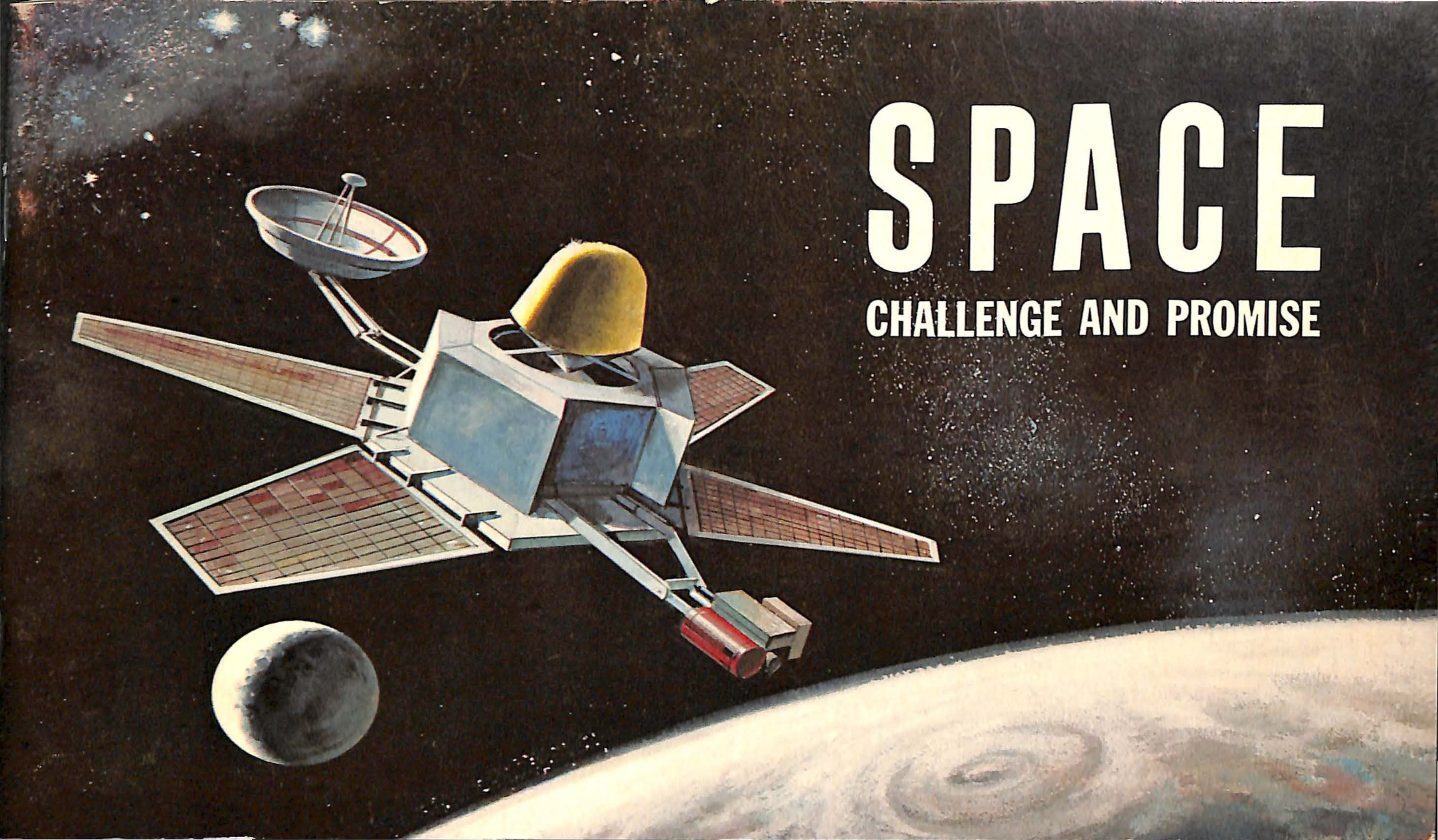
SPACE

CHALLENGE AND PROMISE

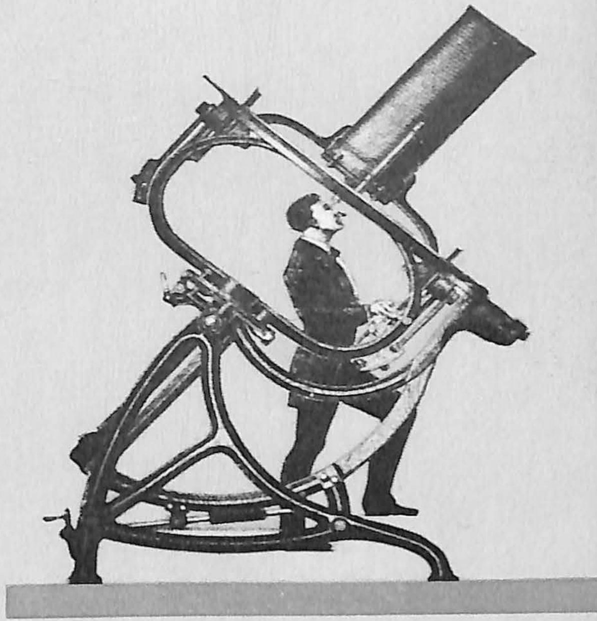


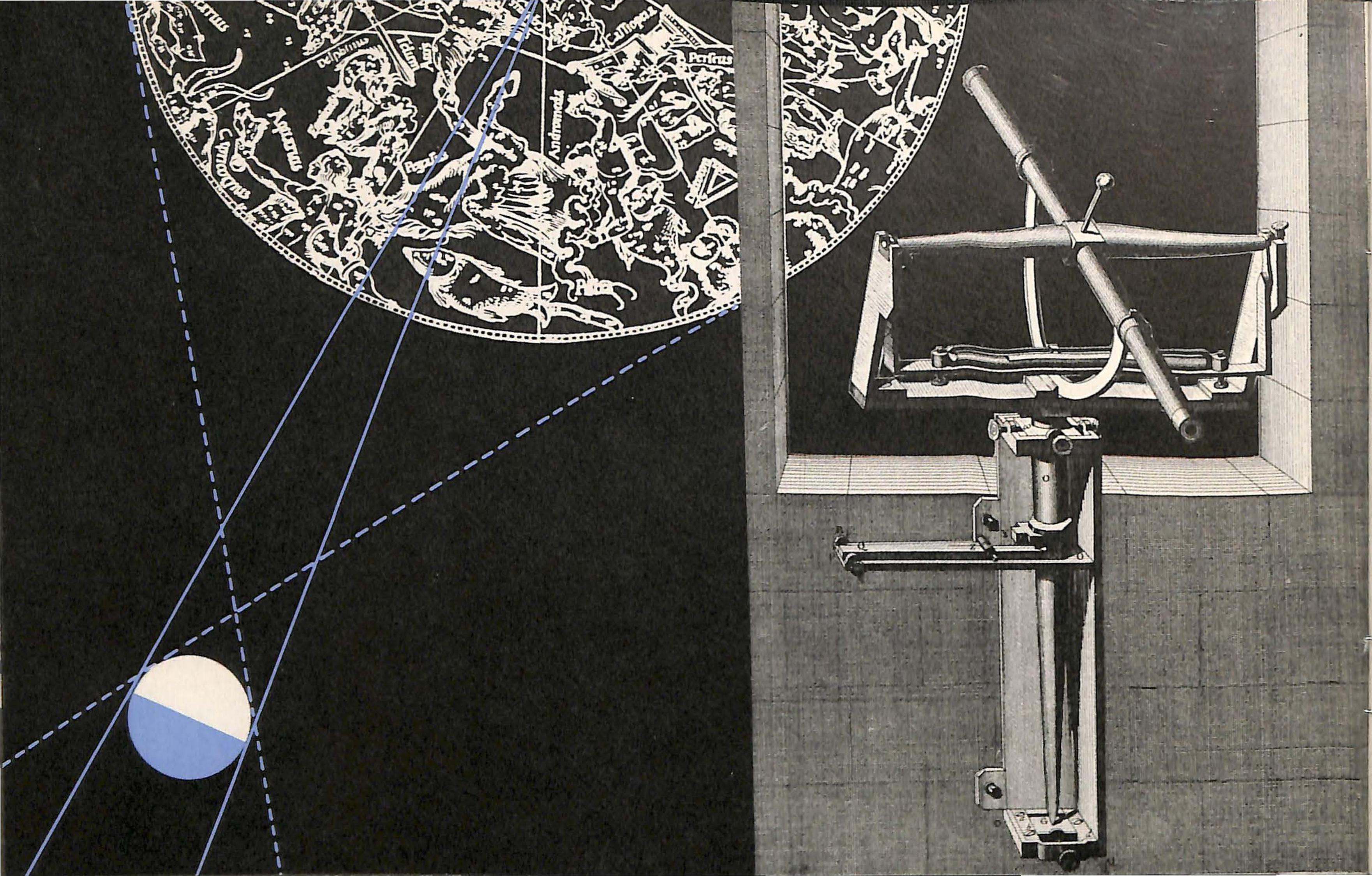
A HISTORY OF SPACE RESEARCH

The Space Age officially began on October 4, 1957, when the first man-made object ever to orbit the earth was successfully launched. It is presumptuous, however, to use this date as the start of space flight. Any great project must start with a dream, and man was dreaming of probing the space beyond his planet centuries before the word **sputnik** was added to our lexicon.

The name of the first dreamer is unknown. Surely, at some point in unrecorded history when man's intelligence had progressed sufficiently to contemplate the idea, a man looked at a star and realized that it was not part of his planet. The first recorded beliefs that there were other bodies in space pre-date the birth of Christ. The first science fiction story—an indication that man had already started to think about moving beyond his planet—was published about 160 A.D.

The next major steps toward achieving flight in space did not occur until the 16th and 17th centuries. With the invention of the telescope, astronomy became a science. In the 16th century, Copernicus laid the groundwork for modern space cartography with a published work called "On the Revolution of Celestial Bodies." He was followed by Johannes Kepler, who discovered the laws of planetary motion, and by the Italian astronomer Galileo.




Cassiopea
Perseus
Andromeda
Aquarius

During the next two centuries there were a great many people who contributed to thought about space flight, some scientists, some dreamers. Certainly not to be overlooked were the early science fiction writers who aroused the interest of the populace, for without general interest, few dreams achieve reality. Among the more important of these, prior to the 20th century, was England's Francis Godwin, who wrote about a journey to the moon—by bird propulsion—as early as 1638. Then there were the great Jules Verne and H. G. Wells, whose works are still read today. In 1865, a little known Frenchman named Achille Eyraud wrote about a trip to Venus in which he employed the reaction principle of propulsion.

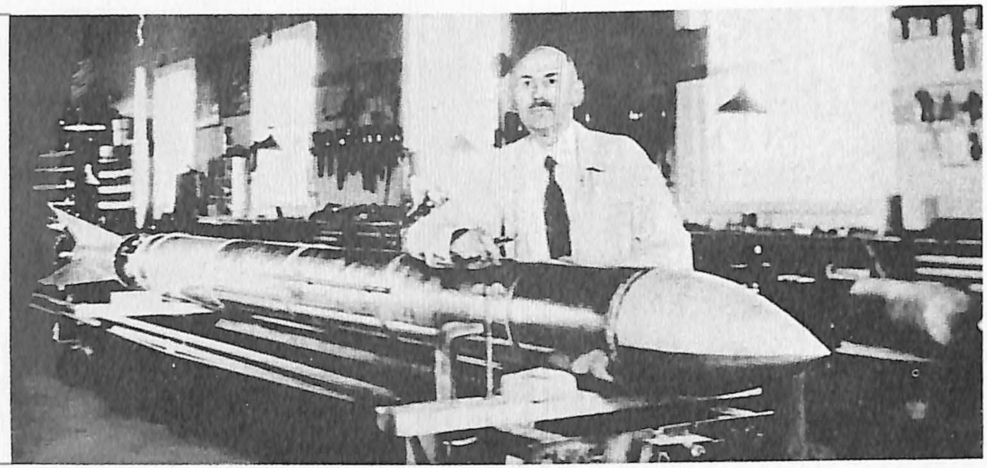
At the start of the 20th century, the dream of space travel took on more concrete aspects. The first real scientific thinking is credited to the Russian, Konstantin Ziolkovsky, who did considerable theoretical work on space flight and rocket propulsion in the early years of the century.

