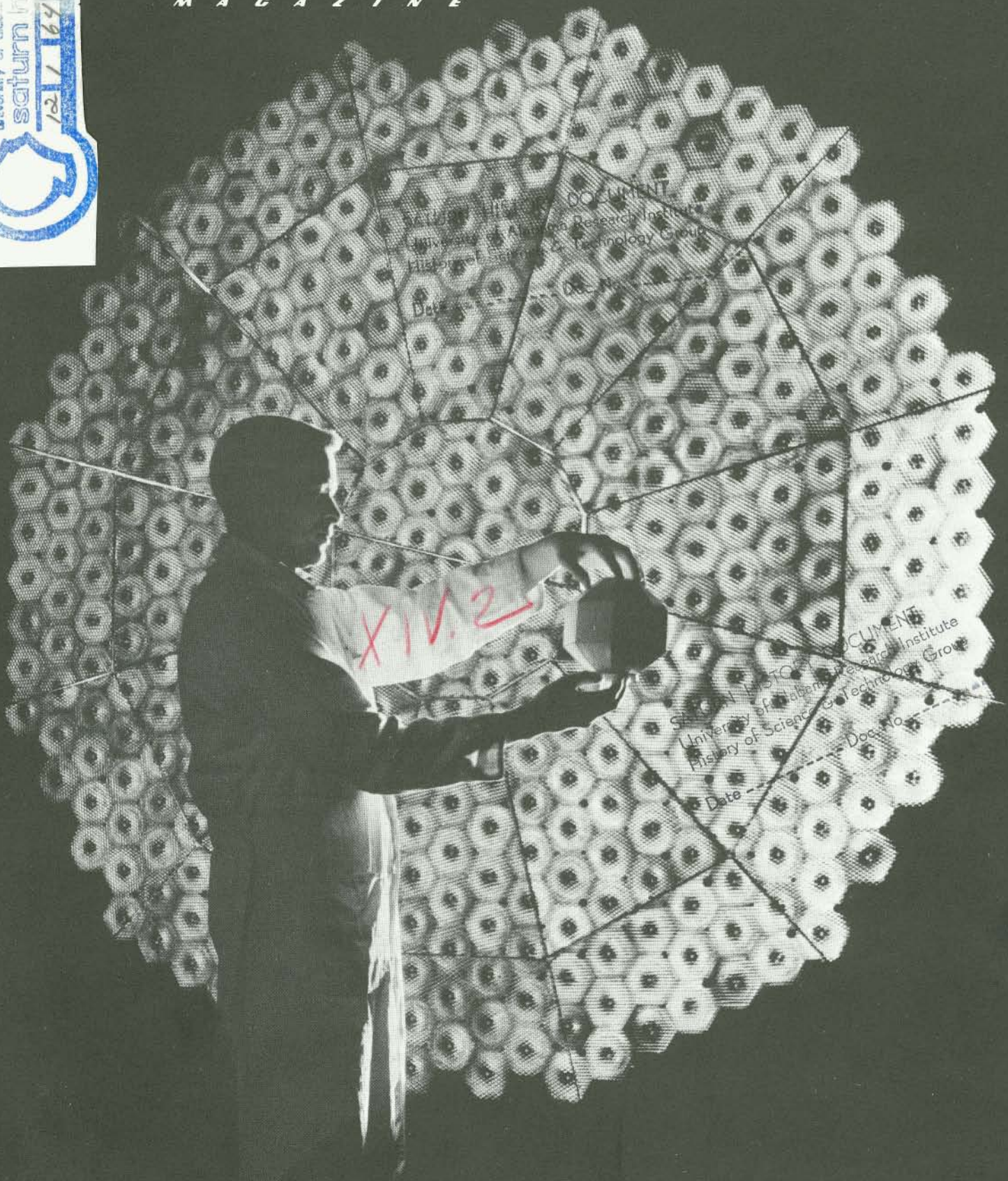
BOEING

MAGAZINE



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In This Issue

ON OUR COVER — An engineer checks a new indoor "sun" now shining brightly in a Boeing laboratory in Seattle. The device is used in research concerned with landing the first man on the moon. For further information, see page 15.

PHOTO CREDITS—Richard Stefanich (cover); John Bodisch (4); Daryl Mitchell (5); Byron Wingett (4, 8, 9, 14, 15); National Aeronautics and Space Administration (6, 7, 11); Vernon Manion (8); Karl Bachmeyer (10); Gordon Williams (12, 13); Pan American World Airways (13); Jack Barkus (14).

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THE BRIEFING

Competitive Boeing subcontracting on the planned United States Air Force large logistics jet transport could total more than $1 billion. Executives of 75 potential subcontractors were briefed on the program at Boeing's Renton plant last month.

Boeing is one of three major aircraft companies engaged in a competition for a contract to design and produce the CX-HLS (Cargo Experimental-Heavy Logistics System) for the Air Force. The system would include the jet transport and its support equipment. The airplane could be the largest ever built. More than 11,000 suppliers in the United States and Canada will participate in the program if Boeing wins the contract.

New orders for Boeing jetliners received last month pushed sales to a record high of 144 planes for the first 10½ months of 1964. The previous record was set in 1960, when the company sold 139 jetliners in 12 months.

The record-making order was received from Pan American World Airways on November 13, 1964, for five more 707-320B Intercontinental airplanes. They will be delivered early in 1966. Earlier in November, Air France also ordered a 707-320B for delivery in 1966. The 707-320Bs are the longest-range jets in service with any airline. The airplane will carry a typical payload of 186 passengers, plus 9,500 pounds of baggage and cargo non-stop between New York and Europe.

The 1964-65 season marks the 14th consecutive year that the United States Army has presented its documentary TV program, *The Big Picture*. The program—six-time winner of the Freedom's Foundation award—shows factual stories. Worthy of special mention is the unique *Army In Action* series which will be released early in 1965.

A brochure telling the story of space flight has been produced by the Smithsonian Institution, Washington, D. C. Although intended for students, the publication provides a useful reference of photos and statistics of American rockets and spacecraft, from the first rocket produced by Dr. Robert H. Goddard in 1926 to the Mercury and X-15 spacecraft. Titled *Masters of Space*, the brochure may be purchased for 50 cents from the Institution.

Air Force orbital laboratory will be platform for manned experiments in space.

Answers to questions on military use of space await launching of

MANNED ORBITAL LABORATORY

By WILLIAM JURY

CAN MAN do a useful military job in space?

