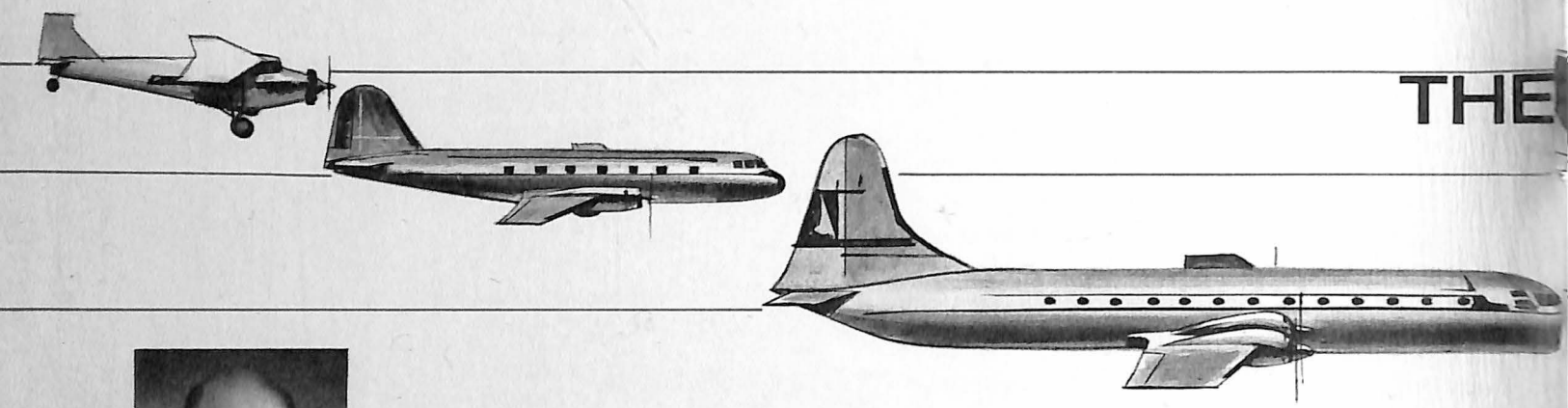
SCHEDULED PASSENGER FLIGHT



THE

MR. TIPTON

BY STUART G. TIPTON
President,
Air Transport Association of America

It has been 50 years since the first airline passenger boarded a plane, departed on schedule and flew the 21 miles from St. Petersburg to Tampa, Fla., at the amazing speed of almost a mile a minute.

The flight cut an hour-and-a-half off the travel time between those cities by steamer, five-and-a-half hours off the time by car, and 11-and-a-half hours off the time by rail.

The flight also marked the beginning of a partnership between aircraft manufacturers and the scheduled airlines of the United States. I'm sure few will disagree that it has been one of the most successful partnerships in the annals of American craftsmanship and enterprise. So successful has it been that the entire history of transportation might be divided into two periods: the first covering some two million years before scheduled passenger flights; and the second period covering the 50 years since.

In the first period, wheels were hewn from stone. Engines powered by steam and by combustible fuels were built. The axle and chassis came along. The final culmination of these accomplishments enabled the traveler to putter along a dusty road at about 15 miles per hour.

In the second period, this progress has been duplicated 40 times over in terms of speed alone. The high point of the 50-year period, of course, has been the introduction into scheduled airline service of the subsonic turbojet airliner, carrying over 150 passengers at cruising speeds of 600 miles per hour.

Thus, it took two million years to accomplish one fraction of that which has been accomplished in the last fifty.

But speed is only one facet of the advances that have been made by the builders and users of airline aircraft. Equally significant has been the progress in the safety, efficiency, economy and reliability of U. S. transports.

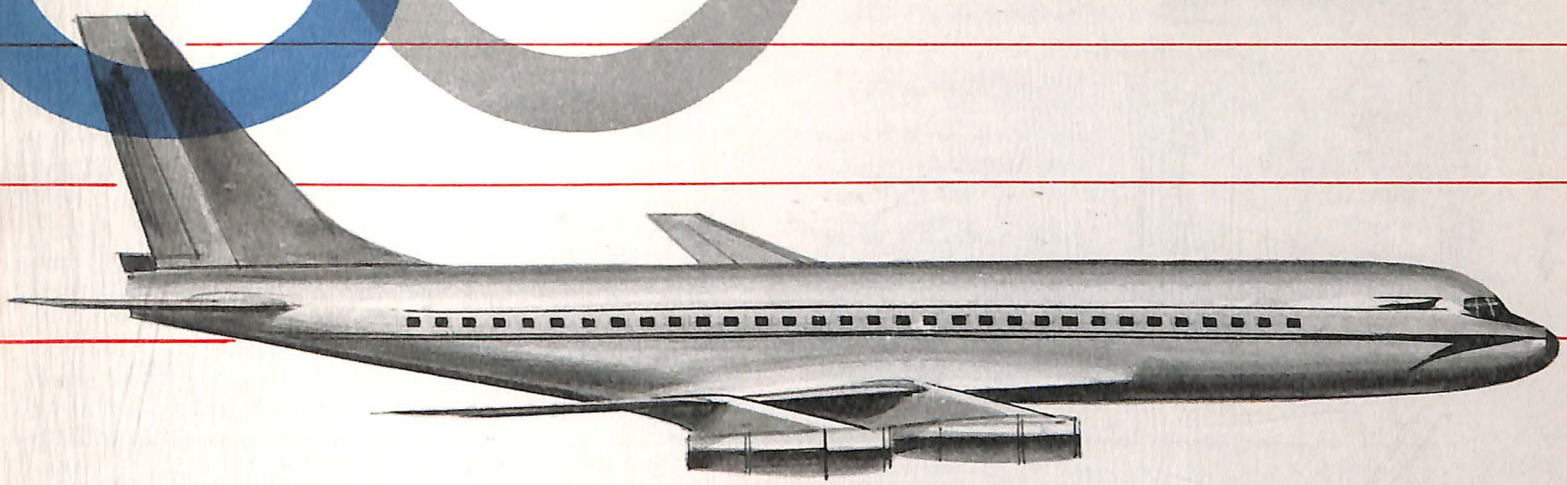
In no other industry have so many man-hours and so much money been expended to make traveling safe. The U. S. scheduled airlines last year spent $650,000,000 — a fifth of all operating expenses — in the maintenance of aircraft.

New techniques in maintenance have included the use of computers and X-ray machines to determine the stress on engines, wings, landing gear and other parts of the aircraft.

Modern methods of maintenance have been supported by the exchange of information between manufacturers and the airlines. The experiences of the airlines and the constant tests by aircraft manufacturers have resulted in numerous changes designed to increase the life and reduce the possibility of failure in aircraft parts.

Suggestions for changes continue long after the aircraft has been placed in service. Service bulletins suggesting changes for one model turbojet airliner alone would make a stack 12 feet high.

50th ANNIVERSARY



Before an aircraft ever carries passengers, it is put through a series of rigorous pre-flight tests. The tests go far beyond any strain that the airplane might be expected to encounter in regular passenger service. They also exceed regulations prescribed by the Federal Aviation Agency before the agency certificates the aircraft for airline service. For example, testing the wings of a turbojet airliner includes applying 425,000 pounds of pressure — about the weight of 50 Cadillacs — on each wing.

A recent study has indicated that if a medium-priced family car were put through comparable tests, the price of the car would be in the $25,000 range.

The result of pre-flight testing by manufacturers, preventative maintenance by the airlines and the cooperation of both in insuring maximum safety has been a steady decrease in accidents.

The fatality rate on scheduled airlines in the decade of the forties was 1.88 per hundred million passenger miles. It dropped to 0.57 in the fifties and 0.37 in the first three years of the sixties. In the first four months of 1964, the rate was 0.30 per 100 million passenger miles.

At the same time, the builders and users of air transports have combined their technical and business skills to bring about a dramatic reduction in operating costs from more than 30 cents per seat mile in the 1920's to about 3.7 cents today.

Today's turbojet airliners fly about five times faster, carry up to ten times more passengers over non-stop distances five times longer than the tri-motor transports which were best performers of the late 1920's. This tremendous growth in seat-miles flown per hour has been a key factor in making the turbine-powered airliner the biggest bargain ever available to passengers and shippers.

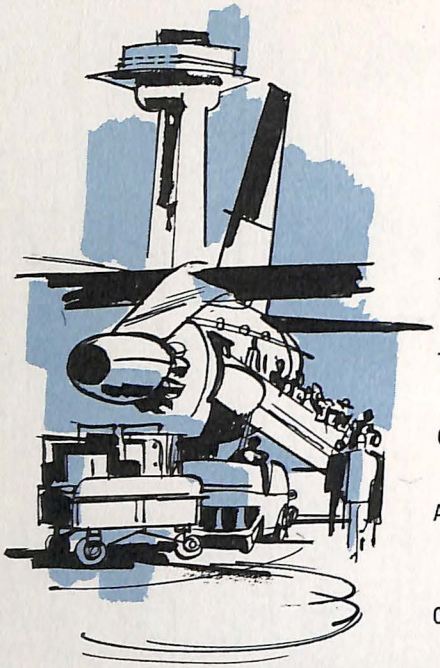
The 420 turbojet and 263 turboprop aircraft in the fleets of U. S. scheduled airlines represent, without question, the most economical planes ever delivered by the manufacturers to the carriers. This is despite the fact that the cost, with spares, of the latest four-engine turbojet airliner is in the neighborhood of $7 million each. The cost of all transports operated by the U. S. scheduled airlines 25 years ago would buy only about five of these big jetliners.

Proof of the tremendous efficiency of the turbojet aircraft is that, while they represent less than a fourth of all U. S. airliners flying today, they accounted for about three-quarters of all revenue passenger miles flown last year.

Because of their size, speed and general operating efficiency, one modern jet airliner is capable of performing — in terms of passenger and cargo ton miles carried — the services of 60 typical transports of 1938 vintage.

While the introduction of turbine-powered airliners has stimulated the economy of air carriers and opened vast new horizons to travelers in just the last six years,

GROWTH OF U. S. SCHEDULED AIRLINES



	1938	1950	1963
Revenue Passengers	1,488,113	19,220,084	**71,418,000**
Revenue Passenger Miles (000)	617,830	10,243,159	**50,361,300**
Ton Miles of Air Mail (000)	12,750	73,968	**356,601**
Ton Miles of Freight (000)	*	248,899	**1,023,077**
Ton Miles of Express (000)	2,173	37,864	**70,834**
Cities Served	286	580	**699**
Average Number of Scheduled Daily Flights	284	2,457	**10,379**
Cruising Speed of Fastest Transport Aircraft (mph)	220	375	**600**

* No freight carried in regular scheduled service.

air transportation owes much of its current success to the pioneers of years before.

This is the year the airlines are observing the 50th year of scheduled service. The first scheduled flight took off from St. Petersburg on January 1, 1914. It was part of a bold and imaginative venture by a small group of business-minded airmen and air-minded businessmen.

The idea of using a "flying machine" to transport passengers was so bold, in fact, that a Florida newspaper greeted the birth of scheduled air transportation with the suggestion that obituaries be written from the manifest before takeoff time — the biographical details might be more difficult to obtain later.

The principal promoters of the first scheduled airline were Percival Fansler and Thomas Benoist. Both Fansler, an engineer and speed boat racer, and Benoist, a successful auto parts manufacturer who had turned to building airplanes, were convinced of the business potential in ferrying passengers by airboat between St. Petersburg and Tampa. The 18-mile jaunt required two hours by steamer, six hours by car and 12 hours by rail.

Benoist offered to provide two airboats and personnel to fly and maintain them. Fansler persuaded twelve St. Petersburg businessmen and the Board of Trade to build a hangar and guarantee $50 a day through January and $25 a day through February and March.

They named their venture the St. Petersburg-Tampa Airboat Line, adopted "Safety First" as its motto and set the rates at $5 per passenger or 100 pounds of cargo. Passengers weighing over 200 were obliged to pay five cents for each excess pound. The contract with the city called for two round-trip flights a day, six days a week. Departure time for the first flight was 10 a.m.

Before flight time, a cheering throng of 3,000 followed a visiting carnival band to the yacht basin. An auction was held and ex-Mayor A. C. Pheil paid $400 for the privilege of being the world's first airline passenger. Auction proceeds went toward the purchase of harbor lights.

Tony Jannus, a young airman who specialized in steady flying rather than the more popular stunt flying, hoisted himself through a maze of wires into the open cockpit and Pheil climbed in beside him.

The Benoist aircraft was a biplane of plywood, spruce and Irish linen. The pusher-type propeller was turned by a six-cylinder, 75-horsepower engine. It was 26 feet in length with a wing span of 36 feet and weighed 1,404 pounds. Cost to build it was $4,150.

Jannus pulled the starting bar, revved the engine and the craft was nudged into the water. As the crowd roared, the airboat skimmed along Tampa Bay and rose into the air. It beached at the Tampa waterfront 23 minutes later.

In three months, the airline carried more than 1,200 passengers without an accident or personal injury. Bad weather and mechanical breakdowns forced cancellations on only seven-and-a-half days.

The airline rebated $360 of its January subsidy to St. Petersburg backers and earned its own way with-

out subsidy in February and March. At the end of March, Florida tourists returned north and the contract with the city expired.

Fansler lived until 1937, long enough to see airliners far more advanced than the Benoist XIV Flying Boat criss-crossing the nation with passengers and cargo. He later wrote:

"Looking back through the 16 years that have elapsed, I am amazed that what I visualized and put into operation was essentially the same as, for instance, the airline between New York and Boston."

Although the first scheduled airline was formed in 1914, it was from a series of events occurring years later that commercial aviation received its major stimuli: World War I; the early mail-flying era; the Kelly Act authorizing postal contracts to airlines; action by Postmaster General Walter Folger Brown, who used his power under the McNary-Watres Act of 1930 to consolidate mail routes out of which today's domestic trunkline system grew; the Civil Aeronautics Act of 1938; and World War II.

Each of these events was marked by improved aircraft. They supplied manufacturers with the incentive to build and carriers the incentive to buy more expensive and more efficient planes.

While literally hundreds of transports were important in the development of air transportation, I believe the history of airline aircraft can be roughly divided into four eras:

THE TRI-MOTOR ERA — The first important improvements in airline airplanes came in the form of the tri-motor transports of the 1920's.

Their engines, structure and aerodynamic design all were significant improvements over the World War I-type technology which had been the basis of all commercial transport designs until that time.

Primary structure in the tri-motors involved trusses made of steel tubes welded together. These were considerably lighter and stronger than the wooden trusses used previously. Light, strong, laminated plywood also began to be used for wing and fuselage coverings in place of fabric. During this era the Ford Tri-motor, the first all-metal commercial airplane, made its debut.

The radial air-cooled engines which went into service on the tri-motors were the most powerful then used to carry passengers. Some delivered more than 500 horsepower and weighed less than two pounds per horsepower. The tri-motors were much lighter for their size than older types.

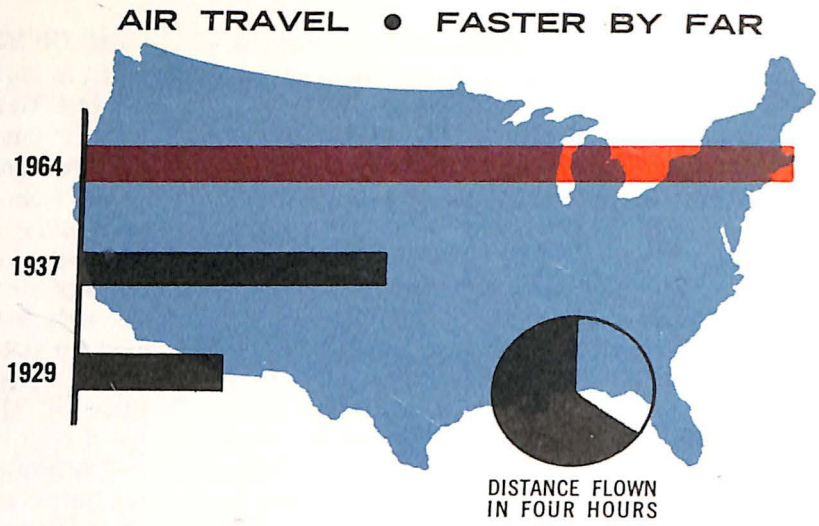
Aerodynamically, the tri-motors set a new standard for streamlining. Even though their landing gear was exposed to the air stream, they had a relatively low drag because they were monoplanes and much "cleaner" than the wire-braced biplanes they superseded.

THE STREAMLINING ERA — The modern, low-drag, streamlined airplane with retractable landing gear, highly efficient airfoil shapes on their wings, "fillets" at the juncture of the wing and fuselage to reduce air flow turbulence, and low-drag engine nacelles, had their birth in the early 1930's.

Research on streamlining, which had been underway for about 10 years, paid off in aircraft such as the Douglas DC-3, the Boeing 247 and Lockheed Orion, which raised economical cruise speeds at least 50 per cent above the tri-motors.

The high aerodynamic efficiency and low drag of the transports of this era required less power from their engines and burned less fuel during the cruise.

Benoist flying board comes "off the step" for the first scheduled passenger flight.



For the first time it was possible for an airliner to carry 20 passengers more than 2,000 miles non-stop.

Radial engines developing more than 1,000 horsepower each became available. Aircraft such as the DC-3 had more power in two engines than the trimotors had in three.

Structural advancement during this era was just as significant as the streamlining and the new engines. The aircraft manufacturers succeeded in building reliable structures using sheet aluminum — by far the strongest material for its weight ever available commercially. The aircraft loads were carried primarily in the aluminum skin, which was stiffened and reinforced at appropriate points by fuselage ribs and stringers, and by wing spars and ribs.

The new powerplant and the structural and aerodynamic developments made efficient four-engine airplanes possible. The Douglas DC-4, Lockheed Constellation and Boeing 307 Stratoliner were developed. They weighed in the neighborhood of 50,000 pounds at take-off, or about twice as much as twin-engined transports of the same era, and they could carry 30 or more passengers coast-to-coast non-stop.

Scheduled transatlantic and transpacific passenger travel was developed into a reliable and regular service through the use of large four-engined flying boats. The flying boats at that time were superior to landplanes for this service because they could land and take-off at higher speeds from the water and, therefore, could carry a larger percentage of their weight as payload.

Cabin pressurization and air conditioning, plus the supercharging of powerplants, pushed airline operations into the 15,000-to-20,000-foot altitude levels. This brought greater operating efficiency and passenger comfort.

THE LONG-RANGE ERA — After World War II, the powerful and efficient piston engines built for the military became available for commercial transports. These engines produced about one horsepower for every pound of engine weight — long considered the ultimate target of efficiency for piston engines. They had a low fuel consumption compared to older powerplants and produced 3,500 horsepower or more.

With these engines, manufacturers were able to build a new family of large, long-range airplanes, while still not incurring the economic penalty of going to more than four engines.

These aircraft weighed in the neighborhood of 120,000 pounds and could carry more than 50 passengers on ranges over 5,000 miles. On shorter hauls, they could carry about 100 passengers.

These transports had the payload carrying ability to put the flying boats out of business. They did not have the problems of winter landings on the water at cities in the Northern latitudes and their very high reliability record overcame concern about the danger of forced landings at sea.

THE TURBINE ENGINE ERA — The gas turbine engine, which was the most revolutionary technical development in airline history, has several benefits over piston powerplants. The gas turbine is lighter and smaller than a piston engine-propeller system in terms of thrust force delivered per pound of powerplant weight. Consequently, they have made possible very large aircraft which can carry an unusually large percentage of their total weight as payload.

Further, the turbojet engine allows an aircraft to cruise nearly twice as fast as a propeller-driven transport, which is especially valuable on long-range airplanes. All types of gas turbine engines have had better reliability records than other engines in airline service. Their time between overhauls and premature removals due to malfunction are phenomenally low.

The very high power and light weight of the jet engines has made it possible to build larger aircraft than in the past. Some of the largest turbojet airliners today weigh more than 320,000 pounds at take-off and can carry well over 150 passengers.

The same basic structural design developed in the 1930's is still in use. Manufacturing methods have improved and they allow very large and efficient parts to be produced, such as tapered wing skins that are thick at the root section near the fuselage and thin at the tips. Swept wing designs and flush riveting over

the entire airplane have lowered drag at high speeds and have improved aerodynamic efficiency.

New and powerful cabin pressurization systems permit the turbojet aircraft to operate in the 30,000 to 40,000-foot range, with unusually fine passenger comfort and maximum flight efficiency for the engines and airframes.

Progress is continuing rapidly in the development of gas turbine engines, and in the structures and aerodynamic efficiency of the frames. Turbofan engines have recently been introduced into service. The turbofans are more powerful for their weight than the pure turbojets. They make possible increases in airplane gross weight, reductions in take-off distance, reduced noise and higher cruising altitudes.

Improvements also have been made in the efficiency of swept wings. Current models have 50 per cent more lifting capacity at low speeds, than those on the original jet transports, without any sacrifice in high speed efficiency. This has resulted in a substantial decrease in landing speeds.

The jetliners first entered airline service in late 1958. U. S. scheduled airlines committed more than their total assets to buy them — an unprecedented plunge for any industry even in the kind of economy existing in the nation today.

Immediately, these revolutionary new aircraft proved a boon to the traveling public, making possible trips during two-week vacations to any part of the world. But the tremendous debts the airlines incurred made their financial condition perilous. Only in the last two years — by learning to operate turbojet aircraft efficiently, increasing overhaul times and streamlining ground services to match the performance of the new planes — have the airlines made the financial breakthrough.

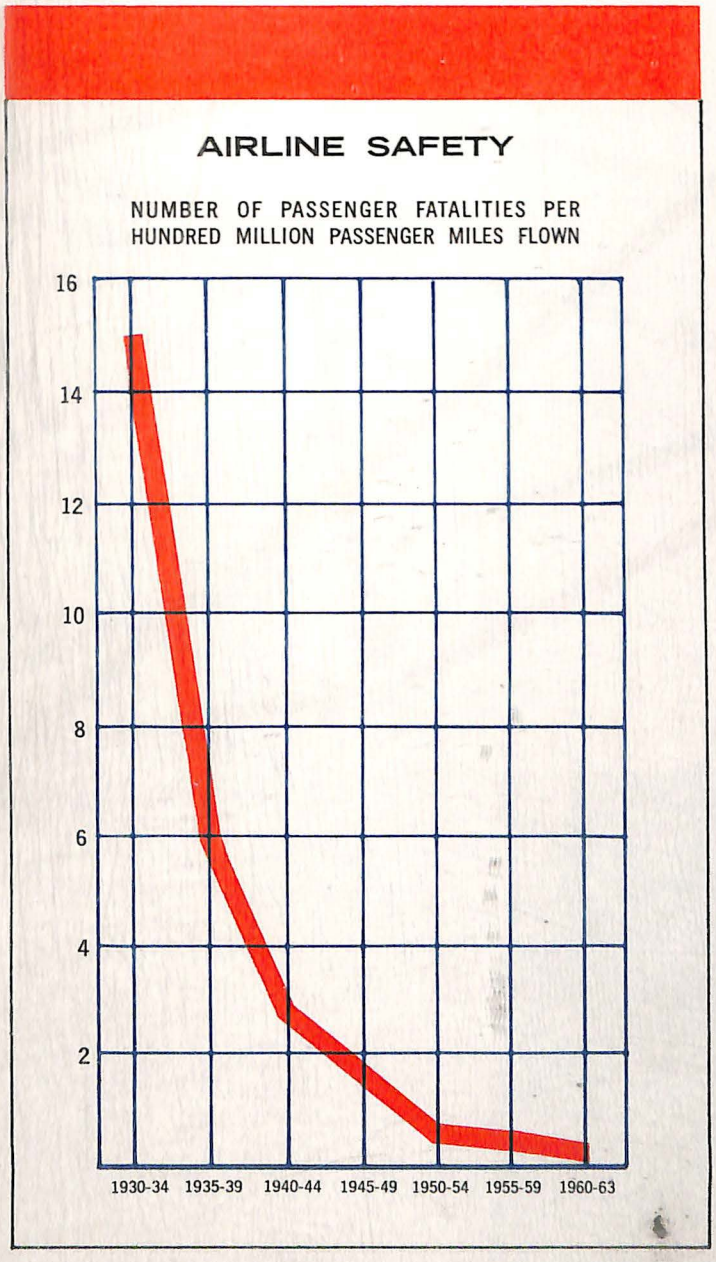
It is typical of the aviation industry that, even before the benefits of one new type aircraft are fully realized, its sights are set on the next era.

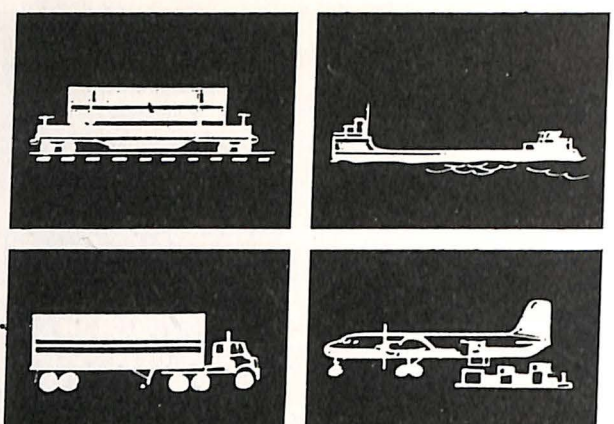
The fifth era of commercial aviation, undoubtedly, will be the supersonic era. Its airplanes are already on the drawing boards and in wind tunnels — planes that promise to carry passengers from New York to London in about the time it requires to go from New York to Philadelphia by train.

I read and hear daily of the awesome problems to overcome before a turbojet airliner traveling at three times the speed of sound joins the airline fleets — heat, weight, sound and runway requirements. But an observer can hardly look back over the 50-year partnership between aircraft manufacturers and the scheduled airlines without coming to the realization that such an aircraft will be flown.

The U. S. supersonic might come after a supersonic from abroad, as was the case with subsonic jets. But the entire history of aviation in the U. S. augurs for a U. S. SST that will eventually dominate the market.

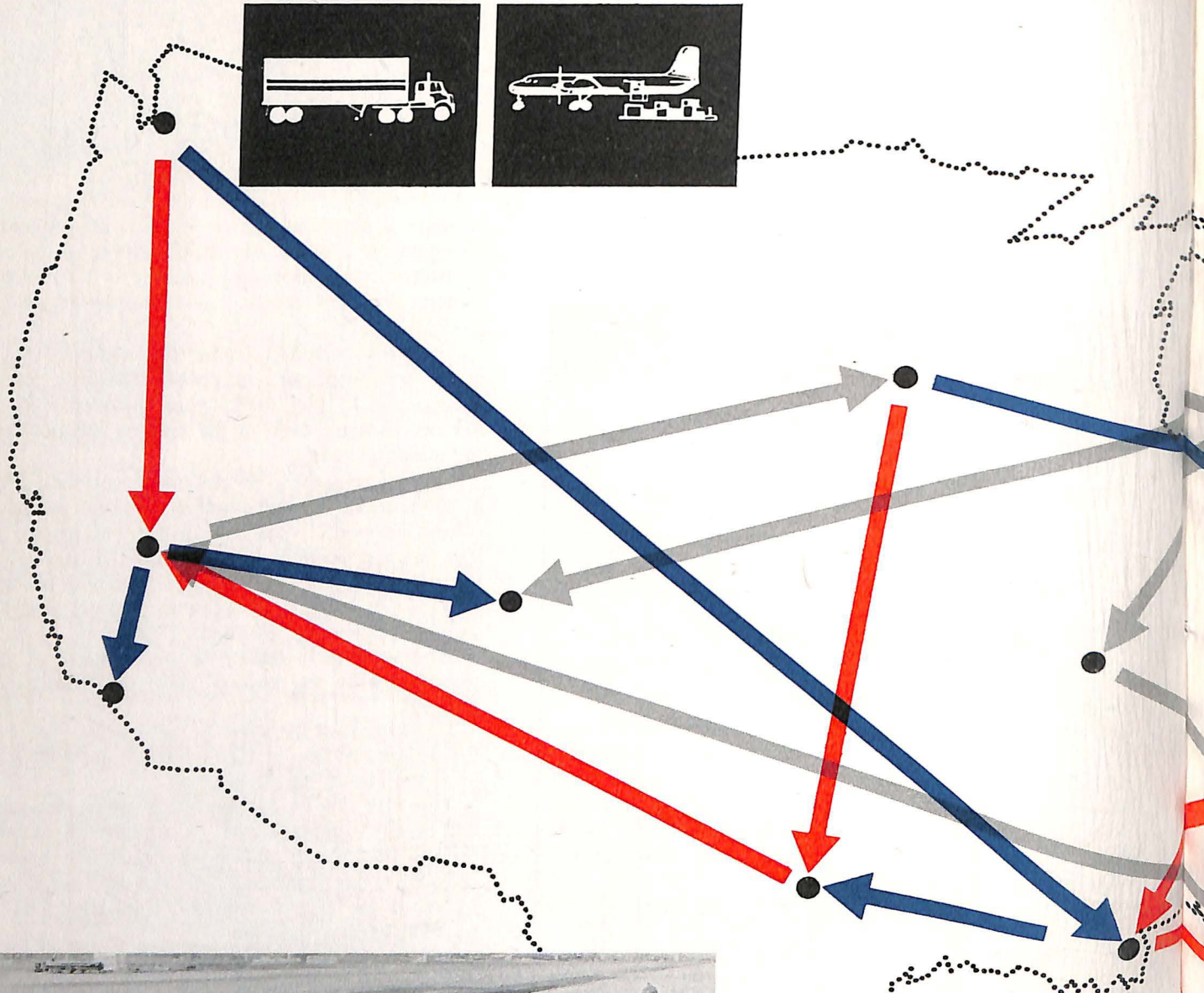
I assure you that the airlines, while looking back with pride over the first 50 years, look forward to the challenge of operating supersonic aircraft to the benefit of passengers, shippers, the nation and our own industry.

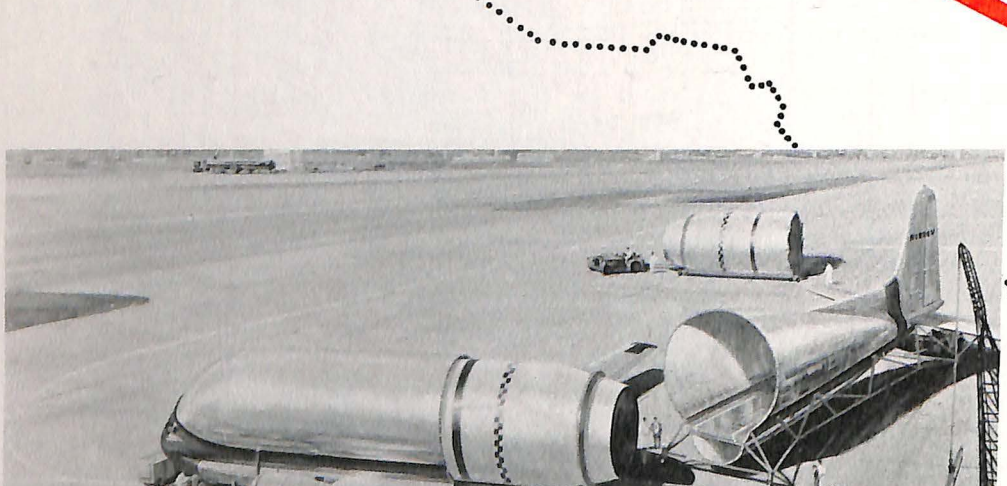




AEROSPACE TRAFFIC

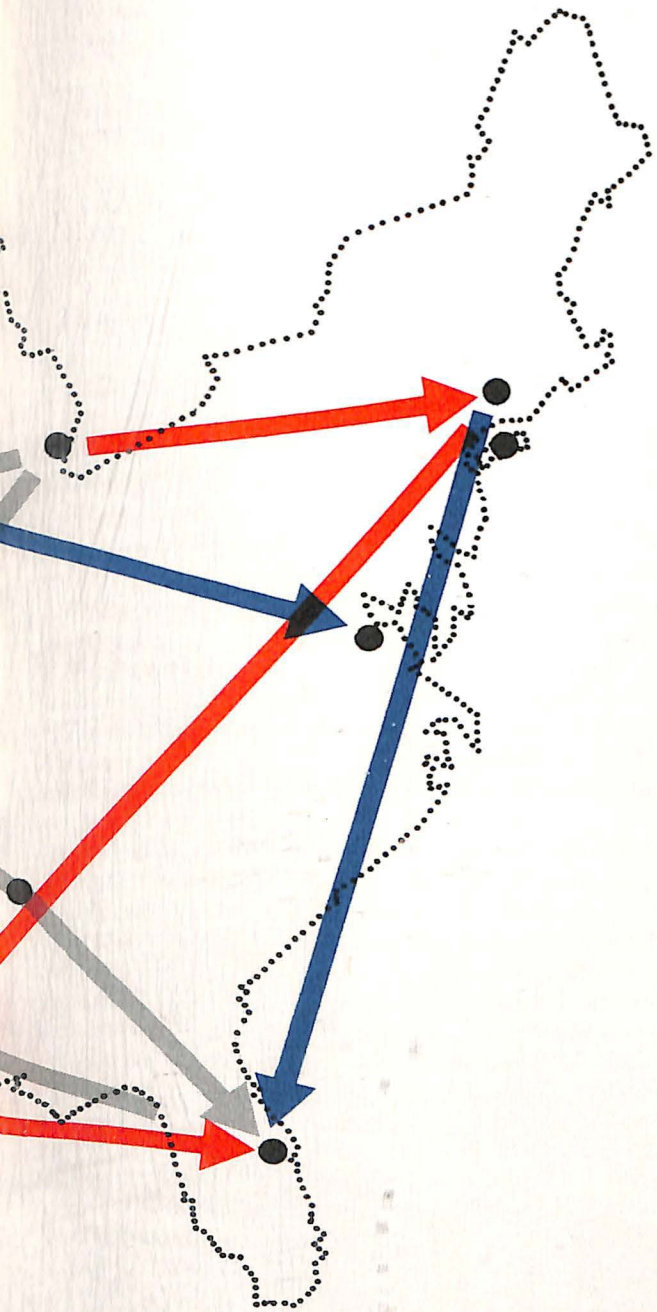
DESIGN





MANAGEMENT — TO DELIVERY

By P. F. Forderer
Chairman, AIA Western Traffic Committee
and
Vern W. Porter
Chairman, AIA Eastern Traffic Committee



America's aerospace industry produces a wide variety of products, but most of them have a common purpose: to deliver a payload (passengers, nuclear warheads or satellites) to a spot on earth or in space hundreds or even hundreds of thousands of miles away.

The airplanes, missiles and space vehicles currently rolling off production lines cause an increase in aerial traffic, and much of this traffic growth is attributable to a group of men whose major responsibility is logistics — moving the raw materials and components into the final assembly plant and delivering the finished product to the ultimate user.

It was not too long ago that an aerospace company had few problems in delivering its finished product. After components had been received from subcontractors, suppliers and vendors, the finished airplane was flown from the prime manufacturer's plant to a military air base or to a private airport where an airline or private citizen took delivery.

The aerospace traffic situation has changed markedly during the past decade. As the industry's product mix has changed, the finished items have become larger and more complicated. Aerospace traffic managers — the men responsible for aerospace logistics — have encountered new shipping problems every time their companies developed an advanced system for use by the military services, the National Aeronautics and Space Administration or by commercial airlines.

Practically every industry employs traffic managers, but the skills of aerospace traffic personnel differ substantially from their counterparts in other industries. The typical aerospace traffic manager has many distinguishing characteristics, but three are unique:

- He works in a predominately inbound activity, while traffic specialists in other industries are primarily concerned with outbound shipments.
- He most frequently is dealing with bulky, fragile items, which seldom have a high repetitive movement pattern and which are not considered the easiest type of freight.
- He operates in an industry where the value of the products shipped is enormous thus making the very substantial shipping costs appear rather small in relation to the over-all cost of the finished product.

In the aerospace industry, the traffic manager starts working long before his company gets a contract to develop and build a new military system or commercial product. In most cases, his responsibilities begin when

his firm prepares its proposal in response to an invitation to bid on a specific contract.

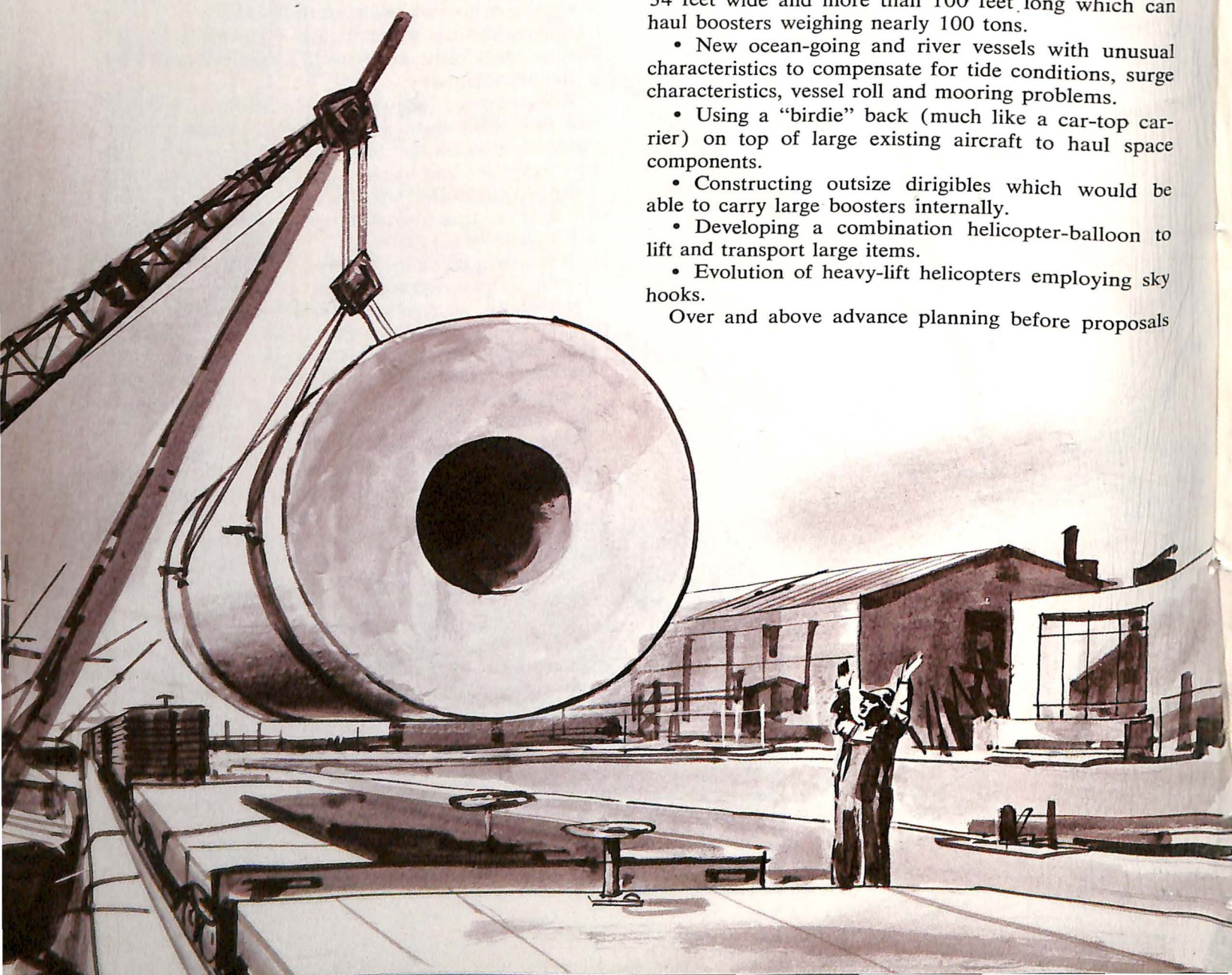
The company's proposal team normally includes a representative from the transportation planning group to make certain that traffic problems are considered in submitting the bid, to insure that the transportation costs are accurately reflected in the bid and to work out a specific transportation plan for delivery of the finished end item.

Most contracts for space age hardware require the movement of the end item to various test sites and ultimately to Cape Kennedy or Vandenberg Air Force Base for launching. These requirements, especially for West Coast companies, are unusually challenging because of the distance involved, the size of the booster or upper stage, the delicate nature of the electronic equipment contained in the space vehicle and the tight delivery schedules. Delivery of the hardware is the contractor's responsibility and the item is not considered "delivered" until it has been checked out at the delivery point.

The typical aerospace traffic manager, confronted with such complex delivery problems, must constantly seek ways of using existing types of transportation (rail, barge, tractor-trailers, airfreighters) and simultaneously plan new approaches to the shipping problem. Some of the new concepts may never be adopted because of impracticability or excessive cost. But included in the thinking of aerospace traffic managers are such proposals as these:

- Utilization of outsized airfreighters much larger than the "pregnant guppy" currently in use to move large boosters.
- Employment of huge twin dirigibles to move boosters or rocket clusters. The booster units would be lashed to a center section suspended between the two lighter-than-air craft.
- Movement of electronic components in specially padded van line trucks.
- Specialized over-the-road transporters more than 34 feet wide and more than 100 feet long which can haul boosters weighing nearly 100 tons.
- New ocean-going and river vessels with unusual characteristics to compensate for tide conditions, surge characteristics, vessel roll and mooring problems.
- Using a "birdie" back (much like a car-top carrier) on top of large existing aircraft to haul space components.
- Constructing outsize dirigibles which would be able to carry large boosters internally.
- Developing a combination helicopter-balloon to lift and transport large items.
- Evolution of heavy-lift helicopters employing sky hooks.

Over and above advance planning before proposals



are submitted and conceiving new types of vehicles for space age transportation, the industry's traffic managers concern themselves with two other problem areas — the movement of household goods when company employees are transferred to new locations and the booking of seats on airlines for traveling executives.

The aerospace industry is also the nation's largest users of van service. Some $15 million is spent each year to move the household effects of reassigned and new employees. Additional millions are spent with van lines for the transportation of delicate, exotic space-age hardware which requires special kid-glove treatment.

The aerospace industry is also the nation's largest user of airline seats. The growth and complexity of the industry has necessitated increasing amounts of executive travel each year, with the result that a typical aerospace company now pays the airlines about $3,500,000 annually for movement of its personnel. The aerospace industry's requirement for fast, safe and on-time delivery of its hardware has made it a principal contributing factor in the growth of air cargo transportation.

However, the most important part of the typical aerospace traffic manager's responsibility is to make certain that the parts and components produced by his company's subcontractors, vendors and suppliers arrive safely and on time to meet tight production schedules.

Most of the firms with which the aerospace industry does business are classified as small business companies. In some instances, the subcontractors and vendors have capable traffic departments. When this occurs, the aerospace traffic manager uses those capabilities to eliminate overlapping and duplication. In most instances, however, the subcontractors are small and have no traffic departments. To keep total costs down, the traffic manager of the prime contractor usually has to assume the traffic function for the subcontractor too. In other words, the industry's traffic managers work not only for their own firms but also take over responsibility for the movement of material from thousands of sub-plants. To provide some idea of the task, the contracting pattern of a typical aerospace company might be analyzed. In one recent year, a major aerospace producer bought more than $92 million worth of goods and services from 4,855 small business concerns. The sum involved 211,069 individual contracts — or more than three-fourths of all the subcontracts placed by the major aerospace company. The problems encountered by the aerospace company's traffic department in getting the parts and components from the 4,855 concerns to the prime contractor's final assembly plants need not be described in detail. Some delays and slippages were inevitable. In general, however, the components arrived on time — in good condition — and were assembled into finished items for the Department of Defense and NASA. The company's traffic department then made certain the finished products were delivered on time and in good condition to the ultimate customers.

Obviously, a responsibility as complex as that of the typical aerospace traffic manager calls for individuals with specialized training and aptitude. As the industry's challenges have intensified, the traffic managers "on the job" have broadened their thinking.

Looking to the future, the aerospace industry recognizes that more traffic specialists will be needed to meet unique requirements. Where will they come from?

A recent survey of employment practices by a subcommittee on education of AIA's Traffic Committees indicates that the size of the traffic department varies directly with the size of the company involved and with the interest top management has in traffic functions. The education subcommittee concluded that aerospace traffic departments must offer employees and potential employees the opportunity to progress. This can be accomplished, the subcommittee declared, by:

- Making upper management aware of the costs of distribution and the contribution traffic can make to management under a favorable business climate.
- Continuing efforts to broaden the responsibilities of traffic to include all related functions of material handling and transportation.
- Developing traffic personnel capable of administering a complete logistic program.

On this last point, the subcommittee recommended a three-part program on the educational requirements and hiring policy covering aerospace traffic personnel. The Traffic Service education subcommittee asserted:

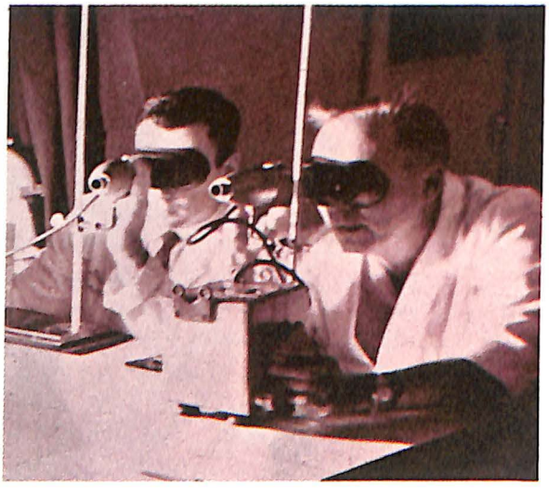
(1) A college degree or equivalent is a requisite for management positions and every effort should be made to raise the educational requirement of aerospace industry traffic departments.

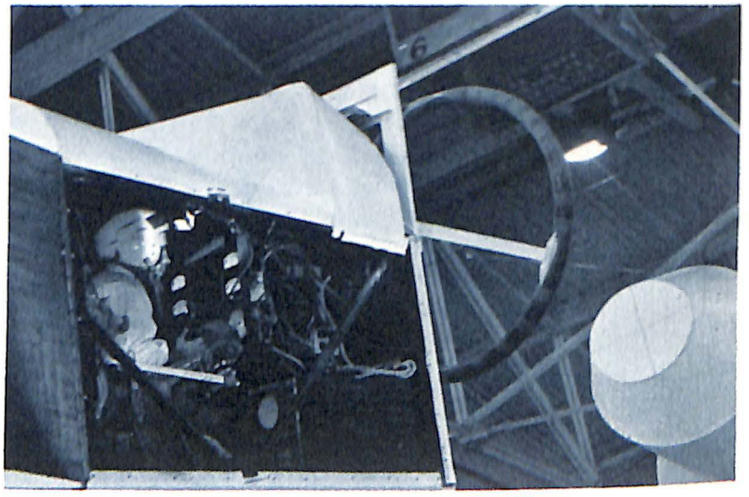
(2) College graduates with majors in transportation are preferred but not essential. General business courses are adequate if the student is interested in transportaton and has the potential to develop.

(3) The aerospace industry should encourage employees to take graduate work, extension courses and on-the-job training to develop their management capabilities.

AEROSPACE TESTING=

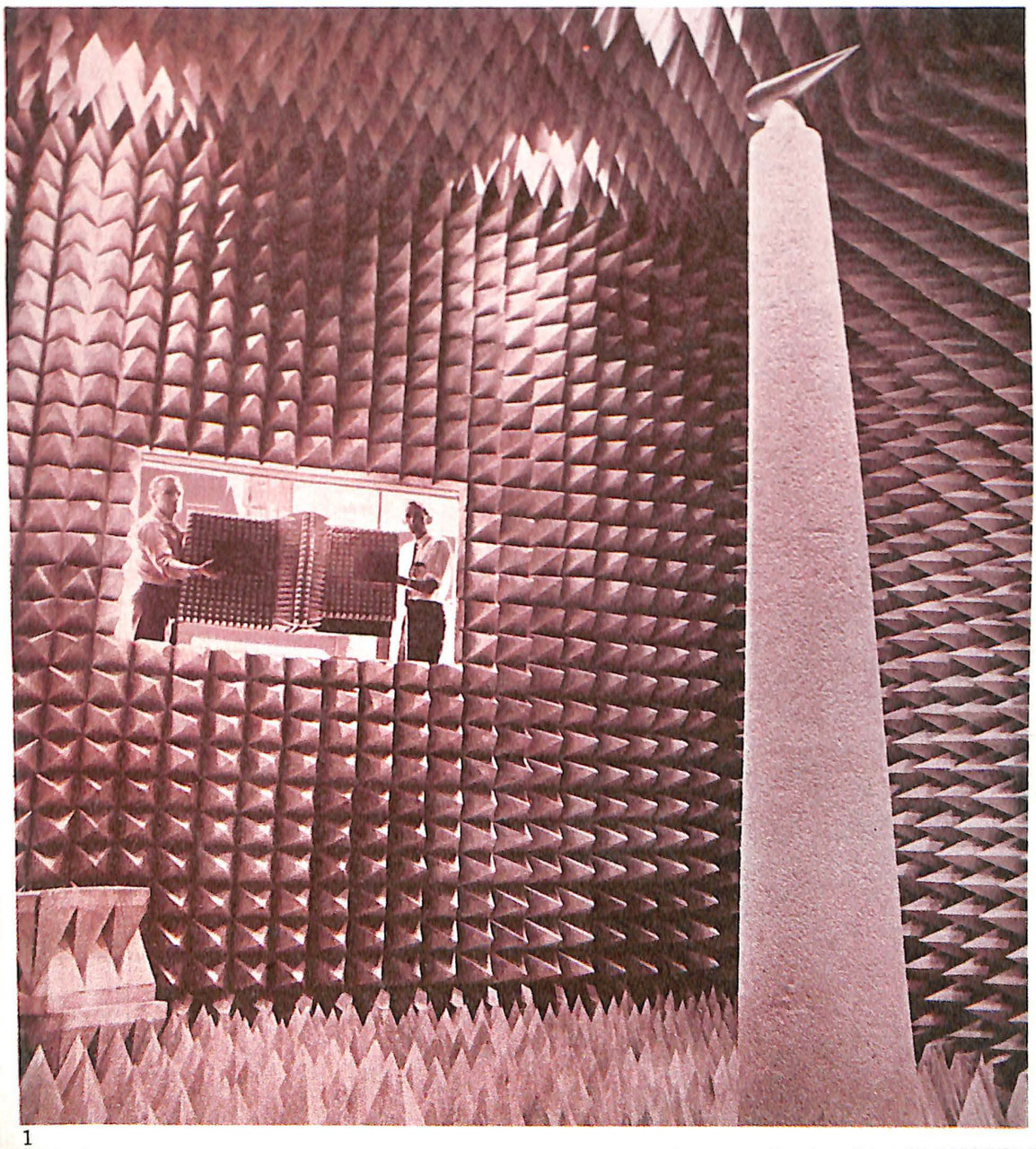
Testing and proving techniques in the aerospace industry are the most ingenious and effective ever developed by American industry. ■ Testing has assumed an increasingly important role in this industry as performance goals have quickly progressed. There are no dress rehearsals for aerospace product performance. Important portions of a flight to the moon will be thoroughly tested **on the ground** long before the first U. S. astronauts climb aboard the Apollo capsule for a lunar mission. ■ The third and final stage of the Saturn V Apollo launch vehicle — the S-IVB — is an example. The S-IVB provides the final "kick" to place Apollo into orbit, then restarts and injects it into a lunar trajectory. The S-IVB ground test program requires 935 tests of components and sub-systems. However, each of these tests consist of several different environmental





PRODUCT RELIABILITY

tests bringing the total number of tests to about 30,000. The total number of tests for the entire Apollo system could run well over a million. ■ Testing equipment is often more complicated and expensive than the hardware it checks. The equipment ranges from a small electronic device to a huge rocket engine test stand anchored in tons of concrete. A substantial portion of the total costs of aerospace products is in testing equipment and procedures. The aerospace industry spends hundreds of millions annually on this highly specialized equipment. ■ Testing equipment will never carry a passenger at supersonic speed or send back data on planets in our solar system. But it is the keystone for the success of these missions. This photo story shows some of the testing equipment for aircraft, missiles and spacecraft in use.



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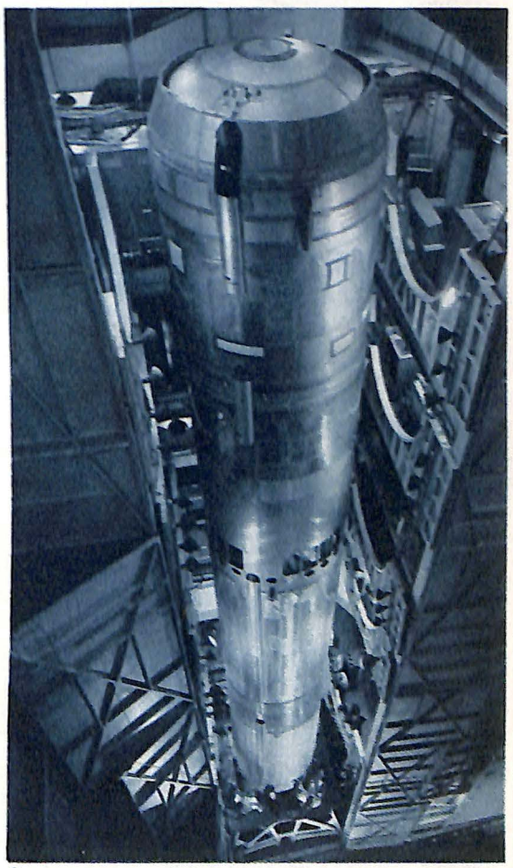
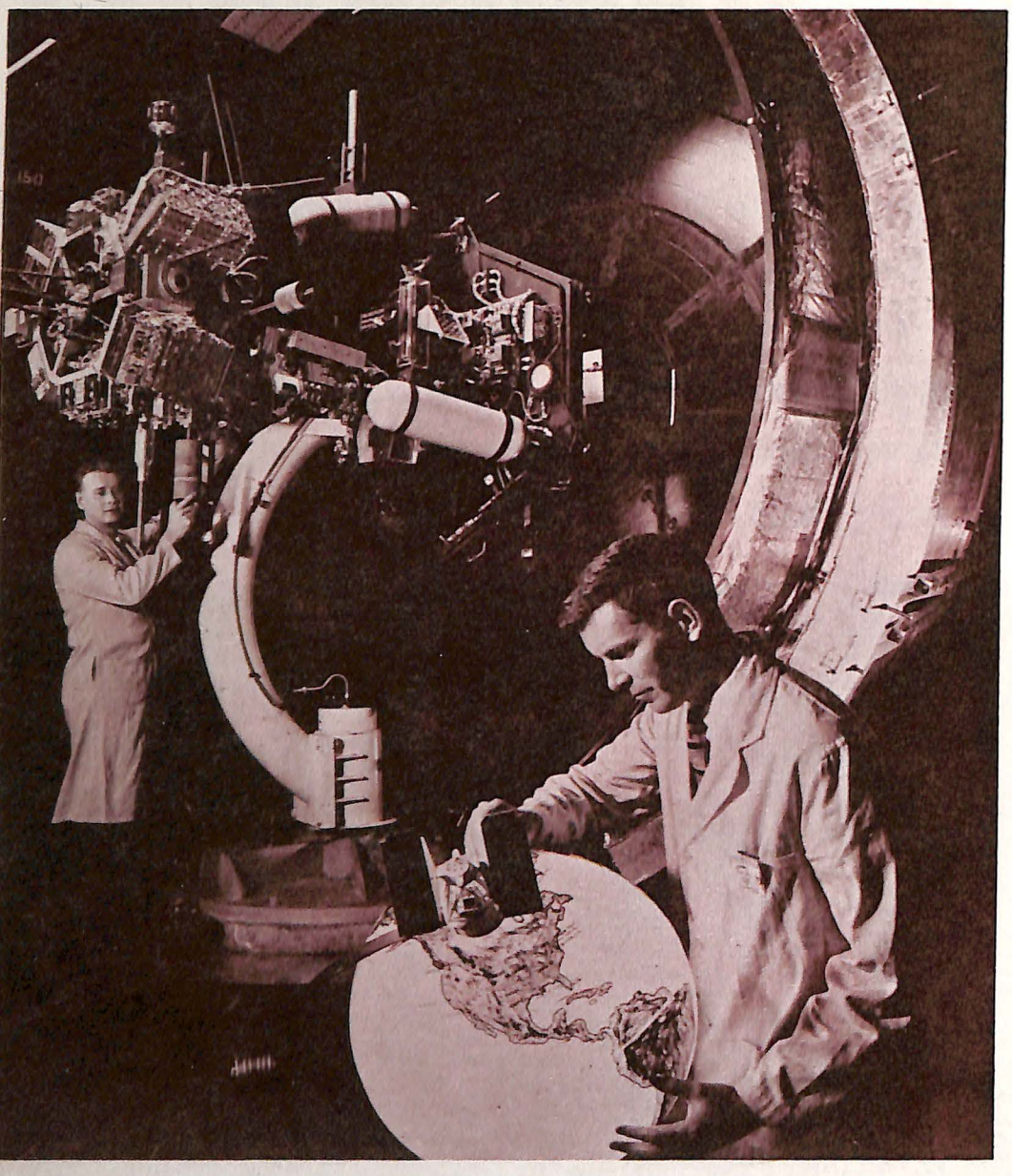


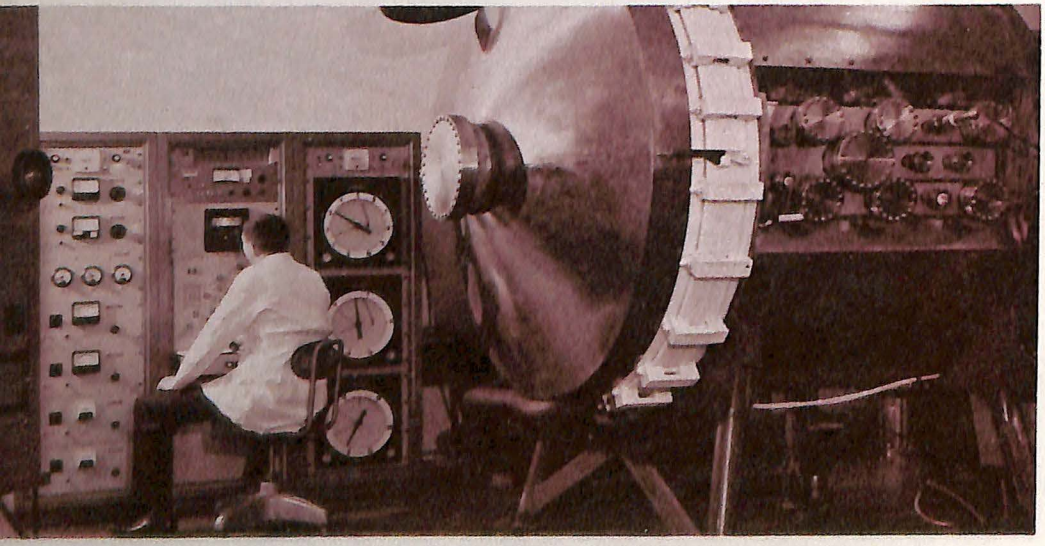
2

1. This test chamber simulates space conditions for communications equipment. The pyramid-shaped absorbers eliminate echoes and distortions, enabling engineers to obtain a true reading of electronic equipment.

2. An ICBM is subjected to vertical test before USAF acceptance.

AEROSPACE TESTING = PRODUCT RELIABILITY





5

3. Reliability of a sensitive weather satellite is checked by scientist as model traces a pattern over the face of a globe of the earth.

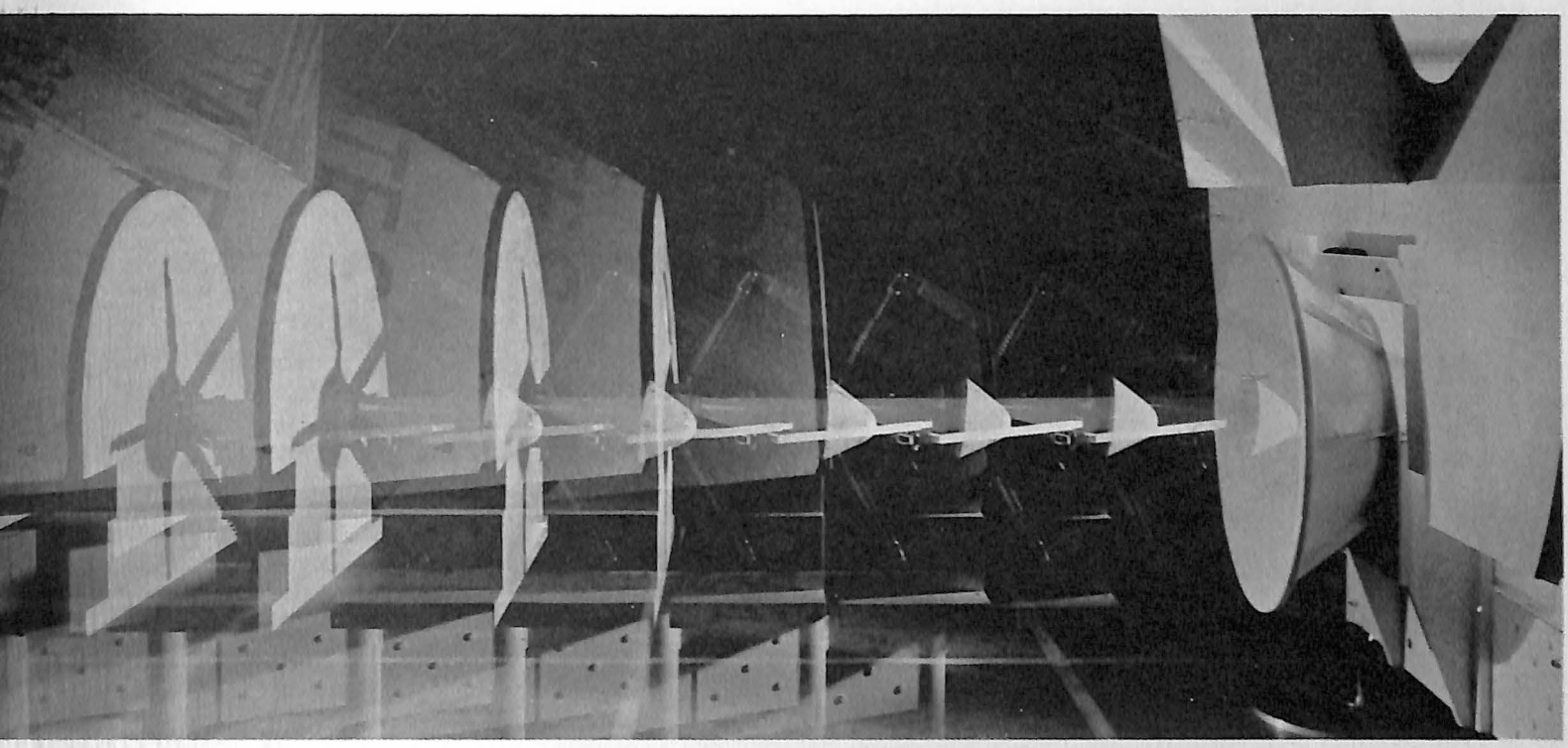
4. This simulation chamber provides new insights into the behavior of materials under space operating conditions.

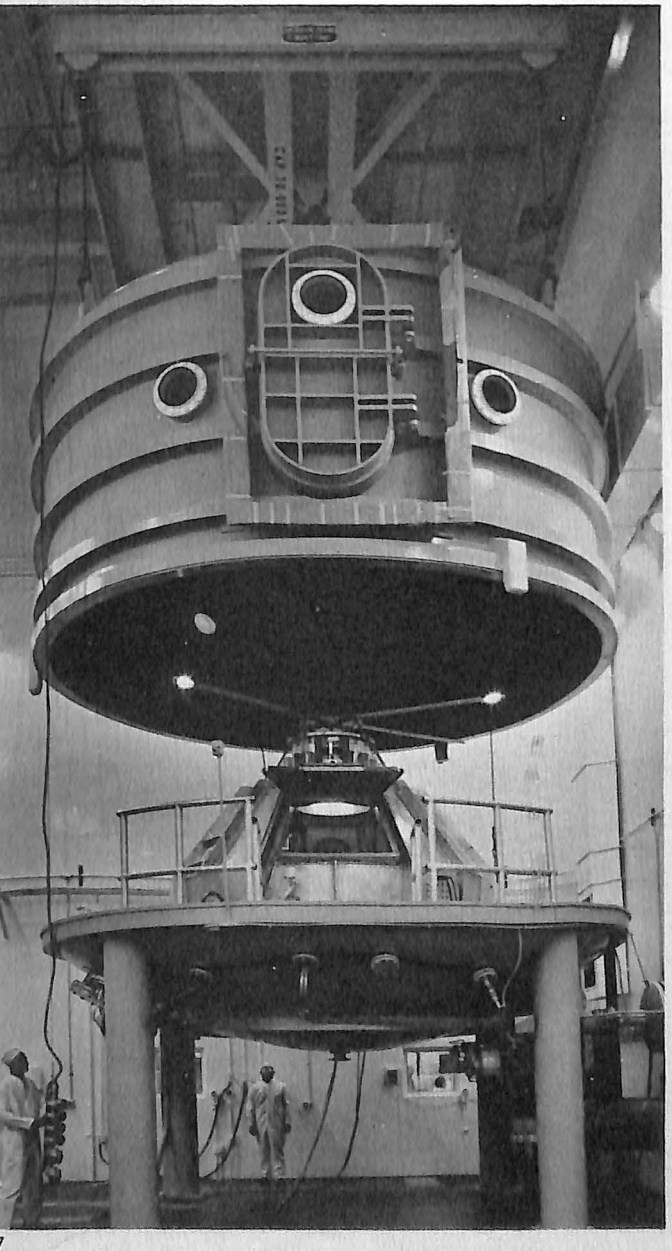
5. Super-hot "oven" conducts structural tests of metals at temperatures as high as 4,000 degrees Fahrenheit.

