Space News ROUNDUP!

VOL. 3 NO. 4 MANNED SPACECRAFT CENTER, HOUSTON, TEXAS DECEMBER 11, 1963

Contractor Executives Given Apollo Status Briefing

Ten senior executives, representing NASA's major Apollo program contractors, visited the Manned Spacecraft Center in Houston last week for a briefing on the current status of Apollo.

This was the second in a series of meetings to be held by NASA and MSC to help keep senior executives up to date on all major aspects of the program. The first meeting was held last October.

During the current two-day briefing the corporate executives and NASA officials visited the John F. Kennedy Space Center at Cape Kennedy, Fla.; the Marshall Space Flight Center, Huntsville, Ala.; the Manned Spacecraft Center, here; and the Michoud plant of MSFC at New Orleans, La.

Executives present for the briefing included: J. L. Atwood, president, North American Aviation, Inc.; Charles Beck, president, Philco Corporation; Donald W. Douglas Jr., president, Douglas Aircraft Company; W. P. Gwinn, president, United Aircraft Corporation; Jack S. Parker, vice president, General Electric Company; Dr. Charles Townes, provost, Massachusetts Institute of Technology; E. Clinton Towl, president, Grumman Aircraft Engineering Corporation; A. L. Williams, president, International Business Machines; Thomas P. Morrow, vice president, Chrysler Corporation; and Dr. John Hornbeck, president, Bellcomm.

NASA officials participating were Dr. George E. Mueller, associate administrator for Manned Space Flight, NASA Headquarters, Washington, D. C.; Dr. Robert R. Gilruth, director, MSC; Dr. Wernher von Braun, director MSFC, Huntsville, Ala.; Dr. Kurt Debus, director, John F. Kennedy Space Center, Cape Kennedy, Fla.; and Dr. Walter C. Williams, deputy associate administrator for Manned Space Flight Operations, NASA Headquarters.

APOLLO CONTRACTOR EXECUTIVES—During a visit last week by executives representing the major Apollo contractors and other NASA officials, a tour of the Crew Systems Division was conducted. Richard S. Johnston, chief of the division (left) explains the space food display to (l. to r.) Jack S. Parker, vice president, General Electric; Dr. Wernher von Braun, director, MSFC; James V. Correale, Crew Systems Division; Dr. Robert R. Gilruth, director, MSC; A.L. Williams, president, International Business Machines; J.L. Atwood, president, North American Aviation; E. Clinton Towl, president, Grumman Aircraft Corporation; W.P. Gwinn, president, United Aircraft Corporation; Donald W. Douglas Jr., president, Douglas Aircraft; Dr. Charles Townes, provost, Massachusetts Institute of Technology; and Dr. Kurt H. Debus, director of John F. Kennedy Space Center.

CREW SYSTEMS TOUR—The Aeronautics and Astronautics Coordination Board (Life Systems Panel) held a meeting at MSC this past week and were conducted on a tour of the Crew Systems Division Facilities. Here they observe a mobility demonstration of a pressurized Apollo prototype space suit. Shown (front row l. to r.) are Dr. Eugene Konecci, NASA Hq.; Dr. Carl Lamanna, Department of Defense; Leo Fox, DOD; Col. F. Freese, DOD; George Chatham, NASA Hq.; and Richard S. Johnston, chief, Crew Systems Division. Robert Spann, suit section engineer, demonstrates the suit as Joe Schmitt operates the controls. Other Crew Systems personnel look on. Not shown but attending the meeting were Lt. Col. Edward Regis and Dr. Richard Belleville of NASA Hq., and Capt. Carl Pruitt, Dr. Richard Trumbull, Col. John Talbot, Gen. James Stewart and Sam Snyder all of DOD.

Apollo Modification Study Contract To Be Extended

A contract amendment in the amount of $49,000 has been issued by the NASA Manned Spacecraft Center to the Space and information Systems Division of North American Aviation, Inc., Downey, Calif. for an extension of a study on modifications to the Apollo spacecraft that may permit it to perform as a space sciences laboratory.

MSC wants to learn if it can adapt the spacecraft for long earth orbital missions. North American was asked to investigate and define concepts evolving from its initial studies, suggesting link-up of modified Apollo vehicles. That is, what happens if two or more modified spacecraft are coupled in space?

The amendment also calls for concepts to establish the maximum number of

(Continued on page 3)

2nd Major Move Begins Tomorrow

Clear Lake Site Commitment Now Stands At $38,911,458

A total of $38,911,458 has been committed to date for the development of the Manned Spacecraft Center Clear Lake Site and with the certification of the Central Data Office Building this past week a total of 11 facilities have been certified as operational or ready for occupancy.

Previously certified facilities included the Translation and Docking Simulator Facility; support offices, shops and warehouses; the fire station and utility plants.

Tomorrow is the scheduled moving date of the 110 employees of the Computation and Data Reduction and the Technical Information Division. They will move into the two-story structures, costing $959,412, which will house the equipment and personnel of the division.

The employees will depart from the leased facil-

(Continued on page 3)

Larger Space Role For Gold Likely, Thanks To A New Plating Technique

Gold promises to be more widely used in space and electronics applications in the future thanks to a revolutionary new gold-plating technique invented by a Lockheed Missiles & Space Co. scientist.

"Lockspray-Gold," the amazing new method of applying gold coatings on material simply by spraying it on as you would ordinary paint, was described by its inventor, D. J. Levy, in a paper presented recently to the national symposium of the Society of Aerospace material and Process Engineers in Seattle, Wash.

Levy said that McDonnell Aircraft Co. engineers are using the Lockheed-developed process for a specialized application on the two-man Gemini capsules now in production.

Besides being a superior heat reflector, gold also is an excellent electrical conductor, Levy said.

Levy also described how his gold-spray process was successfully used in the design of special lightweight furlable antennas developed by Lockheed for space vehicles.

He said a thin-ribbed reflector made from an open square-weave nylon fabric was made conductive by the gold spray process.

"Adhesion of the gold was found to be satisfactory during a series of furl and unfurl cycles, and an excellent radio frequency energy pattern was obtained," Levy said.

"Microscopic examination of the coated cloth showed that the gold was deposited uniformly and completely around each fiber and was quite reflective."

Levy pointed out that gold has been used widely in thermal control applications because of its optical properties and resistance to tarnish. He said gold coatings exhibit high ultraviolet absorption and high infared reflectivity.

In the Gemini capsule application the gold is used to coat the interior of the large adapter ring which links the astronaut's capsule to the booster rocket that puts the capsule in orbit.

The gold plating is designed to retain the heat generated by the equipment within the adapter, and maintain a suitable operating temperature.

Although gold is the ideal substance for thermal control, McDonnell engineers were faced with a virtually insolvable problem. Existing plating methods all had serious drawbacks.

Because of the numerous rib-stiffeners and piping within the adapter the vacuum evaporated method of depositing gold could not be used. Two other alternatives -- reflecting tape, or using an organic gold paint -- also were impractical or had serious limitations.

The gold paint approach was ruled out because it requires a heat treatment of near 1000 degrees F. which would weaken the structural material. Reflecting tape, besides being laborious to apply, would have imposed a severe weight penalty.

Use of the Lockheed Lockspray besides being simple to apply, will mean a weight savings of approximately 75 per cent over reflecting tape.

Other potential uses of the gold spray, Levy said, are in electronic circuitry and for shielding against radio frequency energy interference.

It makes it possible to gold-plate by the simple method of spraying a gold solution from an ordinary spray gun, or from an aerosol bomb. The technique involves the simultaneous spraying of two water-based solutions at room temperature. One contains gold in solution and the other strong chemical reducing agents.

Advantages of Lockspray-Gold include its great flexibility. Levy pointed out that since it can be applied from ordinary spray equipment, there is virtually no limit to the size of the object that can be coated.

GEMINI INERTIAL MEASURING UNIT—The first production unit of the Gemini Inertial Measuring Unit was delivered recently by Minneapolis-Honeywell's Florida aeronautical division, to IBM for integration with the computer. Here, a Honeywell systems technician makes a final visual check of the inertial platform gimbal orientation, sighting through optical access windows in the platform case. The platform, teamed with a power supply and system electronics packages (not shown), comprises the inertial measuring unit which provides the measurement that will tell precisely where the Gemini spacecraft is in space in relation to where it has been.

Shock-Asorbing Crushable Honeycomb Would Permit Soft Landings On Moon

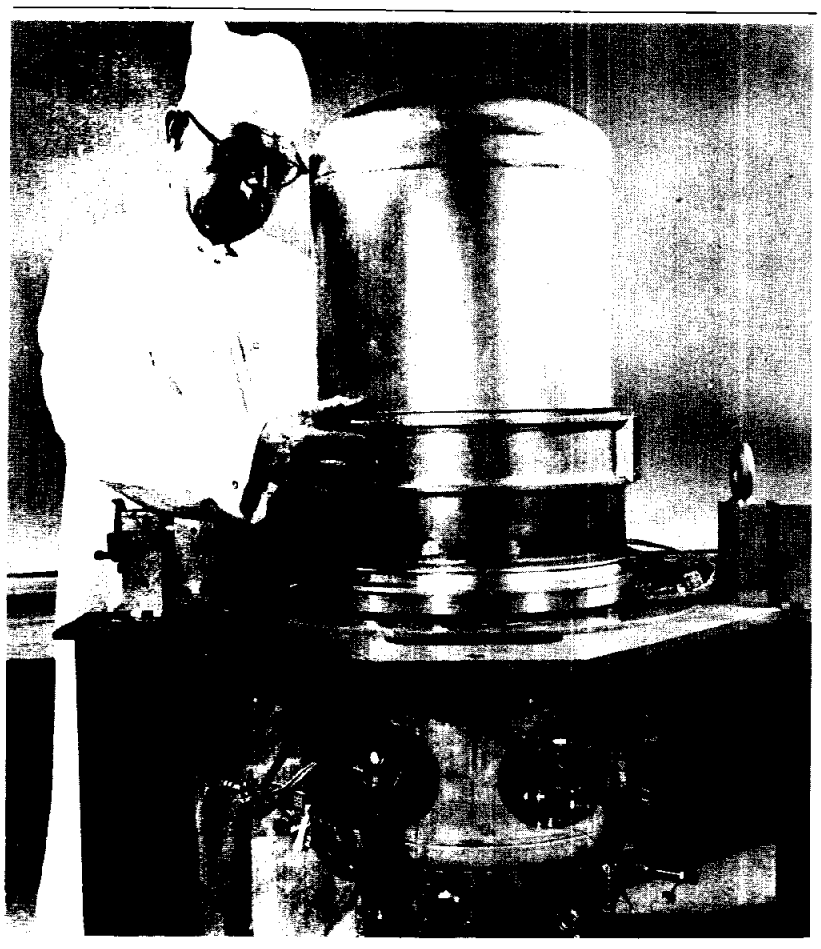
A contract for continued study of a shock-absorbing device that would permit a "soft landing" by a spacecraft on the moon has been awarded to the Bendix Products Aerospace division South Bend, Ind., by the National Aeronautics and Space Administration's Manned Spacecraft Center, it was announced recently.

