NASA Facts

National Aeronautics and Space Administration

Lyndon B. Johnson Space Center

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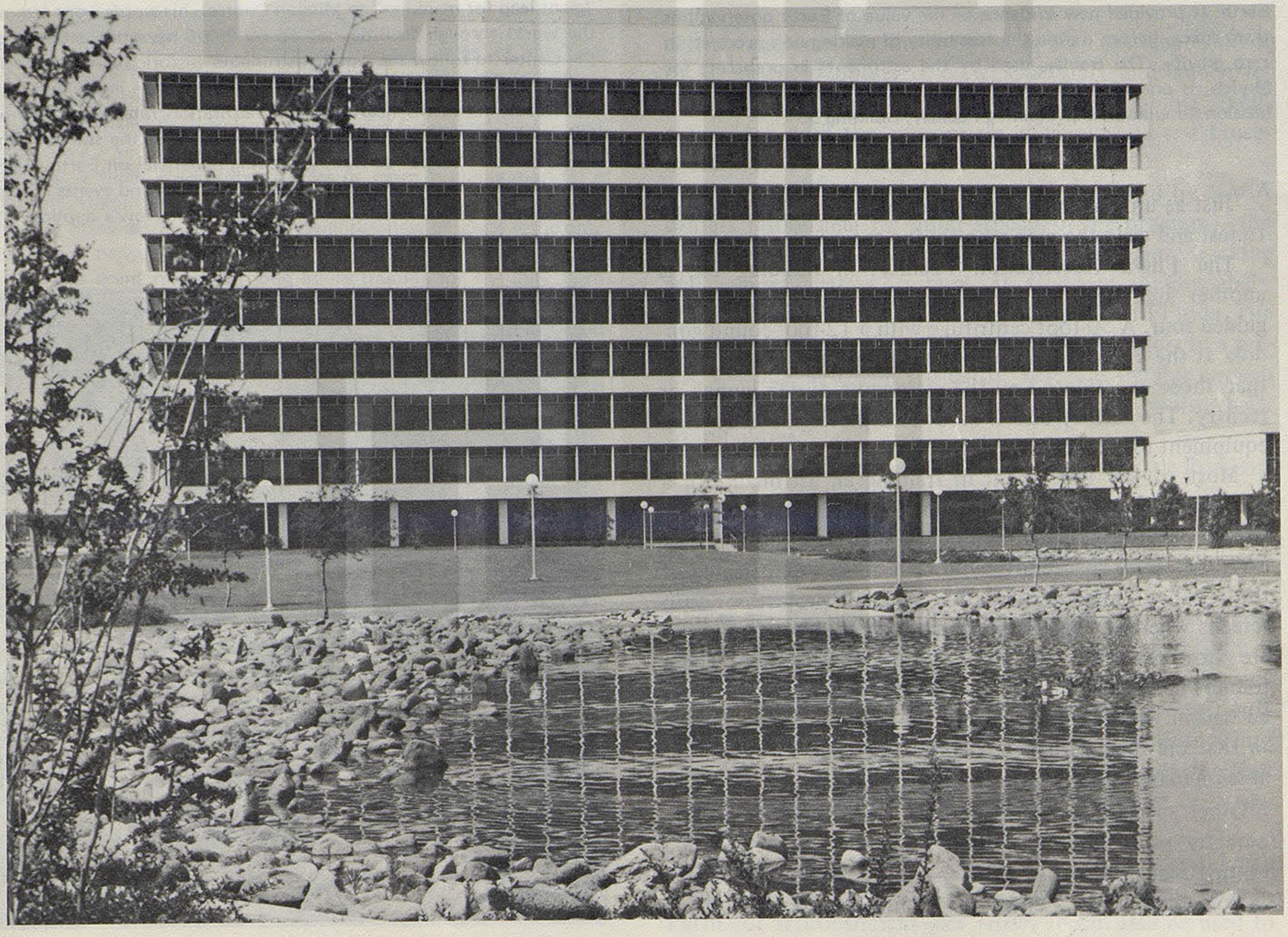
Lyndon B. Johnson Space Center