6. Lunar docking test is shown in eight movements as Apollo command module probe enters drogue of a model of the lunar excursion module.

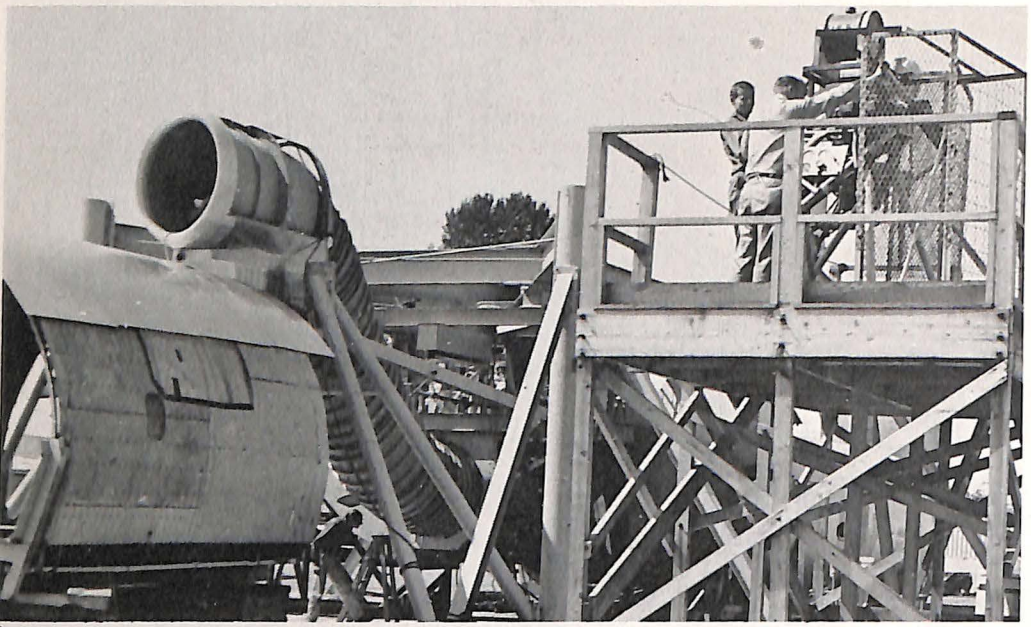
7. Scientists prepare vacuum cell and Apollo crew compartment for manned tests of the environmental control system for astronauts in moon program.

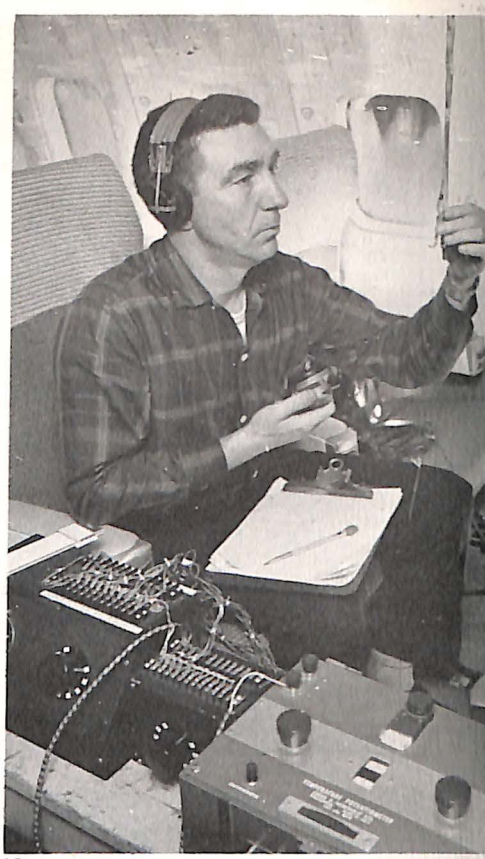
8. "Boilerplate" Apollo command module slams into the water after release from special tower.





AEROSPACE TESTING = PRODUCT RELIABILITY





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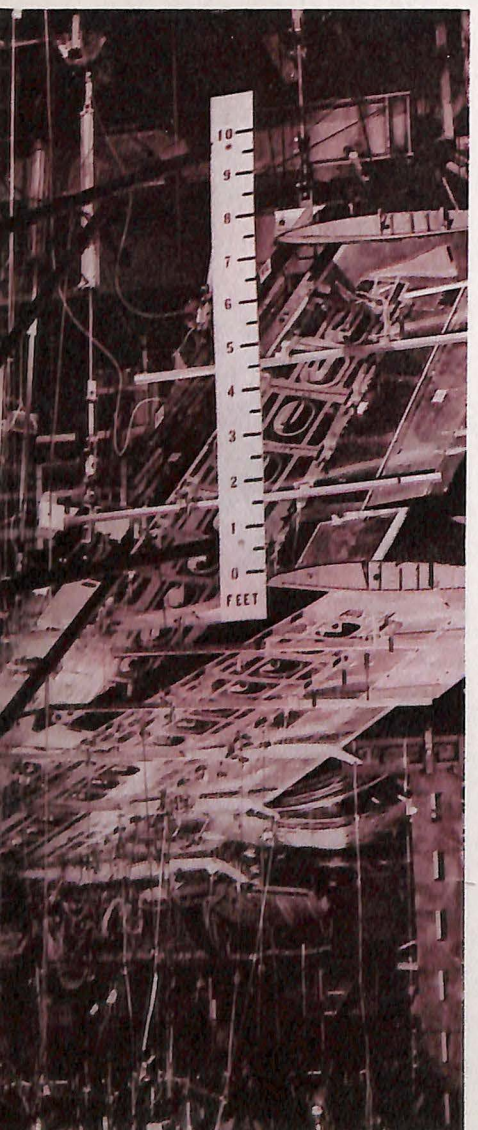
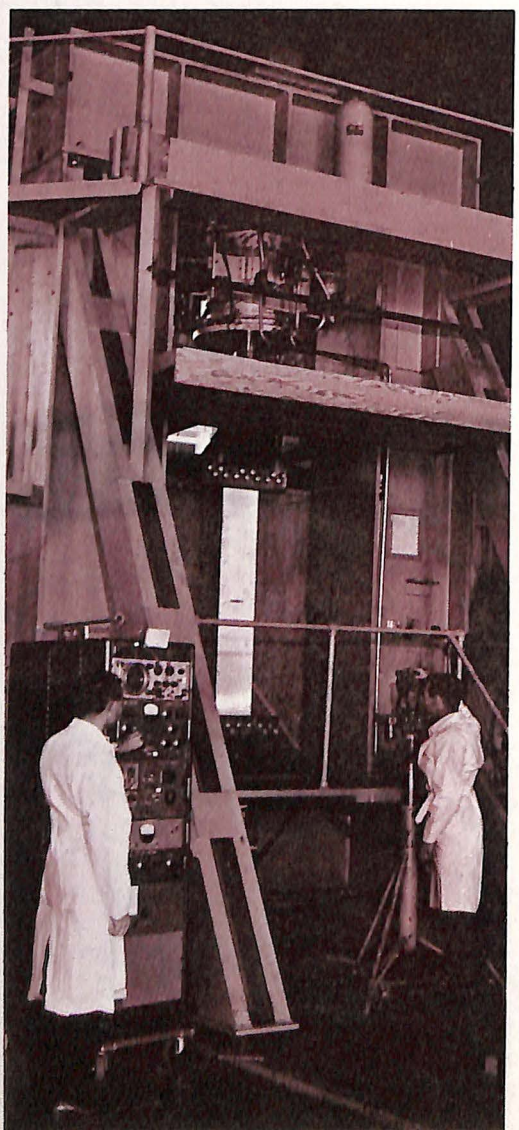




11

9. Two light aircraft engines are used to create a "crosswind" in tests of a turbofan engine.

10. Composite photo shows normal and near-maximum loads exerted on a transport wing. These tests far exceed in-service conditions.

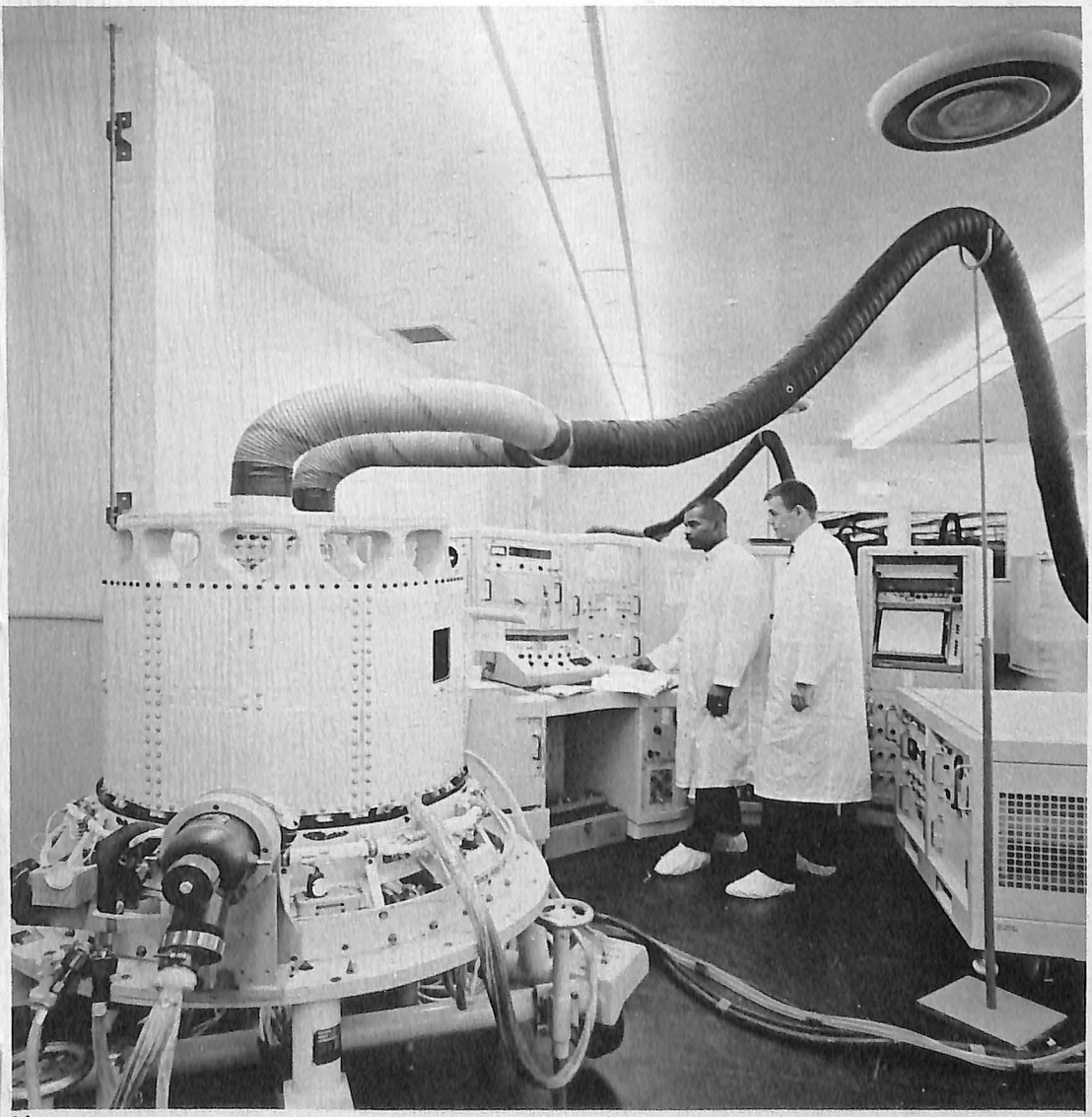
11. Strength and tear resistance of a half-inch titanium plate is tested in a machine which exerts one million pounds of pressure per square inch per second.

12. Engineer checks air-conditioning system of transport cabin in chamber where temperature drops to minus 70 degrees F.

13. Thermocouples, sensitive devices used in missile and aircraft tests, are checked in a vacuum furnace by scientist.

14. Functional tests on an ICBM inertial guidance system are carried out by this equipment.

13



14

AIA MANUFACTURING MEMBERS

Aero Commander, Div.,
Rockwell-Standard Corp.
Aerodex, Inc.
Aerojet-General Corporation
Aeronutronic Division, Philco Corporation
Aluminum Company of America
American Brake Shoe Company
Avco Corporation
Beech Aircraft Corporation
Bell Aerospace Corporation
The Bendix Corporation
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Cessna Aircraft Company
Chandler Evans Corporation
Continental Motors Corporation
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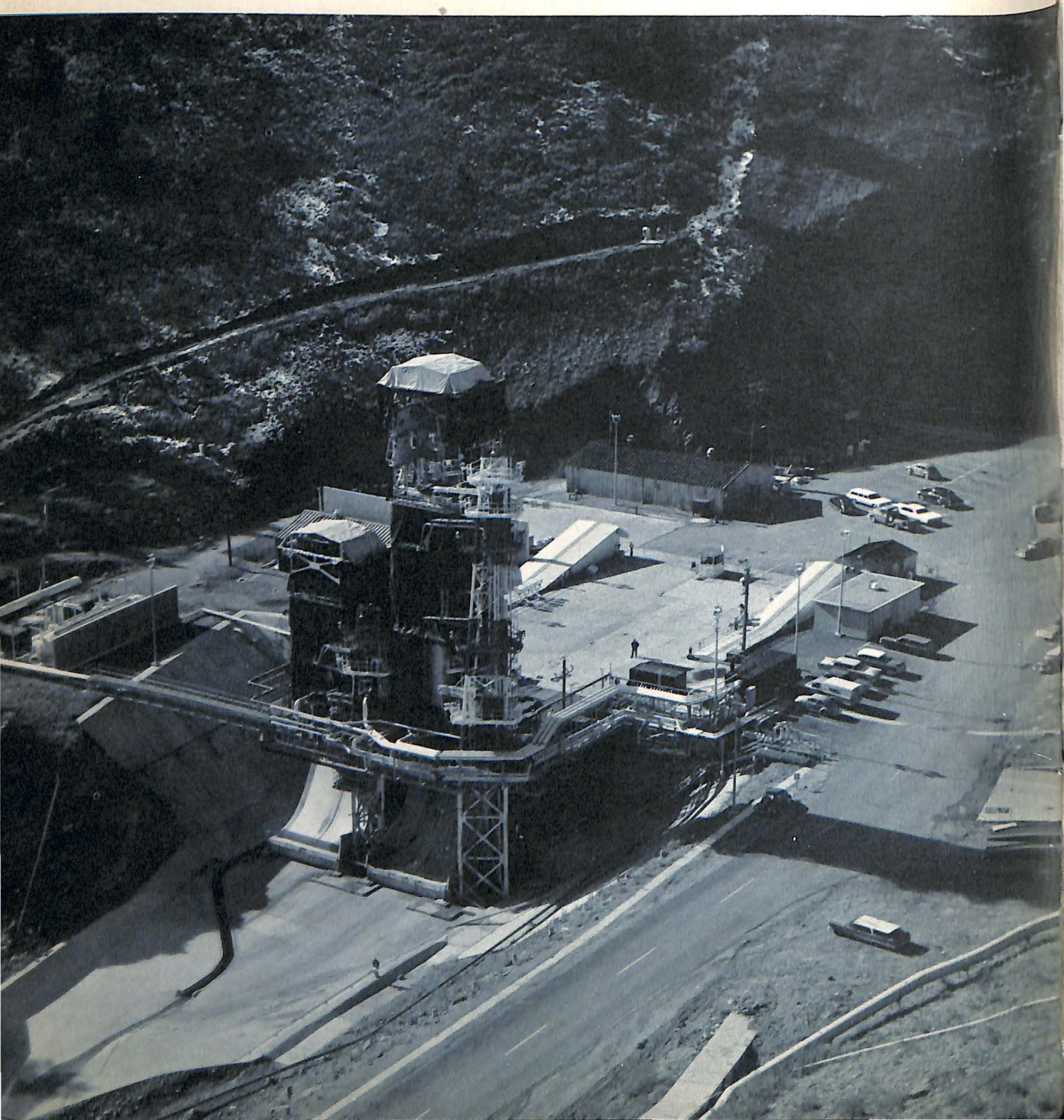

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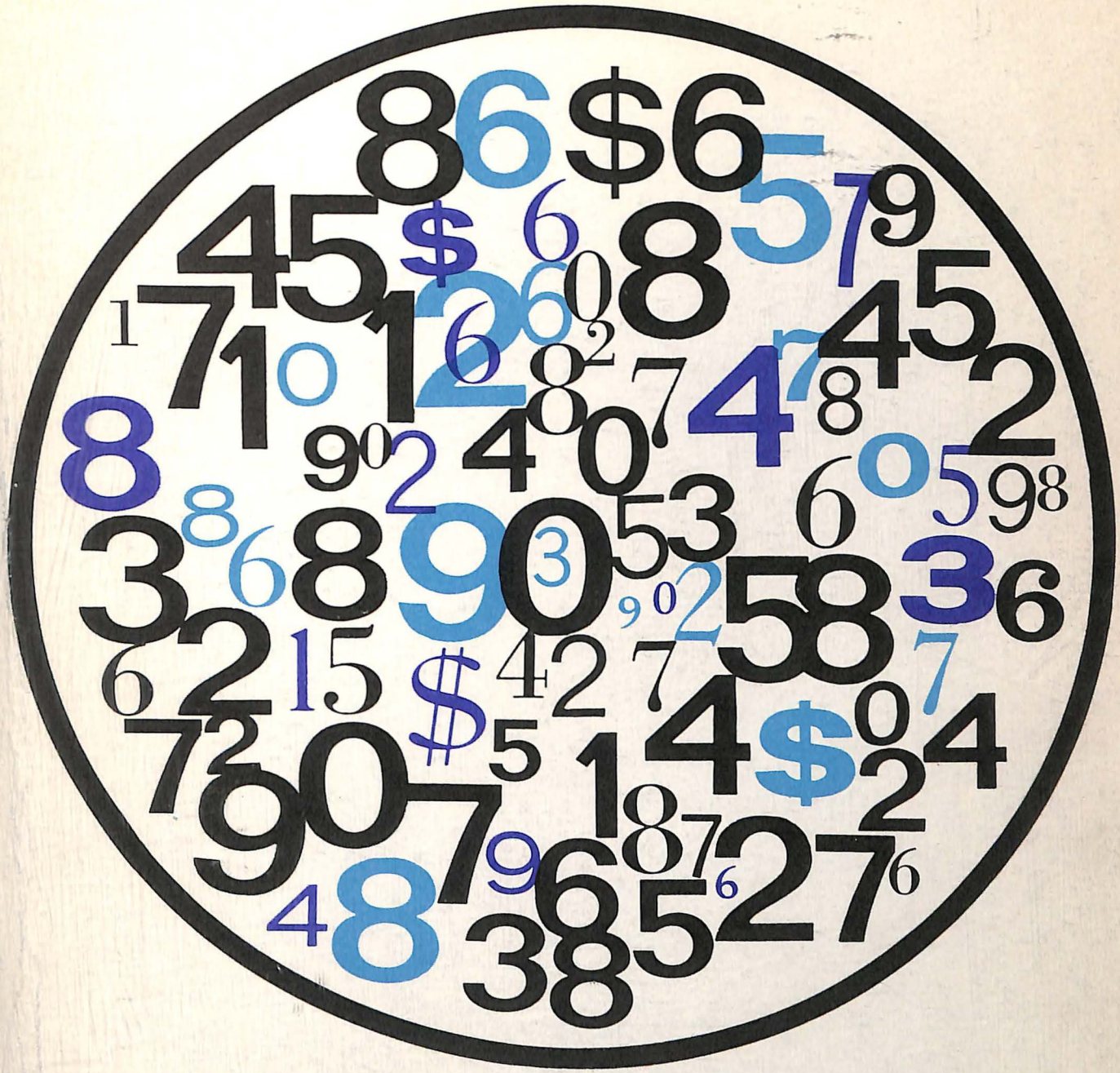
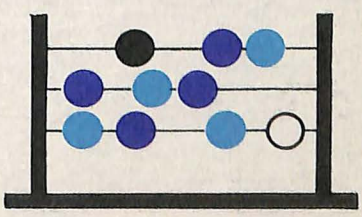


CONTAINING COSTS



BY KARL G. HARR, JR.
President
Aerospace Industries Association

SPACE VALUES

BY DR. EDWARD C. WELSH
Executive Secretary
National Aeronautics and Space Council

The 570-pound Mariner-C spacecraft is a vital step in the exploration of the planet Mars. The Mariner, scheduled for launch in November, will require about eight months to reach the vicinity of Mars, and transmission time for one television picture is approximately eight hours. Two of the spacecraft will be launched. The aerospace industry has designed light-weight equipment, which requires very little power, to carry out this mission. An article, The Key and The Quest, on Page 18, explains the role of scientific satellites in space exploration.

AIA aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.

VOL. 2 NO. 3 FALL 1964

Contents

The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems;

Foster understanding of the aerospace industry's responsibilities in the space exploration program;

Foster understanding of commercial and general aviation as prime factors in domestic and international travel and trade.

AEROSPACE is published quarterly by the Aerospace Industries Association of America, Inc., the national trade association of the designers, developers and manufacturers of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems and other aeronautical systems and their components.

Publication Office: 1725 De Sales Street, N.W., Washington, D. C. 20036

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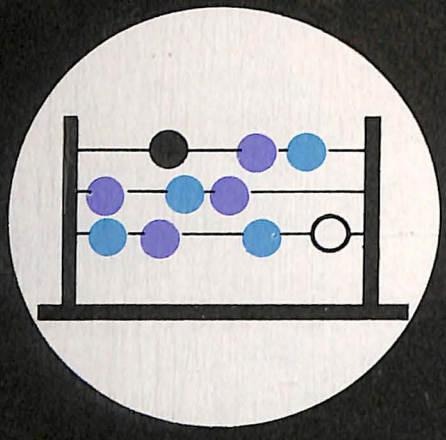


COSTS

By KARL G. HARR, JR.
President, Aerospace Industries Association

Aerospace industry executives discuss cost reduction progams. They are (left to right): Karl G. Harr, Jr., President, Aerospace Industries Association; Daniel J. Haughton, President, Lockheed Aircraft Corp.; Donald W. Douglas, Jr., President, Douglas Aircraft Corp., and Chairman of AIA's Board of Governors; and William M. Allen, President, The Boeing Company.

IT IS A FACT of aerospace life that increased performance costs money. However, the performance curves of aerospace systems are still on the rise as the national space program reaches toward the moon and the requirements of national defense demand aircraft and missiles of broader capabilities than their predecessors.

At the same time, the dictates of the national economy impose a limit on the amount of money that can be spent for defense weaponry and space research. Thus, there falls to the aerospace industry a secondary responsibility as important to the attainment of national objectives as the quality of its product line: the industry must make every effort to reduce overall equipment costs without compromising performance.

In the aerospace industry cost-consciousness has become a way of life. The theme of "Maximum value for minimum dollars" has been instilled in every employe, from top management to hourly labor. Cost reduction efforts probe into every facet of aerospace manufacturing from concept and design to production and test. The effort extends into the plants of the thousands of subcontractors, suppliers and vendors who furnish subsystems, materials and services to the major contractors.

With the vast amount of material being channeled into aerospace production, there are infinite possibilities for making cost reductions, and new ones are being found daily. Cost reduction takes many forms: it might involve redesign or material substitution in a major system to allow cheaper fabrication; it might focus on cumulative savings on hundreds of minute items, such as memo paper or flashlight batteries, on the theory that a penny saved often enough becomes a million dollars.

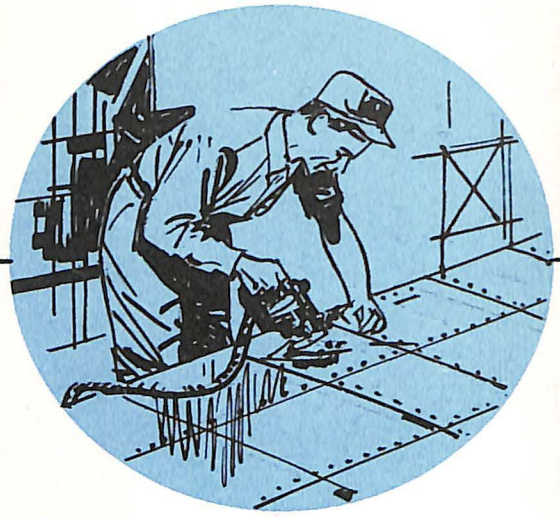
Such a cost reduction program has been in effect in the aerospace industry for many years, and with each year's extension of dollar-saving know-how, the aggregate reduction becomes greater. Last year the industry reached a new peak in trimming production and operating costs with an overall reduction approaching one billion dollars.

Data provided by 34 member companies of the Aerospace Industries Association, whose combined sales amounted to $11.3 billion, produced an estimated total cost reduction of $913,401,000. These savings are not directly included in the Defense Department's cost reduction program nor are the saving efforts of 27 other manufacturing concerns represented by AIA and of the thousands of subcontractors, suppliers and vendors included. However, these savings make it possible for aerospace firms to sell to the Government at lower prices, hence they result in a substantial benefit to the ultimate customer, the taxpayer.

The savings recorded by the 34 companies bracket every level of company activity; they range from several million to a few hundred dollars.

The most significant cost reductions come through the technique of "value engineering," a scientific approach to the attainment of a required function at minimum cost. Value engineers scrutinize every aspect of producing a given system with an eye toward using lower cost materials or finding better methods of fabrication without impairing performance.

Accompanying this article are examples which are indicative of the intense and continuing effort on the part of the aerospace industry to provide the Government with a better product at a lower price. The industry is proud of its cost reduction record over the past several years, but far from complacent about it. There are unquestionably many ways still to be discovered to shave the price of defense and space hardware, and until there are no more the war on costs will continue.

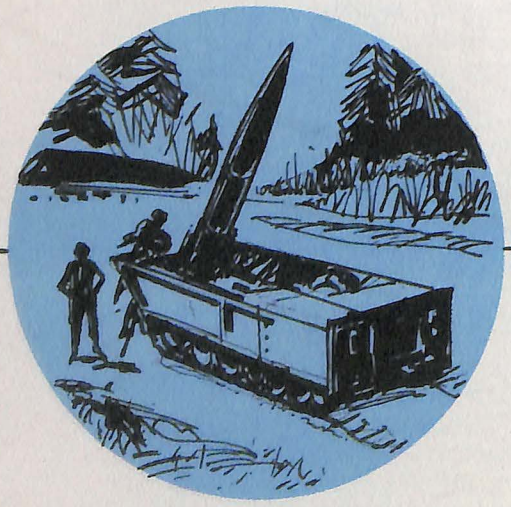


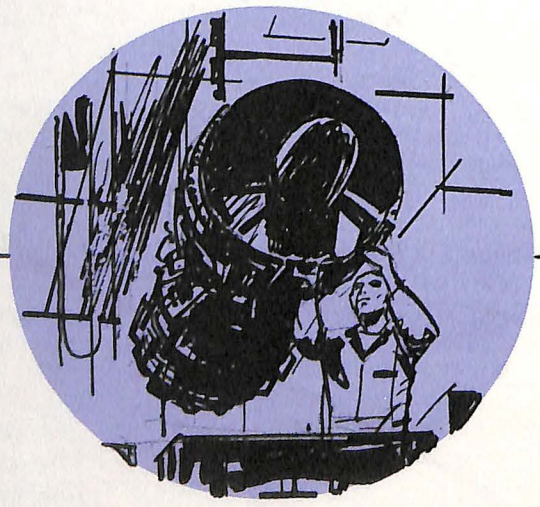
Here are random selections of hundreds of examples of cost-cutting techniques in the aerospace industry. Some obviously involve substantial savings; in other cases the amount saved may seem trivial, but even the smallest cost reduction cannot be overlooked because a dollar saved by one company in one plant can be multiplied a great many times when the technique that produced the saving is applied industry-wide.

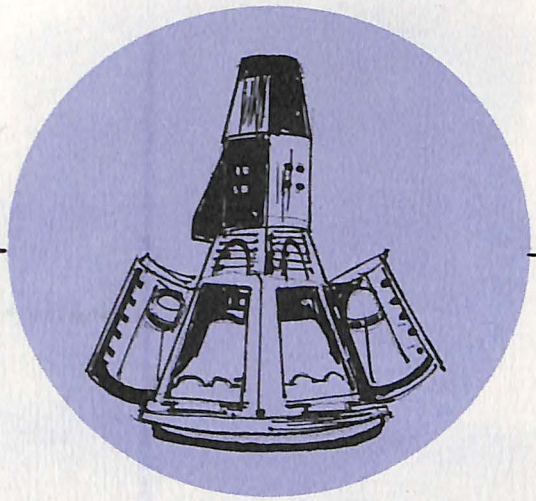
Original specifications for building the wing of a B-52, the Air Force's eight-engine jet bomber, called for driving rivets "subflush," below the surface of the wing. The small subflush gap was then filled with material and sanded smooth. Development of corrosion-preventive materials made it possible for the rivets to be installed conventionally, with the protruding heads shaved flush. Conventional installation, together with elimination of one step (gap filling) permitted a less expensive fabrication process. The new technique proved satisfactory and saved $3,351,000.

The original order for the Gemini two-man spacecraft called for use of high-quality beryllium shingles. Analysis and tests by the manufacturer showed that a less expensive type of beryllium could be used without affecting structural integrity or performance. The substitution was made at a saving of $261,396.

Value engineering during the development phase of the Army's Lance missile brought about no fewer than 65 money saving component changes, all of which are to be carried over into the production run. This saved an estimated $1,500,000 in development costs and additional savings will accrue in production.



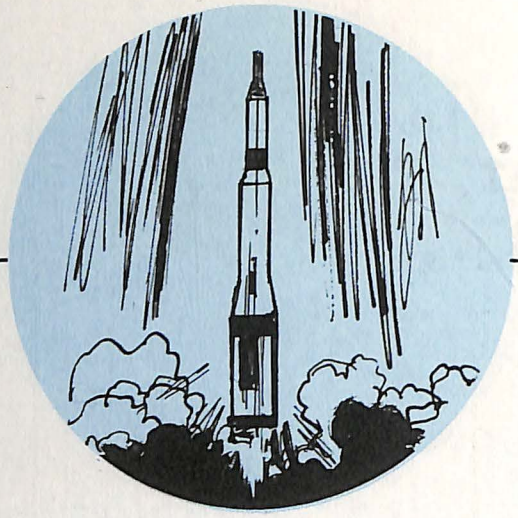




Revision of an over-rigid inspection requirement made another substantial saving. In rebuilding J47 jet engines, one out of three turbine frames was being scrapped because it could not meet the tolerances specified in the technical order governing inspection. An investigation by the contractor determined that the minute degree of difference in tolerance in no way affected the engine alignment or operation. Government inspectors concurred and the technical order was changed, eliminating the necessity for scrapping the high percentage of expensive frames and saving $1,886,000.

Product improvement as a cost reduction potential is found in work on the Polaris missile. For an advanced version of Polaris, the Navy ordered development and production of a new radiometric sextant. An early investigation by the contractor showed that the new sextant would have operational limitations at high altitudes. The Navy approved the contractor's recommendation that the existing sextant be improved to meet the more rigid specifications, saving the estimated $11,230,000 development costs of the proposed new system.

Maintenance costs of an aircraft or missile are constantly undergoing scrutiny. A substantial saving in this area is found in the record of the Navy's UH-2 helicopter, which is scheduled for 100,000 flying hours per year. The authorized Time Between Overhauls (TBO) for the UH-2 was 240 hours. The contractor found that, by making certain engineering changes in the helicopter, TBO could be extended to 480 hours. The maintenance cost reduction is estimated at $948,000.



The foregoing examples involve changes to major systems, but the industry-wide cost reduction effort probes far deeper, into the manufacturing processes for the smallest parts.

The simple step of eliminating chrome from the actuators in the Minuteman missile saved $14,000. Similarly, it was found that a costly fine finish on flap spindles (components of a helicopter rotor hub) contributed nothing to their function and a cruder and equally effective finish was substituted at a saving of $1,728.

Redesigning oil-filled capacitors for very low frequency transmitters used by the Navy saved $5,000 per unit or $530,000 on the 106 transmitters involved.

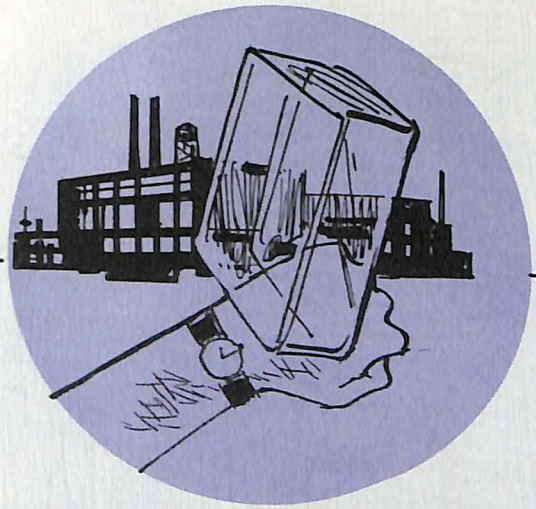
Changing to a plastic molding process for starter switch handles formerly machined from aluminum saved $2,014.

Bonding parts by using low-temperature adhesives instead of high-temperature adhesives which require baking and curing permitted a saving of $1,755.

Instead of working 25 pieces of fiberglass by hand, a contractor developed a process for making access box covers out of a reinforced phenolic molding compound in 15 minutes. Saving, $7,452.

In manufacturing a camera housing, a contractor substituted a casting for a machining process and saved $32,961.

Using less-expensive liquid argon instead of argon gas for protection of the material while fuse-welding spacecraft parts made of titanium saved $17,976, be-



cause the cheaper liquid argon vaporizes at room temperature and becomes, in effect, a gas providing the same protection.

The demand for closer tolerances apparently dictated development of a new machine control unit, but a second look indicated that the existing unit could be modified to meet the tolerances, saving an estimated difference between modification and new development of $30,000. In another plant producing fuzes, a change in cutting tools permitting faster "feed" of material reduced production costs by $131,000.

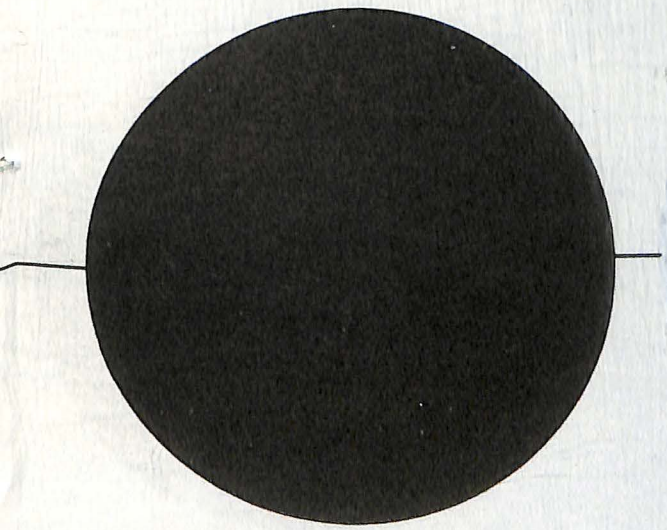
There are many other cost reduction examples of a miscellaneous nature.

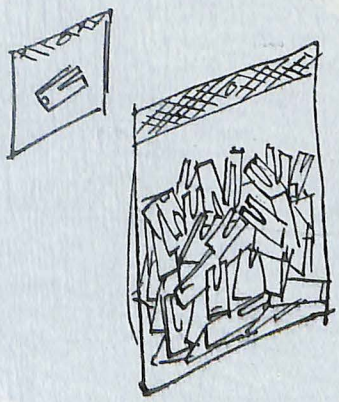
A prime contractor's vendors ship materials or parts in pallets which are normally thrown away. One company initiated the practice of salvaging pallets and using them to move materials around its own plant, saving $11,084.

One company contemplated hiring additional guards to cover several posts, but was able to cut its personnel costs by $31,779 by buying two motor scooters, allowing plant guards to make frequent spot checks of the extra posts.

Another company saved $668 by ordering its cleaning solvent in 55-gallon drums rather than the more expensive air-pressured aerosol cans in which the solvent was normally shipped.

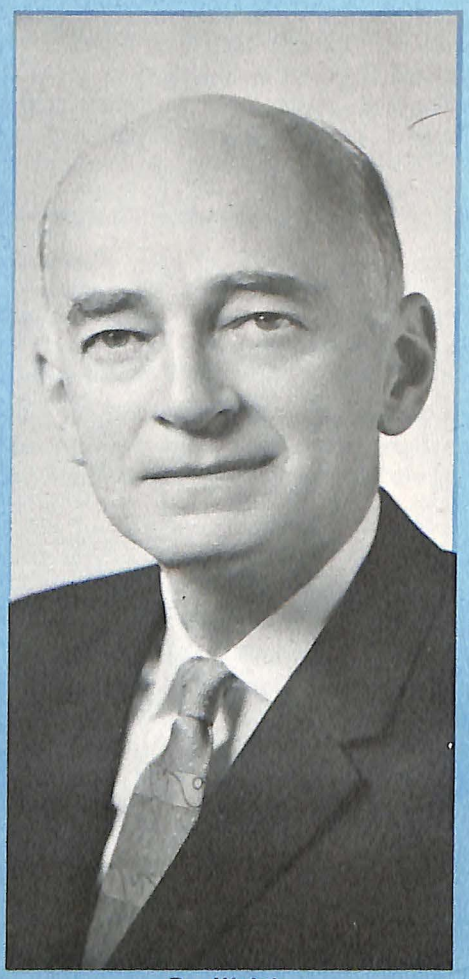
Still another company was taking deliveries of aluminum closures — clips — each wrapped in a pliofilm bag, providing an unnecessary degree of protection. By having them packaged 50 to the bag, the company cut material costs by $12,436.





Space Values

The future of the space program basically depends on public support, and this support comes from public knowledge and appreciation of the benefits — direct and indirect — that space exploration brings. The U. S. today is moving ahead along a comprehensive technological front, attaining results and generating effects that cannot at this time be completely and accurately assessed. A succinct description of some of the benefits was provided recently by Dr. Edward C. Welsh, Executive Secretary of the National Aeronautics and Space Council, before a meeting of AIA's Aerospace Manufacturers Council. Following is an excerpt from Dr. Welsh's talk:



Dr. Welsh

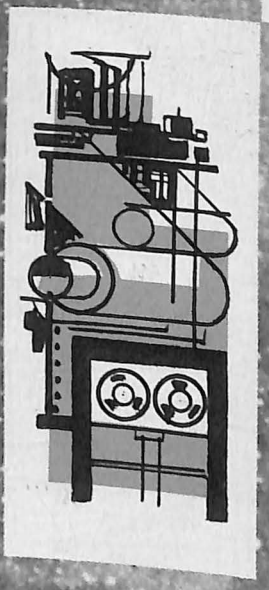
"The space program has been a catalyst, a stimulus to *education* at all levels, with particular attention to science and engineering. How much is it worth to have raised the educational sights of our young people and at the same time to have increased significantly the wealth of knowledge with which to condition them? I cannot put a price on it, but I believe its value will exceed the total cost of the space program.

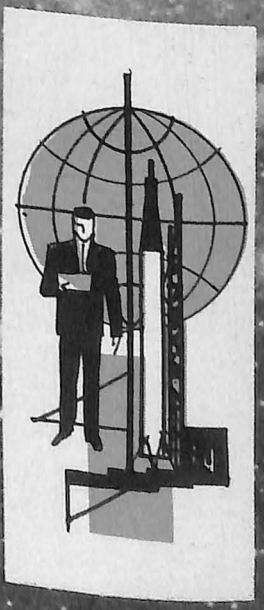
"The contribution of our space program to our *national security* is also considerable. How much more secure are we, due to improved weather information, and better world-wide mapping? How much is it worth to be better informed about potential sources of danger? How can we assess the advantage of developing competence to detect and offset possible aggression from space? I cannot put a price on these contributions to national security, but I am confident that their value also exceeds the total cost of the space program.

"The space program stimulates the development of new products, new productive processes, and new managerial techniques. I cannot place a precise value upon such *innovations,* but I would estimate that such investment will repay itself many times over.

"A substantial difference in influence in *world affairs* evolves from whether a country is in a first position or a second position in power. To a significant degree, a nation's relative position depends on how it stands in advanced technology. International prestige is not a mantle to be weighed lightly or to be worn carelessly. We should be concerned with the image that people of other nations have of the United States. The ideal picture is that of a nation strong in ideas, in technology, in freedom, in standards of living, and in military power to protect the viability of the other prestige ingredients. The space program, effectively and imaginatively conducted, contributes positively to all of those ingredients. I do not know how much such a contribution is worth, but I am confident that if we fail to strive for it, we will be making it clear that we no longer value our freedom highly.

"Combining, as the space program does, the best talents in management, in engineering, and in science, with the most modern facilities available, the net result is the production of *progress.* A program which stimulates education, expands research and development, augments total productivity, increases employment, and improves our international relations, is a program of the greatest economic significance.. By increasing our total national income and gross national product, the national space program expands to a significant degree the size of the base on which our taxes are levied. It increases the profitability — yes, the constructive profitability — of the private sector of our economy."





COOPER
SPACE

By ARNOLD W. FRUTKIN
Assistant Administrator,
Office of International Programs
National Aeronautics and Space Administration

ATING IN

THE prime purpose of the National Aeronautics and Space Administration's international space program is to serve broad foreign policy objectives through useful scientific and technical projects.

But a practical consequence for the American aerospace industry is that the program has stimulated a level of space activity abroad which might not otherwise have been achieved. Purely as a by-product, then, cooperative space projects have created limited markets for American know-how and hardware overseas. This is but another expression of the mutual interest implicit in the cooperative program. But the philosophy and values of the cooperative effort are of broad importance to all Americans, as well as to those overseas who are cooperating with us.

At the outset, it is important to recognize two simultaneous objectives of the entry of the United States into space. The first and essential one is that we acquire sufficient knowledge of space science and enough competence in space technology to assure our security and economic well-being. Secondly, we seek to reduce international tensions and build communities of interest and patterns of cooperation. Superficially contradictory, these two objectives actually reflect a proper balance of prudence and constructive intent.

To establish patterns of cooperation in space, NASA very early offered to enter into projects of mutual interest with the scientists of other countries. The governing philosophy is that the cooperation be literal and substantive. From these basic premises are derived the specific guidelines of the cooperative program: that all participants commit their own resources in funds, personnel, and equipment; that there be no dollar support from the United States; that the content of a given project be of mutual interest and possess valid scientific objectives; that the organizational context be

Here are highlights from Mr. Frutkin's article on international space cooperation and markets:

- **The foreign market in the space field, represented principally by Europe, is developing steadily, though on a modest scale.**
- **There is strong official and industrial interest in Europe in commercial arrangements with American firms for assistance in entering the space field, but it is directed more toward the acquisition of know-how than to the purchase of hardware.**
- **There is abundant evidence of serious intentions on the part of Europe in the space business. This is evidenced by the very high caliber of personnel assigned by the participating countries to the European Space Research and European Launcher Development Organizations as well as by the amount of funds pledged (about $80 million a year to the two organizations), plus the fact that both agencies have been formally ratified.**
- **The European interest is entirely hard-headed and realistic. It doesn't argue that man is compelled to explore the unknown but rather that Europe needs to compete in advanced technologies and to reap any direct economic benefits, such as those which should materialize through communications satellite systems.**
- **European technical development in the space field is behind our own, but theoretical knowledge in the field is on a par with ours and could, if sufficiently supported, begin to express itself in hardware in rather rapid fashion.**

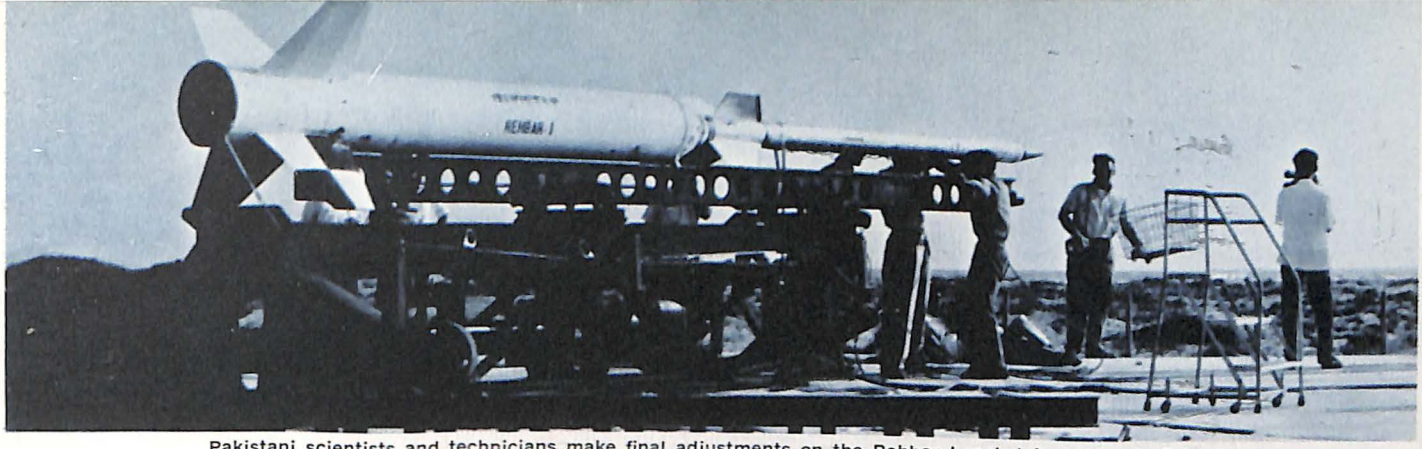
civilian in character; and that the scientific results be open to all interested parties. The policy is admittedly a rigorous one and far removed from concepts of aid or support.

Since the space age is, of course, very young it might well be expected that few nations besides the Soviet Union and the United States have done very much in the field and that, as a consequence, the opportunities for cooperation are few. Yet the appeal of space activity has been vastly underrated by those who have seen in it only elements of prestige. Other advanced countries of the world have understood fully the more substantial reasons for entering into space activity. They have understood that "space science" and "space technology" are not new, narrow or esoteric disciplines with little relevance to the mainstream of national life. They have recognized, on the contrary, that both space science and technology actually enlist a wide range of sciences and technologies and put them to work at their most advanced frontiers—precisely where the greatest gains are likely to be made. It is for this reason that participation in the space age and its programs becomes mandatory for the advanced nation. It is increasingly appreciated that no other peacetime activity of record has an equivalent capacity to stimulate national scientific and engineering communities, educational systems, industries, and governments to new capabilities, standards, and the combined effort which strengthens societies.

Even in the developing countries, the interest in space activity has often been greater than might have been expected. Enlightened authorities recognize that modest involvement in space projects can contribute toward creation of a scientific and technical community, spread an awareness of the character and techniques of the outside world, and stimulate young people to follow badly needed technical careers.

From the U.S. point of view, the participation of both advanced and developing countries in space activity establishes a base for meaningful cooperation. More than this, it develops that base to a level of readiness for more significant cooperation when and if we become ready for it. In a fundamental sense, space cooperation preserves to us a choice, a ready alternative, to destructive competition and worse.

Given this level of realism, it is not surprising that NASA's offers of cooperation, however rigorous, have



Pakistani scientists and technicians make final adjustments on the Rehbar I rocket just prior to firing.

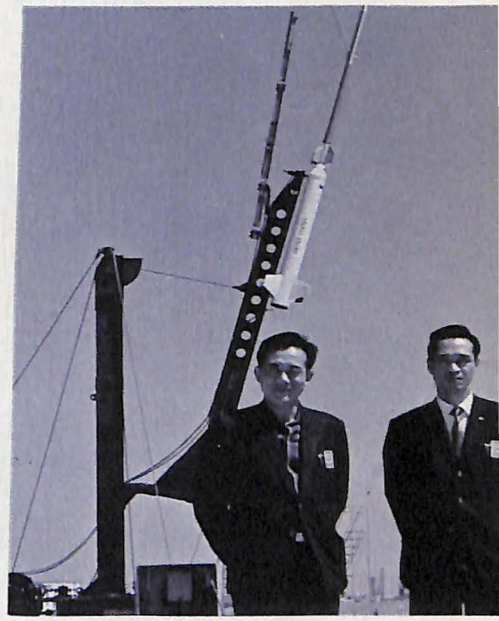
produced a wide and gratifying response from large and small nations alike. What other nations are doing in space, and in particular what they are doing together, is in fact small when compared with the resources going directly into national programs in the U.S. and USSR. Yet, what has been accomplished provides substantial evidence of the feasibility, benefit, and promise of joint action.

To date, agreements have been reached covering the launching of 13 international satellites, of which 3 have already been successfully placed in orbit. These satellites are conceived, financed, and engineered by cooperating nations and then launched by NASA. The agreements for these joint projects are with the United Kingdom, Canada, France, Italy, and the new grouping of nine European states in the European Space Research Organization. A second program has been established under which foreign scientists propose individual experiments for inclusion on large NASA satellites, their proposals to be reviewed in competition with those submitted by American scientists and, if selected, funded and prepared by sponsoring agencies abroad. One such experiment has already flown successfully and more than a dozen additional ones have been scheduled for later flights. As many more have been proposed.

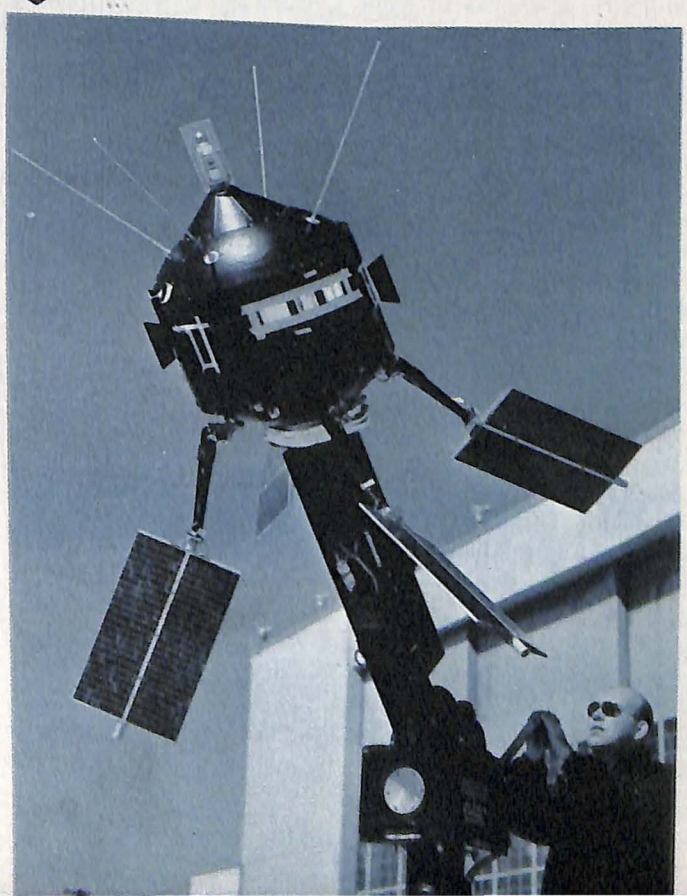
Special international appeal attaches to the use of scientific sounding rockets since their cost is very much less than that of satellite projects and their utilization is relatively more simple. Moreover, the fact that sounding rockets acquire data only in a roughly vertical profile puts a premium on their repeated use at different geographic locations under differing conditions, as well as on their simultaneous use in different locations.

Obviously then, international cooperation is an essential ingredient for successful use of sounding rockets. In the past year alone, NASA has in fact carried out cooperative launching of sounding rockets with a dozen different countries. Many of the launchings have been overseas—in India, Sweden, Norway (with Denmark participating), Pakistan, Italy, Canada and New Zealand. Other countries have joined with us in experiments in the U.S.—Australia, France and Japan. Still other countries are even now approaching their first joint sounding rocket experiments with us—the Netherlands and Argentina. The basic elements in such

Japanese scientists visit NASA's Wallops Station to view activities in connection with the Nike-Cajun project. Rocket carried a Japanese payload.



British satellite, Ariel II, is checked prior to mating it with the Scout launch vehicle. Satellite measures galactic radio noise, micrometeoroids.



programs are the scientific instrumentation of the flight, the rocket itself, the ground instrumentation to receive data from the rockets, and, finally, the analysis of data. The cooperating countries divide responsibility for these elements according to the particular agreement.

Other possibilities for international cooperation include scientific activities which are essentially ground-based in that they utilize instrumentation or facilities on the ground to support or complement satellite experiments. For example, the NASA Tiros/Nimbus weather satellite program was the occasion for enlisting 41 countries in special and conventional weather observations synchronized with the passes of the satellites above, providing for correlation of satellite and local data and experience in using satellite weather data locally. Again, in the communication satellite field, the first experimental communications satellites launched by NASA were tested intercontinentally with the aid of major ground stations built and financed by more than half a dozen countries. In the purely scientific field, too, scientists in some two dozen countries have provided ground instrumentation for participation in ionospheric satellite and geodetic satellite experiments, often necessary to the success of these experiments.

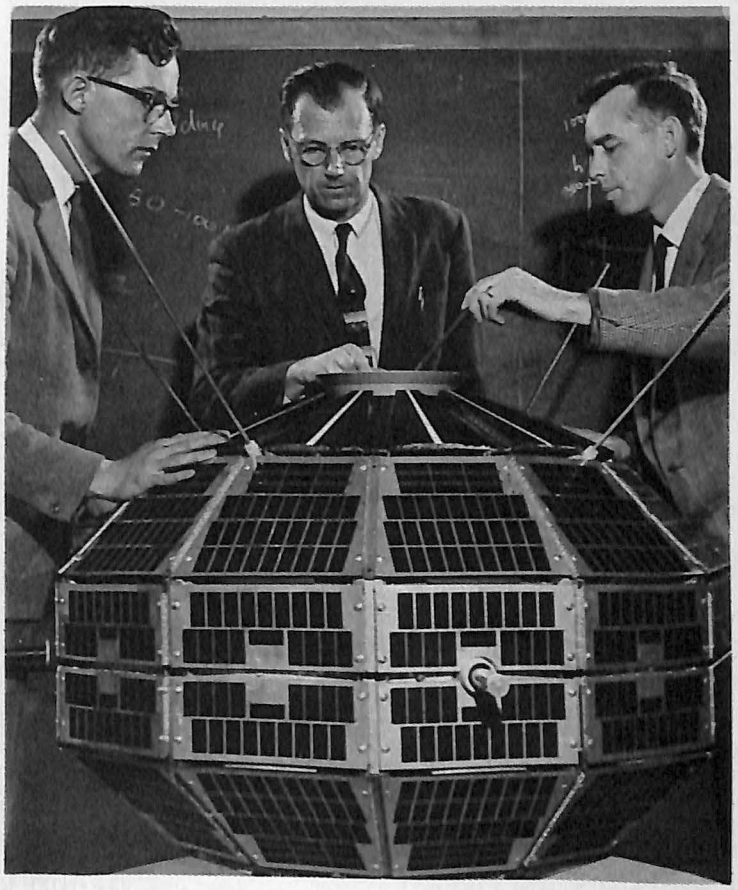
NASA's extensive network of tracking and data acquisition facilities scattered over the globe has been open to local technicians who participate in operating more than half of these overseas stations. The level of interest in such operations abroad is such that British, Canadian, and Australian agencies actually carry significant portions of the operating costs of stations located in their territories. The knowledge and interest which result from this participation are reflected in current foreign planning for their own tracking and data acquisition facilities, with a rational concern for equipments and techniques which are compatible with NASA operations.

Personnel exchanges and training arrangements have their important place in any international effort. Opportunities have been made for senior scientists from abroad to spend a year or more in NASA centers, in research or experimental work. Fellowships at the graduate student level are available in American universities for foreign trainees whose travel and subsistence are paid by their own sponsoring agencies. Training directly and specifically required for the execution of cooperative projects is provided at appropriate NASA centers, including especially the Wallops Station in Virginia. The requirement for investment on the part of the cooperating country assures careful consideration of the training arrangements, the personnel selected to be sent here, and their future utilization at home.

Our debt to gifted foreign scientists in the past is so well known that it is not necessary to emphasize the importance of keeping open the channel between our communities through all the programs briefly described here.

It has already been noted that a by-product of the total NASA international program has been the creation of a limited market abroad for American space products, principally but not exclusively in Europe. This market, of course, is very minor compared to the foreign market for all aerospace products. Moreover, it has been a fundamental tenet of European philosophy in entering the space arena that the necessary hardware was to be acquired within Europe. Only know-how was to be sought from the United States. And this was consistent with the basic justification of European space expenditures on economic grounds. European industry has been a strong proponent of these expenditures, and contributions to the regional space entities, the European Space Research Organization and the European Launcher Development Organization, have been made with the clear understanding that they were to bring back comparable returns to the contributing countries in the form of contract placements. Nevertheless, in practice, it has been found necessary or desirable to procure hardware as well as know-how in the United States. The result to date has been a modest flow, of perhaps $20 million, into the United States for antennas; ground stations; telemetry, command, and power components for satellites; spacecraft subsystems such as solar cells and sensors; sounding rockets and sounding rocket payloads; range equipment; training under contract; design studies; environmental test facilities; reliability evaluation; and so forth. While European industry would undoubtedly hope to reduce this reliance upon American firms, the continued growth of space activity here and abroad is just as likely, instead, to give rise to a two-way flow. On this point, NASA's view of foreign industrial participation in its own programs

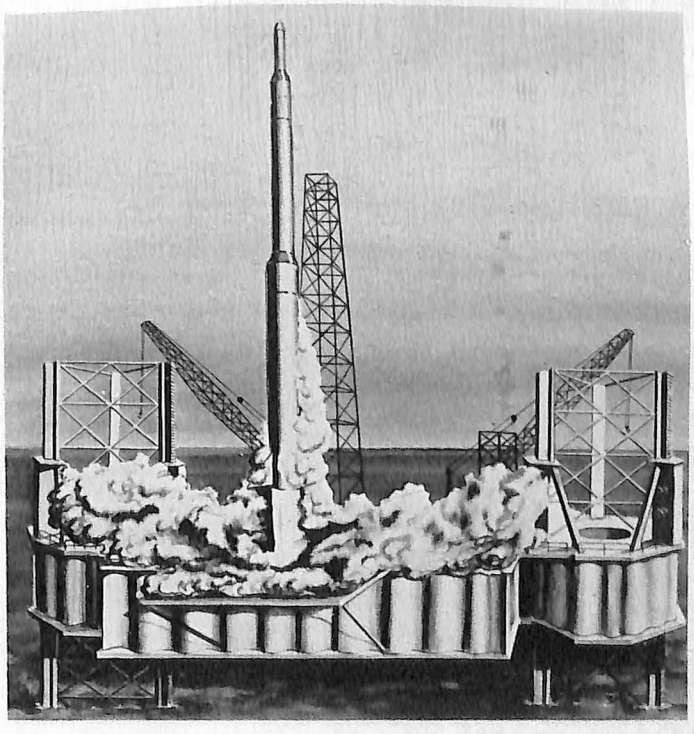
Canadian scientists check a model of the Alouette satellite which is used to investigate the ionosphere.



has been that procurement contracts should be entered into only where there is a clear and special advantage to the United States in product, service, or price—with due regard for the outflow of dollars.

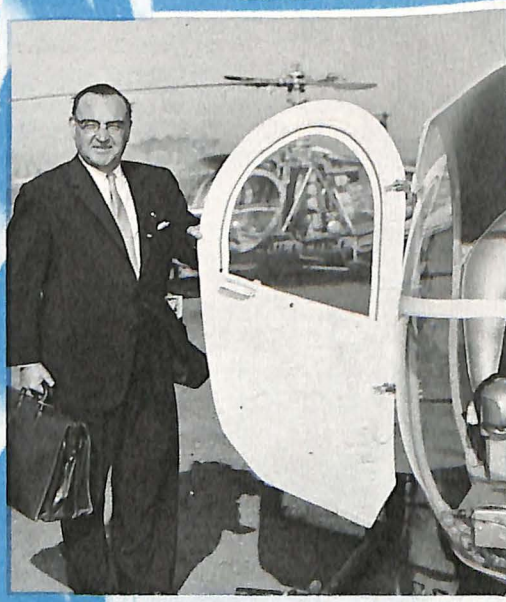
The relative difficulty of contract management is another important element in considering the placement of contracts overseas. The principle, however, is so far virtually academic; in these early stages of space technology development in Europe, little participation has so far been sought by foreign firms. In the future, it must be anticipated that the criteria for NASA overseas procurement may well be met in specific cases. In general, of course, the national interest requires careful evaluation of the benefits to be achieved through exchanges in the forward reaches of technology. Nevertheless, commercial interchange itself is a contribution to stabilizing international relationships and mutual understanding. The maximum commerce within governing policy is certainly to be desired.

Final phase of the joint Italy-United States San Marco project is shown in an artist's conception. The satellite will be launched from a floating platform in the Indian Ocean to achieve an equatorial orbit. Photo at right shows a firing from Wallops Island to test instrumentation of the San Marco satellite.



President Lyndon B. Johnson

Senator and Mrs. Barry M. Goldwater



Governor Edmund G. "Pat" Brown

Republica

GENERAL ELECTION

Democra

GENERAL ELEC

in Congress

Vote for One

Senator and Mrs. Philip A. Hart

Senator Kenneth B. Keating

Governor Nelson A. Rockefeller

Helistops Replace Whistlestops

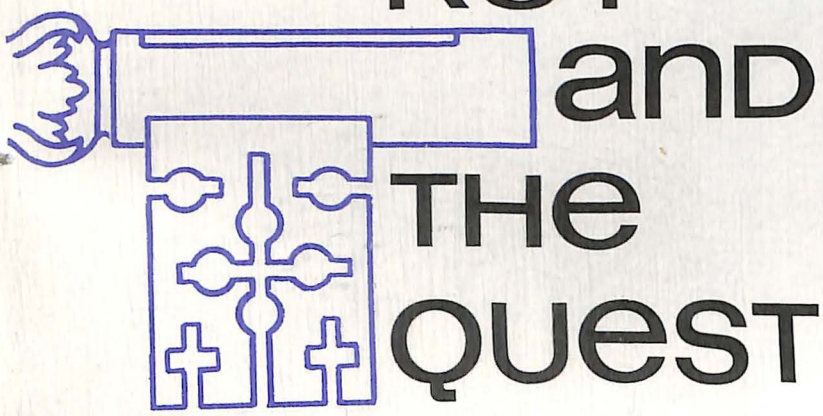
Versatility is one of the major advantages of the helicopter, and it is also a valuable trait for candidates and campaigners. It was inevitable that they would get together. Helicopters are not limited to landing at an airport; they can go where the voters are – a fairground or a schoolyard. Other types of aircraft are used extensively, ranging from four-engine turbojet transports for national candidates to a single-engine private plane for candidates in large districts. The helicopter, which can literally drop in on the voter, is being increasingly utilized by busy campaigners.

"The history of mankind has demonstrated that knowledge is fundamental to human advancement. . . . In the exploration of space, scientific knowledge is both the key and the quest."

DR. HOMER E. NEWELL
Associate Administrator for
Space Sciences and Applications
National Aeronautics and
Space Administration

The aerospace industry is conceiving, designing and building the tools that explore the vastness of space

THE KEY AND THE QUEST



THE WORLD is embarking on a new year of the Space Age. The seven years which have slipped by so quickly have been exciting ones. The peoples of the world have thrilled to the exploits of the astronauts. They have marveled at the awe-inspiring feats of the space probes which pried out the secrets of Venus and gave us photos of the lunar surface. And, through the applied satellites which have brought new techniques in such practical areas as weather forecasting and international communications, they have gained new insight into the potential of science and technology in advancing their way of life.

Obscured by such dramatic achievements has been the contribution of that journeyman spacecraft, the unglamorous, unmanned, earth-orbiting scientific satellite. Nonetheless, this unspectacular member of the spacecraft family has written most of the pages in the encyclopedia of space lore. In ever-mounting volume, scientific satellites have acquired millions of bits of information, and today they are sending observations which fill some 40 miles of magnetic tape daily.

As we enter the eighth year of space exploration, the scientific satellite family is about to be joined by a new member, a spacecraft as impressive in its own way as the manned vehicles under development. It is the Orbiting Geophysical Observatory. Where the first American satellite carried two experiments, OGO has 20 and it weighs almost 30 times as much as its ancestor.

OGO is a member of a new and important group of scientific satellites, the Observatory Class or "streetcar" spacecraft, so called because they carry a great many "passengers" — experiments — by comparison with their predecessors. OGO is the second of its class. The first, largely unheralded, was the Orbiting Solar Observatory, launched more than two years ago. Next year they will be joined by a third teammate, the Orbiting Astronomical Observatory. And, within four or five years, will come the Advanced Orbiting Solar Observatory with twice the payload of the first "streetcar." Throughout the remainder of this decade, several observatories of each type will be launched.