The work to be done under the $99,973 contract will involve testing full-scale crushable aluminum honeycomb structures under various environmental conditions that scientists expect spacecraft to encounter in a moon shot, according to the Bendix announcement.

Bendix engineers will test various sizes and shapes of shock-absorbing capsules of the aluminum material to determine performance characteristics. The current job, company engineers said, is to extend and refine present knowledge already acquired through previous tests made by Bendix, and to find an "efficient material and design."

The engineers said that a shock-absorbing system for a lunar gear must be able to soften the landing shock, but must not contribute rebound that would make a moon vehicle bounce in the light gravity of the moon. They said aluminum honeycomb has these features plus its advantages of light weight and high reliability.

Bendix plans to build a new testing device that will permit observation of the material in operation under vacuum conditions in temperatures ranging from minus 260 degrees F. to plus 300 degrees F.



APOLLO FUEL CELL UNIT—A Pratt and Whitney Aircraft technician positions cover on a fuel cell unit. Using hydrogen and oxygen as energy sources, the fuel cell powerplant will provide electric power for the Apollo spacecraft in its journey to and from the moon. It will generate power without producing smoke, fumes, noise or vibration.

Onboard Astronaut Training A Must During Orbital Flight

What happens to the finely tuned skills of spacecraft pilots after many weeks in orbit or during a long interplanetary voyage?

Two scientists of NASA's Langley Research Center have looked into the question and conclude it is imperative to have some sort of onboard trainer for maintaining and polishing pilot skills.

Techniques astronauts will need to practice would include precise alignment of their spacecraft for reentering the atmosphere, accurate steering to accomplish rendezvous and docking in space, and many others.

Certainly pilot training is nothing new, but there is a significant difference between spacecraft and other flight vehicles. Many spacecraft mission phases are single events which occur once per voyage after relatively long periods of coasting flights. By contrast, in other vehicles the majority of pilot operations are either repetitive or can be practiced on large ground-based simulators when a need arises.

With a keen eye for critical weight limits, Langley aerospace engineer Richard Reid and psychologist Dr. Rayford T. Saucer have proposed a training device built into the spacecraft itself. Weighing less than two pounds, their electronic trainer would employ the spacecraft's own instrument display panel as well as its sensors and control systems.

They believe it would provide the crew with a dynamic simulation capable of maintaining skill at a high pitch in a way that would be real and not only realistic.

Move

(Continued from page 1)

ities at the University of Houston, Rich and Veterans Administration buildings. The technical information group, numbering 25, will move from the VA building and Franklin Development complex on December 20.

With the completion of the second major move, some 250 space agency employees will have been relocated at Clear Lake. Earlier the Logistics Division was moved, as well as elements of the electronics, facilities, security and contracts division.

The Central Data building contains more than 60,000 square feet of space. It consists of digital and analog machine rooms. service area, fireproof storage areas and offices.

The big move from the leased buildings in Houston will take place between Feb. 28 and March 23, 1964. At that time, over 2,500 employees, equipment furniture and office supplies will be relocated. MSC will vacate all leased buildings by July 1, 1964.

The data building is the fourth accepted out of five programmed for construction under the Phase Two contract. The water treatment plant, sewage treatment system and fire station were built and accepted under this contract.

Up to this time, the space agency has committed $4,691,299 for site preparation and construction under Phase Two. Of this amount nearly $1,500,000 was obligated for installation of lateral sewers, driveways, curbs, gutters and utility tunnels for the buildings programmed under this contract.

MSC spent $4,752,858 to prepare the Clear Lake site before the first foundation was laid. The work, under a Phase One construction contract, consisted of relocation of oil pipe lines and a canal; grading and roads, installation of storm sewers, water and gas mines; a water pumping plant and storage tanks, utility tunnels and a field office for the Corps of Engineers. Phase One work was finished July 18, 1963.

Apollo

(Continued from page 1)

modules that can be used and it calls for design on either the zero gravity environment or artificial gravity while the stations are in space.

Also asked for the study to investigate is whether identical power and environmental systems should be placed on each Apollo module or if one large system could supply all modules. All concepts considered are to be compatible with the Gemini spacecraft as well as with Apollo, the space agency said.

North American's initial study determined man's requirements for protracted space missions and evaluated his physiological capacity to work in space under zero gravity or in an artificial "g" environment. That phase called for an investigation of possible use of the Command module as crew quarters and an investigation of the area occupied by the Lunar Excursion module as a laboratory.

The Apollo spacecraft is now designed for a crew of three. During the lunar mission, LEM will take two members to the surface of the moon. LEM will be left in lunar orbit on the return trip to earth. The Service module likewise will be jettisoned prior to atmospheric re-entry and the Command module with its astronaut crew will be the only piece of spacecraft hardware returning.

The study is being conducted for MSC's Advanced Spacecraft Technology Division.

ROUND-THE-CLOCK SPACE SWITCHBOARD— Drawing illustrates how three satellites of the Syncom type can provide worldwide, 24-hour-a-day communications system, including television and telephone service. Each satellite, at 22,230 miles altitude and with orbital speed synchronized so that it appears to remain stationary in relation to a point on earth, could receive and transmit signals to about one third of the globe. Syncom was designed and built for NASA by Hughes Aircraft Corp.

Gemini Verification Instruction Program Launched By Astronaut Frank Borman

MSC Astroanut Frank Borman recently launched the Gemini Verification Instruction Program (VIP) for Aerojet-General Corporation's manufacturing and test personnel in Sacramento, Calif., who produce the liquid rocket engines that will lift Gemini vehicles into space.

Borman said he was impressed with Aerojet's efforts to place great emphasis on the Gemini program and happy to participate in the program which he felt sure would result in a successful flight program.

Borman joined Ray C. Stiff Jr., Aerojet vice president and manager of the Liquid Rocket Plant, in opening the special school for Gemini production personnel.

Initially, the Gemini VIP program involved assignment of the best qualified management employees for this Gemini program. Aerojet also selected the senior hourly personnel, whose broad experience on other programs fitted the needs for this important work.

Each of the selected employees will be given classroom instruction for a period of 30 days, after which a continuing on-the-job training effort will be initiated to keep all Gemini personnel current on new techniques and technology.

"The on-the-job training portion of this program will continue until the last Gemini vehicle is launched," said Charles L. Mraz, Aerojet Gemini program manager.

SPECIAL GEMINI BADGING— Ray C. Stiff Jr., left, vice president of Aerojet-General Corporation and manager of its Liquid Rocket Plant at Sacramento, Calif., shows Gemini Astronaut Frank Borman Gemini badge worn by Aerojet personnel working on Gemini propulsion at Sacramento. Borman holds responsibility in the astronaut team for Gemini propulsion.

Dummies To Aid Space Suit Design

Two dummies will be built to duplicate astronauts' space-piloting movements for NASA's Manned Spacecraft Center by IIT Research Institute.

With actuators for muscles, servo valves serving as a nervous system, and mechanical joints, the articulated dummies will be remote-controlled.

"They'll be able to simulate the weakest or stronger than average of human movements and their limbs and trunks can be made to grow or shrink to match the stature of 90 per cent of U.S. military men," NASA said.

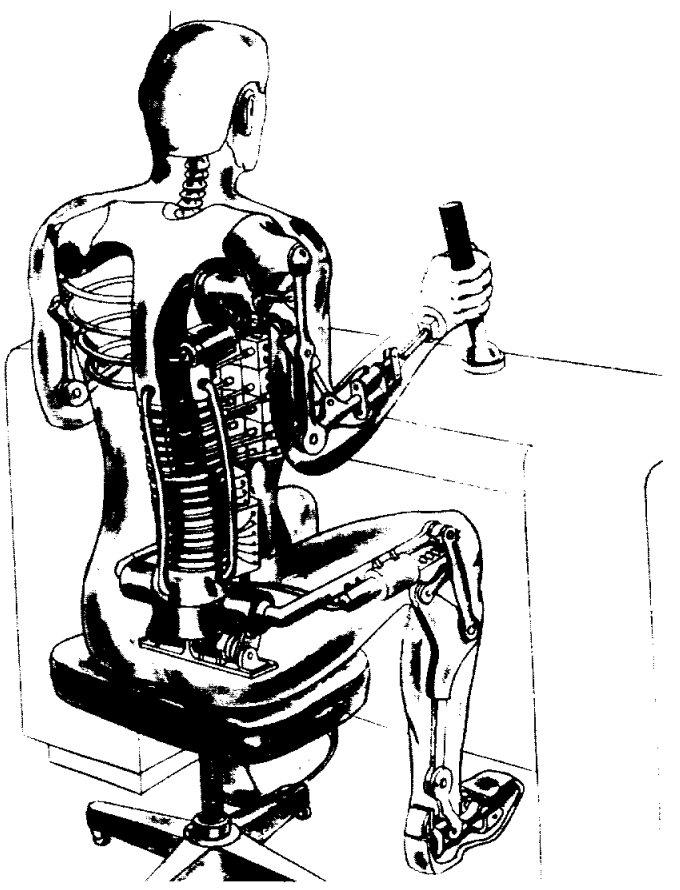
Primary job for the articulated dummies, when completed a year from now, will be to evaluate NASA's existing space suits on an objective basis and to help design better ones.

"Space suits today are far advanced over earlier models," said NASA. "However, the increasing demands of the U.S. space program requires that even more capability be built into them. The articulated dummies will help in the comparative study of mobility and work requirements of individual suit systems.