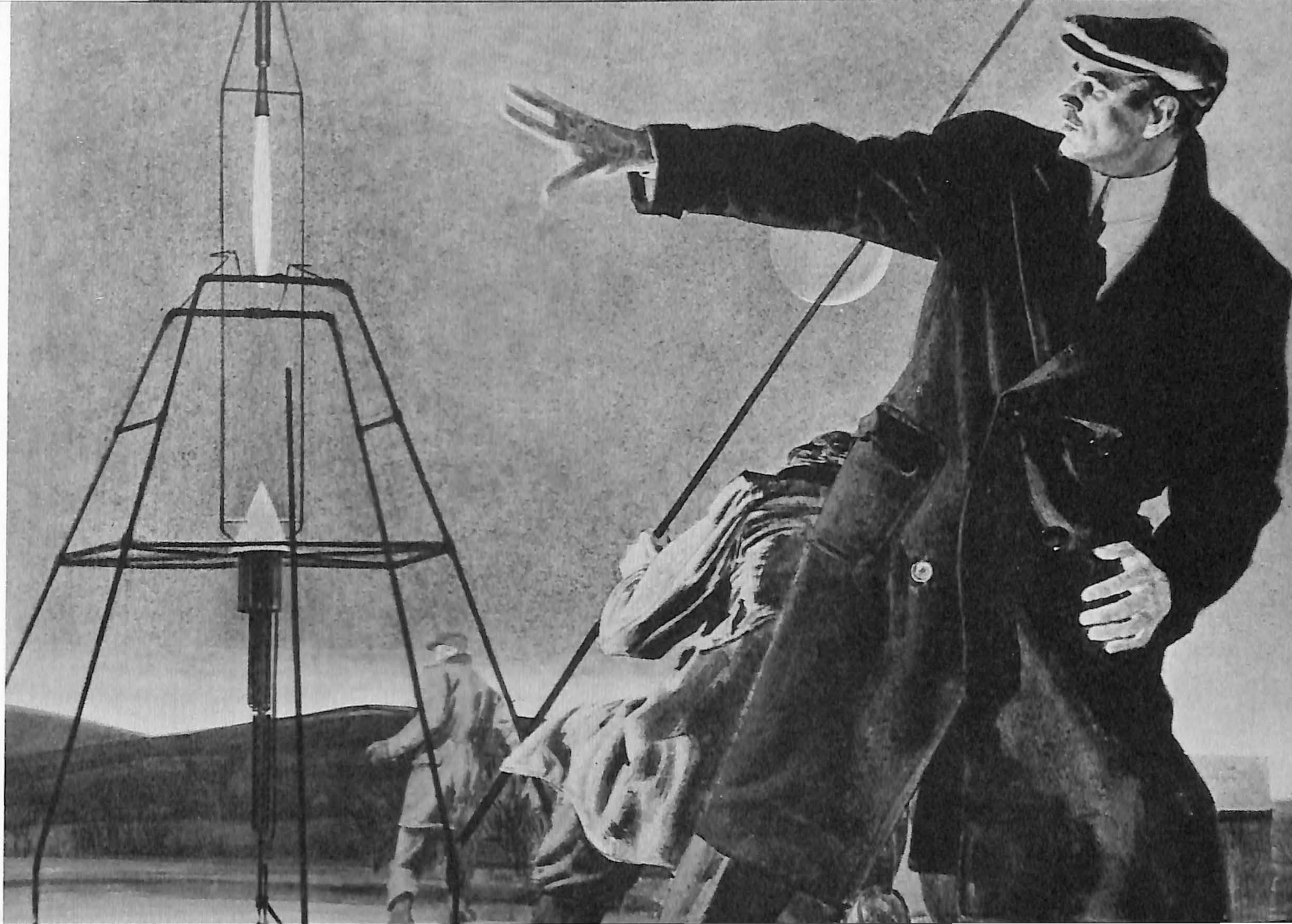
Generally acknowledged as the father of space flight, however, is Dr. Robert H. Goddard, an American. Starting before World War I, Dr. Goddard translated the dream and the theory into hardware. He built a number of rocket motors and ground tested a liquid fuel rocket as early as 1923. On March 16, 1926, Dr.

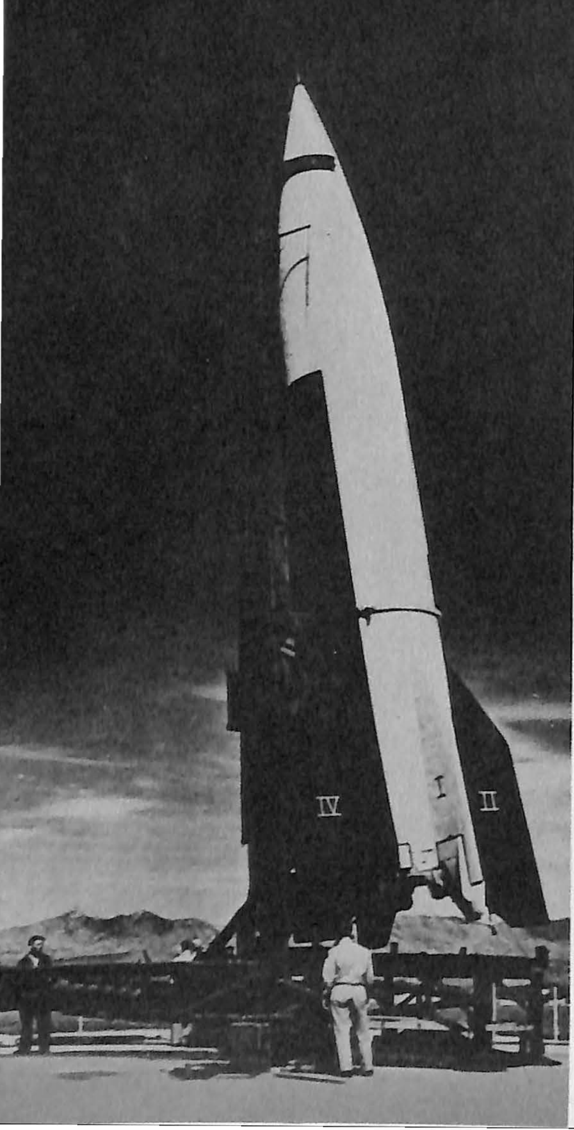
Goddard successfully fired a liquid rocket. This date might be accepted as the start of space hardware.

Dr. Goddard continued his rocket work until his death, but he was unable to arouse enthusiasm in the United States. In Europe, however, rocket power got new impetus. The German Army, aware of the military potential of the rocket, started a research program which culminated in the famed Peenemunde project and the V-2 missile.

The Russians were also aware of the potential. According to the well known



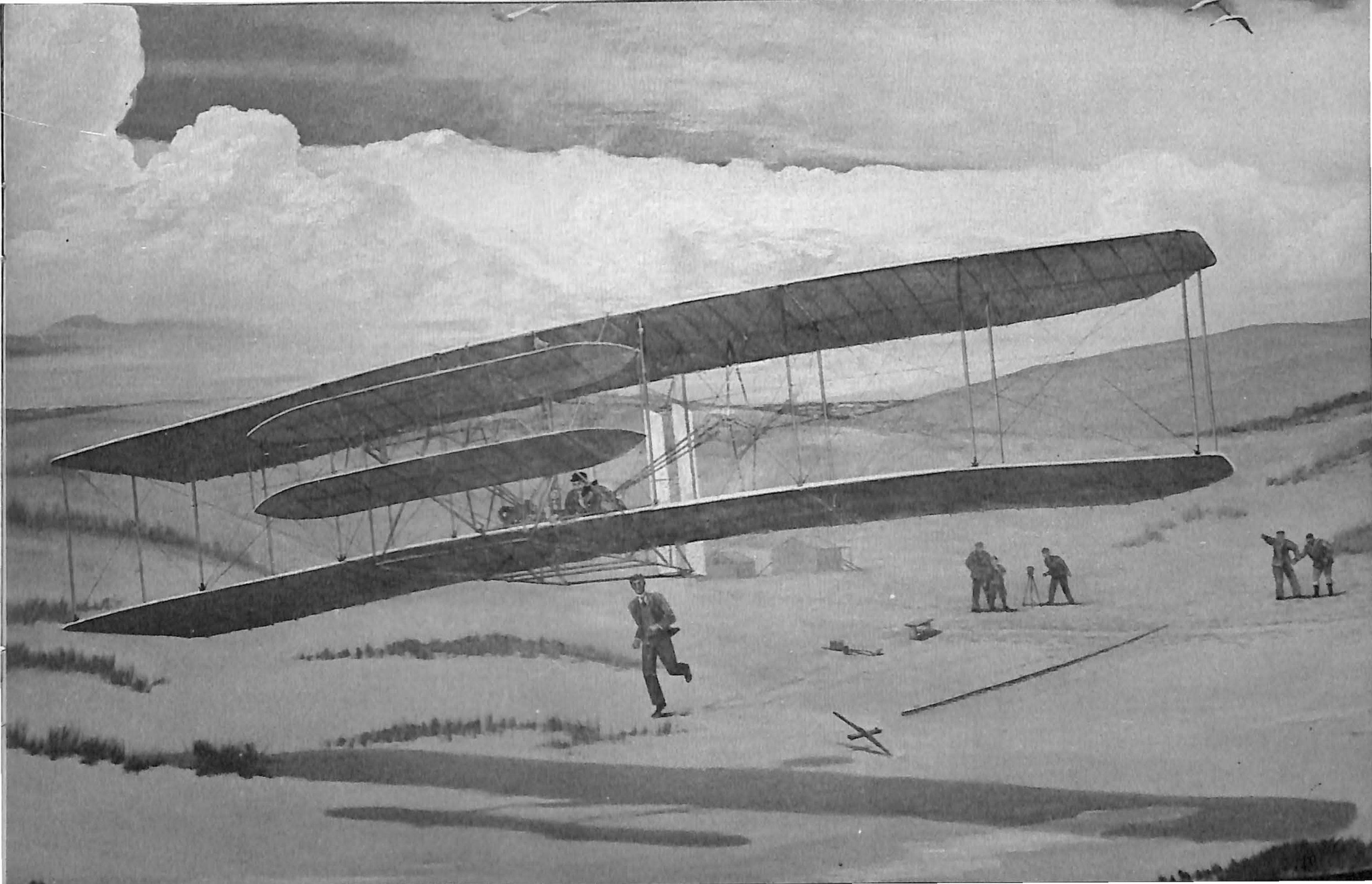


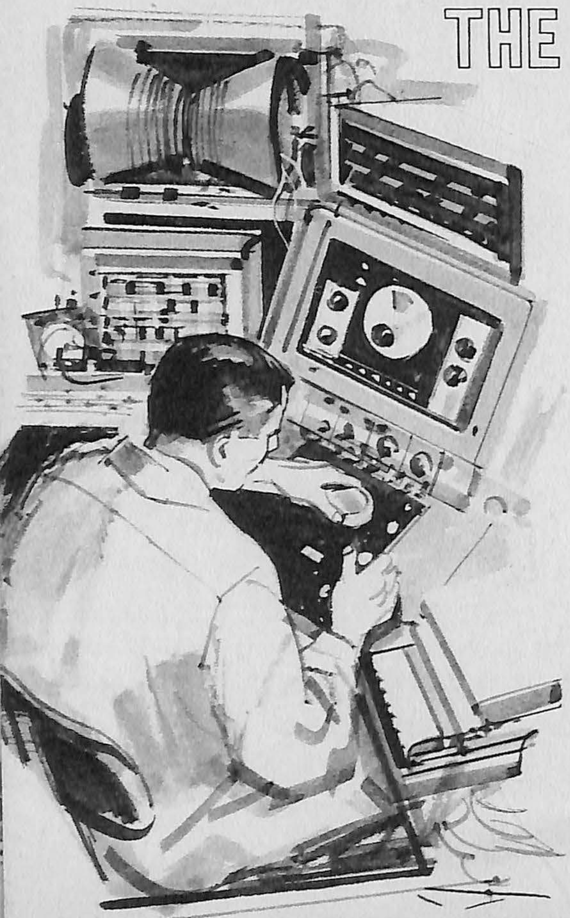


space historian Willy Ley, the Russians fired a liquid fuel rocket to 12 miles altitude in 1936. The Germans had attained 6,500 feet in the same year, and in 1935 Dr. Goddard had sent one of his rockets to 7,500 feet.