The first observatory — OSO-1 — was launched by a three-stage Thor-Delta booster on March 7, 1962. It is still in orbit, although it ceased to be useful six months after launch when it exhausted its supply of nitrogen gas used in control jets which orient the satellite toward the sun. New OSO's will continue the research. Through them scientists hope to penetrate the mysteries of solar flares which emit intensive sheets of radiation and, possibly, to acquire the ability to predict when the flares will occur, an important step toward manned travel within the solar system.

The OSO satellite technically is designated as a "stabilized platform for solar oriented scientific instruments." It has two main sections. One is a wheel-like structure 44 inches in diameter and 23 inches high. Mounted on this wheel is a rotating fan-shaped array containing five continuously sun-aligned experiments. Solar energy is the sole power source for operating electrical equipment on the solar observatory. On

OSO's surface are 1860 solar cells which produce 27 watts of electric power.

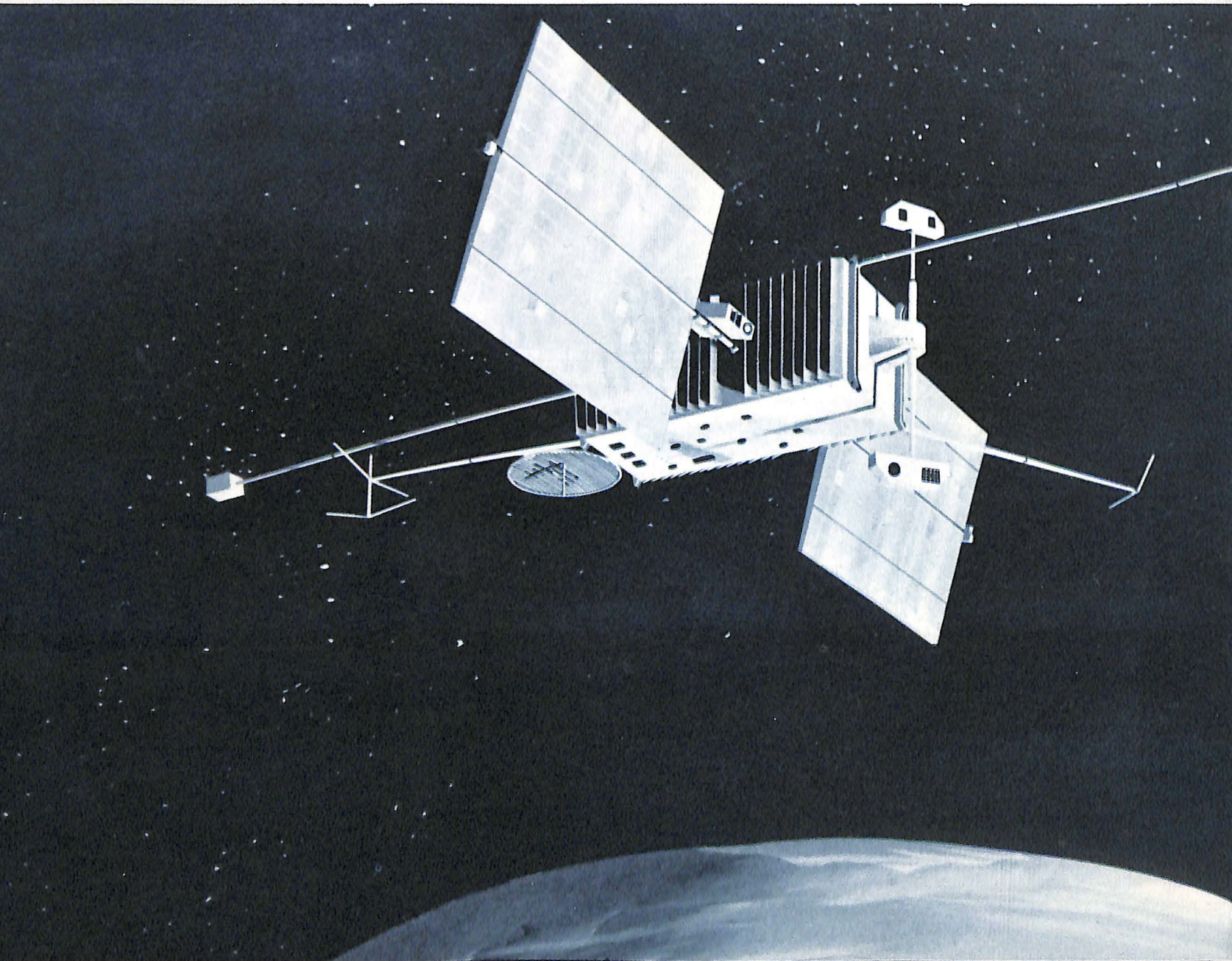
As the OSO is injected into orbit, small rocket motors spin it so that the vehicle maintains a spinning rate of 30 revolutions per minute. This gyroscopic feature of the spacecraft not only gives it stability as a space platform but permits experiments in the wheel portion to point alternately toward and away from the sun. Photodetectors located around the spacecraft activate motors and jets to keep OSO in proper relation to the sun. Other detectors turn off and on the electrical equipment as the satellite enters and emerges from the earth's shadow.

Scientific information gathered by OSO is telemetered to earth by two independent tape recorders and transmitters. For 90 minutes of the 96-minute earth orbit, the experiments' results are directed into a continuous loop tape recorder. During the remaining five minutes, the appropriate ground station directs the recorder to transmit the complex data by radio at a rate 18 times faster than it was recorded. This process clears the tape so that after each transmission, it can record more data. The ground station can order either transmitter on or off and it can also turn on or off the wheel experiments and the sun-pointed tests.

The 13 experiments aboard OSO divide into two groups: five on the fan-shaped upper portion constantly facing the sun and eight in the rotating wheel or lower portion of the satellite. The sun-pointing tests in the upper section establish standards of solar activity during quiet and turbulent periods. The wheel experiments are sky-mapping activities comparing radiations directly from the sun with those from other areas of space.

OGO is two distinct satellites — EGO and POGO. EGO — Eccentric Geophysical Observatory — is so-called because it is intended for launching into an eccentric orbit with an apogee of about 70,000 miles from the earth and a perigee of about 175 miles. EGO's main assignment is to study energetic particles and other geophysical phenomena requiring the type of orbit planned for it. POGO — Polar Orbiting Geo-

Orbiting Geophysical Observatory (OGO) is a "standardized" satellite which can accommodate many different types of experiments. OGO can store up to 86 million bits of information, transmit them to ground stations at a rate of 64,000 bits per second.

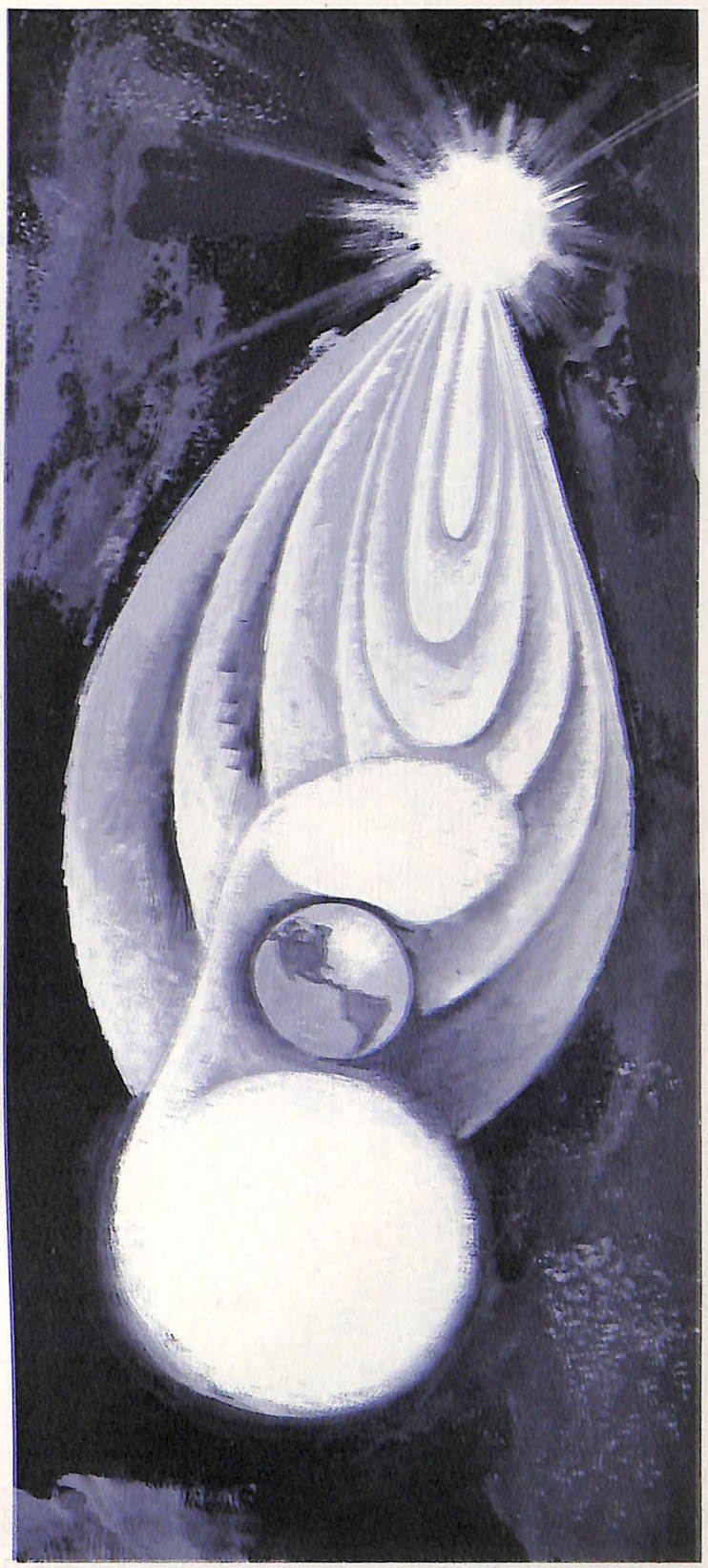


physical Observatory — will have a planned apogee and perigee of 570 and 160 miles, respectively, passing over the poles of the earth and giving particular attention to the unexplored regions of the polar atmosphere.

In terms of experiment integration OGO is the most complex satellite yet attempted by NASA. Some delays have been caused by the problems of integrating 20 separate experiments and eliminating interference among them. Many of the experiments are designed to measure phenomena in space, such as radio noise or fluctuations of the geomagnetic field, whose signals are similar to those generated by motors and power supplies.

With OGO scientists hope to learn more about cosmic rays, the cause of geomagnetic storms, the size and distribution of micrometeorites, and energetic particles trapped in the earth's magnetic field.

A true observatory, OGO will be stabilized in orbit to permit, by virtue of location, observation in preferred directions — toward earth, toward space, toward



Scientific satellites seek knowledge on cosmic rays, energetic particles in the earth's magnetic field, size and distribution of micrometeorites.

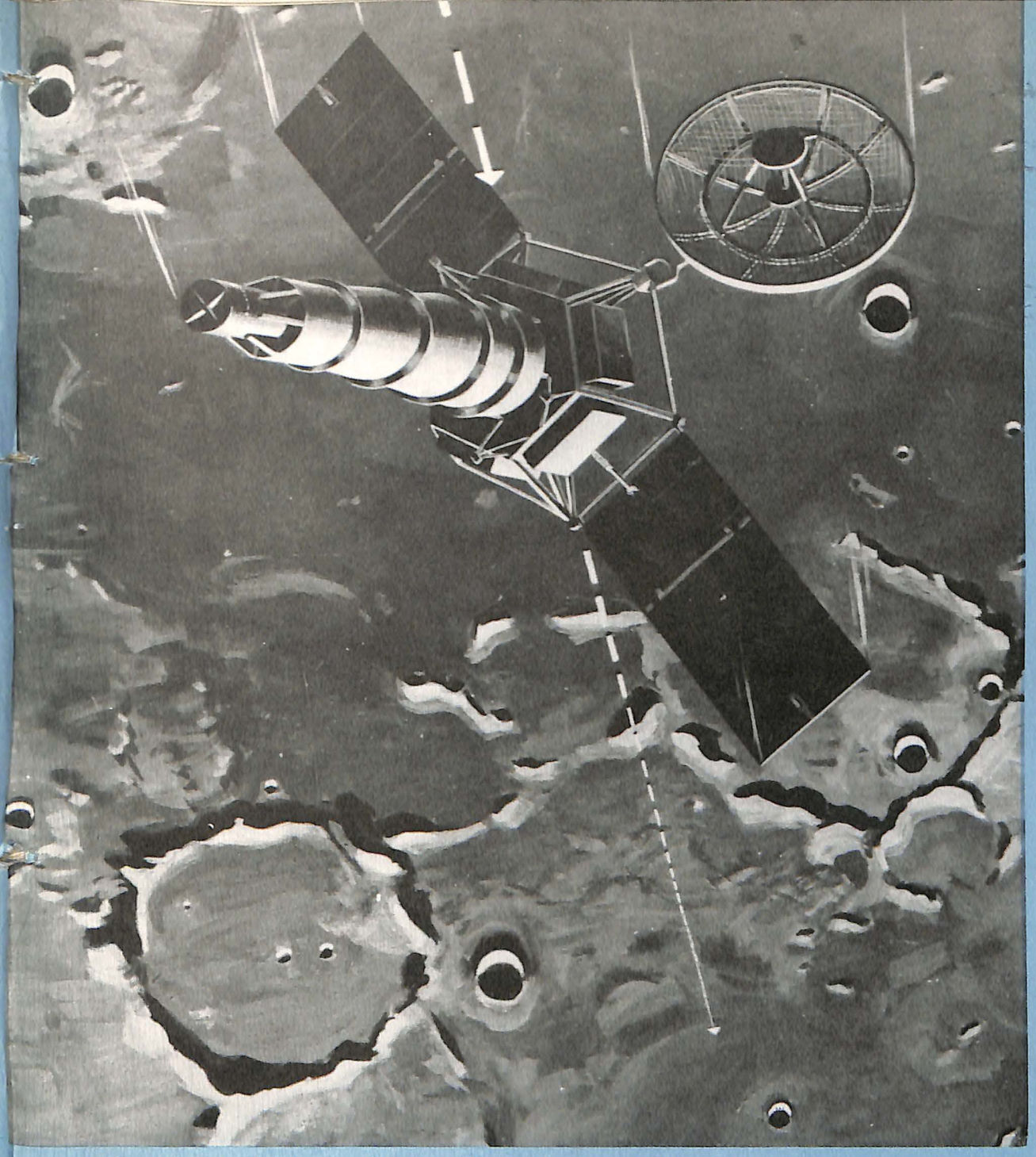
RANGER ■ LUNAR PHOTOGRAPHER

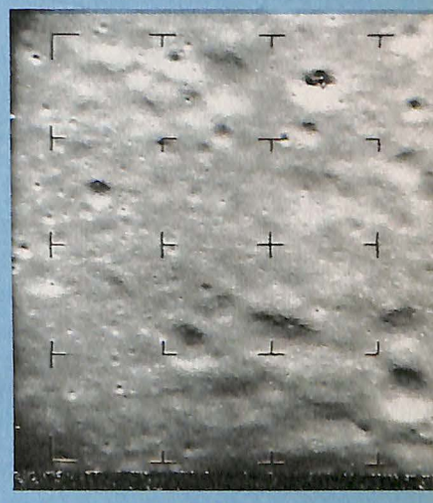
Ranger 7, during the last 16 minutes and 40 seconds of flight prior to impact on the moon's Sea of Clouds, transmitted 4,316 high resolution television pictures of the lunar surface. The feat produced more lunar facts than man had accrued in the three centuries since Galileo pointed his crude telescope toward the moon. ■ The accomplishment is the fruition of several years of dedicated work by the Jet Propulsion Laboratory, the National Aeronautics and Space Administration and more than 1,200 firms of the aerospace industry. ■ Among the major contractors are General Dynamics, North American Aviation, General Electric and Lockheed Aircraft Corp. (Atlas D and Agena B booster systems); Bell Aerosystems (digital accelerometer modules); Textron Electronics (solar cells); General Precision (video processing film converter); Radio Corp. of America (television camera systems); Northrop (computer and sequencer, and attitude control subsystems); Ryan Aeronautical (solar panels) and Honeywell (gyroscopes). The management direction that welded all of these and the many other firms together deserves equal credit. ■ The TV pictures show the lunar terrain to be almost entirely satisfactory for landing the Apollo lunar excursion module.

the sun, and along the orbital path. An important feature of the satellite will be its ability to digest and transmit information it collects on the orbital journey. Because of the short-lived aspect of many of the phenomena it will observe, OGO will be equipped to store up to 86 million bits of data on tape recorders and transmit findings at the moment they are collected to ground stations at a rate of 64,000 bits per second.

OGO is a "standardized" satellite in that it has a basic structure, including controls, data handling and communications systems, which can accommodate many different types of experiments. Experiments are contained in modular compartments on long booms extending from the basic structure, and the various experiment packages are interchangeable. The basic structure is about six feet long and three feet square; it weighs 900 pounds, including 150 pounds of instruments. From the main structure extend two large paddles containing 32,000 solar cells. With booms and paddles extended, OGO is 54 feet long and 20 feet wide.

Scientific instruments will vary from mission to mission but the basic satellite structure will be the same. Later versions may weigh about 1,500 pounds





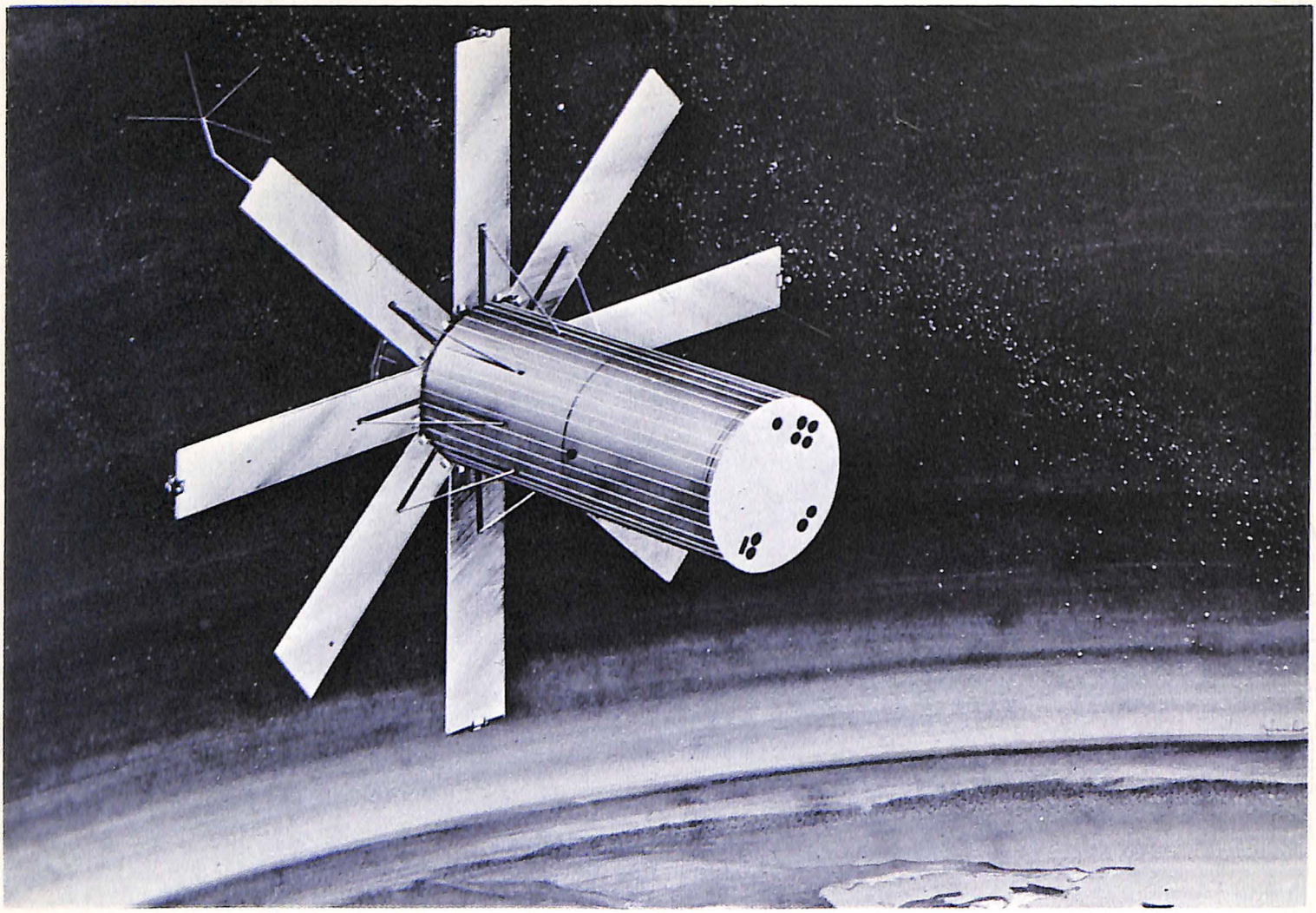
Artist's conception (above) shows Ranger as it drops to moon's surface. Dotted line depicts flight path. Series at right are photos transmitted by Ranger. Top photo was made at an altitude of 470 miles, middle photo at about 235 miles and bottom photo from three miles.

and include a spherical piggyback satellite. Certain experimental sensors will be placed on the booms because they might be affected by the satellite's body. The solar cells and nickel-cadmium batteries will provide an average power supply of 50 watts.

One of NASA's most ambitious and significant scientific satellites is the 3600-pound Orbiting Astronomical Observatory (OAO) scheduled to be placed in a 500-mile circular inclined orbit in 1965. This will be a satellite capable of making astronomical observations from space above the atmosphere, thus avoiding atmospheric distortions which have plagued astronomers using telescopes on the earth's surface.

OAO has self-contained stabilization, communications and power equipment. It is equipped with solar cell paddles to convert sunlight into electrical energy. For astronomical observations, OAO has scientific apparatus and instruments enabling it to perform a wide variety of scientific experiments in a single mission. Included are telescopes with mirrors up to 36 inches; spectrometers for measuring spectral wave lengths; photometers to measure the intensity of light, and image-detecting tubes.

This astronomical observatory will make it possible

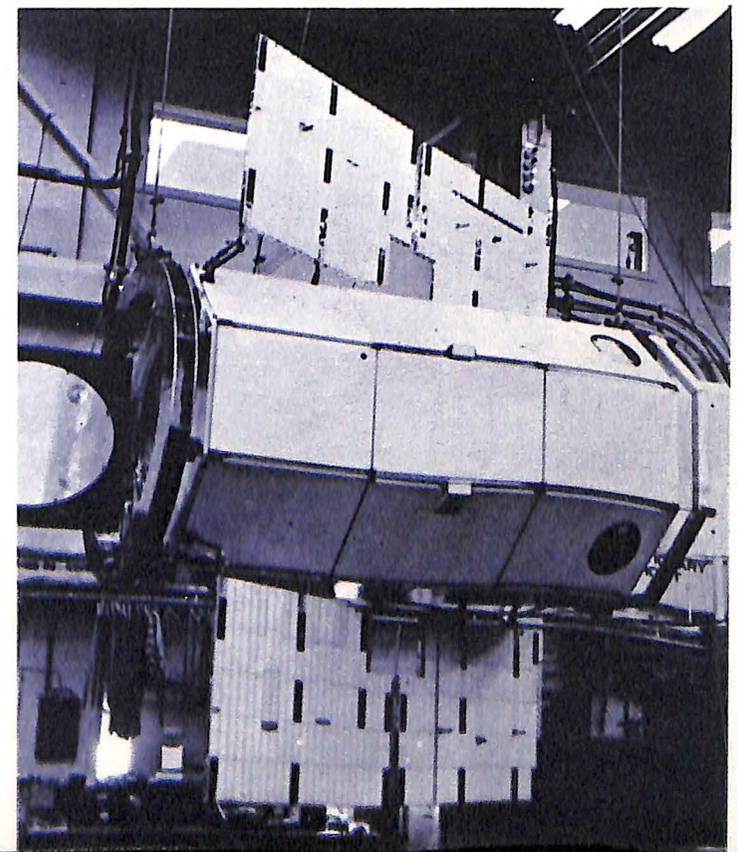


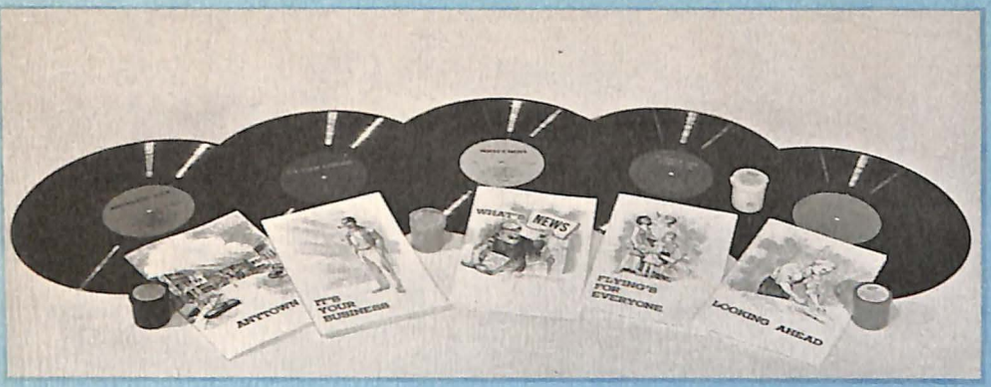
Advanced Orbiting Solar Observatory (AOSO) is a second generation scientific satellite. OSO-1, launched in March, 1962, transmitted information for about six months.

to observe the universe for extended periods from a vantage point above the shimmering haze of the lower atmosphere that contains 99 per cent of the earth's air. OAO will see celestial bodies shining steadily against a black background. It will clearly delineate features which from the earth are either fuzzy or indistinguishable. Astronomers predict that OAO will furnish a wealth of new knowledge about the solar system, stars and composition of space.

The Advanced Orbiting Solar Observatory — AOSO — will be able to carry experiments up to eight feet long by comparison with the three-foot limitation of the original OSO series. It will carry twice the payload — 1000 pounds, compared with OSO's 500 pounds. A prime feature of the advanced satellite will be its superior accuracy. For instance, OSO is limited in its pointing accuracy to one minute of arc. AOSO will have a pointing accuracy to within five seconds of arc. This is best illustrated by noting that a dime at one mile subtends an angle of about two seconds of arc. These differences between the two satellites will help achieve greater resolution of small details on the sun's surfaces as well as in its ultraviolet spectrum. First launching of an AOSO is not scheduled before 1968 or 1969.

Orbiting Astronomical Observatory (OAO) will observe celestial bodies above the shimmering haze of the earth's atmosphere.





A kit of public information materials, portraying the economic impact of general aviation on a community, is being released nationally by Aerospace Industries Association's Utility Airplane Council.

Titled "GROW Kit," the package contains a number of sound slide film presentations and several additional items designed to help dramatize general aviation's role in the economic development of a community and the influence it has on the individual.

The kit was produced by the UAC of AIA and points up the national importance of general aviation which includes all civil flying except that done by the airlines.

For example, for personal and business travel alone, general aviation operates about 43 times more aircraft than all scheduled airlines combined. This branch of flying logs more than four times the number of hours and twice the mileage of all airlines annually.

Serving any community with an airport, general aviation has become one of the biggest feeders of passengers to and from airline connections and, combined with scheduled carriers, forms an efficient air transport team that is growing daily.

A number of communities across the Nation have already obtained GROW Kit packages as an aid in educating their citizens to the need for airports in those areas. Others interested may contact AIA, 1725 De Sales Street, N.W., Washington, D. C. 20036.

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Fairchild Hiller Corporation
Hiller Aircraft Company, Inc.
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 Aerospace Corporation
Grumman Aircraft Engineering Corp.
Gyrodyne Company of America, Inc.
Harvey Aluminum, Inc.
Hercules Powder Co.
Honeywell Inc.
Hughes Aircraft Co.
IBM Corporation
Federal Systems Division
International Telephone and Telegraph Corp.
Kaiser Aerospace & Electronics Corporation
Kaman Aircraft Corporation
Kollsman Instrument Corporation
Lear Jet Corporation
Lear Siegler, Inc.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corporation
The Marquardt Corporation
Martin Company
McDonnell Aircraft Corporation
Menasco Manufacturing Company
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, a Division of International Harvester Co.
Sperry Rand Corporation
Sperry Gyroscope Company Division
Sperry Phoenix Company Division
Sperry Utah Company
Vickers, Inc.
Sundstrand Aviation, Division of Sundstrand Corporation
Thiokol Chemical Corporation
Thompson Ramo Wooldridge Inc.
United Aircraft Corporation
Westinghouse Electric Corporation
Atomic, Defense and Space Group

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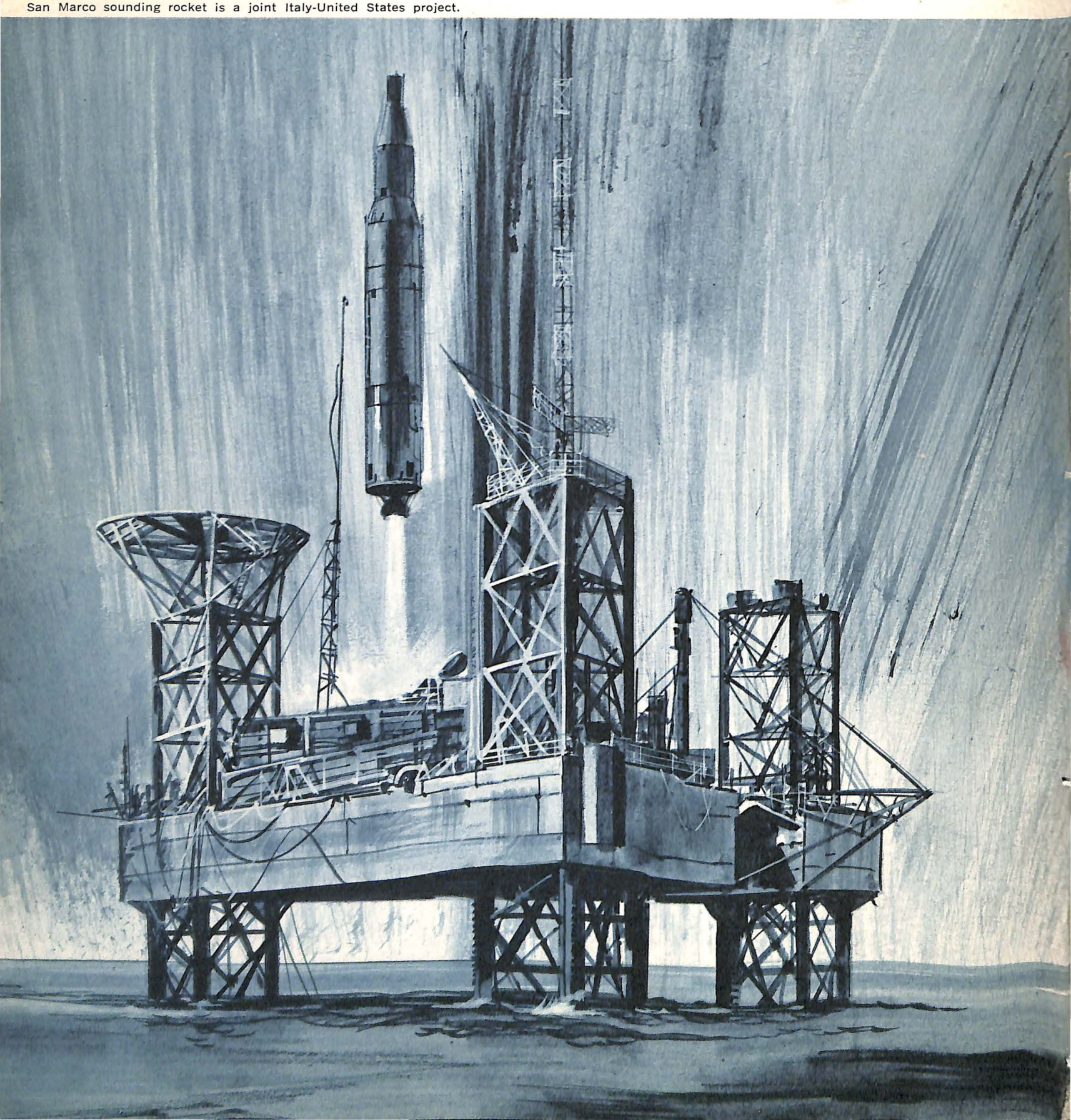
COOPERATING IN SPACE –
San Marco sounding rocket is a joint Italy-United States project.



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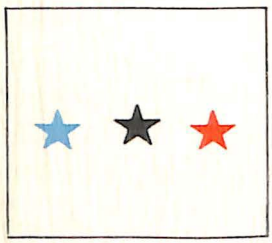
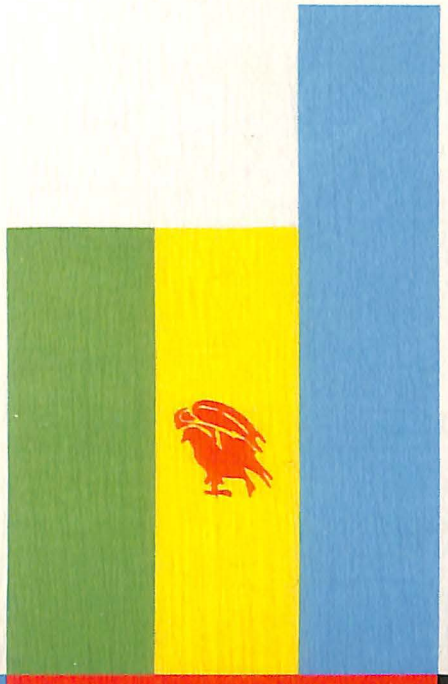
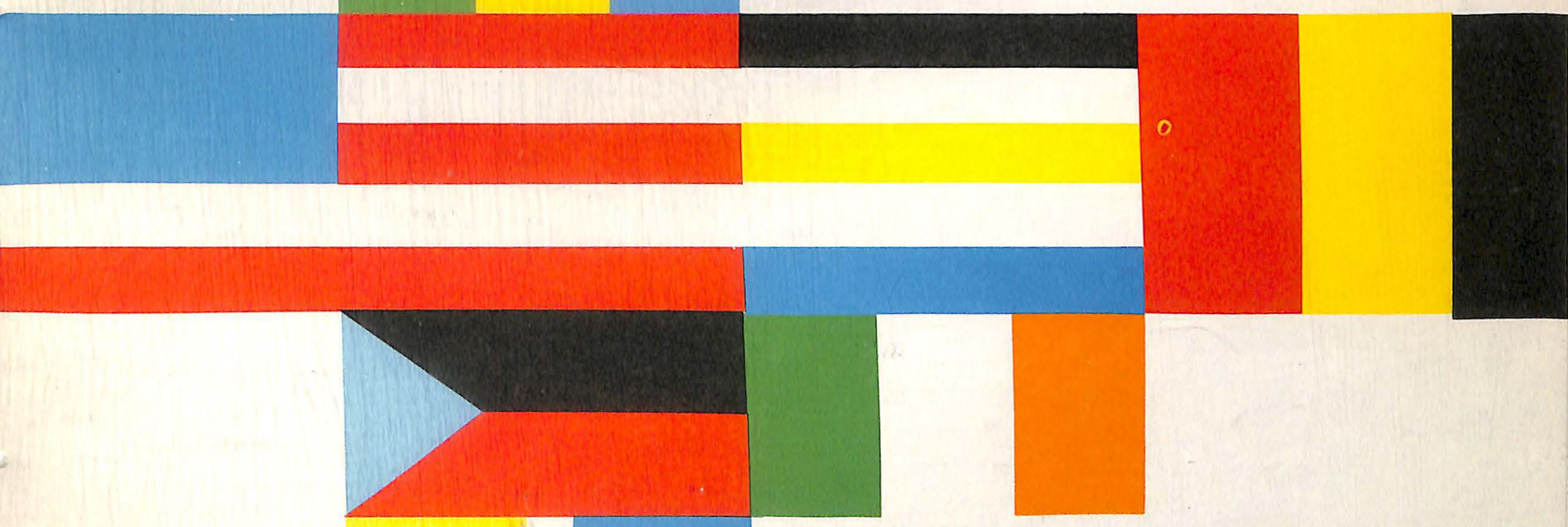
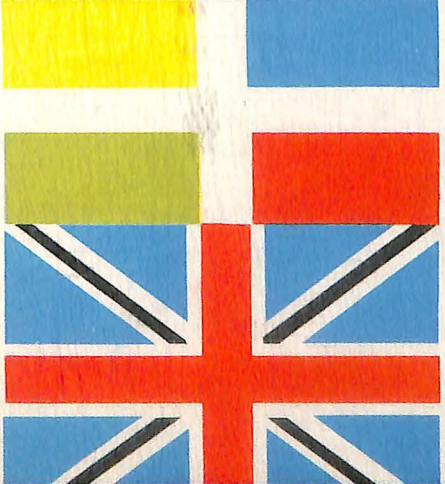




ICAO • OACI

20th Anniversary





TECHNOLOGICAL PROGRESS — an International Asset

By KARL G. HARR, JR.
President, Aerospace Industries Association

United States International Aviation Month, 1964

By the President of the United States of America

A Proclamation

WHEREAS a diplomatic conference was convened at the invitation of the United States of America in Chicago, Illinois, on November 1, 1944, at which was formulated the Convention on International Civil Aviation, opened for signature on December 7, 1944, and signed by plenipotentiaries of the fifty-two participating governments; and

WHEREAS the United States as well as one hundred and five other governments have ratified or adhered to the Convention; and

WHEREAS the Convention created the International Civil Aviation Organization (ICAO); and

WHEREAS the Council of ICAO has decided to observe on December 7, 1964, the twentieth anniversary of the signing of the Convention and to request all member governments to associate the anniversary with any special aviation event held during the year in their respective countries:

NOW, THEREFORE, I, LYNDON B. JOHNSON, President of the United States of America, do hereby proclaim the month of December 1964 as United States International Aviation Month; and I invite the Governors of the States, the Commonwealth of Puerto Rico, the Commissioners of the District of Columbia, and appropriate officials in other areas subject to the jurisdiction of the United States to issue similar proclamations and to join in the observance of the event at all appropriate levels.

I also request interested agencies of the Government, United States international air carriers, the United States aeronautical manufacturing industry, and other interested organizations to cooperate in arranging such activities during the month of observance as may be appropriate.

IN WITNESS WHEREOF, I have hereunto set my hand and caused the Seal of the United States of America to be affixed.

LYNDON B. JOHNSON

AIA aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.

VOL. 2 NO. 4 WINTER 1964

Contents

The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems;

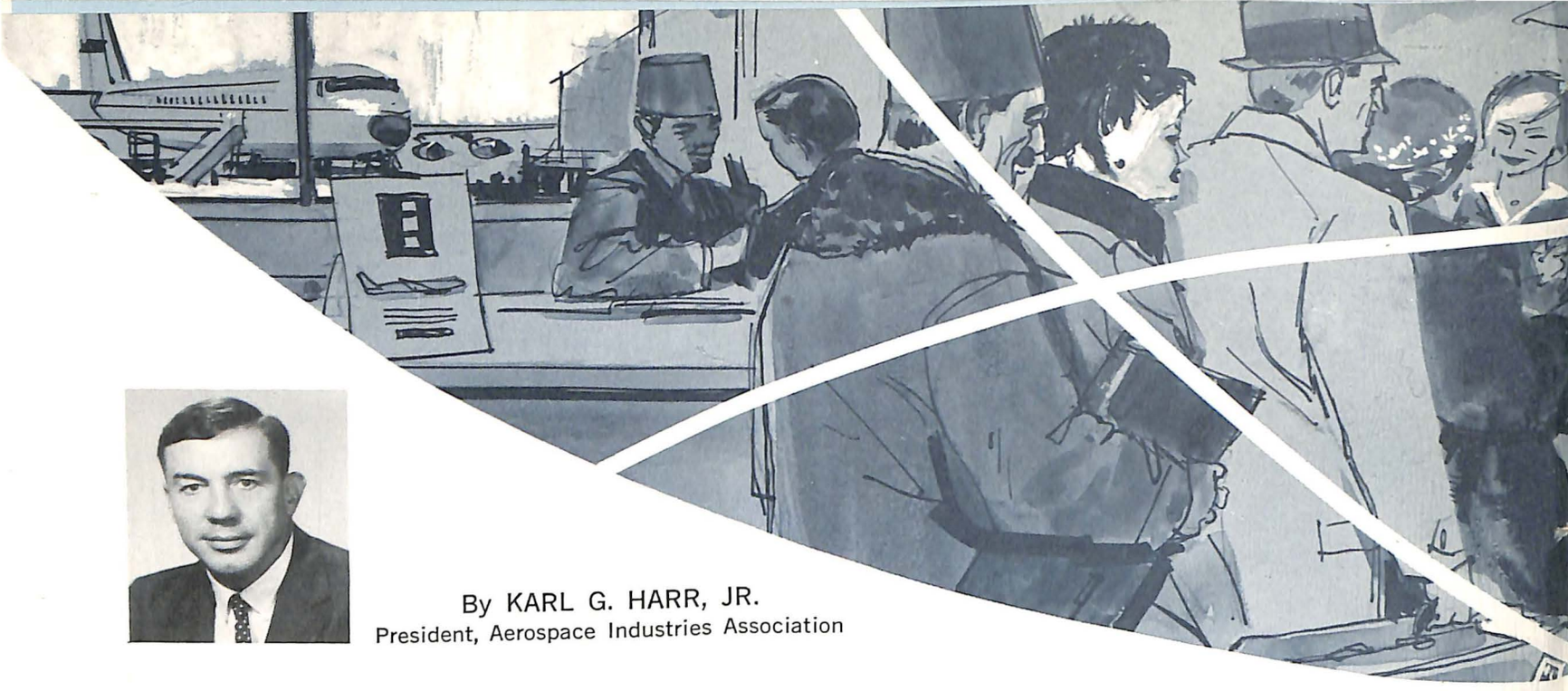
Foster understanding of the aerospace industry's responsibilities in the space exploration program;

Foster understanding of commercial and general aviation as prime factors in domestic and international travel and trade.

AEROSPACE is published quarterly by the Aerospace Industries Association of America, Inc., the national trade association of the designers, developers and manufacturers of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems and other aeronautical systems and their components.

Publication Office: 1725 De Sales Street, N.W., Washington, D. C. 20036

Los Angeles Office: 7660 Beverly Boulevard, Los Angeles 36, California



By KARL G. HARR, JR.
President, Aerospace Industries Association

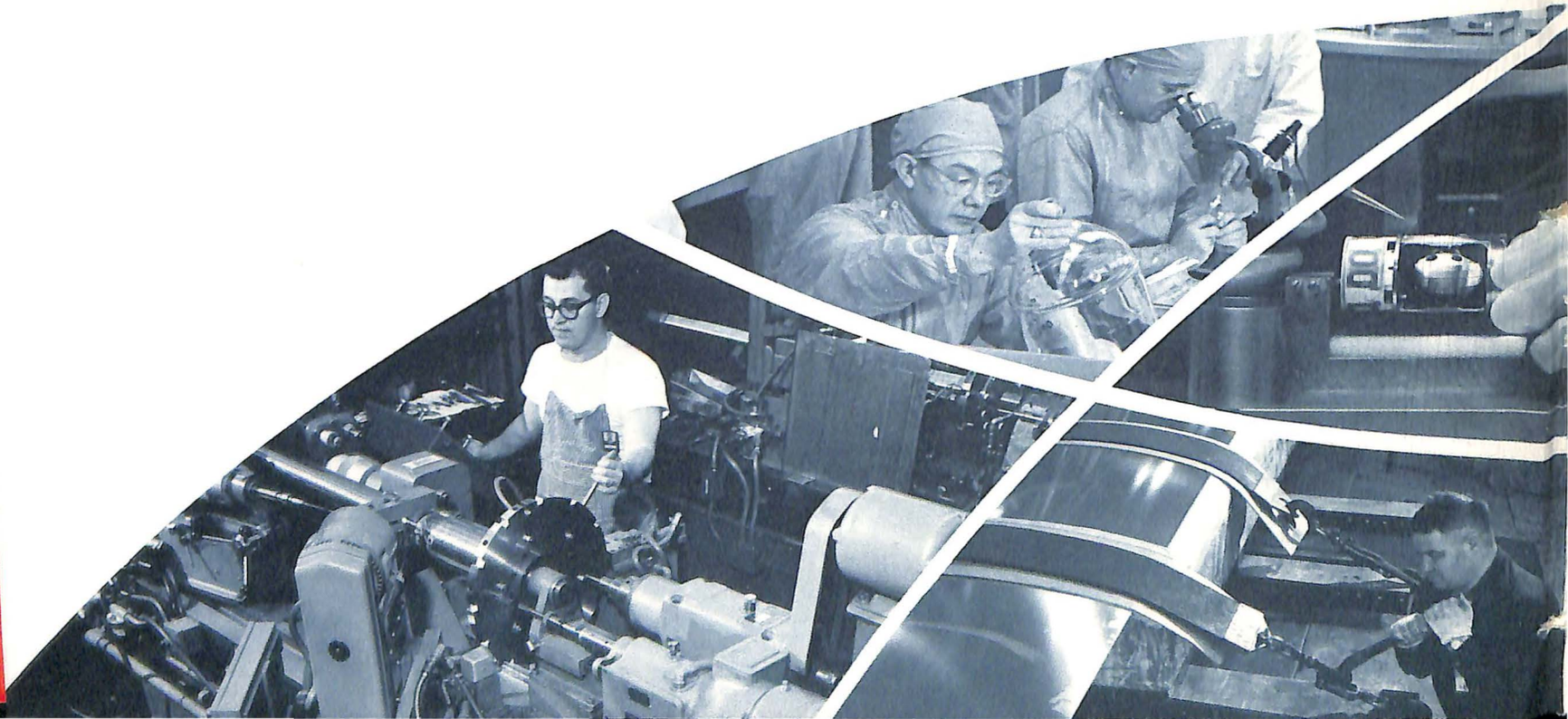
TECHNOLOGICAL PROGRESS

Twenty years ago, while the world was still engaged in the bitterest and most widespread war in history, delegates of 54 nations met in Chicago to found the International Civil Aviation Organization. ICAO was created because of a need recognized by national leaders throughout the world. Its high purpose was exemplified by the simple yet articulate words of President Franklin D. Roosevelt:

> *"With full recognition of the sovereignty and juridical equality of all nations, let us work together so that the air may be used by humanity to serve humanity."*

Today, this exhortation has been eloquently answered. The record of progress and achievement of international aviation during the ensuing 20 years borders on the incredible. A new dimension has been added to world commerce. New concepts in transportation and communication have been born. An almost entirely new industry has been created, adding an increment to the economy of the world and the economic growth of nations. Moreover, all peoples of the world have felt the influence and have benefited from the rapid expansion in international civil aviation.

Thus, it is particularly apropos that the Nation, this



an International Asset

December, salutes international civil aviation for the great contributions it has made to improved understanding between nations and the expansion of world trade. We honor the accomplishments of ICAO on its 20th anniversary, as well as acknowledge the contributions of international air carriers, designers and builders upon which this record of achievement has been based.

The exigencies of World War II provided the impetus for the beginnings of international air transportation as we know it today. The routes flown were those pioneered by the military and the aircraft were military surplus. During the years that followed, a series of continuously improved reciprocal-engine aircraft were designed, produced and delivered to the airlines of the world. More speed, more range, more payload, more reliability, more safety, more comfort and better maintainability were achieved in each new model. Greater profitability attained by the airlines was translated into reduced fares for the public.

But, by far the most dramatic advance was the evolution of the jet transport. The emergence of the commercial jet aircraft revolutionized the transportation habits of the world. Here we see a classic example

of technological progress being used to accelerate global economic growth.

Between 1958 and 1963, the Gross National Product of the United States increased by 31.4 percent, influenced to a significant degree by the 51.6 percent increase in expenditures for air transportation during the same period. This increase was reflected, in turn, in the level of activities of other nations operating in the international air transport field. With the single exception of 1960, every year since the introduction of the jet transport has seen an additional million passengers traveling on the world's airlines. In 1963, more than 7,500,000 passengers were carried by commercial airlines in international travel alone, compared to 500,000 in 1945.

In 1948, the U. S. airlines carried 83.1 percent of all air passengers traveling to and from the United States across the North Atlantic. By 1963, this trend had shifted, with foreign airlines now carrying the majority of these passengers — 58.5 percent. The equipment used throughout the world — the great preponderance of which were of American design and manufacture — had proven its profitability and usefulness and was now welcomed by all nations as a direct

GROSS NATIONAL PRODUCT AND U.S. EXPENDITURES FOR TRANSPORTATION

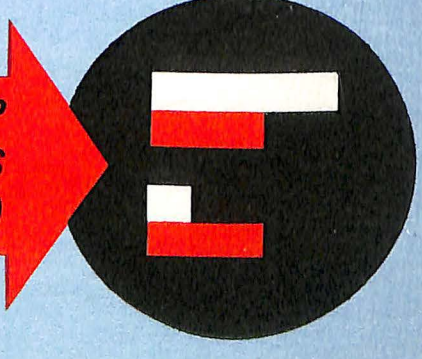
RELATIVE MAGNITUDES OF USE OF AIR AND WATER FOR PASSENGER AND FREIGHT TRANSPORTATION, AS MEASURED BY EXPENDITURES, EXCLUDING GOVERNMENT FREIGHT

	1958	1963	% INCREASE (1963 OVER 1958)
AIR TRANSPORTATION (In Millions)			
TOTAL AIR TRANSPORTATION			
PASSENGER-PRIVATE			
PASSENGER-AIRLINES			
FREIGHT			

WATER TRANSPORTATION (In Millions)			
TOTAL WATER TRANSPORTATION			
PASSENGER			
FREIGHT			

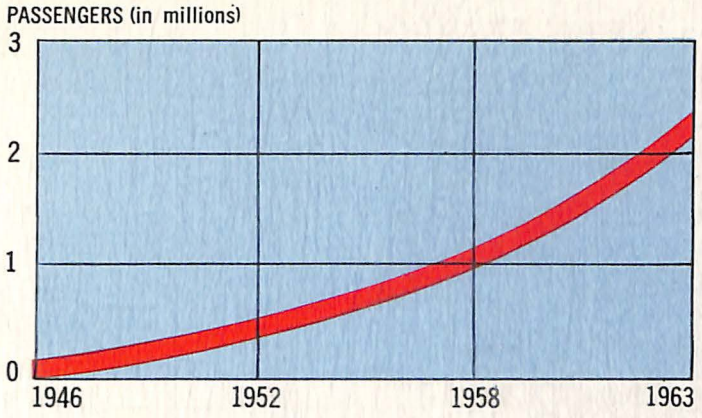
GROSS NATIONAL PRODUCT (In Billions)			

AIR TRANSPORTATION IS GROWING FASTER THAN GNP (51.6% vs 31.4%) WHILE WATER TRANSPORTATION IS NOT GROWING AS RAPIDLY AS GNP (12.4% vs 31.4%)

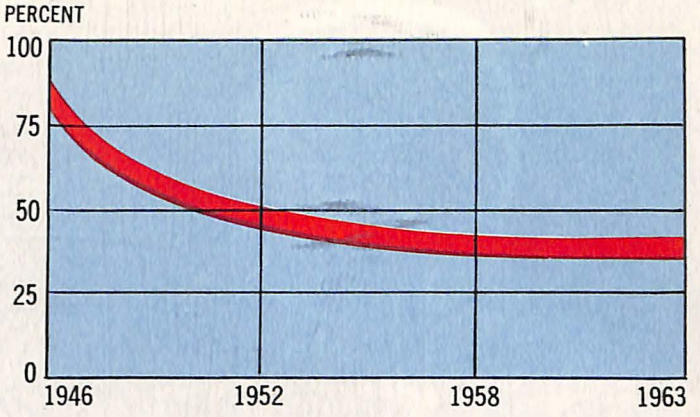


ESTIMATES COMPILED BY TRANSPORTATION ASSOCIATION OF AMERICA

NORTH ATLANTIC AIR TRAFFIC TO AND FROM THE U. S.
(U. S. AND FOREIGN CARRIERS)



PERCENTAGE OF PASSENGERS CARRIED BY U. S. FLAG AIRLINES



contribution to the expansion of the gross national product of each country.

More important, perhaps, is the fact that this expansion in air transportation and this new increment to world economy was not made at the expense of other transportation forms. More people crossed the Atlantic by ship in 1963 than in 1952; but more than three times as many people traveled by air across the Atlantic than by ship in 1963. A new medium of transportation was created which supplemented the old, attracted new customers and created new markets, added to the economic health of the world and gave birth to new job opportunities both in the United States and abroad.

In large measure, the success of this new mode of travel was brought about by the advances in aerospace technology, not because of requirements generated by the airlines. In fact, there was some resistance to the introduction of the jet airliner. However, the jet's speed and comfort had immediate passenger appeal which, alone, guaranteed expansion of the air travel market. Moreover, the jet transport was found to be the best revenue-producing aircraft that the airlines had ever received from manufacturers.

Developed and made operable in the span of only ten years, the commercial jet is a unique manifestation of the 20th Century's emphasis on research and development. R&D, stimulated in the early 1950's by larger expenditures and tied more closely to international needs, has succeeded in vastly compressing development cycles. Thus, the historical time requirement of a score of years, or more, to transform an innovation into practical use was halved in the case of the jet transport.

The visible and dramatic jet transport is, however, only one of the obvious products of our technological maturity. Others abound: weather and communications satellites; improved, yet less expensive, radios and television sets; new cooking ware; and a complete new family of medical achievements, to name a few. Perhaps more important, although less visible, are the by-products of this massive effort. New materials, new techniques of design and manufacture, new and more efficient tools are being evolved and woven into the world's industrial fabric. As we enter the second generation of increased research and development investment, we can look with confidence to an acceleration in the rate at which this vast technological storehouse is translated into identifiable benefits to all the peoples of the world.

As we salute the progress achieved in international civil aviation, perhaps the most encouraging feature is the clear promise of even greater strides yet to come in the next two decades. As today's young people, who accept the airplane as the most efficient and convenient way to travel, reach maturity, the market will widen its sphere of influence. As awareness of the benefits and economies attainable by air freight increase, and, as new equipment, designed or adapted for cargo movement is introduced, a tremendous upsurge in this market is in prospect. Use of the utility aircraft and the helicopter is constantly increasing and, as our technology improves, the rate of increase, too, will accelerate.

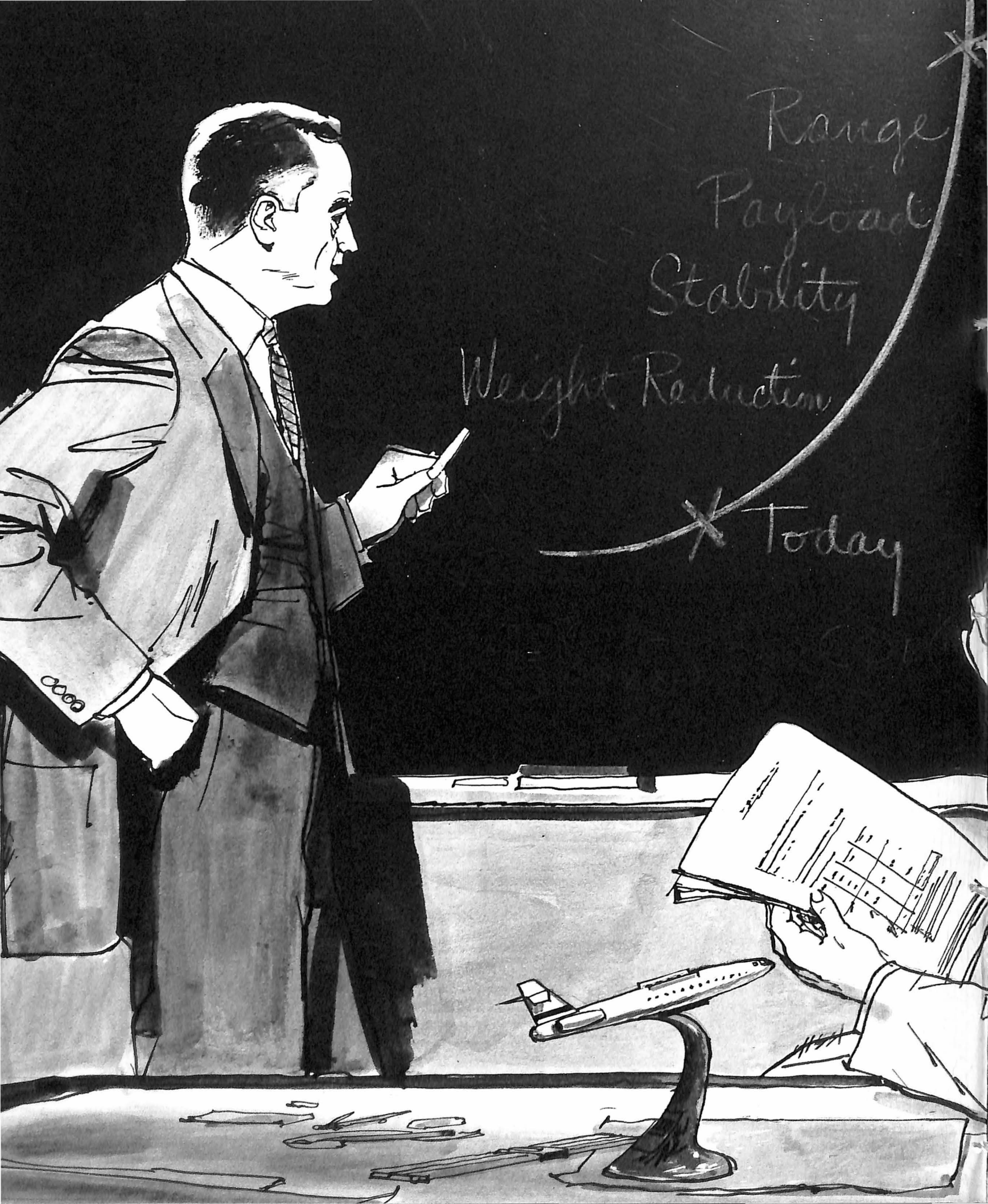
These are not the mere wishes of the over-optimistic. These are the reasoned judgments of realists, willing to invest their own funds to back such judgments. They see a future of almost limitless possibilities.

History, to date, has been primarily a record of man's struggle to live, his effort to wrest from the earth the nourishment, raiment and shelter to sustain life. The nature of his struggle is changing.

For most of the period of that struggle, only a few of his numbers could be spared from the production job in order to govern, to teach, to study, to practice the arts and to perform services for all. Today, our technical wealth allows the production of life's essentials by the few, leaving time for the many to grow, to expand, to seek answers to new and challenging ideas.

Truly, this is revolution. It is the significant phenomenon of the 20th Century. The achievements of our time, however, are like a double-edged sword. The greatness of our miracles must never be allowed to overshadow their accompanying responsibilities. They must be placed in the proper perspective to allow man, now, to attack the ills of ignorance, disease, poverty and war which have so long plagued him.

It is a challenge to every man's worth.


Range
Payload
Stability
Weight Reduction
Today

AEROSPACE TECHNOLOGY

Stimulus to Progress

The world today is in a state of rapid technological change with a faster pace and more rapid changes certain in the future.

Technology and changes in technology are the most important factors stimulating national and international economies. Technology is as important as language, the arts and the sciences in molding our civilization and culture. It is universally accepted that the hope for a better life for all peoples, in both the advanced and underdeveloped nations, rests in mastering the technological revolution and using its powers to satisfy the material needs of a rapidly expanding population.

Once beyond these basic truisms it becomes increasingly difficult to obtain agreement. Many plans are being advanced for properly harnessing modern technology; however, there is no wide agreement on government and business policies to induce maximum growth in this area. The technological revolution is so complex and broad, and has progressed so rapidly that most scientists and engineers, not to mention laymen, cannot fully absorb what is taking place. The future is still uncertain and there is no way to predict which of the scientific disciplines will be most important during the next few decades.

However, despite its complexity, the revolution is old enough and its history understood well enough to permit a limited assessment to be made about both the past and the future. One fact is the key role aviation has played in the technological gains to date. Indeed, it may well be argued that aviation has played the critical role. To those familiar with the technical achievements of the past few years there is no doubt

Transport aircraft speed, range and load capacity have increased vastly. A jet transport today can do the work of approximately 60 piston transport aircraft of the middle 1930's.

that aviation is on the threshold of its brightest era. But, to the casual observer not directly concerned with the industry, it undoubtedly seems that aviation has been by-passed and spaceflight has become the only technical frontier. This opinion is reinforced by the fact that aviation also has lost its monopoly on many strategic military missions. The activity of the aerospace industry reflects this since a large part of its efforts are devoted to missiles and spacecraft and the business of developing new aircraft is not as brisk as in the past.

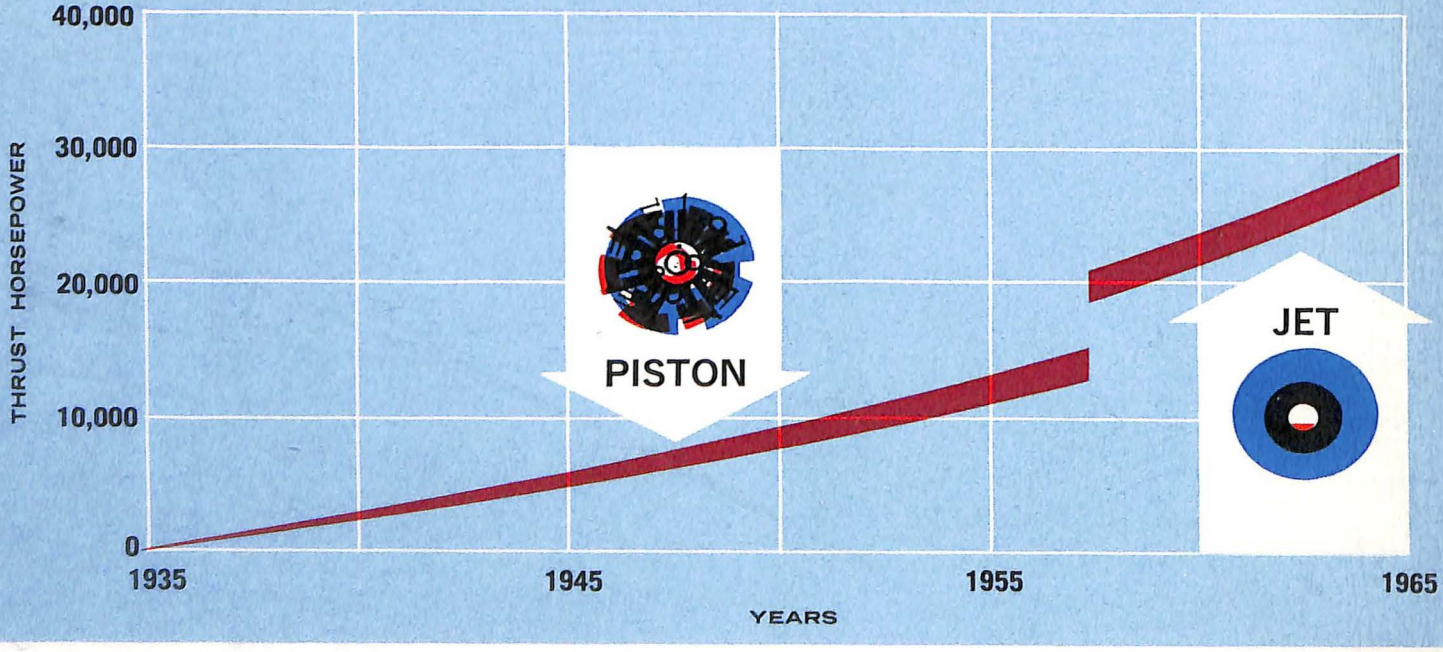
Yet the long-range outlook for aircraft definitely is upward, toward vastly increased activity. The foundations of a new era of progress in aircraft performance have been laid by the research programs of the past few years. This era probably will overshadow anything of the past. Technical advances are at hand which will lower the cost of air transportation more than the switch from wooden to aluminum construction and even more than the advance from piston to jet engines, the most revolutionary gain to date.