"The answers to that question have been limited thus far to rhetorical argument and intuitive judgment," Brockway McMillan, undersecretary of the Air Force, said recently.

But the time is coming when it will be possible to use solid evidence from actual in-orbit experiments to answer the perplexing question of military man's utility and worth in space.

The Air Force is expected to begin developing the Manned Orbital Laboratory, a spacecraft shaped like a Thermos bottle and able to carry two men on a 30-day, 480-orbit trip around the earth.

Hurled into space by a Titan 3-C booster, the MOL will provide the platform from which man can experiment to determine the military's man-in-space role. The first manned flight of the MOL is expected late in 1967 or early in 1968.

Boeing is one of several aerospace companies preparing proposals to develop the important Air Force program. Teamed with Boeing are the Philco Corp., for telecommunications; the Hughes Air-

craft Co., for experiment integration, displays and data processing, and Honeywell, Inc., for attitude control.

Boeing's Harlowe Longfelder, an engineer and manager of 23 years' experience, heads the proposal team. Associated with him is Robert Bateman who, like Longfelder, headed Boeing's advanced space systems organization before becoming directly involved in the company's space station studies.

Most of the 200 other persons taking part in the MOL proposal preparations are veterans of the Dyna-Soar manned spacecraft and Minuteman intercontinental ballistic missile programs. They are supported by the substantial efforts of men in the three companies working with Boeing.

Longfelder believes the technical and management experience from these and earlier jobs gives Boeing a unique advantage in being able to assist the Air Force in the integration and management of a program like MOL.

Boeing has been studying long-duration space flights since 1959. Conceptual studies of space station systems have been going on for more than two years. In terms of related technology experience, the total has been estimated at a whopping 2900 man-years.

Not long ago the company's Aero-Space Division had more than 100 persons studying a four- to six-man orbital research laboratory for the National Aeronautics and Space Administration.

Much of the technology developed in the study of space stations for NASA can be applied to the Air Force space laboratory, says Longfelder, who directed Boeing's study of the space agency's manned orbital research lab.

"A meteoroid doesn't care if it punches a hole in a civilian space station or a military one," he points out.

The possibilities of meteoroids penetrating the walls of a space station were considered several years ago. How great the danger is and what to do about it has been the subject of a continuing study at Boeing for some time.

Penetration of space station components by another sinister foe of space travelers—radiation—is being investigated in the company's $2 million Radiation Effects Laboratory across the Duwamish River from the main Boeing plant in Seattle, Washington. Elsewhere, company computers are helping engineers select the equipment arrangement that will offer space station crews the most protection from radiation.

Perhaps the biggest single boon to Boeing's research posture is the $16 million investment in space development laboratories now nearing completion at Kent, Washington, southeast of Seattle. There, the Aero-Space Division will concentrate its space chambers and simulators and house new facilities for researching microelectronics, materials and processes.

Scheduled for completion next spring, the laboratories are being counted on for an expansion of MOL-related research and development now in progress. The Boeing space flight simulator (see cover and page 15), already set up to simulate the ground and space panorama as it would look to men in an orbiting lab, is helping engineers determine the best way to tie man into MOL space optical systems.

Old hands who seldom seem surprised at the turns taken by aerospace research have been caught taking another look when men dressed in scuba outfits flap by. The divers are members of Boeing's bioastronautics group, experimenting with neutral buoyancy as a substitute for weightlessness.

The MOL will be designed so that crewmen can move about without wearing cumbersome spacesuits. But where to put handholds and how to design ladders and hatches for use in a zero-gravity environment pose new problems to engineers who have never experienced weightlessness themselves.

To know the vagaries of weightlessness, divers work underwater with wrenches, drills and other tools to develop a better understanding of the things that will help a man in space to do a job—where to put foot braces, for example, to keep a man from spinning when he tries to tighten a nut or close a latch.

The dizziness which Project Mercury astronauts suffered when they returned to earth after being weightless for extended periods of time has prompted other researchers at Boeing to experiment with trampolines as a possible cardiovascular conditioner.

Experiments also have been conducted on subjects using an adjustable handhold bar to see if this simple device could be used to keep astronauts fit while weightless for long periods.

The toxic tricks that some materials play when cooped up in a sealed area were discovered by Boeing more than a year ago. It happened during an unsuccessful attempt to evaluate a complete life support system. A proposed 30-day run ended in failure during the fifth day when five men testing the system inside a sealed chamber became violently ill.

The trouble was blamed on a steady buildup of small and normally harmless quantities of toxic gases emitted from materials inside the chamber. The test was resumed successfully months later following a modification of the system and a careful check of suspected sources of contaminants.

The test produced important information on the behavioral, physiological and nutritional effects on human performance, and gave space engineers their first close look at the problem of toxicity of materials in a closed environment.

The Air Force has specified essentially proven hardware for the critical components of the MOL system. In effect, a laboratory is added to an existing Titan 3 booster and a Gemini capsule. The two astronauts will ride into space in a modified Gemini attached to the front end of the MOL canister, a pressurized cylinder approximately the size of a small house trailer.

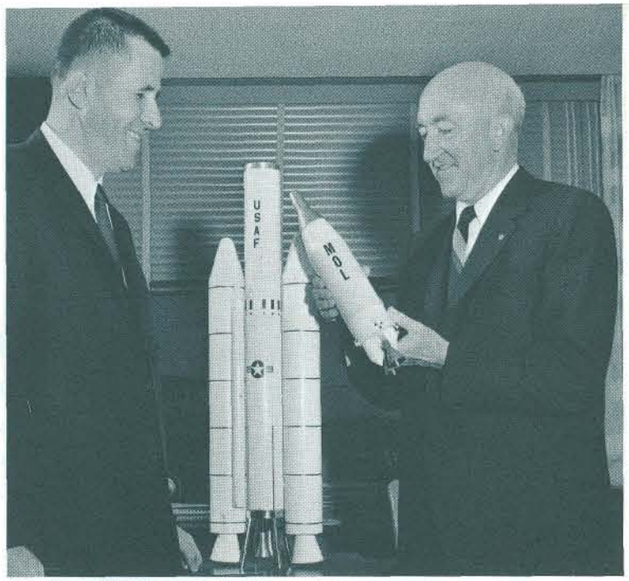
After orbit is attained, the crew will leave the Gemini and enter the canister where they will live and carry out their experiments. When their mission is completed, the astronauts will re-enter the Gemini capsule, cast off from the canister and return to earth.