The Russians apparently did not pursue rocket research with any great fervor after 1936 until the post-World War II years. Dr. Goddard, unable to raise money, was not able to fulfill his dreams of larger rockets. The Germans, however, continued to work diligently in the field. During the war years, great rocket progress was made at the German experimental station of Peenemunde, under the direction of Dr. Wernher von Braun and Dr. (then Major General) Walter Dornberger, both now eminent American citizens. The V-2 developed at Peenemunde is the modern forerunner of our current space boosters.

Post-war progress in rockets, missiles and space flight is too well-known to be recounted here. One final note must be included in any history of space flight: the research of Orville and Wilbur Wright on airplanes merits mention. Although the Wrights were not thinking in terms of either missiles or space flight, their memorable first flight at Kitty Hawk started a continuing program of research and development in aerodynamics and propulsion which later contributed to missile progress, hence to space progress. More important, perhaps, the success of the airplane in the first half of the 20th century accustomed man to thinking in terms of moving above the earth and prepared the citizenry for the public support that space flight needed to make it a reality.





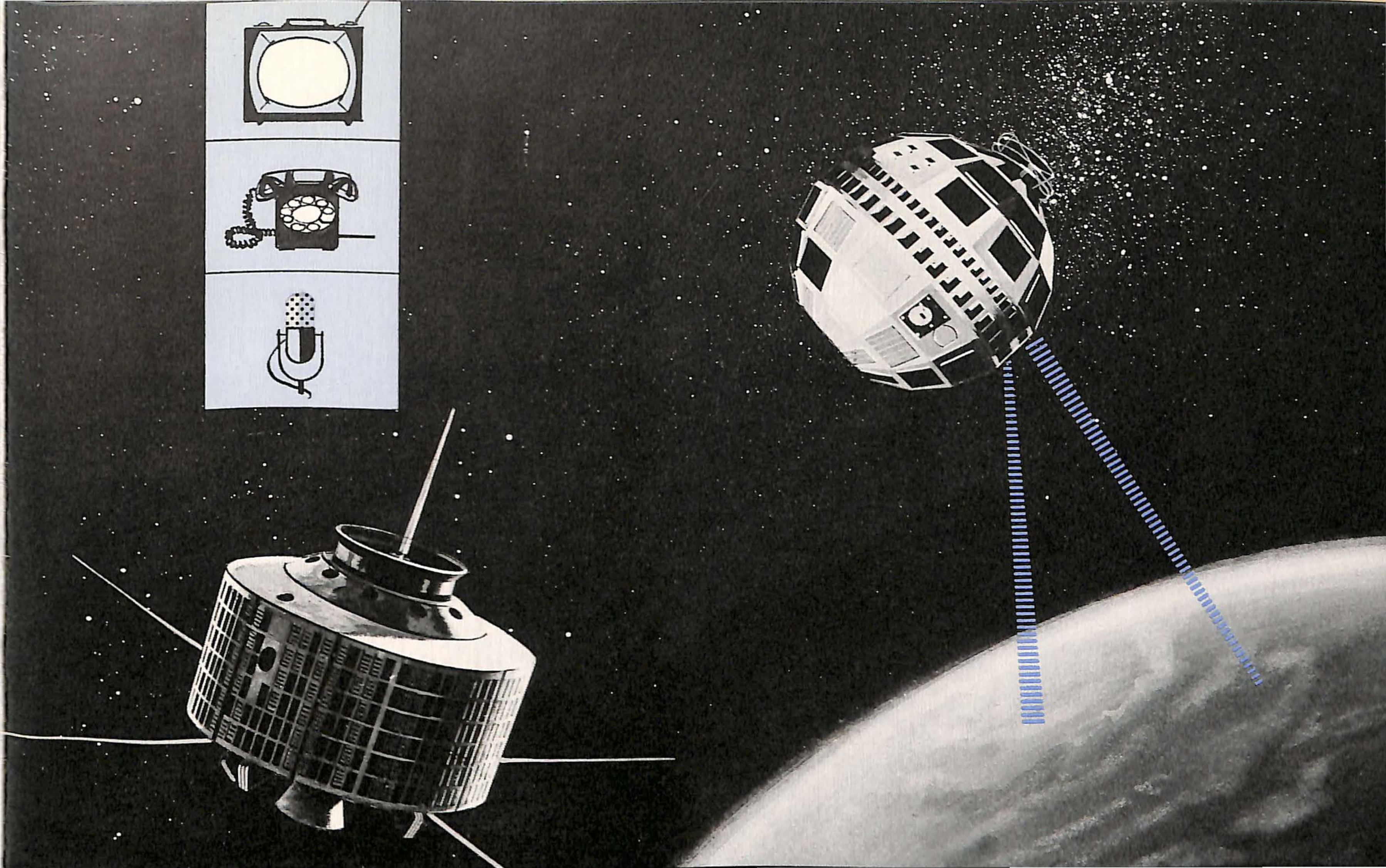
THE REASONS FOR EXPLORING SPACE

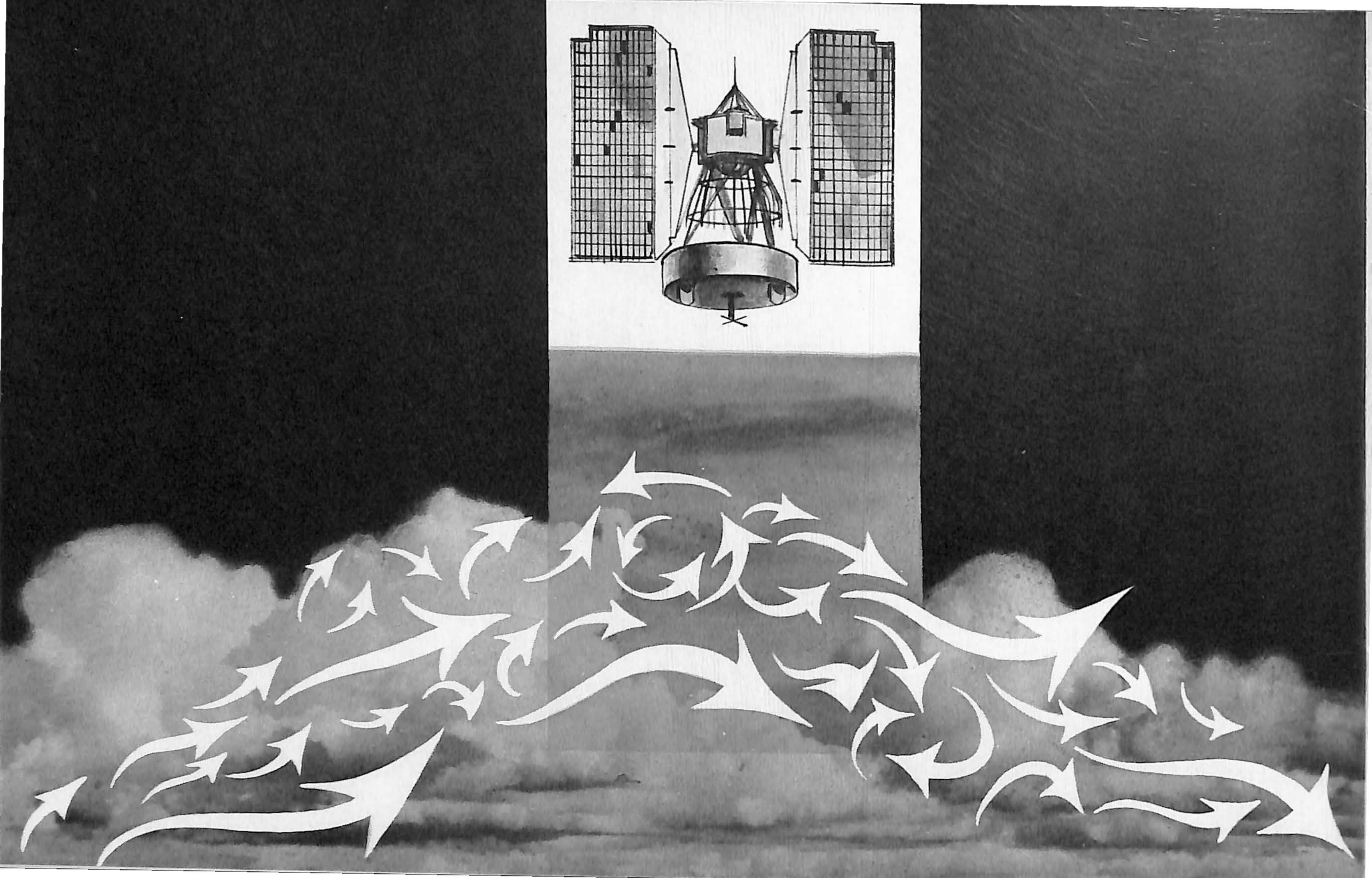
In general, the public is enthusiastic about the possibility of space exploration, but occasionally scientists are asked, "Why do we want to explore space? What return will such research bring? Are we spending vast amounts of money to satisfy man's natural curiosity about the void beyond his atmosphere, or are there concrete benefits which will accrue?"

The main goal of space research is knowledge. Continued probing of the universe will bring a great accumulation of knowledge as the mysteries of space are unlocked. This knowledge will in turn be translated into benefits to mankind.

In the infant years of space research, there have already been a number of demonstrations of how space technology can be put to work for the practical benefit of mankind. The dramatic success of the Telstar communications satellite, which made repeated international telecasts, brought home to the public the fact that space research offers advances in our way of life on earth. Almost overlooked in the enthusiasm over Telstar's use as a spaceborne TV station was the more important use of the communications satellite in overseas message transmission.