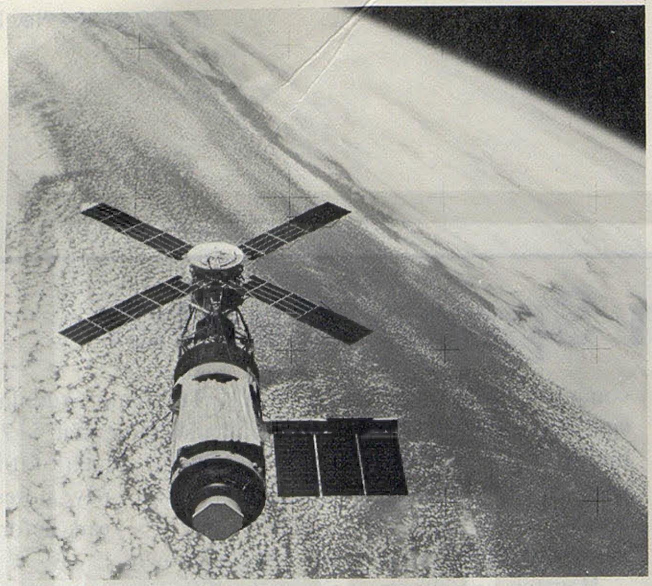
The NASA Lyndon B. Johnson Space Center (JSC) opened for business at its 1620-acre site 25 miles sourtheast of downtown Houston in September 1963. The Center's responsibilities include: design, development, and testing of the spacecraft and associated systems for manned flight; selection and training of the astronauts; planning and conducting the manned missions; and extensive participation in the medical, engineering, and scientific experiments that are helping man understand and improve his environment.

The JSC employs some 3,600 engineers, technicians, scientists, secretaries, mathematicians, managers, clerks, photographers, writers, instructors, administrators, and . . . astronauts. Another 6,000 contractor personnel work at or near the Center to help test spacecraft systems, work out computer programs, or just keep the Center running smoothly. The total combined payroll adds more than $175 million a year to the Houston area economy. Much of it is spent in the Clear Lake business community – new stores, homes, hotels, and schools where, only 15 years before there were open pastures and a few small towns.

Houston was chosen as site of the JSC after an investigation of many prospective locations around the United States. The selection was announced in September 1961. Personnel began moving to offices in Houston from Langley Field, Virginia during October 1961. JSC construction started in April 1962.

The facilities were designed and built to house the wide variety of technical and scientific disciplines required for





Man's longest space journey was aboard the Skylab space station which was launched in May 1973. Nine U.S. astronauts lived and worked aboard this giant station in three separate visits, the longest of which lasted 84 days. Skylab has been described as one of the most scientifically productive endeavors in the history of human exploration. The 171 days (1973-1974) U.S. astronauts spent aboard Skylab clearly demonstrated that man can perform valuable services in Earth orbit as observers, scientists, engineers and repairmen. Skylab produced a wealth of new information about the dynamic processes of the Sun and how this effects all of us here on Earth. It provided new evidence of the value of Earth observations from space, helped define the feasibility of making new products in zero gravity. The trainer, used by the astronauts in preparing for Skylab, is one of the interesting items visitors may inspect in the Mission Simulation and Training Facility, Building 5.

Just as unique are some of the specialized facilities used to test and train the men who fly the spacecraft.

The Flight Acceleration Facility, in Building 29, is another area open to the public as part of the JSC self-guided tour. A 50-foot centrifuge with a 12-foot-round gondola at the end can spin up to impose g-forces even greater than those experienced by the astronauts during launch or reentry. The facility also is used to help design and develop equipment for use in space flight.

Most of the time spent in training an astronaut for a specific mission is logged in simulators – training devices that duplicate spacecraft equipment and control panels, or even the entire spacecraft cabin. The most sophisticated of these, called "mission simulators," include projections onto screens where the spacecraft windows would be. The scenes are those the crew will see during the real mission. These trainers in the Mission Simulation and Training Facility can be tied in with the Mission Control communication system so that crews and flight controllers can practice the entire mission many times before the actual flight.

Other specialized facilities at the Center include a photography processing laboratory, a technical services shop, printing plant, cafeterias, fire department, dispensary, and a Visitor Orientation Center that houses spacecraft which have flown in five American manned space programs – Mercury, Gemini, Apollo, Skylab, and Apollo Soyuz Test Project.

The JSC also maintains aircraft for astronaut training, research programs, and administrative travel at nearby Ellington Air Force Base, and it operates the White Sands Test Facility in New Mexico.