"Live models can tell us there is resistance to motion, but cannot give us this data in uniform, numerical answers. The articulated dummies will have sensors at each of 36 joints from the fingertips to the feet. We'll know how much stress is developed in the mechanical limb to bend the suit and from this we can determine the suit's resistance to motion," NASA reported.

Mechanical joints developed by IITRI to duplicate the motion of the complex human joints will be smoothly powered by hydraulic actuators driven by specially designed, electrically controlled hydraulic servo valves.

The contract to design and build the two power-driven articulated dummies is for $175,000.



MODELS FOR SPACE SUITS— Robots are being built by IIT Research Institute for NASA's Manned Spacecraft Center to use in designing space suits. Remote-controlled, the robots will have actuators for muscles, servo valves as their nervous systems, and mechanical joints, as shown here in a cut-away drawing. They'll also grow or shrink to match stature of 90 percent of U.S. military men.

Apollo-Saturn S-IC Booster By Boeing Is In Manufacturing Phase At Michoud

The United States' goal of a manned lunar landing before 1970 depends for success on the Saturn V space vehicle, the giant that will carry the Apollo spacecraft's three-man crew into orbit about the moon and on deeper space missions. The Boeing Company, long an aerospace leader, is playing a basic and vital part in the project.

As the Manned Spacecraft Center pursues the design and development of the three segment Apollo spacecraft which will top the 362 foot high Saturn V, Boeing is hard at work on the S-IC first stage rocket booster, under the direction of G. C. Marshall Space Flight Center. Design, development, construction and test of nine S-IC boosters, plus one ground test version, are called for in Boeing contracts with the National Aeronautics and Space Administration totaling approximately $500 million. The first launching of an S-IC is scheduled for 1965, with operational flight planned for 1967.

The first of three stages of the Saturn V, the S-IC is of unprecedented size, standing 138.6 feet high and with a diameter of 33 feet, equal to that of a five-room house. The booster's dry weight of 287,000 pounds (comparable to that of a B-52 Stratofortress) will be raised to nearly 2,500 tons when 4,400,000 pounds of liquid oxygen and kerosene propellant fuels are pumped in.

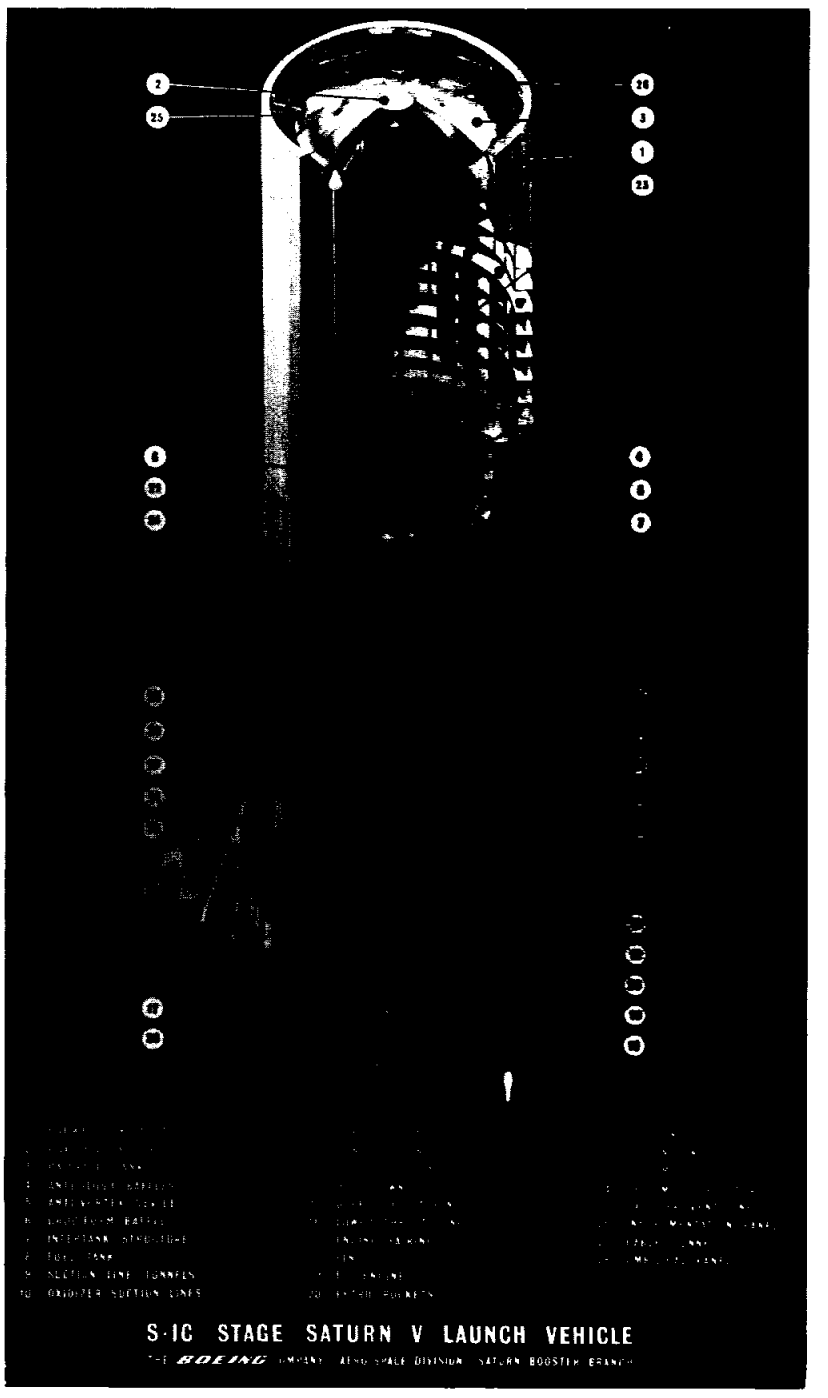
Five F-1 rocket engines under development by the Rocketdyne Division of North American Aviation, Inc. will provide 7-1/2 million pounds of thrust for lift-off. This is 55 times as much power as is generated by Grand Coulee Dam. The second stage of the Saturn V, the S-II, is being developed by North American, and the third stage (S-IVB) by Douglas Aircraft. NAA is also providing the smaller engines for these stages.

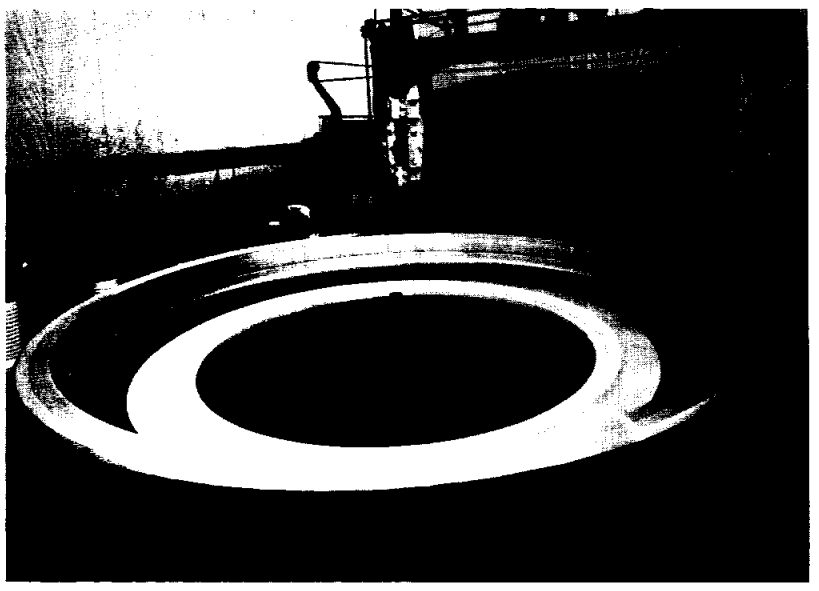
Boeing's Saturn Booster Branch, a part of the company's Aero-Space Division, is headquartered in New Orleans at NASA's huge Michoud Operations Plant 15 miles east of the downtown area. George C. Stoner, vice president-manager, heads up Branch activities at Michoud and five other locations; Seattle, Wichita, Huntsville, the Mississippi Test Operations and Cape Kennedy. Assistant general manager is R. H. (Dick) Nelson, who, like Stoner, is a veteran of engineering and development work on such systems as the B-17, B-47, GAPA, Bomarc and Dyna-Soar. Boeing personnel work alongside NASA counterparts in the laboratories of MSFC, as well as in Huntsville Industrial Center facilities downtown. R. C. (Bob) Dunigan is both Booster Test Manager and Manager-Saturn Operations-Huntsville.

More than 4,500 of the 6,000 Boeing management and employes working on Saturn are in New Orleans, at the Michoud Operations Plant and in two office buildings in the downtown area. Located on land which originally was a grant from Louis XVI of France to one of his military commanders five years before New Orleans was founded, the Michoud Plant has had an interesting history. Designed originally as a shipyard, the plant was used briefly during World War II for the manufacture of tank engines. Two tall brick chimneys which frame the entrance to the plant are left over from a sugar plantation which once occupied the site.

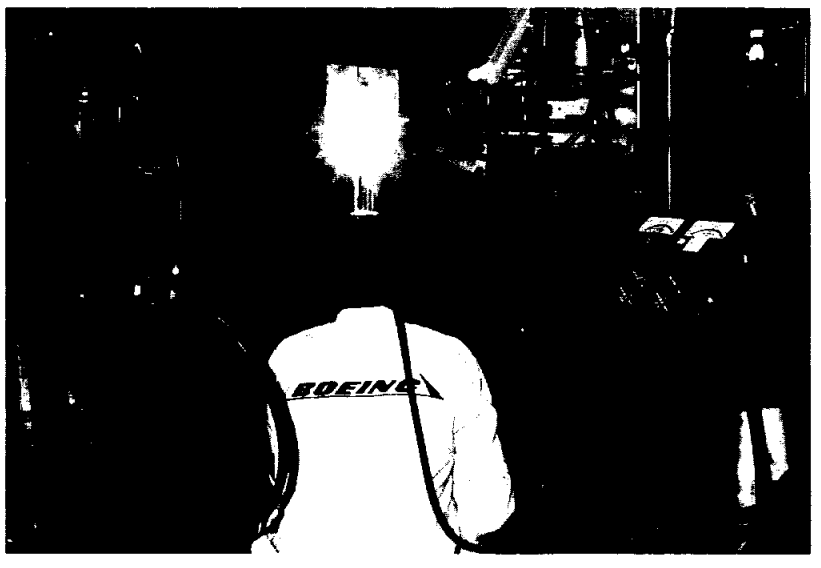
The huge plant (43 acres under one roof), has undergone considerable change in its transformation to a space industry facility. As modifications to the original buildings continue, construction of new facilities has begun to alter the landscape of the 845-acre complex. Chief among these additions are a 215-foot high vertical assembly building; hydrostatic test and cleaning facility for the S-IC booster; a two-story engineering and office building, and a barge dock and access road for shipment of the huge stages to static testing and launch sites.

