SPACE SHUTTLE
ORBITER
101
ROLLOUT
76

SPACE SHUTTLE TRANSPORTATION SYSTEM

A Promising New Era For Earth

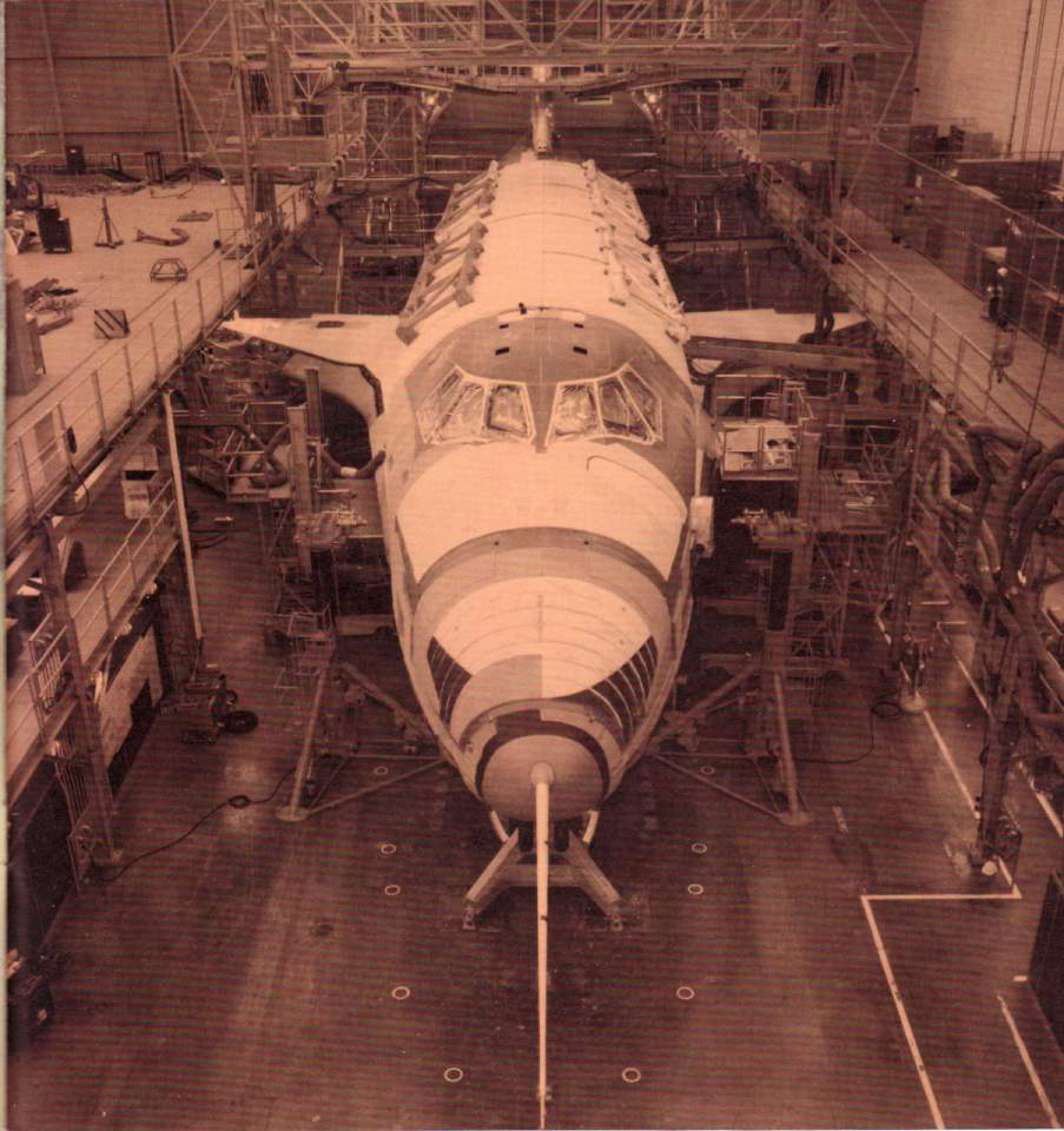
THE ONLY PLANET WE HAVE

One advantage of space is that it lets us see ourselves living together on the only planet we have. While difficult to discern from its surface, earth is essentially one enormous ecological system, exceedingly complex, with infinite numbers and varieties of interrelated and interdependent parts. The quality of life here—indeed, our very survival—depends on the preservation of that system. And to preserve it, we must find ways to use it more wisely.

In this context, Space Shuttle may be the most important spacecraft ever developed. There is no question that it's the most versatile. Reusable, capable of carrying single, multiple, or mixed payloads to and from space at lower costs, it will benefit America and mankind in many ways. Not once or twice but routinely, to the end of this century and beyond.

These missions will begin in 1980, when the Shuttle transportation system becomes operational. Meanwhile, what is being done to meet that date is itself an interesting part of Shuttle history. Here is that story.

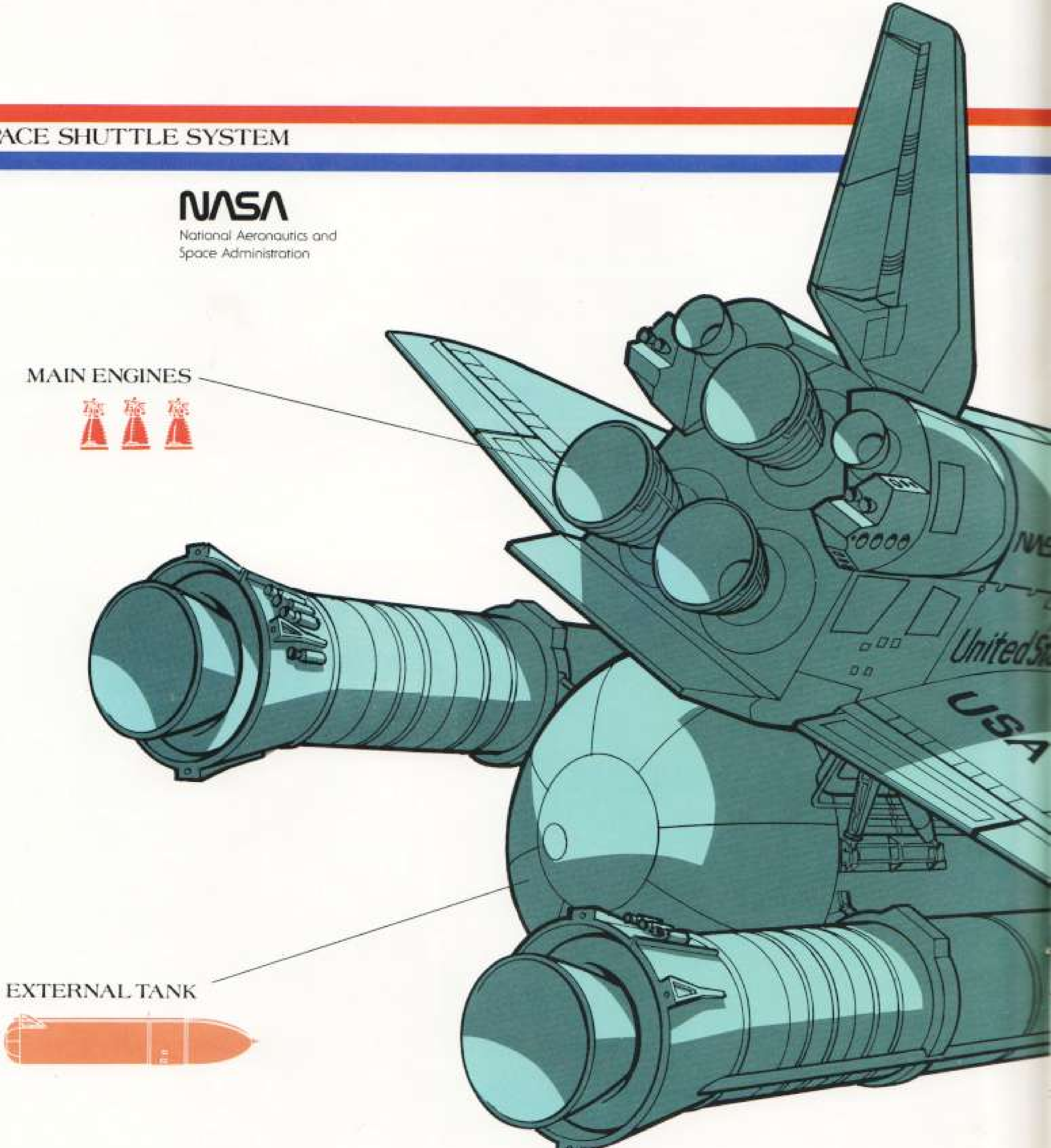

Rockwell International
Space Division



SPACE SHUTTLE SYSTEM

NASA

National Aeronautics and
Space Administration



SHUTTLE CHARACTERISTICS
(values are approximate)

LENGTH
SYSTEM: 56.1 meters (184 feet)
ORBITER: 37.1 meters (122 feet)

