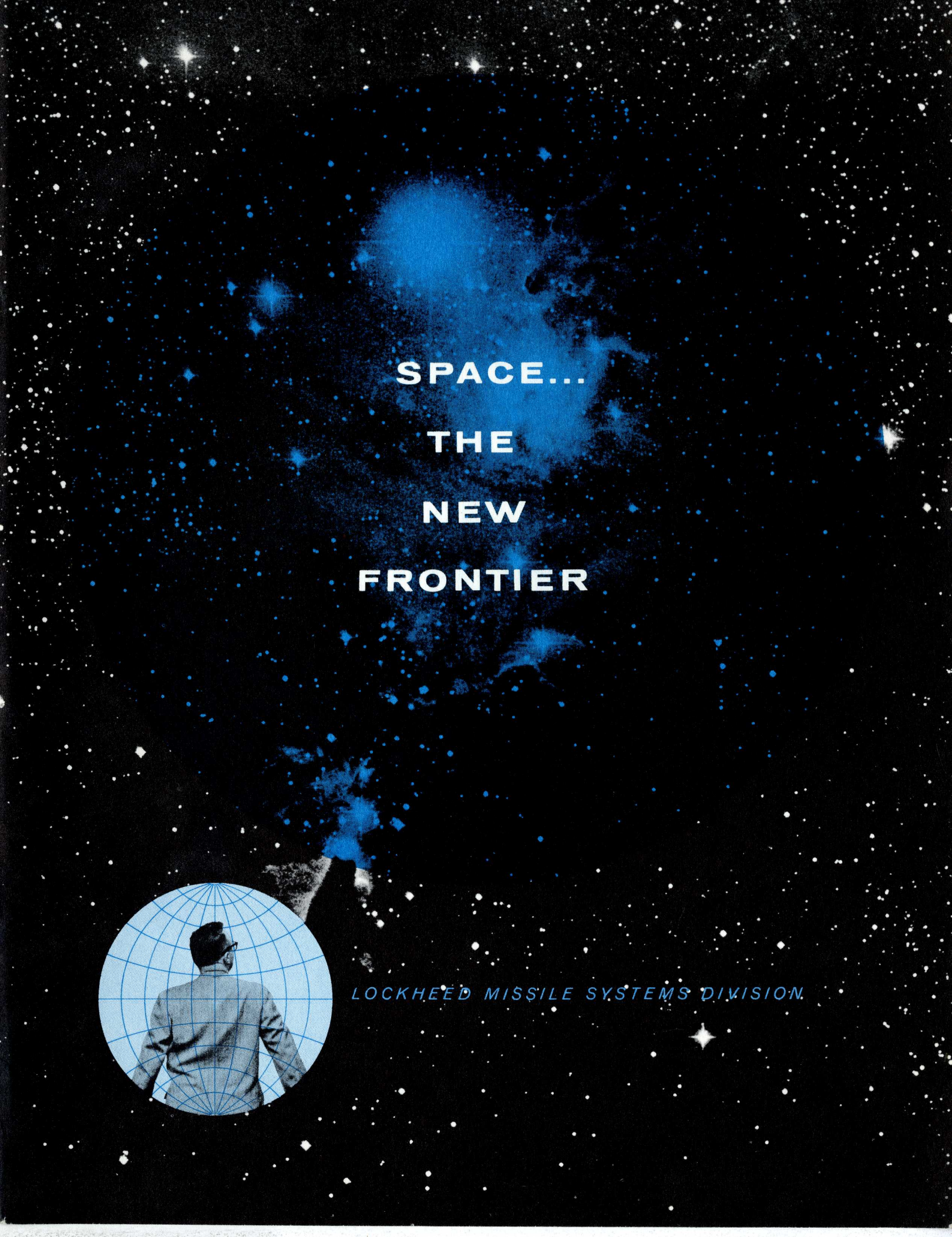

SPACE...
THE
NEW
FRONTIER
LOCKHEED MISSILE SYSTEMS DIVISION

SPACE...THE NEW FRONTIER

To review our history,
objectives and achievements
...to describe our work,
facilities and capabilities...

ORIGINAL PHOTOGRAPHY BY CHARLES TOTTEN PRINTED IN U. S. A.


ON THE THRESHOLD OF

TOMORROW

The discovery of America was more than the discovery of a new world. It was a discovery of a new way of life. For it promised the realization of long-sought human ideals. And the greatest of these are equality and freedom.

The development of this new world required the conquering of great frontiers.

Today we are face to face with an even greater, new frontier—Space! This Age of Space, as it has been aptly named, is filled with vast potentials—for incalculable good and immeasurable evil.

For it creates imperative demands for new discoveries, new inventions, new patterns of method and measurement. And it is with these that we at Lockheed Missile Systems Division are now concerned.

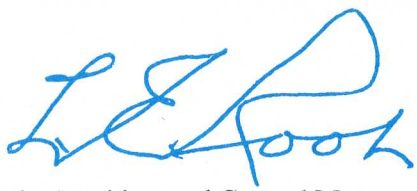
Of necessity, military weapons must receive first consideration. But the scientific accomplishments that make possible these instruments of defense are being shaped to serve and benefit humanity.

Scientists today are wrestling with major problems. Among these is *power:* how to attain more thrust from present types of engines; how to perfect the vital ion engines for space; how to develop ingenious devices for auxiliary power.

Guidance and control pose another major problem. *Communication* still another. The fourth—and vitally important—problem is *reliability*. For we must make our missiles and space vehicles work *right,* every time, in every situation, under every conceivable condition.

All these problems—and countless more—confront the outstanding scientists and engineers who have made Lockheed an acknowledged leader in missiles and spacecraft.

We are in the midst of a gigantic scientific and engineering effort—an effort to explore and conquer the great new frontier of space. And, as we stand poised on the threshold of tomorrow, this much is certain: the forces that motivate our technical and scientific advances today will continue to propel us into ever-widening areas of discovery and invention.



Vice President and General Manager
LOCKHEED MISSILE SYSTEMS DIVISION

SUPER CONSTELLATION

LOCKHEED...YESTERDAY AND TODAY

The history of Lockheed begins in 1913—on the day when, for 20 memorable minutes, a man named Allan Lockheed piloted his Model G hydroplane over San Francisco Bay.

This hydroplane—the design of two air-minded brothers, Allan and Malcolm Lockheed—was the first Lockheed-built aircraft ever to fly the sky. Moreover, it was the first multi-place, tractor-type seaplane ever constructed.

All real growth—even the sturdiest and most flourishing—is gradual. It was 1916 before the brothers formed a small company in Santa Barbara, built a twin engine, 10-passenger flying boat.

In the late '20's Allan opened a shop in Hollywood, started construction of a plane that was to bring world-wide fame to Lockheed. Its name: the Vega.

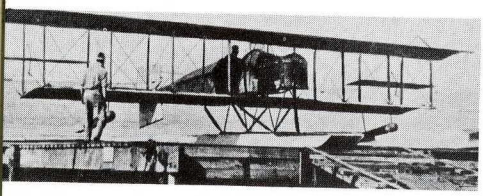
Production now shot forward. Lockheed was expanding and needed more room. So the company moved to Burbank. Here it was that Lockheed built planes around whose names an aura of magic still clings: the Air Express, the Sirius, the Altair, the Orion.

In 1932—the depth of the depression—Robert E. Gross, with several associates, bought the Lockheed company and reorganized it. Shortly after, the courageous new owners staked everything they had on an all-metal, twin-engine transport called the Electra. The transport proved a conspicuous success and marked what is usually regarded as the real beginning of the present company.

Since then, Lockheed has hung up many noted firsts. Especially notable were the wartime successes of its P-38 Lightning interceptors, Hudson bombers, Venturas, Neptunes and other piston-engine aircraft. In early 1944, Lockheed built and flew the country's first jet fighter—the P-80 Shooting Star. The P-80 set another first—it was the victor in history's first all-jet air battle in Korea in 1950. Since that epochal beginning, Lockheed has built more jets than any other company.

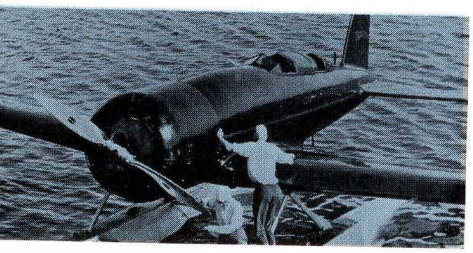
Shortly after VJ Day, Lockheed entered the four-engine, commercial field with its world-famous triple-tailed Constellation, which established new standards of luxury air travel and set speed records around the world. Constellations have also proven their effectiveness with the military as transports and as flying radar pickets.

Carrying on the Lockheed tradition of transport leadership is the new Electra, the finest jet-powered airliner for city-to-city travel, and the new JetStar, a 10 place utility jet trainer/transport. The JetStar set an unusual engineering record. It was completed in *34 weeks from start of design to first flight.*

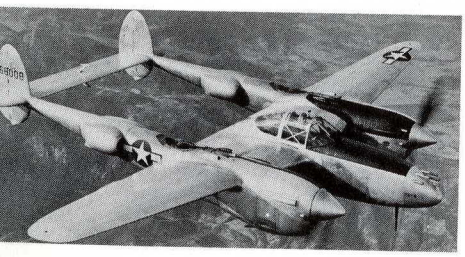


MODEL G SEAPLANE

5 PLACE VEGA

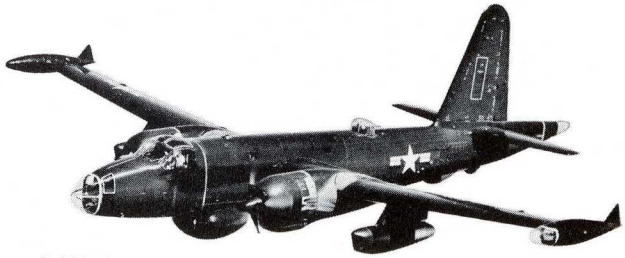


CHARLES A. LINDBERGH WITH SIRIUS

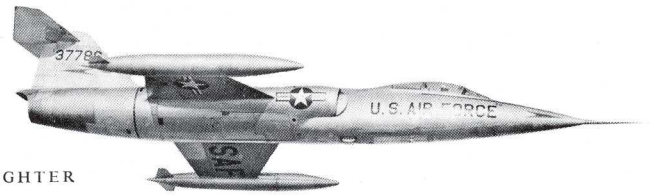


P-38 LIGHTNING

HUDSON BOMBER



P2V-7 NEPTUNE PATROL BOMBER



F-104 STARFIGHTER

10-PASSENGER JETSTAR

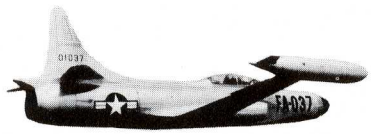
Perhaps the finest tribute to the efficiency of Lockheed's engineering skill in aircraft is its triple triumph in holding simultaneously the world's distance, altitude and speed records. This is the only time in modern aviation history that all three of these major world records have been held by the airplanes of one company. Lockheed achieved this distinction in 1958, when its revolutionary Air Force F-104 Starfighter added the altitude (91,249 ft.), and speed (1,404 mph) records to the company's previously established Navy P2V Neptune distance record from Perth, Australia to Columbus, Ohio—a nonstop flight of 11,236 miles without refueling.

It was as a builder of manned aircraft that Lockheed reached its present stature. Today, Lockheed is one of the largest corporations in America with assets of more than $400 million, and a well balanced diversity between commercial and military programs.

But now with the dawn of the Space Age, company activities are expanding into vast new areas of science. Among these are: manned space vehicles; missiles and satellites; electronics; nucleonics; ultrasonic aerodynamics; new methods of propulsion; investigation of outer space and many other related activities.

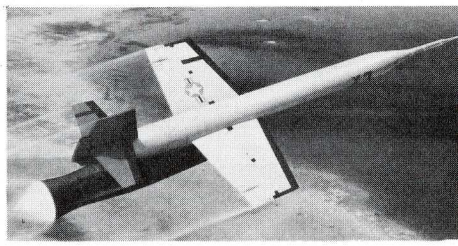
But great as are Lockheed's material assets, much of the company's real strength lies in its sturdy intangibles: its vast store of accumulated knowledge; its experience; its sustained competence; its maintenance of leadership. But above and beyond these great resources is still another —the people who make up the Lockheed Family. They consist of the men who have been "at the controls" for more than a quarter century; the employees who have contributed their skill and know-how; the 25,000 stockholders; and the engineers and scientists who have made possible Lockheed's technical leadership. Together, they represent not only faith in Lockheed but faith in the future of flight.