Throughout this decade, there has been a multifold increase in overseas cable messages, and the rate of increase is still on the rise. The cables now



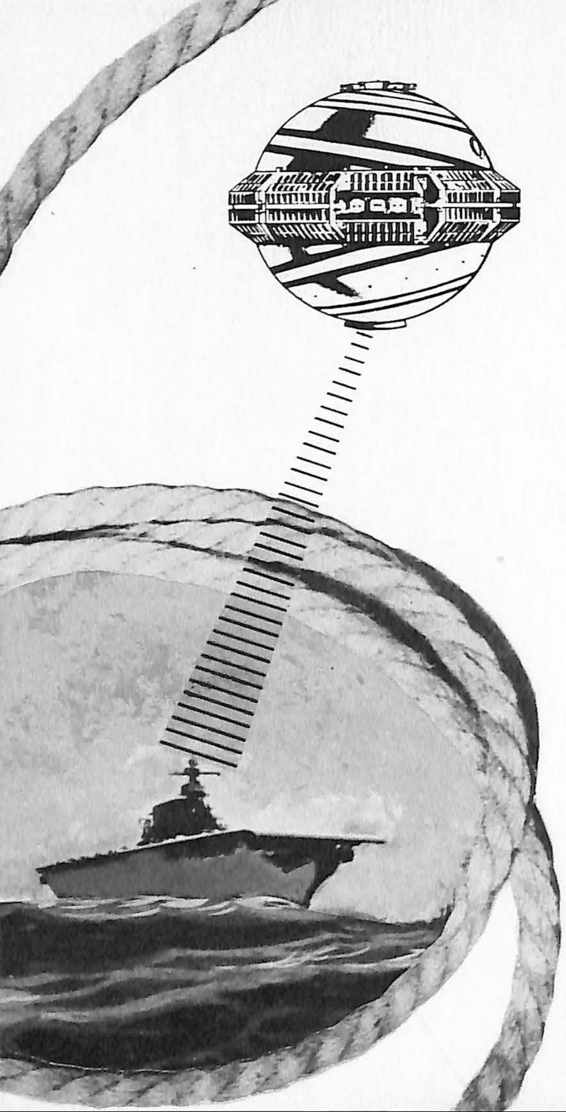


available are threatened with saturation and even projected expansion of the cable system may not be adequate to handle the predictable message rate.

Communications satellites offer an answer. Not only can they solve the problem of crowded cables, but they can also provide less expensive and more rapid overseas message transmission, with an enormous resultant benefit to international commerce.

However, considerable development still remains in the field of communications satellites. The early spacecraft of this type operated in relatively low-altitude orbits, a factor which limited the transmission time between international points. Further development is aimed at a "synchronous" satellite, that is, one whose orbital speed is synchronized with the earth's rotation so that the satellite, in effect, remains over a given point on earth at all times at an altitude of 22,300 miles. A network of synchronous satellites will permit continuous international message or TV transmission.

The National Aeronautics and Space Administration's Tiros satellites also demonstrated a tangible benefit from space research: a better system of weather forecasting. Prior to the space age, the major difficulty in predicting weather was lack of data on cloud distribution, with only about 20 per cent of the earth's surface regularly under observation. The Tiros satellites sent back thousands of cloud cover photos for anlysis by the U. S. Weather Bureau, photographed many tropical storms and even detected incipient hurricanes, thoroughly proving the value of a future weather satellite network.



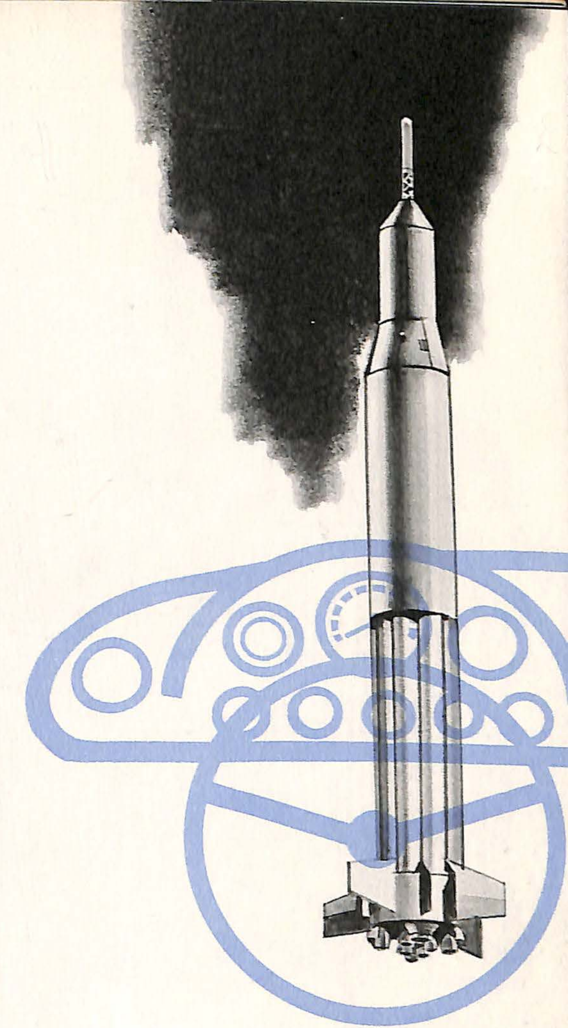
Further development is also under way in this area. Effective as was Tiros, it is possible to develop, within the bounds of existing technology, much more advanced meteorological satellites. Nimbus, the follow-on step in weather research, will be stabilized so that its cameras always point at earth, permitting an increase in the area which can be photographed. Aeros, the third generation metro spacecraft, is being designed for the 22,300-mile-altitude stationary orbit, and, like Nimbus, it will be earth-stabilized.

The ultimate space weather station can give forecasters on earth the complete information they need to provide completely accurate weather predictions, a tremendous benefit to every walk of life. It is certainly within the realm of possibility that, once man has mastered accurate weather forecasting, he may be able to do something about changing the weather.

There is also the navigation satellite. Placed in a precise orbit and equipped with a radio transmitter, it could provide position reports of high accuracy for ships and aircraft. It would, in effect, be an artificial transmitting star whose position is always precisely known, permitting ships and aircraft to fix their own position in relation to that of the satellite. Some experts feel that a device of this type, now in advanced development, may supplant most existing navigation aids.

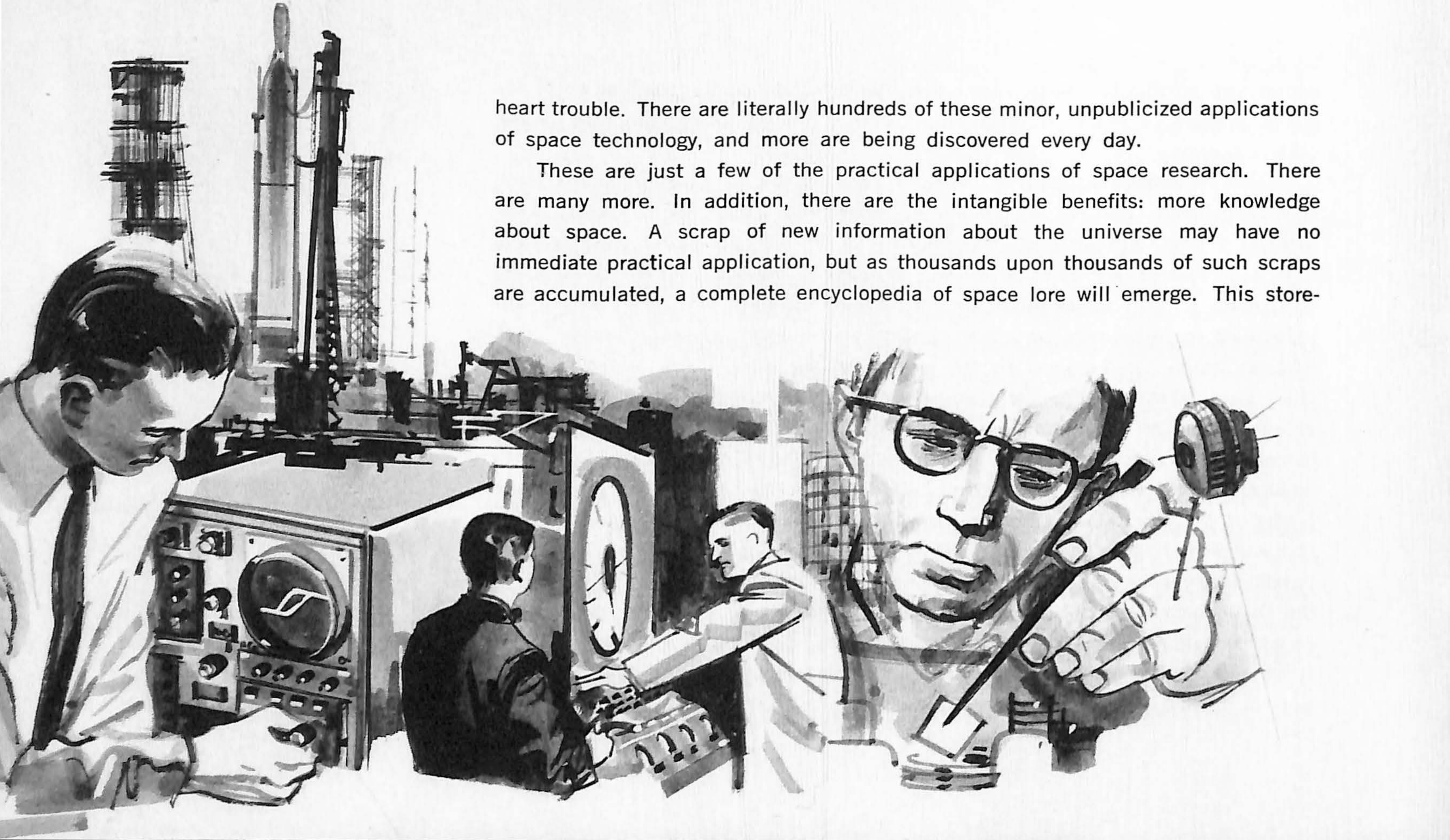
World mapping is still another area where space research can provide benefits. Even today, large portions of the earth cannot be precisely charted for lack of an accurate starting point, called a "base line." A satellite, its position accurately known, can provide the needed base line between itself and a point on earth for global charting. It would permit measurements of thousands of miles with almost perfect accuracy.

Each complete spacecraft is made up of a number of systems, sub-systems and components, and in the course of developing these various parts, other benefits accrue. For instance, development of the Mercury spacecraft brought forth a number of new items which can be used by overseas airlines or shipping companies: a new, non-tippable life raft, a new compact life jacket which can be donned in 10 seconds by a man already in the water, a new inflatable radar reflector which can be seen on the surface of the ocean from an airplane 50 miles away. From work on the Saturn launch vehicle came a new printed cable which is used on an automobile instead of the conventional dashboard wiring harness and which is applicable to any mass produced commercial item as a replacement for conventional harness. Research on air bearings for gyroscopes produced the "air floor," with air jets and sensors to sense the position of a pad and float it on a cushion of air. This is commercially applicable as a materials handling system for palletized loads. Another air bearing application is the "ballistocardiograph," in which the patient may lie on a floating table while an electrocardiogram is being taken, allowing the electrocardiogram to show the recoil and impulse of the heart, indicating the amount of work the heart is doing. Such a device, now in commercial manufacture, can reportedly detect incipient



heart trouble. There are literally hundreds of these minor, unpublicized applications of space technology, and more are being discovered every day.

These are just a few of the practical applications of space research. There are many more. In addition, there are the intangible benefits: more knowledge about space. A scrap of new information about the universe may have no immediate practical application, but as thousands upon thousands of such scraps are accumulated, a complete encyclopedia of space lore will emerge. This store-



house of knowledge will open up new fields for practical application. Thus, peaceful space exploration offers a variety of near-future practical benefits and an unknown number of other applications which time and continued accumulation of knowledge will bring forth.

The products of military space research cannot really be termed benefits, for mankind benefits little from the invention of new methods of destruction. Military research in space is, however, a **must**. As long as the threat of foreign aggression exists, we must continue to develop new methods of defense, and it appears that the next step in aggression is into space. While the Nation's peaceful space exploration program will provide considerable basic knowledge toward the development of defense in space, military research programs must also be undertaken to develop the specific vehicles and techniques for space warfare. It is not yet clear what forms space warfare will take, but the need for investigating the possibilities is apparent.

There is one final why for space research. The Soviet Union has proved masterful in exploiting its space gains for propaganda purposes. To maintain its international prestige, the United States must match or better its competitor's efforts. The Soviets have taken an early lead in the international space competition, but the race will be a long one. The U. S. has the capacity to lead the world in space exploration, but this capacity must be exploited by a strong and continuing program of research.