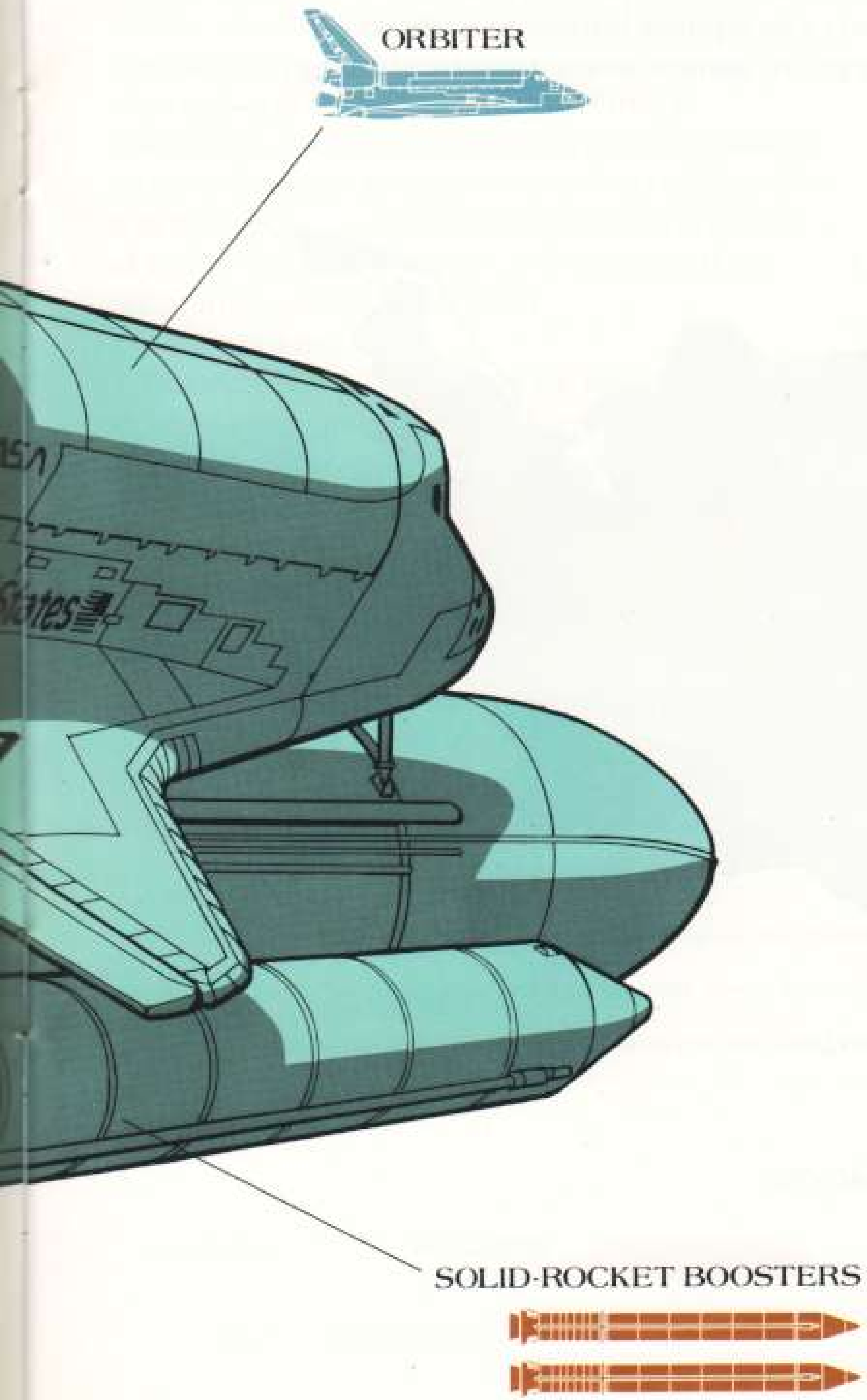
HEIGHT
SYSTEM: 23.1 meters (76 feet)
ORBITER: 17.4 meters (57 feet)

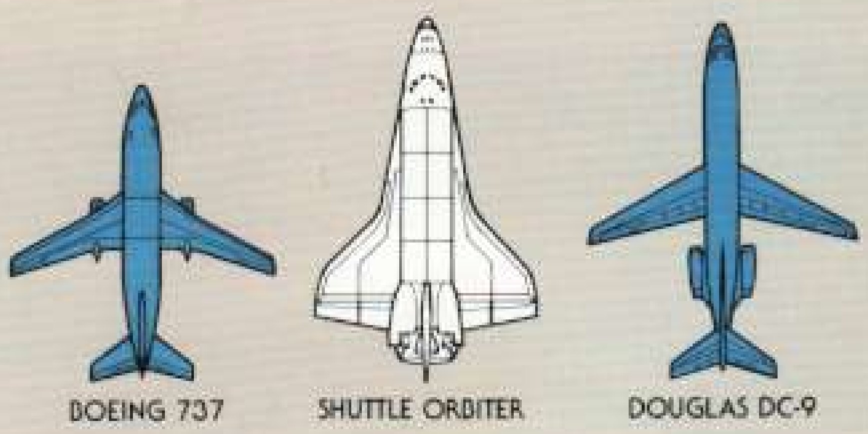
WINGSPAN
ORBITER: 23.8 meters (78 feet)

WEIGHT
GROSS LIFT-OFF:
1.99 million kilograms (4.4 million pounds)
ORBITER LANDING:
84.8 thousand kilograms (187 thousand pounds)

THRUST
SOLID-ROCKET BOOSTERS (2):
11.6 million newtons (2.6 million pounds) of thrust each
ORBITER MAIN ENGINES (3):
2.1 million newtons (470 thousand pounds) of thrust each

CARGO BAY
DIMENSIONS:
18.3 meters (60 feet) long, 4.6 meters (15 feet) in diameter
ACCOMMODATIONS:
Unmanned spacecraft to fully equipped scientific laboratories





A NATIONWIDE ENTERPRISE

Space Shuttle is being developed and built for NASA by America. The NASA industry team is composed of four prime contractors and thousands of subcontractors and suppliers. Almost every state in the nation is involved.

ELEMENT CONTRACTORS

ORBITER: Shuttle system integration	Rockwell International Space Division
MAIN ENGINES	Rockwell International Rocketdyne Division
EXTERNAL TANK	Martin Marietta
SOLID-ROCKET MOTORS	Thiokol

THE SPACECRAFT THAT'S AN AIRCRAFT

Space Shuttle is a unique vehicle. Here's why: The orbiter—protected against the high temperatures encountered during atmospheric entry by reusable surface insulation—is designed to fly numerous missions. It has a cavernous cargo bay, which will enable it to transport to and from earth orbit payloads of many shapes, weights, and sizes. And on returning to earth, it will land like an airplane.

Besides being the contractor for Shuttle system integration, Rockwell International's Space Division is designing, developing, and building the orbiter. Much of this work is done at the Division's space complex in Downey, California, but many orbiter subsystems and components are produced by subcontractors throughout the United States. These elements are brought together for final assembly and checkout at the Division's facility in Palmdale, California.

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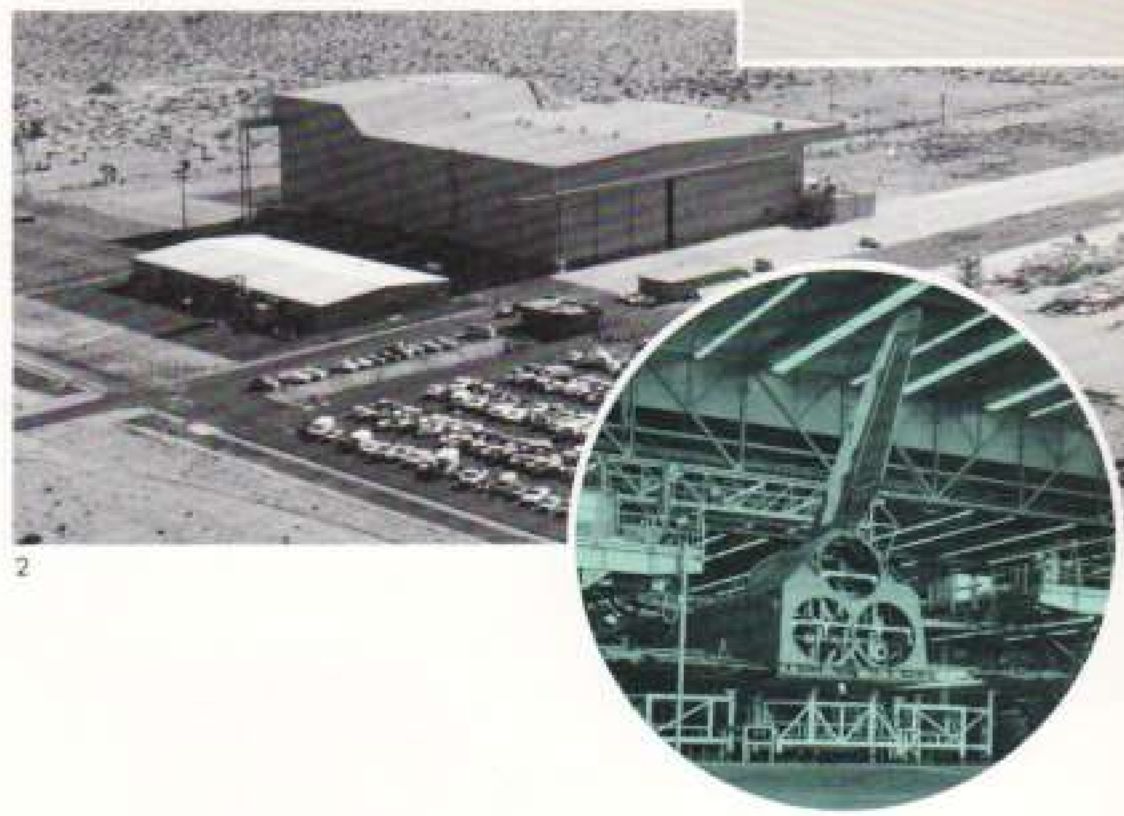


