



MARTIN COMPANY **MARTIN MILESTONES**

DIVISION OF MARTIN MARIETTA CORPORATION

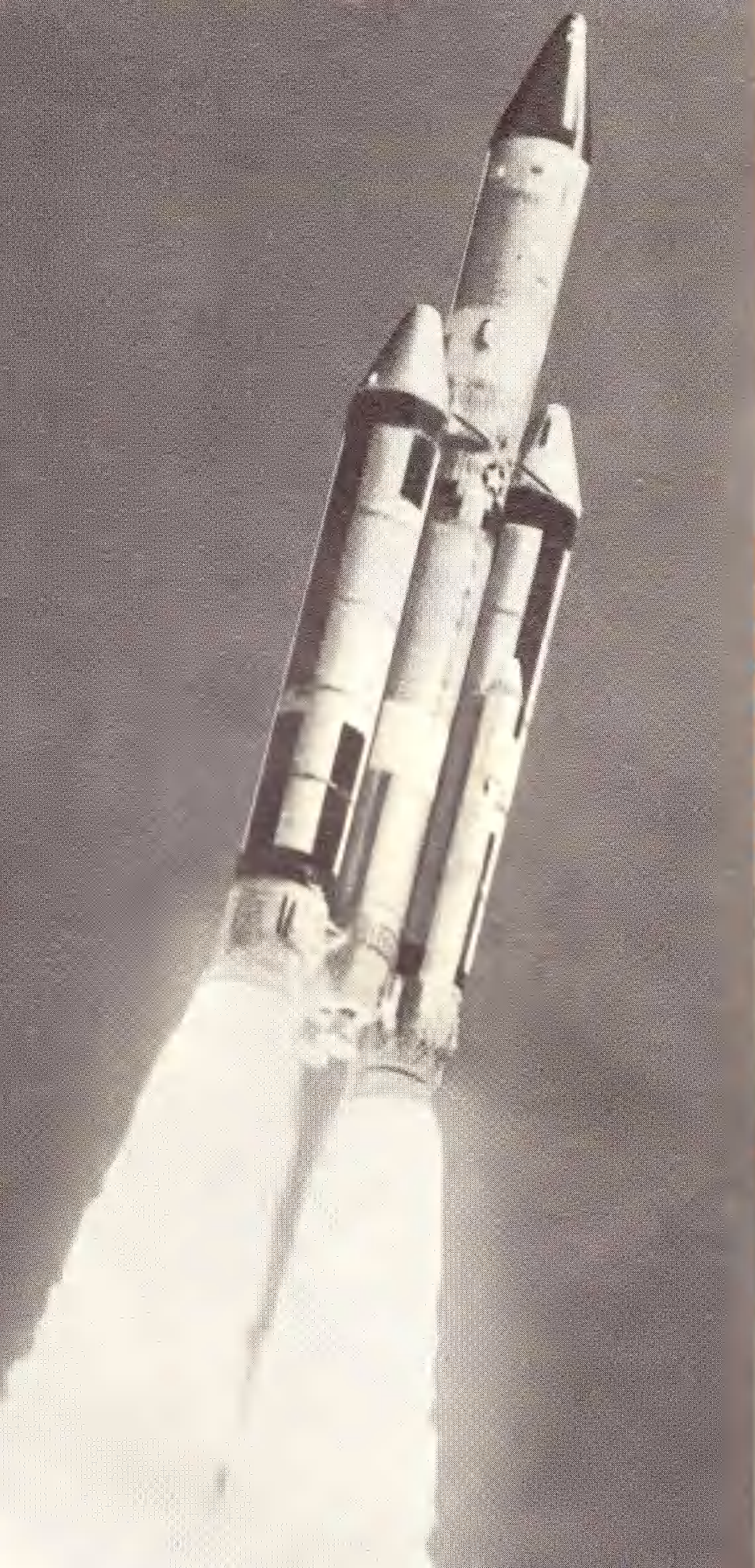


■ The story of Martin Company, from its inception in 1909 as one of the nation's first aircraft manufacturing firms, encompasses man's aspirations to fly.

■ In the history of manned flight, only one thing has remained constant: man's determination to fly ever faster and higher, to roll back the frontiers of his universe.

■ The vehicles of flight—whether airplane, rocket or spacecraft—are fascinating. But man is the real story. At Martin, the heritage of technology that produced some of the 20th Century's most distinguished airplanes has been merged with a diversity of skills and disciplines that span the spectrum of the modern flight sciences. Today, as always, Martin's overriding interest is in man-the-flyer—whether streaking into space aboard a sleek rocket, or sitting in a blockhouse "cockpit" to launch and control rocket-powered flight vehicles.

■ The technology of flight in all its diverse forms rushes ahead at an incredible pace. It would not be possible to recount all of the significant contributions of any major aerospace company, but it is possible to illuminate some of the major milestones along the way. That is the purpose of this booklet about Martin Company in the modern era of flight.



MANAGEMENT

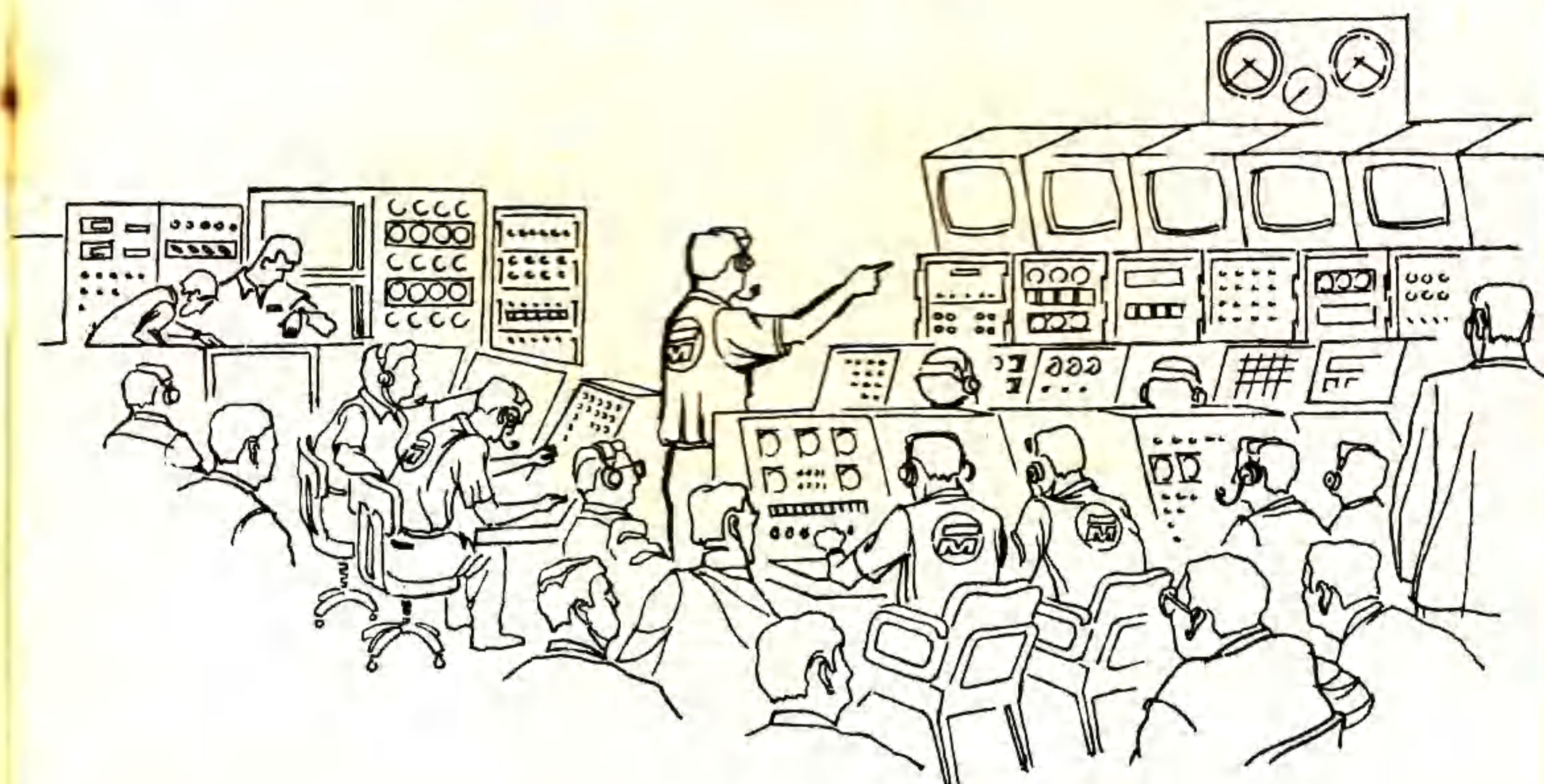
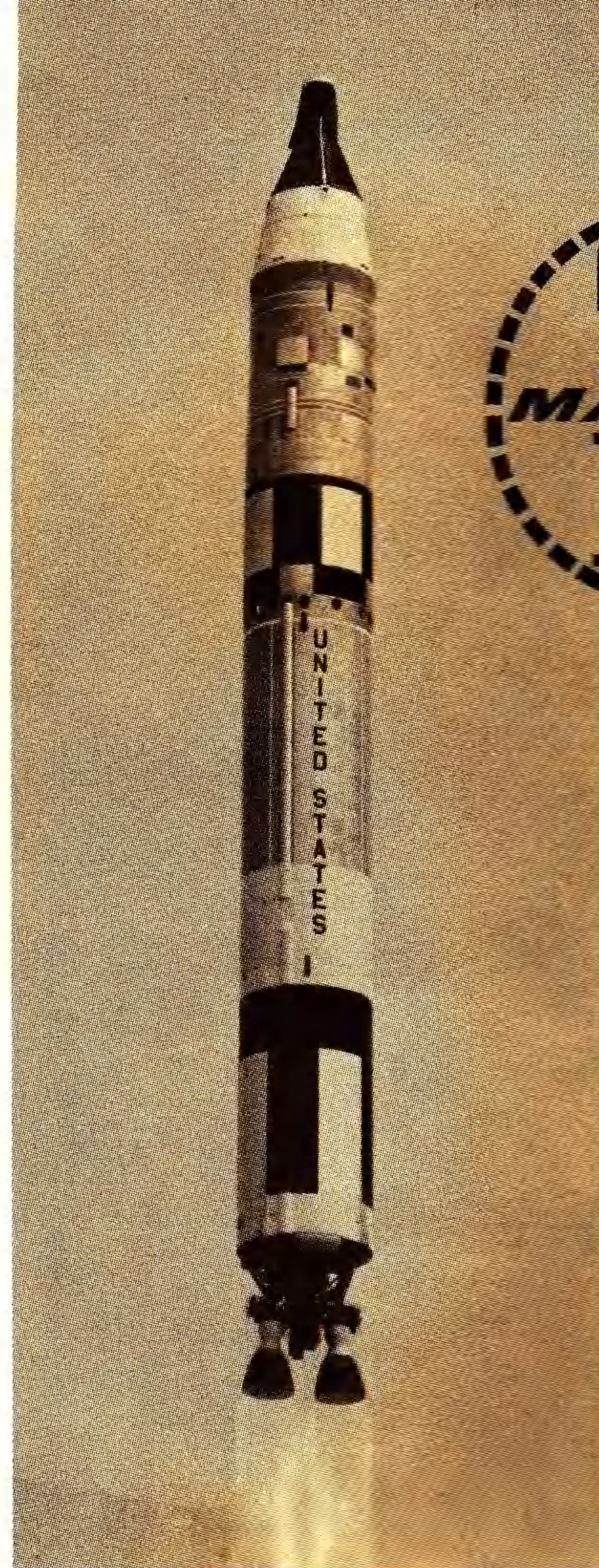
□ From July 1962 through August 1965, 30 straight successful launchings were made of the Titan II or one of the derivatives of this basic system (Gemini Launch Vehicle, Titan III-A, and Titan III-C).