HERCULES SKI-130



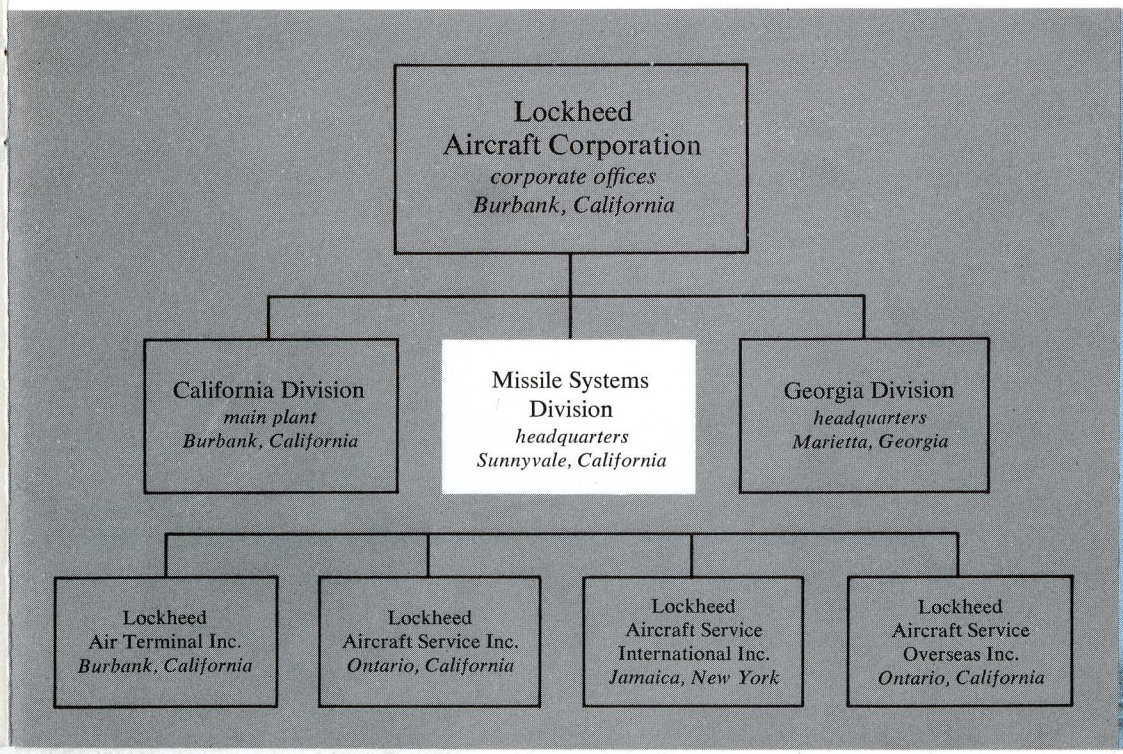
F-94C STARFIRE

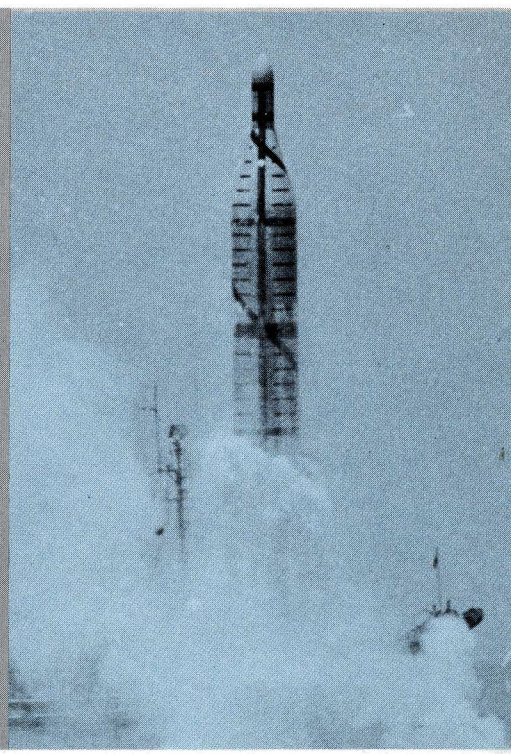
THE ELECTRA

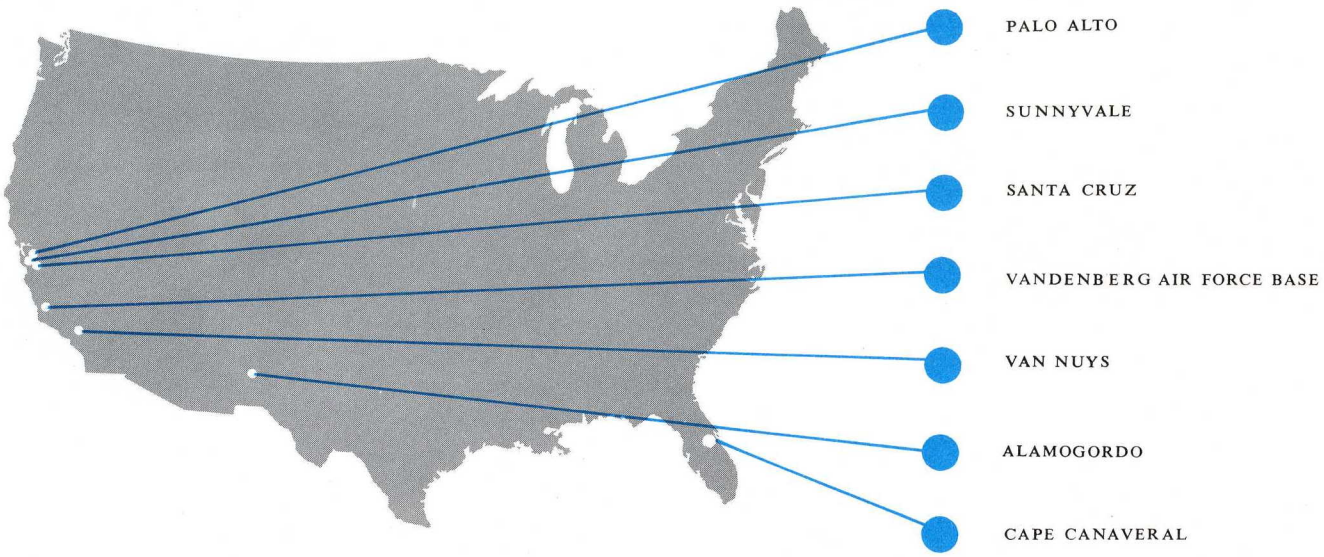


X-7 MISSILE

Pop-up test of Navy Polaris IRBM.







THE MISSILE SYSTEMS DIVISION

"The organization that contributed most in the past year to the development of the art of missiles and astronautics."

This tribute, recently paid Lockheed Missile Systems Division at the first National Missile Industry Conference, reflects the pre-eminent position the company now occupies in the astronautics industry.

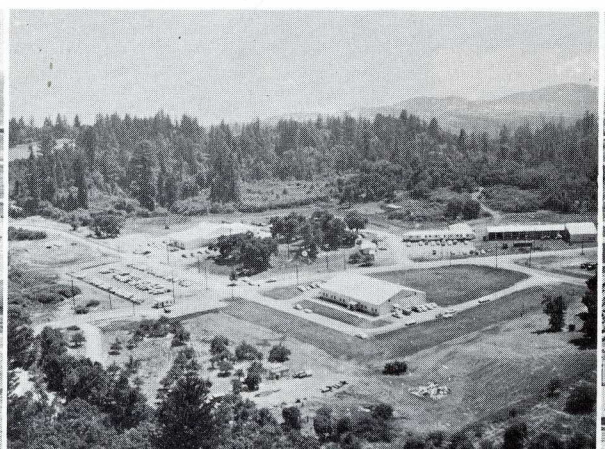
Lockheed's activity in the missile field actually began in 1939. In that year, Lockheed won an Army Air Corps design contract to build a pilotless aircraft. Simple and ingenious, this winning proposal was prophetic of events to come. In performance it represented no marked advance over the designs of the day, but there was one major difference —it was ground-controlled. And thus was launched Lockheed's present broad missile and space program—ranging from sophisticated weapons systems to space vehicles.

Shortly after World War II, Lockheed's design experts began work on a military project—the X-7 ramjet test vehicle. By 1953, Lockheed had greatly expanded its effort in missiles and electronics; and had established a new Division with headquarters at Van Nuys, California.

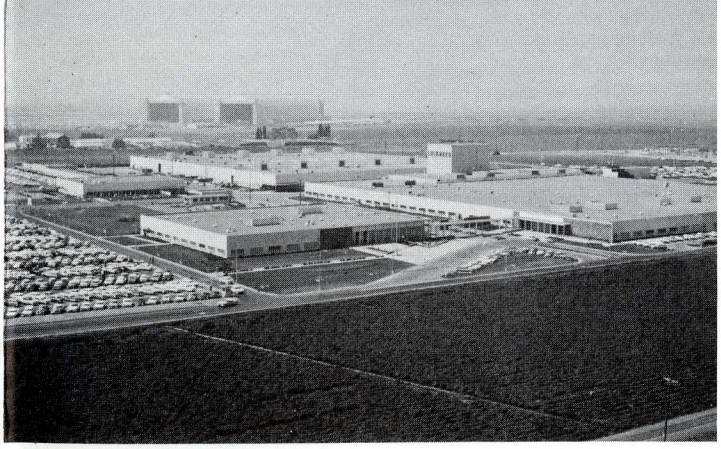
The new Division forged ahead rapidly. In 1956, additional facilities were constructed and headquarters moved to Sunnyvale on the San

Holloman Air Force Base, Alamogordo.

Santa Cruz Test Base.



Van Nuys facility.



Division headquarters, Sunnyvale, California.

Francisco Peninsula. New research and development facilities were located in the Stanford Industrial Park in nearby Palo Alto.

There is only one word to describe the growth of the Lockheed Missile Systems Division—phenomenal. Its field of activities embrace every facet of research and development, engineering, test and manufacture.

Lockheed scientists and engineers work in many different fields of missile and space technology; and on a score of significant projects for the armed forces.

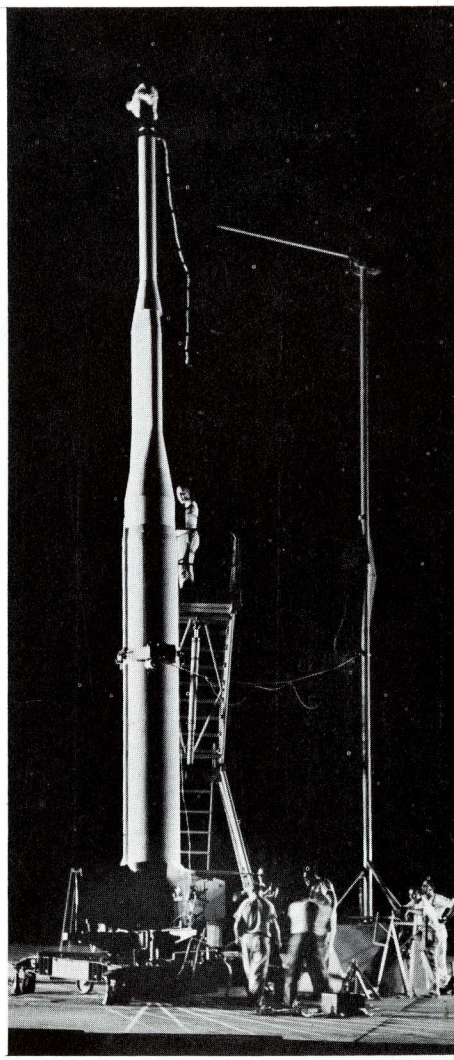
Because of its wide scope of activities and facilities, Lockheed Missile Systems Division easily ranks as one of the largest companies in the industry. The Division now occupies more than a million, seven hundred thousand square feet of laboratory, engineering, manufacturing and office space. Another six hundred thousand square feet is under construction.

The company's facilities at Sunnyvale, Palo Alto and Van Nuys provide complete scientific and technical equipment, including one of the most modern computing centers in the nation.

A 4,000 acre company-owned static test base in the Ben Lomond mountains near Santa Cruz provides for all phases of static field testing. Other Division facilities are maintained at Cape Canaveral, Florida; Alamogordo, New Mexico; Vandenberg AFB near Santa Maria, California; and Hawaii.

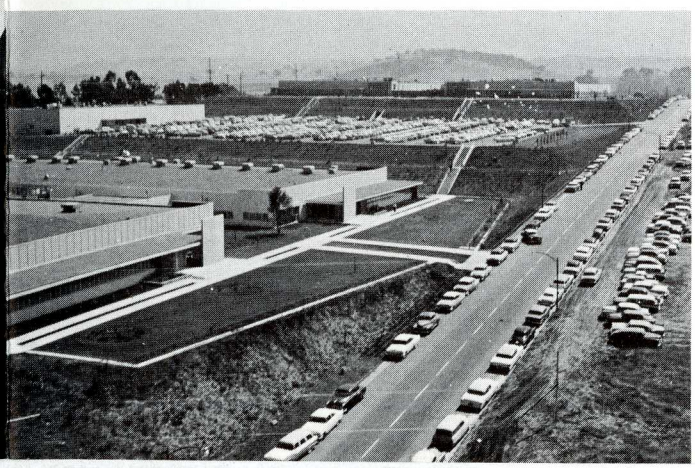
Lockheed holds two of the nation's top-priority, long-range projects; the Air Force Earth Satellite and the Navy Polaris IRBM. Other important projects are the Army Kingfisher, Air Force X-7 and Q-5.