2

3

1 Rockwell's Space Division — home of Apollo — is now home of the Shuttle orbiter.

2 The orbiter is assembled at the Space Division facility in Palmdale, Calif.

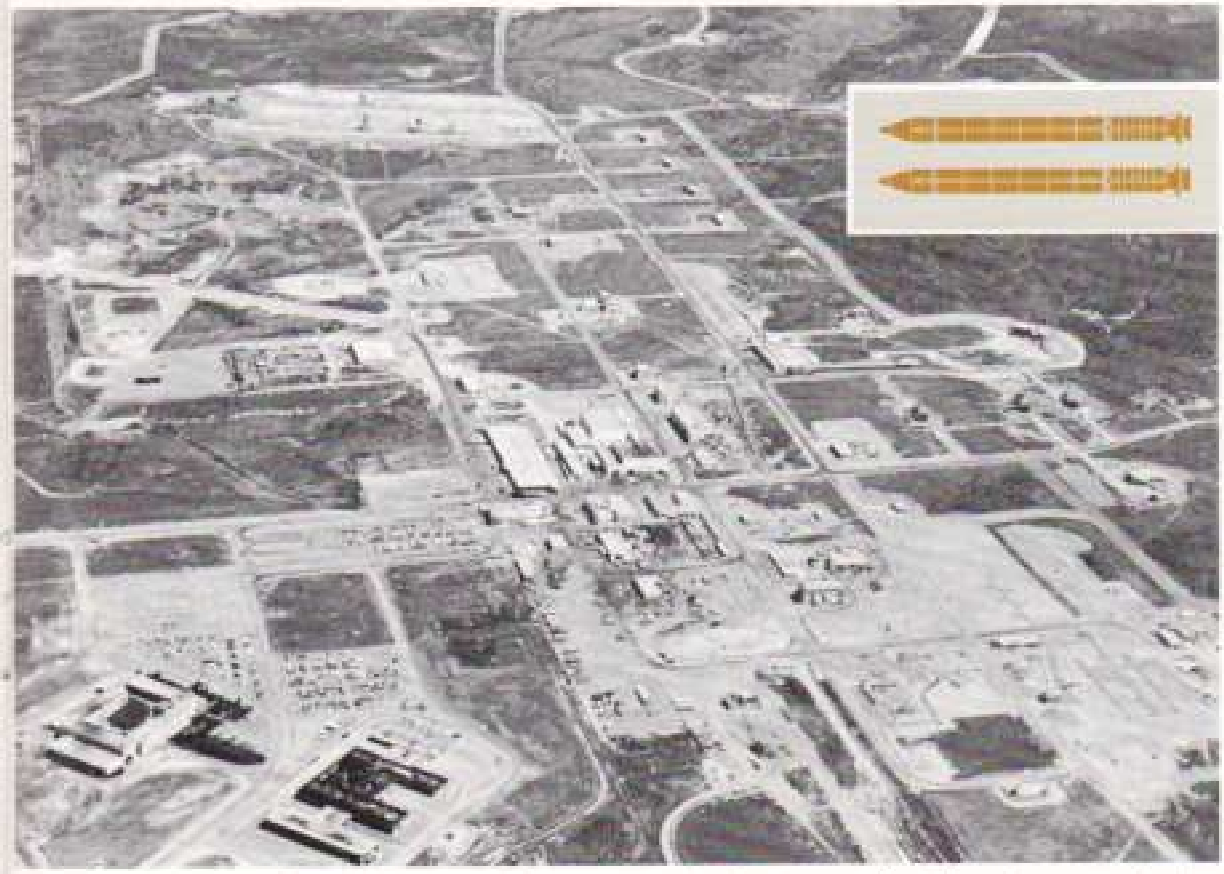
3 Rockwell's Rockerdyne Division is developing and building the Shuttle main engines.

NASA's Johnson Space Center is the lead center for overall Shuttle program development.

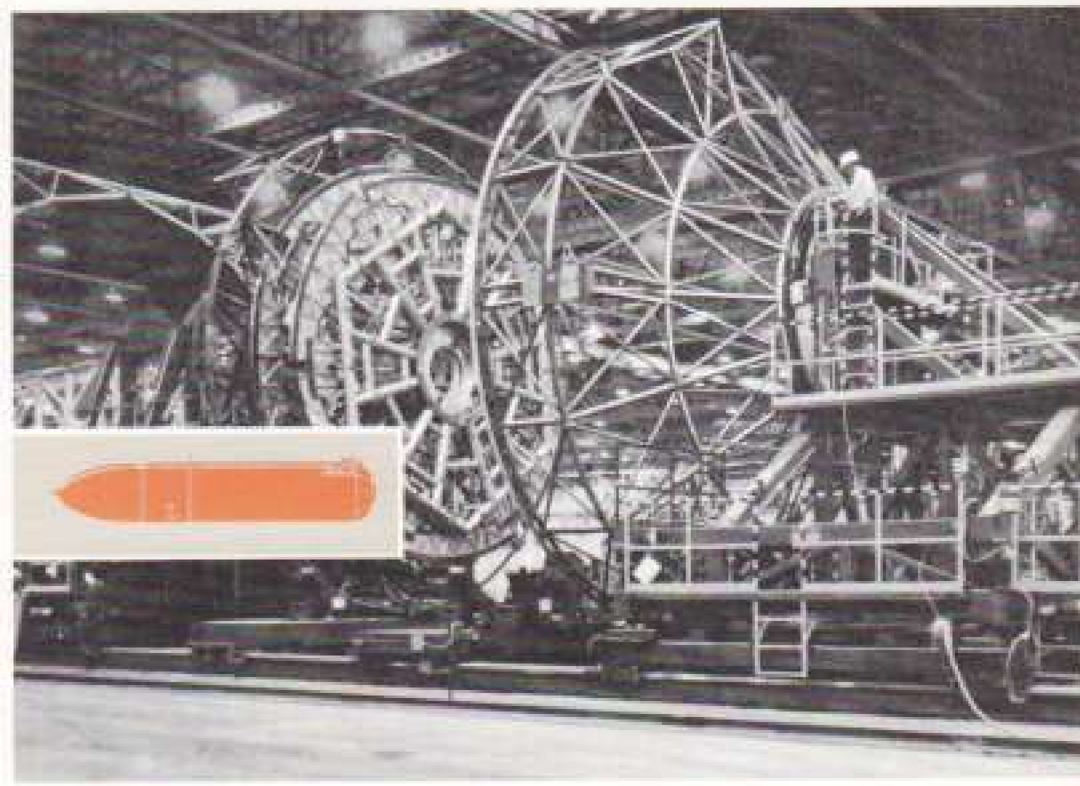
Dryden Flight Research Center at Edwards Air Force Base, Calif., being prepared for approach-and-landing test of first orbiter.

NASA's Marshall Space Flight Center, Huntsville, Ala., is managing the development of the main engine, solid-rocket booster, external tank, and Spacelab. It is also responsible for the mated vertical ground vibration test.

Shuttle main engines are test-fired at the National Space Technology Laboratories in Mississippi.



Thiokol Chemical Corporation is developing and building the motors for the solid-rocket boosters. Boosters, which are separated after launch, will be recovered from the ocean and refurbished for reuse.



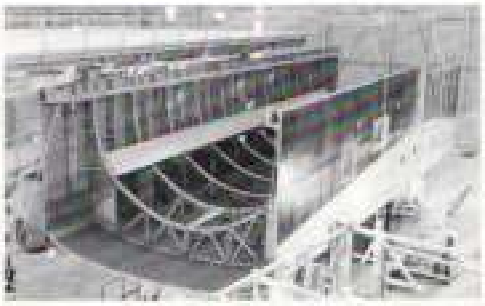
Huge fixture at Michoud, La., facility is used in the assembly of external tank. Tank is built by Martin Marietta.

Vehicle Assembly Building dwarfs other structures at Kennedy Space Center, Fla. Launch Complex 39A (not shown), which was used for the Apollo moon shots, is being modified for Shuttle launches. Shuttle runway is at upper left.

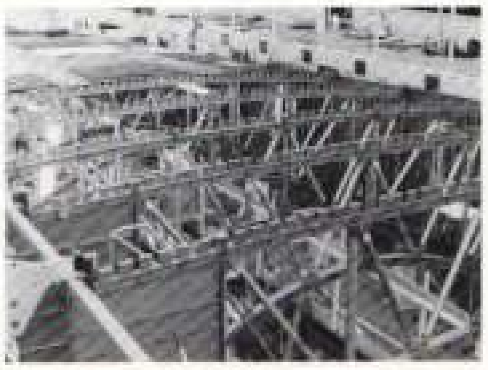
Vandenberg Air Force Base, Calif., also will be a Shuttle launch site.

Lights paint colorful outline of Shuttle runway at Kennedy Space Center.