■ Martin has produced more than 43,000 air-to-surface, surface-to-surface and surface-to-air missiles and space boosters.

□ The Martin-originated "Zero Defects" program—in essence, management's successful effort to reaffirm the individual's pride of workmanship and his personal identity with the product he helps to make—has been widely adopted in the Government and industry.

■ Martin has developed and produced more aerospace ground equipment than any other company in the industry.

□ In 1958 Martin Company established the first and only fully autonomous aerospace division at Canaveral devoted exclusively to the critical checkout, testing and launching of company-produced weapon and space systems from what is now Cape Kennedy. Experience gained by Martin Canaveral personnel in some 180 weapon and space system launchings is unmatched by any other segment of the industry.



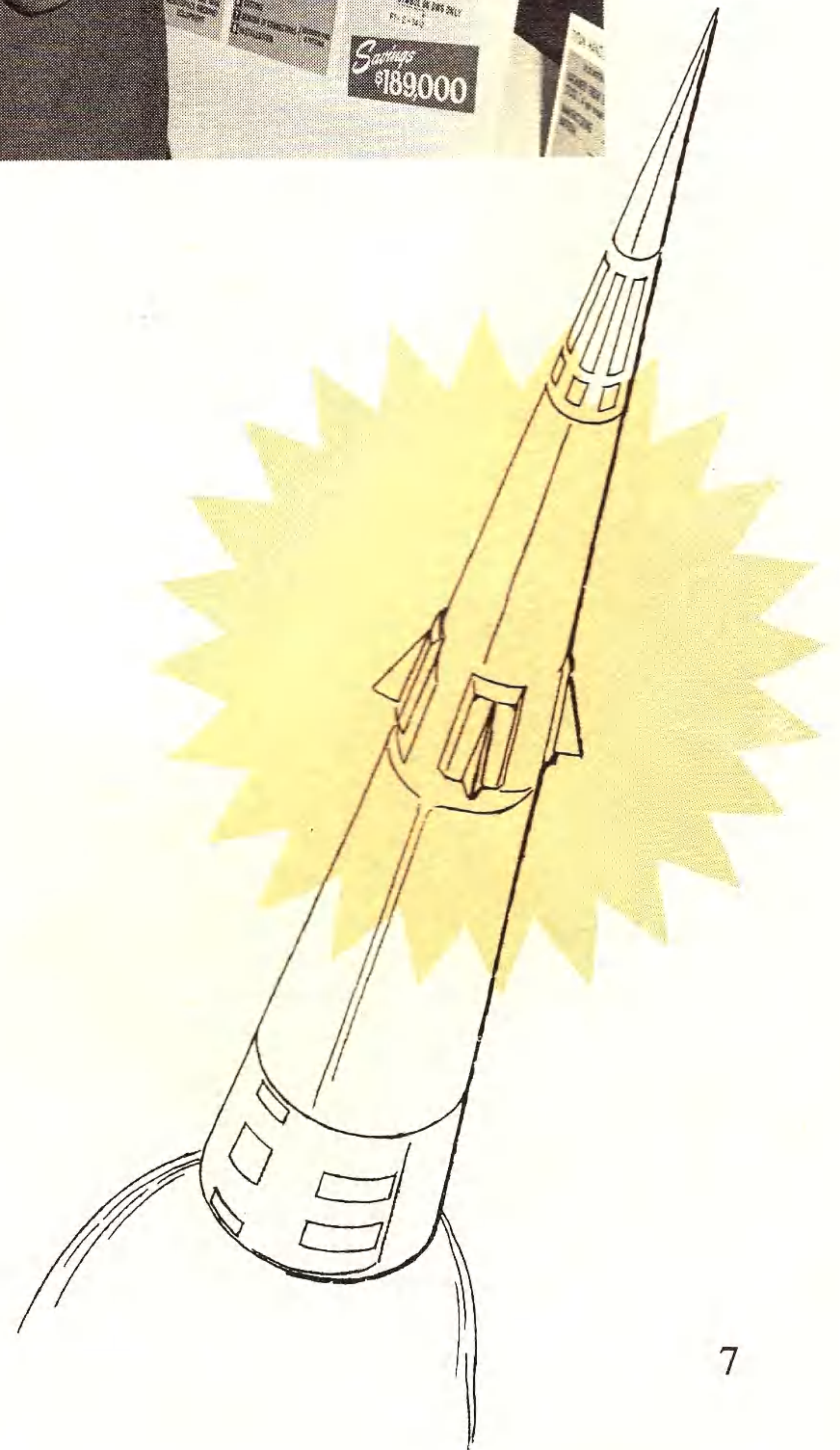
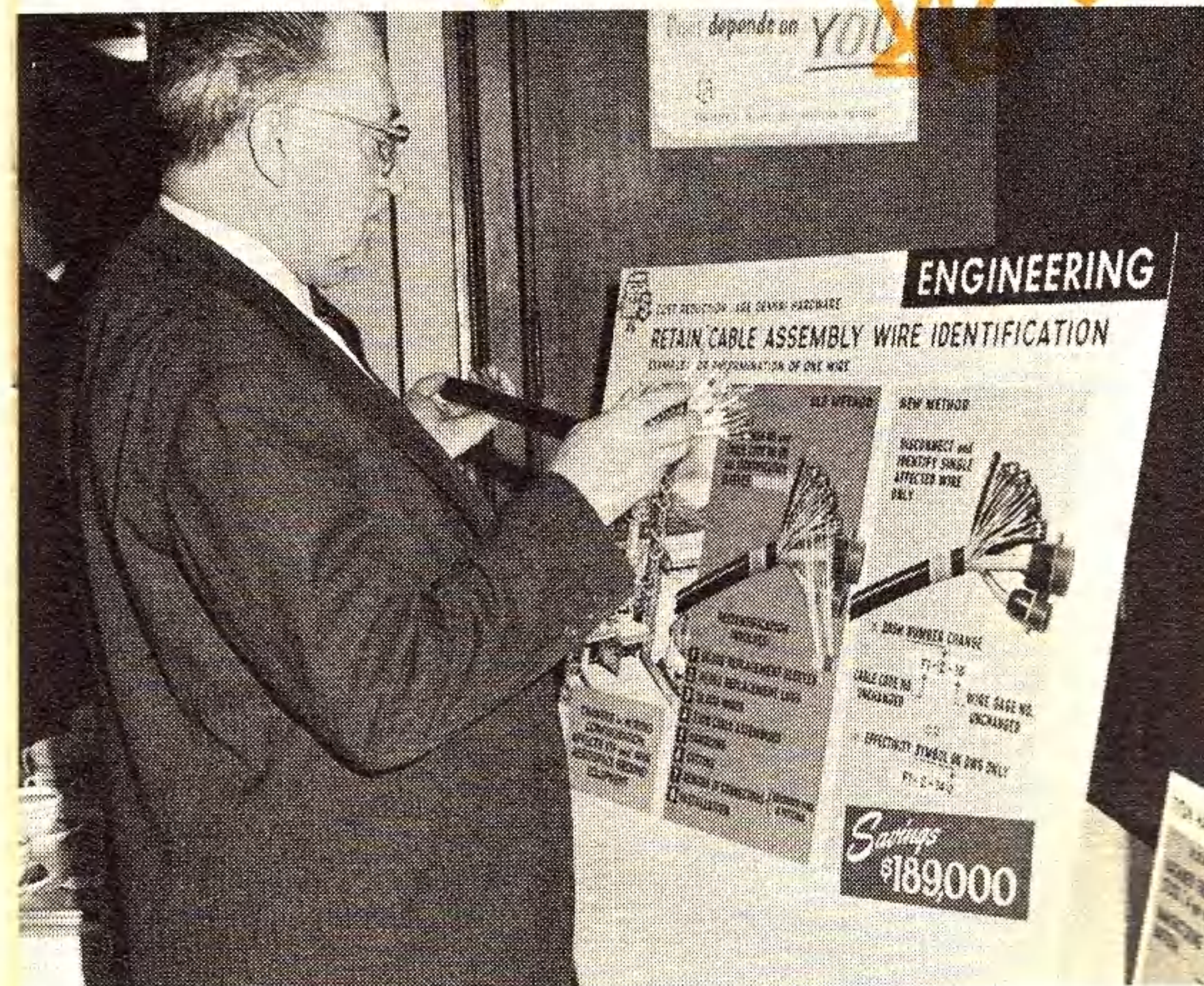
Formal cost reduction programs in the aerospace industry were pioneered by Martin Company. For the period 1960-1964, more than \$300 million in savings on government contracts were documented under formal cost reduction efforts in the company's operating divisions.

The first BIRDIE missile battery fire control system was designed, tested and installed in just 18 months from contract go-ahead.

Since its establishment in 1956, Martin's Orlando Division has delivered more than one billion dollars worth of goods and services with less than 2.2 per cent variance from cost estimates.

Over 30 per cent of all U.S. missiles launched from Cape Kennedy since the establishment of the Eastern Test Range in 1950 have been built by Martin.

In March 1965, just 17 months after development work started, Martin successfully flight-tested—on the first attempt—the planned propulsion system and structure of the Army's Sprint anti-missile missile.



□ The full force of operational Titan II ICBMs was delivered to the Air Force on time and under anticipated costs.

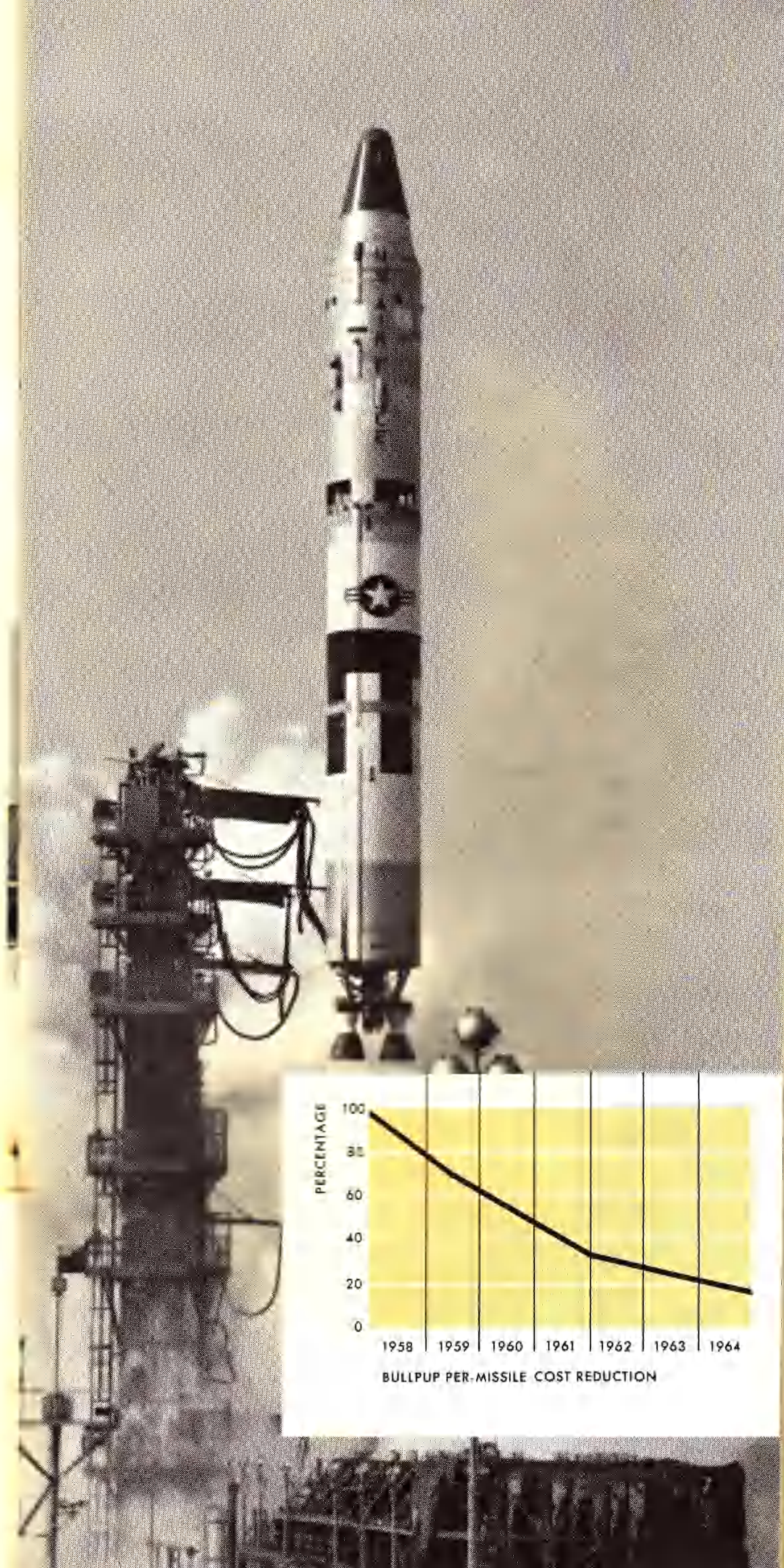
■ Production records for the industry were established by Martin's Orlando Division with the Bullpup missile. Built for the Air Force, Navy and Marine Corps, Bullpups came off the assembly line on schedule for 58 consecutive months from October 1959 to July 1964.