JSC Program Management

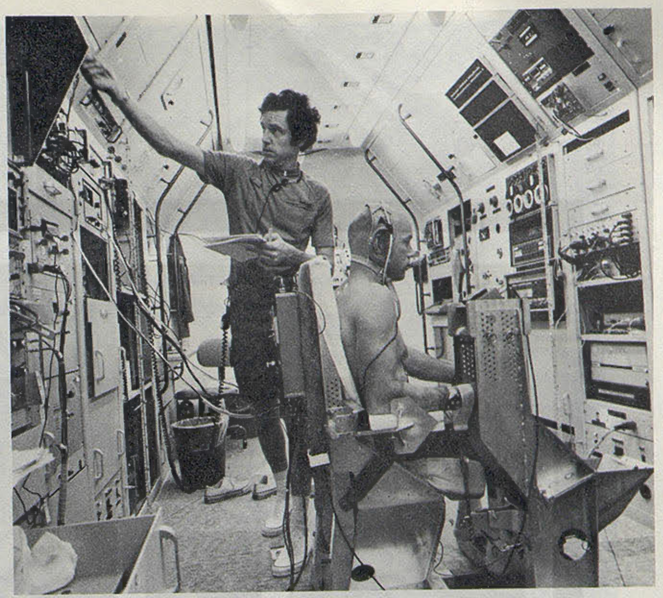
One important function of the National Aeronautics and Space Administration is management. By the time NASA began the second 10 years of its existence, it had conducted manned and unmanned space programs involving some 20,000 contractors from American industry, and – at the peak period of the mid-1960's – 420,000 employees, 35,700 of them working for NASA, and federal funds of about $40 billion.

The scene in Mission Control is a familiar one to TV audiences around the world. What is not shown is the preparation for a space flight – the months of planning and analysis, programming, and practice by Flight Operations Directorate personnel and the thousands of other NASA, Department of Defense, and contractor personnel who support each flight. When Neil Armstrong reported his "giant leap for mankind" to Mission Control, his words went around the world through facilities set up by 2,000 newsmen gathered at the Center to follow the Apollo astronauts' historic flight. The technology which let Mission Control see Armstrong's image and hear his words, check his heartbeat and respiration rate, keep tabs on fellow Moon explorer Edwin Aldrin, and monitor the status of the lunar module "Eagle" as well, is proving beneficial on Earth. Right now, the capability to monitor remote functions and events is helping many hospitals run more efficiently. Tomorrow's applications may not yet have been thought of.

Hundreds of contractor companies helped build the space program. These companies are located throughout the United States and range in size from small several-man shops to corporations employing tens of thousands of people. The task of managing these efforts – bringing everything together in the proper place at the right time with confidence it will work as planned – is monumental.

JSC's largest contribution to program management is in the design and construction of manned spacecraft. Space Shuttle is an example of the job's scope: the Shuttle orbiter, which will carry astronauts, scientists and engineers in Earth orbit and return them to an aircraft-type landing, is manufactured in California; the wings and vertical tail are built in New York; the solid rocket booster motors are made in Utah and the Orbiter's main fuel tank is fabricated in Colorado. Several hundred subcontractors, additional subcontractors, and suppliers scattered throughout dozens of states from coast to coast, provide important support to the program.

JSC overcomes the distance problem by assigning resident managers to the spacecraft contractors' plants where they work closely with the development, manufacturing, and testing activities. Regular reviews and progress reports go into status charts which show whether all phases of the program are moving smoothly ahead. Program management



NASA scientists and astronauts spend many hundreds of hours studying and training at JSC for space flights. As shown above, NASA astronaut Dr. Story Musgrave is performing one of the many medical experiments planned for Space Shuttle as Dr. Charles Sawin, a cardiophysiologist monitors. Simulators and mockups, similar to this Spacelab mockup located at JSC, will be used by engineers and scientists in preparing for the Space Shuttle which is scheduled to fly in early 1979.

JSC's Flight Operations Directorate includes some of the best known people in the world, but the astronauts' jobs are not necessarily filled with glamour and adventure. Like the personnel who work with them, the astronauts put in a full 5-day workweek – and then some – to make manned space flight efficient, safe, and productive. A flight crew spends a year or more in preparation for a mission. Training devices such as the mission simulator are so realistic that many astronauts say the weightlessness of space is the only difference between the practice flights and the actual one. U.S. astronauts spent many and long hours training for the July 1975 U.S./U.S.S.R. Apollo Soyuz mission which culminated when American astronauts Thomas P. Stafford and Donald K. Slayton joined Cosmonaut Aleksey A. Leonov in the Soviet orbital module.