NASA
United States
USA



Mid fuselage



Frame and bottom skins in primary fixture

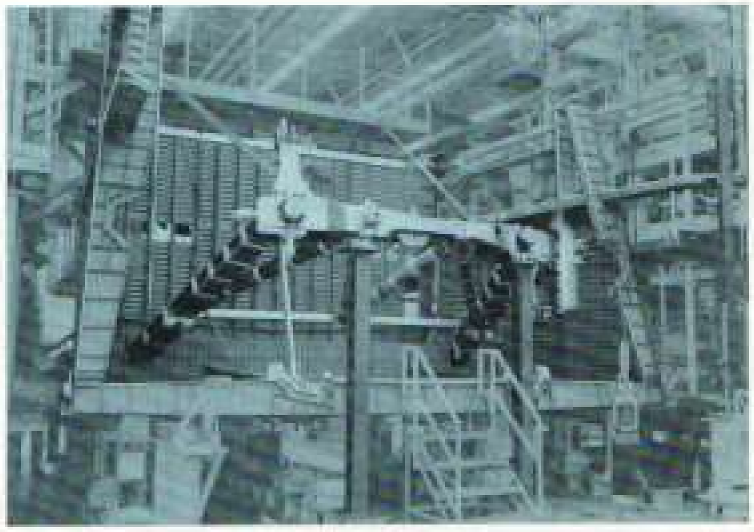
Mid fuselage bulkhead

THE PRODUCTION OF AN ORBITER

Shuttle orbiters are manned spacecraft that will fly many missions over many years; the care that goes into their development is uncompromising. High-quality workmanship marks each phase of orbiter production, and every orbiter must meet exacting assembly standards and demanding checkout requirements.

Here, in pictures, is a summary of the orbiter's assembly and checkout operations.