As Facilities teams began working their problems at all locations during 1962, the Engineering organization under Clint Wilkinson, another veteran from Seattle, labored with Dr. von Braun's specialists to complete the design of the S-IC and execute the hundreds of thousands of drawings for approval by MSFC. Months ago at Boeing's extensive Wichita facilities and at Michoud, long lead time hardware such as tools, dies and jigs for tank dome segments and structural "Y"-rings began taking shape. Operations, headed by Francis L. "Bud" Coenen, has passed numerous milestones in manufacturing and is making weekly shipments to MSFC of major components for the early structural and dynamic test boosters.





RINGS FOR SATURN—Boring mill used to machine structural "Y" rings for Saturn S-IC fuselage-tank joints is 33 feet in diameter, probably the largest in the world. Boeing built outriggers on the original 27-foot turntable. Turntable rotates "Y" ring at about 4 rpm against two cutting heads.

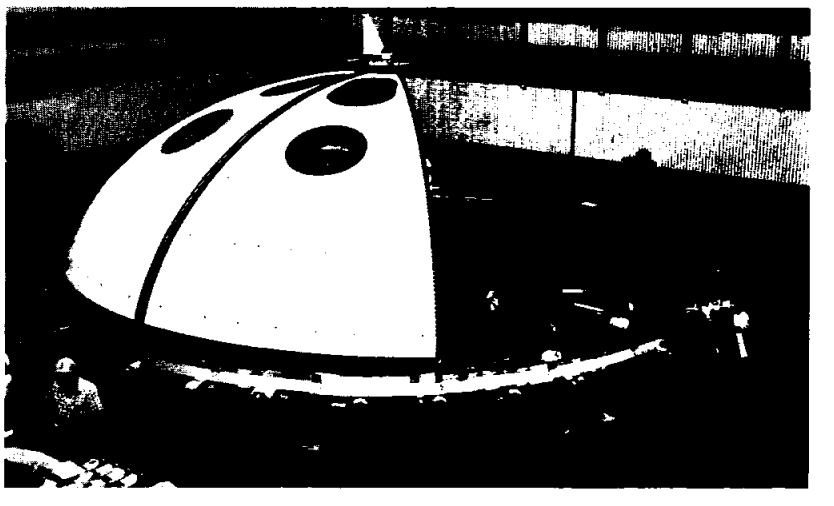


WELDING "Y" RING—Ends of aluminum billets, 5½ inches thick and 34 feet long, are welded together with argon gas equipment to form "Y" ring. Weld is started on test block at top. One half inch of weld is laid in between each X-ray inspection.

Seventeen miles east of Michoud in Slidell, computers fill two floors of a modern building constructed as a FAA Control Center and now the site of the Michoud Computer Office. Like the Michoud plant, the MCO serves the Chrysler Space Division and NASA as well as Boeing.

Eighteen miles farther east. in Hancock County, Miss., heavy construction work is underway on buildings. canals. roads and static test stands at the Mississippi Text Operations where subsequent units of the S-IC and upper stage boosters will be exhaustively test fired. A 128,000-acre "buffer zone" surrounds the central test area of 13,500 acres. Special barges will transport the S-IC stages from Michoud to Huntsville, the MTO and to launch Complex 39 on Merritt Island adjacent to Cape Kennedy. No other means of transport is possible.

It has been an adventure for Boeing to transfer more than 3,000 management and technical personnel from Seattle and Wichita as the nucleus of it Saturn Booster Branch and to establish new operations in three states far removed. For the most part, all have settled quickly and happily, become engrossed in building the "first step to the moon" and are finding much they "like about the South."



SATURN S-IC FUEL TANK DOME—Vacuum chucks designed by Boeing are optically aligned on 33-foot jig to hold tank dome gore segments during welding.

Douglas Space Simulation Laboratory To Test Life-Size Prototype Equipment

Cold, dark, airless space -- more than 30,000 cubic feet of it -- can be created and "bottled" at sea level for use by scientists in the largest and most technically advanced space-test laboratory on the West Coast, the Douglas Space Systems Center in Huntington Beach, Calif.

A 39-foot diameter earth orbit simulator, which can test life-size prototype equipment in an environment equal to that at nearly 500 miles altitude, is the key research tool in the Center's Space Simulation Laboratory.

Fully assembled spacecraft scheduled for manned flight, as well as major assemblies for Douglas' current Saturn S-IVB program for NASA, can be placed within the liquid nitrogen-cooled inner walls of the giant sphere for subjection to most factors of space flight.

The chamber is the largest of four environmental simulators presently housed in the new 28,000-square-foot laboratory building, where a wealth of preflight space data can be produced and analyzed.

The other chambers include two smaller twin cylindrical simulators, each with working test volumes measuring 5 feet in diameter by 6 feet in height. Each is equipped for solar radiation simulation and for a shaker head to test objects for vibration studies.

A fourth high-vacuum unit now in operation is used for environmental testing of Saturn S-IVB components and systems.

The laboratory, shaped like an upright letter "L", is two floors high in the office, control center and shop areas. Ceiling above the large chamber rises 93 feet to the top of the L.

Test specimens enter the building through a receiving airlock which is sealed off from the laboratory proper by huge roll-away doors. Any necessary preparatory work such as welding or drilling is performed in the lock to prevent contamination of the laboratory.

Through its air-conditioning system, the entire building is slightly pressurized to prevent unfiltered air from entering the extremely clean building. Walls of the windowless structure are fastened to the inside of the building's steel framework to provide a smooth interior surface decreasing possible dust accumulation.

Special housing isolates all support equipment producing noise, dirt and heat, with only its attendant graphs, meters and control switches visible in the laboratory. Technicians entering the simulation chambers to prepare a test or make adjustments wear special lint-free gowns, caps and boots.

Two electric cranes -- 25-ton and 5-ton capacities -- traverse the high bay above the large chamber and lift test specimens through the top of the receiving lock or from the floor of the lab. A third overhead crane, which can lift 7-1/2 tons, services the smaller chambers.

Control consoles for the 39-foot chamber are enclosed in a glassed-in room overlooking the giant sphere and its access deck.

Data processing of test measurements may be accomplished within the lab itself or the information may be piped to the Center's 7094 computer in the Engineering Building via a digital data acquisition system in the Structures Laboratory.

The laboratory has its own electric power substation and independent storage of 28,000 gallons of liquid nitrogen, both located outside the building.

A 30-foot diameter lid provides principal access to the large simulation chamber via the overhead cranes. Under normal procedure, large test specimens are slung to the underside of the lid and hoisted by crane into the chamber.

A flat bedplate, 20 feet in diameter, at the bottom of the chamber will accept test objects directly, free of the lid sling. Shakers can be clustered in any array on the bedplate to tortue-test a specimen. Operators can program random vibration, single shock pulses or a time-simulated flight controlled by magnetic tape.

The chamber bedplate is also designed for installation of a high-performance centrifuge, up to 30 feet in diameter, for subjecting test objects to sustained acceleration in the space environment. Other special purpose fixtures can be installed to simulate in-space docking or landing operations and vehicle attitudes and orbits.

The solar simulation system for the cylindrical chambers which can be adapted for use in the 39-foot sphere will provide a 4-foot diameter beam of light which closely matches the sun in intensity and spectral content.

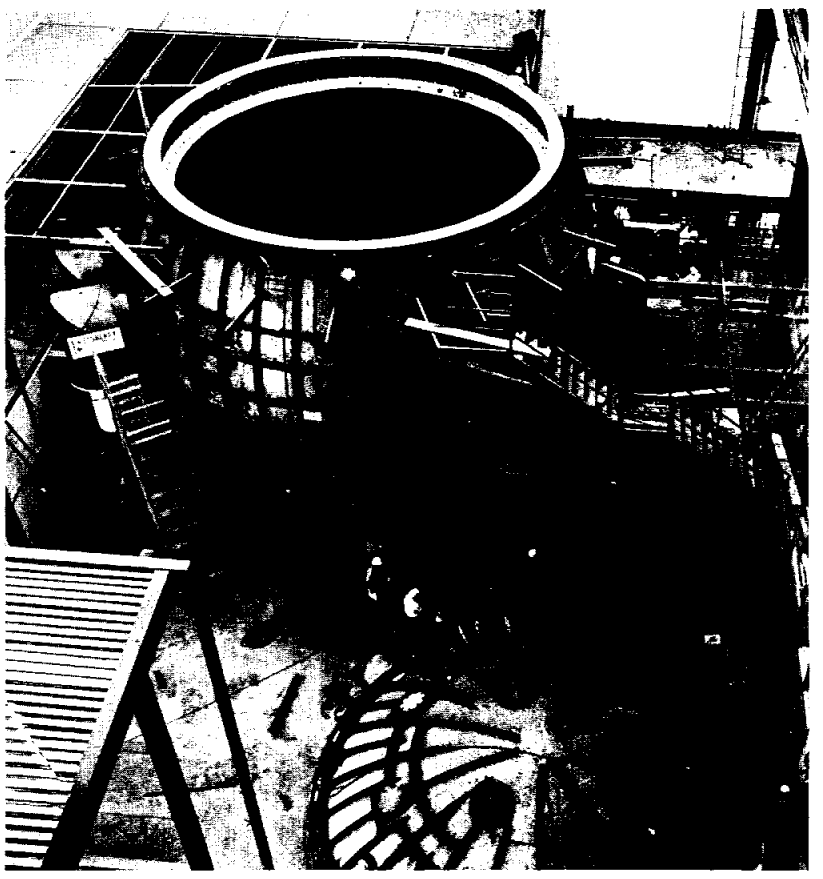
Man-rating of the large chamber is planned for the near future with the addition of a man lock adjacent to a quick-open door. Provision has been made for 20-second recompression of the chamber.