■ Development of the Titan II intercontinental ballistic missile from drawing board to flight test was accomplished in a period of just slightly more than 22 months.

■ The most powerful U. S. intercontinental ballistic missile is the Titan II, with total thrust of 530,000 pounds. Titan II carries twice the payload of any other missile in the U. S. arsenal. A modified version of Titan II is the launch vehicle for the Gemini spacecraft.

□ The Bullpup delivered in 1964 by Martin to the Navy cost only 18 per cent as much as the first one delivered in 1958.

■ With only four Martin-conducted development test flights, the Titan III-A was declared operational by the Air Force. This is the shortest development (flight test) program yet conducted at the Cape.

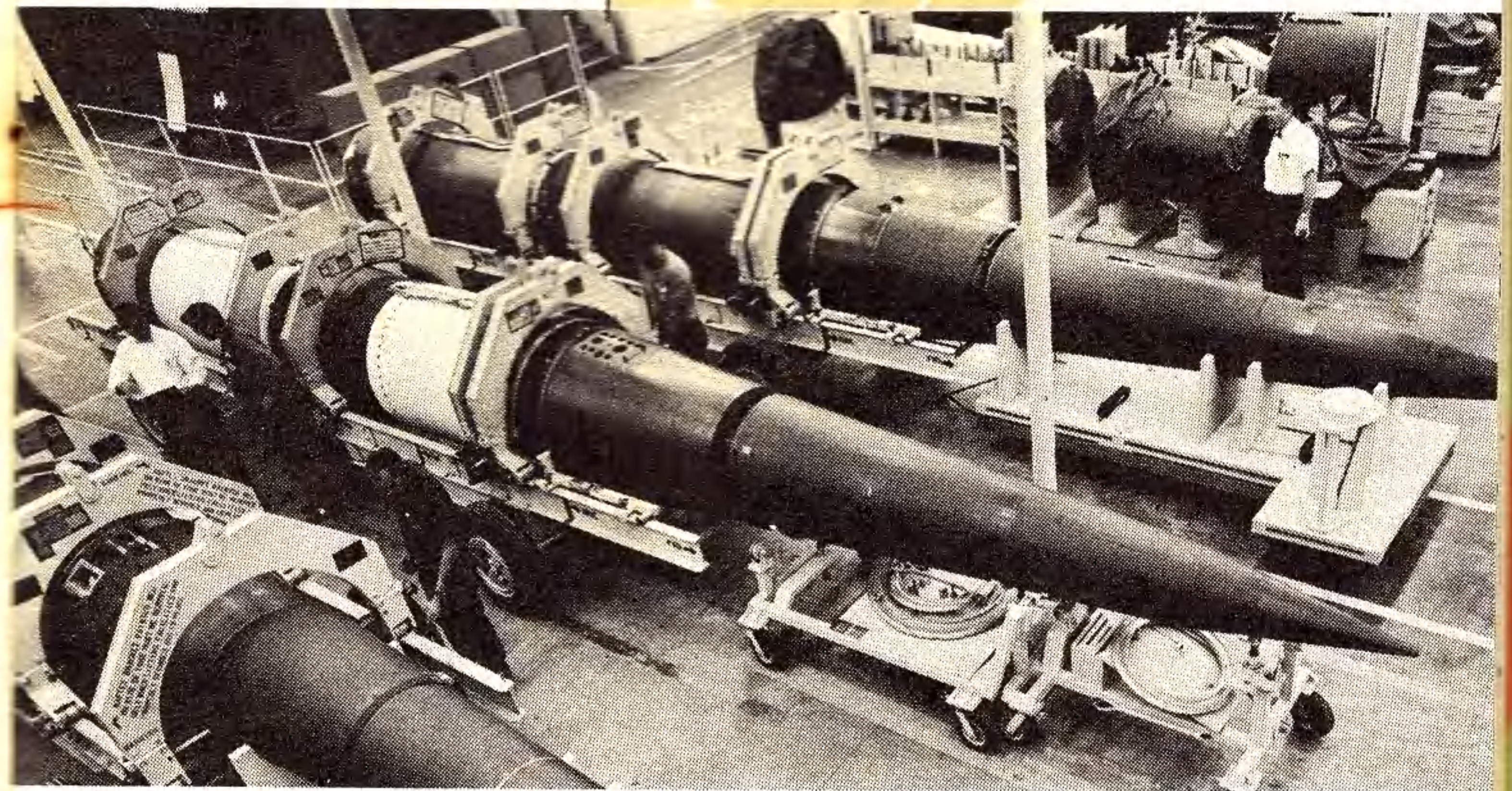
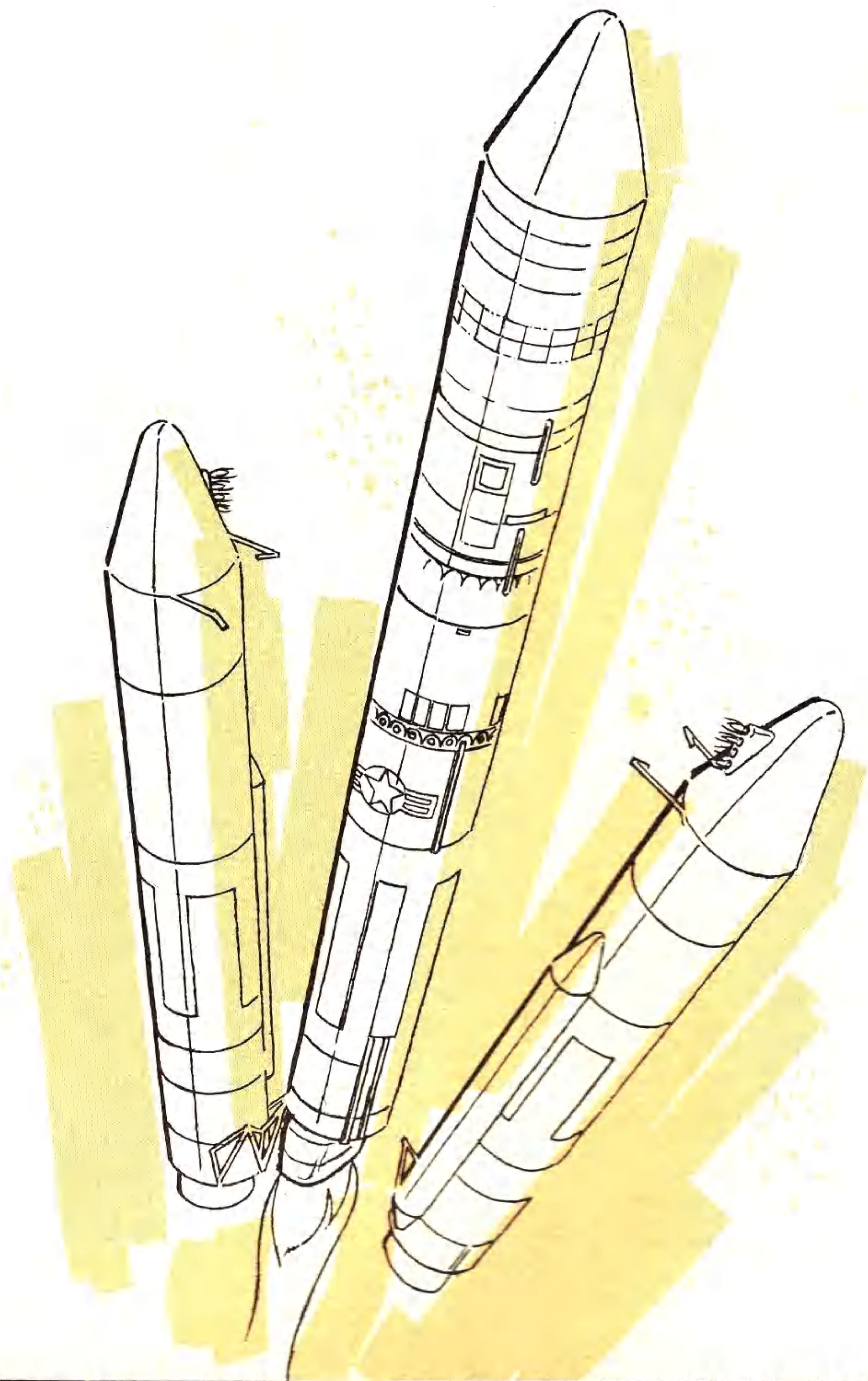


□ The first major space booster contract with multiple incentives on cost, schedule and performance was awarded by the Department of Defense to Martin Company for development of the Titan III Standard Space Launch Vehicle. Since the initiation of the Titan III program in December 1962, all major contract schedule milestones have been met by Martin Company.

■ Martin introduced in 1952 and perfected the systems management concept that is now in general use throughout the aerospace industry.

■ More than 97 per cent of all contract work performed by Martin during the past six years has been completed at or under contract costs and delivered on or before schedule requirements.

□ Of 81,730 contract items negotiated for the Pershing weapon system, only 151 were delivered late. This 99.8 per cent on-schedule performance spans the scope of research and development, testing, production and requirements for spare parts, manuals and training equipment.