Installation of crew



Aft thrust structure

Aft fuselage

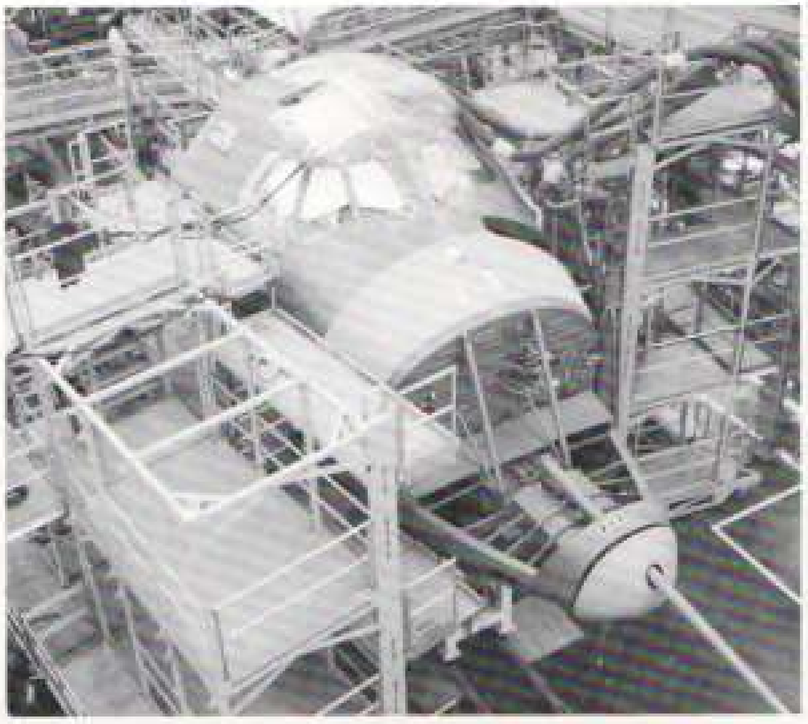
Aft and mid fusel

Major assembly jig for wing

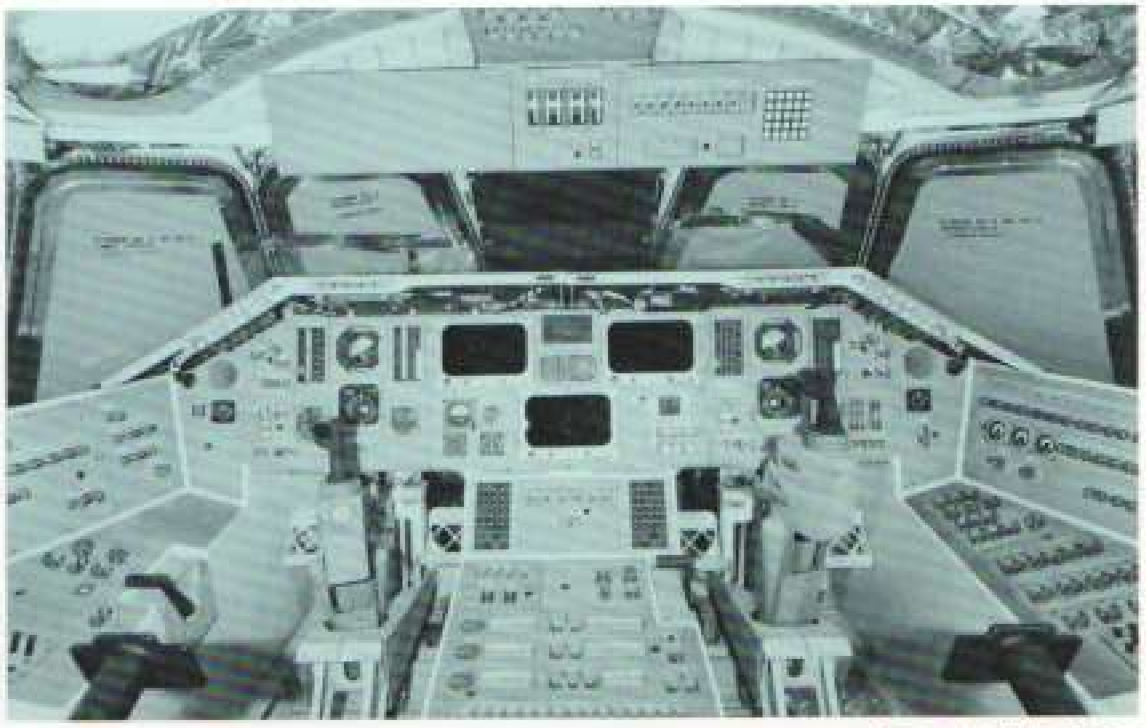
Wing assembly

Preparation of wing for mating

rew module



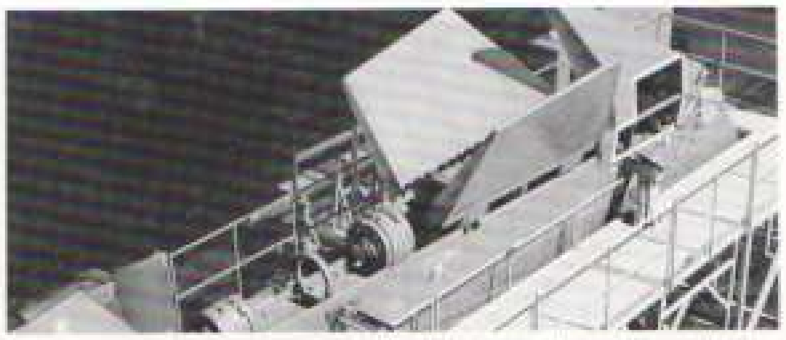
Nose cap and aerodynamic boom installed



Crew module interior

uselage mated

Vertical stabilizer

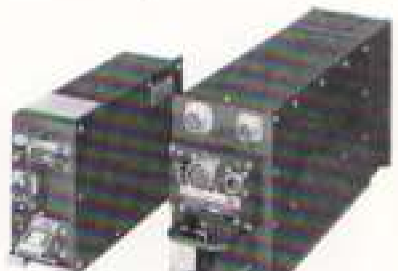


Rudder/speed brake installation

Rudder/speed brake actuator

Elevons

Main, nose landing gears and tires



Microwave scan-beam landing system

Fuel cell heat exchanger

Assembly of cargo bay doors

Section of cargo bay door

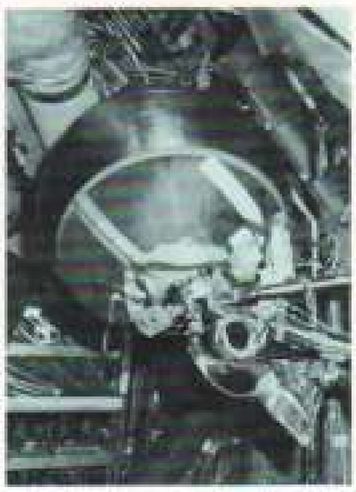
Right-hand cargo bay doors

Main landing gea

Installation of vertical stabilizer

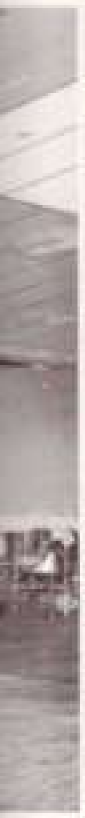
Radar altimeter

Hand controller



Auxiliary power unit tank

Speed brake thrust control



gear

Nose landing gear

Automatic-checkout control room

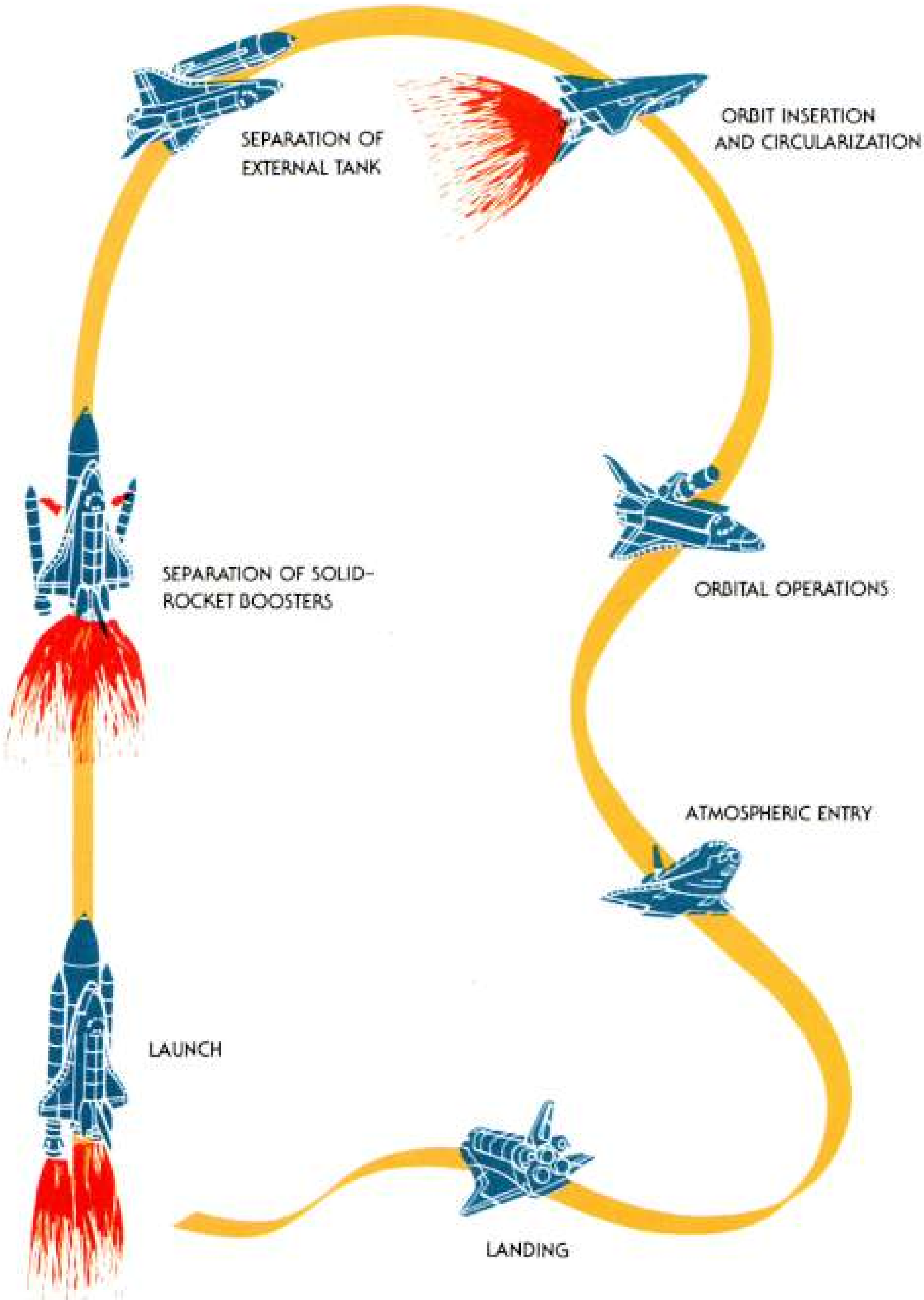
Horizontal vibration test

THE SHUTTLE MISSION

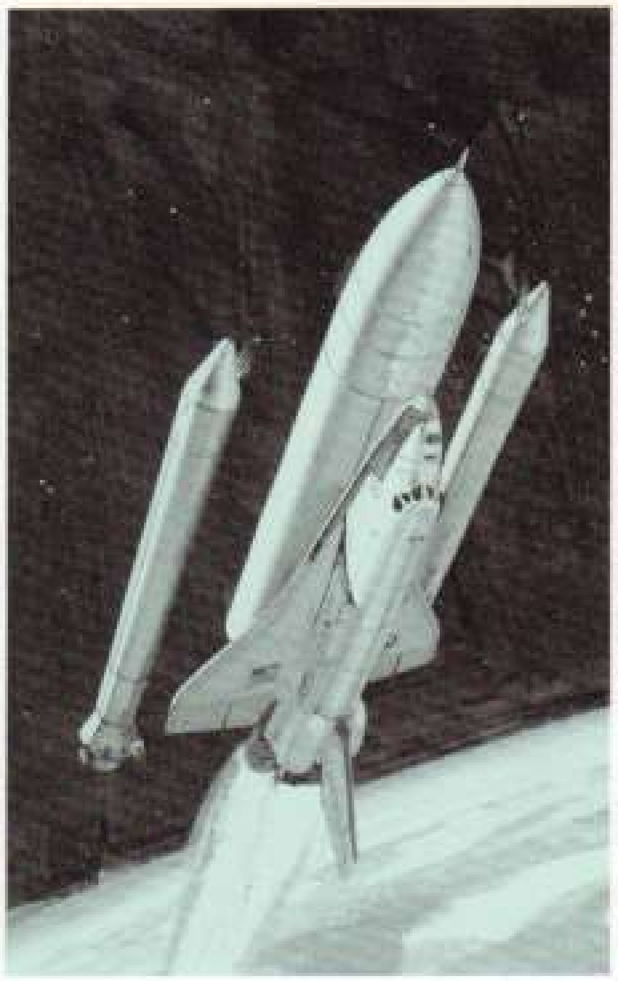
There has never been a space mission or a space vehicle capability even remotely like Shuttle's. Because of the spacecraft's shirt-sleeve atmosphere, qualified specialists and scientists can accompany their equipment and experiments into space.

The first Shuttle space flights will be launched from Kennedy Space Center, with launches from Vandenberg Air Force Base scheduled to begin in 1983. A typical mission will last seven days, but it can be extended up to a month. Within two weeks of landing, the orbiter can be serviced and readied for another flight.

The Shuttle mission model estimates as many as 60 missions per year will be flown during the operational phase of the Shuttle era.



LAUNCH

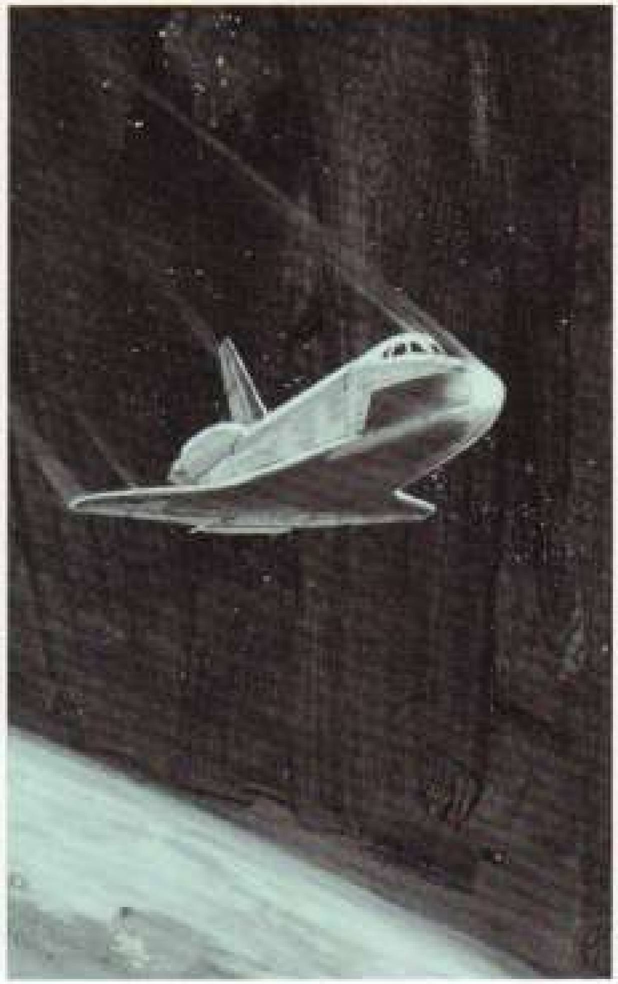


SEPARATION OF SOLID-ROCKET BOOSTERS
HEIGHT: 46 kilometers
(28 miles)
VELOCITY: 5008 km/hr
(3112 mph)

SEPARATION OF EXTERNAL TANK

ORBIT INSERTION AND CIRCULARIZATION
HEIGHT: 185 kilometers
(115 miles, typical)
VELOCITY: 28,300 km/hr
(17,600 mph)

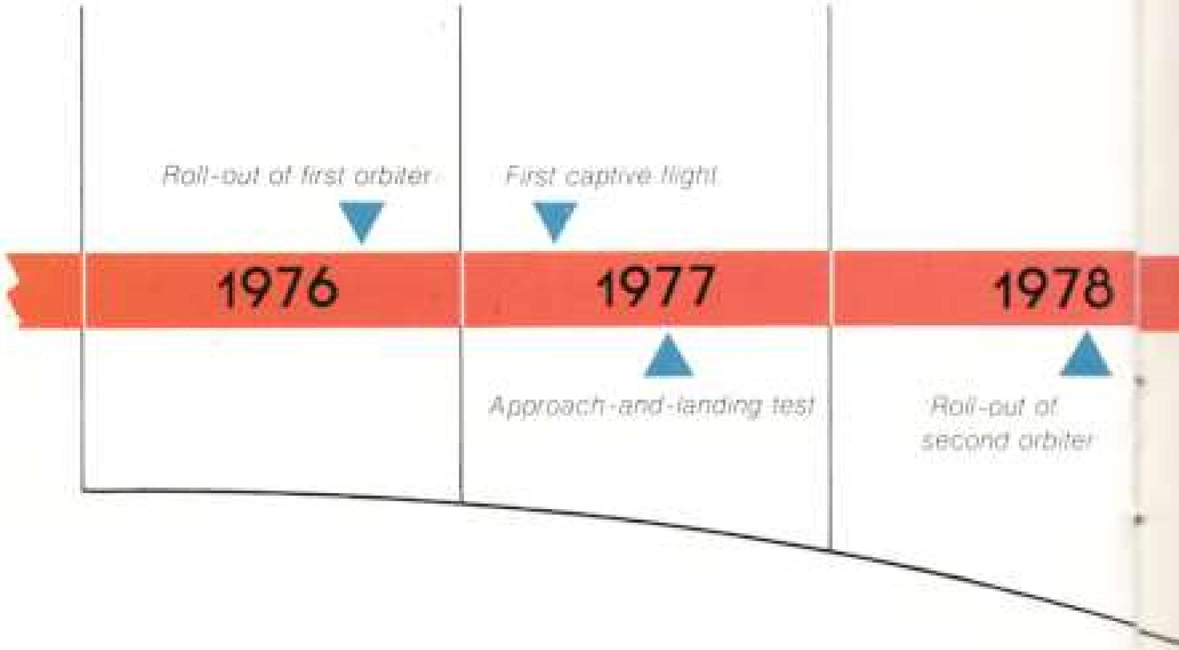
ORBITAL OPERATIONS
HEIGHT: 161-966 kilometers
(100-600 miles)
DURATION: 7-30 days



ATMOSPHERIC ENTRY
HEIGHT: 122 kilometers
(76 miles)
VELOCITY: 26,765 km/hr
(16,633 mph)

LANDING
CROSSRANGE: ±2011 kilometers
(±1250 miles)
(from entry path)
VELOCITY: 335 km/hr
(208 mph)

SERVICING FOR RELAUNCH



OPERATIONS IN SPACE...