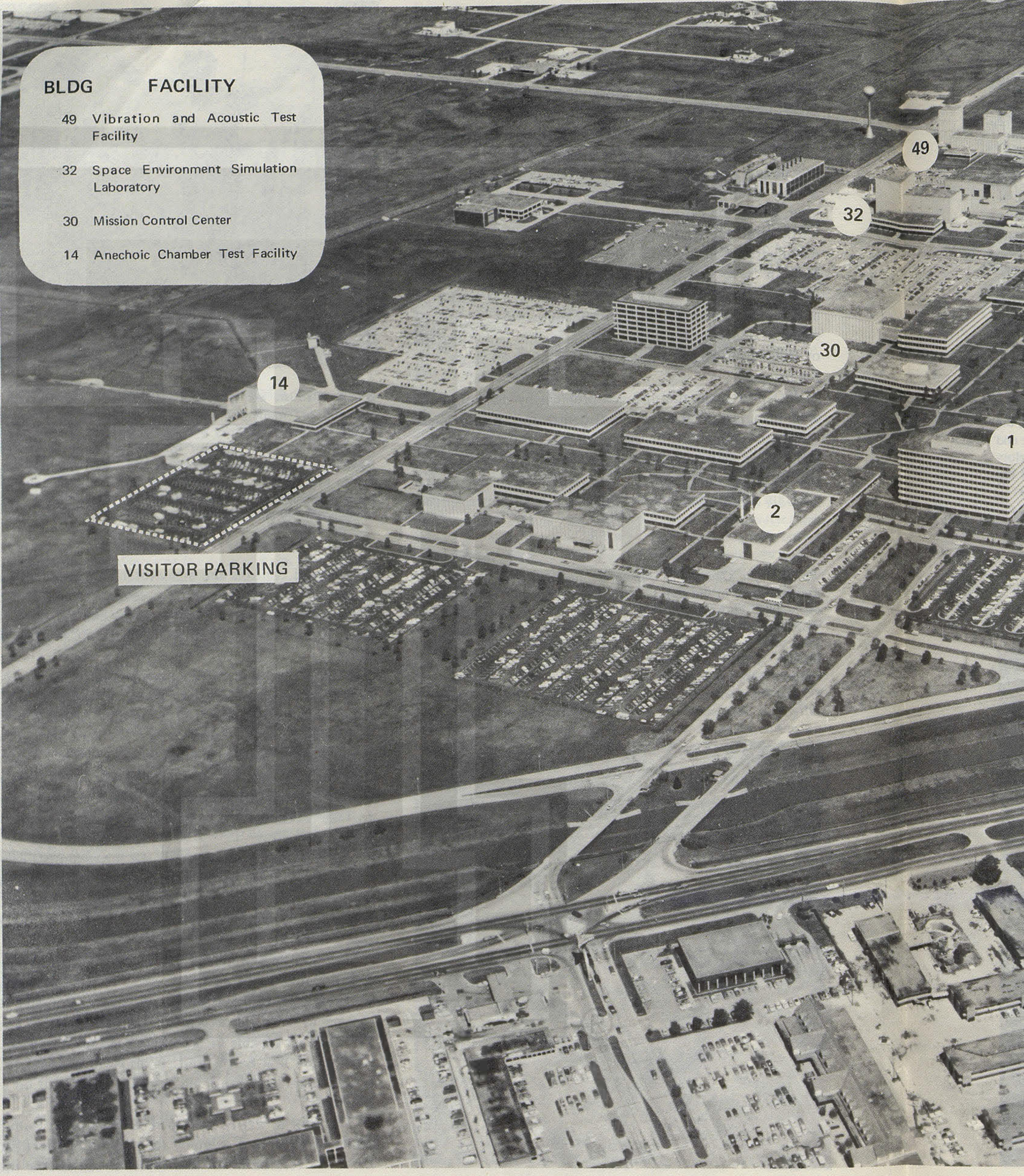
defines and controls the many interfaces between systems to assure compatibility of crew, spacecraft, and launch vehicle; and it establishes quality control and reliability standards, along with the appropriate checkout and test procedures.

Similar management functions are performed by NASA centers responsible for other aspects of the program – the launch vehicle at Marshall in Huntsville, Alabama; tracking and communication systems at Goddard in Greenbelt, Maryland; and launch facilities at Kennedy in Florida. The total effort is coordinated by NASA Headquarters to a precise schedule and rigid standards. Yet, it is flexible enough to take advantage of new technology or to bounce back from failures.

JSC's prime responsibility is the Space Shuttle Program, which is scheduled to fly in early 1979. The Space Shuttle will be a reusable space vehicle operated as a transportation system for a wide variety of space mission in low Earth orbit.