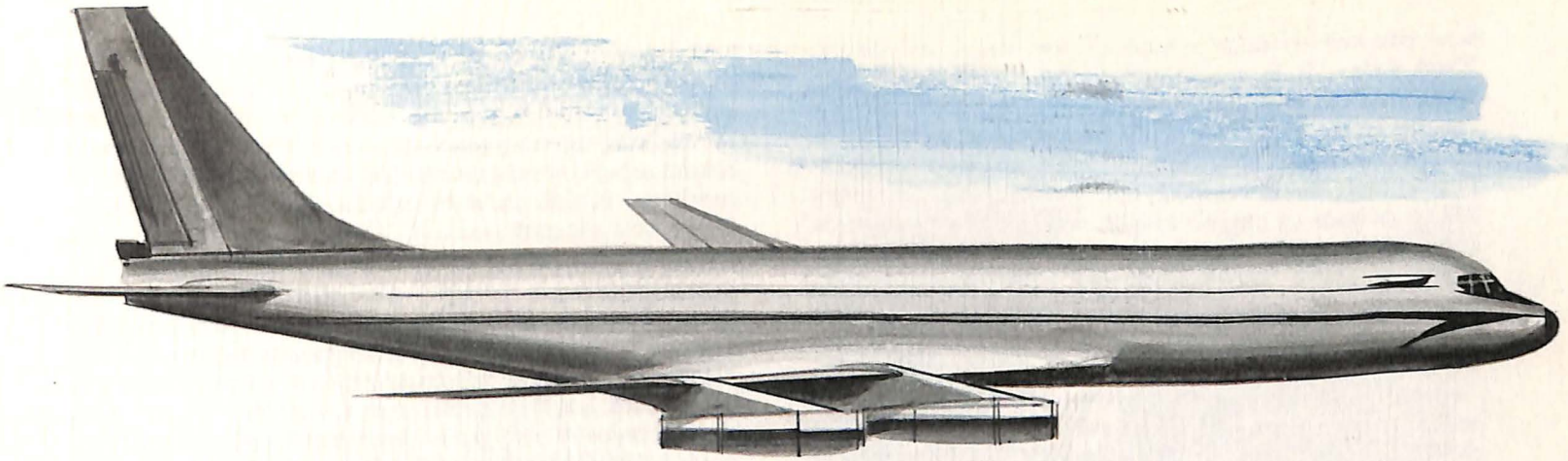
Enough is known of the potential of the new aeronautical technology to predict that all types of aviation — military, airline, and general aviation — will be completely transformed in the next two decades. The day of the manned military airplane is far from over. Today's civil jet transports, which enjoy a high reputation, are far from the ultimate in economical flying machines. The usefulness of all types of aircraft will be vastly improved, and they will be much cheaper to operate in the future.

Perhaps even more important will be the wide-

POWERPLANT PROGRESS

Cruise horsepower of transport aircraft has increased by a factor of 20 during the last 30 years. In comparison with other major transport vehicles, the thrust horsepower of a modern airliner at cruise is 150 percent of a modern cargo ship and 10 times that of a fast passenger train.





spread benefits of the new aeronautical technology outside of aviation. In the past, aeronautical technology, which has provided major advances in high performance engines, efficient air flow design, lightweight structures and material, and high reliability, was put to wide use after it was proven in aviation. Some examples are: high tolerance, long life, lightweight bearings for piston engines; improved lubricants; lightweight electrical systems; highly efficient servo mechanisms; the use of aluminum in truck bodies, auto engines and boats to cut weight and increase payloads; reliable, lightweight 3-point suspension system design for auto, tractor and truck use; and, of great importance, the methods for manufacturing these advances. This pattern of transfer of aeronautical technology will not change. In fact, the opportunity should be greater in the future because the jump in efficiency now considered possible for aircraft structure and powerplant technology is greater than anything yet experienced.

In virtually every respect space technology will complement aeronautical technology. Even though the configurations and operating environments are vastly different, aircraft and space vehicles draw essentially on the same store of technical information, and are concerned with the same primary problems: structure, guidance and propulsion. Advances in space are often of immediate value in aeronautics and vice versa. Consequently, instead of space and missile technology replacing aeronautical work as the technical frontier, they complement and strengthen each other.

Aerospace progress during the next two decades will involve large and complex development projects. Consequently, it will add to a vital national resource pioneered by the aerospace industry in the development of airplanes. This resource matured in the crash programs which produced the nation's intercontinental missiles, and it is being raised to new heights in the Apollo program which will land astronauts on the Moon. This vital resource is the ability to manage very large, extremely complicated programs which involve many engineering skills, many manufacturing processes, many bodies of knowledge, large expenditures, and the coordination of thousands of design, manufacturing and testing tasks on a tight schedule. This new management skill is as important as technology itself, for most of man's pressing problems are very large and the only hope of solving them is through massive efforts.

It will take a thoroughly researched history of the technological revolution to record comprehensively the role of aviation in stimulating progress. Until such a monumental work is completed, the best means of judging aviation's influence is to consider that lightness and high performance are technical virtues in the vast majority of industries.

All engineers are seeking new materials, new design techniques and new understanding of physical phenomena at extremes of temperature, pressure and deformation, which will allow them to produce lighter structures. All industries are interested in running powerplants at higher temperatures and in obtaining higher efficiencies from all energy-conversion equipment from batteries to piston engines. Industry is interested in the manner in which machines and structures vibrate. Industry is interested in devices, techniques and theories to improve automatic systems for controlling complex processes.

Such knowledge is the raw material from which today's industrial profits have been forged, and it is critical to success tomorrow for any business involving technology. The overall importance of the aerospace industry rests heavily on the fact that it has led and continues to pioneer in all of these fields — originally with aircraft and now with the development of spacecraft, missiles and aircraft.

The first great success in producing lightweight equipment must be credited to the Wright Brothers. They were far from the first experimenters with gliding flight and lightweight structures and powerplants intended for powered flight. However, despite the fact that they did not have a formal technical education, they attacked the problem of airplane construction in a highly professional and thorough manner. Their management methods of exhaustive component testing, and properly isolating problems for individual analysis were far ahead of their time and probably better than the aircraft they produced.

The Wrights' technical accomplishments included the operation of a small wind tunnel which was unusually accurate for its day. They originated a system for effective control in banking an airplane by wing "warping," the forerunner of ailerons. Their first airplane had a structure made of spruce wood trusses and

was stressed to take a load of five times its weight. Even today, it is considered to be the lightest which could be built with the construction materials of the day for the loads which normally would be imposed on it.

The Wrights also rated high on their gasoline powerplant. It developed one horsepower for every fifteen pounds of engine weight, well under any internal combustion engine available. This performance compared to about 250 pounds per horsepower for stationary steam engines and more than 50 pounds per horsepower for the best naval torpedo boat steam engines in 1900.

Aviation technology has grown rapidly and experienced at least four periods of substantial advance. The eleven years between the Wrights' first flight and World War I was a period of great experimentation. Many wing shapes, wing-fuselage arrangements, control systems and powerplants were tried. Performance increased significantly but the airplane was still marginal as a transportation vehicle. It was 1909 before the first man flew a distance of 100 miles and 1912 before a speed of 100 mph was exceeded. Frenchmen accomplished both feats.

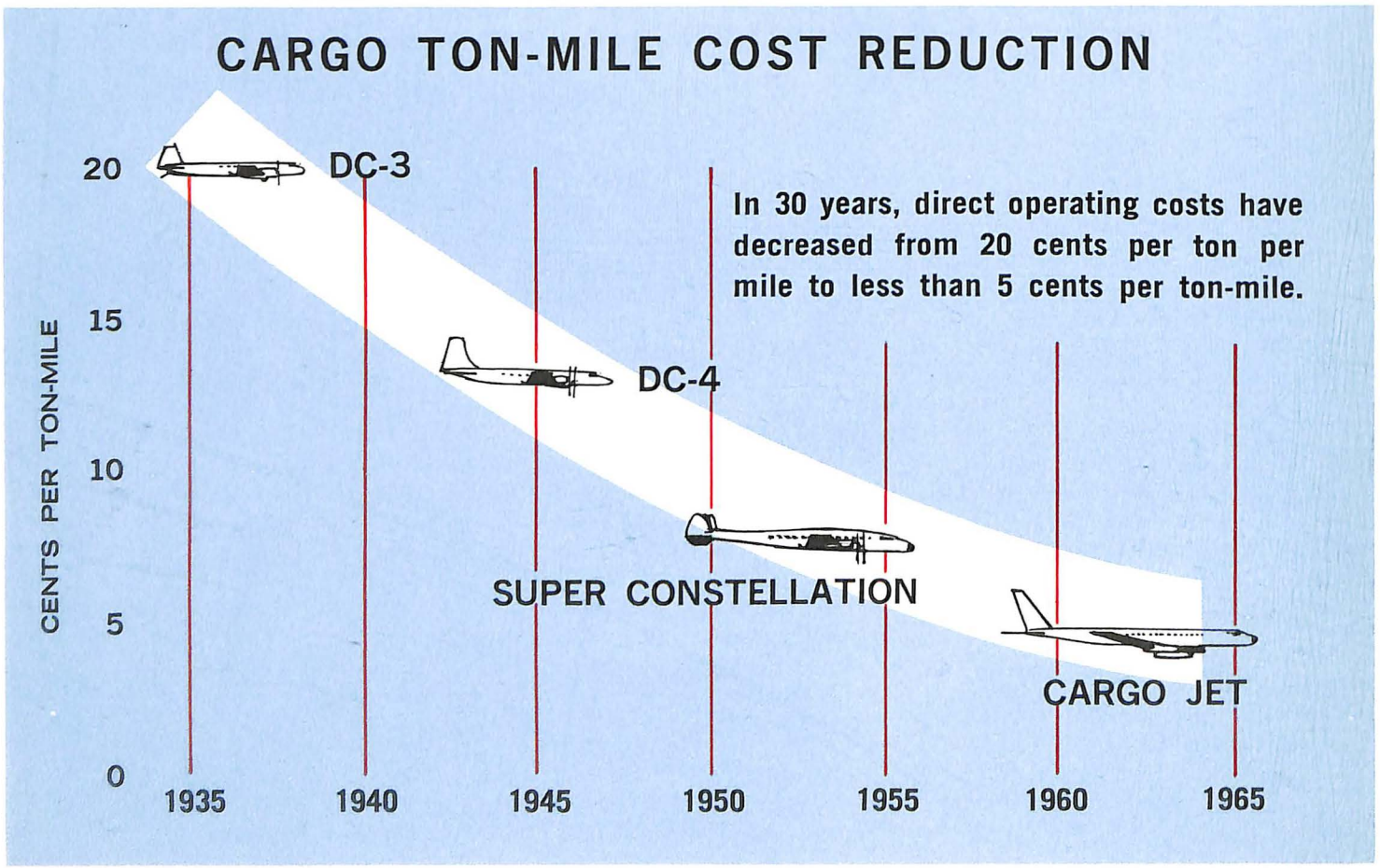
During World War I, the rate of investment in aeronautical research and development increased sharply after it became clear that aircraft had great potential. A reservoir of new lightweight technology was acquired and put to use in the 1920's, making that decade a period of rapid development.

Two advances were of special importance. One was the development of a tubing made of a high-strength steel alloy which could be welded reliably. This steel tubing was several times stronger than spruce wood on an equal weight basis. It allowed the weight of fuselages to be reduced substantially without sacrificing any strength.

The second major advance was in powerplants. The use of new high-strength steel alloys, aluminum and magnesium, increasing the number of cylinders, improving bearing design, adding superchargers and other developments led to a truly phenomenal growth in aircraft engine performance. It had been only slightly over twenty years since the Wrights' 12 horsepower, 180-lb. engine had been considered the best, but the better engines of the 1920's produced more than 500 hp each and weighed well under three pounds per horsepower.

The new powerplants and lighter structure presented unparalleled opportunities for increasing the speed and size of aircraft. Considerable success was achieved in reducing drag and making other aerodynamic refinements to take advantage of these opportunities. Tri-motor transports were built which weighed about 15,000 pounds and could carry 10 passengers more than 750 miles at 110 mph non-stop. The official speed record of fighter/racer aircraft was pushed to nearly 300 mph.

The middle 1930's was another period of great



improvement and it was built on research conducted during the 1920's. Engine output was increased to more than 1,000 hp and it was possible for a twin-engined transport to have more power than a tri-motor only five years older. Some improvement was made again in increasing the horsepower-weight ratio but it was beginning to near a practical limit.

Structures and aerodynamics were the advancing fields. In aerodynamics, it was shown that the low wing monoplane was the best low drag configuration. Retractable landing gear, efficient engine nacelles, and flush head rivets were among the low drag contributions along with efficient fillet designs to smooth the air flow around the wing-fuselage juncture.

Structurally, lightweight semi-monocoque construction was brought to an acceptable state for operational aircraft after more than ten years of research. Semi-monocoque design does away with trusses and carries the loads in the sheet metal skin and the slender stringers, frames and spars that stiffen the skin.

Using this new technology, the maximum speed record reached 300 mph in 1933 and 400 mph in 1939. The altitude record passed 50,000 feet in 1937 and the non-stop long-distance flight record exceeded 8000 miles in 1939. A memorable transport, the Douglas DC-3, began its long operational career in 1936 with better performance than most bombers then in service. It weighed 25,000 pounds, and carried 21 passengers over a 2,000-mile range at about 180 mph.

During the middle 1930's, another aircraft development program with major implications was being carried out by the aerospace industry. This limited program developed the first successful technology for large modern aircraft. It provided the basis for the later design of such aircraft as the Boeing B-17 and B-29 bombers, the Convair B-36 bomber, the Douglas C-54 transport and the Boeing Clipper 314 trans-atlantic flying boat.

Two large, four-engined experimental aircraft were built. One, the Boeing B-15 weighed 75,000 pounds; the other, the Douglas B-19 flew at 165,000 pounds. By comparison, the operational bombers of the day were twin-engined and weighed less than 25,000 pounds. A great deal of new technology had to be perfected in the development of these aircraft, including the manufacture of 96-inch diameter wheels, and the design of the first hydraulic boost system for the controls, because the pilot no longer had the strength to move them unassisted.

New engines producing around 1,350 hp each were one of the keys to success in large aircraft technology. Once available, these engines were put to use in the four-engined Douglas DC-4, Lockheed Constellation and Boeing 307 Stratoliner as well as World War II bombers and fighters. These transports were about twice the size of the twin-engined transports of the period, weighing around 50,000 pounds and with the ability to carry more than 30 passengers non-stop coast-to-coast.

Paralleling these advances in structures and engines are the major contributions to aviation progress made by component designers and manufacturers. These vital components include: communications equipment,

radar sets, flight instruments, electrical, hydraulic and pneumatic systems, engine superchargers, propellers, cabin pressurization and air-conditioning units, and landing gear.

World War II brought the most revolutionary technical advance to date in aviation — the gas turbine engine. Initial reaction to this new type of powerplant was not universally good. At take-off it had about the same thrust-to-weight ratio as the best piston engine propeller unit, and delivered around 1.5 pounds of thrust for each pound of engine weight. At high speed the turbojet gave much better performance than the piston engine, but initially it had mechanical problems, a relatively short life between overhauls and consumed fuel at a discouragingly high rate.

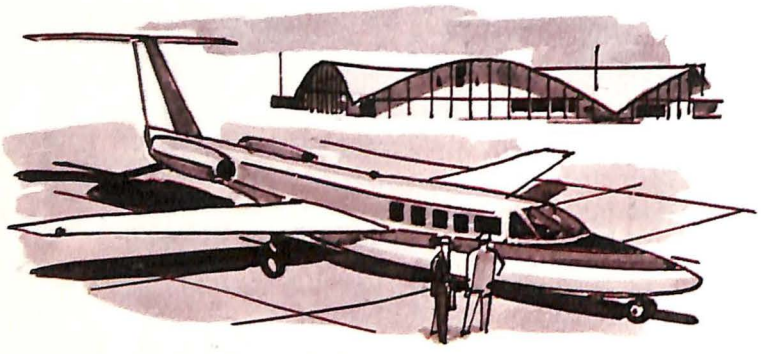
Piston engines were at their zenith in the late 1940's. Their power had been boosted to more than 3,500 hp in a single engine. Their fuel consumption was at an all time low and overhaul life was high. They were put to use in a new generation of transports which were outgrowths of the Douglas, Lockheed and Boeing transports of the early 1940's. Some of them weighed 120,000 pounds and could carry 50 passengers for more than 5,000 miles. On shorter hauls they could carry around 100 passengers.

The day of the piston engine on large first-line aircraft was nearly over, however. Jet engine performance was improved much more rapidly than anyone predicted. During the late 1940's and early 1950's large numbers of jet-powered fighters and bombers were operated by the military. This experience formed the

basis for the design of the first U. S. jet transports which found rapid acceptance by the airlines.

New engine generations have been produced which have significantly better thrust-to-weight ratios than those of the late forties. Their high power and light weight have allowed the size of aircraft to be pushed upward again. Some of the largest jet transports weigh well over 300,000 pounds and can carry more than 150 passengers over transcontinental and trans-atlantic ranges.

The performance and reliability which has been demonstrated by all types of jet aircraft today would have been considered strictly wishful thinking only ten years ago. The time between overhauls of some airline gas turbine engines today is about 6,000 hours. This means that the engines remain on the transport for nearly two years between overhauls and operating costs are lowered significantly. The reliability record of these jet engines, as measured by inflight malfunctions, is more than three times better than any piston



powerplant. In terms of their ability to do a job, the modern turbojet airliner is the equal of 60 typical transports of 1938 vintage, as measured in passenger miles carried in a year.

All branches of aviation have shared in the benefits of progress. The growth of the active general aviation fleet from about 61,000 aircraft in 1950 to nearly 90,000 in 1964 is but one indication of the increasing effectiveness of single-engine and twin-engine lightplanes as rapid, versatile transportation for business and pleasure. Traditionally, general aviation aircraft and engine manufacturers have given their top engineering priority to keeping costs low, so that their products will have the widest possible market. Often considerable time and effort have been required to bring the cost of new technology and increased performance down to a level acceptable in general aviation.

During the past few years much progress has been made in lowering costs. The first twin-jet, executive aircraft now are beginning to enter service. These 500-mph-class airplanes have been sold in encouraging numbers. Small turboprop-powered aircraft capable of speeds around 300 mph now are making a strong bid in the market.

Piston engine performance is being steadily improved through the addition of superchargers for better altitude performance and fuel injection systems for lower fuel consumption. The piston engine still enjoys the advantage of a much lower sales price than the gas turbine engine in the small sizes needed for general aviation.

Most manufacturers have developed low-cost systems for reliably pressurizing small aircraft so that the single-engine piston-driven lightplanes can cruise in the neighborhood of 20,000 feet and achieve a major increase in speed and range performance.

One type of aircraft did not even become practical until 1939 when the modern technological revolution had gained much momentum. This is the vertical take-off and landing aircraft of which the helicopter was the first.

The first successful helicopter flew in 1939 and it was barely able to lift its pilot. Today the Army operates "crane" helicopters which weigh 38,000 pounds when carrying a useful load of more than 20,000 pounds. Transport helicopters in airline service carry 28 passengers and can fly at speeds of 200 mph.

A wide variety of vertical take-off and landing (VTOL) airplanes have been successfully tested. These vehicles have very high cruise speeds and use a variety of schemes, other than the helicopter rotor, to fly vertically for a few moments during take-off and landing. These VTOL aircraft designs include the use of jet engines that turn their exhausts toward the ground, and tilting propellers that turn their slipstreams toward the ground to gain a vertical lift force.

Basically, all types of aircraft have reached their current high level of performance because of lightweight technology. This heavy dependence raises some questions about the future of aviation. Can lightweight technology continue to progress in revolutionary fashion? Can aircraft performance be pushed significantly higher than it is today so that aviation will not reach a plateau in economic attractiveness?

The answer to both of these questions is an unqualified "Yes." All current information indicates that we can look forward to the biggest steps yet taken in the development of lightweight, high-strength structures, and in lightweight, high-power engines.

A number of promising composite materials now are being studied heavily in research programs. These "composites" consist of a base material reinforced with tiny whiskers of high-strength materials to achieve the same effect as reinforcing concrete with steel rods. Some of the "composites" show promise of being more than twice as strong as aluminum on a strength-to-weight basis.

New engines also are in the research stage. Some of them will have more than twice the thrust-to-weight ratio of today's best gas turbines. It is widely predicted that a second generation of engines will be three times better than today's models.

Optimism in the aviation technical community is traditionally high; it has never been higher than today. The opportunities in new structures and engines are far greater than any of the past. If they work out on operational aircraft as well as now predicted, aviation will rise to a completely new prominence in the national and international economies. This progress, as in the past, will stimulate the entire spectrum of technology.

MILITARY EXPORTS

MOTIVATION, MEN AND MONEY

BY HENRY J. KUSS, JR.
Deputy Assistant Secretary of Defense (ISA)
for International Logistics Negotiations

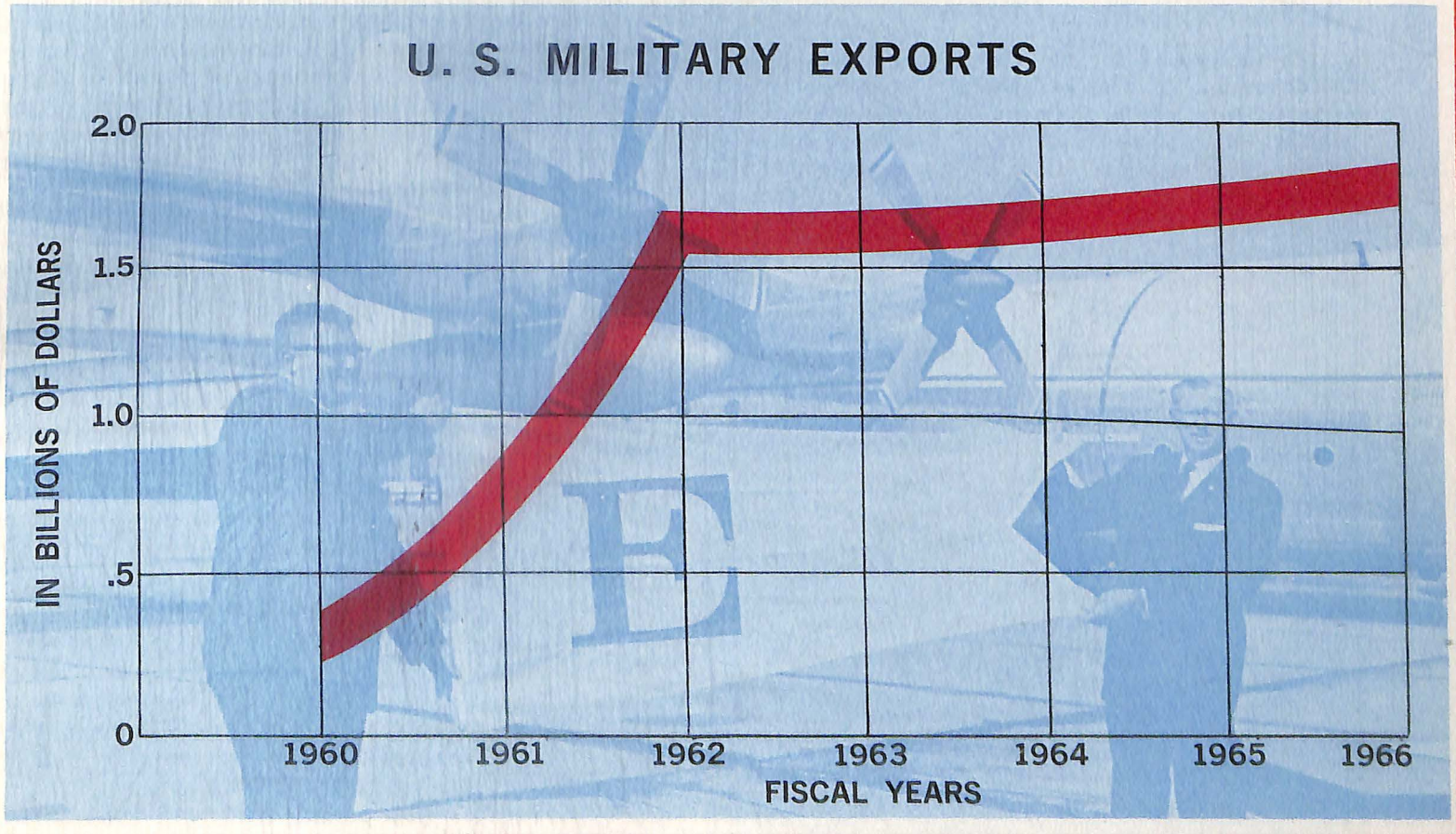
The growth of U.S. military exports is illustrated in the chart below. Has your company participated in this record?

From November 1962 to November 1964 an estimated $3 billion in orders were received by the U.S. Government or U.S. industries from over 35 nations around the world.

About $1.5 billion of these orders are directly identifiable with the aerospace industries — missiles, aircraft, and related systems.

If your company has not participated at all, or fully, in this growth there are many questions that you need to ask yourself. Three of the most important questions are dealt with in this article:

- Do you have the proper motivation for the international market?



SHORT TERM SALES GOALS
(IN MILLIONS — BY FISCAL YEARS)

REGIONS	ACTUAL SALES			POTENTIAL SALES			TOTAL POTENTIAL
	1962	1963	1964	1965	1966	1967	1965 - 67
EUROPE	$1405.8	$1342.8	$1088.2	$1453.6	$1297.0	$1274.1	$4024.7
NEAR EAST, SOUTHEAST ASIA, AFRICA	5.3	75.4	61.9	263.5	154.5	159.5	577.5
FAR EAST	104.5	104.9	262.1	138.1	171.6	170.6	480.3
WESTERN HEMISPHERE (includes Canada)	57.6	53.7	115.0	76.5	164.7	113.0	354.2
	$1573.2	$1576.8	$1527.2	$1931.7	$1787.8	$1717.2	$5436.7

TABLE I

■ Do you have the men with the initiative, intelligence and judgment necessary for the international market?

■ Where is the money coming from to finance production for the international market?

MOTIVATION

The motivation for the international market must be strong and of high purpose if a company expects to participate fully in the potential of the international market. It must be strong because before success is achieved a tremendous effort will be required to learn new languages, new methods of doing business which are as different as the languages, and adapt to a wide range of in-country and regional competition which makes present American competition mild by comparison.

It must be of high purpose because the products are intended for governments allied with the United States — often fighting with U.S. forces — and not for commercial markets. The company which has approached the international market with solely a commercial point of view has fared poorly by comparison with the company that approaches the international market as a member of the defense team.

The Department of Defense has these three objectives for its Military Export Program:

■ *To promote the defensive strength of our Allies consistent with our own political-economic objectives.*

The importance of this objective is illustrated by the fact that in the 10-year period 1952-1961 Congress and the Executive Branch approved the expenditure of over $17 billion in foreign assistance to promote the defensive strength of our Allies. While the financial capability of many of our Allies has made it unnecessary for the Congress and the Executive Branch to continue appropriating for the payment of exports to these Allies, the objective of promoting their defensive strength, through exports, remains.

■ *Promote the concept of cooperative logistics and standardization with our Allies.*

Experience in Europe in the last three years indicates that the potential for standardization has increased several hundred times with the increased industrial participation of U.S. and foreign companies in design and production of military equipment. Because of this participation, aircraft, missile systems, and support equipment are more common to the United States and European logistics systems than ever before.

■ *Offset the unfavorable balance of payments resulting from U.S. military deployments abroad.*

The overseas expenditures of U.S. forces in the last few years constituted a drain on our international balance of payments in an amount approximately equal to the deficiency. One of the major actions taken by this Administration to offset this deficiency was the promotion of military exports consistent with our political and economic objectives to meet the defense objectives of our Allies. Last year export receipts rose to 41 percent of our defense expenditures abroad and brought the net adverse effect of U.S. Department of Defense expenditures down to $1.7 billion from a high of $3 billion in 1961.

Perhaps a company has sufficient reasons for motivation to have high purpose, but the Comptroller's point of view must be considered. This is a point of view which states that the strength of motivation is proportionate to the market potential. Therefore, what is the market potential? This market potential can be expressed in short, medium and long term ways.

■ During the 3-year period, fiscal years 1965-66-67, a specific item market survey indicated a potential

of over $5 billion of military exports. Table I indicates the short term picture both in terms of actual sales for fiscal years 62-63-64 as well as the potential market for fiscal years 65-66-67.

■ During the 10-year period, FY 62-71, those nations of the world allied with the U.S. and capable of financing their own military equipment will expend over $50 billion for military equipment. This is shown in Table II. Some $10 to $15 billion of this requirement exists as a potential export market for American military production.

■ Military research projects in the United States are providing billions of potential sales dollars in military exports. The Honorable Eugene G. Fubini, Assistant Secretary of Defense for Research and Engineering, recently stated that research and development of today would lead to the export production of tomorrow. In the 1965 budget alone he noted that $3 to $4 billion is allocated for research on potentially exportable equipments. In comparison to our $3 to $4 billion, the United Kingdom has a $400 million budget; France, $175 million; and Germany, $180 million. Of 21 research programs that Dr. Fubini gave a "good probability" rating on breakthrough, thirteen were easily identifiable as products of the aerospace industry.

Thus, from any point of view you wish to take — short, medium, long range, company or Defense Department objectives — the basis for motivation of great strength and high purpose exists. It only remains for a company to realize these objectives with the necessary men and funds.

MEN

The requirement for outstanding men is paramount in the international military aviation and export field. Within our own shores we have managed to reduce a great proportion of the military materiel decision-making process to mathematical accuracy.

In the military export field we are dealing, first, with only a marginal portion of the countries' total effort; second, with a portion which is in competition with the countries' own internal political problems; and, third, with a portion that is in competition with other major industrial nations of the world.

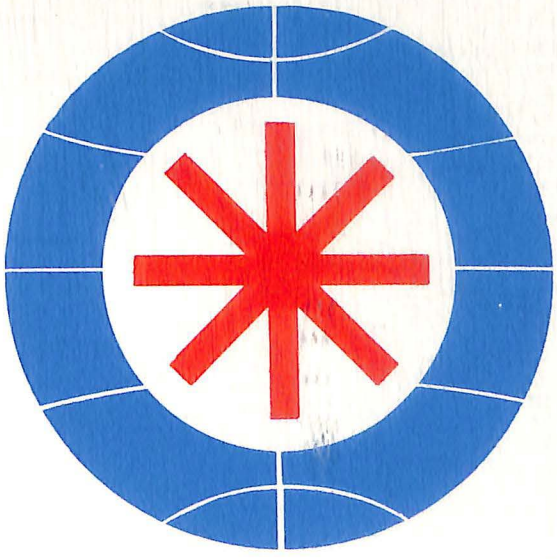
The only machine available to integrate all of the international information on military markets, strategy, politics, tactical doctrine, all in a dynamic state, is a most capable and rounded man. The most important capability in the military export program is a man with a very high "I^3" rating.

■ First "I" is for initiative, self-starting ability, and enthusiasm.

■ Second "I" is for intelligence. Enthusiasm is worth little without the ability to collect and analyze information. Current intelligence, and analysis of that intelligence, is essential in the export market.

■ Third "I" is for insight or intuition. It is insight into problems which is the essential ingredient in making the necessary judgments. This is the most essential element of success in the international military market — the one without which you cannot succeed even if you have a better mousetrap and a reasonable amount of money.

TABLE II



EXPENDITURE FORECAST
(IN MILLIONS)

Based on Fiscal Year projections of specific item forecasts and analyses of expenditures this $10 to $15 billion potential may be found largely as follows:

	FY 62-71 Forecast	
	Minimum	Potential
EUROPE	$ 7,000	$10,000
FAR EAST	1,000	1,500
WESTERN HEMISPHERE (Includes Canada)	500	1,000
NEAR EAST, SOUTHEAST ASIA, AFRICA	500	1,000
OTHER COMMERCIAL (Not identifiable by region)	1,000	1,500
	$10,000	$15,000

Mr. Sullivan

Mr. Dunlap

Mr. Alne

Mr. Gownley

At this point I will note those men in Government and in industry who are prepared to advise you as they are advising me. They all have a high "I³" rating.

In Government, the entire international military picture is under the coordination of eight leaders. Five are in my immediate office and one in each military department. They are:

- James D. Dunlap. As my Deputy he runs our Pentagon office as often as I do, since travel is a necessity to maintain a high "I³" rating in this business.
- Leonard A. Alne. As Director of our Red Negotiating Team he is responsible for international logistics negotiations in Japan, Canada, Taiwan, Sweden, Denmark, Norway, Thailand, Burma, Australia, Malaysia, South Africa, France, New Zealand and NATO.
- Hugh J. Gownley. As Director of our White Negotiating Team he is responsible for all aspects of our German cooperative logistics program.
- Frank J. Fede. As Director of our Blue Negotiating Team he is responsible for Italy, Spain, Argentina, Brazil, Chile, Mexico, Venezula, Peru, Colombia, Ecuador, Belgium and Netherlands.
- Peter E. Feigl. As Director of our Gray Negotiating Team he is responsible for the United Kingdom, Switzerland, Austria, India, Israel, Lebanon, Saudi Arabia, Turkey, Iran, Iraq, Jordan, Greece, Pakistan.
- Brigadier General Howard Eggleston, Department of the Army.
- Captain Bladen D. Claggett, Department of the Navy.
- Colonel George Johnson, Department of the Air Force.

Each of the above directs the sales activities in his department and is responsible for harnessing its resources to the military export program.

You will find as quickly as I did that military exports are neither solely industrial nor governmental in their character. It requires the closest exchange and cooperation between both of these sectors of our national community. Thus, some of the most important men in this business are those who have been requested to serve as advisors on the Defense/Industry Advisory Council's Export Committee. It is indicative that many of the men on our Advisory Committee are from the aerospace industry and have at one time or another been leaders in the Aerospace Industries Association's Export Committee. They carry that same high "I³" rating.

The Committee members are: Mr. Thomas V. Jones, President, Northrop Corporation, who also acts as liaison between the Defense/Industry Advisory Council and the Military Export Committee; Mr. Lawrence Levy, Vice President International, Raytheon Company, who is the Vice Chairman of the Committee; Mr. R. L. Baer, President, United Aircraft International; Mr. Robert E. Baker, Director, International Office, North American Aviation, Inc.; Mr. F. J. Borheck, Director of Aerospace Marketing, The Bendix Corporation; Mr. Dan Callahan, Director of Planning, Defense Space Group, The Chrysler Corporation; Mr. E. M. Constable, President, Lockheed Aircraft International; Mr. Luis F. Corea, Senior Vice President, The Riggs National Bank; Mr. Roy H. Dickerson, Vice President, First National City Bank of New York; Mr. W. J. Kane, Vice President and General Manager, Boeing International Corp.; Mr. T. Norman Labash, Manager, Propulsion and Space Market Planning, General Electric Technical Services Co., Inc.; Mr. C. E. Laechelin, Washington Representative, General Dynamics Corp.; Mr. Victor Leslie, Vice President of Finance, Douglas Aircraft; Mr. R. G. McCune, Washington Representative, Lockheed Aircraft Corp.; Mr. J. P. Mitchell, Vice President, The Chase Manhattan Bank; Mr. J. Gilbert Nettleton, Jr., Deputy Group Executive, International Telephone and Telegraph Corp.; Mr. E. T. Nielson, Jr., Vice President and Manager, Ordnance Division, Food Machinery Corp.; Mr. E. D. Reynolds, Export Manager, Avco Export Corp.; Mr. Charles H. Shuff, Director of Supplies for the World Trade Corporation, IBM World Trade Corp.; Mr. Mansfield Sprague, Vice President, American Machine and Foundry Co.; Mr. L. E. Tollefson, Assistant to the President, Douglas Aircraft Company, Inc.; Mr. A. R. Tyrrell, Vice President, International Division, Atlas Corporation; Mr. Alfred von Klemperer, Vice President, Morgan Guaranty Trust Co.; Mr. Thomas A. Callaghan, International Director, Ford-Philco, Defense-Space Products, Philco Corporation, who represents the National Security Industrial Association; and Mr. C. James Reeves, Jr., Executive Advisor for the International Office, North American Aviation, Inc., who represents the Aerospace Industries Association.

Mr. Fede

Mr. Feigl

We welcome communications between companies and these men on ideas or problems in military exports.

MONEY

The money to finance production for the export market has been a problem of much discussion in our export advisory work over the last two years. Thanks to the work of Charles Sullivan, Assistant to the Secretary of the Treasury and Chairman of the Financial Working Group of the Export Committee, it is no longer a problem for three reasons:

■ About 70 percent of the potential military export orders are covered by progress payments and final delivery payments necessary to finance the production of the export itself.

While there are many differences in procurement practices, most major export recipients have concluded that it is better to provide progress payments and final payments in a manner similar to that extended by the U.S. Government rather than pay the costs of company borrowing in the price of the contract. Thus, agreement on progress payments generally provides the funds for about $10 billion of that $15 billion export market potential previously discussed.

■ About 20 percent of the potential export orders require credit assistance of a short- or medium-term nature in the industrially developed nations. For example, some countries desire credit assistance to cover the progress payment period in order that payments may be made on or shortly after delivery. Others require credit assistance to defer payments from one fiscal year to another.

Our work over the past year and a half with both Government and private banking institutions indicates clearly that we can expect that some $3 billion in credit requirements can be provided directly by private banks or by private banks in association with Government financing institutions. This assumes, of course, that the military export meets the national objectives of our country and thus has the support of the U.S. Government.

■ Finally, about 10 percent of the future export potential requires credit over medium- to long-term periods for nations that cannot acquire private bank credits directly. For these countries the Congress during its last session authorized the Department of Defense to extend credit guarantees.

We are currently planning on the possibility of more than $1.5 billion in credit to be available through this source over the next 10 years. Almost one-third of this amount is already foreseeable as a requirement in specific countries.

Following are expected examples of credit sale financings which may be covered by the guarantee program:

1. Sales by a U.S. exporter directly to an eligible purchaser.
   a. Credit is extended by the exporter and financed by the exporter.
   b. Credit is extended by the exporter under financing obtained by that exporter from an eligible lender.
   c. Credit is not extended by the exporter and the purchaser obtains funds to meet payments to that exporter from an eligible lender pursuant to a loan or other credit agreement between the purchaser and the lender.
2. Sales by the U.S. Government to an eligible purchaser.
   a. Credit is extended by the U.S. Government and is refinanced by the sale to an eligible lender of an evidence of indebtedness received from the purchaser by the U.S. Government (This procedure is subject to AID General Counsel decisions).
   b. Sales contract calls for payment on a cash or dependable undertaking basis and purchaser obtains funds to meet payments to the U.S. from an eligible lender pursuant to a loan or other credit agreement between the purchaser and the lender.

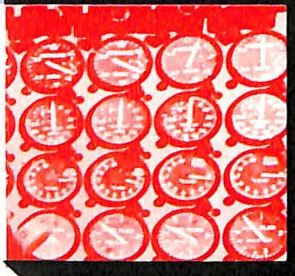
These guarantees will be issued only in support of U.S. foreign policy and with respect to developing countries only where the payments called for in the sales agreement will not unduly interfere with such a country's economic development plan.

It is expected that the issuance of guarantees will be the responsibility of the Assistant Secretary of Defense, ISA. Other elements of the Defense Department, including the military departments, will participate in the actual implementation of this program.

Fees or premiums will be charged in connection with these guarantee agreements. The amount of such fees and premiums will be fixed by the ASD/ISA or his designee and may vary depending on the risks and the foreign and military policy considerations involved.

In conclusion, I would ask all aerospace companies interested in military export potential to examine their motivation carefully. If they find themselves motivated in a strong way because of the Defense objectives of the program and because of their own enlightened self-interest, then begin by placing one or more men with a high "I³" rating on the problem of determining more specifically how these companies will participate in the $10 to $15 billion in military exports expected over the next 10 years.

AEROSPACE EXPORTS -



By DANIEL L. GOLDY
National Export Expansion Coordinator

Expanding Goals

The contribution of the aerospace industry to U. S. exports is impressive. In 1963, the aerospace industry's sales to foreign countries of $1.3 billion — and this excludes military grant aid — represented 5 percent of all U. S. exports.

As President Johnson's export expansion coordinator, working with all departments and agencies, I have learned the aerospace industry is not self-satisfied. The dominant position of American jet transports on airlines serving every continent demonstrates the aggressive interest many aerospace companies have in world markets.

There are many indications that aerospace exports can be increased from the present level of $1.3 billion to $2 billion by 1970. It is forecast that in jet transports alone there is a potential overseas market in the 1964-69 period of $2.2 billion — which would represent some 50,000 additional jobs.

On the basis of technology, performance and price the aerospace industry is confident it can meet these goals if, and the "if" is underscored, available export financing is fully competitive with that offered by other nations.

The Government wants the aerospace industry to expand exports and to help in meeting these goals. This Administration is now pledged to providing fully competitive financing. We are determined to expand exports so the U. S. can achieve an equilibrium in its international accounts, provide the opportunities for industrial growth and the jobs needed by our citizens. This is in addition to developing the trading relationships with free world countries which are indispensable to the exercise of political leadership.

Vice President-elect (then Senator) Hubert Humphrey in a statement made earlier said: "On behalf of the Johnson Administration I can announce that it is the intention of the Administration to help increase production in the aerospace industry by providing fully competitive export financing. We will attempt to accomplish this either through international agreements or by asking our own Export-Import Bank to make its credit policies fully competitive. With this partnership help of your Federal Government we are optimistic that the United States can substantially increase the export of the fine products of our aerospace industry."

And, the next Vice President went on to say: "In today's world marketplace it is not possible to realize the full export potential of a product, no matter how superior it is, unless suitable and adequate financing can be arranged on terms which are competitive with those offered by other nations."

As you can see from Mr. Humphrey's statement, the Administration has a strong interest in expanding U. S. exports. Since 1957, the U. S. has had a total deficit in its balance of payments of $18.4 billion. Thanks to our export expansion drive, we have trimmed the yearly deficit from nearly $4 billion in 1960 to an estimated $2 billion this year.

The success of the export program is indicated by the 28 percent gain in exports in the past four years — climbing from $19.6 billion in 1960 to $25 billion this year. Our record trade surplus of $6.7 billion this year tops the 1960 surplus by 45 percent.

In the export expansion program one of the most challenging tasks has been to get our businessmen to

take a more aggressive interest in world markets. You can't go around the world and see the need for American products without realizing that a good part of the problem is one of motivating our executives to think in terms of overseas markets as well as domestic markets.

A strong case can be made that we should offer tax incentives to motivate our businessmen to increase their overseas sales. We could have an export tax credit — which would pass muster with the General Agreement on Tariffs and Trade (GATT) — by providing accelerated amortization and depreciation rates on investments made by companies which expand their overseas markets; or we could establish an export credit equal to the indirect taxes borne by the product. Many of the competing industrial nations rely heavily upon turnover (excise) taxes which are rebated on exports and in turn levied upon imports. An export tax credit would not only serve to equalize the competition with producers in other nations, but would help generate a keener interest in world markets among American businessmen.

Another facet of our export expansion program involves the competitiveness of American industry in world markets. We found that many of our industries had been falling behind in their ability to compete for world markets because we were putting too small a share of our Gross National Product into the modernization of plant and equipment. Since the late 1950's, the other developed countries have been putting two to three times as much of their Gross National Product into such private investment, and their drive to develop new technology and to cut costs has been reflected in the growing share of world trade taken by these other developed nations.

The Administration responded to this challenge by inaugurating a modernization program which has included conferences with manufacturers and bankers in our major industrial centers, and also tax revision and reform. In 1962, the Administration sought and obtained an investment tax credit and the Treasury Department revised and modernized its tax depreciation guidelines. The combination of these two measures alone has increased corporate cash flow by $5 billion in the past two years. The investment tax credit was restored to its full seven percent in the tax reduction bill passed this year. As a consequence of these tax measures, the estimated returns on investments in new equipment are 35-to-45 percent higher than they were prior to their adoption, and American industry has increased its investment in plant and equipment this year by 13 percent.

The competitive strength of American industry also has been strengthened by the Administration's wage-price guidelines. While they have sometimes been breached, they have effectively served their purpose. Our wholesale prices have been virtually stable; our consumer prices have risen only slightly; and unit labor costs in the United States have been stable. This stability has been achieved at a time when unit labor costs have been rising rapidly in the other developed nations around the world. As a consequence, every month that has gone by has seen an improvement in the relative cost position of American industry in contrast to overseas competitors.

We have been sensitively aware of the concern expressed by companies in the aerospace industry about the adequacy of our export financing facilities. Beginning in 1961, we have made significant progress in improving our export financing program. In many ways it is now equal to or better than those available to our overseas competitors. For example, the Export-Import Bank has established a loan guarantee program whereby it will underwrite the political and commercial risks of medium-term loans made by private commercial banks. The Export-Import Bank also brought into the program the facilities of our private insurance companies organized into the Foreign Credit Insurance Association. FCIA provides credit insurance for exporters.

In the past six weeks, the Export-Import Bank has delegated to the private commercial banks and to FCIA authority to commit the Export-Import Bank on political and commercial risk guarantees up to certain transaction limits in countries representing the major markets of the world. These delegations will serve to expedite financing decisions for exporters and increase the opportunities for exporters to work out the financing arrangements with their banks or with the FCIA, and negotiate their overseas business with their financial commitments in hand.

Despite these improvements, the aerospace industry and other exporters point out to us that certain gaps still exist in our financing arrangements and that there are certain areas where we have not been fully competitive with the other developed countries. These problems were presented at a meeting of the Cabinet

Committee on Export Expansion. As a result of that meeting, Secretary of Commerce Luther H. Hodges, Chairman of the Cabinet Committee, directed me to establish an interagency task force on export financing, to review the problems presented by industry, and to make recommendations to the Cabinet Committee on how best to remedy these difficulties.

The interagency group is now at work and we expect that the recommendations will shortly be forthcoming. In the meantime, one aspect of the financing problem of importance to the aerospace industry has been resolved. In the Foreign Assistance Act, a new provision was included which authorizes the Defense Department to use military assistance funds to guarantee private loans made to finance military exports. Through this authorization the Defense Department is now in position to underwrite financing of those military exports for which alternative financing was not available.

In addition to scrutinizing our export financing facilities, the Administration has also been taking action to modernize its trade promotion and overseas representation programs. Secretary of State

Dean Rusk has reminded our ambassadors and their staffs overseas of the importance of fully supporting the commercial objectives of our export expansion program. Additional funds have been sought to expand our overseas commercial services. In 1961 this Administration initiated programs for commercial exhibits overseas so that American businessmen could sell their products and establish representatives to accomplish effective distribution in foreign countries.

The government can only facilitate the efforts of private businessmen in expanding exports. The success of our export expansion drive depends on the initiative of our private business community. The success we have had to date is clear evidence that American free enterprise has lost none of its vigor.

This article is a summary of remarks that I made before a recent meeting of the Aerospace Industries Association's Export Committee. I was impressed then with the dynamic technology of this industry, and technology is the key to export expansion. The comprehensive research and development programs now under way cannot fail to have a vital and far-reaching stimulus and impetus on the great goal of expanding world trade.

GENERAL AVIATION EXPORTS GAIN

General aviation, an important factor in air transportation in the United States, is making strong gains in other nations.

William T. Piper, Jr., Chairman of the Utility Airplane Council of the Aerospace Industries Association, reports that the general aviation airplane manufacturers will produce more than 9,000 airplanes in 1964. In the first ten months of the year production has already exceeded the 7,569 aircraft shipped in the full twelve months of 1963.

Approximately 20 percent of this production will be exported to more than seventy different countries, and the future for the export business is very promising.

In the last decade the number of general aviation airplanes produced in the United States and sold for use in other parts of the world has increased nearly 400 percent. The dollar value of these aircraft has risen from $6.7 million to approximately $45 million. Although competition from manufacturers in other countries is increasing, the United States companies have an advantage of a strong domestic market which supports an industry that can compete on even terms with foreign manufacturers even though hourly wage rates, overheads, and materials may be substantially higher.

Domestic general aviation users currently operate more than 90,000 active airplanes compared to about 2,000 airliners. These account for 66 percent of all itinerant aircraft movements at the Nation's 277 airports with traffic control towers and virtually all the movements at the more than 8,000 other airports. Of the ten busiest airports in the United States, three have no scheduled airline service. Utilization of general aviation airplanes in the United States, now accounting for more than 14,000,000 annual hours, three times more than the airlines, is increasing at a rate of more than 1,000 hours a day. Corresponding increases in utilization are occurring abroad, where general aircraft transportation is often the only means for accessibility to remote areas.

More than 90 percent of all general airplane production is by five member companies of the Utility Airplane Council — Aero Commander, Beech, Cessna, Lear Jet and Piper. Virtually all the powerplants are manufactured by two engine company members of UAC, Continental Motors and Lycoming Division of Avco Corporation.

Both domestically and in international sales, 1965 appears to hold the same momentum for growth as is present this year. All member companies of the UAC have strengthened and revitalized both their domestic and international sales and service efforts to provide an ever-increasing number of airplanes to serve the transportation needs of the Nation and the world.

exim

Financing Aerospace Exports

bank

By CHARLES M. MERIWETHER,
Director, Export-Import Bank of Washington

THE post-war growth of the aerospace industry in the United States has had natural implications for America's international position. An interesting sidelight of this has been the financing of export sales by the Export-Import Bank of Washington.

In commerce it is the seller who normally extends credit if necessary. With the increasing complexity and capability of aerospace products, the cost has gone up. This has resulted in an increasing demand for adequate credit facilities. When exports of aircraft were limited largely to single-engine private planes, either the buyer could arrange his own financing through his local bank, or the manufacturer would carry the account for a year or two without straining his working capital position.

Today, when international carriers are buying more and more multi-engine jet transports costing as much as $6 million each, the matter of financing has taken on greater significance. The industry has turned increasingly to the Export-Import Bank for assistance.

Established in 1934, the Export-Import Bank exists to facilitate American international trade and to assist in financing such trade. Despite its name, Eximbank has engaged in relatively few transactions relating to imports because usually the seller extends the credit. There are three basic programs operated by the Bank, two of which have served the needs of the aerospace industry.

Eximbank makes loans to foreign borrowers to help cover the U. S. costs incurred in establishing new industry, expanding existing plants or improving transportation and communications facilities. With the rapid development of international air transport in the past decade, the Bank has committed increasing dollar amounts to help make this expansion orderly.

Eximbank also guarantees loans made for American exporters through their commercial banks. This form of financial assistance — replacing to a large extent direct loans — has been used extensively in recent years to assist in developing overseas markets for American aerospace products. The third Eximbank program, foreign credit and political risk insurance, has not been widely used as a means of financing exports of aircraft and related products because the demand has been for credit rather than credit insurance. For aircraft the normal terms are five years — seven years for jets. When the Bank was first requested by the industry to assist in financing the export of jet planes, it was decided that the cost and life expectancy of the planes was such that seven-year terms would be reasonable. In jet financing the Bank was the world leader — first to finance exports of jets and first to offer seven-year terms.

Under the Bank's guarantee program, the foreign buyer is expected to make a cash down-payment of 20 percent, and the American exporter is expected to carry at least 15 percent of the balance. In this way Eximbank has some assurance that the buyer is regarded as responsible and creditworthy. Today it is providing financing to the industry competitive with that offered by any other government. Today no aerospace manufacturer in the United States need miss a sound export sale because of inadequate support by his government in obtaining necessary credit.

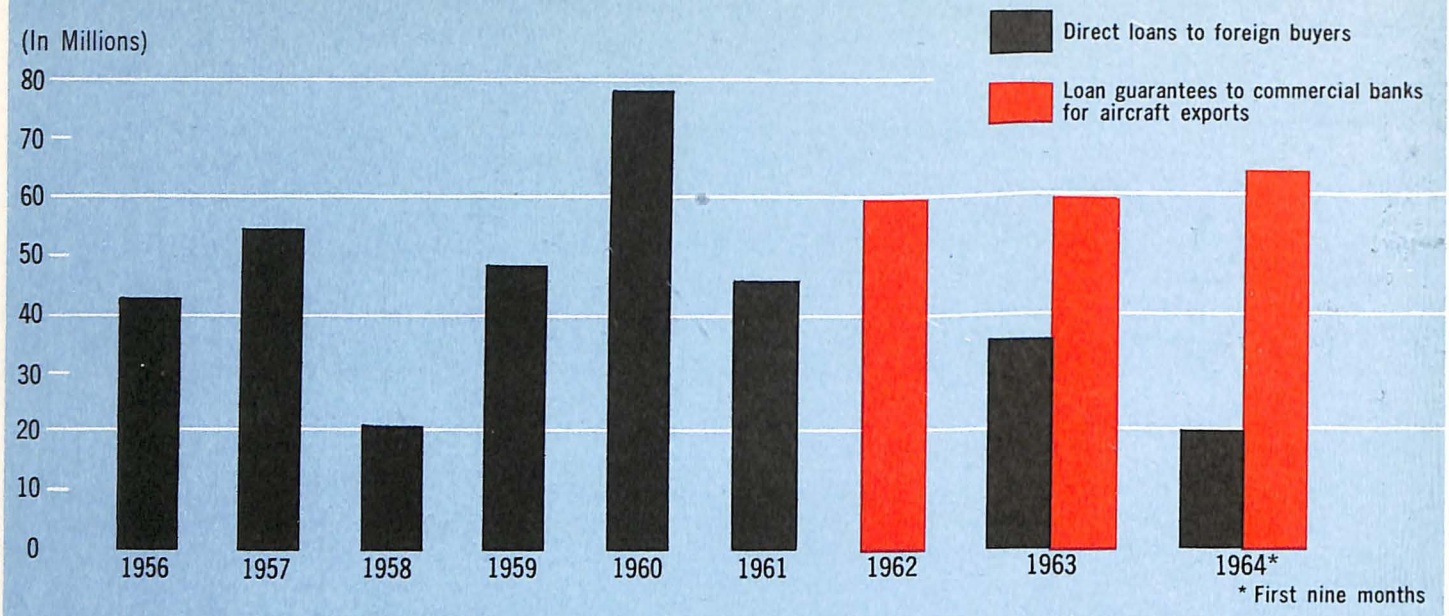
Because the Export-Import Bank is an agency of the Federal Government, its activities must support United States policies. While no reasonable request for financing in the aerospace field has been rejected by the Bank, there are often considerations which are not apparent to the prospective exporter.

Ability of the purchaser to pay is paramount. Availability of commercial financing must also be considered. By law, the Bank may not compete — nor should it in our society — with our banking system. A third consideration is the viability of the proposed venture, related to ability to pay. The Bank determines that there is reasonable assurance of repayment. Not only is this a requirement of the Export-Import Bank Act of 1945, it is also a recognition that exports not paid for do not assist our balance of payments.

Since the end of World War II the number of independent nations has increased dramatically. Frequently newly-established governments, zealous of their new independence, have outlined development programs which transcend their economic capability. One of the questions the Export-Import Bank must have answered is whether funds expended on uneconomic prestige items might not be spent more wisely on other programs yielding more direct benefits to the country's development. Another important group of considerations is whether the buyer's rate structure, expected traffic and load factors are realistically projected.

Answers to these and other questions must be obtained before Eximbank can make a loan or issue its guarantee. Clearly, the answers reflect financial, general economic, political and technical considerations.

EXIMBANK LOANS AND GUARANTEES FOR AIRCRAFT EXPORTS



Total loans and guarantees by the Export-Import Bank for aircraft exports since 1945 through September 1964 is more than $570 million. In 1961, the Bank increased the degree of commercial bank participation in export financing by issuing its guarantee to commercial banks covering their loans made to exporters. As a result, there was a decline of direct Bank credits to exporters. Eximbank financing of export aircraft sales in 1962 was confined almost exclusively to guarantees. Often the Bank's commitment is authorized as a direct loan, but many such loans may subsequently be converted to guarantees of commercial bank loans.

Although the Bank is an independent agency of the Federal Government, there is a close working relationship between the Bank and other Federal agencies — Treasury, Commerce, State, AID, Agriculture — ensuring that Bank activities support overall United States objectives, both domestic and international.

The accompanying chart indicates the extent to which the Export-Import Bank has been instrumental in assuring to the American aerospace industry its rightful place in world markets. Since 1945, when the Bank disbursed funds under its first loan for the purchase of aircraft — three Lockheed planes for T.A.C.A. airlines in South America — Eximbank loans and guarantees have helped finance the purchase of some 340 aircraft, including helicopters as well as piston and jet planes. These sales were made by a score of American manufacturers to private and government-owned carriers in over 30 countries. Purchasers have included better-known international airlines, thus helping American-made aircraft to dominate the world's airways. Obviously, the superiority of American planes is the key to this success story, but these 340 aircraft were bought only after the financing was made available by Eximbank. In addition to these sales, representing a commitment by Eximbank of over $570 million, the Bank has helped finance the export of various aircraft components, particularly jet engines.

The Bank has also assisted in financing the construction of airports around the world. Over $55 million in credits have been authorized by the Bank for this purpose, building or improving facilities in ten countries. This sum does not include Eximbank's commitments in financing the export of communications equipment, much of which may reasonably be assumed to have been used in the field of navigation and other aerospace applications.

As the chart indicates, the amount of Eximbank-provided financing for aircraft has increased dramatically. While this is in part a reflection of the increase in air travel around the world, it is also a reflection of the development of national economies in recent years. Because of its inherent advantages, in many parts of the world the only means of transport — other than local — is via air. Often rail systems are obsolete and cannot meet the demand placed upon them. In South America the problems of building highways and railroads across the Andes are so great the air has become the normal route where time is of any consequence. In parts of Africa it has proven easier, quicker and cheaper to build air fields than to establish the more traditional means of transportation. As technology advances, even to the field of supersonic aircraft, and as more nations around the world raise their abilities to participate fully in 20th Century transportation, there seems every probability that American manufacturers of aerospace materials will continue to hold and increase their share of world markets.

The facilities of the Export-Import Bank will continue to be available to ensure that no sound American export sale is lost because of inadequate credit support. As technology changes, as situations alter, Eximbank will continue to apply its ingenuity to meet the needs of our exporters. The Export-Import Bank is convinced that a large measure of the success of the American aerospace industry rests on a well-founded reliance in free enterprise in which the drive for excellence is predicated on fair competition — internationally as well as here at home.

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OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION • WINTER 1965

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- NAVY: Aircraft Carrier Power By Vice Adm. Paul H. Ramsey
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AIA aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.

VOL. 3 NO. 4 WINTER 1965

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Publisher's Note: The cover of Aerospace features the logotypes of the 61 manufacturing members of the Aerospace Industries Association. Starting in February 1966, Aerospace will be issued monthly in the same format as the present quarterly publication. Principal addition will be a chart of basic economic indicators for the industry such as sales, employment and exports.

The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems;

Foster understanding of the aerospace industry's responsibilities in the space exploration program;

Foster understanding of commercial and general aviation as prime factors in domestic and international travel and trade.

AEROSPACE is published quarterly by the Aerospace Industries Association of America, Inc., the national trade association of the designers, developers and manufacturers of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems and other aeronautical systems and their components.

Publication Office: 1725 De Sales Street, N.W., Washington, D. C. 20036

Los Angeles Office: 7660 Beverly Boulevard, Los Angeles, California 90036

ARMY: Airmobility in Vietnam

By Brigadier General G. P. Seneff, Jr.
Director of Army Aviation

Army airmobility started in Vietnam in December 1961 and has been growing steadily ever since— first in support of South Vietnamese forces, and within the last year in support of both South Vietnamese and U.S. troops.

Recently the tempo of the activity increased to a new pitch with the engagement of the 1st Cavalry Division (Airmobile). The air cavalry soldiers, in a recent foray, for example, were called upon to assist the South Vietnamese Air Force in the relief of the U.S. Special Forces Camp at Plei Me, some 250 miles northeast of Saigon in the central highlands.

The Special Forces Camp was under heavy attack by large numbers of Viet Cong, including some regular forces from Hanoi.

The 1st Cavalry forces arrived in the area entirely by helicopter. They carried with them everything they needed to fight, to subsist and to sustain their operations. The medium Chinook helicopters brought in artillery; the Huey (the Army first gave this turbine helicopter the designation "HU-1" so the flight crews named it "Huey") Delta squad carriers landed the attacking infantrymen; the armed Huey Bravos escorted the other helicopters and delivered suppressive fires against a surprised enemy.

As the infantrymen unloaded, the UH-1B's provided protection and aerial rocket fires as they were needed. Helicopter-equipped Forward Air Controllers brought in the USAF A-1's when the Air Force's heavy punch was required. The force was entirely supplied by air.

The Viet Cong siege was broken after heavy fighting. Many of the Viet Cong headed for the Cambodian border with the 1st Cavalry Division in continuous aerial pursuit. This was one of the key actions engaged in by the 1st Cavalry Division since it arrived in Vietnam in the Fall and established base camp at An Khe in the heart of Viet Cong country in the central highlands. It can be anticipated that in the future the division will engage in larger operations as part of the overall U.S. buildup in Vietnam.

In one year there has been a tremendous improvement in the Army's airmobility capabilities. One year ago the experimental 11th Air Assault Division was engaged in its final testing to put the finishing touches on the Army's evaluation of the airmobile concept. Less than a year later, the 1st Cavalry Division (Airmobile) is a permanent force structure unit and is engaged in combat operations. How did this happen in twelve months?

The 11th Air Assault Division was organized in February 1963 to field test the airmobility concept which was developed by the Howze Board. This concept envisioned the use of organic aerial vehicles in large numbers to improve battlefield mobility. The Howze Board recommended that certain airmobile organizations — divisions, air cavalry brigades, and at least one air transport brigade for logistical support — be added to the Army force structure.

These recommendations called for a substantial increase in the number of organic aerial vehicles and a corresponding decrease in ground vehicles in the formations concerned. The innovations recommended were so radical that the Department of Defense deemed it prudent to examine the subject very extensively before actually incorporating such units in the Army.

A test program was established which resulted in the formation of the experimental 11th Air Assault Division and 10th Air Transport Brigade. The comprehensive test schedule for these units culminated in the field exercise Air Assault II which was conducted in October and November of 1964 in the Carolina maneuver area. This exercise had been preceded by more than 80 tests, war games and operational studies. As has been stated before, the airmobility concept as exemplified by the Air Assault Division was the subject of more analysis and more testing than any other concept the Army has ever evaluated.

Air Assault II was a large scale exercise taking place in an area 150 miles long and 75 miles wide. A full division functioned as aggressors. The whole spectrum of combat situations was played — retrograde, defense, offensive raids and deep penetrations. Why was the exercise so extensive? To be certain that we could obtain the answers to the "big unknowns."

The first unknown was that of logistical impact. Could an Air Line of Communication (ALOC) handle the tonnage required for an air assault division? The average daily consumption for the division was 550

tons as compared to 450 for an infantry division. The main reason for the increase in tonnage is the requirement for additional fuel.

During Air Assault II the division consumed almost three million gallons of fuel. Total tonnages consumed were over 18,000 tons. This required 10,000 supply missions, half of which were flown at night. The exercise showed that an ALOC can be established and sustained over long periods of time to support an airmobile division.

It was also established that the speed with which an airmobile division can accomplish its mission indicates that it will consume 50 percent less tonnage than an infantry division on a like mission. This is because of the rapidity with which an airmobile division can move to its objective. It can do the job in substantially less time.

The 10th Air Transport Brigade was located in the logistics base and was responsible for the retail delivery of supplies to the forward units. Air Force aircraft operated within the *wholesale* ALOC; that is, they delivered supplies to the field army or to the logistics base where the 10th Brigade took over.

The *retail* ALOC in Air Assault II was characterized by the use of relatively unimproved air strips and by short hauls under the control of the ground commander. The 10th Brigade had a mix of fixed wing and rotary wing aircraft with the CH-47 Chinook helicopters and the CV-2 Caribou aircraft being the primary carriers. The exercise revealed that the ALOC could be maintained and that an air assault division could be completely supplied and maintained by air to a distance of 150-200 miles.

Another unknown was the question of our ability to maintain the large numbers of aircraft. The results exceeded the expectations. The medium Chinooks were exposed to field conditions for the first time on a large scale and were available 60 percent of the time. The fixed wing Mohawk surveillance aircraft had almost 80 percent availability. The Hueys, the workhorses of the division, attained the rate of 85 percent, a rate which is also being maintained in the combat environment of Vietnam. All of these availability rates exceeded the Department of the Army's standards.

The question of sustainability was another unknown. During the period in the Carolinas, aircraft of the division and the 10th Brigade flew 70,000 hours, and not a single operation had to be cancelled because of lack of airlift.

The performance and utilization rates were exceptionally high and indicated that aircraft can be operated on a sustained basis. As an example, the Hueys on the peak days were flown 9 to 10 hours in one day. The average crew flew about 200 hours during the two months the division was in the maneuver area. This utilization rate compares favorably with that of ground vehicles.

Another big question was what would happen to the division in bad weather.

Was it a blue sky outfit?

The answer came rather dramatically on the opening day of the exercise when the side effects of Hurricane Isabel blanketed the maneuver area with ceilings down to the tree tops and visibilities down to ⅛ mile.

This weather grounded all other aircraft in the area but the division was able to initiate the exercise with a 100 mile run of a formation of 140 helicopters and to continue with smaller operations for the next two days. This was not accidental — the division had trained for it.

The personnel had learned to deal in "micro-weather," knowing that even when the clouds are in the tree tops in one place, the ceilings will probably be slightly better a half mile away. We had learned to dispatch scout ships to reconnoiter their way through the weather in the same manner that a cavalry reconnaissance screen attempts to pick its way through the enemy.

Another facet tested during the exercise was the ability of the division to operate at night. Routine and effective assault, reconnaissance and logistical support missions were found to be as practical during darkness as under daylight conditions. Night operations up to brigade sizes were planned and executed. Twenty-two company size and four battalion size operations were conducted at night.

In brief, the division operated at night just as well as in the day time. To accomplish this the state of training of both infantry and aviation personnel had to be high. The division reached this level by reversing the training — during preliminary training periods personnel slept in the daytime and worked at night.

This paid off during the exercise where precision, timely reaction and adherence to planned actions resulted in successful night operations. It must be added, however, that there is still one tough combination: that of night and very bad weather. We've even made some progress here.