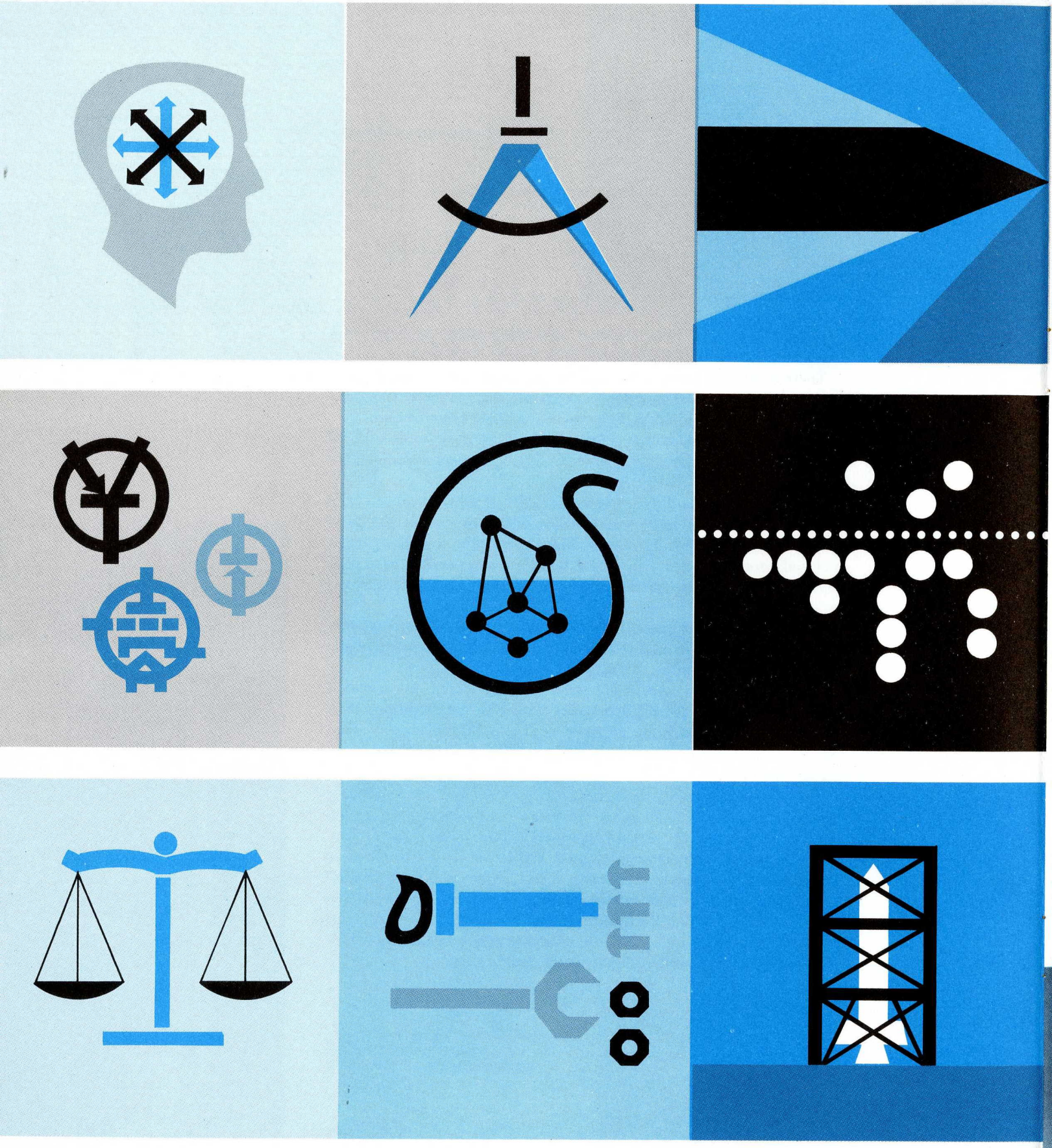
To carry out such complex projects, the frontiers of technology in all areas must be expanded. There is a continuing need for high-level scientists and engineers for research and development, engineering and manufacturing. For the Lockheed Missile Systems Division programs reach far into the future. And it is a rewarding future which men of outstanding talent and inquiring mind are invited to share.



X-17 flight testing is example of Lockheed activities at Cape Canaveral and Vandenberg AFB.

Palo Alto facility.



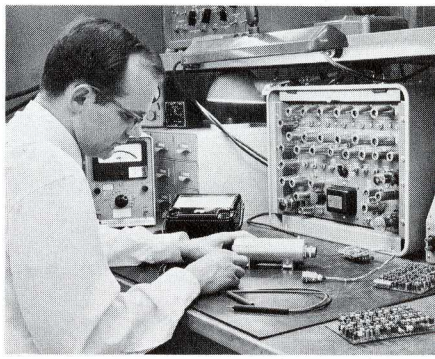


RESEARCH AND DEVELOPMENT

Probably nowhere in industry is the research scientist given more freedom, recognition and opportunity to explore than at Lockheed Missile Systems. Successful companies must always plan for the future. And Lockheed recognizes that its future progress and leadership are dependent on the scope and importance given to research today.

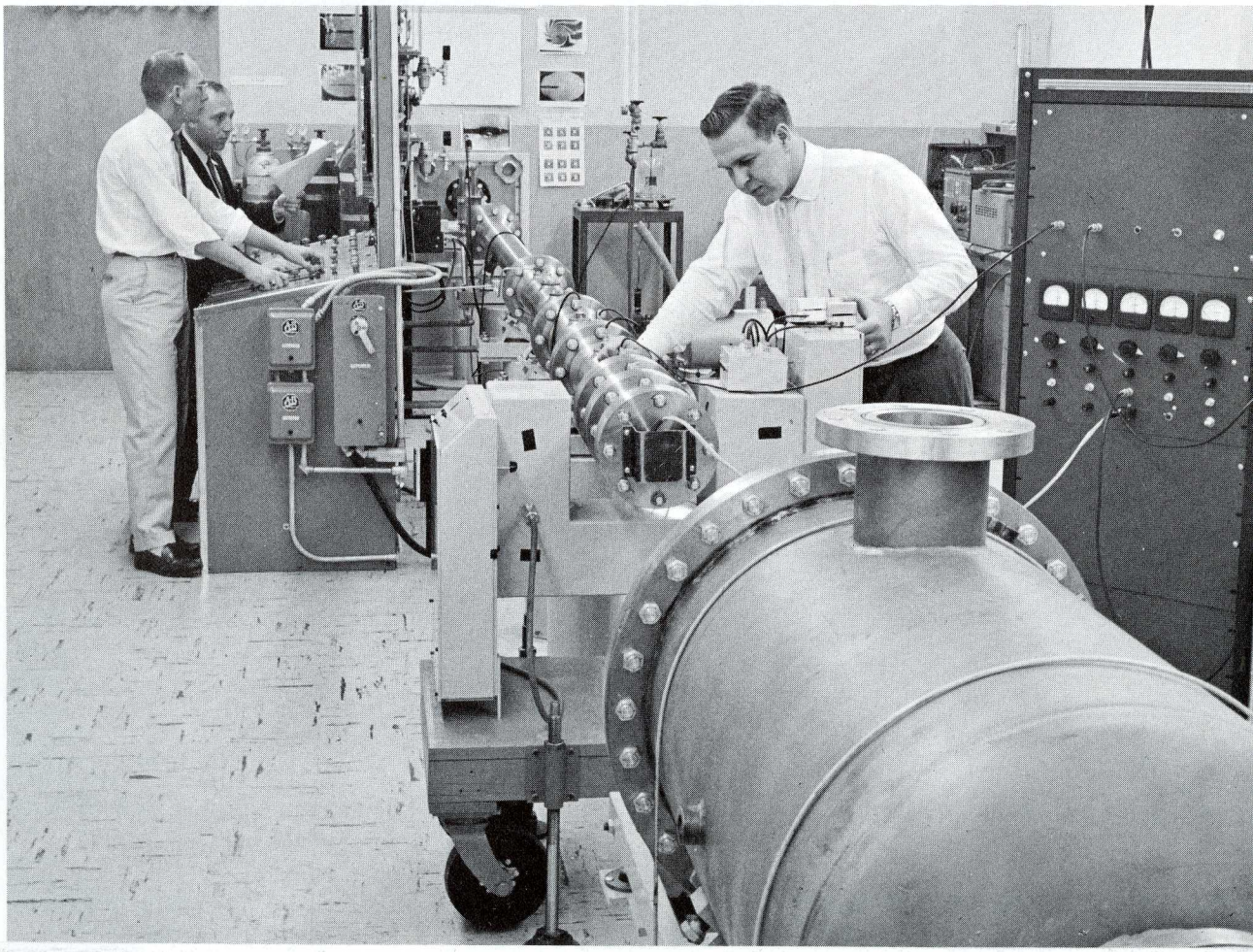
Lockheed devotes more of its own funds and has created larger facilities for research and development than any other company in the missile and space industry. The company encourages and sponsors individual communication with other scientists, the publication of papers and articles, and participation in symposiums and conventions.

A partial list of research programs under investigation includes man in space; space communications; reentry; ionic propulsion; solar sailing; nuclear propulsion; magnetothermodynamics; oceanography; computing machine memories; ultrasonic aerodynamics; human engineering; noise suppression; materials and processes; boundary layer control; electromagnetic wave propagation and radiation; and operations research and analysis.



Monitoring new air-borne 6″ miniaturized TV camera, a Lockheed first in both the missile and television fields.

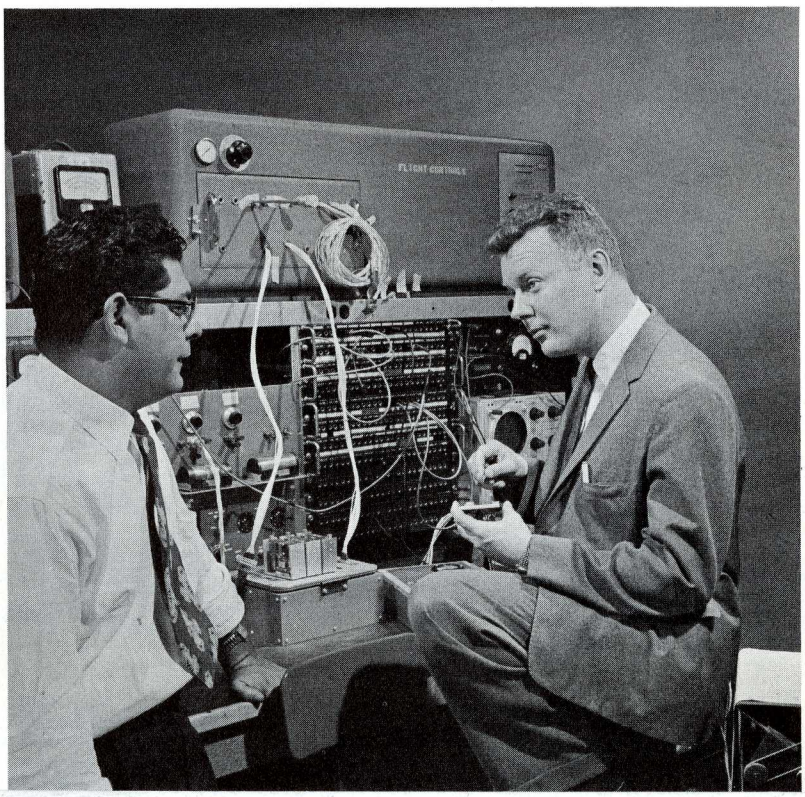
44-foot shock tube—the fastest and hottest tunnel in private industry—can produce speeds up to Mach 22 and temperatures of more than 12,000°F.



FLIGHT IN THREE MEDIUMS

Several things set the Navy Polaris IRBM apart from other outer space weapons in the ballistic missile category. For the Polaris program involves a wholly new concept of weaponry:

- It is the first of the Second Generation missiles.
- It will be dispatched from beneath the surface of the sea.
- It will be radically smaller than currently-developed, land-launched missiles. Yet its payload will be as effective and its range the same as other IRBM's.
- It will be the first operational outer space missile to employ solid fuel as a propellant.
- In a single flight it will travel through three mediums: water, air and outer space.
- Its launching base—a submarine—is a mobile vehicle.
- With three-quarters of the earth's surface being water, almost no target in the world lies outside the Polaris' range.



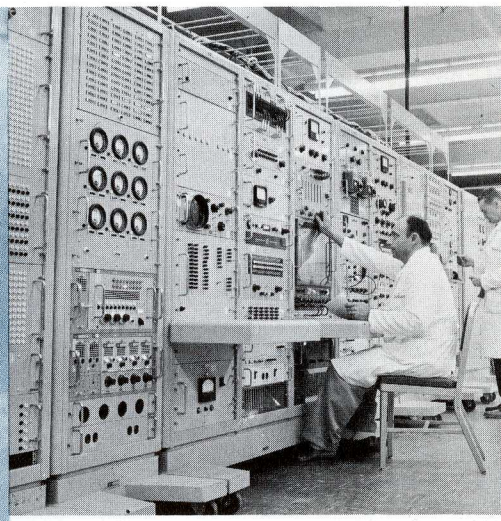
Transistorizing missile flight control systems by Lockheed scientists has meant significant reductions in weight and space requirements.


