degrees thus contributing to the technological foundation for today's high speed aircraft. "This aircraft was a leader in our skirmishes with technology," General Ferguson concluded, "and its memory will live on in the design of our future aerospace systems."