Another big question in the mind of many people was that of the vulnerability of the helicopter. The Army has conducted elaborate experiments at the Combat Developments Command Experimentation Center at Fort Ord, California. The most important finding is that relatively slow, low-flying aircraft are *less* vulnerable to visually sighted weapons than earlier analytic

Vertol CH-47 helicopters unload soldiers from the 1st Cavalry Division (Airmobile) at An Khe in Vietnam.

estimates and opinions had indicated. Statistics from Vietnam offer impressive proof of the helicopter's survivability. Based on 675,000 helicopter combat sorties, the statistics reveal that 2,100 helicopters have been hit by ground fire and of these only 54 were lost. In other words a helicopter is hit by ground fire once in every 300 combat sorties; a helicopter is lost once in every 12,000 combat sorties.

Possibly the biggest "unknown" was the overall tactical effectiveness of the division as revealed during the exercise. The test proved that air assault forces afforded advantages over conventional infantry by permitting more rapid achievement of the objective, more rapid acquisition of key terrain and achievement of the objective with fewer casualties and a more favorable friendly-to-enemy casualty ratio.

The division can be strategically deployed by air at less cost, in less time and with fewer sorties than any normal infantry division since it weighs only one-third as much. It can be tactically deployed over a much greater area than has previously been contemplated with other divisions.

The primary forte of the division is its potential for offensive combat in stability operations and conventional war. The higher spectrum of warfare (medium high tactical nuclear war) was not tested during Air Assault II but it can be extrapolated that the division would have a reduced effectiveness in such an environment, as would other Army divisions.

A final unknown was the question of relations with the Air Force. All tests to date and experience in Vietnam indicate that airmobile forces demand more support from the Air Force rather than replace any support previously requested.

As with other type land forces the airmobile forces and the Air Force are complementary rather than duplicatory. The very nature of airmobile operations can require an air line of communications over distances that only the Air Force can provide. When suitable airfields exist, Air Force "through put" of supplies into the forward Army area is the most economical way of hauling in supplies in bulk. Because airmobile forces must frequently operate beyond immediate range of our artillery, and because they normally have no medium or heavy artillery, they must depend on the Air Force for heavy fire power.

Finally, in any engagement where the enemy possesses air power the Air Force must provide at least local air superiority to facilitate air mobile operations. Systems to provide these types of support which have been developed by the Air Force and the Army worked very well during Air Assault II, and are working well in Vietnam.

The Army evaluated the results of Air Assault II in great detail and concluded that an airmobile division should be substituted for a standard infantry division in the Army force structure. A recommendation to this effect was made to the Secretary of Defense. The recommended division differed in only minor areas from that of the experimental air assault division. Principal changes were the inclusion of one brigade with a parachute capability, the elimination of the Little John rocket battalion because of its limited use in non-nuclear warfare, and the elimination of 24 armed Mohawk aircraft.

On 16 June 1965, Secretary of Defense McNamara announced the approval of the 1st Cavalry Division (Airmobile) as one of the 16 regular Army divisions giving us a capability which no other Army in the world possesses. The Secretary also announced that the division would be combat ready for deployment within eight weeks if that should become necessary.

On 3 July 1965 the 11th Air Assault Division was officially designated the 1st Cavalry Division (Airmobile) at Fort Benning, Georgia. For the first time in 22 years the colors of the 1st Cavalry were in the United States. But they were not to remain here long.

In view of the requirement for additional U.S. forces in Vietnam it was only logical that the 1st Cavalry be considered for deployment. The division is particularly effective over difficult terrain such as the jungles, rice paddies and mountains encountered in Vietnam.

Immediate action was initiated to bring the division up to authorized personnel and equipment strengths so that it could be available for deployment on the first of August. Airborne personnel were transferred into the division to make up the three paratrooper-qualified battalions and the brigade headquarters.

The problem was monumental. Many of the division pilots were Vietnam returnees who had to be replaced. This is in keeping with the Department of the Army policy that no person should spend a second tour in Vietnam before others spend their first tour. In addition the division was short much equipment. This was largely due to the fact that the divisional units were used to accomplish a number of diverse tasks during the early months of 1965 while waiting for a decision on the Army's recommendations to make it a permanent division. As an example, the 11th Air Assault provided a number of personnel and helicopters for the task force which was deployed to the Dominican Republic. From late May through July personnel and

new equipment were assigned to the division in large numbers. While there was much personnel turnover, the division, by hard work and skillful management, was in a deployment status by early August.

So in mid-September the division debarked at Qui Nhon and was shuttled by the Chinook helicopters to its base camp at An Khe. This camp was carved out of the jungles of the central highlands. For weeks the prime weapon of the division was not the helicopter or the mechanics' tool chest — it was the machete.

Officers, men and hired Vietnamese alike cleared the An Khe area; the helicopter parking area, the world's largest helipad — some 3,000 by 4,000 feet — was dubbed the "golf course" by those who noted the similarity between the stroke of the machete wielders and that of a duffer trying to beat his way out of a sand trap. By now, they have settled in and have started combat operations against the Viet Cong in earnest.

While the 1st Cavalry Division represents a new concept in airmobility, it is only one portion of the tremendous Army aviation effort that is being expanded in Vietnam. Since December 1961, we have employed Army aircraft, principally helicopters, to assist the Vietnamese in their stability struggle against the Viet Cong aided and abetted by the North Vietnamese.

In the beginning we employed CH-21 helicopter companies to carry Vietnam soldiers over the continuous terrain barriers typical of the Vietnamese topography. These were replaced by the more modern Hueys as these aircraft came off the production line. Tactics were developed calling for a mix of one armed US-1B for every two troop carriers. The helicopter has given us such a mobility advantage that it can be estimated that without the helicopter the size of the Vietnamese forces would have to be doubled to attain the same battlefield efficiency.

Our rotary wing aircraft have flown over 440,000 hours in Vietnam while the Army's fixed wing aircraft have flown almost 300,000 hours. A large part of the fixed wing hours have been flown by lonely O-1's (the Bird Dog), performing the same role that the Cub performed in the first Army aviation units developed in World War II — "saturation surveillance" — keeping large areas of the country under continuous observation to detect enemy movements and any massing of forces.

When the decision was made to employ U.S. combat forces we had the benefit of three years of experience in transporting Vietnamese troops. We are tailoring our forces to take advantage of the helicopter. While in a normal infantry division there is only one airmobile company of 25 UH-1 helicopters, this was considered unsatisfactory for operations in the tropical environment of Vietnam.

We now plan to employ two airmobile companies for each US brigade or six companies for each division size force. These are in addition to the airmobile companies which will continue to support the Vietnamese.

In addition we are deploying separate CH-47 medium helicopter companies for the first time to give our forces the heavy haul capability. This is particularly important in the case of carrying artillery and ammunition to isolated areas. The Viet Cong had not been subjected to the fires of air-landed artillery before the coming of the 1st Cavalry Division.

Thus, we have two types of airmobile operations going in Vietnam, one by a tailored airmobile force, the other by normal ground forces supported by attached aviation. The Army will continue to observe active operations to determine which is most effective under varying circumstances.

The Army's side of the ALOC will be augmented by additional Caribou transport companies. The experimental 10th Air Transport Brigade which performed this function for the air assault division was not approved as a permanent Army unit. In lieu of the brigade the Army is regrouping certain aviation units under aviation group headquarters. The mix of aviation units to be attached to the group may vary based on the tactical environment and the mission of the units it is supporting.

Accordingly, the 1st Cavalry Division is being supported in Vietnam by other aviation units. The 17th Aviation Company (Caribou) is in direct support. This company was self-deployed in September, the largest aerial deployment ever undertaken by Army aircraft over the Pacific route.

In addition there is a reduced-strength flying crane unit equipped with four CH-54 "Sky Cranes." This unit will be employed to retrieve downed aircraft and will also be employed tactically where heavy lift is required.

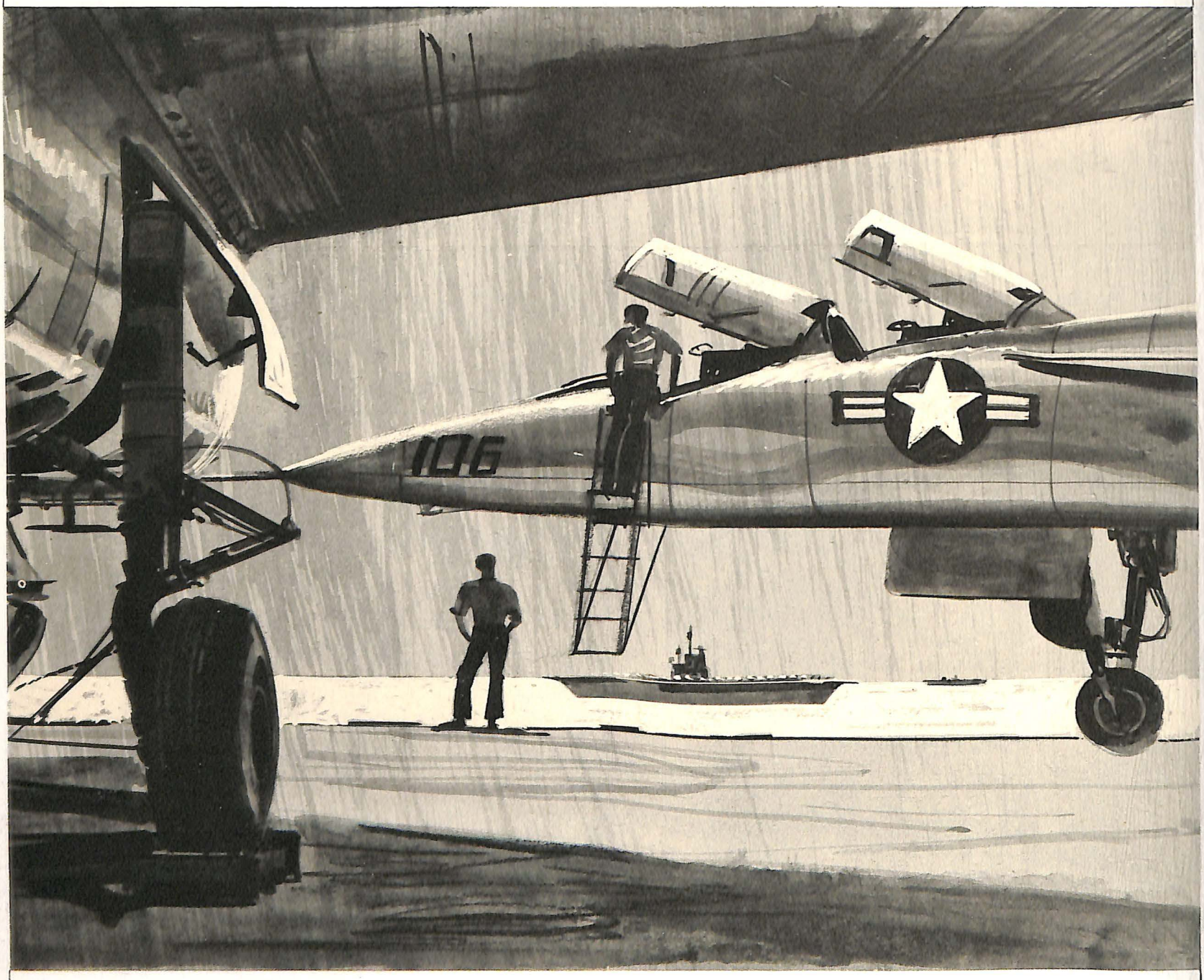
As mentioned earlier, the tempo of the activity of the 1st Cavalry Division can be expected to increase sharply in the days ahead. A note of caution should be sounded. The division has received much attention in the press and has perhaps received too great a buildup as to what can be expected of it. This could lead to disappointment.

The 1st Cavalry Division will pull its weight in Vietnam in sound fashion — but no one division is going to resolve that complicated conflict over night. We should not look for miracles. It will help but the final victory in a stability struggle can only be won by careful and concerted playing of all aspects of the struggle: military, political and economic.

What of the future? Can we expect that the Army will have another airmobile division? A third?

Mr. McNamara has asked the Army to report on possible conversion of other units to the new type division. The Army staff is now evaluating the proper mix of divisions but it is not expected that a final recommendation will be ready until some time in 1966.

NAVY: Aircraft Carrier Power



By Vice Admiral Paul H. Ramsey
Deputy Chief of Naval Operations (Air)

Lieutenant George C. Sweet, one of the first Naval officers to fly, in 1908 wrote some ideas down on paper about the planning, building, buying and testing of airplanes for the Navy.

Lieutenant Sweet made his observations (today they would be called "Operational Requirements") after witnessing a flying demonstration by the Wright Brothers.

What Sweet wanted for the Navy was a plane capable of carrying more than one man, so designed that it could be stowed aboard ship and launched from a

deck as an air scout. It should make "at least 40 miles an hour with the possibility of hovering, if such could be accomplished," Sweet said.

The airplane, he said, should be able to rise from or land upon the water. A "wireless telegraph installation" was also necessary, in Sweet's opinion.

All these things were entirely practicable in the existing state of what Sweet then called "aeroitation." Their achievement, he said, would add greatly to the scouting powers of the fleet, add to its communications means and would materially increase protection against enemy attack. Since underwater minefields in Europe had been detected from the air, why might not approaching submarines be discovered in the same way, Sweet asked.

Sweet suggested that the Navy buy planes that fulfilled the requirements and place them in the hands of its own personnel.

If we employ every man's gift of 20/20 hindsight, it is apparent that Sweet was a prophet of considerable stature. In one fell swoop he conjured up concepts pointing to the seagoing airfield, vertical/short takeoff and landing vehicles, air antisubmarine warfare, air defense, and the use of sophisticated equipments to enhance man's ability in the cockpit.

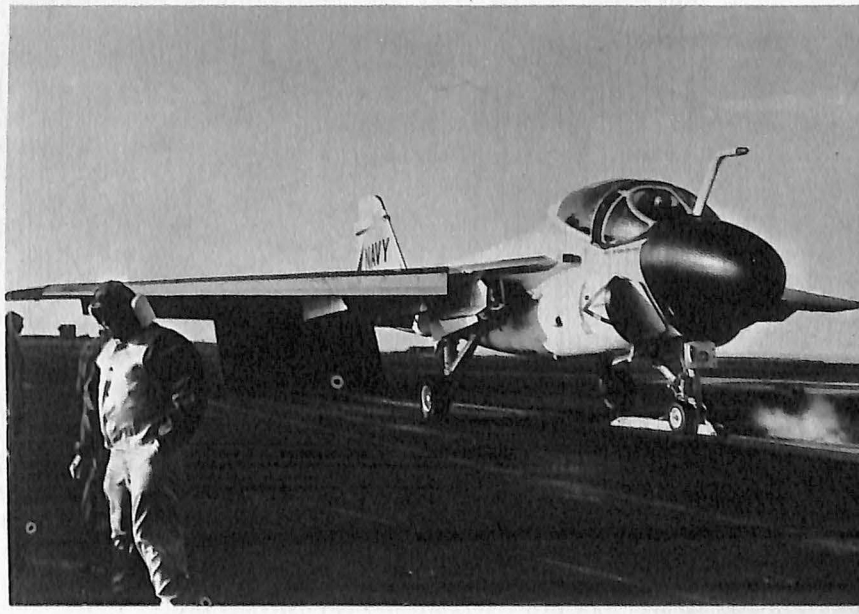
Ever since Sweet's first effort at writing an operational requirement we have been hard at the business of anticipating needs and uses of equipments and of men, of tailoring existing hardware to meet unforeseen or forced demands, and of making use of crystal balls with regard to the demands of the future.

A recent tour of Southeast Asia convinced me that, for all of our "educated guesses," we have been fortunate that most of the products of our aviation industry have rolled off the lines with dual dividends, *growth potential* and *flexibility*.

As an example, the initial requirements in the case of helicopters never addressed themselves to their myriad uses in combat. Nor, at the outset, did anyone envision the strategic bomber, the Boeing B-52, as a conventional bomber. The world's best fighter, the McDonnell F-4 *Phantom* II, doubles in brass as an attack bomber in Vietnam and does well at the job. Almost all of our flying hardware in that area is being used in ways and on missions not specified in the original requirements.

To illustrate the importance of this flexibility, one need look back only a score of years and the lessons we have learned in that short time.

Development of the atom bomb, you will recall, caused a severe change in our planning for war. We concentrated on the delivery of nuclear weapons. Training programs for both operational and maintenance personnel were slanted toward nuclear warfare. Industry, too, was forced to depart from production of conventional weapons and aircraft, because there was no market. Popular thinking favored nuclear weapons



Ling-Temco-Vought A-7A (above) made its first flight recently, is being procured in quantity by the Navy. Grumman A-6A (below) is ready for launch from an aircraft carrier.

that were to be delivered from high speed, high altitude aircraft.

Tactics and requirements met during the Korean conflict taught us that the era of conventional warfare had not passed into history. We learned that we had to keep our conventional warfare capability and still keep our nuclear weapons capability.

That same requirement exists today and probably will remain valid for several years to come. Vietnam has re-emphasized the need to remain flexible in our thinking and to be prepared for a broad spectrum of

responses to any situation.

The Navy since 1950 has kept its nuclear "fist" ready. But, as Admiral David L. McDonald, Chief of Naval Operations, wrote in the November, 1964, *Naval Institute Proceedings,* "the attack carrier's missions over the past 15 years have been varied and non-nuclear in character."

Admiral McDonald recited the instances in which aircraft carriers have been employed around the world, wherever and whenever needed.

"One thing in common about most of these crises is the manner in which carrier forces have been moved toward the trouble spots on the most tenuous strategic warning and prior to national political decisions," Admiral McDonald said.

When the national decision of "measured response" in Vietnam was made in February, 1965, for example, our sea-based tactical airfields were in position and ready to carry out their assigned missions.

This "instant readiness" was achieved by years of practice and planning, on both the operational and support levels. Our on-line aircraft and ordnance are the best available in the world; each piece of equipment is the result of years of testing and trial.

Since 1959, for example, the Navy has been testing and developing new families of conventional weapons, some of which are now in the Fleet and some of which are still on the way.

One of these is the *Snakeye* family of two general purpose bombs, 250 and 500 pounds. The *Snakeye* allows a low level attack to be made without danger to the attacking aircraft from the fragments of its own bomb.

If the pilot desires to make a dive delivery of a high-speed penetration weapon, *Snakeye* may be dropped with closed fins to give a low-drag shape. An advantage of the retarded version is that the attacking aircraft releases its bomb at point blank range and achieves greater hitting accuracy.

A second family of airborne weapons is the air-delivered cluster weapon. Since many targets are poorly defined, a weapon consisting of a large number of small bomblets can spread the warhead effects. The Navy has developed two such weapons. One of them, called *Sadeye,* consists of a clamshell dispenser which opens at a pre-determined spot in its trajectory to dispense small explosive bomblets similar to the simple hand grenade. The second weapon is called the Cluster Bomblet Unit (CBU) which dispenses various types of bomblets from the attacking aircraft.

Aircraft missiles developed by the Navy include the *Sparrow, Sidewinder* and *Shrike.*

Our aircraft development program, which has given us the finest and most versatile team in the world, is producing even better flying machines for the future.

During the 1950 s, a lot of us Naval aviator types got tired of trying to explain why we still depended on propeller airplanes to do the attack job. We still have the A-1 *Skyraider* around today, in Vietnam, but no one seems to doubt its capability anymore. The *Skyraider* undoubtedly qualifies as one of the most "cost effective" airplanes in aviation history. Douglas Aircraft Co. delivered the first models in the 1940 s and the latest ones are still flying effectively in Vietnam.

Experience has shown us that speed is a desirable trait in many airplanes, but not in all of them. During the recent unveiling of the Ling-Temco-Vought A-7A *Corsair* II light attack aircraft, for example, an aerospace writer asked why it was not in the supersonic range.

The answer, of course, lies in an examination of the mission for which the *Corsair* II was designed. The Navy determined that what we needed in our light attack inventory was an airplane that could combine the endurance and load-carrying ability of the prop airplane with the great power of the fan jet engine. The A-7A was the result.

The new airplane, due for delivery to the Fleet in 1966, will carry twice the conventional ordnance load for the same distance of its predecessor, the Douglas A-4 *Skyhawk.* If delivery ranges are short, we can trade off range for greater loads and greater time over a target.

We have aircraft in the supersonic range, too. The Navy's F-4B *Phantom* II is the world's best fighter — so good, in fact, that the U. S. Air Force bought it in numbers for use as an attack aircraft.

We also have supersonic speeds in the F-8 *Crusaders* in our attack carrier wings, and in the North American Aviation RA-5C *Vigilante* reconnaissance aircraft.

For the future Navy there is the General Dynamics-Grumman F-111B, the first aircraft to have a variable-sweep wing that can be partially tucked away for high-speed missions.

In the subsonic field, we have recently introduced the Grumman A-6A *Intruder* aircraft into the Fleet. Like the A-7A, the *Intruder* trades off speed for greater endurance and range, plus an all-weather capability. When the *Corsair* II is joined up with the A-6A, the Navy will have the most potent one-two attack punch

in the world, carrying a multiplicity of weapons and explosive power.

Recent research into the vertical or short takeoff and landing vehicles, known as the V/STOL types, indicate that we are not far from operational use of a new breed of machine. The V/STOL combines slow landing and takeoff speed with a speed greater than that of current helicopters for advanced base operations.

Three major inter-service efforts are being made in the V/STOL area. The XC-142, by Ling-Temco-Vought, is a four-engined, tilt-wing transport. Smaller experiments involving our joint service effort are being conducted with the X-22A, by Bell Aerosystems, and the X-19, by Curtiss Wright.

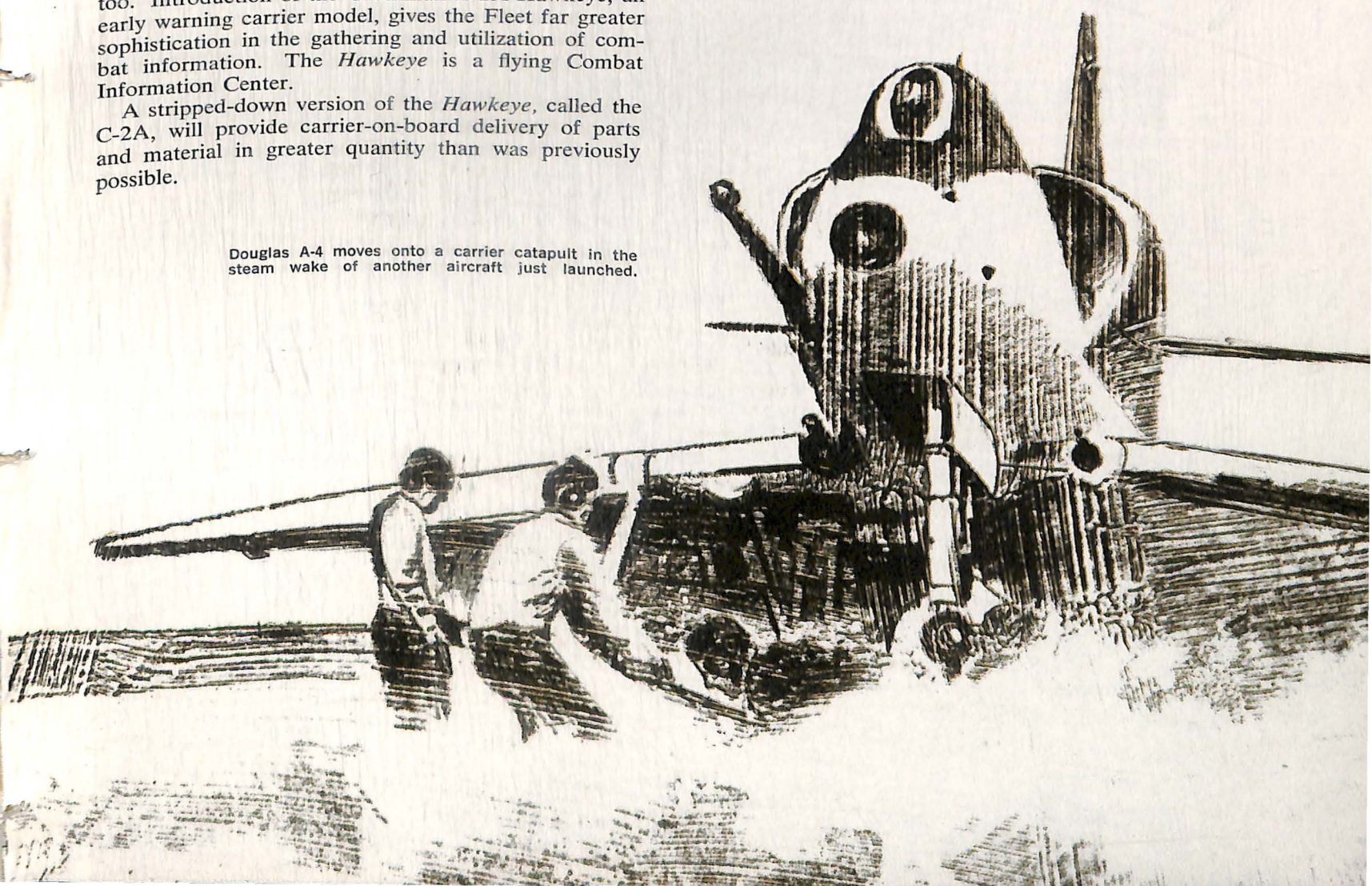
There also are experiments among the producers of helicopters, seeking to combine the vertical lift talents of helicopters with the greater speed of winged aircraft.

Another interesting future aircraft is the OV-10A, the North American Aviation twin-prop, twin-tail conventional aircraft. The OV-10A was designed as a counter-insurgency (COIN) airplane to serve as a reconnaissance spotter airplane, as an armed helicopter escort vehicle and as a cargo/personnel transport.

Support of Marine aviation is part of the Navy's general mission. This can be seen in a casual perusal of the Marine aircraft inventory. They fly their own F-4 *Phantoms,* A-6A *Intruders,* A-4 *Skyhawks,* to mention a few.

The Navy has been refining its supporting aircraft, too. Introduction of the Grumman E-2A Hawkeye, an early warning carrier model, gives the Fleet far greater sophistication in the gathering and utilization of combat information. The *Hawkeye* is a flying Combat Information Center.

A stripped-down version of the *Hawkeye,* called the C-2A, will provide carrier-on-board delivery of parts and material in greater quantity than was previously possible.



Douglas A-4 moves onto a carrier catapult in the steam wake of another aircraft just launched.

It is obvious, from this short recapitulation of the Navy aircraft inventory, that we will have a greater flexibility in our operations as newer aircraft are introduced. We will retain our nuclear delivery capability while being infinitely better equipped to carry on conventional war.

Since last February, the Navy has flown thousands of sorties from its carriers in support of the South Vietnamese people. In a recent month, Navy airplanes delivered more than 5,000 tons of bombs and almost 30,000 rockets in strikes against enemy targets in North and South Vietnam, while USMC aircraft delivered an additional 1600 tons of bombs and some 14,000 rockets.

Our flight schedules run the gamut of the U. S. tactical air warfare capability. Strikes on specific targets call for A-4 *Skyhawks* carrying conventional 250, 500 or 1,000 pound bombs. Other *Skyhawks* are loaded with five-inch Zuni rockets or 2.75 inch rockets, and some carry *Bullpup* guided missiles.

Our carrier based fighters — the F-8 *Crusaders* and F-4 *Phantoms* — carry out weather reconnaissance and perform strike escort duty. On strikes in the North, the fighters establish barriers to keep itinerant MIGs from interfering.

Our A-1 *Skyraiders,* the propeller-driven workhorses of many years, are relied on in jobs ranging from attacking night movements to performing search and rescue duties.

While we point to the fact that this is very much the "stick and rudder, gunsight, bullets and bombs" type of war, the element of sophistication is not to be overlooked in the case of enemy capabilities. They have, and are using, advanced defensive weapons which require the best we have to counteract them. It is no longer a simple war; it is now very sophisticated.

The significance of our carrier operations is in the "soup to nuts" planning involved. Buildings or bridges, locomotives or MIGs; these call for extremes in flexibility in ordnance loading, flexibility in pilot techniques and in scheduling.

The Seventh Fleet is a force of some 140 ships, 70,000 men and hundreds of aircraft. Our operations are conducted ashore and on the sea, as well as in the air. The Navy logistics operation — stretching 8,000 miles from the United States — requires both sealift and airlift. More than 90 per cent of all materials going to South Vietnam is moving by ship.

Part of the Navy's task consists of preventing the Viet Cong from receiving materials in support of operations. With the U. S. Coast Guard and the sea and junk forces of South Vietnam, the Navy has established a screen of 1,252 miles around the coast to prevent delivery of materials to the Viet Cong. This is comparable to guarding a coast stretching from Cape Kennedy to Cape Cod.

Each week our forces are at work identifying, searching and inspecting suspected smuggling craft. Each week, some 6,000 small ships are contacted and investigated.

Navy cruisers and destroyers have been providing Naval gunfire in the coastal areas, on call from the shore.

Based ashore in Vietnam are thousands of Navy personnel in supporting roles among the Vietnamese. More than 2,000 Seabees, the construction battalions, have been at work repairing bridges, building roads and digging wells, in addition to building airfields.

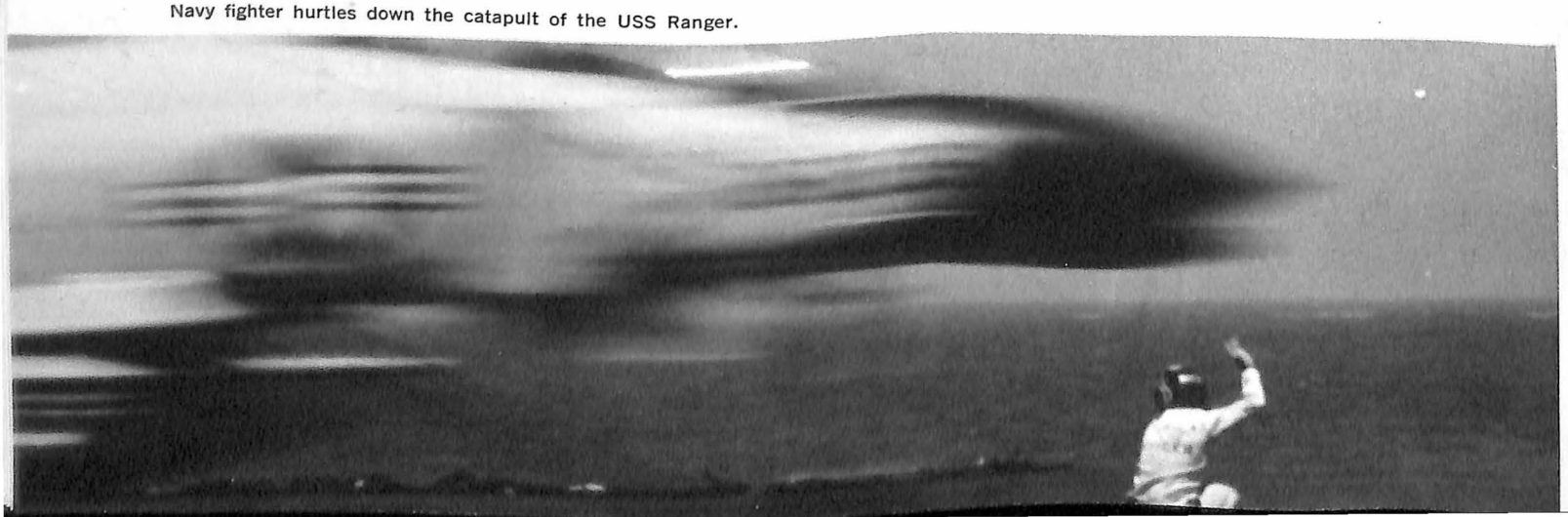
The Navy's Bureau of Yards and Docks is responsible, under the Department of Defense single construction agency plan, for all contract construction in Southeast Asia, Guam and the Philippines. Using several hundred contract employees as well as Army and Navy construction troops, the Navy is overseer of buildings for our troops as well as airfields from which all services fly.

Carrier aviation and other Navy units assigned ashore and afloat, each lend their own unique elements to complement that of the other Services. Together, these forces provide each other with the mutual support that greatly multiplies the effectiveness of this country's effort in Southeast Asia.

We've come a long way since Lieutenant Sweet set down his first operational requirement back in 1908. His simple vision of a deck to launch an "air scout" has evolved into ships such as the USS *Enterprise* and the USS *America,* with flight decks capable of receiving 30-ton aircraft at speeds of more than 130 miles an hour. His "wireless telegraph apparatus" has grown to include the sophisticated radars, communications systems, and instrumentation of the modern carrier aircraft.

But each year, in Washington, Navy men like Sweet are still trying to make educated guesses about tomorrow's problems and tomorrow's needs. It is not an *easy* job!

Navy fighter hurtles down the catapult of the USS Ranger.



USAF: Tactical Air Support

By General J. P. McConnell
Chief of Staff, USAF

To obtain an evaluation of tactical airpower today — especially where close-support aircraft operations are concerned — we can turn to a long list of authoritative sources.

Among the best sources are those Army commanders at all levels whose troops have been supported by units of our Tactical Air Command in combat or joint exercises. By drawing exclusively on their appraisals I could validate our approach to the tactical problem with no requirement for an expanded argument.

From other quarters, however, we are receiving comments that deal very properly, but a shade one-

General Dynamics F-111 (above) will be a major addition to the tactical air power of the Air Force. McDonnell F-4C (below) is proving its value in Vietnam action.

sidedly, with special and isolated examples of deficiency in the tactical field. More often than not, these critics cite the flaws which they can identify by contrasting the runway requirements, speed and loiter time of multi-purpose jet fighters with the characteristics that are considered optimum for the lower levels of conflict. For example, they can present a long list of reasons why a sophisticated jet aircraft based on a semi-prepared airfield is not completely suitable for close support of ground operations against small, widely dispersed guerrilla units in jungle terrain.

This type of criticism very obviously converts the sound principle of "management by exception" into a not-so-sound principle of "disparagement by exception." It fails to consider the requirements posed by the total span of tactical air operations — a span that encompasses many levels and modes of firepower application, and myriad variations in combat environments and political constraints.

There is still another major factor that has made tactical operations perhaps the most widely discussed yet least well understood aspect of our defense effort. I am referring here to the often expressed but mistaken notion that our accelerated action to improve the capabilities of the tactical element of the Air Force has been necessitated by prior emphasis on our strategic forces.

The facts of the case are that efforts to improve our tactical units have been under way throughout the entire history of military aviation. The primary reason for this is that the effectiveness of military aircraft in a tactical role was clearly demonstrated long before their potential in the strategic area had been recognized. Especially since World War II, there has been both the opportunity and the necessity to exercise our tactical forces and to modernize their equipment.

It should be understood, however, that without a clear margin of strategic superiority as an effective deterrent against general war, our tactical forces could not fulfill their intended role. The obvious reason for this is that a failure of our deterrent strategy at the general war level would compel us to employ a major portion of our high performance tactical aircraft in a strategic mode.

In approaching this problem on the basis of first-things-first, we therefore, of necessity, have taken all the essential actions to maintain a clear margin of strategic advantage. It is the extent to which these actions have influenced the communists' pursuit of their expansionist aims that should be identified as the primary cause for the increasingly prominent role which tactical air forces have come to play.

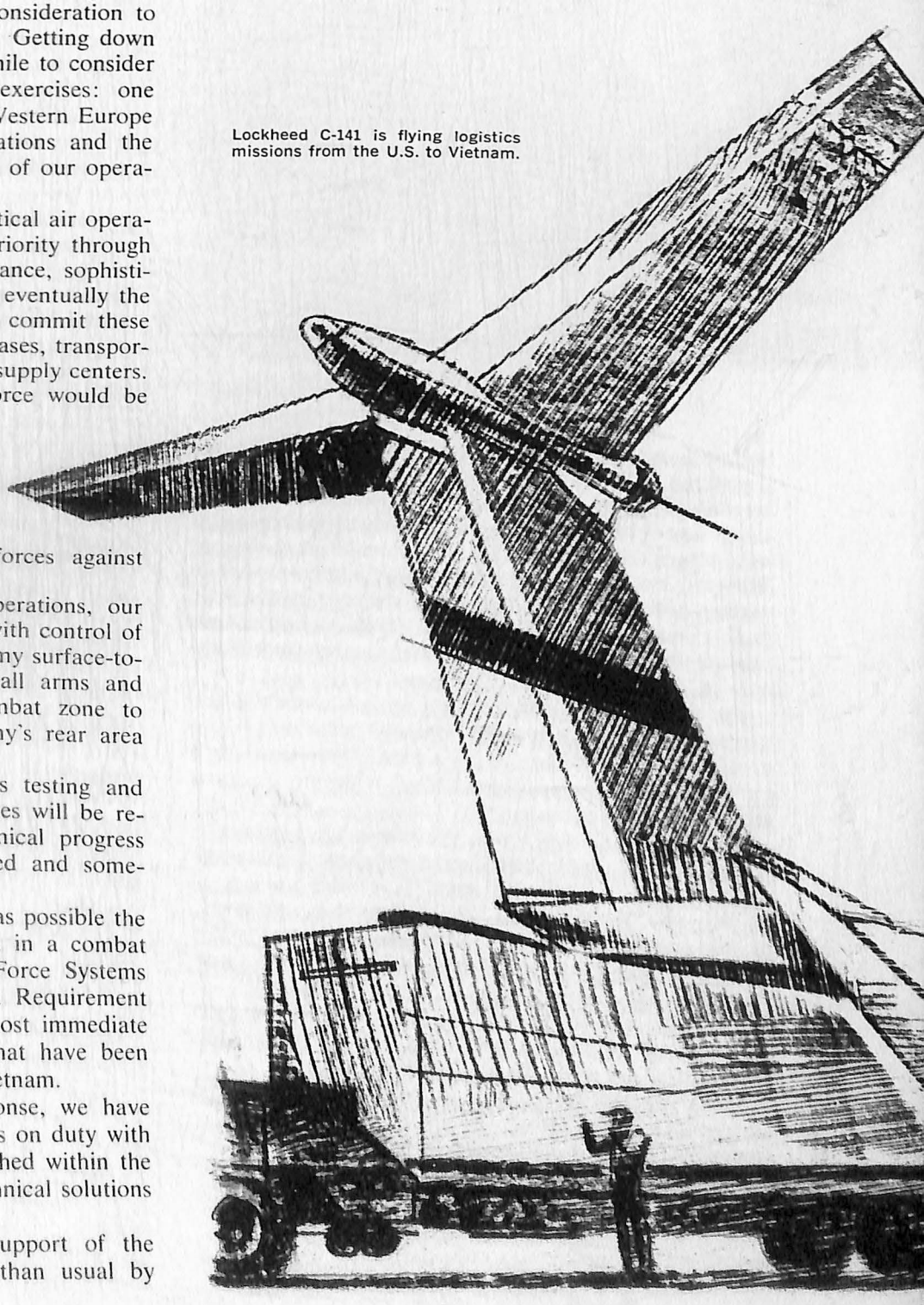
By shutting the door on communist opportunities for large-scale aggression and on their efforts to apply the technique of nuclear blackmail, our position of strategic superiority has forced them to test our will, strength, and patience at the lower levels of conflict. In this way we have created on the world scene something approaching a set of controlled laboratory conditions under which tactical forces can be employed effectively in resolving crisis situations along lines that are favorable to our interests.

In looking at the outcome of crises instigated and supported by the communists since World War II — from their abortive move against the Greek Government in 1946, to their present incursions against South

Vietnam — we can detect a remarkable pattern. In all of these crisis areas, with the possible exception of Berlin, our superior system of logistics and the greater mobility of our forces have given us a clear margin of tactical advantage. Further, tactical airpower's contribution to effective crisis management or conflict control in all of these cases has been substantial and at times decisive. Most important of all, the outcome of these crises, without exception, has been more favorable to our interests than to the communists.

An understanding of these points provides an essential basis for productive discussions of tactical airpower — especially its close support aspect. And again I stress the necessity for giving careful consideration to the total span of tactical air operations. Getting down to specifics, I think it would be worthwhile to consider two types of plans for joint tactical exercises: one addressing nonnuclear contingencies in Western Europe at the upper level of the tactical operations and the other addressing a problem on the scale of our operations in Vietnam.

For Western Europe our plans for tactical air operations call for the attainment of air superiority through large-scale employment of high performance, sophisticated fighters like the F-105, F-4C, and eventually the F-111. They would also simultaneously commit these aircraft to interdiction raids against air bases, transportation systems, and communications and supply centers. At the same time, a portion of this force would be operated in close support of ground forces against heavily defended enemy positions.



Lockheed C-141 is flying logistics missions from the U.S. to Vietnam.

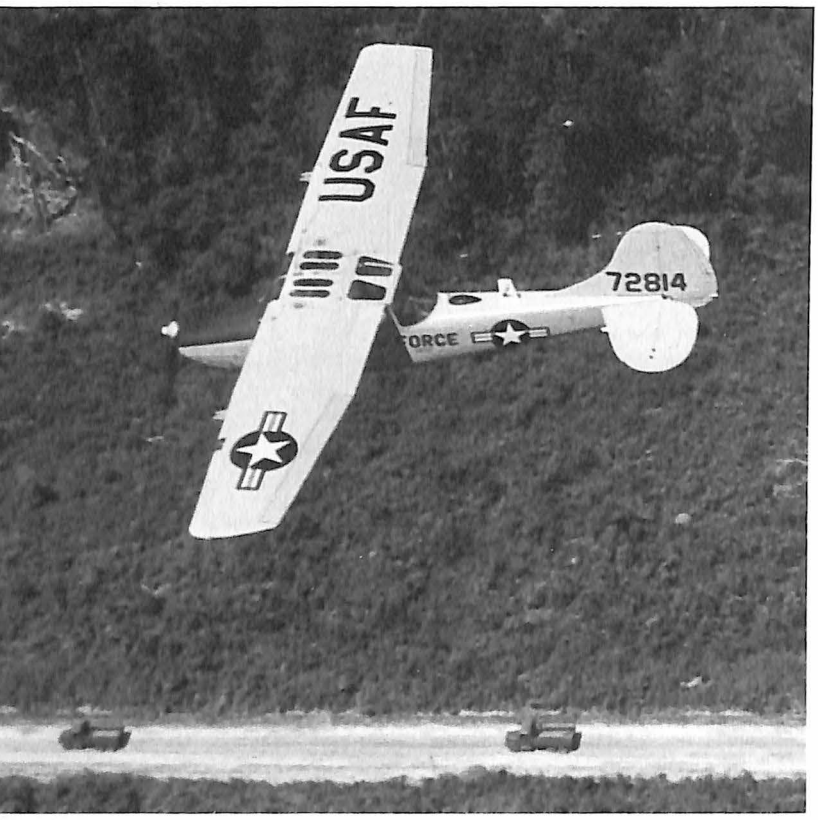
At the lower level of the tactical operations, our plans assume a permissive environment with control of the air uncontested. They assume an enemy surface-to-air defense capability, ranging from small arms and automatic weapons in the forward combat zone to surface-to-air missiles guarding the enemy's rear area interdiction targets.

We are keenly aware that continuous testing and improvement of equipment and procedures will be required due both to the impact of technical progress and to the problems presented by varied and sometimes new combat environments.

As one means of satisfying as rapidly as possible the new requirements for effective operation in a combat zone, we have established in our Air Force Systems Command a Southeast Asia Operational Requirement procedure. This procedure gives us almost immediate notification of new operational needs that have been identified by our tactical air units in Vietnam.

As another guarantee of quick response, we have placed Systems Command representatives on duty with our deployed units and we have established within the Systems Command a focal point for technical solutions to the needs that arise.

In South Vietnam, our close air support of the ground forces is made more difficult than usual by



Cessna O-1E is extensively used by Forward Air Controllers to spot targets.

wider deployments of forces in relatively small units compared to past experience such as Korea. In previous operations, we could be confident that close support targets would materialize along a fairly well-known line of contact with the enemy. We could position our Forward Air Controllers with those ground forces in contact with the enemy, set up our communications and deploy our fighters with some confidence that our posture would be very close to maximum responsiveness in close air support.

By contrast, in South Vietnam we are confronted by a situation in which ground contacts occur in an unpredictable pattern over a wide area. This challenges our ability to be ideally positioned with the elements critical to close air support.

To deny Viet Cong forces the advantage of remaining undetected until they decide to move against an objective, we are placing greater reliance on visual sightings by Forward Air Controllers than on photo reconnaissance. We also have given them better equipment for optical sighting, detection and communications.

And we are rapidly developing equipment that will improve our ability to mark obscure targets so that fighter pilots can more readily find them.

These actions should not be regarded as a long-delayed awakening of the special problems of tactical airpower in unsophisticated environments. Rather, they represent a vital extension of our long term efforts to solve those problems. In fact, it is doubtful if any military force in history has ever been subjected to testing and evaluation that approaches the realism and intensity of that being applied to measure the combat effectiveness of the Air Force's tactical elements.

Long before our intensive evaluation of close support capabilities in Southeast Asia, we had begun a much wider range of testing in the joint exercises monitored by the U. S. Strike Command.

Planned, executed and evaluated by Army and Air Force officers with tactical experience ranging from World War II to the present, these exercises have confronted our tactical forces with contingencies that could develop anywhere at any time.

During the Indian River and Gold Fire Exercises last year, the Air Force demonstrated its capability to support Strike Command in joint tactical operations. In preparation for these exercises, the Tactical Air Command quickly recognized some very important needs for improved hardware and technology. As a result, the Air Force Systems Command has teamed up with TAC on a long list of quick reaction projects to provide the best possible tactical capability. Several impressive demonstrations of new technology have been made in areas of real time reconnaissance, airborne command posts and tactical airlift aerial delivery.

Looking to the future, we must push the development of improved types of tactical aircraft along lines that will satisfy a number of distinct combat tasks.

For the counterair battle, we have learned, both from operational experience and intensive studies, that enemy air must be attacked at its source or its home airfields. As the most sophisticated aircraft developed for this mission, the F-111, which is scheduled to enter our inventory in 1968, will greatly increase our capability. With variable sweep wings permitting speed ranges from one hundred to eighteen hundred and fifty miles per hour, that aircraft will have a capacity for unrefueled overseas deployment and for delivery of vastly increased payloads. I am greatly encouraged by the outcome of flight tests indicating our progress toward obtaining this versatile and high performance aircraft.

For the interception role we need a high performance aircraft that can intercept and kill under conditions where visual sightings are not assured. In the past, we have attempted to develop our tactical fighters so that they would have multi-capabilities for air defense, interdiction, and close support. This course has frequently led to compromises in the performance required for a specialized task. We therefore must continue to develop better solutions to these problems for the future.

An aircraft developed for air-to-air combat can perform adequately in all of the other tactical roles, but the reverse obviously is not true. Therefore, when we decide to develop an air-to-air combat vehicle, the most important criterion must be its ability to outperform enemy fighters.

In a close support role we must have an aircraft that can seek out and identify the target, an aircraft with proper weapons aboard to strike the target, and a method of directing the aircraft to the target.

In the counterinsurgency role we need small, rugged aircraft capable of operating from semi-prepared surfaces with varied types of armament and ordnance loads. Applying operational techniques normally em-

Northrop F-5 is undergoing extensive combat evaluation in Vietnam.

ployed by tactical air forces, these aircraft should be useful against small guerrilla bands and tribal uprisings. They also should be suitable for employment by the police, border patrol, or other paramilitary forces. Naturally, they must be adaptable to procurement, on the basis of simplicity and low cost, through the Military Assistance Program, for unmodernized countries.

We feel that the eventual development of V/STOL tactical aircraft is potentially promising especially for dispersed counterinsurgency operations.

In the fields of weapons, command and control, logistics, and organization there also is a requirement for much progress in developing the capabilities that we will be called upon to apply at the tactical level.

This requirement, however, should not be regarded as an indication that our tactical forces at this time are performing a less than outstanding role. To the contrary, we are receiving daily reports of their impressive operations in Southeast Asia, including such items as a recent account of Air Force sorties in close support of Army troops at Plei Me. That account showed that our "first fighters arrived on target five minutes after the first flareship arrived at Plei Me. From this time on for the next nine days air was scheduled in for continuous coverage and provided immediate reaction.

"Fighters were available constantly during the entire siege with six hundred and four direct air support strike sorties with ninety-five of these being at night. These night sorties were supported by twenty-six flareship sorties. All requests for strike, flares, and Forward Air Controller sorties were honored."

A terse but significant summary of effects produced by these Air Force operations, together with the Navy and Marine sorties flown during that period, was contained in a press account which read, "The Viet Cong attack against Plei Me and an abortive ambush Saturday night of a relief column was in reality a test by the communists of their ability to deal with American airpower during major Viet Cong assaults. On the face of it, the test was a failure."

As concluding points concerning our approach to the improvement of tactical airpower, especially in the area of close support operations, I want to emphasize several Air Force convictions.

One of them is our wholehearted adoption of the joint force concept that no single Service can possess the means to fulfill all of its combat or support needs. Each Service must rely on the others for fulfillment of certain requirements, such as sealift, airlift, security forces and specific types of supporting fire. Joint Force commanders are responsible for integrating Service force capabilities within an overall scheme of operations that best utilize all of the forces available.

The Air Force also holds to the principle that such integration of the combat power of all Services into a fighting team, under the direction of the Joint Force commander, is fundamental to economy and efficiency and assures the most effective accomplishment of the mission.

Where equipment is concerned, our conviction is that we must develop, test, and evaluate our systems in terms of their contribution to the total span of tactical operations from the nuclear through the counterinsurgency levels of conflict.

GODDARD LIBRARY

The Robert Hutchings Goddard Library at Clark University, where America's pioneer space scientist served as a faculty member for 29 years, will be a facility of long-range interest to the aerospace industry and space age scientists and historians.

In addition to being a new University library serving the Clark University community in Worcester, Mass., of 1,500 students and faculty, the Goddard Library will be the permanent repository for Dr. Goddard's professional and personal papers and memorabilia. Foremost in this remarkable collection of Dr. Goddard's papers are his 214 patents, which Dr. Wernher von Braun, Director, Marshall Space Flight Center, often has called "the blueprints of the Space Age."

A special room, handsome in design and well-secured, has been arranged on the ground-level of the building to house the Goddard papers. In this area, because of the importance the collection will have as a basic resource for Space Age scholars, the University has made provisions to assure that scholars, historians, scientists, writers and special visitors will have access to the collection and will be provided with comfortable research and study facilities in which to work.

As the Space Age progresses and brings with it increased awareness of Dr. Goddard's major accomplishments, the general public may well seek to know more about the man, his life and his work. In anticipation of this fact, the University has planned a hall adjacent to the Goddard Collection Room in order to present visual highlights of Dr. Goddard's creative career as an inspiration to visitors from all over the world and to school children, in particular. This area, the Goddard Exhibition Room, will be equipped with the latest and the best in exhibit techniques and materials, and will feature select examples of Dr. Goddard's early rockets, related hardware from the University's existing exhibit and supporting materials from other sources acquired on a loan basis.

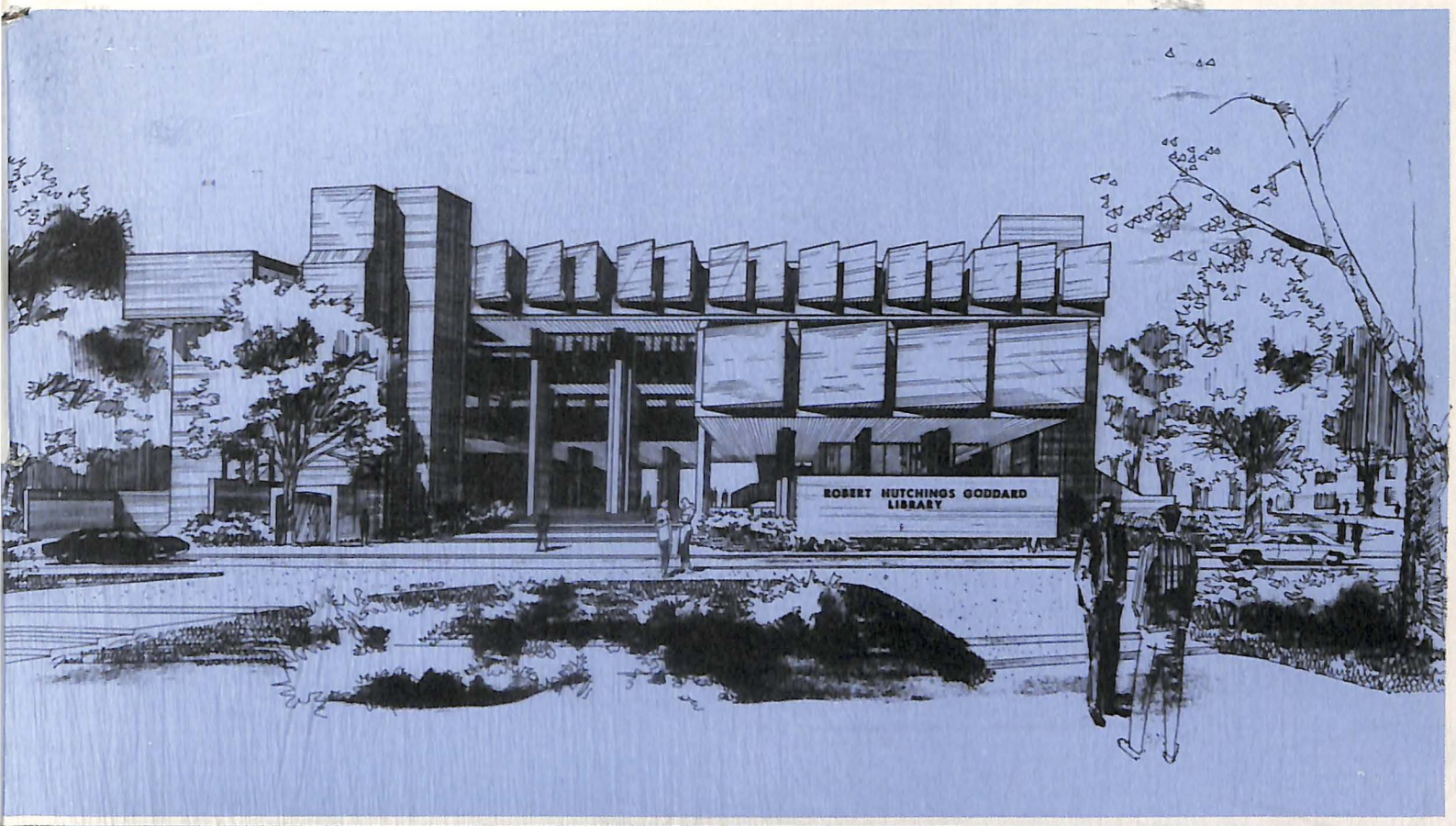
The Goddard Library site also has been selected as the place where the National Aeronautics and Space Administration will erect a sculpture to be the national memorial to Dr. Goddard. Legislation authorizing NASA to proceed with this tribute was approved by Congress in October.

Almost certain to be of particular interest both to the technician and the layman who make such visits will be the Goddard Papers. A gift to the University from Mrs. Robert H. Goddard, a trustee and alumna, this important collection is tangible evidence of Dr. Goddard's comprehension of the overriding importance of precise knowledge — of its patient acquisition and preservation.

Many leading aerospace corporation executives and government officials have accepted important roles in the program's organization. Among the program's leadership are J. Leland Atwood, President of North American Aviation, Inc., who is serving as General Chairman; Courtland S. Gross, Chairman of the Board of Lockheed Aircraft Corporation, the Chairman of the Aerospace Corporations Division; Jack S. Parker, Vice President and Group Executive, Aerospace and Defense Group of the General Electric Company, the Chairman of the Electronic Corporations Division; and William J. Coughlin, editor of *Missiles and Rockets* magazine, the Chairman of the Public Relations Division. Others who hold key leadership positions in the Program include James E. Webb, Administrator, NASA, and Col. John H. Glenn, Jr., U.S.M.C. (Ret.), NASA astronaut, both of whom are Honorary Chairmen; Dr. Raymond L. Bisplinghoff, Special Assistant to the Administrator, NASA, and a member, Board of Directors, American Institute of Aeronautics and Astronautics, who is serving as Chairman of the Professional Societies Division; and Dr. Wernher von Braun, Director, Marshall Space Flight Center, who is Chairman of the International Sponsors Committee.

Among the persons announced as members of Dr. von Braun's Committee are Dr. Robert R. Gilruth, Director, NASA Manned Spacecraft Center, Houston; Dr. William H. Pickering, Director, Jet Propulsion Laboratory; and Rep. George P. Miller of California, Chairman of the House Committee on Science and Astronautics.

Nearly one-third of the necessary funds sought have been pledged to the program and the University has made plans to break ground for construction next March — the 40th anniversary of Dr. Goddard's successful rocket firing on March 26, 1926 in Auburn, Massachusetts.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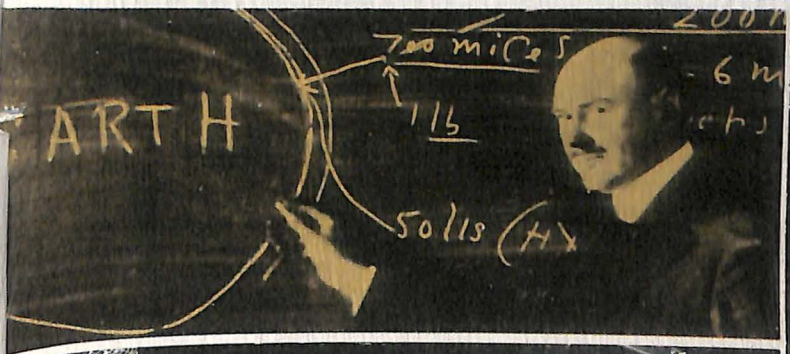
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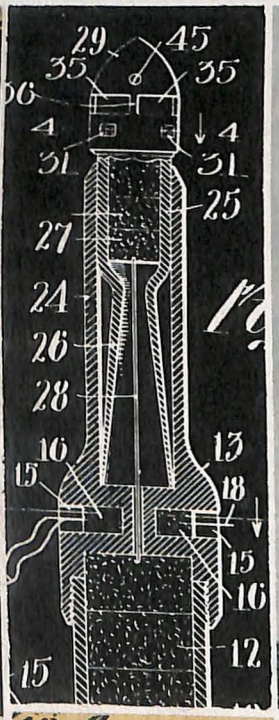
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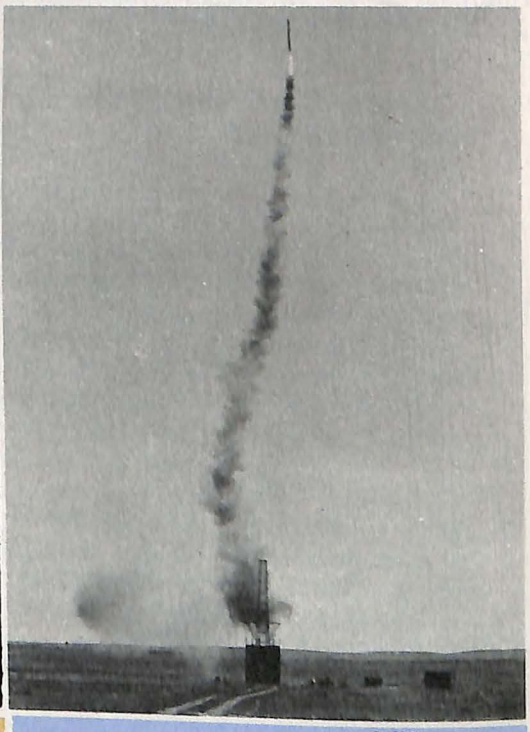


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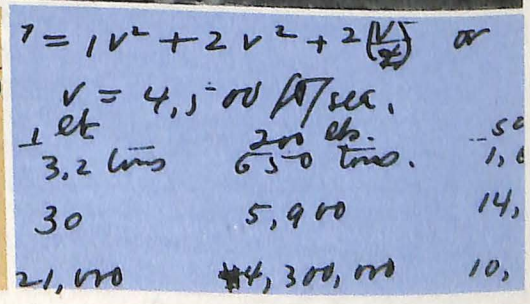
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$v = 4,500$ ft/sec.
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20 lb.
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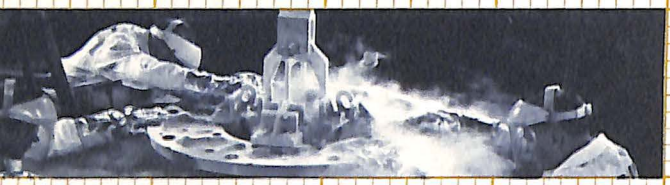
$4,300,000

NATIONAL GROWTH AND AEROSPACE TECHNOLOGY



"Spill-over" and "spin-off" are two words which have crept into the lexicon of the U.S. economy during the past five years. They describe a phenomenon that has been widely discussed, but still is not fully understood.

This phenomenon is the utilization of technology from defense and space programs in the civil economy where it becomes commercially useful and sparks national growth.

The main questions have concerned the amount of spill-over that has occurred and how important it is to civil industry. A good deal of work already has been done to get answers — enough work, in fact, to predict that a thorough enlightenment can be expected in the next few years.

It is becoming clear that the U.S. industrial boom for the past decade has been vitally dependent on the advanced technology created by the aerospace industry in carrying forward the defense and space programs. Evidence is growing that this advanced technology will be even more important to the nation's overall industrial prosperity in the decades ahead. A massive and continually growing infusion of advanced technology will be needed to keep U.S. industry strongly competitive in the world market where it does not enjoy the benefit of relatively low labor and materials costs and often must face formidable tariff barriers.

The principal source of advanced technology has been and will remain in the aerospace industry. Only in its programs are the technical goals high enough and the national requirements urgent enough to move forward in major steps. As these steps are completed and as the technical goals are achieved, the entire economy falls heir to the new technology. There are not two separate worlds of engineering — one for defense and space products, and one for the civil market. New knowledge of importance to missile manufacturers is also important to manufacturers of commercial goods. The main difference is in the timing for employing new technology. Usually, new technology cannot be put to economic use as soon in civil activity.

Very briefly, the key goals in the defense and space programs, as in all engineering, are:

1. Lowering costs.
2. Improving the efficiency of motors, generators and all other energy conversion devices and processes.
3. Improving design, that is, reducing the weight and increasing the strength of all machines, by either improved knowledge of the machine or by using lighter, stronger materials.
4. Improving the accuracies to which machines can be controlled.
5. Improving reliability.
6. Improving communications between men, between men and machines and between machines.

In brief, these are the basic things that engineering always has been about, since the construction of the pyramids and before. They have remained the same even though the number and variety of technologies and

industries have expanded far beyond any vision of the ancients, or even of any man who has lived through the modern technological revolution. Unless some totally unexpected changes occur, these goals will not change as the world goes about creating a completely new civilization during the next thirty years.

The relative importance of each of the goals varies from industry to industry and also changes with the times within each industry. However, when major improvements can be made in any of the technical goals, it usually is possible to gain a competitive advantage in business. When major improvements can be made in several areas simultaneously then technology can be a vital contributor to a strong and continuing economic prosperity through the introduction of new products, lowered costs for all types of goods and services, and the creation of new industry.

In the past, the only important source of new technology which has allowed major improvements simultaneously in several areas has been the aerospace industry with its defense and space program responsibilities. In the future, the continued importance of this industry as a source of advanced technology seems to be assured.

Unfortunately, there is no easy way to establish accurately just how important advanced aerospace technology has been to industry and the nation's economy. Modern technology is exceedingly diverse, and tracing the genealogy of its various branches is a complex task. Considerable scholarly work has been done in an effort to quantify the effects of advanced technology; but none of these studies has been accepted as the definitive work on the subject.

A number of other efforts also have been made in recent years to determine what spill-over exists. Congress, for example, has worked hard to get answers, but much remains to be done. A statement by Vice President Hubert H. Humphrey two years ago when he was leading a Senate investigation still is applicable. He called for a less intuitive and philosophical approach to explaining spin-off. He said, "The statement (that spin-off is large) is made repeatedly, but the statement does not always substantiate the fact . . . what is needed are facts to substantiate the statement."

Vice President Humphrey and many other leading government figures, both inside and outside the Administration, have stressed the need for clarifying the relationship between the spill-over phenomenon and the growth of the economy. They are concerned about the rate at which our technological society must be kept growing, if an increasing population is to find increasing opportunity, if the U.S. government is to continue to meet its responsibilities, and if there is to be any hope for all men to raise their standard of living.

The U.S. investment in advanced technology during the past 25 years is gigantic by any past standards. Since 1940 the government has spent more than $100 billion with 75 percent of it in the military and space programs. To illustrate the uniqueness of this invest-

ment, it is about 100 times the amount spent on R&D in the United States during the first forty years of this century. This is several times greater than the R&D investment in the recorded history of all nations prior to 1940.

It is essential to understand the full effects of this heavy investment on the nation's overall technological vitality and economic health. Future top level planning in government and industry cannot be sound if the incubation processes of useful technology are not fully understood.

No one expects that the defense and space programs will ever be conducted with an eye to promoting spill-over.

For example, the Defense Department has made it quite clear that fostering spill-over is not one of its concerns. Military necessity and improving the national defense are the only justification which will be accepted in the planning of DOD objectives. However, the defense and space efforts have shown that advanced technology is important to the economy. Regardless of what the future brings politically, and what military and space requirements will be ten or twenty years from now, the need for advancing technology will remain. Planners must have better information on the effect of this technology on the national economy, and the effectiveness of the military and space programs in producing this technology.