akimoto

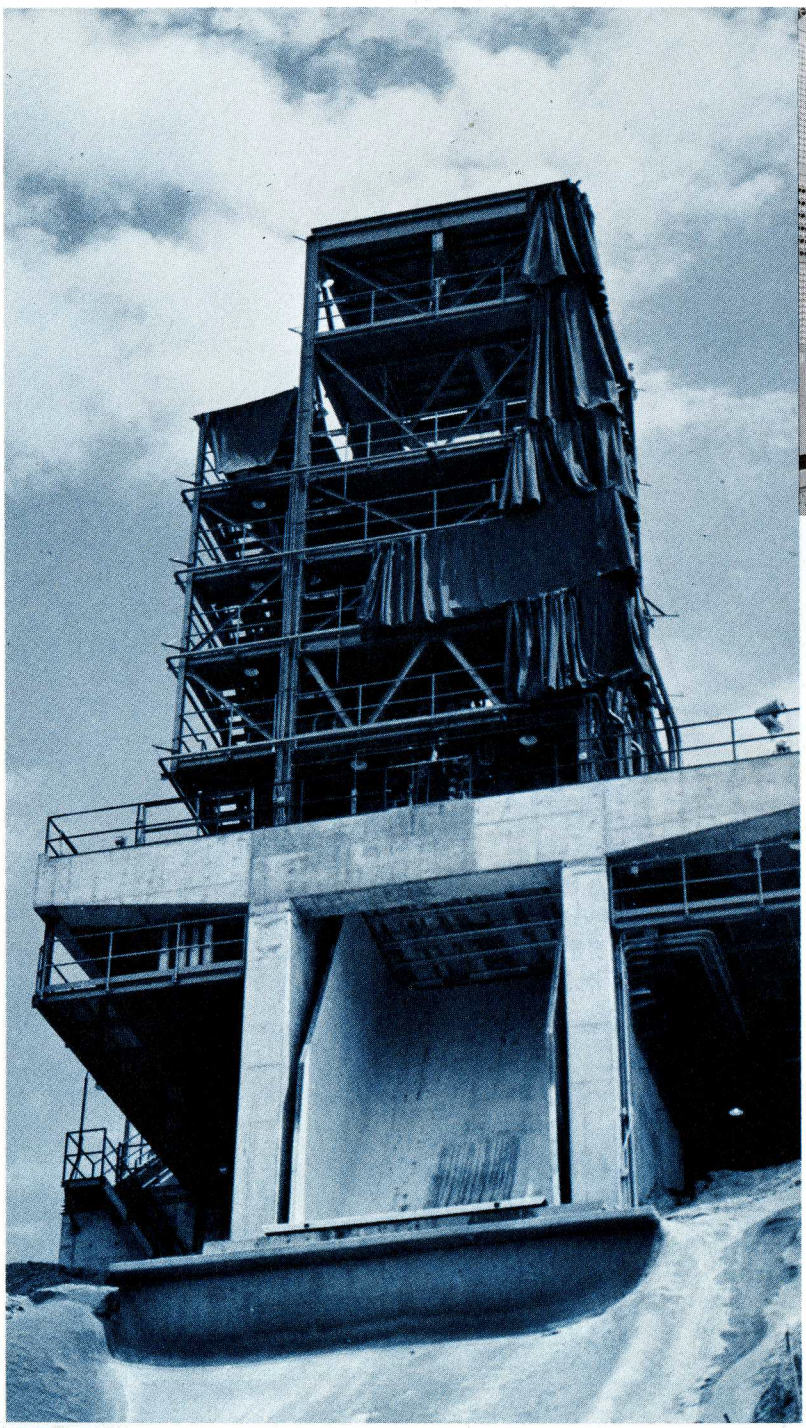
OUTER SPACE

Very little can be said about the Air Force Earth Satellite program at this time, except that its success has necessitated advancing the state of the art in all sciences.

The Earth Satellite is perhaps the most sophisticated outer space program to reach the hardware stage in the U. S. today.



Lockheed-designed automatic missile check-out equipment for quick determination of flight readiness.



One of the Santa Cruz test stands with dynamic thrust mount to simulate flight environment. Vibration oscillator functions during static firings.

ENEMY SIMULATOR, X-7, X-17

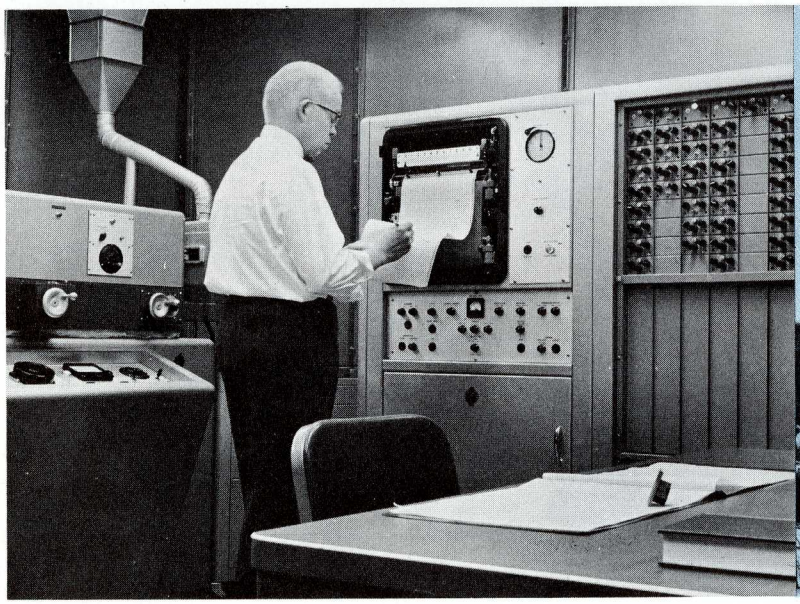
The Kingfisher is the nation's fastest target missile. Developed for the Air Force as the Q-5, and now being manufactured for the Army, the Kingfisher tests the accuracy of our newest supersonic weapons.

It is a ramjet target vehicle with Mach 2-plus capability. It not only has speed to match the defensive missiles, but can also simulate a vast array of supersonic enemy missiles and airplanes attacking from great heights. It is instrumented to score near misses, and even theoretical hits, without itself being destroyed.

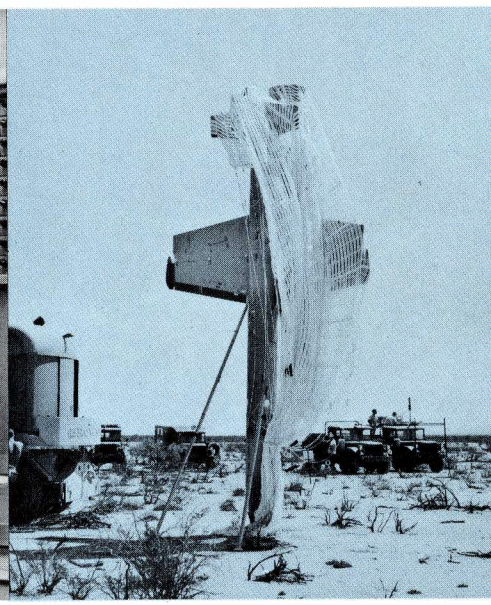
The Kingfisher is recoverable from flight by parachute, permitting weapon system evaluation to be conducted at greatly reduced cost.

The Air Force X-7 is the fastest and highest flying, air breathing test vehicle in the world. Now in full production, it provides a flying test laboratory for the advanced development of ram-jet engines.

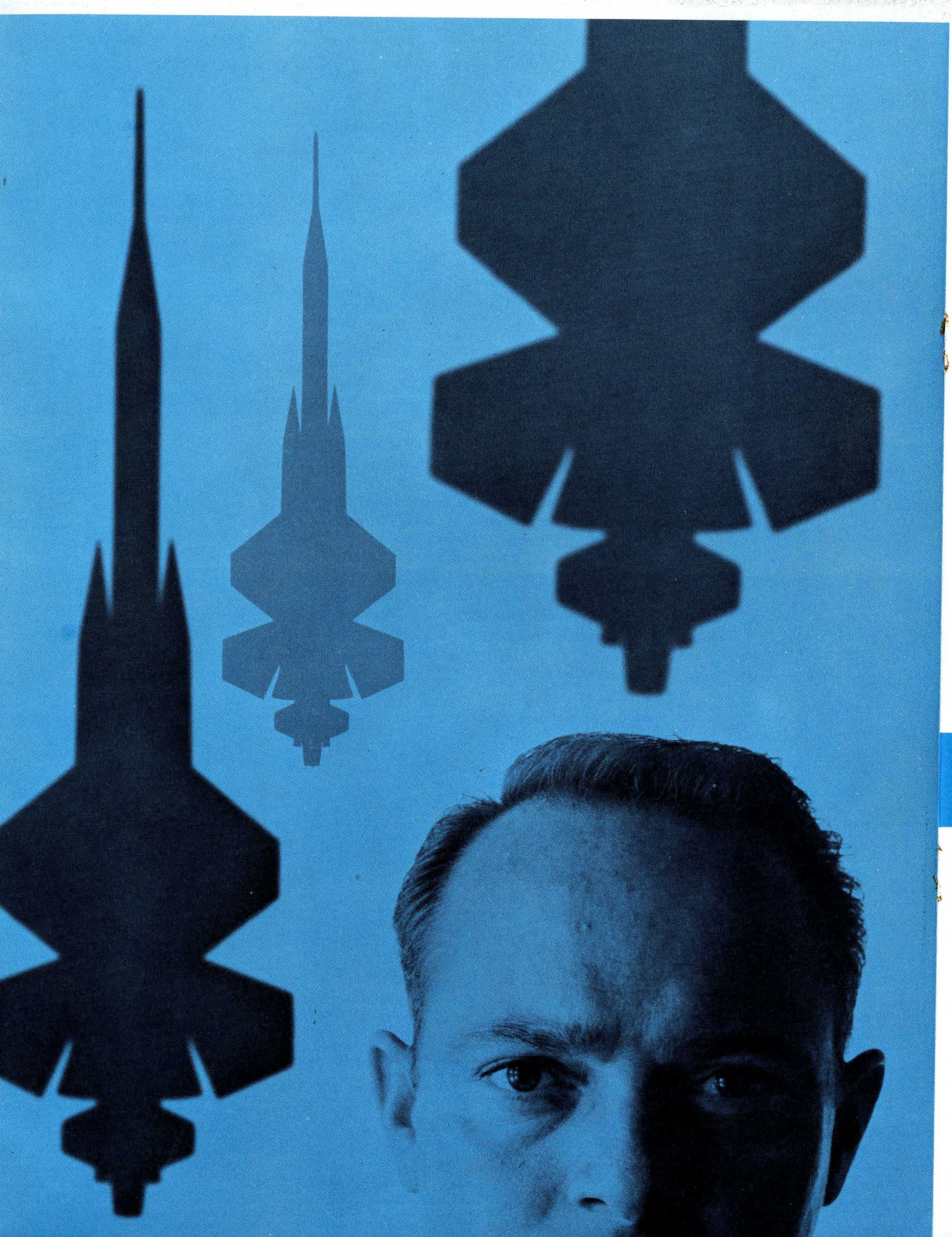
The nation's first successful reentry tests were conducted with the Air Force X-17, and many problems connected with reentry have been solved as a result of this important program. It was also the first large missile to use a solid propellant fuel. The valuable experience gained from this program facilitated the development of Polaris.



The Quantograph—a quantometer, monochrometer, spectograph combination—performs an extremely rapid analysis of any alloy.



X-7 ramjet is recovered by parachute to be flown again and again on engine development missions.



ADVANCED MISSILE AND SPACE TECHNOLOGY

The Missile Systems Division is engaged in all fields of missile and space technology—from concept to operation.

Some of the Division's major activities are highlighted in the following pages . . .

One of the most challenging areas is in advanced systems research. Here future programs are explored, requirements established, preliminary design and analysis performed and experimental models built. Proposals also originate here for the design of new systems for immediate and long term development. Scientists in this area extrapolate from the present state of the art applications as far as a decade or more away.

Important research is conducted in nucleonics. Studies embrace nuclear weapons, hydrodynamics, opacity, thermal and nuclear radiation. Also under investigation are: reactor physics, including criticality, shielding and heat transfer; theoretical research in nuclear, atomic and molecular physics; experimental research in low energy nuclear physics, including fast neutron physics, nuclear reactions and radiation physics.

A special materials research laboratory affords opportunity for high and low temperature studies, metallographic research, gas-reaction ex-

Part of the Division's $3,500,000 advanced computer center. Equipment includes the latest in high-speed digital and analog computers, including 2 Univac 1103A models.

Flight scientists discussing the structural aspects of solar sailing—space travel with the aid of solar radiation pressure—one of the many far-reaching Lockheed studies.

periments, resistance heating, measuring, and high vacuum control and recording.

Work in ionic physics is grouped under two major areas: space physics and plasma physics. In both areas, work is divided between missile and space applications, and open-end exploratory research.

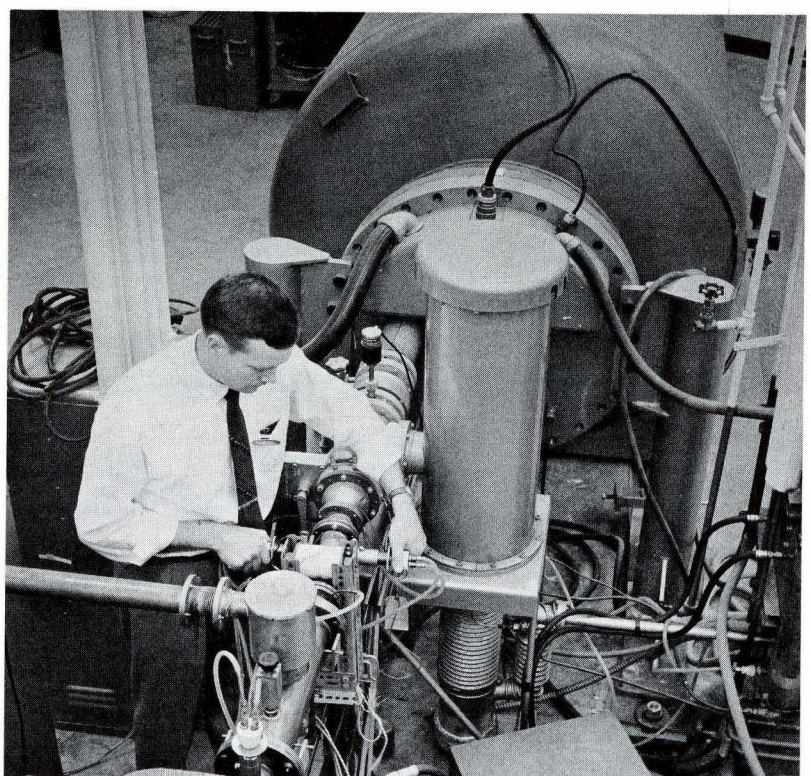
In space physics, particular interests include geomagnetism; atmospheric composition and temperature; effects of micro-meteorites and electromagnetic radiation. Plasma physics research includes magneto-hydrodynamics, which embraces hydromagnetic propulsion; magnetically driven shock tube studies; effects of strong magnetic fields on electromagnetic propagation; and the conversion between plasma and electrical energy. Other plasma physics studies are of high temperature gas properties—such as opacity, transport coefficients, electron and ion reaction rates—and helium second sound studies and nuclear reaction.