That Boeing is determined to win the assignment to assist the Air Force with the ambitious MOL program was made clear on two occasions by William M. Allen, president of The Boeing Company.

Last December, only hours after the Department of Defense cancelled the Dyna-Soar program and announced it was going ahead with the MOL program, Allen assured Boeing employees the company would go after the job "with every bit of ability and initiative we possess."

Last month, Allen told employees that he had "directed our corporate staffs and other divisions to assist the Aero-Space Division in whatever ways necessary to complete our team and develop the winning proposal."

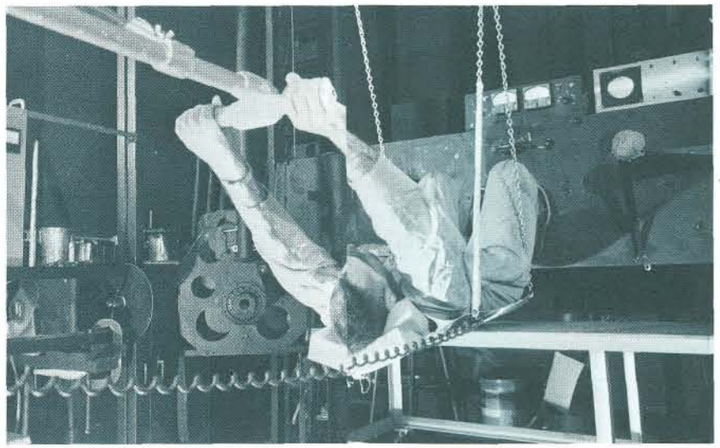
It was one of the few times Allen has repeated himself and there was hardly a person who doubted that the man meant what he said.



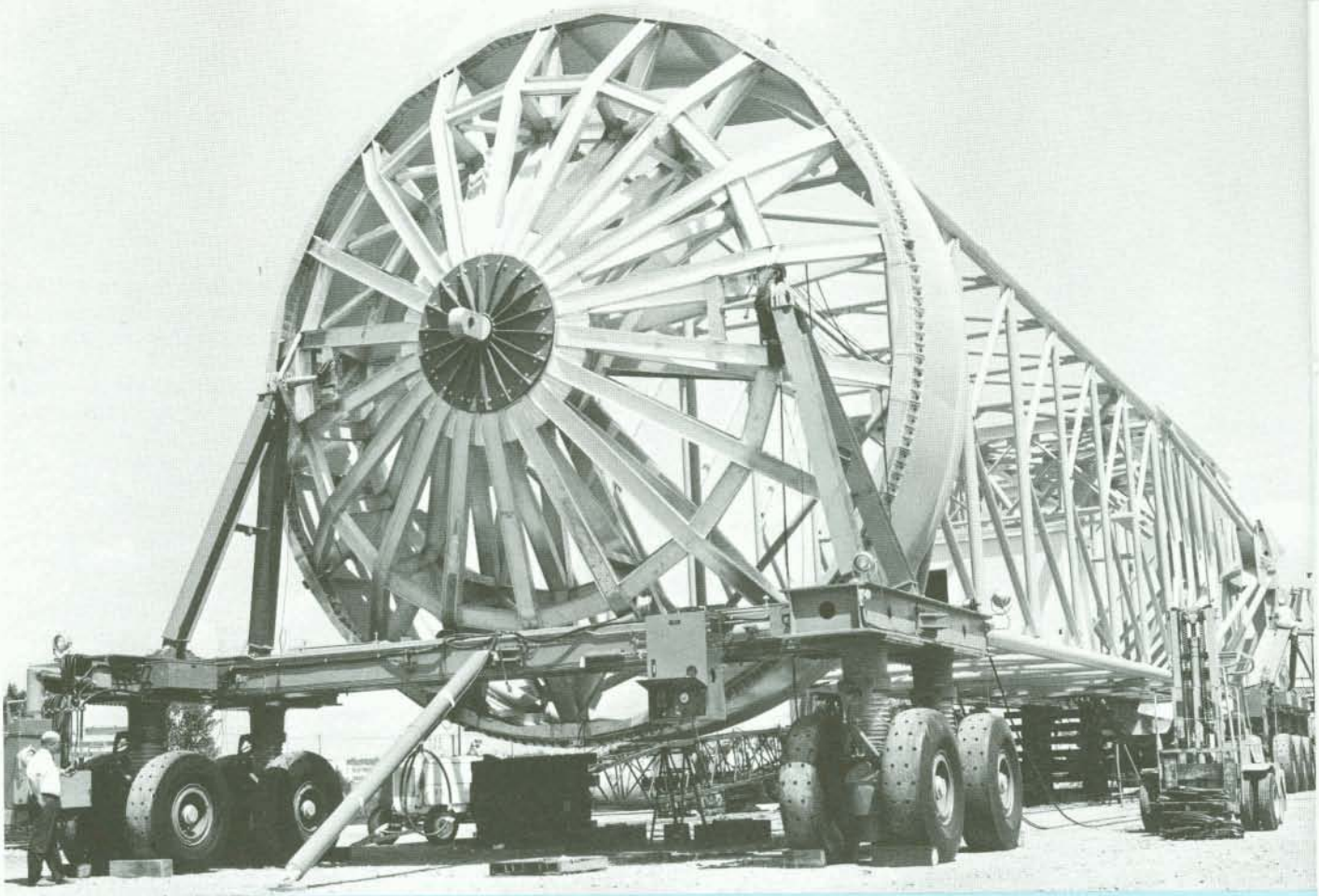
Boeing's William Allen, here with proposal team leader Longfelder, calls MOL job "one of greatest challenges of our time."

MOL crewmen will enjoy shirtsleeve environment.

Boeing test-gun pellet shows damage pea-size meteoroid could inflict.