Features that make Space Shuttle unique include its ability to economically transport space cargo to earth orbit, its longevity, and its versatility. No other spacecraft has flown more than once, but Shuttle will fly repeatedly — 100 missions by each orbiter. And it will accommodate a variety of payload configurations, all devoted to using space to benefit earth. Following is a sampling of what the Shuttle system can do:

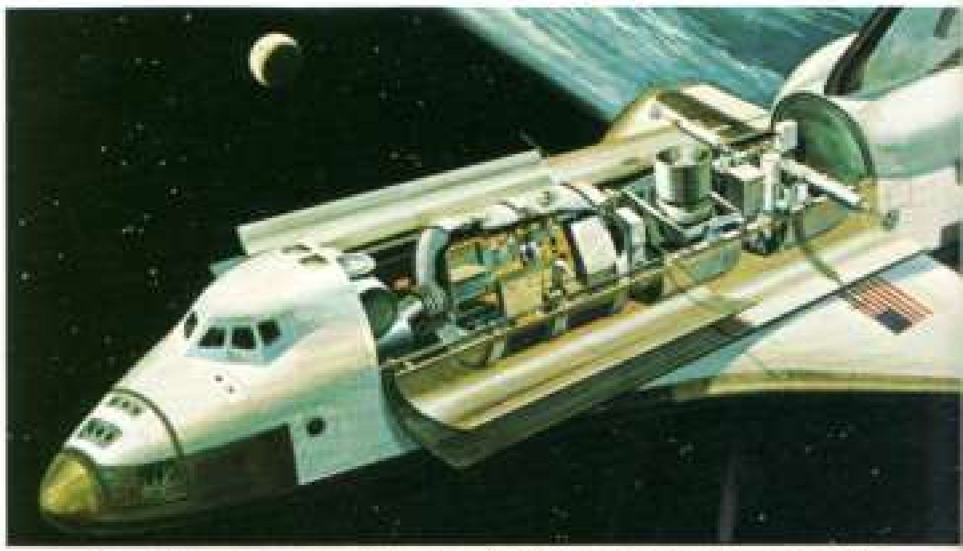
Transport larger and heavier payloads than can be launched by expendable boosters. *This not only will reduce the cost of putting payloads in space but will allow us more flexibility in what we can carry into space.*

Return payloads to earth. *This will permit us to use payloads over and over again and to recover and renovate satellites that would otherwise be abandoned.*

Deploy satellites in orbit, retrieve and refurbish satellites, replace satellite systems, repair satellites. *This will lower the cost and increase the orbital lives of these spacecraft.*

Check out and launch spacecraft on deep-space missions. *This will reduce the risk of losing spacecraft from malfunctions during orbital launch.*

Take scientific labs, scientists, and engineers into space. *This will permit research to be conducted, observations to be made, and manufacturing processes to be developed that cannot be accommodated in ground-based facilities.*



One of the most important Shuttle payloads is Spacelab, being produced in cooperation with NASA by the European Space Agency (ESA). Countries taking part are West Germany, Italy, France, Great Britain, Belgium, Spain, Netherlands, Denmark, Switzerland, and Austria.

...BENEFITS ON EARTH

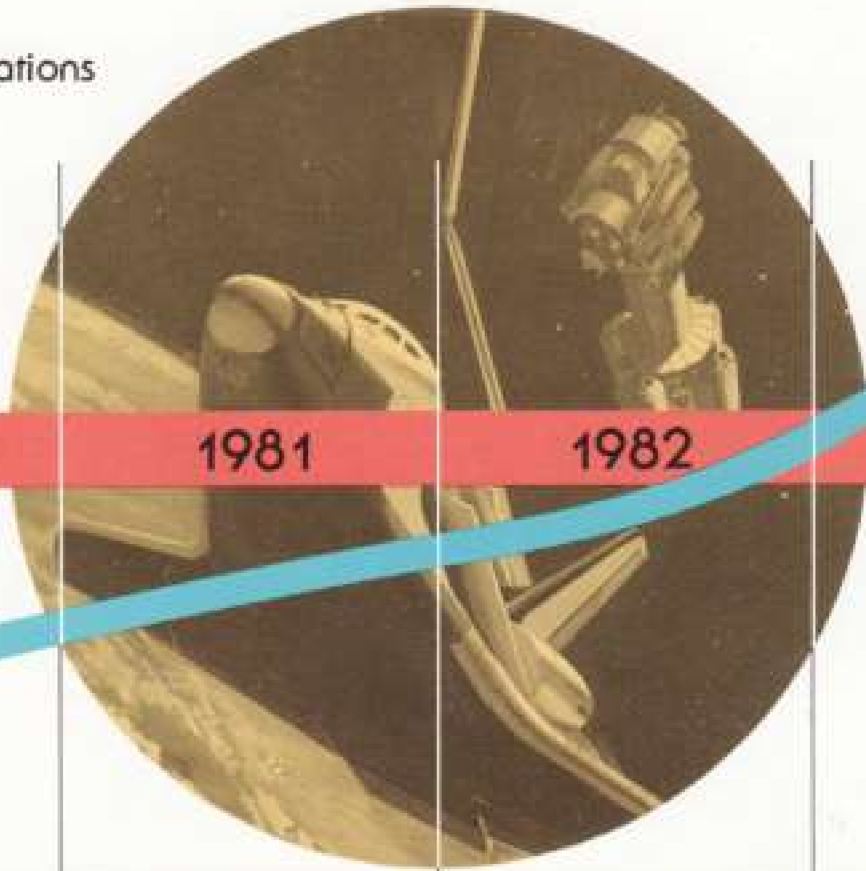
Petroleum Resources

Ag

National Spaceline Operations

First manned orbital flight

78 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984



Missions Per Year

Shuttle-deployed interplanetary spacecraft is attached to an Interim Upper Stage, which will propel it across space to Jupiter.

The space telescope will permit astronomers to study, without atmospheric interference, both the near and the far reaches of the universe. Shuttle operators will set it up in orbit, check it out, and service it.

Agriculture

Timber

Scientific Studies

Mineral Resources

Petroleum Resources

Photographs of the earth taken from space have been used in the exploration for oil and natural gas around the world. The improved satellites of the Shuttle era will be able to locate new sources of fossil fuels.

Agriculture

Sensor systems carried to space by Shuttle can help solve the world's food problems. The sensors can identify the crops in each field, tell the vigor and probable yield of those crops, and detect plant diseases and insect infestations.

The NAVSTAR global positioning system will enable properly equipped users anywhere on earth to determine their exact locations. In the 1980's, Shuttle will be used to launch the NAVSTAR satellites.

Timber

Shuttle-launched satellites can help conserve and protect our forest resources, especially in remote areas. Besides providing accurate inventories of timberlands, these spacecraft can detect forest fires, tree diseases, and pest infestations.

Scientific Studies

Shuttle is capable of carrying to orbit completely equipped scientific laboratories manned by scientists and technicians. In the weightless environment and vacuum of space, these researchers can perform many tasks and conduct many experiments that would not be possible on earth.

Mineral Resources

Potentially large mineral deposits have been identified in many parts of the world through the use of space photographs. The advanced satellites placed in orbit by Shuttle are expected to make many valuable mineral discoveries.

Communications

Communication satellites have made intercontinental television and radio possible and are reducing the cost of transoceanic telephone calls. These costs will be reduced further by the improved satellites taken to orbit by Shuttle.

Environment

Satellites placed in orbit by Shuttle can support environmental studies. These global monitors can send weather information to the ground, survey land-use patterns, check air quality, and track air and water pollution.