Chemistry plays a highly important role in test, materials research, metallurgy, solid state electronics, ordnance and propulsion.

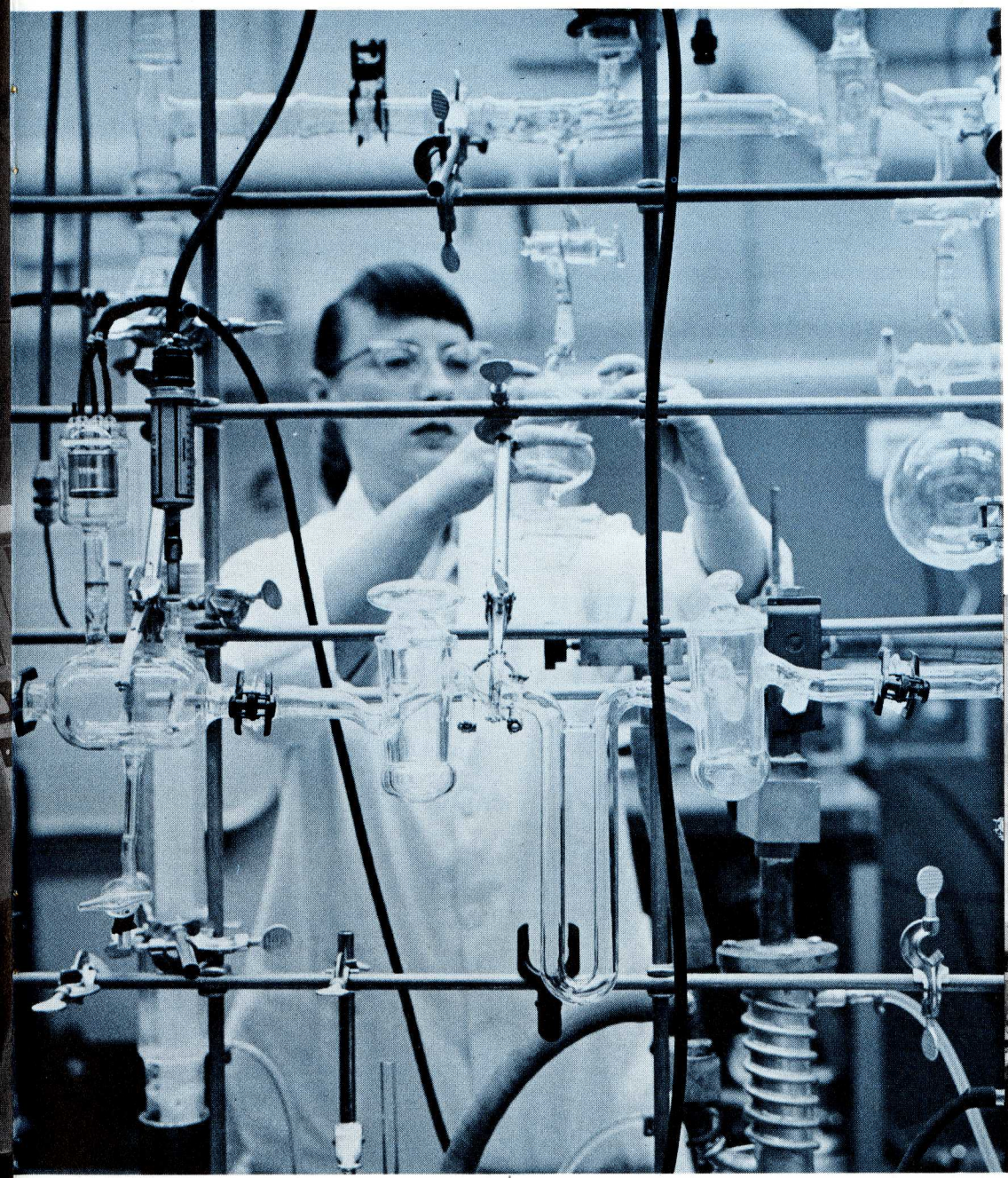
Special materials research is being conducted for advanced missile, space and nuclear applications. Programs include research in high and low temperature materials; radioactive and toxic materials; pure metals; properties of beryllium and the alloys; and the development of refractory and special-purpose metals, cermets and ceramics.

Other chemical studies embrace reaction kinetics and thermodynamics, and the development of new and exotic fuels, high-energy batteries and fuel cells, and explosives.

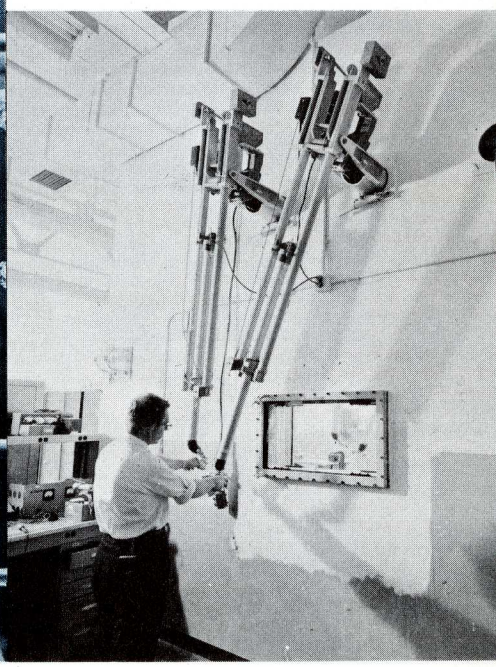
Mathematics is fundamental to the advancement of missile and space technology. Numerical analysis plays a key role, especially in connection with Lockheed's advanced computer center. Game theory, queuing theory, probability theory and modern algebras are important in the



3 million electron volt
Van de Graaff accelerator—typical
of the advanced type of equipment used by
Lockheed research scientists.



Vacuum systems used in study of gas metal reactions at elevated temperatures—one of many studies in the Division's broad materials research program.



The "hot cell"—part of the equipment for advanced radiation research in the nuclear physics laboratory.

development of mathematical models to aid in the design and understanding of subjects as wide-ranging as logical computing systems and the forecasting of financial requirements. The understanding and solution of complex orbit and trajectory problems associated with space navigation place heavy emphasis on geometry and analysis.

The computer center provides the very latest in high-speed digital and analog computers and associated equipment, including two digital Univac 1103A models and two 60 amplifier and two 20 amplifier analog computers.

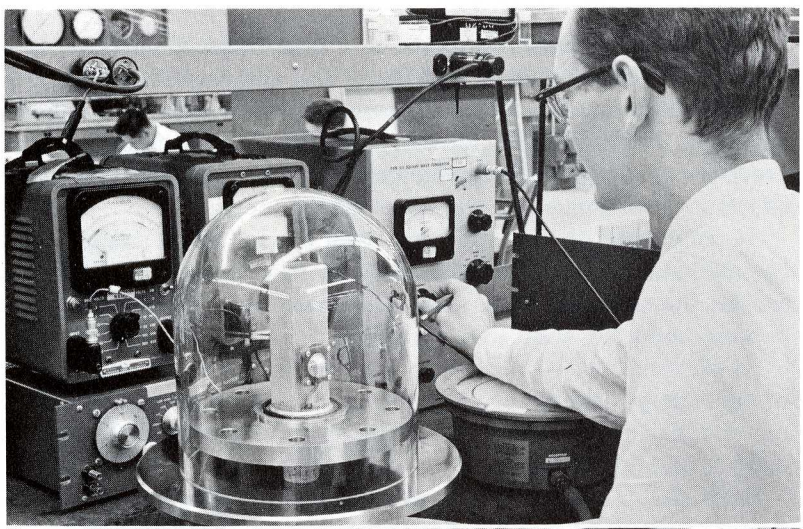
Electronic development at Lockheed has paralleled and contributed to the advancement and diversification of the art itself.

In the design and development of computers, for example, research is being conducted in the building of machines capable of reading 5,000 characters a minute; in the development of high speed digital plotters which will operate up to 5,000 points a second from magnetic tape input; in the improvement of library reference systems in the storing and retrieving of information; in the study of self-organizing machines which will operate essentially without programming. Lockheed-designed automatic missile systems checkout computers are already proving their effectiveness in service.

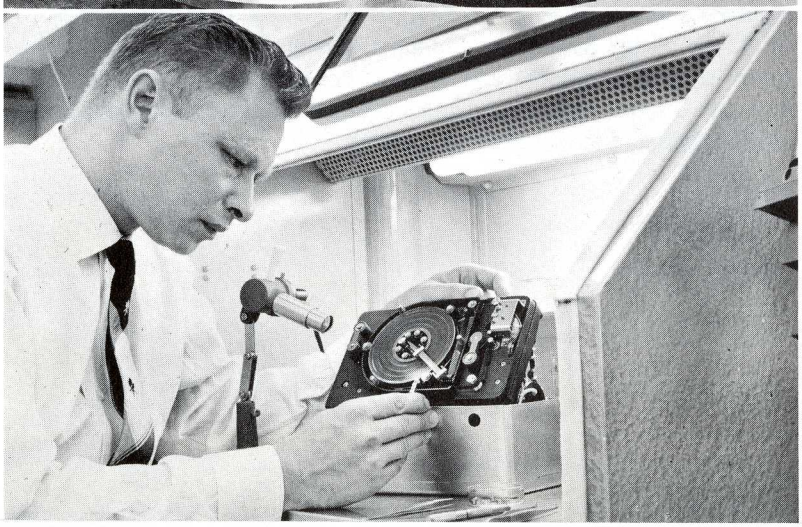
Setting up a diffraction image for a research study in near-infrared optics.

Work in the fields of radar and data link is concerned with research, design and development of systems and equipment for missile tracking, command guidance, detection and relay of information. Noise modulation techniques are under study as part of statistical communication theory and implementation of automatic space communication systems. A series of digital, command-control data link systems, utilizing solid state devices, have been developed, as have a number of radar beacon systems for missile tracking. Of significance, is the development of a radar firing error indicator that measures the intercept trajectory between target and attacking missile.

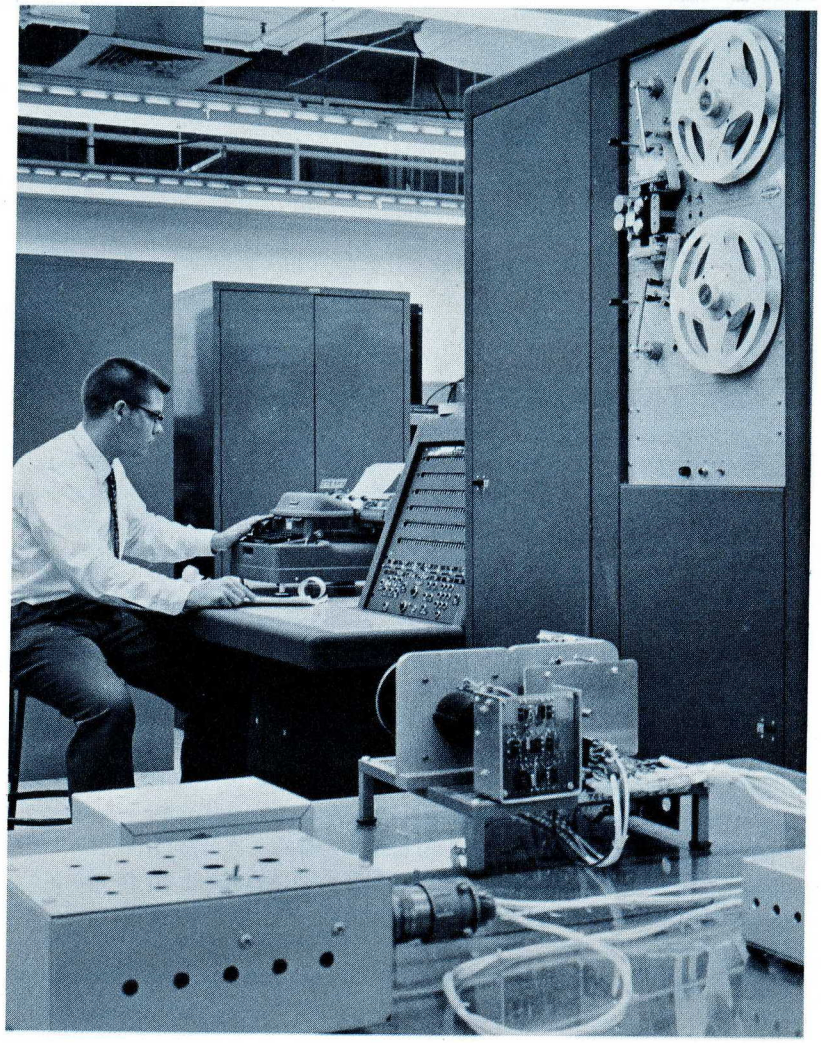
Laboratory studies in antennas and electromagnetic propagation include the application of solid state materials to microwave transmission line components; the design of antennas to survive the rigors of space flight; the effects of space on radio signals and radar detection; and the scattering from missile shapes and space vehicles. Research is also being conducted in the application of ferrites and MASERS; on problems of radio transmission between space vehicles and Earth, reentry scattering and diffraction by man-made objects and ionized gases; and development of antennas for data link systems between satellites and ground stations.