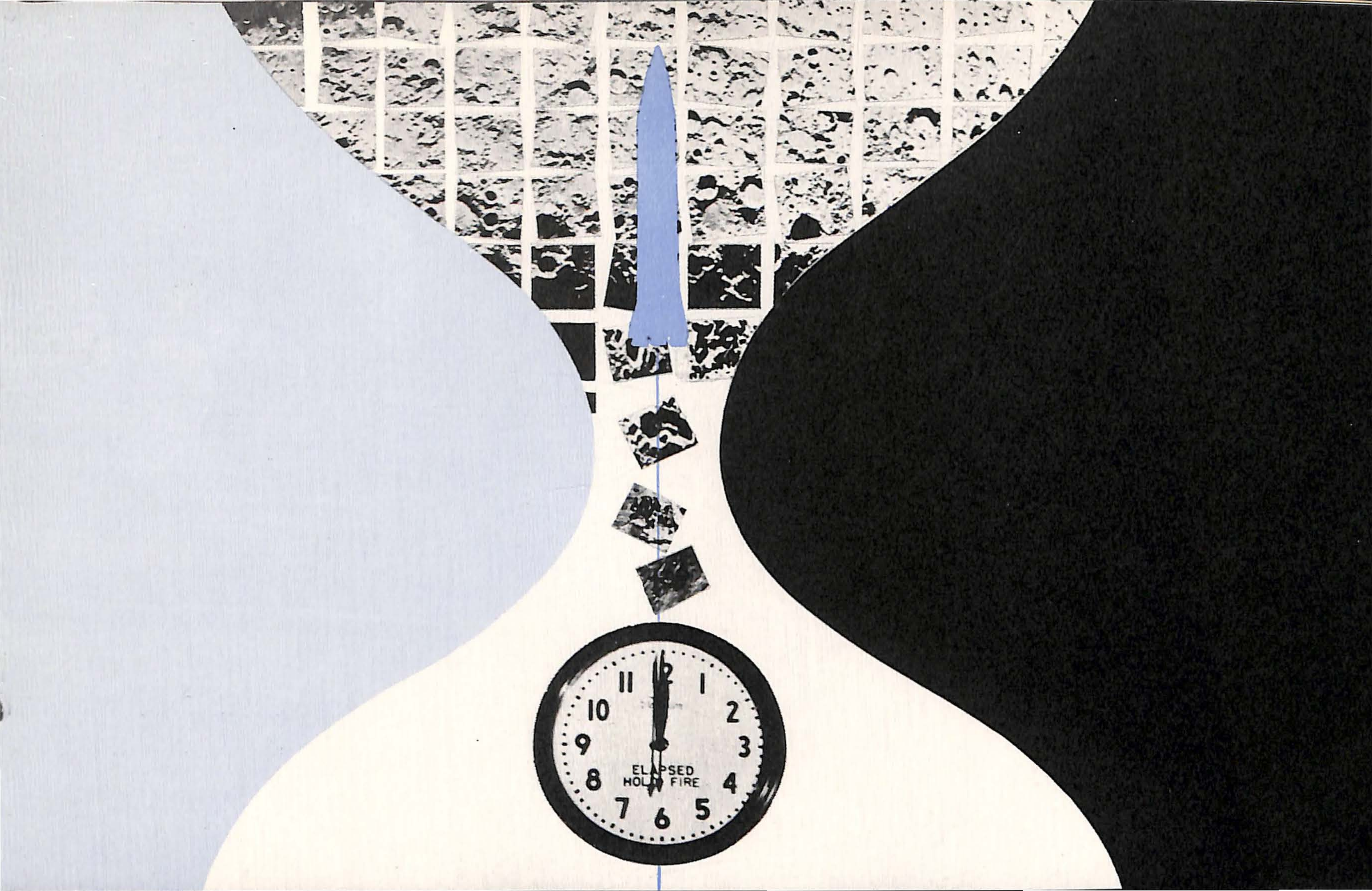
THE NEXT STEPS IN SPACE EXPLORATION

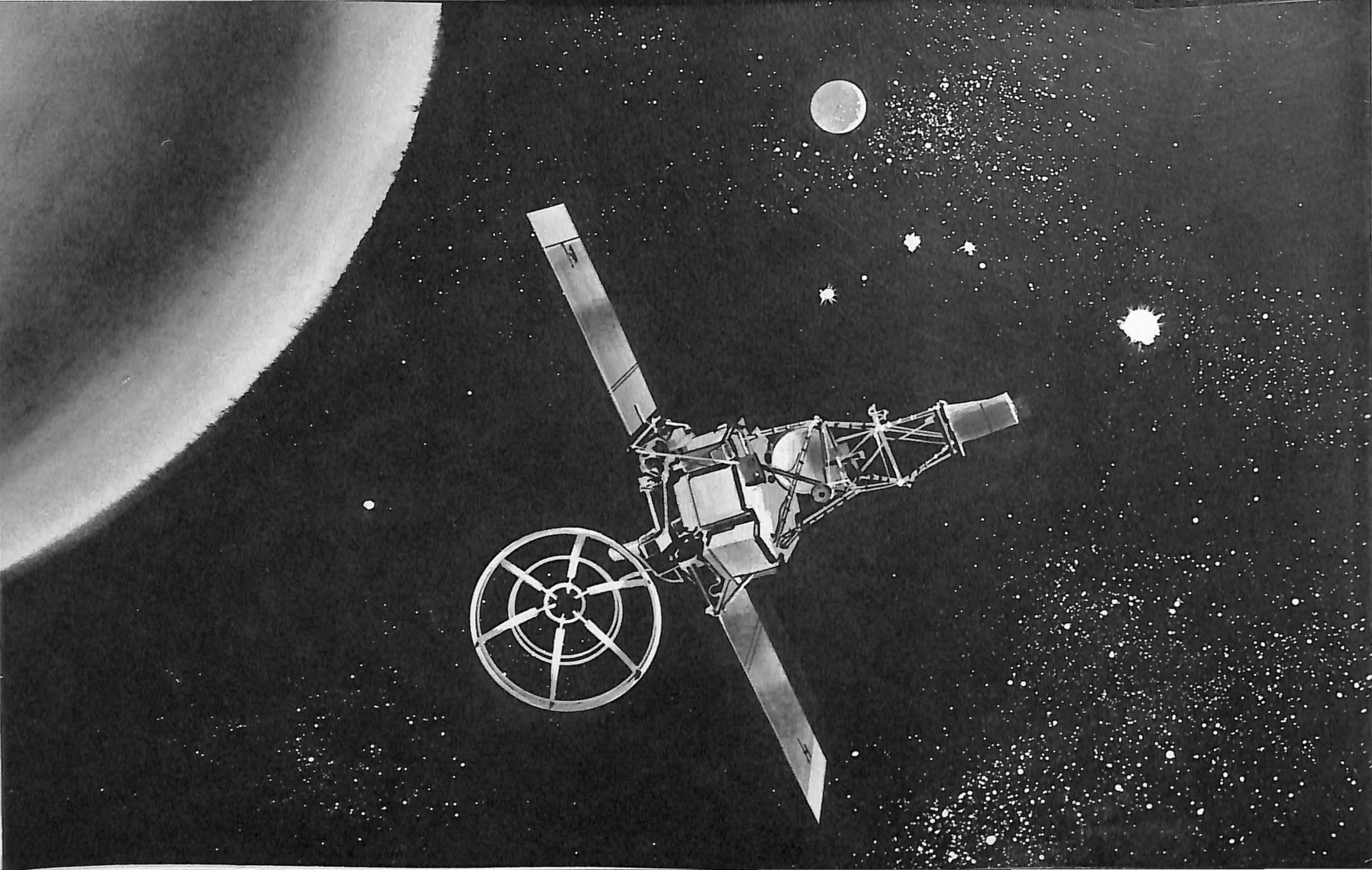
The fantastic achievements of the first years of the Space Age have whetted the appetites of the populace for the even more incredible feats of space exploration believed possible. When, asks the layman, can we visit Mars and Venus, or distant Pluto, or even voyage beyond our own solar system?

It is the brash scientist, indeed, who would attempt to set a timetable for such great events. Manned trips to even the nearest planets impose incredible demands upon science. Consider that the star nearest our sun is four and one-half light years away; in other words, it would take four and one-half years to reach it were it possible to travel at the speed of light, 186,000 miles per second!

One scientist with an aerospace manufacturing company has advanced the theory that man's exploration of the universe may be limited to the very closest stars because of what he termed the "disintegration barrier." At speeds approaching that of light—assuming they can be attained—collision with microscopic interstellar dust particles would result in disintegration of the space vehicle.

Even exploration of our own solar system involves incredible distances. The planet Pluto, the most distant satellite of our sun, is three and a half **billion** miles away. The flight of the space probe Mariner II points up the enormity of even solar space. Although the planet Venus, our "next door neighbor," is a scant


ELAPSED
HOLD FIRE

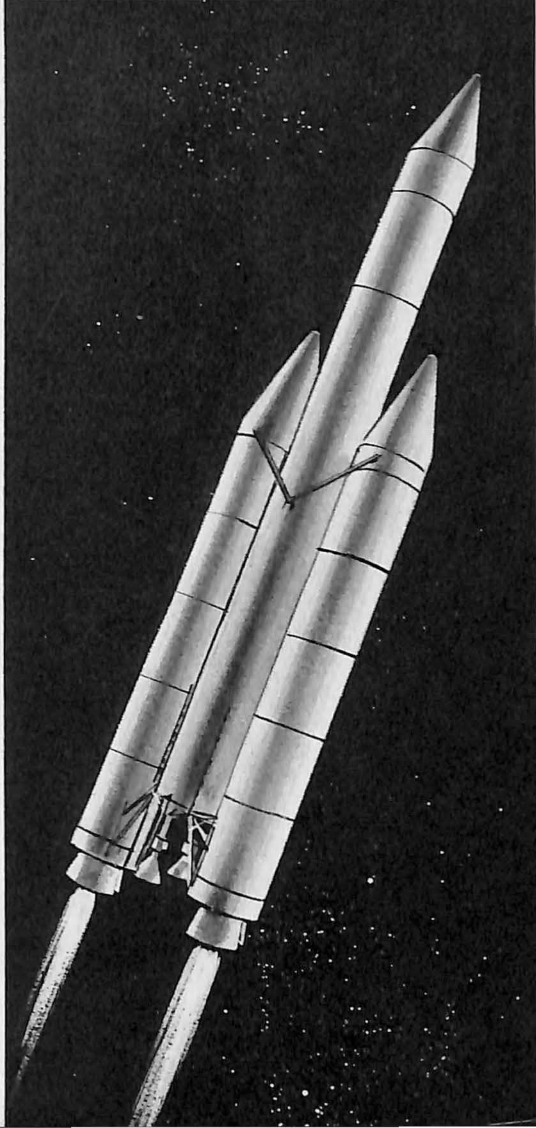


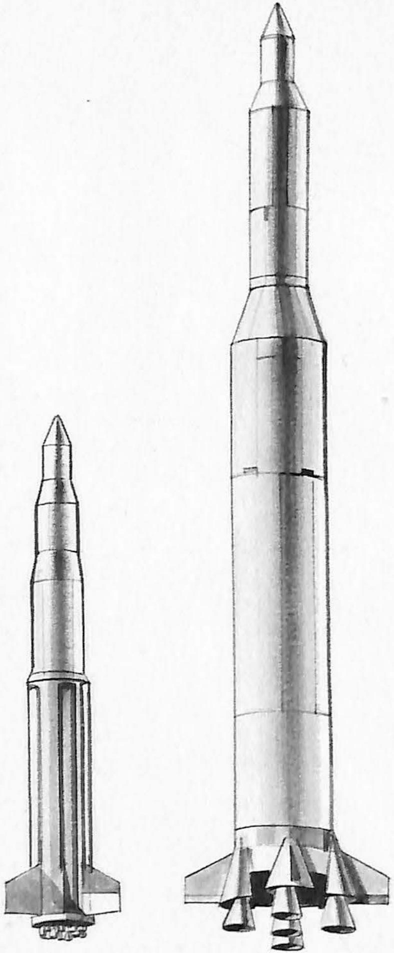
26,000,000 miles distant, it takes a spacecraft like Mariner three and a half months to reach it.