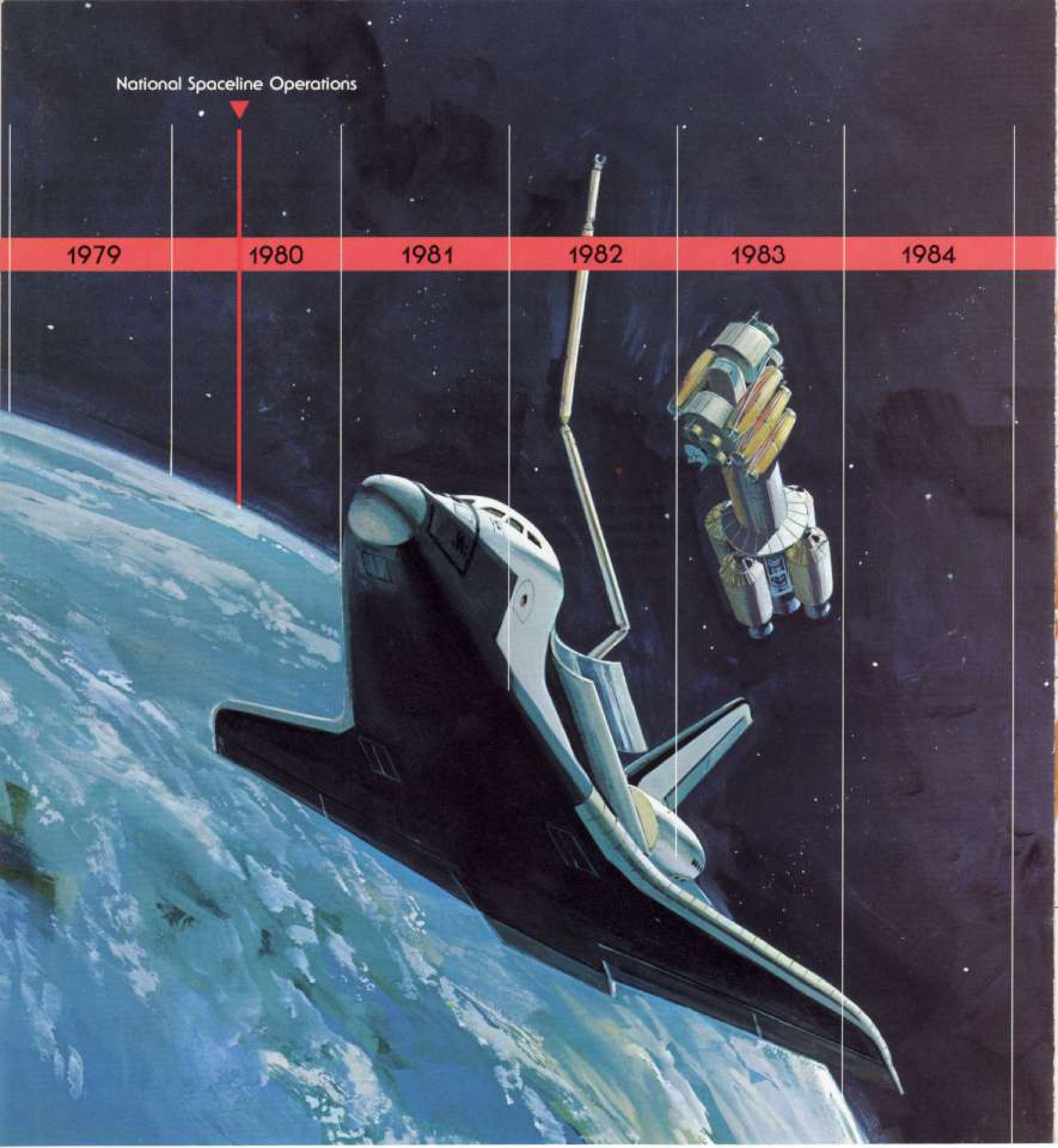
Oceanography

By mapping ocean-surface temperatures, Shuttle-delivered earth-resources satellites will help oceanographers understand current patterns, thus enabling fishing experts to predict the movements of schools of fish. The movement of icebergs and ice islands also can be tracked from space, minimizing the hazards in the North Atlantic shipping lanes.

Communications

Environment

Oceanography


National Spaceline Operations
1979
1980
1981
1982
1983
1984

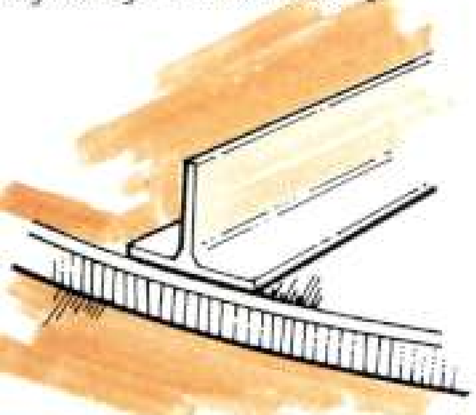

Energy conservation and distribution control


Shock-absorbing foam padding


Electronic watches


Hand-held electronic calculators


Portable paramedic equipment


High-strength adhesive bonding


Global communications


Accurate mapping


Safer highways

THE GROWING BOTTOM LINE

Few Americans could look at these illustrations without recognizing something that has made life easier, better, more enjoyable. Yet these examples of space benefits are but the visible end of the iceberg. There are other benefits, impossible to illustrate, that affect our lives far more profoundly.

Many space benefits can't be seen—they're hidden in technology. The fireproof cloth developed for Apollo can be touched; it has substance and dimensions. But who can identify and measure all that space exploration has done and is doing for medicine, ecology, meteorology, education, communications, materials, manufacturing, science, management, computers...?

The answer, of course, is no one. These benefits are simply incalculable. Our lives, though, are better because of them.

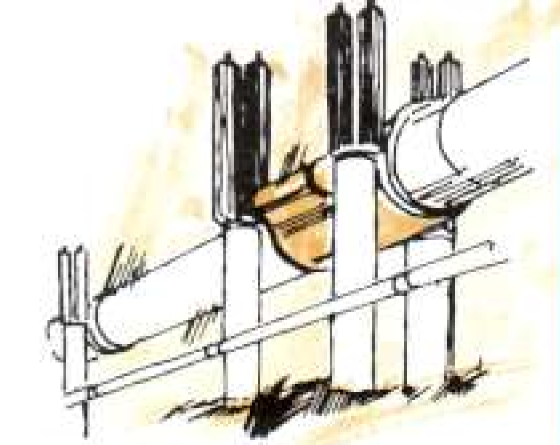

Accurate built-in truck scales


Fire-quenching coatings


Energy-conserving developments


Computerized bridge-safety inspection

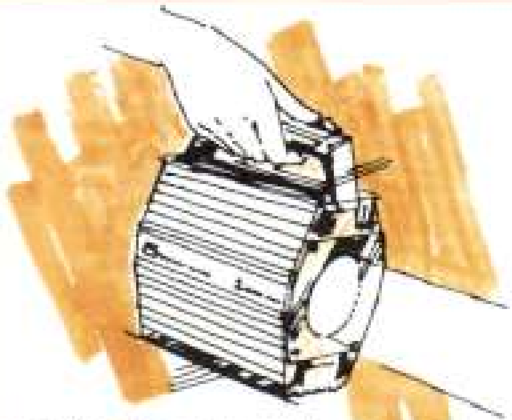
Durable agricultural equipment



Protection of Alaskan pipeline environment

Oil exploration

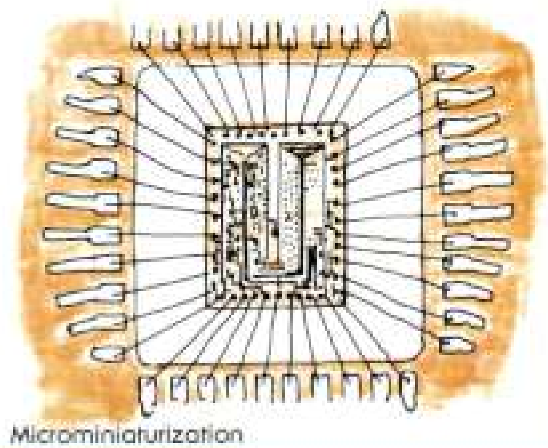
Specially prepared food for the elderly



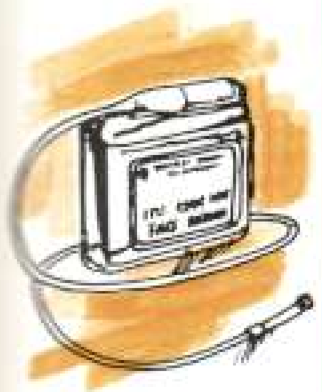
The brightest hand-held light ever produced