Example of Lockheed instrumentation development—ultrasonic temperature probe which measures the speed of sound in various gases.



Lockheed-developed missile-borne magnetic tape recorder is lighter, smaller, yet has increased reliability.



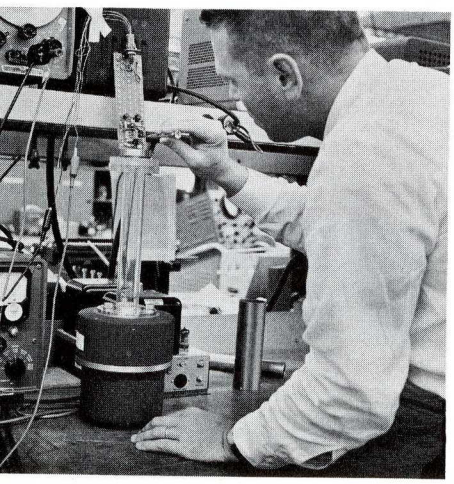
Automatic Checkout and Readiness Equipment (ACRE)—a Lockheed product—*automatically* performs pre-program missile checkouts and runs diagnostic routines to localize trouble.

Solid state electronics encompasses a wide range of activities. Solid state physics concerns itself with theoretical and experimental work in the areas of thermoelectric and radiant energy conversion; paramagnetic resonance studies in solids; ferromagnetics and ferroelectrics; transport processes in solids; electroluminescent and other phosphors; radiation effects in semiconductors; and other related topics.

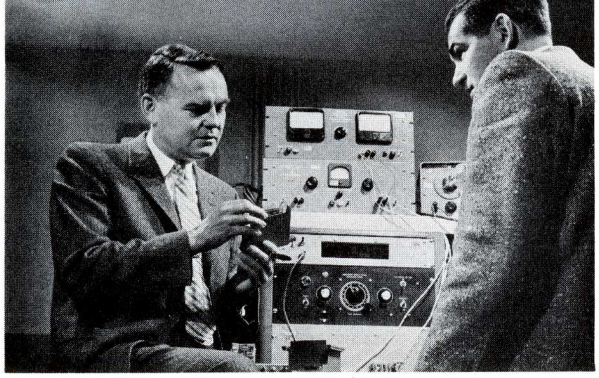
In solid state devices, the basic work applies to the evaluation of environmental effects, and the study of new components based on ferrites, ferroelectrics, thin films, semiconductors, intermetallic compounds, and other solid state materials.

In electrochemistry, solid state work is directed to the development of high-energy batteries and fuel cells, and related research in electrode reaction kinetics and materials synthesis by electrochemical methods and vacuum deposition.

Solid state activities in infrared embrace the development of new systems and sub-systems for long range infrared communications, surveillance, range findings and target tracking. Considerable attention is given to optical devices and systems employing optics. Capability in this area also extends to scanners, encoders, detectors, read-out devices, and analytics of information processing.



A missile instrumentation development—Lockheed-built noise microphone reports sonic damage.



A significant achievement in telemetry is the development by Lockheed of a completely sub-miniaturized FM-FM system, along with a PAM-FM system.

In technical ceramics and in the development and manufacture of ferrites and ferroelectric ceramics, solid state programs are being conducted in special geometries for ferrite recording heads; squareloop toroids for computer applications; and yttrium-iron garnets for microwave applications and microwave ferrites.

Telemetering has been brought to a high degree of successful application in the integration of circuits and components into high-performance systems. A completely sub-miniaturized FM-FM system has been developed, along with a complete PAM-FM system characterized by highly efficient band-width utilization, low power consumption and economy of size and weight. This represents a significant achievement in the field of high capacity telemetry. Other Lockheed designed and developed equipment is successfully providing highly accurate information on temperature, pressure, acceleration, vibration, thrust, vehicle attitude and other conditions during actual hypersonic flights.

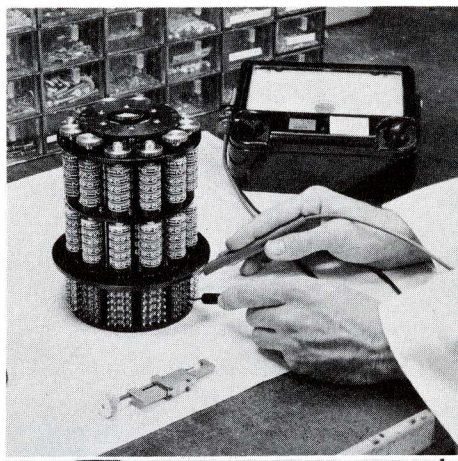
Lockheed maintains an extensive research and development capability in the fields of transducers and instrumentation. Under investigation are the properties of liquids and certain rubber-like solids as a function of amplitude and frequency of excitation; research on piezoresistive materials such as silicon, germanium, and indium antimonide in an effort to develop better transducers; research on capacitive methods of measuring extremely small displacements down to 10^{-12} inch and on a variety of other physical problems.

Other developments are extremely accurate instruments to measure rocket stage separation, slosh of fluids in missile containers, humidity, noise levels and voltages. Studies are conducted on information theory aspects of data transmission and generation of radio frequency power at high ambient temperatures.

Flight controls—one of the most challenging areas of work at Missile Systems Division—includes analysis of flight data and sub-systems performance, design and packaging of flight control components, development of transistorized circuits, operation of specialized flight control test equipment, and fabrication of flight control prototypes. Other work deals with the design, development and testing of rate and free gyros; accelerometers; programmers; computer assemblies; guidance control systems; circuitry; and hydraulic systems and components.

In the flight controls simulation laboratory, mathematical representations of elements in a control system are replaced one by one with actual hardware to determine acceptability of specific designs. From these studies, Lockheed obtains information which is used in further refinement and improvement of final control systems designs.

Lockheed intervalometer—part of missile-borne computer—an example of advanced guidance and miniaturization work.



Studying results of antenna pattern measurements—part of the activity of the Space Communications laboratory.

All aspects of the flight sciences are treated—including aerodynamics, thermodynamics, gas dynamics, propulsion, hydrodynamics, and applied mechanics.

For basic research in gas dynamics, Lockheed has a 44-foot shock tube that simulates pressures and temperatures generated under reentry conditions, and the nation's only privately-owned hot-shot tunnel, which supplies streams of air up to Mach 20, temperatures to 12,000°F, and Reynolds numbers corresponding to missile reentry conditions. Other equipment in the gas dynamics laboratory includes a hypervelocity ballistic range on which projectiles are fired up to 20,000 ft/sec.

Advanced propulsion research concerns both the physicist and chemist. For example, the rocket is no longer considered an over-simplified, one-dimensional flow device in which chemical equilibrium exists in a stream of perfect gas. Rather, under Lockheed's program, it is considered a sophisticated chemical and thermodynamic system in which reaction kinetics is held the key to performance gains. This program also considers the employment of energies released during fission and fusion, and direct uses of solar energy.

Lockheed design engineers face a double challenge—to improve existing designs and devise solutions to new problems.

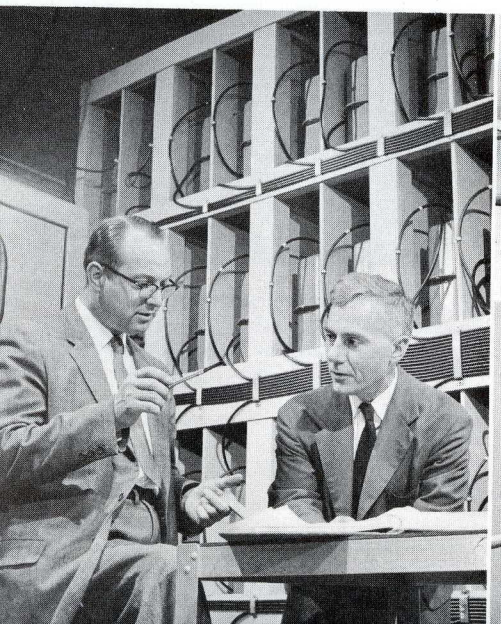
Significant contributions are being made in the mechanical design of vehicle frames, flight controls, hydraulic systems, ignition, and separation systems; and in the electrical design of test, checkout, arming and fusing, guidance, and telemetering equipment.

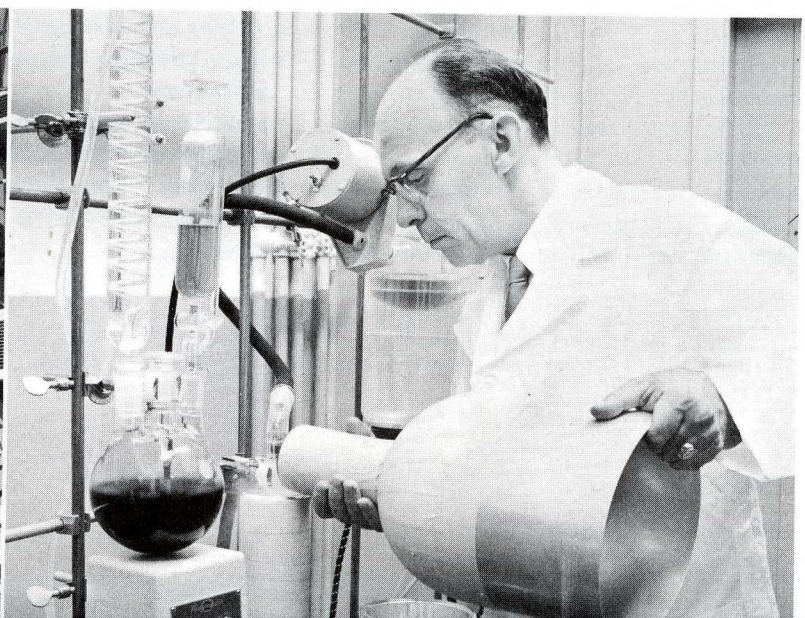
Reentry body development, thrust termination, and underwater launching receive major emphasis in the field of structures. Some of the most difficult structural problems in the industry were successfully met by Lockheed design engineers for Polaris—where the unique water launching environment aggravates the normal critical missile requirement of strength minus weight.

In logistics and ground support, notable developments have been

(below left) Part of giant capacitor bank used to fire Lockheed's new "hot-shot" wind tunnel. Bank is capable of 5 million kilowatt jolt.

(below right) Synthesizing high energy propellant in development of new and exotic fuels in propulsion chemistry laboratory.





made in large and highly complex controls, and equipment for preflight checkout, monitoring and ground handling.

Testing is an integral part of every stage of missile and space programs at Lockheed.

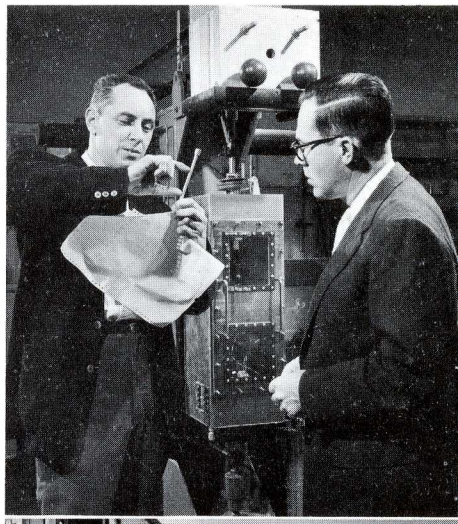
Lockheed maintains one of the most completely equipped missile and space test laboratories in the world. Equipment includes altitude, temperature and humidity chambers; shaker and vibration systems; G-accelerators; and apparatus capable of performing chemical, metallurgical, materials, heat transfer, hydraulic, pneumatic, shock, acceleration, sinusoidal and random vibration, structural, electrical, and electronic tests. A computer-controlled infrared heating system simulates aerodynamic heating effects on complex structures. The test laboratories assay raw materials, evaluate performance, assist in design and development, and, in addition, perform the highly critical job of testing missile systems and components. Unique studies are being made in the creep of materials under high temperatures over very short periods – 15 seconds or less.

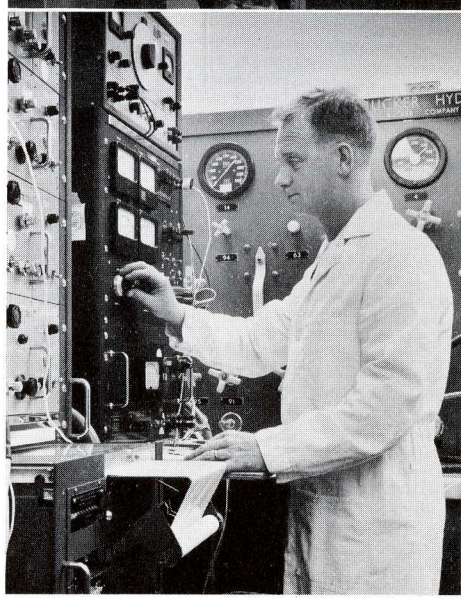
Static field testing is carried on at the Santa Cruz Test Base. All non-inplant laboratory testing is done here, including rigorous checkout of weapons systems and sub-systems under simulated flight conditions. The Santa Cruz Test Base also conducts research and development programs on controls; on hydraulics; on high-pressure gas and propulsion systems.

Ordnance testing is primarily concerned with explosive devices, the majority of which are Lockheed designed and developed. These are used in many ways, such as flight programming, recovery, destruct and stage separations. Separate ordnance test laboratories, with explosion-proof cubicles and altitude explosive test chambers, are used for research projects, with emphasis on fuel development.