Consider the technological demands for a **manned** vehicle capable of journeying to Venus: an extremely powerful propulsion system which can boost the necessarily large payload into the Venus trajectory; additional on-board propulsion for course corrections; a very sturdy frame to protect the crew from the potentially disastrous effects of hull puncture by space matter; a system of protection from radiation; a guidance system of great accuracy; a complete, built-in, earth-like environment for the crew; and a degree of reliability which will permit every component of every system to operate for long periods independently of assistance from earth. Even then, the crew must cope with the hazards of landing on a planet whose surface has never been seen.

Obviously, real interplanetary exploration, to Venus and beyond, remains for some future date. It is, however, possible to outline the next immediate steps in space exploration under what is known as the National Lunar Program, supervised by the National Aeronautics and Space Administration.

The major requirements for fulfillment of this program are more powerful boosters to permit undertaking some of the more difficult space missions. The early American satellites were, for the most part, boosted by rockets of about 150,000 pounds thrust, and Project Mercury manned spacecraft were launched by 360,000-pound-thrust modified missiles. To send up larger payloads, and to send them farther from earth, more power is needed. For this purpose, NASA,





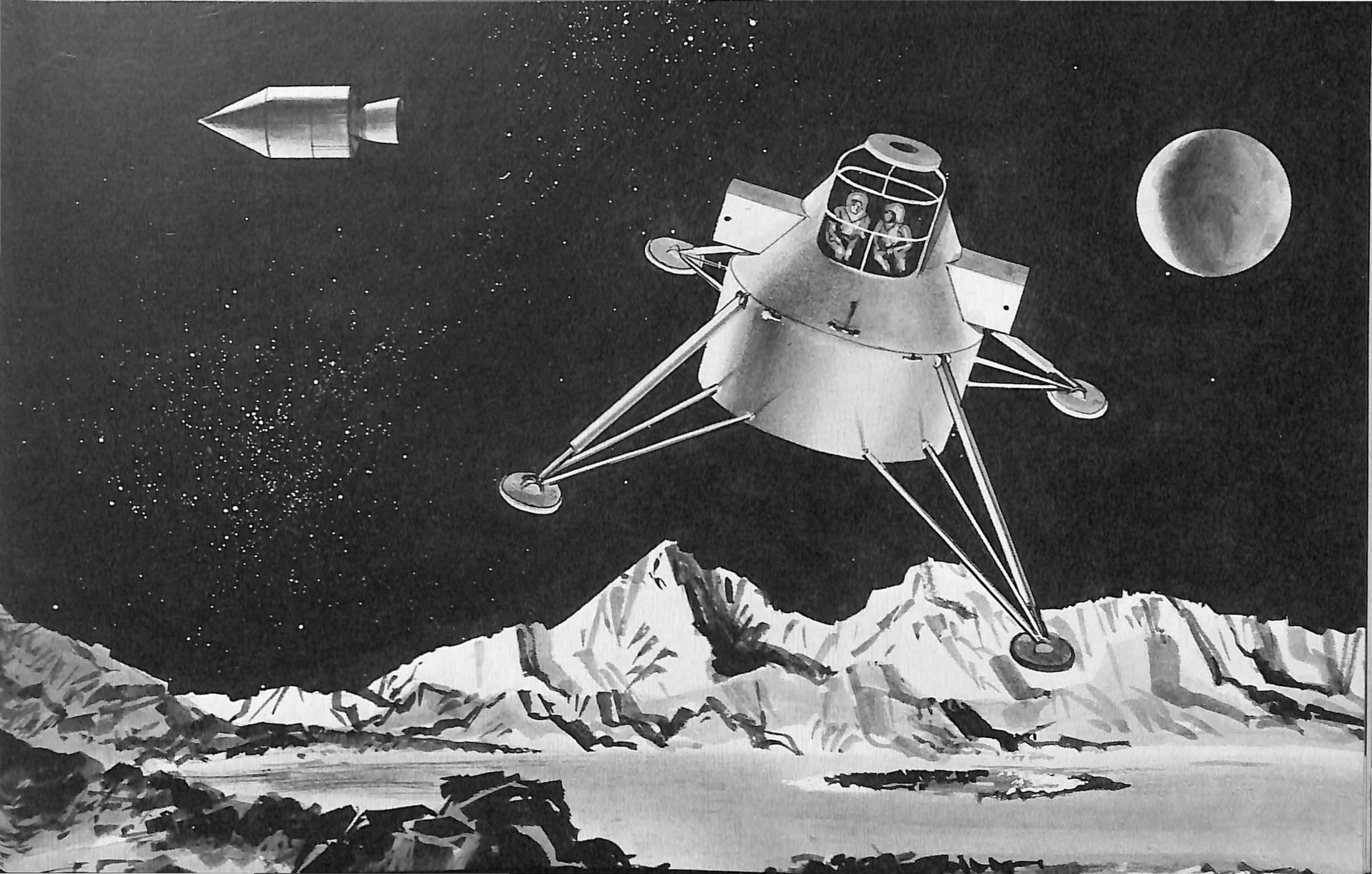
the military services, and their hardware-producing partner, the aerospace industry, are developing a family of high-powered launch vehicles.

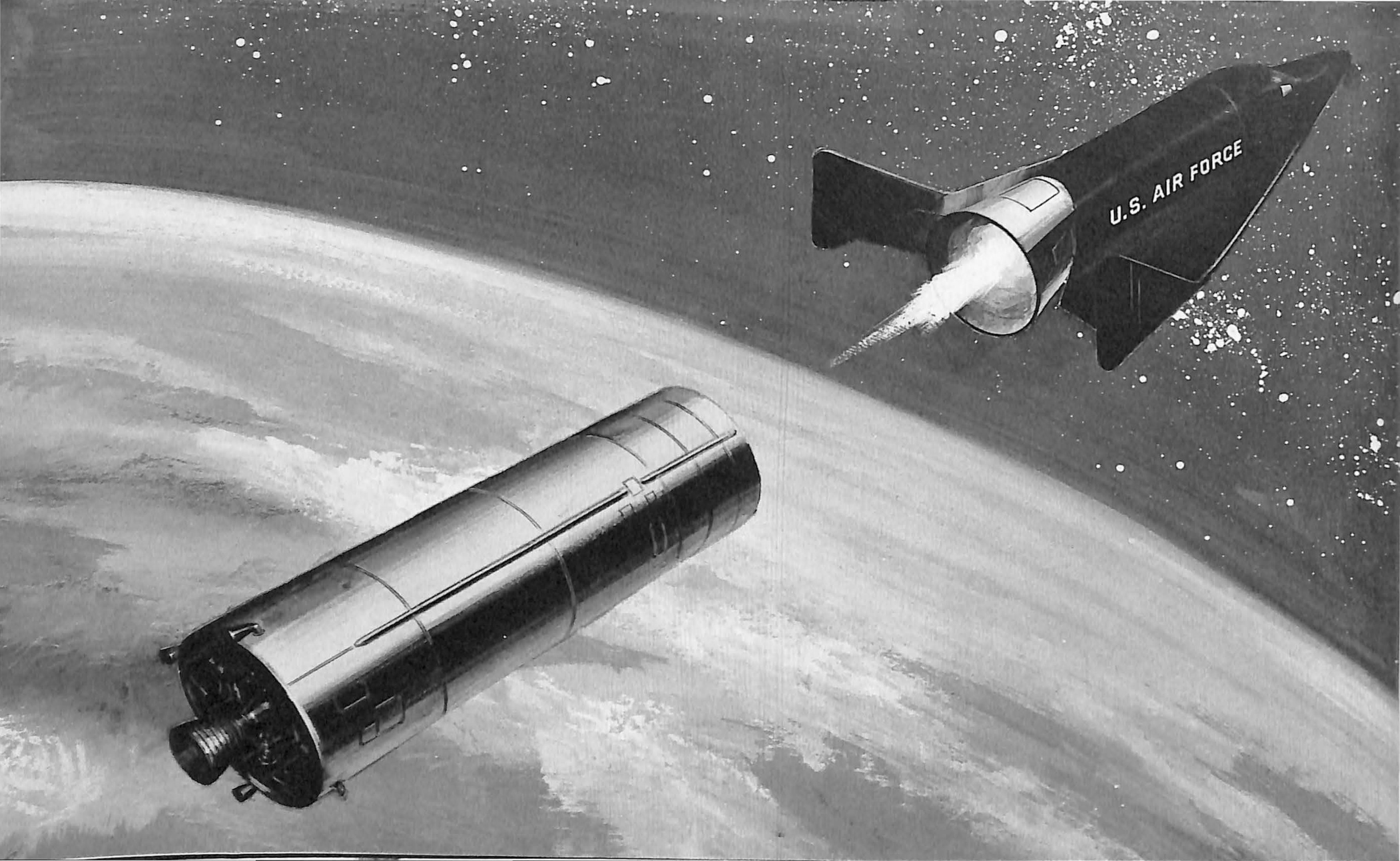
Among these superboosters is Titan III, which consists of a modified Titan ICBM with two large solid rockets "strapped on." This system, which will generate approximately 1,500,000 pounds thrust, will be used to boost the first military manned spacecraft.

For non-military exploration of space, NASA is developing the Saturn group of launch vehicles. There are two basic members of this group, known as C-1 and C-5. The Saturn C-1 is a two-stage vehicle, with eight H-1 engines in its first stage, each developing 188,000 pounds thrust for a total of about 1,500,000 pounds. The second stage has six engines, designated RL-10, each producing 15,000 pounds thrust. In an alternate version of C-1, a third stage made up of two RL-10 engines may be employed.

The C-5, or Advanced Saturn, is a much larger and much more powerful booster. Its main component is a huge engine known as F-1, capable of producing 1,500,000 pounds thrust in a single chamber. Five of these engines, with a total thrust of 7,500,000 pounds, will make up the first stage propulsion system for C-5 The second stage consists of five J-2 engines, each of 200,000 pounds thrust. Third stage is a single J-2 engine.

Beyond these launch vehicles there is contemplated an ever more powerful system, tentatively designated Nova. Nova, which will consist of a cluster of




U.S. AIR FORCE

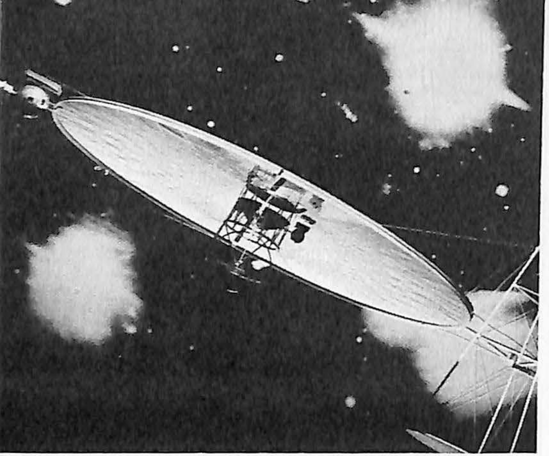
engines of the F-1 type, may have a thrust rating on the order of 20,000,000 pounds or more.

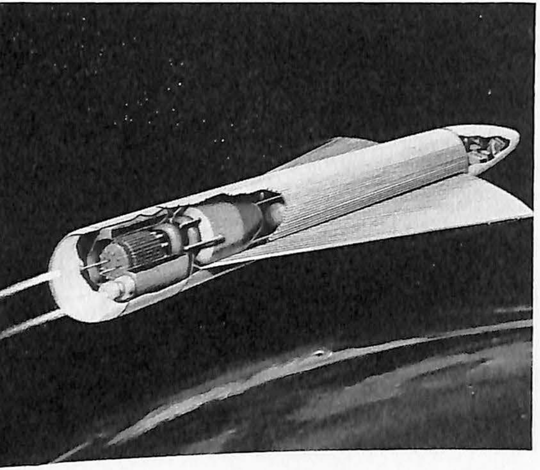
These launch vehicles comprise the keystone of the space exploration program. With them, researchers will be able to conduct a number of advanced missions such as landings on the moon and unmanned probes to some of the planets within our solar system.