The Shuttle will deploy and recover scientific and applications satellites of all types. Since it can carry payloads weighing up to 29,500 kilograms (65,000 pounds), it will replace most of the expendable launch vehicles currently used, and be capable of launching deep space missions into their initial low Earth orbit. It also will provide the first system capable of returning payloads from orbit on a routine basis.

The Shuttle will be able to retrieve satellites from Earth orbit; to repair and redeploy them; or bring them back to Earth for refurbishment and reuse. It can also be used to



BLDG FACILITY
49 Vibration and Acoustic Test Facility
32 Space Environment Simulation Laboratory
30 Mission Control Center
14 Anechoic Chamber Test Facility
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32
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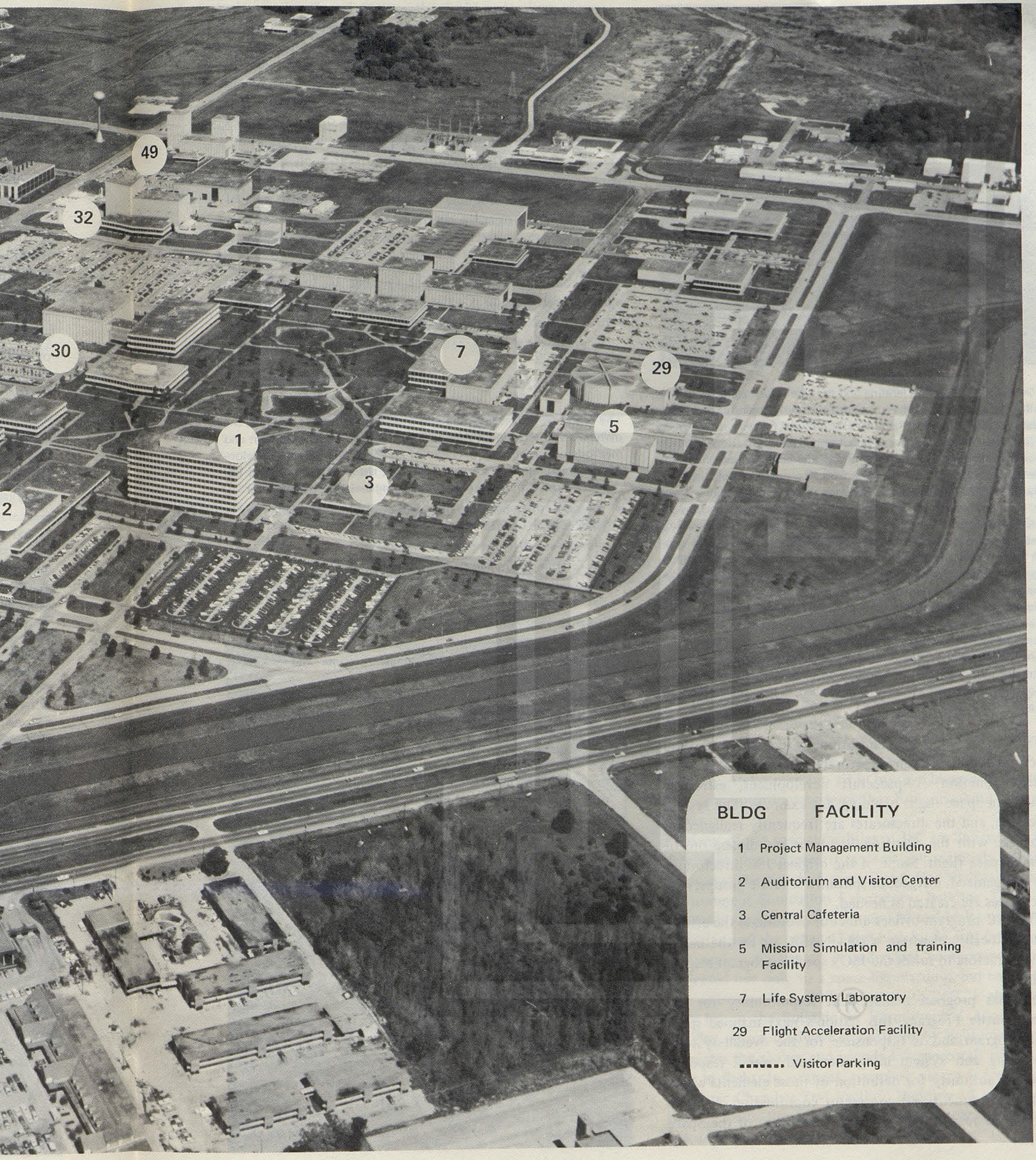
VISITOR PARKING