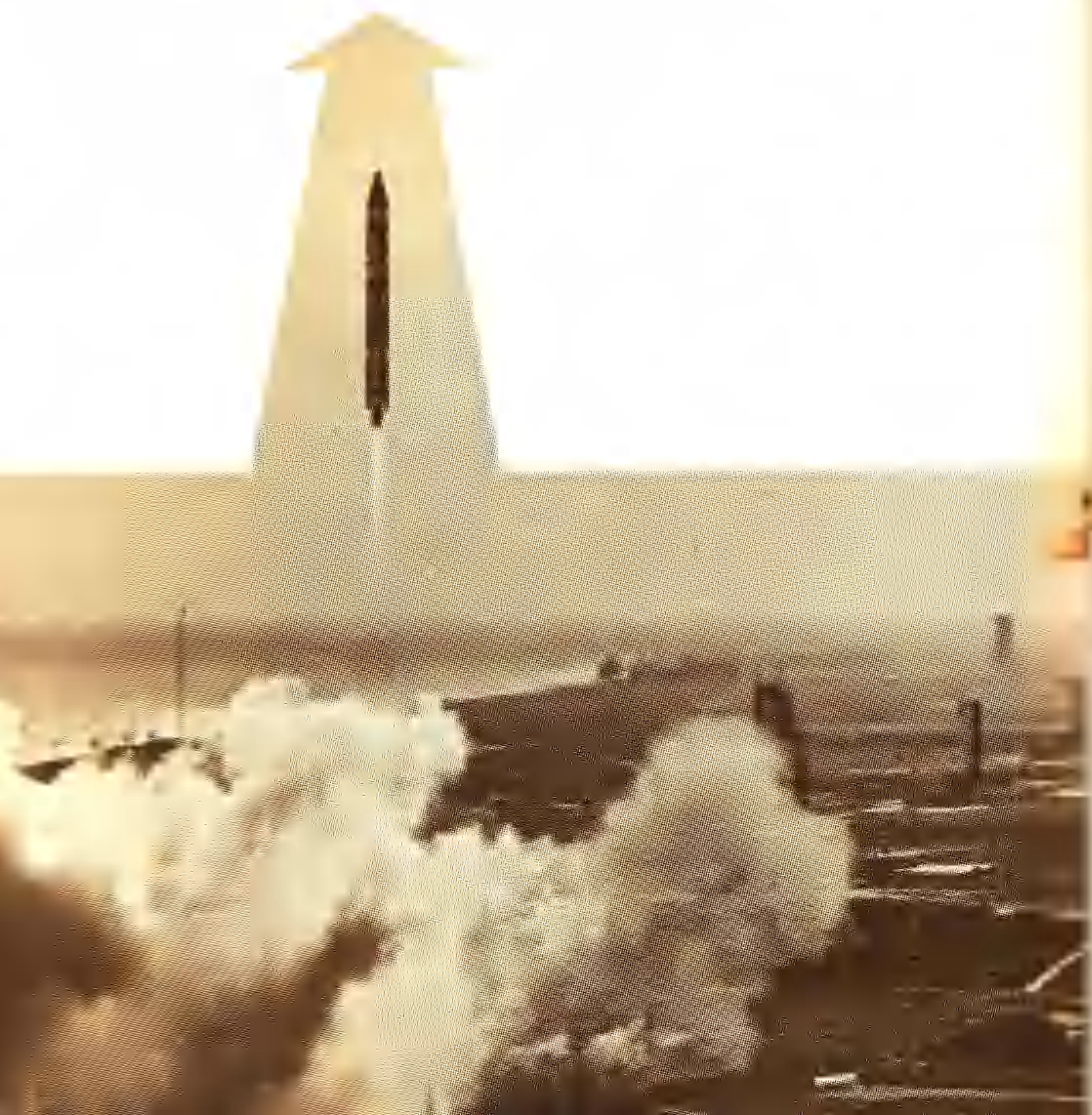


■ All squadrons of the Titan I ICBM, which became operational in 1962, were in place two weeks ahead of the original contract target date fixed in 1959.

■ The Martin-produced Lacrosse was the first Army missile system to be activated (in 1959) with all major hardware available, all direct spares support available, and all manuals, handbooks and documentation complete.

■ The Matador was the first U. S. missile to be produced by assembly line techniques. Ultimately, Martin delivered more than 1000 to the Air Force.

□ At Cape Kennedy, Martin Company has activated 14 launch stands and complexes for missile test flights over the Eastern Test Range, more than any other aerospace firm.



TECHNOLOGY

Use of integral tankage in booster vehicles was pioneered by Martin with the Viking research rocket developed for the Navy.

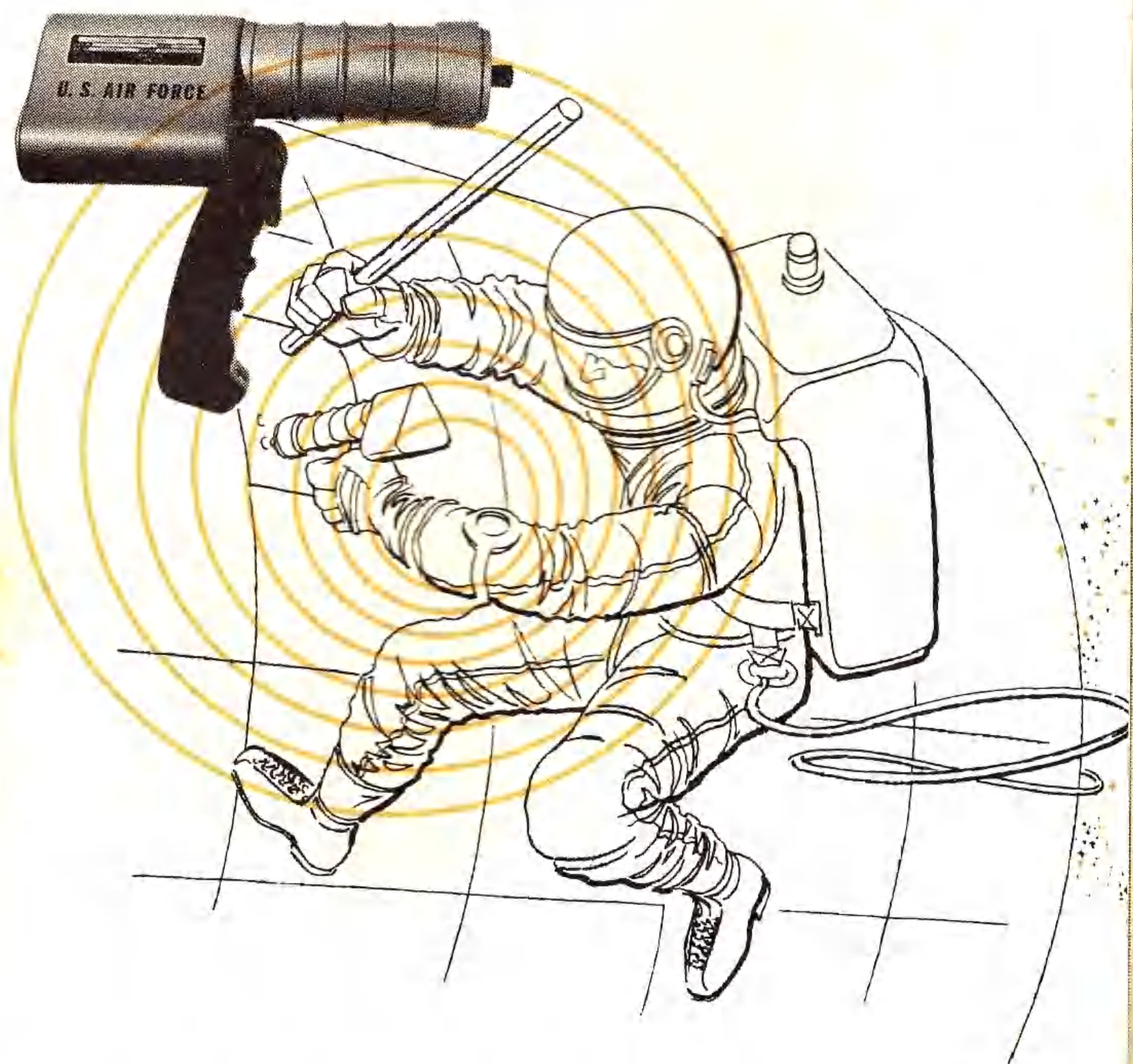
Martin designed and put into operation the first space flight simulator to realistically duplicate the return from orbit of lifting body re-entry spacecraft. An "out-the-window" moving picture allows the simulator pilot to visually maneuver his spacecraft from an altitude of 100,000 feet to an airport runway landing.

Martin research gave rise to the entire field of isotopic power. SNAP 3 was the first system in the world to convert decay heat from radioisotopes into electrical energy on a practical level, and it was the first nuclear device of any type to operate without moving parts—offering longer life and increased reliability.

Explosive forming of large diameter segments of space boosters is one of the latest manufacturing innovations developed by Martin. Basic technology for explosive forming of honeycomb material also has been developed by Martin.

The first zero-reaction torque wrenches for use in space under weightless conditions were designed by Martin engineers.

SNAP 7E, a thermoelectric generator built by Martin, became the first isotope power supply for an undersea device on July 13, 1963, when the Navy's experimental underwater navigational beacon was installed below the Atlantic Ocean, 750 miles east of Jacksonville, Fla. The beacon's signal is picked up by shipboard navigators using underwater listening devices, and positions are plotted using the same principles employed with lighthouse and radio beacon signals.



■ Martin built the first nuclear power supply in space, an isotope generator using Plutonium-238 to produce 2.7 watts of electricity. It provided supplementary power for radio transmitters on a satellite orbited on June 29, 1961.

□ The first U. S. satellite wholly powered by nuclear energy was put in orbit in October 1963. Successful launch of a second military satellite was reported by the Atomic Energy Commission in December 1963. Both are powered by Martin-built SNAP 9A radioisotope generators.