Flight testing is conducted at Cape Canaveral, Alamogordo, and Vandenberg AFB in a unique manner. All components and sub-systems

Checking results of creep rupture in beryllium. Special argon chamber is used in tests for protection from toxic dust and oxide.





Qualification checking of a missile hydraulic actuator in the Hydraulics Test Lab.

Design is a challenging and growing field at Lockheed dealing with varying phases of mechanical, electrical and structural problems.

Quality assurance inspection—checking accuracy of machined threads on a 30″ magnification contour projector.

of a new project are initially tested on known-performance, production missiles. Thus, when the final system is ready for first flight, its individual components already have flight-tested reliability. This new concept of flight testing is a major contribution and has enabled Lockheed to produce extremely complex missile systems in record time and at greatly reduced expense.

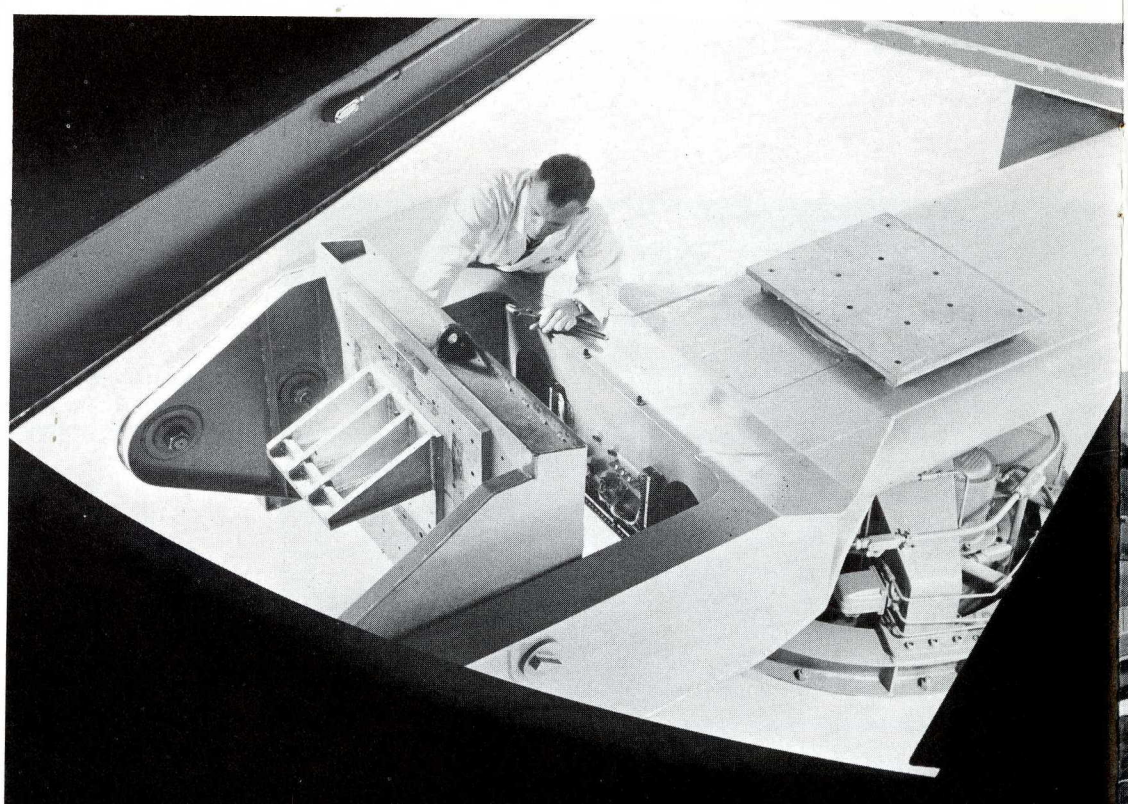
Underwater launch tests—including studies of cavitation, wave simulation and skip motion—are carried on at the Sunnyvale facility and at the Navy test base on San Clemente Island. In addition, structural and other tests are performed at Hunter's Point Naval Shipyard, California.

Rendering engineering concepts into useful hardware is the great challenge of manufacturing. Here, new materials and processes are developed and applied.

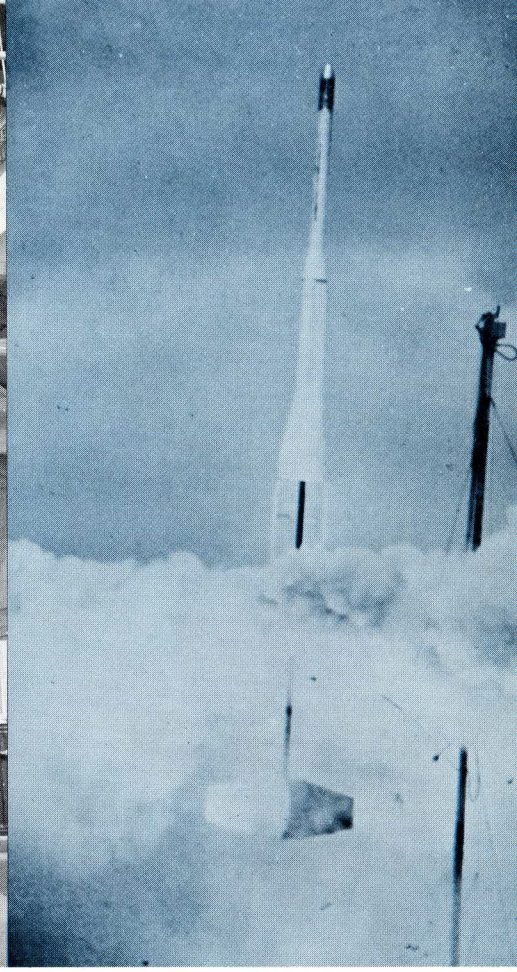
Missile and satellite manufacturing at Lockheed calls for utmost precision in hardware that varies from microscopic to gigantic. New and exotic metals and materials are used in programs from breadboard to production run.

Vital, accelerated programs are evidenced in manufacturing methods; tool engineering; manufacturing research; design and test; metal, electronic, hydraulic, and pneumatic fabrication; and sub and final assembly. Techniques using new metals, glass, plastics, and laminates are under exploration and application. In the field of optics, precisions never before attained have been achieved.

Rapid progress is being made in forming and welding radioactive light metals into wholly new sizes and shapes. Brittle and toxic materials are being worked into accurate forms. Advancements are also being made in chemical milling, plating, and processing methods.



Large centrifuge for environmental testing has unique shaker attachment to provide vibration simultaneously with high G-loadings.



(above left)
Pre-flight check-out on final assembly of X-7 missile. The X-7 holds free-world's speed and altitude records for air breathing missiles.

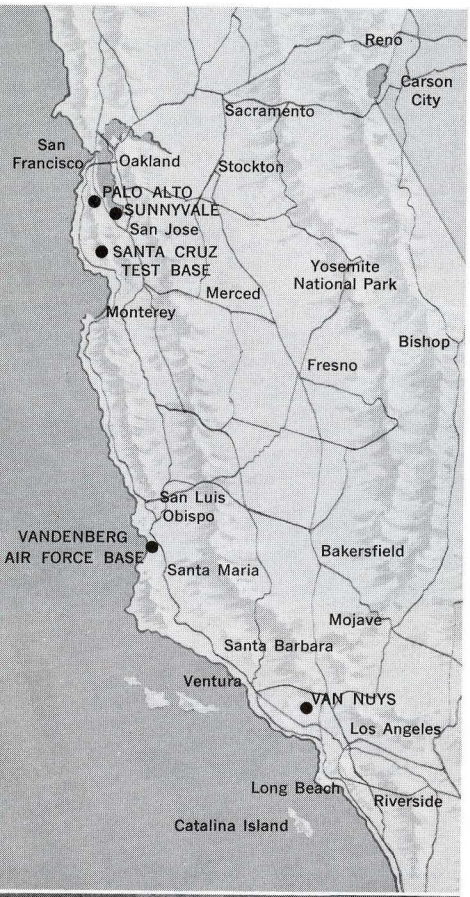
(above right)
Nation's first successful reentry tests were conducted with the X-17.

Complete manufacturing laboratories are maintained for research in chemistry, metallurgy, plastics, and electronics. Engineering, design, fabrication, and installation services are performed in such areas as magnetics, hydraulics, optics, electronics, pneumatics, and mechanics.

Manufacturing production techniques, such as ultrasonic drilling of microscopic holes in extremely hard and dense materials, are developed by the laboratories. Electronics and solid state research makes possible smaller, lighter, and increasingly reliable components and systems for accurate guidance, sensing, and communication at extremes of temperature, vibration, and acceleration.

Quality assurance parallels in importance, and supports the work of weapons systems, project systems, manufacturing, and research and development organizations. Quality assurance establishes audit points, writes procedures as to the technical requirements, provides audit point functional test gear, and performs tests. These activities are supported by laboratory work, performance of data analysis, establishment of standards, and issuance of reports—all to insure that Lockheed products meet or surpass contractural requirements. Economy, as well as quality, is observed at every stage to produce the best products at the least cost.

From concept to operation, the Lockheed Missile Systems Division is capable of performing each step in the research, development, engineering and manufacture of complex systems.



(above top)
Sectional map of California showing Lockheed installations.

Scenic Santa Cruz—northern end of Monterey Bay—lies within a few minutes drive of coastal redwoods

LIVING AT LOCKHEED

Headquarters of Lockheed Missile Systems Division are at Sunnyvale, California. Immediately adjacent are Moffett Field Naval Air Station, and the National Aeronautic and Space Administration's Ames Research Center.

New research and development laboratories are located at Stanford Industrial Park in Palo Alto. From here, one has a view of the entire lower San Francisco Bay across to the mountains of the Diablo Range.

This location on the Peninsula, just 40 minutes south of San Francisco, was chosen by Lockheed after careful consideration of many sites throughout the country. It combines the ideal in living and working conditions.

The climate is mild and smog-free and permits outdoor living the year-round. There is a wide choice of housing—suburban and rural. Residential areas lie along the fringes of the Santa Cruz mountains, which shelter the Peninsula from the nearby Pacific, and toward the Bay on the Peninsula floor in a region of fruit orchards.

Unfurnished modern apartments, with attractive features such as electric kitchens, separate patios and garages, laundry rooms and, occasionally, swimming pools, are plentiful. Handsomely designed shopping centers—that make marketing a pleasure—combine supermarkets, department stores, beauty and barber shops, restaurants, bookstalls, sporting goods and other fine stores.

The Peninsula is convenient to many recreation areas—from the Sierra Nevadas, with skiing, fishing, hunting and camping—to the wide beaches of Half Moon Bay and the Pacific Ocean, just thirty minutes' drive through beautiful redwood forests.

About 30 miles from Sunnyvale in the Ben Lomond mountains, north of Santa Cruz, is the 4,000 acre, company-owned static test firing base. This is in the midst of beautiful, forested hills overlooking the Pacific, yet convenient to many communities, including the charming villages of Carmel and Monterey.

Schools on the Peninsula are considered excellent. Scholastic standards are high, buildings modern and spacious. Stanford University and the University of California at Berkeley, the University of Santa Clara, University of San Francisco, San Jose State College, Mills College for women, and other fine colleges in the surrounding area offer opportunities for higher education.

The universities and colleges, along with such famous research organizations as the University of California's Radiation Laboratory and Ames Research Center, as well as other fine research and engineering companies on the Peninsula, combine to provide a stimulating scientific environment.

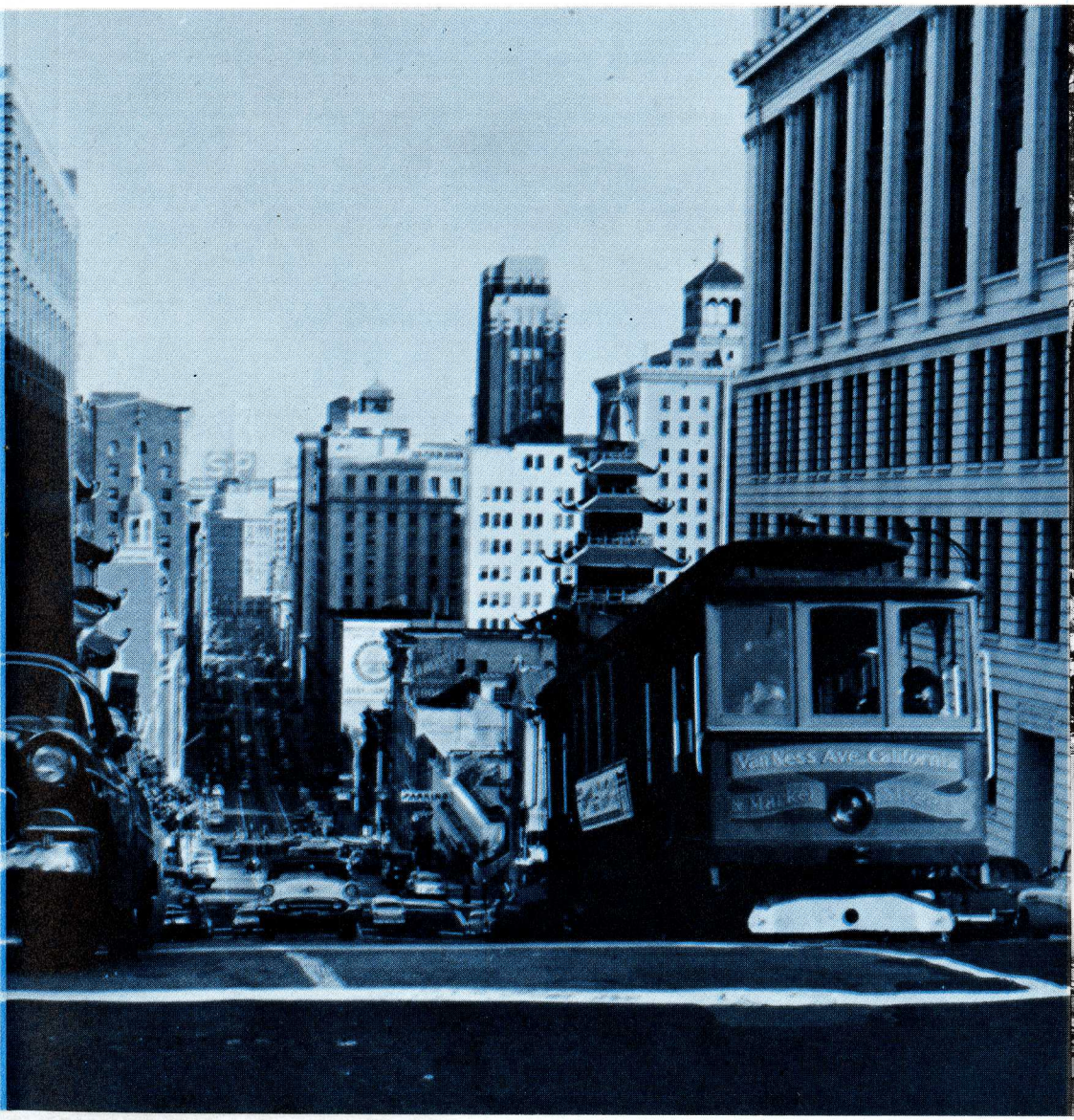
San Francisco is an easy thirty to forty minutes' drive over a new divided freeway that takes one directly to the heart of the city.