Today, the situation definitely is improving. Facts on spill-over are being generated at an increasing rate in government, industries and universities. More important, an improved framework is being built for gathering and for understanding the facts.

One of the major realizations today is that there are three main phases in the creation of new technology. The first is basic research — pure science at work. Progress in this phase cannot be directed or predicted. It depends primarily upon the support and freedom that are allowed truly creative scientists.

The second phase concerns the development of engineering principles which will allow the new basic knowledge to be applied to practical problems. Experience during the last decade has shown conclusively that small-scale, generalized laboratory studies cannot accomplish all that is needed in this phase. Rather extensive units of experimental hardware must be built and tested under conditions which closely resemble their operational environment to obtain data which can be used to accurately predict the performance of complete systems.

The third phase is the development of complete operational hardware systems. Such systems usually draw information from a wide variety of phase two engineering projects. If the phase two work has been conducted thoroughly then the operational systems can be designed with a high degree of confidence and produced on reasonably accurate cost and time schedules.

The precise breakdown of these phases, the number of phases and the nomenclature used to identify them often varies in government and industry organizations. However, R&D administrators have come to agree, in principle, that there are these three phases which are vital in the development of technology. They also agree that the neglect of any one phase will lead rapidly to trouble. Basic research must be conducted continually. Engineering data must be developed in a

Maser, laser technology evolved from an esoteric branch of science twenty years ago. It is estimated that by 1970 masers will represent a business activity between $250 million and $1.25 billion annually.

systematic and continuing manner. Advanced equipment must be produced on a regular basis if design and factory groups are to stay up with the times. If one phase is neglected for long in any major technology, then the nation soon will be incapable of responding to opportunity or crisis by timely production of reliable, new advanced systems.

Crash programs have produced operational systems quickly in the past, but usually it was necessary to neglect phase two work. Often this resulted in inaccurate engineering predictions, cost overruns, and optimistic predictions of delivery dates. Experience has shown that the orderly development of technology requires the three phase approach.

This rule is universal. Civil industry is bound by it as much as the defense and space business. A large reservoir of basic scientific information and engineering data is needed to produce any type of modern system in an orderly, predictable and economic manner. Although civil industry contributes to the generation of this necessary data the vast majority of it comes from the aerospace industry's defense and space programs.

A prime example of how the total system works has been given by Dr. Raymond L. Bisplinghoff, an outstanding scientist from the Massachusetts Institute of Technology who now serves as a special assistant to the NASA Administrator, and who has become one of the most persuasive and articulate disciples of an orderly technology development program for the space agency and the nation. Dr. Bisplinghoff cites the maser as a "textbook" advanced technology case.

The maser originated shortly after World War II due to scientific curiosity in a highly specialized field dealing with the behavior of gases and weak magnetic substances in electromagnetic waves. After about five years of fundamental work on the absorption of microwaves by gaseous ammonia the first workable maser was produced. The maser made it possible to focus, amplify and control electromagnetic energy in a manner never before dreamed possible.

Many talented people were attracted to this field and many new ideas and devices appeared. In the space of a decade the technology moved into the basic engineering study phase and the development of operational systems. Today, more than 500 groups are active in all three phases of maser and laser technology.

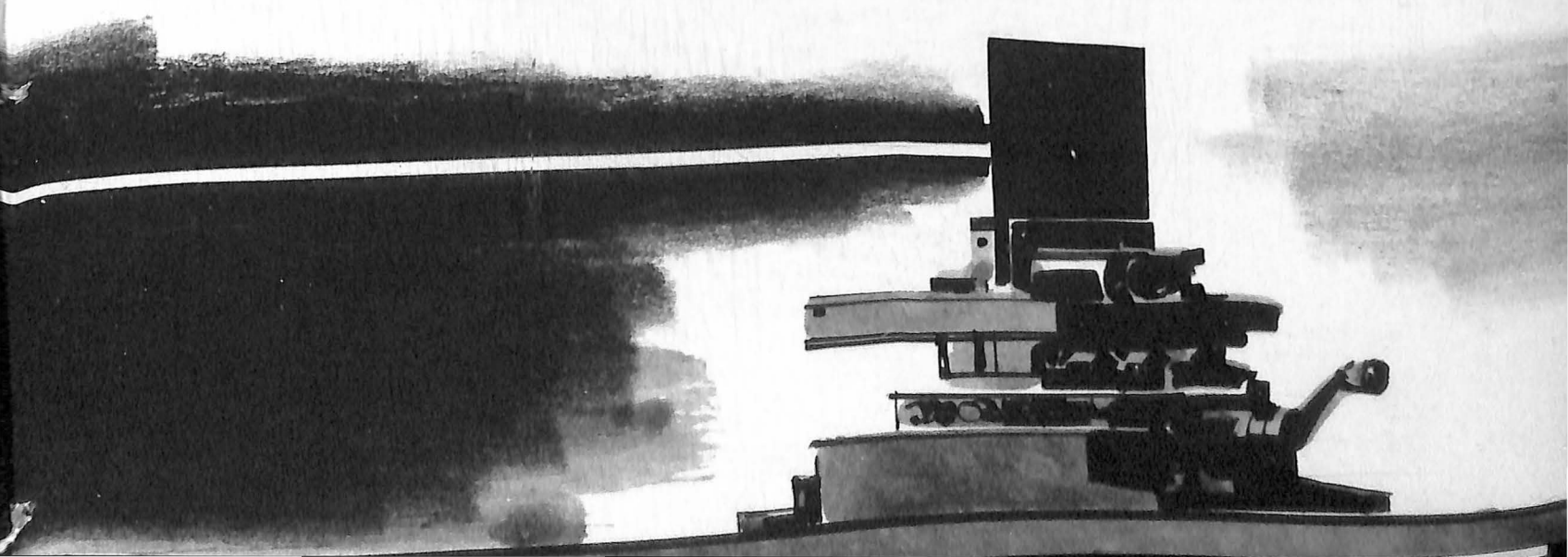
Dr. Bisplinghoff cites financial study estimates that by 1970 masers will represent a business activity somewhere between $250 million and $1.25 billion per year. He also reminds us that no one was able to predict the birth of this new technology. No laboratory director or businessman foresaw that these basic new principles could be put to work in creating an array of devices of completely unprecedented efficiency and precision. These include clocks, long distance and microscopic measuring instruments, manufacturing tools, electromagnetic amplifiers and communications and observation equipment.

Most of the support for maser and laser technology has come from the defense and space programs. The total return on this investment is most difficult to estimate, but it is certain that many billions of dollars will be spent in the civil market for maser and laser devices during the next fifteen years.

Few other examples of spill-over are as easy to document as the maser. Tracing products directly from the defense and space inventory into the civil market has not been a particularly fruitful means of showing the effect of spill-over, and probably never will be. Very few equipments make the transition in recognizable form. It is the technology that is important, but tracing technology often is difficult because of the time lag between the three phases of technology development and the lag customary between defense and space applications and civil uses.

For example, NASA's manned space program today, with its goal of landing men on the moon by 1970, is built primarily on technology developed during the 1950s in the military strategic missile and aircraft programs. NASA is aiming at a new order of equipment reliability, but it is using proven technology of the 1950s as a starting point. The space agency's own advanced technology effort cannot help it materially for a number of years. This program is budgeted at more than $500 million per year and supports a broad spectrum of activity from fundamental research through development of advanced hardware subsystems. It is aimed at gathering the engineering data needed to design a new generation of more efficient space vehicles which can carry men to the planets and remain in space for very long periods without failure.

Similar time lags exist in commercial applications



of technology. The most important commercial technologies today undoubtedly had their origins in the military R&D effort from 1940 to 1955, and in basic research conducted before 1940. And, the technology of greatest commercial importance during the 1970s will spring from the 1955-1965 military and space R&D efforts and from basic research conducted before 1955.

It appears that the best means of gathering facts about spill-over is to study the commercially important technologies of the past 25 years and to trace them to their origins. This will be a huge job for there are more than 30 major industries in the U.S. However, spill-over investigations made in government and industry are leaning toward this method.

The technology of major interest is rather easy to isolate. It is the technology responsible for increasing worker productivity which is a key indicator of efficiency for modern industry. As worker output per hour increases so does the average worker's standard of living and industry's overall ability to compete on the world market.

The fact that the United States has lead the world in worker productivity for many decades is appreciated fully in the Communist as well as the Western nations. Soviet leaders have constantly exhorted their people to catch the U.S. in productivity per worker as well as in gross national product. They emphasize that unless productivity rises as well as the total national output it will never be possible to increase take home pay, the percentage of consumer goods produced or the standard of living.

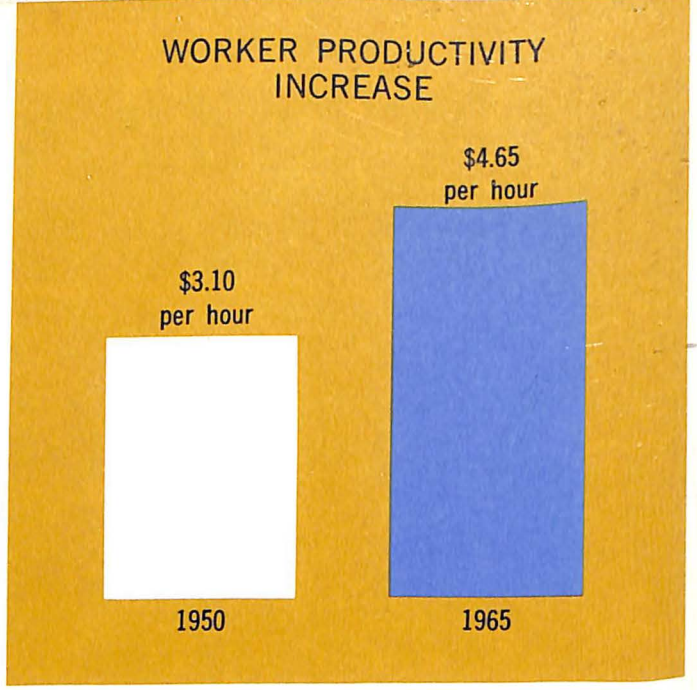
In the U.S. and elsewhere worker productivity in dollars per hour is computed simply by dividing the total output, or gross national product of goods and services, by the total number of man-hours worked. Over the years both have risen sharply and they are the central factors in continuing U.S. prosperity. The gross national product was $100 billion in 1940 and $670 billion in 1965. Worker productivity rose from $3.10 per hour in 1950 to $4.65 in 1965.

A number of factors have contributed to rising worker productivity. These include: improved management, reduction of overhead costs, better sales and distribution techniques, improved selection of finished products, and technical improvements. These factors are overlapping in many respects but technical improvements have had the most to do with boosting productivity, and it is these technical improvements that provide a means for properly understanding spill-over.

Probably the most important technical innovations today are involved in the automation revolution, which is rapidly raising worker productivity in many industries. The three keys to successful automation are:

1. Machine tools which can work to very close tolerances with high repeatability.
2. Servo-control systems which can sense what the machines are doing and feed back the necessary correction and instruction signals.
3. Electronic computers which can store millions of bits of instruction information and release them into the servo-controls in a logical fashion.

The technology of commercial systems of all three types grew out of the defense programs of the 1940s and 1950s.



The best machine tools today are constructed to tolerances measured in millionths of an inch which is about ten times better than 1940 technology. This gives them a high repeatability in high speed automated production. The electronic gages and other high tolerance measuring equipment, and the precision cutting and grinding tools which allow such machines to be built virtually all grew out of aerospace technology.

Another key feature of these machines is hydrostatic bearings which gives the cutting tools an automatic center-finding capability and allows them to remain precisely positioned. The technology of these air and hydraulic bearings reached maturity during the development of inertial guidance systems for aircraft and missiles.

The servo-control systems essentially are adaptations of the autopilots which control missiles and airplanes. The first such non-human feed-back device generally is reported to be the fly-ball governor used to control the gap between the stone-burrs on water-driven flour mills. The forerunners of today's systems were servo devices used to steer automatically the battleship New Mexico across the Gulf Stream and to fly pilotless aircraft as early as World War I. This general type of system was improved during the 1930s and became the aircraft autopilots which were widely used in World War II. Constant improvements in the mechanical and electrical components plus advances in design concepts have led to the precision systems in existence today.

The intriguing story of the electronic computer has been well told many times. The development of this technology has been strongly supported by government agencies since the first equipment entered development in the later 1940s. Today, it is a multi-billion dollar industry and it is still growing.

Another example of a major new technology which has significantly increased worker productivity is powder metallurgy. With these techniques complex

high tolerance parts such as gears can be made by pouring metal powders into powerful die presses which compress them into solid pieces of high strength. Usually no machining is necessary to finish these parts. The fact that the powders can be measured accurately allows an unusually close control on alloying and cuts wastage to what seems to be an irreducible minimum. Powder metallurgy technology rose with support from the defense program. Today it is of considerable importance in automobile manufacture and other civil industry. Rapid growth is predicted for the future with a forecast for a market of at least $500 million for iron powders alone by 1970.

Spill-over from North American Aviation's XB-70 Mach 3 aircraft development has been well documented. The airplane's requirements for high strength, high temperature materials has resulted in numerous technology advances. One was explained by Dr. George A. Roberts, president of Vasco Metals, Inc. of Latrobe, Pa. when he said, "The XB-70 pushed the vacuum melt steel industry ahead seven years." This step forward was brought about because the XB-70A needed H-11 steel heat-treated to a tensile strength of 300,000 psi, nearly twice World War II standards. Even though steel men initially didn't believe it could be done without making the H-11 alloy excessively brittle, it was done. In fact, H-11 and several other alloys have been taken to higher strengths. Dr. Roberts reports, "The commercial market for these vacuum melted steels will be so great we can't begin to realize the growth."

Similar advances were made with thin stainless steel sheet. Only a few years ago the steel industry was rolling high temperature stainless steel to a thickness of two thousandths of an inch in sheets 24 inches wide. This was considered a breakthrough. Then North American wanted this gauge thickness reduced by two-thirds. Many materials engineers still can't believe this was achieved. Today large quantities of sheet only seventy-five ten thousandths of an inch thick are being produced. And the accuracy of sheet thickness is 3 percent instead of the old industry standard of 10 percent.

Rudy Bruner, president of Rodney Metals in New Bedford, Mass., reports that hundreds of new customers are buying such steel sheet for electronic, instrumentation, surgical equipment, recording tapes, dental tape, TV tube screens, atomic energy equipment and so on. The market is world wide, not just a domestic one.

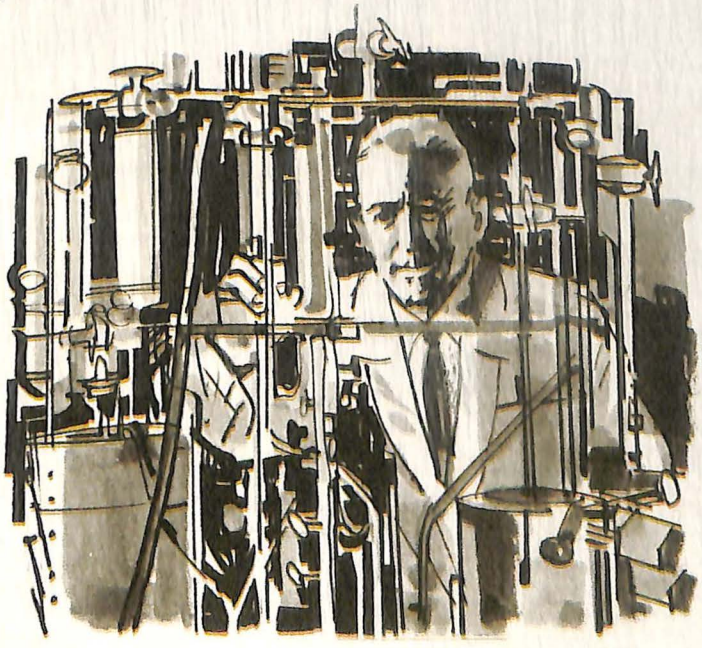
A promising new technique which is nearly ready for the commercial market is the radiation treatment of resin impregnated woods to produce a wood-plastic material that looks and feels like natural wood but is much superior. The new material is stronger, tougher and harder than natural wood and has greater dimensional stability, water and moisture absorption resistance, weatherability, decay resistance, machineability and with the proper additives, fire retardancy.

Work in this area began in the mid-1950s at Brookhaven National Laboratory. The Russians apparently became interested in 1957. Then in 1960 a series of extremely fruitful basic experiments, which are still continuing, began at the University of West Virginia with the support of the Atomic Energy Commission. Lockheed Aircraft Corporation has moved the effort a step forward by systematically generating a large store of engineering data on various wood-plastic combinations at its Georgia Nuclear Laboratory. Commercial production is a possibility in the near future.

Another type of report indicates that spill-over will increase in the future. These forecasts predict what our economy, our industry, our homes, our educational system and all aspects of our society will be twenty or thirty years from now. One such forecast prepared by The Research Institute of America, Inc. states that processes such as powder metallurgy, electrochemical machining and high energy rate forming will be standard throughout industry in a wide range of commercial tasks by 1980. They owe their development primarily to the aerospace industry where they are used today to produce operational hardware. Significant advances in the art are expected in the future.

Looking back into the roots of the present technological revolution and looking ahead into the exciting future, it is impossible to escape the central role that the aerospace industry and the defense and space programs have played and will play in developing technology and in catalyzing economic advances in civil industry. A tight relationship exists between the economy and technology, and prosperity depends upon advancing technology. So many facts are being gathered that our understanding of this important relationship is certain to increase dramatically in the near future. Probably we will find that the dependence is so great that "spill-over" and "spin-off" will fade from the lexicon of our economy. Advanced technology from the aerospace industry and the defense and space programs will be known as the "main spring" or the "main artery" which allows all our industry to stay modern and competitive. — *J. S. Butz, Jr.*

Since 1940 the government has spent more than $100 billion on research and development — 75 percent of it in the defense and space programs. This is about 100 times the R&D investment made by the U. S. government during the first 40 years of this century. The aerospace industry was responsible for carrying out the major portion of the government's R&D investment.



PROs TAKE TO THE AIR

Thirteen of the fourteen teams of the National Football League use air transportation — 208 flights covering 145,055 miles — to travel to their pre-season and regular games this year. Six of the American Football League teams travelled 78,705 miles on 91 trips with United Air Lines. ■ The popularity of air travel with football teams is due to the same appeals that air travel has for businessmen: speed, convenience and service. A team is able to practice at home on the day before a game, arrive in time for a night's rest, and return home after the game. ■ Logistics for transporting a football team requires the attention of a sports representative from the airline. A team carries nearly a ton and a half of equipment, including personal luggage. "Athletic" meals (larger servings) are put aboard. Steak is the favorite and some teams have consumed 30 pounds of beef after a game. Extra milk and soft drinks are always carried since a pro player sometimes loses as much as nine pounds in a game. ■ The football professionals also appreciate the skills of other professionals on the trip — the pilots and crew. They invariably applaud after a good landing. On a rare rough landing, a pro team was silent until one player called out: "Same team, run that play over."

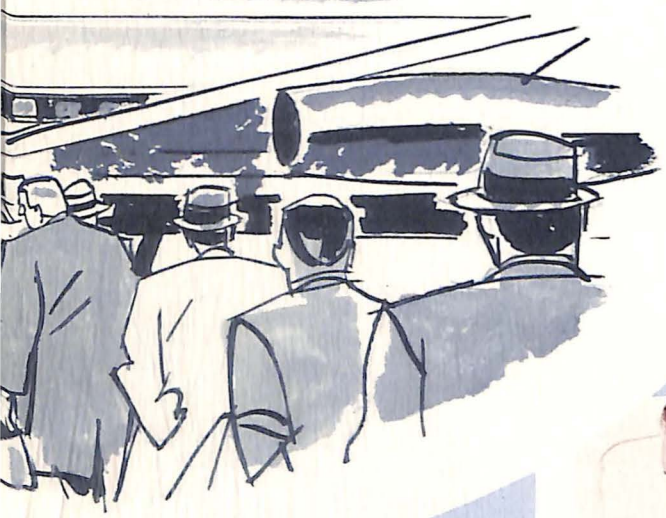
Photos were made during flights by the Washington Redskins and the Chicago Bears.

Redskins' defensive end Carl Kammerer (left) and defensive tackle Fred Williams play cards. Williams has flown thousands of miles during his 14-year career in the National Football League.

Redskins' quarterback Sonny Jurgensen and flanker Bobby Mitchell are pleased with scores in a card game.

George Halas, owner and head coach of the Chicago Bears, goes over plans with quarterbacks Rudy Bukich and Bill Wade.

Redskins' defensive back Tom Walters (left) and Jerry Smith, offensive end, relax during flight.



Chicago Bears' defensive players, end Doug Atkins and linebacker Roger LeClerc, enjoy a steak dinner.

Sam Huff, Redskins' middle linebacker, selects a piece of fruit served on a recent flight.

Fran O'Brien, Redskins' offensive tackle, and defensive end John Paluck discuss plays flying home from game.

onnie Sanders (left) and John Sample, dskins' defensive backs, play cards as ently as they do football.

AIA MANUFACTURING MEMBERS

Aerodex, Inc.
Aerojet-General Corporation
Aeronca Manufacturing Corporation
Aeronutronic Division, Philco Corporation
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, Inc.
Control Systems Division of Colt Industries, Inc.
Continental Motors Corporation
Cook Electric Company
Curtiss-Wright Corporation
Douglas Aircraft Company, Inc.
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ITT Gilfillan, Inc.
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Pacific Airmotive Corporation
Piper Aircraft Corporation
PneumoDynamics Corporation
Radio Corporation of America
Defense Electronic Products
Rockwell-Standard Corp.
Aviation Divisions
Rohr Corporation
The Ryan Aeronautical Company
Solar, Division of International Harvester Co.
Sperry Rand Corporation
Sperry Gyroscope Company Division
Sperry Phoenix Company Division
Sperry Utah Company Division
Vickers, Inc.
Sundstrand Aviation, Division of Sundstrand Corporation
Thiokol Chemical Corporation
TRW Inc.
United Aircraft Corporation
Westinghouse Electric Corporation
Aerospace Electrical Division
Aerospace Division
Astronuclear Laboratory

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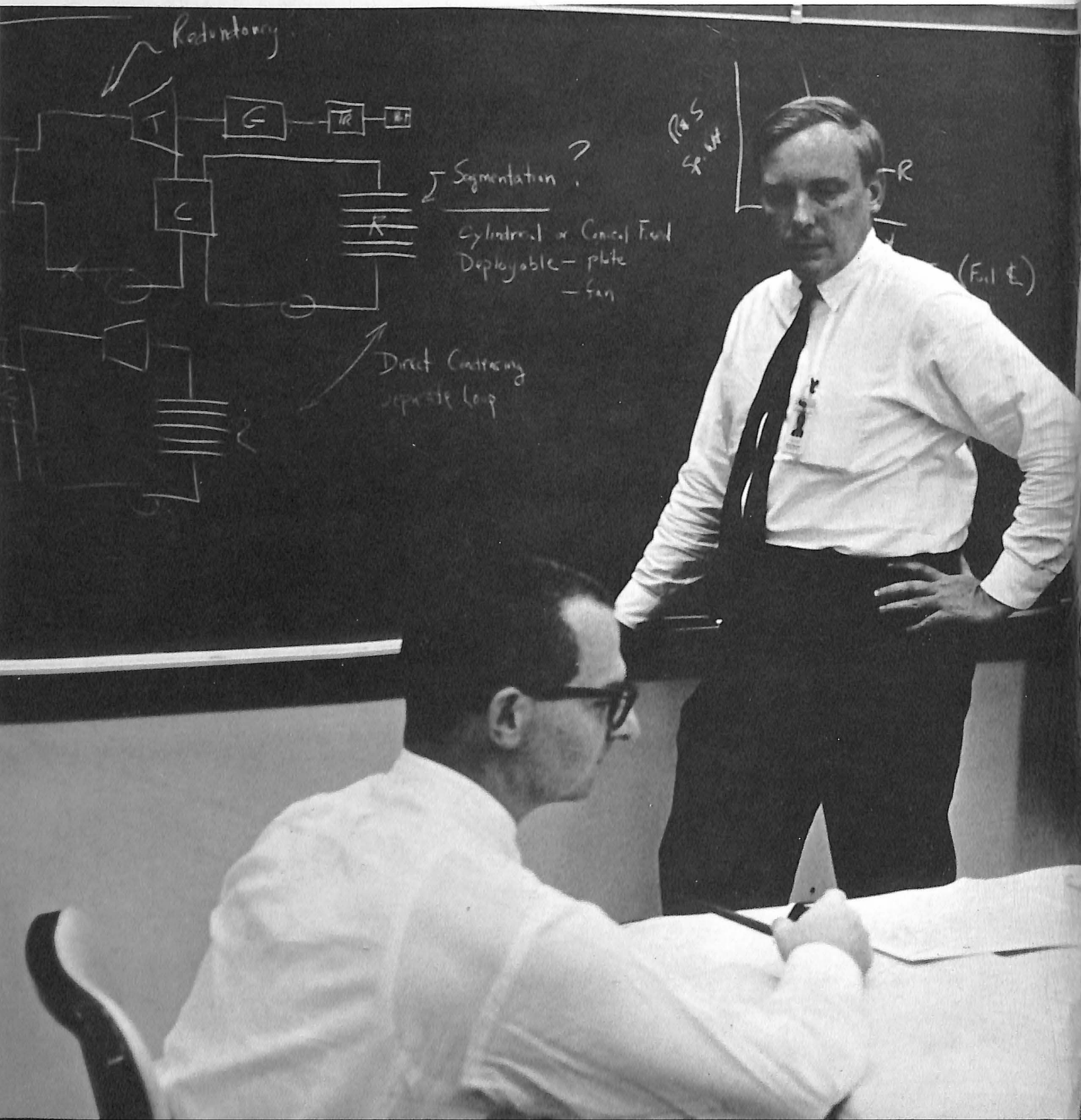
Aerospace scientists work at the forefront of technology. (See *National Growth and Aerospace Technology*, page 18.)



aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION • SPRING 1965

TOMORROW'S TECHNOLOGICAL CHALLENGE ■ BY KARL G. HARR, JR.

THE NATIONAL AIR AND SPACE MUSEUM ■ BY S. PAUL JOHNSTON

The roar of a Martin Titan II from Pad 19 at Cape Kennedy announced the resumption of the U. S. manned space flight program with the "second generation" two-man Gemini capsule, built by McDonnell Aircraft.

The entire three-orbit mission was near perfect. Most important, the astronauts "flew" the capsule, changing the orbital path through the use of rocket controls, a vital step in acquiring space docking capability.

The Gemini project is part of a vast program aimed at placing man on the moon.

Back cover shows Astronauts John W. Young and Virgil I. Grissom in the Gemini just before the hatches were closed for the memorable flight.

AIA aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.

VOL. 3 NO. 1 SPRING 1965

Contents

The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems;

Foster understanding of the aerospace industry's responsibilities in the space exploration program;

Foster understanding of commercial and general aviation as prime factors in domestic and international travel and trade.

AEROSPACE is published quarterly by the Aerospace Industries Association of America, Inc., the national trade association of the designers, developers and manufacturers of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems and other aeronautical systems and their components.

Publication Office: 1725 De Sales Street, N.W., Washington, D. C. 20036

Los Angeles Office: 7660 Beverly Boulevard, Los Angeles 36, California

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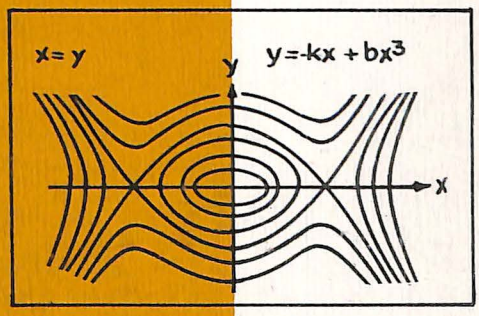
TOMORROW'S TECHNOLOGICAL CHALLENGE

By KARL G. HARR, JR.
President, Aerospace Industries Association

$$2\sum_{S=M-K+1}^{N} \left| \sum \int \phi^{*}_{s+k}(x) f(x) \phi_{s}(x)\, dx \right|^{2}$$

"Go forth and seek: the quarry never found
Is still a fever to the questing hound,
The skyline is a promise, not a bound."
— John Masefield



What does the future hold for the nation's aerospace industry?

Part of the answer to this query can be found by a close look at the budget for fiscal year 1966, now before the Congress; for the budget indicates not only many of the activities of the nation's aerospace industry for the near future, but also provides valuable insight into the industry's workload for the rest of the Twentieth Century.

President Johnson's dollar requests itemize the aircraft, guided missiles, space vehicles, electronic systems and components that will be purchased by the Department of Defense, the National Aeronautics and Space Administration, the Atomic Energy Commission, the Federal Aviation Agency, the U. S. Weather Bureau, and the other government agencies that traditionally buy goods and services from aerospace manufacturers.

The budget also isolates and identifies the numerous research and development projects the industry will pursue with its own and government funds during the 12 months beginning July 1.

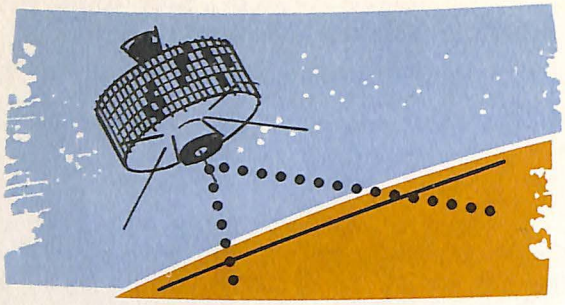
But the production orders and the research efforts listed in the budget document — important clues though they are to the industry's future — do not begin to pinpoint the planning of manpower utilization or the new types of equipment and facilities the industry will require to meet the technological challenges of today and tomorrow.

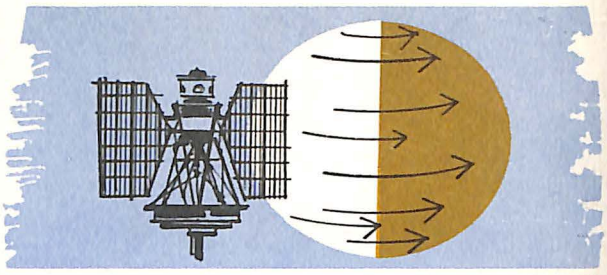
In an America dedicated to the evolution of "The Great Society," one of the nation's unquestioned assets is the technological know-how, manpower and facilities of the aerospace industry in its more than 60 large firms and thousands of smaller companies.

These technological capabilities, unequalled by any other industry, are available to the United States, not only to assure superior aircraft, impregnable national defense and the capability for space exploration, but also to tackle such diverse and complex national needs as efficient and integrated transportation systems, desalination of sea water, air and water pollution control, and the retraining of those made jobless by advances in automation.

Secretary of Defense Robert S. McNamara has made the observation that "It is impossible to schedule invention and innovation, which are the essence of technological progress." Nonetheless, detailed analyses of national requirements can serve to expedite needed inventions and innovations and the industry is skilled in the use of tools for such analyses. In the field of electronic data processing, for example, the aerospace industry has had vast experience.

Ever since the first ENIAC computer was developed





just after World War II, the aerospace industry has used more electronic "brains" for problem solution than any other group and has a skilled manpower pool of electronic data processing specialists.

The budget now being considered by the Congress calls on the aerospace industry to build and develop a variety of aircraft, missile and space systems. They range in size and scope from a new light observation helicopter for the Army to an advanced submarine-launched ballistic missile for the Navy, and to a huge 725,000-pound jet-powered cargo airliner for the U.S. Air Force. In addition, the National Aeronautics and Space Administration is calling on the aerospace industry to design a Voyager spacecraft to probe for life on Mars; the Weather Bureau is planning advanced weather satellites; the Atomic Energy Commission wants several types of rocket and missile propulsion reactors and small space engines; and the Federal Aviation Agency is preparing for 2000-mile-per-hour commercial airliners. The privately owned Communications Satellite Corporation, created by the Congress in 1962, is also setting aside funds for the purchase of boosters, ground equipment and satellites to have an operational space communications system in 1967.

But weapon and space systems projected for the Defense Department, NASA and other government agencies — important as they are in determining the aerospace industry's future role — tell only part of the story.

The fiscal 1966 budget also calls for the spending of large sums for research and development on anti-submarine warfare, oceanography, new optical techniques (including the use of lasers), advanced penetration aids, sonar developments, hydrofoil ships, airborne warning and control systems (especially overland radar), combination turbojet and rocket engines, ground effect machines, vertical and short take-off and landing aircraft and scores of other complex items.

To meet these announced challenges to its varied abilities and to cope with others envisioned by the industry's own scientists and engineers, America's aerospace industry is constantly in the process of adjustment.

Aerospace management personnel are continually reorienting the technical manpower and facilities at their disposal to meet the nation's changing needs. Qualified engineers are shifted from one project to a new one as soon as the first program has been readied for production. (New computers and production equipment are acquired to deliver the most advanced industry products.) Specialists are kept current of the latest advances by a combination of on-the-job training and advanced courses at nearby universities. New test chambers and simulation devices are continually being designed and installed to duplicate the environments in which the industry's future products will have to operate. Existing R&D and production facilities are being modified and new ones built so that knowledge can be gained to design the industry's products of tomorrow. In other words, dynamic adjustments are made to keep pace with the industry's dynamic advances, not only in aerospace per se but also along the entire spectrum of tomorrow's technologies.

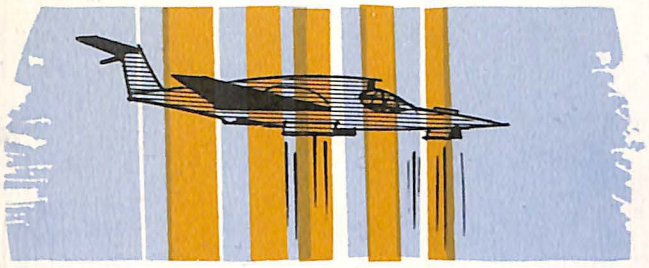
The industry's flexibility is one of the nation's prime resources. The industry has demonstrated that flexibility time and again during the past quarter century; first in making the transition from almost no production to nearly 100,000 planes in World War II, then in switching from piston to jet aircraft, then in moving into the supersonic age, then in developing the hardware to permit man to leave the earth's environment and now in preparing for interplanetary exploration.

The demonstrated ability of the aerospace industry to adapt itself to changing national requirements has heretofore been used primarily to meet national defense needs or those of the civilian space program. But accepting the responsibility for fulfilling DoD and NASA requirements should not act as a limiting factor on the industry. For the industry has many other contributions to make to the nation, and stands ready to fulfill other assignments.

Over the past decade, as the ballistic missile and space programs matured, the industry found it necessary to employ many thousands of scientists and engineers. The talents of these specialists will continue to be needed for aerospace projects similar to those outlined in the fiscal year 1966 budget message.

But those same engineering and scientific skills can also be utilized to try to resolve other national problems.

Skilled manpower and facilities which can be made available for non-aerospace projects are only part of the answer. At the same time that scientific and engineering



specialists were being hired and new research and production facilities were being built, the management capabilities of the industry's top executives were being expanded.

Some of this expansion of management know-how is attributable to the diversification efforts made by many of the leading aerospace firms during the last 10 years. These firms moved into aerospace-related and even non-aerospace fields partly because of a desire to minimize their dependence on government business but primarily because knowledge of these new fields was essential to the success of aerospace programs.

Moreover, the nature of the aerospace systems ordered into development and production made it essential that the companies building the products be able to manage them from concept to operational use. The management techniques evolved for present-day aerospace systems are readily adaptable to other national problem areas.

The federal government recognizes the industry's diverse capabilities and can be expected to make even greater use of those skills in the future. Meanwhile, other levels of government are moving to use the industry's unquestioned technological competence for their own purposes. An article by California's Governor Edmund G. Brown in this issue of *Aerospace* describes the utilization of aerospace industry capabilities for problems in the state.

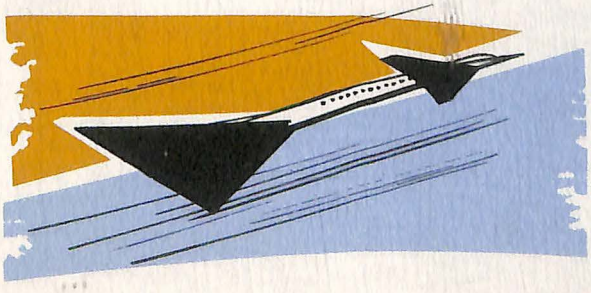
America's needs and the industry's abilities match each other as perfectly as underground solid fuel missiles and the silos through which they are launched. There is little doubt in anyone's mind that progress will continue in both aviation and space and that the firms which comprise the aerospace industry will spearhead that progress.

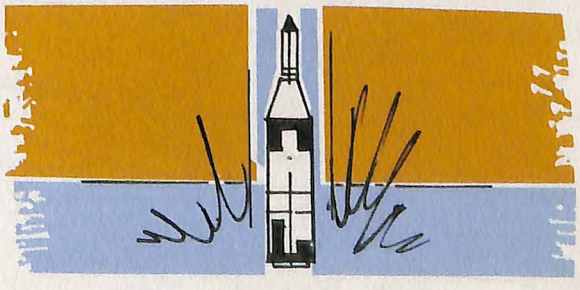
One need not be a major prophet to predict without qualification that:

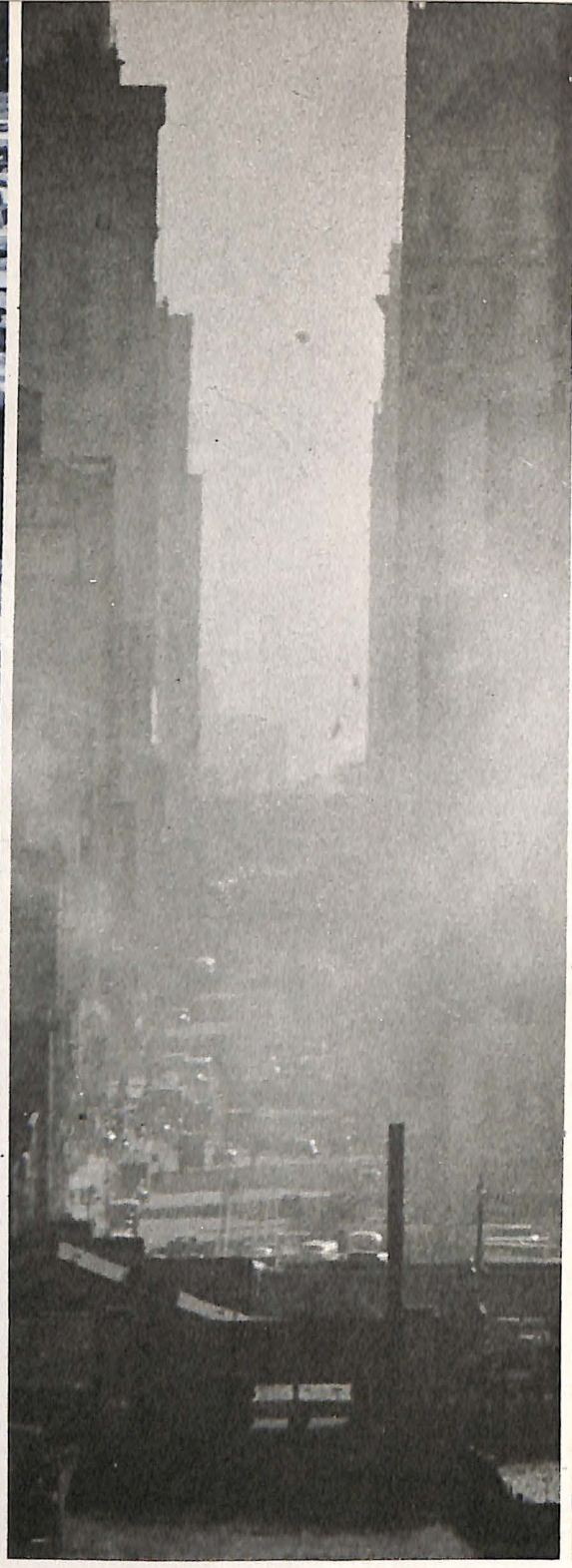
- After the U. S. gets to the moon with Project Apollo, there will be attempts to reach other planets and explore other parts of our universe.
- Even after the 2000-mph jetliner is developed and in service, there will remain a demand for faster transports.
- The U. S. will continue to take advantage of the latest technological advances in defense weaponry to continue the deterrence of any military action that would bring about World War III.
- Efforts to improve our ability to predict and control the weather and thereby improve national living standards will go on, necessitating newer weather satellites and weather-control mechanisms.
- Even though communications satellites will be available for intercontinental transmissions of television, telephone and telegraphic messages in 1967, there will be improvements in commercial comsats in future years.
- Large new transports and cargo handling systems now being developed for the military services will be adopted by passenger and freight airlines to serve commercial users.
- Vertical take-off aircraft will be one of the principal methods of transporting passengers between nearby cities.
- New materials and processes emanating from the national space program will find commercial applications in the same way that atomic energy and radar did after World War II.
- Fast-moving hydrofoil vessels and ground effect machines that skim over both land and water will ultimately prove their potentials in moving passengers and cargo.
- American-built civil and military aircraft will be in increasing demand by foreign buyers.

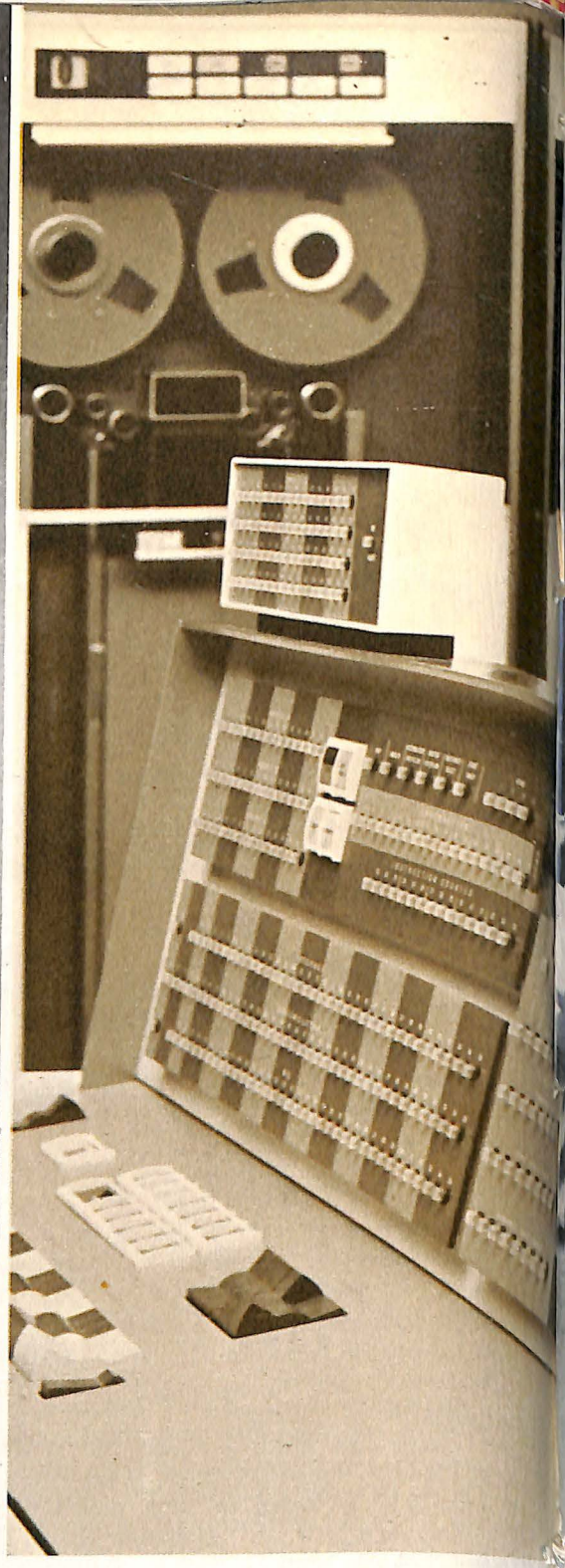
The foregoing are but a few of the scores of projects now being researched by aerospace firms. And they represent only the aviation and space portion of the industry's expanding research effort. As federal and local governments in the future elect to expand their use of the industry's talents to undertake assignments only remotely related to aerospace, the industry's capabilities will be further stretched.

The aerospace industry must be and is gripped with a fever to find its quarry. It does indeed consider the skyline a challenge rather than a limitation. As a result, aerospace firms will go forth to seek. And as the industry seeks and finds, the entire nation will be rewarded.









NEW DIMENSIONS FOR

AEROSPACE

By EDMUND G. BROWN
Governor of California

Can the same systems development skills that put John Glenn into orbit be used to cut the time a commuter must spend between home and office?

Can the kind of "new dimension" thinking that got a moon-probe off the launching pad also get able bodied men off the welfare rolls?

In California, we are finding out.

Some months ago, I asked California's great aerospace industry to put its system engineers to work on four major problems facing this fastest-growing of all states.

■ First, *transportation.* We have more than 9 million cars on the streets and highways of California today, and by 1990 we can expect nearly 25 million. Our annual highway construction tops $700 million. By 1990 our expenditures for city, county and state roads and highways will be climbing in the billions.

With this volume of traffic and this level of spending, we must be sure that we are building the finest and safest transportation network possible. We have asked the engineers to tell us how we can do it, today and for the future.

■ Second, *pollution.* Smog is a growing problem in California. It has become a threat to health and safety in Los Angeles and is beginning to affect the environment of San Francisco, Sacramento and other urban areas.

Our water supply is precious, particularly in southern California, where 50 percent of our population has two percent of our sources of water.

We have asked the system engineers to study our present methods of waste management and suggest better ways to prevent the pollution of our land, water and air.

■ Third, *information collection.* Neither government nor industry can make realistic plans for future devel-

TECHNOLOGY

opment without accurate information about population growth, population characteristics, the movement of people, occupational and education trends and a wide range of other data.

We have asked the system engineers to start from the ground up to build a workable and coordinated system for data gathering.

■ Fourth, *crime and control of criminals*. The crime rate in California, like the crime rate nationally, is a continuing matter of concern. So is the cost of crime. For example, early detection of juvenile delinquents would save the taxpayer the $15,000-$18,000 it costs to provide a bed in a state juvenile institution.

We have asked the engineers whether we can improve our existing systems of criminal justice to deal with our crime problems or whether the answer lies in new approaches that might supplement or even replace existing systems.

We hope that a fresh look at all of these problems will provide answers which so far have eluded us.

I announced my proposal to put space age talent to work on urgent problems in California last November. The response from the aerospace industry was immediate and spectacular. Nearly every leading firm in California with the experience in system development submitted proposals for studies in the four problem areas.

Within two months four companies were at work on the most exciting and promising program I have ever witnessed in government.

This program is unique in America and it emerged first in California, I believe, because of our State's great needs and our great aerospace resource.

Thirty-five percent of our manufacturing industry is concentrated in ordnance, aircraft, electrical and instrument production. The defense-aerospace sector of our economy has been the mainstay of our employment growth for a decade and a half, a period in which California has experienced unprecedented population growth. But with the growing completion of basic weapons systems and the buildup of weapons stockpiles, it recently became obvious that we could no longer depend on growth in this sector to take up our employment slack.

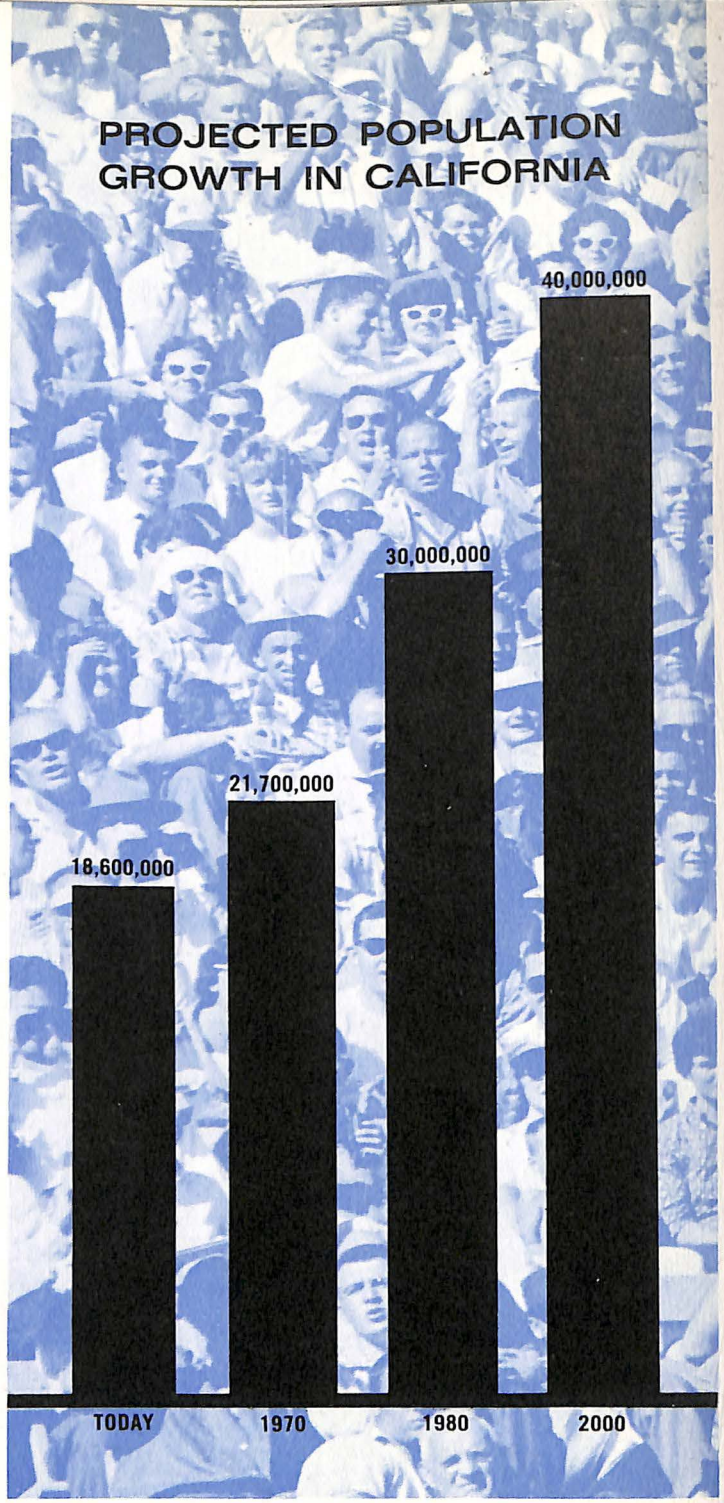
We were also faced with immediate local problems in the cutbacks and phaseouts of such projects as the Navajo program in 1955 and the Skybolt program in 1962.

Shortly after Skybolt, I asked the leaders of the aerospace and electronics industries to meet regularly with me to discuss ways to soften the impact of such cutbacks.

In those discussions, two things became clear at once.

First, our estimates indicated that 50 percent of all engineers and scientists trained in space research and development live and work in California.

Secondly, it was obvious that the men of the aerospace and defense research teams in California shared one talent that might be put to work on community problems. That talent is their ability to think in terms



of new dimensions, to break down barriers and to proceed along new technological lines using new scientific methods.

These, in short, were men who had been told to figure out a way to send a missile to the moon, and they had done it. Nobody found the Polaris missile or the Atlas missile in a mail-order catalog. Teams of Lockheed and General Dynamics engineers designed these missiles to do a job that had never been done before. When North American Aviation began building the Apollo module for the first trip to the moon, they couldn't check out a book on moon travel. They were given a problem and they had to develop a system to solve it.

The record of California aerospace and defense is rich in similar achievements. In most cases, the teams that made these technological breakthroughs still live and work in California. As our discussions progressed over the year, we found ourselves coming back time and again to the same question: If California's aerospace teams can solve the complex problems of outer space, why not those here at home?

We think they can. The aerospace industry agrees.

If this experiment is successful — and I believe it will be — it could lead to a broader base for the aerospace industry as well as a welcome spur to California's economic expansion. More than this, California, pioneer and leader in the space age, could provide the nation with a potent weapon in our assault on the fundamental social problems of our time — crime, disease, illiteracy and the other ancient, unconquered enemies.

The economic value of such a program to California is clear.

Our population increase will continue at nearly 600,000 a year. We have 18,600,000 citizens today. By 1970 we can expect a population of 21,700,000. By 1980 the figure will be approaching 30 million and by the turn of the century it will reach 40 million.

A large portion of California's population — nearly 40 percent — is in the 19-and-under age group. Most of these young people, their numbers swelling by migration from other states, will be entering the labor force in the years ahead, putting severe pressures on our capacity to create new employment.

In simplest terms, we must create at least 200,000 new jobs a year or nearly 4,000 every week merely to keep pace with our massive population growth.

These are the dimensions of our problem. Our aerospace program is an example of the kind of creative policy we are bringing to bear on it.

The need for new directions for the California defense and aerospace industry is equally clear.

California firms receive some 20 percent of all federal defense outlays, 50 percent of NASA contracts and nearly 40 percent of all military prime contracts for research and development. Many California firms are almost totally dependent on federal awards. They are acutely vulnerable to phaseouts and cutbacks and must broaden their base if they are to continue as industrial leaders.

The program we have begun is in R&D. But it holds great promise of ultimately creating entire new industries in which there is every reason to expect success in transferring manpower from defense and space production to other areas.

If we are to arrive at that goal, however, Federal financial assistance will be required.

Federal officials are looking over our shoulders on this program. And President Johnson has indicated his philosophical commitments to such uses for federal funds. He told the Congress in January: "If over the next several years we continue to spend approximately the same amount of dollars annually for our national defense that we are spending today, an ever-larger share of our expanding national wealth will be free to meet other vital needs, both public and private."

The program we have begun has the potential of meeting both public and private needs. It is now still an experiment using just one of a number of possible approaches — the systems analysis approach. We are hopeful that we can make use of other approaches where appropriate, that we can pass from the experimental to the research project stage and that federal funds will be made available for related purposes.

For none of the problems we are studying or anticipate studying are exclusively California problems. They are national in scope, and solutions can be national in application.

Certainly solutions are long overdue. The extent to which non-defense technology has lagged is indicated by the fact that our federal budget for non-defense purposes, after discounting price increases, is not much greater than the budgets of the mid-1930s.

With federal assistance and with California's technological leadership, we hope to make the breakthroughs here in such fields as education, meteorology, medicine, urban redevelopment, housing, and resource development. These and many other areas have had little or no research and development work financed by the federal government during periods of heavy and successful federal spending on defense-oriented R&D.

California is the national leader in production and research and development in today's defense economy. We hope to continue our leadership in an economy shifting away from defense toward peaceful pursuits.

We have the capabilities to do the job. But federal financial support of our efforts will be required.

As I said in my Economic Report to the California Legislature this year: "If we seize the opportunities of the new technology, it can be an instrument not only for great prosperity but for social advance on a scale unknown in history. And California, 'window of the future', national leader in education, pioneer in the age of science and technology, can lead the way."

The important thing is that we have begun.

U.S. PATENT SYSTEM

'The Fuel of Interest'

By MELLON A. GILL
Chairman, Patent Committee
Aerospace Industries Association

A brief note in the history of the *United States Patent Office* reads: "May 22, 1906. Orville and Wilbur Wright, of Dayton, Ohio, receive Patent No. 821,393, for certain 'New and Useful Improvements in Flying-Machines'."

Twenty-nine months earlier, on December 17, 1903, they had accomplished the first successful heavier-than-air, powered flight near Kittyhawk, N. C. That first flight lasted 12 seconds.

Last year, less than six decades after the Wright Brothers had patented their invention, the aerospace industry of this nation employed some 1,100,000 people, making it the largest manufacturing employer in the nation.

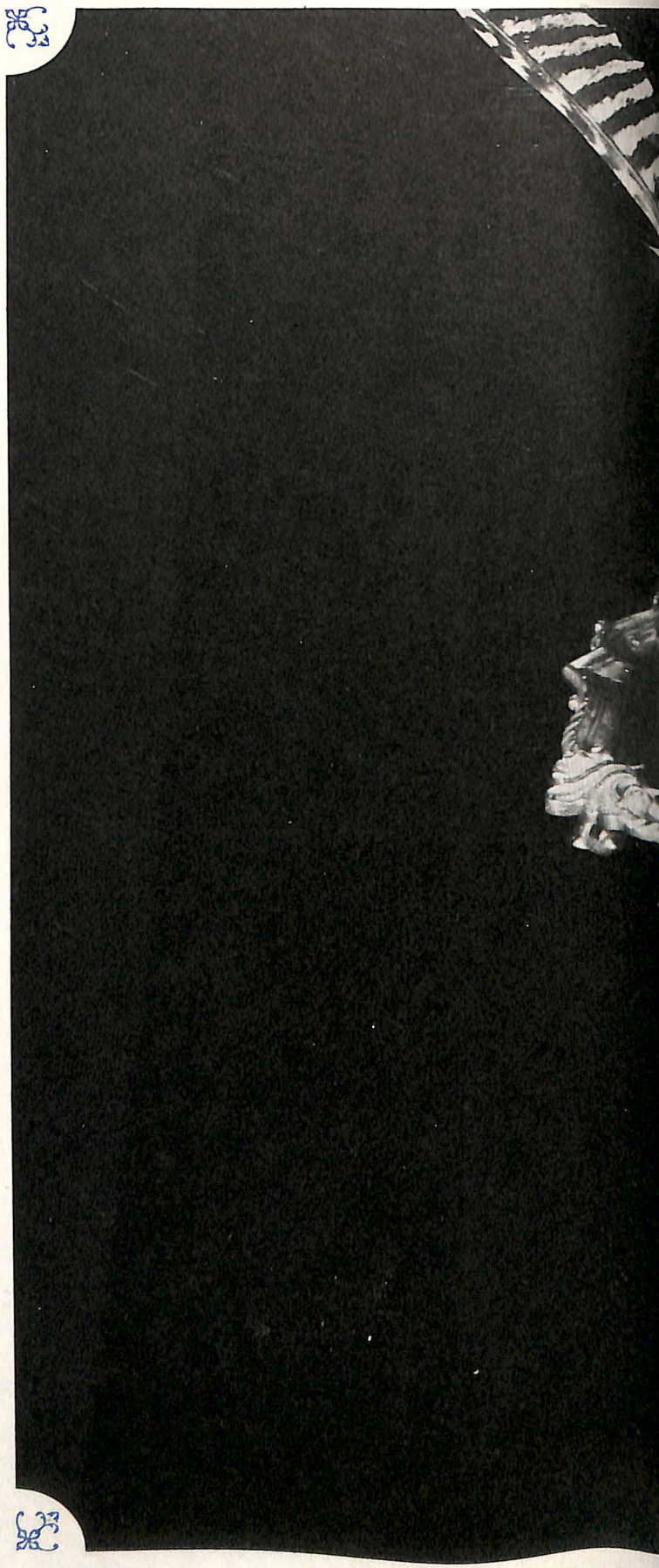
The number of patents that have since been issued in connection with this industry of fantastic accomplishments is very large, and their diverse nature, which has become a hallmark of the industry, give ready proof of the importance of the U. S. Patent System.

Additionally, the fact that the industry employs about 20 per cent of all scientists and engineers in the nation emphasizes that the search for continued advancement goes on at an astonishing pace.

It might be inaccurate to say the business which has placed us on the threshold of moon exploration owes its existence to the Wright brothers, but few can argue effectively that the American patent system is not the cornerstone of the free enterprise philosophy which has paved the way into space.

This year, the United States Patent System is celebrating its 175th Anniversary. When the Constitution was adopted on June 21, 1788, one of the powers granted to the Congress was "To promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries."

Nearly three years later, on April 10, 1790, Presi-




175th
Anniversary
U.S.
Patent System

dent George Washington signed the bill which laid the foundation of the modern American Patent System. The Bureau, thus established, offered the same protection, the same opportunity and the same reward to every individual.

From the outset, the fundamentals of the operations of this newly created Bureau were both simple and direct. Any person who had invented any new and useful process, machine, manufacture or composition of matter, or any improvement thereof, could obtain a patent. Even today, the chief functions of the Patent Office are to administer the patent laws as they relate to the granting of letter patents for inventions, and to administer the federal trademark laws. While the issuance of copyrights was at one time an assigned function of the Patent Office, this activity, in 1870, was transferred to the Library of Congress which is now the custodian of all records and matters concerning copyrights.

The Patent Office is one of the most unusual branches of our government. It has a Patent Examining Corps of over 1,000 highly qualified technical personnel who are trained in all aspects of engineering and the industrial arts, which examines thoroughly every application received to determine whether a patent may be granted — a gigantic task involving the most exhaustive research.

Not only must the examiners search United States and foreign patents to learn if a similar patent has been issued, but they must study scientific books and publications to determine whether the inventive concept has ever been patented or published before.

Public use, sale or publication of an invention for more than one year prior to the filing of the application would bar the issuance of a patent in this country.

The examination and adjudication of applications for patents is the largest and most important function of the Patent Office. The work is divided among a number of Examining Groups, each group having jurisdiction over certain assigned fields of invention. The Patent Examining Corps is staffed with a superintendent, a director for each examining operation, a number of group supervisors and a staff of examiners in each group.

At the present time the Patent Office has approximately 2,500 employees, of whom almost one half are patent examiners. The Patent Office receives over four million pieces of mail each year. Patents issue at the rate of approximately 1,000 each week and over 87,000 new applications are received annually. Understandably, this volume was considerably less during the early years in which the office operated.

For example, it was just over three months after passage of the Act of 1790 before the office issued its first patent to Samuel Hopkins of Pittsford, Vermont, on July 31, 1790, for an improvement in "the making of Pot ash and Pearl ash by a new Apparatus and Process."

The grant was signed by Washington and also bore the signatures of Edmund Randolph, Attorney General, and Thomas Jefferson, Secretary of State.

Despite such enthusiastic observations as Jefferson's that "the issue of patents for new discoveries has given a spring to invention beyond my conception," only 47 patents were issued during the first three years.

Whether the small number of patents issued was a

contributing factor is not clear, but early in 1793, Congress changed the law. They eliminated the requirement that an invention be of "sufficient and useful importance" and substituted a registration system for one of examination. Along with other lesser modifications, these changed the entire tenor of the law and, in succeeding years, the number of patent applications increased significantly.

Jefferson's role in the founding years was given even greater importance when, during his Administration in 1802, he gave the office the status of autonomy by making it a distinct division within the Department of State and, at the same time, creating a Superintendent of Patents.

The next major change to affect the Patent Office was due to the revised Patent Act of 1836. It is generally conceded that this Act reestablished the American system which had been encompassed in the original act. In official publications, it is referred to as "the most important patent law ever enacted in the United States," other than, perhaps, the original act of 1790.

Basically, it reestablished the examination system which had first been in effect and again made it necessary to determine the novelty and usefulness of the invention sought to be patented. The Act also gave official sanction to Jefferson's earlier action, making the Patent Office a recognized Bureau within the Department of State and designating its head as Commissioner.

Additional acts added new facets to the Office's responsibilities and adjusted minor discrepancies in existing rules, but it was not until 1849 that the next major change took place. In that year the Patent Office was transferred from the Department of State to the Department of Interior.

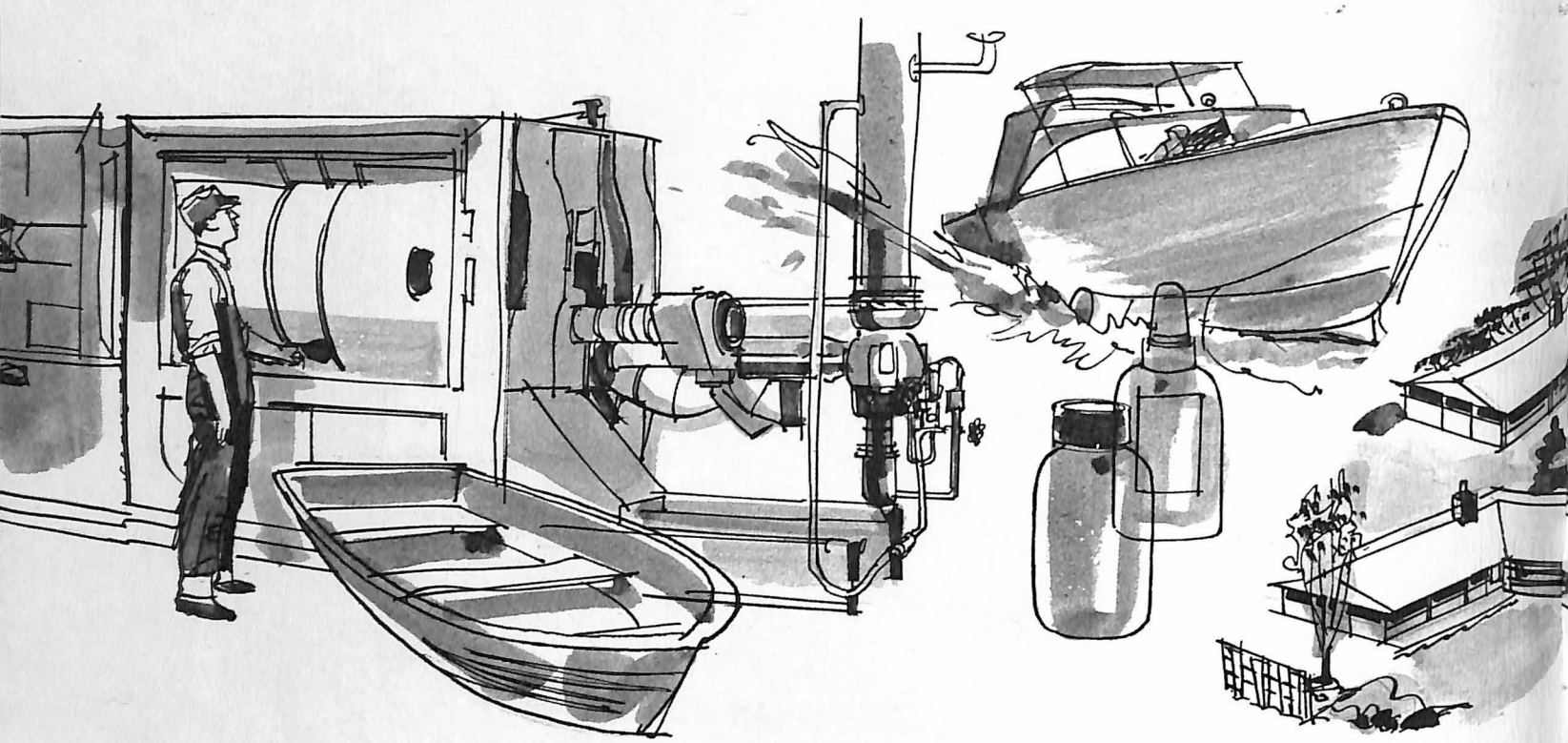
Another significant change occurred in 1861 when an act was passed which increased the life of patents from 14 to 17 years, a period which is still in force. At the same time, however, it withdrew the power of the Commissioner to extend patents beyond their original life. Previously, he had the authority to extend a patent seven years beyond its original life span.