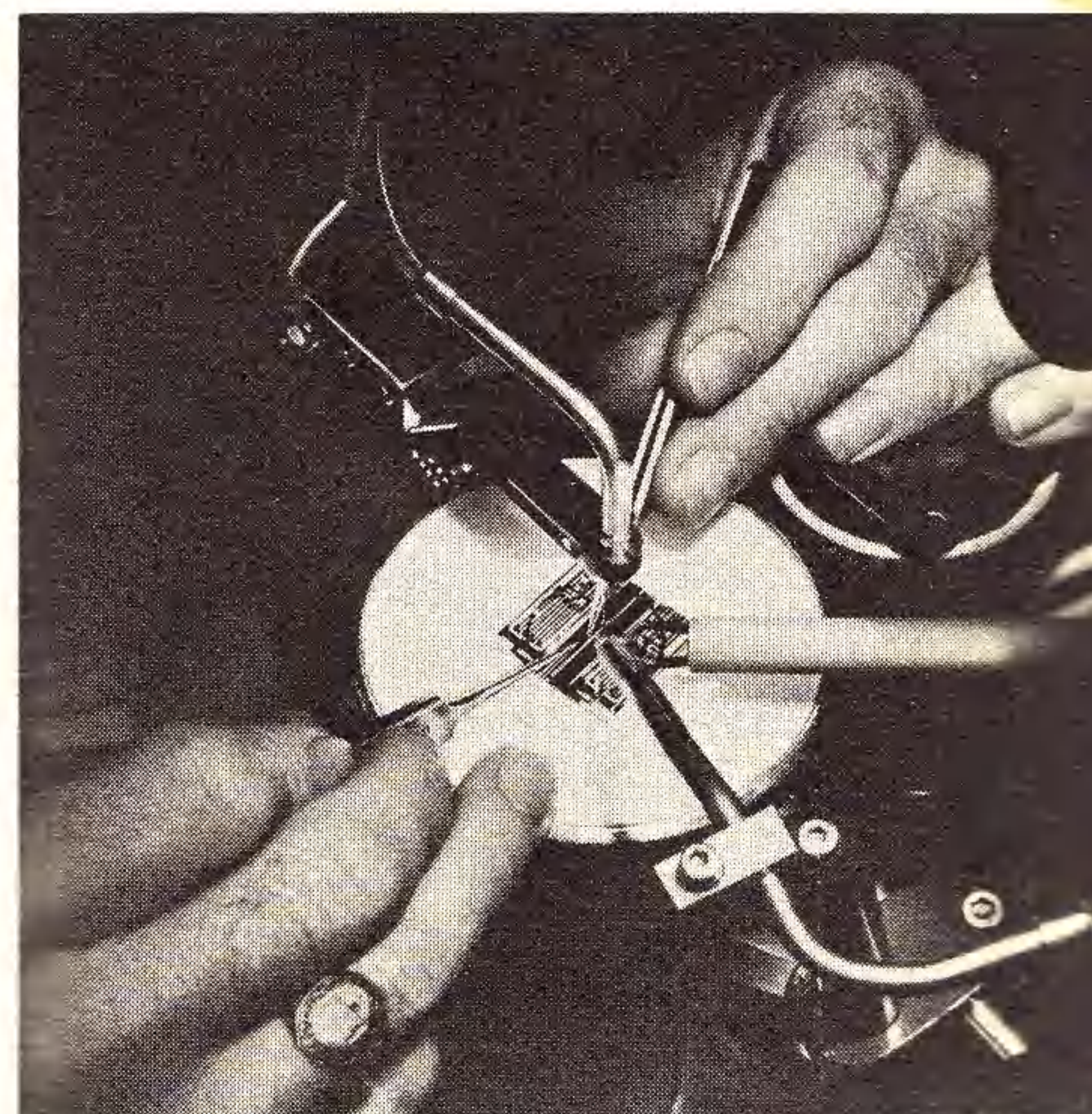
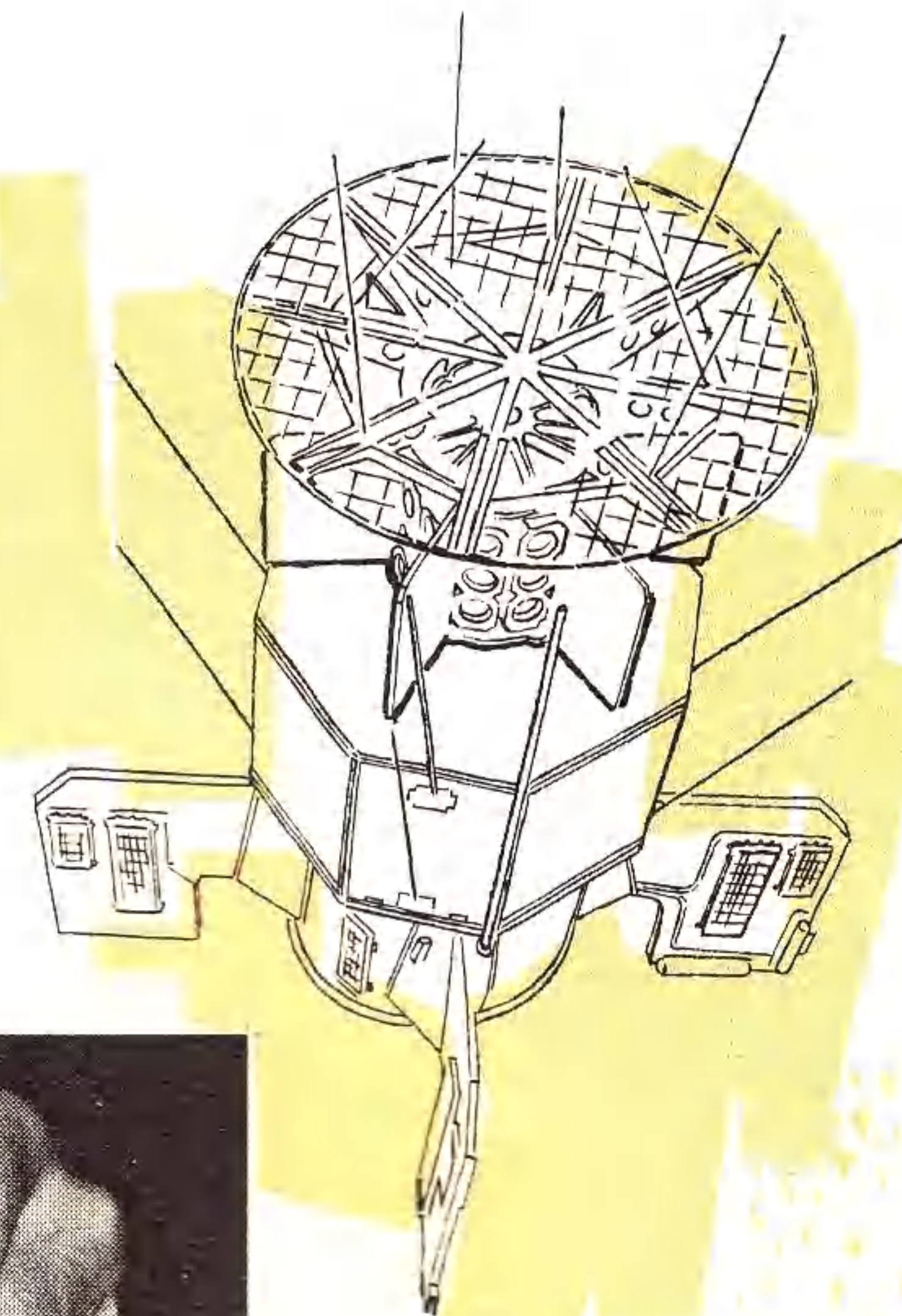
■ Martin Company led the aerospace industry to use of honeycomb sandwich construction in production of missiles and both military and commercial aircraft.

□ A new process for the manufacture of high-quality thin film circuits, developed at Martin, reduces production time and costs significantly.

■ The first programmed Vector Computer has been designed and built by Martin to demonstrate ultra high-speed digital solutions that can solve trigonometric problems 20 times faster than standard computers with the same clock rate.

□ This country's first pulsed-gas laser was developed at Martin in 1962. Since then, the technique has been further advanced to provide the largest and most powerful—over 300 watts peak power output—laser of this type ever built.

■ The first atomic-powered weather stations in the Arctic and Antarctic draw their electricity from Martin-built isotope generators. The station at uninhabited Axel Heiberg in Canada, only 700 miles from the North Pole, was installed on August 21, 1961. The Navy's station on Minna Bluff, 700 miles from the South Pole, began operation on February 8, 1962.



□ Titan I was the nation's first ICBM to be based in fully-hardened underground launch sites. This concept since has been applied to the other Air Force ICBMs—Titan II, Minuteman and Atlas.

■ The gimbaling technique for control of rockets was first applied to Viking, leading the way to elimination of weighty fins on subsequent generations of booster vehicles.

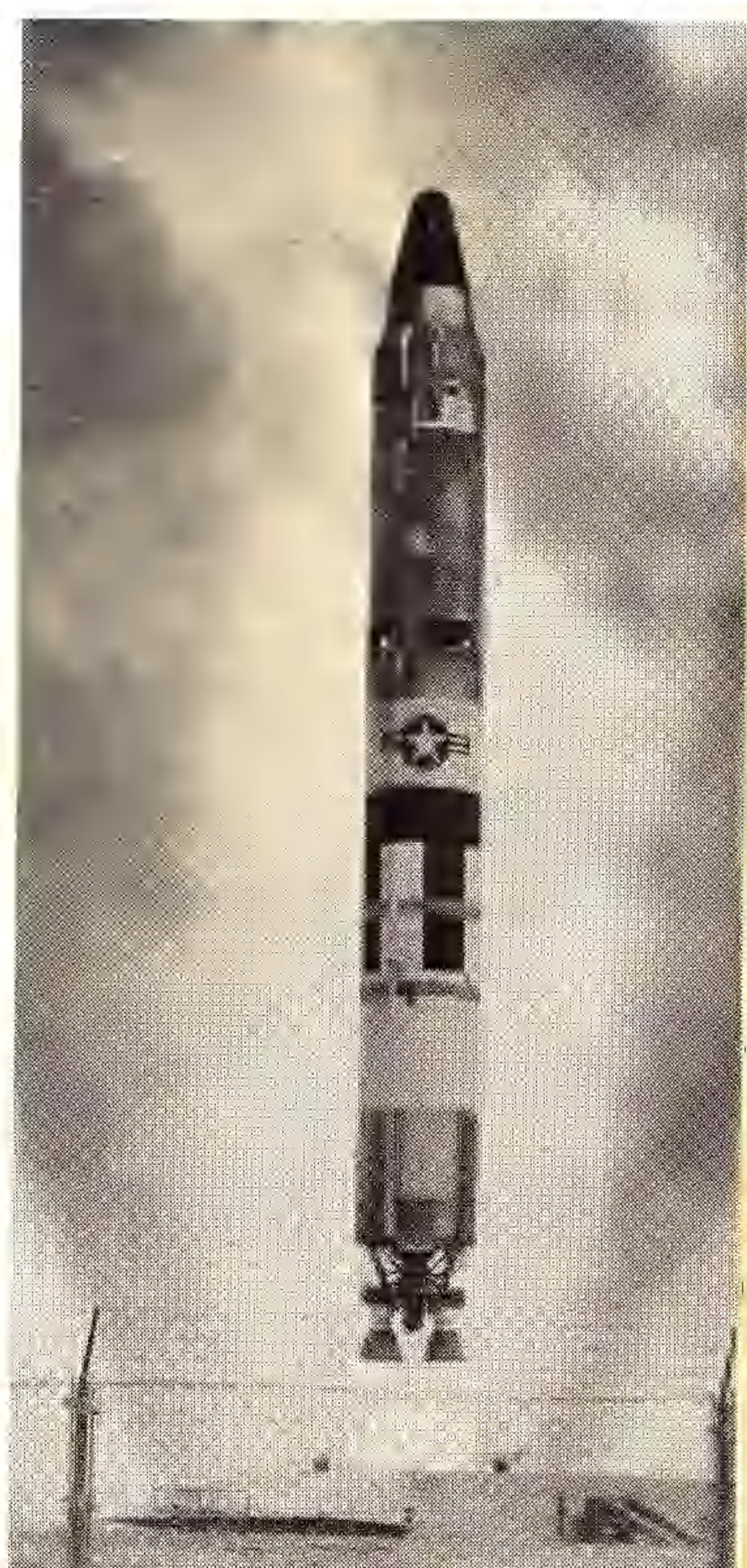
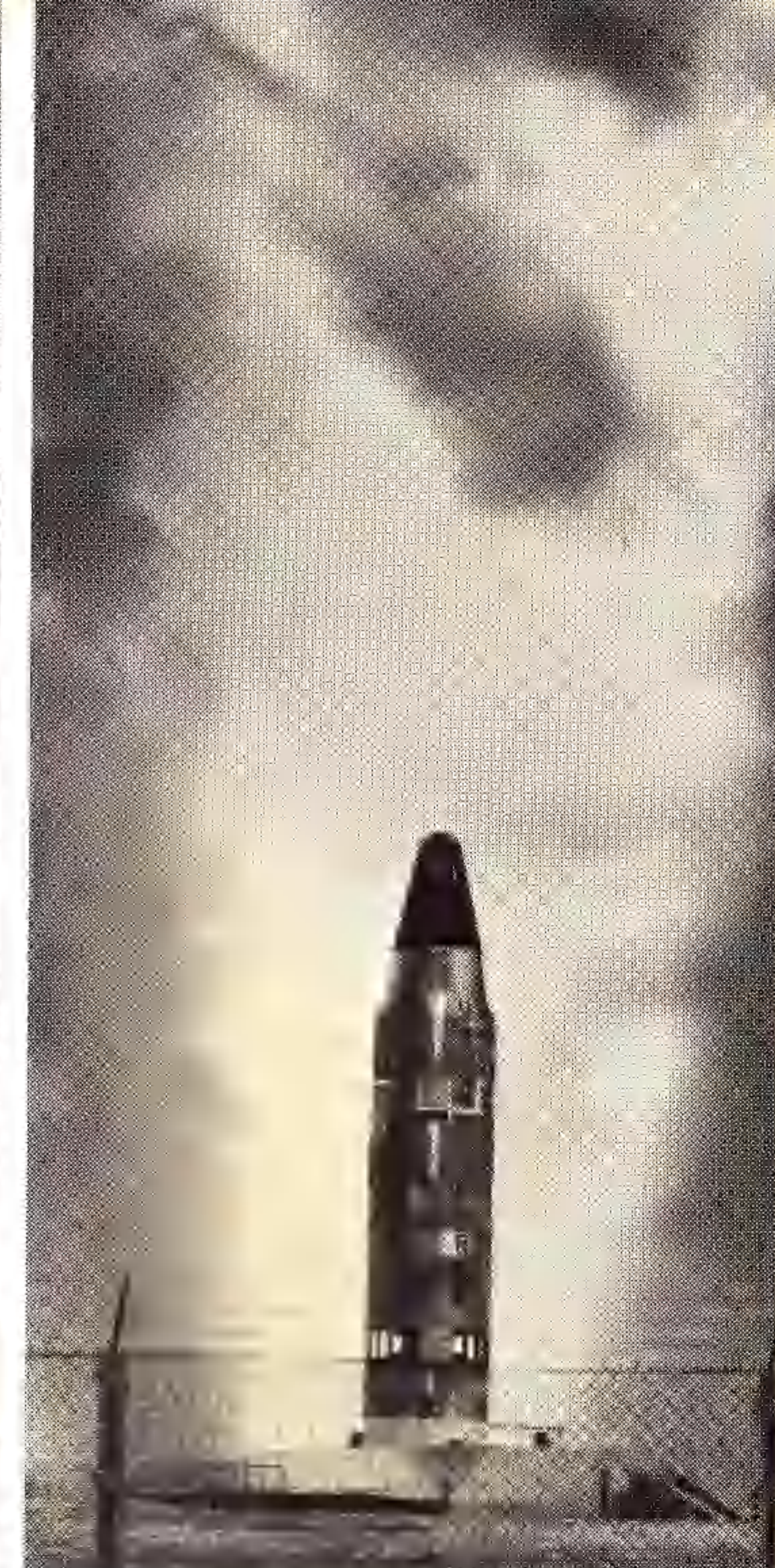
■ The "principle of duality," an important mathematical principle governing the new technology of automation and control systems, was formulated by a Martin scientist.