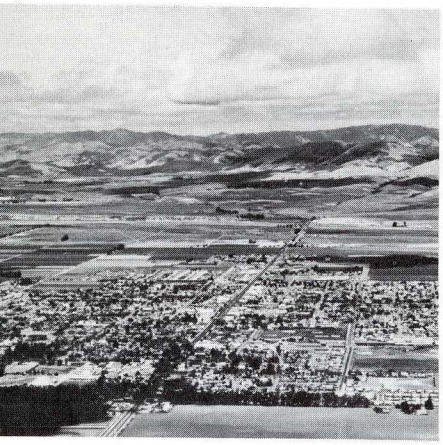
The charm and fascination of this famous city are endless. It is a seat of culture, of business, and of history. Its cosmopolitan atmosphere delights all who visit it. Some of San Francisco's legendary attractions are: Golden Gate; Presidio; Chinatown; Fisherman's Wharf; Embarcadero; Bay Bridge; Nob Hill; "Top of the Mark"; Opera House; Golden Gate Park; Fleishhacker Zoo; Cliff House; Seal Rock; Market Street; Union Square; famed restaurants and hotels; cable cars; and the magnificent panorama of Bay and city as seen from the many beautiful hills.

(below left) California Street cable car climbs up Nob Hill in San Francisco.

(below right) Huge coastal redwood forest in Muir Woods near San Francisco.

(below bottom) Palo Alto Yacht Harbor is headquarters for Peninsula "salts."





Santa Maria—midway between San Francisco and Los Angeles—near Vandenberg Air Force Base.

Famous in song and story as the home of Hollywood's best-known motion picture and television stars, the San Fernando Valley offers pleasant suburban living close to Los Angeles. Lockheed's facility at Van Nuys is in the heart of the Valley, an area of choice home sites.

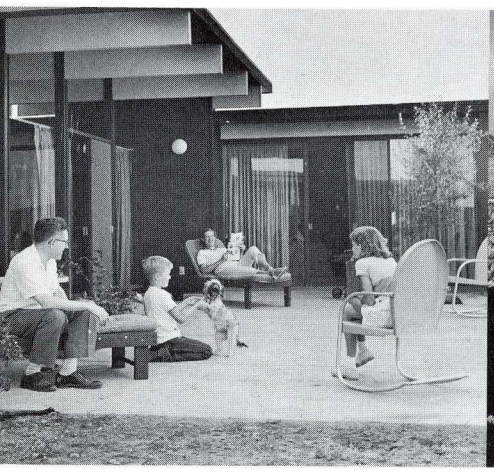
Individually designed, well-planned housing developments offer comfortable and attractive living. The nearby hills offer an abundance of excellent view sites. There are numerous pleasant, roomy apartments.

The San Fernando Valley is one of the most active areas in Southern California. Here are good schools, churches, fine restaurants, and year-round barbecue-patio-pool living. Nearby are some of America's most famous universities: U.C.L.A., California Institute of Technology, and the University of Southern California.

Lockheed Missile Systems' newest location is at Vandenberg Air Force Base near Santa Maria and Lompoc, California, approximately half-way between San Francisco and Los Angeles—making either city an enjoyable weekend trip. The climate and scenery are superb.

Santa Maria is a city of beautiful homes noted for its landscaped flower gardens. The city has an excellent school system and offers modern shops, good restaurants and fine parks. There are several excellent golf courses. Fine surf fishing and swimming are available on the Pacific beaches, only 11 miles away.

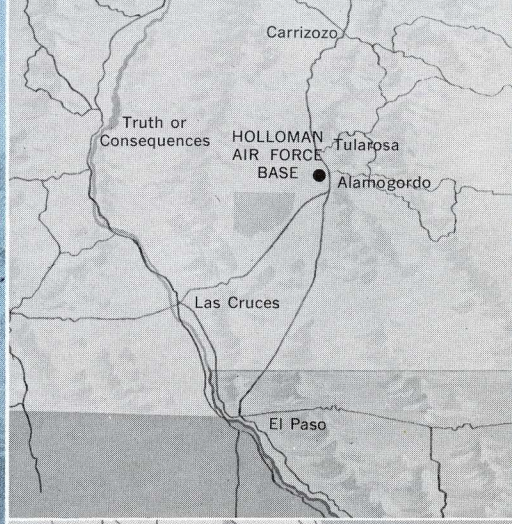
The commercial flower gardens of Lompoc are a dramatic feature of the area. Thousands of acres of flowers, under cultivation for their seeds, form beautiful blankets of color. The mild climate, which makes this area the flower center of the nation, also makes it an ideal community in which to live and work.

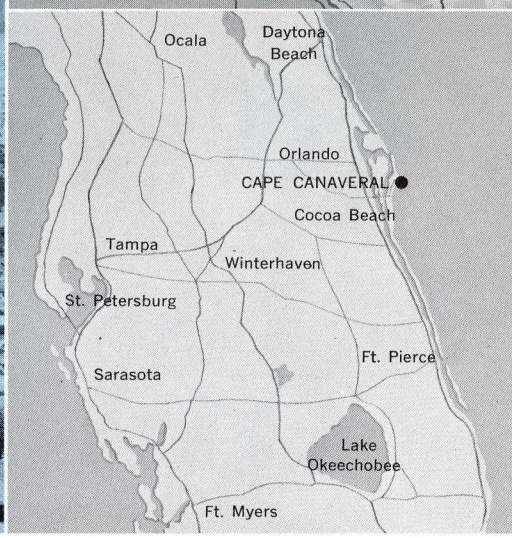


Year-'round patio living is typical of California.

San Fernando Valley—is home of the Van Nuys Division.

Modern Alamogordo is community center for Holloman AFB.





(above top)
New Mexico—Alamogordo and vicinity.

(bottom)
Florida—Cape Canaveral and vicinity.

The flight test facility at the Missile Development Center at Holloman Air Force Base is near Alamogordo, the birthplace of the nuclear age. Alamogordo is a city with modern stores, churches, schools, and homes, offering metropolitan conveniences in the heart of the dry, clear air of the desert.

Lying in the Tularosa Valley at nearly mile-high altitude, it has one of the most healthful climates in the country. Just to the north is the reservation of the famous Mescalero Apaches; beyond that is Lincoln County, scene of the wild days of Billy the Kid. New Mexico, rich in the history of the West, is a wonderful place to live for those who prefer the wide, open spaces.

Cape Canaveral is located on the eastern coast, about halfway between Daytona Beach and Palm Beach, Florida. Skin-diving, boating, water-skiing, fresh water and deep sea fishing are just a few of the many attractions. The towns of Cocoa and Rockledge lie close to Lockheed's flight test facility at Patrick Air Force Base. The educational system is considered the most progressive in the State, largely due to the concentration of engineers and scientists at the Cape.

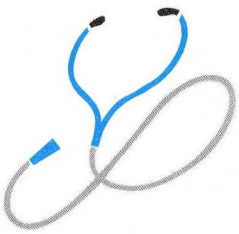
Florida's far-famed beaches are a year-round attraction.

LOCKHEED BENEFITS

Lockheed employee benefits are among the best in the industry. They include:

Life and Health Insurance. Under the Lockheed Employee Group Insurance Plan, the company pays *all* employee costs for life and health insurance. In addition, the employee may buy valuable health protection for his entire family at low group rates. This includes hospital, surgical, and extended benefits. A detailed pamphlet is available on request.

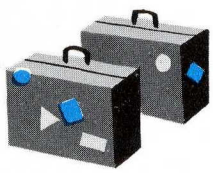
Sick Leave. Sick leave credit is granted to salaried employees at the rate of twelve days each year. If not used, sick leave is allowed to accumulate from year to year. Normally, a total of 30 days is allowed to be used in any one calendar year.



Vacations. After a year's service, employees are eligible for two weeks' paid vacation. Twelve or more years seniority entitles employees to three weeks' vacation.

Holidays. Seven full holidays are observed: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving; December 24th and Christmas Day.

Leaves of Absence. Leaves of absence for personal reasons are granted on an individual basis.



Travel and Moving Allowances. Moving allowances and transportation of household effects are determined on an individual basis.

Employees Recreation Club. Sports car rallies, golf, tennis, softball, dancing, stamp collecting, scouting and many other activities make up the program of the Employees Recreation Club. Membership is free and the Club offers recreational activities for all who wish to participate.

Management Association. The Lockheed Management Association is the largest organization of its kind in northern California. It is affiliated

with the national association. All salaried employees are eligible for membership. It sponsors numerous special events, including courses in management development and social programs.

Credit Union. The Employees Federal Credit Union offers a checkoff plan for savings purposes and loans. Loans are made to employees for car purchases, for home improvements, and emergencies. All employees are eligible.

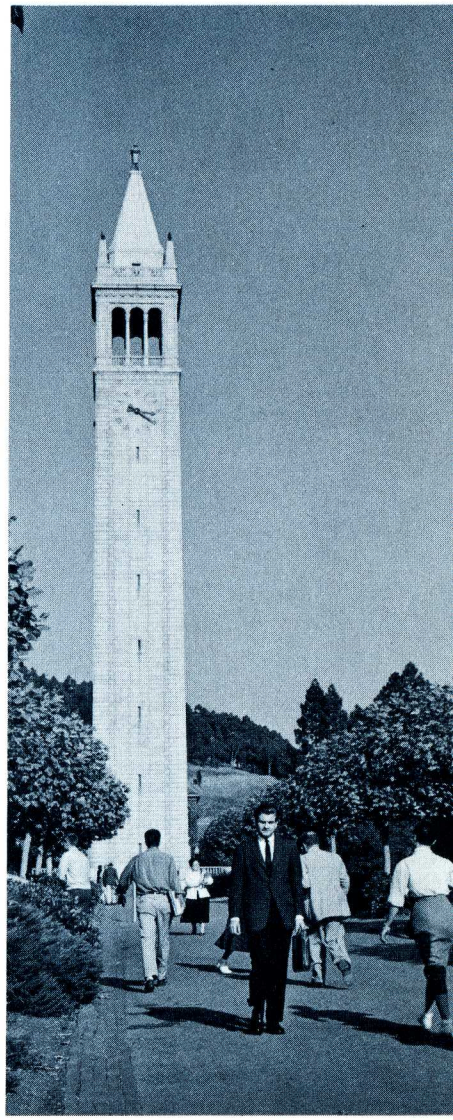
Unions. Certain hourly employees are represented by unions. Agreements with such unions provide for an open shop with maintenance of membership. Hourly employees decide for themselves whether they wish to join a union.

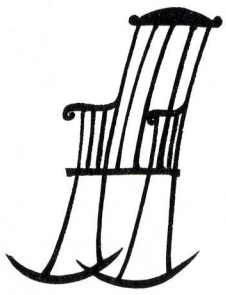
Graduate Study Program. The University of California at Berkeley and Stanford University, both participate in Lockheed's Graduate Study Program. This enables qualified engineers and scientists to obtain advanced degrees at the company's expense while working part time.

Tuition Reimbursement Plan. Salaried employees may receive tuition reimbursement of fifty per cent for approved courses at selected educational institutions.

Patents. The Lockheed Patent Plan provides for the patenting and exploitation of inventions made by employees. The company obtains patent protection and provision is made for the payment of cash awards and a percentage of royalties at no risk or expense to the employee. A detailed booklet on the Patent Plan is available on request.

Retirement Plan. All employees are eligible for the retirement program. *Lockheed pays the entire cost of the program.* Benefits are based on length of service and amount of total earnings. Normal retirement age is 65, however, employees may retire at 55. A minimum of 10 years' service is required. A detailed pamphlet is available on request.





Lockheed

MISSILE SYSTEMS DIVISION

CALIFORNIA:
SUNNYVALE
PALO ALTO
VAN NUYS
SANTA CRUZ
VANDENBERG AIR FORCE BASE

FLORIDA:
CAPE CANAVERAL

NEW MEXICO:
ALAMOGORDO