49
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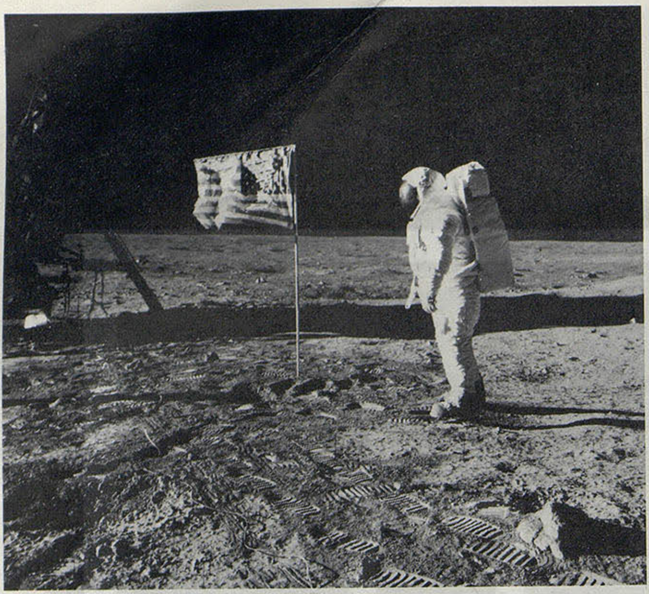
BLDG FACILITY
1 Project Management Building
2 Auditorium and Visitor Center
3 Central Cafeteria
5 Mission Simulation and training Facility
7 Life Systems Laboratory
29 Flight Acceleration Facility
Visitor Parking



The July 20, 1969, Moon landing and the safe return to Earth of the Apollo 11 crew signified the successful accomplishment of a goal set 8 years earlier. But the initial lunar landing, and those that followed, are just the obvious fruits of a nationwide mobilization without precedent. Historically, the most rapid technological advances are forced by war; peacetime benefits from the new technologies generally develop more slowly and, at times, unpredictably. When President Kennedy called for a national effort to land an American on the Moon before the end of the '60s, he mobilized the country's talent and purpose as they never had been, short of war. The program cost Americans less than $20 billion up to that first landing; they spent more than four times as much on liquor, better than twice as much on cigarettes, more on parimutual betting, and more on foreign travel during the same period. Tangible "spinoff" benefits already form a long list. The intangible interest from Apollo dollars is America's self-esteem, its prestige in the eyes of the world, and new path to improved international relations. But probably the greatest of all benefits is the stimulation of basic research and technological development already being applied to help solve problems on Earth.

JSC's mission. JSC was organizationally divided into several directorates, where each directorate was responsible for a specific function — spacecraft development, astronaut training, or space flight planning, for example. The system is flexible, and the directorates are frequently realigned to keep pace with the changing directions and dimensions of manned space flight. Some of the original JSC directorates have reorganized, merged, or split into separate groups; new directorates are created as needed.

The JSC program offices direct or coordinate the efforts required locally, elswhere within NASA, or by the industrial contractors to fulfill the JSC's specific program responsibilities.

JSC has program management responsibility for the Space Shuttle Program, this nation's next manned space flight program and is responsible for the overall systems engineering and system integration and overall responsibility and authority for definition of those elements which require government and contractor coordination. In addition, JSC is responsible for the orbiter stage of the Space Shuttle.

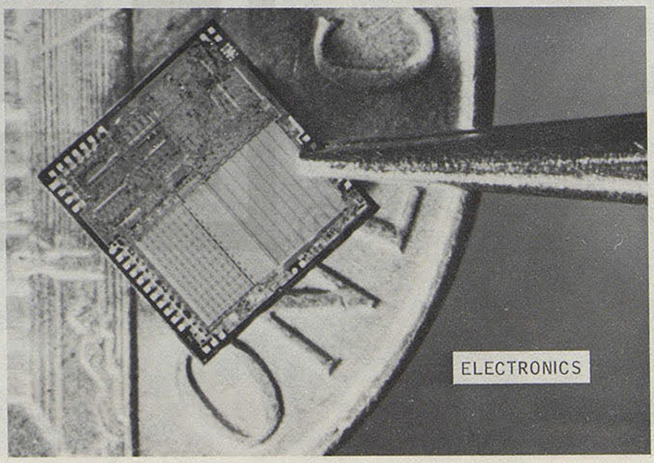
Directorates and program offices are responsible to the Center Director who, in turn, is responsible to the Office of Space Flight at NASA Headquarters in Washington, D.C.