The immediate major step following completion of Project Mercury is Project Gemini, a two-man spacecraft. With this vehicle, NASA will conduct research on earth-orbital flights of durations up to two weeks, space rendezvous and docking techniques, and controlled re-entry with descent terminating on land rather than on water, as was the case with Mercury missions.

After Gemini comes Project Apollo, which might be considered as three separate projects. In the first phase, employing the Saturn C-1 booster, the three-man Apollo spacecraft will be sent on a series of earth-orbital missions of increasing duration, picking up where Gemini leaves off on rendezvous and docking research. In the second phase, with the Saturn C-5 booster, Apollo will conduct circumlunar and lunar orbit missions. Finally, again with the use of the C-5 booster, will come the lunar landing mission.

In a period contemporary with the tail-end of the Gemini program and the start of the Apollo program, the first manned military space project will get under way. The spacecraft is the X-20 Dyna-Soar, a one-man, winged orbital glider de-





signed to investigate certain specific military requirements, primarily controlled re-entry and pin-point landings using aerodynamic controls. Booster for the Dyna-Soar program will be the Titan III. The project will consist of a series of steps: first, glider flights after drops from a "mother" plane; second, supersonic and hypersonic flights, employing a temporary rocket power plant; third, unmanned orbital missions; and, finally, manned orbital flights.

In addition to these manned projects, there will be continuing activity in unmanned spacecraft. There will be further research on communications satellites with 1) Rebound, a program for the launching of multiple passive satellites (like Echo) with a single booster; 2) Relay, an earth-stabilized, medium-altitude, active-repeater satellite; 3) Syncom, a stabilized, synchronous active-repeater with the orbit synchronized with the earth's rotation so that the satellite remains over a given point on earth; and 4) both synchronous and non-synchronous military communications spacecraft.

Research toward an operational system of weather satellites will continue with Nimbus, a polar-orbiting, low-altitude satellite oriented so its cameras always face the earth, and Aeros, a high-altitude, synchronous, equator-orbiting spacecraft.

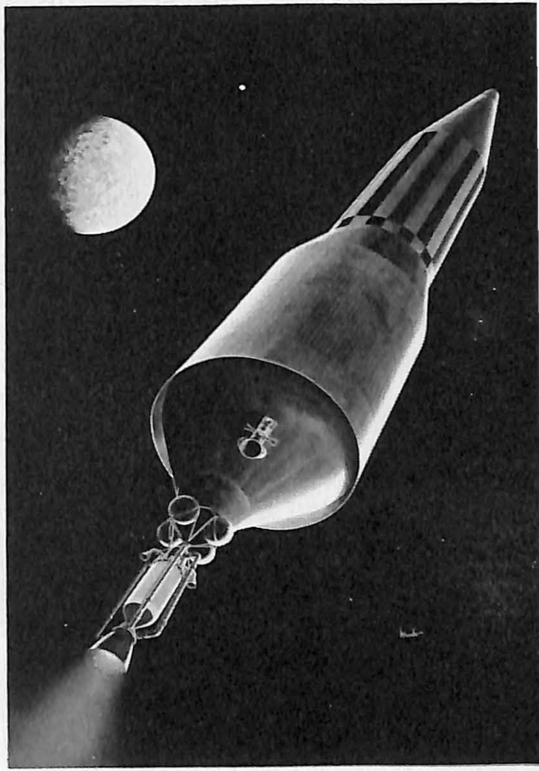
Other important projects include the Orbiting Astronomical Observatory (OAO), a stabilized satellite with which telescopic observations of the ultraviolet, infrared and X-ray spectra will be made, and the Orbiting Geophysical Observatory (OGO), which will investigate such areas as magnetic fields, astronomy, radio propagation, atmospheric measurements, energetic particles and interplanetary dust.

The military services will be conducting parallel development programs on spacecraft with specific military applications. Among these are surveillance and warning spacecraft, maneuverable spacecraft for inspection of unidentified objects in space, logistics, maintenance and rescue spacecraft, and other vehicles of a classified nature.

Unmanned space probes, those which achieve escape trajectory, include Ranger, designed for elementary research in the lunar area; Surveyor, a more advanced lunar explorer which will make soft landings on the moon; additional Mariner spacecraft for acquiring basic data on Venus and Mars; and Voyager, an advanced probe of the Mariner type, designed to orbit or land on the nearby planets.

These are the major elements of the immediate U. S. space program. Looking farther ahead, there will be programs aimed at development of re-usable boosters, an "aerospace plane" which can take off from the ground and penetrate space, and a manned orbiting space station which will find utility either as a permanent space observatory or as a military space platform.

As space development progresses, NASA and the military services will maintain close coordination to insure maximum gains in both military and peaceful areas of space research. Working in concert with both groups will be the aerospace industry, the manufacturers of aircraft, missiles and spacecraft and their associated equipment.



THE ROLE OF THE AEROSPACE INDUSTRY

The execution of the Lunar Program and its military counterpart in space research will require a major national effort. A particular requirement is close and harmonious teamwork between the various groups involved in the program.

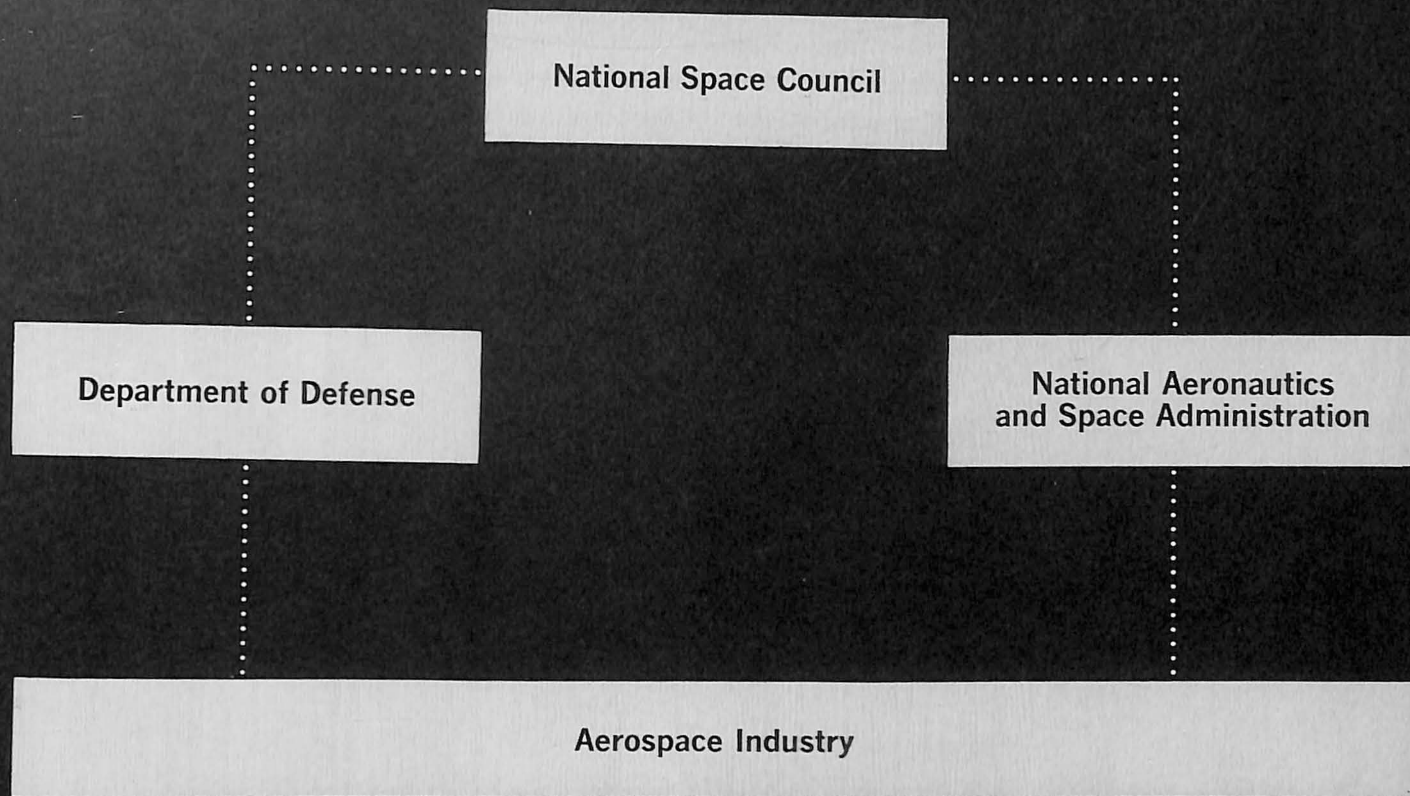
The United States' space exploration team consists of three major members.

There is the National Aeronautics and Space Administration, whose job it is to plan and direct projects aimed at peaceful exploration of space and reap therefrom the scientific knowledge that will lead to betterment of the national way of life.

There is the Department of Defense, charged with investigating the military potential of space exploration.

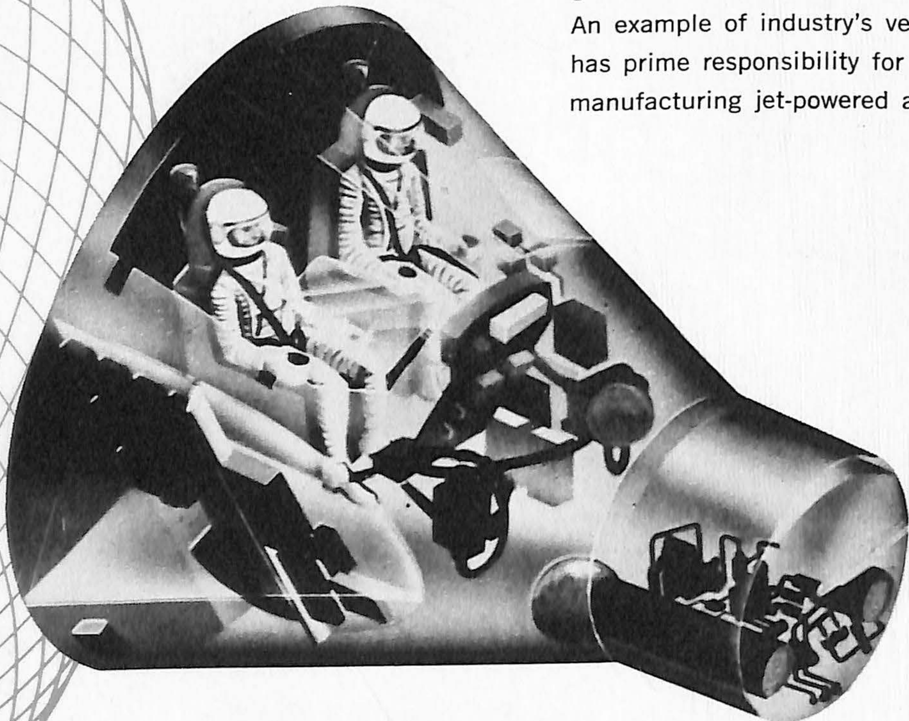
The third member of the team, with co-equal status, is the aerospace industry, which has the responsibility for providing the "hardware" for both civil and military space programs. The most perfect organization, planning and direction of the space program cannot produce the desired results if the equipment is not available.