Man-rating will enable scientists to observe personnel training and indoctrination in the space environment and also allow technicians in space suits to make test adjustments within the chamber while orbital altitude is maintained.

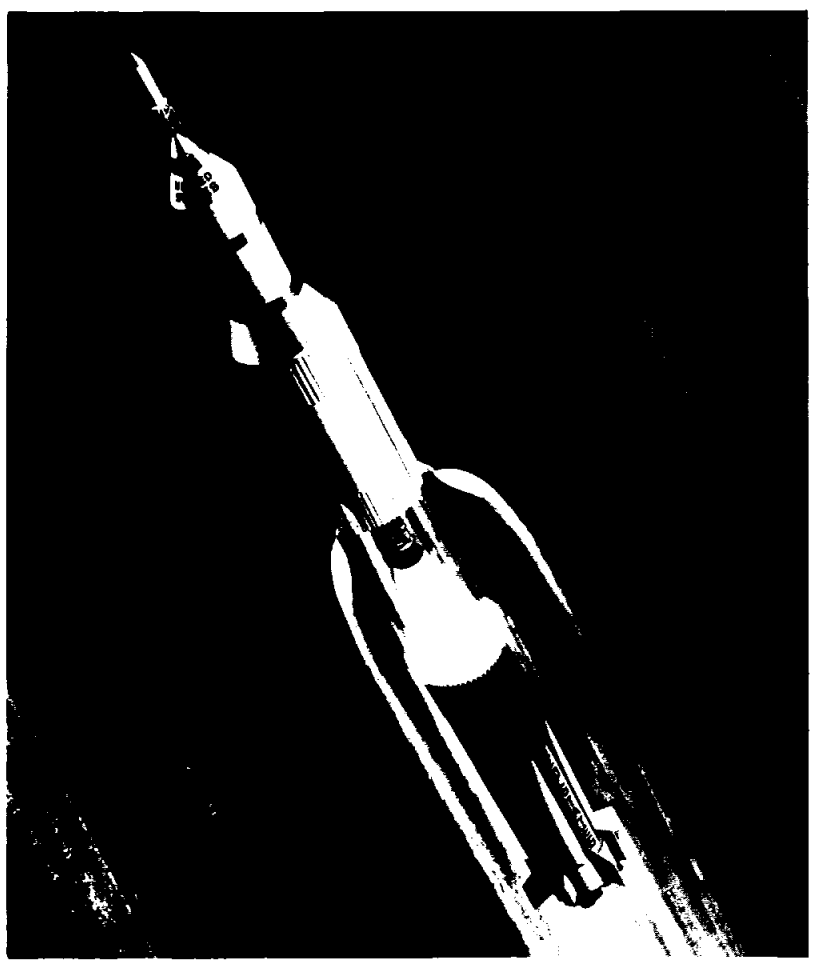
The huge sphere is evacuated of air in three steps. Mechanical pumps draw out most of the air. The pressure is lowered further by an oil diffusion technique. Finally, helium gas, cooled to minus 424 degrees Fahrenheit, is circulated through the chamber, freezing the remaining molecules of air, much as water is frozen in a refrigerator's ice trays. The latter technique is called cryopumping.

The chamber's optically dense inner wall resembles a circular pattern of vertical venetian blinds and contains tubing for the flow of liquid nitrogen. Called a heat sink, the wall is chilled by the nitrogen to minus 230 degrees Fahrenheit. The heat sink also can be heated to a plus 350 degrees Fahrenheit by pumping hot gas through the same system of tubes.

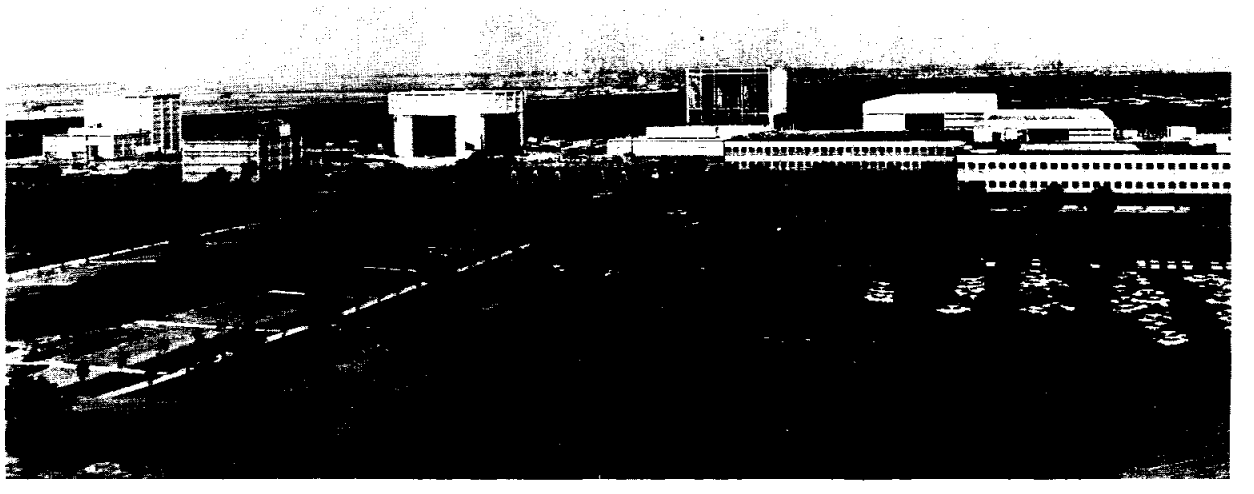
The entire space simulation complex will aid in the research and development of launch vehicles, spacecraft, moon-to-earth communication systems, transportation and handling of supplies, vehicles and structures needed to establish lunar bases, logistic support systems and flight mechanics, manned return, lunar environment and life support systems.



MASSIVE EARTH-ORBIT SPACE SIMULATOR at Douglas Aircraft Company's new Space Systems Center in Huntington Beach, Calif., will be used for testing manned and unmanned satellites and spacecraft and lunar and planetary vehicles. The spherical chamber, measuring 39 feet in diameter, will simulate pressures equivalent to those experienced at 500 miles above the earth. Provisions for man rating are incorporated in the design.



NASA'S SATURN IB SPACE VEHICLE will be used to place the complete Apollo spacecraft into earth orbit as part of the early development and training phase of Project Apollo. Artist's rendering shows the in-space firing of the S-IVB second stage of the Saturn IB as the S-I booster drops away after separation. The S-IVB is powered by a single J-2 liquid hydrogen engine, developing 200,000 pounds of thrust. Saturn IB will boost 16 tons into orbit.



NEW SPACE SYSTEMS CENTER of Douglas Aircraft Company is viewed against the northern horizon in Huntington Beach, Calif. Buildings visible are from left the Space Simulation Laboratory, Systems Integration Laboratory, hemispherical Structures Laboratory, the 115-foot-high Tooling Tower Complex behind the Production Test Laboratory, and the Manufacturing and Assembly Building, located behind the 360,000-square-foot Engineering Complex. Immediately to left of Engineering Complex is cafeteria.

The SPACE NEWS ROUNDUP, an official publication of the Manned Spacecraft Center, National Aeronautics and Space Administration, Houston, Texas, is published for MSC personnel by the Public Affairs Office.

Director ..... Robert R. Gilruth
Public Affairs Officer ..... Paul Haney
Chief, News Bureau ..... Ben Gillespie
Editor ..... Milton E. Reim

CORRECT PRICE TAG PLACED ON PROGRAM

Dr. Robert C. Seamans, associate administrator of the National Aeronautics and Space Administration, speaking before the Greater Albuquerque Chamber of Commerce in New Mexico, Nov. 19, 1963 placed the correct price tag on the space program when he said:

"A careful analysis of costs revealed that most of the $20 billion needed for manned space flight in this decade will be invested in testing rockets and spacecraft and in ground facilities and astronaut training which this country would need and want as soon as possible even if there were no commitment and no intention of sending explorers to the moon in this decade.

"The additional cost of going to the moon will be only $2 billion. This is after the Saturn V rocket and the Apollo spacecraft have been developed and proven out for their primary purpose -- which is to advance rapidly American competence in all aspects of manned space flight.

"This $2 billion figure includes the robot spacecraft which we will send first to investigate the moon; the development of the lunar landing craft which will take the explorers from the Apollo mother ship to the moon and back; and supporting development, such as testing the landing craft, fitting it into the Apollo spacecraft, and such essential work.

"This breakdown places the correct price tag on the extra cost of the lunar mission. It also puts the emphasis where it belongs: on the rapid growth of American competence in all areas of manned space flight, with early experience near earth that is of prime importance for national security."

WELCOME ABOARD

Thirteen new employees joined MSC during the period November 4 through November 24. Six were assigned here in Houston, five to the White Sands Missile Range and two to Cape Kennedy, Fla.

PREFLIGHT OPERATIONS (Cape Kennedy, Fla.): Emmitt A. Reynolds and John N. Dickinson.

WHITE SANDS MISSILE RANGE (White Sands, N. M.): Jeanne M. Waterman, Lawrence J. Puga, Beverly W. Peipelman, Donald R. Campbell and Glen B. Lamkin.

SYSTEMS EVALUATION AND DEVELOPMENT DIVISION: David P. Schmader.

APOLLO SPACECRAFT PROGRAM OFFICE: Robert C. Stults.

SPACECRAFT TECHNOLOGY DIVISION: Thomas R. Kloves.

FLIGHT OPERATIONS DIVISION: Virginia E. Jones.

GROUND SYSTEMS PROJECT OFFICE: Patricia L. Herbert, and Leslie E. Bonner.

Antarctica

(Continued from page 8)

National Aeronautics and Space Administration.

NASA plans to send three astronauts to the Moon by 1970, and the Marshall Center is building the rockets now.

DeFries is in charge of the Marshall Space Flight Center's efforts in the lunar logistics support area. In Antarctica, he will gather data on practical means and ways of exploiting the experience gained in the maintenance and logistics of small Antarctica bases and use it as a guide to supporting astronauts on the Moon.

The study is being made in conjunction with the National Science Foundation which has gathered data on Antarctica for some time. DeFries read various reports on Antarctica before he left.

He hopes to visit McMurdo Sound and several satellite bases of the Byrd Station.