The Center is situated near Clear Lake on a 1620-acre site, much of it donated to NASA by Rice University. It is made up of about 100 different buildings of sizes and uses that range from the nine story Project Management Building to the tiny traffic-control booths at each entrance. While many of the Center's structures are devoted to office space, others are uniquely designed to accomplish special tasks. Some are open to the public for self-guided walking tours, and others can be seen on specially arranged guided tours.

The building probably most familiar to the public is Building 30 Mission Control. TV networks around the world show the activity in Mission Control several times

The broad field of developing and analyzing spacecraft systems, the materials and techniques that go into them, and the equipment and methods of testing them — tasks of the Engineering and Development Directorate at JSC — accounts for many of the new and improved products that make everyday living easier, better, or safer:

- cookware that goes from freezer to oven without cracking and which can be cleaned easily;
- pressure-sensitive fasteners and closures;
- fire-retarding paint and flameproof materials;
- electronics for radio and television sets that are smaller, work better and last longer;
- tungsten fiber-reinforced nickel superalloy four times as strong as previous nickel-base alloys;
- more reliable batteries with longer lifetime and greater rechargeability;
- new thermosetting polyurethane plastics that are stronger than ever, and better molding processes that strengthen conventional plastics; and
- a shock absorber capable of softening of a 60 mph shock to the equivalent of 5 miles an hour, and better methods of sealing, packaging, inspecting, testing, designing, measuring, and manufacturing items equal at home in space or on Earth.

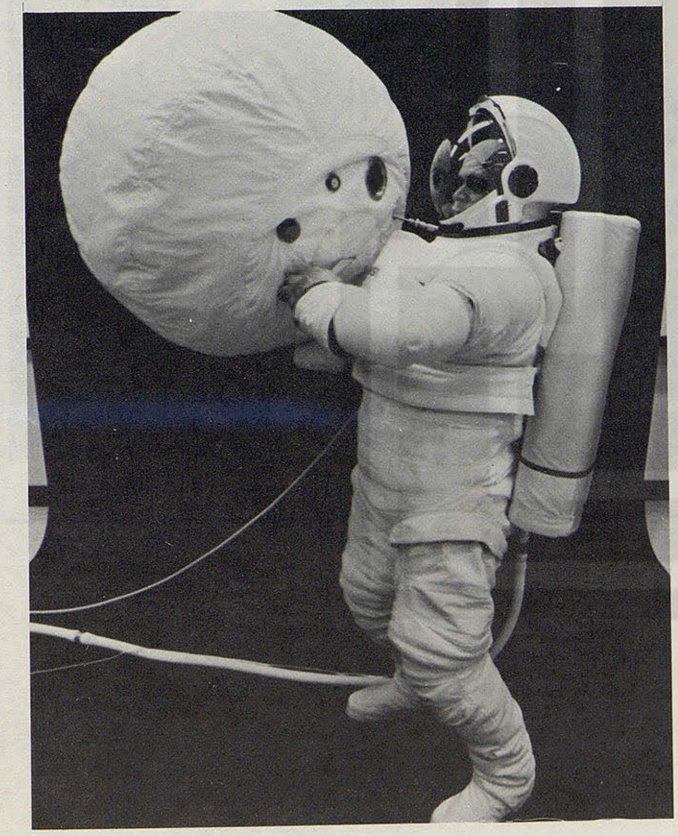

ELECTRONICS

during each manned flight – the flight controllers at rows of consoles, studying the data that helps them make mission decisions.

On the first floor of the windowless Mission Operations half of the building house the computers, processors, control panels, tape recorders, test boards, wiring, displays, controls, and distribution equipment needed to support the activity on the second and third floors. The second half of the first floor, the more conventional-looking Operations Support wing, contains mostly office space.

The Life Sciences Directorate at the Johnson Space Center is responsible not only for helping man to stay alive, healthy and active in space, but also to help find how the knowledge from space flight can help man on Earth. Many hospitals and specialized medical facilities already use space-age products:

- blood pressure or heart monitoring sensors so small they can be inserted by a hypodermic needle rather than surgery;
- contamination control procedures to keep operating and recovery rooms infection-free;
- remote monitoring equipment that lets one nurse keep a continual check on 64 patients at once;
- a health care system for the 4400-square mile Papago Indian reservation in Arizona using telemetry and other space electronics techniques;
- a suitcase-sized emergency treatment kit called Telecare for trained ambulance attendants;
- an adaptation of space food as a means of assuring that some of the nation's senior citizens have easy-to-prepare nutritious meals;
- transducers used to measure spacecraft splashdown impact incorporated into a device for precision fitting of artificial limbs; and
- many more products are still being developed.