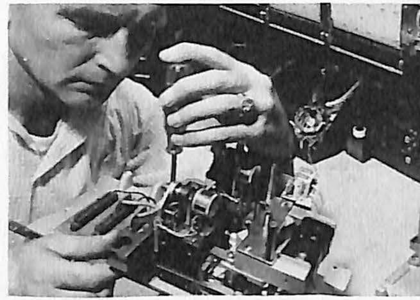
It was logical that the aerospace industry should inherit the task of turning out space equipment. In more than five decades of building aircraft and missiles, the industry accumulated a tremendous storehouse of knowledge about flight within

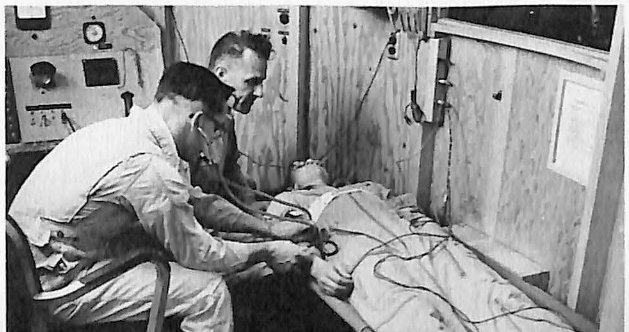

National Space Council
Department of Defense
National Aeronautics and Space Administration
Aerospace Industry

and out of the atmosphere. Such knowledge provided a base for the development and construction of vehicles for space exploration.

Today, manufacture of equipment for both the civilian and military space programs is a rapidly growing segment of the aerospace industry's total work load. An example of industry's versatility is found in the fact that the company which has prime responsibility for Dyna-Soar, the manned military space system, is also manufacturing jet-powered airliners for commercial use. Dyna-Soar or any of the







other space projects would serve as an excellent illustration of the extent to which industry is engaged in the national space exploration program, but, because it is virtually completed, let us consider the aerospace industry's contribution to the Mercury program.

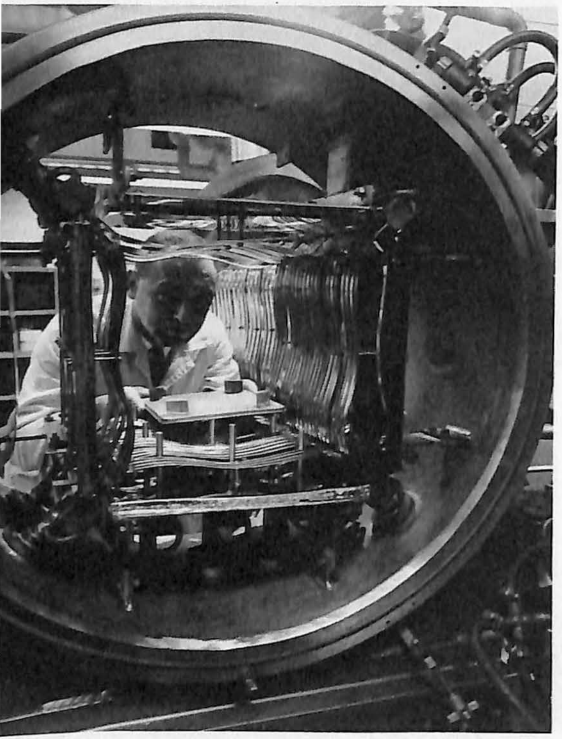
The capsule in which the first American astronauts soared through space was manufactured by a company known for a long time as a top producer of Navy and Air Force aircraft.

The launching vehicle for Project Mercury was a modified intercontinental ballistic missile, built by one of the leading aerospace companies which has for many years been producing aircraft and missiles.

The rocket power plant which provided the "push" to put the capsule in orbit was manufactured by an old-line aircraft company which has in recent years diversified its product line to include rocket power, guidance systems and other products of the Space Age.

Another company, for years engaged in the production of aircraft systems and components, was responsible for the construction and maintenance of the tracking stations on the ground, ground-space communications, and the telemetry of data from the capsule back to earth, including the all important biomedical information as to the physical condition of the astronaut.

These are just the major elements of Mercury. Within the capsule, the launch vehicle and on the ground there were thousands of systems and sub-systems turned



out by industry. The elaborate testing program for Project Mercury involved hundreds of articles—ground check-out equipment, small boosters, escape mechanisms, parachutes, training devices, etc.—provided by industry. Each major contractor in Mercury had hundreds of suppliers and subcontractors and altogether there were several thousand companies participating in the program. About 90 per cent of all the equipment in Project Mercury was industry-supplied.

A further indication of the importance of industry's role in space research is contained in a statement by an official of the National Aeronautics and Space Administration:

"Our intention is to utilize industrial and educational and other non-profit institution to accomplish the major part of our task. More than 75 per cent of our budget is spent with industry, while we retain 'in-house' only enough research and project activity to enable our people to work at the forefront of the field and thus to be able to manage effectively the technical efforts of our contractors."

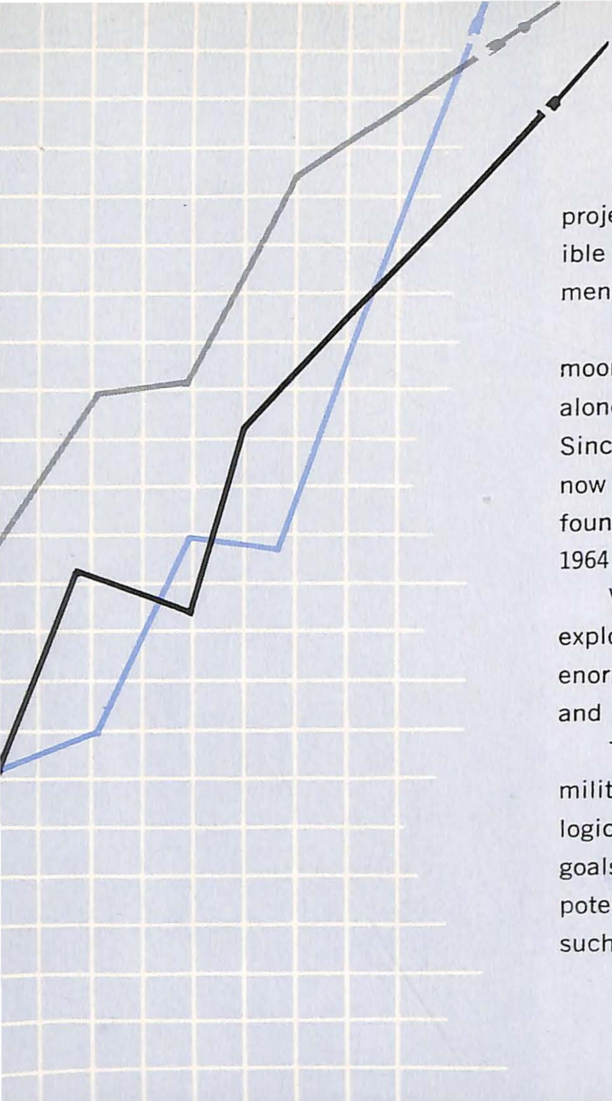
With the U. S. space program now in high gear, manufacture of spacecraft, systems and components and associated ground equipment is becoming an ever more significant portion of the industry's total work load. "Manufacture," as far as the aerospace industry is concerned, is a word whose meaning has changed considerably. It no longer denotes just the construction of a product, because fabrication of an aircraft, missile or a space vehicle is the lesser portion of the total job.

More exacting is the expensive and time-consuming research and development of the extraordinarily complex products of modern aerospace technology and the extensive testing and re-testing required to make them completely reliable.

Reliability has always been an important factor in aerospace products, but with each leap in technology it becomes more important. Consider the degree of reliability required for a manned vehicle operating for long periods in the vacuum of space where malfunction of any part can be disastrous.

The need for such reliability in space hardware, coupled with the ever-growing emphasis on research, development and test, places severe demands on the capabilities of the aerospace industry. The industry must maintain large staffs of scientists and engineers to meet the new technological demands, increasing payroll costs. It must continually divert large portions of its meager earnings to the construction of new facilities to keep pace with technological progress. And, at the same time, it must constantly search for new methods of reducing costs to allow the nation to reap the most benefit from the funds available for space research.

Its role as producing partner of the space exploration team presents a real challenge to the aerospace industry, but it has demonstrated in the past its ability to rise to challenge. The accomplishments of the industry in the early years of space flight indicate its capability to carry out its part in the greater national effort that is to come.



CONCLUSION

Space exploration will be expensive. Of that there is no question. The fantastic projects contemplated for the remainder of this decade, and the even more incredible programs which will follow in later years, will require the most complex equipment imaginable, and complexity is a yardstick of cost.

It is now estimated that, by the time the first U. S. astronauts set foot on the moon, at least $35 billion will have been expended for peaceful space exploration alone. At the same time, heavy funding will be required for military programs. Since the scope of military activity in space is subject to the results of research now under way, cost estimates are necessarily vague. Some indication may be found, however, in the fact that military space expenditures for the fiscal year 1964 will be on the order of $1.5 billion and increases were expected for later years.

Whatever the total cost of a continuing program of military and civil space exploration, its need cannot be questioned. The potential benefits to mankind are enormous and the requirement to meet the competition, for reasons of defense and national prestige, cannot be measured in dollars.

The members of the space exploration team—the civilian space agency, the military services and the aerospace industry—have the brain-power and the technological know-how to accomplish the current objectives and the nebulous future goals not yet defined. They need behind them an enlightened public, aware of the potential benefit and importance of space research and willing to support it. With such support, the United States need be second to none in space.

AIA MANUFACTURING MEMBERS

Aero Commander, Inc.
Aerodex, Inc.
Aerojet-General Corporation
Aeronutronic, Division of Ford Motor Company
Aluminum Company of America
American Brake Shoe Company
Avco Corporation
Beech Aircraft Corporation
Bell Aerospace Corporation
The Bendix Corporation
The Boeing Company
Cessna Aircraft Company
Chandler-Evans Corporation
Continental Motors Corporation
Cook Electric Company
Curtiss-Wright Corporation
Douglas Aircraft Company, Inc.
Fairchild Stratos Corporation
The Garrett Corporation
General Dynamics Corporation
General Electric Company
  Defense Electronics Division
  Flight Propulsion Division
General Laboratory Associates, Inc.
General Motors Corporation
  Allison Division
General Precision, Inc.
The B. F. Goodrich Company
Goodyear Aircraft Corporation
Grumman Aircraft Engineering Corp.
Gyrodyne Company of America, Inc.
Harvey Aluminum
Hiller Aircraft Corporation
Hughes Aircraft Company
IBM Corporation
  Federal Systems Division
Kaiser Aircraft & Electronics, Div. of
  Kaiser Industries Corporation
The Kaman Aircraft Corporation
Kollsman Instrument Corporation
Lear Siegler, Inc.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corporation
The Marquardt Corporation
Martin Company, the Aerospace
  Division of Martin Marietta
  Corporation
McDonnell Aircraft Corporation
Menasco Manufacturing Company
Minneapolis-Honeywell Regulator
  Company
Motorola, Inc.
North American Aviation, Inc.
Northrop Corporation
Pacific Airmotive Corporation
Piper Aircraft Corporation
PneumoDynamics Corporation
Radio Corporation of America
  Defense Electronic Products
Republic Aviation Corporation
Rohr Corporation
The Ryan Aeronautical Company
Solar Aircraft Company
Sperry Rand Corporation
  Sperry Gyroscope Company Division
  Sperry Phoenix Company Division
  Vickers, Inc.
Sundstrand Aviation, Division of
  Sundstrand Corporation
Swiss-American Aviation Corporation
Thiokol Chemical Corporation
Thompson Ramo Wooldridge, Inc.
United Aircraft Corporation
Westinghouse Electric Corporation
  Atomic, Defense and
  Space Group

AIA

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.
1725 DE SALES STREET, N.W., WASHINGTON 6, D.C.