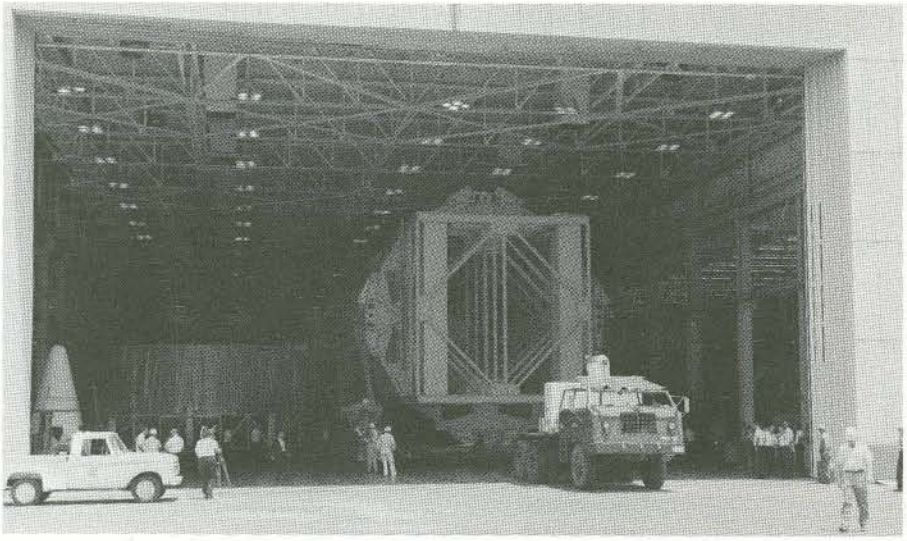


Space lab crews may exercise to stay fit, avoid dizziness.



S-1C simulator is loaded aboard transporter.

Fuel tank for S-1C is carried by mobile crane.



Simulator is used for practice runs at Marshall Space Flight Center.

Rocket movers have muscle, must travel.

BIG WHEELS CARRY BIG BIRD

By WILLIAM B. SHEIL

THE LARGEST vehicle at the NASA/Marshall Space Flight Center in Huntsville, Alabama, has one of the biggest jobs of the space age.

Called the S-IC transporter, it will move the world's largest and most powerful rocket, the Boeing first stage booster of the Saturn 5 moon vehicle, between various manufacturing and testing sites at Marshall.

A two-section vehicle connected by only a single communication wire, the transporter is 38 feet wide and weighs 105 tons. The two dollies have a total of 24 wheels—each five feet tall with a 28-inch tread —of the type used on earth moving equipment. Each 24-ply, 1800 by 25 tire carries 80 pounds of air.

With tractor attached, the assembly is 195 feet long, about two-thirds the length of a football field. The tractor, a modified Army M-26 tank retriever, weighs 50 tons, but half that is ballast. Powered by a 240 horsepower engine, the tractor supplies electrical and pneumatic power to the transporter.

On the road, the vehicle requires 38 feet clearance. In addition to its road work, the transporter will serve as an assembly fixture when the engines are attached to the test stage being built at Marshall.

Once this task has been accomplished, the transporter will carry its 150-ton cargo (the empty weight of an S-IC) to the test stand. The vehicle's maximum speed will be five miles an hour, designed to operate on a road grade of as much as six per cent.

The transporter has the capability of being steered plus or minus 90 degrees from the line of forward movement. This ensures that the vehicle can be moved sideways into various test cells and checkout areas.

Each dual set of wheels has its own individual steering system, which gives the transporter excellent handling characteristics. Built-in jacks can raise the transporter off its wheels and provide more stability during assembly and checkout phases of the operation.

As move coordinator, the master driver in the tractor has the responsibility of directing the vehicle's course. Men walking near each corner of the transporter observe the vehicle's movement and signal the coordinator of any obstacles or hazards. The coordinator can communicate with the transporter's drivers, stationed in cabs on the front and rear of the huge vehicle, by sound-powered phones.

At present the transporter's team is preparing for the real thing by handling an S-IC weight simulator. Made to the exact dimensions of the S-IC, 138 feet long and 33 feet in diameter, the simulator is a large framework of tubing which enables the crew to practice all of the movements it must perform.

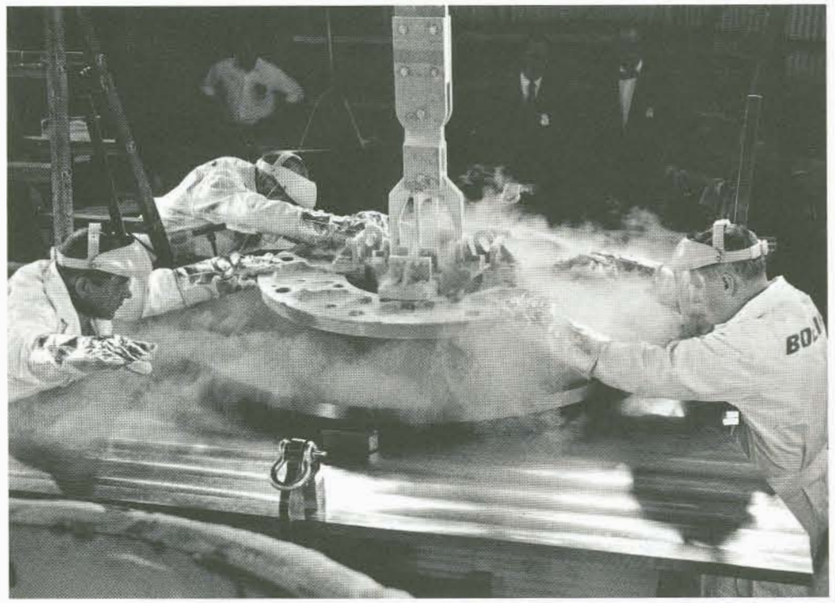
The simulator is being carried over roadways, wheeled in and out out of assembly buildings and placed on test stands, in preparation for handling the first ground test booster in 1965.

Another outsized special vehicle at Huntsville is a 50-ton mobile crane. Completely hydraulic powered, it is being used by Marshall to transport huge bulkheads and components of the Saturn 5 S-IC first stage booster around the sprawling assembly area.

Cradled on eight 20-ply airplane tires, the unit has two 25-ton hoists, which move 15 feet from front to rear. The frame may be enlarged by use of a hydraulic system.

The crane can carry a load equal to its impressive weight: 50 tons. It stands 33½ feet high and is 40 feet long. The frame will extend to 50 feet. Designed under supervision of the NASA/MSFC Manufacturing Division, the unit cost $200,000. It was assembled at Kewanee, Wisconsin.

Early birds will be ground tested on static and dynamic test stands at Marshall in 1965. Later, the ground test program will move to NASA's Mississippi Test Operations on the Pearl River. First unmanned flights from Cape Kennedy, Florida, are scheduled for 1967, with the manned missions slated by 1970. Between now and then, the S-IC transporter and the 50-ton mobile crane will become familiar sights on the Saturn 5 proving grounds in Alabama, Missippi and Florida.