Dr. Wernher von Braun, director of MSFC, said deFries will also study one station for consideration as a point to conduct laboratory experiments on equipment characteristic of the lunar logistics program.

Dr. von Braun, in a letter to the National Science Foundation, said he wanted to work with them to best utilize earth bound knowledge in the space program.

Astronauts on the moon, like scientists in Antarctica, will need a mobile laboratory, a shelter and a means of "locomotion." DeFries plans to exploit these areas and make recommendations. He said the Moon is a "completely hostile and unsupporting environment" as far as the survival of man is concerned, something it has in common with the South Pole.

MSC PERSONALITY

Healthiest People In World Patients Of Dr. D. O. Coons

Dealing with some of the healthiest people in the world is part of the work of Dr. D. O. Coons, deputy chief, Center Medical Operation Office.

Although one of the duties in this office is providing continual medical care of the astronauts, and collecting medical data on them while they are in training, the primary job is support of the space missions.

In this capacity, Dr. Coons said, he and his colleagues act as flight surgeons to the astronauts to help them do a better job and also monitor them in actual flight--with one main concern, safety.

Dr. Coons is a native of Hamilton, Ontario, Canada, and received his medical degree from the University of Toronto in 1948. After an internship in Hamilton, Ontario, he became a senior officer in the Royal Canadian Air Force serving at stations in Camp Borden, Ontario; St. Jean, Quebec from 1949-53 and with the No. 1 Fighter Wing in England and France, 1953-55.

In 1951, he received his wings as a qualified para-rescue physician.

From 1955-56 he was a post-graduate student at Harvard University where he received a masters degree in public health. He was director of aviation medicine, RCAF Hq., Ottawa from 1956-59, and then until 1962 he served as staff officer, Medical Services, Canadian Joint Staff in Washington, D. C.

Serving as principal medical officer and flight surgeon on the Royal Canadian Navy aircraft carrier, HMSC Bonaventure, during 1962-63, he participated in the rescue in September 1962 of the survivors of the ditched Flying Tiger Constellation in the North Atlantic.

While in the RCAF he flew as a passenger in many types of aircraft to observe the conditions under which a pilot must fly and this to better understand the problems of the pilot under actual conditions.

Dr. Coons resigned his commission as a wing commander (USAF equivalent is a lieutenant colonel) in July 1963 and joined MSC in his present capacity in August of 1963.

"Space medicine is a far cry from the clinical variety so familiar to most people. "Dr. Coons said. "Here at MSC we are concerned with helping to devise and design the best possible environmental control and protective systems in which astronauts

DR. D. O. COONS

are to fly." Anything that effects or bears on the pilot in any way. such as what he wears or uses and etc. . , is of utmost concern to us."

Some of his papers have appeared in the Canadian Medical Journal, Canadian Services Medical Journal and the NATO Agardograph. He is a certificated specialist in aviation medicine, American Board of Preventive Medicine and the Canadian Forces Medical Service.

Dr. Coons is a Fellow in Aviation Medicine, Aerospace Medical Association; American College of Preventive Medicine; and the Royal Society of Medicine.

He holds membership in the Aerospace Medical Association, Canadian Aeronautics and Space Institute, Royal Society of Medicine and Alpha Kappa Kappa medical fraternity.

Married to the former Betty Jean Bower of Hamilton, the couple has two children, Carol Ann 7, and Paul Douglas 5, and they reside in Seabrook. In the near future they plan to build a home in El Lago.

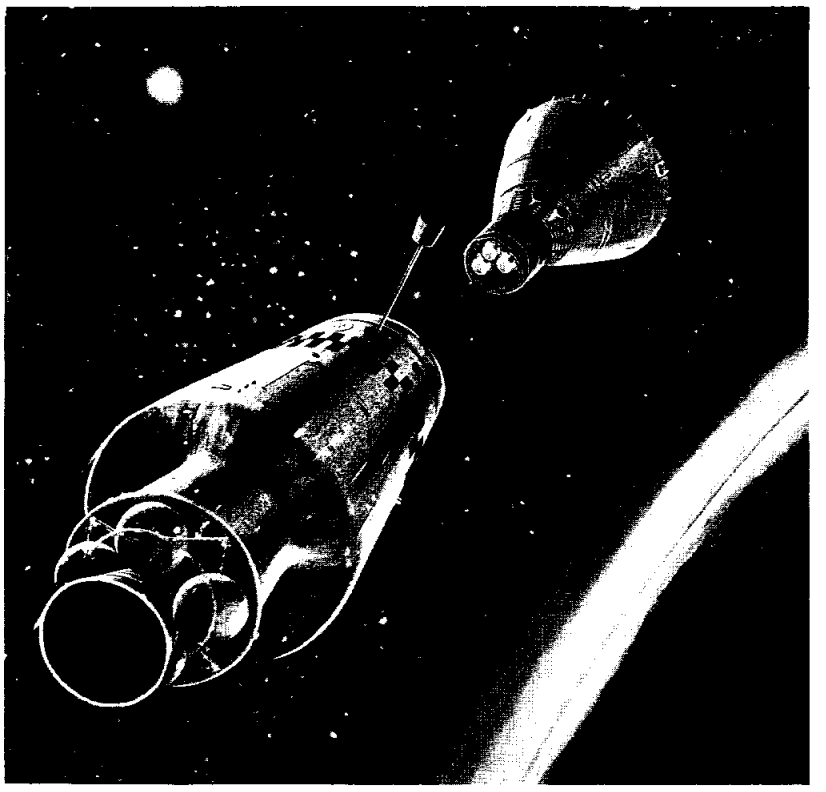
He enjoys his hobbies of collecting Canadian coins, first day of issue cover stamps and Canadian commemorative stamps, and hearldly, in which he is presently collecting the badges or coats of arms of the units with which he was associated in service.

Recently he worked with the Smithsonian Institute in Washington, D. C., helping them enlarge their collection of Canadian coins.

Space Radar For Project Gemini Unique In Design And Purpose

HAND MADE—With an enlargement of a diagram to guide in wiring a component for the Gemini radar, a technician performs a step-by-step operation. Each step is recorded on a master sheet as soon as it is completed.

UNIQUE ANTENNA—The transmitting and receiving antennae for the Gemini radar, shown here, will be located on the front end of the two-man carrying spacecraft. Use of the spiral design antenna, instead of the conventional dish-type, allows a reduction in weight through a simpler mechanical arrangement. The Gemini antenna rotates—like a phonograph record.



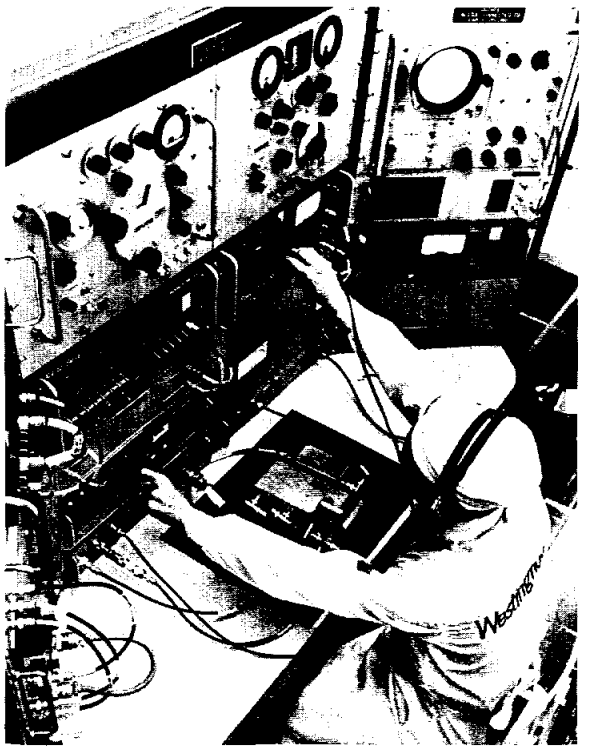
One of the most unusual radars ever built is being assembled and tested at the air arm division of the Westinghouse Defense Center. Purpose of the radar, as shown in the artist's sketch, above, is to assist in the rendezvous in space of two earth-orbiting satellites. One of them will be carrying two U. S. astronauts and the other will be an unmanned Agena rocket vehicle.

Rendezvous and docking of these two satellites is a primary objective of Project Gemini -- the manned space flight program under the technical direction of the Manned Spacecraft Center, here. Prime contractor for the Gemini spacecraft is the McDonnell Aircraft Corp., St. Louis, Mo.

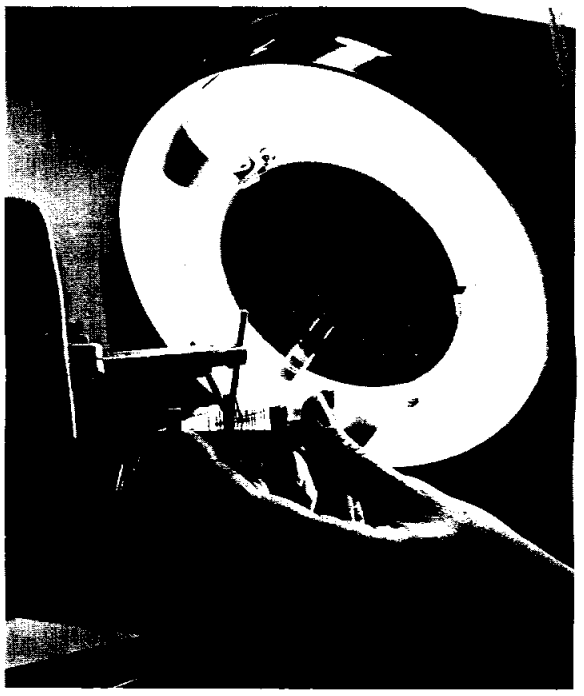
In fulfilling its contract with McDonnell to build the very light-weight radar equipment (shown on front of spacecraft in sketch above) for Project Gemini, Westinghouse has constructed special test facilities and instituted rigid quality control programs to insure the greatest possible reliability of the equipment.

Extremely compact in its construction, the radar and its associated display equipment will enable the astronauts to seek out the Agena, determine its range and bearing and make necessary changes in orbital velocity to complete the rendezvous operation.