What is generally conceded to be the most important patent act since 1836 was adopted in July 1870. Under its provisions, the patent laws were almost completely reorganized and revised. Registration of trademarks was provided for; copyrights were transferred to the Library of Congress; the requirement for models of inventions was eliminated except when requested by the Commissioner.

Again, in succeeding years, Congressional action added additional responsibilities and revised many of those already in effect. Finally, by an Executive Order in 1925, the Patent Office was transferred to the Department of Commerce.

Despite those many adjustments throughout its history, the pace of patent issuance grew rapidly until today more than 3,000,000 patents have been granted. Indication of the quickening pace can be noted from these milestones: Patent No. 1,000,000 was issued in 1911; Patent No. 2,000,000 in 1935; and Patent No. 3,000,000 in 1961. The current pace of issuances is about 50,000 annually.

The names of famous inventors who have availed themselves of the system are legion: Samuel B. Morse (telegraphy); Alexander Graham Bell (telephone); Samuel Colt (firearms); Eli Whitney (cotton gin);



Vincent Bendix (starters); Orville and Wilbur Wright (the airplane); and Dr. Robert Goddard (rockets) are but a few. None, however, was as prolific as Thomas A. Edison, who obtained more than 1,100 patents in his own name.

Much of the miraculous growth and industrial and technological progress of America can be traced directly to the protection afforded inventors under the American Patent System. The incentives of this system have encouraged a deluge of inventions and discoveries leading to the creation of new products, new businesses and new industries. It has created new jobs for millions of people and provided Americans with the highest standard of living in the world.

These ingenious inventors have applied their talents in fields that vary from can openers to computers and high heels to hair nets. How many times during the course of a day does that familiar legend "Pat. Pending" or "Patented U. S. Patent No. ----------" come into view?

The aerospace industry, a relative newcomer, and yet the leader in industrial employment today, includes many companies that owe their existence to patents. To name but a few, Kaman Aircraft Corporation of Hartford, Connecticut, was founded on the strength of one or two patents; United Aircraft Corporation, one of the world's largest producers of aircraft engines, began its corporate life in 1925 on the strength of a handful of internal combustion patents, and another handful of patents on automobile starters led to the development of the Bendix Corporation.

The scientific and technical skills of the aerospace industry, while directed specifically to advancing the sciences of aeronautics and space, have had many beneficial spin-off effects from their research and development programs which have resulted in inventions in many diverse fields and which have been introduced into the economy both domestically and abroad.

For example, the aircraft engines of United Aircraft are now utilized in power generating plants and will soon find additional uses in the marine and railroad applications; Douglas Aircraft Corporation, builder of the famed DC-3, has produced inventions in the field of heavy manufacturing and metal framing equipment; Grumman Aircraft Engineering Corporation, designers and builders of the famous Hellcat of World War II fame and now engaged in the Lunar Excursion Module (LEM) project, has developed and placed on the commercial market aluminum and fiberglass marine vessels, truck and trailer bodies and hydrofoil craft; The Lockheed Corporation, designers and builders of the first operational U. S. military jet aircraft, the P-80, has developed inventions in such diversified fields as plastics, glazings, marine construction and portable modular housing units, each of which has found utilization in commercial markets; The Rohr Corporation is in the prefabricated homes market.

Aerospace companies such as Honeywell Inc., The Boeing Company, North American Aviation, Inc., General Precision, Inc., and several others, through patent licensing agreements, have made their advanced technology available to commercial and government organizations in many nations of the Free World. Thus, American know-how is disseminated to assist underdeveloped countries and, at the same time, easing to a degree the problem of balance of payments.

This does not mean that controversy has not involved the patent system and the administration of patents. Recently, the magnitude of the nation's involvement in research and development has necessitated attention to the government's attitudes toward patent rights resulting from, or arising out of, government-financed research and development.

Private groups and Congressional committees have conducted investigations of the controversial issues involved. Congressional legislation has established patent policies for new areas of research and development, and Executive Branch action is now altering individual agency practices, which have long differed.

Although progress has been made in reaching a uniform patent policy, the situation is far from settled and the controversy continues.

Four years ago, the late Senator Clair Engle of California, authored an article for *Aerospace* on the subject of government rights to acquisition of patents on items it buys for its own use. In part, he said: "The proposal ignores the obvious question: Why should the federal government have anything to do with controlling patents in the first place, except where federal ownership is clearly dictated by health, welfare or security considerations?

"The danger of the 'government-take-all' philosophy is that it appears at first glance to be entirely reasonable. Who, as a taxpayer, wishes to debate the propriety of the government getting all that it pays for. The real issue comes into focus only when one begins to examine what the government does pay for.

"The evidence is irrefutable that when the government contracts for research and development, it pays only for those services. It does not pay for patent rights. As a result of its contract, it receives not only the contracted services but in addition thereto receives, in most instances, a royalty-free license to make, have made and use the patented developments for government purposes. What more does the government need, unless, through government-owned businesses or sale of licenses to private industries, it intends to exploit the patents in competition with private industry?

"Whatever be the government's utilization of the patents it acquires, their very acquisition has the effect of destroying the patents.

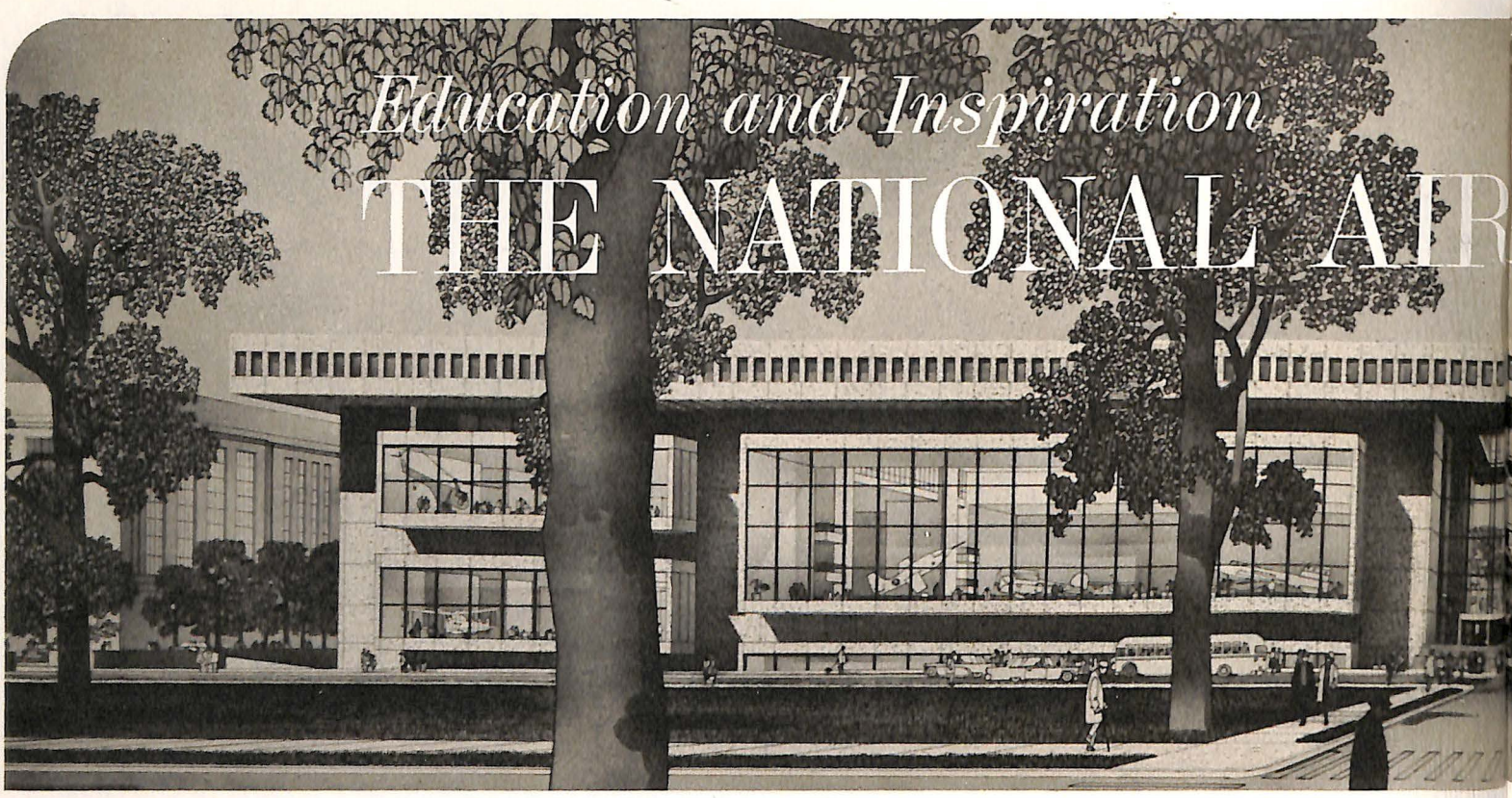
"It is hardly conceivable that the proponents of a 'government-take-all' philosophy do not recognize that enforcement of their policy would greatly reduce research and development incentive at a time when such incentive has proved to be our major resource in competing with the Soviet bloc."

This viewpoint is as sound today as it was then. The invention and creativity that has been fostered and protected by the patent system has transformed America from an agricultural to an industrial nation and from there to leadership of the Free World. It is the system that inspires and stimulates men to greater technical and scientific discovery.

For 175 years the patent system has spurred creativity and inventiveness on the part of the American people leading them to a prosperous economy and the strength of a Free World. Perhaps the best description of the American patent system was given by Abraham Lincoln: "The patent system added the fuel of interest to the fire of genius." Without such fuel, the fire will soon be extinguished.

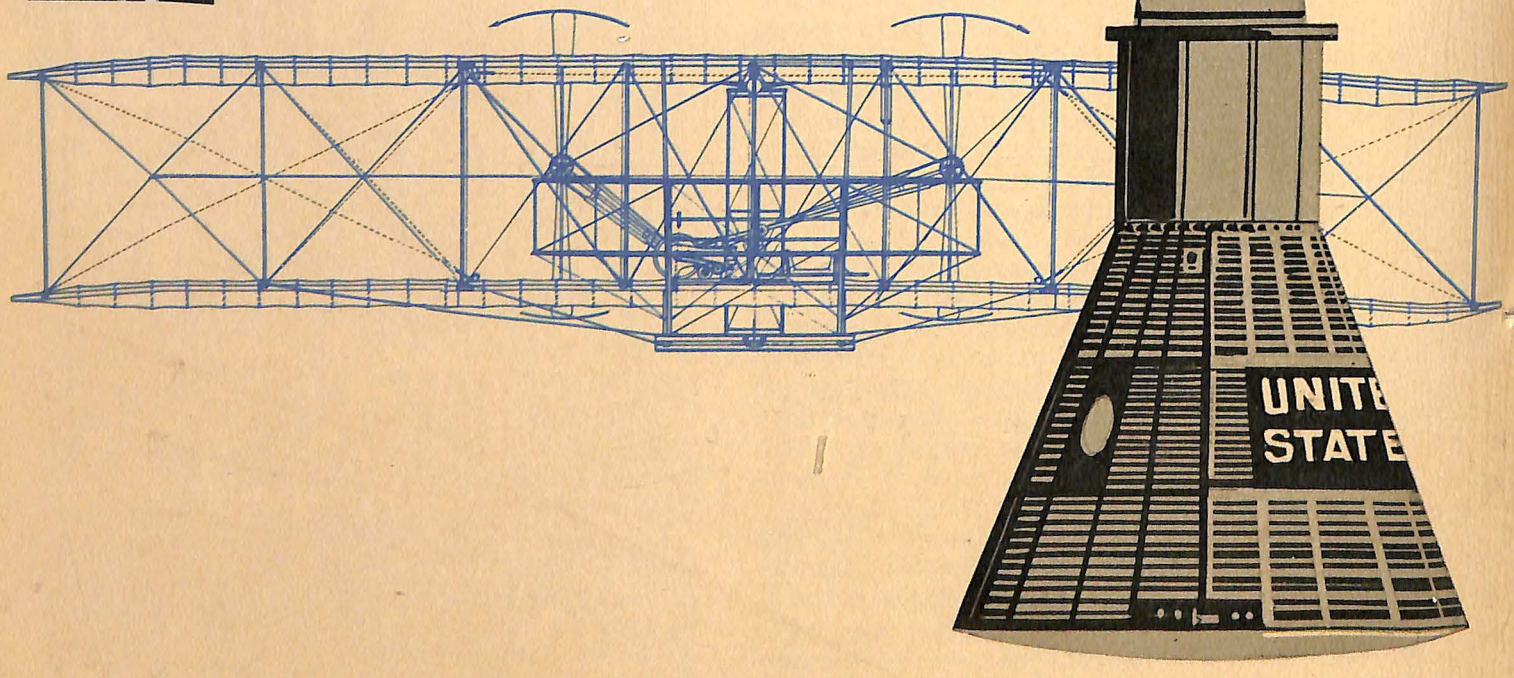
Education and Inspiration

THE NATIONAL AI

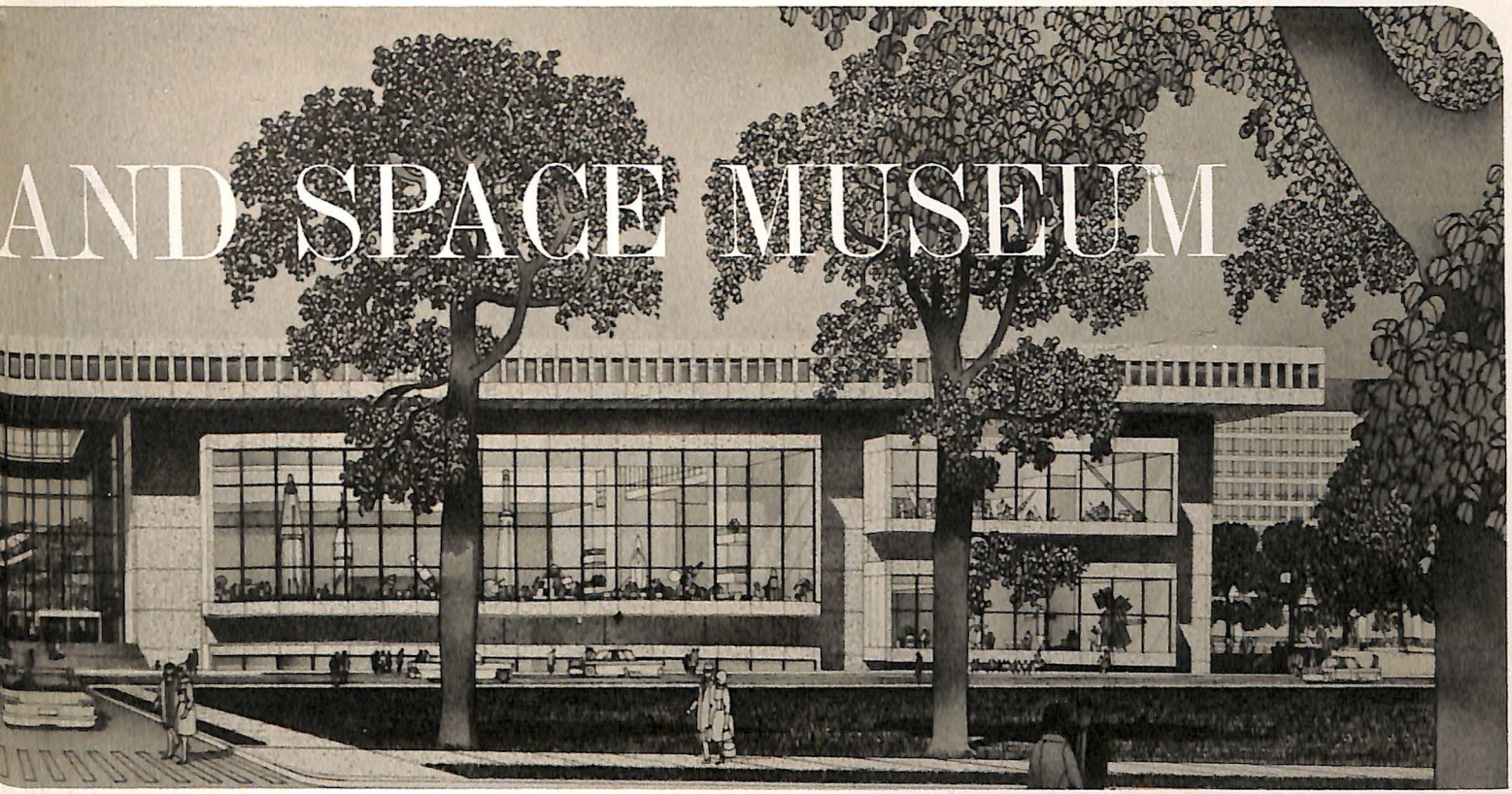


In partnership with the Smithsonian Institution, the aerospac

By S. PAUL JOHNSTON
Director, National Air Museum



AND SPACE MUSEUM



ndustry is participating in a great new public educational facility.

The concept of a museum as an attic full of dusty artifacts has long since been outmoded. S. Dillon Ripley, the Smithsonian's Secretary, views his venerable Institution as a great educational asset — a place where people come not merely to stand in reverence and awe before enshrined mementos of the past, but to gain some knowledge of the world around them, and some inklings of what the future may hold.

As an integral component of the Smithsonian, the new National Air and Space Museum concurs entirely with this philosophy. Every visitor who goes through its halls, whether his stay be brief or protracted, should leave the museum more knowledgeable than when he entered. Young people in particular should be encouraged to learn more about the subject matter on view and be stimulated toward eventual participation in aerospace science and technology. Hopefully, every visitor should be consciously or unconsciously conditioned to better relate his own life and work to the rapidly moving age in which he lives.

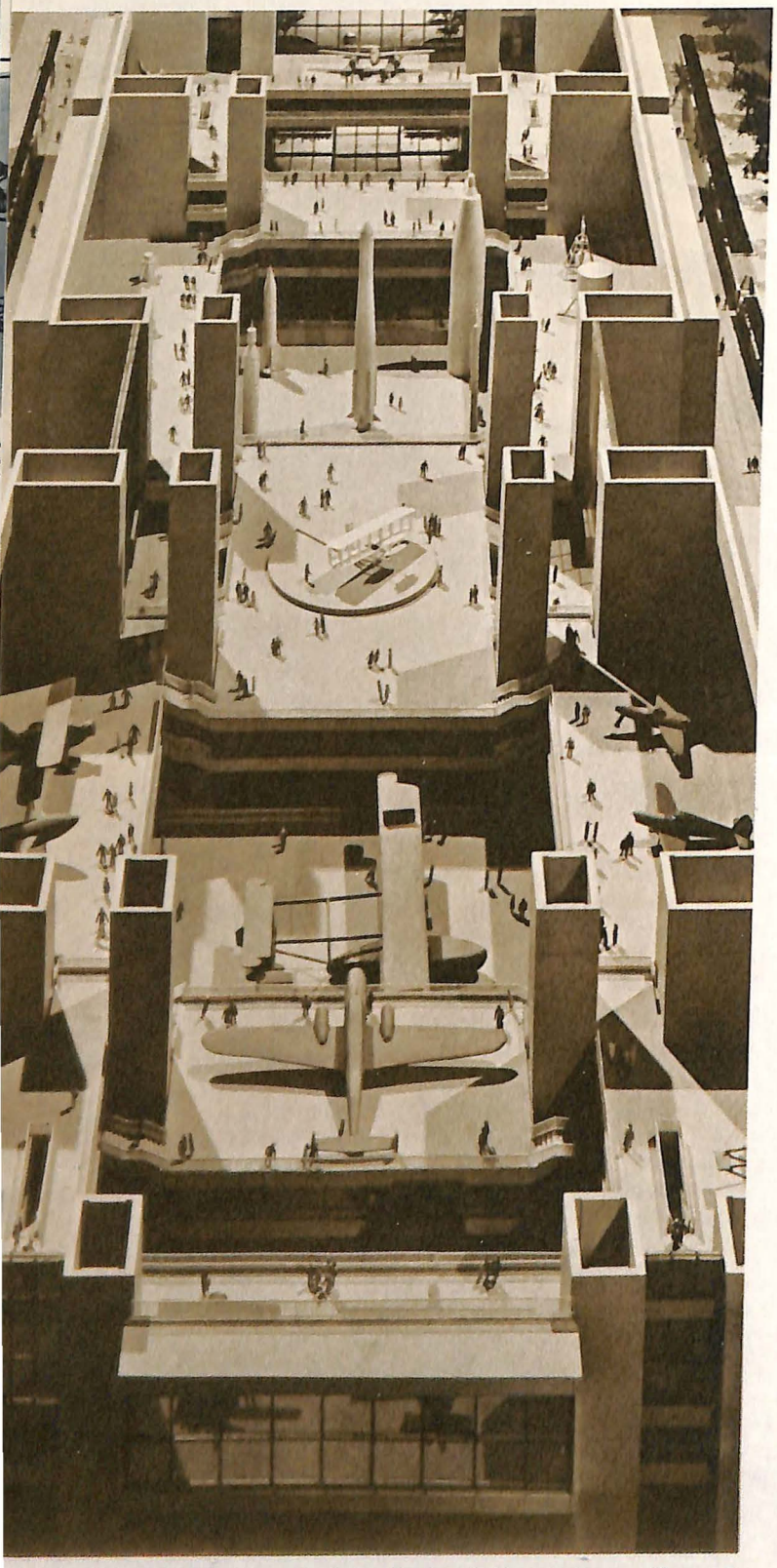
When plans which are now before the Congress are completed, the National Air Museum will become officially the National Air and Space Museum, and, hopefully, by late 1969, a magnificent new facility will be opened on Washington's Mall dedicated entirely to our air and space accomplishments and future potential.

The building design has been approved by the National Capitol Planning Commission and the Commission of Fine Arts. We now await the final Congressional go ahead, the authorization to construct.

In designing the new Air and Space Museum the architect, Gyo Obata, faced two major problems. The first requirement was to provide exhibit areas with a degree of flexibility which would permit the display of objects ranging from sub-miniaturized instruments up to very large complete aircraft, space vehicles, and rocket boosters. The second was to provide a building whose external appearance would be compatible with its location on the Mall in the proximity of the Capitol and the National Gallery of Art.

In solving the problem, Obata literally designed the building from the inside out. By an ingenious combination of exhibit levels suspended between great columns, and the use of large areas of glass, he achieved great flexibility for interior arrangement and a sense of spaciousness appropriate to its character and purpose. Also, by a proper proportioning of external masses, he achieved a remarkable consistency with the classic lines of adjacent structures. The textured cast stone, tinted glass, and dark anodized aluminum selected for exterior treatment will harmonize with the stone and marble of the older buildings on the Mall.

The new Air and Space Museum is conceived as a dynamic instrument — educational as well as inspirational — one which points toward the future as well as presenting a rear-view image of the past. It must, of course, memorialize certain significant past events and provide a proper setting for the important physical objects which have marked significant breakthroughs in man's long trek toward the stars. It deals not only with the chronological mainstream of history, but must



Model of the interior of the National Air and Space Museum shows possible arrangements of exhibits. Final displays will be determined after planning studies are completed — possibly a two-year job. Prime selection criteria are listed on the opposite page.

also explore the many tributaries which have fed it, and the many tangential eddies and whirlpools that are carried along with it.

For the six to eight million people from all walks of life who are expected to visit the facility yearly, the Air and Space Museum must present in clear and understandable fashion a balanced story of where we have been, where we are, and where we are going. It is of interest to note that over 2½ million visitors now go through the NAM's current exhibits annually, and that over 5 million people have gone through the Smithsonian's Museum of History and Technology in the first ten months after opening. For the average citizen, the NASM exhibits must be clearly, logically, and attractively displayed so that even after a brief exposure some worthwhile information will rub off and give the casual, non-technical visitor a better understanding of our flight heritage, our present situation, and future possibilities in air and space.

Smaller, but equally important, audiences are also served by the National Air and Space Museum. Aerospace education "in breadth" must be backed up by education "in depth" for the research-minded segment of the visiting public. A responsibility exists to provide and maintain adequate facilities for reference and study for the serious student of aerospace history and technological development behind the facade of public exhibits. In numbers, this audience is relatively small, but in terms of potential feedback to social development, to the nation's economy and/or to the national defense, this group is very important.

To provide such a center of learning for the American people covering man's conquest of air and space — one of the Air and Space Museum's major functions — extensive library, documentary research, conference and other facilities were called for in the specifications. By utilizing the entire top floor of the building the architect has provided ample space to house all such activities as well as the administrative offices of the museum itself. Thus, the main body of the structure is kept open for exhibits, and free and easy circulation patterns can be provided for the crowds of visitors expected to visit this new national facility yearly.

Plans for the research facility incorporate ample space for reading rooms, bookstacks, files, photograph and film libraries. A vast accumulation of technical and historical material of this kind is already on hand and is arriving in quantity every year. For the benefit of visiting research workers it is planned that the latest techniques for the storage and retrieval of information will be available.

A much smaller group of people wish to investigate actual hardware. It will be impossible, even in the greatly expanded facility planned for the new museum, to put more than a fraction of the available specimens on hand on public display. A separate facility, much larger than the public facility, must be maintained behind the scenes to satisfy the needs of such people.

Such a facility now exists on the outskirts of Washington. Hundreds of aircraft and engines and a vast

amount of parts and accessories are in this study collection, the reservoir from which specimens for public display are drawn. Patent researchers, technical historians, as well as model-building enthusiasts and aircraft-building hobbyists can be given access to original three-dimensional objects in which they may be interested. This operation incorporates, also, specialized workshops for the restoration and repair of aircraft engines and components of all kinds. Although these facilities cannot be open to the public, arrangements can be made for special visits by qualified people.

When the museum was first projected ten or fifteen years ago it was looked upon largely as a museum of aircraft. The events of the past few years, however, have required reexamination and reorientation of the project. The tremendous national space effort, both in manpower and in money, has caused a redefinition of the museum's mandate. It will shortly be designated, by law, as the National Air *and Space* Museum.

In the early days of aviation individual inventors with little else than imagination and a minimum of facilities produced flyable aircraft and laid the basis for our great aircraft industry. Now, however, there are few important "do it yourself" aircraft, and *no* "do it yourself" spacecraft. Even the simplest experimental work at high speeds and high altitudes — especially beyond the fringes of our atmosphere — requires the investment of vast resources and intensive research by teams of scientists. For this reason, it is highly important that NASM maintain close and continuous relationships with National Aeronautics and Space Administration and other government agencies and with the members of AIA.

In planning the museum's program for the next five years we must keep ourselves updated, not only as to developments within government agencies, but also with advanced thinking within the industry. When the museum opens its doors late in 1969, current events and the development of the next five years will already have become history.

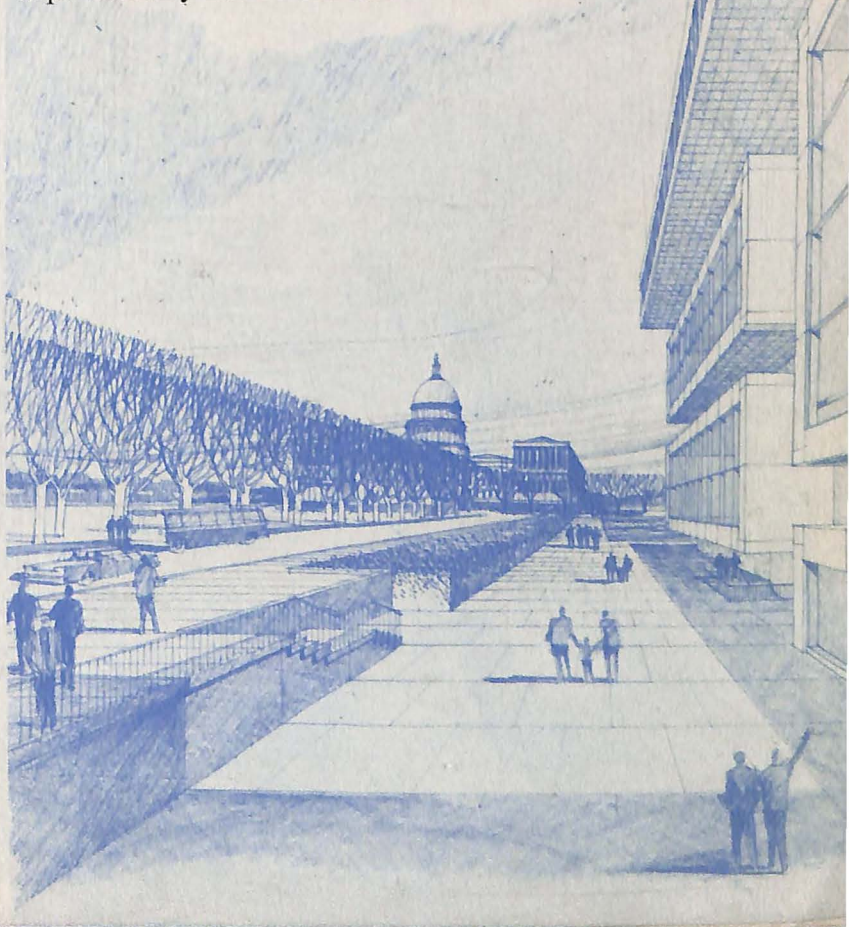
It would clearly be impractical to attempt to save the records and the hardware of *every* development now under way or in prospect for the next five years. In view of the rapid accumulation of data and things, it is important that the items of real significance — the projects that represent real breakthroughs — are recognized and preserved before they become irretrievably lost. Close collaboration between NASM and AIA members becomes tremendously important. This imposes upon NASM a requirement to staff its operations with people who are highly competent in aerospace science and technology so that they can communicate competently with technical and scientific personnel in industry. It implies, also, a willingness on the part of industry to keep the museum well informed (within a proper framework of commercial and national security) on new developments as they appear.

Subject areas and individual specimens for display must be selected to fit the museum's pre-planned programs. In the past, many worthwhile objects have come into our collections as gifts from individual or corporate donors, but decision responsibility for public display must always rest with the museum management. The general criteria for display are:

- Evidence of technical importance
- Historical importance
- Biographical importance
- Public impact
- Practical utility
- Importance in the chronological pattern
- General (or sentimental) interest
- Availability.

Anticipating that collaboration with industry is desirable and will be forthcoming, steps have already been taken to augment the technical and scientific capabilities of the present staff. A number of advisory groups made up of outside experts in special fields of aerospace interest have been recruited. We are also drawing heavily on the technical committees of the American Institute of Aeronautics and Astronautics and other scientific societies. They have been active in assisting in planning future museum programs. Recently, Frederick C. Durant, former American Rocket Society president, with a long background in rocketry and space technology, has joined the staff as Assistant Director, Astronautics. Others of similar caliber in other fields will be added as time and budget permit. They will constitute our principal liaison channels with the technical personnel of the aerospace industry.

Industry's continuing cooperation with purposes and objectives of the museum will make it possible to create a great educational asset both for the country at large and for the aerospace industry in particular. The potentials of such full collaboration are great. We hope that they can be realized.



STEERING IN SPACE

In the world beyond lift-off, beyond the Earth's gravity or the drag of its atmosphere, it is finesse with power — not tons of thrust — that is the critical factor in flight operations of today's satellites and spacecraft, both manned and unmanned. In the vacuum of space nothing moves without a push, nothing falls without a pull. This has introduced the exacting requirement of guiding and controlling the direction and attitude of space vehicles travelling at thousands of miles per hour. This art of astronautics is the design and development of space reaction controls. ■ Powerful booster engines would only hurl spacecraft aloft aimlessly without this family of space maneuvering devices developed by the aerospace industry. Mercury and Gemini could never have returned their crews to Earth without the perfectly timed, sequential firing of small retro rockets. Mariner and Ranger would never have reached Venus and the Moon without the critical mid-course maneuver involving moments of thrust from tiny rocket motors. Apollo, with its complex interfacing events, could not succeed in landing men on the Moon and returning them safely to Earth without subtle directional changes on both trans-lunar and trans-Earth trajectories. The technique of rendezvous in space demands delicate, precise changes in guidance and velocity increments. ■ The tasks of these small control systems in today's space inventory are as infinite as their variety. Orbital plane changes, as evidenced in Gemini, require a series of motors producing upon command thrust levels from 25 to 100 pounds; reaction wheels employ an inertia rotor to develop and store momentum for the attitude control of such space vehicles as the Orbiting Astronomical Observatory. Often, optical devices such as stellar "lock-on" systems are used to produce navigation signals for space flight control orientation. There are rockets designed solely to maintain proper pitch, roll and yaw attitudes of orbiting spacecraft, while others function to produce vehicle tumbling. A technique of using small rocket thrust to induce vector control of big booster engines during powered flight will be initiated with the Titan III program. Further, clusters of tiny rockets are used to separate booster sections after burn-out. ■ Most of these control systems have several things in common. To simplify them while increasing reliability, most now employ storable, hypergolic fuels requiring no igniters. They are made of lightweight metals. The Marquardt Apollo reaction control system weighs five pounds and is 14 inches long. Functionally, they generally require a start-stop-restart capability using very little on-board electrical power. In fact, the attitude control gear for Gemini demands no more power in its orbit mode than a Christmas tree bulb — less than three watts. ■ The movement of spacecraft during flight requires a fine touch. In the airless world they inhabit, finesse in applying a pound of thrust means success or failure. ■ The reaction motors are assisted in their precise tasks by such instruments as floated, rate-integrating gyros. General Precision supplied the gyros which controlled the turn rates in the mid-course correction maneuver for the Mariner mission to Mars.

1. Gemini manned spacecraft cutaway drawing shows separate propulsion systems, built by Rocketdyne, used to control the vehicle in flight. Section at bottom contains the orbital attitude and maneuvering system which was successfully utilized in the Gemini flight. The reentry control system is in the section at the top of the drawing.

2. Clusters of United Technology Center retrorockets propel the 250-ton solid propellant boosters away from the core of the Martin Company's Titan III-C standard space launch vehicle. The solid boosters are produced by United Technology.

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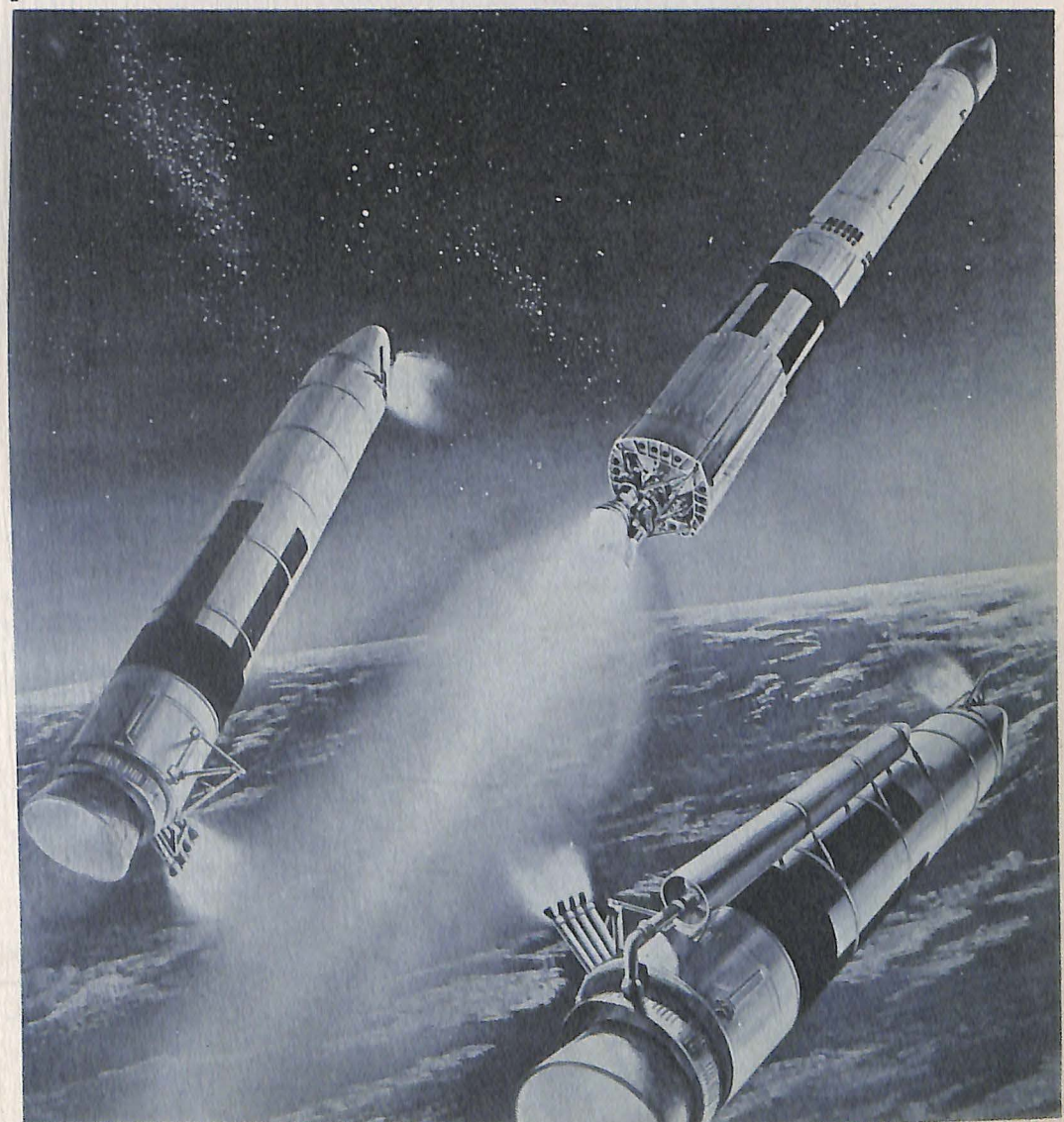

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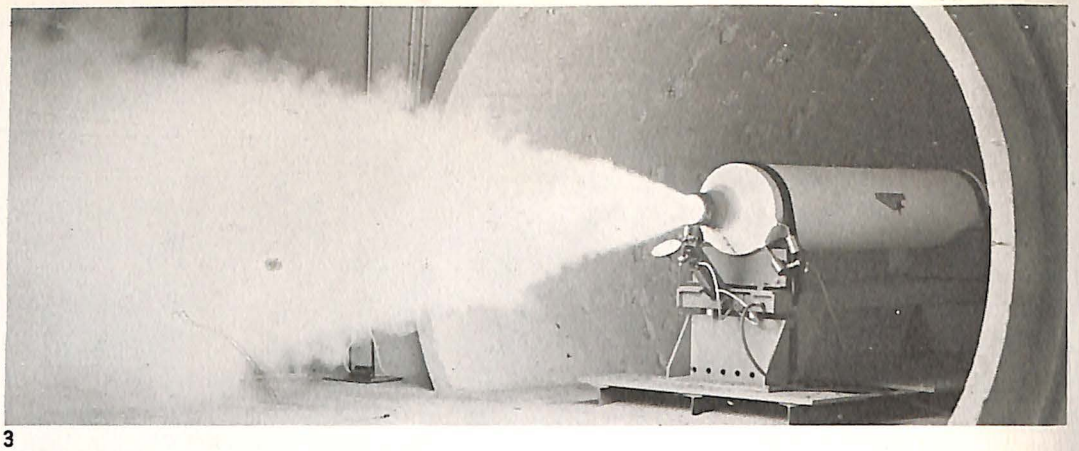
STEERING IN SPACE



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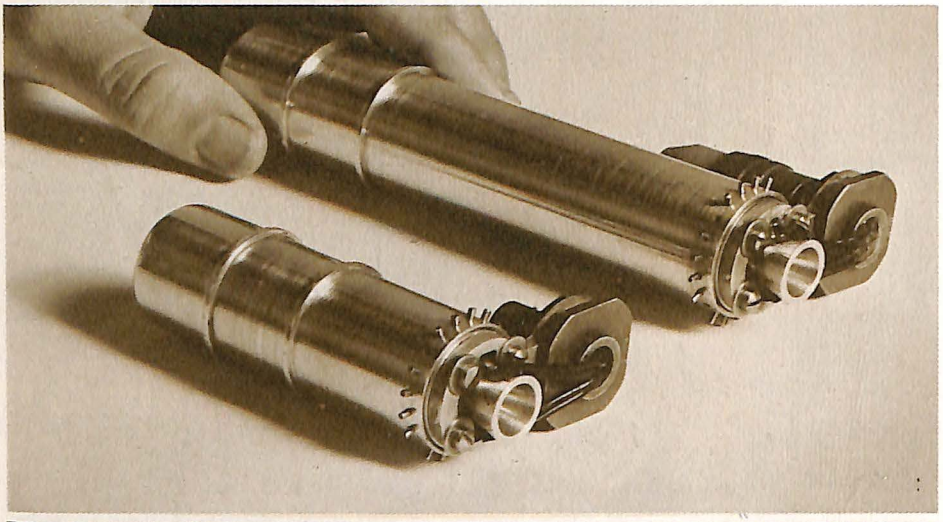
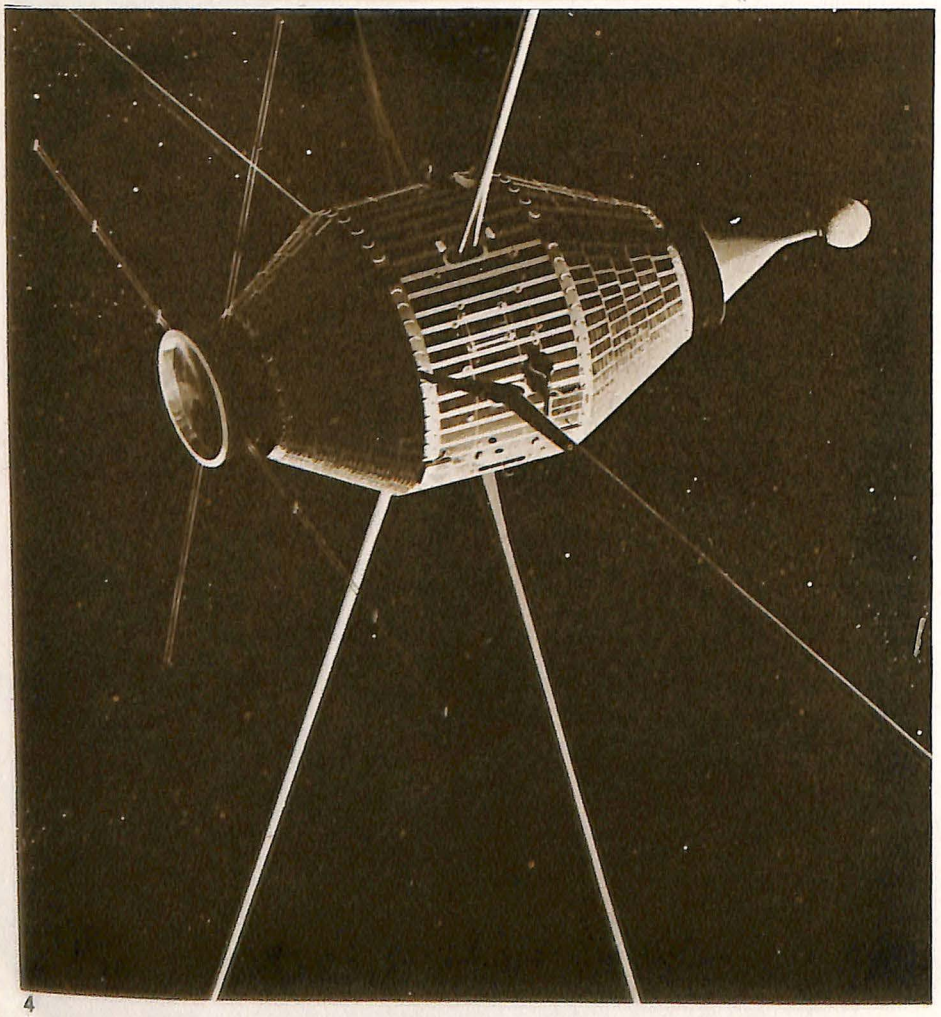




3. Lockheed solid propellant pulse motor fires during a static test involving 40 separate pulses fired on command over a 26-hour period. This capability makes the engine suitable for a wide variety of space missions.

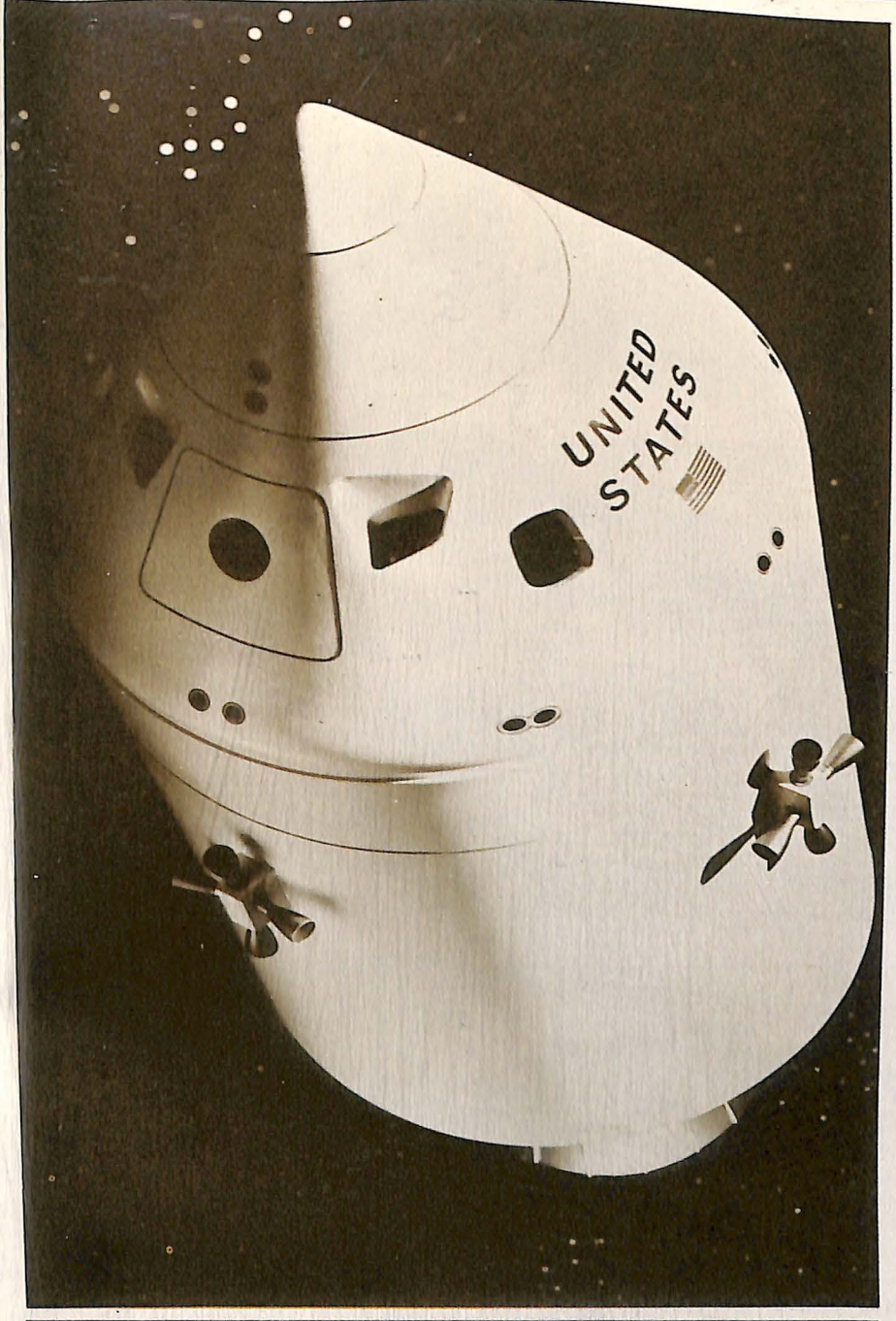
4. National Aeronautics and Space Administration satellite (bottom) is studying the ionosphere from above by measuring electron distribution. Two sets of tiny one-quarter pound thrust engines (top), made by Hercules Powder, enabled the satellite to erect its antenna and regain stability.

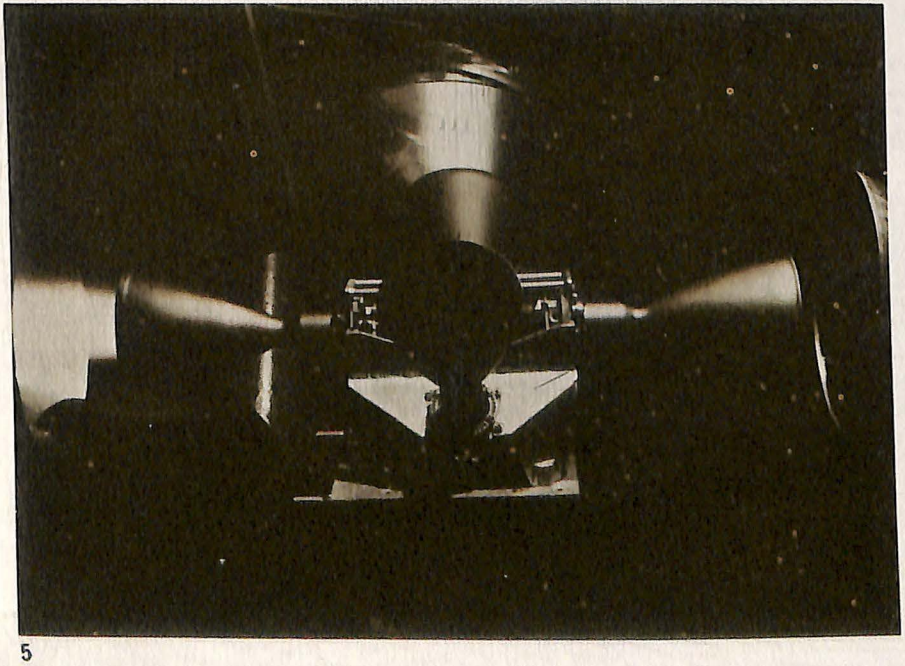
5. Marquardt reaction control rocket systems will be used on the Apollo mission. The engine, shown in a cluster at bottom, weighs less than five pounds and produces 100 pounds of thrust. These film-cooled engines have a long life. In one test, an engine was fired for 11,000 seconds with 31,500 starts. In another test, the engine was fired for more than 3,800 sustained seconds. Thirty-two of these engines will be used on an Apollo mission — sixteen on the service module and sixteen on the Lunar Excursion Module.

6. TRW-Space Technology Laboratories developed this engine for the Surveyor spacecraft, an unmanned vehicle which will make a soft landing on the moon. This is a variable area-injector engine with an ablative thrust chamber used in the spacecraft's vernier propulsion system. Size is shown by ruler at bottom.

7. Apollo system check is performed by a Honeywell engineer on manual controls and panel displays of the vehicle's stabilization and control system. The engineer holds one set of manual control sticks for translation maneuvers (left hand) and rotation maneuvers (right hand).

8. This basketball-size engine had the task of kicking twin nuclear detection satellites (upper left corner) into orbits separated by 140 degrees. The two satellites were mounted one on top of the other for launching. At apogee, the rocket on the first satellite fired and placed it into an assigned orbit. The other spacecraft continued until it reached injection position, and its rocket motor placed it into the proper orbit.





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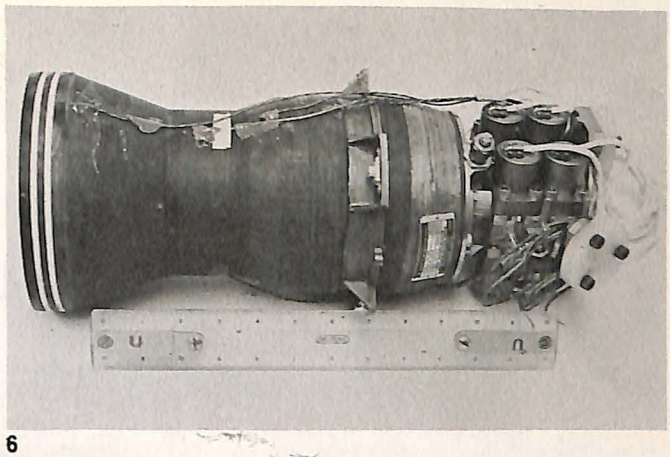

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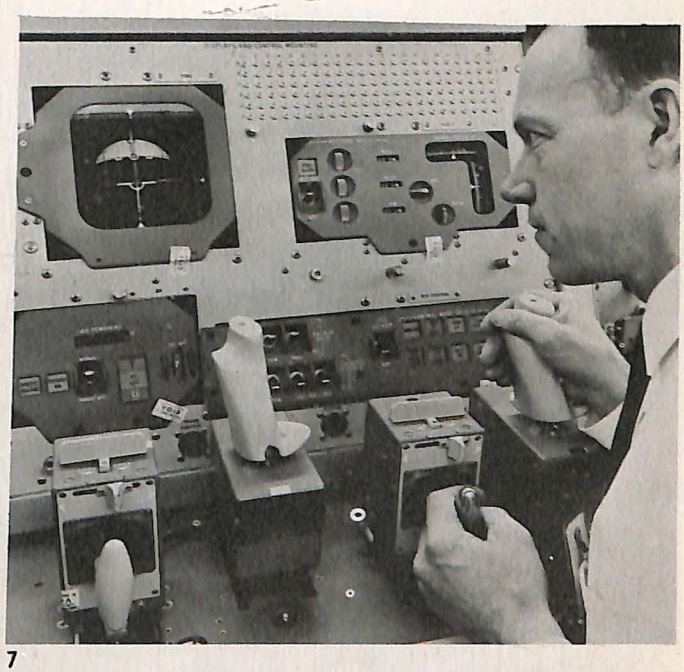

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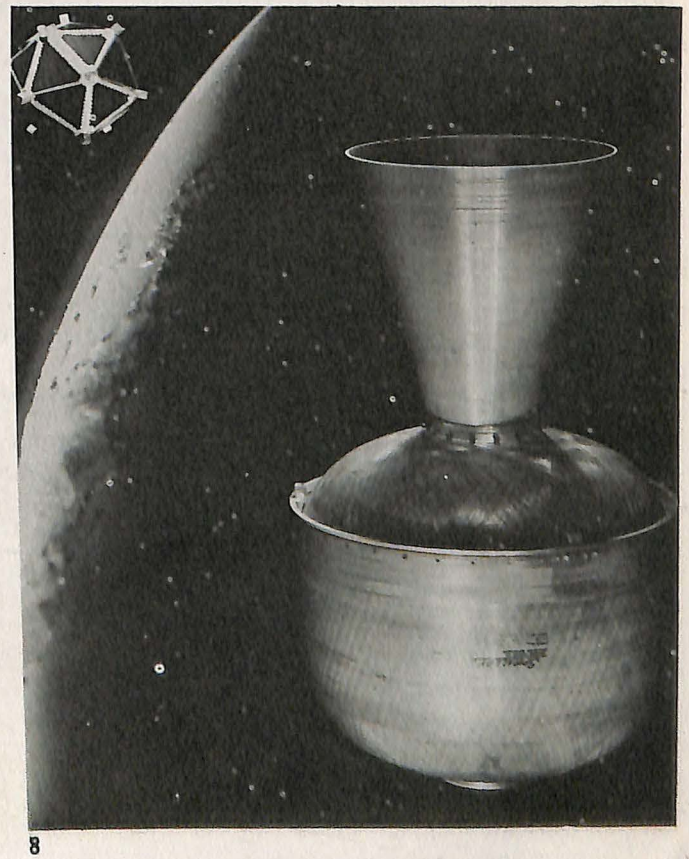

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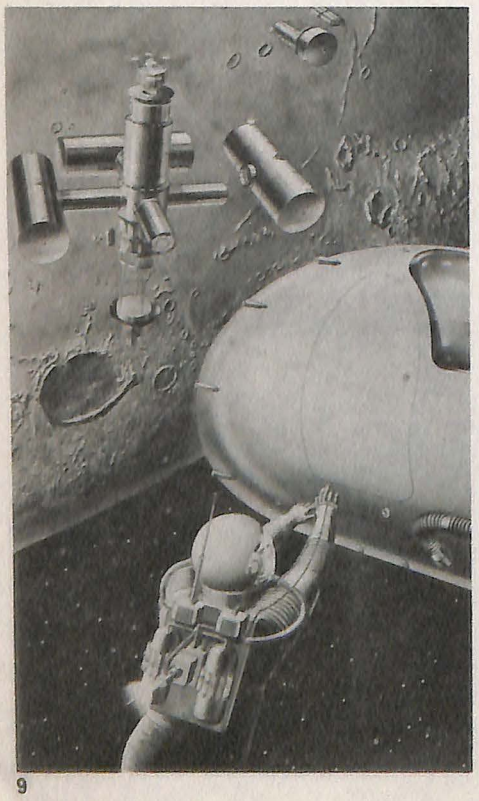
STEERING IN SPACE

9. Hybrid rocket motors, utilizing a solid fuel and a liquid oxidizer, could be used to propel spacemen and maneuver sections of a space station. Hybrids have been developed which produce about 10,000 pounds of thrust.

10-14. Bendix star tracker (No. 10) and attitude control reaction wheel (No. 11) are used in the steering of several major satellites. They are the Orbiting Astronomical Observatory (No. 12), the Nimbus advanced weather satellite (No. 13), and the Orbiting Geophysical Observatory (No. 14). The star tracker acquires and locks onto a pre-selected star and provides displacement error signals for navigation.