Cooled to –300 degrees, SST wing pivot steams during assembly.

Much depends on SST wing pivot.

GOOD TURNER

By DONALD BRANNON

ONE of the toughest problems engineers faced in designing the Boeing supersonic transport was the wing pivot. Boeing's plans call for wings which can move forward for low-speed flight in landing and takeoff and be swept back for superior performance during supersonic flight.

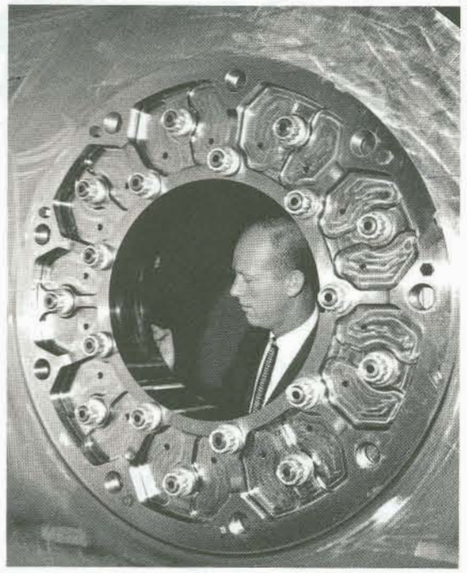
The success of this concept, which designers call variable geometry, depends primarily upon the wing pivot. Forces acting on the pivot during operation will reach as much as three million pounds. Temperatures on the airplane's skin a few inches from the pivot will range from –65 to 450 degrees F. The wings must sweep smoothly through 52 degrees of arc at flight speeds of 136 to 1,800 miles an hour.

To handle this rugged assignment, Boeing has built and currently is testing under simulated flight conditions a full-scale pivot section of an SST wing. The fixed part of this wing contains a pair of simple, rugged clevis joints. The movable part of the wing fits into the slots. Both parts are made of titanium. A vertical, hollow pivot passes through both surfaces of the wing and is bolted to the part which does not move. The pivot bearing measures about 36 inches across, with a 21-inch-diameter hole extending from top to bottom. The movable part of the wing turns around this pivot.

Movement around the pivot is made easy by a bearing of three stainless steel bands with two teflon wear surfaces. Each band is 3.2 inches wide.

The plastic, teflon, has been called one of the most slippery materials in existence. Friction when the wing moves thus is spread over four teflon surfaces, providing smooth movement for the 62½-foot outer wing section.

Part of pivot is mounted in test rig, to operate under simulated flight conditions.



Inspection and maintenance of wing pivot is done through 21-inch-diameter access hole.

The three bands as a group are chilled to –300 degrees F and then fitted into the movable part of the wing. The bands expand as they return to room temperature and thus are held in place. The hollow interior of the pivot allows ready access for inspection.

Boeing has designed and built a powerful test machine which can operate the pivot while exerting up to 4,000,000 pounds of pull on the wing section.

Simultaneously, the machine can surround the section with temperatures ranging from –65 to 450 degrees F. Testing is under way and will continue through the lives of several bearings.

First designed in 1963, the wing pivot is the result of Boeing variable geometry research which began in 1959.

The company has devoted more than 1,000,000 manhours and 10,000 wind tunnel hours to aircraft with movable wings.

View delights helicopter tourists.

Olympic Games structures are new.

Passengers board Boeing Vertol 107 at Tokyo Heliport.

Kanki Airlines' helicopters are busy with

TOKYO TOURS

By KARL BACHMEYER

TOKYO — "It is amazing that the historic Olympic games are being held in such a small place."

This was the comment of one Japanese passenger aboard a Kanki Airlines helicopter tour of Tokyo on opening day of the 18th Olympiad. "Why, the National Stadium looks like an earthenware teacup," the passenger aboard the Boeing Vertol 107 added.

The consensus of the 25 passengers on the seven-minute flight could be summed up briefly as: Seeing Tokyo from the air is a sobering sensation—from this new angle the largest city in the world seems shriveled on a vast landscape.

Kanki Airlines, with Hato Bus Lines, has been operating what it calls a "three-dimensional tour of Tokyo" since Aug. 15. Priced at only 1,800 yen ($5), the tour is a rare bargain in Tokyo, where many prices are high. The tour begins at Tokyo Station about noon, one or more buses taking off according to demand.

The tourists are given a ride over the new network of expressways constructed for the Olympics, past the Imperial Palace with a stop for souvenir snapshots, through Meiji Park for a quick glimpse at several of the Olympic athletic sites and to the Tokyo Metropolitan Heliport at Harumi in the midst of Tokyo Bayside shipping operations.

At the heliport awaits one of the two Boeing Vertol 107s owned by Kanki. The tourists change from bus to helicopter for the aerial view of what they have just seen on the ground, plus a closeup view of the famous Tokyo Tower, nearly as tall as the Eiffel Tower.

The erratic weather of the two-week Olympiad cut down on the revenue Kanki expected during the games. There were about six of the 14 days in which rain and fog canceled the flights (the bus tour continued despite weather, with a reduction in cost). However, opening day (October 10) of the Olympics saw the 107s take off and land 16 times to handle 400 tourists eager for an uncrowded view of the opening ceremonies.

Kanki has been averaging 50 to 60 tour customers a day since the operations began, with a hike to about 100 on holidays and Sundays. The entire helicopter portion of the tour takes 10 minutes from boarding to unloading and a Kanki spokesman says each flight costs about $60, leaving a nice profit margin when the 25 seats are filled.

The attractive Japanese stewardess on each flight also serves as a guide, describing on a PA system the points of interest.

The birds fly at 1,500 feet when skies are clear, descending to 900 when cloudy. Japanese civil aviation regulations require a three-mile visibility for the flights.

Kanki Airlines began operations of Boeing Vertol 107 sightseeing tours two years ago in Kyushu, Japan's southernmost island, conducting flights from Oita to Kumamoto via Beppu. Kanki dropped the Kyushu operation when it moved to Tokyo.

Expanding to bigger things, Kanki now is operating non-scheduled charter flights by 107 from Tokyo to the burgeoning tourist area of Ito, a 2½-hour train trip from Tokyo. The helicopters make the trip in 30 minutes.

Kanki hopes to have the Ito flights on a scheduled daily basis in time for Japan's busiest tourist season, January 1 to 7, the New Year holidays. The company expects to charge 3,000 yen ($8.34) or less for a one-way trip, compared to the 1,200 yen ($3.33) for a first-class train trip.