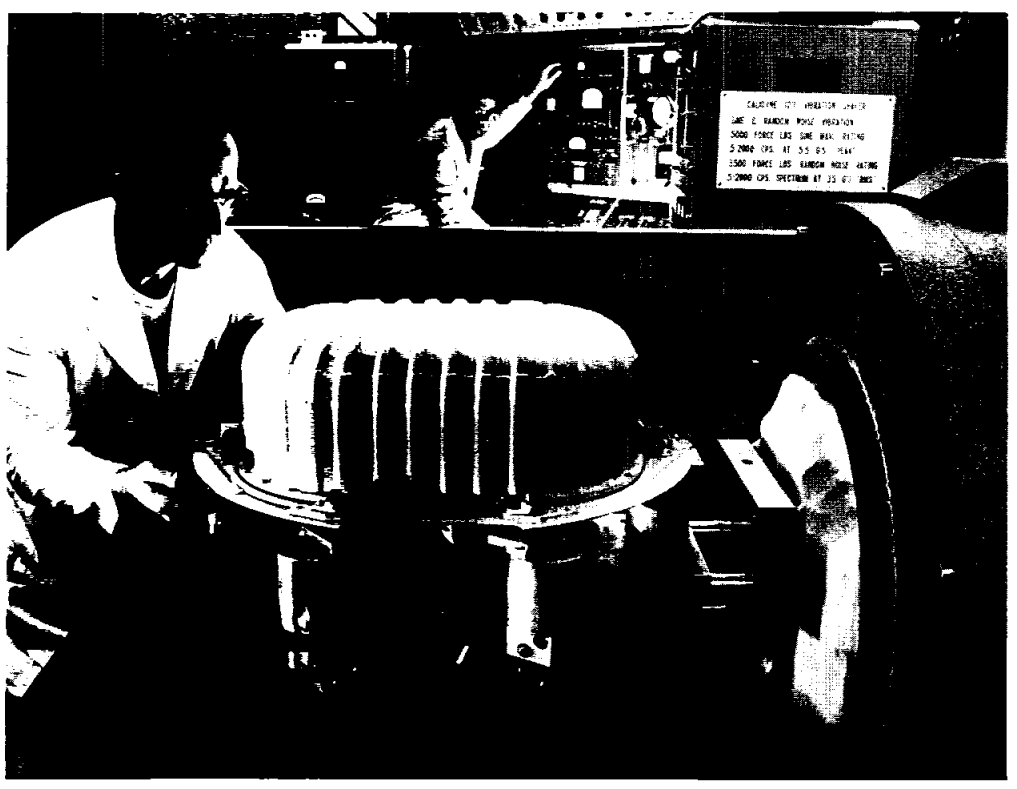
During the rendezvous mission, the two-man Gemini crew will utilize a "command" communications system with which they can maneuver the Agena by remotely starting and stopping its control rockets. This command system on board the spacecraft was designed by Westinghouse as an integral part of the radar and allows simultaneous use of the transmitting and receiving equipment as both a radar and digital command link.



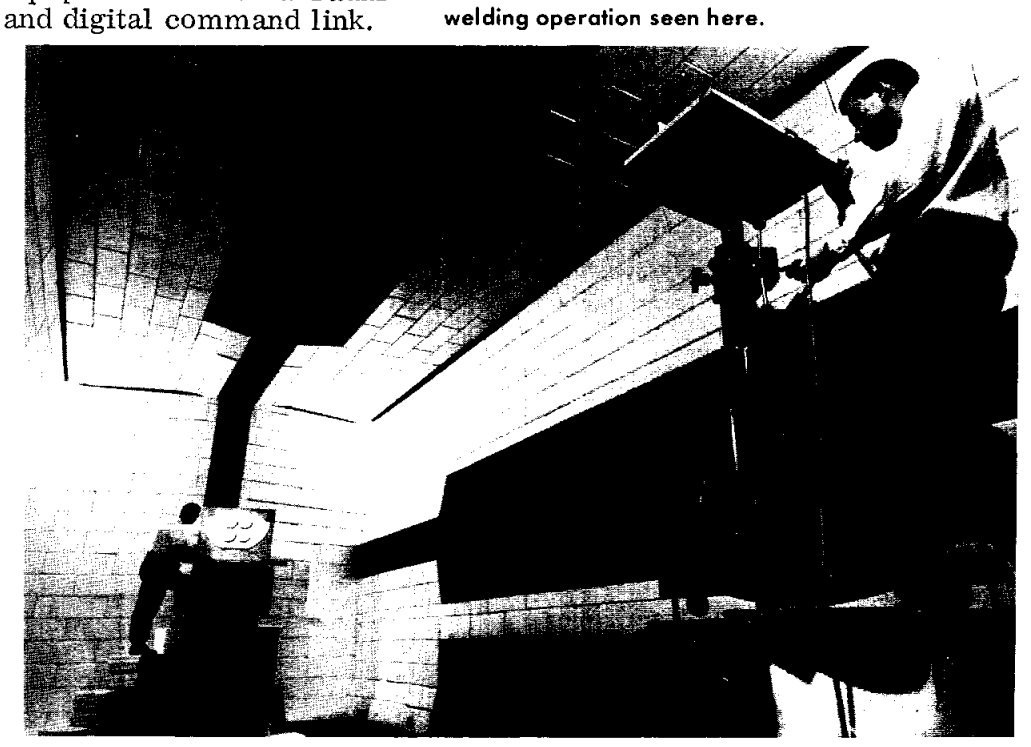
TESTING—Every incoming component undergoes a series of checks and re-checks to insure maximum reliability. Working at the console of this test equipment is a reliability technician.



NO SOLDERING—To insure maximum reliability in the Gemini radar's electronic circuitry, components, or modules which go into it are not soldered—they are welded. Specially trained technicians in the Westinghouse Gemini "clean room" perform the welding operation seen here.



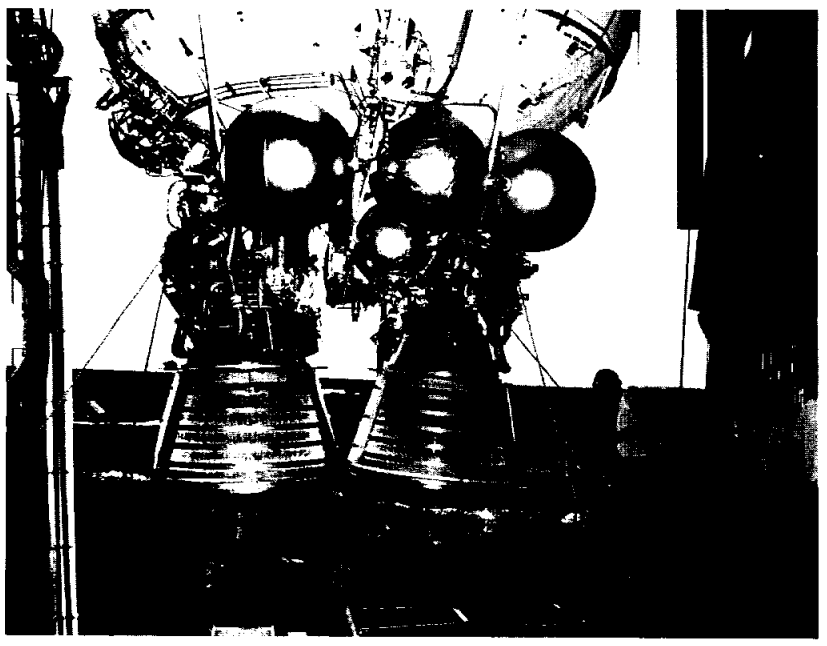
SHAKER TABLE—Reliability of the Gemini rendezvous radar is a paramount consideration at the Westinghouse air arm division. Here, in one of the many tests of the equipment, an engineering test unit of the radar has been installed on a "shaker table"—a machine which subjects the equipment to vibrations such as it might encounter during the actual mission.



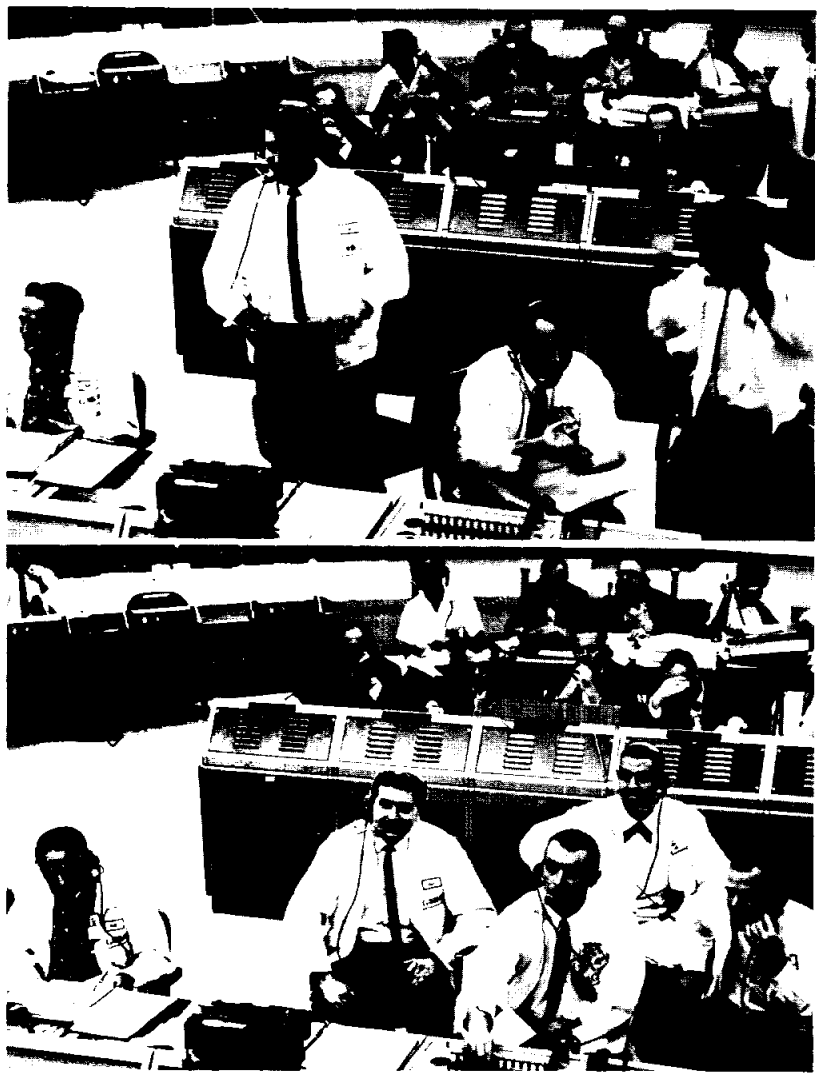
ACCURATE—Extreme accuracy is the objective in the Gemini radar test program. Here, in what is called a "radio frequency anechoic chamber," Westinghouse engineers prepare to measure the pattern of a radar signal as received on the Gemini radar antenna at left. The anechoic chamber is lined with plastic material which prevents reflection of radar signals and therefore, minimizes their distortion. This simulates the "free space" which the radar will encounter in orbit.