■ One of the top 100 new developments of 1963, as cited by *Industrial Research* magazine, was a resin-impregnated porous ceramic heat shield. The Martin-developed shield is extremely light in weight; can withstand long exposures to re-entry heating; and experiences very little distortion due to temperature extremes.

■ SNAP 11, scheduled to be the first nuclear power source to reach the surface of the moon, is under development by Martin for use in the Surveyor unmanned lunar landing program.

■ The Titan III Transtage was the first space propulsion vehicle to be started four times in space, maneuver into four different orbits, and inject three payloads into separate orbits (May 6, 1965).

■ Martin's nuclear engineers designed and built SNAP 7F, the first isotope-powered generator to furnish electricity for commercial use. The 60-watt generator was mounted on an unmanned, off-shore oil rig in the Gulf of Mexico on June 21, 1965, to provide power for navigation warning lights and a foghorn.



□ A communications technique pioneered by Martin provides the ease of dial telephone-type communications without wires and central switchboards. A refinement of this technique, RADA, is an advanced military communications system being developed to handle voice, teletype, facsimile and data transmission and reception within Army combat divisions. RADA will be portable, secure and adaptable to fixed installation, mobile installation and manpack use.

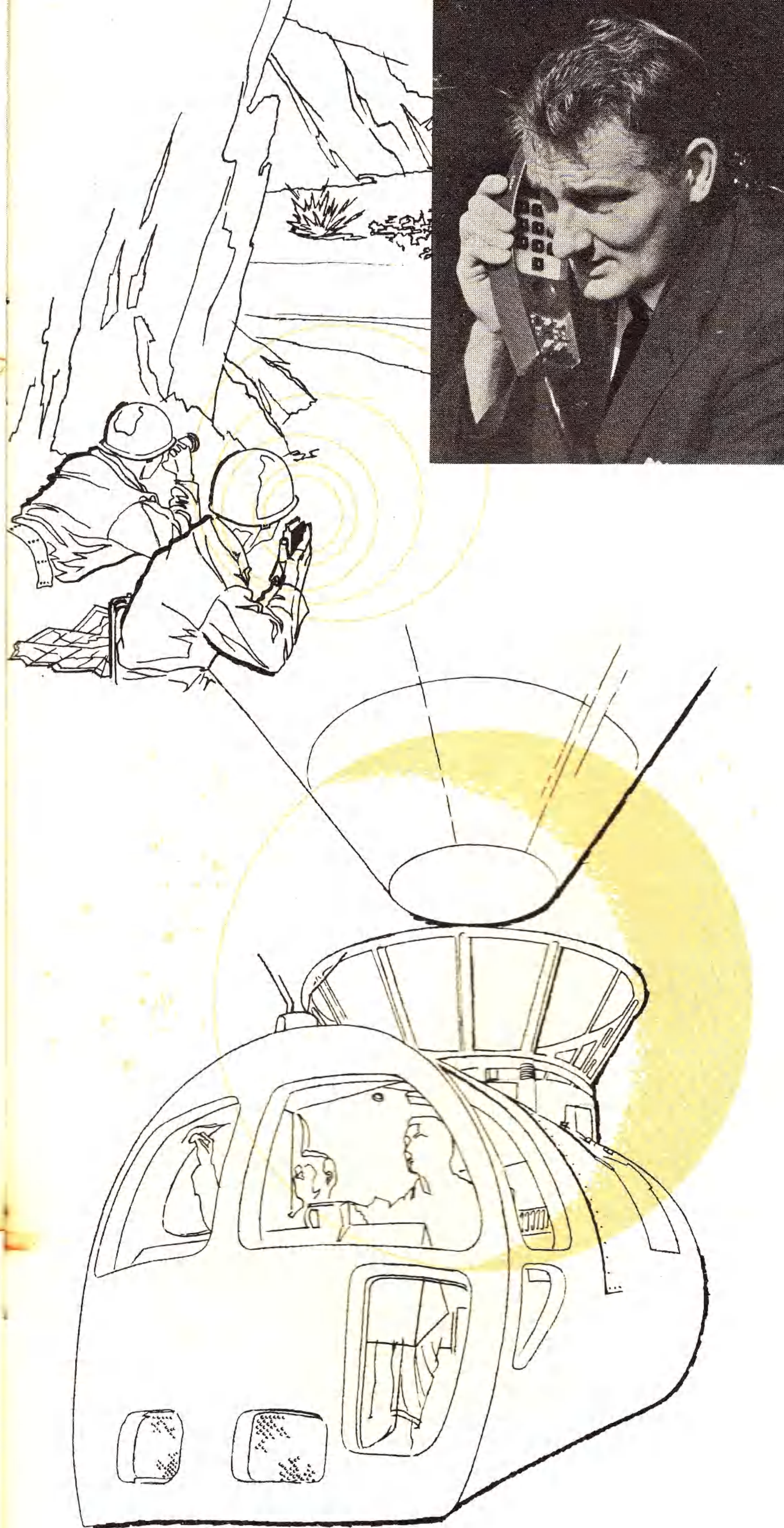
■ Martin's radioisotope production facility at Quehanna, Pa., was the first industrial laboratory in the United States capable of large-scale processing of Strontium-90 for use as fuel in nuclear generators.

■ Martin pioneered the development and use of automatic programmed tools such as computerized milling machines and lathes, now in wide use throughout the aerospace industry.

■ Martin developed the process for manufacturing nuclear reactor tubular fuel elements. These elements make it possible to include more fuel in a core of given weight without sacrificing strength.

□ Since 1956, Martin has devoted more than five million technical man-hours to space flight research. Even before the Russians launched the first Sputnik in October 1957, a team of Martin engineers prepared and presented to the government a plan for a manned base on the moon.

■ The first atomic power source for a lighthouse was built by Martin for the U.S. Coast Guard. The 60-watt thermoelectric generator, SNAP 7B, was installed May 20, 1963, in historic "Baltimore Light", a lighthouse which stands in Chesapeake Bay near the entrance to the Baltimore Harbor.



■ The world's first missile to be launched in free flight from an underground silo was a Titan ICBM. This historic launch, on May 3, 1961, proved the feasibility of the silo launch concept.

□ The first atomic-powered floating weather station, NOMAD, was put in operation in the Gulf of Mexico in February 1964. NOMAD is powered by a 60-watt SNAP 7D generator developed by Martin.

■ Electron beam welding techniques were used first by Martin to fabricate molybdenum foil honeycomb panels.

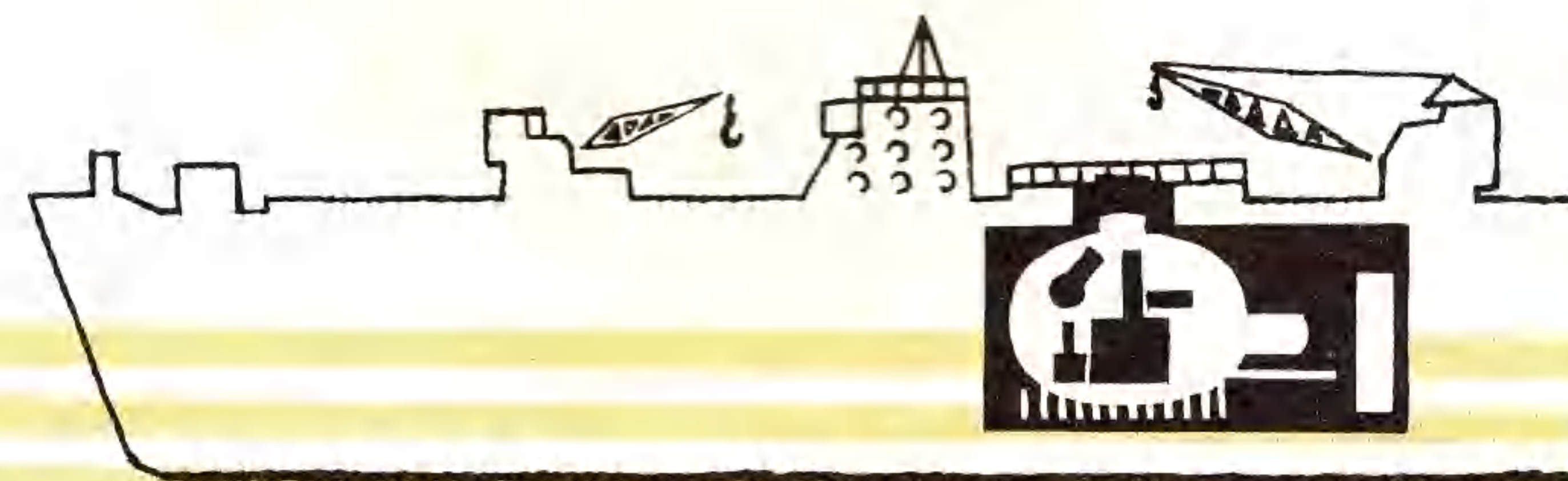
□ The concept and value of airbag restraint systems in protecting astronauts and commercial airline passengers was initiated, developed and proven by Martin engineers at the Baltimore Division.

■ The "trisextant," the first sextant for space navigators, greatly simplifying space navigation computations, was developed by Martin engineers.

□ Martin is building the first floating nuclear power plant (MH-1A) for use by the Army as an emergency source of electrical power for coastal military installations or port cities.

■ The Air Force-Martin Mace was the first U. S. missile to use a jam-proof guidance system. Mace also is the only long-range missile adaptable to both high and low mission patterns.

■ A unique process was developed by Martin to form the 1150-pound high-pressure aluminum bottles used on the Saturn V moon rocket for helium storage. Five-inch nipples are drawn at either end of aluminum tubes, among the largest extrusions ever produced, by a combination forging-drop hammer process to form seamless bottles 17.5 feet long and 22 inches in diameter. No internal matrices or dies were used.