Saturn cleaning operations at Michoud provide

PURITY SURETY

By WILLIAM CLARKE

THEORETICALLY the United States' moon mission could be brought down by a single fingerprint. If oil in the fingerprint mixed with fuels used in the first stage of the Saturn 5 rocket, it could produce an explosive mixture.

The 138-foot first stage, which is under construction by Boeing for the National Aeronautics and Space Administration at New Orleans, will be propelled by a combination of kerosene and liquid oxygen.

The liquid oxygen is contained in a 327,000-gallon tank at the top of the stage and is funneled down to the engines through tunnels, mixed with the fuel and ignited. The combination burns fiercely and produces 1½ million pounds of thrust in each of the Saturn booster's five engines.

Liquid oxygen has one quality not much prized by rocket men. Mixed with any hydrocarbon, such as grease or oil, it becomes dangerously volatile and unstable. A tiny spark can set it off.

To offset the danger, all Saturn parts which come into contact with liquid oxygen are kept especially clean — "LOX clean" — and that means spotless.

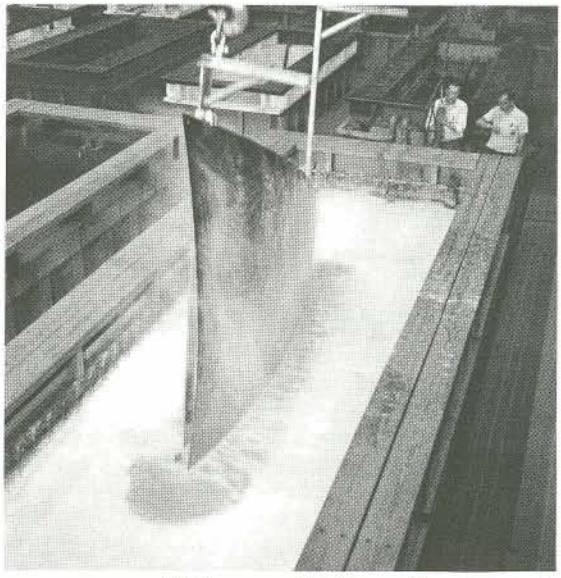
The requirements of a LOX clean operation have necessitated the construction of several unusual facilities at New Orleans. The "world's largest dishwasher" is one. Officially called the "major component cleaning facility," it is a box 40 feet square and 22 feet high, lined with stainless steel. The entire bulkhead end of a LOX tank fits nicely inside the dishwasher, which got its name because the facility uses revolving pipes similar to those in some kitchen dishwashers, which spray both the inside and outside of the parts with streams of cleaning chemicals.

The cleaning process consists of a number of steps which can be varied according to the need. Basically, a part being cleaned is sprayed with a degreasing compound, heated and washed with a detergent solution, rinsed with deionized, contamination-free water, sprayed with a nitric acid solution to de-oxydize it, cleaned off again with water, heated once more, treated by an etching process which actually removes as much as six ten-thousandths of an inch of metal, rinsed again with water and dried with hot, oil-free air.

Essentially the same procedure is used in other cleaning facilities in the Michoud plant. One is a series of vats in which segments of the bulkheads and other parts can be dipped.

The final-cleaning installation, which is just now being completed, is in a mammoth building in which the tanks and the stage itself are to be assembled. When a tank has been welded together it will be lifted by an overhead crane into a fixture at one side of the building. There it will be tested for leaks and the interior chemically cleaned before being closed up for assembly into the entire stage.

Some parts are cleaned three times to ensure spotlessness. Each cleaned part is inspected by both Boeing and NASA quality-control men and wrapped in polyethelene. Work is done on the parts by employees wearing white, lint-free gloves.



Saturn part is dipped in chemical.

Bulkhead is backed into world's biggest dishwasher.

All-metal 42-ton Clipper ship had 4000-mile range.

It seemed as if the Flying Clippers could push on forever.

THE SHIPS HAD WINGS

Following is the major part of a letter written by Capt. William M. Masland to M. D. Klaas of Chatsworth, California, who is compiling a history of the famous Flying Clippers. Twelve of these huge flying boats were built by Boeing between 1937 and 1941 and delivered to Pan American World Airways. At the beginning of the second world war, nine of the Clippers were purchased from Pan Am by the United States War Department, but their operation by the airline with its own crews continued. The other three flying boats were sold to British Overseas Airways.

Captain Masland describes the rigorous training given Clipper crews, and provides a glimpse of service on the flying boats during the big war. He still flies Boeing planes for Pan American on routes around the world, but now the aircraft are 600-mile-an-hour jets.

By CAPT. WILLIAM M. MASLAND

MOST OF US who went to work for Pan Am in 1935 as trainees for Flying Clipper crews were former Navy hotshots. I had been on the old carrier *Langley* and knew all about it, or thought I did. The company wasn't so sure. It put every last one of us into a hangar at Dinner Key, Florida, and there we stayed until we earned our A and E mechanic licenses, even if it took two years, which in some cases it did.

Following this stint we were sent to the radio shops and told to stay until we had earned our commercial radio licenses. This was the license required for radio telegraph operation on commercial circuits—copy 20 words a minute of cipher, know the ins and outs of five different types of equipment and so forth.

Following these exercises we were turned loose on little two-man ships out in the sticks to operate as copilot, mechanic, radio operator. My stint was in Port of Spain running across Venezuela and to Barranquilla on the mouth of the Magdalena. The ships we flew were S-38 and S-41 twin-engine amphibians. We serviced, maintained, repaired, improvised our way across country as wild as you will find. Facilities often were no more than a couple of Indians in a dugout canoe with some five-gallon tins of gas.

We ran a series of courses at home in our spare time and took periodic exams on them. Successful passage of the first series raised us

from apprentice pilots to junior pilots. After completing the circuit, which included time in the engine overhaul shops as well as in the hangars and on the morning runup crews, followed by the year or so in an outbased operation like the one in Venezuela, we went to an ocean division. Here we started all over again at the bottom.

First assignment was as junior flight officer. These ships, at that time the Martin M-130 China Clipper type, were close to marginal as to load. We carried a crew of seven. It was the junior flight officer's job to relieve each of the others in turn; first the captain, then the first officer, then the radio operator, then the engineer — an hour for each. Then the junior officer had an hour off, but used it to understudy the navigator.

Eventually the junior officer navigated a crossing from Alameda to Manila or Hong Kong under the eyes of a checked-out navigator and if successful was moved up a grade to second officer. We followed the practices of ships. Second officer was automatically navigator.