Space News NASA ROUNDUP!

SECOND FRONT PAGE



MATING CENTAUR SECOND STAGE—Cape Kennedy launch technicians mate the second stage of the Centaur. The two 15,000 pound thrust RL-10 hydrogen engines are shown.



MOMENTS OF TRUTH—Tension at instant of liftoff is mirrored in faces of General Dynamics launch team (bottom photo) in blockhouse as experimental Atlas-Centaur space launch vehicle begins historic research and development test flight from Cape Kennedy, Fla. Tension evaporates (top photo) with news that Centaur upper stage has successfully separated from Atlas launch vehicle, has fired its two hydrogen-oxygen engines, and is now racing into an earth orbit trajectory for a successful test flight.

Antarctica Environmental Study Could Aid Astronauts On Moon

A NASA-Marshall Space Flight Center engineer recently left for the South Pole to spend two weeks evaluating operations under inhospitable conditions similar to those that astronauts might expect when they land on the Moon.

Paul J. DeFries, a bespectacled, scholarly specialist in lunar operations, departed carrying only binoculars, a special camera and a good supply of notebooks. He was to be issued survival gear in New Zealand.

DeFries hopes to gather realistic data helpful to the Apollo lunar logistics support study program which is being pursued by the

(Continued on page 6)

Centaur Launch Orbits 5-Ton Satellite Using Revolutionary Hydrogen Engines

A revolutionary hydrogen-fueled Centaur rocket was used by the United States November 27 to orbit a five-ton, 28.5 foot long satellite that is visible to the naked eye as a white flash due to its tumbling action through space.

Launching of the high-energy fueled rocket at 2:03 p.m. from Cape Canaveral (now Cape Kennedy), followed by about 17 hours the successful firing of Explorer-18 or IMP (Interplanetary Monitoring Platform), a 140-pound moonlet carrying instruments for measuring the potentially lethal "solar winds" that astronauts will encounter on trips to the moon and on other flights deep into space.

A spokesman said the relatively worthless satellite, made up mostly of old rocket casing, would appear under ideal weather conditions as a second or third magnitude star and best viewed just after dusk or just before dawn.

The big question as to whether the trouble-plagued Centaur would fly, was answered when the Centaur followed pre-flight predictions almost exactly.

Centaur's second stage has the first rocket engine in the world propelled by high-energy liquid hydrogen fuel. The Atlas first stage pushed the Centaur stage to an altitude of 150 miles where it separated and fired its two 15,000 pound thrust RL-10 hydrogen engines.

Space Administrator James E. Webb said the flight "achieved all of its objectives."

The upper stage burned 380 seconds and drove itself into an earth orbit ranging from 358 miles in perigee to 1,058 miles in apogee.

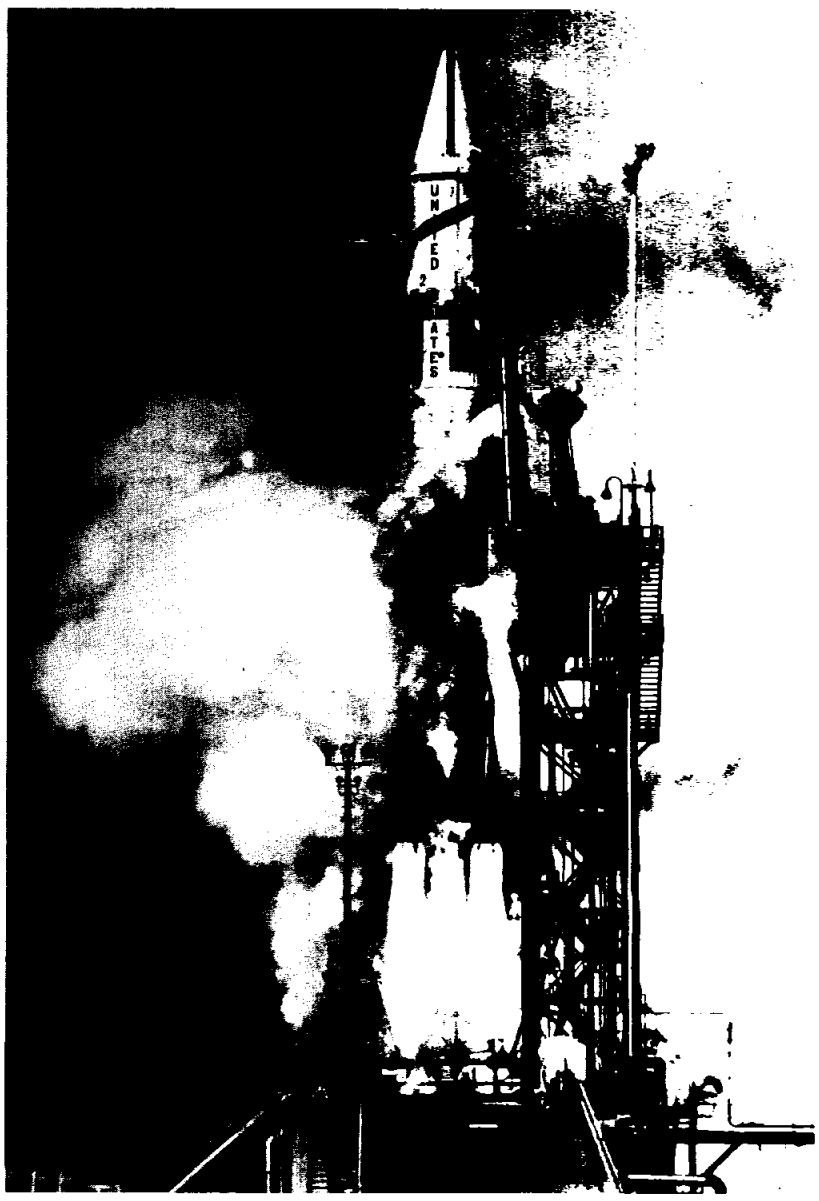
Equipped with a beacon radio, the satellite can be tracked in space by scientists as it journeys around the globe.

For the flight NASA listed four primary test objectives:

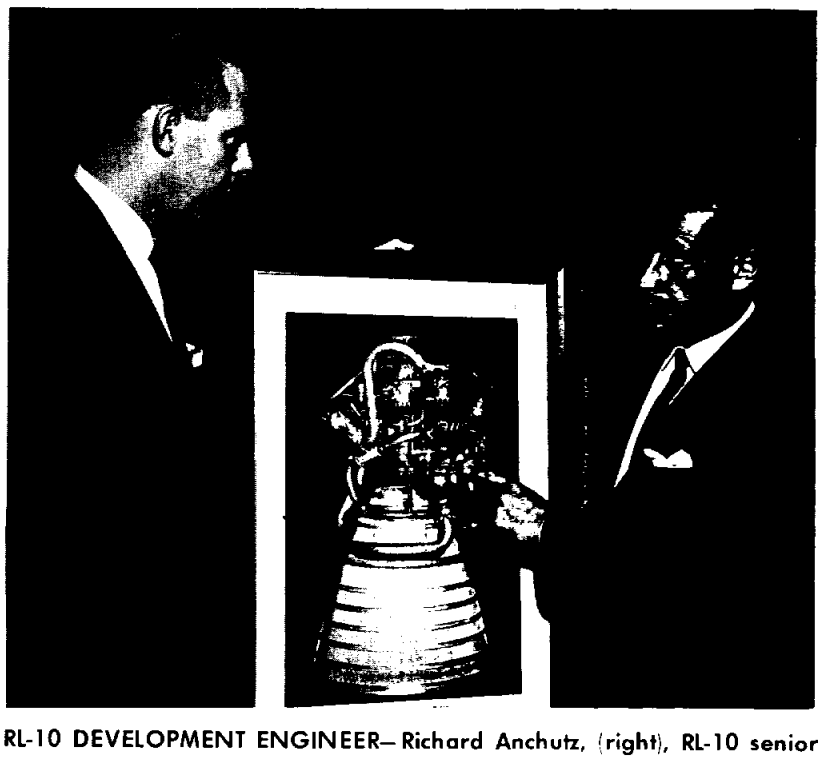
1. Demonstrate ability of the Atlas-Centaur structure to withstand aerodynamic loads.
2. Demonstrate performance of first and second stage separation system.
3. Demonstrate ability of Centaur liquid hydrogen propulsion system to start successfully and achieve stable operation.
4. Evaluate accuracy of the guidance system.

Controlling tricky, super-cold liquid hydrogen, which must be kept at a temperature of 423 degrees below zero to remain liquid, is the key to Centaur's muscle. No prior hydrogen engine has been flown in space, but the United States has made a heavy commitment to hydrogen for upper stage of future rockets, including the Saturn 5 slated to hoist astronauts toward the moon.

Liquid hydrogen produces approximately 40 per cent greater thrust per pound than kerosene-type chemical propellants used by space rockets like the Atlas.



SUCCESSFUL LAUNCH—The Centaur is shown just instants after lift-off from Cape Kennedy by an Atlas for the first successful flight in space of a liquid hydrogen engine. The RL-10 hydrogen engines were in the upper second stage of the Centaur.



RL-10 DEVELOPMENT ENGINEER—Richard Anchutz, (right), RL-10 senior project engineer, Pratt and Whitney's Florida Research and Development Center, West Palm Beach, Fla., explains one of the features of the RL-10 liquid hydrogen rocket engine to Warren Alan White, manager of Pratt and Whitney's Houston Operations Office. Anchutz, here in Houston for a meeting this past week, has worked almost five years in the development of the revolutionary engine which powered the second Stage of the Centaur into an earth orbit on November 27.