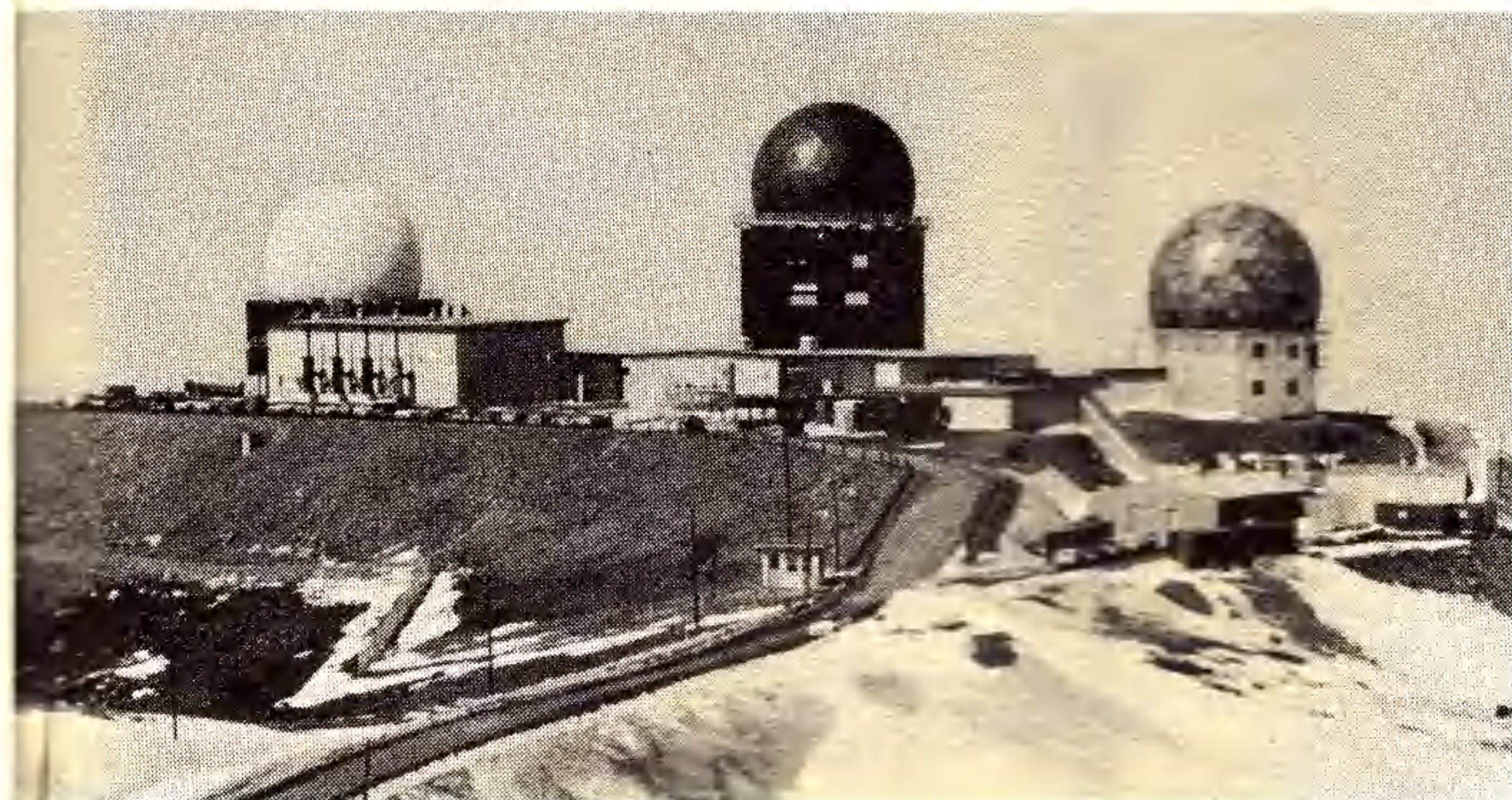
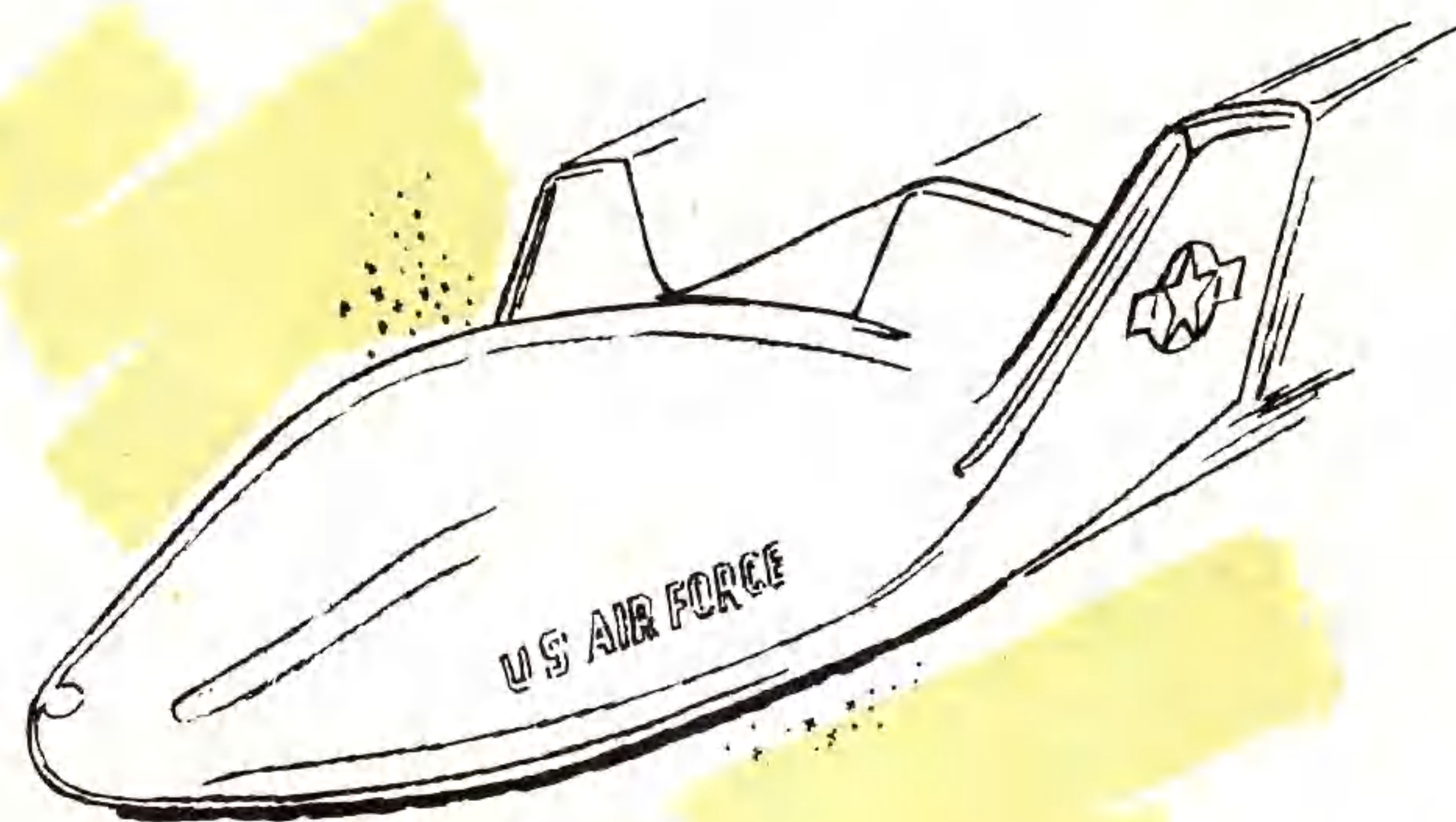
□ The first maneuverable lifting body re-entry vehicle designed for hypersonic speeds at orbital altitude was designed and is being built for the Air Force by Martin.

■ Vanguard was the first rocket designed specifically as a scientific satellite launch vehicle. Techniques and components developed by Martin for the Vanguard program considered major contributions to U. S. rocketry include: use of hypergolic fuels; use of liquid-fueled engines in upper stages; use of titanium and magnesium-thorium metals in structures; and replacement of ground timers and guidance equipment with self-contained airborne systems.

■ The first air-launched multistage ballistic missile to be launched successfully was the Martin-developed 199-B rocket (Bold Orion). A B-47 manned by a Martin crew served as the launch platform. In 1958, seven years before the Gemini rendezvous experiments, an experimental 199-B was fired into the vicinity of the Explorer VI satellite in the first practical demonstration of satellite intercept or rendezvous.

■ Martin developed the first production techniques for fusion welding the high-strength 2014 aluminum alloy, which has strength characteristics similar to steel and is used as the skin for the Titan missile.

□ The first air-transportable nuclear power plant in the world is the Martin-built PM-1, a 1,000 kilowatt reactor manufactured in Baltimore and airlifted to its operational site near Sundance, Wyo. A similar system, PM-3A, is in service in Antarctica where it is the prime power source for the U. S. scientific exploration base at McMurdo Sound.



■ A Martin scientist, Dr. Bessel Kok, discovered a key photosynthetic pigment—called P-700—believed to be the clue needed to unravel the mystery of life-producing photosynthetic energy conversion. The discovery was recognized in 1963 by the Charles F. Kettering Award for Creative Research, the first such award given to anyone working in an industrial research laboratory.

■ Most of the aerospace industry's acoustic testing technology was developed by scientists and engineers at Martin Company's Denver Division.

■ Vanguard II proved for the first time that pictures telemetered from great altitudes can distinguish land, sea and clouds—a simple but impressive forerunner of the advanced meteorological satellites of today.

□ The most significant section of a launch vehicle ever recovered from space, 23.5 feet long and 10 feet in diameter, was the forward half of the GT-5 launch vehicle first stage. Despite the destructive forces of free-fall re-entry, some of the electronics packages, rate gyros, timers and other equipment, were still in place.



PERFORMANCE / RELIABILITY

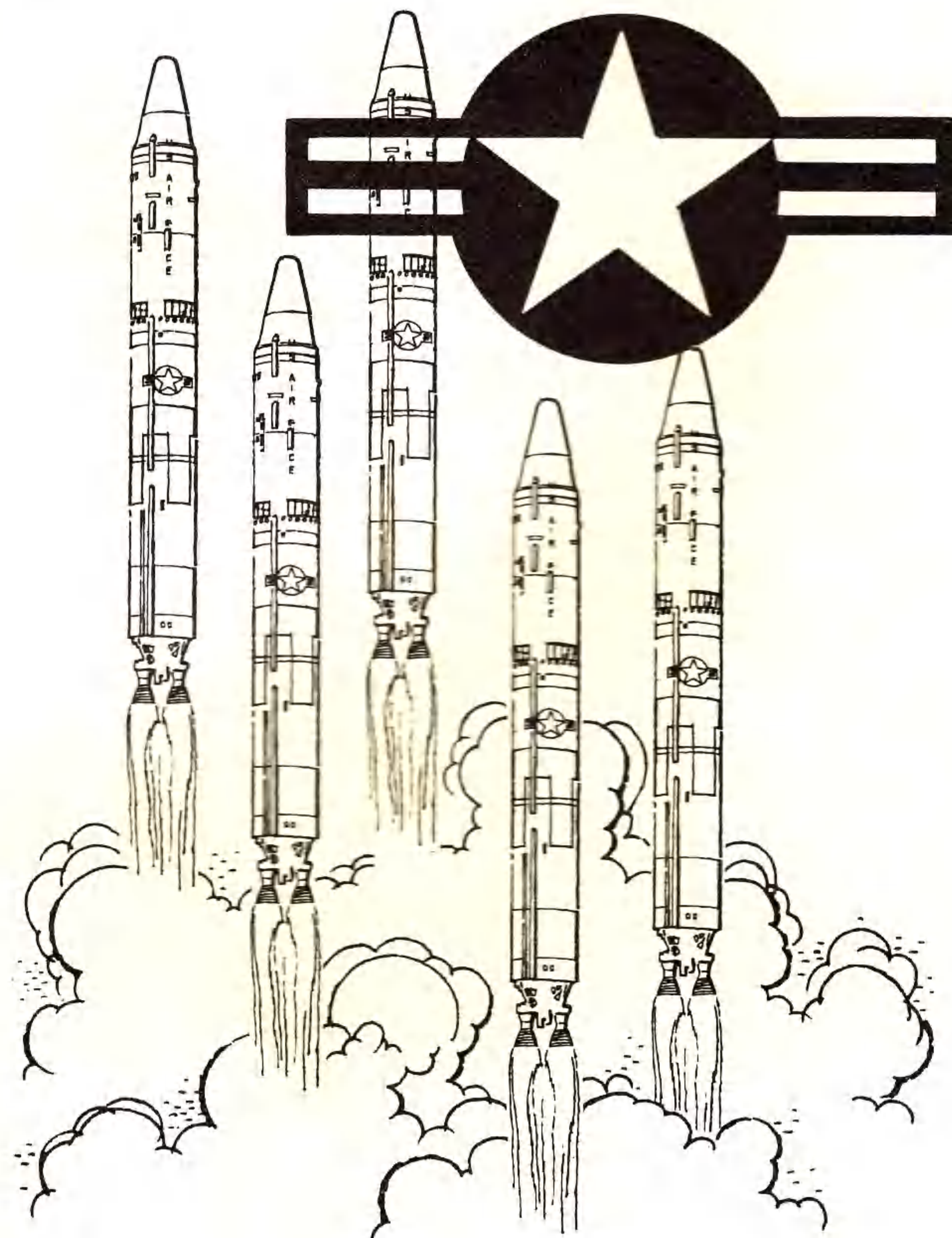
□ The Titan III Integrate-Transfer-Launch facility at Cape Kennedy is so efficient that it could have handled every launch from the Cape's famous "ICBM Row" with pad time to spare.