Fireman's lightweight air packs

Electronic ignition systems

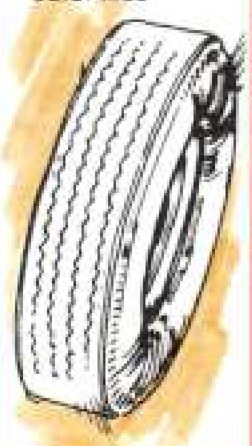


Microminiaturization



Rechargeable pacemakers

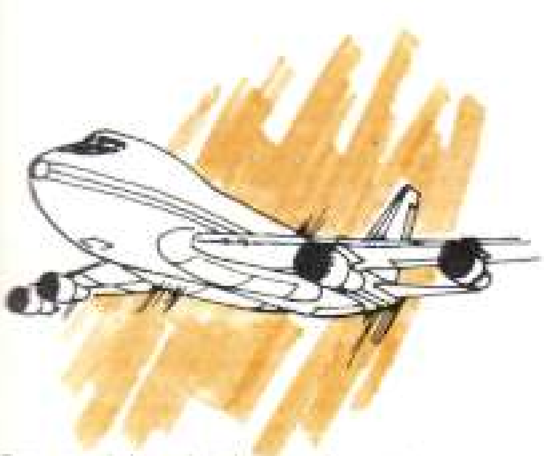
Safer tires



Worldwide TV

Remote medical monitoring

Supersterile operating rooms



Commercial navigation equipment

Voice-controlled wheelchairs

Lighter, more efficient sports equipment

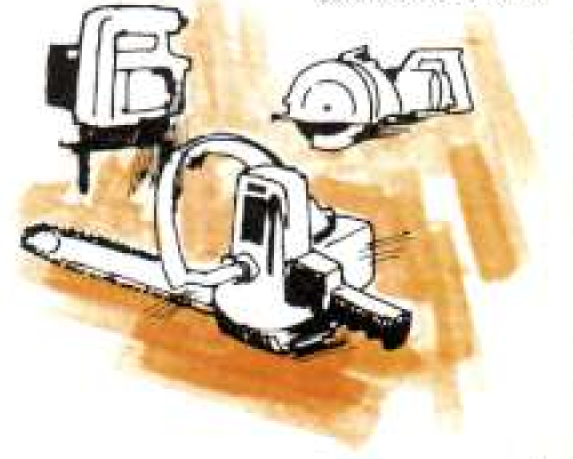
Improved insulation

Detection of pollution

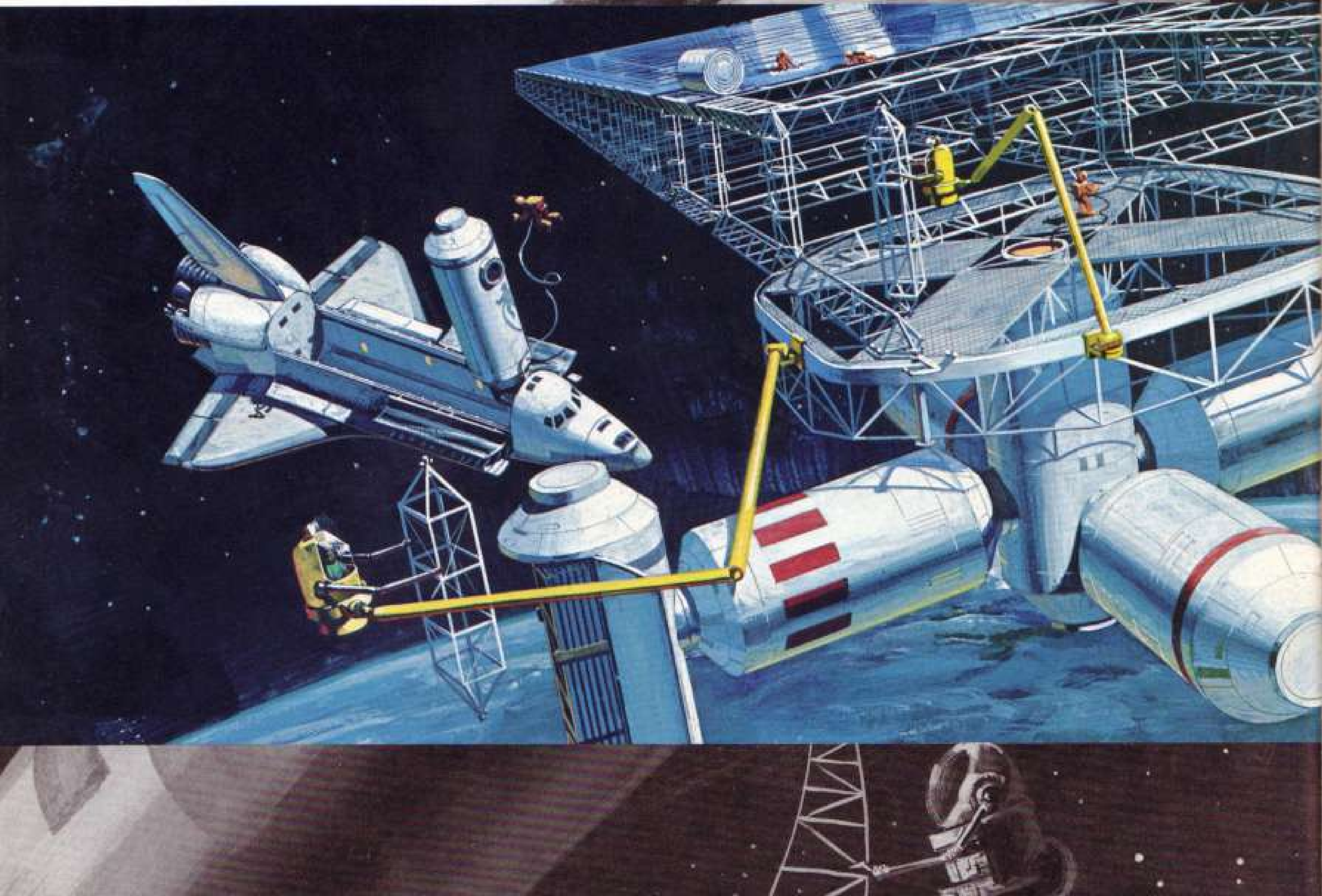
Ultrasonic heart monitoring

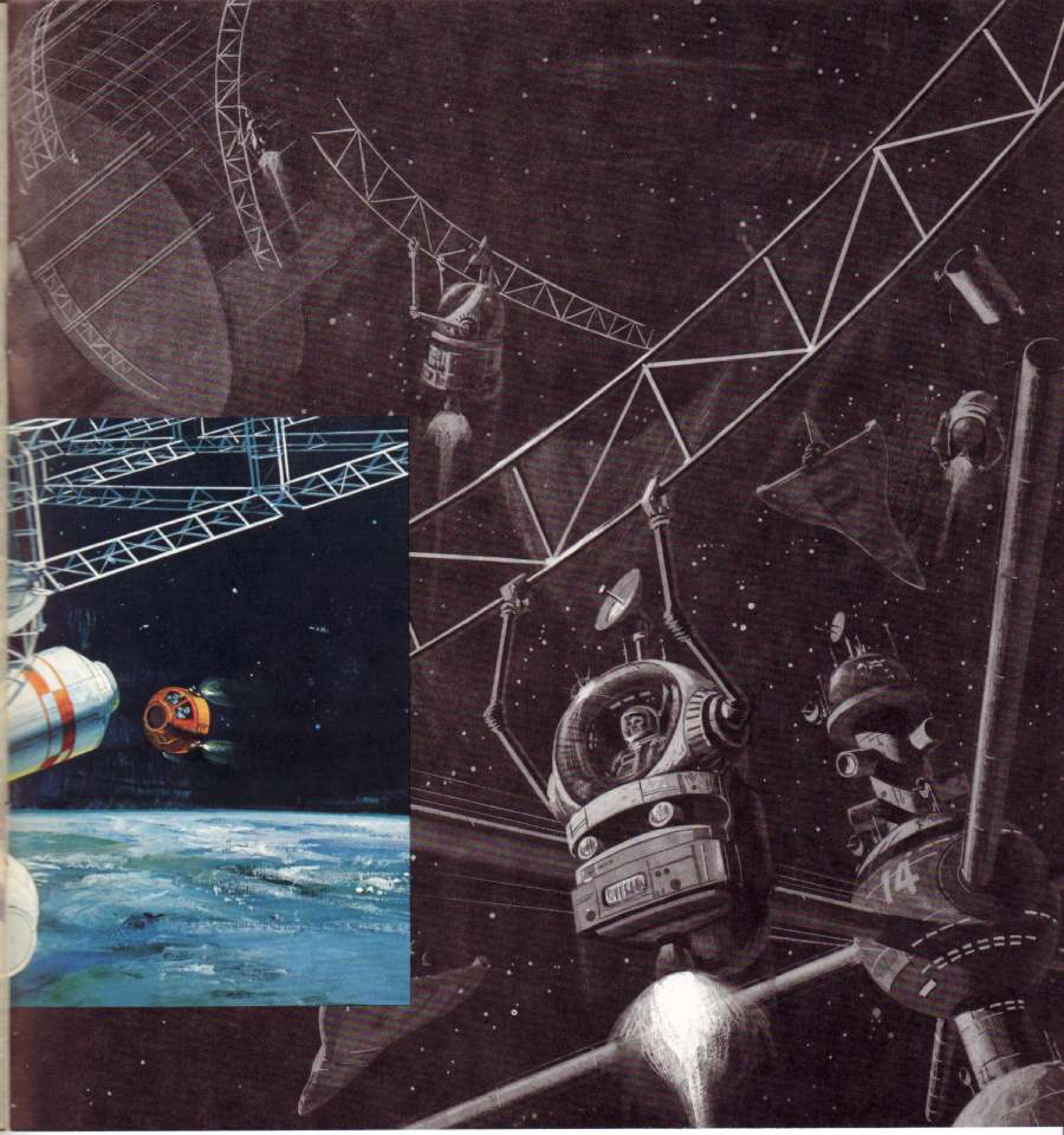
Computerized traffic control

Cordless hand tools



When commenting on the future a few years ago, space observers only conjectured about a self-sustaining space colony. Today they can describe it. Though such a creation is in the distant future, even the discussion of it by space scientists and others is significant. For their interest means that the technology needed to build it is clearly within reach.

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An essential part of that technology is the ability to transport building blocks to space. This is one of the roles Space Shuttle will play in the future, a future in which space could be used to benefit earth in extraordinary ways. For example: Climate control. Space hospitals. Space processing facilities. And permanent space habitats manned by technicians who could assemble satellite solar power stations that supply continuous energy to earth.

These promising possibilities challenge the imagination. Yet they represent barely the beginning of our *working* presence in space—a presence that will depend more and more on the Space Shuttle transportation system. The impact on mankind of these and other space uses can only be estimated. But this much is known: Beginning in 1980, the benefits from space will be increasingly realized in our own lifetimes.