The view of Earth from space is not only spectacular, but informative. Photographs such as this one from Apollo 9 can help survey the natural resources of the world. Work being done by JSC and other NASA centers may help establish more efficient management and use of Earth's commodities. Projects involving unmanned and manned spacecraft, as well as specially equipped airplanes, have already shown the value of remote sensing – observation and measurement from a distance. Coupled with ground data, remote sensing will help maintain an up-to-the-minute picture of the World's farmlands and forests; identify areas of availability, pollution, or waste of Earth's dwindling fresh water supply; globally prospect for new deposits of minerals and petroleum, resources which are now threatened with depletion; and survey the oceans that cover 70 percent of the globe to determine how best to benefit from this source of untapped wealth. Observation from space, being perfected and extended in NASA's Earth Resources Survey Program, has proven most beneficial so far in the science of weather forecasting.

Through space-age electronics, a doctor in Houston can monitor a heartbeat a quarter-million miles away. A systems engineer can tell whether life-sustaining oxygen is flowing at the right rate, or if a switch is in the proper position. And a man can sit in his own home and marvel at the communications systems that bring mankind closer together.

Many of the special facilities of JSC are designed to help determine that spacecraft systems and materials can stand up against the rigors of space flight. One such is the Space Environment Simulation Laboratory, Building 32. It contains two vacuum chambers, one 120 feet high by 65 feet in diameter and the other 43 feet high by 35 feet in diameter. A complete spacecraft or individual components can be subjected not only to a space-like vacuum, but to temperature extremes from 280° F below to 260° F above zero. Near by, in the Building 49 Vibration and Acoustic Test Facility, space hardware is buffeted by equipment which simulates the shakes and sounds the spacecraft will experience in flight. In contrast, complete silence is found in the Anechoic Chamber Test Facility, Building 14, where foam-covered walls, floor, and ceiling soak up stray signals during spacecraft communication system tests.

carry out missions in which scientists and technicians conduct experiments in Earth orbit or service automated satellites already orbiting.

The National Aeronautics and Space Administration plans to develop the Shuttle over the next six years. Horizontal test flights are to begin in 1977, orbital test flights in 1979, and the complete vehicle is to be operational in 1980.

The Shuttle will provide an effective and economical means for the United States to utilize and advance its capabilities in space. It will reduce substantially the cost of space operations for civilian and defense needs in the decade of the 1980's and beyond.

The Shuttle will consist of a reusable orbiter, a large expendable liquid propellant tank and two recoverable and reusable solid propellant rocket boosters. The orbiter will look like a delta-winged airplane, about the size of a DC-9 jet air liner. It will have three liquid fueled rocket engines, a cargo bay 18 meters (60 feet) long and 4.5 meters (15 feet) in diameter, and will be operated by a crew of three. Wingspan will be about 24 meters (78 feet) and it will be about 37 meters (122 feet) long.

With the external tank and solid rocket boosters attached, the total Shuttle will stand about 57 meters (184 feet) tall on the launch pad.

At launch, the two solid rockets and the orbiter's three liquid rocket engines will ignite and burn simultaneously. At an altitude of about 40 kilometers (approximately 25 statute miles) the spent solid rockets will be detached and parachuted into the ocean for recovery and reuse. Following solid rocket staging, the orbiter and its propellant tank will continue ascent. At main engine cutoff, the expendable propellant tank will be jettisoned into a remote ocean area. The orbiter then fires its orbital maneuvering system (OMS) for a short period to achieve orbital insertion. The orbiter with its crew and payload will remain in orbit to carry out its mission, normally for about seven days or less, but when required for as long as 30 days. When the mission is completed the orbiter will return to Earth and land like an airplane.

In addition to the Space Shuttle, scientists and engineers at JSC are studying the feasibility of utilizing space technology for the construction of manned orbiting space stations, in addition to studying the feasibility of placing a satellite in space which could relay energy from the Sun directly to Earth and aid in this Nation's pressing energy crisis.

Nuclear Physcist Dr. Edward Teller once remarked "When Columbus once took off, the purpose was to improve trade relations with China. That problem has not been solved to this very day, but just look at the byproducts."

The byproducts of space flight are just beginning to emerge.