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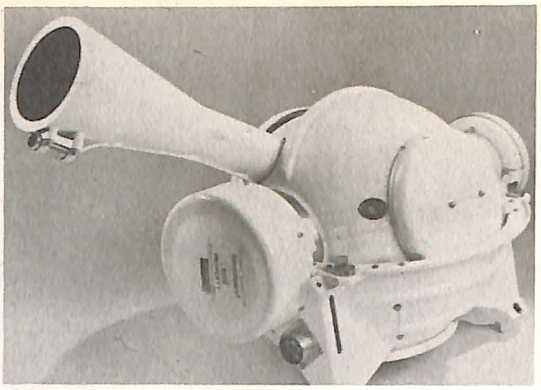

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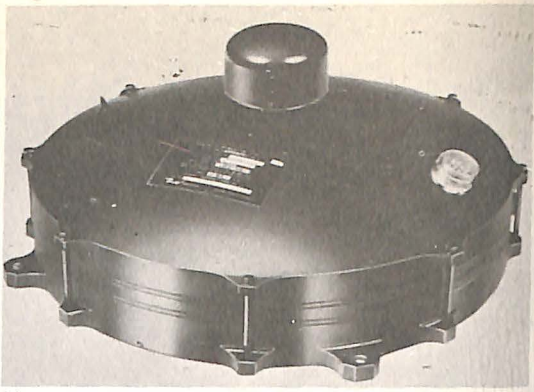

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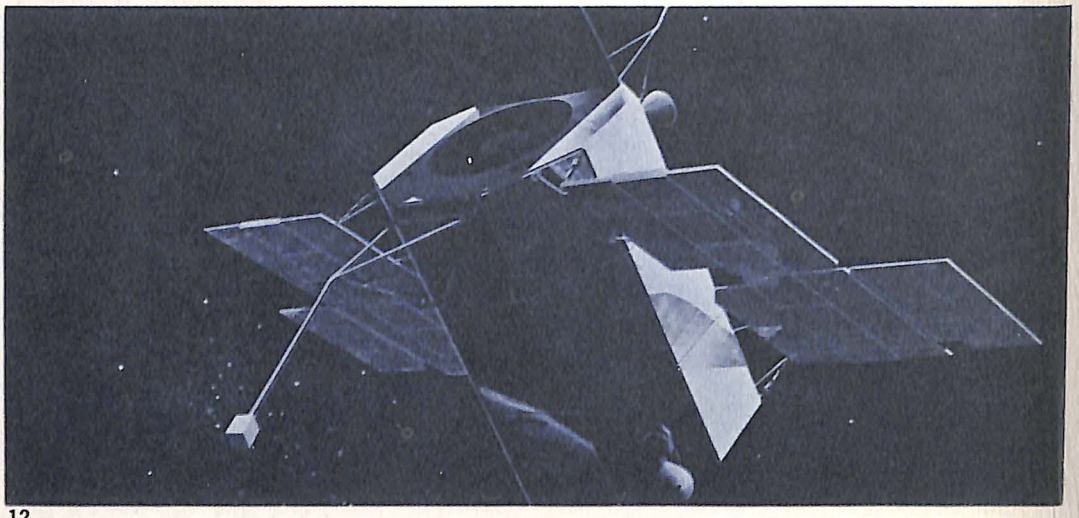

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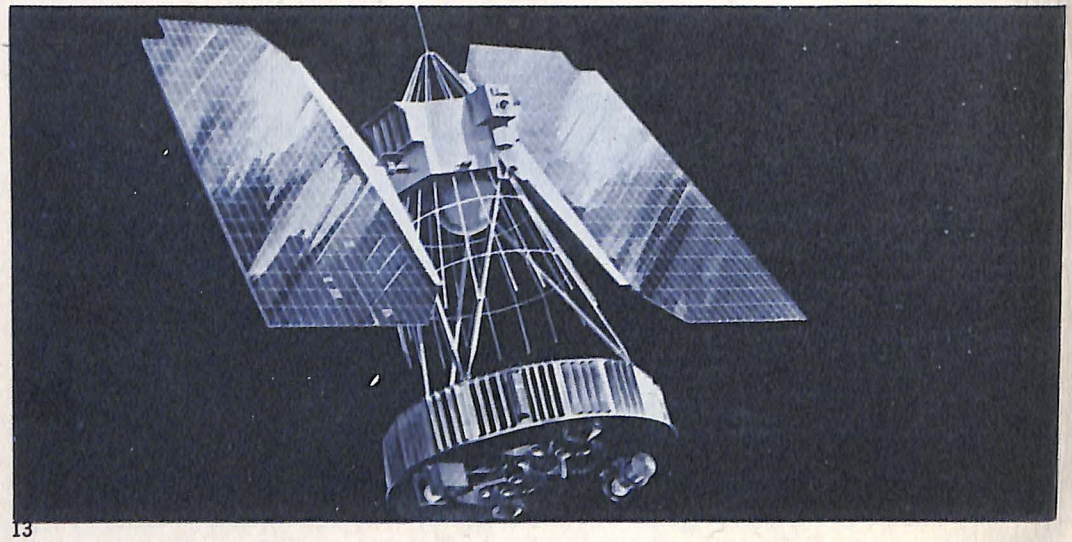

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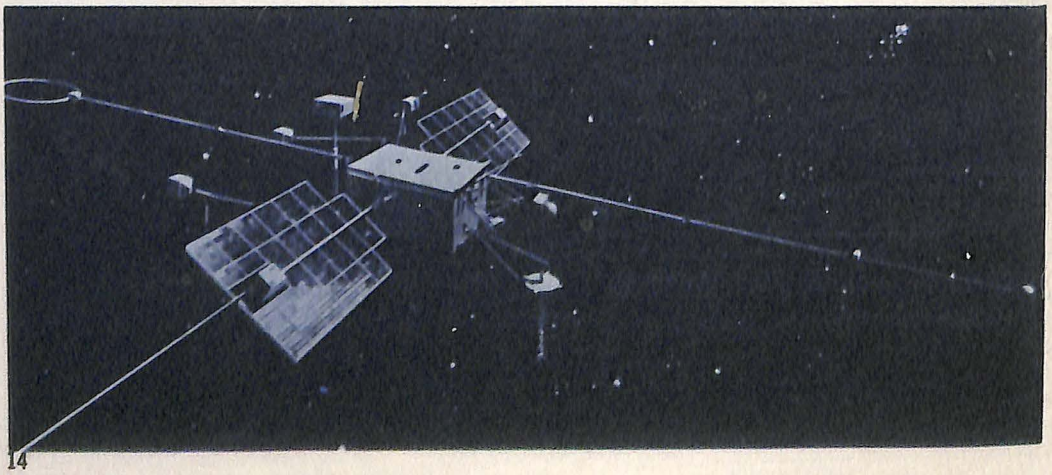
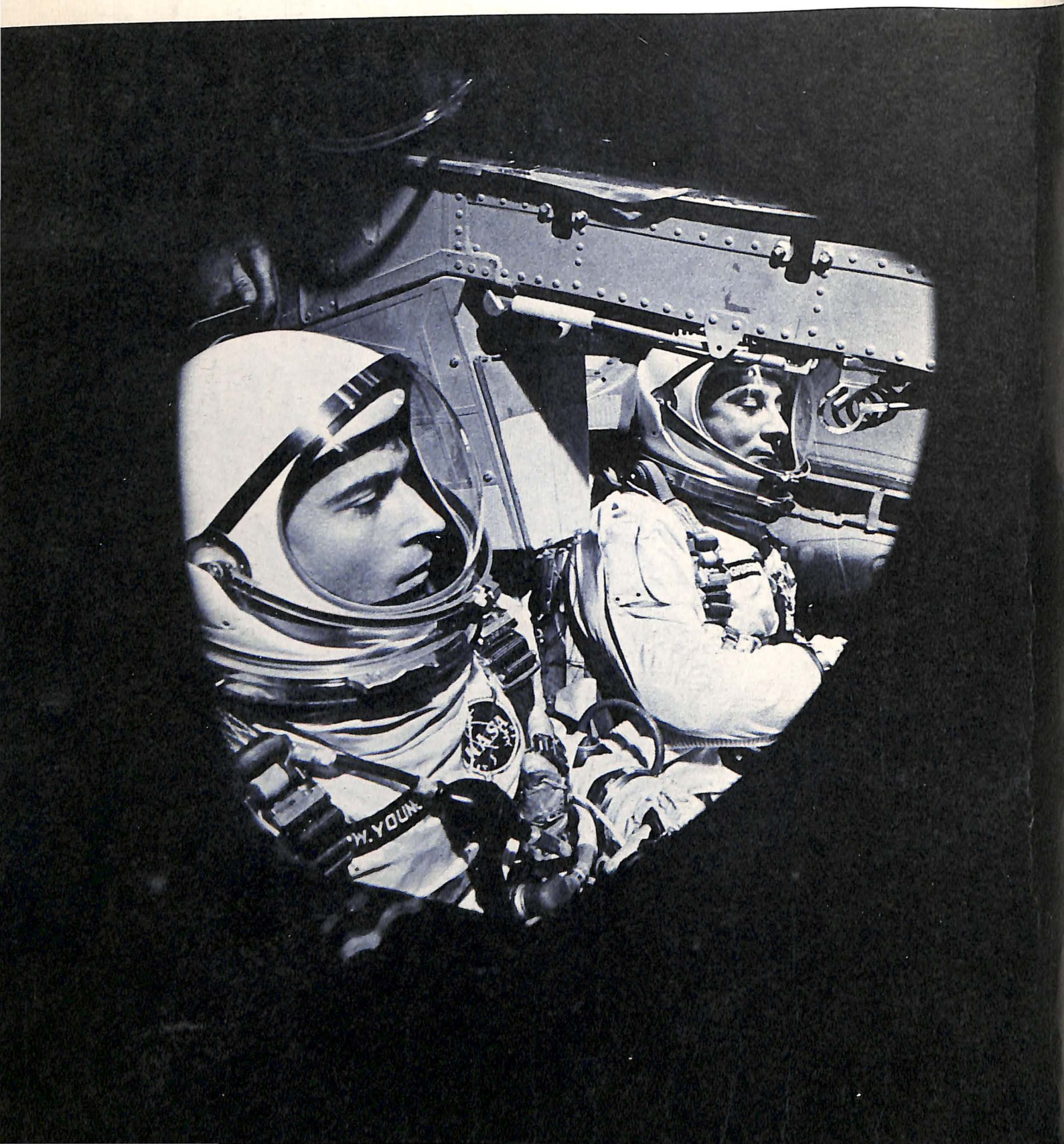


14

AIA MANUFACTURING MEMBERS

Aero Commander Div.
Rockwell-Standard Corp.
Aerodex, Inc.
Aerojet-General Corporation
Aeronutronic Division, Philco Corporation
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, Inc.
Control Systems Division of Colt Industries, Inc.
Continental Motors Corporation
Cook Electric Company
Curtiss-Wright Corporation
Douglas Aircraft Company, Inc.
Fairchild Hiller 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 Aerospace Corporation
Grumman Aircraft Engineering Corp.
Gyrodyne Company of America, Inc.
Harvey Aluminum, Inc.
Hercules Powder Company
Honeywell Inc.
Hughes Aircraft Company
IBM Corporation
Federal Systems Division
International Telephone & Telegraph Corp.
Kaiser Aerospace & Electronics Corporation
Kaman Aircraft Corporation
Kollsman Instrument Corporation
Lear Jet Corporation
Lear Siegler, Inc.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corporation
The Marquardt Corporation
Martin Company
McDonnell Aircraft Corporation
Menasco Manufacturing Company
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, Division of International Harvester Co.
Sperry Rand Corporation
Sperry Gyroscope Company Division
Sperry Phoenix Company Division
Sperry Utah Company Division
Vickers, Inc.
Sundstrand Aviation, Division of Sunstrand Corporation
Thiokol Chemical Corporation
Thompson Ramo Wooldridge Inc.
United Aircraft Corporation
Westinghouse Electric Corporation
Aerospace Electrical Division
Aerospace Division
Astronuclear Laboratory

AEROSPACE INDUSTRIES ASSOCIATION
1725 De Sales St., N.W., Washington, D. C. 20036



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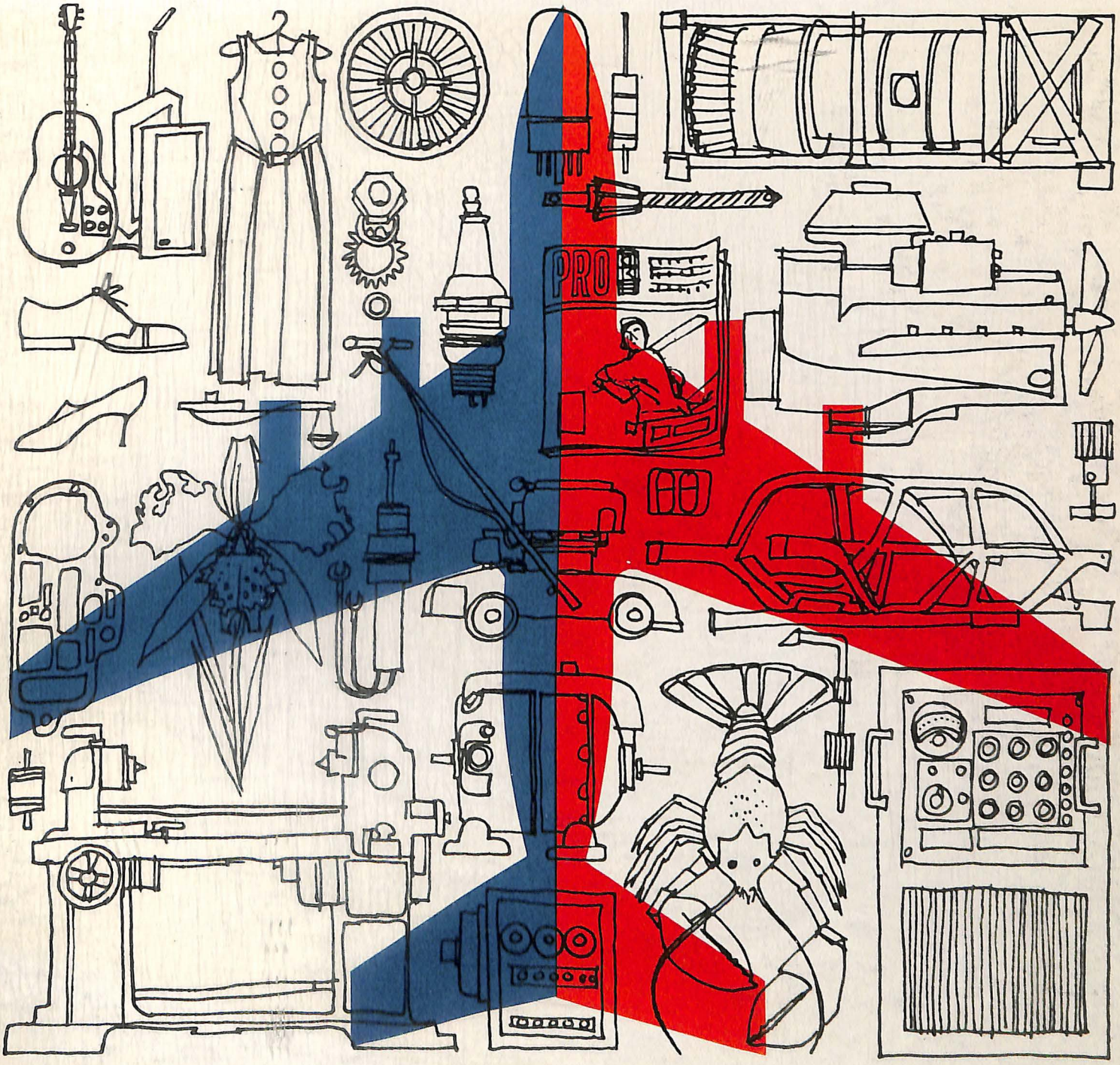


■ BREAKTHROUGH IN AIR CARGO By Stanley H. Brewer

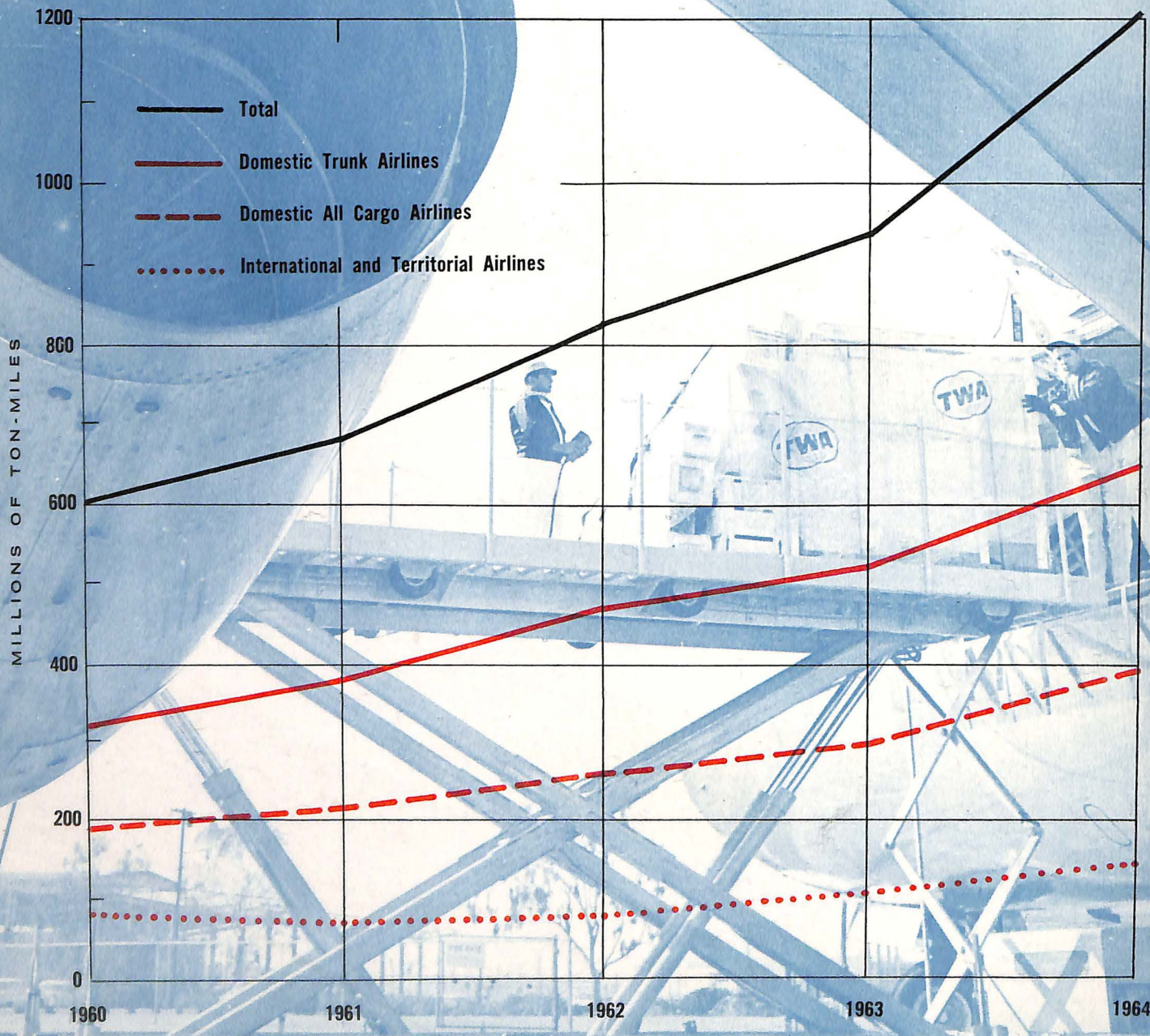
■ SPIN-OFF FROM SPACE: AN INTERIM REPORT By Karl G. Harr, Jr.

■ CODSIA — 'UNITY WITHOUT UNIFORMITY' By William H. Moore

AIR FREIGHT GROWTH

U. S. Scheduled Carriers
(1960-1964)

Air freight ton-miles have nearly doubled from 1960 to 1964 for the scheduled U. S. carriers. Bulk of the increase has come from the domestic trunklines. Local service airlines, which are not shown in this chart, increased from 4 million ton-miles in 1960 to 12 million in 1964. Air freight carried in the first six months of 1965 amounted to 455,124,000 ton-miles for only the domestic trunk lines and the all-cargo carriers. This is a gain of 25.6 per cent over the same period in 1964. Development of high-speed, economical turbine-powered transports by the aerospace industry provided the means for the breakthrough in air cargo.



AIA aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.

VOL. 3 NO. 2 SUMMER 1965

Contents

The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems;

Foster understanding of the aerospace industry's responsibilities in the space exploration program;

Foster understanding of commercial and general aviation as prime factors in domestic and international travel and trade.

AEROSPACE is published quarterly by the Aerospace Industries Association of America, Inc., the national trade association of the designers, developers and manufacturers of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems and other aeronautical systems and their components.

Publication Office: 1725 De Sales Street, N.W., Washington, D. C. 20036

Los Angeles Office: 7660 Beverly Boulevard, Los Angeles, California 90036

BREAKTHROUGH IN AIR CARGO

By STANLEY H. BREWER
Professor of Transportation
College of Business Administration
University of Washington

The financial and traffic data of U. S. airlines for 1964 indicate their biggest and best year in every department. Just three years ago, however, the picture was quite different; trunkline carriers of the United States suffered their worst financial difficulties in 1961. In February of 1962, Mr. C. R. Smith, of American Airlines, was asked why the airlines were in trouble.

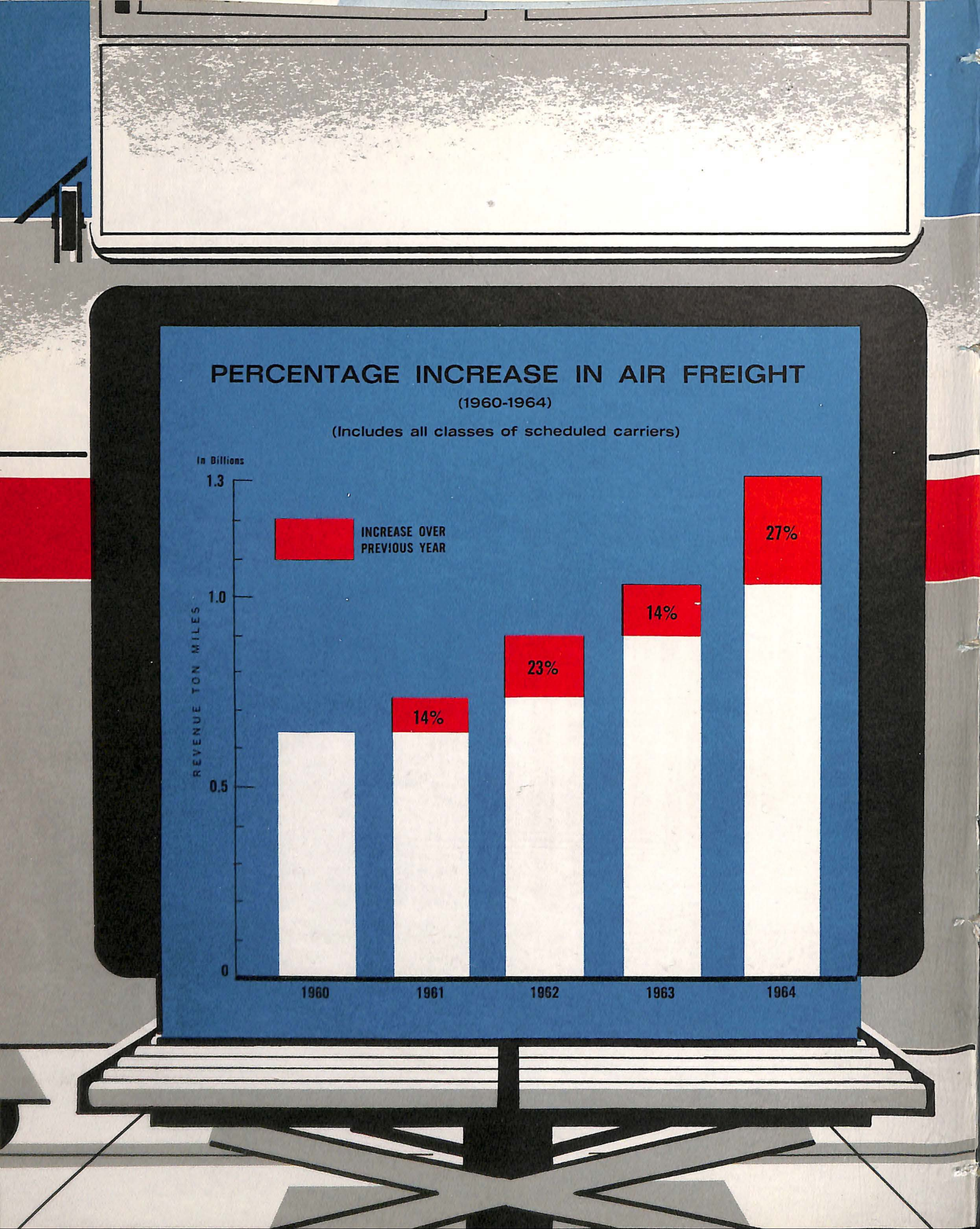
". . . The real problem," he said, ". (is that) . . if you have an airline system that is already burdened with over production, and then all of a sudden you put a machine on there that is twice as big and goes twice as fast — in other words, the jet — you very much accentuate the problem."

Mr. Smith could very well have been talking about one of the troubles of the air cargo industry today. There is presently an over capacity problem in air freight, and this problem will become much more acute in the future.

This is the breakthrough period for air cargo. Combination trunkline air carriers of the United States carried 651,314,272 ton miles of freight in 1964. This was 130,682,000 more than the 520,632,000 ton miles they transported in 1963. The increase exceeded the total tonnage hauled by these carriers fifteen years ago and was 25 per cent more than they moved in 1963. Air carriers that have purchased jet and turboprop cargo aircraft showed more dramatic results. In 1964 the freight traffic of the three domestic all-cargo lines was up 40.3 per cent over 1963. Three major air carriers — American, Trans World and United Air Lines — in the introductory year of cargo jet aircraft increased their freight business from 370,269,000 ton miles in 1963 to 462,159,000 ton miles last year.

The United States international air carriers had similar successes. Pan American's air freight increased 35.9 per cent system-wide in 1964 over 1963. International ton miles of freight for Trans World Airlines grew 23.7 per cent from 1963 to 1964, and the domestic business of this company was up from 78,-581,000 ton miles in 1963 to 112,802,000 ton miles in 1964. This was a 43.5 per cent growth for 1964 over 1963.

Even the local service carriers with their serious limitations in cargo carrying capacity showed substantial improvement last year in cargo growth. Freight ton miles for the 13 regional carriers increased by 32.1 when 1964 is compared with 1963. Revenue ton miles of freight for Lake Central and Trans Texas jumped nearly 60 per cent during the period and for Allegheny and Pacific the gain was well over 40 per cent. Some local service lines frankly admitted they had to discourage customers from shipping more because of


PERCENTAGE INCREASE IN AIR FREIGHT
(1960-1964)
(Includes all classes of scheduled carriers)
In Billions
REVENUE TON MILES
1.3
1.0
0.5
0
INCREASE OVER PREVIOUS YEAR
14%
23%
14%
27%
1960
1961
1962
1963
1964

baggage hold capacity problems in their smaller aircraft. However, this will not be a limitation as these carriers phase into the short-range jets several of them have ordered. Many of the local service carriers will move into jet equipment programs within the next few years. They are taking a serious look at the substantial possibilities there are for reducing subsidy payments and still meeting commitments for the new equipment from increased revenues from passengers and freight. Their passenger loads are improving but the greatest possibility they have for rapidly increasing revenues is from cargo.

The new short-range quick-change jet aircraft being offered by manufacturers should be especially attractive to local service lines. In some instances these new planes are too large for many low density passenger routes served by regional carriers, but they are not too large for combination passenger and freight operations. The possibility for this equipment being used in all-freight operations during off-peak night and early morning periods is attractive. The extra utilization will go a long way toward resolving financial problems these carriers will have when they purchase the jets.

These 1964 rates of growth over 1963 were higher than most forecasts made in the early years of the breakthrough period. This probably means that the necessary ingredients are now in the formula for unprecedented rates of growth for air cargo in the years ahead. There is now a new dimension in the air freight business and that is the promise of rewards in the future where there have been few in the past. However, as is true of every situation where there are potential profits, there is a mad rush for the gold fields. At the moment, there is little agreement and much controversy about staking claims in the first place, and the kind of mining operation to be set up in the second place.

The air carriers that hope to exploit the vast and rapidly growing potential in air freight are only a small segment of the business establishments that hope to reap some rewards for their years of planning and effort and investments in the future of air cargo. Aircraft manufacturers have sold numbers of turboprop and jet aircraft in all-cargo, combination and convertible configurations to airline customers. The possibilities for future sales of these and other models are exciting. These companies are increasing the variety and sizes of airplanes they offer and nearly all of the new models have cargo applications.

Manufacturers and builders of ground-handling equipment and terminals have also spent substantial sums on a large number of products designed for speeding ground-handling and reducing costs. Progress has been made but greater efficiency must be achieved in order to reduce the time and costs of loading and unloading, and movement of freight through terminals. There is little agreement between companies and as a result a number of cargo handling systems are being employed. The incompatibility of these systems at various air terminals is becoming a major problem.

The airline and aircraft manufacturing industries historically have been passenger-oriented. Little attention was given to freight, and as a result these industries are just beginning to realize how very different the freight and passenger businesses are. The most important difference is the fact that the passenger is for the most part service-oriented, while most freight is cost-oriented. In order to sustain the healthy growth necessary to keep up with rapid increases in air freight capacity, many problems must be resolved. One of the most important is the development of a pricing structure that will enable operators to exploit the demand curve of the cost-oriented freight.

Combination air carriers have in recent years concerned themselves to a much greater extent with market segmentation in order to test the demand curve for passengers. Three classes of service in a single airplane are now common, and some economists are beginning to advocate a fourth class. Seasonal fares are offered extensively in high-density tourist markets.

Passengers are relatively homogeneous, while freight is heterogeneous. The opportunities to segment the market for freight and exploit demand curves for products moving between various points are limitless. There are myriads of opportunities to experiment with seasonal rates, directional rates, and rates for various weights of shipments. Although air carriers are trying all manner of experimentation within the framework of their present pricing structure, it still has serious limitations.

The major fact that has become clear to carriers interested in air freight is that they must attract larger shipments. The average shipment of less than 200 pounds that moves by air carriers is expensive to document and handle; there is simply no way to make money on small shipments at the rates that must be charged to remain competitive with surface transportation. This is especially true when the freight moves in all-cargo aircraft. When it is transported in baggage holds of combination aircraft, it becomes a matter of what costs are allocated to this segment of the operations.

Government agencies will play an increasing role in the development of air freight. In many ways they have the power and responsibilities for developing the environment in which this industry will grow. Several agencies are involved, and some of the problems these agencies must cope with will become increasingly complex.

Aircraft engineers have moved technology ahead very rapidly in both the air freight and the passenger business. A major concern of many aviation executives, government regulators and economists is that aircraft engineers are well ahead of social scientists and that many of the socio-economic problems must be resolved before the inventions and design innovations of these engineers can be exploited. For instance, the engineers are enthusiastic about the possible uses of quick-change airplanes. Some of the airlines have announced purchases of these aircraft, and more are contemplating such action. The logic for the development of these aircraft is indisputable. There are substantial economies to be gained from increasing utilization of aircraft, and this is certainly attractive to operators. When fully allocated costs of these craft are covered by daytime passenger operations, any revenue they can attract

above direct operating costs for freight hauls at night would be profitable.

The smaller quick-change aircraft could be operated in relatively short-haul markets where it would compete with trucking firms. In order to do this, airline companies must develop a pricing structure that will enable them to be more competitive with the motor carriers. In this field, their price competition must be close to the level of the trucks for several reasons. Motor carriers price on a door-to-door basis. They pick up late in the afternoon and deliver to distances up to 600 miles from the origin by the next morning. Despite the fact that the airplane is faster, there will often be no advantage in this speed, because deliveries cannot be made until the enterprise opens for business the following morning. Therefore competition will have to be based on total cost to the shipper or receiver of the material.

The 600 million ton miles of air freight moved domestically by the United States trunk line carriers last year could have been moved by ten of the big cargo jets. Jet aircraft of all kinds are being absorbed by the airlines of the world in unprecedented numbers, and this trend will continue. Those aircraft in passenger configurations all have much greater capacity to move freight than any of their piston-engined predecessors. Even the Douglas DC 9's and Boeing 737's have more than 600 cubic feet of space in baggage holds. This is 50 per cent more capacity than the 400 odd cubic feet available in the holds of big piston planes. Cargo revenues are important to the airlines, and they will become much more important. Because of the changing nature of the passenger business, airlines may be destined to live with lower average load factors than they maintained with piston aircraft. This means that the incentive to fill baggage holds with cargo will increase.

In addition to the possibilities for rapid growth in freight traffic, there may be new developments in mail programs that could fill some of the excess capacity but here again, many problems must be resolved. Among these is the question of what rates will obtain when more first class mail is shifted to the airlines. The decision should be carefully evaluated in economic terms to determine the extent to which marginal revenues might exceed marginal costs in exploiting this demand curve.

Many problems must be resolved in attempting to broaden markets for international air freight. The United States international air carriers have an entirely different environment in which to do business than the domestic lines. Rates are made through the International Air Transport Association, which is a trade association instead of a government agency. The very nature of competition and controls is entirely different. Distances are generally greater and the ships with which airlines compete internationally move slower and price their services differently than motor carriers and railroads. The kind of pricing structure these operators use to expand and exploit freight markets may be quite different than that developed by domestic airlines. United States international air carriers must compete with many foreign flag airlines that are heavily subsidized by their governments. As a result, they are often motivated differently than the free enterprise, non-subsidized United States lines. Freight traffic is often controlled by large combines of consolidators or forwarders in foreign countries. These combines exercise their power and influence differently than the consolidators in the United States that are prevented from joining in cartels.

Despite these many problems the air cargo industry is moving ahead at an increasing pace and this trend should continue for a number of reasons. There are for the first time potential profits from the common carriage of air freight. This has stimulated interest from many segments of the business. Top management in both the airline and aircraft manufacturing businesses are now vitally interested in air cargo. As a result the many problems of this segment of the aviation business are receiving increasing attention. Government agencies are aware of the rapid growth and resulting problems

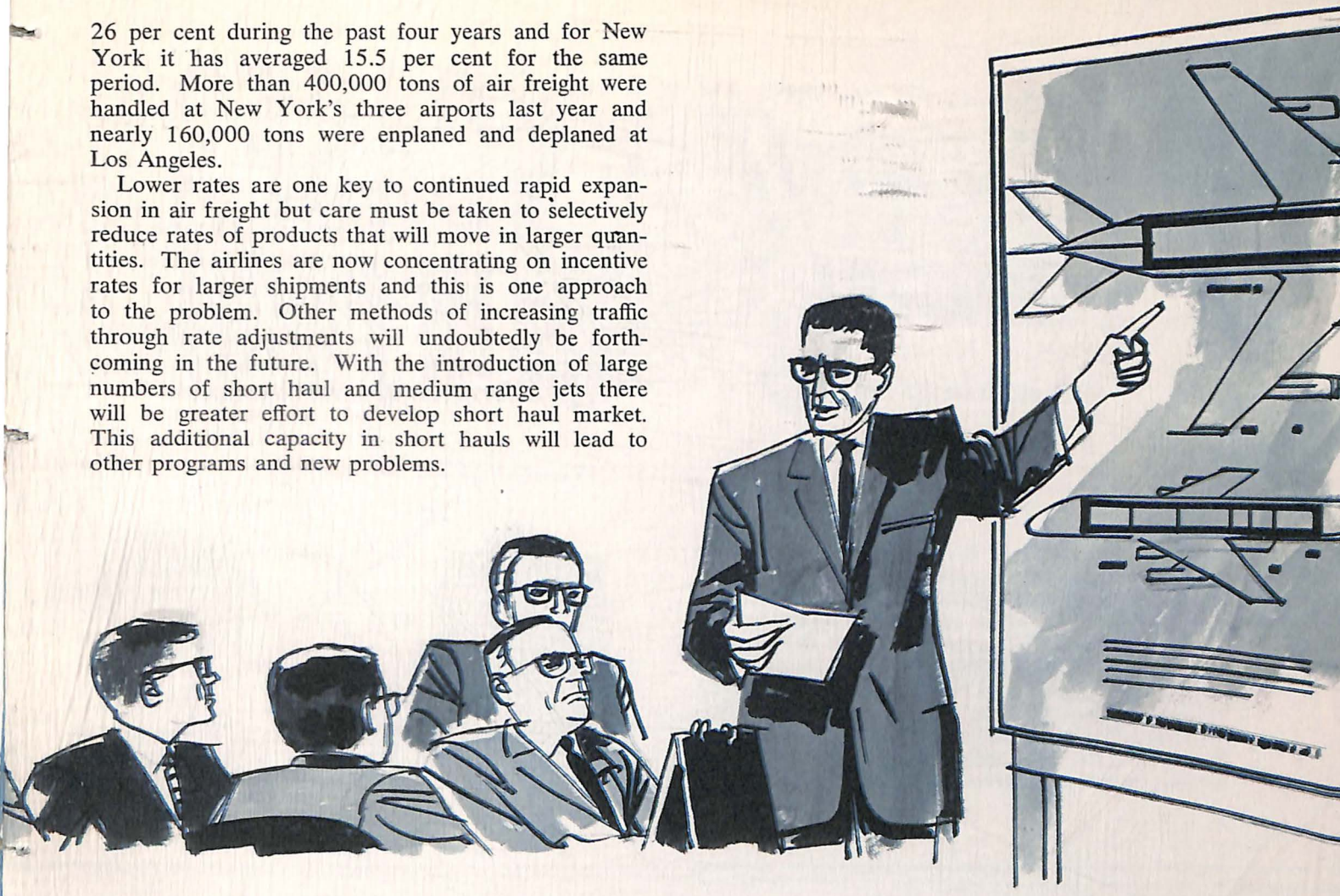
in air freight and increasing effort is being expended to resolve some of the socio-economic dilemmas.

Competition and capacity for freight is increasing rapidly and rates on individual commodities are being adjusted downward. The average freight-rate yield for domestic trunks was 22.14 cents a ton mile in 1964; down from 23.58 in 1960. For domestic all-cargo lines the comparative figures were 17.92 cents in 1960 and 13.59 cents in 1964. United States international and territorial carriers collected an average of 26.74 cents a ton mile for freight last year compared with 31.85 in 1960. Local service and helicopter carriers had a yield of 56.34 cents a ton mile in the earlier year and 56.58 cents in the latest year.

The substantial differences in yield for the various groups of carriers reflect several things. A high proportion of small shipments moving relatively short distances for some carriers will result in high ton mile yield but this does not necessarily mean the traffic is profitable. All-cargo carriers are concentrating on larger shipments generated by freight forwarders and big shippers that move long distances. This accounts in part for their lower yield. There has been heavier concentration on long haul traffic between New York and Pacific Coast cities of San Francisco and Los Angeles and this kind of competition will spread to other areas. Air freight traffic in and out of Los Angeles has increased at an average annual rate of

26 per cent during the past four years and for New York it has averaged 15.5 per cent for the same period. More than 400,000 tons of air freight were handled at New York's three airports last year and nearly 160,000 tons were enplaned and deplaned at Los Angeles.

Lower rates are one key to continued rapid expansion in air freight but care must be taken to selectively reduce rates of products that will move in larger quantities. The airlines are now concentrating on incentive rates for larger shipments and this is one approach to the problem. Other methods of increasing traffic through rate adjustments will undoubtedly be forthcoming in the future. With the introduction of large numbers of short haul and medium range jets there will be greater effort to develop short haul market. This additional capacity in short hauls will lead to other programs and new problems.



Completely integrated systems approaches to movement and transfer of freight between short haul and long haul carriers should be given attention. Economies can be effected through compatibility in air freight terminals and aircraft loading systems as more freight is moved in and out of tributary and local service areas for long haul movement. Attention should be given to development of more through routes and joint rates. Divisions of these joint rates will have to be negotiated in such a manner as to encourage larger quantities of tributary and gateway traffic.

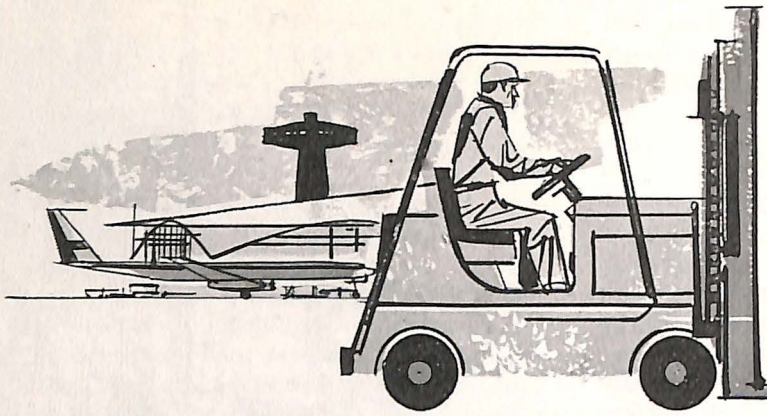
All of these programs will stimulate development of air freight and broaden markets. The average size of shipments will increase as rates are lowered and shippers are able to evaluate the improved distribution economics it is possible to attain by greater reliance on air freight. Domestic air freight growth should continue at average rates of slightly more than 20 per cent for some years in the future. International and territorial traffic should move ahead at average rates of nearly 30 per cent because of the longer average distances that tend to accelerate ton mile growth figures.

There has been rapid growth in air freight traffic in recent years, and this trend will continue. The carriers now have much more economic equipment for freight carriage than formerly, and there are opportunities to profit from the common carrier air freight business. These new opportunities have awakened the interest of top management in airlines and aircraft manufacturers in this segment of the aviation business, but there are many serious socio-economic problems that must be resolved.

Aircraft engineers are far ahead of managers and economists who must determine ways to exploit the rapidly advancing technology in air freight transportation. These managers and economists, however, may not be free to exploit this technology because of the many governmental controls that are and must be exercised in equating intra- and intermodel competition in the transportation business.

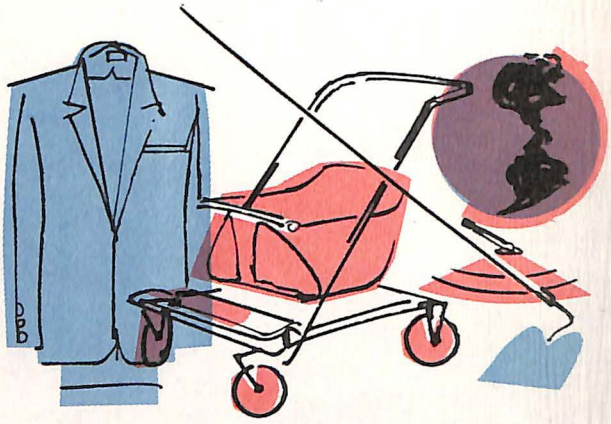
Many challenging problems of the air freight industry are now being attacked by government officials and airline executives. The speed and manner in which they arrive at solutions to these problems will determine how rapidly this segment of the airline industry will grow. Intra- and intermodel competitive relationships are among the more difficult problems that must be resolved and these will become even more trying in the future. The quality of the service offered and the rates charged will have a major impact on growth and these matters are the crux of intra- and intermodel relationships.

Despite these many problems, ton mile growth for domestic airlines should average more than 20 per cent and for international and overseas lines it will be approximately 30 per cent during the next five years.

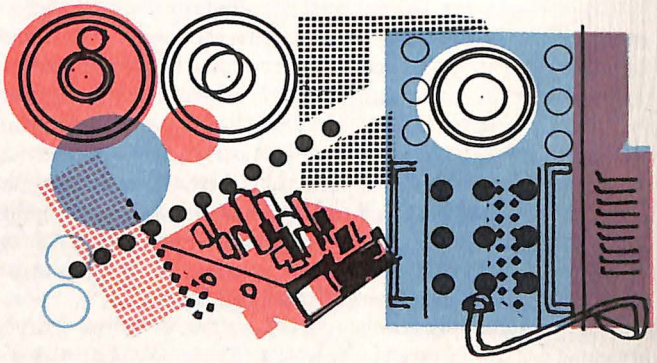


CASES IN POINT

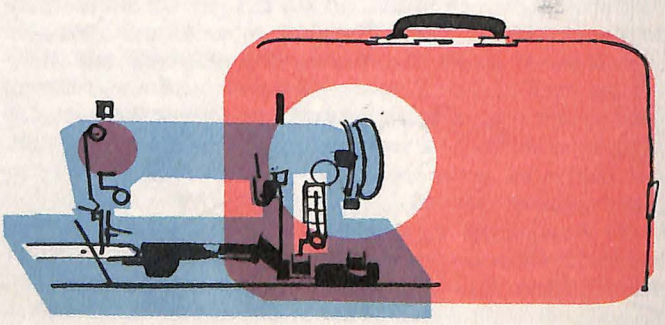
SEARS, ROEBUCK This firm recently started weekly air shipments of 12,000 pounds of merchandise ranging from clothing to farm equipment from Los Angeles to its Honolulu stores. When all shipments went by sea, inventories were tied up for weeks and this lengthy time span required long-range seasonal forecasts for many articles. Today store managers can order daily by air mail and carry a greater model variety in each product line. The transportation-distribution manager for Sears points out these additional advantages: improved product control, lower inventory and warehouse costs.



NORTH AMERICAN AVIATION (Autonetics Division) All forms of air freight transportation are used by this aerospace company for the prompt movement of high-value precision electronic equipment. Since 1962, Autonetics has been consolidating shipments from its many suppliers within a 200-mile radius of five terminal cities — Boston, New York, Philadelphia, Cleveland and Chicago. The traffic manager for Autonetics states: "Our thousands of suppliers must be tied in with tight production schedules. We operate with low inventory and fast attrition or consumption."



SINGER MANUFACTURING COMPANY Experimental shipments of sewing machines recently made from the Singer plant in Scotland to the U. S. may lead to the movement of 50 tons of machines each week. Singer's general traffic manager points out: "You can't match air with surface costs solely by a rate yardstick. We feel that air shipments will shorten our pipeline by 80 per cent." The ocean pipeline involved inventory costs based traditionally on six months in distribution warehouses and three months in the transport pipeline.



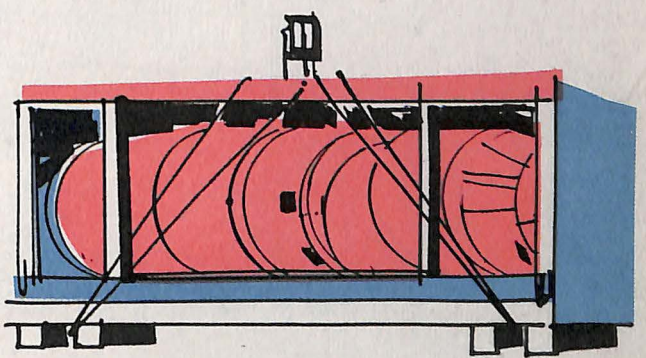
The increases in air freight during the past few years and the gains forecast for the future are due to an uncomplicated economic factor: Lower total cost.

A substantial portion of air freight business comes, of course, from high priority and perishable commodities. But air freight offers more than simply speed. Expensive warehousing and large inventories can be greatly reduced or eliminated with air freight. A breakdown of the type of commodity carried by a major airline shows that items such as cut flowers and fresh fruit rank behind machine, auto and electrical parts and printed matter.

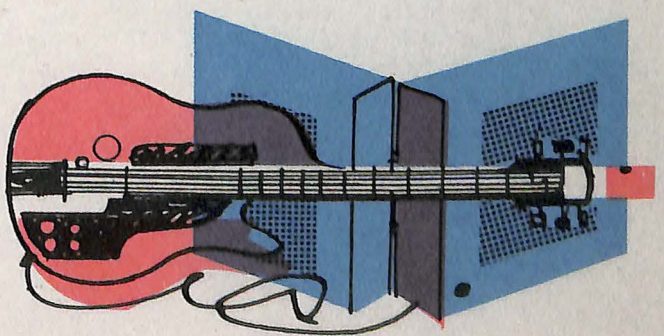
Here are some case histories of firms using air cargo and the benefits derived.

AMERICAN OPTICAL COMPANY A study by American Optical indicated that use of air freight could reduce inventories of eyeglass frames and other ophthalmic products at its 261 locations across the nation by 25 per cent. The volume of air freight shipments was increased and an inventory reduction of 27 per cent was achieved. The inventory reduction offset the cost of air freight and more, producing a savings of $100,000.

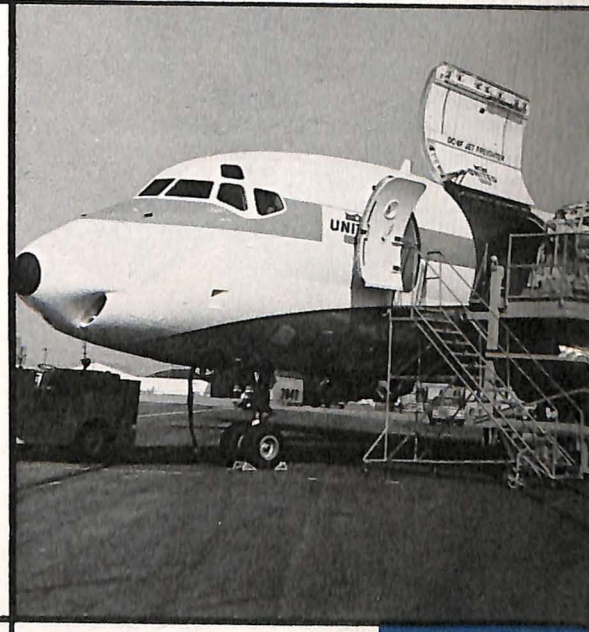
SOUTHERN CALIFORNIA EDISON COMPANY A 35,000-lb. turbine rotor was shipped by air from Newark, N. J. to the generating plant of Southern California Edison at Oxnard, Calif. Delivery by surface carrier would have required five days longer than by air. During those five days the new plant generated $12,500 in electricity nearly two and a half times the cost of the air shipment.



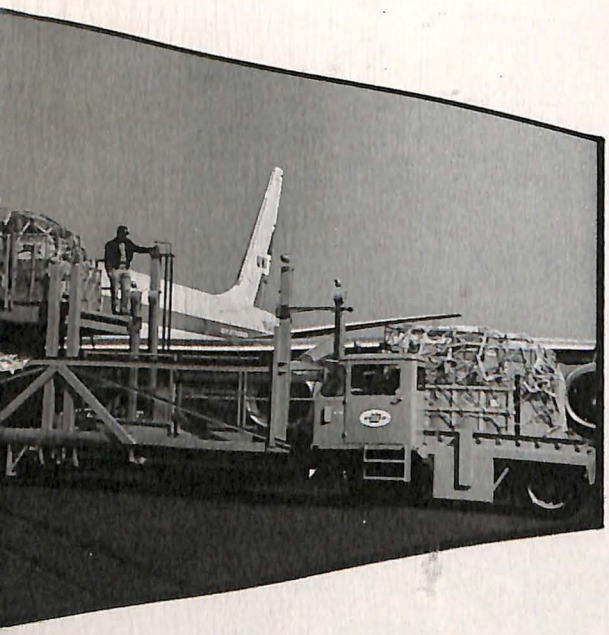
FENDER ELECTRIC INSTRUMENT COMPANY Fender manufactures electric guitars, amplifiers and related products, shipping them to Europe, Australia, South Africa, Hong Kong, Japan and Latin America where modern American music—rock and roll, jazz, hootenanny and country — is very popular. The assistant to the president of Fender reports that air freight is used extensively to penetrate this growing market with about 70 per cent of its shipments to Europe made by air. "Every day a piece of merchandise is in transit," he says, "it costs somebody money."

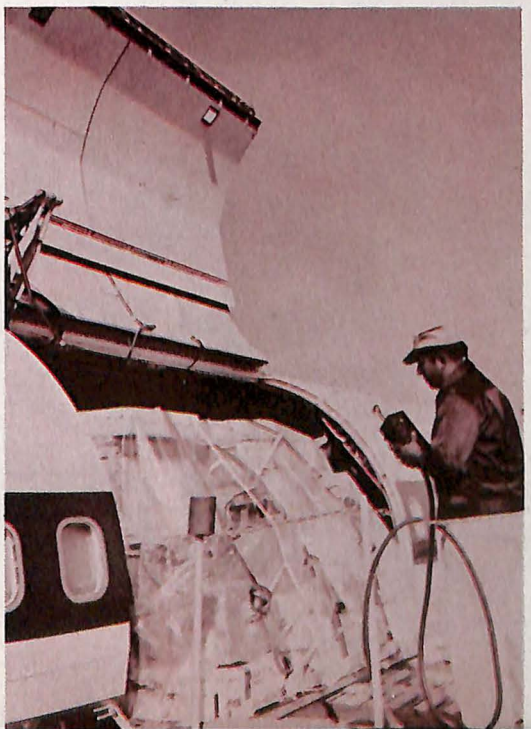


AIR FREIGHT - ON THE WAY UP

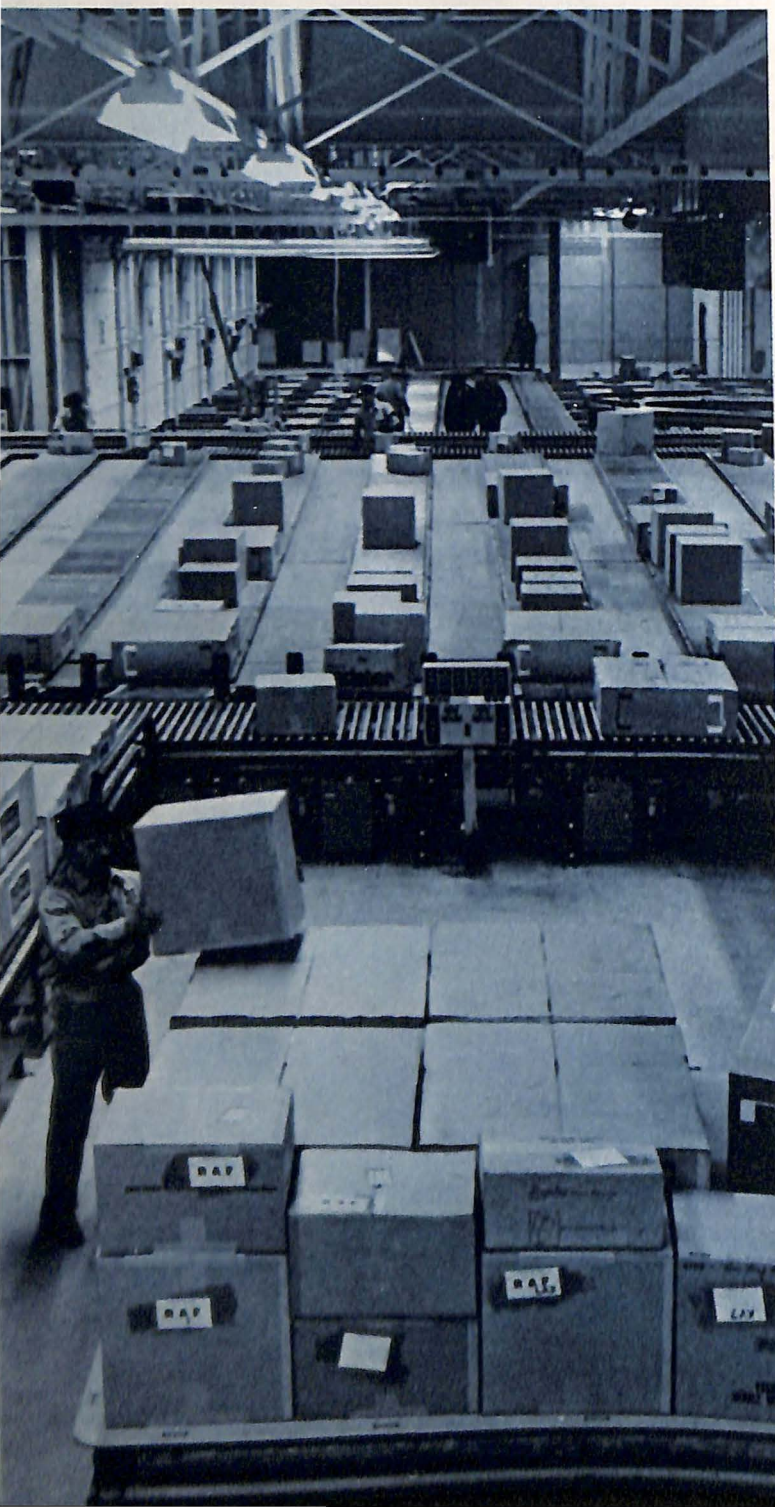


Turbine-powered transports have created a new measurement of the dimensions of the U. S.: today the nation is five hours wide and two hours deep. They have transformed geographic relationships to other nations. For example, the time required for rail shipment from Philadelphia to Boston is equivalent to the air shipment time between Boston and Paris. ■ These photos of activities at airports show the wide and growing variety of products being shipped by air. Handling and storage facilities are being constructed and improved, and shipments move expeditiously through the terminals. ■ General aviation aircraft are filling a gap in air cargo operations where off-route origination and destination points are encountered. ■ Helicopters provide a link between terminals and delivery points. Their unique capabilities also are utilized to move cargo to locations that often are inaccessible by surface transportation methods.



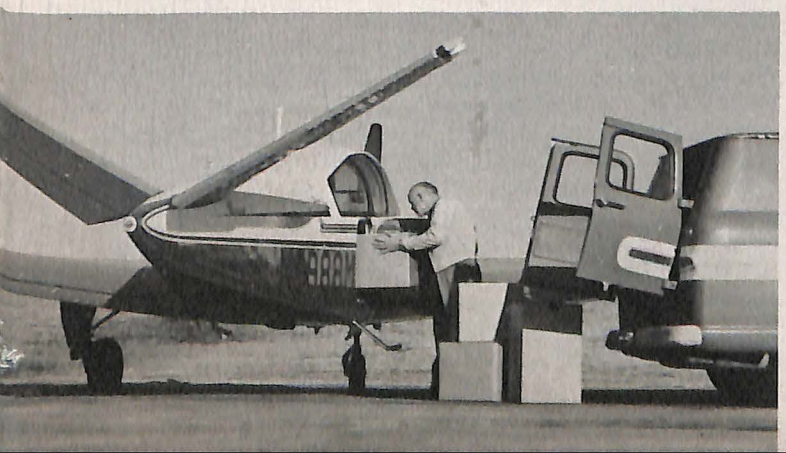


AIR FREIGHT — ON THE WAY UP

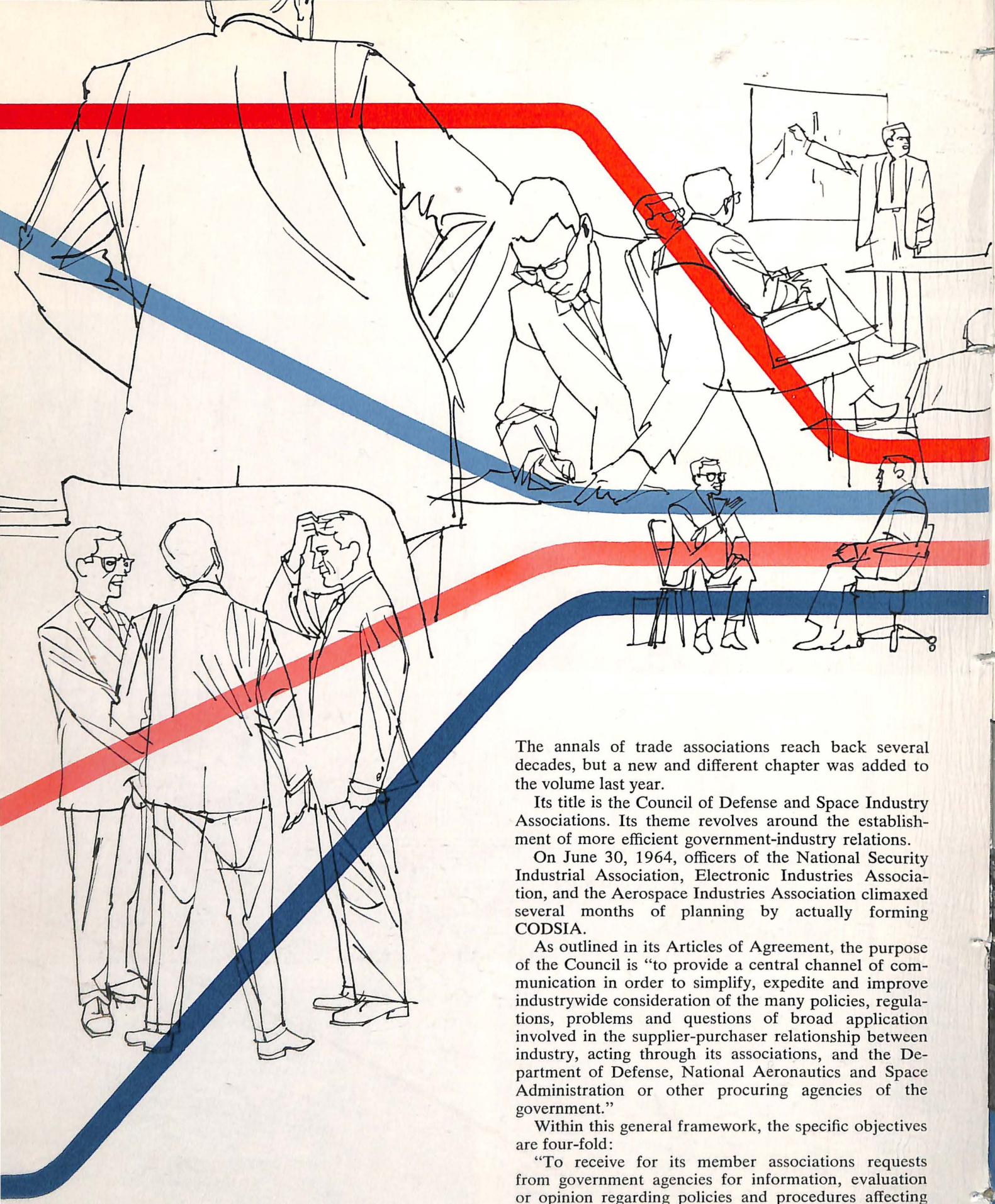



EGGS
EGGS
EGGS


AIRBORNE




NORTHWEST



The annals of trade associations reach back several decades, but a new and different chapter was added to the volume last year.

Its title is the Council of Defense and Space Industry Associations. Its theme revolves around the establishment of more efficient government-industry relations.

On June 30, 1964, officers of the National Security Industrial Association, Electronic Industries Association, and the Aerospace Industries Association climaxed several months of planning by actually forming CODSIA.

As outlined in its Articles of Agreement, the purpose of the Council is "to provide a central channel of communication in order to simplify, expedite and improve industrywide consideration of the many policies, regulations, problems and questions of broad application involved in the supplier-purchaser relationship between industry, acting through its associations, and the Department of Defense, National Aeronautics and Space Administration or other procuring agencies of the government."

Within this general framework, the specific objectives are four-fold:

"To receive for its member associations requests from government agencies for information, evaluation or opinion regarding policies and procedures affecting

By WILLIAM H. MOORE
Vice President
Electronic Industries Association

CODSIA

'unity without uniformity'

the government-industry relationship, and to facilitate and coordinate association replies thereto.

"To cooperate with and, upon request, assist in the work of the Defense Industry Advisory Council and any similar advisory organization.

"To minimize duplication of effort among its member associations in their relationship with the government, and the attendant waste of time, effort and expense by both government and industry.

"To initiate constructive concepts, policies and procedures for improvement of the government-industry relationship."

The Articles provide for the Council to operate under the guidance of a Policy Committee; liaison between the Council and its member associations is handled by an Operating Committee, composed of one representative from each of those associations.

During its first year, Karl G. Harr, Jr., of AIA, was Chairman of CODSIA; Robert Beach and Gerald Lynch of NSIA successively served as Chairman of the Policy Committee; I chaired the Operating Committee; and Col. W. W. Thybony of NSIA was Executive Secretary.

Early in July, officers who would head CODSIA during its second year of operation were selected.

Arthur P. Clow, vice president, Defense Activities, Western Electric Co., Inc., succeeded Karl Harr as Council Chairman. Mr. Clow represents EIA on CODSIA's Policy Committee. The Chairman of the Council will also act as Chairman of the Policy Committee, which has been eliminated as a separate position.

Fred C. Holder, manager, Special Products Division, American Motors Corp., Automobile Manufacturers Association representative on the Policy Committee, is to be Vice Chairman of the Council, a new position.

William W. Thybony, NSIA's Director of Committees, was named Chairman of the Operating Committee for the coming year.

The new Executive Secretary is Franz O. Ohlson, Assistant Director, Industry Planning Service, AIA. James Ellis of AMA will continue to serve as CODSIA's contact with DIAC.

The Executive Secretary is the official contact point for CODSIA. He receives and processes inquiries and information and refers proposed projects to the Operating Committee for consideration. It is his responsibility to learn which member associations wish to participate in any given project, to schedule CODSIA meetings, and to maintain the books and records of the Council.

It was apparent from the outset, because each of the existing associations had special industrial functions to

perform or unique interests to promote, that situations were bound to arise in which associations would have divergent views. As a result, the Articles leave no doubt that full allowance must be made for the preservation and communication of such views. Each association, either individually or through a minority report, is free to express its own position.

Within weeks after its establishment, CODSIA's effectiveness was strengthened by application for membership from three additional associations. First to join the original three was the Automobile Manufacturers Association. AMA was closely followed by the Atomic Industrial Forum and the Western Electronic Manufacturers Association.

As CODSIA operates, any member association may propose any procurement matter for CODSIA consideration, but only matters which are approved by three or more members become active cases. During the first year of operation, nearly 50 projects were considered, and thirty-odd cases were completed or were under study. These have included such diverse subjects as rental costs, pricing of technical data, administration of patent rights, and the Cost and Economic Information System (CEIS).

Most cases involve government-industry cooperation in solving common problems. One of the earliest was a request forwarded to CODSIA by then Assistant Secretary of Defense for Installations and Logistics Thomas D. Morris. He asked that the Council nominate three men from among its membership to a DOD-Industry Procurement Training Advisory Committee. Their aim was to establish a broader program of training participation by both DOD and industry in procurement and procurement-related aspects of logistics management. Working closely with members from Defense and each of the military services, the group established a program and submitted a report to DIAC earlier this year. It is continuing as a group, and will monitor accomplishments in joint training.

Proposed changes to the Armed Services Procurement Regulation have occasioned many CODSIA cases. Because of the importance of ASPR to both buyers and sellers, there is great interest in its policies and even its exact phrasing. Consequently, CODSIA committees have addressed themselves to many ASPR matters during the year.

For instance, one case dealt with a proposed revision to Section XIII on Government Property. When the draft revision had been completed, early in 1964, it was submitted to industry for comments. Thereafter it was extensively revised and was scheduled to be issued without further review by industry. Consequently, the Council requested further discussions with DOD.

Though time was short before scheduled publication, a meeting was arranged with the ASPR Committee and several joint suggestions were submitted on matters considered to be most important to industry, such as the definition of Special Test Equipment and the competitive advantage evaluation procedure.

The ASPR Committee carefully considered the additional suggestions, asked CODSIA for further statistical support for its presentation, and then incorporated

several of the suggestions in the new revision of Section XIII.

There are also numerous instances in which a government agency has invited comments through CODSIA. Late in 1964, for example, such action was requested on a proposed DOD revision to MIL-D-70327. This was the specification for drawings, engineering and associated lists.

The Council designated a Task Group to consolidate industry comments which, in turn, were forwarded to DOD. The consensus was that the proposed revision was really new in concept and embraced much more than a simple revision to the existing specification. Thus, it recommended an industry-government meeting for discussion and clarification. The recommendation was readily accepted by Brig. Gen. Allen T. Stanwix-Hay, Director of the DOD Office of Technical Data and Standardization Policy. Results of the meeting were mutually acceptable to both government and industry.

In summing up CODSIA's initial achievements, Chairman Harr has pointed out that the Council's areas of interest have expanded from concern with strictly purchase matters to encompass broader procurement problems in technical, economic, quality assurance, facility and data matters.

Moreover, reports from significant government officials indicate that the organization has, in fact, been successful in meeting specific government needs for coordinating industry views, and that its suggestions for reconciling differences between government and industry have been helpful and worthwhile.

"In this past year," Harr noted, "through Operating Committee meetings, we have proven that the associations of industries dealing with the government can, in fact, speak as one voice on many issues, although of course, rigid adherence is always maintained to the fundamental principle that each member association is entirely free to express divergent views. What we have been able to achieve in CODSIA, then, is unity without uniformity — an enviable concept and a healthy way of doing business."

This past year's experience has also answered some of the questions raised during the initial organizational meetings. It has demonstrated that industry's needs and desires with respect to government procurement policies and procedures are sufficiently similar so that it is more important to express them well in one letter than it is to say them several different times in several different ways, which may seem confusing or even contradictory when read by government officials.

Secondly, it has become increasingly clear that when DOD adopts a policy, issues a regulation or prescribes a contract clause, it applies with equal force to all of industry, not just to one company or to a group of companies represented by a particular trade association. Thus again it makes sense for all of industry to join in a mutual effort to see that the clause or regulation or policy is as acceptable as possible to all of industry.

"In short," Harr has concluded, "reduced to one simple sentence, in my opinion our first year's operation as CODSIA has been a successful one. Now let's look to the future."

Attending the AIA "E" award ceremony were (left to right): Karl G. Harr, Jr., president of AIA; Ken M. Smith, vice president and general manager, Aero Commander Division of Rockwell-Standard Corp.; Erle M. Constable, president, Lockheed Aircraft International, Inc., and Chairman of AIA's International Committee; and Joseph T. Geuting, Jr., manager of AIA's Utility Airplane Council.

AWARD

Jack T. Bradley, director of AIA's International Service, Erle M. Constable and Karl G. Harr, Jr. discuss future aerospace export plans.

Karl G. Harr, Jr., president of AIA, accepts the President's "E" award from Under Secretary of Commerce LeRoy Collins.

The Aerospace Industries Association recently was presented with the President's "E" award for excellence in exporting. Presentation was made by Under Secretary of Commerce LeRoy Collins to Karl G. Harr, Jr., AIA president. The citation states:

"The Aerospace Industries Association of America, Inc., through its International Committee, has consistently and effectively supported AIA members in their efforts to increase export trade by representing the industry in negotiations with policy-making officials of the United States and other governments. Additionally, AIA has published trade reports, directories and aerospace marketing information, and conducted national meetings and symposia to advance the industry's world trade posture. The successful export promotion activities conducted by the Aerospace Industries Association reflect credit on management and the American free enterprise system, and contribute significantly to the Export Expansion Program."

In accepting the award, Mr. Harr reported that in the next five years, 1965 through 1969, exports of transport aircraft are expected to exceed the record of the past five years by nearly half a billion dollars; exports of utility aircraft are estimated to increase by a quarter of a million dollars and rotary wing exports will increase nearly two and a half times in dollar value for the same time period. As evidence of these increases, Mr. Harr pointed out that in the first five months of 1965, exports of large transport aircraft are up 55 percent in dollar value, utility aircraft have gained 17 percent and rotary wing aircraft 159 percent, compared with the first five months of 1964.