■ The successful flight of the first Titan III-C on June 18, 1965, proved the concept of combining the brute force of large solid rocket motors and the maneuverability of powerful liquid fueled launch vehicles.

■ All existing records for continuous operation of military nuclear power plants were broken by the Martin-built PM-1 reactor at Sundance, Wyo., with a run of 2628 hours.

■ Vanguard I, launched March 17, 1958, by the Martin-developed Vanguard rocket, transmitted data for six years. This satellite discovered eddy currents in the earth's magnetic fields; "solar" winds in the vicinity of the earth caused by sun spots; and also detected irregularities in the earth's shape giving scientists first evidence that our planet is pear-shaped.

□ Five Titan II missiles were launched in succession by Air Force crews during Demonstration and Shakedown Operations in October 1964, each impacting its payload in the target area and setting a record unequalled in ICBM history.



□ A circular orbit, more perfect than the Earth's orbit around the Sun, and less eccentric than any ballbearing ever machined, was established by a Titan III-A on December 10, 1964.

■ Only one failure occurred in the 33-launch flight test program for Titan II—a reliability record for ballistic missiles of all types. Most or all objectives were achieved on the other 32 flights.

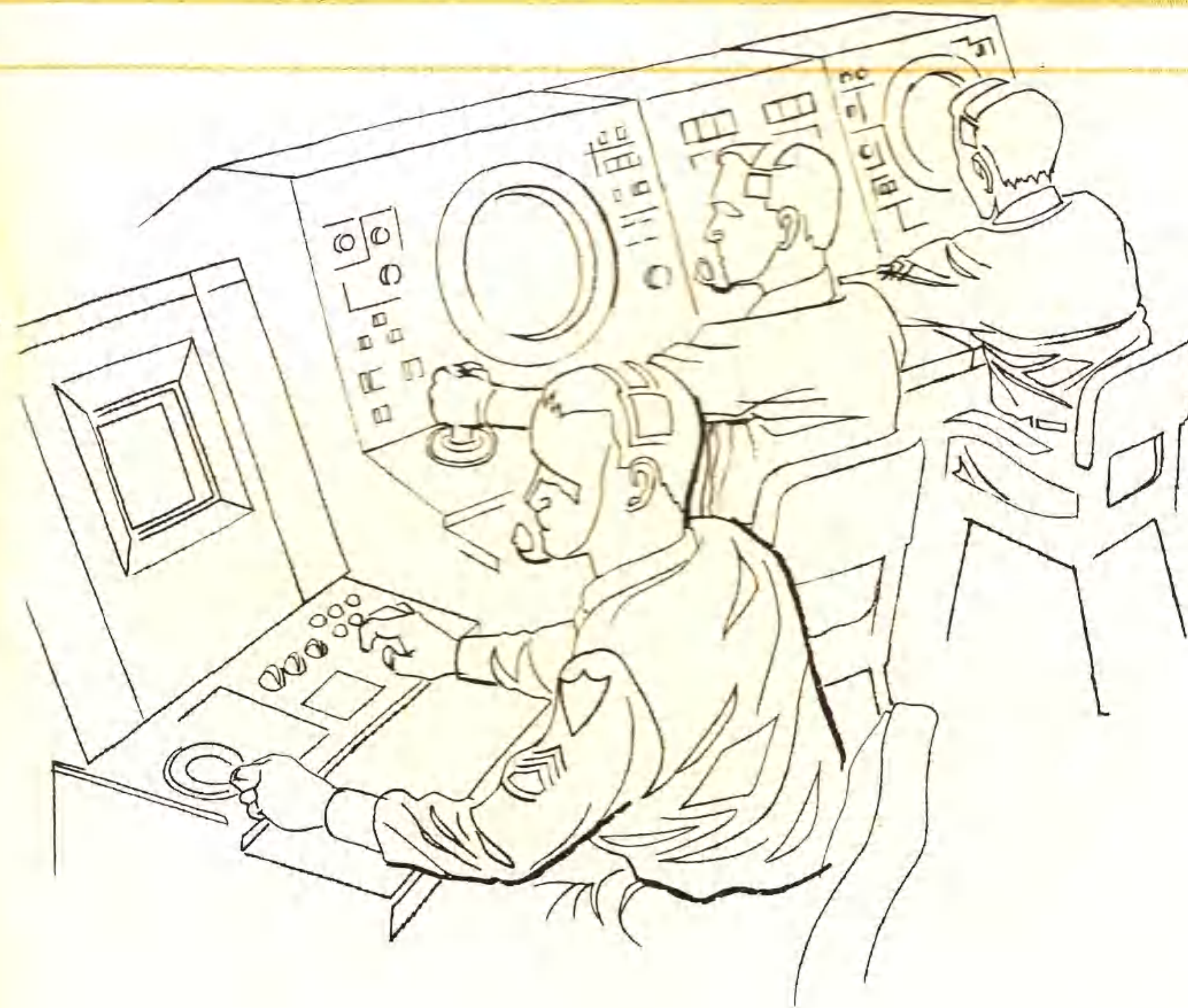
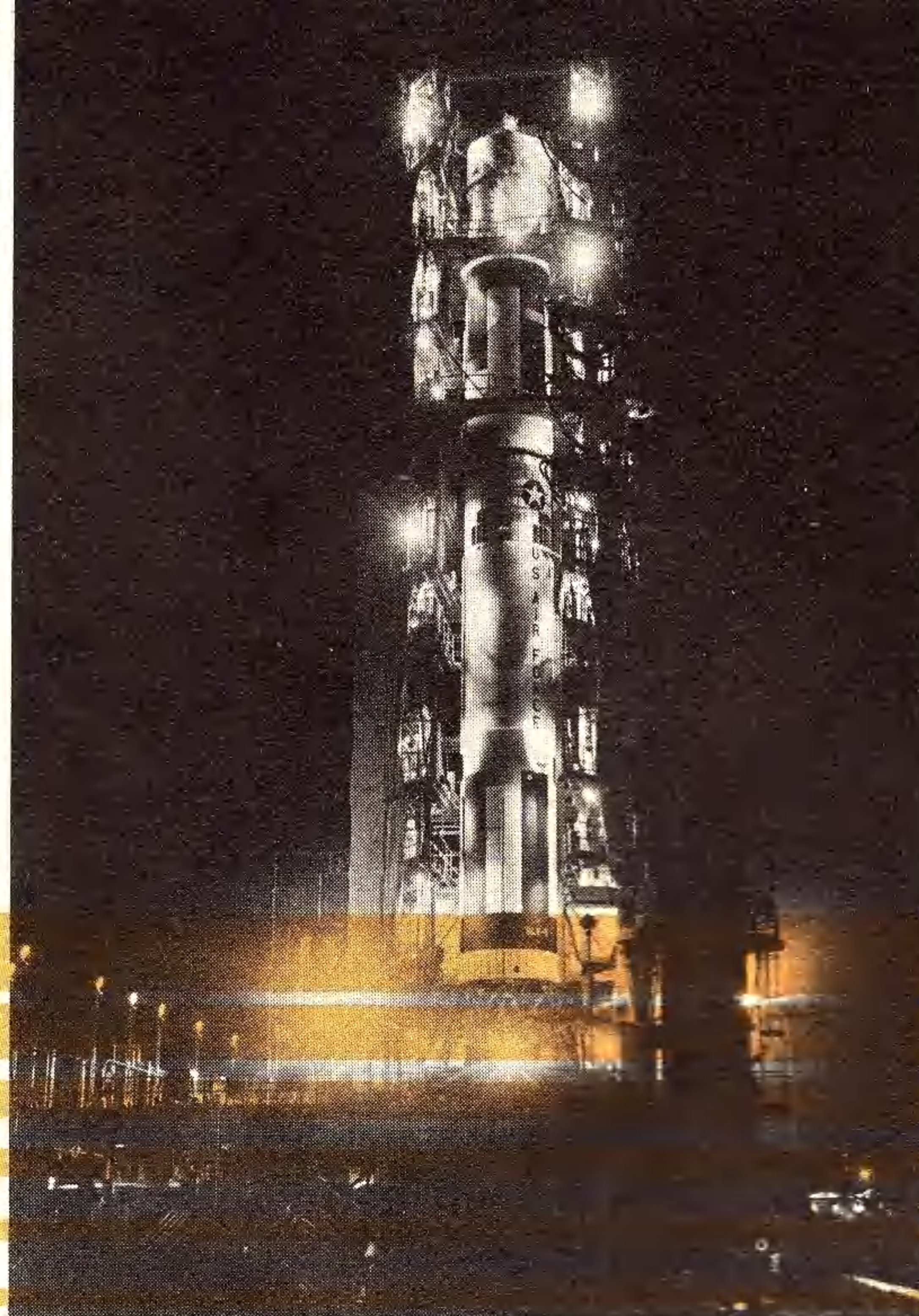
■ Because of its proven reliability and other outstanding characteristics as a weapon system, the Martin-developed Bullpup was adopted as a NATO weapon and is now being built under license in Europe by a NATO production organization with technical assistance from Martin.

■ Titan II was the first U. S. missile to undergo a successful all-systems test on its maiden flight. This was a 5000-mile flight down the Eastern Test Range on March 16, 1962.

□ Martin-built Missile Master and BIRDIE anti-aircraft fire control and coordination systems have demonstrated a reliability on the order of 98 per cent in actual operation. These systems, the first of which was installed in 1957, protect 25 of the nation's principal metropolitan areas.

■ GT-1, the first Gemini-Titan II launch vehicle, flew a perfect orbital mission, April 8, 1964, marking the first time in the history of U.S. space programs that a launch vehicle performed flawlessly on its first flight, on the scheduled launch day, at the scheduled launch time, without a moment's "hold." On August 21, 1965, the launching of GT-5 marked the first perfect, no-holds countdown for U.S. manned space flights.

■ The first manned Gemini-Titan II flight (GT-3), March 23, 1965, recorded a flawless performance for the launch vehicle, with Astronauts Virgil Grissom and John Young boosted into orbit "without a jiggle or a bump."



2nd Edition
October 1965

MARTIN AVIATION MILESTONES

- First extended over-ocean flight*
- First aerial bombing experiment*
- First Army training plane*
- First multi-passenger plane*
- First free-fall parachute jump*
- First armored plane*
- First armed pursuit plane*
- First twin-engine bomber*
- First bomber to sink a battleship*
- First night air mail plane*
- First all-metal monoplane*
- First all-metal seaplane*
- First successful large plane designed to be launched from carriers*
- First practical dive bomber*
- First "modern" bomber*
- First air-cooled engine bomber*
- First enclosed gun turret*
- First commercial plane equipped with air-cooled engines*
- First trans-Pacific air mail flight*
- First trans-Pacific passenger flight*
- First Army plane equipped with powered gun turrets*
- First Allied bomber to complete 200 missions*
- First aircraft to use tandem landing gear*
- First bomber with rotating bomb bay*
- First six-jet bomber*
- First post-World War II ground support bomber*
- First aircraft with performance-improving T-tail*
- First aircraft employing self-sealing Mareng cell fuel tanks*
- First jet seaplane*

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