While this was going on we also were studying and taking exams. My exam in meteorology would be typical. It was given by Clover, the chief meteorologist. It took three hours; he asking the questions and I hopefully answering.

All in all there were about 100 exams before we ran through the course from apprentice pilot to junior pilot to captain coastwise to master of ocean flying boats. The tests ran through the area of navigation starting with charts and projections, plane sailing, Mercator sailing, celestial navigation including cosine-haversine method, admiralty law, aircraft structures and strength of materials, power plants and fuels, at least one foreign language, the history and culture of the countries to which we were flying, and on and on.

Capt. William M. Masland

It all came in handy before we were through. I have been at the local met office with my navigator making my own forecast and my own flight plan while the first officer was loading the ship, the engineers beating out some needed fittings at the local blacksmith shop and the two stewards baking their own bread in an oven they had constructed on the beach. Then we loaded fuel out of a surf boat, loaded it to our own specifications, and were off, often to a place none of us had ever seen before, sometimes to a place no one had ever flown before.

I have in the files of Special Mission 72 a note from Ibn Saud, forwarded through the State Department, saying that it would be all right for me to fly across Arabia if I avoided flying over certain holy cities, but if for any reason I was forced down, he would have to disclaim any knowledge of this authorization.

This Mission 72 was to wait at Bahrein in the Persian Gulf until the Casablanca Conference was over and then fly Roosevelt, Churchill and Stalin to Australia for a meeting with Chiang Kai-shek. They changed their minds because the Japanese got wind of it. Apparently my crew was the only group in the Middle East which did not know of the plan. We made the flight anyhow, taking General Wedemeyer and his staff and then continuing on around the world.

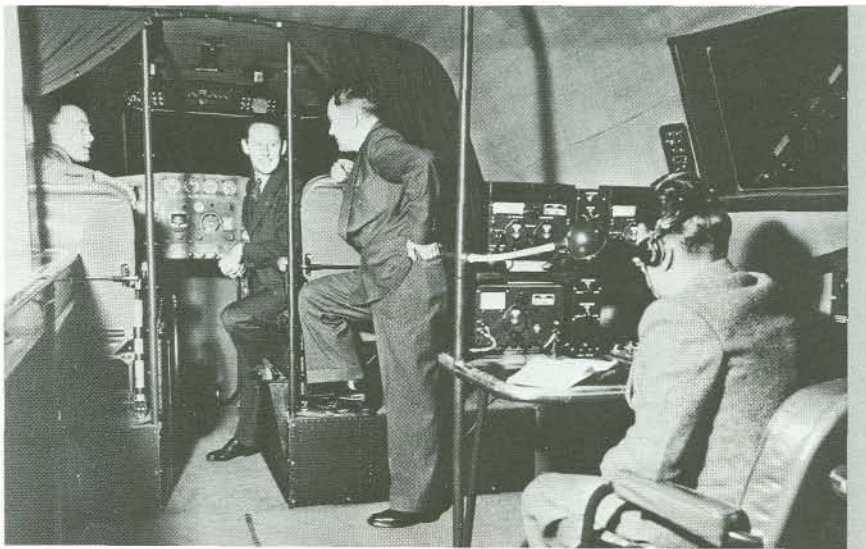
It was all hard work, but also a lot of fun. There were sometimes long hours of high tension; a night at sea in the Gulf of Paria with a dead engine and rising winds; everybody shooting at us, especially our friends.

And there were days or nights of great beauty; a quiet night at anchor in the remote port of Angra dos Reis (Anchorage of the Kings) on the Brasilian coast; an anchor watch on a cold clear night in the Persian Gulf with the stars hanging as low overhead as the lamps in a mosque.

The pattern is gone, as well as the ships. I don't know from one port to the next who will be on my crew. But it's still fun, the jets are lovely ships and the upper atmosphere has its own beauty.

Clipper crews had plenty of elbow room.

From left: Admiral Leahy, President Roosevelt, Harry Hopkins and PAA Captain Cone dine aboard a Clipper en route from Casablanca, January, 1943.



ADVENTURES IN MANAGEMENT

TAYLORED TALENT

ONE AUTUMN afternoon in 1956 a Boeing B-47 bomber took to the Kansas skies and made a bit of history. In 40 seconds it completed the half loop and half roll of its first Immelman.

The pilot, Richard W. Taylor, and his crew were assisting the Air Force in a B-47 bomb-tossing tactic, proving that the airplane could take it. Both plane and pilot performed flawlessly. It was one of many tests which preceded Taylor's recent appointment, at age 42, as director of engineering at the company's Wichita Branch.

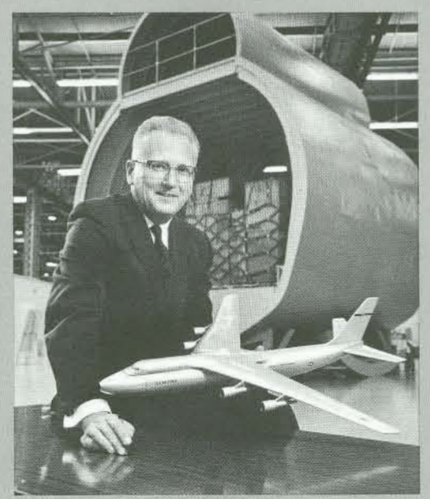
He is a graduate of Purdue University and has a fistful of commercial pilot ratings. His 21 years of flight experience began as a liaison pilot in the Army. He joined Boeing in 1946 in Seattle as a flight test analyst, married an Irish girl he had met in Oklahoma, and by 1950 was ready for the B-47 flight test work in Wichita. Dick had already flown everything from the B-29 to the Stratocruiser.

"He struck me as a midnight-oil professional," recalls an associate, "with a thirst for operational facts related to aircraft design."

By 1956 Taylor was chief of flight test at Wichita and two years later was named B-52 engineering program manager. Then in 1961 the Taylor talents were needed for new product development. With his wife and five children scheduled to come later, he journeyed back to Seattle, where he served, in turn, as assistant chief engineer for both the TFX and the SST.

In these programs, Taylor was picked on several occasions as a spokesman for the team. He is not a windy speaker, but the report was, "He quietly brought the house down. He had the operational savvy. Everyone sensed it."

Taylor has a best-effort campaign noiselessly going on in his 1,800-man organization. He thinks of his group as a pool of talent, fed by objectives and delegated authority. "I like to watch for individual ripples," he says.



AIRPLANE ENGINEER

AT WRIGHT FIELD in 1945 a Boeing team presented to the Air Force a new idea—the concept of a sweptwing, jet-powered bomber, first of its kind in the world. This plane became the famous B-47. As the Boeing men earnestly made their pitch, the most interested listener was Lt. K. F. Holtby, Air Force project officer for the B-47.

In 1947, out of the Air Force and with a California Institute of Technology degree in his pocket, Holtby headed for Seattle, anxious to join the Boeing engineering effort he had witnessed at Wright Field. He's been in it ever since. Now 42 years old, he is assistant program director for system performance on one of the biggest jobs ever tackled by the company, design of the CX-HLS cargo airplane.

Holtby has made a number of contributions to the configuration of Boeing airplanes. His early analysis of highly swept, flexible wings led to the use of wing spoilers for lateral control on Boeing jets. He also initiated the use of leading edge Kruger flaps on the 707 series airplanes.

Holtby worked on the supersonic transport design and was responsible for early investigation of its variable-sweep wing. He also was one of the two original engineers on Boeing's CX-HLS. The other was Maynard L. Pennell, now a Boeing Airplane Division vice-president.

Holtby's talent as a manager was recognized early. Six years after joining the company, he was chief aerodynamicist for the Wichita Division; three years later, he was returned to Seattle to become chief aerodynamicist for the division which produces jet transports; in 1960 he was in charge of staff engineering activity on the supersonic transport, as well as reviewing all of the division's research activity.

Then came a Sloan Fellowship at Massachusetts Institute of Technology, where authorities further honed Holtby's techniques.

Dedicated skiers, Holtby, his wife and all but the youngest of their five children hit the slopes each year when the snow flies.

In skiing, his most memorable run was on Mount Blanc, an eleven-mile downhill schuss. At Boeing, however, his progress has been upward from the day he joined the company and began "learning from the people I worked for."

Boeing builds a giant collimated light source.

SYNTHETIC SUNSHINE

By WESLEY ROBINSON

"I DON'T care if the sun don't shine" goes an ageless popular tune—but certain Boeing engineers do care. They are studying missions to the moon with the help of a space-flight simulator. Essential to their tests is an accurate portrayal of the moon's surface as it would look to an astronaut making a landing.

For this they require light as nearly like sunlight as possible, to make accurate shadows on a moon-surface model. Sunlight is almost perfectly collimated light—that is, its rays are almost exactly parallel.

A single large light bulb with a six-foot mirror, though technically possible, was impractical because of inherent optical problems.

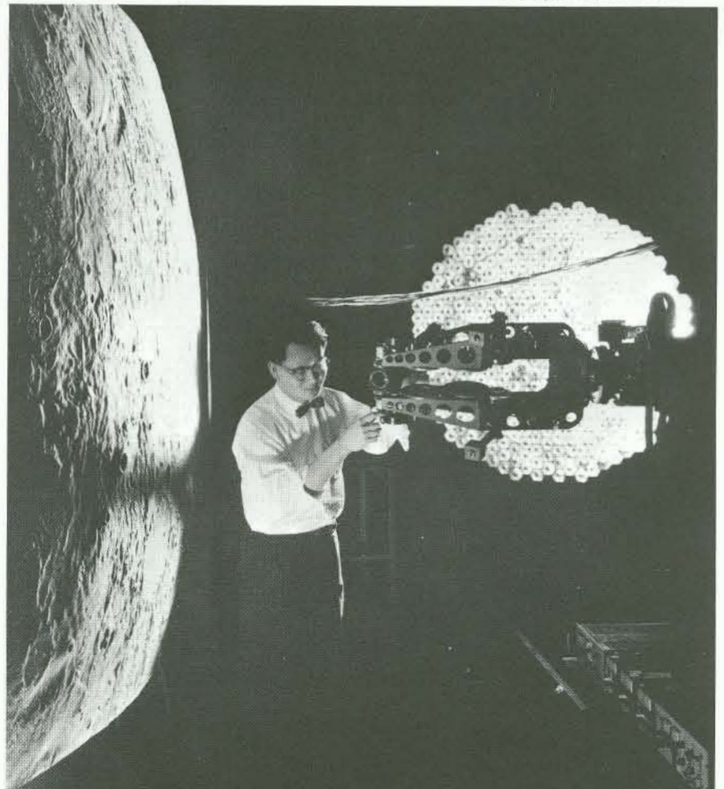
The device used is a seven-foot-tall bank of 433 lights and reflectors, arranged to produce a 72-inch circle of collimated light.

Although a person looking at the artificial sun from 50 inches away sees only a circle of intense light, one would find up close a small shadow cast by the light bulb itself in the center of each mirror. The bulb's direct light, being non-collimated, is absorbed by a honeycomb that stops non-aligned rays. The bulb itself is an obstacle blocking collimated rays that occur by reflection from the mirror behind it.

Plans are under way for another and larger collimated light bank at Boeing's new Kent space center, to contain 900 lights.

An article explaining operation of the space flight simulator was published in the *Boeing Magazine* of April, 1964.

TV camera photographs shadows made on moon model by artificial sun.



AIR FRANCE

AIR-INDIA

AIR MADAGASCAR

AMERICAN AIRLINES

COLOMBIAN NATIONAL AIRWAYS

BRITISH OVERSEAS AIRWAYS CORPORATION

BRITISH WEST INDIAN AIRWAYS

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WORLD AIRWAYS

*Boeing jet service begins later **Flies Boeing-Vertol 107 helicopters

These airlines can fly you almost anywhere in the world.

(In these jets.)

There's hardly a corner of the world that isn't home to at least one of these airlines. National customs, cuisine and decor are often transplanted right into the Boeing jetliners they fly.

Your flight may be in a Boeing 707, the 720, or the new 727. In any case, you travel with the assurance born of unflagging reliability on a worldwide scale. (Since 1958, Boeing jets have carried nearly 70 million passengers, and have flown a total of more than a billion and a half miles.)

It all adds up to one good suggestion: Do your traveling by Boeing jet.

In addition to the airlines shown above, Boeing jetliners are flown under lease by Air Afrique, Air Algerie, Air Congo, Indian, LIA, Nigeria and TAP airlines.

BOEING Jetliners

LONG-RANGE 707 · MEDIUM-RANGE 720 · SHORT-RANGE 727